Whitehaven

Blackwater North Extension Project

Appendix A
Soils and Land Suitability Assessment



Soils and Land Suitability Assessment

BLACKWATER NORTH EXTENSION PROJECT

Prepared for Whitehaven Blackwater Pty Ltd

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EXECUTIVE SUMMARY

GT Environmental Pty Ltd was commissioned by Resource Strategies Pty Ltd on behalf of the Proponent, Whitehaven Blackwater Pty Ltd, to complete a Soils and Land Suitability (SALS) Assessment for the Blackwater North Extension Project (the Project). Whitehaven Blackwater is a wholly owned subsidiary of Whitehaven Coal Limited.

The Project would comprise an extension of open cut mining operations into Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759 herein referred to as the study area. The study area covers an area of approximately 6,907.60 hectares (ha) and is located wholly within the Central Highlands Regional Council Local Government Area.

The Project would allow mining of additional coal reserves of approximately 200 million tonnes (Mt) until 2055 with an approximate start date of 2030, at a rate of up to 19 million tonnes per annum (Mtpa) run-of-mine coal.

The key conclusions of the SALS Assessment are as follows:

- 22 Soil Profile Classes (SPCs) across 83 Unique Mapping Areas (UMAs) are present in the study area.
    - Soils range from shallow clay loam soils, sodic subsoil clays texture contrast soils to structured, moderate to very deep clay soils to clays with microrelief on limited to completely cleared, level to gently undulating plains and rises.
    - SPCs have been classified in four of the 14 Australian Soil Classification orders including Dermosol, Kandosols, Sodosol and Vertosols.
- The suitability framework for each SPC was assessed against the nominated Regional Frameworks (Department of Science, Information Technology, Innovation and the Arts and Department of Natural Resources and Mines, 2013) for the Inland Fitzroy and Southern Burdekin Area land uses. These land uses include dryland and furrow irrigated barley, chickpea, cotton, maize, millet, mungbean, oat, safflower, sorghum, soybean, sunflower, triticale and wheat.
    - One SPC, 18Bl(Ro), has been identified as being able to support crop land uses for cotton, maize, mungbean, safflower, sorghum, soybean and sunflower.
    - Three SPCs, SPCs 2Dn(Te), 8Dn(Te) and 20Bl(Ro), can support cotton.
    - All remaining SPCs and UMAs as follows are unsuitable and presented severe or extreme limitations with respect to supporting crop land uses. 2Dn(Te) (UMA 5), 3Bl(Te), 4Bl(Te), 8Dn(Te) (UMA 12), 9Dn(Ro), 10Ct(Ro), 11Bl(Ta), 12Da(Te), 14Bl(Ro), 15Bl(Ro), 17Bl(Ro), 19Bl(Ro), (UMAs 50,51) 16Bl(Ta), 21Bl(Ta) and 22Bl(Wy)

- The SPCs were assessed against Suitability for Beef Cattle Grazing Land Suitability Assessment Techniques (Department of Minerals and Energy, 1995) with reference for beef cattle grazing in the *Land resource survey and evaluation of the Kilcummin area, Queensland* (Shields and Williams, 1991). Beef cattle grazing was assessed across the SPCs and specific UMAs with the following results:
    - SPCs 11Bl(Ta), 12Da(Te), 18Bl(Ro) and 22Bl(Wy) were assessed as Class 3, suitable land which is moderately suited to beef cattle grazing but which requires significant inputs to ensure sustainable use.
    - SPCs 2Dn(Te), 3Bl(Te), 4Bl(Te), 8Dn(Te), 9Dn(Ro), 10Ct(Ro), 11Bl(Ta) (UMAs 50,51) 14Bl(Ro), 15Bl(Ro), 16Bl(Ta), 17Bl(Ro), 19Bl(Ro) and 20Bl(Ro) were assessed as Class 4, marginally suited for beef cattle grazing and would require major inputs to ensure sustainability.
    - SPCs 2Dn(Te) (UMA 7) and 21Bl(Ta) were assessed as Class 5, unsuitable land with extreme limitations in which the land is unsuited and cannot be sustainably used for a proposed agricultural use.
- The assessment of Agricultural Land Classes (ALCs) across the study area based on the Regional Frameworks, additional land use limitations and beef cattle grazing classes indicated the following:
    - Approximately 73.36 ha is ALC A1, assessed as suitable for a wide range of current and potential broadacre and horticultural crops.
    - Approximately 810.11 ha is ALC B, assessed as land that is suitable for a narrow range of crops. The land is suitable for sown pastures and may be suitable for a wider range of crops with changes to knowledge, economics or technology including the availability of water for spray or furrow irrigation.
    - Approximately 3,755.39 ha is ALC C1, assessed as suitable for grazing sown pastures requiring ground disturbance for establishment; or native pastures on higher fertility soils.
    - Approximately 2,081.02 ha is ALC C2, assessed as suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1.
    - Approximately 184.72 ha is ALC C3, assessed as suitable for light grazing of native pastures in accessible areas.
    - ALC A, A2, and D were not mapped within the study area. No areas were designated as disturbed.
    - Soil assessed as suitable for potential cropping land may be impacted as part of the disturbance (approximately 492.86 ha, 7.6 percent of the disturbance footprint), however the assessed cropping land is currently been used as cattle grazing (pre mine land use). The rehabilitation of soils to support the post mine land use (PMLU) of beef cattle grazing indicates that soils are likely to still support the potential agricultural land uses such as cropping in the future, if agricultural land uses were to change.
- The *Regional Planning Interests Act 2014* and *Regional Planning Interests Regulation 2014* identify and protect areas of Queensland that are of regional interest. The study area was

assessed against Strategic Cropping Area (SCA) and Priority Agricultural Area (PAA) requirements.

  - Desktop review of the study area compared to Queensland Government Development Assessment Mapping System (Queensland Globe, 2026) confirmed that no SCA was located within the study area.
  - Desktop review of the study area compared to Queensland Government Development Assessment Mapping System (Queensland Globe, 2026) confirmed that no PAA was located within the study area.

- An Acid Sulfate Soil field assessment was undertaken during the SALS Assessment. The field observations were reviewed and the result (i.e., very low field indicators for potential acid sulfate soils [PASS]) is consistent with the desktop review against the Atlas of Australian Acid Sulfate Soils mapping which showed the study area as "Extremely low probability of occurrence."
  - It is assessed as highly unlikely the study area includes actual acid sulfate soils and / or PASS, however, environmental management plans should consider proactive procedures to visually monitor and identity acid sulfate soils during the Project's lifespan.
- In summary, topsoil resources from the majority of SPCs contain soils that are suitable for reuse in rehabilitation activities.
  - Topsoil in the study area consisted of fair to poorly structured, low fertility, shallow to deep soils which are indicative of the area, however, all are suitable for reuse in rehabilitation. Approximately 3,519,715 cubic metres is available as topsoil within the disturbance area.
  - Subsoils for six SPCs (1Dn(Te), 2Dn(Te), 12Da(Te), 18Bl(Ro), 20Bl(Ro)and 22Bl(Wy)) had no limitations and were similar in physical and chemical attributes where the subsoil may be stripped to depth and used as topsoil.

    Nine of the SPCs (3Bl(Te), 4Bl(Te), 5Dn(Ro), 7Bl(Pg), 8Dn(Te), 13Bl(Ta), 14Bl(Ro), 15Bl(Ro) and 19Bl(Ro)), were similar, however did have sodic subsoils at depth. Separation of the five SPCs with no limitations and the eight SPCs with sodic subsoils would be recommended with respect to stockpiling. This would prevent impacts to the five subsoils and the need for any additional amelioration treatment.
  - Soil amelioration recommendations such as gypsum application may benefit some of the deeper sodic subsoils as well as organic matter and fertiliser application. These amelioration recommendations are only for situations where the PMLU of beef cattle grazing is not being achieved. General management, storage and handling recommendations have been provided to retain and improve the quality of topsoil for rehabilitation reuse.

1 INTRODUCTION

1.1 Project Title and Proponent

The Blackwater North Extension Project, (herein referred to as the Project) involves an extension of open-cut mining operations into areas located within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Blackwater Mine (BWM) is a joint venture between Whitehaven Coal Limited (Whitehaven) (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven, is the operator of the BWM and Proponent for the Project.

1.2 Project Commission

GT Environmental Pty Ltd (GTE) was commissioned by Resource Strategies Pty Ltd on behalf of the Proponent to complete a Soils and Land Suitability (SALS) Assessment for the Project.

1.3 Project Overview

The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

Whitehaven Blackwater proposes to develop the Project, which would extend the current open cut mining development at the BWM to within SA 7 on ML 1762 and SA 10 on ML 1759 (Figure 1). The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 million tonnes per annum (Mtpa) of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;

- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

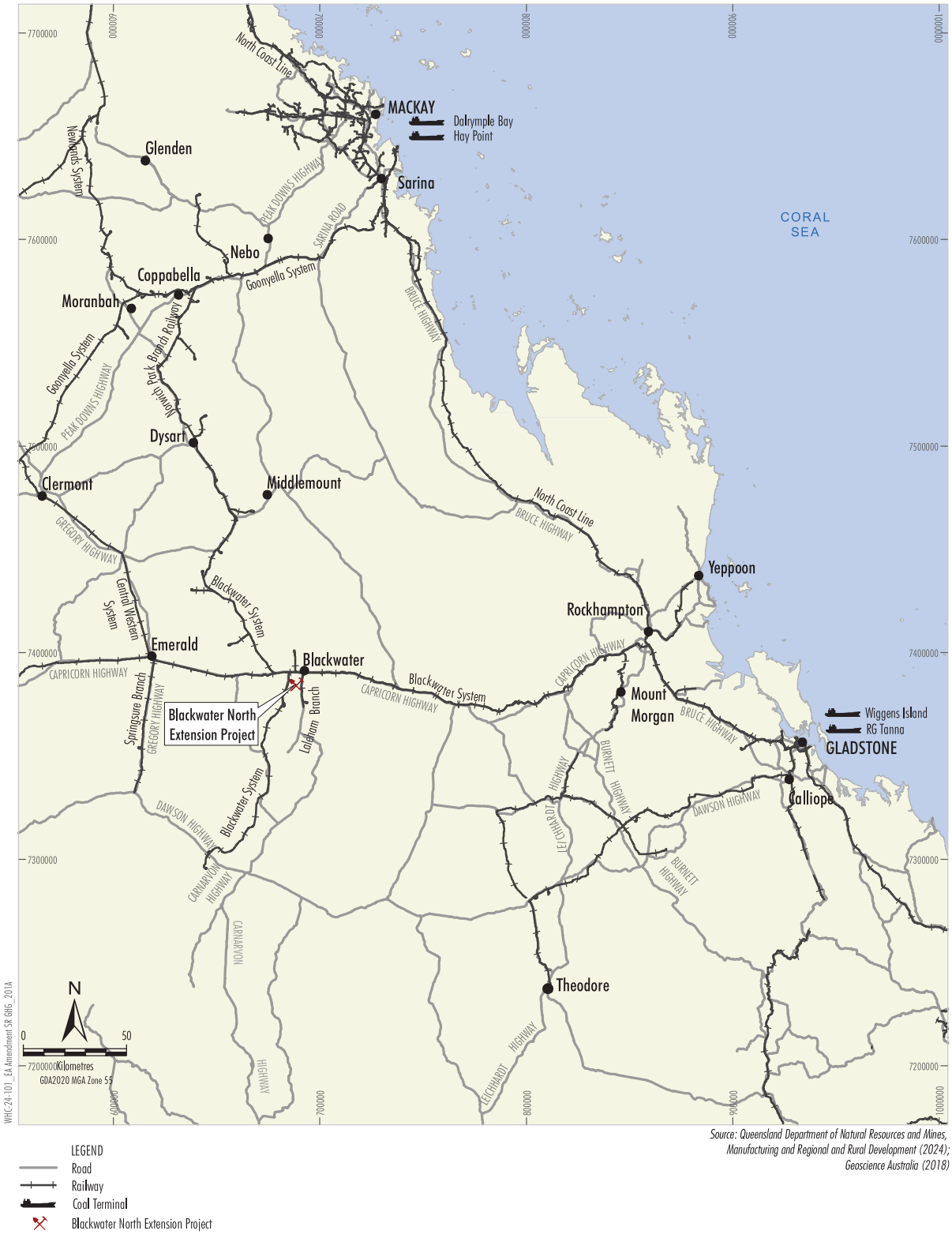
The Project layout is shown on Figure 2.

1.4 Scope of Report

This report provides a baseline assessment, agricultural land assessment and topsoil materials balance assessment as part of the SALS Assessment for the study area including:

- a description of the study area setting (Section 2),
- a description of the assessment methods and relevant guidelines (Sections 3 and 4),
- identification and description of soil profile classes (SPCs) and their distribution across the study area (Section 5),
- an assessment of the selected cropping land uses and Agricultural Land Classes / Classifications (ALCs) for each SPC (Section 6),
- an assessment of the Regional Planning Interests (RPI) for the study area (Section 7),
- an assessment of field and laboratory indicators for potential and actual acid sulfate soils (PASS / AASS) (Section 8), and
- an assessment of the soil values and suitability of each SPC for reuse in mine rehabilitation activities and soil management requirements, including soil stripping, storage, placement and amelioration (Section 9).

Figure 1: Regional Context



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Geoscience Australia (2018)

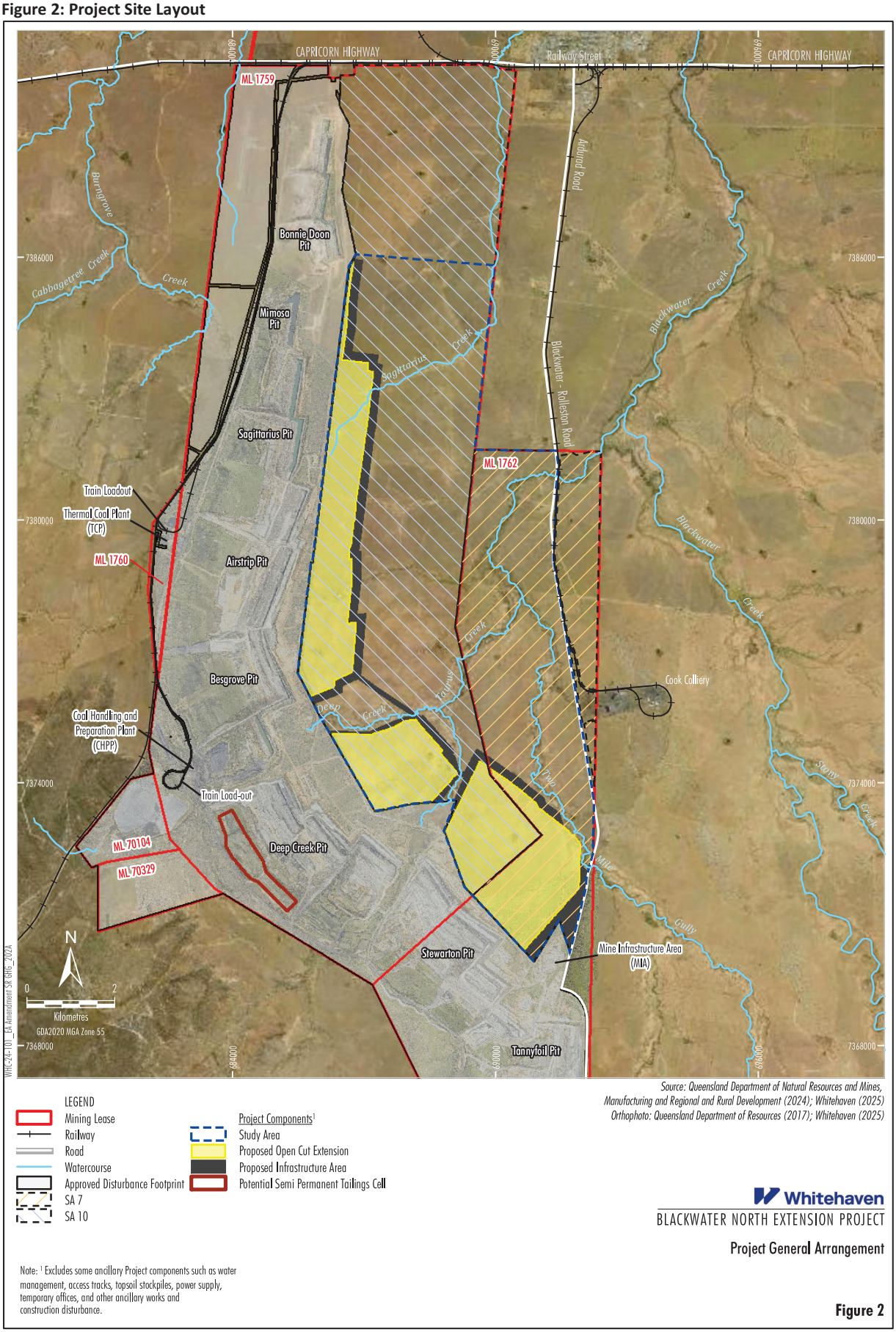
LEGEND
- Road
- Railway
- Coal Terminal
- Blackwater North Extension Project

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BLACKWATER NORTH EXTENSION PROJECT

Regional Location

Figure 1

Figure 2: Project Site Layout



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Approved Disturbance Footprint
- SA 7
- SA 10

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential Semi Permanent Tailings Cell

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

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BLACKWATER NORTH EXTENSION PROJECT

Project General Arrangement

Figure 2

2 PROJECT SETTING

2.1 Local and Regional Context

The Project is located in the Central Highlands Regional Council LGA, approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (shown in Figure 1).

2.2 Land Use

The dominant land use observed within the study area includes beef cattle grazing, agricultural activities on sown pastures and native pastures on high fertility soils (Queensland Globe, 2026).

2.3 Climate

The nearest Bureau of Meteorology (BoM) weather station able to provide all required data is located at Blackwater airport (BoM Station Number 035134), approximately 3.5 km north-west of the study area. A summary of weather statistics (BoM, 2024) is provided below in Table 2-1.

Table 2-1: Climate Summary Information, BoM weather station - Blackwater Airport

Climate Statistic	Value
Mean Maximum Temperature (May 2013- September 2024)	30.3 degrees Celsius (°C)
Mean Minimum Temperature (May 2013- September 2024)	16.3 °C
Mean Annual Rainfall (May 2013- September 2024)	548.4 millimetres (mm)

2.4 Topography and Hydrology

The topography of the study area includes level and gently undulating plains. The elevation across the study area ranges from approximately 188 metres (m) Australian Height Datum (AHD) to 230 m AHD.

Drainage lines, from north to south of the Project include Sagittarius creek, Taurus Creek and Two Mile Gully, all are tributaries of Blackwater Creek. Several unnamed tributaries associated with these Creeks transect the study area. These local tributaries generally drain in a northeasterly direction and join Blackwater Creek to the east of the Project area.

2.5 Regional Geology

The study area is located within the Bowen Basin. Detailed surface geology (Queensland Globe, 2026) indicates the study area is underlain by four major surface geologies. These are summarised in Table 2-2.

Table 2-2: Regional Surface Geology of the Study Area

Rock Unit Name	Lithological Summary	Age	Dominant Rock
Rangal Coal Measures	Calcareous sandstone, calcareous shale, mudstone, coal, concretionary limestone	Late permian	Arenite-midrock
Rewan Group	Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base)	Early Triassic – middle triassic	Arenite-midrock
TQa-QLD	Locally red-brown mottled, poorly consolidated sand, silt, clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected)	Late tertiary - quaternary	Alluvium
Qa-QLD	Clay, silt, sand and gravel; flood-plain alluvium	Quaternary	Alluvium

2.6 Vegetation

The composition of vegetation communities is generally associated with the topography, soils and geologic material. The dominant vegetation observed across the study area included *Acacia harpophylla* (Brigalow) and *Lysiphyllum hookeri* (Bauhinia).

3 OVERVIEW OF STUDY METHODS AND GUIDELINES

An overview of the study methods and supporting guidelines and standards is provided below.

3.1 General Soil Survey

This soil survey was scoped and conducted in accordance with the *Guidelines for Surveying Soil and Land Resources* (McKenzie et al., 2008), *Queensland Soil and Land Resource Survey Information Guideline* (Department of Resources [DoR], 2021) and *Queensland Land Resource Assessment Guidelines, Volume 1: Soil and Land Resource Assessment* (Department of Environment and Science [DES], 2021a).

3.2 Soil Type Classification

Soil characteristics and soil profiles have been described in accordance with the *Australian Soil and Land Survey Field Handbook, Fourth Edition* (National Committee on Soil and Terrain [NCST], 2024), DoR (2021) and DES (2021a).

Soils have been grouped according to their parent material and position in the landscape and classified in accordance with the *Australian Soil Classification* (ASC) (Isbell, 2021). Soils have also been correlated to soils mapped in Commonwealth Scientific and Industrial Research Organisation land system boundaries, such as *Lands of the Isaac-Comet Area, Queensland* (Story et al., 1967) over the study area.

3.3 Soil Type Collection and Assessment

Collection of soil samples for laboratory analysis was undertaken based on Land Suitability Assessment Techniques (LSAT) outlined in the *Technical Guidelines for Environmental Management of Exploration and Mining in Queensland* (Department of Minerals and Energy [DME], 1995), DoR (2021) and DES (2021a).

The physical and chemical properties of soils relevant to the potential for erosion has been determined for analysed site samples within the soil profile based on field and laboratory assessment of dispersive attributes including, but not limited to, texture, R1 dispersion and Emerson Aggregate Test (EAT) results.

Interpretation of the field and analytical results were undertaken with review against the following documents:

- *Analytical methods and interpretations used by the Agricultural Chemistry Branch for soil and land use surveys* (Bruce and Rayment, 1982),
- *Interpreting Soil Analysis for Agricultural Use in Queensland* (Baker and Eldershaw, 1993),
- *Interpreting Soil Test Results, Third Edition* (Hazelton and Murphy, 2016),
- *Soil Survey Standard Test Method Emerson Aggregate Test* (Department of Sustainable Natural Resources, n.d),
- *Soil Analysis, an Interpretation Manual* (Peveril et al., 1999),
- *Soil Chemical Methods – Australia* (Rayment and Lyons, 2011),
- *Soil Physical Measurement and Interpretation for Land Evaluation* (McKenzie et al., 2002),
- *Soil Testing and Some Test Interpretations used by the Queensland Department of Primary Industries (QDPI)* (Bruce and Rayment, 1984), and

- *Understanding Soils and Soil Data*, pp 109–133 (Shaw, 1988).

3.4 Land Capability, Suitability and Agricultural Land Classification

Land classification is based on the Land Capability Classification (LCC) in Queensland, outlined in the *Guidelines for Agricultural Land Evaluation* (GALE) (Department of Science, Information Technology and Innovation [DSITI] and Department of Natural Resources and Mines [DNRM], 2015), QDPI (1994) and DME (1995).

This land classification covers the evaluation of land attributes for arable, pastoral and other agricultural land uses. It is appropriate where evaluation for a limited range of agricultural land uses is required at a broadscale intensity over a large area.

Determination of land suitability for the study area has been conducted based on the GALE (DSITI and DNRM, 2015), *Regional Land Suitability Frameworks for Queensland* (Department of Science, Information Technology, Innovation and the Arts [DSITIA] and DNRM, 2013), DoR (2021) and DES (2021a).

The suitability of soils for rehabilitation has been assessed using field and laboratory assessment of texture, fertility, dispersive and structural attributes.

Groupings of soils with similar attributes are described as soil types in DES *Application requirements for activities with impacts to land* (DES, 2025). Soil types are defined either as the ASC suborder or SPC within *Queensland Soil and Land Resource Survey Information Guideline* (DoR, 2021). For this assessment and to adhere to the more relevant DES (2021a), SPC terminology and assessment has been used.

Other guidelines and reports that have assisted in soil classification, nominating criterions and assessing effective rooting depth (ERD) include the *Salinity Management Handbook, Second Edition* (Department of Environment and Resource Management [DERM], 2011) and '*Soil salinity – electrical conductivity and chloride*' in *Soil Analysis: an interpretation manual* (Shaw, 1999).

The soil assessment comprised a desktop study, field surveys and data analysis and interpretation. Section 4 provides a detailed description of the soil assessment methodology.

3.5 Topsoil Resource Assessment

Assessment of the topsoil resource was undertaken with the soil assessment and land suitability assessment. This assessed the available topsoil resource, its suitability, limitations and recommendations for reuse in mine rehabilitation and seeks to provide information for inclusion in the Progressive Rehabilitation and Closure Plan (PRC Plan).

The assessment of the impacts on land and topsoil resources will also include review of the DES *Application requirements for activities with impacts to land* (DES, 2025)*, Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government, 2016), Perry et al., (1964), and *Mine Rehabilitation Handbook* (Minerals Council of Australia, 1998) were reviewed with the field and laboratory results in assessing topsoil resource quality and quantity.

3.6 Regional Planning Interests Assessment

The *Regional Planning Interests Act 2014* (RPI Act) and *Regional Planning Interests Regulation 2014* (RPI Regulation) identifies and protects areas of Queensland that are of regional interest. The RPI Act protects each of the following areas of regional interest:

- Priority Living Areas (PLAs),
- Strategic Environmental Areas (SEAs),
- Priority Agricultural Areas (PAAs), and,
- Strategic Cropping Areas (SCAs).

The study area was assessed against the SCAs and PAAs.

3.7 Acid Sulfate Soil Assessment

Assessment of Acid Sulfate Soils (ASS) was undertaken with the SALS Assessment. This included review of available desktop resources such as Queensland Globe and Australian Soil Resource Information System (ASRIS) including Atlas of Australian Acid Sulfate Soils mapping (ASRIS, 2025).

Fieldworks included field observations for indicators for ASS materials of observation sites for SPCs. These observations have been reviewed against Table 5-1 of the *National Acid Sulfate Soils Guidance, National acid sulfate soils sample and identification methods manual* (Sullivan et al., 2018).

4 DETAILED METHODOLOGY

4.1 Desktop Study

GTE reviewed the available soils and land resources information for the study area to develop preliminary distributions of SPCs to inform the development of the field survey program.

4.1.1 Regional Land and Soils Report References and Documentation

The following soils studies and publicly available information were reviewed to identify available data and recommendations relevant to the study area, and to determine potential field sampling locations:

- *Land Resources Assessment Report, Blackwater Mine - North Extension Project* (SLR Consulting Australia [SLR], 2023).
    - This study encompasses the entire study area. Soil survey and mapping was conducted to a survey density of 1 site per 11 ha, exceeding 1:125,000 survey intensity and includes 43 detailed sites, 20 analysed and 37 check sites. Detailed and analysed sites were conducted to a maximum of 1.20 metres below ground level (mbgl) with soil testing to a depth of 1.00 mbgl consisting of pH, electrical conductivity (EC), cation exchange capacity (CEC), exchangeable sodium percentage (ESP), particle size analysis (PSA) and EAT.
    - This SLR (2023) report, including field and laboratory data, was extensively reviewed and incorporated into this SALS Assessment.
- *Lands of the Isaac-Comet Area, Queensland* (Story et al., 1967).
    - The area of Isaac-Comet encompasses the study area. Based on Story et al. (1967), a potential of over 40 soil types across the various land systems may be present including gently undulating plains of Poplar Box woodlands to Brigalow downs, undulating country with cracking clays.
- *Land Resource Survey and Evaluation of the Kilcummin Area, Queensland* (Shields and Williams, 1991).
    - This survey area is to the west, outside of the study area. However, it provides a practical application of land evaluation of the Land Resources Branch (*Guidelines for Agricultural Land Evaluation in Queensland*, Land Resource Branch, Department of Primary Industries, 1990) LSAT.
- Soil and Land Information (SALI) (Queensland Globe, 2026).
    - Review of the available soils information on Queensland Globe, SALI, existing soils sites and varying degrees of information. The information included the following observation sites for Project Central West Region Salinity Investigations Site SALTC293 and SALTC294. These two sites are presented in Figure 3 and in Appendix G. Soil sites observed located to the east of the study area associated with The Survey of the Isaac-Comet Area (Story et al., 1967) included ZDK170, ZDK172, ZDK173 and Fitzroy Soil Erodibility Mapping Project, site FSE194. Other information reviewed included detailed surface geology, contours, water courses, ALCs and ASSs.

- Queensland Agricultural Land Audit, Central Queensland (Department of Agricultural, Fisheries and Forestry, 2013).
    - The Queensland Agricultural Land Audit for Central Queensland covers the Project site. The audit outlines the regional agricultural profile, the current and potential agricultural land use, data confidence and mapping for the region.

      The general findings and key regional issues of the region state there is a good soil resource base and rainfall with productive agricultural and pastoral land that supports agricultural industry. Reliable water resources are present for irrigation. The central Queensland area is a major cattle breeding region for northern Australia with major abattoirs and cattle saleyards.

      Weaknesses of the region consist of invasive plants and animals, infrastructure funding, road transport infrastructure through declining road conditions, access to skilled labour throughout the area due to competing mining industry and unreliable and inadequate telecommunications.

4.1.2 Satellite Imagery

Satellite Imagery from Google Earth and Queensland Globe (viewed January 2026) was reviewed as part of the desktop study. The satellite imagery assisted with creating preliminary boundaries, site locations and access on site.

4.2 Field Work

4.2.1 Survey Timing

Five field surveys were undertaken across the study area between the following dates:

- 7 July 2025,
- 8 to 10 September 2025,
- 13 to 16 October 2025,
- 20 to 23 October 2025, and
- 3 to 7 November 2025.

4.2.2 Survey Team

All fieldwork trips were led by Reece McCann, Associate Environmental Scientist with a degree in Environmental Technology and over 15 years' experience in conducting SALS and Strategic Cropping Land (SCL) assessments over a 20-year plus professional career as a consultant in contaminated land and environmental soil science.

Reece was assisted in the field by environmental consultants Greg Tuck, Matthew Mooney and Lewis Arnold. Project assistance during the fieldworks was provided by Project Director Greg Tuck.

4.2.3 Survey Techniques

Preliminary sampling locations were derived from the desktop review of background information, existing available soils information and an examination of satellite imagery patterns. The specific locations of the survey sites were further refined in the field based on available site access, and whether the location was likely representative of the SPC being described. An SPC may be defined as a three-dimensional soil body such that any profile within the body has a similar number and arrangement of horizons whose attributes are within a defined range (Donnollan et al., 1998).

Free, integrated survey, and gradient-oriented transect (Gradsect) techniques (McKenzie et al., 2008) were used to verify SPCs and assign boundaries to each. Free survey is a commonly used method in land assessment as it enables flexibility in site selection (over grid mapping techniques), to achieve a more accurate and time effective result. It is well suited to detailed-scale surveys and is commonly used in soil surveys for resource projects in Queensland. Gradsect techniques were utilised across accessible tracks of varying topography. This provided a detailed cross section of the landscape and assisted in identifying patterns of soil variation.

Surveyed polygons were identified as individual mapped polygons, referred to as Unique Mapping Areas (UMAs).

4.2.4 Soil Survey Intensity

A medium intensity (McKenzie et al., 2008 and DES, 2021a) soil survey was selected for the study area based on previously submitted and approved SALS assessments for recent comparable projects. The survey intensity outlined below has been submitted previously for areas in central and north Queensland regions and is deemed acceptable based on the complexity of the landscape.

The nominated soil survey intensity considered the layout of the study area while being in accordance with the relevant guidelines for the proposed mine site components for the study area.

The soil survey considered available information within the *Land Resources Assessment Report, Blackwater Mine - North Extension Project* (SLR, 2023). In conducting the soil survey, GTE were able to leverage existing sites (SLR, 2023) to meet targeted soil survey intensities for disturbance and non-disturbance areas. Every observation site class exceeded the minimum percentage required numbers, as outlined in DES (2021a). Every UMA identified contains at least one observation site to assist in soil classification.

New Class IV(a) and Class IV(b) sites are generally placed in the proposed disturbance areas as SLR (2023) sites generally satisfy Class IV(a) and IV(b) site density requirements for non-disturbance areas.

The following soil survey intensities for proposed disturbance and non-disturbance components of the study area were achieved, with totals for each class of site exceeding the minimum required by DES (2021a):

- Areas planned for mining disturbance – 1:25,000, McKenzie et al. (2008) and DES (2021a).
- Areas not planned for mining disturbance – 1:100,000, McKenzie et al. (2008) and DES (2021a).

4.2.5 Soil Survey Observation Sites

Soil survey sites were conducted in accordance with McKenzie et al. (2008), DES (2021a) and DoR (2021):

- Detailed sites:
  - Class I - detailed profile description with no laboratory analysis.
  - Class II (a) - deep bore (greater than [>] 2.00 m) detailed profile description with no laboratory analysis.
- Analysed sites:
  - Class II (b) - deep bore (> 2.00 m) detailed profile description with limited or non-standard laboratory analysis,
  - Class III (a) - profile with limited or non-standard laboratory analysis:
    - these profiles are associated with the nominated laboratory analysis for existing SLR analysed sites.
  - Class III (b) - profile with standard laboratory analysis:
    - these profiles are associated with the nominated laboratory analysis for GTE analysed sites.
- Brief Mapping Observation sites:
  - Class IV (a) - brief profile description with some soil morphological data recorded.
  - Class IV (b) - brief mapping observation with no soil morphological data recorded.

Detailed site locations were assessed prior to fieldworks and placed across the study area. If an area was observed to benefit from additional detailed sites, these were conducted. Class IV sites were conducted at either regular intervals, to either define SPC boundaries or to confirm an area based on the landform, vegetation, surface conditions or soil morphological conditions.

The detailed sites for the mine site were generally conducted to 1.50 mbgl, in line with current expectations of SALS assessments referenced against McKenzie at al. (2008), DoR (2021) and DES (2021a) guidelines.

Naming conventions for soil survey sites are as follows:

- Detailed sites with “D” prefix indicate a detailed, analysed and detailed (deep boring) including Class I, Class II (a), Class II (b), Class III (a) and Class III (b) sites described as part of the assessment.
- Brief mapping observation sites with “C” prefix indicate Class IV (a) and Class IV (b) sites described as part of the assessment.
- SLR (2023) sites with “B” prefix indicate Class IV (a) sites and with “C” prefix indicate Class IV (b) sites.

The soil survey site types are labelled separately with unique colour identifiers on Figure 3.

Class I, II (a), II (b) and III Sites

Class I and II (a) (herein known as detailed sites) were undertaken at 44 locations, Class II (b) and Class III (herein known as analysed sites) were undertaken at 22 locations (Figure 3).

The sites were used to describe the range of soil profile morphological attributes as per the NCST (2024) including landforms, slope, surface conditions, rock cover, major vegetation and soil colour (as per Munsell Color [2009] Soil Colour Charts). At each detailed site, an assessment was also made of the quality, depth and quantities of reusable soil resources.

The soil profile at each detailed site was exposed using the excavator test pit method and where not possible, 100 mm hand auger (with various attachments) where access dictated, as well as shovel, crowbar and picks for exposing the A horizon. Soil profiles were undertaken in accordance with the *Guidelines for Surveying Soil and Land Resources* (McKenzie et al., 2008).

The information recorded from detailed sites included:

- location (Geocentric Datum of Australia [GDA] 2020) and type of soil observation (e.g., erosion exposed cutting or hand auger),
- major vegetation types,
- landform type, position of the site and slope gradient,
- surface condition (e.g., presence of cracks, surface crust, rocks, stones and cobbles, erosion status, microrelief),
- types and vertical extent of soil horizons,
- colour (as per Munsell Color [2009] Soil Colour Charts) and mottling of each horizon,
- observations of field texture, pH, presence and abundance of segregations, coarse fragments, structure, consistence and pedality and moisture content for each horizon,
- the presence of organic matter, roots and prevalence of biological activity,
- the presence of gleyed horizons, iron staining and jarosite presence, and
- photographs of the soil profile and surrounding landscape.

Class II (a), II (b), III (a) and III (b) including soil sampling of profiles was conducted as per McKenzie et al. (2008), with samples taken at standard depths incorporating the surface and every horizon change in the soil profile (typically at depths of 0.00-0.10 m, 0.20-0.30 m, 0.50-0.60 m, 0.80-0.90 m, 1.10-1.20 m and 1.40-1.50 m). Two additional soil samples were collected for depths below 1.50 m, generally at 1.70-1.80 m and 1.90-2.00 m pending soil horizons observed.

These depths were modified for sites in which field observations revealed soil horizons intersecting at these nominated depths, to ensure samples were collected in each separate horizon, and not across multiple horizons or in sub-horizon boundaries. These analysed sites were assessed against a nominated laboratory suite, as outlined in Section 4.3.

The data collected from the detailed sites are shown in Appendix A.

Class II sites were undertaken at 9 locations (Figure 3). The sites were randomly selected within SPCs that allowed augering beyond 1.50 mbgl.

Class IV (a) and IV (b) Sites

Class IV (a) and IV (b) sites were undertaken at 40 and 53 locations respectively (Figure 3). These sites were used to confirm SPC type and refine mapped soil boundaries.

For Class IV (a) and IV (b) sites, basic soil attributes were recorded at each observation site to confirm the SPC, and surface conditions including rock, slope percentage, landform type and position, major vegetation and land condition were also noted. Class IV(a) sites were augered to a nominal depth in which salient features for soil and SPC classification could be undertaken (i.e., depth of A horizon, exposing the B21 horizon). The data collected from the Class IV (a) and IV (b) sites is shown in Appendix B.

4.2.6 Laboratory Analysis

Soil samples were collected from all dominant SPCs present in the study area. For each site selected as an analysed site, the soil samples were collected from a detailed site that was representative of that SPC.

Laboratory analysis was undertaken to assist in determining the overall characterisation of the soils and to establish any physical and chemical limitations of soils. Laboratory analysis was also used to identify soils that may require specific management measures.

Samples were analysed at Environmental Analysis Laboratory who are accredited by the National Association of Testing Authority and certified by the Australasian Soil and Plant Analysis Council.

Soil samples were analysed for a laboratory suite, based on recommended standard suites within guidelines DoR (2021), DES (2021a), the Suitability Frameworks for the Gulf Plains area (DSITIA and DNRM, 2013) and indicators for soil resource quality for mine rehabilitation (Australian Government, 2016).

Existing SLR (2023) sites were reviewed with existing laboratory data to be utilised within this SALS Assessment Report. Applicable new sites where SLR (2023) data was chosen to be leveraged, were conducted at SLR (2023) site locations. Identified gaps within the existing SLR (2023) site laboratory analysis was completed to meet the nominated GTE laboratory suite for the Project.

The laboratory analysis parameters and rationale for soil horizons of each analysed site are shown in Table 4-1.

Table 4-1: Analytical Program and Number of Samples

Test	Soil Profile Horizon	Justification
Field measurements pH	All	Used for 'on the spot' estimates of pH to assist in initially categorizing soils, potential chemical barriers, general health and ERD. This field measurement is based on the Standard Operating Procedure (SOP) outlined in *Queensland Land Resource Assessment Guidelines – Volume 2: Field tests Version 1.0* (DES, 2021b).
Field measurements Dispersion	All	Used for 'on the spot' indicators of dispersion and slaking of soil, specifically peds of soils. This field measurement is based on the SOP outlined in *Queensland Land Resource Assessment Guidelines – Volume 2: Field tests Version 1.0* (DES, 2021b).
pH	All	Measurement of pH is a useful indicator of various soil properties (e.g., values > 8.5 usually indicate high exchangeable sodium levels and the presence of carbonates and nutrient availability limitations).
EC	All	The measure of EC is used as a means of appraising soil salinity. The electrical conductance increases with soluble salt content and thus allows simple interpretation of salinity.
Chloride (Cl^-)	All	The chloride anion is usually present in soil associated with sodium. It is highly mobile making it a valuable indicator of salt and water movement. It provides additional confirmation of soil salinity.
Effective Cation Exchange Capacity (ECEC), Exchangeable Cations, Calcium : Magnesium ratio (Ca:Mg), ESP	All	The amounts and relative proportions of the exchangeable cations in soil have important effects on both physical and chemical properties. High levels of exchangeable sodium cause dispersion and increased swelling, reducing water movement and affecting near surface aeration, whereas exchangeable calcium flocculates colloids and would reduce swelling tendencies. Excessively high or low concentrations of one or the other of the cations may impact buffering capacity and, as a result, soil nutrient availability.
PSA (less than [<] 2 mm)	All	PSA data provides an assessment of the composition of a soil (based on the dominant grain size in a soil). This assists with confirmation of field observations as well as providing better grounds for identification of SPC and water holding capacity.
R1 Dispersion	All	The measure of R1 dispersion is useful when used in conjunction with ESP and the Ca:Mg for predicting soil physical behaviour.
EAT	All	The measure of EAT is useful when determining soil physical behaviour.
Available Nitrogen (N), Total N and Nitrate	Topsoil	Testing provides an indication of the general fertility of soils and thus their suitability as a topdressing agent.
Extractable Potassium	Topsoil	Testing provides an indication of the general fertility of soils and thus their suitability as a topdressing agent.
Phosphorus (P) / Phosphorus Buffering Index (PBI)	Topsoil	Testing provides an indication of the general fertility of soils and thus their suitability as a topdressing agent.
Organic Matter / Carbon	Topsoil	Testing for soil organic matter provides an indication of the general fertility of soils and thus suitability as a topdressing agent. It also assists in interpretation of soil structural properties and provides information on stored nutrients which may not yet be accessible to plants but may become available in the future.
Sulfur	Topsoil	Total levels of sulfur help identify whether organic matter or gypsum are present in a soil profile.
Selected Trace Elements	Topsoil	The analysis of copper, zinc, manganese and iron will assess extractable concentrations of these micronutrients in the soil, potential deficiencies (copper, zinc, manganese and iron) as well as any potential phytotoxicity issues that may exist (all elements).

The laboratory results assessments are provided in Section 5 for each SPC, with the laboratory summary for each SPC provided in Appendix C and laboratory certificates in Appendix L.

4.3 Interpretation of Key Field and Laboratory Soils Data

Key field and laboratory data for each SPC was assessed based on the following guidelines. These guidelines assisted with the classification of the SPCs, land suitability and topsoil resource for mine rehabilitation. The basis for the assessment is provided in Appendix D which outlines the key assessed attributes and nominated criteria.

4.4 Effective Rooting Depth

ERD is defined by the depth in which approximately 90% of plant roots will extract water and is defined by physical or chemical attributes (barriers) within the subsoil that restrict growth and affect Plant Available Water Capacity (PAWC).

Land Resource Assessment of the Windeyers Hill Area (Burgess, 2003) and RPI Guideline 08/14 (Department of State Development, Manufacturing, Infrastructure and Planning [DSDMIP], 2019) outline ERD criteria with respect to physical and chemical barriers. Burgess (2003) includes a catchment area of the Isaac-Connors and Mackenzie River which cover an area of approximately 35,404 kilometres squared (km^2), where the Project site is located within. DSDMIP (2019), which includes criteria relevant to cropping land uses, was also considered.

Based on this document and guideline, Table 4-2 outlines the nominated physical and chemical barrier criteria for ERD.

Table 4-2: Initial Nominated Effective Rooting Depth Criteria

Physical/Chemical Value	Criteria
pH	≤ 5 and ≥ 9 for rigid soils (non-shrink swell soils, such as Dermosols, and Sodosols). ≤ 5 for non-rigid soils (Shrink swell clays, Vertosols)
EC (1:5 water)	> 0.8 deciSiemens per metre (dS/m)
Cl^-	> 1,000 milligrams per kilogram (mg/kg)[1]
Strongly Sodic Conditions	ESP > 15% (where clay content was 20% and CEC is > 3.0 centimoles per kilogram [cmol(+)/kg])
Extremely low exchangeable Ca:Mg	≤ 0.1
Depth to C or R horizons	Physical barrier presence at depth including hard pans, gravel layers, bedrock or other hard materials

1- Chloride levels are reviewed against EC and Exchangeable Calcium levels where if EC / Chloride levels are high to very high then chloride levels are not high enough to be a limiting property i.e., high EC is influenced by calcium sulfate (gypsum).

Shaw (1999) was reviewed in conjunction with DERM (2011) against nominated land uses for the Project site. The SALFPREDICT model assesses the water uptake weighted profile mean EC, saturated extract (ECse) throughout the rootzone of the soil to determine a likely salt load that will affect a crop. It also calculates the likely leaching fraction of the soil to help determine the likelihood of salt removal from the rootzone to deeper in the soil profile. It predicts a potential impact of salinity on a range of crops, indicating likely yield responses.

To assess a yield percentage, available nominated crop land uses and Class II(b) / III site laboratory data was entered within the SALFPREDICT model. Nine crop land uses (Barley, Cotton, Maize [Corn], Oat, Safflower, Sorghum, Soybean, Sunflower and Wheat were identified as having data available within the SALFPREDICT model and were assessed. To minimise any outside influence of saline waters, 'rainfall – irrigation water' (DERM, 2011) was utilised as the water input. The SALFPREDICT Quick Calculator and Predictive Calculator were completed and provided results, including PAWC.

Plant salt-tolerance data was also assessed against based on the ECse (SALFPREDICT) values from the SALFPREDICT model with Class III laboratory data. This assessed the depth of the soil of which the ECse against 90, 75 and 50% yield criteria were exceeded. This would assist in identifying any low yields based on a nominated rooting depth of 0.60 m. The proposed depth was based on seedling and root establishment, not germination or early seedling establishment (DERM, 2011). A total of 13 crop land uses were assessed.

Any physical barrier that prevented further excavation or augering of a test pit or borehole respectively, including bedrock, coarse gravel layer or regolith were recorded as refusal.

During discussions with the regulator regarding EC, Chloride and Sodium as ERD as outlined in Burgess (2003), it was advised that these attributes are transient and will change following disturbance, stockpiling, mixing (with other less salty subsoil) and weather exposure as well as application of good quality irrigation water.

Table 4-3 outlines the nominated physical and chemical barrier criteria for ERD. Assessment of plant yield and plant salt-tolerance data for the available crop land uses is presented for each SPC in Section 5.

Table 4-3: Proposed Effective Rooting Depth Criteria

Physical / Chemical Value	Criteria
pH	≤ 5 and ≥ 9 for rigid soils (non-shrink swell soils, such as Dermosols, and Sodosols). ≤ 5 for non-rigid soils (Shrink swell clays, Vertosols)
Extremely low exchangeable Ca:Mg	≤0.1
Plant yield based on SALFPREDICT modelling for the following crop land uses; Barley, chickpea, cotton, maize, millet, mungbean, oat, safflower, sorghum, soybean, sunflower, triticale and wheat.	A yield response > 65% for any particular crop is considered suitable.
Plant Salt-Tolerance Data (DERM, 2011) for the following crop land uses; Barley, chickpea, cotton, maize, millet, mungbean, oat, safflower, sorghum, soybean, sunflower, triticale and wheat.	A yield response > 65% for any particular crop is considered suitable within a nominated root zone of 0.60 m.
Depth to C or R horizons	Physical barrier presence at depth including regolith, gravel layers, bedrock or other hard materials

4.5 Land Suitability and Agricultural Land Assessment

Land suitability is primarily based on classifications provided within the GALE (DSITI and DNRM, 2015) and Regional Frameworks (DSITIA and DNRM, 2013).

ALC is based on a simple hierarchical scheme that is applicable across Queensland. It allows the interpreted land evaluation data to indicate the location and extent of agricultural land that can be used for a wide range of land uses with minimal land degradation.

This evaluation scheme has evolved through various guidelines and state planning policies and is currently referenced in regional or shire council planning schemes. ALC assessment guidelines are shown in Section 6.

4.6 Regional Planning Interests

The RPI Act and RPI Regulation identify and protect areas of Queensland that are of regional interest. The RPI Act protects PLAs, SEAs, PAAs and SCAs.

As part of the SALS desktop study, applicability for assessments for PAA and SCA was conducted.

4.7 Acid Sulfate Soils Assessment

Review of the ASRIS including the Atlas of Australian Acid Sulfate Soils mapping (ASRIS, 2025) was undertaken. The ASS mapping is classified with a nationally consistent legend that includes a risk assessment.

5 SOIL AND LAND SUITABILTY RESULTS

The following sections outline the SPCs observed across the study area, the land suitability, ALC and soil resources.

5.1 Soil Profile Classes Summary

A total of 22 SPCs have been observed and mapped encompassing 83 UMAs within the study area (shown in Figure 3).

Table 5-1 lists the SPCs identified in the study area and provides a description of each SPC concept including basic soil morphology, position in the landscape, and applicable UMAs and sites.

SPCs have been classified in accordance with the ASC (Isbell, 2021) in which four of the 14 ASC Soil Orders have been observed (shown in Figure 4). The UMAs, detailed sites, ALC, topsoil thickness and areas are presented in Table 5-1.

Detailed descriptions of each SPC and their Class III analysed site are provided in the following sections (Sections 5.1.2 to 5.1.23). Appendix A presents Class I, II and III site descriptions.

5.1.1 SLR Soil Summary and Associated GTE Sites and SPCs Summary

As discussed in Section 4.1.1, sites from a previous Land Resource Assessment (SLR, 2023) was available for review and use across the study area. A review of the report and all associated observation sites were undertaken to assess their potential use in the SALS Assessment.

On review, GTE decided to reference the observation sites and include them to assist in meeting the nominated survey scale. A review of the check sites indicated generally surface observation sites, which were nominated as Class IV(b) within this SALS Assessment. Detailed sites were assessed in greater detail where attributes to soil classification, observations of microrelief and inclusion of laboratory data were considered. These were nominated as Class IV(a) sites due to test pit depths of 1.20 mbgl and a nominal depth description up to 1.00 mbgl. A further review of this detailed and check site data is presented in Appendix E and F.

The key data from the SLR (2023) report was the reuse of detailed sites used for analysis. Seven soil mapping units were located within the study area with six SLR (2023) sites identified, where the intent was for GTE to re-visit the location, conduct an analysed site and complete the field and laboratory data gaps where required. Table 5-2 provides a summary of these sites.

Table 5-1: Land Summary of SPCs in the Study Area as per the SALS Assessment

SPC map code[1] / Report No.	SPC Concept	ASC (Dominant to sub-order)	UMAs (*Analysed)	Detailed sites (*Analysed)	SLR (2023) Analysed Site relevant to GTE Analysed site	Regional Frameworks / Limitations Suitability	Beef Cattle Grazing / Limitations Suitability	ALC	Topsoil Thickness for Use in Mine Rehabilitation (mbgl)	Total Area (ha)
1Dn(Te)	Deep, reddish brown clay soil with a soft surface and strongly structured, sodic subsoils and is associated with flat to gently undulating plains with Bauhinia.	Brown Vertosol	1*	D1*	-	Cotton (Class 4). Remaining land uses (Class 5)	Class 4	Class C2	0.20-0.40	139.54
2Dn(Te)	Deep, dark grey clay soil with a self-mulching surface and moderately to strong structured subsoil and is associated with flat to gently undulating plains with cleared Bauhinia vegetation.	Black Vertosol	2, 3*, 4, 5, 6, 7, 8	D3*, D55	B25	UMAs 2, 3, 4, 6, and 8: Cotton (Class 3). Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5) UMA 5: Cotton (Class 4). Remaining land uses (Class 5) UMA 7: All land uses (Class 5)	UMA 7: Class 5 UMAs 2, 3, 4, 5, 6, 7, and 8: Class 4	UMAs 2, 3, 4, 6, and 8: Class B UMA 5: Class C2 UMA 7: Class C3	0.20-1.00	414.16
3Bl(Te)	Very deep, brown clay sandy soil with a firm surface and strong structured subsoils and is associated with flat to gently undulating rises with sparse woodlands of whitewood vegetation and grasslands	Black Dermosol	9*	D5*	-	All land uses (Class 4)	Class 4	Class C2	0.20-0.80	12.39
4Bl(Te)	Very deep, grey clay soil overlying weathered substrate with self-mulching/flake surface and strong structured subsoils and is associated with gently undulating plains with grasslands.	Grey Dermosol	10, 11	D6*, D20	-	Cotton (Class 4). Remaining land uses (Class 5)	Class 4	Class C1	0.20-0.60	46.17

SPC map code[1] / Report No.	SPC Concept	ASC (Dominant to sub-order)	UMAs (*Analysed)	Detailed sites (*Analysed)	SLR (2023) Analysed Site relevant to GTE Analysed site	Regional Frameworks / Limitations Suitability	Beef Cattle Grazing / Limitations Suitability	ALC	Topsoil Thickness for Use in Mine Rehabilitation (mbgl)	Total Area (ha)
5Dn(Ro)	Deep, grey clay soils with a cracking surface and strong structured subsoils and is associated with gently undulating rises with drainage and depressions with sparse acacia vegetation and grasslands.	Grey Vertosol	13, 14*, 15, 16, 17	D7*, D26, D33, D42, D50	-	Cotton (Class 3). Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 4	Class B	0.20-0.45	239.28
6Bl(Pg)	Gilgaied, deep, brown clay soils with a cracking surface and strong structured, sodic and salinity impacted subsoils and is associated with gently undulating plains with open Brigalow scrub vegetation.	Brown Vertosol	18*, 19, 20, 21, 22, 23	D12m/d*, D9m/d	-	All land uses (Class 4)	Class 5	Class C2	-	141.38
7Bl(Pg)	Very deep, grey clay soil with a cracking surface and strong structured subsoils and is associated with gently undulating plains with sparse Brigalow scrub.	Grey Vertosol	24, 25*, 26, 27, 28	D14m/d*, D15	-	All land uses (Class 4)	Class 5	Class C2	0.00-0.50	304.18
8Dn(Te)	Moderately deep, grey clay soil with a self-mulching and moderate structured subsoils and is associated with gently undulating rises with lower lying and drainage areas.	Grey Dermosol	12, 29, 30*, 31	D19*, D34	-	UMA 12: Cotton (Class 4). Remaining land uses (Class 5) UMAs 29, 30 and 29: Cotton (Class 3). Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 4	UMA 12: Class C2 UMAs 29, 30 and 29: Class B	0.00-0.50	180.85
9Dn(Ro)	Very deep, black on grey, brown clay soil with a self-mulching, sometimes cracking surface and strong structured subsoils and is associated with flat plains with Mitchell grasslands and sparse Prickly Acacia vegetation.	Black Vertosol	33*, 34, 36, 37, 38, 39, 40, 41, 42	D21*, D28	-	All land uses (Class 4)	Class 4	Class C1	-	589.65

SPC map code[1] / Report No.	SPC Concept	ASC (Dominant to sub-order)	UMAs (*Analysed)	Detailed sites (*Analysed)	SLR (2023) Analysed Site relevant to GTE Analysed site	Regional Frameworks / Limitations Suitability	Beef Cattle Grazing / Limitations Suitability	ALC	Topsoil Thickness for Use in Mine Rehabilitation (mbgl)	Total Area (ha)
10Ct(Ro)	Very deep, grey on clay soil with self-mulching, no coarse fragment surface and strong structured subsoils and is associated with flat and gently undulating plains associated with drainage and low-lying areas with sparse bauhinia and brigalow.	Grey Vertosol	43, 44*, 45, 46, 47, 48	D16, D17, D22*, D23, D25, D27, D30, D31, D35, D40, D47, D48, D51, D53, D54, D56, D57, D60	B10	All land uses (Class 4)	Class 4	Class C1	-	1773.82
11Bl(Ta)	Moderately deep, texture contrast loam on medium clay soil with a hard-setting, with coarse fragments on the surface and sodic subsoils on shallow substrate and is associated with flat plains with sparse Prickly Acacia and Vine tree.	Brown Sodosol	49, 50, 51, 52*, 53, 54, 55, 56	D24*	-	UMAs 50 and 51: Cotton (Class 4). Remaining land uses (Class 5) UMAs 49, 52, 53, 54, 55 and 56: Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	UMAs 50 and 51: Class 4 UMAs 49, 52, 53, 54, 55 and 56: Class 3	UMAs 50 and 51: Class C2 UMAs 49, 52, 53, 54, 55 and 56: Class C1	-	218.42
12Da(Te)	Very deep clay loam on structured clay soil with a firm surface and is associated with residual rises with sparse brigalow.	Grey Dermosol	57, 58	D4, D32*	B12	Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 3	Class C1	0.20-0.90	203.00
13Bl(Ta)	Very deep, clay soil with a firm surface, with coarse fragments, mottled subsoils and is associated with flat, gently undulating plains with sparse current bush.	Brown Dermosol	59, 60, 61*	D36*	-	Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 4	Class C2	0.20-1.40	111.47

SPC map code[1] / Report No.	SPC Concept	ASC (Dominant to sub-order)	UMAs (*Analysed)	Detailed sites (*Analysed)	SLR (2023) Analysed Site relevant to GTE Analysed site	Regional Frameworks / Limitations Suitability	Beef Cattle Grazing / Limitations Suitability	ALC	Topsoil Thickness for Use in Mine Rehabilitation (mbgl)	Total Area (ha)
14Bl(Ro)	Very deep, black on grey-brown clay soil with a cracking surface and strong structured subsoils and is associated with low lying areas and drainage depressions located near residual rises with sparse bauhinia vegetation.	Black Vertosol	35*	D37*	B05	All land uses (Class 4)	Class 4	Class C2	0.20-0.50	64.20
15Bl(Ro)	Moderately deep clay soil with a self-mulching surface deep bedrock and is associated with gently undulating plains with sparse bauhinia	Brown Vertosol	62, 63, 64, 65*, 66	D2, D8, D10, D11, D13, D39*, D61, D66	-	All land uses (Class 4)	Class 4	Class C2	0.20-0.60	1040.57
16Bl(Ta)	Very shallow; clay loam surfaced on clay subsoils with a hard-setting on shallow bedrock and is associated with hillslopes and Bauhinia.	Grey Sodosol	32, 67*, 68, 69	D43*	-	Cotton (Class 4). Remaining land uses (Class 5)	Class 4	Class C2	-	38.52
17Bl(Ro)	Deep clay uniform soil with a cracking surface and is associated with gently undulating plains and is associated with sparse bauhinia and brigalow	Grey Vertosol	70, 71, 72, 73*	D29, D38, D41, D44*, D46	B01	All land uses (Class 4)	Class 4	Class C1	-	348.24
18Bl(Ro)	Very deep, grey clay uniform soil with self-mulching surface and is associated with gently undulating plains with sparse bauhinia and brigalow.	Grey Vertosol	74*	D45*	-	Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 3). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 4)	Class 3	Class A1	0.20-1.00	76.36
19Bl(Ro)	Very deep, brown clay soils with a surface flake and strong structured subsoils and is associated with gently undulating plains and rises with sparse bauhinia and brigalow vegetation.	Brown Vertosol	75*, 76, 77, 78, 79, 80	D18, D49, D52*, D62, D63, D64	-	Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 4	Class C1	0.20-1.40	756.86

SPC map code[1] / Report No.	SPC Concept	ASC (Dominant to sub-order)	UMAs (*Analysed)	Detailed sites (*Analysed)	SLR (2023) Analysed Site relevant to GTE Analysed site	Regional Frameworks / Limitations Suitability	Beef Cattle Grazing / Limitations Suitability	ALC	Topsoil Thickness for Use in Mine Rehabilitation (mbgl)	Total Area (ha)
20Bl(Ro)	Moderately deep, uniform grey clay soils with surface flake and strong structured clay subsoils and is associated with gently undulating plains with open woodland including brigalow vegetation	Grey Vertosol	81*	D58*	-	Cotton (Class 3). Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	Class 4	Class B	0.20-0.80	27.81
21Bl(Ta)	Very deep, texture contrast brown sandy loams on grey and yellow brown mottled clay subsoils with hard-setting surface and is associated with gently undulating plains with sparse Brigalow vegetation on grasslands.	Grey Sodosol	82*	D59*	B21	All land uses (Class 5)	Class 5	Class C3	0.20-0.45	167.19
22Bl(Wy)	Deep, gradational textured, weakly structured soils with firm surfaces loamy subsoils and is associated with gently undulating plains with sparse brigalow and bauhinia vegetation.	Brown Kandosol	83*	D65*	-	Cotton (Class 4). Remaining land uses (Class 5)	Class 4	Class C1	0.45-1.00	13.54

1 - SPC name codes are based on the dominant land system in which they occupy. The letters in the brackets are based on the soil type within the landscape it resembles. The number is an internal number ordering system used by GTE.

Figure 3: Soil Profile Classes

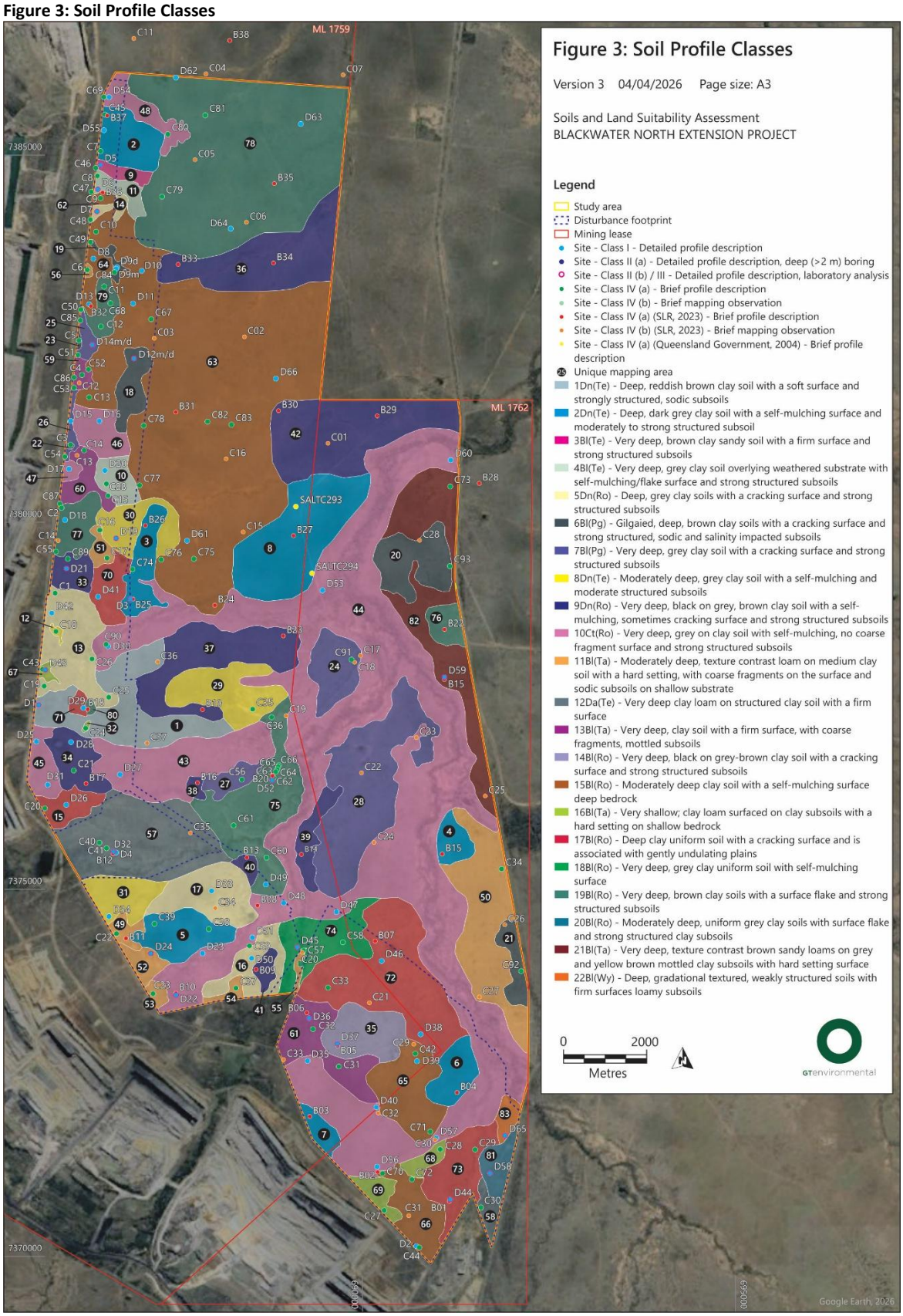


Figure 4: Australian Soil Classification

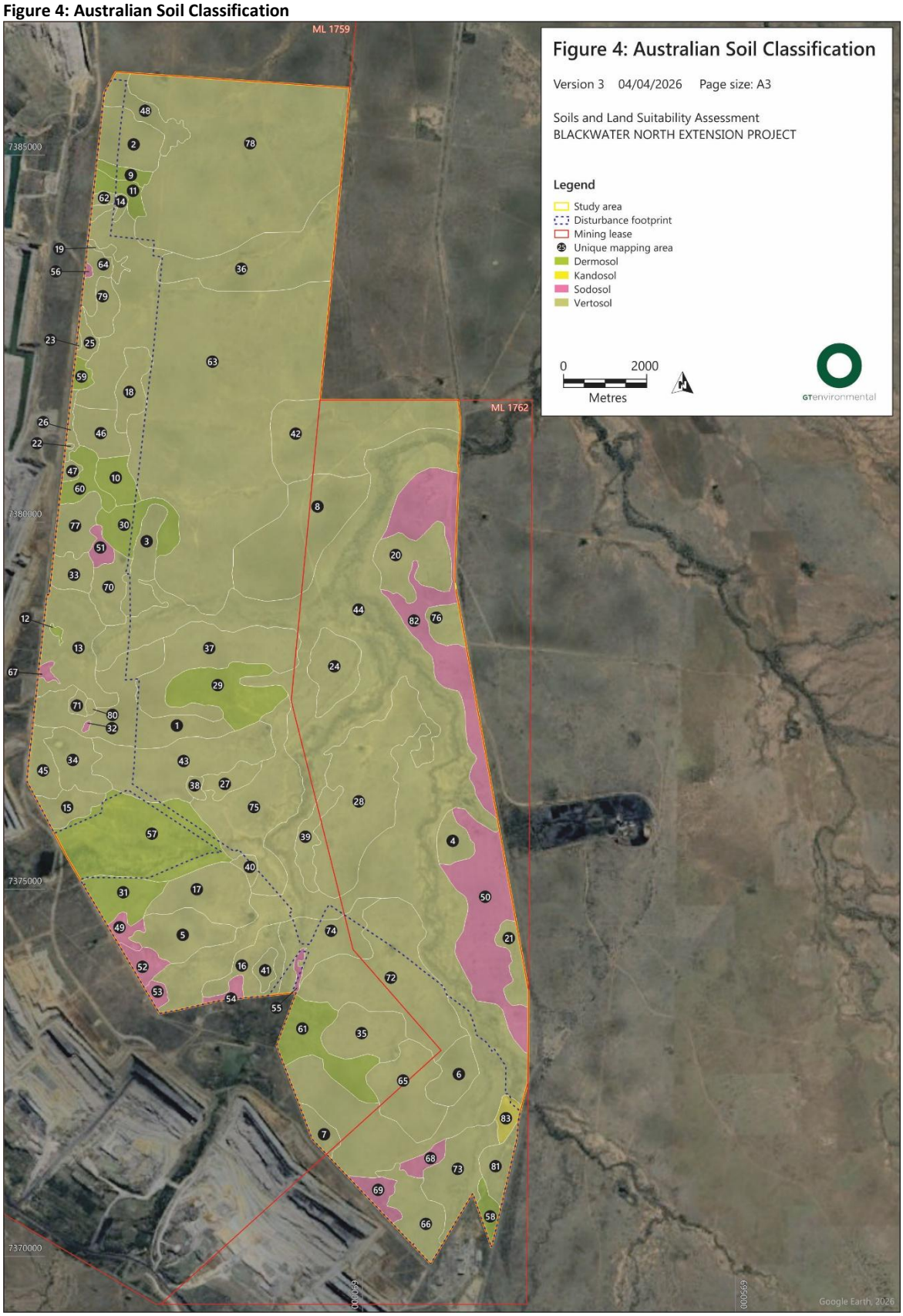


Table 5-2: SLR (2023) Detailed (Analysed) Sites Review for GTE SALS Assessment Summary

SLR Soil Mapping Unit	SLR Classification / Soil Types	Nominated SLR Detailed (Analysed) Site	Samples Analysed	Number of Samples	GTE Review	Nominated GTE Class III(a) Sites
2B	Eutrophic Red Dermosol	B01	Yes	4	No profile to review	D44
1	Self-Mulching Black Vertosol	B05	Yes	4	Gilgai observed as present	D37
1	Self-Mulching Red Vertosol	B10	Yes	4	Gilgai observed as present	D22
3	Eutrophic Red Chromosol	B12	Yes	4	No profile to review	D32
1	Subnatric Brown Sodosol	B21	Yes	4	No gilgai observed	D59
1	Self-Mulching Brown Vertosol	B25	Yes	4	Gilgai observed as present	D3
2A	Eutrophic Red Dermosol	B28	Yes	4	Soil Map Unit (SMU) appears to be similar if not the same as SMU 2B. GTE do not recommend this is separated based on SLR description.	-

5.1.2 Soil Profile Class 1Dn(Te): Brown Vertosol

Overview and Concept

1Dn(Te) is characterised by deep, reddish brown clay soil with a soft surface and strongly structured, sodic subsoils. The SPC is associated with flat to gently undulating plains with Bauhinia. The SPC is situated in the centre-west portion of the study area over an area of 139.54 ha.

Analysed site

The nominated analysed site, site D1, is summarised in Table 5-3. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-4. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-3: Land Summary 1Dn(Te) - Analysed Site D1

Item	Description
Analysed Site	D1
UMAs	1

Representative Landscape Photograph



Soil Profile Photograph



(Profile viewed top to bottom, 0.60 m)

Location GDA2020 ZONE 55	685633 7377526
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Bauhinia
Disturbance	Extensive clearing
Landform pattern / pattern	Simple slope, gently undulating plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / Moderate
Slope (%) / Erosion	2.0 / 3.0, No erosion observed

Table 5-3: Land Summary 1Dn(Te) - Analysed Site D1 (continued)

Surface condition / Surface coarse fragments or segregations		Self-mulching, no coarse fragments					
SPC ASC Order / Suborder		Brown Vertosol					
Associated Land System / Soil		Daunia / Teviot					
Total area (ha)		139.54					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Light medium clay	Moderate / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	2.5Y5 / 2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 8.0 No dispersion after 10 minutes No slaking
B21 0.20-0.40 Abrupt 5-20 mm	Light clay	Moderate / Firm Angular blocky 20-50 mm Slickensides	< 2% calcium carbonate 2-6 mm	2.5Y5 / 3 Light olive brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine < 1 mm Few	0.30 / 7.5 No dispersion after 10 minutes Partial slaking
BC 0.40-0.60 End of borehole (EOBH)	Medium clay	Massive / Loose Angular blocky 20-50 mm Slickensides	20-50% coarse fragments 20-60 mm 20-50% coarse fragments 6-20 mm	10YR5 / 3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.50 / 9.0 No dispersion after 10 minutes No slaking
	Refusal on cemented pan						

Table 5-4: Soil Chemistry and Assessment for 1Dn(Te), Analysed Site D1

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils increase from moderately alkaline to strong alkaline
EC	Topsoil is low in EC levels. Subsoil increases from high to very high
ECEC	High throughout the profile
ESP	Non-sodic levels in topsoil. Subsoil is non-sodic and increase below 0.40 mbgl
Ca:Mg	Very high throughout the profile
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Light medium clay in topsoil. Subsoils consist of medium clays with silty clay loam in BC horizon
EAT	Topsoil is non-dispersive with carbonate and gypsum present. Subsoil in B21 disperses after remoulding. BC horizon has indicated some dispersion.
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.018
SALFPREDICT PAWC (PAWCER) Total (mm/60cm)	72.7
ERD	Soil Depth on BC horizon is 0.40 mbgl and 0.60 mbgl on refusal

Key Analysis	Assessment Summary
	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90 to 75% for all crop land uses. The limitation for ERD is soil depth of 0.40 m.
Summary of limitations and management	The soil has less than favourable PAWC, very low nutrient levels, fertility status and moderate soil structure. Topsoil pH is moderately alkaline with low EC non-sodic levels and favourable surface conditions with shallow subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

5.1.3 Soil Profile Class 2Dn(Te): Black Vertosol

Overview

2Dn(Te) is characterised by deep, dark grey clay soil with a self-mulching surface and moderately to strong structured subsoils. The SPC is associated with flat to gently undulating plains with cleared Bauhinia vegetation. The SPC is situated across the Project site in the centre and south portion of the study area over an area of 414.16 ha.

Analysed site

The nominated analysed site, site D3, is summarised in Table 5-5. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-6. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-5: Land Summary 2Dn(Te), Analysed Site D3

Item	Description
Analysed Site	D3
UMAs	2, 3, 4, 5, 6, 7, 8
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.00 m)
Location GDA2020 ZONE 55	686900 7378950
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Bauhinia
Disturbance	Limited clearing
Landform pattern / pattern	Simple slope, gently undulating plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / Moderate
Slope (%) / Erosion	1.0 / 1.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Self-mulching (Flake), no coarse fragments

Table 5-5: Land Summary 2Dn(Te), Analysed Site D3 (continued)

SPC ASC Order / Suborder		Black Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Teviot					
Total area (ha)		414.16					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.10 Clear 20-50 mm	Light clay	Strong / Very firm Subangular blocky 5-10 mm No Slickensides	< 2% coarse fragments 6-20 mm	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2 mm Common	0.05 / 8.0 No dispersion after 10 minutes Partial slaking
B21 0.10-0.30 Clear 20-50 mm	Light clay	Moderate / Very firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.20 / 8.0 No dispersion after 10 minutes Partial slaking
B22 0.30-0.65 Clear 20-50 mm	Medium clay	Strong / Firm Angular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR2 / 2 No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	0.45 / 8.0 No dispersion after 10 minutes Complete slaking
B23 0.65-0.84 Clear 20-50 mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.75 / 8.5 No dispersion after 10 minutes Complete slaking
BC 0.84-1.00 EOBH	Light medium clay Silty	Massive / loose Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20 mm	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	No roots	0.92 / 9.0 No dispersion after 10 minutes Partial slaking
	Refusal on weathered substrate						

Table 5-6: Soil Chemistry for 2Dn(Te), Analysed Site D3

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils range from slightly acid to neutral to strongly alkaline
EC	Topsoil is low in EC levels. Subsoil remains low.
ECEC	High throughout the profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic
Ca:Mg	Very high throughout the profile
P	High in topsoil. Low in the B21 horizon of subsoil
PSA	Topsoil is clay loam. Subsoil consists of light clay increasing to medium heavy clay with clay loam in BC horizon
EAT	Topsoil disperses after remoulding. Subsoil in B21 is non-dispersive with carbonate and gypsum present
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	78.80
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% yield was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses. The limitation for ERD is soil depth of 1.00 m.
Summary of limitations and management	The soil has less than favourable PAWC, high nutrient levels, fertility status and moderate to strong soil structure. Topsoil pH is neutral alkaline with low EC, non-sodic levels and favourable surface conditions with deep subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.50 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

Associated SLR (2023) Site Assessment

The analysed site undertaken by SLR (2023) was site B25, described as a Self-Mulching Brown Vertosol within Soil Unit 1 (Self-Mulching Black Brown Vertosol) with incipient gilgai.

GTE conducted site D3 within 5.50 m of B25 (SLR, 2023) and the classification indicated it was a Black Vertosol with no gilgai observed at or within the area. Based on the D3 profile observation, GTE are confident that this site should be classified as a Black Vertosol, therefore site B25 (SLR, 2023) is considered an unmappable sub-dominant soil type within this SPC.

The laboratory analysis was utilised with D3 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

5.1.4 Soil Profile Class 3Bl(Te): Black Dermosol

Overview

3Bl(Te) is characterised by very deep, brown clay sandy soil with a firm surface and strong structured subsoils. The SPC is associated with flat to gently undulating rises with sparse woodlands of whitewood vegetation and grasslands. The SPC is situated in the north western portion of the study area over an area of 12.39 ha.

Analysed site

The nominated analysed site, site D5, is summarised in Table 5-7. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-8. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-7: Land Summary 3Bl(Te), Analysed Site D5

Item	Description
Analysed Site	D5
UMAs	9
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.00 m)
Location GDA2020 ZONE 55	686565 7384805
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Whitewood, grassland
Disturbance	Limited clearing
Landform pattern / pattern	Hillslope, flat, gently undulating rises
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderately well / Slow
Slope (%) / Erosion	2.0 / 2.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Firm, no coarse fragments

Table 5-7: Land Summary 3Bl(Te), Analysed Site D5 (continued)

SPC ASC Order / Suborder		Black Dermosol					
Associated Land System / Soil		Blackwater / Teviot					
Total area (ha)		12.39					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking
B21 0.20-0.40 Clear 20-50 mm	Medium clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	0.30 / 8.0 Slight Dispersion after 10 minutes Partial slaking
B22 0.40-0.80 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	0.60 / 8.0 Slight Dispersion after 10 minutes Partial slaking
B23 0.80-1.30 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3 / 3 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	1.05 / 6.0 Slight Dispersion after 10 minutes Partial slaking
B24 1.30-1.60 Clear 20-50 mm	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	5YR5 / 6 Yellowish red Mottles: 10YR4 / 2 Dark greyish brown Few 2%-10% Few < 5 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.45 / 5.5 No dispersion after 10 minutes Partial slaking
C 1.60-2.00 End of test pit (EOTP)	-	-	-	-	-	-	1.80 / 5.5 No dispersion after 10 minutes Partial slaking
	Refusal on bedrock						

Table 5-8: Soil Chemistry for 3Bl(Te), Analysed Site D5

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils range from moderately alkaline to strongly alkaline
EC	Topsoil is low in EC levels. Subsoil increases from moderate to very high
ECEC	High throughout the profile
ESP	Non-sodic levels in topsoil. Subsoils range from non-sodic to strongly sodic
Ca:Mg	Topsoil is very high. Subsoil decreases to high and moderate at depth
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium clay Subsoil consists of medium heavy clay to medium clay
EAT	Topsoil has some dispersion Subsoil has some dispersion throughout the profile
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	125.10
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% yield was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses. There are no limitations for ERD
Summary of limitations and management	The soil has favourable PAWC, very low nutrient levels, fertility status and strong soil structure. Topsoil pH is neutral alkaline with low EC, non-sodic levels and favourable surface conditions with deep subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.80 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 15.1 tonnes per hectare (t/ha)for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.40 mbgl

5.1.5 Soil Profile Class 4Bl(Te): Grey Dermosol

Overview

4Bl(Te) is characterised by very deep, grey clay soil overlying weathered substrate with self-mulching / flake surface and strong structured subsoils. The SPC is associated with gently undulating plains with grasslands. The SPC is situated in the east-west portion of the study area over an area of 46.17 ha.

Analysed site

The nominated analysed site, site D6, is summarised in Table 5-9. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-10. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-9: Land Summary 4Bl(Te), Analysed Site D6

Item	Description
Analysed Site	D6
UMAs	10, 11, 12
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.60 m)
Location GDA2020 ZONE 55	686529 7384441
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Grassland
Disturbance	Complete clearing, not cultivated
Landform pattern / pattern	Simple slope, gently undulating rises
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	2.0 / 1.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Surface flake, no coarse fragments

Table 5-9: Land Summary 4Bl(Te), Analysed Site D6 (continued)

SPC ASC Order / Suborder		Grey Dermosol					
Associated Land System / Soil		Daunia / Teviot					
Total area (ha)		46.17					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Light medium clay Silty	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking
B21 0.20-0.60 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2 mm Common	0.40 / 7.5 Slight Dispersion after 10 minutes No slaking
B22 0.60-0.90 Clear 20-50 mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 4 Dark yellowish brown Mottles: Pale orange-brown, Few 2%-10%	Dry Imperfect drained	Fine 1-2 mm Few	0.75 / 7.5 Slight Dispersion after 10 minutes Partial slaking
B3 0.90-1.20 Clear 20-50 mm	Clay Loam	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 4 Dark yellowish brown Mottles: Pale orange-brown, Few 10%-20%	Very poorly drained	No roots	-
C 1.20-1.60 EOTP	-	-	-	-	Very poorly drained	No roots	-
	Refusal on weathered substrate						

Table 5-10: Soil Chemistry for 4Bl(Te), Analysed Site D6

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils range from moderate alkaline to strongly alkaline
EC	Topsoil is very low. Subsoil increases from moderate to very high
ECEC	Topsoil is moderate. Subsoil ranges from high to moderate with depth
ESP	Non-sodic levels in topsoil. Subsoils range from non-sodic to strongly sodic
Ca:Mg	High throughout soil profile
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is light clay Subsoil consists of medium heavy clay to clay loam in the BC horizon
EAT	Topsoil disperses after remoulding Subsoil disperses after remoulding with some dispersion below 0.80 m
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.025

Key Analysis	Assessment Summary
SALFPREDICT PAWC (PAWCER) Total (mm/50cm)	65.80
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses. The SPC is assessed as a Dermosol. As such, it has been assessed against the pH limitations. It was assessed from 0.50 mbgl, pH was > 9.0, therefore the PAWC based on the SALFPREDICT modelling has been assessed at this depth. There are limitations for ERD, relating to subsoil pH.
Summary of limitations and management	The soil has favourable PAWC, low nutrient levels, fertility status and strong soil structure. Topsoil pH is neutral alkaline with very low EC, non-sodic levels and favourable surface conditions with deep subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.60 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.60 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 12.6 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.00 mbgl

5.1.6 Soil Profile Class 5Dn(Ro): Grey Vertosol

Overview

5Dn(Ro) is characterised by deep, grey clay soils with a cracking surface and strong structured subsoils. The SPC is associated with gently undulating rises with drainage and depressions with sparse acacia vegetation and grasslands. The SPC is situated in the centre and south-west portions of the study area over an area of 239.29 ha.

Analysed site

The nominated analysed site, site D7 is summarised in Table 5-11. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-12. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-11: Land Summary 5Dn(Ro), Analysed Site D7

Item	Description
Analysed Site	D7
UMAs	13, 14, 15, 16, 17
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.20 m)
Location GDA2020 ZONE 55	686513 7384178
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Grassland
Disturbance	Complete clearing, not cultivated
Landform pattern / pattern	Simple slope, gently undulating rises
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed

Table 5-11: Land Summary 5Dn(Ro), Analysed Site D7 (continued)

Surface condition / Surface coarse fragments or segregations	Cracking, no coarse fragments						
SPC ASC Order / Suborder	Grey Vertosol						
Associated Land System / Soil	Blackwater, Daunia / Rolleston						
Total area (ha)	239.28						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-015 Clear 20-50 mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 20-60 mm	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking
B21 0.15-0.45 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 20-60mm	10YR4 / 2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2 mm Common	0.30 / 7.5 No dispersion after 10 minutes Partial slaking
B22 0.45-0.60 Clear 20-50 mm	Medium clay	Strong / Firm Subangular blocky 50-100 mm Slickensides	< 2% coarse fragments and nodules 2-6 mm	10YR4 / 2 Dark greyish brown Mottles: 10YR4 / 3 Brown Very few < 2% Medium 5-15 mm	Moderately moist Imperfectly drained	Fine 1-2 mm Common	0.60 / 7.5 Moderate dispersion after 10 minutes Complete slaking
C 0.60-1.20 EOTP	-	-	-	-	-	-	-
	Refusal on weathered substrate						

Table 5-12: Soil Chemistry for 5Dn(Ro), Analysed Site D7

Key Analysis	Assessment Summary
Soil pH (H_20)	Moderately alkaline throughout soil profile
EC	Topsoil is low. Subsoil increases from low to high
ECEC	High throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils range from non-sodic to strongly sodic
Ca:Mg	High throughout soil profile
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium clay Subsoil is medium heavy clay
EAT	Topsoil is non-dispersive with carbonate and gypsum present Subsoil has some dispersion
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015

Key Analysis	Assessment Summary
SALFPREDICT PAWC (PAWCER) Total (mm/60cm)	86.0
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses except Maize at 75%. The limitation for ERD is soil depth of 0.60 m.
Summary of limitations and management	The soil has unfavourable PAWC, very low nutrient levels, fertility status, strong soil structure and moderately deep soils. Topsoil pH is moderately alkaline with low EC, non-sodic levels and favourable surface conditions with deep subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.45 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.45 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 9.1 t/ha for each 0.10 m to achieve ESP of 5.5 based on the highest sodic levels at 0.50 mbgl.

5.1.7 Soil Profile Class 6Bl(Pg): Brown Vertosol (Gilgai)

Overview

6Bl(Pg) is characterised by gilgaied, deep, brown clay soils with a cracking surface and strong structured, sodic and salinity impacted subsoils. The SPC is associated with gently undulating plains with open Brigalow scrub vegetation. The SPC is situated in small areas across the study area over an area of 141.38 ha.

Analysed site

The nominated analysed site, site D12 mound (m), is summarised in Table 5-13 with D12 depression (d) in Appendix A. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-14. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-13: Land Summary 6Bl(Pg), Analysed Site D12m

Item	Description
Analysed Site	D12m (Mound position)
UMAs	18, 19, 20, 21, 22, 23
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.20 m)
Location GDA2020 ZONE 55	687003 7382185
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Open Brigalow Scrub
Disturbance	Extensive clearing
Landform pattern / pattern	Plain, gently undulating rises
Microrelief / Rock outcrop	Normal microrelief, no rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed

Table 5-13: Land Summary 6Bl(Pg), Analysed Site D12m (continued)

Surface condition / Surface coarse fragments or segregations	Cracking, no coarse fragments						
SPC ASC Order / Suborder	Grey Vertosol						
Associated Land System / Soil	Blackwater, Daunia / Pegunny						
Total area (ha)	141.38						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 8.0 No dispersion after 10 minutes Partial slaking
B21 0.20-0.60 Gradual 50-100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5 / 3 Brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2 mm Common	0.40 / 5.5 No dispersion after 10 minutes Partial slaking
B22 0.60-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	No inclusions or segregations	10YR5 / 4 Yellowish brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2 mm Few	1.20 / 6.5 No dispersion after 10 minutes Complete slaking

Table 5-14: Soil Chemistry for 6Bl(Pg), Analysed Site D12m

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly acidic. Subsoils are moderately acid to slightly alkaline below 1.20 m
EC	Topsoil is moderate. Subsoil increases from very high to extreme
ECEC	Topsoil is high. Subsoil is moderate to high throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are sodic
Ca:Mg	Topsoil is high. Subsoils are moderate to high
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium heavy clay Subsoil is medium heavy clay throughout
EAT	Topsoil is non-dispersive with carbonate and gypsum present Subsoil has some dispersion
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	131 (115.2 Depression location)

Key Analysis	Assessment Summary
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for barley and cotton crop land uses. Maize, oat, sorghum, soybean, sunflower and wheat present 50% yield. There are no limitations for ERD.
Summary of limitations and management	Topsoil recovery may be difficult with the undulating nature of gilgai areas. Care is recommended when stripping the topsoil as to avoid mixing with sodic subsoils. Otherwise, gypsum application may be required, refer to Subsoil recommendation below. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.20 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 14.7 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels of the depression location at 0.80 mbgl.

5.1.8 Soil Profile Class 7Bl(Pg): Grey Vertosol (Gilgai)

Overview

7Bl(Pg) is characterised by very deep, grey clay soil with a cracking surface and strong structured subsoils. The SPC is associated with gently undulating plains with sparse Brigalow scrub. The SPC is situated mainly in the eastern and centre portions of the study area over an area of 304.18 ha.

Analysed site

The nominated analysed site, site D14m, is summarised in Table 5-15. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-16. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-15: Land Summary 7Bl(Pg), Analysed Site D14m

Item	Description
Analysed Site	D14m (Mound position)
UMAs	24, 25, 26, 27, 28
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 2.20 m)
Location GDA2020 ZONE 55	686471 7382392
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Open Brigalow scrub
Disturbance	Limited clearing
Landform pattern / pattern	Plain, gently undulating plains
Microrelief / Rock outcrop	Normal microrelief, no rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Cracking, no coarse fragments

Table 5-15: Land Summary 7Bl(Pg), Analysed Site D14m (continued)

SPC ASC Order / Suborder		Grey Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Pegunny					
Total area (ha)		304.18					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Gradual 50-100 mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking
B21 0.20-0.40 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	< 2% coarse fragments 20-60 mm	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.30 / 7.0 No dispersion after 10 minutes Partial slaking
B22 0.40-0.60 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	< 2% coarse fragments 20-60 mm	10YR5 / 2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	0.50 / 6.5 Moderate dispersion after 10 minutes Complete slaking
B23 0.60-1.90 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 100-200 mm Slickensides	< 2% coarse fragments 20-60 mm	10YR5 / 2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	1.00 / 7.0 1.50 / 7.0 No dispersion after 10 minutes Complete slaking
B24 1.90-2.20 EOTP	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	10-20% coarse fragments 20-60mm 2-10% coarse fragments 6-20mm	10YR5 / 2 Greyish brown Mottles: Brown Few 2%-10% Few < 5 mm	Moderately moist Imperfectly drained	Very fine < 1 mm Few	2.00 / 7.0 No dispersion after 10 minutes Complete slaking

Table 5-16: Soil Chemistry for 7Bl(Pg), Analysed Site D14m

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly acidic. Subsoils are moderately alkaline to slightly alkaline below 1.20 m
EC	Topsoil is low. Subsoil varies from moderate to extreme throughout soil profile
ECEC	Topsoil is moderate. Subsoil is moderate to high throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic increasing to sodic below 0.50 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to moderate with depth
P	Moderate in topsoil. Very low in the B21 horizon of subsoil

Key Analysis	Assessment Summary
PSA	Topsoil is medium heavy clay Subsoil is medium heavy clay throughout
EAT	Topsoil is non-dispersive with carbonate and gypsum present Subsoil has some dispersion
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	110.9 (106.8 Depression location)
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses except Maize at 75%. There are no limitations for ERD.
Summary of limitations and management	Topsoil recovery may be difficult with the undulating nature of gilgai areas. Care is recommended when stripping the topsoil as to avoid mixing with sodic subsoils. Otherwise, gypsum application may be required, refer to Subsoil recommendation below. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.40 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 17.9 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels of the mound location at 0.80 mbgl.

5.1.9 Soil Profile Class 8Dn(Te): Grey Dermosol

Overview

8Dn(Te) is characterised by moderately deep, grey clay soil with a self-mulching and moderate structured subsoils. The SPC is associated with gently undulating rises with lower lying and drainage areas. The SPC is situated in the centre and centre-south portions of the study area over an area of 180.85 ha.

Analysed site

The nominated analysed site, site D19, is summarised in Table 5-17. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-18. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-17: Land Summary 8Dn(Te), Analysed Site D19

Item	Description
Analysed Site	D19
UMAs	29, 30, 31, 32
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.10 m)
Location GDA2020 ZONE 55	686719 7379753
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse shrubbery including ruby salt bush and emu apple
Disturbance	Extensive clearing
Landform pattern / pattern	Drainage depression, gently undulating plains
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Moderate
Slope (%) / Erosion	3.0 / 3.0, No erosion observed

Table 5-17: Land Summary 8Dn(Te), Analysed Site D19 (continued)

Surface condition / Surface coarse fragments or segregations	Surface flake, < 2% coarse fragments 6-20mm						
SPC ASC Order / Suborder	Grey Dermosol						
Associated Land System / Soil	Daunia / Teviot						
Total area (ha)	180.85						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.05 Clear 20-50 mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 2-6 mm	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.03 / 7.0 No dispersion after 10 minutes Partial slaking
B21 0.05-0.30 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 6-20 mm	10YR5 / 2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.18 / 7.5 No dispersion after 10 minutes Partial slaking
B22 0.30-0.50 Gradual 50-100 mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20 mm	10YR5 / 2 Greyish brown Mottles: Brown Common 10%-20% Few < 5 mm	Dry Imperfectly drained	Very fine < 1 mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking
B3 0.50-0.60	Clay Loam Coarse	Massive / Weak No Slickensides	20-50% coarse fragments 6-20 mm	10YR5 / 4 Yellowish brown Mottles: Brown Many 20%-50% Few < 5 mm	Dry Imperfectly drained	No roots	0.55 / 7.0 Slight Dispersion after 10 minutes Partial slaking
BC 0.60-0.90	Clay Loam Coarse	Massive / Weak No Slickensides	50-90% coarse fragments 6-20 mm	10YR5 / 4 Yellowish brown Mottles: Brown Many 20%-50% Few < 5 mm	Dry Imperfectly drained	No roots	0.55 / 7.0 Slight Dispersion after 10 minutes Partial slaking
C 0.90-1.10 EOTP	-	-	-	-	-	-	-
	Refusal on cemented pan						

Table 5-18: Soil Chemistry for 8Dn(Te), Analysed Site D19

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils are moderately alkaline with neutral to slightly alkaline below 0.50 m
EC	Topsoil is very low. Subsoil varies from low to high throughout soil profile
ECEC	Topsoil is high. Subsoil is high to moderate throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic increasing to strongly sodic below 0.50 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high at 0.50 m
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium clay Subsoil is light medium clay to clay loam and light clay to depth
EAT	Topsoil disperses after remoulding Subsoil indicates disperses after remoulding and some dispersion below 0.40 m
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	95.90
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for barley, cotton, sorghum and wheat crop land uses. Maize, oat, soybean and sunflower present 75 and 50% yield. The limitation for ERD is soil depth of 0.60 m.
Summary of limitations and management	The soil has favourable PAWC, low nutrient levels, fertility status and moderately deep soils. Topsoil pH is moderately alkaline with very low EC, non-sodic levels and favourable surface conditions with moderately deep, sodic subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Topsoil horizon is shallow, however, refer to subsoil for additional recommendations. Subsoil to 0.50 mbgl may be stripped to this depth and utilised as topsoil. Subsoil below 0.50 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 11.2 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.50 mbgl.

5.1.10 Soil Profile Class 9Dn(Ro): Black Vertosol

Overview

9Dn(Ro) is characterised by very deep, black on grey, brown clay soil with a self-mulching, sometimes cracking surface and strong structured subsoils. The SPC is associated with flat plains with Mitchell grasslands and sparse Prickly Acacia vegetation. The SPC is situated across the majority of the study area, over an area of 589.65 ha.

Analysed site

The nominated analysed site, site D21, is summarised in Table 5-19. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-20. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-19: Land Summary 9Dn(Ro), Analysed Site D21

Item	Description
Analysed Site	D21
UMAs	33, 34, 36, 37, 38, 39, 40, 41, 42
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 2.10 m)
Location GDA2020 ZONE 55	686057 7379329
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Flat plain, gently undulating plains
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / < 1.0, No erosion observed

Table 5-19: Land Summary 9Dn(Ro), Analysed Site D21 (continued)

Surface condition / Surface coarse fragments or segregations	Cracking, < 2% coarse fragments 6-20 mm						
SPC ASC Order / Suborder	Black Vertosol						
Associated Land System / Soil	Blackwater, Daunia / Rolleston						
Total area (ha)	589.65						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.10 Clear 20-50 mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 6-20 mm	10YR3 / 1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.05 / 8.0 No dispersion after 10 minutes Complete slaking
B21 0.10-0.60 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR3 / 1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.35 / 7.5 No dispersion after 10 minutes Partial slaking
B22 0.60-1.00 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.80 / 7.5 No dispersion after 10 minutes Complete slaking
B23 1.00-1.90 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5 / 2 Greyish brown Mottles: Brown Common 10%-20% Few < 5 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.40 / 7.0 No dispersion after 10 minutes Complete slaking
C 1.90-2.10 EOTP	-	-	-	-	-	-	-

Table 5-20: Soil Chemistry for 9Dn(Ro), Analysed Site D21

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils are moderately alkaline with neutral to slightly alkaline below 1.40 m
EC	Topsoil is very low. Subsoil varies from high to moderate throughout soil profile
ECEC	Topsoil is high. Subsoil is high to moderate throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are sodic increasing to strongly sodic below 1.40 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high at 1.40 m
P	Low in topsoil. Very low in the B21 horizon of subsoil

Key Analysis	Assessment Summary
PSA	Topsoil is light medium clay Subsoil is medium heavy clay to medium clay to depth
EAT	Topsoil indicates no dispersion. Carbonates and gypsum may be present Subsoil indicates disperses after remoulding and some dispersion below 0.50 m
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	124.80
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for barley and cotton crop land uses. Maize, oat, sorghum, soybean, sunflower and wheat present 75 and 50% yield. There are no limitations for ERD.
Summary of limitations and management	The soil has favourable PAWC, low nutrient levels, fertility status and very deep soils. Topsoil pH is moderately alkaline with very low EC, non-sodic levels and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.10 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 16.3 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.80 mbgl.

5.1.11 Soil Profile Class 10Ct(Ro): Grey Vertosol

Overview

10Ct(Ro) is characterised by very deep, grey clay soil with self-mulching, no coarse fragment surface and strong structured subsoils. The SPC is associated with flat and gently undulating plains associated with drainage and low-lying areas with sparse bauhinia and brigalow. The SPC is situated across the majority of the study area, over an area of 1,773.82 ha.

Analysed site

The nominated analysed site, site D22, is summarised in Table 5-21. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-22. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-21: Land Summary 10Ct(Ro), Analysed Site D22

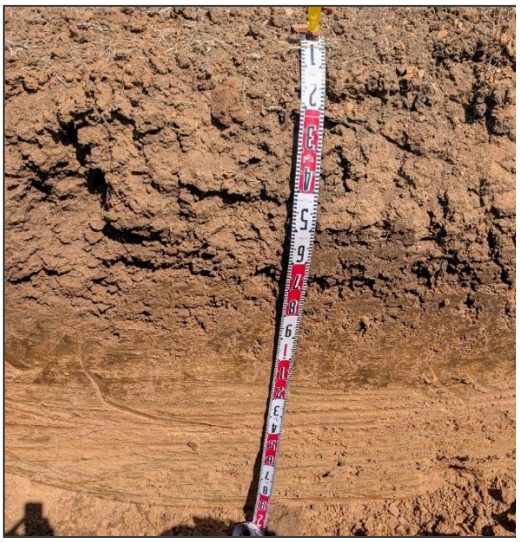
Item	Description
Analysed Site	D22
UMAs	43, 44, 45, 46, 47, 48
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 2.10 m)
Location GDA2020 ZONE 55	687457 7373577
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Flat plain, gently undulating plains
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed

Table 5-21: Land Summary 10Ct(Ro), Analysed Site D22 (continued)

Surface condition / Surface coarse fragments or segregations	Surface flake, No coarse fragments						
SPC ASC Order / Suborder	Grey Vertosol						
Associated Land System / Soil	Blackwater, Daunia / Rolleston						
Total area (ha)	1,773.82						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.10 Clear 20-50 mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.05 / 7.0 No dispersion after 10 minutes Partial slaking
B21 0.10-0.50 Gradual 50-100 mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.30 / 7.5 No dispersion after 10 minutes Partial slaking
B22 0.50-0.80 Diffuse > 100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 4 Dark yellowish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2 mm Few	0.65 / 7.5 No dispersion after 10 minutes Complete slaking
B23 0.80-1.10 Diffuse > 100 mm	Medium clay Sandy	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR5 / 4 Reddish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	0.95 / 5.5 Slight Dispersion after 10 minutes Complete slaking
B24 1.10-1.80 Gradual 50-100 mm	Medium clay	Strong / Firm Angular blocky 20-50 mm No Slickensides	< 2% coarse fragments 6-20 mm	7.5YR4 / 4 Brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.45 / 5.5 No dispersion after 10 minutes Complete slaking
C 1.80-2.00 EOTP	-	-	-	-	-	-	-

Table 5-22: Soil Chemistry for 10Ct(Ro), Analysed Site D22

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils vary between moderately alkaline and neutral to slightly alkaline
EC	Topsoil is low. Subsoil varies from moderate to very high with depth
ECEC	Topsoil is high. Subsoil is high to moderate throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are sodic increasing to extremely strongly sodic below 0.50 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high at 0.50 m
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium clay Subsoil is medium heavy clay to light clay to depth
EAT	Topsoil indicates disperses after remoulding Subsoil indicates disperses after remoulding and some dispersion below 1.00 m
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	116.70
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for barley, cotton, oat, sorghum, sunflower and wheat crop land uses. Maize and soybean present 75 and 50% yield. There are no limitations for ERD.
Summary of limitations and management	The soil has favourable PAWC, low nutrient levels, fertility status and very deep soils. Topsoil pH is moderately alkaline with low EC, non-sodic levels and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.10 mbgl may benefit from gypsum application due to extremely sodic levels. SodiCalc (2026) recommends approximately 15 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.

Associated SLR (2023) Site Assessment

The analysed site undertaken by SLR (2023) was site B10, a Self-Mulching Red Vertosol within Soil Unit 1 (Self-Mulching Black Brown Vertosol) with incipient gilgai.

GTE conducted site D22 within 1.7 m of B10 and the classification indicated it was a Grey Vertosol with no gilgai observed at or within the area. Based on the observation sites undertaken by GTE, no Red Vertosol was encountered, therefore, this is considered an anomaly, more so than a sub-dominant soil type.

The laboratory analysis was utilised with D22 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

5.1.12 Soil Profile Class 11Bl(Ta): Brown Sodosol

Overview

11Bl(Ta) is characterised by moderately deep, texture contrast loam on medium clay soil with a hard-setting, with coarse fragments on the surface and sodic subsoils on shallow substrate. The SPC is associated with flat plains with sparse Prickly Acacia and Vine tree. The SPC is situated in the centre and centre-east portions of the study area, over an area of 218.42 ha.

Analysed site

The nominated analysed site, site D24, is summarised in Table 5-23. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-24. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-23: Land Summary 11Bl(Ta), Analysed Site D24

Item	Description
Analysed Site	D24
UMAs	49, 50, 51, 52, 53, 55,
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.20 m)
Location GDA2020 ZONE 55	687133 7374146
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Simple slope, gently undulating plains
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / Slow
Slope (%) / Erosion	2.0 / < 1.0, No erosion observed

Table 5-23: Land Summary 11Bl(Ta), Analysed Site D24 (continued)

Surface condition / Surface coarse fragments or segregations	Hard-setting, < 2% coarse fragments 6-20 mm						
SPC ASC Order / Suborder	Brown Sodosol						
Associated Land System / Soil	Blackwater, Daunia / Taurus						
Total area (ha)	218.42						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Gradual 50-100 mm	Loam	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 6.0 No dispersion after 10 minutes Complete slaking
B21 0.20-0.60 Gradual 50-100 mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	0.40 / 7.5 No dispersion after 10 minutes Partial slaking
B22 0.60-1.00 Clear 20-50 mm	Medium clay	Strong / Firm Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Few	0.80 / 7.5 No dispersion after 10 minutes Complete slaking
C 1.00-1.20 EOTP	-	-	-	-	-	-	-

Table 5-24: Soil Chemistry for 11Bl(Ta), Analysed Site D24

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils vary between neutral to slightly alkaline to strongly alkaline
EC	Topsoil is very low. Subsoil is high
ECEC	Topsoil is low. Subsoil is moderate throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are strongly sodic
Ca:Mg	Topsoil is high. Subsoils are moderate throughout soil profile
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is loam Subsoil is medium clay to light clay to depth
EAT	Topsoil indicates disperses after remoulding Subsoil indicates some dispersion
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.040

Key Analysis	Assessment Summary
SALFPREDICT PAWC (PAWCER) Total (mm/80cm)	78.40
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for barley, cotton, sorghum, sunflower and wheat crop land uses. Maize and oat present 75 and 50% yield. The SPC is assessed as a Sodosol. As such, it has been assessed against the pH limitations. It was assessed from 0.80 mbgl, pH was > 9.0, therefore the PAWC based on the SALFPREDICT modelling has been assessed at this depth. There are limitations for ERD, relating to subsoil pH.
Summary of limitations and management	The soil has less than favourable PAWC, low nutrient levels, fertility status, moderately deep sodic soils and hard-setting surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.20 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 11.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.

5.1.13 Soil Profile Class 12Da(Te): Grey Dermosol

Overview

12Da(Te) is characterised by very deep clay loam on structured clay soil with a firm surface. The SPC is associated with residual rises with sparse brigalow. The SPC is situated in two UMAs located centre west and to the south east of the study area, over an area of 203.00 ha.

Analysed site

The nominated analysed site, site D32, is summarised in Table 5-25. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-26. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-25: Land Summary 12Da(Te), Analysed Site D32

Item	Description
Analysed Site	D32
UMAs	57, 58
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.80 m)
Location GDA2020 ZONE 55	686675 7375468
Current Use	Beef Cattle Grazing
Geology (Dominant)	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Residual rise, gently undulating rises
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 2.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Firm, < 2% coarse fragments 6-20 mm

Table 5-25: Land Summary 12Da(Te), Analysed Site D32 (continued)

SPC ASC Order / Suborder	Grey Dermosol						
Ass. Land System / Soil	Blackwater, Daunia / Teviot						
Total area (ha)	203.00						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abund-ance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Clay loam Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking
B21 0.20-0.50 Gradual 50-100 mm	Medium clay Sandy	Moderate / Very strong Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	7.5YR4 / 2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.35 / 6.5 No dispersion after 10 minutes Partial slaking
B22 0.50-0.80 Clear 20-50 mm	Medium clay Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.65 / 8.0 Moderate dispersion after 10 minutes Partial slaking
B23 0.80-1.20 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm No Slickensides	2-10% calcium carbonate 2-6mm	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	1.00 / 8.0 Slight Dispersion after 10 minutes Partial slaking
B24 1.20-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR3 / 1 Very dark grey Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.50 / 7.0 No dispersion after 10 minutes Complete slaking

Table 5-26: Soil Chemistry for 12Da(Te), Analysed Site D32

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils vary between neutral to slightly alkaline to moderately alkaline
EC	Topsoil is very low. Subsoil increases from very low to very high below 1.10 m
ECEC	Topsoil is low. Subsoil is moderate throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are strongly sodic
Ca:Mg	Topsoil is very high. Subsoils are high decreasing to moderate at depth
P	Low in topsoil. Low in the B21 horizon of subsoil
PSA	Topsoil is loam Subsoil varies between clay loam and light medium clay at depth
EAT	Topsoil indicates disperses after remoulding Subsoil indicates dispersion after remoulding some dispersion to 1.10 m, with no dispersion to 1.40 m with some dispersion to 1.80 m

Key Analysis	Assessment Summary
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.040
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	77.50
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has less than favourable PAWC, low nutrient levels, fertility and firm surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.90 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

Associated SLR (2023) Site Assessment

The analysed site undertaken by SLR (2023) was site B12, a Eutrophic Red Chromosol within Soil Unit 3 (Eutrophic Black Brown Dermosols). No soil profile was provided within the SLR (2023) report, therefore, no review of the fieldwork data or photos could be assessed.

GTE conducted site D32 within 1.7 m of B12 and the classification indicated it was a Grey Dermosol. Based on the observation sites undertaken by GTE, no Red Chromosol was encountered, therefore, this is considered an anomaly, more so than a sub-dominant soil type.

The laboratory analysis was utilised with D32 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

5.1.14 Soil Profile Class 13Bl(Ta): Brown Dermosol

Overview

13Bl(Ta) is characterised by very deep, clay soil with a firm surface, with coarse fragments, mottled subsoils. The SPC is associated with flat, gently undulating plains with sparse current bush. The SPC is located within three UMAs situated in the north west and south of the study area, over an area of 111.47 ha.

Analysed site

The nominated analysed site, site D36, is summarised in Table 5-27. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-28. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-27: Land Summary 13Bl(Ta), Analysed Site D36

Item	Description
Analysed Site	D36
UMAs	59, 60, 61

Representative Landscape Photograph



Soil Profile Photograph



(Profile viewed top to bottom, 1.20 m)

Location GDA2020 ZONE 55	689214 73732
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Flat plain, gently undulating plains
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	2.0 / 2.0, No erosion observed

Table 5-27: Land Summary 13Bl(Ta), Analysed Site D36 (continued)

Surface condition / Surface coarse fragments or segregations	Firm, 2-10% coarse fragments 20-60 mm
SPC ASC Order / Suborder	Brown Dermosol
Associated Land System / Soil	Blackwater, Daunia / Taurus
Total area (ha)	111.47
Phases and / or variants	None

Soil Profile Morphology Summary

Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 20-60 mm	7.5YR4 / 2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking
B21 0.20-0.40 Gradual 50-100 mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4 / 2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.30 / 6.5 No dispersion after 10 minutes Partial slaking
B22 0.40-0.70 Gradual 50-100 mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6 mm 2-10% calcium carbonate 6-20 mm	7.5YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.55 / 7.0 No dispersion after 10 minutes Partial slaking
B23 0.70-0.90 Gradual 50-100 mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6 mm 2-10% calcium carbonate 6-20 mm	7.5YR5 / 4 Reddish brown Mottles: Pale brown Very few < 2% Medium 5-15 mm	Dry Moderately well drained	Very fine < 1 mm Few	0.80 / 8.0 No dispersion after 10 minutes Partial slaking
B24 0.90-1.70 Gradual 50-100 mm	Medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6 mm 2-10% coarse fragments 6-20 mm	10YR5 / 6 Yellowish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.30 / 7.5 No dispersion after 10 minutes Complete slaking
BC 1.70-2.00 EOTP	Sandy loam	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20 mm 20-50% coarse fragments 2-6 mm	10YR5 / 6 Yellowish brown No mottles or bleaching	Dry Moderately well drained	No roots	1.85 / 7.5 No dispersion after 10 minutes Complete slaking

Table 5-28: Soil Chemistry for 13Bl(Ta), Analysed Site D36

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils vary between moderately alkaline to strongly alkaline
EC	Topsoil is very low. Subsoil is low increasing to high throughout the soil profile
ECEC	Topsoil is moderate. Subsoil is high decreasing to low throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic increasing to sodic below 1.40 m
Ca:Mg	Topsoil is very high. Subsoils are high reducing to moderate
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is light medium clay Subsoil is medium clay to clay loam and light clay at depth
EAT	Topsoil reports dispersion after remoulding Subsoil reports no dispersion with carbonates and gypsum present to 1.40 m. Some dispersion below 1.40 m is reported
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.018
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	97.8
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all land uses. The SPC is assessed as a Dermosol. As such, it has been assessed against the pH limitations. It was assessed from 0.50 mbgl, pH was < 9.0, therefore the PAWC based on the SALFPREDICT modelling has been assessed at this depth. There are limitations for ERD, relating to subsoil pH.
Summary of limitations and management	The soil has less than favourable PAWC, very low nutrient levels, fertility status and firm setting surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 1.40 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 6.8 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.40 mbgl.

5.1.15 Soil Profile Class 14Bl(Ro): Black Vertosol

Overview

14Bl(Ro) is characterised by very deep, black on grey-brown clay soil with a cracking surface and strong structured subsoils. The SPC is associated with low lying areas and drainage depressions located near residual rises with sparse bauhinia vegetation. The SPC is situated in one UMA located to the centre south over an area of 64.20 ha.

Analysed site

The nominated analysed site, site D37, is summarised in Table 5-29. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-30. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-29: Land Summary 14Bl(Ro), Analysed Site D37

Item	Description
Analysed Site	D37
UMAs	35
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.90 m)
Location GDA2020 ZONE 55	689679 7372849
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse bauhinia
Disturbance	Extensive clearing
Landform pattern / pattern	Gently undulating rises, drainage depression
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	2.0 / 2.0, No erosion observed

Table 5-29: Land Summary 14Bl(Ro), Analysed Site D37 (continued)

Surface condition / Surface coarse fragments or segregations		Cracking, < 2% coarse fragments 20-60 mm					
SPC ASC Order / Suborder		Black Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Rolleston					
Total area (ha)		64.20					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 6-20 mm	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking
B21 0.20-0.60 Gradual 50-100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3 / 1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking
B22 0.60-1.30 Diffuse > 100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown Mottles: Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	0.95 / 7.5 No dispersion after 10 minutes Complete slaking
B23 1.30-1.90 EOTP	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20 mm	10YR5 / 3 Brown Mottles: Orange, 10-20%, 5-15 mm Dark grey, 10%-20% 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.55 / 7.5 No dispersion after 10 minutes Complete slaking

Table 5-30: Soil Chemistry for 14Bl(Ro), Analysed Site D37

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils are generally moderately alkaline
EC	Topsoil is low. Subsoil varies from low to very high throughout soil profile
ECEC	Topsoil is high. Subsoil is very high to high throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic to 0.50 m. Increases to sodic below 0.50 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high at 1.10 m
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium heavy clay Subsoil is medium heavy clay to light clay to depth

Key Analysis	Assessment Summary
EAT	Topsoil reports no dispersion. Carbonates and gypsum may be present Subsoil reports no dispersion. Carbonates and gypsum may be present. Below 1.40 m, some dispersion is reported
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.040
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	124.30
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where no value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is above 90% for all crop land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has favourable PAWC, very low nutrient levels, fertility status. Topsoil pH is moderately alkaline with low EC, non-sodic levels and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 0.50 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 0.00 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.00 mbgl. Based on this calculation result, if visual observations of sodic soils are observed, an application of 2.5 t/ha may be adequate.

Associated SLR (2023) Site Assessment

The analysed site undertaken by SLR (2023) was site B05, a Self-Mulching Black Vertosol within Soil Unit 1 (Self-Mulching Black Brown Vertosol). No soil profile was provided within the SLR (2023) report, therefore, no review of the fieldwork data or photos could be assessed.

GTE conducted site D37 within 3.0 m of B05 and the classification indicated it was a Black Vertosol.

The laboratory analysis was utilised with D37 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

5.1.16 Soil Profile Class 15BI(Ro): Brown Vertosol

Overview

15BI(Ro) is characterised by moderately deep clay soil with a self-mulching surface, deep bedrock. The SPC is associated with gently undulating plains with sparse bauhinia. The SPC is situated within five UMAs, the majority to the north of the study area, over an area of 1,040.57 ha.

Analysed site

The nominated analysed site, site D39, is summarised in Table 5-31. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-32. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-31: Land Summary 15BI(Ro), Analysed Site D39

Item	Description
Analysed Site	D39
UMAs	62, 63, 64 ,65, 66
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.65 m)
Location GDA2020 ZONE 55	690706 7372655
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse bauhinia
Disturbance	Extensive clearing
Landform pattern / pattern	Gently undulating plain, flat plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	2.0 / 1.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Self-mulching, < 2% coarse fragments 20-60 mm

Table 5-31: Land Summary 15Bl(Ro), Analysed Site D39 (continued)

SPC ASC Order / Suborder		Brown Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Rolleston					
Total area (ha)		1,040.57					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium clay Sandy Fine	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking
B21 0.20-0.50 Gradual 50-100 mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm Slickensides	< 2% coarse fragments 2-6 mm	7.5YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Medium 2-5 mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking
B22 0.50-0.90 Clear 20-50 mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	50-90% coarse fragments 200-600 mm 50-90% coarse fragments 0.6m-2.0 m	10YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	0.70 / 8.0 No dispersion after 10 minutes Partial slaking
BC 0.90-1.40 Gradual 50-100 mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20 mm	10YR4 / 4 Dark yellowish brown Mottles: Yellow Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.15 / 8.0 No dispersion after 10 minutes Partial slaking
R 1.40-1.65 EOTP	-	-	-	-	-	-	-
	Refusal on bedrock						

Table 5-32: Soil Chemistry for 15Bl(Ro), Analysed Site D39

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils are moderately alkaline increasing to strongly alkaline
EC	Topsoil is very low. Subsoil increases from low to very high throughout soil profile
ECEC	Topsoil is moderate. Subsoil is generally high throughout soil profile
ESP	Topsoil is non-sodic. Subsoils are non-sodic to 0.80 m. Increases to sodic and strongly sodic below 1.10 m
Ca:Mg	Topsoil is very high. Subsoils are generally very high
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is medium clay

Key Analysis	Assessment Summary
	Subsoil is medium clay, clay loam to light clay to depth
EAT	Topsoil reports dispersion after remoulding Subsoil reports no dispersion. Carbonates and gypsum may be present. Subsoil below 0.80 m, some dispersion is reported
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.040
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	100.90
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at or above 90% for all crop land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has favourable PAWC, very low nutrient levels, favourable surface conditions with moderately deep subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 0.60 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 17.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.80 mbgl.

5.1.17 Soil Profile Class 16Bl(Ta): Grey Sodosol

Overview

16Bl(Ta) is characterised by very shallow clay loam surfaced on clay subsoils with a hard-setting on shallow bedrock. The SPC is associated with hillslopes and Bauhinia. The SPC is situated in three UMAs located in the centre west and southern portions of the study area, over an area of 38.52 ha.

Analysed site

The nominated analysed site, site D43, is summarised in Table 5-33. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-34. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-33: Land Summary 16Bl(Ta), Analysed Site D43

Item	Description
Analysed Site	D43
UMAs	67, 68, 69
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 0.35 m)
Location GDA2020 ZONE 55	685753 7378011
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse bauhinia
Disturbance	Extensive clearing
Landform pattern / pattern	Gently undulating plain, flat plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, Scald erosion observed
Surface condition / Surface coarse fragments or segregations	Hard-setting, < 2% coarse fragments 20-60 mm

Table 5-33: Land Summary 16Bl(Ta), Analysed Site D43 (continued)

SPC ASC Order / Suborder		Grey Sodosol					
Associated Land System / Soil		Blackwater, Daunia / Taurus					
Total area (ha)		38.52					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.10 Clear 20-50 mm	Clay Loam Sandy Fine	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR4 / 2 Brown No mottles or bleaching	Dry Well drained	Fine 1-2 mm Common	0.05 / 6.0 Moderate dispersion after 10 minutes Partial slaking
B21 0.10-0.20 Clear 20-50 mm	Medium heavy clay	Moderate / Very firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	0.15 / 6.0 Slight Dispersion after 10 minutes Partial slaking
B22 0.20-0.40 EOBH	Medium clay	Strong / Very firm Subangular blocky 5-10 mm No Slickensides	< 2% coarse fragments 6-20 mm	2.5Y4 / 1 Dark grey No mottles or bleaching	Dry Imperfectly drained	Very fine < 1 mm Few	0.25 / 8.0 No dispersion after 10 minutes Partial slaking
	Refusal on bedrock						

Table 5-34: Soil Chemistry for 16Bl(Ta), Analysed Site D43

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils are moderately alkaline
EC	Topsoil is low. Subsoil is moderate
ECEC	Topsoil is low. Subsoil is moderate
ESP	Topsoil is non-sodic. Subsoils are sodic
Ca:Mg	Topsoil is high. Subsoils are high
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is clay loam Subsoil is medium clay
EAT	Topsoil reports some dispersion Subsoil reports some dispersion
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/40cm)	60.3

Key Analysis	Assessment Summary
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is above 90% for all crop land uses. The limitation for ERD is soil depth of 0.35 m.
Summary of limitations and management	The soil has unfavourable PAWC, low nutrient levels, unfavourable surface conditions and shallow subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.40 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 4.6 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.10 mbgl.

5.1.18 Soil Profile Class 17Bl(Ro): Grey Vertosol

Overview

17Bl(Ro) is characterised by a deep clay uniform soil with a cracking surface. The SPC is associated with gently undulating plains with sparse bauhinia and brigalow. The SPC is situated in four UMAs located in the centre and southern areas of the study area, over an area of 348.24 ha.

Analysed site

The nominated analysed site, site D44, is summarised in Table 5-35. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-36. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-35: Land Summary 17Bl(Ro), Analysed Site D44

Item	Description
Analysed Site	D44
UMAs	70, 71, 72, 73
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.60 m)
Location GDA2020 ZONE 55	691122 7370776
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse Bauhinia and Brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Gently undulating plain, flat plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed
Surface condition / Surface coarse fragments or segregations	Cracking, no coarse fragments

Table 5-35: Land Summary 17Bl(Ro), Analysed Site D44 (continued)

SPC ASC Order / Suborder		Grey Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Rolleston					
Total area (ha)		348.24					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.10 Clear 20-50 mm	Light clay Sandy	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 6-20 mm	7.5YR3 / 2 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.05 / 6.0 No dispersion after 10 minutes Partial slaking
B21 0.10-0.20 Clear 20-50 mm	Light medium clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	< 2% coarse fragments 20-60 mm	7.5YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.15 / 6.5 No dispersion after 10 minutes Partial slaking
B22 0.20-0.40 Gradual 50-100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	< 2% coarse fragments 2-6 mm	7.5YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking
B23 0.40-0.80 Diffuse > 100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	< 2% coarse fragments 2-6 mm < 2% calcium carbonate 2-6 mm	7.5YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.60 / 8.0 No dispersion after 10 minutes Complete slaking
B24 0.80-1.20 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 2-6 mm < 2% calcium carbonate 2-6 mm Manganese nodules	7.5YR4 / 4 Brown Mottles: Pale Grey Few 2%-10% Few < 5 mm	Dry Moderately well drained	Very fine < 1 mm Few	1.00 / 7.5 No dispersion after 10 minutes Complete slaking
C 1.20-1.60 EOTP	-	-	-	-	-	-	-

Table 5-36: Soil Chemistry for 17Bl(Ro), Analysed Site D44

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is slightly acidic to neutral. Subsoils are neutral to slightly alkaline increasing to strongly alkaline
EC	Topsoil is low. Subsoil increases from low to high throughout the profile
ECEC	Topsoil is low. Subsoil is moderate to high

Key Analysis	Assessment Summary
ESP	Topsoil is non-sodic. Subsoils are sodic
Ca:Mg	Topsoil is very high. Subsoils are very high to high at 1.10 m below
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is clay loam Subsoil is light clay increasing to medium heavy clay
EAT	Topsoil reports dispersion after being remoulded Subsoil reports dispersion after being remoulded and increases to some dispersion below 1.40 m
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.015
SALFPREDICT PAWC (PAWCER) Total (mm/30cm)	114.40
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at or above 90% for all crop land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has a favourable PAWC, very low nutrient levels, and unfavourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below 0.10 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 5.0 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.50 mbgl

Associated SLR (2023) Sites Assessment

The analysed site undertaken by SLR (2023) was site B01, a Eutrophic Red Dermosol within Soil Unit 2B (Eutrophic Red Dermosols). No soil profile was provided within the SLR (2023) report, therefore, no review of the fieldwork data or photos could be assessed.

GTE conducted site D44 within 5.1 m of B01 and the classification indicated it was a Grey Vertosol. Based on the observation sites undertaken by GTE, no Red Dermosol was encountered, therefore, this is considered an anomaly, more so than a sub-dominant soil type.

The laboratory analysis was utilised with D44 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

SLR (2023) site B07 reported a Self-Mulching Vertosol. Based on GTE field observations across UMA 72, and generally across the project site, no ASC of Red Vertosol was observed. It is therefore, aggregated within the larger observed ASC of Grey Vertosol.

5.1.19 Soil Profile Class 18Bl(Ro): Grey Vertosol

Overview

18Bl(Ro) is characterised by a very deep, grey clay uniform soil with a self-mulching surface. The SPC is associated with gently undulating plains with sparse bauhinia and brigalow. The SPC is situated in one UMA located in the centre-southern portion of the study area, over an area of 76.36 ha.

Analysed site

The nominated analysed site, site D45, is summarised in Table 5-37. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-38. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-37: Land Summary 18Bl(Ro), Analysed Site D45

Item	Description
Analysed Site	D45
UMAs	74

Representative Landscape Photograph



Soil Profile Photograph



(Profile viewed top to bottom, 1.60 m)

Location GDA2020 ZONE 55	689137 7374206
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse Bauhinia and Moreton Bay Ash
Disturbance	Extensive clearing
Landform pattern / pattern	Gently undulating plain, flat plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Moderate
Slope (%) / Erosion	< 1.0 / < 1.0, Scald erosion observed
Surface condition / Surface coarse fragments or segregations	Surface flake, no coarse fragments

Table 5-37: Land Summary 18Bl(Ro), Analysed Site D45 (continued)

SPC ASC Order / Suborder		Grey Vertosol					
Associated Land System / Soil		Blackwater, Daunia / Rolleston					
Total area (ha)		76.36					
Phases and / or variants		None					
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium heavy clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2 mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking
B21 0.20-0.40 Gradual 50-100 mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking
B22 0.40-0.80 Diffuse > 100 mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.60 / 7.5 No dispersion after 10 minutes Partial slaking
B23 0.80-1.40 Diffuse > 100 mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3 / 1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	1.10 / 7.5 No dispersion after 10 minutes Complete slaking
B24 1.50-2.00 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3 / 1 Very dark grey Mottles: Brown Few 2%-10% Few < 5 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.75 / 6.0 No dispersion after 10 minutes Partial slaking
	Refusal on cemented soil						

Table 5-38: Soil Chemistry for 18Bl(Ro), Analysed Site D45

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils are moderately alkaline decreasing to slightly acidic to neutral
EC	Topsoil is low. Subsoil levels reported at very low increasing to moderate
ECEC	Topsoil is moderate. Subsoil is high to moderate at depth
ESP	Topsoil is non-sodic. Subsoils are non-sodic
Ca:Mg	Topsoil is very high. Subsoils are very high

Key Analysis	Assessment Summary
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is clay loam Subsoil is light medium clay increasing to medium heavy clay
EAT	Topsoil reports dispersion after being remoulded Subsoil reports no dispersion, carbonate and gypsum present to 1.10 m. Some dispersion is reported below 1.10 m
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/30cm)	104.50
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is above 90% for all crop land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has a favourable PAWC, very low nutrient levels and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 2.00 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

5.1.20 Soil Profile Class 19Bl(Ro): Brown Vertosol

Overview

19Bl(Ro) is characterised by very deep, brown clay soils with a surface flake and strong structured subsoils. The SPC is associated with gently undulating plains and rises with sparse bauhinia and brigalow vegetation. The SPC is situated across six UMAs, the majority in the northern portion of the study area, over an area of 756.86 ha.

Analysed site

The nominated analysed site, site D52 is summarised in Table 5-39. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-40. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-39: Land Summary SPC 19Bl(Ro), Analysed Site D52

Item	Description
Analysed Site	D52
UMAs	75, 76, 77, 78, 79, 80
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 2.20 m)
Location GDA2020 ZONE 55	688782 7376440
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse Bauhinia and brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Flat plain, gently undulating rises
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	1.0 / 1.0, No erosion observed

Surface condition / Surface coarse fragments or segregations	Surface flake, < 2% coarse fragments 6-20 mm
SPC ASC Order / Suborder	Brown Vertosol
Associated Land System / Soil	Blackwater, Daunia / Rolleston
Total area (ha)	756.86
Phases and / or variants	None

Soil Profile Morphology Summary

Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Light clay Sandy	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20 mm	10YR3 / 2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking
B21 0.20-0.40 Clear 20-50 mm	Medium clay Sandy	Strong / Strong Subangular blocky 20-50 mm Slickensides	< 2% coarse fragments 2-6 mm	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0..30 / 7.0 No dispersion after 10 minutes No slaking
B22 0.40-1.00 Gradual 50-100 mm	Medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% calcium carbonate 6-20 mm < 2% coarse fragments 2-6 mm	10YR4 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.70 / 8.0 No dispersion after 10 minutes Complete slaking
B23 1.00-1.70 Diffuse > 100 mm	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	< 2% coarse fragments 2-6 mm	10YR5 / 3 Brown Mottles: Dark Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.35 / 7.5 No dispersion after 10 minutes Partial slaking
B24 1.70-2.20 EOTP	Medium clay Sandy Coarse	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6 mm	10YR4 / 3 Brown Mottles: Dark Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	1.95 / 7.5 No dispersion after 10 minutes Partial slaking

Table 5-40: Soil Chemistry for 19Bl(Ro), Analysed Site D52

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils vary between moderately alkaline and neutral to slightly alkaline
EC	Topsoil is very low. Subsoil varies from very low to very high throughout soil profile
ECEC	Topsoil is low. Subsoil varies from very low to very high throughout soil profile
ESP	Non-sodic levels in topsoil. Subsoils are non-sodic, increasing to sodic below 1.40 m
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to moderate at 1.40 m

Key Analysis	Assessment Summary
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is clay loam Subsoil is clay loam to light clay
EAT	Topsoil disperses after remoulding Subsoil reports no dispersion. Carbonates and gypsum may be present. Some dispersion below 0.80 m
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	83.6
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses except Maize. Maize was reported at 75% yield within 0.60 m. There are no limitations for ERD.
Summary of limitations and management	The soil has less than favourable PAWC, low nutrient levels, fertility status. Topsoil pH is neutral with very low EC, non-sodic levels and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 1.40 mbgl may benefit gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 9.3 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.70 mbgl.

SLR (2023) Sites associated with 19Bl(Ro)

SLR (2023) site B22 reported a Self-Mulching Black Vertosol. On review of the major colours within the upper 0.50 m of the B21 horizon, the soil profile was classified as a Brown Vertosol. This fits in with the SPC and associated UMA 76, which includes this site.

5.1.21 Soil Profile Class 20Bl(Ro): Grey Vertosol

Overview

20Bl(Ro) is characterised by moderately deep, uniform grey clay soils with surface flake and strong structured clay subsoils. The SPC is associated with gently undulating plains with open woodland including brigalow vegetation. The SPC is situated in one UMA, located in the southern portion of the study area, over an area of 27.81 ha.

Analysed site

The nominated analysed site, site D58 is summarised in Table 5-41. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-42. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-41: Land Summary 20Bl(Ro), Analysed Site D58

Item	Description
Analysed Site	D58
UMAs	81

Representative Landscape Photograph



Soil Profile Photograph



(Profile viewed top to bottom, 0.80 m)

Location GDA2020 ZONE 55	691692 7371103
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Open woodland including brigalow
Disturbance	Limited clearing
Landform pattern / pattern	Flat plain, gently undulating plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / moderate
Slope (%) / Erosion	2.0 / 1.0, No erosion observed

Surface condition / Surface coarse fragments or segregations	Surface flake, < 2% coarse fragments 6-20 mm
SPC ASC Order / Suborder	Grey Vertosol
Associated Land System / Soil	Blackwater/ Rolleston
Total area (ha)	27.81
Phases and / or variants	None

Soil Profile Morphology Summary

Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Medium clay	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking
B21 0.20-0.40 Clear 20-50 mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4 / 1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.30 / 7.5 Slight Dispersion after 10 minutes Partial slaking
B22 0.40-0.80 EOBH	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm Slickensides	< 2% calcium carbonate 2-6 mm	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Common	0.60 / 8.0 No dispersion after 10 minutes Complete slaking
	Refusal on bedrock						

Table 5-42: Soil Chemistry for 20Bl(Ro), Analysed Site D58

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is moderately alkaline. Subsoils vary between moderately alkaline and strongly alkaline
EC	Topsoil is very low. Subsoil increases from low to high throughout soil profile
ECEC	Topsoil is high. Subsoil decreases from high to moderate throughout soil profile
ESP	Topsoil is non-sodic. Subsoils are non-sodic
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high from 0.70 m
P	Very low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is light medium clay Subsoil is light medium clay to light clay
EAT	Topsoil disperses after remoulding Subsoil reports no dispersion. Carbonates and gypsum may be present. Some dispersion below 0.80 m
Surface K-Factor (GTE)	Low (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.018
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	98.7

Key Analysis	Assessment Summary
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is at 90% for all crop land uses except Maize. Maize was reported at 75% yield within 0.60 m. There are no limitations for ERD.
Summary of limitations and management	The soil has favourable PAWC, very low nutrient levels and fertility status. Topsoil pH is neutral with very low EC, non-sodic levels, very high cation exchange and favourable surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.80 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

5.1.22 Soil Profile Class 21Bl(Ta): Grey Sodosol

Overview

21Bl(Ta) is characterised by very deep, texture contrast brown sandy loams on grey and yellow brown mottled clay subsoils with a hard-setting surface. The SPC is associated with gently undulating plains with sparse Brigalow vegetation on grasslands. The SPC is situated in one UMA, located in the centre-east portion of the study area, over an area of 167.19 ha.

Analysed site

The nominated analysed site, site D59, was undertaken to complete data gaps in the existing SLR (2023) site, B21, and is summarised in Table 5-43. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-44. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-43: Land Summary 21Bl(Ta), Analysed Site D59

Item	Description
Analysed Site	D59
UMAs	82
Representative Landscape Photograph	**Soil Profile Photograph**
	 (Profile viewed top to bottom, 1.80 m)
Location GDA2020 ZONE 55	691156 7377835
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow
Disturbance	Extensive clearing
Landform pattern / pattern	Simple slope, gently undulating plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Imperfect / Slow
Slope (%) / Erosion	2.0 / 1.0, No erosion observed

Table 5-43: Land Summary 21Bl(Ta), Analysed Site D59 (continued)

Surface condition / Surface coarse fragments or segregations	Hard-setting, no coarse fragments						
SPC ASC Order / Suborder	Grey Sodosol						
Associated Land System / Soil	Blackwater / Taurus						
Total area (ha)	167.19						
Phases and / or variants	None						
Soil Profile Morphology Summary							
Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A1 0.00-0.20 Clear 20-50 mm	Sandy loam	Weak / Weak Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR3 / 2 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2 mm Many	0.10 / 6.0 No dispersion after 10 minutes Complete slaking
A2 0.20-0.45 Abrupt 5-20 mm	Sandy loam	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4 / 2 Brown No mottles or bleaching	Dry Well drained	Fine 1-2 mm Common	0.33 / 6.5 No dispersion after 10 minutes Complete slaking
B21 0.45-0.90 Gradual 50-100 mm	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	< 2% coarse fragments 2-6 mm	7.5YR4 / 1 Dark grey Mottles: Brown Many 20%-50% Medium 5-15 mm	Dry Imperfectly drained	Very fine < 1 mm Few	0.65 / 8.5 Slight Dispersion after 10 minutes Partial slaking
B22 0.90-1.80 EOTP	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	10-20% calcium carbonate 20-60 mm 10-20% calcium carbonate 6-20 mm Coarse fragments < 2%, 2-6 mm	10YR5 / 4 Yellowish brown Mottles: Dark Grey Common 10%-20% Few < 5 mm	Dry Imperfectly drained	No roots	1.35 / 8.5 No dispersion after 10 minutes Complete slaking

Table 5-44: Soil Chemistry for 21Bl(Ta), Analysed Site D59

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils vary between moderately alkaline and strongly alkaline
EC	Topsoil is low. Subsoil increases from low to very high throughout soil profile
ECEC	Topsoil is low. Subsoil varies between low and high throughout soil profile
ESP	Topsoil is non-sodic. Subsoils are sodic to strongly sodic, decreasing below 1.10 m
Ca:Mg	Topsoil is very high. Subsoils very between moderate to very high
P	Very low in topsoil. Very low in the B21 horizon of subsoil

Key Analysis	Assessment Summary
PSA	Topsoil is sandy loam Subsoil is light clay
EAT	Topsoil disperses after remoulding Subsoil reports some dispersion throughout the soil profile
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/50cm)	43.7
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is above 90% for all crop land uses. The SPC is assessed as a Sodosol. As such, it has been assessed against the pH limitations. It was assessed from 0.50 mbgl, pH was > 9.0, therefore, the PAWC based on the SALFPREDICT modelling has been assessed at this depth. There are limitations for ERD, relating to subsoil pH.
Summary of limitations and management	The soil has less than favourable PAWC, very low nutrient levels, fertility status, low cation exchange, hard-setting surface conditions and sodic subsoils. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below 0.45 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 7.4 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.

SLR (2023) Sites associated with 21Bl(Ta)

SLR (2023) site B21 reported a Subnatric Brown Sodosol within Soil Unit 1 (Self-Mulching Black Brown Vertosols). GTE conducted site D59 within 5.1 m of the original site and colour graded a Grey Sodosol. Based on the experience of two of GTE field personnel at the time, review of the SLR profile and observations onsite, the assessment is the area is a Grey Sodosol.

The laboratory analysis was utilised with D59 laboratory providing additional data and completing data gaps based on the nominated laboratory suite.

5.1.23 Soil Profile Class 22Bl(Wy): Brown Kandosol

Overview

22Bl(Wy) is characterised by deep, gradational textured, weakly structured soils with firm surfaces and loamy subsoils. The SPC is associated with gently undulating plains with sparse brigalow and bauhinia vegetation. The SPC is situated in one UMA, located in the southern portion of the study area, over an area of 13.54 ha.

Analysed site

The nominated analysed site, site D65, is summarised in Table 5-45. A summary of site key laboratory analysis assessment and summary of limitations and management is available in Table 5-46. Detailed site descriptions, Class IV site descriptions and the laboratory analysis summary are available in Appendix A, B and C, respectively.

Table 5-45: Land Summary 22Bl(Wy), Analysed Site D65

Item	Description
Analysed Site	D65
UMAs	83

Representative Landscape Photograph



Soil Profile Photograph



(Profile viewed top to bottom, 0.80 m)

Location GDA2020 ZONE 55	691894 7371606
Current Use	Cattle Grazing
Geology	Stratified Unit dominated by volcanic and metamorphic rock
Vegetation	Sparse brigalow and bauhinia
Disturbance	Extensive clearing
Landform pattern / pattern	Flat plain, gently undulating plain
Microrelief / Rock outcrop	No microrelief or rock outcrop
Drainage / Permeability	Moderate well / moderate
Slope (%) / Erosion	1.0 / 1.0, No erosion observed

Surface condition / Surface coarse fragments or segregations	Firm, < 2% coarse fragments 6-20 mm
SPC ASC Order / Suborder	Brown Kandosol
Associated Land System / Soil	Blackwater / Taurus, Wyesby
Total area (ha)	13.54
Phases and / or variants	None

Soil Profile Morphology Summary

Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH Dispersion Field Test
A11 0.00-0.05 Clear 20-50 mm	Sandy loam	Weak / Weak Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Rapidly drained	Very fine < 1 mm Many	0.03 / 6.5 No dispersion after 10 minutes Partial slaking
A12 0.05-0.20 Clear 20-50 mm	Sandy loam	Weak / Weak Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4 / 2 Dark greyish brown No mottles or bleaching	Dry Rapidly drained	Very fine < 1 mm Common	0.14 / 6.0 No dispersion after 10 minutes No slaking
A2 0.20-0.45 Gradual 50-100 mm	Sandy loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3 / 3 Dark brown No mottles or bleaching	Dry Well drained	Very fine < 1 mm Few	0.32 / 6.0 Slight Dispersion after 10 minutes Partial slaking
B21 0.45-0.80 Gradual 50-100 mm	Clay loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	< 2% coarse fragments 2-6 mm	10YR5 / 3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine < 1 mm Few	0.62 / 7.5 Moderate dispersion after 10 minutes Partial slaking
B21 0.80-1.00 EOBH No recovery	Silty loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	< 2% coarse fragments 2-6 mm	10YR5 / 3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.90 / 7.5 No dispersion after 10 minutes Complete slaking

Table 5-46: Soil Chemistry for 22Bl(Wy), Analysed Site D65

Key Analysis	Assessment Summary
Soil pH (H_20)	Topsoil is neutral to slightly alkaline. Subsoils vary between neutral to slightly alkaline to strongly alkaline at depth
EC	Topsoil is low. Subsoil increases from low to moderate at depth
ECEC	Topsoil is very low. Subsoil increases from very low to low throughout soil profile
ESP	Topsoil is non-sodic. Subsoils are non-sodic
Ca:Mg	Topsoil is very high. Subsoils are very high decreasing to high from 0.50 m

Key Analysis	Assessment Summary
P	Low in topsoil. Very low in the B21 horizon of subsoil
PSA	Topsoil is sandy loam Subsoil is clay loam to sandy clay loam
EAT	Topsoil disperses after remoulding Subsoil disperses after remoulding with some dispersion at 0.50 m, then no dispersion. Carbonates and gypsum may be present from 0.80 m. Some dispersion below 0.80 m
Surface K-Factor (GTE)	Moderate (Rosewell and Loch, 2002). Estimate USLE (Rosewell, 1993) 0.030
SALFPREDICT PAWC (PAWCER) Total (mm/100cm)	73.2
ERD	Review of analytical data in SALFPREDICT, eight crop land uses (Section 4.4) all have 100% plant yield with the inclusion of rainfall, except Safflower where 7% value was provided. Based on calculated ECse value (SALFPREDICT) throughout the soil profile and a nominated rooting depth of 0.60 m, assessment against the plant salt-tolerance data (DERM, 2011) crop land use yield is above 90% for all crop land uses. There are no limitations for ERD.
Summary of limitations and management	The soil has less than favourable PAWC, low nutrient levels, very low cation exchange and unfavourable firm surface conditions. Topsoil resource may be recommended for use on flat to sloped areas. Subsoil to 0.45 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

6 LAND SUITABILITY ASSESSMENT

6.1 Agricultural Land Suitability

The assessment of the study area for agricultural land suitability includes evaluating the potential of the land for land management options such as cropping or grazing.

Agricultural land suitability assessment involves defining the classes to assess against the appropriate land management options (shown in Section 6.2) for the area based on available frameworks (shown in Section 6.3) and the land use requirements and limitations to assess the conditions for the land management options (shown in Section 6.4).

6.2 Land Suitability Classes

GALE (DSITI and DNRM, 2015) was utilised to assess Land Suitability Classes and ALC. GALE defines five Land Suitability Classes for use in Queensland (Table 6-1) in which the land suitability for agriculture (i.e., cropping or grazing) decreases progressively from Land Suitability Class 1 to Class 5, based on the severity of the land use limitations.

Table 6-1: Land Suitability Classes

Land Suitability Class	Suitability	Limitations[1]	Definition[2]
1	Suitable	Negligible	Highly productive land requiring only simple management practices to maintain economic production.
2	Suitable	Minor	Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production.
3	Suitable	Moderate	Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production.
4	Unsuitable	Severe / Marginally suitable	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.
5	Unsuitable	Extreme	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.

1 - Definitions from GALE (DSITI and DNRM, 2015) and LSAT (DME, 1995) where applicable
2 - Definitions from GALE (DSITI and DNRM, 2015)

Land rated as Land Suitability Classes 1 to 3 is considered suitable for agricultural land use with negligible to moderate limitations. It should be noted that with the use of soil improvement techniques (e.g., fertiliser, amelioration) Class 3 land may be just as productive as Class 1 or 2 land.

Land rated as Land Suitability Class 4 is unsuitable for agricultural land use due to the severity of one or more limitations. However, in some circumstances it may be possible to upgrade Class 4 land to a more suitable class with the implementation of considerable soil improvement measures.

Land rated as Land Suitability Class 5 is considered entirely unsuitable for the specified land use as the limitation(s) are so severe that the inputs required to initiate and maintain the specified land use are not sustainable.

6.3 Land Suitability Use and Assessments

The Regional Frameworks (DSITIA and DNRM, 2013) provides the attributes, limitations and suitability subclass values for land suitability limitations assessment.

In reviewing the Regional Frameworks (DSITIA and DNRM, 2013) suitability subclasses and attributes, the following assessments were undertaken:

- An assessment was undertaken for each SPC for the 13 land management options listed for the Suitability Framework for the Inland Fitzroy Southern Burdekin Area. These included:
    - Dryland cropping land uses, barley, chickpea, maize, millet, mungbean, oat, safflower, sorghum, soybean, sunflower, triticale and wheat.
    - Furrow irrigated cropping land uses, cotton.

It is noted that the Suitability Framework for the Inland Fitzroy and Southern Burdekin Area does not include beef cattle grazing (rainfed) as a subclass for a potential agricultural land use. Therefore, assessment of beef cattle grazing was completed using the LSAT (DME, 1995) beef cattle grazing land suitability frameworks for semi-arid sub tropics of Queensland with additional guidance from Shields and Williams (1991).

The associated limitations have been summarised in Section 6.4.

6.3.1 SLR (2023) Land Suitability Assessment Review

A review of SLR (2023) indicates a land suitability assessment was conducted for cropping and beef cattle grazing in accordance with current guidelines for cropping land use (GALE, DSITI and DNRM, 2015 and Regional Frameworks, DSITIA and DNRM, 2013) and nominated guidelines for beef cattle land use, including *A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open cut coal mining in the Bowen Basin, Queensland.* Highlands Environmental, pp.1-10 (Queensland draft, Short, 2013).

Land use limitations were selected based on these guidelines and assessed against the Regional Frameworks (DSITIA and DNRM, 2013); however, no specific crop land uses were specified. Land suitability and land capability results are provided in Appendix E (SLR, 2023).

GTE's review of these sections and results indicate that although an assessment was conducted, GTE understands that this may not meet current expectations or be in accordance with the guidelines which is stated; for example, but not limited to:

- No individual cropping land uses are nominated for any SMU in Appendix E (SLR, 2023),
- No assessment of limitations for beef cattle grazing is presented (i.e., as per Appendix E) (SLR, 2023), just the results within Figure 5-6,
- No individual UMA assessment is addressed or present within the assessment, however, based on Figure 4-1 (SLR, 2023), only four UMAs were identified, and
- LCC was conducted; however, this is more suited for scales of 1:250,000 or smaller. The SLR (2023) assessment was undertaken exceeding a scale of 1:125,000, in which the LCC was not required.

Based on GTE's review of presented field and laboratory data within SLR's (2023) SALS assessment, GTE have undertaken a Land Suitability Assessment for the project site. Where relevant, field and laboratory data from SLR (2023) has been used, however, no land suitability or capability results have carried over to this SALS Assessment.

6.4 Land Use Limitations and Simple and Complex Diagnostic Attributes

The following land use limitations have been considered and proposed where applicable based on available information from field, laboratory and available report documents. The land use limitations are assessed on simple or complex diagnostic attributes. Simple diagnostic attributes are those that are measured in the field or laboratory and complex diagnostic attributes are made up of several contributing diagnostic attributes and are generally difficult to measure directly or calculate.

6.4.1 Cropping Suitability, Land Use Limitations

The following land use limitations have been considered where applicable based on available information, for the Suitability Framework for the Inland Fitzroy and Southern Burdekin Area:

- water erosion (E),
- erosion hazard, subsoil erodibility (Es),
- soil water availability (M),
- narrow moisture range (Pm),
- surface soil condition (Ps),
- rockiness (R),
- microrelief(Tm), and
- wetness (W).

The remaining limitations have been assessed by review of Table 8 of the GALE (DSITI and DNRM, 2015) where limitations have diagnostic attributes and indicators for the agricultural land uses.

6.4.2 Beef Cattle Grazing, Land Use Limitations

An assessment was undertaken for beef cattle grazing using the LSAT (DME, 1995) beef cattle grazing land suitability frameworks for the semi-arid sub tropics of Queensland. This assessment includes the following land use limitations:

- water availability,
- nutrient deficiency,
- soil physical factors,
- salinity,
- rockiness,
- microrelief,
- pH,
- wetness,
- topography,
- water erosion, and
- flooding.

Vegetation regrowth land use limitation is not assessed as this pertains to a management limitation and is excluded from the assessment.

Guidance was also taken from Shields and Williams (1991) and the expectations of the Queensland DoR with respect to the limitations, specifically water availability and salinity.

6.5 Regional Frameworks, Complex Limitations SPC Assessment Summary

The following sub-sections provide summaries of the Regional Frameworks and complex limitations for the SPCs.

6.5.1 Regional Frameworks SPC Assessment Summary

Desktop, field and laboratory data collected from analysed sites in the study area were reviewed against the Regional Frameworks (DSITIA and DNRM, 2013) limitations for each selected land use.

Table 6-2 providing a detailed description of the land attributes and limitations in the study area and the corresponding Land Suitability Classes providing a summary of the limitations for each SPC.

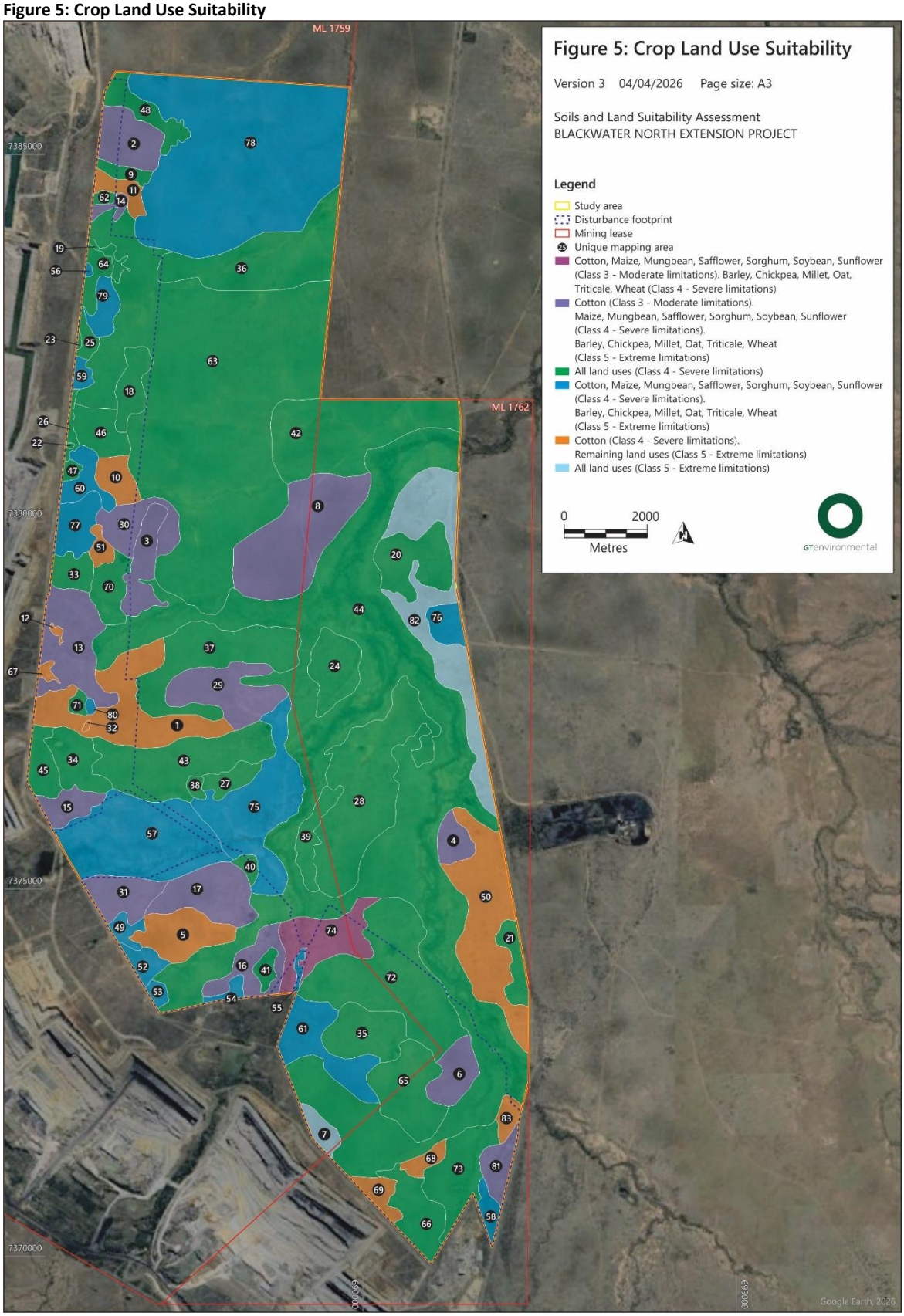
The assessed categories of Land Suitability Classes for each crop land use and associated SPC are detailed in Appendix H, summarised and shown in Table 6-2 and on Figure 5.

Table 6-2: SPCs for Regional Frameworks, Suitability Subclasses for Land Uses

Regional Frameworks Assessment	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 3). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 4)	18Bl(Ro)	74	76.36	54.59
Cotton (Class 3). Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	2Dn(Te)	2, 3, 4, 6, 8	810.11	438.27
	5Dn(Ro)	13, 14, 15, 16, 17		
	8Dn(Te)	29, 30, 31		
	20Bl(Ro)	81		
All land uses (Class 4)	3Bl(Te)	9	4,245.99	1,265.76
	6Bl(Pg)	18, 19, 20, 21, 22, 23		
	7Bl(Pg)	24, 25, 26, 28		
	9Dn(Ro)	33, 34, 36, 37, 38, 39, 40, 41, 42		
	10Ct(Ro)	43, 44, 45, 46, 47, 48		
	14Bl(Ro)	35		
	15Bl(Ro)	62, 63, 64, 65, 66		
	17Bl(Ro)	70, 71, 72, 73		
Cotton, Maize, Mungbean, Safflower, Sorghum, Soybean, Sunflower (Class 4). Barley, Chickpea, Millet, Oat, Triticale, Wheat (Class 5)	11Bl(Ta)	49, 52, 53, 54, 55	1,123.88	292.3
	12Da(Te)	57, 58		
	13Bl(Ta)	59, 60, 61		
	19Bl(Ro)	75, 76, 77, 78, 79, 80		
Cotton (Class 4). Remaining land uses (Class 5)	1Dn(Te)	1	466.54	247.39
	2Dn(Te)	5		
	4Bl(Te)	10, 11		
	8Dn(Te)	12		
	11Bl(Ta)	50, 51		
	16Bl(Ta)	32, 67, 68, 69		
	22Bl(Wy)	83		

Regional Frameworks Assessment	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
All land uses (Class 5)	2Dn(Te)	7	184.72	18.23
	21Bl(Ta)	82		

Figure 5: Crop Land Use Suitability



6.5.2 Beef Cattle Grazing SPC Assessment Summary

The SPCs were assessed against the Suitability for Beef Cattle Grazing LSAT (DME, 1995) (refer to Appendix E) with reference to beef cattle grazing in the *Land resource survey and evaluation of the Kilcummin area, Queensland* (Shields and Williams, 1991).

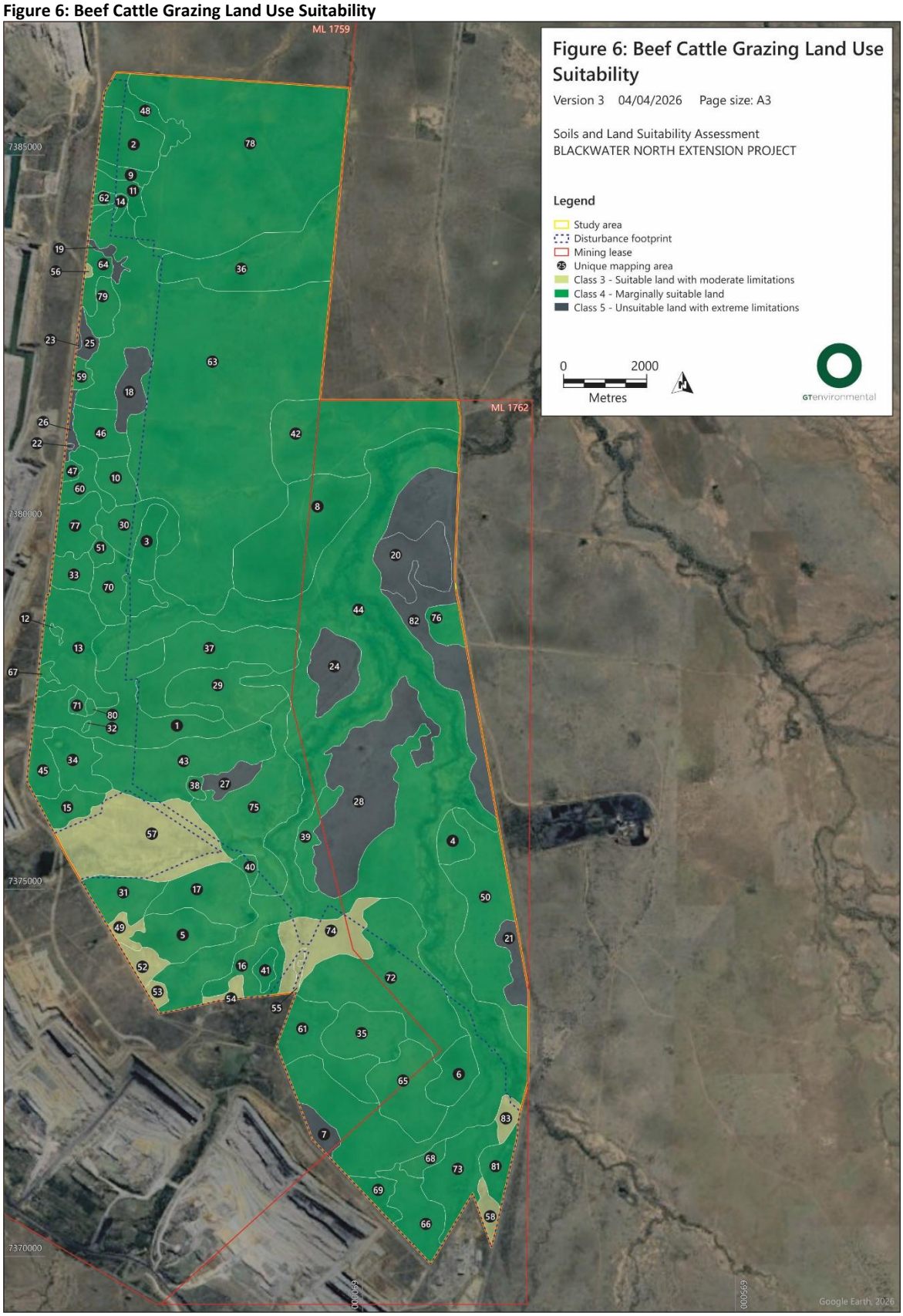
The assessment is presented in Appendix I and summarised in Table 6-3. This assessment will assist in determining the limitations for beef cattle grazing and the ALC with the regional frameworks overall class. Land suitability classes for beef cattle grazing is shown in Figure 6.

Table 6-3: SPCs for Beef Cattle Grazing, Suitability Subclasses for Land Uses

Beef Cattle Grazing Assessment	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
Class 3 Agricultural – Suitable land with moderate limitations	11Bl(Ta)	49, 52, 53, 54, 55, 56	345.45	167.23
	12Da(Te)	57, 58		
	18Bl(Ro)	74		
	22Bl(Wy)	83		
Class 4 Agricultural – Marginally suitable land	1Dn(Te),	1	5,931.87	2,065.57
	2Dn(Te)	2, 3, 4, 5, 6, 8		
	3Bl(Te)	9		
	4Bl(Te)	10, 11		
	5Dn(Ro)	13, 14, 15, 16, 17		
	8Dn(Te)	12, 29, 30, 31		
	9Dn(Ro)	33, 34, 36, 37, 38, 39, 40, 41, 42		
	10Ct(Ro)	43, 44, 45, 46, 47, 48		
	11Bl(Ta)	50, 51		
	13Bl(Ta)	59, 60, 61		
	14Bl(Ro)	35		
	15Bl(Ro)	62, 63, 64, 65, 66		
	16Bl(Ta)	32, 67, 68, 69		
	17Bl(Ro)	70, 71, 72, 73		
	19Bl(Ro)	75, 76, 77, 78, 79, 80		
	20Bl(Ro)	81		

Beef Cattle Grazing Assessment	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
Class 5 Agricultural – Unsuitable land with extreme limitations	2Dn(Te)	7	630.28	83.74
	6Bl(Pg)	18, 19, 20, 21, 22, 23		
	7Bl(Pg)	24, 25, 26, 28		
	21Bl(Ta)	82		

Figure 6: Beef Cattle Grazing Land Use Suitability



6.5.3 Regional Frameworks Summaries for Non-Analysed UMAs

As land suitability assessments are not conventionally conducted at such a scale in which additional laboratory analysis is available, the assessment of Class III, Class IV(a) and Class IV(b) sites may be undertaken. This assessment includes reviewing surface conditions such as slope, microrelief, rockiness and soil profile depth in SPC associated UMAs, in which the analysed site is not located.

This provides further accuracy for the Regional Frameworks for cropping and beef cattle grazing and ALC assessment across the study area. These may include SPC phases or variants observed in which a change was observed in an SPC e.g., depth to rock.

To allow for this additional information to be used to assess Land Suitability Classes for the Regional Frameworks, all UMAs will remain assessed as per their SPC analysed site land suitability and ALC unless surface conditions and / or soil profile indicated otherwise.

To provide further context to the information used, from this SALS Assessment and SLR (2023), UMA confidence codes (DES, 2021a and DoR, 2021) provide a qualitative statement in the relative confidence in delineating the spatial extent of a UMA and / or describing its attributes. UMA confidence codes range from one to six, depending on the level of desktop and / or fieldwork undertaken. UMA confidence codes have been applied to each UMA. The land use limitation summaries, review and amended assessment with confidence codes is presented in Appendix J as well on Figures 5, 6 and 7 where applicable. Tables 6-2, 6-3 and 6-6 include the amended results, where applicable of these assessments.

6.5.4 Agricultural Land Class

ALC is based on a simple hierarchical scheme that is applicable across Queensland. It allows the interpreted land evaluation data to indicate the location and extent of agricultural land that can be used for a wide range of land uses with minimal land degradation.

This evaluation scheme has evolved through various guidelines and state planning policies and is currently referenced in the GALE (DSITI and DNRM, 2015). The ALC evaluation scheme is shown in Table 6-4.

Table 6-4: Agricultural Land Classes

ALC	Land Suitability	Description	Number of Land Uses	Suitability Class
Crop Land	A	Land that is suitable for a wide range[1] of current and potential crops with nil to moderate limitations to production.	-	-
	A1	Suitable for a wide range of current and potential broadacre and horticultural[2] crops.	>=4	1-3
	A2	Suitable for a wide range of current and potential horticultural crops only.	>=4	1-3
Limited Crop Land	B	Land that is suitable for a narrow range[3] of crops. The land is suitable for sown pastures and may be suitable for a wider range of crops with changes to knowledge, economics or technology.	<=3	1-3
Pasture Land	C	Land that is suitable only for improved or native pastures due to limitations that preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment.	-	-
	C1	Suitable for grazing sown pastures requiring ground disturbance for establishment; or native pastures on higher fertility soils.[4]	n/a	4/5
	C2	Suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1.	n/a	4/5
	C3	Suitable for light grazing of native pastures in accessible areas and includes steep land more suited to forestry or catchment protection.	n/a	5[7]
Non-Agricultural Land[5]	D	Land not suitable for agricultural use, including land alienated from agricultural use.	n/a	5
Complex Classes	A/C A/D B/C C/D	Land that is a complex of class A, B C or D land where it is not possible to delineate the land class at the map scale. The dominant class is the first code in the sequence and is assumed to be > 50% of the area, but <70%[6].	n/a	-

1. A wide range of crops is four or more crop types of local commercial significance.
2. Horticulture includes intensively grown small crops (e.g., vegetables) as well as tree crops (e.g., grown for nuts, seeds or fruit). Silviculture (plantation forestry) is not included.
3. A narrow range of crops is three or fewer crop types (broadacre or horticulture) of local commercial significance. Silviculture (plantation forestry) may be included. Crops with similar agronomic requirements e.g., maize and grain sorghum, peaches and nectarines are not generally regarded as different crop types. Different management regimes (including irrigation strategies) for the same crop do not increase the number of crops.
4. Class C1 includes brigalow and gidgee lands that are not suitable for cropping.
5. Non-agricultural land includes land that cannot be placed in any of the other land classes and includes land alienated from agricultural use (e.g., urban areas) and land with high order conservation tenure (e.g., national parks). It is noted that the State Forests within the study area have been assessed as part of this SALS Assessment.
6. In cases where two or more land classes are equally dominant and none are > 50%, judgement is used to identify the most appropriate ALC for the unit.
7. Include land uses where the majority are class 5 with the exception of only one land use of class 4.

Table 6-5 lists the outcome of the agricultural land assessment using the ALC evaluation scheme as shown in Table 6-4 and the Land Suitability Classes of each SPC. The ALCs within the study area are shown in Figure 7.

Table 6-5: Agricultural Land Classification Assessment Summary

ALC	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
A - Crop Land	-		0	0
A1 - Crop Land	18Bl(Ro)	74	76.36	54.59
A2 - Crop Land	-		0	0
B - Limited Crop Land	2Dn(Te)	2, 3, 4, 6, 8	810.11	438.27
	5Dn(Ro)	13, 14, 15, 16, 17		
	8Dn(Te)	29, 30, 31		
	20Bl(Ro)	81		
C - Pasture Land	-		0	0
C1 - Pasture Land	4Bl(Te)	10, 11	3,755.39	1,031.45
	9Dn(Ro)	33, 34, 36, 37, 38, 39, 40, 41, 42		
	10Ct(Ro)	43, 44, 45, 46, 47, 48		
	11Bl(Ta)	49, 52, 53, 54, 55, 56		
	12Da(Te)	57, 58		
	19Bl(Ro)	75, 76, 77, 78, 79, 80		
	22Bl(Wy)	83		
	17Bl(Ro)	70, 71, 72, 73		
C2 - Pasture Land	1Dn(Te)	1	2,081.02	774.00
	2Dn(Te)	5		
	3Bl(Te)	9		
	6Bl(Pg)	18, 19, 20, 21, 22, 23		
	7Bl(Pg)	24, 25, 26, 27, 28		
	11Bl(Ta)	50, 51		
	13Bl(Ta)	59, 60, 61		
	14Bl(Ro)	35		
	15Bl(Ro)	62, 63, 64, 65, 66		

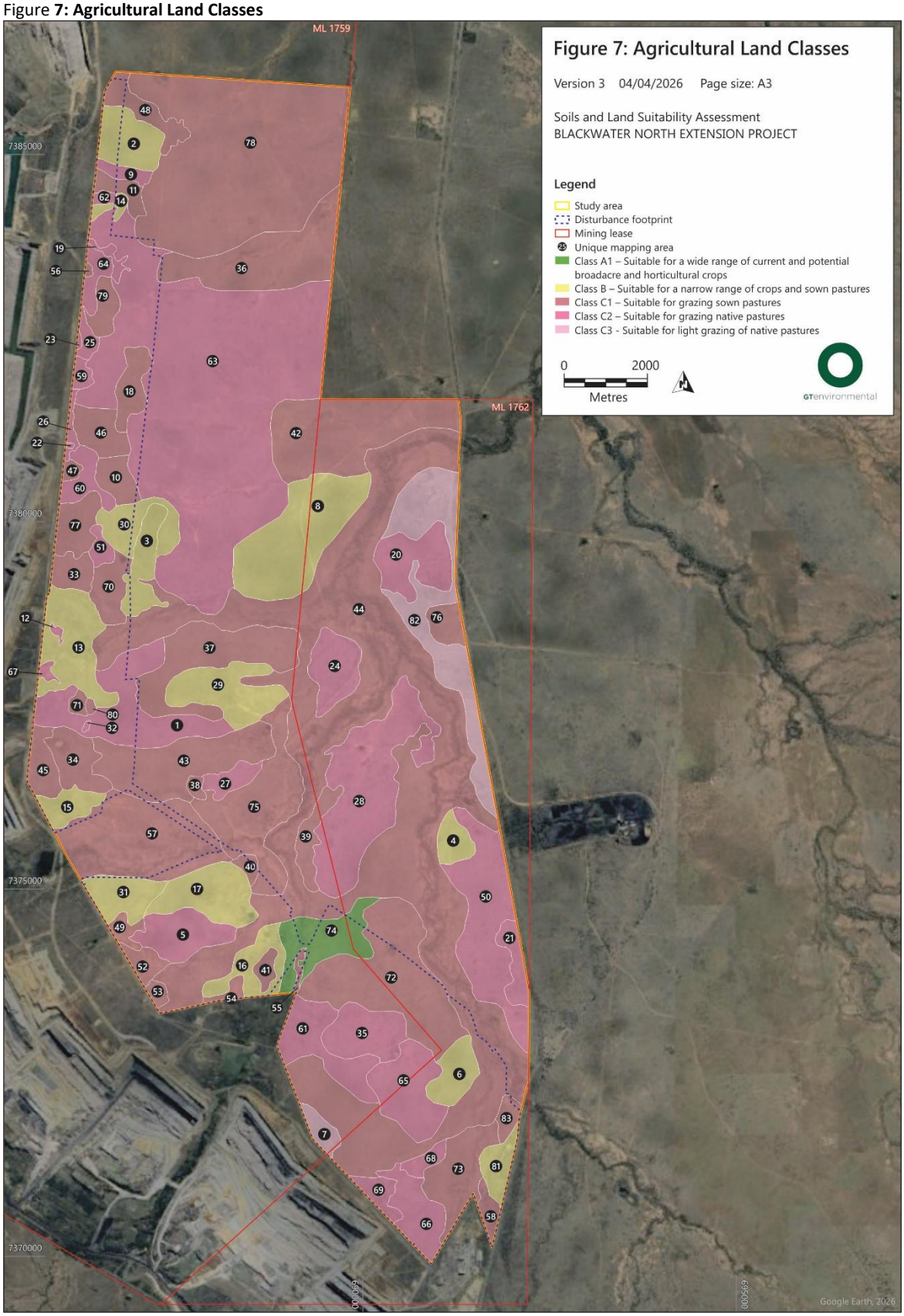
ALC	SPCs	UMAs	Area within the Study area (ha)	Area within the Project area (ha)
	16Bl(Ta)	32, 67, 68, 69		
C3 - Pasture Land	2Dn(Te)	7	184.72	18.23
	21Bl(Ta)	82		
D - Non-Agricultural Land	-		0	0

The assessment of ALC for the study area indicates the following classes:

- Approximately 73.36 ha is ALC A1,
    - Suitable for a wide range of current and potential broadacre and horticultural crops.
- Approximately 810.11 ha is ALC B,
    - Land that is suitable for a narrow range of crops. The land is suitable for sown pastures and may be suitable for a wider range of crops with changes to knowledge, economics or technology including the availability of water for spray or furrow irrigation.
- Approximately 3,755.39 ha is ALC C1,
    - Suitable for grazing sown pastures requiring ground disturbance for establishment; or native pastures on higher fertility soils.
- Approximately 2,081.02 ha is ALC C2,
    - Suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1.
- Approximately 184.72 ha is ALC C3,
    - Suitable for light grazing of native pastures in accessible areas.

ALC A, A2, and D were not mapped within the study area. No areas were designated as disturbed.

Figure **7: Agricultural Land Classes**



7 REGIONAL PLANNING INTERESTS ASSESSMENT

The RPI Act identifies and protects areas of Queensland that are of regional interest. The RPI Act protects each of the following areas of regional interest:

- PLAs,
- SEAs,
- PAAs, and
- SCAs.

The study area was assessed against the SCAs and PAAs.

7.1 Assessment of Strategic Cropping Areas

SCAs consist of the areas shown on the SCL Trigger Map (Queensland Globe, 2026). Land mapped as a SCA is, or is likely to be, highly suitable for cropping due to a combination of the land's soil, climate and landscape features (RPI Act).

Desktop review of the SCL Trigger Map confirmed that no SCA was mapped within the study area. Therefore, an SCA Assessment in accordance with RPI 08/14 was not undertaken.

7.2 Assessment of Priority Agricultural Areas

PAAs are areas of regionally significant agricultural production that are identified in a regional plan. Identifying PAAs ensures that resource activities that seek to operate in these areas do not unreasonably constrain, restrict or prevent on-going agricultural operation.

Identification of PAAs was undertaken for the study area. Desktop review of the study area compared to Queensland Government Development Assessment Mapping System (Queensland Globe, 2026) confirmed that no PAA was located within the study area.

8 ACID SULFATE SOILS ASSESSMENT

A review of the ASRIS including the Atlas of Australian Acid Sulfate Soils mapping was undertaken. It was identified that most of the study area is shown as the following:

- C4 - Extremely low probability of occurrence, based on very low confidence.

ASS typically naturally occur in low-lying coastal areas below 5 m AHD. The study area is at an elevation of 183 to 227 m AHD and is located approximately 200 km inland from the eastern Queensland coastline.

Fieldworks included field observations for indicators for ASS materials of observation sites for SPCs. These observations have been reviewed against Table 5-1 of the *National Acid Sulfate Soils Guidance, National acid sulfate soils sample and identification methods manual* (Sullivan et al., 2018), and are summarised below in Section 8.1.

8.1 Assessment of Actual and Potential Acid Sulfate Soils

Assessment of study area SPCs for AASS and PASS included the following indicators:

- field pH:
    - AASS, field $pH_F \leq 4$, when field $pH_F > 4$ but < 5 may indicate some existing acidity, and
    - PASS, field $pH_F > 4$ and commonly neutral.
- presence of corroded shell (AASS) or shell (PASS),
- jarositic horizons or substantial iron oxide mottling in surface (AASS),
- a sulfurous smell, e.g., hydrogen sulphide or ‘rotten egg’ gas, and
- dead, dying, stunted vegetation scalded or bare low-lying areas (AASS).

Field pH was initially conducted using a pH indictor kit and meter. Laboratory pH analysis results were also reviewed. All other indicators were visually inspected within the soil profile and field as part of the SALS Assessment. A summary of the SPC assessment is shown in Table 8-1.

Table 8-1: Acid Sulphate Soil Assessment

SPC	AASS / PASS Assessment	Assessment
1Dn(Te)	The pH is moderately alkaline to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	No field indication of PASS. No field indicators of AASS.
2Dn(Te)	The pH is slightly acid to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
3Bl(Te)	The pH is neutral to moderately alkaline. One sample at 1.40-1.50 mbgl was reported to be strongly acidic, between moderately alkaline horizons. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
4Bl(Te)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
5Dn(Ro)	The pH is moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	No field indication of PASS. No field indicators of AASS.
6Bl(Pg)	The pH for the mound position is moderately acid to neutral alkaline. The pH for the depression position is neutral to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
7Bl(Pg)	The pH for the mound position is neutral to moderately alkaline. The pH for the depression position is slightly acidic to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
8Dn(Te)	The pH is neutral to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
9Dn(Ro)	The pH is neutral to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
10Ct(Ro)	The pH is slightly acid to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
11Bl(Ta)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
12Da(Te)	The pH is slightly acid to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
13Bl(Ta)	The pH is moderately alkaline to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	No field indication of PASS. No field indicators of AASS.
14Bl(Ro)	The pH is moderately alkaline to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	No field indication of PASS. No field indicators of AASS.
15Bl(Ro)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
16Bl(Ta)	The pH is neutral to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.

SPC	AASS / PASS Assessment	Assessment
17Bl(Ro)	The pH is slightly acid to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
18Bl(Ro)	The pH is slightly acid to moderately alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
19Bl(Ro)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
20Bl(Ro)	The pH is moderately alkaline to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	No field indication of PASS. No field indicators of AASS.
21Bl(Ta)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.
22Bl(Wy)	The pH is neutral to strongly alkaline. No observation of shells, corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils.	Very low field indication of PASS. No field indicators of AASS.

17 of the 22 SPCs, 2Dn(Te), 3Bl(Te), 4Bl(Te), 6Bl(Pg), 7Bl(Pg), 8Dn(Te), 9Dn(Ro), 10Ct(Ro), 11Bl(Ta), 12Da(Te), 15Bl(Ro), 16Bl(Ta), 17Bl(Ro), 18Bl(Ro), 19Bl(Ro), 21Bl(Ta) and 22Bl(Wy), reported pH at slightly acidic to neutral levels within the soil profile.

The remaining indicators (corroded shell, jarosite horizons, iron oxide mottling, sulfurous smell or waterlogged soils) were not observed, therefore, the assessment indicates very low field indication of PASS, if very unlikely.

The remaining five SPCs, 1Dn(Te), 5Dn(Ro), 13Bl(Ta), 14Bl(Ro) and 20Bl(Ro) presented no field indications of AASS and / or PASS.

This result (i.e., very low field indicators for PASS) is consistent with the desktop review against the Atlas of Australian Acid Sulfate Soils mapping which showed the study area as “Extremely low probability of occurrence”.

It is assessed as highly unlikely the study area includes AASS and / or PASS.

9 SOIL MANAGEMENT MEASURES

9.1 Study Area Disturbance

The study area will have areas of disturbance including but not limited to, open cut mining pits, mine infrastructure laydown areas and associated roads and access tracks.

All SPCs in the study area have been assessed to determine their suitability for topsoil resource stripping and reuse for rehabilitation activities. This information may also be used to provide guidance for Soil and Capping Material Assessment requirements outlined within section 3.6.1 of the PRC Plan Guideline.

9.2 Proposed Post Mine Land Uses

Soil management measures are recommended for the rehabilitation of the disturbance area to the proposed post mine land use (PMLU). The Project area would be rehabilitated to land suitable for beef cattle grazing, or woodland habitat, consistent with the PMLUs described in the Blackwater Mine PRC Plan (Whitehaven, 2025).

Rehabilitation for beef cattle grazing would be undertaken in accordance with the PRC Plan and would involve seeding of native and naturised exotic species, including palatable, productive grasses and legumes, consistent with current grazing best management practices. Recommended soil management measures to achieve rehabilitation would include best practice for stripping, stockpiling and re-application of soil resources.

Woodland habitat may be included within the PMLU with the following recommendations and soil management measures assisting to support this re-establishment of vegetation communities.

Further recommendations, as discussed below, have been included to allow additional options such as organic matter and fertiliser application if the initial or ongoing rehabilitation is not achieving the desired outcome.

9.3 Topsoil Resource Assessment and Availability

Topsoil resource stripping depths for growth media have been assessed by depth of surface horizons which includes the quality of soil, nutrients for vegetation establishment and growth, as well as the properties of underlying subsoils (A12, A2 and B horizons) which may be similar, suitable or not suitable to include within the soil resource. This assessment also considers all relevant soil observations and laboratory data collected from the SPCs (e.g., soil texture, soil structure, pH, chloride, CEC, potential for dispersive attributes based on ESP and EAT, and fertility indicators).

Technical Guidelines for Environmental Management of Exploration and Mining in Queensland (DME, 1995), *Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government, 2016), Perry et al. (1964), and *Mine Rehabilitation Handbook* (Minerals Council of Australia, 1998) were reviewed with the field and laboratory results in assessing topsoil resource quality and quantity.

In summary, topsoil resources from the majority of SPCs are suitable for reuse as topsoil in rehabilitation activities, as shown in Table 9-1.

Topsoil in the study area in general was moderately structured, with very low to very high fertility consisting of moderately deep to very deep clay soils. 16 of the 22 SPCs had sodic subsoils which may have an impact on soil resource stripping and management.

Topsoil within these SPCs may require additional management and input (including amelioration and selective handling and storage) prior to use during rehabilitation as described in Table 9-1.

9.4 Recommended Topsoil and Subsoil Stripping Depths, Limitations and Volumes

Table 9-1 provides the recommended stripping depth, suitability for reuse in PMLU rehabilitation, identified limitations, management recommendations within each applicable SPC and approximate volume of topsoil available. The volumes of topsoil shown are calculated based on areas of SPC which intersect the disturbance area.

Table 9-2 provides a summary of recommended stripping depths and available topsoil volumes for major project components, which supports the PRC Plan (Whitehaven, 2025) in identifying topsoil quality, quantity and topsoil depth requirements. Topsoil is a valuable growth medium layer for rehabilitation and the establishment of the potential PMLUs. An assessment of the suitability of subsoil for use as a growth medium and capping material was also undertaken.

Further discussion of key limitations and management requirements is provided in Section 9.5. It is recommended that these sections be reviewed in conjunction with Table 9-1. The topsoil stripping depths are shown in Figure 8.

Table 9-1: Recommended Topsoil Stripping Depths, Limitations, Management Measures and Available Volumes

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
1Dn(Te)	0.00-0.20	0.20-0.40	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.
2Dn(Te)	0.00-0.10	0.10-1.00	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are favourable for topsoil with very high phosphorus levels. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 1.00 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
3Bl(Te)	0.00-0.20	0.20-0.80 / 0.80-1.60	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.80 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.80 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 15.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.40 mbgl.
4Bl(Te)	0.00-0.20	0.20-0.60 / 0.60-1.20	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.60 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.60 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 12.6 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.00 mbgl.
5Dn(Ro)	0.00-0.20	0.20-0.45 / 0.45-0.60	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.45 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.45 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 9.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.50 mbgl.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
6Bl(Pg)	0.00-0.20	0.20-1.80	Yes / Subsoil has recommendations	Topsoil Topsoil recovery may be difficult with the undulating nature of gilgai areas. Care is recommended when stripping the topsoil as to avoid mixing with sodic subsoils. Otherwise, gypsum application may be required, refer to subsoil recommendation below. Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.20 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 14.7 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels of the depression location at 0.80 mbgl.
7Bl(Pg)	0.00-0.15	0.15-0.50 / 0.50-1.45	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil recovery may be difficult with the undulating nature of gilgai areas. Care is recommended when stripping the topsoil as to avoid mixing with sodic subsoils. Otherwise, gypsum application may be required, refer to subsoil recommendation below. Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported moderate levels of phosphorus. The soils of this SPC have the highest levels reported at 11 mg/kg. If the PMLU has not been achieved, topsoil may respond to an application of fertiliser. Subsoil Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below this 0.40 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 17.9 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels of the mound location at 0.80 mbgl.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
8Dn(Te)	0.00-0.05	0.05-0.50 / 0.50 – 0.90	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Topsoil horizon is shallow, however, refer to subsoil for additional recommendations. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.50 mbgl may be stripped to this depth and utilised as topsoil. Subsoil below 0.50 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 11.2 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.50 mbgl.
9Dn(Ro)	0.00-0.10	0.10-1.40	Yes / Subsoil has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.10 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 16.3 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.80 mbgl.
10Ct(Ro)	0.00-0.10	0.10-1.80	Yes / Subsoil has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.10 mbgl may benefit from gypsum application due to extremely sodic levels. SodiCalc (2026) recommends approximately 15 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
11Bl(Ta)	0.00-0.20	0.20-1.00	Yes / Subsoil has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.20 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 11.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.
12Da(Te)	0.00-0.20	0.20-0.90	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are favourable for topsoil with very high phosphorus levels. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are low, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.90 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.
13Bl(Ta)	0.00-0.20	0.20-1.40 / 1.40-1.70	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are low, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 1.40 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 1.40 mbgl may benefit gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 6.8 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.40 mbgl.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
14Bl(Ro)	0.00-0.20	0.20-0.50 / 0.50-1.90	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are low, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.50 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 0.50 mbgl may benefit gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 0.00 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.00 mbgl. Based on this calculation, no treatment is required. If visual observations of sodic soils are observed, an application of 2.5 t/ha may be adequate.
15Bl(Ro)	0.00-0.20	0.20-0.60 / 0.60-0.90	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are low, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.60 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 0.60 mbgl may benefit gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 17.1 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.80 mbgl.
16Bl(Ta)	0.00-0.10	0.10-0.40	Yes / Subsoil has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below this 0.40 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 4.6 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.10 mbgl.

SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
17Bl(Ro)	0.00-0.10	0.10-1.20	Yes / Subsoil has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below 0.10 mbgl may benefit from gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 5.0 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.50 mbgl.
18Bl(Ro)	0.00-0.20	0.20-1.00	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 2.00 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.
19Bl(Ro)	0.00-0.20	0.20-1.40 / 1.40-2.20	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported very low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are low, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 1.40 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil. Subsoil below 1.40 mbgl may benefit gypsum application due to sodic levels. SodiCalc (2026) recommends approximately 9.3 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 1.70 mbgl.

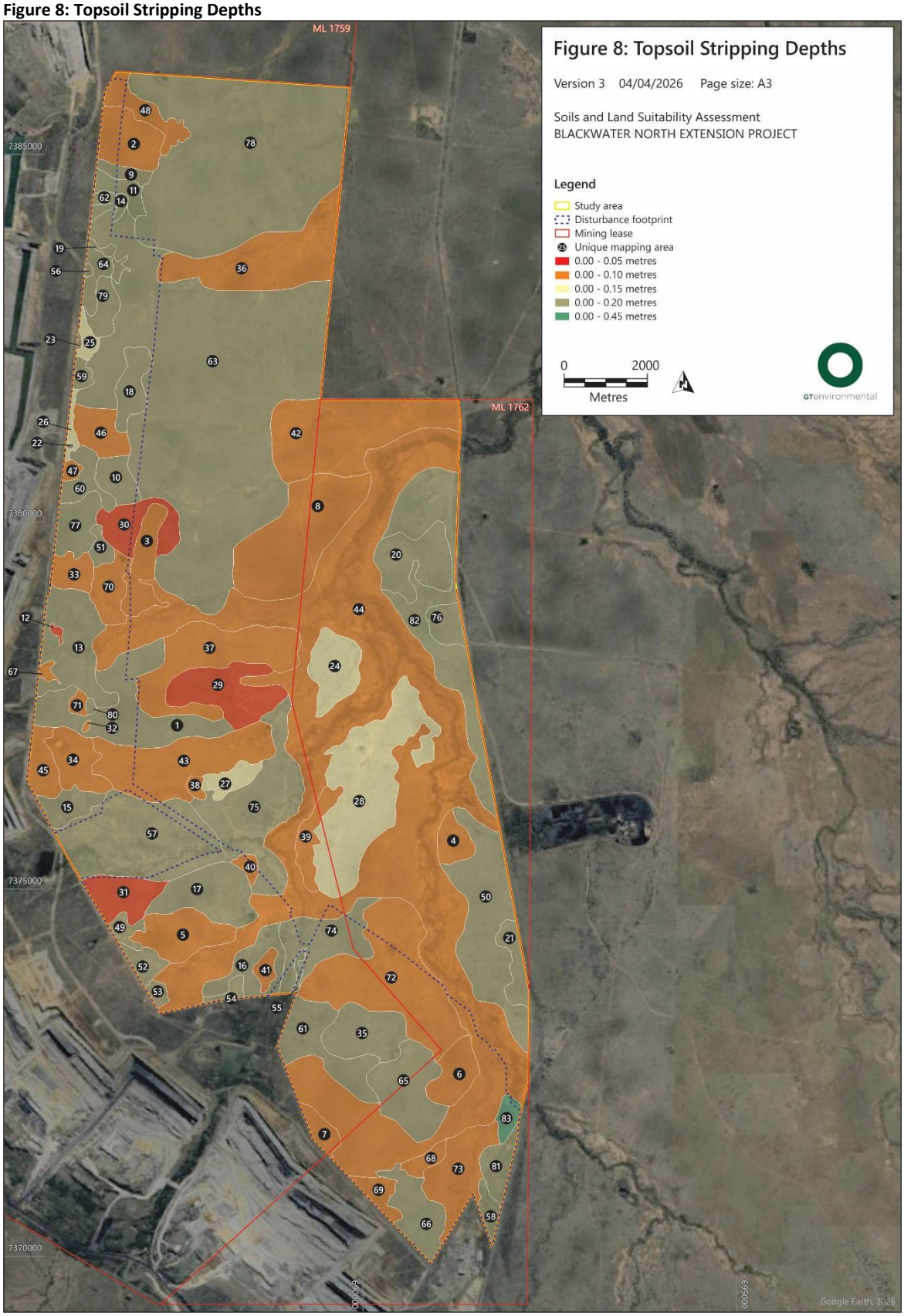
SPC	Topsoil Depth (mbgl)	Subsoil Depths (mbgl)	Suitable for Rehabilitation	Limitations and / or Recommended Amelioration and Management Measures
20Bl(Ro)	0.00-0.20	0.20-0.80	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.80 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.
21Bl(Ta)	0.00-0.20	0.20-0.45 / 0.45-1.80	Yes / Subsoil second strip depth has recommendations	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil resource may be recommended for use on flat to sloped (may benefit from treatment) areas, to support the placement of topsoil. Subsoil below 0.45 mbgl may benefit from gypsum application due to strongly sodic levels. SodiCalc (2026) recommends approximately 7.4 t/ha for each 0.10 m to achieve ESP of 5.5, based on the highest sodic levels at 0.90 mbgl.
22Bl(Wy)	0.00-0.45	0.45-1.00	Yes	Topsoil Topsoil resource may be recommended for use on flat to sloped areas. Fertility attributes are low for topsoil with reported low levels of phosphorus. Topsoil may respond to an application of fertiliser, if the PMLU has not been achieved. Subsoil Subsoil may be considered as a secondary topsoil, due to minor to no major limitation. Fertility attributes are not favourable, however, mixing with other suitable, fertile soil or treatment with organic matter and / or fertiliser may increase its suitability. Subsoil to 0.45 mbgl may be stripped to this depth and utilised as topsoil. Subsoil resource may be recommended for use on flat to sloped areas, to support the placement of topsoil.

Table 9-2: Available Topsoil and Subsoil Volumes within the Proposed Disturbance Area

SPC	Area (ha) within the proposed disturbance area	Available Topsoil Volume (Cubic metres [m³])	Available Subsoil Volume (m³) Double Stripping[1]	Available Subsoil Volume (m³) Treated Subsoil
1Dn(Te)	82.69	165,380	165,380	0
2Dn(Te)	147.06	147,060	1,323,540	0
3Bl(Te)	4.51	9,020	27,060	36,080
4Bl(Te)	34.47	68,940	137,880	206,820
5Dn(Ro)	242.45	484,900	606,125	363,675
6Bl(Pg)	45.46	90,920	0	727,360
7Bl(Pg)	20.05	30,075	70,175	190,475
8Dn(Te)	73.92	36,960	332,640	295,680
9Dn(Ro)	93.53	93,530	0	1,215,890
10Ct(Ro)	431.00	431,000	0	7,327,000
11Bl(Ta)	63.77	127,540	0	510,160
12Da(Te)	48.03	96,060	336,210	0
13Bl(Ta)	115.90	231,800	1,390,800	347,700
14Bl(Ro)	66.77	133,540	200,310	934,780
15Bl(Ro)	321.19	642,380	1,284,760	963,570
16Bl(Ta)	40.06	40,060	0	120,180
17Bl(Ro)	312.81	312,810	0	3,440,910
18Bl(Ro)	54.59	109,180	436,720	0
19Bl(Ro)	76.56	153,120	918,720	612,480
20Bl(Ro)	28.92	57,840	173,520	0
21Bl(Ta)	0	0	0	0
22Bl(Wy)	12.80	57,600	70,400	0
Total	**2,316.54**	**3,519,715**	**7,474,240**	**17,292,760**

1. Double stripping of the nominated SPC subsoils may be used to bolster topsoil volumes, as assessed in Table 9-1

Figure 8: Topsoil Stripping Depths



9.5 Soil Amelioration and Management

As discussed in Table 9-1, there are identified limitations for some SPCs which will benefit from amelioration and management to improve the topsoil resource quality.

These limitations are linked to generally neutral to moderately alkaline pH, sodic or dispersive soils, poor surface soil structure, low fertility indicators, low CEC or potentially firm to hard-setting surfaces restricting seedling emergence.

Any recommended amelioration undertaken on a topsoil or subsoil resource should be monitored to ensure the objective of the treatment has been met. The following sections look to provide further details for the management of these limitations.

9.5.1 pH Amelioration

Soil pH surface levels across the SPCs are generally neutral to moderately alkaline with subsoils ranging from strongly acid (3Bl(Te), Site D5, 1.40-1.50 mbgl) to moderate to strongly alkaline in general for subsoils. Sites D6, D36 and D59 have alkaline subsoils (pH > 9.0), which based on their soil classification have been assessed as an ERD chemical barrier.

Soils with these pH values in the strongly acidic (pH < 5.5) or strongly alkaline (pH > 9.0) range are associated with reduced availability of nutrients or root growth inhibition. Observations on site indicated vegetation species in the study area appeared to be healthy during all five fieldworks periods.

The Suitability of Beef Cattle Grazing (DME, 1995) limitation for pH indicates that surface soils are suitable (Class 2 and 3) with none assessed as unsuitable (Class 4 or 5).

Overall, pH amelioration is not recommended for the SPCs in the study area for the reestablishment of native vegetation, however, any use of organic matter and / or fertilisers for rehabilitation activities may alter a soils' pH.

9.5.2 Salinity Amelioration

Salinity within soils and potential crop land uses has been presented in Appendix K as plant yield % and plant salt-tolerance data (DERM, 2011). Based on the application of rainfall to all nine crop land uses (Section 4.4), SPCs have 100% plant yield, except for Safflower where results provided were assessed as not consistent when compared to all other land uses, which were. The plant salt-tolerance data comparison does show that 22 SPCs have potential reduced yield % within a rooting depth of 0.60 m.

It is noted that elements such as EC, Chloride and Sodium are transient and will change following disturbance, stockpiling, mixing (with other less salty subsoil) and weather exposure as well as application of good quality irrigation water.

Based on this assessment, no amelioration is recommended.

9.5.3 Sodicity / Dispersion Amelioration

ESP indicates the proportion of the CEC occupied by exchangeable sodium cations. Soils with elevated ESP may be prone to disperse on contact with water and can provide unfavourable soil conditions such as surface crusting, low infiltration, hard and dense subsoils and susceptibility to erosion.

The general rating for ESP, as outlined in Appendix D, indicates that 6 to 15 are sodic, 15 to 20 are strongly sodic and > 20 are extremely sodic. The nominated topsoil stripping depths, include recommended soil management measures (application of gypsum) for soil resources that are observed as sodic to extremely sodic.

ESP results are assessed in conjunction with ECEC and clay content (%), where if a result reports ECEC < 3 cmol(+)/kg or < 15% clay, ESP results could not be relied upon as an indicator for sodicity.

Table 9-3 summaries the ESP of subsoils for each SPC.

Table 9-3: SPC Topsoil and Subsoil ESP Assessment

Subsoil Sodicity	Subsoil Profile – Lowest EAT Class
Non-Sodic Subsoils	1Dn(Te), 2Dn(Te), 12Da(Te), 18Bl(Ro), 20Bl(Ro) and 22Bl(Wy)
Sodic Subsoils	5Dn(Ro), 6Bl(Pg), 7Bl(Pg), 13Bl(Ta), 14Bl(Ro), 16Bl(Ta) and 17Bl(Ro)
Strongly Sodic Subsoils	3Bl(Te), 4Bl(Te), 8Dn(Te), 9Dn(Ro), 11Bl(Ta), 15Bl(Ro), 19Bl(Ro) and 21Bl(Ta)
Extremely Sodic Subsoils	10Ct(Ro)

It is recommended that these soil resources, where suitable, may benefit from an application of fine grade gypsum to be used on sloped surfaces and stockpiling of these SPC's subsoils be kept separate from the remaining SPC's subsoil stockpiles. Additional information is recommended in Section 9.6.

A review of the SPCs for EAT classes indicated some SPCs had dispersion throughout the soil profile. The following indicates the SPCs and their lowest EAT classes for topsoil and subsoil, as summarised below in Table 9-4.

Table 9-4: SPC Topsoil and Subsoil EAT Assessment

SPC	Topsoil – EAT Class	Subsoil Profile – Lowest EAT Class
1Dn(Te)	Class 4 – No dispersion. Carbonate and Gypsum present	Class 2 – Some Dispersion
2Dn(Te)	Class 3 – Dispersion after remoulding	Class 4 – No dispersion. Carbonate and Gypsum present
3Bl(Te)	Class 2 – Some Dispersion	Class 2 – Some Dispersion
4Bl(Te)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
5Dn(Ro)	Class 4 – No dispersion. Carbonate and Gypsum present	Class 2 – Some Dispersion
6Bl(Pg)	Class 2 – Some Dispersion	Class 2 – Some Dispersion
7Bl(Pg)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
8Dn(Te)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
9Dn(Ro)	Class 4 – No dispersion. Carbonate and Gypsum present	Class 2 – Some Dispersion
10Ct(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion

SPC	Topsoil – EAT Class	Subsoil Profile – Lowest EAT Class
11Bl(Ta)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
12Da(Te)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
13Bl(Ta)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
14Bl(Ro)	Class 4 – No dispersion. Carbonate and Gypsum present	Class 2 – Some Dispersion
15Bl(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
16Bl(Ta)	Class 2 – Some Dispersion	Class 2 – Some Dispersion
17Bl(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
18Bl(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
19Bl(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
20Bl(Ro)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
21Bl(Ta)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion
22Bl(Wy)	Class 3 – Dispersion after remoulding	Class 2 – Some Dispersion

Further information for SPCs, amelioration and recommended soil depths is provided in Table 9-1.

9.5.4 Fertiliser Amelioration

SPCs were observed in general to have low to very high fertility indicators of macronutrients phosphorus and varying levels of available nitrogen, potassium, calcium, magnesium and sulfur levels.

Native vegetation and some introduced pasture species are adapted to low nutrient levels and in general, it may not be required to apply fertiliser where the PMLU relies on native vegetation establishment.

As detailed in Table 9-1, SPCs which may benefit from an application of fertiliser include all SPCs except 2Dn(Te), however, fertiliser application would be more appropriate during final soil replacement and seed bed preparation and any of the following recommendations are a guide only. It is recommended that appropriate fertiliser rates be determined through rehabilitation trials prior to the commencement of full-scale rehabilitation.

If an application of fertiliser is required, it is recommended that the laboratory analysed nutrient levels be reviewed against target nutrient levels for the nominated PMLU prior to removal of soils from stockpiles.

Typical application rates indicate that levels of nitrogen fertiliser of between 100 to 450 kilograms per hectare (kg/ha) may be appropriate, however, for native woodlands an initial application of 20 kg/ha may be more suitable. Nitrogen fertilisers such as Urea, Monoammonium phosphate (MAP) and Diammonium phosphate (DAP) are considered general fertilisers to use to boost nutrient levels.

Neutralising lime may be recommended with these fertilisers if pH levels reduce to 5.5 or below, however, this is unlikely based on pH rates of the SPCs of the study area. Typical application rates of neutralising lime for fertilisers such as MAP and DAP may be approximately 5.4 and 3.6 kilograms (kg) for every 1 kg of Nitrogen (Fertiliser Industry Federation of Australia Inc., 2006).

Phosphorus fertilisers which may not require any additional amelioration include single and triple super phosphate.

As stated above, application of any fertiliser should be approached with caution as it may be costly and create limitations such as acidic soil conditions, contaminated runoff or encourage weed growth. Soil sampling and analysis of proposed rehabilitation soil resources throughout the life of the mine to assess potential fertiliser application is recommended. Other variables such as slope of landform, soil texture, structure, surface and vegetation for PMLU may be considered prior to any application of fertiliser.

Amelioration and use of fertilisers is only recommended as an option if the desired outcome of the PMLU has not been achieved with all other avenues undertaken.

9.5.5 Organic Matter Amelioration

Organic matter incorporated into the topsoil would increase organic levels, improve soil structure, increase CEC, reduce erosion as well as increase water holding capacity. SPCs which may benefit from amelioration with organic matter are generally sandier, firm setting soils with low CEC and PAWC such as 22Bl(Wy) (Very low surface CEC), 12Da(Te) (Low surface CEC), 17Bl(Ro) (Low surface CEC) and 21Bl(Ta) (Low surface CEC).

It is recommended, where possible, to utilise an organic matter source generated from land clearing or stripped vegetation, where it is near the rehabilitation area and readily available. The application may depend on the vegetation type whether native species or if the desired PMLU outcome is establishing a pasture or crop, as incorporation of weed seed should be avoided. It is also noted that timing between clearing of vegetation and the commencement of rehabilitation may render organic matter unavailable. The establishment of vegetation cover on stockpiled areas may assist in providing organic matter.

The suppliers and source of material should be reviewed prior to use in the study area. A review of suppliers should include if they comply with Australian Standard (AS) AS 4454-2021 (Composts, soil conditioners and mulches). Suppliers complying with this AS will provide confidence that the product they are supplying will not include the introduction of weeds to the study area.

Where available and cost effective, the following application rates may be considered if the desired PMLU outcome has not been achieved:

- manure may be applied at a rate of between 5-30 t/ha for small to large feedlots for cattle grazing, depending on the type of manure (Tucker et al., 2015),
- compost may be applied at 70-150 t/ha (Kelly, 2006),
- biosolid application may be applied at recommended application rate of 50 dry t/ha for amelioration of compacted soils (Kelly, 2006).

The application of organic matter should be treated as per fertiliser amelioration, where it is only recommended as an option if the desired outcome of the PMLU has not been achieved with all other avenues undertaken.

9.6 Topsoil Recovery, Storage and Placement Recommendations

The following subsections are a general guide to the recovery, storage and placement of topsoil and subsoil resources.

9.6.1 General Topsoil Stripping Management

The following are recommended general management procedures for topsoil stripping activities, which also include handling measures to retain soil attributes for rehabilitation:

- HSE Environmental representatives, supervisors and competent operators should be familiar with the areas to be stripped based on existing soils mapping and recommended topsoil stripping depth.
- Current weather forecast should be checked prior to stripping of soils to reduce exposure of bare sodic, erosive soils and sediment runoff.
- If a Permit to Disturb (PTD) is required, then this shall be compiled and submitted with the proposed plan of disturbance, with approval received before commencing.
- All soil resource stripping shall be undertaken in accordance with relevant Environmental Authority and PTD
- Vegetation clearing should occur immediately prior to stripping. This will reduce the loss of topsoil and mixing with unsuitable soils and potentially reclaimed mulch. Vegetation removed may be stockpiled and reused as mulch if handled as appropriate and depending on the vegetation type with respect to the desired post-mining land use, as well as the presence of any problem weed species.
- Suitable machinery, shall comply with onsite procedures including, but not limited to, weed and feral animal management. Machinery shall be utilised in recovering topsoil and subsoil resources such as GPS assisted scrapers or dozers. Stripping and ripping should be undertaken with care to reduce the mixing of subsoils during topsoil stripping.
- Inspections of the stripped areas should be undertaken to observe any unexpected changes in soils. Inspections should occur where it is suspected that subsoils are present in the stripped topsoil based on a change in texture, soil colour and unexpected change in stripping depth. Stripping of SPCs identified with chemical barriers in subsoil such as sodic impacted subsoils should be supervised. Inspection of the stripped areas should be undertaken and if possible, surveying of the area to obtain volumes removed from the SPC.
- Stripping of topsoil and subsoils shall be undertaken in accordance with the recommendations outlined within this SALS Assessment. The collection of subsoil at increased depths as an alternative growth media may not be allowed due to the possibility of including highly sodic and dispersive subsoils.

- Areas of land upgradient and downgradient of soil stripping activities, low-lying areas or areas of observed runoff should have suitable erosion and sediment control measures in place such as clean water diversion bunds, sediment-affected water diversion bunds and / or sediment fencing prior to construction commencing.
- Topsoil suspected of being mixed with subsoils should be either resampled and analysed as the current stockpile or separated from topsoil and placed with the appropriate subsoil stockpile.
- Application of gypsum may be considered during this phase, as the earlier integration of amelioration will assist in the future reuse of sodic, impacted soils.

9.6.2 Stockpiling Management

The following are recommended general procedures for stockpile management:

- Topsoil and subsoil (not suitable for double stripping) materials should be stockpiled separately with records maintained of the material's origin in a topsoil inventory.
- Stockpile locations should be placed in areas outside the mining activities, as close to the area to be rehabilitated as possible and away from drainage lines. These include, in order of prioritisation, directing into a rehabilitation area, stockpiled on top of dump near rehab slope, low wall close to toe of dump, low wall in available locations or the high wall.
- Any known sloped areas, natural drainage pathways such as overland flow and drainage lines as well as high traffic areas should be avoided.
- The stockpiles should have appropriate measures in place to prevent erosion.
- Where possible, stockpile locations should be placed against existing vegetated areas to function as a buffer, or adjacent to any rise in landscape to provide protection from wind erosion.
- Adequate erosion and sediment control including but not limited to sediment fencing, shall be placed on the down slope area of stockpiles.
- Locations are to be designated off limits by remaining grazing stock, machinery and vehicles.
- Locations should be placed in areas where it may assist future rehabilitation reuse, i.e., near nominated project components to reduce movement of materials, where possible.
- Stockpiles should have a maximum height of 3.0 m, preferably 2.0 m with a batter recommended no steeper than 3 h : 1 v (horizontal run to vertical rise). Stockpiles required to be more than 3.0 m in height shall require additional erosion and sediment controls and ideally be temporary stored.
- The surface of the stockpile should be flat.
- The installation of plastic lined catch drains or runoff areas along the surface edge of waste or elevated landforms may assist in minimising surface runoff on batter slopes.

- Covering of the stockpiles with grasses or groundcover species appropriate to the nominated PMLU would minimise erosion and soil loss, minimise the establishment of weeds, assist in maintaining organic matter, nutrients and microbial activity and rejuvenate native vegetation through existing seedbank.
- Stockpiles consisting of dispersive subsoils (refer Section 9.5.3) may require further management to reduce sediment loss and erosion. Management recommendations may include:
    - reducing the stockpile batter to 2 h : 1 v;
    - application of fine grade gypsum at the recommended 'worst case' amount, as listed for the SPCs to be stockpiled across the surface of the stockpile; and
    - covering of the stockpile surface and batters with a product such as hydro mulch, polymer or coirweb.
- An inspection of the stockpiles should occur once they are completed with scheduled ongoing maintenance as required.

9.6.3 Topsoil Reinstatement and Placement Depth

The following are general procedures recommended for the reinstatement of topsoil:

- Review of the topsoil and subsoil resource material. SPCs that are potentially dispersive or erosive are recommended for placement on flat plains to slopes up to 10% if possible.

  If placement of topsoil or subsoil resources that are potentially dispersive or erosive is on steeper slope or visual observation during the pre-strip indicates erosive attributes such as hard-setting surfaces, an application of gypsum may be recommended.

  However, if clay content percentage is low (< 20%), gypsum may not improve the soil stability.
- Subsoil resource material should be recovered from the subsoil stockpiles and placed initially prior to topsoil resource material.
- Topsoil resource material ideally should be recovered from the stockpiles closest to the disturbance area. This would reduce handling time, haul distance of topsoil resource materials, movement of plant and machinery and ensure that placement work may occur in the shortest period (i.e., reduce exposure to rainfall events).
- Topsoil should be placed in even layers at the recommended depths to ensure enough coverage and soil to re-establish vegetation.
- Sediment and erosion controls are to be utilised to ensure that loss of soil resources is minimal and product can be recovered.
- Inspection and maintenance of rehabilitation areas are to be undertaken to ensure erosion and sediment control measures are performing as constructed. Measures are to be outlined within the Projects Erosion and Sediment Control Plan (ESCP) as detailed in Section 9.6.4.

- Topsoil should be inspected prior to reinstatement for invasive vegetation (plants and weeds) and should be controlled.
- Inspections are to be recorded, including any issues and improvements, to ensure soil resource application is appropriate across all rehabilitated areas.
- Topsoil placement depth across areas requiring rehabilitation is recommended at a depth of 0.15 to 0.20 m with a minimum depth of 0.10 m. In general, subsoils placed underneath and supporting topsoil with a recommended horizon of 0.20-0.60 m. This is to allow sufficient depth for shallow scarifying and ripping of topsoils (if required) and vegetation establishment.
- The preparation of the surface, whether it includes ripping, seeding and / or adding amelioration treatments should occur during one operation to minimise compaction and surface structure degradation.
- The application rate and method if a fertiliser is to be used should be reviewed and understood by the operator and supervisor.
- After the placement of topsoil, additional seeding should be used to assist with encouraging suitable vegetation regrowth.
- The application of good quality, irrigation water to the soil should be used to assist in the leaching of salts throughout the profile. This would assist in the establishment of vegetation, especially in potential future application of pastures or crop land uses.

9.6.4 Erosion and Sediment Control Plan

The *BWM Erosion and Sediment Control Plan* (Whitehaven, 2022) has been prepared for the approved BWM, in accordance with the International Erosion Control Association's (IECA's) 'Best Practice Erosion and Sediment Control' document (IECA, 2008).

The BWM ESCP would be reviewed and updated, where necessary, to ensure the Project achieves:

- no worsening of the existing levels of soil loss from the land in or downslope of the study area;
- no increased risk of erosion, or other land degradation, on land or in waterways downslope of the study area; and
- no net increase in the sediment load leaving the study area and entering waterways and / or watercourses.

The BWM ESCP should be reviewed to accommodate any ongoing need for erosion and sediment control for all aspects of the Project.

10 CONCLUSION

The key conclusions of the SALS Assessment are as follows:

- 22 SPCs across 83 UMAs are present in the study area.
    - Soils range from shallow clay loam soils, sodic subsoil clays texture contrast soils to structured, moderate to very deep clay soils to clays with microrelief on limited to completely cleared, level to gently undulating plains and rises.
    - SPCs have been classified in four of the 14 ASC orders including Dermosol, Kandosols, Sodosol and Vertosols.
- The suitability framework of each SPC was assessed against the nominated Regional Frameworks (DSITIA and DNRM, 2013) for the Inland Fitzroy and Southern Burdekin Area land uses. These land uses include dryland and furrow irrigated barley, chickpea, cotton, maize, millet, mungbean, oat, safflower, sorghum, soybean, sunflower, triticale and wheat.
    - One SPC, 18Bl(Ro) has been identified as being able to support crop land uses for cotton, maize, mungbean, safflower, sorghum, soybean and sunflower.
    - Three SPCs, SPCs 2Dn(Te), 8Dn(Te) and 20Bl(Ro) can support cotton.
    - All of the remaining SPCs and UMAs as follows are unsuitable and presented severe or extreme limitations with respect to supporting crop land uses. 2Dn(Te) (UMA 5), 3Bl(Te), 4Bl(Te), 8Dn(Te) (UMA 12), 9Dn(Ro), 10Ct(Ro), 11Bl(Ta), 12Da(Te), 14Bl(Ro), 15Bl(Ro), 17Bl(Ro), 19Bl(Ro), (UMAs 50,51) 16Bl(Ta), 21Bl(Ta) and 22Bl(Wy).
    - The remaining two SPCs, Tm(4Rv) and Tm(11Rv) presented severe or extreme limitations with respect to supporting crop land uses.
    - The suitability of nominated pastures was also assessed, with eight SPCs (Wn(1Rv), Bk(2Rv), Bk(5Rv), Bk(6Rv), Bk(7Rv), Bk(8Rv), Bk(9Rv), Wn(10Rv)) identified as being able to support one pasture land use.
    - The remaining three SPCs, (Nm(3Rv), Tm(4Rv) and Tm(11Rv)) presented severe or extreme limitations with respect to supporting crop land uses.
- The SPCs were assessed against Suitability for Beef Cattle Grazing LSAT (DME, 1995) with reference for beef cattle grazing in the *Land resource survey and evaluation of the Kilcummin area, Queensland* (Shields and Williams, 1991). This assessment assists in determining the limitations for beef cattle grazing. The following SPCs and specific UMAs were assessed:
    - SPCs 11Bl(Ta), 12Da(Te), 18Bl(Ro) and 22Bl(Wy) were assessed as Class 3, suitable land which is moderately suited to beef cattle grazing but which requires significant inputs to ensure sustainable use,
    - SPCs 2Dn(Te), 3Bl(Te), 4Bl(Te), 8Dn(Te), 9Dn(Ro), 10Ct(Ro), 11Bl(Ta) (UMAs 50,51) 14Bl(Ro), 15Bl(Ro), 16Bl(Ta), 17Bl(Ro), 19Bl(Ro) and 20Bl(Ro) were assessed as Class 4,

marginally suited for beef cattle grazing and would require major inputs to ensure sustainability,, and

- SPCs 2Dn(Te) (UMA 7) and 21Bl(Ta) were assessed as Class 5, unsuitable land with extreme limitations in which the land is unsuited and cannot be sustainably used for a proposed agricultural use.

- The assessment of ALCs across the study area based on the Regional Frameworks, additional land use limitations and beef cattle grazing classes indicated the following:
  - Approximately 73.36 ha is ALC A1, assessed as suitable for a wide range of current and potential broadacre and horticultural crops.
  - Approximately 810.11 ha is ALC B, assessed as land that is suitable for a narrow range of crops. The land is suitable for sown pastures and may be suitable for a wider range of crops with changes to knowledge, economics or technology including the availability of water for spray or furrow irrigation.
  - Approximately 3,755.39 ha is ALC C1, assessed as suitable for grazing sown pastures requiring ground disturbance for establishment; or native pastures on higher fertility soils.
  - Approximately 2,081.02 ha is ALC C2, assessed as suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1.
  - Approximately 184.72 ha is ALC C3, assessed as suitable for light grazing of native pastures in accessible areas.
  - ALC A, A2, and D were not mapped within the study area. No areas were designated as disturbed.
  - Soil assessed as suitable for potential cropping land may be impacted as part of the disturbance (approximately 492.86 ha, 7.6% of the disturbance footprint), however the assessed cropping land is currently been used as cattle grazing (pre mine land use). The rehabilitation of soils to support the PMLU of beef cattle grazing indicates that soils are likely to still support the potential agricultural land uses such as cropping in the future, if agricultural land uses were to change.
- The RPI Act and RPI Regulation identify and protect areas of Queensland that are of regional interest. The study area was assessed against SCA and PAA requirements.
  - Desktop review of the study area compared to Queensland Government Development Assessment Mapping System (Queensland Globe, 2026) confirmed that no SCA was located within the study area.
  - Desktop review of the study area compared to Queensland Government Development Assessment Mapping System (Queensland Globe, 2026) confirmed that no PAA was located within the study area.

- An ASS field assessment was undertaken during the SALS Assessment. The field observations were reviewed and the result (i.e., very low field indicators for PASS) is consistent with the desktop review against the Atlas of Australian Acid Sulfate Soils mapping which showed the study area as "Extremely low probability of occurrence."
    - It is assessed as highly unlikely the study area includes AASS and / or PASS, however, environmental management plans should consider proactive procedures to visually monitor and identity ASS during the Project's lifespan.
- In summary, topsoil resources from the majority of SPCs contain soils that are suitable for reuse in rehabilitation activities.
    - Topsoil in the study area consisted of fair to poorly structured, low fertility, shallow to deep soils which are indicative of the area, however, all are suitable for reuse for rehabilitation.
    - Subsoils for five SPCs (1Dn(Te), 2Dn(Te), 12Da(Te), 18Bl(Ro) and 22Bl(Wy)) had no limitations and were similar in physical and chemical attributes where the subsoil may be stripped to depth and used as topsoil.

      Eight of the SPCs (3Bl(Te), 4Bl(Te), 5Dn(Ro), 8Dn(Te), 13Bl(Ta), 14Bl(Ro), 15Bl(Ro) and 19Bl(Ro)) were similar, however did have sodic subsoils at depth. Separation of the five SPCs with no limitations and the eight SPCs with sodic subsoils would be recommended with respect to stockpiling. This would prevent impacts to the five subsoils with no limitations and the need for any additional amelioration treatment.
    - Soil amelioration recommendations such as gypsum application may benefit some of the deeper sodic subsoils as well as organic matter / fertiliser application pending the PMLU i.e., if cropping land uses were selected. Management, storage and handling recommendations have been provided to retain and improve the quality of topsoil for rehabilitation reuse pending the final PMLU.

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12 GLOSSARY OF ACRONYMS, UNITS AND TERMS

The following acronyms have been used in this report.

Acronym	Description
AASS	Actual Acid Sulfate Soils
AHD	Australian Height Datum
ALC	Agricultural Land Class / Classification
AS	Australian Standard
ASC	Australian Soil Class / Classification
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
BWM	Blackwater Mine
BoM	Bureau of Meteorology
Ca:Mg	Calcium Magnesium Ratio
CEC	Cation Exchange Capacity
CHPP	Coal Handling and Preparation Plant
Cl^-	Chloride
DAP	Diammonium Phosphate
DERM	Department of Environment and Resource Management
DES	Department of Environment and Science (Queensland)
DME	Department of Minerals and Energy (Queensland)
DNRM	Department of Natural Resources and Mines (Queensland)
DoR	Department of Resources (Queensland)
DSDMIP	Department of State Development, Manufacturing, Infrastructure and Planning (Queensland)
DSITI	Department of Science, Information Technology and Innovation
DSITIA	Department of Science, Information Technology, Innovation and the Arts
EAT	Emerson Aggregate Test
EC	Electrical Conductivity
ECEC	Effective Cation Exchange Capacity
ECse	Electrical Conductivity, saturated extract
EOBH	End of Borehole
EOTP	End of Test Pit

Acronym	Description
ERD	Effective Rooting Depth
ESCP	Erosion and Sediment Control Plan
ESP	Exchangeable Sodium Percentage
GALE	Guidelines for Agricultural Land Evaluation in Queensland
GDA	Geocentric Datum of Australia
GradSect	Gradient-oriented Transect
GTE	GT Environmental Pty Ltd
IECA	International Erosion Control Association
LCC	Land Capability Classification
LGA	Local Government Area
LSAT	Land Suitability Assessment Techniques
m AHD	Elevation in metres with respect to the Australian Height Datum
MAP	Monoammonium Phosphate
mbgl	Metres below ground level
ML	Mining lease
NCST	National Committee on Soil and Terrain
P	Phosphorus
PAA	Priority Agricultural Areas
PASS	Potential Acid Sulfate Soils
PAWC	Plant Available Water Capacity
PLA	Priority Living Areas
PMLU	Post Mine Land Use
PRC Plan	Progressive Rehabilitation and Closure Plan
PSA	Particle Size Analysis
PTD	Permit to Disturb
QDPI	Queensland Department of Primary Industries
RPI	Regional Planning Interests
SA	Surface Area
SALI	Soil and Land Information

Acronym	Description
SALS	Soil and Land Suitability
SCA	Strategic Cropping Areas
SCL	Strategic Cropping Land
SEA	Strategic Environmental Areas
SLR	SLR Consulting Pty Ltd
SMU	Soil Map Unit
SPC	Soil profile class
SOP	Standard Operating Procedure
TCP	Thermal Coal Plant
UMA	Unique Mapping Area
Whitehaven Blackwater	Whitehaven Blackwater Pty Ltd
h : v	Horizontal run to vertical rise

The following units of measurement have been used in this report.

Unit	Description
°C	Degrees Celsius. Unit of Measurement, of temperature.
%	Percent. Unit of Measurement, an amount in or for every hundred.
cmol(+)/kg	Centimoles of positive charge per kilogram
dS	deciSiemens. Unit of measurement, the system of units base unit of specific conductance (Electrical conductivity).
dS/m	deciSiemens per metre.
ha	Hectare. Unit of measurement of area. A metric unit of square measure, equal 10,000 square metres.
kg	Kilogram. Unit of measurement, the system of units base unit of mass.
kg/ha	Kilograms per hectare.
km	Kilometres. Unit of measurement of length, equal to 1,000 metres.
km^2	Kilometres squared.
m	Metre. Unit of measurement, the system of units base unit of length.
m^3	Cubic metres.
meq	Milliequivalent. Unit of measurement, a measurement of chemical activity.
meq/100g	Milliequivalents per 100 grams of soil.

Unit	Description
mg	Milligram. Unit of measurement of mass, equal to 1,000 of a gram.
mg/kg	Milligrams per kilogram.
mm	Millimetres. Unit of measurement of length, equal to 1,000 of a metre.
mm/100 cms	Millimetres per 100 cm.
Mtpa	Million tonnes per annum.
t	Tonne. Unit of measurement of mass, equal to 1,000 kilograms.
t/ha	Tonnes per hectare. Unit of volume across an area. 0.1 kg/m^2.
µm	Micrometre. Unit of measurement, equal to equalling 1×10^{-6} of a metre.

The following terms used in this report have been described below.

Term	Description
A horizon	Mineral horizon at or near the surface with some accumulation of humified organic matter, usually darker in colour than underlying horizons and with maximum biological activity for any given soil profile (NCST, 2024).
Analysed Site	A selected detailed site and location assessed as Analysed of the SPC for which characterisation, land suitability and topsoil stripping resource is assessed.
B horizon	Horizons consisting of one or more mineral soil layers characterised by one or more of the following: a concentration of silicate clay, iron, aluminium, organic material or several of these; a structure and / or consistence unlike that of the A horizons above or of any horizons below; stronger colours, usually expressed as higher chroma and / or redder hue, than those of the A horizons above or of those horizons below (The National Committee on Soil and Terrain 2009).
C Horizon	Layers below the solum (AB horizons / profiles) of consolidated or unconsolidated material, usually partially weathered, little affected by pedogenic processes, and either like or unlike the material from which the solum presumably formed.
Calcium Magnesium Ratio (Ca:Mg)	Ratios of exchangeable Calcium (Ca) to exchangeable Magnesium (Mg) are used to support assessments of subsoil dispersibility where Ca:Mg < 0.1 are often associated with highly dispersive subsoils.
Effective Cation Exchange Capacity (ECEC)	The maximum positive charge required to balance the negative charge on colloids (clays and other charged particles). The units are milli-equivalents per 100 grams of material or centimoles of charge per kilogram of exchanger. ECEC is often used as a measure of soil fertility and nutrient retention capacity.
Chromosol	Soils with a clear or abrupt textural contrast B horizon and in which the upper 0.20 m of the B horizon or major part of the entire B2 horizon if it is < 0.20 m thick, is not sodic and not strongly acid.
Clay	A soil material composed of particles finer than 0.002 mm. When used as a soil texture group such soils contain at least 35% clay.
Colluvial	Unconsolidated, poorly sorted soil and rock material transported largely by gravity (i.e., mass movement), deposited on lower slopes.

Term	Description
Colwell P	A laboratory method for the measure of available soil phosphorus using a bicarbonate extractable method.
Compost	Decomposed organic matter.
Dermosol	Soils with structured B2 horizons greater than weak and do not have clear or abrupt textural b horizon.
Dispersion	A process by which species in solution mix with a second solution, thus reducing in concentration. In the case of sodic soils, it will predispose the soil material to lose structure and disseminate into the solution.
Dispersion Ratio (R1)	The measurement of soil dispersion when used in conjunction with ESP and the Ca:Mg ratio for predicting soil physical behaviour.
Effective Rooting Depth (ERD)	The depths of which vegetation roots may readily penetrate the soil profile and have access to water and nutrients. Usually reduced through physical and chemical barriers, for example, refusal on rock or chloride above 800 mg/kg.
Electrical Conductivity (EC)	The EC of water is a measure of its ability to conduct an electric current. The EC of soils will vary depending on the texture and amount of moisture held by the soil particles. Electrical conductance increases with soluble salt content and thus allows simple interpretation of salinity.
Emerson Aggregate Test (EAT)	The test classifies the behaviour of soil aggregates, when immersed, remoulded, their coherence in water and when disturbed.
Erosion	The displacement of soil, rock or dissolved material by wind or water flow from one location on the earth and then travels to another location.
Exchangeable Sodium Percentage (ESP)	The amount of sodium as a proportion of all cations in a soil is termed the Exchangeable Sodium Percentage. It is calculated by dividing the exchangeable sodium by the cation exchange capacity (CEC), multiplied by 100. ESP values > 6% are considered sodic, with values > 15% considered very sodic. ESP = (Exchangeable sodium (meq/100g) / CEC (meq/100g)) x 100.
Field pH	The measurement of the pH in the field by a Manutec Pty Ltd, Soil pH Test Kit. This kit consists of pH dye indicator, Barium Sulphate and reference colour chart. Also known as Raupach pH kit.
Field Texture	The size distribution of particles finer than 2 mm, reflected in the behaviour of a small handful of moistened soil kneaded into a bolus and assessment of ribbon.
Gleyed	Indicative of permanent or periodic intense reduction due to wetness and is characterised by greying, bluish or greenish colour, generally of low chroma. Mottling may be prominent as well as rusty root channel mottling.
Gradient	The rate of inclination of a slope. The degree of deviation from the horizontal.
Gully (Erosion)	The displacement of soil by running water that forms clearly defined, narrow channels that generally carry water only during or after heavy rain.
Horizon	An individual soil layer, based on texture and colour, which differs from those above and below.
Jarosite	Iron sulfate mineral found in Acid Sulfate Soils. Form distinct butter or straw-coloured mottles with a hue of 2.5Y or yellower and a value chroma of 6 or more.

Term	Description
Kandosol	Soils that have well-developed B2 horizons in which the major part if massive or has only a weak grade of structure (compare with tenic B horizon and cemented pans) and have a maximum clay content in some part of the B2 horizon which exceeds 15% (i.e., heavy sandy loam, SL+).
Lithic	Containing large amounts of fragments derived from previously formed rocks.
Loam	A medium textured soil of approximate composition 10-25% clay, 25-50% silt and > 50% sand.
Massive	Refers to the condition of the soil layer in which the layer appears to be as a coherent or solid mass which is largely devoid of peds.
Microrelief	Refers to relief up to a few metres about the plane of the land surface with alternating mounds and depressions formed due to clay horizons shrinking and swelling with alternate drying and wetting cycles.
Mottles	Areas of contrasting colour in the overall soil colour which are caused by anerobic conditions as a result of poor aeration. Usually, an indicator of poor drainage and retention of water.
Ped	An individual natural soil aggregate. In an undisturbed state peds will group together to form larger aggregates.
Pedality	Describes a soil in which some or all of the soil material occurs in the form of peds in the moist state.
pH	A logarithmic index for the concentration of hydrogen ions in an aqueous solution, which is used as a measure of acidity.
Phase, soil	A phase is a subdivision of an SPC based on attributes that have particular significance to the use of the soil (Powell, 2008). Any attribute or combination of attributes can be used to differentiate a phase, as long as the attribute class limits stay within those defined for the SPC. Phases commonly include criteria based on texture, coarse fragments, slope, colour, erosion, depth, microrelief or salinity.
Plant Available Water Capacity (PAWC)	Amount of soil water stored between the field capacity (soil water content where water ceases to drain readily from the soil) and plant wilting point. Usually expressed as an equivalent depth of rainfall in mm.
Profile, soil	Vertical section of soil from the soil surface through all of its horizons to parent material, consolidated substrate or unconsolidated material.
Sand	Soil particles in the size range > 0.02–2.0 mm.
Silt	Soil particles in the size range 0.02–0.002 mm.
Soil Profile Class (SPC)	Soils grouped into a single management unit on the basis of similar morphology, position on the landscape, substrate and chemistry. An SPC is considered a consociation where one class (Australian Soil Class) is dominant.
Sodic	Also commonly referred to as a non-saline alkali soil. It is a soil that contains sufficient exchangeable sodium and does not contain appreciable quantities of soluble salts. A term given to soil with a level of exchangeable sodium cations > 10-15% of the soils cation exchange capacity (CEC), or soluble sodium cations > 10-15 times the square root of soluble calcium and magnesium cations.
Sodosol	Soils with a clear or abrupt textural contrast B horizon and in which the upper 0.20 m of the B horizon or major part of the entire B2 horizon is sodic and not strongly acid.

Term	Description
Solum	The soil profile that includes horizons A and B.
Subsoil	Subsurface material comprising the B and C horizons of soils with distinct profiles. They often have brighter colours and higher clay content than topsoils.
Texture	The size of particles in the soil. Texture is divided into six groups, depending on the amount of coarse sand, fine sand, silt and clay in the soil.
Topsoil	Part of the soil profile, typically the A1 horizon, containing material, which is usually darker, more fertile and better structured than the underlying layers.
Unique Mapping Area (UMA)	When the unique set of soil and land attributes associated with an individual polygon are described and collected, the polygon is referred to as a unique mapping area. UMAs assist in identifying different land attributes such as degree of rockiness and slope which may either be part of the same soil type or not.
UMA Confidence Codes	1 - Visited UMA, one or more observations made, confident in allocation of attributes and delineation of boundary 2 - Visited UMA, one or more observations made, low confidence in allocation of attributes and / or delineation of boundary 3 - Visited UMA, no observations made, confident in allocation of attributes and delineation of boundary 4 - Visited UMA, no observations made, low confidence in allocation of attributes and / or delineation of boundary 5 - Did not visit UMA, no observations made, confident in allocation of attributes and delineation of boundary 6 - Did not visit UMA, no observations made, low confidence in allocation of attributes and / or delineation of boundary
Variant, soil	A variant has one or more profile attributes clearly outside the defined range of any existing SPC, however it has too few profiles described for a complete definition, or it occupies an area too small to warrant its own SPC. Variants also include attributes that do not affect land use, such as colour.
Vertosol	Soils with all of the following, a clay field texture or 35% or more clay throughout the solum except for thin surface crusty horizons 30 mm or less thick, when dry, open cracks occur at some time in most years at least 5 mm wide and extend to the surface or the base of any plough layer peaty horizon self-mulching horizon or thin surface crusty horizon and slickenside and / or lenticular peds occur at some depth in the solum.
Weathered / Weathering	The chemical or physical breakdown of rocks and minerals. It may take the form of disintegration into smaller pieces of rock, or chemical weathering where minerals are converted and removed in soil solution.

13 APPENDICES

Appendix A Detailed Site Descriptions

Site D1	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 685633 7377526 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 1Dn(Te) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Auger	**Survey Date / Described by:** 10/9/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Undulating plain Plain Simple slope Slope 2.0 / 3.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia No microrelief Extensive clearing No erosion	Self-Mulching No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Light medium clay	Moderate / Very firm Subangular blocky 2-5 mm Slickensides	No inclusions or segregations	2.5Y5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 8.0 No dispersion after 10 minutes No slaking	0.00-0.10 0.20-0.30 0.50-0.60
			B21 0.20-0.40 Abrupt 5-20mm	Light clay	Moderate / Firm Angular blocky 5-10 mm Slickensides	<2% calcium carbonate 2-6mm	2.5Y5/3 Light olive brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			BC 0.40-0.60 End of borehole (EOBH)	Medium clay	Massive / Loose Angular blocky 5-10 mm Slickensides	20-50% coarse fragments 20-60mm 20-50% coarse fragments 6-20mm	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.50 / 9.0 No dispersion after 10 minutes No slaking	
			Refusal on cemented pan								

Landscape



Surface



Soil Profile



Site D2	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 690677 7370147 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 11/9/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 3.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub Grassland No microrelief Extensive clearing No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.05 Clear 20-50mm	Light medium clay	Moderate / Strong Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.03 / 8.5 No dispersion after 10 minutes Complete slaking	0.00-0.05 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.30-1.40
			B21 0.05-0.30 Clear 20-50mm	Medium clay	Strong / Firm Angular blocky 50-100 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/2 Dark greyish brown Mottles: Black Very few <2% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.15 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.35-0.70 Clear 20-50mm	Medium clay	Strong / Firm Angular blocky 50-100 mm Slickensides	<2% calcium carbonate 2-6mm	7.5YR4/3 Brown Mottles: Orange and grey Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.45 / 8.5 No dispersion after 10 minutes Partial slaking	
			B23 0.70-1.00 Clear 20-50mm	Medium clay	Strong / Very firm Angular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm	7.5YR4/4 Brown Mottles: Black Few 2%-10% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.85 / 7.0 Slight Dispersion after 10 minutes Complete slaking	
			B24 1.00-1.30 Clear 20-50mm	Medium heavy clay	Strong / Very firm Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/6 Strong brown Mottles: Brown Very few <2% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	1.15 / 5.5 Slight Dispersion after 10 minutes Complete slaking	
			BC 1.30-1.40 EOBH	Medium clay	Moderate / Weak Angular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm 10-20% coarse fragments 6-20mm	7.5YR4/6 Strong brown Mottles Black Very few <2% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.35 / 5.0 Slight Dispersion after 10 minutes Complete slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site D3	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686900 7378950 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 2Dn(Te) / Black Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Auger	**Survey Date / Described by:** 13/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Whitewood, sparse No microrelief Limited clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light clay	Strong / Very firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments 6-20mm	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 0.90-1.00
			B21 0.10-0.30 Clear 20-50mm	Light clay	Moderate / Very firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.20 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.30-0.65 Clear 20-50mm	Medium clay	Strong / Firm Angular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR2/2 No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.45 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.65-0.84 Clear 20-50mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.75 / 8.5 No dispersion after 10 minutes Complete slaking	
			BC 0.84-1.00 EOBH	Light medium clay Silty	Massive / loose Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	No roots	0.92 / 9.0 No dispersion after 10 minutes Partial slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D4	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686653 7375479 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 12Da(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 13/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Residual rise Flat Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia No microrelief Extensive clearing No erosion	Surface crust <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Clay loam, sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.50 Gradual 50-100mm	Medium clay Sandy	Moderate / Very strong Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 EOBH	Medium clay Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.65 / 8.5 No dispersion after 10 minutes Complete slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site D5	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686565 7384805 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 3Bl(Te) / Black Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 14/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Hillslope Flat Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Whitewood Grassland No microrelief Extensive clearing No erosion	Firm No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.00-1.10 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 8.0 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.40-0.80 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.60 / 8.0 Slight Dispersion after 10 minutes Partial slaking	
			B23 0.80-1.30 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	1.05 / 6.0 Slight Dispersion after 10 minutes Partial slaking	
			B24 1.30-1.60 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	5YR5/6 Yellowish red Mottles: 10YR4/2 Dark greyish brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.45 / 5.5 No dispersion after 10 minutes Partial slaking	
			C 1.60-2.00 End of test pit (EOTP)	-	-	-	-	-	-	1.80 / 5.5 No dispersion after 10 minutes Partial slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D6	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686529 7384441 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 4Bl(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 14/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Complete clearing, not cultivated No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Light medium clay Silty	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20
			B21 0.20-0.60 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Common	0.40 / 7.5 Slight Dispersion after 10 minutes No slaking	
			B22 0.60-0.90 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown Mottles: Pale orange-brown, Few 2%-10%	Dry Imperfect drained	Fine 1-2mm Few	0.75 / 7.5 Slight Dispersion after 10 minutes Partial slaking	
			B3 0.90-1.20 Clear 20-50mm	Clay Loam	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown Mottles: Pale orange-brown, Common 10%-20%	Very poorly drained	No roots	-	
			C 1.20-1.60 EOTP	-	-	-	-	Very poorly drained	No roots	-	

Landscape



Surface



Soil Profile



Site D7	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686513 7384178 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 5Dn(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 14/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Drainage Depression Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland Acacia No microrelief Complete clearing, not cultivated No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-015 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 20-60mm	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90
			B21 0.15-0.45 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 20-60mm	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Common	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.45-0.60 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 50-100 mm Slickensides	<2% coarse fragments and nodules 2-6mm	10YR4/2 Dark greyish brown Mottles: 10YR4/3 Brown Very few <2% Medium 5-15 mm	Moderately moist Moderately well drained	Fine 1-2mm Common	0.60 / 7.5 Moderate dispersion after 10 minutes Complete slaking	
			C 0.60-1.20 EOTP – Weathered substrate								

Landscape



Surface



Soil Profile



Site D8	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686482 7383509 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Whitewood Grassland No microrelief Complete clearing, not cultivated No erosion	Cracking 2-10% coarse fragments 200-600mm Rock outcrop present <2% flake	A1 0.00-0.15 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR3/2 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 7.0 No dispersion after 10 minutes No slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20
			B21 0.15-0.40 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments and nodules 2-6mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.25 / 7.5 No dispersion after 10 minutes No slaking	
			B22 0.40-0.70 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm Manganese nodules and rock fragments <2mm	10YR4/4 Dark yellowish brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Moderately well drained	Fine 1-2mm Common	0.55 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.70-1.10 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm	2-10% coarse fragments 2-6mm <2% coarse fragments 6-20mm	10YR4/4 Dark yellowish brown Mottles: Pale brown Common 10%-20% Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Common	0.90 / 8.0 No dispersion after 10 minutes Partial slaking	
			C 1.10-1.20 EOTP	-	-	-	-	-	-	-	
			Refusal on weathered substrate								

Landscape



Surface





Soil Profile



Site D9 Mound	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686755 7383408 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 6Bl(Pg) / Brown Vertosol gilgai	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								Sample (m) / Observations
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland Normal gilgai Complete clearing, not cultivated No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 8.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.15-0.40 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.28 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-1.00 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	2-10% coarse fragments	10YR4/3 Brown Mottles: Brown and dark brown Few 2%-10% Few <5 mm	Moderately moist Imperfectly drained	Fine 1-2mm Few	0.70 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.50 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 50-100 mm Slickensides	<2% coarse fragments and manganese nodules 2-6mm	7.5YR4/4 Brown Mottles: Brown Very few <2% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	1.25 / 6.5 No dispersion after 10 minutes Complete slaking	
			B24 1.50-1.70 EOBH	Medium heavy clay	Strong / Strong Subangular blocky 50-100 mm Slickensides	<2% coarse fragments and manganese nodules 2-6mm	7.5YR4/6 Strong brown Mottles: Brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	No roots	1.60 / 6.0 No dispersion after 10 minutes Complete slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site D9 Depression	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686769 7383420 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 6Bl(Pg) / Brown Vertosol gilgai	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland Normal gilgai Complete clearing, not cultivated No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.40 Clear 20-50mm	Medium heavy clay	Strong / Rigid Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	2.5Y4/2 Weak red No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.20 / 7.0 Slight Dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 1.10-1.20 1.40-1.50 1.80-1.90
			B21 0.40-0.60 Clear 20-50mm	Medium heavy clay	Strong / Very strong Subangular blocky 50-100 mm Slickensides	<2% coarse fragments 6-20mm	2.5Y4/2 Weak red No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.50 / 8.0 Moderate dispersion after 10 minutes Partial slaking	
			B22 0.60-0.80 Gradual 50-100mm	Medium heavy clay	Strong / Very strong Subangular blocky 50-100 mm Slickensides	<2% coarse fragments 6-20mm	2.5Y5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.70 / 8.0 Strong dispersion after 10 minutes Complete slaking	
			B23 0.80-1.30 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments	7.5YR4/4 Brown Mottles: Brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.05 / 6.5 No dispersion after 10 minutes Complete slaking	
			B24 1.30-1.70 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 6-20mm	7.5YR4/4 Brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.45 / 6.5 No dispersion after 10 minutes Partial slaking	
			C 1.70-1.90 EOTP	-	-	-	-	-	-	-	

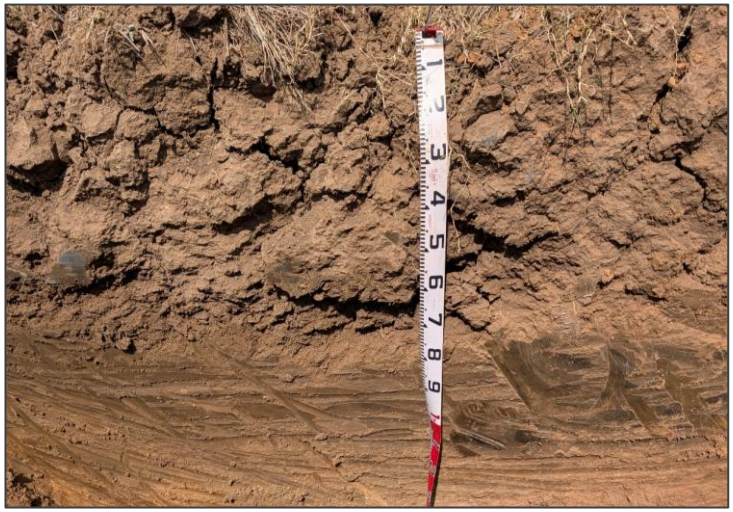
Landscape



Surface



Soil Profile



Site D10	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687134 7383371 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.45 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm <2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.33 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.45-0.80 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.62 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.80-1.20 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments and manganese nodules	7.5YR5/4 Reddish brown No mottles or bleaching	Dry Moderately well drained	No roots	1.00 / 8.0 Slight Dispersion after 10 minutes Complete slaking	
			C 1.20-1.40	-	-	-	-	-	-	-	
			R 1.40-1.50	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D11	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686985 7382892 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Lower slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse vegetation No microrelief Complete clearing, not cultivated No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.20 Abrupt 5-20mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.5 No dispersion after 10 minutes Complete slaking	No samples taken
			B21 0.20-0.50 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.35 / 8.0 No dispersion after 10 minutes Complete slaking	
			BC 0.50-0.90 Clear 20-50mm	Medium heavy clay	Moderate / Firm Subangular blocky No Slickensides	10-20% coarse fragments 20-60mm <2% coarse fragments 6-20mm	10YR4/4 Dark yellowish brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Moderately well drained	Fine 1-2mm Few	0.70 / 8.0 No dispersion after 10 minutes Complete slaking	
			C 0.90-1.00	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D12 Mound	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687003 7382185 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 6Bl(Pg) / Brown Vertosol gilgai	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse Normal gilgai Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 8.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/3 Brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Common	0.40 / 5.5 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	No inclusions or segregations	10YR5/4 Yellowish brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	1.20 / 6.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D12 Depression	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 687002 7382190 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 6Bl(Pg) / Brown Vertosol gilgai	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class III / Test pit	Survey Date / Described by: 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse Normal gilgai Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.5 Slight Dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/3 Brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Common	0.40 / 6.5 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.60-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	No inclusions or segregations	10YR5/3 Brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	0.80 / 7.5 1.40 / 7.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D13	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686401 7382909 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 15/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-20 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	7.5YR4/3 Brown Mottles: Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Common	0.40 / 8.5 No dispersion after 10 minutes Complete slaking	
			B22 0.60-0.80 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	7.5YR5/3 Mottles: Pale brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Common	0.70 / 8.5 No dispersion after 10 minutes Complete slaking	
			B23 0.80-1.00 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/6 Yellowish brown Mottles: Grey Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	0.90 / 8.0 No dispersion after 10 minutes Partial slaking	
			C 1.00-1.70 EOTP	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D14 Mound	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686471 7382392 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 7Bl(Pg) / Grey Vertosol	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class II/III / Test pit	Survey Date / Described by: 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Whitewood Normal gilgai Limited clearing No erosion	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 20-60mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.30 / 7.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 20-60mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.50 / 6.5 Moderate dispersion after 10 minutes Complete slaking	
			B23 0.60-1.90 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 100-200 mm Slickensides	<2% coarse fragments 20-60mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	1.00 / 7.0 1.50 / 7.0 No dispersion after 10 minutes Complete slaking	
			B24 1.90-2.20 EOTP	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	10-20% coarse fragments 20-60mm 2-10% coarse fragments 6-20mm	10YR5/2 Greyish brown Mottles: Brown Few 2%-10% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	2.00 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D14 Depression	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686466 7382399 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 7Bl(Pg) / Grey Vertosol	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class III / Test pit	Survey Date / Described by: 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Whitewood Normal gilgai Limited clearing	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.15 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 6.0 Slight Dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.30-1.40
			B21 0.15-0.50 Gradual 50-100mm	Medium heavy clay	Strong / Very strong Subangular blocky 100-200 mm Slickensides	<2% coarse fragments 6-20mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 8.5 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.50-1.00 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Few	0.75 / 7.0 No dispersion after 10 minutes Partial slaking	
			B23 1.00-1.30 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 6-20mm	10YR5/2 Greyish brown Mottles: Pale Grey Many 20%-50% Coarse 15-30 mm	Dry Imperfectly drained	Very fine <1mm Few	1.15 / 8.0 No dispersion after 10 minutes Complete slaking	
			BC 1.30-1.45 EOTP	Light medium clay, sandy	Moderate / Firm Subangular blocky 20-50 mm No Slickensides	20-50% coarse fragments 20-60mm	10YR5/2 Greyish brown Mottles: Yellow Many 20%-50% Coarse 15-30 mm	Dry Imperfectly drained	No roots	1.38 / 7.0 No dispersion after 10 minutes Complete slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D15	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686130 7381355 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 7Bl(Pg) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class II(a) / Test pit	**Survey Date / Described by:** 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Normal gilgai Limited clearing No erosion	Cracking <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Medium heavy clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 7.0 No dispersion after 10 minutes Complete slaking	No samples taken
			B21 0.15-0.30 Clear 20-50mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.22 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.30-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR5/2 Greyish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	0.45 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 0.60-1.70 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Moderately moist Moderately well drained	Fine 1-2mm Few	0.90 / 7.0 1.40 / 7.0 No dispersion after 10 minutes Complete slaking	
			B24 1.70-2.20 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Brown Many 20%-50% Coarse 15-30 mm	Moderately moist Moderately well drained	Very fine <1mm Few	2.00 / 6.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D16	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686472 7381335 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 10Ct(Ro) / Grey Vertosol	**Geology (Dominant): Alluvium**	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Ruby Salt Bush, medium height No microrelief, nearby gilgai observed but not in immediate area of this site No erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.05 Clear 20-50mm	Light medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR5/4 Yellowish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.03 / 7.5 No dispersion after 10 minutes Complete slaking	0.00-0.05 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.05-0.45 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Coarse >5mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.45-1.30 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	<2% coarse fragments 6-20mm	7.5YR5/4 Reddish brown Mottles: Red Many 20%-50% Few <5 mm	Dry Imperfectly drained	Medium 2-5mm Few	0.90 / 5.5 No dispersion after 10 minutes Complete slaking	
			B23 1.30-1.90 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm Slickensides	<2% coarse fragments 6-20mm	10YR6/1 Grey Mottles: Red 10-20%, 5-15mm Brown, many 20%-50% Very coarse >30 mm	Moderately moist Imperfectly drained	No roots	1.30 / 5.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D17	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686079 7380691 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Mid-slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia, sparse No microrelief Limited clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.05 Clear 20-50mm	Light medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.03 / 8.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.05-0.60 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Medium 2-5mm Common	0.30 / 7.0 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.35 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR5/4 Yellowish brown Mottles: Pale brown Very few <2% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	1.00 / 7.5 Moderate dispersion after 10 minutes Complete slaking	
			BC 1.35-1.50 EOTP	Medium clay	Strong / Very firm Subangular blocky 50-100 mm No Slickensides	2-10% coarse fragments 2-6mm	2.5Y5/3 Light olive brown Mottles: Pale Grey, 10-20%, 5-15mm Dark brown, common 10%-20%, Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	1.42 / 7.5 Slight Dispersion after 10 minutes Complete slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D18	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686034 7379970 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 16/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Mid-slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia, sparse No microrelief Extensive clearing No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Light medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 20-60mm 2-10% coarse fragments 6-20mm	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 015-0.40 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 6-20mm 2-10% coarse fragments 20-60mm	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.28 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.60 Gradual 50-100mm	Light medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 6-20mm 10-20% calcium carbonate 20-60mm	7.5YR4/4 Brown Mottles: Brown Very few <2% Few <5 mm	Dry Imperfectly drained	Fine 1-2mm Few	0.50 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.60-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 6-20mm	7.5YR5/4 Reddish brown Mottles: Grey Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	1.40 / 8.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D19	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686719 7379753 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 8Dn(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Drainage Depression Open depression Slope 3.0 / 3.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Ruby Salt Bush Emu Apple No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.05 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.03 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.05 0.20-0.30 0.40-0.50 0.50-0.60 0.80-0.90
			B21 0.05-0.30 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.18 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.30-0.50 Gradual 50-100mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm	10YR5/2 Greyish brown Mottles: Brown Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking	
			B3 0.50-0.60	Clay Loam Coarse	Massive / Weak No Slickensides	20-50% coarse fragments 6-20mm	10YR5/4 Yellowish brown Mottles: Brown Many 20%-50% Few <5 mm	Dry Imperfectly drained	No roots	0.55 / 7.0 Slight Dispersion after 10 minutes Partial slaking	
			BC 0.60-0.90	Clay Loam Coarse	Massive / Weak No Slickensides	50-90% coarse fragments 6-20mm	10YR5/4 Yellowish brown Mottles: Brown Many 20%-50% Few <5 mm	Dry Imperfectly drained	No roots	0.55 / 7.0 Slight Dispersion after 10 minutes Partial slaking	
			C 0.90-1.10 EOTP – Refusal on cemented pan								

Landscape



Surface



Soil Profile



Site D20	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686578 7380646 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 4Bl(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Hillslope Upper slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 60-200mm No rock outcrop	A1 0.00-0.05 Clear 20-50mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.03 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.05 0.05-0.15 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.80-1.90
			B21 0.05-0.15 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.15-0.70 Clear 20-50mm	Medium heavy clay	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm <2% coarse fragments 20-60mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking	
			B3 0.70-0.90 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm	10YR4/3 Brown Mottles: Brown Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	0.80 / 7.5 No dispersion after 10 minutes Complete slaking	
			BC 0.90-1.80 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm 10-20% coarse fragments 20-60mm	10YR4/3 Brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.35 / 7.0 No dispersion after 10 minutes Partial slaking	
			C 1.80-2.00 EOTP	-	-	-	-	Dry	No roots	1.90 / 7.0 Slight Dispersion after 10 minutes Partial slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D21	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686057 7379329 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 9Dn(Ro) / Black Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class II/III / Test pit	**Survey Date / Described by:** 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 1.0 / <1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 8.0 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.10-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.00 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.80 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.90 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/2 Greyish brown Mottles: Brown Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.40 / 7.0 No dispersion after 10 minutes Complete slaking	
			C 1.90-2.10								

Landscape



Surface



Soil Profile



Site D22	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 687457 7373577 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class III / Test pit	Survey Date / Described by: 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Brigalow No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.0 No dispersion after 10 minutes Partial slaking	Site indicated as Red Vertosol in SLR (2023), however in this instance site was observed as Brown Vertosol 0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.00-1.10 1.30-1.40 1.60-1.70
			B21 0.10-0.50 Gradual 50-100mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Few	0.65 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 0.80-1.10 Diffuse >100mm	Medium clay Sandy	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR5/4 Reddish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.95 / 5.5 Slight Dispersion after 10 minutes Complete slaking	
			B24 1.10-1.80 Gradual 50-100mm	Medium clay	Strong / Firm Angular blocky 20-50 mm No Slickensides	<2% coarse fragments 6-20mm	7.5YR4/4 Brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.45 / 5.5 No dispersion after 10 minutes Complete slaking	
			C 1.80-2.00 EOTP								

Landscape



Surface



Soil Profile



Site D23	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 687800 7374140 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.70 Gradual 50-100mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.45 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.70-1.20 Clear 20-50mm	Medium heavy clay Sandy Fine	Moderate / Strong Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 6-20mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.95 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 1.20-1.80 Clear 20-50mm	Medium clay Sandy Fine	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/1 Dark grey Mottles: Pale brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.60 / 8.0 Moderate dispersion after 10 minutes Complete slaking	
			B24 1.80-2.00 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% calcium carbonate 6-20mm	2.5Y5/3 Light olive brown Mottles: Pale brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.90 / 7.5 Moderate dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D24	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687133 7374146 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 11Bl(Ta) / Brown Sodosol	**Geology (Dominant):** Alluvium	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 20/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Brigalow Emu Apple No microrelief Extensive clearing Scald erosion	Hard setting <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Loam	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 6.0 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20
			B21 0.20-0.60 Gradual 50-100mm	Medium clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.40 / 7.5 Slight dispersion after 10 minutes Partial slaking	
			B22 0.60-1.00 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.80 / 7.5 Slight dispersion after 10 minutes Complete slaking	
			C 1.00-1.20 EOTP								

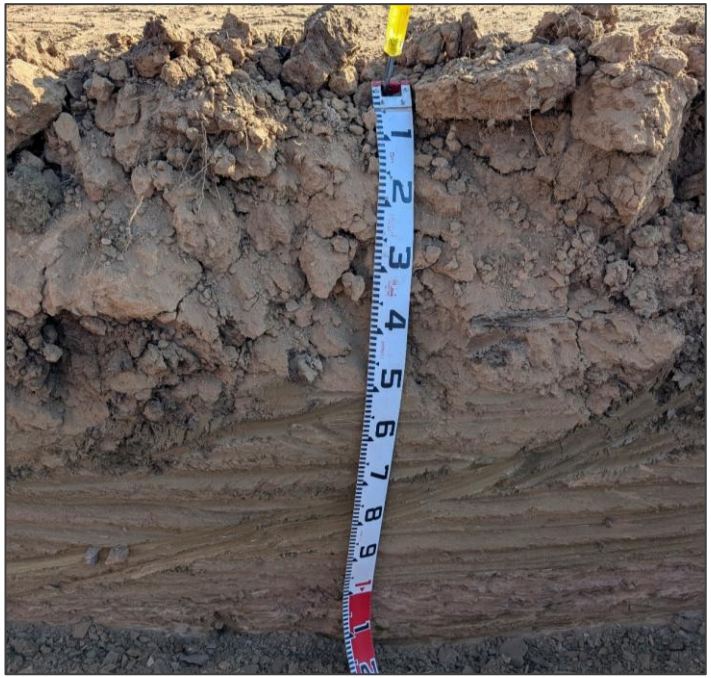
Landscape



Surface



Soil Profile



Site D25	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 685606 7377041 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 3.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia Eremophila No microrelief Extensive clearing Gully erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 6-20mm	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.00 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.80 / 7.5 Slight Dispersion after 10 minutes Partial slaking	
			B23 1.00-1.50 Clear 20-50mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	7.5YR5/4 Reddish brown Mottles: Brown Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.25 / 6.5 Slight Dispersion after 10 minutes Partial slaking	
			C 1.50-1.80 EOTP	-	-	-	-	-	-	1.65 / 5.5	

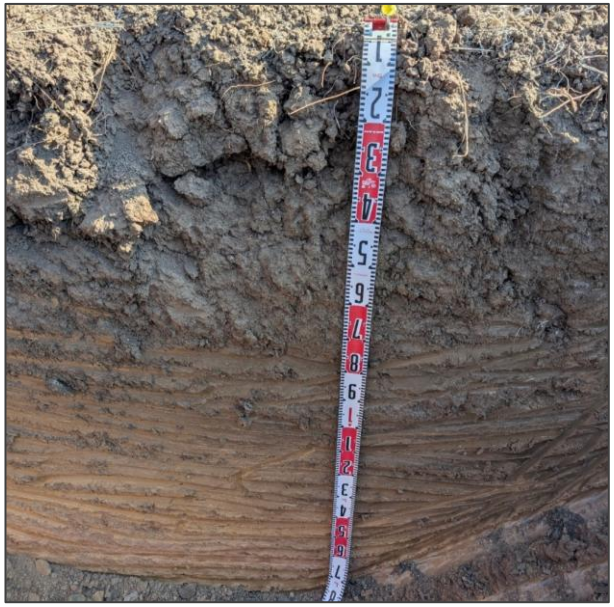
Landscape



Surface



Soil Profile



Site D26	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 685987 7376160 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.05 / 6.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.10-0.50 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey Mottles: Brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Common	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm 2-10% coarse fragments 6-20mm	2.5Y4/2 Weak red Mottles: Brown Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.65 / 7.5 Moderate dispersion after 10 minutes Complete slaking	
			BC 0.80-1.30 Clear 20-50mm	Medium clay	Massive / Firm Subangular blocky 20-50 mm No Slickensides	20-50% coarse fragments 2-6mm 20-50% coarse fragments 20-60mm	2.5Y4/3 Reddish brown Mottles: Pale brown Few 2%-10%	Dry Moderately well drained	No roots	1.05 / 6.0 No dispersion after 10 minutes Complete slaking	
			C 1.30-1.80 EOTP	-	-	-	-	-	-	1.55 / 6.0 Slight Dispersion after 10 minutes Partial slaking	
			Refusal on weathered substrate								

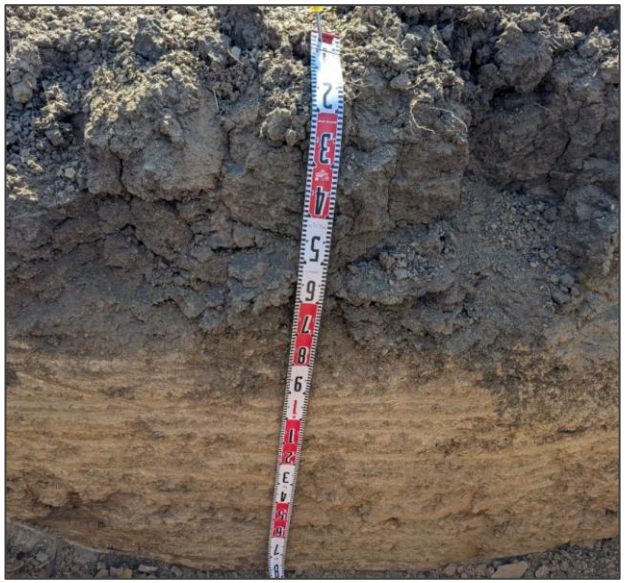
Landscape



Surface



Soil Profile



Site D27	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686688 7376571 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Medium height No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm <2% coarse fragments 20-60mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 8.0 No dispersion after 10 minutes Complete slaking	No samples taken
			B21 0.10-0.60 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.60-0.90 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 20-60mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.75 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 0.90-1.30 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/4 Brown Mottles: Black Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Fine 1-2mm Few	1.10 / 6.0 Slight Dispersion after 10 minutes Complete slaking	
			B24 1.30-2.00 EOTP	Medium heavy clay	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	10-20% coarse fragments 6-20mm	7.5YR5/4 Reddish brown Mottles: Red Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.65 / 5.5 Slight Dispersion after 10 minutes Complete slaking	

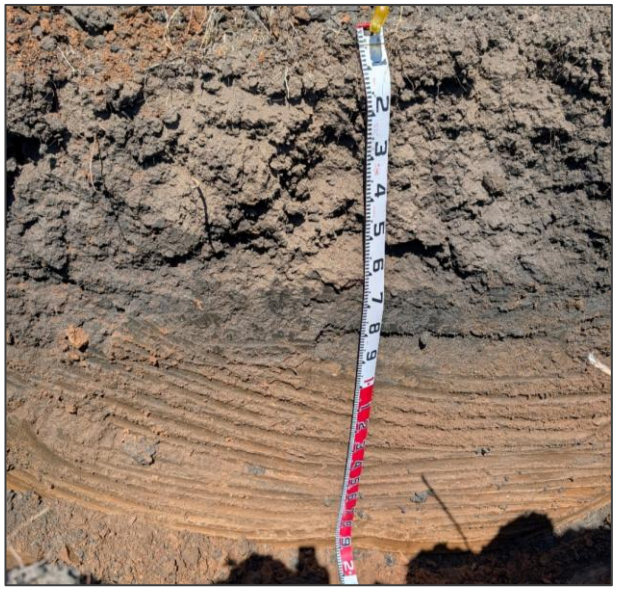
Landscape



Surface



Soil Profile



Site D28	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686087 7377007 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 9Dn(Ro) / Black Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class II(a) / Test pit	**Survey Date / Described by:** 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow. sparse No microrelief Extensive clearing	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay	Moderate / Strong Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 20-60mm 2-10% coarse fragments 6-20mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.60 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR2/1 Black No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 8.0 No dispersion after 10 minutes Complete slaking	
			B22 0.60-1.00 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.80 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.30 Diffuse >100mm	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown Mottles: Black Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.15 / 7.5 No dispersion after 10 minutes Complete slaking	
			B24 1.30-1.90 Gradual 50-100mm	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown Mottles: Black Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.50 / 6.0 No dispersion after 10 minutes Partial slaking	
			B24 1.90-2.20 EOTP	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown Mottles: Black Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	2.05 / 6.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D29	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686269 7377476 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia, sparse No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.10-0.45 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.45-0.70 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 200-600mm <2% coarse fragments 2-6mm	2.5Y4/3 Reddish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.58 / 7.5 No dispersion after 10 minutes Complete slaking	
			BC 0.70-1.00 Gradual 50-100mm	Medium clay Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 20-60mm 20-50% coarse fragments 6-20mm	2.5Y4/3 Reddish brown Mottles: Orange dark grey 10-20%, <5mm Common 10%-20% Few <5 mm	Dry Imperfectly drained	No roots	0.85 / 7.5 No dispersion after 10 minutes Partial slaking	
			C 1.00-1.85 EOTP	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D30	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686573 7378317 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class II(a) / Test pit	Survey Date / Described by: 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Poplar Box Bauhinia, sparse No microrelief Extensive clearing Gully erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80 2.00-2.10
			B21 0.20-0.50 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Brown Few 2%-10% Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Common	0.35 / 7.0 No dispersion after 10 minutes Complete slaking	
			B22 0.50-0.80 Clear 20-50mm	Light medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.65 / 7.5 No dispersion after 10 minutes Partial slaking	
			B23 0.80-1.20 Clear 20-50mm	Light medium clay Silty	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR2/1 Black Mottles: Brown Few 2%-10% Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Few	1.00 / 6.0 Slight dispersion after 10 minutes Complete slaking	
			B24 1.20-2.10 EOTP	Light medium clay Sandy Coarse	Moderate / Firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	1.60 / 7.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D31	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 685743 7376460 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse No microrelief Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 20-60mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 20-60mm <2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.60-0.90 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm <2% coarse fragments 6-20mm	10YR3/3 Dark brown Mottles: Black Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.75 / 7.5 No dispersion after 10 minutes Partial slaking	
			B23 0.90-1.80 EOTP	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm	10YR5/4 Yellowish brown Mottles: Red - 10-20%, <5mm Common Black - 10%-20% Coarse 15-30 mm	Dry Imperfectly drained	Very fine <1mm Few	1.35 / 6.0 Slight Dispersion after 10 minutes Partial slaking	

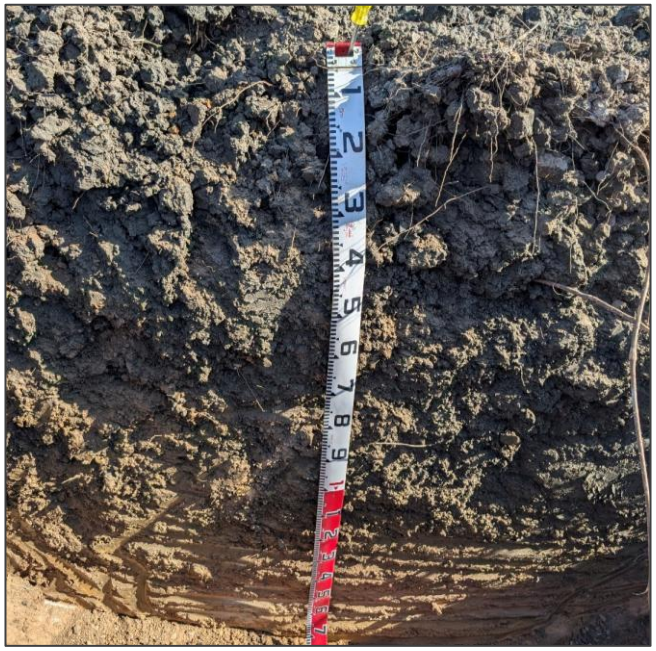
Landscape



Surface



Soil Profile



Site D32	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686675 7375468 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 12Da(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Residual rise Flat Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia No microrelief Extensive clearing No erosion	Firm <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Clay loam Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80 Similar location as D4 (auger site), revisited for D32 using test pit method
			B21 0.20-0.50 Gradual 50-100mm	Medium clay Sandy	Moderate / Very strong Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 6.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 Clear 20-50mm	Medium clay Sandy	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.65 / 8.0 Moderate dispersion after 10 minutes Partial slaking	
			B23 0.80-1.20 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm No Slickensides	2-10% calcium carbonate 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	1.00 / 8.0 Slight Dispersion after 10 minutes Partial slaking	
			B24 1.20-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 50-100 mm No Slickensides	No inclusions or segregations	10YR3/1 Very dark grey Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.50 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D33	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687993 7374979 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 5Dn(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing Scald erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 0.90-1.00
			B21 0.20-0.50 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.70 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	10-20% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.60 / 7.0 No dispersion after 10 minutes Partial slaking	
			BC 0.70-0.90 Gradual 50-100mm	Medium clay	Moderate / Firm Angular blocky 10-20 mm No Slickensides	20-50% coarse fragments	2.5Y4/4 Olive brown Mottles: Orange 10-20%, 5-15mm Grey, Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	0.80 / 7.0 No dispersion after 10 minutes Partial slaking	
			C 0.90-1.00 EOTP	-	-	-	-	-	-	-	

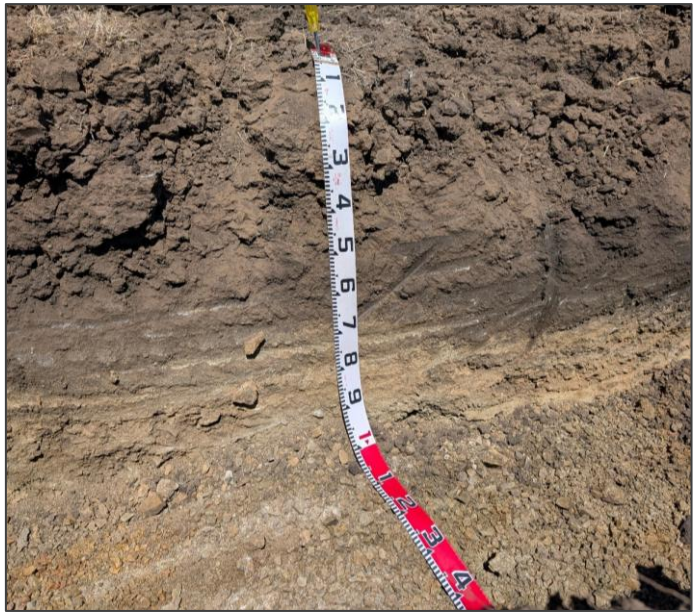
Landscape



Surface



Soil Profile



Site D34	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686564 7374628 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 8Dn(Te) / Grey Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat drainage line Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing Gully erosion	Surface flake <2% coarse fragments 60-200mm Rock outcrop present <2%	A1 0.00-0.20 Clear 20-50mm	Light clay Sandy	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm <2% coarse fragments 60-200mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 Slight Dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.55 Gradual 50-100mm	Light medium clay Sandy	Moderate / Firm Subangular blocky 20-50 mm No Slickensides	10-20% coarse fragments 2-6mm 2-10% coarse fragments 6-20mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.38 / 7.0 No dispersion after 10 minutes Partial slaking	
			BC 0.55-0.90 Clear 20-50mm	Medium clay	Moderate / Firm Angular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm	2.5Y4/4 Olive brown Mottles: Orange 10-20%, 5-15mm Grey, Common 10%-20%, Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.78 / 8.0 No dispersion after 10 minutes Partial slaking	
			C 0.90-1.10 EOTP	-	-	-	-	-	-	-	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D35	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 689238 7372672 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 3.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse No microrelief Limited clearing No erosion	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Complete slaking	Site indicated as Red Vertosol in SLR (2023), however site was observed as Grey Vertosol. Red subsoil horizon coverage not enough. No samples taken
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.40 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.60-0.90 Diffuse >100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	7.5YR4/4 Brown Mottles: Black Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.75 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 0.90-1.40 Clear 20-50mm	Medium heavy clay	Strong / Firm Angular blocky 5-10 mm No Slickensides	<2% coarse fragments 2-6mm	5YR4/6 Yellowish red Mottles: Black Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.15 / 6.0 No dispersion after 10 minutes Partial slaking	
			BC 1.40-1.70 EOTP	Medium heavy clay	Strong / Firm Angular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm	5YR5/6 Yellowish red Mottles: Pale Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.55 / 6.0 No dispersion after 10 minutes Partial slaking	

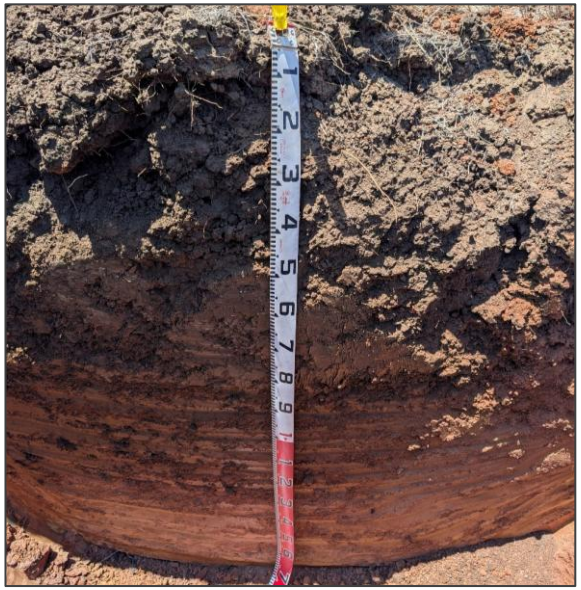
Landscape



Surface



Soil Profile



Site D36	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 689214 7373261 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 13BL(TA) / Brown Dermosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 22/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Current Bush No microrelief Extensive clearing No erosion	Firm 2-10% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 20-60mm	7.5YR4/2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Gradual 50-100mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 6.5 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.70 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm 2-10% calcium carbonate 6-20mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.55 / 7.0 No dispersion after 10 minutes Partial slaking	
			B23 0.70-0.90 Gradual 50-100mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm 2-10% calcium carbonate 6-20mm	7.5YR5/4 Reddish brown Mottles: Pale brown Very few <2% Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Few	0.80 / 8.0 No dispersion after 10 minutes Partial slaking	
			B24 0.90-1.70 Gradual 50-100mm	Medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm 2-10% coarse fragments 6-20mm	10YR5/6 Yellowish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.30 / 7.5 No dispersion after 10 minutes Complete slaking	
			BC 1.70-2.00 EOTP	Sandy loam	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm 20-50% coarse fragments 2-6mm	10YR5/6 Yellowish brown No mottles or bleaching	Dry Moderately well drained	No roots	1.85 / 7.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D37	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 689679 7372849 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 14Bl(Ro) / Black Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 21/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Drainage Depression Open depression Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia Open woodland No microrelief Extensive clearing Gully erosion	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.60 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.30 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.95 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 1.30-1.90 EOTP	Medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm	10YR5/3 Brown Mottles: Orange, 10-20%, 5-15mm Dark grey, 10%-20% 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.55 / 7.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D38	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 690733 7372998 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class II(a) / Test pit	**Survey Date / Described by:** 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia, sparse No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm, No Slickensides	No inclusions or segregations	2.5Y4/2 Weak red No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.5 No dispersion after 10 minutes, Partial slaking	No samples taken
			B21 0.10-0.20 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 10-20 mm, Slickensides	2-10% coarse fragments 2-6mm	2.5Y4/2 Weak red No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.15 / 7.5 No dispersion after 10 minutes, Partial slaking	
			B22 0.20-0.50 Gradual 50-	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm, Slickensides	2-10% coarse fragments 2-6mm	2.5Y4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 7.5 No dispersion after 10 minutes, Partial slaking	
			B23 0.50-0.80 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm, Slickensides	2-10% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or	Dry Moderately well drained	Very fine <1mm Common	0.65 / 8.0 No dispersion after 10 minutes, Complete slaking	
			B3 0.80-1.00 Gradual 50-100mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm, No Slickensides	10-20% coarse fragments 20-60mm 20-50% coarse fragments 6-20mm	2.5Y4/3 Reddish brown No mottles or bleaching	Dry Imperfectly drained	Fine 1-2mm Few	0.90 / 7.0 No dispersion after 10 minutes, Partial slaking	
			BC 1.00-1.20 Gradual 50-100mm	Light medium clay	Weak / Firm Angular blocky 5-10 mm, No Slickensides	50-90% coarse fragments 6-20mm	10YR5/3 Brown Mottles: Orange Few 2%-10% <5 mm	Dry Imperfectly drained	No roots	1.10 / 6.5 No dispersion after 10 minutes, Partial slaking	
			C 1.20-2.10 EOTP	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D39	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 690706 7372655 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia No microrelief Extensive clearing No erosion	Self-mulching <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Sandy Fine	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20
			B21 0.20-0.50 Gradual 50-100mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Medium 2-5mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.90 Clear 20-50mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	50-90% coarse fragments 200-600mm 50-90% coarse fragments 0.6m-2.0m	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.70 / 8.0 No dispersion after 10 minutes Partial slaking	
			BC 0.90-1.40 Gradual 50-100mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm	10YR4/4 Dark yellowish brown Mottles: Yellow Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.15 / 8.0 No dispersion after 10 minutes Partial slaking	
			R 1.40-1.65 EOTP	-	-	-	-	-	-	-	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D40	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 690167 7372041 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia, sparse No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay Sandy Fine	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 8.0 No dispersion after 10 minutes Complete slaking	No samples taken
			B21 0.10-0.60 Gradual 50-100mm	Medium clay Sandy Fine	Strong / Strong Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.60-0.80 Gradual 50-100mm	Medium clay Sandy Fine	Strong / Strong Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 2-6mm	7.5YR4/4 Brown Mottles: Black Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Common	0.70 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.80-1.30 Gradual 50-100mm	Medium clay Sandy Fine	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm 2-10% calcium carbonate 2-6mm	7.5YR4/4 Brown Mottles: Orange Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.05 / 8.0 No dispersion after 10 minutes Complete slaking	
			BC 1.30-2.00 EOTP	Medium clay Sandy Fine	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm 2-10% calcium carbonate 2-6mm	7.5YR5/6 Strong brown Mottles: Orange Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.65 / 8.0 No dispersion after 10 minutes Complete slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D41	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686462 7378980 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Open depression adjacent Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Bottle Tree Brigalow Tall height No microrelief Limited clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.10-0.30 Gradual 50-100mm	Light medium clay Sandy Fine	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.20 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.30-0.70 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.50 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.70-1.00 Clear 20-50mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.85 / 7.5 No dispersion after 10 minutes Complete slaking	
			B24 1.00-1.20 EOTP	Medium heavy clay	Moderate / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	2.5Y3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	1.10 / 7.5 No dispersion after 10 minutes Complete slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site D42	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 685856 7378774 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 5Dn(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Scrub No microrelief Limited clearing No erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	0.08 / 8.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.15-0.65 Gradual 50-100mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Coarse >5mm Common	0.40 / 8.5 No dispersion after 10 minutes Complete slaking	
			BC 0.65-0.85 EOBH	Medium heavy clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	2-10% coarse fragments 6-20mm	10YR5/3 Brown Mottles: Black Few 2%-10% Few <5 mm	Dry Imperfectly drained	No roots	0.75 / 8.5 No dispersion after 10 minutes Partial slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D43	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 685753 7378011 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 16Bl(Ta) / Grey Sodosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Auger	**Survey Date / Described by:** 23/10/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Hillslope Simple slope Slope 3.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia No microrelief Extensive clearing Scald erosion also sheet erosion, rills	Hard setting <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Clay Loam Sandy Fine	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	0.05 / 6.0 Moderate dispersion after 10 minutes Partial slaking	0.00-0.10 0.10-0.20 0.20-0.30
			B21 0.10-0.20 Clear 20-50mm	Medium heavy clay	Moderate / Very firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.15 / 6.0 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.20-0.40 EOBH	Medium clay	Strong / Very firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments 6-20mm	2.5Y4/1 Dark grey No mottles or bleaching	Dry Imperfectly drained	Very fine <1mm Few	0.25 / 8.0 No dispersion after 10 minutes Partial slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D44	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 691122 7370776 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 03/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Lower slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia and Brigalow Current Bush No microrelief Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light clay Sandy	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm	7.5YR3/2 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.05 / 6.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.10-0.20 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50
			B21 0.10-0.20 Clear 20-50mm	Light medium clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 20-60mm	7.5YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.15 / 6.5 No dispersion after 10 minutes Partial slaking	
			B22 0.20-0.40 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	7.5YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.40-0.80 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.60 / 8.0 No dispersion after 10 minutes Complete slaking	
			B24 0.80-1.20 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 2-6mm <2% calcium carbonate 2-6mm Manganese nodules	7.5YR4/4 Brown Mottles: Pale Grey Few 2%-10% Few <5 mm	Dry Imperfect drained	Very fine <1mm Few	1.00 / 7.5 No dispersion after 10 minutes Complete slaking	
			C 1.20-1.60 EOTP								

Landscape



Surface



Soil Profile



Site D45	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 689137 7374206 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 18Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 03/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope <1.0 / <1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia Moreton Bay Ash No microrelief Extensive clearing Scald erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Gradual 50-100mm	Medium heavy clay Silty	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.80 Diffuse >100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.60 / 7.5 No dispersion after 10 minutes Partial slaking	
			B23 0.80-1.40 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	1.10 / 7.5 No dispersion after 10 minutes Complete slaking	
			B24 1.50-2.00 EOTP Refusal on cemented soil	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/1 Very dark grey Mottles: Brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.75 / 6.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D46	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 690276 7374005 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 4/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Drainage Depression Open depression Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia, sparse No microrelief Limited clearing Sheet erosion	Surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Medium clay Sandy	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.50 Clear 20-50mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.35 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 Clear 20-50mm	Medium heavy clay Sandy Fine	Strong / Strong Subangular blocky 10-20 mm Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.65 / 8.0 No dispersion after 10 minutes Partial slaking	
			BC 0.80-1.50 Gradual 50-100mm	Light medium clay Sandy	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 2-6mm	10YR5/4 Yellowish brown Mottles: Brown Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.10 / 8.0 No dispersion after 10 minutes Complete slaking	
			C 1.50-2.00 EOTP	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D47	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 689612 7374633 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class II(a) / Test pit	Survey Date / Described by: 4/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Grassland No microrelief Extensive clearing No erosion	Surface flake 2-10% coarse fragments 60-200mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm	10YR4/3 Brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.05 / 8.0 No dispersion after 10 minutes Complete slaking	No samples taken
			B21 0.10-0.30 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 5-10 mm No Slickensides	2-10% coarse fragments 20-60mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.20 / 7.0 No dispersion after 10 minutes Partial slaking	
			B22 0.30-0.60 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.45 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.60-1.40 Gradual 50-100mm	Medium heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	1.00 / 8.0 Slight dispersion after 10 minutes Complete slaking	
			B24 1.40-1.80 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/2 Greyish brown Mottles: Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.60 / 7.0 No dispersion after 10 minutes Complete slaking	
			BC 1.80-2.10 EOTP	Medium clay	Strong / Firm Angular blocky 5-10 mm No Slickensides	20-50% coarse fragments 6-20mm	2.5Y5/3 Light olive brown Mottles: Orange Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.95 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D48	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 688951 7374853 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class II(a) / Test pit	Survey Date / Described by: 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia, sparse No microrelief Limited clearing Scald erosion	Cracking, with surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.30 Clear 20-50mm	Medium clay Sandy Fine	Strong / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.15 / 8.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.30-0.60 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.45 / 8.0 No dispersion after 10 minutes Complete slaking	
			B22 0.60-1.50 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/3 Brown Mottles: Pale Grey Few 2%-10% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.05 / 7.0 Slight dispersion after 10 minutes Partial slaking	
			BC 1.50-2.10 EOTP	Light medium clay Sandy	Moderate / Firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown Mottles: Dark Grey Few 2%-10% Few <5 mm	Dry Imperfectly drained	No roots	1.80 / 7.5 No dispersion after 10 minutes Complete slaking	

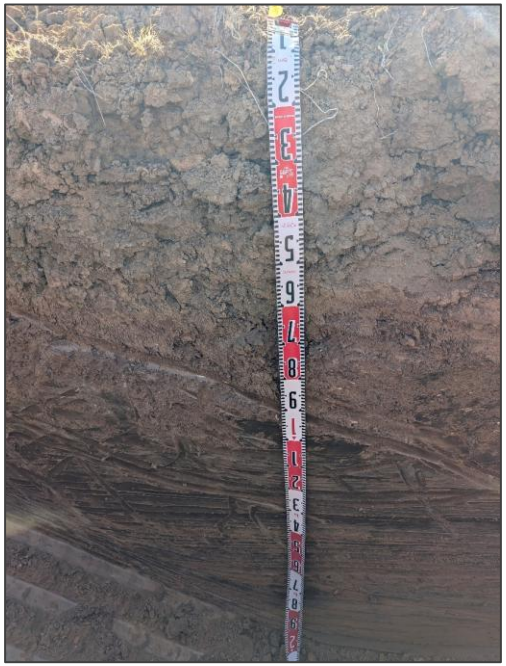
Landscape



Surface



Soil Profile



Site D49	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 688698 7375044 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia Ruby Salt Bush Grassland No microrelief Limited clearing Scald erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay Silty	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Very fine <1mm Few	0.05 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.10-0.40 Gradual 50-100mm	Light medium clay Silty	Strong / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.25 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.70 Diffuse >100mm	Light medium clay Silty	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 6-20mm Minor gravel layer	10YR4/4 Dark yellowish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.55 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.70-1.20 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.95 / 8.0 No dispersion after 10 minutes Complete slaking	
			B24 1.20-1.80 EOBH	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR5/4 Yellowish brown Mottles: Grey Few 2%-10% Few <5 mm	Dry Moderately well drained	Very fine <1mm Few	1.50 / 8.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D50	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 688483 7374030 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 5Dn(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Auger	**Survey Date / Described by:** 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Whitewood Ruby Salt Bush Sparse Emu apple, willow wattle No microrelief Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop self-mulching	A1 0.00-0.15 Clear 20-50mm	Medium heavy clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.08 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90
			B21 0.15-0.50 Gradual 50-100mm	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	<2% calcium carbonate 2-6mm	2.5Y4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.95 EOBH	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	<2% calcium carbonate 2-6mm	2.5Y4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.80 / 8.0 Slight Dispersion after 10 minutes Complete slaking	
			Refusal on weathered substrate								

Landscape



Surface



Soil Profile



Site D51	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 688529 7374336 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / <1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia No microrelief Extensive clearing Scald erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.20-0.40 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.80 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.60 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.80-1.20 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR5/4 Yellowish brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.00 / 6.5 Slight Dispersion after 10 minutes Complete slaking	
			B3 1.20-1.60 Gradual 50-100mm	Medium clay Silty	Strong / Firm Angular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/4 Yellowish brown Mottles: Black Few 2%-10% Few <5 mm	Dry Imperfectly drained	No roots	1.40 / 6.0 No dispersion after 10 minutes Complete slaking	
			C 1.60-1.70 EOTP	-	-	-	-	-	-	-	
			BC 1.70+ Refusal on bedrock								

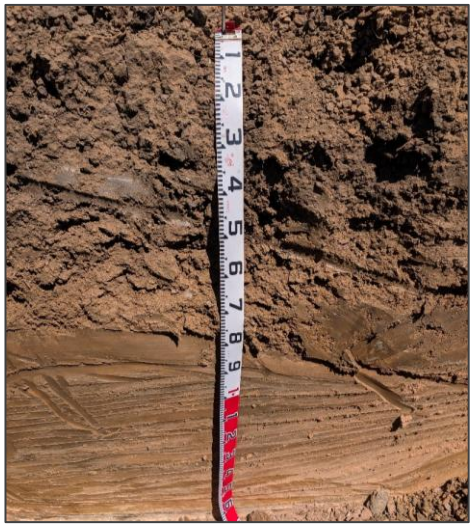
Landscape



Surface



Soil Profile



Site D52	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 688782 7376440 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Sparse Bauhinia and Brigalow No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Light clay Sandy	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 6.5 No dispersion after 10 minutes No slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80 2.00-2.10
			B21 0.20-0.40 Clear 20-50mm	Medium clay Sandy	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0..30 / 7.0 No dispersion after 10 minutes No slaking	
			B22 0.40-1.00 Gradual 50-100mm	Medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% calcium carbonate 6-20mm <2% coarse fragments 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.70 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.70 Diffuse >100mm	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown Mottles: Dark Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.35 / 7.5 No dispersion after 10 minutes Partial slaking	
			B24 1.70-2.20 EOTP	Medium clay Sandy Coarse	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown Mottles: Dark Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	1.95 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D53	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 689513 7379001 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 5/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Stream channel Open depression Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia Tall height No microrelief No effective disturbance; hoofed animals Sheet erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	2.5Y4/2 Weak red No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.45 Gradual 50-100mm	Medium heavy clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	2.5Y4/2 Weak red No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.33 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.45-1.00 Diffuse >100mm	Medium heavy clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.75 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.80 EOTP	Medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	1.40 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D54	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 686680 7385714 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class II(a) / Test pit	Survey Date / Described by: 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Whitewood Sparse No microrelief Limited clearing No erosion	Cracking Self-mulching with surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80 2.00-2.10
			B21 0.20-0.50 Gradual 50-100mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey Mottles: Pale Brown Common 10%-20% Medium 5-15 mm	Moderately moist Moderately well drained	Very fine <1mm Common	0.35 / 8.0 No dispersion after 10 minutes Complete slaking	
			B22 0.50-1.00 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown Mottles: Pale Grey 2-10%, <5mm Red - Common 10%-20% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Common	0.75 / 6.5 No dispersion after 10 minutes Complete slaking	
			B23 1.00-2.10 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown Mottles: Pale Grey Red, 10-20%, 5-15mm Common 10%-20% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Common	1.50 / 6.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface





Soil Profile



Site D55	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 686603 7385246 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 2Dn(Te) / Black Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class II(a) / Test pit	**Survey Date / Described by:** 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Level plain Plain Flat Slope <1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Complete clearing, not cultivated No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Gradual 50-100mm	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.80 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.40 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.80-1.00 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	2-10% coarse fragments 2-6mm	10YR4/2 Dark greyish brown Mottles: Black Common 10%-20% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Common	0.90 / 7.5 No dispersion after 10 minutes Complete slaking	
			BC 1.00-1.30 Gradual 50-100mm	Light medium clay Sandy Fine	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm	10YR4/4 Dark yellowish brown Mottles: Pale Grey Orange, 2-10%, <5mm Common 10%-20% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	1.15 / 7.0 No dispersion after 10 minutes Partial slaking	
			C 1.30-2.20 EOTP	-	-	-	-	-	-	-	

Landscape



Surface



Soil Profile



Site D56	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 690156 7371197 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class II(a) / Test pit	Survey Date / Described by: 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating rises Hillslope Simple slope Slope 2.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia Whitewood No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Silty	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Well drained	Very fine <1mm Common	0.10 / 7.5 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.80 Diffuse >100mm	Medium clay, faint	Strong / Firm Subangular blocky 20-50 mm Slickensides	10-20% calcium carbonate 6-20mm 10-20% coarse fragments 20-60mm	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.50 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.80-1.40 Diffuse >100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	7.5YR4/4 Brown Mottles: Dark Grey Common 10%-20% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	1.10 / 7.0 No dispersion after 10 minutes Complete slaking	
			B23 1.40-2.20 EOTP	Medium clay Sandy	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	5YR5/6 Yellowish red Mottles: Dark Grey Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.80 / 7.5 No dispersion after 10 minutes Complete slaking	

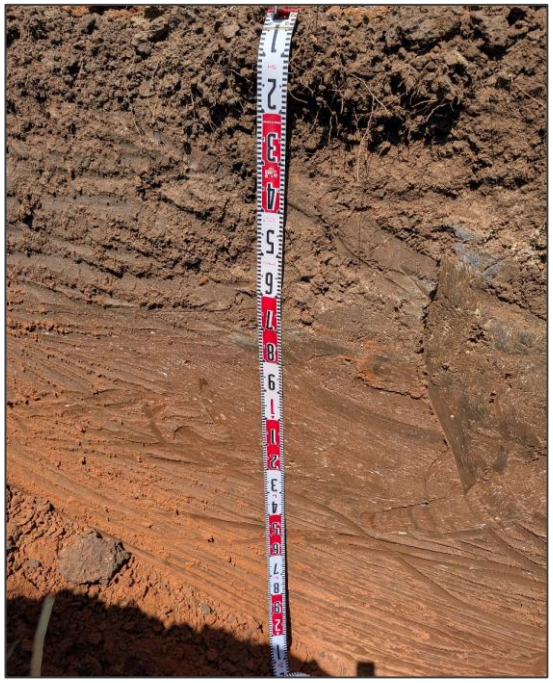
Landscape



Surface



Soil Profile



Site D57	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 690939 7371619 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow Ruby Salt Bush No microrelief Extensive clearing Scald erosion	Surface flake 2-10% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay Sandy	Strong / Firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.10 / 7.0 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Clear 20-50mm	Medium clay Sandy	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 7.0 No dispersion after 10 minutes Complete slaking	
			B22 0.40-0.80 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	2.5Y4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.60 / 8.0 No dispersion after 10 minutes Complete slaking	
			B23 0.80-1.10 Diffuse >100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.95 / 8.0 No dispersion after 10 minutes Complete slaking	
			B24 1.10-1.60 Diffuse >100mm	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm 10-20% coarse fragments 2-6mm	10YR4/3 Brown Mottles: Black Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	No roots	1.35 / 7.5 No dispersion after 10 minutes Complete slaking	
			BC 1.60-1.80 EOTP	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	10-20% coarse fragments 6-20mm 10-20% coarse fragments 2-6mm	10YR4/6 Dark yellowish brown Mottles: Pale Grey ,2-10%, <5mm Orange, Common 10%-20%, Medium 5-15 mm	Dry Imperfectly drained	No roots	1.70 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D58	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 691692 7371103 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 20Bl(Ro) / Grey Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Auger	**Survey Date / Described by:** 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Open woodland No microrelief Limited clearing No erosion	Surface flake <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80
			B21 0.20-0.40 Clear 20-50mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.30 / 7.5 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.40-0.80 EOBH	Medium heavy clay Sandy Fine	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% calcium carbonate 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.60 / 8.0 No dispersion after 10 minutes Complete slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D59	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 691156 7377835 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 21Bl(Ta) / Grey Sodosol	**Geology (Dominant):** Alluvium	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class III / Test pit	**Survey Date / Described by:** 6/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse No microrelief Extensive clearing No erosion	Hard setting No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Sandy loam	Weak / Weak Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR3/2 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Many	0.10 / 6.0 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			A2 0.20-0.45 Abrupt 5-20mm	Sandy loam	Moderate / Very firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	0.33 / 6.5 No dispersion after 10 minutes Complete slaking	
			B21 0.45-0.90 Gradual 50-100mm	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	7.5YR4/1 Dark grey Mottles: Brown Many 20%-50% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.65 / 8.5 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.90-1.80 EOTP	Medium heavy clay Sandy	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	10-20% calcium carbonate 20-60mm 10-20% calcium carbonate 6-20mm Coarse fragments <2%, 2-6mm	10YR5/4 Yellowish brown Mottles: Dark Grey Common 10%-20% Few <5 mm	Dry Imperfectly drained	No roots	1.35 / 8.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D60	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 691284 7380721 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 10Ct(Ro) / Grey Vertosol	Geology (Dominant): Alluvium	Soil Survey Type / Observation Class / Method: Free / Detailed Class I / Test pit	Survey Date / Described by: 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Stream channel Open depression Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Bauhinia Ruby Salt Bush Sparse No microrelief Limited clearing Sheet erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Medium 2-5mm Many	0.10 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.70-0.80 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.40 Clear 20-50mm	Medium clay	Strong / Strong Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey Mottles: Brown Few 2%-10% Few <5 mm	Dry Moderately well drained	Coarse >5mm Many	0.30 / 7.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.60 Gradual 50-100mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey Mottles: Brown Many 20%-50% Few <5 mm	Dry Imperfectly drained	Fine 1-2mm Few	0.50 / 8.0 No dispersion after 10 minutes Partial slaking	
			B23 0.60-2.00 EOTP	Medium clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown Mottles: Brown Common 10%-20% Few <5 mm	Moderately moist Imperfectly drained	Fine 1-2mm Few	1.30 / 8.0 Slight dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D61	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687657 7379698 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Risecrest Crest Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow Ruby Salt Bush Sparse No microrelief Extensive clearing Scald erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Light medium clay Sandy Fine	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.08 / 7.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20
			B21 0.15-0.70 Clear 20-50mm	Light medium clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% calcium carbonate 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Medium 2-5mm Common	0.45 / 8.0 No dispersion after 10 minutes Complete slaking	
			BC 0.70-1.10 Clear 20-50mm	Medium clay	Strong / Very firm Angular blocky 10-20 mm No Slickensides	20-50% coarse fragments 6-20mm	10YR5/4 Yellowish brown Mottles: Pale Grey 10-20%, 5-15mm Orange, Common 10%-20%, Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	0.90 / 7.0 No dispersion after 10 minutes Complete slaking	
			C 1.10-1.50 EOTP	-	-	-	-	-	-	-	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D62	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 687596 7385994 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing Scald erosion	Cracking, with surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium clay	Strong / Strong Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 6-20mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.10 / 7.5 No dispersion after 10 minutes Partial slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90 1.10-1.20 1.40-1.50 1.70-1.80
			B21 0.20-0.65 Clear 20-50mm	Medium clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/3 Brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.40 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.65-1.10 Diffuse >100mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm <2% coarse fragments 6-20mm	10YR5/4 Yellowish brown Mottles: Orange Common 10%-20% Few <5 mm	Dry Moderately well drained	Very fine <1mm Common	0.90 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 1.10-1.80 EOTP	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm No Slickensides	2-10% coarse fragments 2-6mm 2-10% coarse fragments 6-20mm	10YR4/4 Dark yellowish brown Mottles: Pale Grey 2-10%, <5mm Orange, Common 10%-20%, Medium 5-15 mm	Dry Moderately well drained	Very fine <1mm Common	1.45 / 6.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D63	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 689260 7385313 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Extensive clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.08 / 8.0 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.15-0.40 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.28 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-1.00 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.70 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 1.00-1.40 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% calcium carbonate 2-6mm	7.5YR4/4 Brown Mottles: Pale Brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Common	1.20 / 7.0 No dispersion after 10 minutes Complete slaking	
			B3 1.40-1.50 Clear 20-50mm	Clay loam	Strong / Firm Subangular blocky 10-20 mm No Slickenside	<2% coarse fragments 2-6mm	10YR5/6 Yellowish brown No mottles or bleaching	Dry Moderately well drained	No roots	1.45 / 6.0 No dispersion after 10 minutes Complete slaking	
			BC 1.50-1.80 EOTP	-	-	-	-	-	-	-	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site D64	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 688292 7383905 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating rises Hillslope Simple slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow, sparse No microrelief Extensive clearing No erosion	Cracking with surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 7.5 No dispersion after 10 minutes Partial slaking	No samples taken
			B21 0.15-0.40 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% coarse fragments 20-60mm	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.28 / 8.0 No dispersion after 10 minutes Complete slaking	
			B22 0.40-1.00 Diffuse >100mm	Medium heavy clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	<2% calcium carbonate 2-6mm	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.65 / 6.0 No dispersion after 10 minutes Partial slaking	
			B23 1.00-1.80 EOTP	Medium heavy clay	Strong / Very firm Angular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR5/4 Yellowish brown Mottles: Red 2-10%, <5mm Pale grey, few 2%-10% Few <5 mm	Dry Moderately well drained	No roots	1.40 / 5.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site D65	Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy: 691894 7371606 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 22Bl(Wy) / Brown Kandosol	Geology (Dominant): Arenite-Mudrock	Soil Survey Type / Observation Class / Method: Free / Detailed Class III / Auger	Survey Date / Described by: 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow Sparse No microrelief Extensive clearing No erosion	Firm <2% coarse fragments 2-6mm No rock outcrop	A11 0.00-0.05 Clear 20-50mm	Sandy loam	Weak / Weak Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Rapidly drained	Very fine <1mm Many	0.03 / 6.5 No dispersion after 10 minutes Partial slaking	0.00-0.05 0.10-0.20 0.20-0.30 0.50-0.60 0.80-0.90
			A12 0.05-0.20 Clear 20-50mm	Sandy loam	Weak / Weak Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Rapidly drained	Very fine <1mm Common	0.14 / 6.0 No dispersion after 10 minutes No slaking	
			A2 0.20-0,45 Gradual 50-100mm	Sandy loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Very fine <1mm Few	0.32 / 6.0 Slight Dispersion after 10 minutes Partial slaking	
			B21 0.45-0.80 Gradual 50-100mm	Clay loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.62 / 7.5 Moderate dispersion after 10 minutes Partial slaking	
			B21 0.80-1.00 EOBH No recovery	Silty loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments 2-6mm	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.90 / 7.5 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site D66	**Location (mE/mS GDA2020 ZONE 5) / Method, Accuracy:** 688931 7381952 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Geology (Dominant):** Arenite-Mudrock	**Soil Survey Type / Observation Class / Method:** Free / Detailed Class I / Test pit	**Survey Date / Described by:** 7/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Crest Slope 1.0 / 2.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Scrub No microrelief Complete clearing, not cultivated	Surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Medium heavy clay Silty	Moderate Firm No slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Many	0.10 / 8.5	No samples taken
			B21 0.20-0.60 Clear 20-50mm	Medium heavy clay	Moderate Firm Slickensides	<2% calcium carbonate 2-6mm	10YR4/3 Brown Mottles: Orange Common 10%-20% Few <5 mm	Dry	Fine 1-2mm Few	0.40 / 8.0	
			BC 0.60-1.00 EOTP	Medium heavy clay	Moderate Firm Slickensides	20-50% coarse fragments 60-200mm	10YR4/4 Dark yellowish brown Mottles: Orange Common 10%-20% Medium 5-15 mm	Dry	No roots	0.80 / 8.0	
			Refusal on bedrock								

Landscape



Surface



Soil Profile





Appendix B Class IV Site Descriptions

Site C1	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 685881 7379056 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 5Dn(Ro) / Grey Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Exposed profile cutting	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Natural Woodland Gently undulating plain Plain Slope 1% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow Sparse No microrelief Extensive clearing No erosion	Self-mulching No coarse fragments 6-20mm No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Silty clay loam Silty	Moderate Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.10 / 7.5	-
			B21 0.20-0.70 Clear 20-50mm	Light clay	Moderate Very firm Subangular blocky 20-50 mm Faint Slickensides	<2% coarse fragments	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.40 / 8.0	
			B22 0.70-0.80 End of profile	Medium clay	Moderate Very firm Subangular blocky No Slickensides	<2% coarse fragments	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.75 / 8.0	

Landscape



Surface



Soil Profile



Site C2	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 685995 7380182 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 19Bl(Ro) / Brown Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Undulating plain Plain Mid-slope Slope 3% / 8% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Sparse No microrelief Limited clearing No erosion	Surface flake No coarse fragments	A1 0.00-0.10 Clear 20-50mm	Light clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 9.0	-
			B21 0.10-0.40 Clear 20-50mm	Light medium clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.25 / 9.0	
			B22 0.40-0.85 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.62 / 7.0	
			B3 0.85-0.95 End of bore hole (EOBH)	Light medium clay	Weak / Firm Subangular blocky 5-10 mm No Slickensides	2-10% coarse fragments 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Imperfectly drained	No roots	0.90 / 7.5	

Landscape



Surface



Soil Profile



Site C3	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686113 7381038 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 6Bl(Pg) / Brown Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Mid-slope Slope 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub Medium height Melon hole gilgai 20% coverage No effective disturbance; natural No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.15 Abrupt 5-20mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	-	-
			B21 0.15-1.00 EOBH	Heavy clay	Strong / Strong Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	-	

Landscape



Surface



Soil Profile



Site C4	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686283 7381960 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 13Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Open depression Slope 2.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Sparse No microrelief Limited clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Light clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	-
			B21 0.20-0.50	Light medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	
			B22 0.50-1.00 EOBH	Light medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	

Landscape



Surface



Soil Profile



Site C5	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686275 7382443 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 6Bl(Pg) / Brown Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat 1.0 / 1.0 **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Sparse Normal gilgai Limited clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Light clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	-
			B21 0.15-0.40 Diffuse >100mm	Light medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	
			B22 0.40-0.90 EOBH	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	7.5YR4/4 Brown No mottles or bleaching	Dry Well drained	No roots	-	

Landscape



Surface



Soil Profile



Site C6	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686387 7383392 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 11Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 07/07/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Mid-slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing No erosion	Firm No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Clay loam	Weak / Weak Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	-
			B21 0.20-0.80 EOBH	Light clay	Moderate / Strong Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	-	

Landscape



Surface



Soil Profile



Site C7	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686568 7384949 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 2Dn(Te) / Black Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 08/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Level plain Plain Flat Slope 1% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bull Mitchell Grass No microrelief Complete clearing, not cultivated No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.15 Abrupt 5-20mm	Light clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.08 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.15-0.65 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.45 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.65-0.90 Clear 20-50mm	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/3 Dark brown Mottles: Black Very few <2% Few <5 mm	Dry Well drained	Fine 1-2mm Few	0.77 / 8.5 No dispersion after 10 minutes Partial slaking	
			B23 0.90-1.00 EOBH	Medium clay	Strong / Very firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	No roots	0.95 / 8.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C8	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686528 7384676 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 4Bl(Te) / Grey Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 08/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Simple slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bull Mitchell Grass Grassland No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.15 Abrupt 5-20mm	Light clay	Moderate / Weak Subangular blocky 10-20 mm No slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Many	0.08 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.15-0.45 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 50-100 mm No slickensides	<2% coarse fragments 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Common	0.28 / 9.0 No dispersion after 10 minutes Partial slaking	
			B22 0.45-0.60 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm No slickensides	2-10% calcium carbonate 6-20mm	2.5Y4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.52 / 9.0 No dispersion after 10 minutes Partial slaking	
			B23 0.60-1.00 EOBH	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	2-10% coarse fragments 6-20mm	2.5Y4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	No roots	0.80 / 9.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C9	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686568 7384339 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 08/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2% / 5% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bull Mitchell Grass Grassland No microrelief Complete clearing, not cultivated No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.05 Abrupt 5-20mm	Medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.03 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.05-0.35 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.20 / 7.5 No dispersion after 10 minutes Partial slaking	
			B21 0.35-0.70 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.50 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.70-1.00 EOBH	Medium clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm No roots	0.85 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C10	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686479 7383878 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 15Bl(Ro) / Brown Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 08/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bull Mitchell Grass Grassland No microrelief Complete clearing, not cultivated No erosion	Cracking <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.5 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.40 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 50-100 mm Slickensides	No inclusions or segregations	7.5YR4/3 Brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Fine 1-2mm Common	0.25 / 8.0 No dispersion after 10 minutes Complete slaking	
			B22 0.40-0.60 Clear 20-50mm	Medium heavy clay	Strong / Weak Subangular blocky 50-100 mm Slickensides	No inclusions or segregations	7.5YR5/3 Brown Mottles: Orange Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.50 / 9.0 No dispersion after 10 minutes Complete slaking	
			B23 0.60-1.00 EOBH	Medium clay	Strong / Firm Angular blocky 5-10 mm No Slickensides	No inclusions or segregations	7.5YR5/4 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.80 / 8.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C11	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686606 7383191 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Lower slope Slope 2% / 3% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland ironbark No microrelief Complete clearing, not cultivated	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Light clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.08 / 7.5 No dispersion after 10 minutes Partial slaking	-
			B21 0.15-0.85 Clear 20-50mm	Light medium clay Heavy	Strong / Firm Subangular blocky 5-10 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.50 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.85-1.20 EOBH	Medium clay	Strong / Firm Subangular blocky 5-10 mm No slickensides	No inclusions or segregations	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	1.00 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C12	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686568 7382663 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 19Bl(Ro) / Brown Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.05 / 8.5 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.40 Gradual 50-100mm	Light medium clay	Moderate / Very firm Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.35 / 8.5 No dispersion after 10 minutes No slaking	
			B22 0.40-0.70 Gradual 50-100mm	Medium clay	Strong / Strong Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	10YR4/4 Dark yellowish brown Mottles: Pale brown Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	0.55 / 8.5 No dispersion after 10 minutes Partial slaking	
			B23 0.70-1.20 EOBH	Medium heavy clay	Strong / Strong Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate <2mm	10YR4/4 Dark yellowish brown Mottles: Orange Few 2%-10% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	0.95 / 8.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C13	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686422 7381673 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 15Bl(Ro) / Brown Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Lower slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Extensive clearing	Cracking No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 8.0 No dispersion after 10 minutes No slaking	-
			B21 0.10-0.45	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 8.0 No dispersion after 10 minutes No slaking	
			B22 0.45-1.00 EOBH	Medium heavy clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	No roots	0.75 / 8.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C14	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686320 7380926 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 13Bl(Ta) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Abrupt 5-20mm	Clay loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	7.5YR4/2 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Many	0.05 / 7.0 Slight Dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.35 Clear 20-50mm	Light medium clay	Strong / Strong Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	7.5YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.20 / 8.0 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.35-1.00 EOBH	Light medium clay	Strong / Very firm Angular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm, faint	7.5YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.65 / 8.5 Slight Dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C15	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686603 7380371 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 13Bl(Ta) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH**	**Sample (m) / Observations**
Grazing Undulating plain Mid-slope Slope 4% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Abrupt 5-20mm	Light medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/4 Dark yellowish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 7.0 No dispersion after 10 minutes	-
			B21 0.10-0.60 Clear 20-50mm	Medium clay	Strong / Firm Angular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B21 0.60-1.00 EOBH	Medium clay	Strong / Firm Angular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/4 Dark yellowish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.80 / 9.0 Slight Dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C16	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686536 7379890 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 11Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Undulating plain Plain Simple slope Slope 3% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub No microrelief Extensive clearing Gully erosion	Cracking 2-10% coarse fragments 20-60mm No rock outcrop	A1 0-0.05 Abrupt 5-20mm	Light clay	Weak / Weak Angular blocky 5-10 mm No Slickensides	2-10% coarse fragments 6-20mm	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.03 / 9.0	0.00-0.05 0.20-0.30 0.50-0.60 0.70-0.80
			B21 0.05-0.85 EOBH	Light medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	20-50% coarse fragments 20-60mm No inclusions or segregations	10YR5/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.45 / 6.5	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site C17	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686614 7379467 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 11Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Crest Slope 1% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Complete clearing, not cultivated	Surface flake No coarse fragments No rock outcrop	A1 0,00-0.10 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 8.0 Slight Dispersion after 10 minutes Partial slaking	0.00-0.10 0.10-0.20 0.30-0.40
			B21 0.10-0.25 Abrupt 5-20mm	Medium clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry	Fine 1-2mm Few	0.18 / 9.0 Slight Dispersion after 10 minutes Partial slaking	
			B22 0.25-0.45 EOBH	Medium clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry	Fine 1-2mm Few	0.35 / 8.0 Slight Dispersion after 10 minutes Partial slaking	
			Refusal on cemented pan								

Landscape



Surface



Soil Profile



Site C18	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 685894 7378520 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 8Dn(Te) / Grey Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 09/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Undulating plain Plain Upper slope Slope 1% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing No erosion	Firm 2-10% coarse fragments 20-60mm No rock outcrop	A1 0-0.15 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR5/2 Greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.08 / 7.0 Slight Dispersion after 10 minutes No slaking	-
			B21 0.15-0.50 EOBH	Medium clay	Strong / Strong Angular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.32 / 7.5 Slight Dispersion after 10 minutes Partial slaking	
			Refusal on cemented pan								

Landscape



Surface



Soil Profile



Site C19	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 685729 7377775 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 5Dn(Ro) / Grey Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Mid-slope Slope 4% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Grassland Acacia No microrelief Extensive clearing	Surface Flake No coarse fragments No rock outcrop	A1 0.00-0.13 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Moderately moist Well drained	Fine 1-2mm Few	0.07 / 6.5 No dispersion after 10 minutes Complete slaking	0.00-0.10 0.20-0.30 0.50-0.60 0.80-0.90
			B21 0.13-0.60 Clear 20-50m	Medium clay Silty	Strong / Firm Subangular blocky 5-10 mm Slickensides	<2% calcium carbonate 6-20mm	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Few	0.40 / 7.0 No dispersion after 10 minutes Complete slaking	
			B22 0.60-0.95 EOBH	Medium clay Silty	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.75 / 7.0 No dispersion after 10 minutes Complete slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site C20	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 685717 7376110 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 17Bl(Ro) / Grey Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Undulating plain Plain Mid-slope Slope 4% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.08 / 7.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.15-1.00 EOBH	Medium clay Silty	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.60 / 7.5 No dispersion after 10 minutes No slaking	

Landscape



Surface



Soil Profile



Site C21	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686105 7376609 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 9Dn(Ro) / Black Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 1% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.15 Gradual 50-100mm	Medium clay	Moderate / Weak Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown Mottles	Dry Moderately well drained	Fine 1-2mm Common	0.08 / 7.0 No dispersion after 10 minutes No slaking	-
			B21 0.15-0.65 Gradual 50-100mm	Medium heavy clay	Strong / Firm Angular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/1 Very dark grey Mottles: Pale brown Very few <2% Few <5 mm	Moderately moist Imperfectly drained	Very fine <1mm Common	0.45 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.65-1.0 EOBH	Medium heavy clay	Moderate / Weak Angular blocky 20-50 mm Slickensides	<2% calcium carbonate 6-20mm	10YR4/2 Dark greyish brown Mottles: Brown Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.85 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site C22	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686660 7374423 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 11Bl(Ta) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Upper slope Slope 2% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Complete clearing, not cultivated	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Loam	Weak / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	7.5YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.10 / 6.5 No dispersion after 10 minutes No slaking	-
			B21 0.20-0.60 EOBH No Recovery of soil	Medium clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.40 / 9.0 Slight dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C23	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 687142 7373573 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 11Bl(Ta) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Upper slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub No microrelief Extensive clearing No erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Loam	Moderate / Strong Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Many	-	-
			B21 0.10-0.45 Gradual 50-100mm	Medium heavy clay	Strong / Weak Angular blocky 50-100 mm Slickensides	<2% coarse fragments 6-20mm <2% coarse fragments <2mm manganiferous nodules <2mm	10YR3/3 Dark brown Mottles: Brown Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	-	
			BC 0.45-0.80 EOBH	Medium clay	Weak / Very weak Subangular blocky 10-20 mm No Slickensides	2-10% calcium carbonate 6-20mm	2.5Y5/3 Light olive brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	-	

Landscape



Surface



Soil Profile



Site C24	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686263 7377184 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 16Bl(Ta) / Grey Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Mid-slope Slope 2% / 3% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Open woodland No microrelief Extensive clearing No erosion	Hard setting No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Clay loam	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 8.5 No dispersion after 10 minutes Partial slaking	--
			B21 0.10-0.25 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.18 / 9.0 No dispersion after 10 minutes Partial slaking	
			BC 0.25-0.35 EOBH	Medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 9.0 No dispersion after 10 minutes Partial slaking	
			Refusal on bedrock								

Landscape



Surface



Soil Profile



Site C25	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686594 7377606 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 5Dn(Ro) / Grey Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Lower slope Slope 2% / 3% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Complete clearing, not cultivated	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	-	-
			B21 0.10-0.50 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	-	
			BC 0.50-0.60 EOBH	Medium clay	Weak / Very weak Subangular blocky 10-20 mm No Slickensides	2-10% calcium carbonate 6-20mm	2.5Y5/3 Light olive brown Mottles: Brown Common 10%-20% Medium 5-15 mm	Dry Imperfectly drained	Very fine <1mm Few	-	

Landscape



Surface



Soil Profile



Site C26	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 686409 7378079 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 5Dn(Ro) / Grey Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 10/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Lower slope Slope 1% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Open woodland No microrelief Extensive clearing No erosion	Surface flake <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Strong / Firm Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 7.5 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.55 Gradual 50-100mm	Medium clay	Moderate / Very firm Angular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Pale brown Few 2%-10% Few <5 mm	Dry Moderately well drained	Fine 1-2mm Few	0.35 / 8.5 No dispersion after 10 minutes Partial slaking	
			BC 0.55-0.80 EOBH	Light clay	Massive / Loose No Slickensides	20-50% coarse fragments 6-20mm 20-50% coarse fragments 2-6mm	10YR6/2 Light brownish grey No mottles or bleaching	Dry Moderately well drained	No roots	0.70 / 8.0 Moderate dispersion after 10 minutes No slaking	

Landscape



Surface



Soil Profile



Site C27	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 690230 7370634 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 16Bl(Ta) / Grey Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Simple slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Limited clearing No erosion	Cracking No coarse fragments No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 7.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.50 EOBH No recovery of soil	Medium clay	Strong / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.30 / 8.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C28	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 691001 7371456 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 16Bl(Ta) / Grey Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Simple slope Slope 2% / 3% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Moderate / Very firm Angular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.35 Clear 20-50mm	Medium clay	Moderate / Very firm Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.25 / 8.5 No dispersion after 10 minutes Partial slaking	
			BC 0.35-0.60 EOBH	Light medium clay	Massive / Loose	20-50% coarse fragments 2-6mm 20-50% coarse fragments 20-60mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.50 / 8.0 No dispersion after 10 minutes Partial slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site C29	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 691447 7371443 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro)) / Grey Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow Medium height No microrelief Extensive clearing No erosion	Self-mulching No coarse fragments No rock outcrop	A1 0.00-0.10 Gradual 50-100mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Well drained	Fine 1-2mm Common	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.60 Diffuse >100mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.35 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.60-1.00 EOBH	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.80 / 9.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site C30	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 691543 7370618 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 12Da(Te)) / Grey Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Limited clearing No erosion	Firm <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Moderate / Firm Subangular blocky 10-20 mm Faint Slickensides	No inclusions or segregations	10YR4/1 Dark grey No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.40 Diffuse >100mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Faint Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.25 / 8.5 No dispersion after 10 minutes Partial slaking	
			B22 0.40-1.00 EOBH	Medium clay	Strong / Firm Subangular blocky 20-50 mm No Slickensides	<2% coarse fragments and manganese nodules 6-20mm	10YR4/3 Brown Mottles: Pale brown Few 2%-10% Medium 5-15 mm	Dry Moderately well drained	Fine 1-2mm Few	0.70 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C31	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 689683 7372597 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 13Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Upper slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Grassland No microrelief Extensive clearing No erosion	Firm 2-10% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay	Weak / Weak Subangular blocky 5-10 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.25 Clear 20-50mm	Light medium clay	Moderate / Weak Angular blocky 20-50 mm No Slickensides	<2% calcium carbonate 6-20mm <2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.18 / 8.5 No dispersion after 10 minutes Complete slaking	
			B22 0.25-0.45 Clear 20-50mm	Light clay	Weak / Weak Subangular blocky 20-50 mm No Slickensides	2-10% calcium carbonate 6-20mm <2% coarse fragments 6-20mm	10YR4/3 Brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.35 / 8.5 No dispersion after 10 minutes Partial slaking	
			B23 0.45-0.70 Abrupt 5-20mm	Medium clay	Moderate / Very firm Angular blocky 20-50 mm No Slickensides	2-10% coarse fragments 6-20mm <2% calcium carbonate 2-6mm	7.5YR4/4 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.55 / 8.5 No dispersion after 10 minutes Partial slaking	
			B24 0.70-1.00 EOBH	Light medium clay	Moderate / Firm Angular blocky 20-50 mm No Slickensides	<2% coarse fragments 6-20mm <2% coarse fragments 2-6mm	7.5YR4/4 Brown Mottles: Grey Very few <2% Few <5 mm	Dry Imperfectly drained	Very fine <1mm Few	0.85 / 8.0 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C32	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 689279 7373071 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 13Bl(Ta)) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**							
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Mid-slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Open woodland No microrelief Extensive clearing No erosion	Firm 2-10% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Strong / Strong Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.40 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	2-10% calcium carbonate 6-20mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.25 / 8.0 No dispersion after 10 minutes No slaking	
			B22 0.40-0.60 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% calcium carbonate 6-20mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.50 / 8.5 No dispersion after 10 minutes Partial slaking	
			B23 0.60-1.00 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm No Slickensides	<2% calcium carbonate 6-20mm	7.5YR4/4 Brown Mottles: Pale brown Few 2%-10% Few <5 mm	Dry Moderately well drained	Fine 1-2mm Few	0.80 / 8.5 No dispersion after 10 minutes No slaking	

Landscape



Surface



Soil Profile



Site C33	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 689513 7373651 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 17Bl(Ro) / Gery Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 11/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Open depression Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow scrub No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light medium clay	Moderate / Very firm Angular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.05 / 8.0	-
			B21 0.10-0.50 Gradual 50-100mm	Medium heavy clay	Strong / Very firm Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm <2% calcium carbonate 2-6mm	2.5Y4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Common	0.35 / 9.0	
			B22 0.50-0.80 Clear 20-50mm	Medium clay	Moderate / Firm Angular blocky 20-50 mm Slickensides	<2% calcium carbonate 2-6mm No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.65 / 8.5	
			B23 0.80-1.00 EOBH	Medium heavy clay	Moderate / Weak Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	7.5YR4/4 Brown Mottles: Brown Few 2%-10% Medium 5-15 mm	Moderately moist Imperfectly drained	Very fine <1mm Few	0.90 / 8.5	

Landscape



Surface



Soil Profile



Site C34	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 691878 7375159 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 11Bl(Ta) / Brown Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Open woodland No microrelief Extensive clearing	Firm No coarse fragments No rock outcrop	A1 0.00-0.18 Clear 20-50mm	Silty loam	Massive / Loose Granular No Slickensides	<2% coarse fragments 2-6mm	7.5YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.10 / 7.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.18-0.47 Clear 20-50mm	Light clay	Weak / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	7.5YR3/3 Dark brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.32 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.47-0.68 EOBH	Light clay	Weak / Firm Angular blocky 10-20 mm No Slickensides	<2% calcium carbonate 2-6mm	7.5YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.58 / 8.5 Slight dispersion after 10 minutes Partial slaking	
			Refusal on cemented pan								

Landscape



Surface



Soil Profile



Site C35	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 688588 7377380 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 8Dn(Te) / Grey Dermosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Gently undulating plain Plain Flat Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow scrub No microrelief Extensive clearing Rill erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.20 Clear 20-50mm	Clay loam	Weak / Weak Angular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Many	0.10 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.20-0.35 Clear 20-50mm	Light clay	Weak / Weak Angular blocky 20-50 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.28 / 8.5 No dispersion after 10 minutes No slaking	
			BC 0.35-0.50 EOBH	Light clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.42 / 8.5 No dispersion after 10 minutes No slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site C36	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 688804 7377298 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 19Bl(Ro) / Brown Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Exposed profile cutting	Survey Date / Described by: 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH / Dispersion / Slaking	Sample (m) / Observations
Grazing Level plain Plain Open depression Slope 3% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Open woodland No microrelief Extensive clearing Gully erosion	Surface flake No coarse fragments No rock outcrop	A1 0.00-0.18 Clear 20-50mm	Light clay	Weak / Weak Angular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Many	0.10 / 8.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.18-0.35 Clear 20-50mm	Light clay	Weak / Weak Angular blocky 20-50 mm Slickensides	<2% coarse fragments 2-6mm	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Common	0.28 / 8.5 No dispersion after 10 minutes No slaking	
			B22 0.35-1.00+ End of profile	Light clay	Moderate / Firm Subangular blocky 10-20 mm No Slickensides	<2% coarse fragments 2-6mm	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Very fine <1mm Few	0.60 / 8.5 No dispersion after 10 minutes No slaking	

Landscape



Surface



Soil Profile



Site C37	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 688262 7373639 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 11Bl(Ta) / Brown Dermosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2% / 2% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Sparse No microrelief Extensive clearing	Surface flake 2-10% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.15 Clear 20-50mm	Clay loam	Massive / Loose Angular blocky 5-10 mm No Slickensides	<2% coarse fragments 2-6mm	10YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.08 / 7.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.15-0.50	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/3 Brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.30 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.90 EOBH	Medium clay	Moderate / Very firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.70 / 7.5 No dispersion after 10 minutes Partial slaking	
			No recovery of soil								

Landscape



Surface



Soil Profile



Site C38	**Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy:** 687935 7374475 / GPS <3.00m	**Soil Profile Class / Australian Soil Class:** 2Dn(Te) / Black Vertosol	**Soil Survey Type / Observation Class / Method:** Free / Class IV(a) / Auger	**Survey Date / Described by:** 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	**Vegetation / Microrelief / Disturbance / Erosion**	**Surface condition / surface rock / Rock outcrop**	**Soil Profile Description**								
			Horizon / Depth (m) / Boundary	**Field Texture**	**Structure / Strength / Pedality / Slickensides**	**Coarse fragments / Segregations**	**Colour / Mottle / Bleaching**	**Soil water status / Drainage**	**Roots Size / Abundance**	**Depth (m) / Field pH / Dispersion / Slaking**	**Sample (m) / Observations**
Grazing Gently undulating plain Plain Flat Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Brigalow scrub Open woodland No microrelief Extensive clearing No erosion	Cracking <2% coarse fragments 2-6mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Strong / Very firm Angular blocky 20-50 mm No Slickensides	No inclusions or segregations	10YR3/1 Very dark grey No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Common	0.05 / 7.0 No dispersion after 10 minutes Partial slaking	-
			B21 0.10-0.50 Diffuse >100mm	Medium heavy clay	Strong / Firm Angular blocky 20-50 mm Slickensides	<2% coarse fragments <2mm	10YR3/1 Very dark grey No mottles or bleaching	Moderately moist Moderately well drained	Very fine <1mm Few	0.35 / 7.5 No dispersion after 10 minutes Partial slaking	
			B22 0.50-0.80 EOBH	Medium heavy clay	Strong / Very firm Angular blocky 20-50 mm Slickensides	<2% calcium carbonate 2-6mm	10YR4/1 Dark grey No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Few	0.65 / 7.5 No dispersion after 10 minutes Partial slaking	

Landscape



Surface



Soil Profile



Site C39	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 687178 7374537 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 2Dn(Te) / Black Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 12/09/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description								
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Gently undulating plain Plain Mid-slope Slope 2% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Bauhinia Sparse No microrelief Extensive clearing No erosion	Self-mulching <2% coarse fragments 6-20mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Light clay	Moderate / Firm Subangular blocky 5-10 mm No Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Well drained	Fine 1-2mm Few	0.05 / 7.5	-
			B21 0.10-0.60 Gradual 50-100mm	Medium clay	Strong / Very firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Dry Moderately well drained	Fine 1-2mm Few	0.35 / 7.5	
			B22 0.60-1.00 EOBH	Medium clay	Strong / Firm Subangular blocky 10-20 mm No Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Dry Moderately well drained	No roots	0.80 / 7.5	

Landscape



Surface



Soil Profile



Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C40	686376 7375625 GPS <3.00m	12Da(Te) / Class IV(b)	Date: 21/10/2025 Grazing, gently undulating rises, risecrest, crest, minor area <5 ha, aggregated into UMA 57 / 12Da(Te). Open woodland, extensive clearing, no microrelief, no rock outcrop, scald erosion. Surface: 5-10% coarse fragments, 60-200 mm	
Site C41	686511 7375532 GPS <3.00m	12Da(Te) / Class IV(b)	Date: 21/10/2025 Grazing, gently undulating rises, residual rise, lower slope, start of rise, minor area <5 ha, aggregated into UMA 57 / 12Da(Te). Open woodland, extensive clearing, no microrelief, no rock outcrop, scald erosion. Surface: 5-10% coarse fragments, 60-200 mm	
Site C42	690703 7372706 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 23/10/2025 Grazing, gently undulating plains, flat, slope <1% Bauhinia, scrub, extensive clearing, no microrelief, no erosion, no rock outcrop Surface: Self mulching, <2% coarse fragments, 20-60 mm, medium clay, 7.5YR4/3 Brown	-

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C43	685717 7378011 GPS <3.00m	16Bl(Ta) / Class IV(b)	Date: 23/10/2025 Grazing, gently undulating rises, simple slope, slope 2-3% Bauhinia, grassland, extensive clearing, no microrelief, scald and sheet erosion, no rock outcrop Surface: Firm with areas of crusting, <% coarse fragments, 20-60 mm, light medium clay, 7.5YR4/2 Brown	 
Site C44	690653 7370148 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 03/11/2025 Grazing, gently undulating plains, lower slope, slope 1% Bauhinia, Brigalow, extensive clearing, no microrelief, no erosion, no rock outcrop Surface: Firm, no coarse fragments, light sandy clay, 7.5YR3/2	-

Site C45	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy: 686634 7385472 / GPS <3.00m	Soil Profile Class / Australian Soil Class: 2Dn(Te) / Black Vertosol	Soil Survey Type / Observation Class / Method: Free / Class IV(a) / Auger	Survey Date / Described by: 03/11/2025 / MCCR

Land use / Landform Pattern / Element / Slope (% slope, clinometer), Acid Sulfate Soil (ASS)	Vegetation / Microrelief / Disturbance / Erosion	Surface condition / surface rock / Rock outcrop	Soil Profile Description							
			Horizon / Depth (m) / Boundary	Field Texture	Structure / Strength / Pedality / Slickensides	Coarse fragments / Segregations	Colour / Mottle / Bleaching	Soil water status / Drainage	Roots Size / Abundance	Depth (m) / Field pH	Sample (m) / Observations
Grazing Level plain Plain Flat Slope 1% / 1% **ASS Attributes** pH < 5 <4: No Shell / Corroded Shell: No Jarositic horizons: Potential Sulfurous smell: No Dead, dying, stunted vegetation: No Further Assessment: No	Brigalow Grassland No microrelief Complete clearing, not cultivated No erosion	Surface flake <2% coarse fragments 20-60mm No rock outcrop	A1 0.00-0.10 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	No inclusions or segregations	10YR3/2 Very dark greyish brown No mottles or bleaching	Moist Well drained	Fine 1-2mm Few	0.05 / 7.0 No dispersion after 10 minutes Partial slaking	No samples taken Recent rainfall prior to site visit
			B21 0.10-0.40 Clear 20-50mm	Medium clay	Strong / Firm Subangular blocky 20-50 mm Slickensides	2-10% calcium carbonate 6-20mm	10YR3/2 Very dark greyish brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Few	0.25 / 8.0 No dispersion after 10 minutes Partial slaking	
			B22 0.40-0.95 Clear 20-50mm	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR3/3 Dark brown No mottles or bleaching	Moderately moist Moderately well drained	Fine 1-2mm Few	0.70 / 7.5 No dispersion after 10 minutes Complete slaking	
			B23 0.95-1.00 EOBH	Medium heavy clay	Strong / Firm Subangular blocky 10-20 mm Slickensides	No inclusions or segregations	10YR4/2 Dark greyish brown Mottles: Brown Common 10%-20% Few <5 mm	Moderately moist Moderately well drained	Fine 1-2mm Few	0.97 / 7.0 No dispersion after 10 minutes Complete slaking	

Landscape



Surface



Soil Profile



Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C46	686518 7384762 GPS <3.00m	Boundary – 3Bl(Te) / 4Bl(Te) Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plains, lower slope, slope 1% Grassland, extensive clearing, no microrelief, no erosion, no rock outcrop Surface: Firm, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	
Site C47	686475 7384419 GPS <3.00m	Boundary – 4Bl(Te) / 15Bl(Ro) Class IV(b)	Date: 04/11/2025 Boundary – Surface colour changes to brown heading towards the south. Grey to the north.	
Site C48	686430 7384037 GPS <3.00m	5Dn(Ro) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plains, mid slope, open depression area Grassland, Acacia, extensive clearing, no microrelief, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR3/2 Very dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C49	686420 7383767 GPS <3.00m	6Bl(Pg) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plains, mid slope, open depression area Grassland, Acacia, extensive clearing, gilgai in immediate area extending to the east, no erosion, minor rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	
Site C50	686311 7382886 GPS <3.00m	Near boundary – 7Bl(Pg) / 15Bl(Ro) Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plains, mid slope Gilgai boundary site Brigalow, extensive clearing, gilgai in immediate area extending to the south (none to the north), no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey	
Site C51	686230 7382225 GPS <3.00m	Boundary – 7Bl(Pg) / 13Bl(Ta) Class IV(b)	Date: 04/11/2025 Boundary site, gilgai increases to the north. No gilgai to the south.	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C52	686389 7382028 GPS <3.00m	13Bl(Ta) / Class IV(b)	Date: 04/11/2025 Dam to the south, disturbance area covering approximately 0.5 ha. Area aggregated into UMA 59 / 13Bl(Ta)	
Site C53	686171 7381780 GPS <3.00m	Boundary – 7Bl(Pg) / 13Bl(Ta) Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, mid slope Gilgai boundary site Brigalow, extensive clearing, gilgai in immediate area extending to the south (none to the north), no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey	
Site C54	686058 7380830 GPS <3.00m	Near boundary – 7Bl(Pg) / 10Ct(Ro) Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, mid slope Gilgai boundary site Brigalow, extensive clearing, gilgai in immediate area extending to the north (none to the south), no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C55	685902 7379582 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, lower slope, 2% Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Firm, isolated area (0.5-1.0 ha) of rocks on surface – 20-600mm, light medium clay, 10YR3/2 Very dark greyish brown	
Site C56	688450 7376507 GPS <3.00m	7Bl(Pg) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, mid slope Brigalow, extensive clearing, gilgai observed, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C57	689204 7374168 GPS <3.00m	11Bl(Ta) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, drainage line, gully Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Exposed soil profile, shows 0.80 m soil depth over eroded bedrock. Surface: Cracking, no coarse fragments, clay loam, 10YR3/3 Dark brown	
Site C58	689681 7374242 GPS <3.00m	18Bl(Ro) / Class IV(b)	Date: 04/11/2025 Grazing, gently undulating plain, mid slope, 1% Sparse Bauhina, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C59	688493 7374238 GPS <3.00m	5Dn(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain, flat plain, <1% Sparse Bauhina and Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey Aerial imagery suggests boundary between north and south areas.	-
Site C60	688685 7375439 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain, gully, drainage line Sparse Bauhina, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Flake, <2% coarse fragments 20-60mm, light clay - sandy, 10YR3/2 Very dark greyish brown	
Site C61	688267 7375835 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain Sparse Bauhina, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Flake, <2% coarse fragments 2-6mm, light clay - sandy, 10YR3/2 Very dark greyish brown Isolated area with scalded surface covering <1 ha	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C62	688799 7376454 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plains Sparse Bauhina and Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Firm, no coarse fragments 2-6mm, sandy clay loam, 10YR3/2 Very dark greyish brown	 

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C63	688847 7376568 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plains Sparse Bauhina, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Firm, no coarse fragments, sandy clay loam, 10YR3/3 Dark brown	 
Site C64	688865 7376603 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain Sparse Bauhina and Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Firm, no coarse fragments, sandy clay loam, 10YR3/2 Very dark greyish brown	-
Site C65	688877 7376634 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain Sparse Bauhina and Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Firm, no coarse fragments, sandy clay loam, 10YR3/2 Very dark greyish brown	-
Site C66	688885 7376665 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 05/11/2025 Grazing, gently undulating plain Sparse Bauhina and Brigalow, extensive clearing, no gilgai observed, no erosion, no rock outcrop Surface: Firm, no coarse fragments, sandy clay loam, 10YR3/2 Very dark greyish brown	-

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C67	687232 7382661 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain Sparse vegetation, extensive clearing, no erosion, no rock outcrop Minor area gilgai observed in immediate area, <10% coverage, not observed in broader area, therefore aggregated into UMA 63 / 15Bl(Ro) Surface: Self mulching, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	
Site C68	686707 7382940 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain Sparse vegetation, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Self mulching, no coarse fragments, light clay, 10YR4/2 Dark greyish brown	
Site C69	686642 7385711 GPS <3.00m	10Ct(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain, flat plain <1% Sparse vegetation, extensive clearing, no erosion, no rock outcrop Minor area gilgai observed in immediate area, <10% coverage, not observed in broader area, not observed at nearby site D54, therefore aggregated into UMA 48 / 10Ct(Ro) Surface: Self mulching, no coarse fragments, medium clay - silty, 10YR4/1 Dark grey	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C70	690192 7371142 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain, lower slope, depression, drainage line Brigalow and Bauhinia, limited clearing, no gilgai, no erosion, no rock outcrop Surface: Self mulching, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	
Site C71	690898 7371680 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain, lower slope, depression, drainage line Brigalow, limited clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	 

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C72	690621 7371071 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 06/11/2025 Grazing, gently undulating plain, lower slope, depression, drainage line Grassland, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	 

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C73	691255 7380354 GPS <3.00m	20Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, upper to mid slope, 2% Brigalow and Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Hard setting, no coarse fragments, sandy loam, 7.5YR3/2	 
Site C74	686931 7379314 GPS <3.00m	Boundary 2Dn(Te) / 17Bl(Ro) Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, flat plain, <1% Sparse Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light clay, 10YR3/2 Very dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C75	687750 7379472 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, mid slope, <1% Sparse Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	 
Site C76	687331 7379476 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, mid slope, <1% Sparse Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C77	687037 7380446 GPS <3.00m	Near boundary 15Bl(Ro) / 4Bl(Te) Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, gully, soil depth on exposed profile shows 1.2m+ Sparse Bauhinia and Brigalow, extensive clearing, no gilgai, gully erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	
Site C78	687135 7381274 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, mid slope, <1% Brigalow, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C79	687402 7384348 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, simple slope, <1% Grassland, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, medium clay, 10YR4/3 Brown	 
Site C80	687483 7385209 GPS <3.00m	10Ct(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, depression, gully Limited clearing, no gilgai, no erosion, no rock outcrop Surface: Cracking and self mulching in areas, no coarse fragments, light medium clay, 10YR4/1 Dark grey	
Site C81	687959 7385438 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, simple slope, <1% Grassland, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, medium clay, 10YR4/3 Brown	-

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C82	688039 7381267 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, mid slope, <1% Grassland, sparse Brigalow, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	 
Site C83	688340 7381227 GPS <3.00m	15Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plain, mid slope, <1% Grassland, sparse Brigalow, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, light medium clay, 10YR4/2 Dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C84	686739 7383375 GPS <3.00m	Boundary – 6Bl(Pg) / 15Bl(Ro) Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, mid slope Gilgai boundary site Brigalow, extensive clearing, gilgai in immediate area extending to the east (none to the west), no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	
Site C85	686286 7382653 GPS <3.00m	7Bl(Pg) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, mid slope Brigalow, extensive clearing, gilgai observed, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR4/1 Dark grey	-
Site C86	686188 7381933 GPS <3.00m	13Bl(Ta) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, drainage line, gully Brigalow, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, light clay, 10YR4/3 Brown	-
Site C87	685981 7380217 GPS <3.00m	19Bl(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, drainage line, gully Brigalow, extensive clearing, no gilgai, gully erosion, no rock outcrop Surface: Self mulching, no coarse fragments, light clay, 10YR3/2 Very dark greyish brown	-
Site C88	686597 7380487 GPS <3.00m	4Bl(Te) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, drainage line, gully Brigalow, extensive clearing, no gilgai, gully erosion, no rock outcrop Surface: Flake, no coarse fragments, light medium clay, 10YR3/2 Very dark greyish brown	

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C89	686064 7379484 GPS <3.00m	9Dn(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, minor drainage line Brigalow, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Cracking, no coarse fragments, medium clay, 10YR3/1 Very dark grey	
Site C90	686565 7378346 GPS <3.00m	10Ct(Ro) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, drainage line, exposed soil profile observed to 1.0m depth Bauhinia, extensive clearing, no gilgai, no erosion, no rock outcrop Surface: Flake, no coarse fragments, medium clay, 10YR4/2 Dark greyish brown	
Site C91	689908 7378062 GPS <3.00m	7Bl(Pg) / Class IV(b)	Date: 07/11/2025 Desktop site. Review of SLR (2023) site C18 landscape and surface photos, combined with aerial imagery shows gilgai. This site is within UMA 24, aerial and landscape photos show similarity with nearby UMA 28 (Grey Vertosol).	-

Site No.	Location (mE/mS GDA2020 ZONE 55) / Method, Accuracy	Soil Profile Class / Observation Class	Description	Plates
Site C92	692160 7373851 GPS <3.00m	6Bl(Pg) / Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, flat, slope <1% Brigalow, extensive clearing, no erosion, no rock outcrop, Normal gilgai Surface: Flake, <2% coarse fragments, 20-60 mm, light clay, 10YR4/3 Brown	
Site C93	691275 7379297 GPS <3.00m	Boundary – 6Bl(Pg) / 21Bl(Ta) Class IV(b)	Date: 07/11/2025 Grazing, gently undulating plains, flat, slope <1% Gilgai boundary site Brigalow, extensive clearing, no erosion, no rock outcrop, Normal gilgai in immediate area extending to the east (none to the west) - 30% coverage - 0.5 to 1.0m deep mound position Surface: Flake, <2% coarse fragments, 20-60 mm, light clay, 10YR4/3 Brown	

Appendix C Analysed Site Laboratory Summary

Table AppC-1: Soil Chemistry for 1Dn(Te), Analysed Site D1

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
pH 1:5 water (pH units)	8.55	8.94	9.2
pH CaCl2 (following 4A1) pH units	7.84	8.17	8.35
Organic Carbon (W&B) % (40°C)	1.66	0.7	-
Nitrate - N (2M KCl) (mg/kg)	2.7	<1.0	-
Ammonium - N (2M KCl) (mg/kg)	1.4	<1.0	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-
PBI + Col P	100	92	-
Colwell Potassium (mg/kg)	500	150	-
KCl Sulfur (S) (mg/kg)	5.8	6.8	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	4650	3860	2520
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	458	563	536
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	415	126	92
Sodium (NH4Cl/BaCl2) (mg/kg)	200	1320	1410
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	23.2	19.3	12.6
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	3.77	4.63	4.41
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	1.06	0.322	0.234
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.87	5.73	6.15
Ca:Mg ratio	6.2	4.2	2.9
K:Mg ratio	0.28	0.07	0.05
GTRI	-	-	-
ECR (%)	6.7	20	27
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	4490	4090	2720
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	471	563	561
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	455	136	100
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	28.8	274	659
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	22.4	20.4	13.6
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	3.87	4.63	4.61
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.16	0.347	0.256

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.125	1.19	2.87
Ca:Mg ratio	5.8	4.4	2.9
K:Mg ratio	0.3	0.08	0.06
ECR (%)	4.7	5.8	15
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	27.6	26.6	21.3
Calcium (%)	81.3	76.8	63.7
Magnesium (%)	14	17.4	21.7
Potassium (%)	4.2	1.3	1.2
Sodium (%)	0.5	4.5	13
Aluminium (%)	0	0	0
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-
Chloride (mg/kg)	62	700	830
Salinity EC 1:5 (dS/m)	0.17	0.67	0.71
Boron (mg/kg)	1.4	-	-
Iron (Fe) (mg/kg)	6.2	-	-
Manganese (Mn) (mg/kg)	3.5	-	-
Copper (Cu) (mg/kg)	0.6	-	-
Zinc (Zn) (mg/kg)	0.27	-	-
Oxalate ext. Molybdenum (mg/kg)	0.81	-	-
Dumas Total Nitrogen (% dry wt)	0.21	0.12	-
TDS (mg(/L)	110	430	450
% Air-dry Moisture Content (% of dry wt)	2.9	3.2	2.6
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0288	0.0316	0.0263
Moisture (dry basis) (%)	3.01	3.17	2.09
Moisture 105Â°C (dry basis) (%)	10.1	12.5	8.1
Texture (ISSS Classification)	Clay	Clay	Silty Clay Loam
Gravel fraction (% of whole sample)	1.5	0.8	57.4

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sand fraction (%(< 2 mm fraction)	40.8	30.2	43.3
Silt fraction (% < 2 mm fraction)	14.8	17.9	28.5
Clay fraction (% < 2 mm fraction)	44.4	51.9	28.2
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.4	0.66	0.35
EAT	4	3	2
15 Bar (%)	20.3	22.7	15.1

'-' indicates no laboratory assessment was undertaken

Table AppC-2: Soil Chemistry for 2Dn(Te), Analysed Site D3 (SLR Site B25 (2023)

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D3-0.00-0.10 (B25, SLR 2023)	D3-0.20-0.30 (B25, SLR 2023)	D3-0.50-0.60 (B25, SLR 2023)	D3-0.70-0.80	D3-0.90-1.00 (B25, SLR 2023)
pH 1:5 water	7.26	6.8	8.06	-	9.13
Organic Carbon (W&B)	3.85	1.5	-	-	-
Nitrate - N (2M KCl)	3.8	47	-	-	-
Ammonium - N (2M KCl)	4.1	<1.0	-	-	-
Colwell Phosphorus	18	5.5	-	-	-
PBI + Col P	67	94	-	-	-
Colwell Potassium	1800	1100	-	-	-
KCl Sulfur (S)	11	37	-	-	-
Exchangeable Calcium	19	23	28	-	20
Exchangeable Magnesium	6.7	7.9	8.3	-	5.7
Exchangeable Potassium	0.56	0.37	0.36	-	0.18
Exchangeable Sodium	0.42	0.62	0.91	-	1.2
Exchangeable acidity	<0.02	<0.02	-	-	-
Exchangeable aluminium	<0.02	<0.02	-	-	-
This Exchangeable hydrogen	<0.02	<0.02	-	-	-
Calcium/Magnesium Ratio	2.9	2.9	3.4		3.6
ECEC	27	32	38	-	27
Calcium (%)	72	72	75	-	74
Magnesium (%)	25	25	22	-	21
Potassium (%)	2.1	1.2	0.95	-	0.64
Sodium - ESP (%)	1.6	2	2.4	-	4.3
Aluminium (%)	0.04	0.05	0.04	-	0.04
Hydrogen (%)	0	0	0	-	0
CaCl2 extr. Aluminium	<0.1	-	-	-	-
Chloride	41	380	1100	1200	740
EC	0.117	0.087	0.189	-	740
Boron	2.7	-	-	-	-
Iron (Fe)	8.1	-	-	-	-
Manganese (Mn)	11	-	-	-	-
Copper (Cu)	0.9	-	-	-	-
Zinc (Zn)	1.1	-	-	-	-
Oxalate ext. Molybdenum	0.59	-	-	-	-
Dumas Total Nitrogen	0.38	0.14	-	-	-
% Air-dry Moisture Content	2.9	3.5	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D3-0.00-0.10 (B25, SLR 2023)	D3-0.20-0.30 (B25, SLR 2023)	D3-0.50-0.60 (B25, SLR 2023)	D3-0.70-0.80	D3-0.90-1.00 (B25, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0286	0.0351	-	-	-
Moisture (dry basis)	5.75	5.67	8.57	8.4	4.62
Moisture 105Â°C (dry basis)	---	---	---	---	---
Texture (ISSS Classification)	Clay Loam	Clay	Clay	Clay	Clay Loam
Gravel fraction	2.4	1	53.7	45.7	87.1
Sand fraction	51.6	47.9	24.9	31	58.7
Silt fraction	21.4	15.2	18.1	10.7	12.4
Clay fraction	27	36.9	57	58.3	29
Moisture 40Â°C (dry basis)	2.9	5.1	7	6.3	3.3
R1 Dispersion Ratio	0.31	0.31	0.27	0.37	0.57
EAT	3	4	4	---	4
15 Bar (%)	19.5	18.1	23.4	22.4	12.4

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-3: Soil Chemistry for 3Bl(Te), Analysed Site D5

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	7.63	8.63	8.96	8.13	8.63	5.21	8.08
pH CaCl2 (following 4A1) pH units	6.42	7.67	8.12	7.52	8.01	4.6	7.4
Organic Carbon (W&B) % (40°C)	1.34	1.12	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	1.7	1.3	-	-	-	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-	-	-	-
PBI + Col P	116	112	-	-	-	-	-
Colwell Potassium (mg/kg)	97	80	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	7.5	6.3	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3900	4330	4400	2980	3450	2290	2940
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1080	1310	1360	1460	1490	1490	1420
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	115	109	88	110	121	100	116
Sodium (NH4Cl/BaCl2) (mg/kg)	566	1010	1120	2440	2110	2210	1890
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	19.5	21.6	22	14.8	17.2	11.4	14.7
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	8.89	10.8	11.2	12	12.3	12.3	11.7
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.294	0.278	0.226	0.281	0.309	0.255	0.297
Sodium (NH4Cl/BaCl2) (cmol/kg)	2.46	4.38	4.87	10.6	9.19	9.6	8.23

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	2.2	2	2	1.2	1.4	0.9	1.3
K:Mg ratio	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
GTRI	-	-	-	-	-	-	-
ECR (%)	8.9	13	13	29	24	29	24
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	4060	4470	4330	3140	3570	2490	3260
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1060	1430	1530	1590	1640	1520	1660
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	144	133	105	118	120	98.8	118
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	314	532	446	1150	1020	1200	1050
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	20.3	22.3	21.6	15.7	17.8	12.4	16.3
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	8.72	11.7	12.6	13.1	13.5	12.5	13.7
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.368	0.34	0.269	0.301	0.306	0.253	0.302
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.36	2.31	1.94	4.99	4.43	5.24	4.55
Ca:Mg ratio	2.3	1.9	1.7	1.2	1.3	1	1.2
K:Mg ratio	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
ECR (%)	5.6	7.2	6.1	16	13	18	14
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	1.3	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	1.2	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	0.1	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	30.7	36.7	36.4	34	36.1	31.7	34.8
Calcium (%)	66	60.8	59.3	46.1	49.4	39.2	46.7
Magnesium (%)	28.4	32	34.7	38.4	37.5	39.4	39.3
Potassium (%)	1.2	0.9	0.7	0.9	0.9	0.8	0.9
Sodium (%)	4.4	6.3	5.3	15	12	17	13
Aluminium (%)	0	0	0	0	0	3.8	0
Hydrogen (%)	0	0	0	0	0	0.3	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	130	290	350	1400	1100	1500	1200
Salinity EC 1:5 (dS/m)	0.13	0.35	0.46	1	0.97	1	0.88
Boron (mg/kg)	1.4	-	-	-	-	-	-
Iron (Fe) (mg/kg)	27	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	28	-	-	-	-	-	-
Copper (Cu) (mg/kg)	2.2	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.18	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.3	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.11	0.092	-	-	-	-	-
TDS (mg(/L)	83	230	290	650	620	660	570
% Air-dry Moisture Content (% of dry wt)	3.5	4	5.3	4.4	3.5	4	4.3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0349	0.0395	0.0531	0.0437	0.0347	0.0404	0.0425
Moisture (dry basis) (%)	3.4	4.13	3.33	3.15	3.1	3.31	3.18
Moisture 105Â°C (dry basis) (%)	11.7	15.1	13.3	12.4	14	13.1	13.7

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Silty Clay	Clay
Gravel fraction (% of whole sample)	< 0.1	< 0.1	4.3	< 0.1	3.4	< 0.1	< 0.1
Sand fraction (%(< 2 mm fraction)	38.5	30.8	31.7	31.2	29.4	17.1	29.8
Silt fraction (% < 2 mm fraction)	10.2	13.5	11.9	13	13.5	28.2	14.8
Clay fraction (% < 2 mm fraction)	51.3	55.8	56.4	55.9	57.1	54.7	55.4
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.44	0.51	0.44	0.66	0.57	0.74	0.66
EAT	2	2	2	2	2	2	2
15 Bar (%)	25.8	28.2	27.3	26.8	27.1	28.2	29.9

'-' indicates no laboratory assessment was undertaken

Table AppC-4: Soil Chemistry for 4Bl(Te), Analysed Site D6

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
pH 1:5 water (pH units)	7.17	8.98	9.07	9.1	8.95
pH CaCl2 (following 4A1) pH units	6.06	8.09	8.26	8.37	8.14
Organic Carbon (W&B) % (40°C)	1.77	0.91	-	-	-
Nitrate - N (2M KCl) (mg/kg)	1.2	<1.0	-	-	-
Ammonium - N (2M KCl) (mg/kg)	2.5	1.2	-	-	-
Colwell Phosphorus (mg/kg)	7.3	<5.0	-	-	-
PBI + Col P	68	122	-	-	-
Colwell Potassium (mg/kg)	330	100	-	-	-
KCl Sulfur (S) (mg/kg)	4.8	8.9	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	2400	3900	3470	2110	2000
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	746	1250	1260	1060	1140
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	252	126	109	67	64
Sodium (NH4Cl/BaCl2) (mg/kg)	205	1030	1380	1680	1890
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	12	19.4	17.3	10.6	10
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.13	10.3	10.4	8.69	9.38
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.644	0.321	0.278	0.17	0.163
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.892	4.47	6.02	7.32	8.22
Ca:Mg ratio	2	1.9	1.7	1.2	1.1
K:Mg ratio	0.11	<0.05	<0.05	<0.05	<0.05
GTRI	-	-	-	-	-
ECR (%)	7.8	14	19	28	30

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2470	4020	3940	2250	2050
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	784	1440	1350	1140	1130
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	307	137	108	81.8	52.2
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	66.4	319	465	595	934
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	12.3	20.1	19.6	11.2	10.2
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.45	11.8	11.1	9.34	9.32
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.785	0.35	0.275	0.209	0.134
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.289	1.39	2.02	2.59	4.06
Ca:Mg ratio	1.9	1.7	1.8	1.2	1.1
K:Mg ratio	0.12	<0.05	<0.05	<0.05	<0.05
ECR (%)	5.4	5.2	7	12	18
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	19.8	33.6	33	23.3	23.8
Calcium (%)	62.1	59.7	59.5	48	43.1
Magnesium (%)	32.5	35.2	33.6	40	39.2
Potassium (%)	4	1	0.8	0.9	0.6
Sodium (%)	1.5	4.1	6.1	11	17
Aluminium (%)	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-
Chloride (mg/kg)	44	260	420	1100	1100
Salinity EC 1:5 (dS/m)	0.074	0.39	0.51	0.91	0.91

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
Boron (mg/kg)	0.77	-	-	-	-
Iron (Fe) (mg/kg)	25	-	-	-	-
Manganese (Mn) (mg/kg)	38	-	-	-	-
Copper (Cu) (mg/kg)	1.4	-	-	-	-
Zinc (Zn) (mg/kg)	0.96	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	0.84	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.16	0.093	-	-	-
TDS (mg(/L)	47	250	330	580	580
% Air-dry Moisture Content (% of dry wt)	2.4	3.4	3.2	3.3	2.9
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0243	0.0336	0.0323	0.0329	0.0289
Moisture (dry basis) (%)	1.54	3.17	2.94	1.44	2.15
Moisture 105Â°C (dry basis) (%)	3.5	15.5	16.2	5.8	7.4
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay Loam
Gravel fraction (% of whole sample)	< 0.1	0.3	1.1	47.4	0.3
Sand fraction (%(< 2 mm fraction)	48.8	32.2	36.2	43.8	50.3
Silt fraction (% < 2 mm fraction)	15.2	9	10.7	15.7	18.3
Clay fraction (% < 2 mm fraction)	36	58.8	53.1	40.5	31.4
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-
R1 Dispersion Ratio	0.39	0.54	0.6	0.69	0.5
EAT	3	3	3	2	2
15 Bar (%)	27.2	26.4	24.9	17.4	22.9

'-' indicates no laboratory assessment was undertaken

Table AppC-5: Soil Chemistry for 5Dn(Ro), Analysed Site D7

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
pH 1:5 water (pH units)	8.57	8.96	8.76
pH CaCl2 (following 4A1) pH units	7.82	8.01	7.92
Organic Carbon (W&B) % (40°C)	1.46	0.78	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-
Ammonium - N (2M KCl) (mg/kg)	1.6	<1.0	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-
PBI + Col P	133	115	-
Colwell Potassium (mg/kg)	120	120	-
KCl Sulfur (S) (mg/kg)	5.6	4.6	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	5520	4470	2990
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	796	1010	1150
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	171	132	132
Sodium (NH4Cl/BaCl2) (mg/kg)	227	530	1510
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	27.6	22.3	14.9
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.55	8.31	9.43
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.438	0.338	0.339
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.988	2.3	6.56
Ca:Mg ratio	4.2	2.7	1.6
K:Mg ratio	0.07	<0.05	<0.05
GTRI	-	-	-
ECR (%)	4	7.9	22
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	5340	4800	2690
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	813	1100	1090
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	172	137	139
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	48.7	126	725
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	26.7	24	13.4
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.69	9.07	8.93
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.439	0.349	0.355

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.212	0.55	3.15
Ca:Mg ratio	4	2.6	1.5
K:Mg ratio	0.07	<0.05	<0.05
ECR (%)	1.9	2.6	14
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	34	33.9	25.9
Calcium (%)	78.4	70.6	51.9
Magnesium (%)	19.7	26.7	34.5
Potassium (%)	1.3	1	1.4
Sodium (%)	0.6	1.6	12
Aluminium (%)	0	0	0
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-
Chloride (mg/kg)	25	57	640
Salinity EC 1:5 (dS/m)	0.16	0.23	0.58
Boron (mg/kg)	1.2	-	-
Iron (Fe) (mg/kg)	11	-	-
Manganese (Mn) (mg/kg)	4.6	-	-
Copper (Cu) (mg/kg)	1.1	-	-
Zinc (Zn) (mg/kg)	0.19	-	-
Oxalate ext. Molybdenum (mg/kg)	0.92	-	-
Dumas Total Nitrogen (% dry wt)	0.15	0.099	-
TDS (mg(/L)	100	140	370
% Air-dry Moisture Content (% of dry wt)	2.8	3.4	3.6
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0275	0.0338	0.036
Moisture (dry basis) (%)	3.35	2.84	2.69
Moisture 105Â°C (dry basis) (%)	8.6	12.6	13.4
Texture (ISSS Classification)	Clay	Clay	Clay
Gravel fraction (% of whole sample)	2.1	9.4	20

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sand fraction (%(< 2 mm fraction)	31.9	30.2	28.2
Silt fraction (% < 2 mm fraction)	16.8	14.6	16.5
Clay fraction (% < 2 mm fraction)	51.3	55.2	55.3
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.26	0.57	0.77
EAT	4	2	2
15 Bar (%)	20.9	21.9	22.8

'-' indicates no laboratory assessment was undertaken

Table AppC-6: Soil Chemistry for 6BI(Pg), Analysed Site 12m

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	7.75	5.67	5.77	5.75	7.65	7.22	7.59
pH CaCl2 (following 4A1) pH units	7.11	5.22	5.36	5.42	7.26	6.76	7.2
Organic Carbon (W&B) % (40°C)	0.75	0.42	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	1.6	1.7	-	-	-	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-	-	-	-
PBI + Col P	100	94	-	-	-	-	-
Colwell Potassium (mg/kg)	220	170	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	20	56	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3410	2040	1910	1740	2150	2390	2120
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1060	1210	1210	1210	1280	1360	1320
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	195	173	201	203	246	257	276
Sodium (NH4Cl/BaCl2) (mg/kg)	436	1470	1940	2320	2480	2570	2570
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	17	10.2	9.54	8.69	10.7	11.9	10.6
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	8.75	9.92	9.96	9.94	10.5	11.2	10.9
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.499	0.441	0.514	0.52	0.629	0.656	0.707
Sodium (NH4Cl/BaCl2) (cmol/kg)	1.9	6.4	8.43	10.1	10.8	11.2	11.2

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	1.9	1	1	0.9	1	1.1	1
K:Mg ratio	0.06	<0.05	0.05	0.05	0.06	0.06	0.07
GTRI	-	-	-	-	-	-	-
ECR (%)	8.5	25	31	36	35	34	36
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3550	2110	1910	1640	2310	2290	2080
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1110	1110	1120	1040	1380	1330	1300
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	235	201	250	226	311	285	329
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	101	471	618	560	690	690	686
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	17.7	10.5	9.52	8.19	11.5	11.4	10.4
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	9.13	9.16	9.2	8.54	11.3	10.9	10.7
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.602	0.514	0.639	0.578	0.795	0.728	0.842
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.44	2.05	2.69	2.44	3	3	2.99
Ca:Mg ratio	1.9	1.2	1	1	1	1	1
K:Mg ratio	0.07	0.06	0.07	0.07	0.07	0.07	0.08
ECR (%)	3.7	12	15	15	14	14	15
Exchangeable acidity (cmol/kg)	<0.02	0.11	0.06	0.06	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	0.06	<0.02	0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	0.05	0.04	0.03	<0.02	<0.02	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	27.9	22.4	22.1	19.8	26.7	26.1	24.9
Calcium (%)	63.5	47.1	43.1	41.4	43.2	43.8	41.7
Magnesium (%)	32.8	40.9	41.6	43.1	42.6	41.9	42.9
Potassium (%)	2.2	2.3	2.9	2.9	3	2.8	3.4
Sodium (%)	1.6	9.2	12	12	11	12	12
Aluminium (%)	0	0.3	0.1	0.1	0	0	0
Hydrogen (%)	0	0.2	0.2	0.2	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	300	1500	2200	3000	3000	2700	3300
Salinity EC 1:5 (dS/m)	0.33	1.1	1.5	2	2.1	1.9	2.3
Boron (mg/kg)	2.9	-	-	-	-	-	-
Iron (Fe) (mg/kg)	18	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	7.7	-	-	-	-	-	-
Copper (Cu) (mg/kg)	1.6	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.26	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.1	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.098	0.031	-	-	-	-	-
TDS (mg(/L)	210	700	970	1200	1400	1200	1400
% Air-dry Moisture Content (% of dry wt)	3.3	3.6	5	5.1	3.1	3.2	3.5
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.033	0.0359	0.0498	0.0508	0.0308	0.0321	0.0345
Moisture (dry basis) (%)	2.63	2.69	2.98	2.79	3.6	3.16	3.81
Moisture 105Â°C (dry basis) (%)	7.2	12.2	14.1	12.2	14.1	14.2	14.5

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Clay	Clay
Gravel fraction (% of whole sample)	0.8	< 0.1	0.2	9	18.1	17.9	2.8
Sand fraction (%(< 2 mm fraction)	31	24	24.1	25.2	25.1	23	25.2
Silt fraction (% < 2 mm fraction)	13	16.6	15.7	15.8	16.7	15.8	13.9
Clay fraction (% < 2 mm fraction)	56	59.4	60.2	59.1	58.2	61.2	60.9
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.42	0.65	0.69	0.69	0.66	0.71	0.78
EAT	4	2	2	2	2	2	2
15 Bar (%)	21.3	23.5	23.2	23.5	23.2	23.4	24.1

'-' indicates no laboratory assessment was undertaken

Table AppC-7: Soil Chemistry for 6BI(Pg), Analysed Site 12d

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	8.21	7.79	8.02	8.23	8.08	7.96	7.19
pH CaCl2 (following 4A1) pH units	7.49	7.2	7.51	7.69	7.57	7.5	6.7
Organic Carbon (W&B) % (40°C)	0.88	0.41	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	1	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-	-	-
Colwell Phosphorus (mg/kg)	5.9	<5.0	-	-	-	-	-
PBI + Col P	90	89	-	-	-	-	-
Colwell Potassium (mg/kg)	230	130	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	4.2	18	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3920	2550	2330	2250	2350	2210	1980
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	847	1090	1150	1090	1200	1270	1160
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	242	147	163	164	197	230	179
Sodium (NH4Cl/BaCl2) (mg/kg)	232	1800	2450	2310	2590	2680	1970
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	19.6	12.7	11.7	11.2	11.7	11	9.86
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.97	8.96	9.43	8.98	9.83	10.5	9.58
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.618	0.375	0.417	0.418	0.504	0.587	0.458
Sodium (NH4Cl/BaCl2) (cmol/kg)	1.01	7.83	10.7	10	11.3	11.6	8.57

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	2.8	1.4	1.2	1.3	1.2	1.1	1
K:Mg ratio	0.09	<0.05	<0.05	<0.05	0.05	0.06	<0.05
GTRI	-	-	-	-	-	-	-
ECR (%)	5.8	27	34	34	35	36	32
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3440	2390	2130	2240	2140	2060	1960
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	800	1060	1070	1100	1110	1120	1160
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	258	166	179	175	223	247	223
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	52.9	580	643	682	681	602	538
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	17.2	11.9	10.6	11.2	10.7	10.3	9.79
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.58	8.71	8.84	9.03	9.13	9.23	9.52
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.659	0.423	0.458	0.447	0.569	0.631	0.569
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.23	2.52	2.8	2.97	2.96	2.62	2.34
Ca:Mg ratio	2.6	1.4	1.2	1.2	1.2	1.1	1
K:Mg ratio	0.1	<0.05	0.05	<0.05	0.06	0.07	0.06
ECR (%)	3.6	13	14	14	15	14	13
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	24.6	23.6	22.7	23.6	23.3	22.7	22.2
Calcium (%)	69.7	50.6	46.8	47.3	45.8	45.1	44.1
Magnesium (%)	26.7	36.9	38.9	38.2	39.1	40.6	42.9
Potassium (%)	2.7	1.8	2	1.9	2.4	2.8	2.6
Sodium (%)	0.9	11	12	13	13	12	11
Aluminium (%)	0	0	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	26	1500	2200	2300	2600	3000	2500
Salinity EC 1:5 (dS/m)	0.14	1.1	1.5	1.5	1.7	2	1.6
Boron (mg/kg)	0.86	-	-	-	-	-	-
Iron (Fe) (mg/kg)	15	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	8.2	-	-	-	-	-	-
Copper (Cu) (mg/kg)	1.8	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.25	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.1	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.095	0.055	-	-	-	-	-
TDS (mg(/L)	92	690	980	980	1100	1300	1000
% Air-dry Moisture Content (% of dry wt)	2.7	3	2.6	2.7	3.2	3.1	4.1
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0267	0.0297	0.0262	0.0271	0.0323	0.0305	0.0408
Moisture (dry basis) (%)	2.39	2.57	2.61	2.47	2.37	2.74	2.73
Moisture 105Â°C (dry basis) (%)	4.7	10.6	11.3	11.1	11.9	11.7	10.6

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Clay	Clay
Gravel fraction (% of whole sample)	7	8.9	5	0.7	0.4	1.6	3.3
Sand fraction (%(< 2 mm fraction)	39.7	35.7	34.4	39.5	36.8	34.1	30.2
Silt fraction (% < 2 mm fraction)	13.1	12.3	13.4	10.3	11.4	13.6	13.7
Clay fraction (% < 2 mm fraction)	47.3	52.1	52.2	50.2	51.8	52.3	56.1
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.43	0.69	0.68	0.71	0.72	0.69	0.68
EAT	2	2	2	2	2	2	2
15 Bar (%)	18.5	21	21.2	24.2	24.5	23.8	25.1

'-' indicates no laboratory assessment was undertaken

Table AppC-8: Soil Chemistry for 7Bl(Pg), Analysed Site D14d

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.30-1.40
pH 1:5 water (pH units)	7.51	7.55	7.67	6.61	8.16	7.54
pH CaCl2 (following 4A1) pH units	6.19	6.36	7.16	5.88	7.52	6.9
Organic Carbon (W&B) % (40°C)	0.55	0.64	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	<1.0	1.1	-	-	-	-
Colwell Phosphorus (mg/kg)	11	12	-	-	-	-
PBI + Col P	84	94	-	-	-	-
Colwell Potassium (mg/kg)	180	230	-	-	-	-
KCl Sulfur (S) (mg/kg)	4.1	4	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3070	3040	3200	2260	2120	1820
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	894	911	1270	1010	1220	1130
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	193	231	179	127	197	148
Sodium (NH4Cl/BaCl2) (mg/kg)	263	394	1810	1320	1780	1720
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	15.3	15.2	16	11.3	10.6	9.1
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	7.35	7.49	10.4	8.31	10.1	9.34
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.495	0.592	0.458	0.325	0.503	0.379
Sodium (NH4Cl/BaCl2) (cmol/kg)	1.14	1.71	7.88	5.75	7.73	7.48
Ca:Mg ratio	2.1	2	1.5	1.4	1.1	1
K:Mg ratio	0.07	0.08	<0.05	<0.05	<0.05	<0.05
GTRI	-	-	-	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.30-1.40
ECR (%)	6.7	9.2	24	24	29	30
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2730	3290	3210	2080	2290	1680
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	774	955	1190	907	1360	1050
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	211	297	202	142	247	151
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	96.7	162	497	438	716	494
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	13.6	16.4	16	10.4	11.4	8.36
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.37	7.86	9.77	7.46	11.2	8.66
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.54	0.76	0.515	0.364	0.631	0.386
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.421	0.704	2.16	1.91	3.11	2.15
Ca:Mg ratio	2.1	2.1	1.6	1.4	1	1
K:Mg ratio	0.09	0.1	0.05	<0.05	0.06	<0.05
ECR (%)	4.6	5.7	9.4	11	14	13
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	21	25.7	28.5	20.1	26.4	19.6
Calcium (%)	65	63.8	56.3	51.5	43.3	42.8
Magnesium (%)	30.4	30.5	34.3	37.2	42.5	44.3
Potassium (%)	2.6	3	1.8	1.8	2.4	2

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.30-1.40
Sodium (%)	2	2.7	7.6	9.5	12	11
Aluminium (%)	0	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-
Chloride (mg/kg)	42	150	1700	1000	1500	1500
Salinity EC 1:5 (dS/m)	0.06	0.14	1.2	0.72	1	1
Boron (mg/kg)	0.53	-	-	-	-	-
Iron (Fe) (mg/kg)	28	-	-	-	-	-
Manganese (Mn) (mg/kg)	24	-	-	-	-	-
Copper (Cu) (mg/kg)	2.2	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.46	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.1	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.044	0.057	-	-	-	-
TDS (mg(/L)	38	87	770	460	650	640
% Air-dry Moisture Content (% of dry wt)	2.9	3.8	4.5	3.3	2.8	2.2
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.029	0.0378	0.0448	0.0328	0.0284	0.0218
Moisture (dry basis) (%)	2.54	2.66	3.21	2.3	2.39	2.25
Moisture 105Â°C (dry basis) (%)	5.7	6.9	12.9	8.7	8.9	10
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Clay
Gravel fraction (% of whole sample)	0.3	7.6	11.8	6.9	8.7	9.5
Sand fraction (%(< 2 mm fraction)	41.5	36.1	23.9	44.2	43.2	39.8
Silt fraction (% < 2 mm fraction)	13.8	11.7	16.2	11.4	11.6	19.5

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.30-1.40
Clay fraction (% < 2 mm fraction)	44.7	52.3	60	44.4	45.2	40.7
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-
R1 Dispersion Ratio	0.48	0.6	0.53	0.67	0.73	0.61
EAT	3	2	2	2	2	2
15 Bar (%)	21.2	22.8	25.3	20.6	21	17.4

'-' indicates no laboratory assessment was undertaken

Table AppC-9: Soil Chemistry for 7Bl(Pg), Analysed Site D14m

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
pH 1:5 water (pH units)	7.18	8.36	8.19	8.03	7.47	7.41	7.41	7.21
pH CaCl2 (following 4A1) pH units	6.34	7.7	7.36	7.57	7.02	7.01	6.96	6.73
Organic Carbon (W&B) % (40°C)	1.77	1.16	-	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	1.2	<1.0	-	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	2.2	1.3	-	-	-	-	-	-
Colwell Phosphorus (mg/kg)	10	<5.0	-	-	-	-	-	-
PBI + Col P	82	118	-	-	-	-	-	-
Colwell Potassium (mg/kg)	410	140	-	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	5.6	7.4	-	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3660	4240	2560	2380	2190	2250	2310	-
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	948	923	968	1390	1420	1460	1560	-
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	423	164	145	287	299	308	331	-
Sodium (NH4Cl/BaCl2) (mg/kg)	215	974	1070	2750	2890	3000	3110	-
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	18.3	21.2	12.8	11.9	10.9	11.3	11.5	-
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	7.8	7.59	7.96	11.4	11.7	12	12.8	-
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	1.08	0.42	0.371	0.735	0.764	0.786	0.847	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.937	4.24	4.64	12	12.6	13	13.5	-
Ca:Mg ratio	2.3	2.8	1.6	1	0.9	0.9	0.9	-
K:Mg ratio	0.14	0.06	<0.05	0.07	0.07	0.07	0.07	-
GTRI	-	-	-	-	-	-	-	-
ECR (%)	7.2	14	19	35	37	37	37	-
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3100	3780	2510	2240	1690	1650	1730	-
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	831	818	944	1280	1080	1080	1190	-
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	471	186	170	313	271	278	312	-
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	48.2	163	393	740	612	648	749	-
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	15.5	18.9	12.5	11.2	8.42	8.26	8.66	-
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.84	6.73	7.77	10.6	8.92	8.84	9.82	-
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.2	0.476	0.434	0.801	0.693	0.711	0.797	-
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.21	0.707	1.71	3.22	2.66	2.82	3.26	-
Ca:Mg ratio	2.3	2.8	1.6	1.1	0.9	0.9	0.9	-
K:Mg ratio	0.18	0.07	0.06	0.08	0.08	0.08	0.08	-
ECR (%)	6	4.4	9.6	16	16	17	18	-
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
ECEC (cmol/kg)	23.7	26.8	22.4	25.7	20.7	20.6	22.5	-
Calcium (%)	65.2	70.5	55.8	43.4	40.7	40	38.4	-
Magnesium (%)	28.8	25.1	34.7	41	43.1	42.9	43.6	-
Potassium (%)	5.1	1.8	1.9	3.1	3.4	3.4	3.5	-
Sodium (%)	0.9	2.6	7.6	13	13	14	14	-
Aluminium (%)	0	0	0	0	0	0	0	-
Hydrogen (%)	0	0	0	0	0	0	0	-
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-	-
Chloride (mg/kg)	120	780	670	2900	3000	3000	3200	2400
Salinity EC 1:5 (dS/m)	0.13	0.62	0.49	1.9	1.9	1.9	2.1	1.6
Boron (mg/kg)	0.87	-	-	-	-	-	-	-
Iron (Fe) (mg/kg)	27	-	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	26	-	-	-	-	-	-	-
Copper (Cu) (mg/kg)	1.9	-	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.72	-	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.2	-	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.17	0.12	-	-	-	-	-	-
TDS (mg(/L)	82	390	310	1200	1200	1200	1300	1000
% Air-dry Moisture Content (% of dry wt)	2.8	3	2.6	3.9	4.7	4.7	4.2	-
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.028	0.0296	0.0255	0.0394	0.0469	0.0466	0.0418	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Moisture (dry basis) (%)	2.48	2.33	1.88	3.14	3.25	2.97	3.23	-
Moisture 105Â°C (dry basis) (%)	4.8	8.2	8.1	13.7	14.7	13.1	15	-
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Clay	Clay	-
Gravel fraction (% of whole sample)	0.3	0.9	7.2	0.2	10.2	9	19.4	-
Sand fraction (%(< 2 mm fraction)	33.6	32.3	47.7	25.4	23.7	49.2	23	-
Silt fraction (% < 2 mm fraction)	19.9	17.5	11.4	16.2	15.7	11.5	15.3	-
Clay fraction (% < 2 mm fraction)	46.6	50.2	41	58.4	60.6	39.3	61.7	-
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.38	0.35	0.61	0.7	0.76	0.99	0.79	-
EAT	3	3	2	2	2	2	2	-
15 Bar (%)	20.9	14.1	18.3	27.8	24.1	24	24.9	-

'-' indicates no laboratory assessment was undertaken

Table AppC-10: Soil Chemistry for 8Dn(Te), Analysed Site D19

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
pH 1:5 water (pH units)	8.19	8.82	8.95	7.96	8.88
pH CaCl2 (following 4A1) pH units	7.38	7.87	8.03	7.14	7.99
Organic Carbon (W&B) % (40°C)	1.64	1.1	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-
Ammonium - N (2M KCl) (mg/kg)	4.8	<1.0	-	-	-
Colwell Phosphorus (mg/kg)	9.3	<5.0	-	-	-
PBI + Col P	67	100	-	-	-
Colwell Potassium (mg/kg)	470	170	-	-	-
KCl Sulfur (S) (mg/kg)	4.2	5.7	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	4640	5050	3170	1750	3150
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	779	743	501	670	653
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	405	181	88	59	114
Sodium (NH4Cl/BaCl2) (mg/kg)	145	426	513	1750	1100
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	23.1	25.2	15.8	8.73	15.7
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.41	6.11	4.13	5.51	5.37
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	1.03	0.464	0.225	0.151	0.292
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.632	1.85	2.23	7.61	4.8
Ca:Mg ratio	3.6	4.1	3.8	1.6	2.9
K:Mg ratio	0.16	0.08	0.05	<0.05	0.05
GTRI	-	-	-	-	-
ECR (%)	5.3	6.9	11	35	19

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3890	4620	2770	1850	2910
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	684	680	440	667	602
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	453	178	77.3	70.2	112
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	36.1	105	162	917	440
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	19.4	23	13.8	9.25	14.5
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	5.62	5.59	3.62	5.49	4.95
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.16	0.456	0.198	0.18	0.285
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.157	0.458	0.705	3.99	1.91
Ca:Mg ratio	3.5	4.1	3.8	1.7	2.9
K:Mg ratio	0.21	0.08	0.06	<0.05	0.06
ECR (%)	5	3.1	4.9	22	10
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	26.4	29.6	18.4	18.9	21.7
Calcium (%)	73.7	78	75.4	48.9	67
Magnesium (%)	21.3	18.9	19.7	29	22.9
Potassium (%)	4.4	1.5	1.1	1	1.3
Sodium (%)	0.6	1.5	3.8	21	8.8
Aluminium (%)	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-
Chloride (mg/kg)	21	16	120	1000	370
Salinity EC 1:5 (dS/m)	0.099	0.15	0.21	0.76	0.38

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.00-1.10
Boron (mg/kg)	0.9	-	-	-	-
Iron (Fe) (mg/kg)	7.7	-	-	-	-
Manganese (Mn) (mg/kg)	6.2	-	-	-	-
Copper (Cu) (mg/kg)	0.94	-	-	-	-
Zinc (Zn) (mg/kg)	0.36	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.1	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.16	0.1	-	-	-
TDS (mg(/L)	64	99	130	490	240
% Air-dry Moisture Content (% of dry wt)	2.8	3	1.7	3.1	2.2
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0278	0.0301	0.0169	0.0309	0.0218
Moisture (dry basis) (%)	2.3	2.49	1.82	2.04	1.68
Moisture 105Â°C (dry basis) (%)	5.9	7.7	6.4	8.3	6.6
Texture (ISSS Classification)	Clay	Clay	Clay Loam	Clay Loam	Clay Loam
Gravel fraction (% of whole sample)	0.5	9.5	0.3	6.6	56.7
Sand fraction (%(< 2 mm fraction)	33.6	39.2	45.8	44.3	40.9
Silt fraction (% < 2 mm fraction)	18.8	19.1	22.4	23	21.9
Clay fraction (% < 2 mm fraction)	47.7	41.7	31.8	32.8	37.2
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-
R1 Dispersion Ratio	0.43	0.44	0.44	0.52	0.51
EAT	3	3	2	2	2
15 Bar (%)	19.3	17.4	13.3	16.1	14

'-' indicates no laboratory assessment was undertaken

Table AppC-11: Soil Chemistry for 9Dn(Ro), Analysed Site 21

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	8.06	8.79	8.72	8.59	8.67	7.42	7.99
pH CaCl2 (following 4A1) pH units	7.38	8.07	8.1	7.94	8.11	6.75	7.28
Organic Carbon (W&B) % (40°C)	2.37	1.1	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	2.7	<1.0	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	2.4	1.4	-	-	-	-	-
Colwell Phosphorus (mg/kg)	9.3	<5.0	-	-	-	-	-
PBI + Col P	99	118	-	-	-	-	-
Colwell Potassium (mg/kg)	640	140	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	7.2	8.5	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	5200	4570	3990	4210	3960	3180	2710
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	643	863	864	942	937	988	817
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	544	174	174	167	190	165	143
Sodium (NH4Cl/BaCl2) (mg/kg)	32.4	1530	2050	2600	2660	2580	2080
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	25.9	22.8	19.9	21	19.8	15.9	13.5
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	5.29	7.1	7.11	7.75	7.71	8.13	6.72
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	1.39	0.445	0.445	0.427	0.486	0.421	0.366
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.141	6.67	8.9	11.3	11.6	11.2	9.03

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	4.9	3.2	2.8	2.7	2.6	2	2
K:Mg ratio	0.26	0.06	0.06	0.06	0.06	0.05	0.05
GTRI	-	-	-	-	-	-	-
ECR (%)	4.7	19	26	29	31	33	32
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	4790	4620	4150	3520	3690	2360	2230
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	637	1020	975	903	828	745	648
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	690	233	233	190	191	124	122
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	10.6	528	864	983	663	851	793
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	23.9	23.1	20.7	17.6	18.4	11.8	11.1
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	5.24	8.41	8.02	7.42	6.81	6.13	5.33
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.76	0.596	0.597	0.486	0.487	0.318	0.313
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.046	2.3	3.76	4.28	2.88	3.7	3.45
Ca:Mg ratio	4.6	2.7	2.6	2.4	2.7	1.9	2.1
K:Mg ratio	0.34	0.07	0.07	0.07	0.07	0.05	0.06
ECR (%)	5.8	8.4	13	16	12	18	19
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	31	34.4	33.1	29.7	28.6	21.9	20.2
Calcium (%)	77.2	67.1	62.6	59	64.4	53.7	55
Magnesium (%)	16.9	24.5	24.2	25	23.8	27.9	26.4
Potassium (%)	5.7	1.7	1.8	1.6	1.7	1.4	1.5
Sodium (%)	<0.2	6.7	11	14	10	17	17
Aluminium (%)	0	0	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	<5	870	1500	1500	1700	1600	1100
Salinity EC 1:5 (dS/m)	0.11	0.8	1.2	1.1	1.3	1.1	0.83
Boron (mg/kg)	1.1	-	-	-	-	-	-
Iron (Fe) (mg/kg)	12	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	13	-	-	-	-	-	-
Copper (Cu) (mg/kg)	1.4	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.67	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.23	0.11	-	-	-	-	-
TDS (mg(/L)	72	510	740	720	820	710	530
% Air-dry Moisture Content (% of dry wt)	3.1	3.3	3.2	4.7	3.1	4.1	3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0309	0.033	0.0321	0.0465	0.0305	0.0413	0.0297
Moisture (dry basis) (%)	2.69	2.74	2.66	2.86	2.73	2.52	2.61
Moisture 105Â°C (dry basis) (%)	3.7	11.3	10.7	12.6	12.6	11.8	11.1

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Clay	Silty Clay	Clay
Gravel fraction (% of whole sample)	0.9	6.4	6.7	18.8	18	3.2	43.1
Sand fraction (%(< 2 mm fraction)	36.8	22.7	22.1	25.1	20.6	13.3	34.3
Silt fraction (% < 2 mm fraction)	22.5	18.3	17	16.3	20.2	27.1	17.9
Clay fraction (% < 2 mm fraction)	40.8	59	60.9	58.6	59.3	59.6	47.8
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.37	0.63	0.7	0.75	0.68	0.72	0.65
EAT	4	3	2	2	2	2	2
15 Bar (%)	20.9	22.9	22.9	23.7	22.6	22.2	16.9

'-' indicates no laboratory assessment was undertaken

Table AppC-12: Soil Chemistry for 10Ct(Ro) Analysed Site D22 (SLR Site B10 (2023)

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D22-0.00-0.10 (B25, SLR 2023)	D22-0.20-0.30 (B25, SLR 2023)	D22-0.50-0.60 (B25, SLR 2023)	D3-0.70-0.80	D22-0.90-1.00 (B25, SLR 2023)
pH 1:5 water	8.53	8.57	8.68	-	6.15
Organic Carbon (W&B)	1.33	1.25	-	-	-
Nitrate - N (2M KCl)	<1.0	<1.0	-	-	-
Ammonium - N (2M KCl)	1.2	1.1	-	-	-
Colwell Phosphorus	7.9	<5.0	-	-	-
PBI + Col P	101	118	-	-	-
Colwell Potassium	310	150	-	-	-
KCl Sulfur (S)	8.4	5.6	-	-	-
Exchangeable Calcium	23	23	19	-	11
Exchangeable Magnesium	9.3	10	11	-	10
Exchangeable Potassium	0.6	0.56	0.42	-	0.33
Exchangeable Sodium	1.4	2.7	8	-	10
Exchangeable acidity	<0.02	<0.02	-	-	-
Exchangeable aluminium	<0.02	<0.02	-	-	-
This Exchangeable hydrogen	<0.02	<0.02	-	-	-
Calcium/Magnesium Ratio	2.5	2.3	1.7	-	1.1
ECEC	34	36	39	-	32
Calcium (%)	67	63	50	-	35
Magnesium (%)	27	28	29	-	32
Potassium (%)	1.8	1.5	1.1	-	1
Sodium - ESP (%)	4	7.4	21	-	32
Aluminium (%)	0.03	0.04	0.03	-	0.5
Hydrogen (%)	0	0	0	-	0.1
CaCl2 extr. Aluminium	<0.1	-	-	-	-
Chloride	100	29	1500	1600	
EC	0.155	0.258	0.797	-	1.058
Boron	1.3	-	-	-	-
Iron (Fe)	14	-	-	-	-
Manganese (Mn)	12	-	-	-	-
Copper (Cu)	1.5	-	-	-	-
Zinc (Zn)	0.4	-	-	-	-
Oxalate ext. Molybdenum	1.2	-	-	-	-
Dumas Total Nitrogen	0.13	0.12	-	-	-
% Air-dry Moisture Content	3.5	3.6	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D22-0.00-0.10 (B25, SLR 2023)	D22-0.20-0.30 (B25, SLR 2023)	D22-0.50-0.60 (B25, SLR 2023)	D3-0.70-0.80	D22-0.90-1.00 (B25, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0345	0.0361	-	-	-
Moisture (dry basis)	5.95	7.12	7.25	-	6.23
Moisture 105Â°C (dry basis)	---	---	---	-	---
Texture (ISSS Classification)	Clay	Clay	Clay	-	Clay
Gravel fraction	2	18.2	84.1	-	27.3
Sand fraction	34.4	25.6	27.9	-	36.3
Silt fraction	16.9	16.4	15	-	19.8
Clay fraction	48.8	58	57.1	-	43.9
Moisture 40Â°C (dry basis)	0.3	3.4	7.6	-	6.6
R1 Dispersion Ratio	0.35	0.37	0.61	-	0.59
EAT	3	4	4	-	4
15 Bar (%)	20.4	20.9	21.5	18.9	-

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-13: Soil Chemistry for 10Ct(Ro), Analysed Site D22

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.00-1.10	1.30-1.40	1.60-1.70
pH 1:5 water (pH units)	6.01	6.08	5.71
pH CaCl2 (following 4A1) pH units	5.26	5.27	5
Organic Carbon (W&B) % (40°C)	-	-	-
Nitrate - N (2M KCl) (mg/kg)	-	-	-
Ammonium - N (2M KCl) (mg/kg)	-	-	-
Colwell Phosphorus (mg/kg)	-	-	-
PBI + Col P	-	-	-
Colwell Potassium (mg/kg)	-	-	-
KCl Sulfur (S) (mg/kg)	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	2010	1970	1840
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1140	1150	1120
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	103	100	109
Sodium (NH4Cl/BaCl2) (mg/kg)	2040	1860	2120
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	10	9.82	9.2
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	9.39	9.44	9.23
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.263	0.254	0.278
Sodium (NH4Cl/BaCl2) (cmol/kg)	8.89	8.1	9.21
Ca:Mg ratio	1.1	1	1
K:Mg ratio	<0.05	<0.05	<0.05
GTRI	-	-	-
ECR (%)	32	30	34
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2020	2040	1940
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1010	1050	1080
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	101	109	108
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	940	956	981
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	10.1	10.2	9.66
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	8.28	8.65	8.86
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.258	0.277	0.276

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.00-1.10	1.30-1.40	1.60-1.70
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	4.09	4.16	4.27
Ca:Mg ratio	1.2	1.2	1.1
K:Mg ratio	<0.05	<0.05	<0.05
ECR (%)	19	19	20
Exchangeable acidity (cmol/kg)	<0.02	<0.02	0.62
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	0.55
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	0.07
ECEC (cmol/kg)	22.7	23.2	23.7
Calcium (%)	44.4	43.7	40.8
Magnesium (%)	36.5	37.2	37.4
Potassium (%)	1.1	1.2	1.2
Sodium (%)	18	18	18
Aluminium (%)	0	0	2.3
Hydrogen (%)	0	0	0.3
CaCl2 extr. Aluminium (mg/kg)	-	-	-
Chloride (mg/kg)	1400	1500	1400
Salinity EC 1:5 (dS/m)	0.92	0.95	0.92
Boron (mg/kg)	-	-	-
Iron (Fe) (mg/kg)	-	-	-
Manganese (Mn) (mg/kg)	-	-	-
Copper (Cu) (mg/kg)	-	-	-
Zinc (Zn) (mg/kg)	-	-	-
Oxalate ext. Molybdenum (mg/kg)	-	-	-
Dumas Total Nitrogen (% dry wt)	-	-	-
TDS (mg(/L)	590	610	590
% Air-dry Moisture Content (% of dry wt)	2.7	3.3	3.1
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0265	0.0334	0.0312
Moisture (dry basis) (%)	2.56	2.23	2.11
Moisture 105Â°C (dry basis) (%)	9.4	9.7	8.7
Texture (ISSS Classification)	Clay	Clay	Silty Clay Loam
Gravel fraction (% of whole sample)	< 0.1	49.7	0.4

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.00-1.10	1.30-1.40	1.60-1.70
Sand fraction (%(< 2 mm fraction)	36.5	39.7	32.8
Silt fraction (% < 2 mm fraction)	22.6	18.4	28
Clay fraction (% < 2 mm fraction)	41	42	39.2
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.51	0.59	0.42
EAT	2	2	2
15 Bar (%)	18.3	18.5	17.8

'-' indicates no laboratory assessment was undertaken

Table AppC-14: Soil Chemistry for 11Bl(Ta), Analysed Site D24

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90
pH 1:5 water (pH units)	7.69	7.64	8.38	9.07
pH CaCl2 (following 4A1) pH units	6.38	6.72	7.5	8.11
Organic Carbon (W&B) % (40°C)	0.8	0.57	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	20	-	-
Ammonium - N (2M KCl) (mg/kg)	1.4	2.2	-	-
Colwell Phosphorus (mg/kg)	6	<5.0	-	-
PBI + Col P	51	118	-	-
Colwell Potassium (mg/kg)	300	89	-	-
KCl Sulfur (S) (mg/kg)	4.4	8.7	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	1490	1660	1920	1640
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	596	1180	1240	1090
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	201	85	100	86
Sodium (NH4Cl/BaCl2) (mg/kg)	151	1530	1570	1560
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	7.44	8.26	9.56	8.19
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	4.9	9.75	10.2	8.98
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.515	0.218	0.257	0.22
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.656	6.64	6.84	6.8
Ca:Mg ratio	1.5	0.9	0.9	0.9
K:Mg ratio	0.11	<0.05	<0.05	<0.05
GTRI	-	-	-	-
ECR (%)	8.7	28	26	29
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1450	1590	1890	1500
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	593	1150	1310	1020
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	236	106	117	91.2

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	44.7	740	860	751
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	7.24	7.91	9.41	7.47
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	4.88	9.48	10.8	8.41
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.603	0.27	0.3	0.233
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.194	3.22	3.74	3.27
Ca:Mg ratio	1.5	0.8	0.9	0.9
K:Mg ratio	0.12	<0.05	<0.05	<0.05
ECR (%)	6.2	17	17	18
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	12.9	20.9	24.3	19.4
Calcium (%)	56.1	37.9	38.8	38.6
Magnesium (%)	37.8	45.4	44.6	43.4
Potassium (%)	4.7	1.3	1.2	1.2
Sodium (%)	1.5	15	15	17
Aluminium (%)	0	0	0	0
Hydrogen (%)	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-
Chloride (mg/kg)	40	900	890	630
Salinity EC 1:5 (dS/m)	0.057	0.68	0.68	0.54
Boron (mg/kg)	0.49	-	-	-
Iron (Fe) (mg/kg)	15	-	-	-
Manganese (Mn) (mg/kg)	26	-	-	-
Copper (Cu) (mg/kg)	0.9	-	-	-
Zinc (Zn) (mg/kg)	0.46	-	-	-
Oxalate ext. Molybdenum (mg/kg)	0.64	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90
Dumas Total Nitrogen (% dry wt)	0.09	0.084	-	-
TDS (mg(/L)	37	440	430	350
% Air-dry Moisture Content (% of dry wt)	1.6	3.7	3.2	3.3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0163	0.037	0.0319	0.0325
Moisture (dry basis) (%)	1.1	2.37	2.14	1.9
Moisture 105Â°C (dry basis) (%)	2.8	12.8	10.7	9.4
Texture (ISSS Classification)	Clay Loam	Clay	Clay	Clay Loam
Gravel fraction (% of whole sample)	1.1	1.1	1.1	21
Sand fraction (%(< 2 mm fraction)	68.3	36.1	39.8	46.8
Silt fraction (% < 2 mm fraction)	10	13.3	16.3	17.3
Clay fraction (% < 2 mm fraction)	21.7	50.6	43.9	35.9
Moisture 40Â°C (dry basis) (%)	-	-	-	-
R1 Dispersion Ratio	0.47	0.43	0.65	0.56
EAT	3	2	2	2
15 Bar (%)	12.8	17.5	19.7	18.5

'-' indicates no laboratory assessment was undertaken

Table AppC-15: Soil Chemistry for 12Da(Te), Analysed Site D32 (SLR Site b12 (2023))

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D32-0.00-0.10 (B12, SLR 2023)	D32-0.20-0.30 (B12, SLR 2023)	D32-0.50-0.60 (B12, SLR 2023)	D32-0.80-0.90	(B12 0.90-1.00, SLR 2023)
pH 1:5 water	6.87	7.04	8.28	-	8.89
Organic Carbon (W&B)	1.38	0.55	-	-	-
Nitrate - N (2M KCl)	<1.0	<1.0	-	-	-
Ammonium - N (2M KCl)	5.4	<1.0	-	-	-
Colwell Phosphorus	8.2	6.2	-	-	-
PBI + Col P	38	53	-	-	-
Colwell Potassium	170	220	-	-	-
KCl Sulfur (S)	5.4	13	-	-	-
Exchangeable Calcium	8.7	8.6	11	-	14
Exchangeable Magnesium	4.4	4.4	6.6	-	8.3
Exchangeable Potassium	0.45	0.4	0.53	-	0.63
Exchangeable Sodium	0.64	0.57	0.91	-	2.7
Exchangeable acidity	<0.02	<0.02	-	-	-
Exchangeable aluminium	<0.02	<0.02	-	-	-
This Exchangeable hydrogen	<0.02	<0.02	-	-	-
Calcium/Magnesium Ratio	2	1.9	1.7	-	1.6
ECEC	14	14	19	-	25
Calcium (%)	61	61	59	-	54
Magnesium (%)	31	32	34	-	33
Potassium (%)	3.1	2.9	2.7	-	2.5
Sodium - ESP (%)	4.5	4.1	4.7	-	11
Aluminium (%)	0.09	0.08	0.06	-	0.04
Hydrogen (%)	0	0	0	-	0
CaCl2 extr. Aluminium	<0.1	-	-	-	-
Chloride	6	67	300	760	
EC	0.046	0.042	0.13	-	0.498
Boron	0.57	-	-	-	-
Iron (Fe)	12	-	-	-	-
Manganese (Mn)	19	-	-	-	-
Copper (Cu)	0.79	-	-	-	-
Zinc (Zn)	0.56	-	-	-	-
Oxalate ext. Molybdenum	0.47	-	-	-	-
Dumas Total Nitrogen	0.11	0.05	-	-	-
% Air-dry Moisture Content	1.2	1.9	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	D32-0.00-0.10 (B12, SLR 2023)	D32-0.20-0.30 (B12, SLR 2023)	D32-0.50-0.60 (B12, SLR 2023)	D32-0.80-0.90	(B12 0.90-1.00, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0117	0.0192		-	-
Moisture (dry basis)	5.95	7.12	7.25	-	6.23
Moisture 105Â°C (dry basis)	---	---	---	-	---
Texture (ISSS Classification)	Clay	Clay	Clay	-	Clay
Gravel fraction	2	18.2	84.1	-	27.3
Sand fraction	34.4	25.6	27.9	-	36.3
Silt fraction	16.9	16.4	15	-	19.8
Clay fraction	48.8	58	57.1	-	43.9
Moisture 40Â°C (dry basis)	0.3	3.4	7.6	-	6.6
R1 Dispersion Ratio	0.35	0.37	0.61	-	0.59
EAT	3	4	4	-	4
15 Bar (%)	8.5	14.5	12.9	13.3	-

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-16: Soil Chemistry for SPC 12, Analysed Site D32

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	8.67	8.66	8.46
pH CaCl2 (following 4A1) pH units	8.09	8.15	8.04
Organic Carbon (W&B) % (40°C)	-	-	-
Nitrate - N (2M KCl) (mg/kg)	-	-	-
Ammonium - N (2M KCl) (mg/kg)	-	-	-
Colwell Phosphorus (mg/kg)	-	-	-
PBI + Col P	-	-	-
Colwell Potassium (mg/kg)	-	-	-
KCl Sulfur (S) (mg/kg)	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	2160	2190	2090
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1010	1190	1210
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	247	262	286

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Sodium (NH4Cl/BaCl2) (mg/kg)	797	1100	1140
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	10.8	10.9	10.4
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	8.28	9.78	10
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.632	0.671	0.73
Sodium (NH4Cl/BaCl2) (cmol/kg)	3.47	4.78	4.95
Ca:Mg ratio	1.3	1.1	1
K:Mg ratio	0.08	0.07	0.07
GTRI			
ECR (%)	18	21	22
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1990	2020	1910
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1130	1260	1280
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	283	298	331
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	91.7	169	137
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	9.95	10.1	9.53
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	9.32	10.4	10.5
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.724	0.762	0.846
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.399	0.735	0.598
Ca:Mg ratio	1.1	1	0.9
K:Mg ratio	0.08	0.07	0.08
ECR (%)	5.5	6.8	6.7
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	20.4	22	21.5
Calcium (%)	48.8	45.8	44.3
Magnesium (%)	45.7	47.4	49
Potassium (%)	3.6	3.5	3.9
Sodium (%)	2	3.3	2.8
Aluminium (%)	0	0	0

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	-	-	-
Chloride (mg/kg)	740	1000	1300
Salinity EC 1:5 (dS/m)	0.71	0.89	1.1
Boron (mg/kg)	-	-	-
Iron (Fe) (mg/kg)	-	-	-
Manganese (Mn) (mg/kg)	-	-	-
Copper (Cu) (mg/kg)	-	-	-
Zinc (Zn) (mg/kg)	-	-	-
Oxalate ext. Molybdenum (mg/kg)	-	-	-
Dumas Total Nitrogen (% dry wt)	-	-	-
TDS (mg(/L)	450	570	700
% Air-dry Moisture Content (% of dry wt)	1.9	2.3	2.2
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0185	0.0232	0.0217
Moisture (dry basis) (%)	1.57	1.86	1.8
Moisture 105Â°C (dry basis) (%)	9.3	10.2	9.4
Texture (ISSS Classification)	Clay	Clay	Clay
Gravel fraction (% of whole sample)	13.2	50.9	7.8
Sand fraction (%(< 2 mm fraction)	49.1	43.6	43.5
Silt fraction (% < 2 mm fraction)	13.2	14.5	16.4
Clay fraction (% < 2 mm fraction)	37.7	41.9	40.1
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.59	0.57	0.5
EAT	4	2	2
15 Bar (%)	15.5	17.9	15.5

'-' indicates no laboratory assessment was undertaken

Table AppC-17: Soil Chemistry for 13Bl(Ta), Analysed Site 36

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	8	8.52	9.01	9.06	9.03	8.7	8.39
pH CaCl2 (following 4A1) pH units	6.94	7.74	8.12	8.31	8.27	7.91	7.36
Organic Carbon (W&B) % (40°C)	1.23	0.69	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	2.1	1.3	-	-	-	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-	-	-	-
PBI + Col P	86	157	-	-	-	-	-
Colwell Potassium (mg/kg)	110	72	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	6.2	5.2	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3210	3620	2720	2240	2190	1400	1010
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	794	1050	1170	1180	1090	924	605
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	115	92	82	86	89	70	53
Sodium (NH4Cl/BaCl2) (mg/kg)	79.9	324	778	839	879	777	620
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	16	18.1	13.6	11.2	10.9	6.99	5.03
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.53	8.61	9.65	9.73	8.97	7.6	4.98
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.295	0.236	0.21	0.219	0.227	0.18	0.135
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.348	1.41	3.39	3.65	3.83	3.38	2.7

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	2.4	2.1	1.4	1.1	1.2	0.9	1
K:Mg ratio	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
GTRI	-	-	-	-	-	-	-
ECR (%)	2.8	5.8	13	16	17	20	22
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3380	3900	2830	2330	5740	1560	998
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	821	1130	1320	1320	932	1030	589
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	141	90.6	84	76.5	163	64.8	42
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	12.7	58.5	116	110	157	278	211
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	16.9	19.4	14.1	11.6	28.6	7.77	4.98
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.75	9.31	10.8	10.9	7.67	8.51	4.85
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.359	0.232	0.215	0.196	0.417	0.166	0.107
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.055	0.254	0.506	0.479	0.681	1.21	0.92
Ca:Mg ratio	2.5	2.1	1.3	1.1	3.7	0.9	1
K:Mg ratio	0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05
ECR (%)	1.7	1.7	2.8	2.9	2.9	7.8	9.5
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	24	29.2	25.7	23.2	37.4	17.7	10.9
Calcium (%)	70.2	66.5	55	50.1	76.6	44	45.9
Magnesium (%)	28.1	31.8	42.2	47	20.5	48.2	44.7
Potassium (%)	1.5	0.8	0.8	0.8	1.1	0.9	1
Sodium (%)	0.2	0.9	2	2.1	1.8	6.9	8.5
Aluminium (%)	0	0	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	11	26	290	550	490	570	360
Salinity EC 1:5 (dS/m)	0.067	0.2	0.41	0.56	0.53	0.49	0.29
Boron (mg/kg)	1.1	-	-	-	-	-	-
Iron (Fe) (mg/kg)	11	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	11	-	-	-	-	-	-
Copper (Cu) (mg/kg)	0.92	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.22	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	0.98	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.1	0.084	-	-	-	-	-
TDS (mg(/L)	43	130	260	360	340	310	190
% Air-dry Moisture Content (% of dry wt)	2.9	2.6	2.6	2.4	1.9	2.3	1
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0287	0.0256	0.0262	0.0241	0.0194	0.0227	0.0103
Moisture (dry basis) (%)	1.83	2.46	2.07	1.72	1.73	1.4	1.08
Moisture 105Â°C (dry basis) (%)	5.8	9.7	8.6	7.4	7.9	6.1	5

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Sandy Clay	Sandy Clay Loam	Sandy Loam
Gravel fraction (% of whole sample)	7.2	5.5	6.1	10.2	48.8	5.5	13
Sand fraction (%(< 2 mm fraction)	55.5	49.4	49.4	52.7	62.7	63.5	78.4
Silt fraction (% < 2 mm fraction)	3.3	4.4	7.3	8.6	4	5.8	4.1
Clay fraction (% < 2 mm fraction)	41.2	46.3	43.4	38.7	33.3	30.7	17.5
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.24	0.26	0.35	0.37	0.59	0.57	0.38
EAT	3	4	4	4	4	2	2
15 Bar (%)	18.7	19.9	12.9	17.8	14.3	15.2	9.1

'-' indicates no laboratory assessment was undertaken

Table AppC-18: Soil Chemistry for 14Bl(Ro), Analysed Site D32 (SLR Site B05 (2023))

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10 (B05, SLR 2023)	0.20-0.30 (B05, SLR 2023)	0.50-0.60 (B05, SLR 2023)	0.80-0.90	0.90-1.00, (B05, SLR 2023)
pH 1:5 water	8.2	8.91	9.03	-	8.97
Organic Carbon (W&B)	1.31	1.22	-	-	-
Nitrate - N (2M KCl)	<1.0	<1.0	-	-	-
Ammonium - N (2M KCl)	2.1	1.3	-	-	-
Colwell Phosphorus	<5.0	<5.0	-	-	-
PBI + Col P	119	112	-	-	-
Colwell Potassium	120	110	-	-	-
KCl Sulfur (S)	4	6.8	-	-	-
Exchangeable Calcium	29	39	36	-	28
Exchangeable Magnesium	6.8	9.3	13	-	12
Exchangeable Potassium	1	0.47	0.48	-	0.34
Exchangeable Sodium	0.37	1.7	4.2	-	0.34
Exchangeable acidity	<0.02	<0.02	-	-	-
Exchangeable aluminium	<0.02	<0.02	-	-	-
This Exchangeable hydrogen	<0.02	<0.02	-	-	-
Calcium/Magnesium Ratio	4.3	4.2	2.8	-	2.4
ECEC	37	51	53	-	45
Calcium (%)	78	77	67	-	61
Magnesium (%)	18	18	24	-	26
Potassium (%)	2.8	0.94	0.91	-	0.76
Sodium - ESP (%)	0.98	3.3	7.9	-	13
Aluminium (%)	0.03	0.02	0.01	-	0.01
Hydrogen (%)	0	0	0	-	0
CaCl2 extr. Aluminium	<0.1	-	-	-	-
Chloride	14	340	580	1500	-
EC	0.128	0.159	0.298	-	0.688
Boron	0.9	-	-	-	-
Iron (Fe)	15	-	-	-	-
Manganese (Mn)	6.8	-	-	-	-
Copper (Cu)	1.2	-	-	-	-
Zinc (Zn)	0.12	-	-	-	-
Oxalate ext. Molybdenum	1.3	-	-	-	-
Dumas Total Nitrogen	0.15	0.1	-	-	-
% Air-dry Moisture Content	3.3	3.7	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10 (B05, SLR 2023)	0.20-0.30 (B05, SLR 2023)	0.50-0.60 (B05, SLR 2023)	0.80-0.90	0.90-1.00, (B05, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0332	0.0365	-	-	-
Moisture (dry basis)	7.97	8.2	7.92	7.77	-
Moisture 105Â°C (dry basis)	-	-	-	-	-
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	-
Gravel fraction	17.7	32.3	< 0.1	2.7	-
Sand fraction	30.1	27.7	29.4	29.9	-
Silt fraction	16.3	14.1	14.3	10.4	-
Clay fraction	53.6	58.2	56.3	59.8	-
Moisture 40Â°C (dry basis)	-	-	-	-	-
R1 Dispersion Ratio	0.29	0.49	0.49	0.44	-
EAT	4	4	4	-	4
15 Bar (%)	8.5	14.5	12.9	13.3	-

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-19: Soil Chemistry for SPC 14, Analysed Site D37

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	8.5	8.99	8.99
pH CaCl2 (following 4A1) pH units	7.91	8.18	8.26
Organic Carbon (W&B) % (40°C)	-	-	-
Nitrate - N (2M KCl) (mg/kg)	-	-	-
Ammonium - N (2M KCl) (mg/kg)	-	-	-
Colwell Phosphorus (mg/kg)	-	-	-
PBI + Col P	-	-	-
Colwell Potassium (mg/kg)	-	-	-
KCl Sulfur (S) (mg/kg)	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3360	3000	2880
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1060	992	1030
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	132	91	82

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Sodium (NH4Cl/BaCl2) (mg/kg)	1630	1590	1660
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	16.8	15	14.4
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	8.7	8.16	8.47
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.337	0.233	0.21
Sodium (NH4Cl/BaCl2) (cmol/kg)	7.11	6.91	7.24
Ca:Mg ratio	1.9	1.8	1.7
K:Mg ratio	<0.05	<0.05	<0.05
GTRI			
ECR (%)	23	24	25
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3620	3170	3050
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1170	1110	1220
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	135	91.4	89.6
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	563	601	787
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	18	15.8	15.2
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	9.62	9.09	10.1
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.346	0.234	0.229
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	2.45	2.61	3.42
Ca:Mg ratio	1.9	1.7	1.5
K:Mg ratio	<0.05	<0.05	<0.05
ECR (%)	9.2	10	13
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	30.5	27.8	28.9
Calcium (%)	59.2	57	52.6
Magnesium (%)	31.6	32.7	34.8
Potassium (%)	1.1	0.8	0.8
Sodium (%)	8	9.4	12
Aluminium (%)	0	0	0

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	-	-	-
Chloride (mg/kg)	1400	960	990
Salinity EC 1:5 (dS/m)	1	0.81	0.81
Boron (mg/kg)	-	-	-
Iron (Fe) (mg/kg)	-	-	-
Manganese (Mn) (mg/kg)	-	-	-
Copper (Cu) (mg/kg)	-	-	-
Zinc (Zn) (mg/kg)	-	-	-
Oxalate ext. Molybdenum (mg/kg)	-	-	-
Dumas Total Nitrogen (% dry wt)	-	-	-
TDS (mg(/L)	640	520	520
% Air-dry Moisture Content (% of dry wt)	2.9	3.2	3.3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0285	0.0317	0.0328
Moisture (dry basis) (%)	3.6	2.73	2.53
Moisture 105Â°C (dry basis) (%)	12	8.2	9.5
Texture (ISSS Classification)	Clay	Clay	Clay
Gravel fraction (% of whole sample)	5.6	8.6	66.4
Sand fraction (%(< 2 mm fraction)	36.6	49.5	46.1
Silt fraction (% < 2 mm fraction)	13.3	13.7	14.4
Clay fraction (% < 2 mm fraction)	50.2	36.8	39.5
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.52	0.52	0.47
EAT	3	2	2
15 Bar (%)	15.5	17.9	15.5

'-' indicates no laboratory assessment was undertaken

Table AppC-20: Soil Chemistry for 15Bl(Ro), Analysed Site D39

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20
pH 1:5 water (pH units)	7.78	8.54	8.78	9.3	9.28
pH CaCl2 (following 4A1) pH units	6.85	7.8	7.97	8.4	8.48
Organic Carbon (W&B) % (40°C)	1.5	1.61	-	-	-
Nitrate - N (2M KCl) (mg/kg)	1	8.9	-	-	-
Ammonium - N (2M KCl) (mg/kg)	1.5	<1.0	-	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-	-
PBI + Col P	107	141	-	-	-
Colwell Potassium (mg/kg)	160	130	-	-	-
KCl Sulfur (S) (mg/kg)	4.3	11	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	4270	5190	3930	2880	2830
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	505	615	610	935	793
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	171	146	85	71	79
Sodium (NH4Cl/BaCl2) (mg/kg)	158	313	684	2660	2230
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	21.3	25.9	19.6	14.4	14.1
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	4.15	5.06	5.02	7.69	6.52
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.437	0.373	0.216	0.182	0.202
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.686	1.36	2.97	11.6	9.72
Ca:Mg ratio	5.1	5.1	3.9	1.9	2.2
K:Mg ratio	0.11	0.07	<0.05	<0.05	<0.05
GTRI					
ECR (%)	4.2	5.3	11	35	32

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3960	4840	3510	3080	3140
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	450	616	540	907	803
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	201	161	73.7	57.2	69
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	44.4	57.2	84.5	836	892
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	19.8	24.1	17.5	15.4	15.7
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	3.7	5.07	4.45	7.46	6.61
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.515	0.412	0.188	0.146	0.176
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.193	0.249	0.368	3.64	3.88
Ca:Mg ratio	5.3	4.8	3.9	2.1	2.4
K:Mg ratio	0.14	0.08	<0.05	<0.05	<0.05
ECR (%)	2.9	2.2	2.5	14	15
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	24.2	29.9	22.5	26.6	26.3
Calcium (%)	81.8	80.8	77.8	57.7	59.5
Magnesium (%)	15.3	17	19.7	28	25.1
Potassium (%)	2.1	1.4	0.8	0.6	0.7
Sodium (%)	0.8	0.8	1.6	14	15
Aluminium (%)	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-
Chloride (mg/kg)	17	45	250	860	720
Salinity EC 1:5 (dS/m)	0.065	0.2	0.36	0.86	0.78

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20
Boron (mg/kg)	1.1	-	-	-	-
Iron (Fe) (mg/kg)	11	-	-	-	-
Manganese (Mn) (mg/kg)	16	-	-	-	-
Copper (Cu) (mg/kg)	1.4	-	-	-	-
Zinc (Zn) (mg/kg)	0.2	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.3	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.19	0.13	-	-	-
TDS (mg(/L)	42	130	230	550	500
% Air-dry Moisture Content (% of dry wt)	2.7	2.3	2.5	3.1	2.8
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0274	0.0233	0.0254	0.0307	0.0283
Moisture (dry basis) (%)	2.22	2.26	1.73	2.23	2.18
Moisture 105Â°C (dry basis) (%)	6.4	8.3	8.1	9.4	9.6
Texture (ISSS Classification)	Clay	Clay	Clay	Clay	Silty Clay Loam
Gravel fraction (% of whole sample)	3.7	0.5	20.4	43.1	55.5
Sand fraction (%(< 2 mm fraction)	43.3	40.9	56.2	34.6	31.6
Silt fraction (% < 2 mm fraction)	10.1	12	9.9	22.7	28.7
Clay fraction (% < 2 mm fraction)	46.6	47.2	33.9	42.8	39.7
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-
R1 Dispersion Ratio	0.26	0.22	0.54	0.67	0.64
EAT	3	4	4	2	2
15 Bar (%)	19.5	19.2	15.3	21.7	22.8

'-' indicates no laboratory assessment was undertaken

Table AppC-21: Soil Chemistry for 16Bl(Ta), Analysed Site D43

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
pH 1:5 water (pH units)	7.4	8.15	8.72
pH CaCl2 (following 4A1) pH units	6.16	6.99	7.76
Organic Carbon (W&B) % (40°C)	0.68	0.83	-
Nitrate - N (2M KCl) (mg/kg)	<1.0	<1.0	-
Ammonium - N (2M KCl) (mg/kg)	1.3	1.1	-
Colwell Phosphorus (mg/kg)	6.5	<5.0	-
PBI + Col P	56	89	-
Colwell Potassium (mg/kg)	240	140	-
KCl Sulfur (S) (mg/kg)	4.8	7	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	1750	2530	2860
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	625	1110	1230
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	148	125	143
Sodium (NH4Cl/BaCl2) (mg/kg)	297	700	896
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	8.71	12.6	14.3
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	5.14	9.11	10.1
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.377	0.32	0.366
Sodium (NH4Cl/BaCl2) (cmol/kg)	1.29	3.04	3.9
Ca:Mg ratio	1.7	1.4	1.4
K:Mg ratio	0.07	<0.05	<0.05
GTRI	-	-	-
ECR (%)	11	13	15
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1640	2570	2670
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	589	1130	1140
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	178	158	141
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	130	378	357
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	8.16	12.8	13.3
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	4.85	9.3	9.39
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.454	0.405	0.362

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.565	1.64	1.55
Ca:Mg ratio	1.7	1.4	1.4
K:Mg ratio	0.09	<0.05	<0.05
ECR (%)	7.3	8.5	7.8
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	14	24.2	24.6
Calcium (%)	58.2	53	54.1
Magnesium (%)	34.6	38.5	38.1
Potassium (%)	3.2	1.7	1.5
Sodium (%)	4	6.8	6.3
Aluminium (%)	0	0	0
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-
Chloride (mg/kg)	87	240	270
Salinity EC 1:5 (dS/m)	0.094	0.22	0.32
Boron (mg/kg)	0.56	-	-
Iron (Fe) (mg/kg)	14	-	-
Manganese (Mn) (mg/kg)	22	-	-
Copper (Cu) (mg/kg)	1.1	-	-
Zinc (Zn) (mg/kg)	0.56	-	-
Oxalate ext. Molybdenum (mg/kg)	0.79	-	-
Dumas Total Nitrogen (% dry wt)	0.096	0.11	-
TDS (mg(/L)	60	140	210
% Air-dry Moisture Content (% of dry wt)	1.5	4	3.3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0149	0.0396	0.0328
Moisture (dry basis) (%)	1.62	2.75	2.8
Moisture 105Â°C (dry basis) (%)	5.9	10.9	11
Texture (ISSS Classification)	Clay Loam	Clay	Clay
Gravel fraction (% of whole sample)	1.9	6.8	1.3

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	0.00-0.10	0.20-0.30	0.50-0.60
Sand fraction (%(< 2 mm fraction)	57.7	34.8	36.9
Silt fraction (% < 2 mm fraction)	14.8	13.9	11.6
Clay fraction (% < 2 mm fraction)	27.5	51.3	51.5
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.59	0.63	0.65
EAT	2	2	2
15 Bar (%)	15.5	22.7	21.6

'-' indicates no laboratory assessment was undertaken

Table AppC-22: Soil Chemistry for SPC 14Bl(Ro), Analysed Site D44 (SLR Site B01 (2023))

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10 (B01, SLR 2023)	0.10-0.20	0.20-0.30 (B01, SLR 2023)	0.50-0.60 (B01, SLR 2023)	0.80-0.90	(B01 0.9-1.0, SLR 2023)
pH 1:5 water	6.79		7.68	9.03	-	9.19
Organic Carbon (W&B)	1.89	1.35	-	-	-	-
Nitrate - N (2M KCl)	3.7	<1.0	-	-	-	-
Ammonium - N (2M KCl)	1.6	1.2	-	-	-	-
Colwell Phosphorus	<5.0	<5.0	-	-	-	-
PBI + Col P	60	74	-	-	-	-
Colwell Potassium	310	86	-	-	-	-
KCl Sulfur (S)	5.4	3.7	-	-	-	-
Exchangeable Calcium	11		11	22	-	13
Exchangeable Magnesium	2.1		2.7	9.3	-	1.8
Exchangeable Potassium	0.55		0.21	0.27	-	<0.12
Exchangeable Sodium	0.4		1.1	4.5	-	1.3
Exchangeable acidity	<0.02	<0.02	-	-	-	-
Exchangeable aluminium	<0.02	<0.02	-	-	-	-
This Exchangeable hydrogen	<0.02	<0.02	-	-	-	-
Calcium/Magnesium Ratio	5		4.2	2.4	-	7.4
ECEC	14		15	36	-	17
Calcium (%)	77		74	61	-	81
Magnesium (%)	16		18	26	-	11
Potassium (%)	4		1.4	0.74	-	0.3
Sodium - ESP (%)	2.9		7.3	12	-	7.6
Aluminium (%)	0.08		0.04	0.04	-	0.09
Hydrogen (%)	0		0	0	-	0
CaCl2 extr. Aluminium	<0.1	-	-	-	-	-
Chloride	21	15	120	630	830	
EC	0.151		0.125	0.402	-	0.609
Boron	0.56	-	-	-	-	-
Iron (Fe)	18	-	-	-	-	-
Manganese (Mn)	34	-	-	-	-	-
Copper (Cu)	1.2	-	-	-	-	-
Zinc (Zn)	0.78	-	-	-	-	-
Oxalate ext. Molybdenum	0.62	-	-	-	-	-
Dumas Total Nitrogen	0.16	0.11	-	-	-	-
% Air-dry Moisture Content	1.8	2.2	-	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon					
	0.00-0.10 (B01, SLR 2023)	0.10-0.20	0.20-0.30 (B01, SLR 2023)	0.50-0.60 (B01, SLR 2023)	0.80-0.90	(B01 0.9-1.0, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0183	0.0215	-	-	-	-
Moisture (dry basis)	3.77	4.78	7.9	7.5	6.24	2.79
Moisture 105Â°C (dry basis)	---	---	---	---	---	10.8
Texture (ISSS Classification)	Clay Loam	Clay	Clay	Clay	Clay	Clay
Gravel fraction	2.5	11	20.9	4.7	13.4	11.7
Sand fraction	55.7	50.9	30.7	33.1	37.2	39.6
Silt fraction	16.9	13.8	9.3	9.3	9.2	10.5
Clay fraction	27.5	35.4	60	57.6	53.7	50
Moisture 40Â°C (dry basis)	1.9	3.9	9.5	8.5	9.3	-
R1 Dispersion Ratio	0.37	0.3	0.46	0.6	0.67	0.74
EAT	3	-	3	2	-	-
15 Bar (%)	11.3	12.7	22.8	20.1	17.9	-

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-23: Soil Chemistry for 17Bl(Ro), Analysed Site D44

Analysis (Unit)	Sample Depth (mbgl) / Horizon
	1.10-1.20
pH 1:5 water (pH units)	8.54
pH CaCl2 (following 4A1) pH units	7.72
Organic Carbon (W&B) % (40°C)	-
Nitrate - N (2M KCl) (mg/kg)	-
Ammonium - N (2M KCl) (mg/kg)	-
Colwell Phosphorus (mg/kg)	-
PBI + Col P	-
Colwell Potassium (mg/kg)	-
KCl Sulfur (S) (mg/kg)	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	2610
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	1110
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	103
Sodium (NH4Cl/BaCl2) (mg/kg)	1730
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	13
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	9.12
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.264
Sodium (NH4Cl/BaCl2) (cmol/kg)	7.52
Ca:Mg ratio	1.4
K:Mg ratio	<0.05
GTRI	
ECR (%)	26
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2700
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1170
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	98.8
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	834

Analysis (Unit)	Sample Depth (mbgl) / Horizon
	1.10-1.20
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	13.5
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	9.66
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.253
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	3.63
Ca:Mg ratio	1.4
K:Mg ratio	<0.05
ECR (%)	14
Exchangeable acidity (cmol/kg)	<0.02
Exchangeable aluminium (cmol/kg)	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02
ECEC (cmol/kg)	27
Calcium (%)	49.9
Magnesium (%)	35.7
Potassium (%)	0.9
Sodium (%)	13
Aluminium (%)	0
Hydrogen (%)	0
CaCl2 extr. Aluminium (mg/kg)	-
Chloride (mg/kg)	860
Salinity EC 1:5 (dS/m)	0.68
Boron (mg/kg)	-
Iron (Fe) (mg/kg)	-
Manganese (Mn) (mg/kg)	-
Copper (Cu) (mg/kg)	-
Zinc (Zn) (mg/kg)	-
Oxalate ext. Molybdenum (mg/kg)	-
Dumas Total Nitrogen (% dry wt)	-
TDS (mg(/L)	430
% Air-dry Moisture Content (% of dry wt)	2.9

Analysis (Unit)	Sample Depth (mbgl) / Horizon
	1.10-1.20
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0287
Moisture (dry basis) (%)	2.79
Moisture 105Â°C (dry basis) (%)	10.8
Texture (ISSS Classification)	Clay
Gravel fraction (% of whole sample)	11.7
Sand fraction (%(< 2 mm fraction)	39.6
Silt fraction (% < 2 mm fraction)	10.5
Clay fraction (% < 2 mm fraction)	50
Moisture 40Â°C (dry basis) (%)	---
R1 Dispersion Ratio	0.74
EAT	2
15 Bar (%)	18.2

'-' indicates no laboratory assessment was undertaken

Table AppC-24: Soil Chemistry for 18Bl(Ro), Analysed Site D45

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	7.54	8.25	8.16	7.71	7.28	6.51	6.95
pH CaCl2 (following 4A1) pH units	6.88	7.52	7.52	7.29	6.75	5.92	6.33
Organic Carbon (W&B) % (40°C)	1.35	1.34	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	1.5	<1.0	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	<1.0	1.5	-	-	-	-	-
Colwell Phosphorus (mg/kg)	7.2	<5.0	-	-	-	-	-
PBI + Col P	49	96	-	-	-	-	-
Colwell Potassium (mg/kg)	540	210	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	5.9	5.5	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3570	4360	5010	4990	4920	4550	3960
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	496	636	868	1020	987	905	806
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	477	203	195	210	243	251	214
Sodium (NH4Cl/BaCl2) (mg/kg)	16.3	69.6	480	681	724	714	626
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	17.8	21.7	25	24.9	24.6	22.7	19.8
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	4.08	5.23	7.14	8.37	8.12	7.45	6.63
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	1.22	0.519	0.499	0.537	0.62	0.642	0.546
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.071	0.303	2.09	2.96	3.15	3.11	2.72

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Ca:Mg ratio	4.4	4.2	3.5	3	3	3	3
K:Mg ratio	0.3	0.1	0.07	0.06	0.08	0.09	0.08
GTRI							
ECR (%)	5.6	3	7.4	9.5	10	11	11
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2820	4220	4460	4570	4240	3650	3420
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	408	611	847	915	879	746	732
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	421	226	204	214	252	257	226
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	<6.0	17.3	103	121	143	155	143
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	14.1	21.1	22.3	22.8	21.1	18.2	17.1
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	3.36	5.03	6.97	7.53	7.23	6.14	6.03
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	1.08	0.579	0.523	0.546	0.643	0.657	0.577
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.024	0.075	0.446	0.524	0.62	0.674	0.621
Ca:Mg ratio	4.2	4.2	3.2	3	2.9	3	2.8
K:Mg ratio	0.32	0.12	0.08	0.07	0.09	0.11	0.1
ECR (%)	5.9	2.4	3.2	3.4	4.3	5.2	4.9
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
ECEC (cmol/kg)	18.5	26.8	30.2	31.4	29.6	25.7	24.3
Calcium (%)	75.9	78.8	73.7	72.6	71.3	70.9	70.3
Magnesium (%)	18.1	18.8	23.1	24	24.4	23.9	24.8
Potassium (%)	5.8	2.2	1.7	1.7	2.2	2.6	2.4
Sodium (%)	<0.2	0.3	1.5	1.7	2.1	2.6	2.6
Aluminium (%)	0	0	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-
Chloride (mg/kg)	40	13	280	760	760	750	630
Salinity EC 1:5 (dS/m)	0.092	0.081	0.31	0.58	0.57	0.54	0.47
Boron (mg/kg)	0.79	-	-	-	-	-	-
Iron (Fe) (mg/kg)	11	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	7.6	-	-	-	-	-	-
Copper (Cu) (mg/kg)	0.93	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.47	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	0.66	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.12	0.13	-	-	-	-	-
TDS (mg(/L)	59	52	200	370	370	350	300
% Air-dry Moisture Content (% of dry wt)	2.1	2.4	4	3.9	3.9	3.8	3.9
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0214	0.0241	0.0403	0.0386	0.0387	0.0383	0.0388
Moisture (dry basis) (%)	1.57	2.21	2.66	2.7	2.69	2.77	2.29
Moisture 105Â°C (dry basis) (%)	6.4	10.4	11.5	12.1	13.6	13.6	12.3

Analysis (Unit)	Sample Depth (mbgl) / Horizon						
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80
Texture (ISSS Classification)	Clay Loam	Clay	Clay	Clay	Clay	Clay	Clay
Gravel fraction (% of whole sample)	0.8	0.2	43.6	10.1	< 0.1	4.8	1.9
Sand fraction (%(< 2 mm fraction)	52.6	35.1	29.9	23.5	26.7	26.3	32
Silt fraction (% < 2 mm fraction)	16.4	20.3	18.2	20.3	19.4	22.4	19.4
Clay fraction (% < 2 mm fraction)	31	44.6	51.9	56.3	53.9	51.3	48.6
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.49	0.33	0.31	0.35	0.53	0.56	0.61
EAT	3	4	4	4	2	2	2
15 Bar (%)	16.9	20.2	22.8	23.6	26	25.3	22.6

'-' indicates no laboratory assessment was undertaken

Table AppC-25: Soil Chemistry for 19Bl(Ro), Analysed Site D52

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
pH 1:5 water (pH units)	7.48	8.03	9.23	9.14	8.99	9.02	9.09	7.91
pH CaCl2 (following 4A1) pH units	6.38	7.11	8.21	8.4	8.33	8.29	8.32	7.1
Organic Carbon (W&B) % (40°C)	1.14	0.47	-	-	-	-	-	-
Nitrate - N (2M KCl) (mg/kg)	2.6	<1.0	-	-	-	-	-	-
Ammonium - N (2M KCl) (mg/kg)	2.3	1.2	-	-	-	-	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-	-	-	-	-
PBI + Col P	60	78	-	-	-	-	-	-
Colwell Potassium (mg/kg)	260	110	-	-	-	-	-	-
KCl Sulfur (S) (mg/kg)	4.4	3.5	-	-	-	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	2300	2330	1890	1480	1710	1210	1360	-
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	366	467	1040	1040	1270	990	994	-
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	226	121	99	97	101	80	88	-
Sodium (NH4Cl/BaCl2) (mg/kg)	24.3	80.9	829	1080	1310	1200	1210	-
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	11.5	11.6	9.43	7.41	8.52	6.06	6.78	-
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	3.01	3.84	8.55	8.55	10.5	8.14	8.18	-
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.579	0.309	0.253	0.247	0.257	0.205	0.224	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.106	0.352	3.6	4.72	5.71	5.21	5.25	-
Ca:Mg ratio	3.8	3	1.1	0.9	0.8	0.7	0.8	-
K:Mg ratio	0.19	0.08	<0.05	<0.05	<0.05	<0.05	<0.05	-
GTRI								-
ECR (%)	4.5	4.1	18	24	24	28	27	-
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	2130	2280	1720	1470	1530	1140	1220	-
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	340	435	1030	1120	1280	1020	986	-
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	263	122	88.7	98.2	85.7	77.9	78.5	-
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	<6.0	14.6	78.1	186	256	213	329	-
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	10.6	11.4	8.59	7.32	7.62	5.67	6.08	-
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	2.8	3.58	8.44	9.22	10.5	8.38	8.11	-
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.673	0.311	0.227	0.251	0.219	0.199	0.201	-
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	<0.020	0.064	0.34	0.81	1.11	0.925	1.43	-
Ca:Mg ratio	3.8	3.2	1	0.8	0.7	0.7	0.8	-
K:Mg ratio	0.24	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	-
ECR (%)	4.8	2.4	3.2	6	6.8	7.4	10	-
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
ECEC (cmol/kg)	14.1	15.3	17.6	17.6	19.5	15.2	15.8	-
Calcium (%)	75.3	74.2	48.8	41.6	39.1	37.4	38.4	-
Magnesium (%)	19.8	23.3	48	52.4	54.1	55.2	51.3	-
Potassium (%)	4.8	2	1.3	1.4	1.1	1.3	1.3	-
Sodium (%)	<0.2	0.4	1.9	4.6	5.7	6.1	9	-
Aluminium (%)	0	0	0	0	0	0	0	-
Hydrogen (%)	0	0	0	0	0	0	0	-
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-	-	-	-
Chloride (mg/kg)	10	49	310	670	760	840	710	810
Salinity EC 1:5 (dS/m)	0.038	0.054	0.45	0.69	0.85	0.8	0.74	0.7
Boron (mg/kg)	0.74	-	-	-	-	-	-	-
Iron (Fe) (mg/kg)	14	-	-	-	-	-	-	-
Manganese (Mn) (mg/kg)	21	-	-	-	-	-	-	-
Copper (Cu) (mg/kg)	1.2	-	-	-	-	-	-	-
Zinc (Zn) (mg/kg)	0.28	-	-	-	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	0.68	-	-	-	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.097	0.077	-	-	-	-	-	-
TDS (mg(/L)	24	35	290	440	540	510	470	450
% Air-dry Moisture Content (% of dry wt)	1.8	1.5	1.6	1.5	2.3	1.4	1.7	-
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0178	0.0146	0.0164	0.015	0.0231	0.0144	0.0165	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon							
	0.00-0.10	0.20-0.30	0.50-0.60	0.80-0.90	1.10-1.20	1.40-1.50	1.70-1.80	2.00-2.10
Moisture (dry basis) (%)	1.34	1.49	1.31	1.68	1.92	2.07	1.58	-
Moisture 105Â°C (dry basis) (%)	6.5	6.4	6.4	6	7.4	7.2	6.6	-
Texture (ISSS Classification)	Clay	Sandy Clay	Clay	Clay	Clay	Clay	Clay	-
Gravel fraction (% of whole sample)	2.7	1.9	4.2	16.5	18.1	19.3	3.9	-
Sand fraction (%(< 2 mm fraction)	61.3	62.4	54.6	54	46.6	51.7	54.7	-
Silt fraction (% < 2 mm fraction)	7.1	5.6	11.5	10.9	13.5	11.5	10.3	-
Clay fraction (% < 2 mm fraction)	31.7	32	34	35.2	39.9	36.8	35.1	-
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-	-	-	-
R1 Dispersion Ratio	0.32	0.39	0.62	0.66	0.72	0.72	0.63	-
EAT	3	4	4	2	2	2	2	-
15 Bar (%)	12.7	13.6	15	15.2	15.4	14.3	13.7	-

'-' indicates no laboratory assessment was undertaken

Table AppC-26: Soil Chemistry for SPC 20BI(Ro), Analysed Site D58

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.70-0.80
pH 1:5 water (pH units)	8.49	8.61	9.01	8.93
pH CaCl2 (following 4A1) pH units	7.5	7.58	8.16	8.2
Organic Carbon (W&B) % (40°C)	1.07	1.15	-	-
Nitrate - N (2M KCl) (mg/kg)	2.5	1.5	-	-
Ammonium - N (2M KCl) (mg/kg)	1.3	1.1	-	-
Colwell Phosphorus (mg/kg)	<5.0	<5.0	-	-
PBI + Col P	92	78	-	-
Colwell Potassium (mg/kg)	190	130	-	-
KCl Sulfur (S) (mg/kg)	5	10	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	3910	3870	2980	2790
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	723	751	847	878
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	181	152	111	104
Sodium (NH4Cl/BaCl2) (mg/kg)	228	657	1070	1140
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	19.5	19.3	14.9	13.9
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	5.95	6.18	6.97	7.23
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.463	0.388	0.284	0.267
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.991	2.86	4.67	4.94
Ca:Mg ratio	3.3	3.1	2.1	1.9
K:Mg ratio	0.08	0.06	<0.05	<0.05
GTRI	-	-	-	-
ECR (%)	5.4	11	18	20
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	3930	3730	3150	2470
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	750	769	915	853
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	218	183	124	121

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.70-0.80
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	62.4	291	193	211
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	19.6	18.6	15.7	12.3
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.17	6.33	7.52	7.02
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.557	0.469	0.318	0.31
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.271	1.27	0.837	0.918
Ca:Mg ratio	3.2	2.9	2.1	1.8
K:Mg ratio	0.09	0.07	<0.05	<0.05
ECR (%)	3.1	6.5	4.7	6
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	26.6	26.7	24.4	20.6
Calcium (%)	73.7	69.7	64.4	60
Magnesium (%)	23.2	23.7	30.9	34.1
Potassium (%)	2.1	1.8	1.3	1.5
Sodium (%)	1	4.7	3.4	4.5
Aluminium (%)	0	0	0	0
Hydrogen (%)	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-
Chloride (mg/kg)	29	140	500	540
Salinity EC 1:5 (dS/m)	0.1	0.22	0.56	0.58
Boron (mg/kg)	0.81	-	-	-
Iron (Fe) (mg/kg)	11	-	-	-
Manganese (Mn) (mg/kg)	6.8	-	-	-
Copper (Cu) (mg/kg)	1.3	-	-	-
Zinc (Zn) (mg/kg)	0.31	-	-	-
Oxalate ext. Molybdenum (mg/kg)	1.1	-	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon			
	0.00-0.10	0.20-0.30	0.50-0.60	0.70-0.80
Dumas Total Nitrogen (% dry wt)	0.13	0.1		
TDS (mg(/L)	66	140	360	370
% Air-dry Moisture Content (% of dry wt)	3.5	3.6	2.8	2.6
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0352	0.036	0.0276	0.0255
Moisture (dry basis) (%)	2.35	3.08	1.78	1.68
Moisture 105Â°C (dry basis) (%)	10.4	10.3	8.9	8.5
Texture (ISSS Classification)	Clay	Clay	Clay	Clay
Gravel fraction (% of whole sample)	1	0.5	0.7	3
Sand fraction (%(< 2 mm fraction)	42.2	42.1	48.3	56.1
Silt fraction (% < 2 mm fraction)	14.7	14.7	10	7.3
Clay fraction (% < 2 mm fraction)	43.1	43.2	41.7	36.7
Moisture 40Â°C (dry basis) (%)	-	-	-	-
R1 Dispersion Ratio	0.35	0.55	0.51	0.62
EAT	3	2	3	2
15 Bar (%)	20.9	22.7	18.4	18.1

'-' indicates no laboratory assessment was undertaken

Table AppC-27: Soil Chemistry for 21Bl(Ta), Analysed Site D59 (SLR Site B21 (2023))

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10 (B21, SLR 2023)	0.20-0.30 (B21, SLR 2023)	0.50-0.60 (B21, SLR 2023)	D59-0.80-0.90	(B21 0.9-1.0, SLR 2023)
pH 1:5 water	7.83	8.81	9.25	-	9.25
Organic Carbon (W&B)	0.35	-	0.22	-	-
Nitrate - N (2M KCl)	<1.0	-	<1.0	-	-
Ammonium - N (2M KCl)	<1.0	-	<1.0	-	-
Colwell Phosphorus	<5.0	-	<5.0	-	-
PBI + Col P	21	-	73	-	-
Colwell Potassium	130	-	180	-	-
KCl Sulfur (S)	<2.5	-	4.8	-	-
Exchangeable Calcium	5.4	7.6	6.8	-	20
Exchangeable Magnesium	0.91	6.3	7.7	-	9
Exchangeable Potassium	0.38	0.33	0.37	-	0.35
Exchangeable Sodium	<0.065	0.98	2.1	-	5.8
Exchangeable acidity	<0.02	-	<0.02	-	-
Exchangeable aluminium	<0.02	-	<0.02	-	-
This Exchangeable hydrogen	<0.02	-	<0.02	-	-
Calcium/Magnesium Ratio	6	1.2	0.88	-	2.2
ECEC	6.8	15	17	-	35
Calcium (%)	80	50	40	-	57
Magnesium (%)	13	41	45	-	26
Potassium (%)	5.6	2.2	2.2	-	1
Sodium - ESP (%)	0.52	6.4	12	-	17
Aluminium (%)	0.17	0.1	0.07	-	0.02
Hydrogen (%)	0	0	0	-	0
CaCl2 extr. Aluminium	<0.1	-	-	-	-
Chloride	<5	5	51	170	-
EC	0.067	0.05	0.131		0.731
Boron	0.26	-	-	-	-
Iron (Fe)	4.3	-	-	-	-
Manganese (Mn)	4.7	-	-	-	-
Copper (Cu)	0.47	-	-	-	-
Zinc (Zn)	<0.08	-	-	-	-
Oxalate ext. Molybdenum	<0.25	-	-	-	-
Dumas Total Nitrogen	0.035	-	0.05	-	-
% Air-dry Moisture Content	0.3	-	1.7	-	-

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.10 (B21, SLR 2023)	0.20-0.30 (B21, SLR 2023)	0.50-0.60 (B21, SLR 2023)	D59-0.80-0.90	(B21 0.9-1.0, SLR 2023)
S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	0.0032	-	0.0169	-	-
Moisture (dry basis)	1.18	1.11	4.54	4.41	-
Moisture 105Â°C (dry basis)	-	-	-	-	-
Texture (ISSS Classification)	Sandy Loam	Sandy Loam	Sandy Clay	Clay	-
Gravel fraction	4.7	5.7	2	6.4	-
Sand fraction	87.5	83.5	57.5	57.5	-
Silt fraction	2	5.1	3.4	4.8	-
Clay fraction	10.4	11.4	39.1	37.8	-
Moisture 40Â°C (dry basis)	2.4	1.5	6.1	6.4	-
R1 Dispersion Ratio	0.44	0.42	0.69	0.68	-
EAT	3	2	2	-	2
15 Bar (%)	2.7	3.4	13.5	12.4	-

Legend
GTE Laboratory Data
SLR Site Data

'-' indicates no laboratory assessment was undertaken

Table AppC-28: Soil Chemistry for SPC 21Bl(Ta), Analysed Site D59

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
pH 1:5 water (pH units)	9.32	9.3	9.3
pH CaCl2 (following 4A1) pH units	8.36	8.31	8.39
Organic Carbon (W&B) % (40°C)	-	-	-
Nitrate - N (2M KCl) (mg/kg)	-	-	-
Ammonium - N (2M KCl) (mg/kg)	-	-	-
Colwell Phosphorus (mg/kg)	-	-	-
PBI + Col P	-	-	-
Colwell Potassium (mg/kg)	-	-	-
KCl Sulfur (S) (mg/kg)	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	1430	1610	1490
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	747	850	791
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	145	122	142

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Sodium (NH4Cl/BaCl2) (mg/kg)	814	1140	957
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	7.13	8.04	7.46
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	6.15	6.99	6.51
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.37	0.313	0.363
Sodium (NH4Cl/BaCl2) (cmol/kg)	3.54	4.98	4.16
Ca:Mg ratio	1.2	1.2	1.1
K:Mg ratio	0.06	<0.05	0.06
GTRI	-	-	-
ECR (%)	23	26	24
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	1430	1680	1500
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	820	976	826
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	165	130	154
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	95.4	123	95.4
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	7.14	8.36	7.49
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	6.74	8.03	6.79
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.423	0.333	0.395
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.415	0.536	0.415
Ca:Mg ratio	1.1	1	1.1
K:Mg ratio	0.06	<0.05	0.06
ECR (%)	5.7	5	5.4
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02
ECEC (cmol/kg)	14.7	17.3	15.1
Calcium (%)	48.5	48.4	49.6
Magnesium (%)	45.8	46.5	45
Potassium (%)	2.9	1.9	2.6
Sodium (%)	2.8	3.1	2.7
Aluminium (%)	0	0	0

Analysis (Unit)	Sample Depth (mbgl) / Horizon		
	1.10-1.20	1.40-1.50	1.70-1.80
Hydrogen (%)	0	0	0
CaCl2 extr. Aluminium (mg/kg)	-	-	-
Chloride (mg/kg)	370	670	460
Salinity EC 1:5 (dS/m)	0.48	0.69	0.55
Boron (mg/kg)	-	-	-
Iron (Fe) (mg/kg)	-	-	-
Manganese (Mn) (mg/kg)	-	-	-
Copper (Cu) (mg/kg)	-	-	-
Zinc (Zn) (mg/kg)	-	-	-
Oxalate ext. Molybdenum (mg/kg)	-	-	-
Dumas Total Nitrogen (% dry wt)	-	-	-
TDS (mg(/L)	300	440	350
% Air-dry Moisture Content (% of dry wt)	1.5	1.7	1.5
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0153	0.0167	0.0145
Moisture (dry basis) (%)	1.11	1.37	1.17
Moisture 105Â°C (dry basis) (%)	7.4	7.4	7.6
Texture (ISSS Classification)	Sandy Clay	Clay	Clay
Gravel fraction (% of whole sample)	23.3	29.3	19.5
Sand fraction (%(< 2 mm fraction)	64.9	57	58.1
Silt fraction (% < 2 mm fraction)	2.8	8	4.9
Clay fraction (% < 2 mm fraction)	32.3	35	37
Moisture 40Â°C (dry basis) (%)	-	-	-
R1 Dispersion Ratio	0.69	0.73	0.68
EAT	2	2	2
15 Bar (%)	11	12.7	12.1

'-' indicates no laboratory assessment was undertaken

Table AppC-29: Soil Chemistry for SPC 22BI(Wy), Analysed Site D65

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.05	0.10-0.20	0.20-0.30	0.50-0.60	0.80-0.90
pH 1:5 water (pH units)	7.48	7.85	7.68	8.03	9.14
pH CaCl2 (following 4A1) pH units	6.74	6.99	6.6	7.03	8.24
Organic Carbon (W&B) % (40°C)	0.64	0.49	-	-	-
Nitrate - N (2M KCl) (mg/kg)	3.1	1.1	-	-	-
Ammonium - N (2M KCl) (mg/kg)	<1.0	<1.0	-	-	-
Colwell Phosphorus (mg/kg)	5.9	<5.0	-	-	-
PBI + Col P	20	19	-	-	-
Colwell Potassium (mg/kg)	330	360	-	-	-
KCl Sulfur (S) (mg/kg)	2.5	<2.5	-	-	-
Calcium (Ca) - NH4Cl/BaCl2 (mg/kg)	616	814	862	1490	1890
Magnesium (Mg) - NH4Cl/BaCl2 (mg/kg)	114	99	201	544	613
Potassium (K) - NH4Cl/BaCl2 (mg/kg)	259	299	215	167	162
Sodium (NH4Cl/BaCl2) (mg/kg)	11.1	13	65.9	257	456
Calcium (Ca) - NH4Cl/BaCl2 (cmol/kg)	3.07	4.06	4.3	7.45	9.44
Magnesium (Mg) - NH4Cl/BaCl2 (cmol/kg)	0.94	0.813	1.65	4.47	5.04
Potassium (K) - NH4Cl/BaCl2 (cmol/kg)	0.662	0.765	0.55	0.428	0.414
Sodium (NH4Cl/BaCl2) (cmol/kg)	0.048	0.057	0.287	1.12	1.98
Ca:Mg ratio	3.3	5	2.6	1.7	1.9
K:Mg ratio	0.7	0.94	0.33	0.1	0.08
GTRI	-	-	-	-	-
ECR (%)	15	14	12	11	14

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.05	0.10-0.20	0.20-0.30	0.50-0.60	0.80-0.90
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (mg/kg)	496	542	847	1560	1740
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (mg/kg)	118	84.1	210	600	640
Potassium (K) - prewash alc. pH 8.5 NH4Cl (mg/kg)	183	185	203	182	161
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	<6.0	<6.0	7	62.9	32.7
Calcium (Ca) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	2.47	2.7	4.23	7.76	8.69
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.97	0.692	1.73	4.93	5.27
Potassium (K) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	0.468	0.472	0.518	0.465	0.411
Sodium (Na) - prewash alc. pH 8.5 NH4Cl (cmol/kg)	<0.020	<0.020	0.03	0.274	0.142
Ca:Mg ratio	2.6	3.9	2.4	1.6	1.7
K:Mg ratio	0.48	0.68	0.3	0.09	0.08
ECR (%)	12	12	8.4	5.5	3.8
Exchangeable acidity (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable aluminium (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
Exchangeable hydrogen (cmol/kg)	<0.02	<0.02	<0.02	<0.02	<0.02
ECEC (cmol/kg)	3.92	3.87	6.5	13.4	14.5
Calcium (%)	63.2	69.7	65	57.8	59.9
Magnesium (%)	24.8	17.9	26.5	36.7	36.3
Potassium (%)	12	12	8	3.5	2.8
Sodium (%)	<0.2	0.2	0.5	2	1
Aluminium (%)	0	0	0	0	0
Hydrogen (%)	0	0	0	0	0
CaCl2 extr. Aluminium (mg/kg)	<0.1	-	-	-	-
Chloride (mg/kg)	15	<5	17	92	270
Salinity EC 1:5 (dS/m)	0.058	0.059	0.052	0.13	0.32

Analysis (Unit)	Sample Depth (mbgl) / Horizon				
	0.00-0.05	0.10-0.20	0.20-0.30	0.50-0.60	0.80-0.90
Boron (mg/kg)	0.18	-	-	-	-
Iron (Fe) (mg/kg)	13	-	-	-	-
Manganese (Mn) (mg/kg)	8.1	-	-	-	-
Copper (Cu) (mg/kg)	0.45	-	-	-	-
Zinc (Zn) (mg/kg)	0.41	-	-	-	-
Oxalate ext. Molybdenum (mg/kg)	<0.25	-	-	-	-
Dumas Total Nitrogen (% dry wt)	0.075	0.039	-	-	-
TDS (mg(/L)	37	38	33	84	200
% Air-dry Moisture Content (% of dry wt)	0.3	0.3	0.5	1.6	1.3
S7 Gravimetric water content of air dried fine fraction (GWCad-ff) (g/g)	0.0027	0.0026	0.0046	0.016	0.0131
Moisture (dry basis) (%)	0.298	0.288	0.472	1.19	1.27
Moisture 105Â°C (dry basis) (%)	4.4	2.3	3.4	7.1	7.1
Texture (ISSS Classification)	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Clay	Sandy Clay Loam
Gravel fraction (% of whole sample)	3	2.2	10.4	2	4
Sand fraction (%(< 2 mm fraction)	85.7	86.1	78.7	64.3	68.2
Silt fraction (% < 2 mm fraction)	3.9	3.6	3.9	4.4	6.8
Clay fraction (% < 2 mm fraction)	10.4	10.3	17.4	31.3	25
Moisture 40Â°C (dry basis) (%)	-	-	-	-	-
R1 Dispersion Ratio	0.32	0.43	0.49	0.61	0.59
EAT	3	3	3	2	4
15 Bar (%)	4.7	4.2	7.7	14	11.4

'-' indicates no laboratory assessment was undertaken

Appendix D Interpretation of Key Field and Laboratory Soils Data

Soil pH (1:5 soil/water)

Table AppD-1 presents the pH ratings used to interpret pH data (Adapted from Slattery et al. [1999] and McKenzie et al. [2004]).

Table AppD-1: **pH (1:5 soil/water)**

$pH_{1:5}$	Rating
<3.0 / 3.0-4.0	Very strongly acid
4.0-5.5	Strongly acid
5.5-6.0	Moderately acid
6.0-7.0	Slightly acid to neutral
7.0-8.0	Neutral to slightly alkaline
8.0-9.0	Moderately alkaline
9.0-10.0	Strongly alkaline
10.0-11.0	Very strongly alkaline

Electrical Conductivity

Table AppD-2 presents the EC 1:5 salinity ratings used to assess the significance of laboratory measured EC 1:5 data where clay content was known (Shaw, R.J. 1988).

Table AppD-2: Electrical Conductivity Ratings

Rating	EC 1:5 deciSiemens per metre (dS/m)			
	10-20 per cent (%) clay	20-40 % clay	40-60 % clay	60-80 % clay
Very low	<0.05	<0.08	<0.12	<0.18
Low	0.05-0.10	0.08-0.17	0.12-0.25	0.18-0.37
Moderate	0.10-0.25	0.17-0.40	0.25-0.58	0.37-0.85
High	0.25-0.45	0.40-0.67	0.58-1.00	0.85-1.5
Very high	0.45-0.70	0.67-1.05	1.00-1.58	1.5-2.4
Extreme	>0.70	>1.05	>1.58	>2.4

Cation Exchange Capacity

Table AppD-3 presents the ratings used to assess CEC levels in the topsoil as a guide to overall fertility status (Landon 1991).

Table AppD-3: Cation Exchange Capacity Ratings

Rating	CEC/Equivalent CEC (milliequivalent [meq]/100 grams [g] of soil)
Very low	<5
Low	5-15
Moderate	15-25
High	25-40
Very high	>40

Cation Dominance – Exchangeable Sodium Percentage

Table AppD-4 presents the ratings used to interpret sodicity levels (Baker and Eldershaw 1993).

Table AppD-4: Exchangeable Sodium Percentage Ratings

Rating	ESP (%)
Non-sodic (low)	<6
Sodic (moderate)	6-15
Strongly sodic (high)	15-20
Extremely sodic (very high)	>20

Calcium / Magnesium Ratio (Ca:Mg)

Table AppD-5 presents the ratings used to interpret Ca/Mg ratios (Baker and Eldershaw, 1993). Soils that disperse readily but have low ESP levels; often have high levels of Mg relative to the other cations. The ratio of Ca to Mg provides a guide to the relative abundance of the two major cations and is useful when used in conjunction with ESP and R1 ratio for predicting soil physical behaviour.

Table AppD-5: Ca:Mg Ratio Ratings

Rating	Ca/Mg Ratio	Comments
Very low	<0.10	Mg is >10 times more dominant than Ca
Low	0.10–0.50	Mg is 5–10 times more dominant than Ca
Moderate	0.51–1.0	Ca and Mg becoming co-dominant
High	1.1–2	Ca more dominant than Mg
Very high	>2	Ca >2 times more dominant than Mg

Phosphorus

Table AppD-6 presents Bicarbonate Extractable Phosphorus categories shown by Ahern et al. (1994). The ratings were used to assess available Bicarb. extr. P levels.

Table AppD-6: Available Phosphorus

Rating	Bicarbonate Extractable Phosphorus
Very low	<5
Low	6-9
Moderate	10-15
High	16-40
Very high	>40

Dispersion Ratio R1

Table AppD-7 presents the ratings used to interpret the R1 ratios (Baker and Eldershaw, 1993). The R1 ratio is a measure of the amount of silt and clay that disperses during testing compared with the total amount of silt and clay present. As such, it is a direct laboratory measure of soil dispersion and is useful when used in conjunction with ESP, EAT and the Ca/Mg ratio for predicting soil physical behaviour.

Table AppD-7: Dispersion Ratio Ratings

Rating	R1 Ratio
Low	<0.6
Moderate	0.6–0.8
High	0.8–0.95
Very high	>0.95

Emerson Aggregate Test

This test assesses the behaviour and cohesion of the soil aggregate in a brief period (two hours). The soil behaviours assessed were slaking and dispersion. Plate AppD-1 outlines the EAT assessment and class number and Table AppA-8 outlines the Emerson classes as per Australian Standard AS1289.3.8.1-2006 (Standards Australia, 2016).

Plate AppD-1: Determining the Emerson Class Number of Aggregates

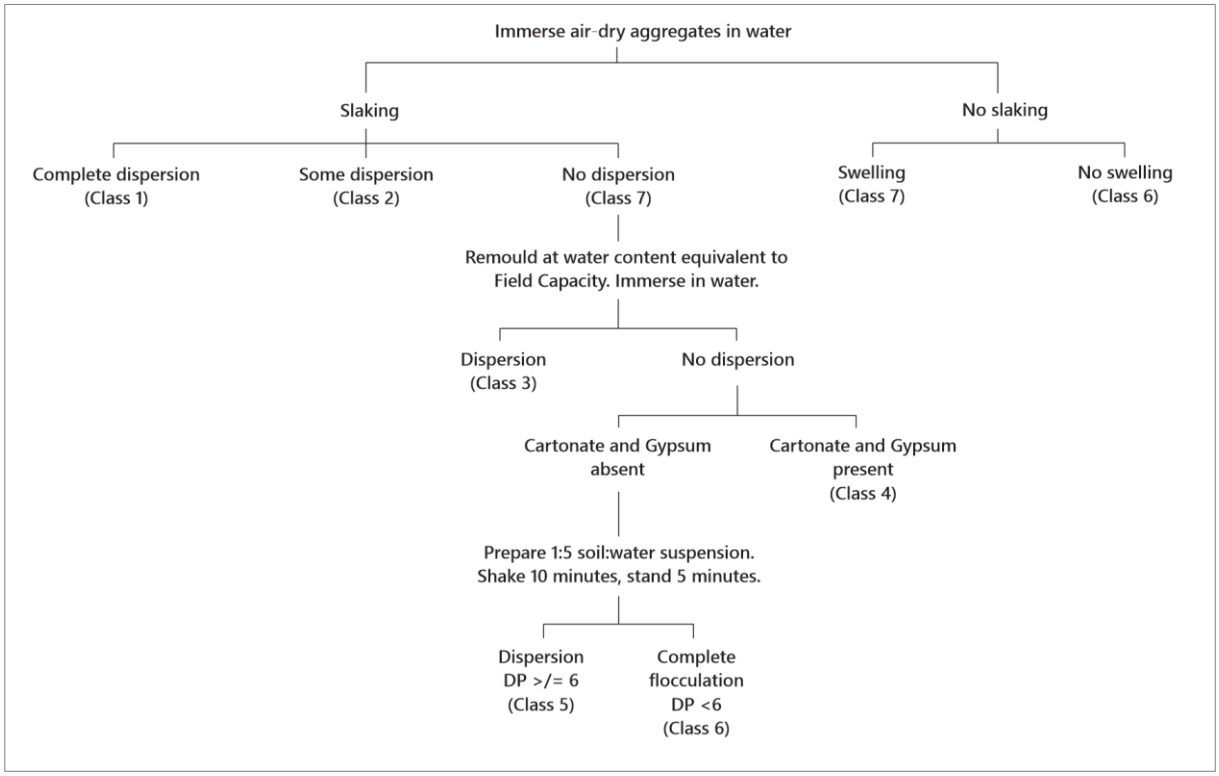


Table AppA-8: Emerson Class Descriptions

Emerson Class	Description
Class 1	Air-dried crumbs of soil show a strong dispersing reaction, i.e. a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10 min. In extreme cases, all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
Class 2	Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognizable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs.
Class 3	The soil remoulded at the plastic limit disperses in water.
Class 4	The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present.
Class 5	The remoulded soil does not disperse in water and the 1:5 soil / water suspension remains dispersed after five minutes.
Class 6	The remoulded soil does not disperse in water and the 1:5 soil / water suspension begins to flocculate within five minutes.
Class 7	The air-dried crumbs of soil remain coherent (do not disperse) in water and swell.
Class 8	The air-dried crumbs of soil remain coherent (do not disperse) in water and do not swell.

Soil Erodibility

The Universal Soil Loss Equation (USLE) soil erodibility factor (K factor) of topsoil was estimated from suggested K factor values from Rosewell (1993). Table AppD-9 outlines the K factors from soil texture.

Table AppD-9: Estimating USLE K factors from Soil Texture

Soil texture	Suggested K factor
Sand	0.015
Clayey sand	0.025
Loamy sand	0.020
Sandy loam	0.030
Fine sandy loam	0.035
Sandy clay loam	0.025
Loam	0.040
Loam, fine sandy	0.050
Silt loam	0.055
Clay loam	0.030
Silty clay loam	0.040
Fine sandy clay loam	0.025
Sandy clay	0.017
Silty clay	0.025
Light clay	0.025
Light medium clay	0.018
Medium clay	0.015
Heavy clay	0.012

These K factor values are assessed against the soil erodibility classes from Rosewell and Loch (2002) outlined in Table AppD-10.

Table AppD-10: Estimating USLE K factors from Soil Texture

Rating	K of the USLE (t/ha/yr per unit of rainfall erosivity)
Very low	0.00-0.01
Low	0.01-0.02
Moderate	0.02-0.04
High	0.04-0.06
Very high	>0.06

Particle Size Analysis and Soil Texture

Particle size analysis (PSA) measures the composition percentage of sand, silt, and clay sized particles, this allows soil texture to be determined.

The triangular texture diagram based on international fractions (Marshall, 1947), as shown in NCST (2024) has been used to derive soil texture based on PSA laboratory results.

Plant Available Water Capacity

Plant available water capacity (PAWC) is the amount of water that may be stored within a soil profile of up to 1.20 m in depth (DSITI & DNRM, 2015) and is the difference between a drained upper limit and crop lower limit. The amount of water a soil profile may hold impacts on its ability to provide for and be used by vegetation.

The soil texture lookup table from RPI 08/14 Guideline (DSDMIP, 2019) was initially used to estimate PAWC. Using available Class III observation site laboratory data, pedotransfer modelling as per the Salinity Management Handbook (using SALFPredict) (DERM, 2011) was used to assess PAWC.

This overall PAWC total was affected by the soil texture, physical and chemical barriers, as discussed further in Section 4.4 with results outlined in SPC summaries in Section 5 and Appendix F.

Appendix E SLR (2023) Detailed Sites Review

Table AppE-1: Summary of SLR (2023) Detailed Sites Review

Site	SLR Classifciation	SMU	GTE Classficiation	Samples Analysed	Issue	Notes	Site able to be used	Report / Mapping GTE Decision 22Dec25 RM
B01	Eutrophic Red Dermosol	2B	n/a	Yes	No profile to review		Need to check for soil profile - NOT AVAILABLE	No Profile to review, site conducted by GTE. D44 conducted on site, Grey Vertosol
B02	Self-Mulching Black Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol		Colour is incorrect based on dominant colour class in the upper 0.5 m of the B2 horizon. No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Linear Gilgai noted. No gilgai mound / depression site conducted	Yes - But amendment of soiil profile assessment needed	Incorrect colour grading on SLR site. Based on SLR horizons, it would grade as a Brown soil (SPC 15). Amend change in report, UMA upidated to include this in UMA
B03	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted. Shallow site to 0.40 m	Yes - But additional informaiton provided may pull it out as a separate SPC	Additional UMA added for this site. GTE SPC 2 is too deep, remember to assess as a shallow UMA (AG land Asserssment)
B04	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Linear Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B05	Self-Mulching Black Vertosol	1	n/a	Yes	No profile to review		Need to check for soil profile - NOT AVAILABLE	No Profile to review, site conducted by GTE. D37 conducted on site, Black Vertosol
B06	Self-Mulching Red Vertosol	1	Red Dermosol, or Self mulching Red Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton provided may pull it out as a separate SPC / confirm ASC	Correct colour for Red Vertosol. Site D36 is within 75m. We could move this closer to amend this, but in any case, the area is too small and unmappable. A subdominant vertosol as D36 is a Brown Dermosoil. Highlight in report, no change to mapping
B07	Self-Mulching Black Vertosol	1	n/a	Yes	No profile to review		Need to check for soil profile - NOT AVAILABLE	No Profile to review, site conducted by GTE. D22 conducted on site, Grey Vertosol
B08	Self-Mulching Grey Vertosol	1	Grey Dermosol, or Self mulching Grey Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Normal Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton provided may pull it out as a separate SPC / confirm ASC	UMA amended for this site
B09	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Linear Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B10	Self-Mulching Red Vertosol	1	Red Dermosol, or Self mulching Red Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Linear Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton provided may pull it out as a separate SPC / confirm ASC	GTE Site D22 conducted on B10 site. Red Vertosol was not observed. Area remains as Grey Vertosol
B11	Self-Mulching Black Vertosol	1	Self-Mulching Black Vertosol			Incipient Linear Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton provided may the depth may pull it out as separate SPC	Additional UMA added for this site
B12	Eutrophic Red Chromosol	3	n/a	Yes	No profile to review		Need to check for soil profile - NOT AVAILABLE	Sub-dominant soil tyupe in SLR report. Site D32 / D4 (Grey Dermosol) was conducted within 5 metres. No Profile to review, therefore no changes made Area remains as Grey Dermosol
B13	Self-Mulching Black Vertosol	1	Self-Mulching Black Vertosol			Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton provided may the depth may pull it out as separate SPC	Additional UMA added for this site

B14	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B15	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site. SPC 2 (due to SLR refusal at 0.90 m).
B16	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B17	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B18	Self-Mulching Black Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Cant assess horizon depths due to photo placemnt. Agree it is a brown vertosol Amend change in report, amend in mapping, UMA added
B19	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	UMA amended for this site
B20	Eutrophic Red Chromosol	3	Red Chromosol	Yes			Yes - But additional informaiton provided may the depth may pull it out as separate SPC	Sub-dominant soil tyupe in SLR report. Site D52 (Grey Dermosol) was conducted within 35 metres. Surface around B20 may indicate anotehr soil type, but area is too small to be mapped. Sites to the north east indicate mixed ssurface soils. Area remains as Grey Dermosol
B21	Subnatric Brown Sodosol	1	Brown Sodosol, or Brown Chromosol	Yes	No profile to review		Yes - Check for lab to confirm ASC	Site D59 conducted, Grey Sodosol
B22	Self-Mulching Black Vertosol	1	Red Dermosol, or Self mulching Red Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But amendment of soiil profile assessment needed	Incorrect colour grading on SLR site. Based on SLR horizons, it would grade as a Brown Vertosol (SPC 15). Amend change in report, amend in mapping, UMA amended
B23	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	UMA amended for this site
B24	Self-Mulching Black Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But amendment of soiil profile assessment needed	Incorrect colour grading on SLR site. Based on SLR horizons, it would grade as a Brown Vertosol (SPC 19). Amend change in report, amend in mapping, new UMA asdded
B25	Self-Mulching Brown Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	D3 completed within 5 m of B25. D3 is a black vertosol, and B25 wouldn't be mappabale at this scale, therefore no ASC change.
B26	Self-Mulching Brown Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But amendment of soiil profile assessment needed	Incorrect colour grading on SLR site. Based on SLR horizons, it would grade as a Black Vertosol (SPC 19). Amend change in report, amend in mapping, UMA amended
B27	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site. SPC 2 due to weathered material at 1.0m

B28	Eutrophic Red Dermosol	2A	n/a	Yes	No profile to review		Need to check for soil profile NOT AVAILABLE	Site D60 completed nearby. Agree, no ASC change.
B29	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Melonhole noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B30	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Additional UMA added for this site
B31	Self-Mulching Brown Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Loacted within Brown Vertosol SPC Agree, no ASC change.
B32	Self-Mulching Red Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But amendment of soiil profile assessment needed	Incorrect colour grading on SLR site. GTE re-assesses as a Brown Vertosol. Amend change in report, no change to mapping
B33	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Site D10 completed nearby. Additional UMA added for the site
B34	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Crabhole Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Site D64 completed nearby. Agree, no ASC change.
B35	Self-Mulching Brown Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Site D64 completed nearby. UMA Amended
B36	Self-Mulching Brown Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Draft mapping lines moved. Agree, no ASC change
B37	Self-Mulching Black Vertosol	1	Black Dermosol, or Self-Mulching Black Vertosol		No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Site C45 completed nearby. Agree, no ASC change.
B38	Self-Mulching Brown Vertosol	1	Brown Dermosol, or Self-mulching Brown Vertosol	Yes	No Slickensides and/or lenticular peds noted (discsussed in Section 4.1.1, Vertosol Description)	Incipient Gilgai noted. No gilgai mound / depression site conducted	Yes - But additional informaiton will be needed to confirm ASC	Site D62 completed to the south. Agree, no ASC change.

Appendix F SLR (2023) Check Sites Review

Table AppF-1: Summary of SLR (2023) Check Sites Review

Site	SLR Classifciation	SMU	GTE Classficiation	Issue	Notes	Site able to be used	Report / Mapping GTE Decision
C01	Self-Mulching Black Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C02	Self-Mulching Brown Vertosol	1	Self -mulching present Not enough information to confirm ASC	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C03	Self-Mulching Brown Vertosol	1	Self -mulching present Not enough information to confirm ASC	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C04	Self-Mulching Black Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Outside of project area, different soil type
C05	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C06	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C07	Self-Mulching Black Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Offsite
C08	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Offsite
C09	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Offsite
C10	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Offsite
C11	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Offsite
C12	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface appears similar, likley a vertic dermosol. Acknowledge in report
C13	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface appears similar, likley a vertic dermosol. Acknowledge in report
C14	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.

C15	Self-Mulching Brown Vertosol	1	Surface flake present B21 horizon shown but with no measurements	Surface site / profile witgh no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But additional informaiton will be needed to confirm ASC	SPC UMA Reviewed Agree, no ASC change.
C16	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C17	Brown Dermosol	1 (sub-dominant)	Surface looks soft, profile has not been scrapped back to see structure.	Surface site / profile witgh no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But additional informaiton will be needed to confirm ASC	Site is located to close / on disturbance (track). Is not considered realiable . No UMA changes
C18	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	GTE review of C18 photo indicates gilgai, as per UMA. Site C91 completed within the area
C19	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface is same colour as GTE SPC UMA. Acknowledge in report
C20	Brown Dermosol	1 (sub-dominant)	Surface looks soft, profile has not been scrapped back to see structure.	Surface site / profile witgh no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But additional informaiton will be needed to confirm ASC	UMA added for this and an adjcent GTE Site C57
C21	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface colour is brown, however no profile photos avbilablae so best ot leave as SPC Grey Vertosol
C22	Brown Dermosol	3	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Area too small to map out, between the sat imagery of the gilgai. Area is deemed to be the major gilgai SPC
C23	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface is same colour as GTE SPC UMA (Site D47). Acknowledge in report
C24	Self-Mulching Brown Vertosol	1	Minimal surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface is same colour as GTE SPC UMA (Site D47). Acknowledge in report
C25	Brown Dermosol	1 (sub-dominant)	Surface looks soft, profile has not been scrapped back to see structure.	Surface site / profile witgh no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But additional informaiton will be needed to confirm ASC	Site has been decided to fit within the SPC 21 (Grey sodosol) as a sub-dominant soil.
C26	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Site C92 conducted and UMA is observed as gilgai, surrounding by brown soils. Therefore Brown vertosol gilgai UMA included
C27	Self-Mulching Brown Vertosol	1	Surface looks soft, profile has not been scrapped back to see structure.	Surface site / profile with no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But additional informaiton will be needed to confirm ASC	Surface doesn't look flaing, likley the Brown dermosol
C28	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.

C29	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C30	Red Dermosol	2B	Cracks not wide enough. Not enough information to confirm ASC.`	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Area looks distrubed and colour isnt red. GTE assumes Site D57 <15 m away is more accurate as a grey vertosol
C31	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C32	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.
C33	Epipdeal Brown Vertosol	1	Surface does not present vertic properties Not enough information to	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Surface resembles a firm surfgace, not epipedal. Stays as Dermosol
C34	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Only surface is shown as brown. Not enough to change the GTE SPC Grey Vertosol
C35	Brown Dermosol	3	Surface likley hard, minor flake Not enough information to	Surface site / profile with no measurement tape. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	Only surface is shown as brown. Not enough to change the GTE SPC Grey Dermosol
C36	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	UMA Amended
C37	Self-Mulching Brown Vertosol	1	Surface flake present Not enough information to confirm ASC.	Surface site / No profile. SLR assessment is based on minimimal infomration	Assess as adjacent Detailed site / UMA, unless it is obvious . Site only good for Surface check	Yes - But amendment of soiil profile assessment may be needed	SPC UMA Reviewed Agree, no ASC change.

Appendix G Project Central West Region Soil Sites

Project description

Project name:	Central West Region Salinity Investigations
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	

Site characteristics

Date described:	24/06/2004	Observation type:	Relatively undisturbed soil core
Site Type:	Free survey site	Observation class:	Class IIIa (limited chemistry)
Slope (%):	1	Morphological type:	Crest
Slope type	Abney level or clinometer and tape	Landform element:	Crest
Geology:	Not recorded	Landform pattern:	Plain
Soil Name:	Not recorded	Substrate lithology:	Sandstone
Runoff:	Slow	Depth to free water:	Not recorded
Permeability:	Slowly permeable (5-50 mm/day)	Erosion:	Not recorded
Drainage:	Moderately well drained	Microrelief type:	Zero or none
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	No bedrock exposed	Vertical interval (m):	N/A
Surface condition:	Periodic cracking; Self-mulching	Horizontal interval (m):	N/A
Surface coarse fragments:	Few (2-10%), detrital sedimentary rock (unidentified), medium pebbles (6-20 mm)	Microrelief component sampled:	N/A

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-23.67881	148.85534	55	689197	7380102	Not recorded	Averaging GNSS
GDA 2020	-23.67880	148.85535	55	689198	7380103		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Endocalcareous, Self-mulching, Black Vertosol; non-gravelly, fine, medium fine, moderate.	No analytical data are available but confidence is fair.	Isbell (1996) The Australian Soil Classification (First Edition)	N/A	Brown clay	Ug5.13

Vegetation

Community name	Mid-high open woodland, Acacia harpophylla	
Stratum	Species	Common name
Tallest 6.01-12 m	*Acacia harpophylla*	brigalow
	Brachychiton rupestris	narrow-leaved bottle tree, bottle tree, Queensland bottle tree

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A11	0	0.05	Very dark greyish brown (10YR 3/2) moist	no mottles or other colour patterns mottle;	Light medium clay	Strong 5-10 mm Subangular blocky structure; Strong 2-5 mm Granular structure;	no coarse fragments;	No segregations;		clear
2	B21	0.05	0.3	Very dark greyish brown (10YR 3/2) moist	no mottles or other colour patterns mottle;	Medium clay	Strong 10-20 mm Angular blocky structure;	no coarse fragments;	No segregations;		gradual
3	B22	0.3	0.6	Dark brown (7.5YR 3/2) moist	no mottles or other colour patterns mottle;	Medium clay	Strong 10-20 mm Angular blocky structure; Strong 5-10 mm Subangular blocky structure;	no coarse fragments;	No segregations;		diffuse
4	B23	0.6	0.85	Dark brown (7.5YR 3/3) moist	no mottles or other colour patterns mottle;	Medium clay	Moderate 5-10 mm Lenticular structure;	no coarse fragments;	Very few (<2%) Fine (<2mm) Calcareous Nodules;		gradual

5	BC	0.85	1.05	Brown (7.5YR 4/4) moist	no mottles or other colour patterns mottle;		Moderate 2-5 mm Polyhedral structure;	abundant (50-90%) angular sandstone small pebbles (2-6 mm); common (10-20%) angular sandstone medium pebbles (6-20 mm);				gradual
6	C	1.05	1.2					very abundant (>90%) sandstone (size not recorded);				

Field test	
Field EC 1:5 soil/water dS/m	
Depth (m)	Value
0.01	.19
0.3	1.17
0.6	1.65
0.9	1.26

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.01	7.5
0.3	8.5
0.6	8.5
0.9	8.0

Notes			
Note level	Horizon name	Horizon no	Note
Observation			Disturbance data derived (in 2023) from remote sensing (aerial photography, satellite imagery). Accuracy of the disturbance value is influenced by accuracy of the site location and availability of imagery close to the date of site description.

Laboratory test results					
				Sample	1
				Upper depth (m)	0.5
				Lower depth (m)	0.6
Group	Method	Code	Units	Bulked Sample	N
Profile General	pH - 1:5 water	4A1			8.4
	EC - 1:5 water	3A1	dS/m		1.27
	Cl - 1:5 water - automated	5A2	mg/kg		1450
	Water sol NO3 - automated	7B1	mg/kg		4.40
Alcoholic Cations	Exch Ca - alcoh. NH4Cl, pH8.5, prewash	15C1_Ca	cmol_c/kg		16.60
	Exch Mg - alcoh. NH4Cl, pH8.5, prewash	15C1_Mg	cmol_c/kg		12.10
	Exch Na- alcoh. NH4Cl, pH8.5, prewash	15C1_Na	cmol_c/kg		7.40
	Exch K - alcoh. NH4Cl, pH8.5, prewash	15C1_K	cmol_c/kg		0.50
	CEC - alcoh. NH4Cl, pH8.5, prewash	15C1_CEC	cmol_c/kg		36.0
Other Cations	ESP (Exch. Na %)	15N1	%		21.0

Photo No: 140
Date: 4/04/2005
Title: S 293 Soil
Desc:



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Project SALTC Site 294 Observation 1

SALI4320

Project description

Project name:	Central West Region Salinity Investigations
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	

Site characteristics

Date described:	24/06/2004	Observation type:	Relatively undisturbed soil core
Site Type:	Free survey site	Observation class:	Class IIIa (limited chemistry)
Slope (%):	1	Morphological type:	Simple slope
Slope type	Abney level or clinometer and tape	Landform element:	Plain
Geology:	Not recorded	Landform pattern:	Plain
Soil Name:	Not recorded	Substrate lithology:	Clay
Runoff:	Slow	Depth to free water:	Not recorded
Permeability:	Slowly permeable (5-50 mm/day)	Erosion:	Not recorded
Drainage:	Imperfectly drained	Microrelief type:	Normal gilgai
Disturbance:	Complete clearing - pasture - but never cultivated	Proportion gilgai:	Not recorded
Rock outcrop:	No bedrock exposed	Vertical interval (m):	0.15
Surface condition:	Periodic cracking; Self-mulching	Horizontal interval (m):	6
Surface coarse fragments:	Very few (<2%), silcrete, medium pebbles (6-20 mm)	Microrelief component sampled:	Not recorded

Site location

Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-23.68673	148.85734	55	689390	7379222	Not recorded	Averaging GNSS
GDA 2020	-23.68672	148.85736	55	689391	7379223		

Soil classification

Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Endocalcareous-Endohypersodic, Self-mulching, Black Vertosol; non-gravelly, fine, medium fine, very deep.	No analytical data are available but confidence is fair.	Isbell (1996) The Australian Soil Classification (First Edition)	N/A	Brown clay	Ug5.15

Vegetation

Community name	Tall sparse shrubland, Acacia harpophylla	
Stratum	Species	Common name
Tallest 1.01-3.0 m	*Acacia harpophylla*	brigalow
Lowest	*Cenchrus ciliaris*	buffel grass

Profile morphology

No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A11	0	0.05	Very dark greyish brown (2.5Y 3/2) moist	no mottles or other colour patterns mottle;	Light clay	Strong 5-10 mm Subangular blocky structure; Strong 2-5 mm Granular structure;	no coarse fragments;	No segregations;		gradual
2	B21	0.05	0.3	Very dark greyish brown (2.5Y 3/2) moist	no mottles or other colour patterns mottle;	Light medium clay	Strong 10-20 mm Angular blocky structure;	no coarse fragments;	No segregations;		diffuse
3	B22k	0.3	1	Very dark greyish brown (2.5Y 3/2) moist	no mottles or other colour patterns mottle;	Medium clay	Moderate 20-50 mm Subangular blocky structure; Moderate 5-10 mm Lenticular structure;	no coarse fragments;	Common (10-20%) Fine (<2mm) Calcareous Nodules; Few (2-10%) Medium (2-6 mm) Calcareous Nodules;		diffuse

4	B3	1	1.65	Dark brown (10YR 3/3) moist	common (10-20%) medium (5-15 mm) distinct brown mottle;	Medium clay	Moderate 5-10 mm Lenticular structure;	no coarse fragments;	Few (2-10%) Fine (<2mm) Calcareous Nodules; Few (2-10%) Medium (2-6 mm) Calcareous Soft segregations; Few (2-10%) Fine (<2mm) Manganiferous Veins;		

Field test

Field dispersion test as per LRO guideline (2012)

Depth (m)	Value
0.01	0
0.3	0
0.6	0
0.9	1
1.2	1
1.5	1

Field test

Field EC 1:5 soil/water dS/m

Depth (m)	Value
0.01	.27
0.3	2.33
0.6	2.18
0.9	2.5
1.2	2.55
1.5	2.39

Field test

pH by Raupach and Tucker method

Depth (m)	Value
0.01	7.0
0.3	8.5
0.6	8.5
0.9	8.5
1.2	8.5
1.5	8.0

Notes

Note level	Horizon name	Horizon no	Note
Observation			Disturbance data derived (in 2023) from remote sensing (aerial photography, satellite imagery). Accuracy of the disturbance value is influenced by accuracy of the site location and availability of imagery close to the date of site description.
Horizon	A11	1	B3 SODIC MEDIUM CLAY
Horizon	B3	4	B3 sodic medium clay

Laboratory test results

				Sample	1	2
				Upper depth (m)	0.2	0.8
				Lower depth (m)	0.3	0.9
Group	Method	Code	Units	Bulked Sample	N	N
Profile General	pH - 1:5 water	4A1			8.3	8.3
	EC - 1:5 water	3A1	dS/m		1.31	1.78
	Cl - 1:5 water - automated	5A2	mg/kg		1880	2330
	Water sol NO3 - automated	7B1	mg/kg		<1	<1
Alcoholic Cations	Exch Ca - alcoh. NH4Cl, pH8.5, prewash	15C1_Ca	cmol_c/kg		21.60	15.90
	Exch Mg - alcoh. NH4Cl, pH8.5, prewash	15C1_Mg	cmol_c/kg		7.85	9.18
	Exch Na- alcoh. NH4Cl, pH8.5, prewash	15C1_Na	cmol_c/kg		4.85	7.31
	Exch K - alcoh. NH4Cl, pH8.5, prewash	15C1_K	cmol_c/kg		0.46	0.38
	CEC - alcoh. NH4Cl, pH8.5, prewash	15C1_CEC	cmol_c/kg		38.0	36.0
Other Cations	ESP (Exch. Na %)	15N1	%		13.0	20.0

Photo No: 141
Date: 24/06/2004
Title: S 294 Soil
Desc: Black vertosol over clay sediments



Photo No: 142
Date: 24/06/2004
Title: S 294 Landscape
Desc: Cleared brigalow



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Appendix H Regional Frameworks SPC Assessments

Table AppJ-1: Summary of Land Suitability classes for 1Dn(Te), Representative Site D1

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4M	1	1	2	1	1	1	1	1	1	1	1	1	1
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppJ-2: Summary of Land Suitability classes for 2Dn(Te), Representative Site D3

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	11	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Surface Condition (Ps)	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4M	1	1	2	1	1	1	1	1	1	1	1	1	1
Overall Suitability Class		5	5	3	4	5	4	5	4	4	4	4	5	5

Table AppJ-3: Summary of Land Suitability classes for 3Bl(Te), Representative Site D5

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-4: Summary of Land Suitability classes for 4Bl(Te)Representative Site D6

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppJ-5: Summary of Land Suitability classes for 5Dn(Ro), Representative Site D7

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4S	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Suitability Class		5	5	3	4	5	4	5	4	4	4	4	5	5

Table AppJ-6: Summary of Land Suitability classes for 6Bl(Pg), Representative Site D12m

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	22	2	2	2	2	2	2	2	2	2	2	2	2	2
Soil Water Availability (M)[1]	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

1 – Soil water availability is based on the lowest PAWC of both the mound and depression, which is depression at 115.2 mm/100cms

Table AppJ-7: Summary of Land Suitability classes for 7Bl(Pg), Representative Site D14m

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	22	2	2	2	2	2	2	2	2	2	2	2	2	2
Soil Water Availability (M) [1]	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Wetness (W)[2]	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

1 – Soil water availability is based on the lowest PAWC of both the mound and depression, which is depression at 106.8 mm/100cms
2 – Wetness assessed on depression site location, D14d

Table AppJ-8: Summary of Land Suitability classes for 8Dn(Te), Representative Site D19

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	41	3	3	3	3	3	3	3	3	3	3	3	3	3
Erosion Hazard (Es)	42	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3M	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class		5	5	3	4	5	4	5	4	4	4	4	5	5

Table AppJ-9: Summary of Land Suitability classes for 9Dn(Ro), Representative Site D21

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	22	2	2	2	2	2	2	2	2	2	2	2	2	2
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-10: Summary of Land Suitability classes for 10Ct(Ro), Representative Site D22

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	33	4	4	4	4	4	4	4	4	4	4	4	4	4
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-11: Summary of Land Suitability classes for 11Bl(Ta), Representative Site D24

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	33	4	4	4	4	4	4	4	4	4	4	4	4	4
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	8	4	4	4	4	4	4	4	4	4	4	4	4	4
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4S	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Suitability Class		5	5	4	4	5	4	5	4	4	4	4	5	5

Table AppJ-12: Summary of Land Suitability classes for 12Da(Te), Representative Site D32

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	4	4	5	4	5	4	4	4	4	5	5

Table AppJ-13: Summary of Land Suitability classes for 13Bl(Ta), Representative Site D36

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	31	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	4	4	5	4	5	4	4	4	4	5	5

Table AppJ-14: Summary of Land Suitability classes for 14Bl(Ro), Representative Site D37

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-15: Summary of Land Suitability classes for 15Bl(Ro), Representative Site D39

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	~
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-16: Summary of Land Suitability classes for 16Bl(Ta), Representative Site D43

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Narrow Moisture Range (Pm)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	8	4	4	4	4	4	4	4	4	4	4	4	4	4
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	~
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppJ-17: Summary of Land Suitability classes for 17Bl(Ro), Representative Site D44

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	22	2	2	2	2	2	2	2	2	2	2	2	2	2
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		4	4	4	4	4	4	4	4	4	4	4	4	4

Table AppJ-18: Summary of Land Suitability classes for 18Bl(Ro), Representative Site D45

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3M	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class		4	4	3	3	4	3	4	3	3	3	3	4	4

Table AppJ-19: Summary of Land Suitability classes for 19Bl(Ro), Representative Site D52

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	4	4	5	4	5	4	4	4	4	5	5

Table AppJ-20: Summary of Land Suitability classes for 20Bl(Ro), Representative Site D58

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Erosion Hazard (Es)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	4	5	5	3	4	5	4	5	4	4	4	4	5	5
Narrow Moisture Range (Pm)	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Surface Condition (Ps)	5	3	3	3	3	3	3	3	3	3	3	3	3	3
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4M	1	1	2	1	1	1	1	1	1	1	1	1	1
Overall Suitability Class		5	5	3	4	5	4	5	4	4	4	4	5	5

Table AppJ-21: Summary of Land Suitability classes for 21Bl(Ta), Representative Site D59

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Soil Water Availability (M)	6	5	5	5	5	5	5	5	5	5	5	5	5	5
Narrow Moisture Range (Pm)	6	3	3	3	3	3	3	3	3	3	3	3	3	3
Surface Condition (Ps)	8	4	4	4	4	4	4	4	4	4	4	4	4	4
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	3S	4	4	4	4	4	4	4	4	4	4	4	4	4
Overall Suitability Class		5	5	5	5	5	5	5	5	5	5	5	5	5

Table AppJ-22: Summary of Land Suitability classes for 22Bl(Wy), Representative Site D65

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	22	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	21	1	1	1	1	1	1	1	1	1	1	1	1	1
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Narrow Moisture Range (Pm)	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Surface Condition (Ps)	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Rockiness (R)	G2	1	1	1	1	1	1	1	1	1	1	1	1	1
Microrelief (Tm)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wetness (W)	4M	1	1	2	1	1	1	1	1	1	1	1	1	1
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Appendix I Beef Cattle Grazing Suitability Assessment

Table AppK-1: Summary of Beef Cattle Grazing Land Suitability Classes for SPCs

SPC / Class III Site	Water Availability	Nutrient Def	Physical Factors	Salinity	Rockiness	Gilgai	pH	ESP	Wetness	Topography	Water erosion	Flooding	Beef Cattle Grazing Class
1Dn(Te) / D1	4	4	2	3	1	-	3	1	1	-	1	1	**4**
2Dn(Te) / D3	3	1	2	4	1	-	2	1	1	-	1	1	**4**
3Bl(Te) / D5	1	4	1	3	1	-	2	1	1	-	1	1	**4**
4Bl(Te) / D6	4	3	3	3	1	-	2	1	1	-	1	1	**4**
5Dn(Ro) / D7	3	4	3	3	1	-	3	1	1	-	1	1	**4**
6Bl(Pg) / D12m/d	2	3	3	5	1	1	3	1	1	-	1	1	**5**
7Bl(Pg) / d14m/d	2	1	3	5	1	1	2	1	1	-	1	1	**5**
8Dn(Te) / D19	3	3	3	4	1	-	3	1	1	-	1	1	**4**
9Dn(Ro) / D21	2	3	3	4	1	-	3	1	1	-	1	1	**4**
10Ct(Ro) / D22	2	3	3	4	1	-	3	1	1	4	1	2	**4**
11Bl(Ta) / D24	3	3	2	3	1	-	2	1	1	-	2	1	**3**
12Da(Te) / D32	3	3	1	2	1	-	2	1	2	-	1	1	**3**
13Bl(Ta) / D36	3	4	1	3	1	-	3	1	1	-	1	1	**4**
14Bl(Ro) / D37	2	4	3	2	1	-	3	1	1	-	1	1	**4**
15Bl(Ro) / D39	2	4	3	3	1	-	2	1	1	-	1	1	**4**
16Bl(Ta) / D43	4	3	2	3	1	-	2	1	1	-	2	1	**4**
17Bl(Ro) / D44	2	4	3	3	1	-	2	1	1	-	1	1	**4**
18Bl(Ro) / D45	2	3	3	3	1	-	2	1	1	-	1	1	**3**
19Bl(Ro) / D52	3	4	3	3	1	-	2	1	1	-	1	1	**4**
20Bl(Ro) / D58	3	4	3	3	1	-	3	1	1	-	1	1	**4**
21Bl(Ta) / D59	5	4	2	1	1	-	2	1	2	-	2	1	**5**
22Bl(Wy) / D65	4	3	1	1	1	-	2	1	1	-	1	1	**3**

Appendix J Regional Frameworks UMA Assessments

Table AppL-1: Land Suitability Classes, Limitation and Crop Land Assessment UMAs distinct from SPCs

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
1	1Dn(Te)	D1 (Analysed Site)[1]	1	-		
2	2Dn(Te)	D55	1	No limitation amendments to SPC UMA		
3	2Dn(Te)	D3 (Analysed Site)	1	-		
4	2Dn(Te)	B15 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
5	2Dn(Te)	B11 (SLR, 2023), C38, C39	2	Incipient gilgai reported, none present in photo or satellite imagery review. Soil profile indicates weathered substrate at 0.85 mbgl. PAWC would likely be impacted, which would reduce it slightly. The amount cannot be accurately assessed, however it is based on site D3 PAWC at 0.90 mbgl (SALFPredict, 2025), the PAWC would be below 75 mm/100cm C38 indicated soil profile depth of 0.80 mbgl C39 indicated soil profile depth of 0.80 mbgl Limitation Amendments to SPC UMA		
				Soil water availability updated in Table AppL-2	No limitation amendments to UMA	ALC updated in Table AppL-3
6	2Dn(Te)	B04 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
7	2Dn(Te)	B03 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. Soil profile indicates weathered substrate at 0.40 mbgl. PAWC would likely be impacted, which would reduce it slightly. The amount cannot be accurately assessed, however it is based on site D3 PAWC at 0.40 mbgl (SALFPredict, 2025), the PAWC would be 46 mm/100cm		
				Soil water availability updated in Table AppL-4	Water availability limitation updated in Table AppL-5	ALC updated in Table AppL-6
8	2Dn(Te)	SLR Site B27	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
9	3Bl(Te)	D5 (Analysed site)	1	-		
10	4Bl(Te)	D20	1	No limitation amendments to SPC UMA		
11	4Bl(Te)	D6 (Analysed site)	1	-		
12	8Dn(Te)	C18	1	Soil profile indicates weathered substrate at 0.85 mbgl. PAWC would likely be impacted, which would reduce it slightly. The amount cannot be accurately assessed, however it is based on site D19 PAWC at 0.50 mbgl (SALFPredict, 2025), the PAWC would be below 66.7 mm/100cm		
				Soil water availability updated as Table AppL-7	Limitation assessed in Table AppL-8, no change	ALC updated in Table AppL-9
13	5Dn(Ro)	D42	1	Soil profile indicates weathered substrate at 0.85 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D7 PAWC at 0.85 mbgl (SALFPredict, 2025), the PAWC		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
				would be above 97 mm/100cm, calculated at 0.70 mbgl. It is assumed that the PAWC would be above 100 mm100cm and has been assessed as this.		
				Soil water availability assessed in Table AppL-10, no change	Water availability limitation assessed in Table AppL-11, no change	No updates for cropping or beef cattle grazing, therefore no update to ALC
14	5Dn(Ro)	D7 (Analysed Site)	1	-		
15	17Bl(Ro)	D26	1	Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-12, no change	-	No updates for cropping therefore no update to ALC
16	5Dn(Ro)	D50	1	Soil profile indicates weathered substrate at 0.95 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D7 PAWC at 0.85 mbgl (SALFPredict, 2025), the PAWC would be above 97 mm/100cm, calculated at 0.70 mbgl. It is assumed that the PAWC would be above 100 mm100cm and has been assessed as this.		
				Soil water availability assessed in Table App-10, no change	Water availability limitation assessed in Table AppL-11, no change	No updates for cropping or beef cattle grazing, therefore no update to ALC
17	5Dn(Ro)	D33	1	Soil profile indicates weathered substrate at 0.90 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D7 PAWC at 0.85 mbgl (SALFPredict, 2025), the PAWC would be above 97 mm/100cm, calculated at 0.70 mbgl. It is assumed that the PAWC would be above 100 mm100cm and has been assessed as this.		
				Soil water availability assessed in Table App-10, no change	Water availability limitation assessed in Table AppL-11, no change	No updates for cropping or beef cattle grazing, therefore no update to ALC
18	6Bl(Pg)	D12m/d (Analysed Site)	1	-		
19	6Bl(Pg)	D9m/d	1	Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-10, no change	-	No updates for cropping therefore no update to ALC
20	6Bl(Pg)	C28	1	Boundary of UMA, no assessment undertaken		
21	6Bl(Pg)	C26	1	No limitation amendments to SPC UMA		
22	6Bl(Pg)	C3	1	No limitation amendments to SPC UMA		
23	6Bl(Pg)	C5	1	No limitation amendments to SPC UMA		
24	7Bl(Pg)	C18	2	Boundary of UMA, no assessment undertaken		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
25	7Bl(Pg)	D14m/d (Analysed site)	1	-		
26	7Bl(Pg)	D15	1	No limitation amendments to SPC UMA		
27	7Bl(Pg)	-	5	No limitation amendments to SPC UMA		
28	7Bl(Pg)	C22	1	Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-14, no change	-	No updates for cropping therefore no update to ALC
29	8Dn(Te)	C35	1	Site has no recovery of soil at 0.50 m not refusal. Based on the assessment of the field site, this isn't an indicator of refusal therefore no amendment to soil profile or PAWC will be undertaken. No limitation amendments to SPC UMA		
30	8Dn(Te)	D19 (Analysed site)	1	-		
31	8Dn(Te)	D34	1	No limitation amendments to SPC UMA		
32	16Bl(Ta)	C24	1	No limitation amendments to SPC UMA		
33	9Dn(Ro)	D21 (Analysed site)	1	-		
34	9Dn(Ro)	D28	1	No limitation amendments to SPC UMA		
35	14Bl(Ro)	D37 (Analysed site)	1	-		
36	9Dn(Ro)	B33, B34 (SLR, 2023)	2	Incipient / crabhole gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
37	9Dn(Ro)	B19, B23 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
38	9Dn(Ro)	B16 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
39	9Dn(Ro)	B14 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
40	9Dn(Ro)	B13 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
41	9Dn(Ro)	B13 (SLR, 2023)	2	Incipient linear gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
42	9Dn(Ro)	B29, B30 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review.		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
				Slope at Site B30 indicates 3%, but on review this is likely a simple, short slope within the drainage line. GTE has assessed this as not representative of the UMA as a whole, and therefore will not be assessed. No limitation amendments to SPC UMA		
43	10Ct(Ro)	D27	1	No limitation amendments to SPC UMA		
44	10Ct(Ro)	D21 (Analysed site), D22, D23, D30, D47, D48, D53, D60	1	No limitation amendments to SPC UMA		
45	10Ct(Ro)	D25, D31	1	No limitation amendments to SPC UMA		
46	10Ct(Ro)	D16	1	No limitation amendments to SPC UMA		
47	10Ct(Ro)	D17	1	No limitation amendments to SPC UMA		
48	10Ct(Ro)	D54, C69	1	Site c69 indicates one single gilgai in the area. As no other gilgai were observed, this was considered sub-dominant of the UMA and unmappable. No limitation amendments to SPC UMA		
49	11Bl(Ta)	C22	1	Site has no recovery of soil at 0.60 m not refusal. Based on the assessment of the field site, this isn't an indicator of refusal therefore no amendment to soil profile or PAWC will be undertaken. No limitation amendments to SPC UMA.		
50	11Bl(Ta)	C34	1	Soil profile indicates weathered substrate at 0.68 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D24 PAWC at 0.80 mbgl (SALFPredict, 2025), the PAWC would be 72.6 mm/100cm, calculated at 0.70 mbgl.		
				Soil water availability assessed in Table App-15	Water availability limitation assessed in Table AppL-16	ALC updated in Table AppL-17
51	11Bl(Ta)	C34	1	Soil profile indicates weathered substrate at 0.45 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D24 PAWC at 0.80 mbgl (SALFPredict, 2025), the PAWC would be 55.26 mm/100cm, calculated at 0.50 mbgl.		
				Soil water availability assessed in Table App-15	Water availability limitation assessed in Table AppL-16	ALC updated in Table AppL-17
52	11Bl(Ta)	D24 (Analysed site)	1	-		
53	11Bl(Ta)	C23	1	Soil profile indicates weathered substrate at 0.80 mbgl. PAWC would not be impacted. The PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		
54	11Bl(Ta)	C37	1	Soil profile indicates weathered substrate at 0.80 mbgl. PAWC would not be impacted. The PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
55	11Bl(Ta)	C57	2	Profile of the soil exposure presents weathered substrate. A ruler measurement is within the photo, however notes indicate approximately 0.80 of soil from surface to the weathered substrate. Soil profile indicates weathered substrate at 0.80 mbgl. PAWC would not be impacted. The PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		
56	11Bl(Ta)	C6	1	Soil profile indicates weathered substrate at 0.80 mbgl. PAWC would not be impacted. The PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		
57	12Da(Te)	D32 (Analysed site)	1	-		
58	12Da(Te)	C30	1	No limitation amendments to SPC UMA		
59	13Bl(Ta)	C4	1	No limitation amendments to SPC UMA		
60	13Bl(Ta)	C14	1	No limitation amendments to SPC UMA		
61	13Bl(Ta)	D36 (Analysed site)	1	-		
62	15Bl(Ro)	C9	1	No limitation amendments to SPC UMA		
63	15Bl(Ro)	D10, D11, D61, D66, C10, C13	1	Soil profile for site D11 indicates weathered substrate at 0.90 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D36 PAWC at 1.00 mbgl (SALFPredict, 2025), the PAWC would be 94.10 mm/100cm, calculated at 0.90 mbgl. Based on the review of the entire UMA and overall depths of the key sites, both Class I and IV(a), it is assessed that this depth is an anomaly. It is assessed the overall UMA falls within existing cropping and beef cattle grazing PAWC, No limitation amendments to SPC UMA		
64	15Bl(Ro)	D8, D13	1	No limitation amendments to SPC UMA		
65	15Bl(Ro)	D39	1	No limitation amendments to SPC UMA		
66	15Bl(Ro)	D2	1	No limitation amendments to SPC UMA		
67	16Bl(Ta)	D43 (Analysed site)	1	-		
68	16Bl(Ta)	C28	1	Soil profile indicates weathered substrate at 0.60 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed, however it is based on site D43 PAWC at 0.40 mbgl (SALFPredict, 2025), the PAWC would be above 60.3 mm/100cm, calculated at 0.40 mbgl. It is assumed that the PAWC would be above 60 and below 75 mm/100cm and has been assessed as this. The assumed PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		
69	16Bl(Ta)-	C27	1	Soil profile indicates weathered substrate at 0.50 mbgl. PAWC would likely be impacted, which would increase. The amount cannot be accurately assessed,		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
				however it is based on site D43 PAWC at 0.40 mbgl (SALFPredict, 2025), the PAWC would be above 60.3 mm/100cm, calculated at 0.40 mbgl. It is assumed that the PAWC would be above 60 and below 75 mm/100cm and has been assessed as this. The assumed PAWC falls within existing cropping and beef cattle grazing PAWC. No limitation amendments to SPC UMA		
70	17Bl(Ro)	D41	1	No limitation amendments to SPC UMA		
71	17Bl(Ro)	D29	1	Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-18, no change	-	No updates for cropping, therefore no update to ALC
72	17Bl(Ro)	C33, D38, D46 B07 (SLR, 2023)	1	Incipient gilgai reported, none present in photo or satellite imagery review. Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-18, no change	-	No updates for cropping, therefore no update to ALC
73	17Bl(Ro)	D44 (Analysed site), B01 (SLR, 2023)	1	-		
74	18Bl(Ro)	D45 (Analysed site)	1	-		
75	19Bl(Ro)	D49, D52 (Analysed site)	1	-		
76	19Bl(Ro)	B22 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. Slope is reported as 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-19, no change	-	No updates for cropping, therefore no update to ALC
77	19Bl(Ro)	D18	1	Slope is reported as 2.0 / 2.0 %. This impacts the water erosion and erosion hazard for cropping.		
				Soil water availability assessed in Table AppL-19, no change	-	No updates for cropping, therefore no update to ALC
78	19Bl(Ro)	D62, D63, D64, B35 (SLR, 2023)	1	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		
79	19Bl(Ro)	C11, C12	1	No limitation amendments to SPC UMA		
80	19Bl(Ro)	B18 (SLR, 2023)	2	Incipient gilgai reported, none present in photo or satellite imagery review. No limitation amendments to SPC UMA		

UMA	SPC	Key Site/s Reviewed	UMA Confidence Code	Cropping Land Use Limitations and Assessment	Beef Cattle Grazing Land Use Limitations and Assessment	Agricultural Land Use Classification Land Use Limitations and Assessment
81	20Bl(Ro)	D58 (Analysed site)	1	-		
82	21Bl(Ta)	D59 (Analysed site) B21 (SLR, 2023)	1	-		
83	22Bl(Wy)	D65 (Analysed site)	1	-		

1- Analysed sites are already assessed, as per Appendix X and X, therefore no further assessment is required for the UMA it occupies.

Table AppL-2: UMA 5 Re-assessment for 2Dn(Te)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppL-3: UMA 5 Re-assessment for 2Dn(Te)

ALC	UMA
C2	UMA 5

Table AppL-4: UMA 7 Re-assessment for 2Dn(Te)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Soil Water Availability (M)	6	5	5	5	5	5	5	5	5	5	5	5	5	5
Overall Suitability Class		5	5	5	5	5	5	5	5	5	5	5	5	5

Table AppL-5: UMA 7 Re-assessment for 2Dn(Te)

Water Availability[1]	Nutrient Def	Physical Factors	Salinity[2]	Rockiness	Gilgai	pH	ESP	Wetness	Topography	Water erosion	Flooding	Beef Cattle Grazing Class
5	-	-	-	-	-	-	-	-	-	-	-	**5**

Table AppL-6: UMA 7 Re-assessment for SPC 2

ALC	SPC
C3	SPC 2

Table AppL-7: UMA 12 Re-assessment for 8Dn(Te)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Overall Suitability Class		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppL-8: UMA 12 Re-assessment for 8Dn(Te)

Water Availability	Nutrient Def	Physical Factors	Salinity[2]	Rockiness	Gilgai	pH	ESP	Wetness	Topography	Water erosion	Flooding	Beef Cattle Grazing Class
4	-	-	-	-	-	-	-	-	-	-	-	**4**

Table AppL-9: UMA 12 Re-assessment for 8Dn(Te)

ALC	SPC
C2	SPC 8

Table AppL-10: UMAs 13, 16, 17 Re-assessment for 5Dn(Ro)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Soil Water Availability (M)	3	4	4	3	3	4	3	4	3	3	3	3	4	4
Overall Suitability Class[1]		4	4	4	4	4	4	4	4	4	4	4	4	4

1- Wetness limitation indicates higher overall suitability class

Table AppL-11: UMAs 13, 16, 17 Re-assessment for 5Dn(Ro)

Water Availability[1]	Nutrient Def	Physical Factors	Salinity[2]	Rockiness	Gilgai	pH	ESP	Wetness	Topography	Water erosion	Flooding	Beef Cattle Grazing Class
2	4	4	3	3	1	-	3	1	1	-	1	**4**

Table AppL-12: UMA 15 Re-assessment for 17Bl(Ro)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class[1]		4	4	3	3	4	3	4	3	3	3	3	4	4

1- Soil water availability limitation indicates higher overall suitability class

Table AppL-13: UMA 19 Re-assessment for 6Bl(Pg)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class[1]		4	4	4	4	4	4	4	4	4	4	4	4	4

1- Wetness limitation indicates higher overall suitability class

Table AppL-14: UMA 28 Re-assessment for 7Bl(Pg)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class[1]		4	4	4	4	4	4	4	4	4	4	4	4	4

1- Wetness limitation indicates higher overall suitability class

Table AppL-15: UMA 50, 51 Re-assessment for 11Bl(Ta)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Soil Water Availability (M)	5	5	5	4	5	5	5	5	5	5	5	5	5	5
Overall Suitability Class[1]		5	5	4	5	5	5	5	5	5	5	5	5	5

Table AppL-16: UMA 50, 51 Re-assessment for 11Bl(Ta)

Water Availability[1]	Nutrient Def	Physical Factors	Salinity[2]	Rockiness	Gilgai	pH	ESP	Wetness	Topography	Water erosion	Flooding	Beef Cattle Grazing Class
4	3	2	3	1	-	2	1	1	-	2	1	**4**

Table AppL-17: UMA 50, 51 Re-assessment for 11Bl(Ta)

ALC	UMA
C2	50, 51

Table AppL-18: UMAs 71, 72 Re-assessment for 17Bl(Ro)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class[1]		4	4	3	3	4	3	4	3	3	3	3	4	4

1- Soil water availability limitation indicates higher overall suitability class

Table AppL-19: UMAs 76, 77 Re-assessment for 19Bl(Ro)

Limitation Categories	Limitation Value	Suitability subclasses for different land uses												
		Barley	Chickpea	Cotton	Maize	Millet	Mung bean	Oat	Safflower	Sorghum	Soybean	Sunflower	Triticale	Wheat
Water Erosion (E)	31	2	2	2	2	2	2	2	2	2	2	2	2	2
Erosion Hazard (Es)	32	3	3	3	3	3	3	3	3	3	3	3	3	3
Overall Suitability Class[1]		5	5	4	4	5	4	5	4	4	4	4	5	5

1- Soil water availability and wetness limitations indicates higher overall suitability class

Appendix K Crop Land Use Yield Assessments

Table AppM-1: Summary of Crop Land Use Assessment against Plant Salt-Tolerance Data (DERM, 2011)

SPC	Sample ID:	Electrical Conductivity (dS/m)	ECse (dS/m) (SALFPREDICT)	Root Depth Observed (m) - Class III Site	Crops	Barley	Cotton	Maize	Oat	Safflower	Sorghum	Soybean	Sunflower	Wheat
					90% Yield (Ecse, dS/m)	10	9.6	2.5	5.5	-	7.4	5.5	5.9	7.4
					75% Yield (Ecse, dS/m)	13	12.5	3.8	6.3	-	8.4	6.3	6.5	9.5
					50% Yield (Ecse, dS/m)	18	17.3	5.9	7.5	-	9.9	7.5	7.5	13
1Dn(Te)	D1-0.00-0.10	0.17	1.0	0.40				90% Yield		-				
	D1-0.20-0.30	0.67	5.5						90% Yield	-		90% Yield		
	D1-0.50-0.60	0.71	6.5			90% Yield	90% Yield	75% Yield		-	90% Yield	75% Yield	90% Yield	90% Yield
2Dn(Te)	D3-0.00-0.10	0.04	0.7	1.00m						-				
	D3-0.20-0.30	0.09	1.4							-				
	D3-0.50-0.60	1.42	3.0					90% Yield		-				
	D3-0.70-0.80	2.71	3.5							-				
	D3-0.90-1.00	3.11	3.4			90% Yield	90% Yield		90% Yield	-	90% Yield	90% Yield	90% Yield	90% Yield
3Bl(Te)	D5-0.00-0.10	0.13	1.1	1.80m						-				
	D5-0.20-0.30	0.35	2.5							-				
	D5-0.50-0.60	0.46	2.8							-				
	D5-0.80-0.90	1.00	2.8							-				
	D5-1.00-1.10	0.97	8.1							-		50% Yield	50% Yield	90% Yield
	D5-1.40-1.50	1.00	7.9							-				
	D5-1.70-1.80	0.88	8.7			90% Yield	90% Yield	90% Yield	90% Yield	-	90% Yield			
4Bl(Te)	D6-0.00-0.10	0.07	0.6	1.00m						-				
	D6-0.20-0.30	0.39	2.7					90% Yield		-				
	D6-0.50-0.60	0.51	3.8					75% Yield		-				
	D6-0.80-0.90	0.91	7.8					50% Yield	50% Yield	-	90% Yield	50% Yield	50% Yield	90% Yield
	D6-1.00-1.10	0.91	8.1			90% Yield	90% Yield			-				
5Dn(Ro)	D7-0.00-0.10	0.16	0.8	0.60										
	D7-0.20-0.30	0.23	1.2											
	D7-0.50-0.60	0.58	4.7			90% Yield	90% Yield	75% Yield	90% Yield	-	90% Yield	75% Yield	90% Yield	90% Yield
6Bl(Pg)	D12m-0.00-0.10	0.33	2.6	1.80				90% Yield	50% Yield	-	90% Yield	90% Yield	90% Yield	90% Yield
	D12m-0.20-0.30	1.10	9.5					50% Yield		-	75% Yield	50% Yield	50% Yield	50% Yield
	D12m-0.50-0.60	1.50	11.5			90% Yield	90% Yield			-	50% Yield			
	D12m-0.80-0.90	2.00	15.2			75% Yield	75% Yield			-				
	D12m-1.10-1.20	2.10	19.0			50% Yield	50% Yield			-				
	D12m-1.40-1.50	1.90	17.1							-				
	D12m-1.70-1.80	2.30	19.9							-				
7Bl(Pg)	D14m-0.00-0.10	0.13	1.1	1.80						-				
	D14m-0.20-0.30	0.62	5.6					75% Yield	90% Yield	-	90% Yield	90% Yield	90% Yield	
	D14m-0.50-0.60	0.49	4.9							-				
	D14m-0.80-0.90	1.90	16.4			75% Yield	75% Yield	50% Yield	50% Yield	-	50% Yield	50% Yield	50% Yield	50% Yield
	D14m-1.10-1.20	1.90	15.4							-				
	D14m-1.40-1.50	1.90	15.4							-				
	D14m-1.70-1.80	2.10	17.5				50% Yield			-				
8Dn(Te)	D19-0.00-0.05	0.10	0.5	0.90						-				
	D19-0.20-0.30	0.15	0.7							-				
	D19-0.40-0.50	0.21	1.7							-				
	D19-0.50-0.60	0.76	6.9					50% Yield	75% Yield	-		75% Yield	75% Yield	
	D19-0.80-0.90	0.38	3.5			90% Yield	90% Yield			-	90% Yield			90% Yield
9Dn(Ro)	D21-0.00-0.10	0.11	-	1.80						-				
	D21-0.20-0.30	0.80	6.5					50% Yield	75% Yield	-		75% Yield	75% Yield	
	D21-0.50-0.60	1.20	10.4			90% Yield	90% Yield			-	50% Yield	50% Yield	50% Yield	75% Yield
	D21-0.80-0.90	1.10	8.5							-				
	D21-1.10-1.20	1.30	11.6							-				
	D21-1.40-1.50	1.10	9.3							-				
	D21-1.70-1.80	0.83	7.6							-				
10Ct(Ro)	D22-0.00-0.10	0.16	1.1	1.80						-				
	D22-0.20-0.30	0.26	1.1							-				
	D22-0.50-0.60	0.80	5.8					75% Yield	90% Yield	-		90% Yield		
	D22-0.80-0.90	1.06	7.6					50% Yield	75% Yield	-	90% Yield	50% Yield	50% Yield	90% Yield
	D22-1.00-1.10	0.92	9.3						50% Yield	-	75% Yield			
	D22-1.30-1.40	0.95	9.1							-				
	D22-1.60-1.70	0.92	8.9							-				

11Bl(Ta)	D24-0.00-0.10	0.06	**0.5**	0.90							-				
	D24-0.20-0.30	0.68	**5.8**					75% Yield	90% Yield		-		90% Yield		
	D24-0.50-0.60	0.68	**6.1**					50% Yield	75% Yield		-			90% Yield	
	D24-0.80-0.90	0.54	**4.6**								-				
12Da(Te)	D32-0.00-0.10	0.05	**0.3**	1.80							-				
	D32-0.20-0.30	0.04	**0.6**								-				
	D32-0.50-0.60	0.13	**1.5**								-				
	D32-0.80-0.90	0.50	**4.0**					75% Yield			-				
	D32-1.10-1.20	0.71	**5.2**								-				
	D32-1.40-1.50	0.89	**6.5**					50% Yield	90% Yield		-		90% Yield	90% Yield	
	D32-1.70-1.80	1.10	**8.1**						50% Yield		-	90% Yield	50% Yield	50% Yield	90% Yield
13Bl(Ta)	D36-0.00-0.10	0.07	**0.3**	1.80							-				
	D36-0.20-0.30	0.20	**1.0**								-				
	D36-0.50-0.60	0.41	**3.1**					90% Yield			-				
	D36-0.80-0.90	0.56	**4.9**					75% Yield			-				
	D36-1.10-1.20	0.53	**4.8**								-				
	D36-1.40-1.50	0.49	**4.7**								-				
	D36-1.70-1.80	0.29	**3.5**								-				
14Bl(Ro)	D37-0.00-0.10	0.13	**0.6**	1.80							-				
	D37-0.20-0.30	0.16	**1.8**								-				
	D37-0.50-0.60	0.30	**2.0**								-				
	D37-0.80-0.90	0.69	**5.1**					75% Yield			-				
	D37-1.10-1.20	1.00	**9.5**						50% Yield		-	75% Yield	50% Yield	50% Yield	75% Yield
	D37-1.40-1.50	0.81	**6.9**								-				
	D37-1.70-1.80	0.81	**7.0**								-				
15Bl(Ro)	D39-0.00-0.10	0.07	**0.4**	1.80							-				
	D39-0.20-0.30	0.20	**1.1**								-				
	D39-0.50-0.60	0.36	**2.8**					90% Yield			-				
	D39-0.80-0.90	0.86	**6.9**					50% Yield	75% Yield		-		75% Yield	75% Yield	
	D39-1.10-1.20	0.78	**6.3**								-				
16Bl(Ta)	D43-0.00-0.10	0.09	**1.0**	1.80							-				
	D43-0.10-0.20	0.22	**1.8**								-				
	D43-0.20-0.30	0.32	**2.4**								-				
17Bl(Ro)	D44-0.00-0.10	0.15	**0.8**	1.80							-				
	D44-0.10-0.20	0.13	-								-				
	D44-0.20-0.30	0.40	**1.0**								-				
	D44-0.50-0.60	0.61	**2.9**					90% Yield			-				
	D44-0.80-0.90		**2.9**								-				
	D44-1.10-1.20	0.68	**5.2**					75% Yield			-				
18Bl(Ro)	D45-0.00-0.10	0.09	**0.7**	1.80							-				
	D45-0.20-0.30	0.08	**0.4**								-				
	D45-0.50-0.60	0.31	**2.3**												
	D45-0.80-0.90	0.58	**4.9**					75% Yield			-				
	D45-1.10-1.20	0.57	**4.8**								-				
	D45-1.40-1.50	0.54	**4.7**								-				
	D45-1.70-1.80	0.47	**4.0**								-				
19Bl(Ro)	D52-0.00-0.10	0.04	**0.2**	1.80							-				
	D52-0.20-0.30	0.05	**0.6**								-				
	D52-0.50-0.60	0.45	**3.8**					75% Yield							
	D52-0.80-0.90	0.69	**6.7**					50% Yield	75% Yield		-		75% Yield	75% Yield	
	D52-1.10-1.20	0.85	**7.2**								-				
	D52-1.40-1.50	0.80	**8.1**						50% Yield		-	90% Yield	50% Yield	50% Yield	90% Yield
	D52-1.70-1.80	0.74	**7.0**								-				
20Bl(Ro)	D58-0.00-0.10	0.10	**0.5**	0.80							-				
	D58-0.20-0.30	0.22	**1.5**								-				
	D58-0.50-0.60	0.56	**4.5**					75% Yield			-				
	D58-0.70-0.80	0.58	**4.9**								-				
21Bl(Ta)	D59-0.00-0.10	0.07	-	1.80							-				
	D59-0.20-0.30	0.05	**0.2**								-				
	D59-0.50-0.60	0.13	**0.9**								-				
	D59-0.80-0.90	0.73	**3.0**					90% Yield			-				
	D59-1.10-1.20	0.48	**4.3**					75% Yield	75% Yield		-		75% Yield	75% Yield	
	D59-1.40-1.50	0.69	**6.5**					50% Yield			-				
	D59-1.70-1.80	0.55	**5.1**								-				
22Bl(Wy)	D65-0.00-0.05	0.06	**0.4**	1.00							-				
	D65-0.10-0.20	0.06	-								-				
	D65-0.20-0.30	0.05	**0.4**								-				
	D65-0.50-0.60	0.13	**1.2**								-				
	D65-0.80-0.90	0.32	**3.1**					90% Yield			-				

Appendix L Laboratory Certificates

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Eurofins APAL Test Method Codes												
Crop	Actual Crop	SubmissionID	SamplingDate	DateReceived	BatchID	Batch Position No.	AgentName	ClientName	SampleName	Barcode	SampleDepth	Postcode
		147219		2025-11-20	46601	36	GT Environmental - Reece McCann	BWN	D3-0.00-0.10	111981004	0-0.1	4120
		147219		2025-11-20	46601	25	GT Environmental - Reece McCann	BWN	D3-0.20-0.30	111981005	0.2-0.3	4120
		147219		2025-11-20	46601	40	GT Environmental - Reece McCann	BWN	D3-0.50-0.60	111981006	0.5-0.6	4120
		147219		2025-11-20	46601	31	GT Environmental - Reece McCann	BWN	D3-0.70-0.80	111981007	0.7-0.8	4120
		147219		2025-11-20	46601	43	GT Environmental - Reece McCann	BWN	D3-0.90-1.00	111981008	0.9-1	4120
		147219		2025-11-20	46601	6	GT Environmental - Reece McCann	BWN	D22-0.00-0.10	111981064	0-0.1	4120
		147219		2025-11-20	46601	11	GT Environmental - Reece McCann	BWN	D22-0.20-0.30	111981065	0.2-0.3	4120
		147219		2025-11-20	46601	20	GT Environmental - Reece McCann	BWN	D22-0.50-0.60	111981066	0.5-0.6	4120
		147219		2025-11-20	46601	19	GT Environmental - Reece McCann	BWN	D22-0.80-0.90	111981067	0.8-0.9	4120
		147219		2025-11-20	46601	12	GT Environmental - Reece McCann	BWN	D32-0.00-0.10	111981075	0-0.1	4120
		147219		2025-11-20	46601	14	GT Environmental - Reece McCann	BWN	D32-0.20-0.30	111981076	0.2-0.3	4120
		147219		2025-11-20	46603	34	GT Environmental - Reece McCann	BWN	D32-0.50-0.60	111981077	0.5-0.6	4120
		147219		2025-11-20	46604	47	GT Environmental - Reece McCann	BWN	D32-0.80-0.90	111981078	0.8-0.9	4120
		147219		2025-11-20	46603	24	GT Environmental - Reece McCann	BWN	D37-0.00-0.10	111981089	0-0.1	4120
		147219		2025-11-20	46603	5	GT Environmental - Reece McCann	BWN	D37-0.20-0.30	111981090	0.2-0.3	4120
		147219		2025-11-20	46603	16	GT Environmental - Reece McCann	BWN	D37-0.50-0.60	111981091	0.5-0.6	4120
		147219		2025-11-20	46603	45	GT Environmental - Reece McCann	BWN	D37-0.80-0.90	111981092	0.8-0.9	4120
		147219		2025-11-20	46604	23	GT Environmental - Reece McCann	BWN	D44-0.00-0.10	111980904	0-0.1	4120
		147219		2025-11-20	46604	13	GT Environmental - Reece McCann	BWN	D44-0.10-0.20	111980905	0.1-0.2	4120
		147219		2025-11-20	46604	20	GT Environmental - Reece McCann	BWN	D44-0.20-0.30	111980906	0.2-0.3	4120
		147219		2025-11-20	46604	4	GT Environmental - Reece McCann	BWN	D44-0.50-0.60	111980907	0.5-0.6	4120
		147219		2025-11-20	46604	1	GT Environmental - Reece McCann	BWN	D44-0.80-0.90	111980908	0.8-0.9	4120
		147219		2025-11-20	46604	50	GT Environmental - Reece McCann	BWN	D59-0.00-0.10	111980929	0-0.1	4120
		147219		2025-11-20	46603	41	GT Environmental - Reece McCann	BWN	D59-0.20-0.30	111980930	0.2-0.3	4120
		147219		2025-11-20	46603	29	GT Environmental - Reece McCann	BWN	D59-0.50-0.60	111980931	0.5-0.6	4120
		147219		2025-11-20	46604	49	GT Environmental - Reece McCann	BWN	D59-0.80-0.90	111980932	0.8-0.9	4120

NOTE 1: Walkley and Black Organic Carbon % (40°C) data presented in this test report have been obtained by a combination of laboratory wet chemistry and the equivalent modelled result from Mid-Infrared Diffuse Reflectance Spectroscopy and Partial Least Squares Regression (PLSR) analysis. An explanatory

		TMs-006A	TMs-007NO3	TMs-007NH4	TMs-009B	TMs-009I2	TMs-018	TMs-010D	TMs-015G	TMs-015G
Transect GPS Start	Transect GPS Finish	Organic Carbon (W&B)	Nitrate - N (2M KCl)	Ammonium - N (2M KCl)	Colwell Phosphorus	PBI + Col P	Colwell Potassium	KCl Sulfur (S)	Exchangeable acidity	Exchangeable aluminium
		% (40°C)	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	cmol/kg	cmol/kg
N/A	N/A	3.85	3.8	4.1	18	67	1800	11	<0.02	<0.02
N/A	N/A	1.5	47	<1.0	5.5	94	1100	37	<0.02	<0.02
N/A	N/A									
N/A	N/A									
N/A	N/A									
N/A	N/A	1.33	<1.0	1.2	7.9	101	310	8.4	<0.02	<0.02
N/A	N/A	1.25	<1.0	1.1	<5.0	118	150	5.6	<0.02	<0.02
N/A	N/A									
N/A	N/A									
N/A	N/A	1.38	<1.0	5.4	8.2	38	170	5.4	<0.02	<0.02
N/A	N/A	0.55	<1.0	<1.0	6.2	53	220	13	<0.02	<0.02
N/A	N/A									
N/A	N/A									
N/A	N/A	1.31	<1.0	2.1	<5.0	119	120	4	<0.02	<0.02
N/A	N/A	1.22	<1.0	1.3	<5.0	112	110	6.8	<0.02	<0.02
N/A	N/A									
N/A	N/A									
N/A	N/A	1.89	3.7	1.6	<5.0	60	310	5.4	<0.02	<0.02
N/A	N/A	1.35	<1.0	1.2	<5.0	74	86	3.7	<0.02	<0.02
N/A	N/A									
N/A	N/A									
N/A	N/A									
N/A	N/A	0.35	<1.0	<1.0	<5.0	21	130	<2.5	<0.02	<0.02
N/A	N/A									
N/A	N/A	0.22	<1.0	<1.0	<5.0	73	180	4.8	<0.02	<0.02
N/A	N/A									

y technical note is available upon request. The exception is for quoted work that specifically required laboratory wet chemistry.

TMs-015G	TMs-028	TMs-005	TMs-012C	TMs-012A	TMs-012A	TMs-012A	TMs-012A	TMs-031	TMs-007	TMs-002A1	TMs-002A1
Exchangeable hydrogen	CaCl2 extr. Aluminium	Chloride	Boron	Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Oxalate ext. Molybdenum	Dumas Total Nitrogen	% Air-dry Moisture Content	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)
cmol/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	% dry wt	% of dry wt	g/g
<0.02	<0.1	41	2.7	8.1	11	0.9	1.1	0.59	0.38	2.9	0.0286
<0.02		380							0.14	3.5	0.0351
		1100									
		1200									
		740									
<0.02	<0.1	100	1.3	14	12	1.5	0.4	1.2	0.13	3.5	0.0345
<0.02		29							0.12	3.6	0.0361
		1500									
		1600									
<0.02	<0.1	6	0.57	12	19	0.79	0.56	0.47	0.11	1.2	0.0117
<0.02		67							0.05	1.9	0.0192
		300									
		760									
<0.02	<0.1	14	0.9	15	6.8	1.2	0.12	1.3	0.15	3.3	0.0332
<0.02		340							0.1	3.7	0.0365
		580									
		1500									
<0.02	<0.1	21	0.56	18	34	1.2	0.78	0.62	0.16	1.8	0.0183
<0.02		15							0.11	2.2	0.0215
		120									
		630									
		830									
<0.02	<0.1	<5	0.26	4.3	4.7	0.47	<0.08	<0.25	0.035	0.3	0.0032
		5									
<0.02		51							0.05	1.7	0.0169
		170									

SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D3-0.00-0.10
Barcode:	111981004	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		3.85						
	Dumas Total Nitrogen	% dry wt		0.38						
Other tests	% Air-dry Moisture Content	% of dry wt		2.9						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0286						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		3.8						
	Ammonium - N (2M KCl)	mg/kg		4.1						
	Colwell Phosphorus	mg/kg		18						
	PBI + Col P			67						
	Colwell Potassium	mg/kg		1800						
	KCl Sulfur (S)	mg/kg		11						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		2.7						
	Iron (Fe)	mg/kg		8.1						
	Manganese (Mn)	mg/kg		11						
	Copper (Cu)	mg/kg		0.90						
	Zinc (Zn)	mg/kg		1.1						
	Oxalate ext. Molybdenum	mg/kg		0.59						
Salt	Chloride	mg/kg		41						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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NOTE[2]: Walkley and Black Organic Carbon % (40°C) data presented in this test report have been obtained by a combination of laboratory wet chemistry and the equivalent modelled result from Mid-Infrared Diffuse Reflectance Spectroscopy and Partial Least Squares Regression (PLSR) analysis. An explanatory technical note is available upon request. The exception is for quoted work that specifically required laboratory wet chemistry.

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D3-0.20-0.30
Barcode:	111981005	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.2-0.3
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.50						
	Dumas Total Nitrogen	% dry wt		0.14						
Other tests	% Air-dry Moisture Content	% of dry wt		3.5						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0351						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		47						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		5.5						
Extractable N-P-K-S	PBI + Col P			94						
Extractable N-P-K-S	Colwell Potassium	mg/kg		1100						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		37						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		380						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D3-0.50-0.60
Barcode:	111981006	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.5-0.6
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		1100						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D3-0.70-0.80
Barcode:	111981007	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.7-0.8
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		1200						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D3-0.90-1.00
Barcode:	111981008	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.9-1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		740						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D22-0.00-0.10
Barcode:	111981064	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.33						
	Dumas Total Nitrogen	% dry wt		0.13						
Other tests	% Air-dry Moisture Content	% of dry wt		3.5						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0345						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
	Ammonium - N (2M KCl)	mg/kg		1.2						
	Colwell Phosphorus	mg/kg		7.9						
	PBI + Col P			101						
	Colwell Potassium	mg/kg		310						
	KCl Sulfur (S)	mg/kg		8.4						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		1.3						
	Iron (Fe)	mg/kg		14						
	Manganese (Mn)	mg/kg		12						
	Copper (Cu)	mg/kg		1.5						
	Zinc (Zn)	mg/kg		0.40						
	Oxalate ext. Molybdenum	mg/kg		1.2						
Salt	Chloride	mg/kg		100						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D22-0.20-0.30
Barcode:	111981065	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.2-0.3
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.25						
	Dumas Total Nitrogen	% dry wt		0.12						
Other tests	% Air-dry Moisture Content	% of dry wt		3.6						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0361						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		1.1						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		<5.0						
Extractable N-P-K-S	PBI + Col P			118						
Extractable N-P-K-S	Colwell Potassium	mg/kg		150						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		5.6						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		29						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D22-0.50-0.60
Barcode:	111981066	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.5-0.6
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		1500						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D22-0.80-0.90
Barcode:	111981067	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.8-0.9
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		1600						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D32-0.00-0.10
Barcode:	111981075	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.38						
	Dumas Total Nitrogen	% dry wt		0.11						
Other tests	% Air-dry Moisture Content	% of dry wt		1.2						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0117						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
	Ammonium - N (2M KCl)	mg/kg		5.4						
	Colwell Phosphorus	mg/kg		8.2						
	PBI + Col P			38						
	Colwell Potassium	mg/kg		170						
	KCl Sulfur (S)	mg/kg		5.4						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		0.57						
	Iron (Fe)	mg/kg		12						
	Manganese (Mn)	mg/kg		19						
	Copper (Cu)	mg/kg		0.79						
	Zinc (Zn)	mg/kg		0.56						
	Oxalate ext. Molybdenum	mg/kg		0.47						
Salt	Chloride	mg/kg		6						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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NOTE[2]: Walkley and Black Organic Carbon % (40°C) data presented in this test report have been obtained by a combination of laboratory wet chemistry and the equivalent modelled result from Mid-Infrared Diffuse Reflectance Spectroscopy and Partial Least Squares Regression (PLSR) analysis. An explanatory technical note is available upon request. The exception is for quoted work that specifically required laboratory wet chemistry.

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D32-0.20-0.30
Barcode:	111981076	**Crop:**	NOT SPECIFIED
Batch Number:	46601	**Sample Depth:**	0.2-0.3
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		0.55						
	Dumas Total Nitrogen	% dry wt		0.050						
Other tests	% Air-dry Moisture Content	% of dry wt		1.9						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0192						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		6.2						
Extractable N-P-K-S	PBI + Col P			53						
Extractable N-P-K-S	Colwell Potassium	mg/kg		220						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		13						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		67						

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SOIL ANALYSIS

Agent: GT Environmental
Agent Address: 4 / 162 Juliette Street, GREENSLOPES, QLD, 4120
Client: BWN
Test Set or Quotation:
Barcode: 111981077
Batch Number: 46603
Submission ID: 147219

Report Date: 03/12/2025
Sampling Date: NA
Date Received: 20/11/2025
Sample Name: D32-0.50-0.60
Crop: NOT SPECIFIED
Sample Depth: 0.5-0.6
GPS Start: NA
GPS End: NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		300						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D32-0.80-0.90
Barcode:	111981078	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0.8-0.9
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		760						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D37-0.00-0.10
Barcode:	111981089	**Crop:**	NOT SPECIFIED
Batch Number:	46603	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.31						
	Dumas Total Nitrogen	% dry wt		0.15						
Other tests	% Air-dry Moisture Content	% of dry wt		3.3						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0332						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
	Ammonium - N (2M KCl)	mg/kg		2.1						
	Colwell Phosphorus	mg/kg		<5.0						
	PBI + Col P			119						
	Colwell Potassium	mg/kg		120						
	KCl Sulfur (S)	mg/kg		4.0						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		0.90						
	Iron (Fe)	mg/kg		15						
	Manganese (Mn)	mg/kg		6.8						
	Copper (Cu)	mg/kg		1.2						
	Zinc (Zn)	mg/kg		0.12						
	Oxalate ext. Molybdenum	mg/kg		1.3						
Salt	Chloride	mg/kg		14						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D37-0.20-0.30
Barcode:	111981090	**Crop:**	NOT SPECIFIED
Batch Number:	46603	**Sample Depth:**	0.2-0.3
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.22						
	Dumas Total Nitrogen	% dry wt		0.10						
Other tests	% Air-dry Moisture Content	% of dry wt		3.7						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0365						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		1.3						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		<5.0						
Extractable N-P-K-S	PBI + Col P			112						
Extractable N-P-K-S	Colwell Potassium	mg/kg		110						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		6.8						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		340						

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SOIL ANALYSIS

Agent: GT Environmental
Agent Address: 4 / 162 Juliette Street, GREENSLOPES, QLD, 4120
Client: BWN
Test Set or Quotation:
Barcode: 111981091
Batch Number: 46603
Submission ID: 147219

Report Date: 03/12/2025
Sampling Date: NA
Date Received: 20/11/2025
Sample Name: D37-0.50-0.60
Crop: NOT SPECIFIED
Sample Depth: 0.5-0.6
GPS Start: NA
GPS End: NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		580						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D37-0.80-0.90
Barcode:	111981092	**Crop:**	NOT SPECIFIED
Batch Number:	46603	**Sample Depth:**	0.8-0.9
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		1500						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D44-0.00-0.10
Barcode:	111980904	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.89						
	Dumas Total Nitrogen	% dry wt		0.16						
Other tests	% Air-dry Moisture Content	% of dry wt		1.8						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0183						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		3.7						
	Ammonium - N (2M KCl)	mg/kg		1.6						
	Colwell Phosphorus	mg/kg		<5.0						
	PBI + Col P			60						
	Colwell Potassium	mg/kg		310						
	KCl Sulfur (S)	mg/kg		5.4						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		0.56						
	Iron (Fe)	mg/kg		18						
	Manganese (Mn)	mg/kg		34						
	Copper (Cu)	mg/kg		1.2						
	Zinc (Zn)	mg/kg		0.78						
	Oxalate ext. Molybdenum	mg/kg		0.62						
Salt	Chloride	mg/kg		21						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D44-0.10-0.20
Barcode:	111980905	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0.1-0.2
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		1.35						
	Dumas Total Nitrogen	% dry wt		0.11						
Other tests	% Air-dry Moisture Content	% of dry wt		2.2						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0215						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		1.2						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		<5.0						
Extractable N-P-K-S	PBI + Col P			74						
Extractable N-P-K-S	Colwell Potassium	mg/kg		86						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		3.7						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		15						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D44-0.20-0.30
Barcode:	111980906	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0.2-0.3
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		120						

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SOIL ANALYSIS

Agent: GT Environmental
Agent Address: 4 / 162 Juliette Street, GREENSLOPES, QLD, 4120
Client: BWN
Test Set or Quotation:
Barcode: 111980907
Batch Number: 46604
Submission ID: 147219

Report Date: 03/12/2025
Sampling Date: NA
Date Received: 20/11/2025
Sample Name: D44-0.50-0.60
Crop: NOT SPECIFIED
Sample Depth: 0.5-0.6
GPS Start: NA
GPS End: NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		630						

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SOIL ANALYSIS

Agent: GT Environmental
Agent Address: 4 / 162 Juliette Street, GREENSLOPES, QLD, 4120
Client: BWN
Test Set or Quotation:
Barcode: 111980908
Batch Number: 46604
Submission ID: 147219

Report Date: 03/12/2025
Sampling Date: NA
Date Received: 20/11/2025
Sample Name: D44-0.80-0.90
Crop: NOT SPECIFIED
Sample Depth: 0.8-0.9
GPS Start: NA
GPS End: NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		830						

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D59-0.00-0.10
Barcode:	111980929	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0-0.1
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		0.35						
	Dumas Total Nitrogen	% dry wt		0.035						
Other tests	% Air-dry Moisture Content	% of dry wt		0.3						
	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0032						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
	Ammonium - N (2M KCl)	mg/kg		<1.0						
	Colwell Phosphorus	mg/kg		<5.0						
	PBI + Col P			21						
	Colwell Potassium	mg/kg		130						
	KCl Sulfur (S)	mg/kg		<2.5						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
	Exchangeable hydrogen	cmol/kg		<0.02						
Trace Elements	Boron	mg/kg		0.26						
	Iron (Fe)	mg/kg		4.3						
	Manganese (Mn)	mg/kg		4.7						
	Copper (Cu)	mg/kg		0.47						
	Zinc (Zn)	mg/kg		<0.08						
	Oxalate ext. Molybdenum	mg/kg		<0.25						
Salt	Chloride	mg/kg		<5						
Al	CaCl2 extr. Aluminium	mg/kg		<0.1						

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SOIL ANALYSIS

Agent: GT Environmental
Agent Address: 4 / 162 Juliette Street, GREENSLOPES, QLD, 4120
Client: BWN
Test Set or Quotation:
Barcode: 111980930
Batch Number: 46603
Submission ID: 147219

Report Date: 03/12/2025
Sampling Date: NA
Date Received: 20/11/2025
Sample Name: D59-0.20-0.30
Crop: NOT SPECIFIED
Sample Depth: 0.2-0.3
GPS Start: NA
GPS End: NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		5						

NOTE[1]: Eurofins APAL will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:	DS1	**Sample Name:**	D59-0.50-0.60
Barcode:	111980931	**Crop:**	NOT SPECIFIED
Batch Number:	46603	**Sample Depth:**	0.5-0.6
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
	Organic Carbon (W&B) [2]	% (40°C)		0.22						
	Dumas Total Nitrogen	% dry wt		0.050						
Other tests	% Air-dry Moisture Content	% of dry wt		1.7						
Other tests	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)	g/g		0.0169						
Extractable N-P-K-S	Nitrate - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Ammonium - N (2M KCl)	mg/kg		<1.0						
Extractable N-P-K-S	Colwell Phosphorus	mg/kg		<5.0						
Extractable N-P-K-S	PBI + Col P			73						
Extractable N-P-K-S	Colwell Potassium	mg/kg		180						
Extractable N-P-K-S	KCl Sulfur (S)	mg/kg		4.8						
Exchangeable cations	Exchangeable aluminium	cmol/kg		<0.02						
Exchangeable cations	Exchangeable hydrogen	cmol/kg		<0.02						
Salt	Chloride	mg/kg		51						

NOTE[1]: Eurofins APAL will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

NOTE[2]: Walkley and Black Organic Carbon % (40°C) data presented in this test report have been obtained by a combination of laboratory wet chemistry and the equivalent modelled result from Mid-Infrared Diffuse Reflectance Spectroscopy and Partial Least Squares Regression (PLSR) analysis. An explanatory technical note is available upon request. The exception is for quoted work that specifically required laboratory wet chemistry.

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SOIL ANALYSIS

Agent:	GT Environmental	**Report Date:**	03/12/2025
Agent Address:	4 / 162 Juliette Street, GREENSLOPES, QLD, 4120	**Sampling Date:**	NA
Client:	BWN	**Date Received:**	20/11/2025
Test Set or Quotation:		**Sample Name:**	D59-0.80-0.90
Barcode:	111980932	**Crop:**	NOT SPECIFIED
Batch Number:	46604	**Sample Depth:**	0.8-0.9
Submission ID:	147219	**GPS Start:**	NA
		GPS End:	NA

	Analyte	Unit	Desired Level	Level Found	c.mol/kg	Very Low	Low	Acceptable	High	Excessive
Salt	Chloride	mg/kg		170						

NOTE[1]: Eurofins APAL will review published literature for crop desired levels, and reserves the right to make changes to this information in test reports as and when these reviews are conducted.

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Eurofins APAL Test Method Codes														
Crop	Actual Crop	SubmissionID	SamplingDate	DateReceived	BatchID	Batch Position No.	AgentName	ClientName	SampleName	Barcode	SampleDepth	Postcode	Transect GPS Start	Transect GPS Finish
		147220		2025-11-20	46603	23	GT Environmental - Reece McCann	BWN	D1-0.00-0.10	111981001	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	12	GT Environmental - Reece McCann	BWN	D1-0.20-0.30	111981002	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	24	GT Environmental - Reece McCann	BWN	D1-0.50-0.60	111981003	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	42	GT Environmental - Reece McCann	BWN	D5-0.00-0.10	111981009	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	44	GT Environmental - Reece McCann	BWN	D5-0.20-0.30	111981010	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	28	GT Environmental - Reece McCann	BWN	D5-0.50-0.60	111981011	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46603	22	GT Environmental - Reece McCann	BWN	D5-0.80-0.90	111981012	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46603	10	GT Environmental - Reece McCann	BWN	D5-1.00-1.10	111981013	1-1.1	4120	N/A	N/A
		147220		2025-11-20	46601	33	GT Environmental - Reece McCann	BWN	D5-1.40-1.50	111981014	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46601	35	GT Environmental - Reece McCann	BWN	D5-1.70-1.80	111981015	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46601	34	GT Environmental - Reece McCann	BWN	D6-0.00-0.10	111981016	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	38	GT Environmental - Reece McCann	BWN	D6-0.20-0.30	111981017	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46603	13	GT Environmental - Reece McCann	BWN	D6-0.50-0.60	111981018	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	27	GT Environmental - Reece McCann	BWN	D6-0.80-0.90	111981019	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46601	29	GT Environmental - Reece McCann	BWN	D6-1.00-1.10	111981020	1-1.1	4120	N/A	N/A
		147220		2025-11-20	46603	20	GT Environmental - Reece McCann	BWN	D7-0.00-0.10	111981021	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	3	GT Environmental - Reece McCann	BWN	D7-0.20-0.30	111981022	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	32	GT Environmental - Reece McCann	BWN	D7-0.50-0.60	111981023	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	37	GT Environmental - Reece McCann	BWN	D12m-0.00-0.10	111981024	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	45	GT Environmental - Reece McCann	BWN	D12m-0.20-0.30	111981025	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	26	GT Environmental - Reece McCann	BWN	D12m-0.50-0.60	111981026	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	30	GT Environmental - Reece McCann	BWN	D12m-0.80-0.90	111981027	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46601	41	GT Environmental - Reece McCann	BWN	D12m-1.10-1.20	111981028	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	16	GT Environmental - Reece McCann	BWN	D12m-1.40-1.50	111981029	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46601	39	GT Environmental - Reece McCann	BWN	D12m-1.70-1.80	111981030	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46604	45	GT Environmental - Reece McCann	BWN	D12d-0.00-0.10	111981031	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46604	46	GT Environmental - Reece McCann	BWN	D12d-0.20-0.30	111981032	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	41	GT Environmental - Reece McCann	BWN	D12d-0.50-0.60	111981033	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	7	GT Environmental - Reece McCann	BWN	D12d-0.80-0.90	111981034	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	27	GT Environmental - Reece McCann	BWN	D12d-1.10-1.20	111981035	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	25	GT Environmental - Reece McCann	BWN	D12d-1.40-1.50	111981036	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46601	9	GT Environmental - Reece McCann	BWN	D12d-1.70-1.80	111981037	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46604	40	GT Environmental - Reece McCann	BWN	D14d-0.00-0.10	111981038	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	10	GT Environmental - Reece McCann	BWN	D14d-0.20-0.30	111981039	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	30	GT Environmental - Reece McCann	BWN	D14d-0.50-0.60	111981040	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	28	GT Environmental - Reece McCann	BWN	D14d-0.80-0.90	111981041	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	42	GT Environmental - Reece McCann	BWN	D14d-1.10-1.20	111981042	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	31	GT Environmental - Reece McCann	BWN	D14d-1.30-1.40	111981043	1.3-1.4	4120	N/A	N/A
		147220		2025-11-20	46604	44	GT Environmental - Reece McCann	BWN	D14m-0.00-0.10	111981044	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46604	26	GT Environmental - Reece McCann	BWN	D14m-0.20-0.30	111981045	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	33	GT Environmental - Reece McCann	BWN	D14m-0.50-0.60	111981046	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	8	GT Environmental - Reece McCann	BWN	D14m-0.80-0.90	111981047	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	5	GT Environmental - Reece McCann	BWN	D14m-1.10-1.20	111871227	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	35	GT Environmental - Reece McCann	BWN	D14m-1.40-1.50	111981049	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46604	43	GT Environmental - Reece McCann	BWN	D14m-1.70-1.80	111981050	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46604	32	GT Environmental - Reece McCann	BWN	D14m-2.00-2.10	111981051	2-2.1	4120	N/A	N/A
		147220		2025-11-20	46604	38	GT Environmental - Reece McCann	BWN	D19-0.00-0.05	111981052	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46604	24	GT Environmental - Reece McCann	BWN	D19-0.20-0.30	111981053	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	6	GT Environmental - Reece McCann	BWN	D19-0.40-0.50	111981054	0.4-0.5	4120	N/A	N/A
		147220		2025-11-20	46601	1	GT Environmental - Reece McCann	BWN	D19-0.50-0.60	111981055	0.5-0.6	4120	N/A	N/A

		147220		2025-11-20	46604	37	GT Environmental - Reece McCann	BWN	D19-0.80-0.90	111981056	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46601	16	GT Environmental - Reece McCann	BWN	D21-0.00-0.10	111981057	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	17	GT Environmental - Reece McCann	BWN	D21-0.20-0.30	111981059	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	18	GT Environmental - Reece McCann	BWN	D21-0.50-0.60	111981060	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	29	GT Environmental - Reece McCann	BWN	D21-0.80-0.90	111981061	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	36	GT Environmental - Reece McCann	BWN	D21-1.10-1.20	111981062	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	34	GT Environmental - Reece McCann	BWN	D21-1.40-1.50	111981063	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46604	39	GT Environmental - Reece McCann	BWN	D21-1.70-1.80	111981058	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46601	8	GT Environmental - Reece McCann	BWN	D24-0.00-0.10	111981071	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	2	GT Environmental - Reece McCann	BWN	D24-0.20-0.30	111981072	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46601	7	GT Environmental - Reece McCann	BWN	D24-0.50-0.60	111981073	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	5	GT Environmental - Reece McCann	BWN	D24-0.80-0.90	111981074	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46601	15	GT Environmental - Reece McCann	BWN	D36-0.00-0.10	111981082	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	8	GT Environmental - Reece McCann	BWN	D36-0.20-0.30	111981083	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46603	43	GT Environmental - Reece McCann	BWN	D36-0.50-0.60	111981084	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46601	13	GT Environmental - Reece McCann	BWN	D36-0.80-0.90	111981085	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46603	25	GT Environmental - Reece McCann	BWN	D36-1.10-1.20	111981086	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46601	4	GT Environmental - Reece McCann	BWN	D36-1.40-1.50	111981087	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46603	6	GT Environmental - Reece McCann	BWN	D36-1.70-1.80	111981088	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46603	21	GT Environmental - Reece McCann	BWN	D39-0.00-0.10	111981096	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	15	GT Environmental - Reece McCann	BWN	D39-0.20-0.30	111981097	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	14	GT Environmental - Reece McCann	BWN	D39-0.50-0.60	111981098	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	21	GT Environmental - Reece McCann	BWN	D39-0.80-0.90	111981099	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46603	11	GT Environmental - Reece McCann	BWN	D39-1.10-1.20	111981100	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46603	1	GT Environmental - Reece McCann	BWN	D43-0.00-0.10	111980901	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46601	21	GT Environmental - Reece McCann	BWN	D43-0.10-0.20	111980902	0.1-0.2	4120	N/A	N/A
		147220		2025-11-20	46604	19	GT Environmental - Reece McCann	BWN	D43-0.20-0.30	111980903	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	15	GT Environmental - Reece McCann	BWN	D45-0.00-0.10	111980910	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	4	GT Environmental - Reece McCann	BWN	D45-0.20-0.30	111980911	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	9	GT Environmental - Reece McCann	BWN	D45-0.50-0.60	111980912	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	12	GT Environmental - Reece McCann	BWN	D45-0.80-0.90	111980913	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	3	GT Environmental - Reece McCann	BWN	D45-1.10-1.20	111980914	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	11	GT Environmental - Reece McCann	BWN	D45-1.40-1.50	111980915	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46604	2	GT Environmental - Reece McCann	BWN	D45-1.70-1.80	111980916	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46601	22	GT Environmental - Reece McCann	BWN	D52-0.00-0.10	111980917	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	14	GT Environmental - Reece McCann	BWN	D52-0.20-0.30	111980918	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46604	17	GT Environmental - Reece McCann	BWN	D52-0.50-0.60	111980919	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46603	19	GT Environmental - Reece McCann	BWN	D52-0.80-0.90	111980920	0.8-0.9	4120	N/A	N/A
		147220		2025-11-20	46604	10	GT Environmental - Reece McCann	BWN	D52-1.10-1.20	111980921	1.1-1.2	4120	N/A	N/A
		147220		2025-11-20	46604	18	GT Environmental - Reece McCann	BWN	D52-1.40-1.50	111980922	1.4-1.5	4120	N/A	N/A
		147220		2025-11-20	46604	22	GT Environmental - Reece McCann	BWN	D52-1.70-1.80	111980923	1.7-1.8	4120	N/A	N/A
		147220		2025-11-20	46601	23	GT Environmental - Reece McCann	BWN	D52-2.00-2.10	111980924	2-2.1	4120	N/A	N/A
		147220		2025-11-20	46603	36	GT Environmental - Reece McCann	BWN	D58-0.00-0.10	111980925	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	40	GT Environmental - Reece McCann	BWN	D58-0.20-0.30	111980926	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46603	37	GT Environmental - Reece McCann	BWN	D58-0.50-0.60	111980927	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46604	48	GT Environmental - Reece McCann	BWN	D58-0.70-0.80	111980928	0.7-0.8	4120	N/A	N/A
		147220		2025-11-20	46603	28	GT Environmental - Reece McCann	BWN	D65-0.00-0.05	111980936	0-0.1	4120	N/A	N/A
		147220		2025-11-20	46603	32	GT Environmental - Reece McCann	BWN	D65-0.10-0.20	111980937	0.1-0.2	4120	N/A	N/A
		147220		2025-11-20	46603	30	GT Environmental - Reece McCann	BWN	D65-0.20-0.30	111980938	0.2-0.3	4120	N/A	N/A
		147220		2025-11-20	46603	38	GT Environmental - Reece McCann	BWN	D65-0.50-0.60	111980939	0.5-0.6	4120	N/A	N/A
		147220		2025-11-20	46603	31	GT Environmental - Reece McCann	BWN	D65-0.80-0.90	111980940	0.8-0.9	4120	N/A	N/A

NOTE 1: Walkley and Black Organic Carbon % (40°C) data presented in this test report have been obtained by a combination of laboratory wet chemistry and the equivalent modelled result from Mid-Infrared Diffuse Reflectance Spectroscopy and Partial Least Squares Regression (PLSR) analysis. An explanatory technical note is available upon request. The exception is for quoted

TMs-004A	TMs-004B4	TMs-006A	TMs-007NO3	TMs-007NH4	TMs-009B	TMs-009I2	TMs-018	TMs-010D	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E
pH 1:5 water	pH CaCl2 (following 4A1)	Organic Carbon (W&B)	Nitrate - N (2M KCl)	Ammonium - N (2M KCl)	Colwell Phosphorus	PBI + Col P	Colwell Potassium	KCl Sulfur (S)	Calcium (Ca) - NH4Cl/BaCl2	Magnesium (Mg) - NH4Cl/BaCl2	Potassium (K) - NH4Cl/BaCl2	Sodium (NH4Cl/BaCl2)	Calcium (Ca) - NH4Cl/BaCl2	Magnesium (Mg) - NH4Cl/BaCl2
pH units	pH units	% (40°C)	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol/kg	cmol/kg
8.55	7.84	1.66	2.7	1.4	<5.0	100	500	5.8	4650	458	415	200	23.2	3.77
8.94	8.17	0.7	<1.0	<1.0	<5.0	92	150	6.8	3860	563	126	1320	19.3	4.63
9.2	8.35								2520	536	92	1410	12.6	4.41
7.63	6.42	1.34	<1.0	1.7	<5.0	116	97	7.5	3900	1080	115	566	19.5	8.89
8.63	7.67	1.12	<1.0	1.3	<5.0	112	80	6.3	4330	1310	109	1010	21.6	10.8
8.96	8.12								4400	1360	88	1120	22	11.2
8.13	7.52								2980	1460	110	2440	14.8	12
8.63	8.01								3450	1490	121	2110	17.2	12.3
5.21	4.6								2290	1490	100	2210	11.4	12.3
8.08	7.4								2940	1420	116	1890	14.7	11.7
7.17	6.06	1.77	1.2	2.5	7.3	68	330	4.8	2400	746	252	205	12	6.13
8.98	8.09	0.91	<1.0	1.2	<5.0	122	100	8.9	3900	1250	126	1030	19.4	10.3
9.07	8.26								3470	1260	109	1380	17.3	10.4
9.1	8.37								2110	1060	67	1680	10.6	8.69
8.95	8.14								2000	1140	64	1890	10	9.38
8.57	7.82	1.46	<1.0	1.6	<5.0	133	120	5.6	5520	796	171	227	27.6	6.55
8.96	8.01	0.78	<1.0	<1.0	<5.0	115	120	4.6	4470	1010	132	530	22.3	8.31
8.76	7.92								2990	1150	132	1510	14.9	9.43
7.75	7.11	0.75	<1.0	1.6	<5.0	100	220	20	3410	1060	195	436	17	8.75
5.67	5.22	0.42	<1.0	1.7	<5.0	94	170	56	2040	1210	173	1470	10.2	9.92
5.77	5.36								1910	1210	201	1940	9.54	9.96
5.75	5.42								1740	1210	203	2320	8.69	9.94
7.65	7.26								2150	1280	246	2480	10.7	10.5
7.22	6.76								2390	1360	257	2570	11.9	11.2
7.59	7.2								2120	1320	276	2570	10.6	10.9
8.21	7.49	0.88	<1.0	<1.0	5.9	90	230	4.2	3920	847	242	232	19.6	6.97
7.79	7.2	0.41	1	<1.0	<5.0	89	130	18	2550	1090	147	1800	12.7	8.96
8.02	7.51								2330	1150	163	2450	11.7	9.43
8.23	7.69								2250	1090	164	2310	11.2	8.98
8.08	7.57								2350	1200	197	2590	11.7	9.83
7.96	7.5								2210	1270	230	2680	11	10.5
7.19	6.7								1980	1160	179	1970	9.86	9.58
7.51	6.19	0.55	<1.0	<1.0	11	84	180	4.1	3070	894	193	263	15.3	7.35
7.55	6.36	0.64	<1.0	1.1	12	94	230	4	3040	911	231	394	15.2	7.49
7.67	7.16								3200	1270	179	1810	16	10.4
6.61	5.88								2260	1010	127	1320	11.3	8.31
8.16	7.52								2120	1220	197	1780	10.6	10.1
7.54	6.9								1820	1130	148	1720	9.1	9.34
7.18	6.34	1.77	1.2	2.2	10	82	410	5.6	3660	948	423	215	18.3	7.8
8.36	7.7	1.16	<1.0	1.3	<5.0	118	140	7.4	4240	923	164	974	21.2	7.59
8.19	7.36								2560	968	145	1070	12.8	7.96
8.03	7.57								2380	1390	287	2750	11.9	11.4
7.47	7.02								2190	1420	299	2890	10.9	11.7
7.41	7.01								2250	1460	308	3000	11.3	12
7.41	6.96								2310	1560	331	3110	11.5	12.8
7.21	6.73													
8.19	7.38	1.64	<1.0	4.8	9.3	67	470	4.2	4640	779	405	145	23.1	6.41
8.82	7.87	1.1	<1.0	<1.0	<5.0	100	170	5.7	5050	743	181	426	25.2	6.11
8.95	8.03								3170	501	88	513	15.8	4.13
7.96	7.14								1750	670	59	1750	8.73	5.51

8.88	7.99								3150	653	114	1100	15.7	5.37
8.06	7.38	2.37	2.7	2.4	9.3	99	640	7.2	5200	643	544	32.4	25.9	5.29
8.79	8.07	1.1	<1.0	1.4	<5.0	118	140	8.5	4570	863	174	1530	22.8	7.1
8.72	8.1								3990	864	174	2050	19.9	7.11
8.59	7.94								4210	942	167	2600	21	7.75
8.67	8.11								3960	937	190	2660	19.8	7.71
7.42	6.75								3180	988	165	2580	15.9	8.13
7.99	7.28								2710	817	143	2080	13.5	6.72
7.69	6.38	0.8	<1.0	1.4	6	51	300	4.4	1490	596	201	151	7.44	4.9
7.64	6.72	0.57	20	2.2	<5.0	118	89	8.7	1660	1180	85	1530	8.26	9.75
8.38	7.5								1920	1240	100	1570	9.56	10.2
9.07	8.11								1640	1090	86	1560	8.19	8.98
8	6.94	1.23	<1.0	2.1	<5.0	86	110	6.2	3210	794	115	79.9	16	6.53
8.52	7.74	0.69	<1.0	1.3	<5.0	157	72	5.2	3620	1050	92	324	18.1	8.61
9.01	8.12								2720	1170	82	778	13.6	9.65
9.06	8.31								2240	1180	86	839	11.2	9.73
9.03	8.27								2190	1090	89	879	10.9	8.97
8.7	7.91								1400	924	70	777	6.99	7.6
8.39	7.36								1010	605	53	620	5.03	4.98
7.78	6.85	1.5	1	1.5	<5.0	107	160	4.3	4270	505	171	158	21.3	4.15
8.54	7.8	1.61	8.9	<1.0	<5.0	141	130	11	5190	615	146	313	25.9	5.06
8.78	7.97								3930	610	85	684	19.6	5.02
9.3	8.4								2880	935	71	2660	14.4	7.69
9.28	8.48								2830	793	79	2230	14.1	6.52
7.4	6.16	0.68	<1.0	1.3	6.5	56	240	4.8	1750	625	148	297	8.71	5.14
8.15	6.99	0.83	<1.0	1.1	<5.0	89	140	7	2530	1110	125	700	12.6	9.11
8.72	7.76								2860	1230	143	896	14.3	10.1
7.54	6.88	1.35	1.5	<1.0	7.2	49	540	5.9	3570	496	477	16.3	17.8	4.08
8.25	7.52	1.34	<1.0	1.5	<5.0	96	210	5.5	4360	636	203	69.6	21.7	5.23
8.16	7.52								5010	868	195	480	25	7.14
7.71	7.29								4990	1020	210	681	24.9	8.37
7.28	6.75								4920	987	243	724	24.6	8.12
6.51	5.92								4550	905	251	714	22.7	7.45
6.95	6.33								3960	806	214	626	19.8	6.63
7.48	6.38	1.14	2.6	2.3	<5.0	60	260	4.4	2300	366	226	24.3	11.5	3.01
8.03	7.11	0.47	<1.0	1.2	<5.0	78	110	3.5	2330	467	121	80.9	11.6	3.84
9.23	8.21								1890	1040	99	829	9.43	8.55
9.14	8.4								1480	1040	97	1080	7.41	8.55
8.99	8.33								1710	1270	101	1310	8.52	10.5
9.02	8.29								1210	990	80	1200	6.06	8.14
9.09	8.32								1360	994	88	1210	6.78	8.18
7.91	7.1													
8.49	7.5	1.07	2.5	1.3	<5.0	92	190	5	3910	723	181	228	19.5	5.95
8.61	7.58	1.15	1.5	1.1	<5.0	78	130	10	3870	751	152	657	19.3	6.18
9.01	8.16								2980	847	111	1070	14.9	6.97
8.93	8.2								2790	878	104	1140	13.9	7.23
7.48	6.74	0.64	3.1	<1.0	5.9	20	330	2.5	616	114	259	11.1	3.07	0.94
7.85	6.99	0.49	1.1	<1.0	<5.0	19	360	<2.5	814	99	299	13	4.06	0.813
7.68	6.6								862	201	215	65.9	4.3	1.65
8.03	7.03								1490	544	167	257	7.45	4.47
9.14	8.24								1890	613	162	456	9.44	5.04

work that specifically required laboratory wet chemistry.

TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1
Potassium (K) - NH4Cl/BaCl2	Sodium (NH4Cl/BaCl2)	Ca:Mg ratio	K:Mg ratio	GTRI	ECR	Calcium (Ca) - prewash alc. pH 8.5 NH4Cl	Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl	Potassium (K) - prewash alc. pH 8.5 NH4Cl	Sodium (Na) - prewash alc. pH 8.5 NH4Cl	Calcium (Ca) - prewash alc. pH 8.5 NH4Cl	Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl	Potassium (K) - prewash alc. pH 8.5 NH4Cl	Sodium (Na) - prewash alc. pH 8.5 NH4Cl	Ca:Mg ratio
cmol/kg	cmol/kg				%	mg/kg	mg/kg	mg/kg	mg/kg	cmol/kg	cmol/kg	cmol/kg	cmol/kg	
1.06	0.87	6.2	0.28		6.7	4490	471	455	28.8	22.4	3.87	1.16	0.125	5.8
0.322	5.73	4.2	0.07		20	4090	563	136	274	20.4	4.63	0.347	1.19	4.4
0.234	6.15	2.9	0.05		27	2720	561	100	659	13.6	4.61	0.256	2.87	2.9
0.294	2.46	2.2	<0.05		8.9	4060	1060	144	314	20.3	8.72	0.368	1.36	2.3
0.278	4.38	2	<0.05		13	4470	1430	133	532	22.3	11.7	0.34	2.31	1.9
0.226	4.87	2	<0.05		13	4330	1530	105	446	21.6	12.6	0.269	1.94	1.7
0.281	10.6	1.2	<0.05		29	3140	1590	118	1150	15.7	13.1	0.301	4.99	1.2
0.309	9.19	1.4	<0.05		24	3570	1640	120	1020	17.8	13.5	0.306	4.43	1.3
0.255	9.6	0.9	<0.05		29	2490	1520	98.8	1200	12.4	12.5	0.253	5.24	1
0.297	8.23	1.3	<0.05		24	3260	1660	118	1050	16.3	13.7	0.302	4.55	1.2
0.644	0.892	2	0.11		7.8	2470	784	307	66.4	12.3	6.45	0.785	0.289	1.9
0.321	4.47	1.9	<0.05		14	4020	1440	137	319	20.1	11.8	0.35	1.39	1.7
0.278	6.02	1.7	<0.05		19	3940	1350	108	465	19.6	11.1	0.275	2.02	1.8
0.17	7.32	1.2	<0.05		28	2250	1140	81.8	595	11.2	9.34	0.209	2.59	1.2
0.163	8.22	1.1	<0.05		30	2050	1130	52.2	934	10.2	9.32	0.134	4.06	1.1
0.438	0.988	4.2	0.07		4	5340	813	172	48.7	26.7	6.69	0.439	0.212	4
0.338	2.3	2.7	<0.05		7.9	4800	1100	137	126	24	9.07	0.349	0.55	2.6
0.339	6.56	1.6	<0.05		22	2690	1090	139	725	13.4	8.93	0.355	3.15	1.5
0.499	1.9	1.9	0.06		8.5	3550	1110	235	101	17.7	9.13	0.602	0.44	1.9
0.441	6.4	1	<0.05		25	2110	1110	201	471	10.5	9.16	0.514	2.05	1.2
0.514	8.43	1	0.05		31	1910	1120	250	618	9.52	9.2	0.639	2.69	1
0.52	10.1	0.9	0.05		36	1640	1040	226	560	8.19	8.54	0.578	2.44	1
0.629	10.8	1	0.06		35	2310	1380	311	690	11.5	11.3	0.795	3	1
0.656	11.2	1.1	0.06		34	2290	1330	285	690	11.4	10.9	0.728	3	1
0.707	11.2	1	0.07		36	2080	1300	329	686	10.4	10.7	0.842	2.99	1
0.618	1.01	2.8	0.09		5.8	3440	800	258	52.9	17.2	6.58	0.659	0.23	2.6
0.375	7.83	1.4	<0.05		27	2390	1060	166	580	11.9	8.71	0.423	2.52	1.4
0.417	10.7	1.2	<0.05		34	2130	1070	179	643	10.6	8.84	0.458	2.8	1.2
0.418	10	1.3	<0.05		34	2240	1100	175	682	11.2	9.03	0.447	2.97	1.2
0.504	11.3	1.2	0.05		35	2140	1110	223	681	10.7	9.13	0.569	2.96	1.2
0.587	11.6	1.1	0.06		36	2060	1120	247	602	10.3	9.23	0.631	2.62	1.1
0.458	8.57	1	<0.05		32	1960	1160	223	538	9.79	9.52	0.569	2.34	1
0.495	1.14	2.1	0.07		6.7	2730	774	211	96.7	13.6	6.37	0.54	0.421	2.1
0.592	1.71	2	0.08		9.2	3290	955	297	162	16.4	7.86	0.76	0.704	2.1
0.458	7.88	1.5	<0.05		24	3210	1190	202	497	16	9.77	0.515	2.16	1.6
0.325	5.75	1.4	<0.05		24	2080	907	142	438	10.4	7.46	0.364	1.91	1.4
0.503	7.73	1.1	<0.05		29	2290	1360	247	716	11.4	11.2	0.631	3.11	1
0.379	7.48	1	<0.05		30	1680	1050	151	494	8.36	8.66	0.386	2.15	1
1.08	0.937	2.3	0.14		7.2	3100	831	471	48.2	15.5	6.84	1.2	0.21	2.3
0.42	4.24	2.8	0.06		14	3780	818	186	163	18.9	6.73	0.476	0.707	2.8
0.371	4.64	1.6	<0.05		19	2510	944	170	393	12.5	7.77	0.434	1.71	1.6
0.735	12	1	0.07		35	2240	1280	313	740	11.2	10.6	0.801	3.22	1.1
0.764	12.6	0.9	0.07		37	1690	1080	271	612	8.42	8.92	0.693	2.66	0.9
0.786	13	0.9	0.07		37	1650	1080	278	648	8.26	8.84	0.711	2.82	0.9
0.847	13.5	0.9	0.07		37	1730	1190	312	749	8.66	9.82	0.797	3.26	0.9
1.03	0.632	3.6	0.16		5.3	3890	684	453	36.1	19.4	5.62	1.16	0.157	3.5
0.464	1.85	4.1	0.08		6.9	4620	680	178	105	23	5.59	0.456	0.458	4.1
0.225	2.23	3.8	0.05		11	2770	440	77.3	162	13.8	3.62	0.198	0.705	3.8
0.151	7.61	1.6	<0.05		35	1850	667	70.2	917	9.25	5.49	0.18	3.99	1.7

0.292	4.8	2.9	0.05		19	2910	602	112	440	14.5	4.95	0.285	1.91	2.9
1.39	0.141	4.9	0.26		4.7	4790	637	690	10.6	23.9	5.24	1.76	0.046	4.6
0.445	6.67	3.2	0.06		19	4620	1020	233	528	23.1	8.41	0.596	2.3	2.7
0.445	8.9	2.8	0.06		26	4150	975	233	864	20.7	8.02	0.597	3.76	2.6
0.427	11.3	2.7	0.06		29	3520	903	190	983	17.6	7.42	0.486	4.28	2.4
0.486	11.6	2.6	0.06		31	3690	828	191	663	18.4	6.81	0.487	2.88	2.7
0.421	11.2	2	0.05		33	2360	745	124	851	11.8	6.13	0.318	3.7	1.9
0.366	9.03	2	0.05		32	2230	648	122	793	11.1	5.33	0.313	3.45	2.1
0.515	0.656	1.5	0.11		8.7	1450	593	236	44.7	7.24	4.88	0.603	0.194	1.5
0.218	6.64	0.9	<0.05		28	1590	1150	106	740	7.91	9.48	0.27	3.22	0.8
0.257	6.84	0.9	<0.05		26	1890	1310	117	860	9.41	10.8	0.3	3.74	0.9
0.22	6.8	0.9	<0.05		29	1500	1020	91.2	751	7.47	8.41	0.233	3.27	0.9
0.295	0.348	2.4	<0.05		2.8	3380	821	141	12.7	16.9	6.75	0.359	0.055	2.5
0.236	1.41	2.1	<0.05		5.8	3900	1130	90.6	58.5	19.4	9.31	0.232	0.254	2.1
0.21	3.39	1.4	<0.05		13	2830	1320	84	116	14.1	10.8	0.215	0.506	1.3
0.219	3.65	1.1	<0.05		16	2330	1320	76.5	110	11.6	10.9	0.196	0.479	1.1
0.227	3.83	1.2	<0.05		17	5740	932	163	157	28.6	7.67	0.417	0.681	3.7
0.18	3.38	0.9	<0.05		20	1560	1030	64.8	278	7.77	8.51	0.166	1.21	0.9
0.135	2.7	1	<0.05		22	998	589	42	211	4.98	4.85	0.107	0.92	1
0.437	0.686	5.1	0.11		4.2	3960	450	201	44.4	19.8	3.7	0.515	0.193	5.3
0.373	1.36	5.1	0.07		5.3	4840	616	161	57.2	24.1	5.07	0.412	0.249	4.8
0.216	2.97	3.9	<0.05		11	3510	540	73.7	84.5	17.5	4.45	0.188	0.368	3.9
0.182	11.6	1.9	<0.05		35	3080	907	57.2	836	15.4	7.46	0.146	3.64	2.1
0.202	9.72	2.2	<0.05		32	3140	803	69	892	15.7	6.61	0.176	3.88	2.4
0.377	1.29	1.7	0.07		11	1640	589	178	130	8.16	4.85	0.454	0.565	1.7
0.32	3.04	1.4	<0.05		13	2570	1130	158	378	12.8	9.3	0.405	1.64	1.4
0.366	3.9	1.4	<0.05		15	2670	1140	141	357	13.3	9.39	0.362	1.55	1.4
1.22	0.071	4.4	0.3		5.6	2820	408	421	<6.0	14.1	3.36	1.08	0.024	4.2
0.519	0.303	4.2	0.1		3	4220	611	226	17.3	21.1	5.03	0.579	0.075	4.2
0.499	2.09	3.5	0.07		7.4	4460	847	204	103	22.3	6.97	0.523	0.446	3.2
0.537	2.96	3	0.06		9.5	4570	915	214	121	22.8	7.53	0.546	0.524	3
0.62	3.15	3	0.08		10	4240	879	252	143	21.1	7.23	0.643	0.62	2.9
0.642	3.11	3	0.09		11	3650	746	257	155	18.2	6.14	0.657	0.674	3
0.546	2.72	3	0.08		11	3420	732	226	143	17.1	6.03	0.577	0.621	2.8
0.579	0.106	3.8	0.19		4.5	2130	340	263	<6.0	10.6	2.8	0.673	<0.020	3.8
0.309	0.352	3	0.08		4.1	2280	435	122	14.6	11.4	3.58	0.311	0.064	3.2
0.253	3.6	1.1	<0.05		18	1720	1030	88.7	78.1	8.59	8.44	0.227	0.34	1
0.247	4.72	0.9	<0.05		24	1470	1120	98.2	186	7.32	9.22	0.251	0.81	0.8
0.257	5.71	0.8	<0.05		24	1530	1280	85.7	256	7.62	10.5	0.219	1.11	0.7
0.205	5.21	0.7	<0.05		28	1140	1020	77.9	213	5.67	8.38	0.199	0.925	0.7
0.224	5.25	0.8	<0.05		27	1220	986	78.5	329	6.08	8.11	0.201	1.43	0.8
0.463	0.991	3.3	0.08		5.4	3930	750	218	62.4	19.6	6.17	0.557	0.271	3.2
0.388	2.86	3.1	0.06		11	3730	769	183	291	18.6	6.33	0.469	1.27	2.9
0.284	4.67	2.1	<0.05		18	3150	915	124	193	15.7	7.52	0.318	0.837	2.1
0.267	4.94	1.9	<0.05		20	2470	853	121	211	12.3	7.02	0.31	0.918	1.8
0.662	0.048	3.3	0.7		15	496	118	183	<6.0	2.47	0.97	0.468	<0.020	2.6
0.765	0.057	5	0.94		14	542	84.1	185	<6.0	2.7	0.692	0.472	<0.020	3.9
0.55	0.287	2.6	0.33		12	847	210	203	7	4.23	1.73	0.518	0.03	2.4
0.428	1.12	1.7	0.1		11	1560	600	182	62.9	7.76	4.93	0.465	0.274	1.6
0.414	1.98	1.9	0.08		14	1740	640	161	32.7	8.69	5.27	0.411	0.142	1.7

TMs-015C1	TMs-015C1	TMs-015C1	TMs-015G	TMs-015G	TMs-015G	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-028	TMs-005
K:Mg ratio	GTRI	ECR	Exchangeable acidity	Exchangeable aluminium	Exchangeable hydrogen	ECEC	Calcium	Magnesium	Potassium	Sodium	Aluminium	Hydrogen	CaCl2 extr. Aluminium	Chloride
		%	cmol/kg	cmol/kg	cmol/kg	cmol/kg	%	%	%	%	%	%	mg/kg	mg/kg
0.3		4.7	<0.02	<0.02	<0.02	27.6	81.3	14	4.2	0.5	0	0	<0.1	62
0.08		5.8	<0.02	<0.02	<0.02	26.6	76.8	17.4	1.3	4.5	0	0		700
0.06		15	<0.02	<0.02	<0.02	21.3	63.7	21.7	1.2	13	0	0		830
<0.05		5.6	<0.02	<0.02	<0.02	30.7	66	28.4	1.2	4.4	0	0	<0.1	130
<0.05		7.2	<0.02	<0.02	<0.02	36.7	60.8	32	0.9	6.3	0	0		290
<0.05		6.1	<0.02	<0.02	<0.02	36.4	59.3	34.7	0.7	5.3	0	0		350
<0.05		16	<0.02	<0.02	<0.02	34	46.1	38.4	0.9	15	0	0		1400
<0.05		13	<0.02	<0.02	<0.02	36.1	49.4	37.5	0.9	12	0	0		1100
<0.05		18	1.3	1.2	0.1	31.7	39.2	39.4	0.8	17	3.8	0.3		1500
<0.05		14	<0.02	<0.02	<0.02	34.8	46.7	39.3	0.9	13	0	0		1200
0.12		5.4	<0.02	<0.02	<0.02	19.8	62.1	32.5	4	1.5	0	0	<0.1	44
<0.05		5.2	<0.02	<0.02	<0.02	33.6	59.7	35.2	1	4.1	0	0		260
<0.05		7	<0.02	<0.02	<0.02	33	59.5	33.6	0.8	6.1	0	0		420
<0.05		12	<0.02	<0.02	<0.02	23.3	48	40	0.9	11	0	0		1100
<0.05		18	<0.02	<0.02	<0.02	23.8	43.1	39.2	0.6	17	0	0		1100
0.07		1.9	<0.02	<0.02	<0.02	34	78.4	19.7	1.3	0.6	0	0	<0.1	25
<0.05		2.6	<0.02	<0.02	<0.02	33.9	70.6	26.7	1	1.6	0	0		57
<0.05		14	<0.02	<0.02	<0.02	25.9	51.9	34.5	1.4	12	0	0		640
0.07		3.7	<0.02	<0.02	<0.02	27.9	63.5	32.8	2.2	1.6	0	0	<0.1	300
0.06		12	0.11	0.06	0.05	22.4	47.1	40.9	2.3	9.2	0.3	0.2		1500
0.07		15	0.06	<0.02	0.04	22.1	43.1	41.6	2.9	12	0.1	0.2		2200
0.07		15	0.06	0.02	0.03	19.8	41.4	43.1	2.9	12	0.1	0.2		3000
0.07		14	<0.02	<0.02	<0.02	26.7	43.2	42.6	3	11	0	0		3000
0.07		14	<0.02	<0.02	<0.02	26.1	43.8	41.9	2.8	12	0	0		2700
0.08		15	<0.02	<0.02	<0.02	24.9	41.7	42.9	3.4	12	0	0		3300
0.1		3.6	<0.02	<0.02	<0.02	24.6	69.7	26.7	2.7	0.9	0	0	<0.1	26
<0.05		13	<0.02	<0.02	<0.02	23.6	50.6	36.9	1.8	11	0	0		1500
0.05		14	<0.02	<0.02	<0.02	22.7	46.8	38.9	2	12	0	0		2200
<0.05		14	<0.02	<0.02	<0.02	23.6	47.3	38.2	1.9	13	0	0		2300
0.06		15	<0.02	<0.02	<0.02	23.3	45.8	39.1	2.4	13	0	0		2600
0.07		14	<0.02	<0.02	<0.02	22.7	45.1	40.6	2.8	12	0	0		3000
0.06		13	<0.02	<0.02	<0.02	22.2	44.1	42.9	2.6	11	0	0		2500
0.09		4.6	<0.02	<0.02	<0.02	21	65	30.4	2.6	2	0	0	<0.1	42
0.1		5.7	<0.02	<0.02	<0.02	25.7	63.8	30.5	3	2.7	0	0		150
0.05		9.4	<0.02	<0.02	<0.02	28.5	56.3	34.3	1.8	7.6	0	0		1700
<0.05		11	<0.02	<0.02	<0.02	20.1	51.5	37.2	1.8	9.5	0	0		1000
0.06		14	<0.02	<0.02	<0.02	26.4	43.3	42.5	2.4	12	0	0		1500
<0.05		13	<0.02	<0.02	<0.02	19.6	42.8	44.3	2	11	0	0		1500
0.18		6	<0.02	<0.02	<0.02	23.7	65.2	28.8	5.1	0.9	0	0	<0.1	120
0.07		4.4	<0.02	<0.02	<0.02	26.8	70.5	25.1	1.8	2.6	0	0		780
0.06		9.6	<0.02	<0.02	<0.02	22.4	55.8	34.7	1.9	7.6	0	0		670
0.08		16	<0.02	<0.02	<0.02	25.7	43.4	41	3.1	13	0	0		2900
0.08		16	<0.02	<0.02	<0.02	20.7	40.7	43.1	3.4	13	0	0		3000
0.08		17	<0.02	<0.02	<0.02	20.6	40	42.9	3.4	14	0	0		3000
0.08		18	<0.02	<0.02	<0.02	22.5	38.4	43.6	3.5	14	0	0		3200
														2400
0.21		5	<0.02	<0.02	<0.02	26.4	73.7	21.3	4.4	0.6	0	0	<0.1	21
0.08		3.1	<0.02	<0.02	<0.02	29.6	78	18.9	1.5	1.5	0	0		16
0.06		4.9	<0.02	<0.02	<0.02	18.4	75.4	19.7	1.1	3.8	0	0		120
<0.05		22	<0.02	<0.02	<0.02	18.9	48.9	29	1	21	0	0		1000

0.06		10	<0.02	<0.02	<0.02	21.7	67	22.9	1.3	8.8	0	0		370
0.34		5.8	<0.02	<0.02	<0.02	31	77.2	16.9	5.7	<0.2	0	0	<0.1	<5
0.07		8.4	<0.02	<0.02	<0.02	34.4	67.1	24.5	1.7	6.7	0	0		870
0.07		13	<0.02	<0.02	<0.02	33.1	62.6	24.2	1.8	11	0	0		1500
0.07		16	<0.02	<0.02	<0.02	29.7	59	25	1.6	14	0	0		1500
0.07		12	<0.02	<0.02	<0.02	28.6	64.4	23.8	1.7	10	0	0		1700
0.05		18	<0.02	<0.02	<0.02	21.9	53.7	27.9	1.4	17	0	0		1600
0.06		19	<0.02	<0.02	<0.02	20.2	55	26.4	1.5	17	0	0		1100
0.12		6.2	<0.02	<0.02	<0.02	12.9	56.1	37.8	4.7	1.5	0	0	<0.1	40
<0.05		17	<0.02	<0.02	<0.02	20.9	37.9	45.4	1.3	15	0	0		900
<0.05		17	<0.02	<0.02	<0.02	24.3	38.8	44.6	1.2	15	0	0		890
<0.05		18	<0.02	<0.02	<0.02	19.4	38.6	43.4	1.2	17	0	0		630
0.05		1.7	<0.02	<0.02	<0.02	24	70.2	28.1	1.5	0.2	0	0	<0.1	11
<0.05		1.7	<0.02	<0.02	<0.02	29.2	66.5	31.8	0.8	0.9	0	0		26
<0.05		2.8	<0.02	<0.02	<0.02	25.7	55	42.2	0.8	2	0	0		290
<0.05		2.9	<0.02	<0.02	<0.02	23.2	50.1	47	0.8	2.1	0	0		550
0.05		2.9	<0.02	<0.02	<0.02	37.4	76.6	20.5	1.1	1.8	0	0		490
<0.05		7.8	<0.02	<0.02	<0.02	17.7	44	48.2	0.9	6.9	0	0		570
<0.05		9.5	<0.02	<0.02	<0.02	10.9	45.9	44.7	1	8.5	0	0		360
0.14		2.9	<0.02	<0.02	<0.02	24.2	81.8	15.3	2.1	0.8	0	0	<0.1	17
0.08		2.2	<0.02	<0.02	<0.02	29.9	80.8	17	1.4	0.8	0	0		45
<0.05		2.5	<0.02	<0.02	<0.02	22.5	77.8	19.7	0.8	1.6	0	0		250
<0.05		14	<0.02	<0.02	<0.02	26.6	57.7	28	0.6	14	0	0		860
<0.05		15	<0.02	<0.02	<0.02	26.3	59.5	25.1	0.7	15	0	0		720
0.09		7.3	<0.02	<0.02	<0.02	14	58.2	34.6	3.2	4	0	0	<0.1	87
<0.05		8.5	<0.02	<0.02	<0.02	24.2	53	38.5	1.7	6.8	0	0		240
<0.05		7.8	<0.02	<0.02	<0.02	24.6	54.1	38.1	1.5	6.3	0	0		270
0.32		5.9	<0.02	<0.02	<0.02	18.5	75.9	18.1	5.8	<0.2	0	0	<0.1	40
0.12		2.4	<0.02	<0.02	<0.02	26.8	78.8	18.8	2.2	0.3	0	0		13
0.08		3.2	<0.02	<0.02	<0.02	30.2	73.7	23.1	1.7	1.5	0	0		280
0.07		3.4	<0.02	<0.02	<0.02	31.4	72.6	24	1.7	1.7	0	0		760
0.09		4.3	<0.02	<0.02	<0.02	29.6	71.3	24.4	2.2	2.1	0	0		760
0.11		5.2	<0.02	<0.02	<0.02	25.7	70.9	23.9	2.6	2.6	0	0		750
0.1		4.9	<0.02	<0.02	<0.02	24.3	70.3	24.8	2.4	2.6	0	0		630
0.24		4.8	<0.02	<0.02	<0.02	14.1	75.3	19.8	4.8	<0.2	0	0	<0.1	10
0.09		2.4	<0.02	<0.02	<0.02	15.3	74.2	23.3	2	0.4	0	0		49
<0.05		3.2	<0.02	<0.02	<0.02	17.6	48.8	48	1.3	1.9	0	0		310
<0.05		6	<0.02	<0.02	<0.02	17.6	41.6	52.4	1.4	4.6	0	0		670
<0.05		6.8	<0.02	<0.02	<0.02	19.5	39.1	54.1	1.1	5.7	0	0		760
<0.05		7.4	<0.02	<0.02	<0.02	15.2	37.4	55.2	1.3	6.1	0	0		840
<0.05		10	<0.02	<0.02	<0.02	15.8	38.4	51.3	1.3	9	0	0		710
														810
0.09		3.1	<0.02	<0.02	<0.02	26.6	73.7	23.2	2.1	1	0	0	<0.1	29
0.07		6.5	<0.02	<0.02	<0.02	26.7	69.7	23.7	1.8	4.7	0	0		140
<0.05		4.7	<0.02	<0.02	<0.02	24.4	64.4	30.9	1.3	3.4	0	0		500
<0.05		6	<0.02	<0.02	<0.02	20.6	60	34.1	1.5	4.5	0	0		540
0.48		12	<0.02	<0.02	<0.02	3.92	63.2	24.8	12	<0.2	0	0	<0.1	15
0.68		12	<0.02	<0.02	<0.02	3.87	69.7	17.9	12	0.2	0	0		<5
0.3		8.4	<0.02	<0.02	<0.02	6.5	65	26.5	8	0.5	0	0		17
0.09		5.5	<0.02	<0.02	<0.02	13.4	57.8	36.7	3.5	2	0	0		92
0.08		3.8	<0.02	<0.02	<0.02	14.5	59.9	36.3	2.8	1	0	0		270

TMs-003	TMs-012C	TMs-012A	TMs-012A	TMs-012A	TMs-012A	TMs-031	TMs-007	TMs-003	TMs-002A1	TMs-002A1
Salinity EC 1:5	Boron	Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Oxalate ext. Molybdenum	Dumas Total Nitrogen	TDS	% Air-dry Moisture Content	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)
dS/m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	% dry wt	mg/L	% of dry wt	g/g
0.17	1.4	6.2	3.5	0.6	0.27	0.81	0.21	110	2.9	0.0288
0.67							0.12	430	3.2	0.0316
0.71								450	2.6	0.0263
0.13	1.4	27	28	2.2	0.18	1.3	0.11	83	3.5	0.0349
0.35							0.092	230	4	0.0395
0.46								290	5.3	0.0531
1								650	4.4	0.0437
0.97								620	3.5	0.0347
1								660	4	0.0404
0.88								570	4.3	0.0425
0.074	0.77	25	38	1.4	0.96	0.84	0.16	47	2.4	0.0243
0.39							0.093	250	3.4	0.0336
0.51								330	3.2	0.0323
0.91								580	3.3	0.0329
0.91								580	2.9	0.0289
0.16	1.2	11	4.6	1.1	0.19	0.92	0.15	100	2.8	0.0275
0.23							0.099	140	3.4	0.0338
0.58								370	3.6	0.036
0.33	2.9	18	7.7	1.6	0.26	1.1	0.098	210	3.3	0.033
1.1							0.031	700	3.6	0.0359
1.5								970	5	0.0498
2								1200	5.1	0.0508
2.1								1400	3.1	0.0308
1.9								1200	3.2	0.0321
2.3								1400	3.5	0.0345
0.14	0.86	15	8.2	1.8	0.25	1.1	0.095	92	2.7	0.0267
1.1							0.055	690	3	0.0297
1.5								980	2.6	0.0262
1.5								980	2.7	0.0271
1.7								1100	3.2	0.0323
2								1300	3.1	0.0305
1.6								1000	4.1	0.0408
0.06	0.53	28	24	2.2	0.46	1.1	0.044	38	2.9	0.029
0.14							0.057	87	3.8	0.0378
1.2								770	4.5	0.0448
0.72								460	3.3	0.0328
1								650	2.8	0.0284
1								640	2.2	0.0218
0.13	0.87	27	26	1.9	0.72	1.2	0.17	82	2.8	0.028
0.62							0.12	390	3	0.0296
0.49								310	2.6	0.0255
1.9								1200	3.9	0.0394
1.9								1200	4.7	0.0469
1.9								1200	4.7	0.0466
2.1								1300	4.2	0.0418
1.6								1000		
0.099	0.9	7.7	6.2	0.94	0.36	1.1	0.16	64	2.8	0.0278
0.15							0.1	99	3	0.0301
0.21								130	1.7	0.0169
0.76								490	3.1	0.0309

0.38								240	2.2	0.0218
0.11	1.1	12	13	1.4	0.67	1	0.23	72	3.1	0.0309
0.8							0.11	510	3.3	0.033
1.2								740	3.2	0.0321
1.1								720	4.7	0.0465
1.3								820	3.1	0.0305
1.1								710	4.1	0.0413
0.83								530	3	0.0297
0.057	0.49	15	26	0.9	0.46	0.64	0.09	37	1.6	0.0163
0.68							0.084	440	3.7	0.037
0.68								430	3.2	0.0319
0.54								350	3.3	0.0325
0.067	1.1	11	11	0.92	0.22	0.98	0.1	43	2.9	0.0287
0.2							0.084	130	2.6	0.0256
0.41								260	2.6	0.0262
0.56								360	2.4	0.0241
0.53								340	1.9	0.0194
0.49								310	2.3	0.0227
0.29								190	1	0.0103
0.065	1.1	11	16	1.4	0.2	1.3	0.19	42	2.7	0.0274
0.2							0.13	130	2.3	0.0233
0.36								230	2.5	0.0254
0.86								550	3.1	0.0307
0.78								500	2.8	0.0283
0.094	0.56	14	22	1.1	0.56	0.79	0.096	60	1.5	0.0149
0.22							0.11	140	4	0.0396
0.32								210	3.3	0.0328
0.092	0.79	11	7.6	0.93	0.47	0.66	0.12	59	2.1	0.0214
0.081							0.13	52	2.4	0.0241
0.31								200	4	0.0403
0.58								370	3.9	0.0386
0.57								370	3.9	0.0387
0.54								350	3.8	0.0383
0.47								300	3.9	0.0388
0.038	0.74	14	21	1.2	0.28	0.68	0.097	24	1.8	0.0178
0.054							0.077	35	1.5	0.0146
0.45								290	1.6	0.0164
0.69								440	1.5	0.015
0.85								540	2.3	0.0231
0.8								510	1.4	0.0144
0.74								470	1.7	0.0165
0.7								450		
0.1	0.81	11	6.8	1.3	0.31	1.1	0.13	66	3.5	0.0352
0.22							0.1	140	3.6	0.036
0.56								360	2.8	0.0276
0.58								370	2.6	0.0255
0.058	0.18	13	8.1	0.45	0.41	<0.25	0.075	37	0.3	0.0027
0.059							0.039	38	0.3	0.0026
0.052								33	0.5	0.0046
0.13								84	1.6	0.016
0.32								200	1.3	0.0131

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Eurofins APAL Test Method Codes											
Crop	Actual Crop	SubmissionID	SamplingDate	DateReceived	BatchID	Batch Position No.	AgentName	ClientName	SampleName	Barcode	SampleDepth
		147218		2025-11-20	46603	7	GT Environmental - Reece McCann	BWN	D22-1.00-1.10	111981068	1-1.1
		147218		2025-11-20	46601	3	GT Environmental - Reece McCann	BWN	D22-1.30-1.40	111981069	1.3-1.4
		147218		2025-11-20	46603	42	GT Environmental - Reece McCann	BWN	D22-1.60-1.70	111981070	1.6-1.7
		147218		2025-11-20	46603	44	GT Environmental - Reece McCann	BWN	D32-1.10-1.20	111981079	1.1-1.2
		147218		2025-11-20	46603	26	GT Environmental - Reece McCann	BWN	D32-1.40-1.50	111981080	1.4-1.5
		147218		2025-11-20	46603	18	GT Environmental - Reece McCann	BWN	D32-1.70-1.80	111981081	1.7-1.8
		147218		2025-11-20	46603	9	GT Environmental - Reece McCann	BWN	D37-1.10-1.20	111981093	1.1-1.2
		147218		2025-11-20	46603	35	GT Environmental - Reece McCann	BWN	D37-1.40-1.50	111981094	1.4-1.5
		147218		2025-11-20	46603	17	GT Environmental - Reece McCann	BWN	D37-1.70-1.80	111981095	1.7-1.8
		147218		2025-11-20	46603	2	GT Environmental - Reece McCann	BWN	D44-1.10-1.20	111980909	1.1-1.2
		147218		2025-11-20	46603	39	GT Environmental - Reece McCann	BWN	D59-1.10-1.20	111980933	1.1-1.2
		147218		2025-11-20	46603	33	GT Environmental - Reece McCann	BWN	D59-1.40-1.50	111980934	1.4-1.5
		147218		2025-11-20	46603	27	GT Environmental - Reece McCann	BWN	D59-1.70-1.80	111980935	1.7-1.8

			TMs-004A	TMs-004B4	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E
Postcode	Transect GPS Start	Transect GPS Finish	pH 1:5 water	pH CaCl2 (following 4A1)	Calcium (Ca) - NH4Cl/BaCl2	Magnesium (Mg) - NH4Cl/BaCl2	Potassium (K) - NH4Cl/BaCl2	Sodium (NH4Cl/BaCl2)	Calcium (Ca) - NH4Cl/BaCl2	Magnesium (Mg) - NH4Cl/BaCl2
			pH units	pH units	mg/kg	mg/kg	mg/kg	mg/kg	cmol/kg	cmol/kg
4120	N/A	N/A	6.01	5.26	2010	1140	103	2040	10	9.39
4120	N/A	N/A	6.08	5.27	1970	1150	100	1860	9.82	9.44
4120	N/A	N/A	5.71	5	1840	1120	109	2120	9.2	9.23
4120	N/A	N/A	8.67	8.09	2160	1010	247	797	10.8	8.28
4120	N/A	N/A	8.66	8.15	2190	1190	262	1100	10.9	9.78
4120	N/A	N/A	8.46	8.04	2090	1210	286	1140	10.4	10
4120	N/A	N/A	8.5	7.91	3360	1060	132	1630	16.8	8.7
4120	N/A	N/A	8.99	8.18	3000	992	91	1590	15	8.16
4120	N/A	N/A	8.99	8.26	2880	1030	82	1660	14.4	8.47
4120	N/A	N/A	8.54	7.72	2610	1110	103	1730	13	9.12
4120	N/A	N/A	9.32	8.36	1430	747	145	814	7.13	6.15
4120	N/A	N/A	9.3	8.31	1610	850	122	1140	8.04	6.99
4120	N/A	N/A	9.3	8.39	1490	791	142	957	7.46	6.51

TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015E	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1
Potassium (K) - NH4Cl/BaCl2	Sodium (NH4Cl/BaCl2)	Ca:Mg ratio	K:Mg ratio	GTRI	ECR	Calcium (Ca) - prewash alc. pH 8.5 NH4Cl	Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl	Potassium (K) - prewash alc. pH 8.5 NH4Cl	Sodium (Na) - prewash alc. pH 8.5 NH4Cl	Calcium (Ca) - prewash alc. pH 8.5 NH4Cl
cmol/kg	cmol/kg				%	mg/kg	mg/kg	mg/kg	mg/kg	cmol/kg
0.263	8.89	1.1	<0.05		32	2020	1010	101	940	10.1
0.254	8.1	1	<0.05		30	2040	1050	109	956	10.2
0.278	9.21	1	<0.05		34	1940	1080	108	981	9.66
0.632	3.47	1.3	0.08		18	1990	1130	283	91.7	9.95
0.671	4.78	1.1	0.07		21	2020	1260	298	169	10.1
0.73	4.95	1	0.07		22	1910	1280	331	137	9.53
0.337	7.11	1.9	<0.05		23	3620	1170	135	563	18
0.233	6.91	1.8	<0.05		24	3170	1110	91.4	601	15.8
0.21	7.24	1.7	<0.05		25	3050	1220	89.6	787	15.2
0.264	7.52	1.4	<0.05		26	2700	1170	98.8	834	13.5
0.37	3.54	1.2	0.06		23	1430	820	165	95.4	7.14
0.313	4.98	1.2	<0.05		26	1680	976	130	123	8.36
0.363	4.16	1.1	0.06		24	1500	826	154	95.4	7.49

TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015C1	TMs-015G	TMs-015G	TMs-015G	TMs-Cal02
Magnesium (Mg) - prewash alc. pH 8.5 NH4Cl	Potassium (K) - prewash alc. pH 8.5 NH4Cl	Sodium (Na) - prewash alc. pH 8.5 NH4Cl	Ca:Mg ratio	K:Mg ratio	GTRI	ECR	Exchangeable acidity	Exchangeable aluminium	Exchangeable hydrogen	ECEC
cmol/kg	cmol/kg	cmol/kg				%	cmol/kg	cmol/kg	cmol/kg	cmol/kg
8.28	0.258	4.09	1.2	<0.05		19	<0.02	<0.02	<0.02	22.7
8.65	0.277	4.16	1.2	<0.05		19	<0.02	<0.02	<0.02	23.2
8.86	0.276	4.27	1.1	<0.05		20	0.62	0.55	0.07	23.7
9.32	0.724	0.399	1.1	0.08		5.5	<0.02	<0.02	<0.02	20.4
10.4	0.762	0.735	1	0.07		6.8	<0.02	<0.02	<0.02	22
10.5	0.846	0.598	0.9	0.08		6.7	<0.02	<0.02	<0.02	21.5
9.62	0.346	2.45	1.9	<0.05		9.2	<0.02	<0.02	<0.02	30.5
9.09	0.234	2.61	1.7	<0.05		10	<0.02	<0.02	<0.02	27.8
10.1	0.229	3.42	1.5	<0.05		13	<0.02	<0.02	<0.02	28.9
9.66	0.253	3.63	1.4	<0.05		14	<0.02	<0.02	<0.02	27
6.74	0.423	0.415	1.1	0.06		5.7	<0.02	<0.02	<0.02	14.7
8.03	0.333	0.536	1	<0.05		5	<0.02	<0.02	<0.02	17.3
6.79	0.395	0.415	1.1	0.06		5.4	<0.02	<0.02	<0.02	15.1

TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-Cal02	TMs-005	TMs-003	TMs-003	TMs-002A1	TMs-002A1
Calcium	Magnesium	Potassium	Sodium	Aluminium	Hydrogen	Chloride	Salinity EC 1:5	TDS	% Air-dry Moisture Content	S7 Gravimetric water content of air dried fine fraction (GWCad-ff)
%	%	%	%	%	%	mg/kg	dS/m	mg/L	% of dry wt	g/g
44.4	36.5	1.1	18	0	0	1400	0.92	590	2.7	0.0265
43.7	37.2	1.2	18	0	0	1500	0.95	610	3.3	0.0334
40.8	37.4	1.2	18	2.3	0.3	1400	0.92	590	3.1	0.0312
48.8	45.7	3.6	2	0	0	740	0.71	450	1.9	0.0185
45.8	47.4	3.5	3.3	0	0	1000	0.89	570	2.3	0.0232
44.3	49	3.9	2.8	0	0	1300	1.1	700	2.2	0.0217
59.2	31.6	1.1	8	0	0	1400	1	640	2.9	0.0285
57	32.7	0.8	9.4	0	0	960	0.81	520	3.2	0.0317
52.6	34.8	0.8	12	0	0	990	0.81	520	3.3	0.0328
49.9	35.7	0.9	13	0	0	860	0.68	430	2.9	0.0287
48.5	45.8	2.9	2.8	0	0	370	0.48	300	1.5	0.0153
48.4	46.5	1.9	3.1	0	0	670	0.69	440	1.7	0.0167
49.6	45	2.6	2.7	0	0	460	0.55	350	1.5	0.0145

ESSA /EAL(NATA,ASPAC)

5 Dunphy St Sunnybank Hills
Qld 4109

Phone: 0403245560

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Reference: **25012835 ESSA25 BWNGTE**

Date Received: 19/11/2025
Date Completed: 27/11/2025

FINAL REPORT

Project: BWN

All results in this report relate only to the items tested. Results are expressed on an "as received basis".

Client Name: GTE

Contact: Dennis Baker

Sample Type: Soil

Number of samples: 138 of 140 BWN

ESSA (EAL)Pty Ltd

Soil Analysis Report

Batch Number: 25012835 ESSA237346

Date Received: 19/11/2025

Date Completed: 27/11/2025

Client: GTE BWN (25)

Report ID	E25-01-2835_EALP1_1								
Client Sample ID:			D1-0.00-0.10	D1-0.20-0.30	D1-0.50-0.60	D5-0.00-0.10	D5-0.20-0.30	D5-0.50-0.60	D6-0.00-0.10
EAL Sample ID:			E25-01-2835-0001	E25-01-2835-0002	E25-01-2835-0003	E25-01-2835-0004	E25-01-2835-0005	E25-01-2835-0006	E25-01-2835-0011
Moisture (dry basis)	%	---	3.01	3.17	2.09	3.4	4.13	3.33	1.54
Moisture 105Â°C (dry basis)	%	<0.1	10.1	12.5	8.1	11.7	15.1	13.3	3.5
Texture (ISSS Classification)	---	---	Clay	Clay	Silty Clay Loam	Clay	Clay	Clay	Clay
Gravel > 2 mm fraction	% of whole sample	<0.1	1.5	0.8	57.4	< 0.1	< 0.1	4.3	< 0.1
Sand > 20 µm fraction	% < 2 mm fraction	<0.1	40.8	30.2	43.3	38.5	30.8	31.7	48.8
Silt 2-20 µm fraction	% < 2 mm fraction	<0.1	14.8	17.9	28.5	10.2	13.5	11.9	15.2
Clay < 2 µm fraction	% < 2 mm fraction	<0.1	44.4	51.9	28.2	51.3	55.8	56.4	36
Moisture 40Â°C (dry basis)	%	<0.1	---	---	---	---	---	---	---
R1 Dispersion Ratio	---	---	0.4	0.66	0.35	0.44	0.51	0.44	0.39
Emerson Aggregate Test - Class	---	---	4	3	2	2	2	2	3

D6-0.20-0.30	D6-0.50-0.60	D6-0.80-0.90	D6-1.10-1.20	D7-0.00-0.10	D7-0.20-0.30	D7-0.50-0.60	D12m-0.00-0.10	D12m-0.20-0.30	D12m-0.50-0.60	D12m-0.80-0.90
E25-01-2835-0012	E25-01-2835-0013	E25-01-2835-001	E25-01-2835-0015	E25-01-2835-0016	E25-01-2835-001	E25-01-2835-0018	E25-01-2835-0019	E25-01-2835-0020	E25-01-2835-0021	E25-01-2835-0022
3.17	2.94	1.44	2.15	3.35	2.84	2.69	2.63	2.69	2.98	2.79
15.5	16.2	5.8	7.4	8.6	12.6	13.4	7.2	12.2	14.1	12.2
Clay	Clay	Clay	Clay Loam	Clay	Clay	Clay	Clay	Clay	Clay	Clay
0.3	1.1	47.4	0.3	2.1	9.4	20	0.8	< 0.1	0.2	9
32.2	36.2	43.8	50.3	31.9	30.2	28.2	31	24	24.1	25.2
9	10.7	15.7	18.3	16.8	14.6	16.5	13	16.6	15.7	15.8
58.8	53.1	40.5	31.4	51.3	55.2	55.3	56	59.4	60.2	59.1
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0.54	0.6	0.69	0.5	0.26	0.57	0.77	0.42	0.65	0.69	0.69
3	3	2	2	4	2	2	4	2	2	2

D12m-1.10-1.20	D12m-1.40-1.50	D12m-1.70-1.80	D12d-0.00-0.10	D12d-0.20-0.30	D12d-0.50-0.60	D12d-0.80-0.90	D12d-1.10-1.20	D12d-1.40-1.50	D12d-1.70-1.80
E25-01-2835-0023	E25-01-2835-0024	E25-01-2835-0025	E25-01-2835-0026	E25-01-2835-0027	E25-01-2835-0028	E25-01-2835-0029	E25-01-2835-0030	E25-01-2835-0031	E25-01-2835-0032
3.6	3.16	3.81	2.39	2.57	2.61	2.47	2.37	2.74	2.73
14.1	14.2	14.5	4.7	10.6	11.3	11.1	11.9	11.7	10.6
Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
18.1	17.9	2.8	7	8.9	5	0.7	0.4	1.6	3.3
25.1	23	25.2	39.7	35.7	34.4	39.5	36.8	34.1	30.2
16.7	15.8	13.9	13.1	12.3	13.4	10.3	11.4	13.6	13.7
58.2	61.2	60.9	47.3	52.1	52.2	50.2	51.8	52.3	56.1
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0.66	0.71	0.78	0.43	0.69	0.68	0.71	0.72	0.69	0.68
2	2	2	2	2	2	2	2	2	2

D14d-0.00-0.10	D14d-0.20-0.30	D14d-0.50-0.60	D14d-0.80-0.90	D14d-1.10-1.20	D14d-1.30-1.40	D14m-0.00-0.10	D14m-0.20-0.30	D14m-0.50-0.60	D14m-0.80-0.90
E25-01-2835-0033	E25-01-2835-0034	E25-01-2835-0035	E25-01-2835-0036	E25-01-2835-0037	E25-01-2835-0038	E25-01-2835-0039	E25-01-2835-0040	E25-01-2835-0041	E25-01-2835-0042
2.54	2.66	3.21	2.3	2.39	2.25	2.48	2.33	1.88	3.14
5.7	6.9	12.9	8.7	8.9	10	4.8	8.2	8.1	13.7
Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
0.3	7.6	11.8	6.9	8.7	9.5	0.3	0.9	7.2	0.2
41.5	36.1	23.9	44.2	43.2	39.8	33.6	32.3	47.7	25.4
13.8	11.7	16.2	11.4	11.6	19.5	19.9	17.5	11.4	16.2
44.7	52.3	60	44.4	45.2	40.7	46.6	50.2	41	58.4
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0.48	0.6	0.53	0.67	0.73	0.61	0.38	0.35	0.61	0.7
3	2	2	2	2	2	3	3	2	2

D14m-1.10-1.20	D14m-1.40-1.50	D14m-1.70-1.80	D19-0.00-0.05	D19-0.20-0.30	D19-0.40-0.50	D19-0.50-0.60	D19-0.80-0.90	D21-0.00-0.10	D21-0.20-0.30
E25-01-2835-0043	E25-01-2835-0044	E25-01-2835-0045	E25-01-2835-0046	E25-01-2835-0047	E25-01-2835-0048	E25-01-2835-0049	E25-01-2835-0050	E25-01-2835-0051	E25-01-2835-0052
3.25	2.97	3.23	2.3	2.49	1.82	2.04	1.68	2.69	2.74
14.7	13.1	15	5.9	7.7	6.4	8.3	6.6	3.7	11.3
Clay	Clay	Clay	Clay	Clay	Clay Loam	Clay Loam	Clay Loam	Clay	Clay
10.2	9	19.4	0.5	9.5	0.3	6.6	56.7	0.9	6.4
23.7	49.2	23	33.6	39.2	45.8	44.3	40.9	36.8	22.7
15.7	11.5	15.3	18.8	19.1	22.4	23	21.9	22.5	18.3
60.6	39.3	61.7	47.7	41.7	31.8	32.8	37.2	40.8	59
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0.76	0.99	0.79	0.43	0.44	0.44	0.52	0.51	0.37	0.63
2	2	2	3	3	2	2	2	4	3

D21-0.50-0.60	D21-0.80-0.90	D21-1.10-1.20	D21-1.40-1.50	D21-1.70-1.80	D24-0.00-0.10	D24-0.20-0.30	D24-0.50-0.60	D24-0.80-0.90	D36-0.00-0.10
E25-01-2835-0053	E25-01-2835-0054	E25-01-2835-0055	E25-01-2835-0056	E25-01-2835-0057	E25-01-2835-0058	E25-01-2835-0059	E25-01-2835-0060	E25-01-2835-0061	E25-01-2835-0062
2.66	2.86	2.73	2.52	2.61	1.1	2.37	2.14	1.9	1.83
10.7	12.6	12.6	11.8	11.1	2.8	12.8	10.7	9.4	5.8
Clay	Clay	Clay	Silty Clay	Clay	Clay Loam	Clay	Clay	Clay Loam	Clay
6.7	18.8	18	3.2	43.1	1.1	1.1	1.1	21	7.2
22.1	25.1	20.6	13.3	34.3	68.3	36.1	39.8	46.8	55.5
17	16.3	20.2	27.1	17.9	10	13.3	16.3	17.3	3.3
60.9	58.6	59.3	59.6	47.8	21.7	50.6	43.9	35.9	41.2
---	---	---	---	---	---	---	---	---	---
0.7	0.75	0.68	0.72	0.65	0.47	0.43	0.65	0.56	0.24
2	2	2	2	2	3	2	2	2	3

D36-0.20-0.30	D36-0.50-0.60	D36-0.80-0.90	D36-1.10-1.20	D36-1.40-1.50	D36-1.70-1.80	D39-0.00-0.10	D39-0.20-0.30	D39-0.50-0.60	D39-0.80-0.90
E25-01-2835-0063	E25-01-2835-0064	E25-01-2835-0065	E25-01-2835-0066	E25-01-2835-0067	E25-01-2835-0068	E25-01-2835-0069	E25-01-2835-0070	E25-01-2835-0071	E25-01-2835-0072
2.46	2.07	1.72	1.73	1.4	1.08	2.22	2.26	1.73	2.23
9.7	8.6	7.4	7.9	6.1	5	6.4	8.3	8.1	9.4
Clay	Clay	Clay	Sandy Clay	Sandy Clay Loam	Sandy Loam	Clay	Clay	Clay	Clay
5.5	6.1	10.2	48.8	5.5	13	3.7	0.5	20.4	43.1
49.4	49.4	52.7	62.7	63.5	78.4	43.3	40.9	56.2	34.6
4.4	7.3	8.6	4	5.8	4.1	10.1	12	9.9	22.7
46.3	43.4	38.7	33.3	30.7	17.5	46.6	47.2	33.9	42.8
---	---	---	---	---	---	---	---	---	---
0.26	0.35	0.37	0.59	0.57	0.38	0.26	0.22	0.54	0.67
4	4	4	4	2	2	3	4	4	2

D39-1.10-1.20	D43-0.00-0.10	D43-0.10-0.20	D43-0.20-0.30	D45-0.00-0.10	D45-0.20-0.30	D45-0.50-0.60	D45-0.80-0.90	D45-1.10-1.20	D45-1.40-1.50	D45-1.70-1.80
E25-01-2835-0073	E25-01-2835-007	E25-01-2835-0075	E25-01-2835-0076	E25-01-2835-0077	E25-01-2835-0078	E25-01-2835-0079	E25-01-2835-0080	E25-01-2835-0081	E25-01-2835-0082	E25-01-2835-0083
2.18	1.62	2.75	2.8	1.57	2.21	2.66	2.7	2.69	2.77	2.29
9.6	5.9	10.9	11	6.4	10.4	11.5	12.1	13.6	13.6	12.3
Silty Clay Loam	Clay Loam	Clay	Clay	Clay Loam	Clay	Clay	Clay	Clay	Clay	Clay
55.5	1.9	6.8	1.3	0.8	0.2	43.6	10.1	< 0.1	4.8	1.9
31.6	57.7	34.8	36.9	52.6	35.1	29.9	23.5	26.7	26.3	32
28.7	14.8	13.9	11.6	16.4	20.3	18.2	20.3	19.4	22.4	19.4
39.7	27.5	51.3	51.5	31	44.6	51.9	56.3	53.9	51.3	48.6
---	---	---	---	---	---	---	---	---	---	---
0.64	0.59	0.63	0.65	0.49	0.33	0.31	0.35	0.53	0.56	0.61
2	2	2	2	3	4	4	4	2	2	2

D52-0.00-0.10	D52-0.20-0.30	D52-0.50-0.60	D52-0.80-0.90	D52-1.10-1.20	D52-1.40-1.50	D52-1.70-1.80	D58-0.00-0.10	D58-0.20-0.30	D58-0.50-0.60	D58-0.70-0.80
E25-01-2835-0084	E25-01-2835-0085	E25-01-2835-0086	E25-01-2835-0087	E25-01-2835-0088	E25-01-2835-0089	E25-01-2835-0090	E25-01-2835-0091	E25-01-2835-0092	E25-01-2835-0093	E25-01-2835-0094
1.34	1.49	1.31	1.68	1.92	2.07	1.58	2.35	3.08	1.78	1.68
6.5	6.4	6.4	6	7.4	7.2	6.6	10.4	10.3	8.9	8.5
Clay	Sandy Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay
2.7	1.9	4.2	16.5	18.1	19.3	3.9	1	0.5	0.7	3
61.3	62.4	54.6	54	46.6	51.7	54.7	42.2	42.1	48.3	56.1
7.1	5.6	11.5	10.9	13.5	11.5	10.3	14.7	14.7	10	7.3
31.7	32	34	35.2	39.9	36.8	35.1	43.1	43.2	41.7	36.7
---	---	---	---	---	---	---	---	---	---	---
0.32	0.39	0.62	0.66	0.72	0.72	0.63	0.35	0.55	0.51	0.62
3	4	4	2	2	2	2	3	2	3	2

D65-0.00-0.05	D65-0.10-0.20	D65-0.20-0.30	D65-0.50-0.60	D65-0.80-0.90	D3-0.00-0.10	D3-0.20-0.30	D3-0.50-0.60	D3-0.70-0.80	D3-0.90-1.00	D22-0.00-0.10
E25-01-2835-0095	E25-01-2835-0096	E25-01-2835-0097	E25-01-2835-009	E25-01-2835-0099	E25-01-2835-0100	E25-01-2835-0101	E25-01-2835-0102	E25-01-2835-0103	E25-01-2835-0104	E25-01-2835-0105
0.298	0.288	0.472	1.19	1.27	5.75	5.67	8.57	8.4	4.62	5.95
4.4	2.3	3.4	7.1	7.1	---	---	---	---	---	---
Sandy Loam	Sandy Loam	Sandy Loam	Sandy Clay	Sandy Clay Loam	Clay Loam	Clay	Clay	Clay	Clay Loam	Clay
3	2.2	10.4	2	4	2.4	1	53.7	45.7	87.1	2
85.7	86.1	78.7	64.3	68.2	51.6	47.9	24.9	31	58.7	34.4
3.9	3.6	3.9	4.4	6.8	21.4	15.2	18.1	10.7	12.4	16.9
10.4	10.3	17.4	31.3	25	27	36.9	57	58.3	29	48.8
---	---	---	---	---	2.9	5.1	7	6.3	3.3	0.3
0.32	0.43	0.49	0.61	0.59	0.31	0.31	0.27	0.37	0.57	0.35
3	3	3	2	4	---	---	---	---	---	---

D22-0.20-0.30	D22-0.50-0.60	D22-0.80-0.90	D22-1.00-1.10	D22-1.30-1.40	D22-1.60-1.70	D32-0.00-0.10	D32-0.20-0.30	D32-0.50-0.60	D32-0.80-0.90	D32-1.10-1.20
E25-01-2835-0106	E25-01-2835-0107	E25-01-2835-0108	E25-01-2835-0109	E25-01-2835-0110	E25-01-2835-0111	E25-01-2835-0112	E25-01-2835-0113	E25-01-2835-0114	E25-01-2835-0115	E25-01-2835-0116
7.12	7.25	6.23	2.56	2.23	2.11	2.65	4.36	3.97	4.18	1.57
---	---	---	9.4	9.7	8.7	---	---	---	---	9.3
Clay	Clay	Clay	Clay	Clay	Silty Clay Loam	Loam	Clay	Clay	Clay	Clay
18.2	84.1	27.3	< 0.1	49.7	0.4	< 0.1	11.2	7.5	23.6	13.2
25.6	27.9	36.3	36.5	39.7	32.8	68.6	56.5	58.5	54.9	49.1
16.4	15	19.8	22.6	18.4	28	11.6	8.4	8.5	9.8	13.2
58	57.1	43.9	41	42	39.2	19.8	35.1	33	35.3	37.7
3.4	7.6	6.6	---	---	---	1.5	5	3.6	5	---
0.37	0.61	0.59	0.51	0.59	0.42	0.38	0.64	0.48	0.57	0.59
---	---	---	2	2	2	---	---	---	---	4

D32-1.40-1.50	D32-1.70-1.80	D37-0.00-0.10	D37-0.20-0.30	D37-0.50-0.60	D37-0.80-0.90	D37-1.10-1.20	D37-1.40-1.50	D37-1.70-1.80	D44-0.00-0.10	D44-0.10-0.20
E25-01-2835-0117	E25-01-2835-0118	E25-01-2835-0119	E25-01-2835-0120	E25-01-2835-0121	E25-01-2835-0122	E25-01-2835-0123	E25-01-2835-0124	E25-01-2835-0125	E25-01-2835-0126	E25-01-2835-0127
1.86	1.8	7.97	8.2	7.92	7.77	3.6	2.73	2.53	3.77	4.78
10.2	9.4	---	---	---	---	12	8.2	9.5	---	---
Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay	Clay Loam	Clay
50.9	7.8	17.7	32.3	< 0.1	2.7	5.6	8.6	66.4	2.5	11
43.6	43.5	30.1	27.7	29.4	29.9	36.6	49.5	46.1	55.7	50.9
14.5	16.4	16.3	14.1	14.3	10.4	13.3	13.7	14.4	16.9	13.8
41.9	40.1	53.6	58.2	56.3	59.8	50.2	36.8	39.5	27.5	35.4
---	---	---	---	---	---	---	---	---	1.9	3.9
0.57	0.5	0.29	0.49	0.49	0.44	0.52	0.52	0.47	0.37	0.3
2	2	---	---	---	---	3	2	2	---	---

D44-0.20-0.30	D44-0.50-0.60	D44-0.80-0.90	D44-1.10-1.20	D59-0.00-0.10	D59-0.20-0.30	D59-0.50-0.60	D59-0.80-0.90	D59-1.10-1.20	D59-1.40-1.50	D59-1.70-1.80
E25-01-2835-0128	E25-01-2835-0129	E25-01-2835-0130	E25-01-2835-0131	E25-01-2835-0132	E25-01-2835-0133	E25-01-2835-0134	E25-01-2835-0135	E25-01-2835-0136	E25-01-2835-0137	E25-01-2835-0138
7.9	7.5	6.24	2.79	1.18	1.11	4.54	4.41	1.11	1.37	1.17
---	---	---	10.8	---	---	---	---	7.4	7.4	7.6
Clay	Clay	Clay	Clay	Sandy Loam	Sandy Loam	Sandy Clay	Clay	Sandy Clay	Clay	Clay
20.9	4.7	13.4	11.7	4.7	5.7	2	6.4	23.3	29.3	19.5
30.7	33.1	37.2	39.6	87.5	83.5	57.5	57.5	64.9	57	58.1
9.3	9.3	9.2	10.5	2	5.1	3.4	4.8	2.8	8	4.9
60	57.6	53.7	50	10.4	11.4	39.1	37.8	32.3	35	37
9.5	8.5	9.3	---	2.4	1.5	6.1	6.4	---	---	---
0.46	0.6	0.67	0.74	0.44	0.42	0.69	0.68	0.69	0.73	0.68
---	---	---	2	---	---	---	---	2	2	2

ESSA Pty Ltd/ EAL NATA ASPAC

METHOD DESCRIPTIONS

Soil

Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
pH	4A1	1.1	0.1	pH	pH	1:5 water extr, pH meter
EC	3A1	5.4	0.01	dS/m	Electrical conductivity	1:5 water extr, EC meter
Cl	5A2	10.0	10.0	mg/kg	Chloride	1:5 water extr, (AA) colorimetric
NO3-N	7C2	6.7	1.0	mg/kg	Nitrate-nitrogen	1:5 water extr, (AA) colorimetric
NH4-N	7C2	7.8	0.6	mg/kg	Ammonium-nitrogen	1M KCl extr, (AA) colorimetric
Bicarb.P	9B2	16.8	1.0	mg/kg	Bicarb.ext.phosphorus	0.5M NaHCO3 @ pH 8.5, (AA) colorimetric
TN	7A2	12.9	0.01	%	Total Kjeldahl Nitrogen	Sulphuric acid digest, (AA) colorimetric
OC	8B1	9.7	0.02	%	Organic Carbon	Walkley & Black, (H2SO4/K2Cr2O7), titr.
Ca (Neut)	15A1	10.3	0.10	meq/100g	Exchangeable calcium	1M NH4Cl @ pH 7.0 shake, AAS
Mg (Neut)	15A1	6.6	0.10	meq/100g	Exchangeable magnesium	1M NH4Cl @ pH 7.0 shake, AAS
Na (Neut)	15A1	7.3	0.03	meq/100g	Exchangeable sodium	1M NH4Cl @ pH 7.0 shake, AAS
K (Neut)	15A1	3.9	0.02	meq/100g	Exchangeable potassium	1M NH4Cl @ pH 7.0 shake, AAS
ECEC	15J1	5.0	1	meq/100g	Effective cation ex.capacity	Sum of exchangeable cations
ESP	15N1	5.0	3	%	Exchangeable Na%	(Exchangeable Na/sum of exch.cations)%
Sand	no ref	22.1	1.0	%	Particle size, sand	Hydrometer, gravimetric
Silt	no ref	16.6	1.0	%	Particle size, silt	Hydrometer, gravimetric
Clay	no ref	12.7	1.0	%	Particle size, clay	Hydrometer, gravimetric
(-) 15Bar					Moisture	Pressure Plate

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992 /2011)**

For Manager **D E Baker BSc CPSS**
Analytical Services: _____

Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
Soluble Salts included in Exchangeable Cations - Except PRE-WASHED (if EC>0.3dS/m).

Lab Accrediation for M4626
ASPAC

Director and Principal Soil Scientist – ESSA Pty Ltd



ity
Adjunct Professional Fellow Southern Cross University
Chief Soil Chemistry Trainer Soil Science Australia (National & Qld)
Hon. Life Member Soil Science Australia (National & Qld)
Certified Professional Practicing Soil Scientist CPSS

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
Ca (Alc)	15C1	7.2	0.18	meq/100g	Exchangeable calcium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Mg (Alc)	15C1	4.7	0.31	meq/100g	Exchangeable magnesium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Na (Alc)	15C1	9.6	0.09	meq/100g	Exchangeable sodium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
K (Alc)	15C1	4.8	0.02	meq/100g	Exchangeable potassium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
CEC	15I3	5.7	1.0	meq/100g	Cation Exchange Capacity	KNO3 + Ca(NO3)2 extr, (AA) colorimetric
DTPA-Cu	12A1	17.1	0.26	mg/kg	DTPA ext. copper	DTPA extraction, AAS
DTPA-Zn	12A1	16.4	0.10	mg/kg	DTPA ext. zinc	DTPA extraction, AAS
DTPA-Mn	12A1	9.0	0.32	mg/kg	DTPA ext. manganese	DTPA extraction, AAS
DTPA-Fe	12A1	13.0	0.23	mg/kg	DTPA ext. iron	DTPA extraction, AAS
ADMC	2A1	11.9	0.4	%	Air Dried Moisture Content	Gravimetric oven dry @ 105C
R1	NA	20.2	NA		Dispersion Ratio	Ratio [Aqueous dispersible (Silt + Clay):Total (Silt + Clay)]
SO4-S	10B3	11.5	0.6	mg/kg	Sulfate sulfur	Ca(H2PO4)2 @ pH 4.0 extractable sulfate-sulfur, ICPOES
Al	15G1	NA	NA	meq/100g	Exchangeable Aluminium	Exch. Hydrogen and Aluminium by 1M KCl
H+	15G1	NA	NA	meq/100g	Exchangeable Acidity	Exch. Hydrogen and Aluminium by 1M KCl
15 Bar		NA	NA		15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C
1/3 Bar		NA	NA		15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

For Manager
Analytical Services: _____

QUALITY CONTROL DATA

Reference 25012835

Soil

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

Test Method	Units		Actual Value	Acceptance Criteria [Range]
pH	pH	r118		9.7 - 10.1
EC	dS/m	r118		.301 - .334
Cl	mg/kg	r118		28 -40
NO3-N	mg/kg	rv		3 - 8
NH4-N	mg/kg	B		80-96
Olsen P	mg/kg	rv		15 - 20
Total Kjeldahl N	%	32-13		.329 - .485
Total P	%	aspac 111		.040 - .052
Organic Carbon	%	rv		1.82 - 2.3
Ca (Exch. cations)pH7	meq/100g	B		6.96 - 8.04
Mg (Exch. cations)pH7	meq/100g	B		1.88 - 2.22
Na (Exch. cations)pH7	meq/100g	B		.057 - .182
K (Exch. cations)pH7	meq/100g	B		1.21 - 1.41
Exch. Acidity	meq/100g			NA
ECEC	meq/100g	A		NA
CEC	meq/100g	S12		58 - 73
ESP	%	A		NA
Coarse sand	%	RD		29 -33
Fine Sand	%	RD		27 - 32
Silt	%	RD		10 - 16
Clay	%	RD		21 - 29
R1		RD		.38 - .57

Test Method	Units	Test Soil	Actual Value	Acceptance Criteria [Range]
DTPA-Cu	mg/kg	112-09		1.52 - 1.82
DTPA-Zn	mg/kg	112-09		1.25 - 1.45
DTPA-Mn	mg/kg	112-09		148 - 178
DTPA-Fe	mg/kg	112-09		7.9 - 13.2
Suflate-sulfur	mg/kg	B		5 - 12
ADMC	%			NA
15 Bar	%	G	29, 29, 30, 31	23 - 32
0.33 Bar	%	G		36 - 52
Ca (Exch. cations)pH8.5	meq/100g	S12		27.7 - 37.4
Mg (Exch. cations)pH8.5	meq/100g	S12		22.6 - 26.5
Na (Exch. cations)pH8.5	meq/100g	S12		2.0 - 2.28
K (Exch. cations)pH8.5	meq/100g	S12		1.64 - 2.09

ESSA /DETSI(NATA)

5 Dunphy St Sunnybank Hills
Qld 4109

Phone: 0403245560

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Date Received: 19/11/2025
Date Completed: 15/01/2026

FINAL REPORT

Project: BWN (15 Bar)

All results in this report relate only to the items tested. Results are expressed on an "as received basis".

Client Name: GTE

Contact: Dennis Baker

Sample Type: Soil

Number of samples: 138 Selected of 140

ESSA (DETSI)Pty Ltd

Soil Analysis Report

Reference: DESTI 0886 **Ex 2501 2835**

Reported 15/01/2026

Client: GTE

Soil Analysis Report

Job No: 25-0886

Report ID: 25-0886-F-V1

Sample No	Customer's ID	Site ID	Project ID	S_15_BAR 15 Bar %
25-0886-0001	D1-0.00-0.10		BWNSAMPLESVIAEALLISM	20.3
25-0886-0002	D1-0.20-0.30		BWNSAMPLESVIAEALLISM	22.7
25-0886-0003	D1-0.50-0.60		BWNSAMPLESVIAEALLISM	15.1
25-0886-0004	D5-0.00-0.10		BWNSAMPLESVIAEALLISM	25.8
25-0886-0005	D5-0.20-0.30		BWNSAMPLESVIAEALLISM	28.2
25-0886-0006	D5-0.50-0.60		BWNSAMPLESVIAEALLISM	27.3
25-0886-0007	D5-0.80-0.90		BWNSAMPLESVIAEALLISM	26.8
25-0886-0008	D5-1.10-1.20		BWNSAMPLESVIAEALLISM	27.1
25-0886-0009	D5-1.40-1.50		BWNSAMPLESVIAEALLISM	28.2
25-0886-0010	D5-1.70-1.80		BWNSAMPLESVIAEALLISM	29.9
25-0886-0011	D6-0.00-0.10		BWNSAMPLESVIAEALLISM	27.2
25-0886-0012	D6-0.20-0.30		BWNSAMPLESVIAEALLISM	26.4
25-0886-0013	D6-0.50-0.60		BWNSAMPLESVIAEALLISM	24.9
25-0886-0014	D6-0.80-0.90		BWNSAMPLESVIAEALLISM	17.4
25-0886-0015	D6-1.10-1.20		BWNSAMPLESVIAEALLISM	22.9
25-0886-0016	D7-0.00-0.10		BWNSAMPLESVIAEALLISM	20.9
25-0886-0017	D7-0.20-0.30		BWNSAMPLESVIAEALLISM	21.9
25-0886-0018	D7-0.50-0.60		BWNSAMPLESVIAEALLISM	22.8
25-0886-0019	D12m-0.00-0.10		BWNSAMPLESVIAEALLISM	21.3
25-0886-0020	D12m-0.20-0.30		BWNSAMPLESVIAEALLISM	23.5
25-0886-0021	D12m-0.50-0.60		BWNSAMPLESVIAEALLISM	23.2
25-0886-0022	D12m-0.80-0.90		BWNSAMPLESVIAEALLISM	23.5
25-0886-0023	D12m-1.10-1.20		BWNSAMPLESVIAEALLISM	23.2
25-0886-0024	D12m-1.40-1.50		BWNSAMPLESVIAEALLISM	23.4
25-0886-0025	D12m-1.70-1.80		BWNSAMPLESVIAEALLISM	24.1
25-0886-0026	D12d-0.00-0.10		BWNSAMPLESVIAEALLISM	18.5
25-0886-0027	D12d-0.20-0.30		BWNSAMPLESVIAEALLISM	21
25-0886-0028	D12d-0.50-0.60		BWNSAMPLESVIAEALLISM	21.2
25-0886-0029	D12d-0.80-0.90		BWNSAMPLESVIAEALLISM	24.2
25-0886-0030	D12d-1.10-1.20		BWNSAMPLESVIAEALLISM	24.5
25-0886-0031	D12d-1.40-1.50		BWNSAMPLESVIAEALLISM	23.8
25-0886-0032	D12d-1.70-1.80		BWNSAMPLESVIAEALLISM	25.1
25-0886-0033	D14d-0.00-0.10		BWNSAMPLESVIAEALLISM	21.2
25-0886-0034	D14d-0.20-0.30		BWNSAMPLESVIAEALLISM	22.8
25-0886-0035	D14d-0.50-0.60		BWNSAMPLESVIAEALLISM	25.3
25-0886-0036	D14d-0.80-0.90		BWNSAMPLESVIAEALLISM	20.6
25-0886-0037	D14d-1.10-1.20		BWNSAMPLESVIAEALLISM	21
25-0886-0038	D14d-1.30-1.40		BWNSAMPLESVIAEALLISM	17.4
25-0886-0039	D14m-0.00-0.10		BWNSAMPLESVIAEALLISM	20.9
25-0886-0040	D14m-0.20-0.30		BWNSAMPLESVIAEALLISM	14.1
25-0886-0041	D14m-0.50-0.60		BWNSAMPLESVIAEALLISM	18.3
25-0886-0042	D14m-0.80-0.90		BWNSAMPLESVIAEALLISM	27.8
25-0886-0043	D14m-1.10-1.20		BWNSAMPLESVIAEALLISM	24.1
25-0886-0044	D14m-1.40-1.50		BWNSAMPLESVIAEALLISM	24
25-0886-0045	D14m-1.70-1.80		BWNSAMPLESVIAEALLISM	24.9
25-0886-0046	D19-0.00-0.05		BWNSAMPLESVIAEALLISM	19.3
25-0886-0047	D19-0.20-0.30		BWNSAMPLESVIAEALLISM	17.4
25-0886-0048	D19-0.40-0.50		BWNSAMPLESVIAEALLISM	13.3
25-0886-0049	D19-0.50-0.60		BWNSAMPLESVIAEALLISM	16.1

25-0886-0050	**D19-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	14
25-0886-0051	**D21-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	20.9
25-0886-0052	**D21-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	22.9
25-0886-0053	**D21-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	22.9
25-0886-0054	**D21-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	23.7
25-0886-0055	**D21-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	22.6
25-0886-0056	**D21-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	22.2
25-0886-0057	**D21-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	16.9
25-0886-0058	**D24-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	12.8
25-0886-0059	**D24-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	17.5
25-0886-0060	**D24-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	19.7
25-0886-0061	**D24-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	18.5
25-0886-0062	**D36-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	18.7
25-0886-0063	**D36-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	19.9
25-0886-0064	**D36-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	12.9
25-0886-0065	**D36-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	17.8
25-0886-0066	**D36-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	14.3
25-0886-0067	**D36-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	15.2
25-0886-0068	**D36-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	9.1
25-0886-0069	**D39-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	19.5
25-0886-0070	**D39-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	19.2
25-0886-0071	**D39-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	15.3
25-0886-0072	**D39-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	21.7
25-0886-0073	**D39-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	22.8
25-0886-0074	**D43-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	15.5
25-0886-0075	**D43-0.10-0.20**	**BWNSAMPLESVIAEALLISM**	22.7
25-0886-0076	**D43-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	21.6
25-0886-0077	**D45-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	16.9
25-0886-0078	**D45-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	20.2
25-0886-0079	**D45-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	22.8
25-0886-0080	**D45-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	23.6
25-0886-0081	**D45-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	26
25-0886-0082	**D45-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	25.3
25-0886-0083	**D45-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	22.6
25-0886-0084	**D52-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	12.7
25-0886-0085	**D52-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	13.6
25-0886-0086	**D52-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	15
25-0886-0087	**D52-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	15.2
25-0886-0088	**D52-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	15.4
25-0886-0089	**D52-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	14.3
25-0886-0090	**D52-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	13.7
25-0886-0091	**D58-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	20.9
25-0886-0092	**D58-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	22.7
25-0886-0093	**D58-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	18.4
25-0886-0094	**D58-0.70-0.80**	**BWNSAMPLESVIAEALLISM**	18.1
25-0886-0095	**D65-0.00-0.05**	**BWNSAMPLESVIAEALLISM**	4.7
25-0886-0096	**D65-0.10-0.20**	**BWNSAMPLESVIAEALLISM**	4.2
25-0886-0097	**D65-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	7.7
25-0886-0098	**D65-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	14
25-0886-0099	**D65-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	11.4
25-0886-0100	**D3-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	19.5
25-0886-0101	**D3-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	18.1
25-0886-0102	**D3-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	23.4
25-0886-0103	**D3-0.70-0.80**	**BWNSAMPLESVIAEALLISM**	22.4
25-0886-0104	**D3-0.90-1.00**	**BWNSAMPLESVIAEALLISM**	12.4
25-0886-0105	**D22-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	20.4
25-0886-0106	**D22-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	20.9
25-0886-0107	**D22-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	21.5
25-0886-0108	**D22-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	18.9
25-0886-0109	**D22-1.00-1.10**	**BWNSAMPLESVIAEALLISM**	18.3
25-0886-0110	**D22-1.30-1.40**	**BWNSAMPLESVIAEALLISM**	18.5
25-0886-0111	**D22-1.60-1.70**	**BWNSAMPLESVIAEALLISM**	17.8
25-0886-0112	**D32-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	8.5
25-0886-0113	**D32-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	14.5
25-0886-0114	**D32-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	12.9
25-0886-0115	**D32-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	13.3
25-0886-0116	**D32-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	15.5

25-0886-0117	**D32-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	17.9
25-0886-0118	**D32-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	15.5
25-0886-0119	**D37-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	16.2
25-0886-0120	**D37-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	23.4
25-0886-0121	**D37-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	23.5
25-0886-0122	**D37-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	20.8
25-0886-0123	**D37-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	20.1
25-0886-0124	**D37-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	14.2
25-0886-0125	**D37-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	15.9
25-0886-0126	**D44-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	11.3
25-0886-0127	**D44-0.10-0.20**	**BWNSAMPLESVIAEALLISM**	12.7
25-0886-0128	**D44-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	22.8
25-0886-0129	**D44-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	20.1
25-0886-0130	**D44-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	17.9
25-0886-0131	**D44-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	18.2
25-0886-0132	**D59-0.00-0.10**	**BWNSAMPLESVIAEALLISM**	2.7
25-0886-0133	**D59-0.20-0.30**	**BWNSAMPLESVIAEALLISM**	3.4
25-0886-0134	**D59-0.50-0.60**	**BWNSAMPLESVIAEALLISM**	13.5
25-0886-0135	**D59-0.80-0.90**	**BWNSAMPLESVIAEALLISM**	12.4
25-0886-0136	**D59-1.10-1.20**	**BWNSAMPLESVIAEALLISM**	11
25-0886-0137	**D59-1.40-1.50**	**BWNSAMPLESVIAEALLISM**	12.7
25-0886-0138	**D59-1.70-1.80**	**BWNSAMPLESVIAEALLISM**	12.1

This job has been authorized by:

Name: Fred Oudyn

Role: Principal Scientist

NATA

WORLD RECOGNISED ACCREDITATION

ESSA Pty Ltd/ DETSI

METHOD DESCRIPTIONS

Soil

Reference: Reference: DESTI 0886 **Ex 2501 2835**

Methods used to Analyse Samples

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
pH	4A1	1.1	0.1	pH	pH	1:5 water extr, pH meter
EC	3A1	5.4	0.01	dS/m	Electrical conductivity	1:5 water extr, EC meter
Cl	5A2	10.0	10.0	mg/kg	Chloride	1:5 water extr, (AA) colorimetric
NO3-N	7C2	6.7	1.0	mg/kg	Nitrate-nitrogen	1:5 water extr, (AA) colorimetric
NH4-N	7C2	7.8	0.6	mg/kg	Ammonium-nitrogen	1M KCl extr, (AA) colorimetric
Bicarb.P	9B2	16.8	1.0	mg/kg	Bicarb.ext.phosphorus	0.5M NaHCO3 @ pH 8.5, (AA) colorimetric
TN	7A2	12.9	0.01	%	Total Kjeldahl Nitrogen	Sulphuric acid digest, (AA) colorimetric
OC	8B1	9.7	0.02	%	Organic Carbon	Walkley & Black, (H2SO4/K2Cr2O7), titr.
Ca (Neut)	15A1	10.3	0.10	meq/100g	Exchangeable calcium	1M NH4Cl @ pH 7.0 shake, AAS
Mg (Neut)	15A1	6.6	0.10	meq/100g	Exchangeable magnesium	1M NH4Cl @ pH 7.0 shake, AAS
Na (Neut)	15A1	7.3	0.03	meq/100g	Exchangeable sodium	1M NH4Cl @ pH 7.0 shake, AAS
K (Neut)	15A1	3.9	0.02	meq/100g	Exchangeable potassium	1M NH4Cl @ pH 7.0 shake, AAS
ECEC	15J1	5.0	1	meq/100g	Effective cation ex.capacity	Sum of exchangeable cations
ESP	15N1	5.0	3	%	Exchangeable Na%	(Exchangeable Na/sum of exch.cations)%
Sand	no ref	22.1	1.0	%	Particle size, sand	Hydrometer, gravimetric
Silt	no ref	16.6	1.0	%	Particle size, silt	Hydrometer, gravimetric
Clay	no ref	12.7	1.0	%	Particle size, clay	Hydrometer, gravimetric
15 Bar					Pressure Plate	

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992 /2011)**

For Manager
Analytical Services: **D E Baker BSc MASSSI**

Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
Soluble Salts included in Exchangeable Cations - Except PRE-WASHED (if EC>0.3dS/m).

Director and Principal Soil Scientist – ESSA Pty Ltd

Adjunct Professional Fellow Southern Cross University
Chief Soil Chemistry Trainer Soil Science Australia (National & Qld)
Hon. Life Member Soil Science Australia (National & Qld)
Certified Professional Practicing Soil Scientist CPSS

Analyte	ALHS*	Uncertainty %	LOQ	Unit	Name	Method Description
Ca (Alc)	15C1	7.2	0.18	meq/100g	Exchangeable calcium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Mg (Alc)	15C1	4.7	0.31	meq/100g	Exchangeable magnesium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
Na (Alc)	15C1	9.6	0.09	meq/100g	Exchangeable sodium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
K (Alc)	15C1	4.8	0.02	meq/100g	Exchangeable potassium	1M NH4Cl (alcoholic) @ pH 8.5 leach, AAS
CEC	15I3	5.7	1.0	meq/100g	Cation Exchange Capacity	KNO3 + Ca(NO3)2 extr, (AA) colorimetric
DTPA-Cu	12A1	17.1	0.26	mg/kg	DTPA ext. copper	DTPA extraction, AAS
DTPA-Zn	12A1	16.4	0.10	mg/kg	DTPA ext. zinc	DTPA extraction, AAS
DTPA-Mn	12A1	9.0	0.32	mg/kg	DTPA ext. manganese	DTPA extraction, AAS
DTPA-Fe	12A1	13.0	0.23	mg/kg	DTPA ext. iron	DTPA extraction, AAS
ADMC	2A1	11.9	0.4	%	Air Dried Moisture Content	Gravimetric oven dry @ 105C
R1	NA	20.2	NA		Dispersion Ratio	Ratio [Aqueous dispersible (Silt + Clay):Total (Silt + Clay)]
SO4-S	10B3	11.5	0.6	mg/kg	Sulfate sulfur	Ca(H2PO4)2 @ pH 4.0 extractable sulfate-sulfur, ICPOES
Al	15G1	NA	NA	meq/100g	Exchangeable Aluminium	Exch. Hydrogen and Aluminium by 1M KCl
H+	15G1	NA	NA	meq/100g	Exchangeable Acidity	Exch. Hydrogen and Aluminium by 1M KCl
15 Bar		NA	NA		15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C
1/3 Bar		NA	NA		15 Bar Analysis	Pressure Plate/Gravimetric oven dry @ 105C

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

For Manager
Analytical Services:

ESSA Pty Ltd/DETSI

QUALITY CONTROL DATA

Reference Reference: DESTI 0886 **Ex 2501 2835**

Soil

*** Australian Laboratory Handbook of Soil and Water Chemical Methods (1992)**

Test Method	Units		Actual Value	Acceptance Criteria [Range]
pH	pH	r118		9.7 - 10.1
EC	dS/m	r118		.301 - .334
Cl	mg/kg	r118		28 -40
NO3-N	mg/kg	rv		3 - 8
NH4-N	mg/kg	B		80-96
Olsen P	mg/kg	rv		15 - 20
Total Kjeldahl N	%	32-13		.329 - .485
Total P	%	aspac 111		.040 - .052
Organic Carbon	%	rv		1.82 - 2.3
Ca (Exch. cations)pH7	meq/100g	B		6.96 - 8.04
Mg (Exch. cations)pH7	meq/100g	B		1.88 - 2.22
Na (Exch. cations)pH7	meq/100g	B		.057 - .182
K (Exch. cations)pH7	meq/100g	B		1.21 - 1.41
Exch. Acidity	meq/100g			NA
ECEC	meq/100g	A		NA
CEC	meq/100g	S12		58 - 73
ESP	%	A		NA
Coarse sand	%	RD		29 -33
Fine Sand	%	RD		27 - 32
Silt	%	RD		10 - 16
Clay	%	RD		21 - 29
R1		RD		.38 - .57

Test Method	Units	Test Soil	Actual Value	Acceptance Criteria [Range]
DTPA-Cu	mg/kg	112-09		1.52 - 1.82
DTPA-Zn	mg/kg	112-09		1.25 - 1.45
DTPA-Mn	mg/kg	112-09		148 - 178
DTPA-Fe	mg/kg	112-09		7.9 - 13.2
Suflate-sulfur	mg/kg	B		5 - 12
ADMC	%			NA
15 Bar	%	G	29, 29, 30, 31	23 - 32
0.33 Bar	%	G		36 - 52
Ca (Exch. cations)pH8.5	meq/100g	S12		27.7 - 37.4
Mg (Exch. cations)pH8.5	meq/100g	S12		22.6 - 26.5
Na (Exch. cations)pH8.5	meq/100g	S12		2.0 - 2.28
K (Exch. cations)pH8.5	meq/100g	S12		1.64 - 2.09

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Whitehaven

Blackwater North Extension Project

Appendix B
Surface Water and Flooding Assessment



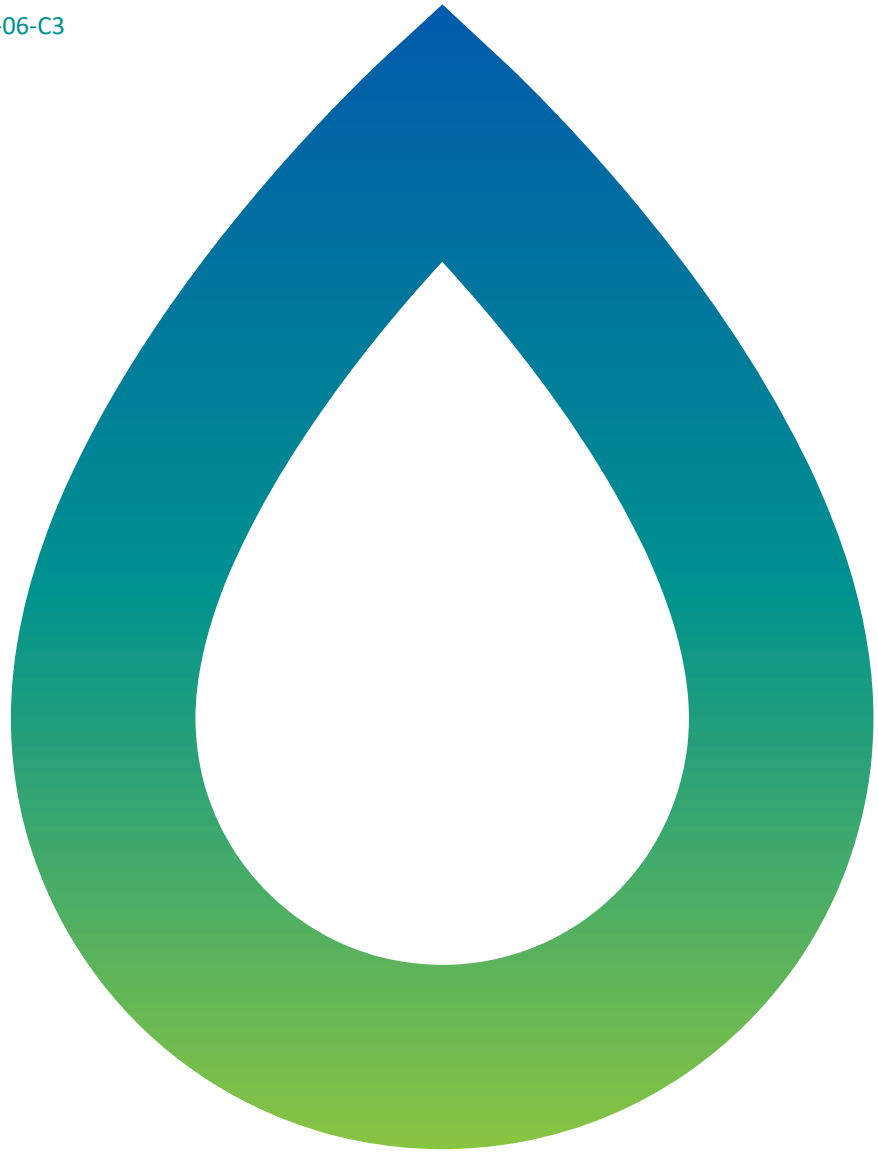
BLACKWATER NORTH EXTENSION PROJECT

Surface Water Assessment

Whitehaven Blackwater Pty Ltd

17 April 2026

1559-06-C3



DETAILS

Report Title	Blackwater North Extension Project, Surface Water Assessment
Client	Whitehaven Blackwater Pty Ltd

THIS REVISION

Report Number	1559-06-C3
Date	17 April 2026
Author	Ardianto Notodirdjo
Reviewer	Michael Batchelor

NOTE: This report has been prepared on the assumption that all information, data and reports provided to us by our client, on behalf of our client, or by third parties (e.g. government agencies) is complete and accurate and on the basis that such other assumptions we have identified (whether or not those assumptions have been identified in this advice) are correct. You must inform us if any of the assumptions are not complete or accurate. We retain ownership of all copyright in this report. Except where you obtain our prior written consent, this report may only be used by our client for the purpose for which it has been provided by us.

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1 INTRODUCTION

1.1 BACKGROUND

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (refer to Figure 1.1). BWM's Mining Leases (MLs) include ML 1759, ML 1760, ML 1761, ML 1762, ML 1767, ML 1771, ML 1772, ML 1773, ML 1792, ML 1800, ML 1812, ML 1829, ML 1860, ML 1862, ML 1907, ML 70091, ML 70103, ML 70104, ML 70139, ML 70167 and ML 70329 (refer to Figure 1.1).

The BWM has been in operation since 1967 and is currently owned and operated by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven). It operates under Environmental Authority (EA) EPML00717813, granted under the Queensland *Environmental Protection Action 1994* (EP Act).

The BWM comprises a series of open cut mining pits along an approximately 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, and truck and shovel fleets for overburden removal and haulage. The BWM produces up to 17.6 million tonnes per annum (Mtpa) of product coal, predominantly high-quality coking coal for use in steelmaking as well as high energy thermal coal.

Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

1.2 PROJECT DESCRIPTION

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on ML 1762 and SA 10 on ML 1759 (Figure 1.1). The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML 1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;
- ongoing exploration activities in the Project area; and

- other associated infrastructure, equipment and activities.

Figure 1.2 shows the general arrangement of the Project site, including the open cut pit extents within SA 7 on ML 1762 and SA 10 on ML 1759.

1.3 SCOPE OF WORK

This Surface Water Assessment (SWA) has been prepared to support the environmental approvals for the Project and aims to:

- Describe the existing surface water environment around the Project, including the hydrological setting, surface water quality characteristics, environmental values (EVs) and flooding behaviour.
- Describe the existing BWM Surface Water Management System (SWMS) and the proposed changes to the SWMS required as part of the Project.
- Assess potential impacts of the Project on the surface water environment, identify associated risks, and propose mitigation strategies to protect hydrological and ecological systems.

1.4 REPORT STRUCTURE

This report is structured as follows:

- Section 2 provides an overview of the regulatory framework for the Project.
- Section 3 describes the existing surface water environment, including baseline data on climate, drainage networks, and water quality.
- Section 4 provides an overview of the existing SWMS and the BWM site characteristics.
- Section 5 provides details on the water management objectives, strategies and systems, including water management infrastructure and erosion and sediment control (ESC) measures.
- Section 6 presents the results of the site water balance and evaluates the predicted behaviour of the SWMS and final voids under varying climatic conditions.
- Section 7 describes the predicted behaviour of the final voids under varying climatic conditions.
- Section 8 describes the flood behaviour under existing and future (Project) conditions and assesses the impact of the Project on flooding behaviour around BWM.
- Section 9 describes the impact of catchment loss resulting from the Project on flow regime in the waterways in the vicinity of the Project.
- Section 10 details the potential impacts of the Project and outlines mitigation and management measures to minimise adverse effects on surface water resources.
- Section 11 provides a list of references.

The report includes three appendices:

  - Appendix A describes the development and calibration of the hydrological model used to estimate design flood discharges across the Project area.
  - Appendix B describes the operational water balance model including inflows, outflows, and storage dynamics under varying climatic conditions completed by HydroBalance (2026). It was developed in coordination with groundwater modelling by SLR Consulting Australia Pty Ltd (SLR) (2026).
  - Appendix C assesses the potential for the Project to result in a surface water impact on the Great Barrier Reef World Heritage Property, National Heritage Place, and Marine Park, which are listed as Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Great Barrier Reef (GBR)

surface water impact assessment was undertaken by Water and Environment Pty Ltd (WRM) (2026).

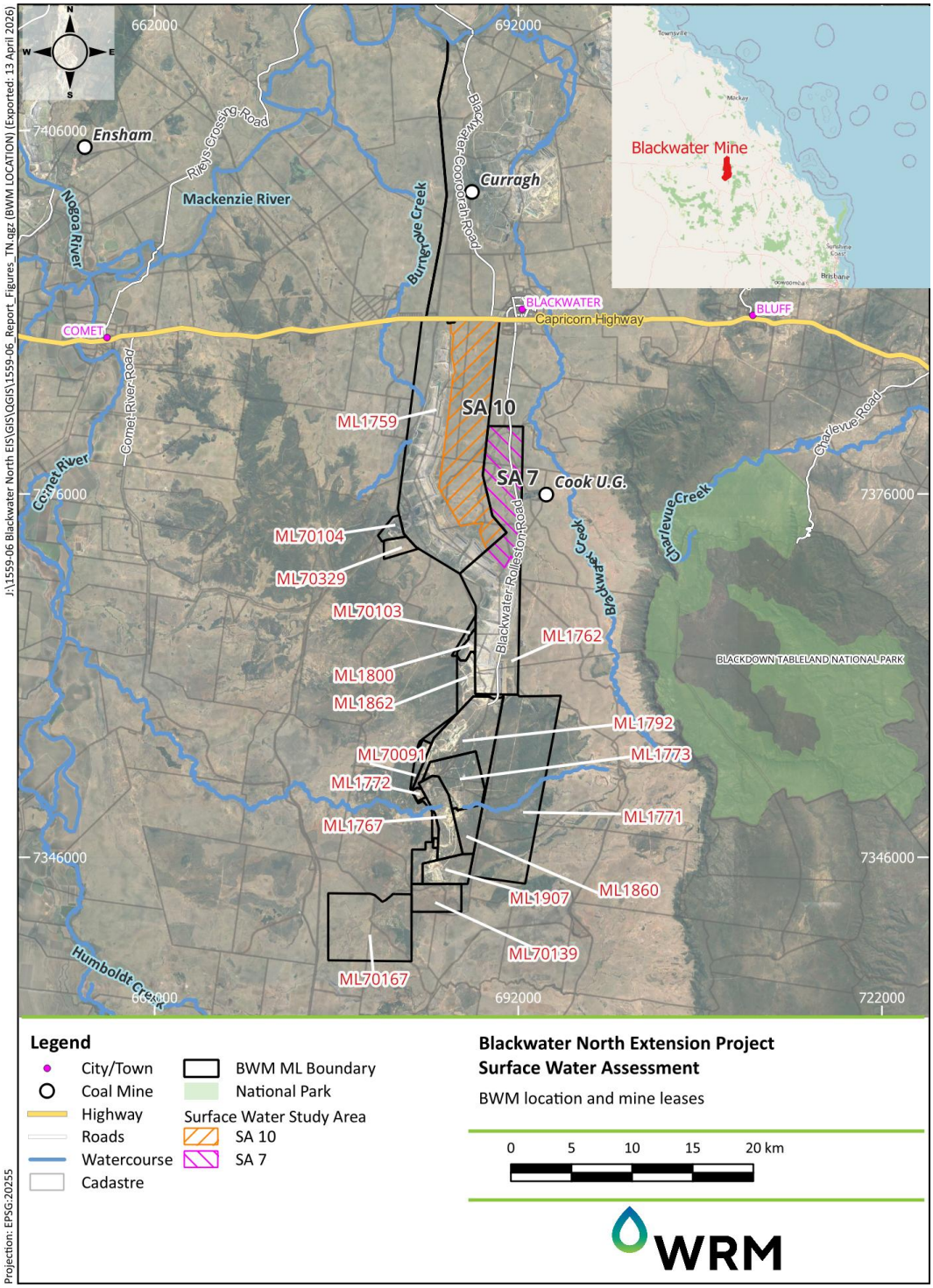


Figure 1.1 BWM Location and Mine Leases

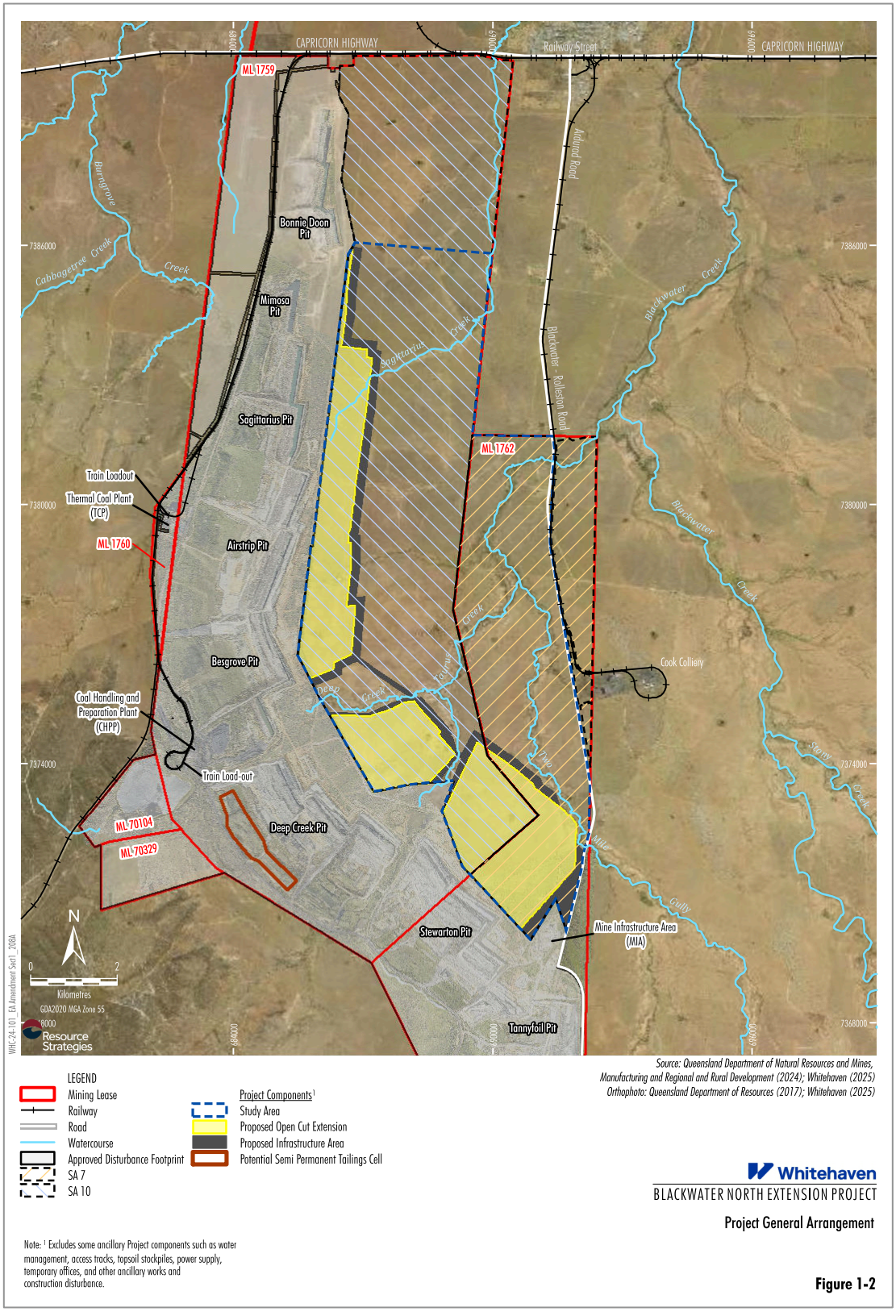


Figure 1.2 Project General Arrangement

2 REGULATORY FRAMEWORK

This section describes the regulatory framework (legislation, policies and standards) at Commonwealth and State level that would apply to surface water management for the Project.

2.1 COMMONWEALTH

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act outlines the requirements relating to the management and protection of MNES.

BM Alliance Coal Operations Pty Ltd (BMA) (former owners of the BWM) previously lodged a referral under the EPBC Act for the Project (EPBC 2023/09723). On 22 March 2024, the Department of Climate Change, Energy, the Environment and Water determined the Project to be a 'Controlled Action.' The controlled action includes 'a water resource, in relation to unconventional gas development and large coal mining development (sections 24D & 24E)' as the controlling provision relevant to this assessment.

Following Whitehaven Blackwater's acquisition of the BWM from BMA, the Referral was withdrawn on 6 November 2025.

2.2 QUEENSLAND

2.2.1 Environmental Protection Act 1994

2.2.1.1 Overview

Resource activities are defined as environmentally relevant activities (ERAs) under the EP Act, and as such, the development and operation of the Project are governed by the EP Act. The objective of the EP Act is to:

> *protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (**ecologically sustainable development**).*

2.2.1.2 Environmental Authority

An EA is granted in accordance with the EP Act and details the conditions that govern the ERA. In the context of surface water management, the EA will set out conditions that will be relevant to the Project, including:

- management of contained water including release;
- Water Management Plan (WMP) requirements;
- regulation of water structures including dams and levees;
- saline drainage management;
- acid rock drainage management; and
- storm water and sediment laden runoff management.

2.2.1.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water) is the primary instrument for surface water management under the EP Act. The EPP Water governs discharge to land, surface water and groundwater, aims to protect EVs and sets water quality guidelines and objectives.

The processes to identify EVs and to determine Water Quality Guidelines (WQGs) and Water Quality Objectives (WQOs) in Queensland waters are based on the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG (2018) guidelines).

2.2.1.4 Mackenzie Sub-basin Environmental Values and Water Quality Objectives 2011

The relevant document, pursuant to the EPP Water, for the Project is the *Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin, September 2011* (Department of Environment and Heritage Protection [DEHP], 2013). The document is made pursuant to the provisions of the EPP Water. It contains EVs and WQOs for waters in the Mackenzie River Sub-basin, and they are listed under Schedule 1 of EPP Water. Refer to Section 3.3 for further details.

2.2.1.5 Guideline – Application Requirements for Activities with Impacts to Water

The EP Act and the *Environmental Protection Regulation 2019* (EP Regulation) specify the regulatory requirements for prescribed ERAs. The *Guideline – Application requirements for activities with impacts to water* (Department of the Environment, Tourism, Science and Innovation [DETSI], 2026) focuses on the types of impacts that ERAs can have on water and outlines the information to be provided to the department as part of the ERA application process.

Section 4 of the guideline requires the applicant to provides details on a number of surface water-related issues, including:

- discharges and releases;
- unplanned and uncontrolled releases;
- water infrastructure;
- wetlands;
- hydrology of receiving waters; and
- mixing zones.

The guideline also refers to the department's technical guideline, *Wastewater release to Queensland waters* (DETSI, 2025a), which is discussed in Section 2.2.1.8.

2.2.1.6 Reef discharge standards for industrial activities

The *Reef discharge standards for industrial activities* (Department of Environment, Science and Innovation [DESI], 2024a) guideline outlines the additional requirements to address section 41AA of the EP Regulation, regarding the potential impacts to the GBR catchment waters (GBR catchments) from the release of fine sediments (FS) and dissolved inorganic nitrogen (DIN). Section 41AA of the EP Regulation states:

> 3. *The administering authority must refuse to grant the application if the authority considers that –*
>
> *(a) the relevant activity will, or may, have a residual impact; and*
>
> *(b) having regard to the matters mentioned in the water quality offset policy, the residual impact will not be adequately counterbalanced by offset measures for the relevant activity.*
>
> 4. *A residual impact of a relevant activity is the presence of fine sediment, or dissolved inorganic nitrogen, in Great Barrier Reef catchment waters, or waters mentioned in subsection (1)(b), that –*
>
> *(a) was released to the water because of the relevant activity; and*

(b) remains, or is likely to remain in the water despite mitigation measures for the relevant activity.

The intent of section 41AA of the EP Regulation is to achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters as outlined in the *Reef discharge standards for industrial activities* (DESI, 2024a).

2.2.1.7 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures

The *Manual for assessing consequence categories and hydraulic performance of structures* (the Manual) (DETSI, 2025b) defines the methodology and assessment criteria to determine if a structure associated with an ERA should be regulated under the EP Act. The manual details the hydraulic design requirements for regulated structures and this document has been used as a reference in the preliminary design of the SWMS and preliminary sizing of dams associated with the Project.

2.2.1.8 Technical Guideline – Wastewater Release to Queensland Waters

The technical guideline, *Wastewater Release to Queensland Waters* (DETSI, 2025a) is provided to support a risk-based assessment approach to licensing releases of wastewater to surface water and applies the philosophy of the ANZG (2018) guidelines and the intent of the *Environmental Protection (Water) Policy 2009*.

2.2.2 Water Act 2000

2.2.2.1 Overview

In Queensland, the *Water Act 2000* (Water Act) is the primary statutory document that establishes a framework for the planning, allocation and use of non-tidal water. The Water Act is primarily administered by the Department of Local Government, Water and Volunteers (DLGWV).

The main purpose of the Water Act is to provide a framework for the following:

- The sustainable management of Queensland's water resources and quarry material by establishing a system for:
  - the planning, allocation and use of water; and
  - the allocation of quarry material and riverine protection.
- The sustainable and secure water supply for the south-east Queensland region and other designated regions.
- The management of impacts on underground water caused by the exercise of underground water rights by the resource sector.
- The effective operation of water authorities.

A watercourse is defined by the Water Act as a river, creek or stream in which water flows permanently or intermittently and includes the bed and banks and any other element of a river, creek or stream confining or containing water. The DLGWV have published a watercourse identification map of the state that shows: watercourses (other than their lateral limits); the downstream limit of watercourses; drainage features; lakes; and springs.

2.2.2.2 Water Plan (Fitzroy Basin) 2011

The *Water Plan (Fitzroy Basin) 2011* was developed under the Water Act to:

- define the availability of water in the Fitzroy Basin;
- provide a framework for sustainably managing water and the taking of water;
- identify priorities and mechanisms for dealing with future water requirements;
- provide a framework for establishing water allocations;
- provide a framework for reversing, where practicable, degradation in natural ecosystems;
- regulate the taking of overland flow water; and
- regulate the taking of groundwater.

2.2.2.3 Water Regulation 2016

Water Regulation 2016 is subordinate legislation to the Water Act and provides details, protocol and instruction for the following:

- Water rights and planning.
- Statutory authorisations to take or interfere with water.
- Matters relating to water licenses.
- Water allocations.
- Water supply and demand management.
- Declarations about watercourses.

2.2.3 Water Supply (Safety and Reliability) Act 2008

The Water Supply (Safety and Reliability) Act 2008 provides for the safety and reliability of water supply in Queensland. The purpose is achieved primarily by:

- providing a regulatory framework for providing water and sewerage services in the State;
- providing a regulatory framework for providing recycled water and drinking water quality, primarily for protecting public health;
- the regulation of referable dams; and
- stating flood mitigation responsibilities.

3 EXISTING SURFACE WATER ENVIRONMENT

3.1 DRAINAGE NETWORK

3.1.1 Overview

There are seven waterways within the vicinity of the Project. These waterways have been defined from the Ordered Drainage 100K mapping layer from the Queensland Government Qspatial website, which identifies riverine systems, watercourses, waterways or drainage lines (here referred to collectively as waterways) for the Project area. The drainage layer classifies the hierarchy of streams using the Strahler (1957) stream ordering system. A first order stream starts at the top of a catchment and has no other streams flowing into it. Second-order streams form when two first-order streams join. They are bigger in size due to the water from both first-order streams combining. Third-order streams form when two or more second-order streams join, and so on.

In the vicinity of the Study area, there are:

- two waterways of Strahler stream order five, which include Blackwater Creek and Taurus Creek (downstream of Two Mile Gully confluence);
- two waterways of stream order four, which include Two Mile Gully and Taurus Creek (upstream of Two Mile Gully confluence);
- three waterways of stream order three, which include Emu Creek, Deep Creek and Sagittarius Creek; and
- there are also several waterways of stream order one, which are minor drainage features that drain the Project area directly to Two Mile Gully and/or Taurus Creek.

Descriptions of these waterways are given below.

3.1.2 Regional drainage features

Figure 3.2 show the regional drainage characteristics in the vicinity of the Study area. The Project is located within the Mackenzie subcatchment of the greater Fitzroy Basin. Blackwater Creek, a tributary of the Mackenzie River, is the main watercourse in the vicinity of the Project area and flows in a northerly direction to the east of the Project. Figure 3.2 shows Blackwater Creek catchment to the Mackenzie River.

The Blackwater Creek catchment originates at its headwaters from the west of BWM and drains in an easterly direction across the BWM ML. Blackwater Creek drains north and joins the Mackenzie River approximately 33 km north of BWM.

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, discharging into the Coral Sea south-east of Rockhampton, near Port Alma. The total Fitzroy River catchment is 142,665 square kilometres (km²).

The catchment area of Blackwater Creek, encompassing the Project area, is approximately 1,100 km². This represents around 0.8 percent (%) of the overall Fitzroy River catchment. The Project disturbance footprint is approximately 23 km² and represents 2% of the Blackwater Creek catchment and 0.016% of the overall Fitzroy River catchment area.

3.1.3 Local drainage features

3.1.3.1 Overview

Figure 3.3 shows the local drainage features in the vicinity of the Study area, which comprise of several waterways of stream order two to three that are tributaries of Blackwater Creek. Descriptions of these local waterways are given in the below subsections.

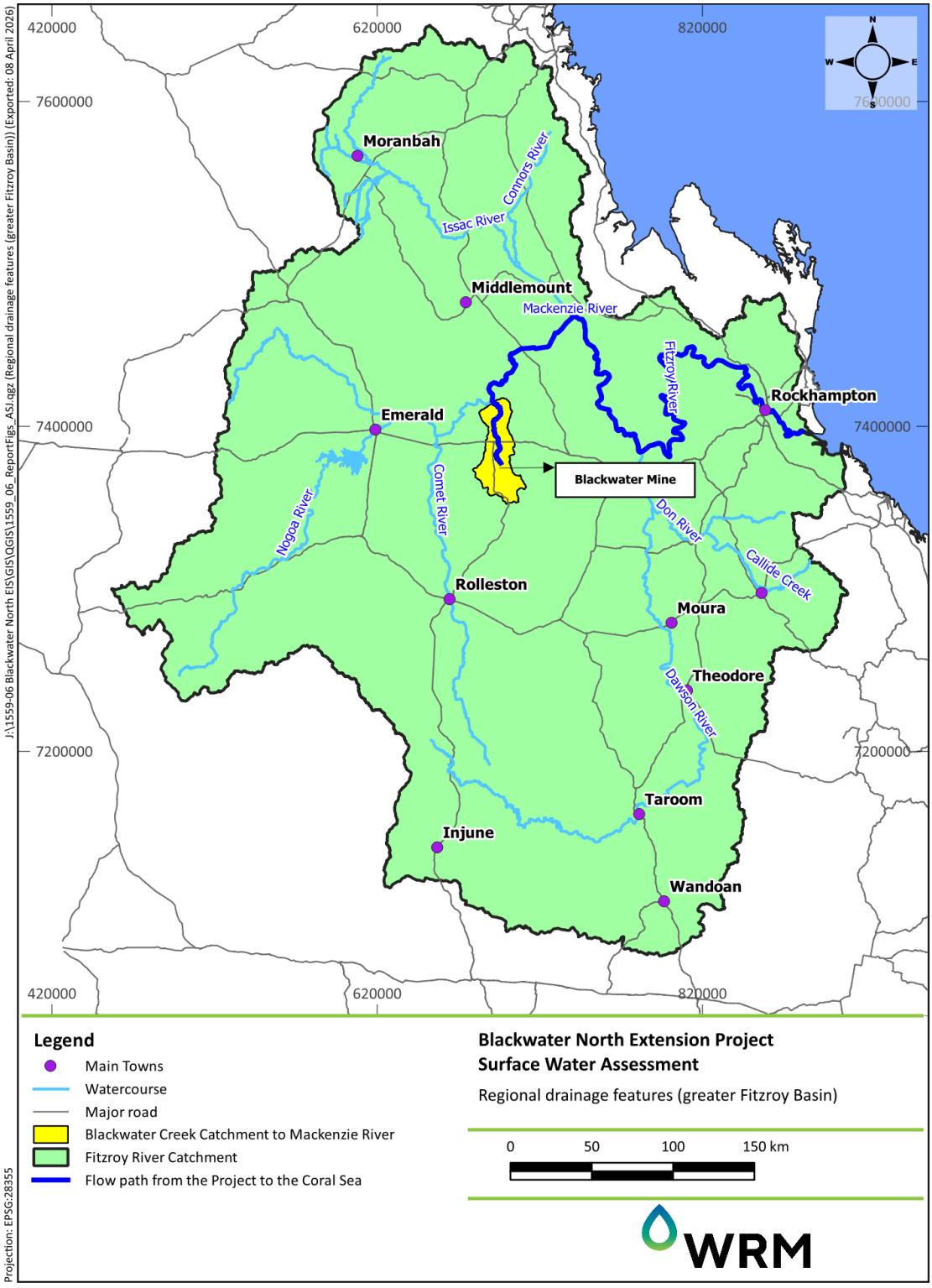


Figure 3.1 **Regional drainage features (greater Fitzroy Basin)**

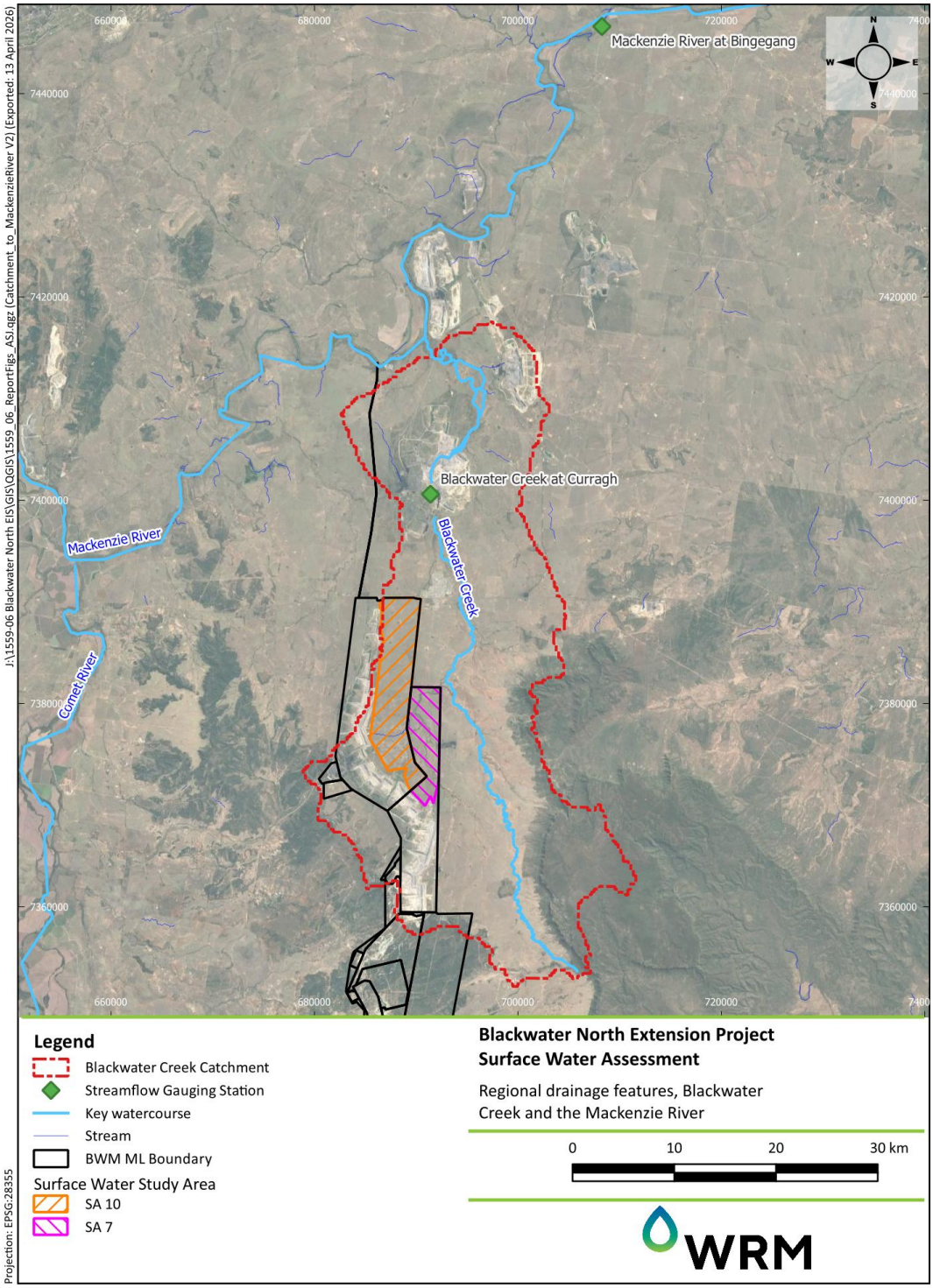


Figure 3.2 Regional drainage features, Blackwater Creek and the Mackenzie River

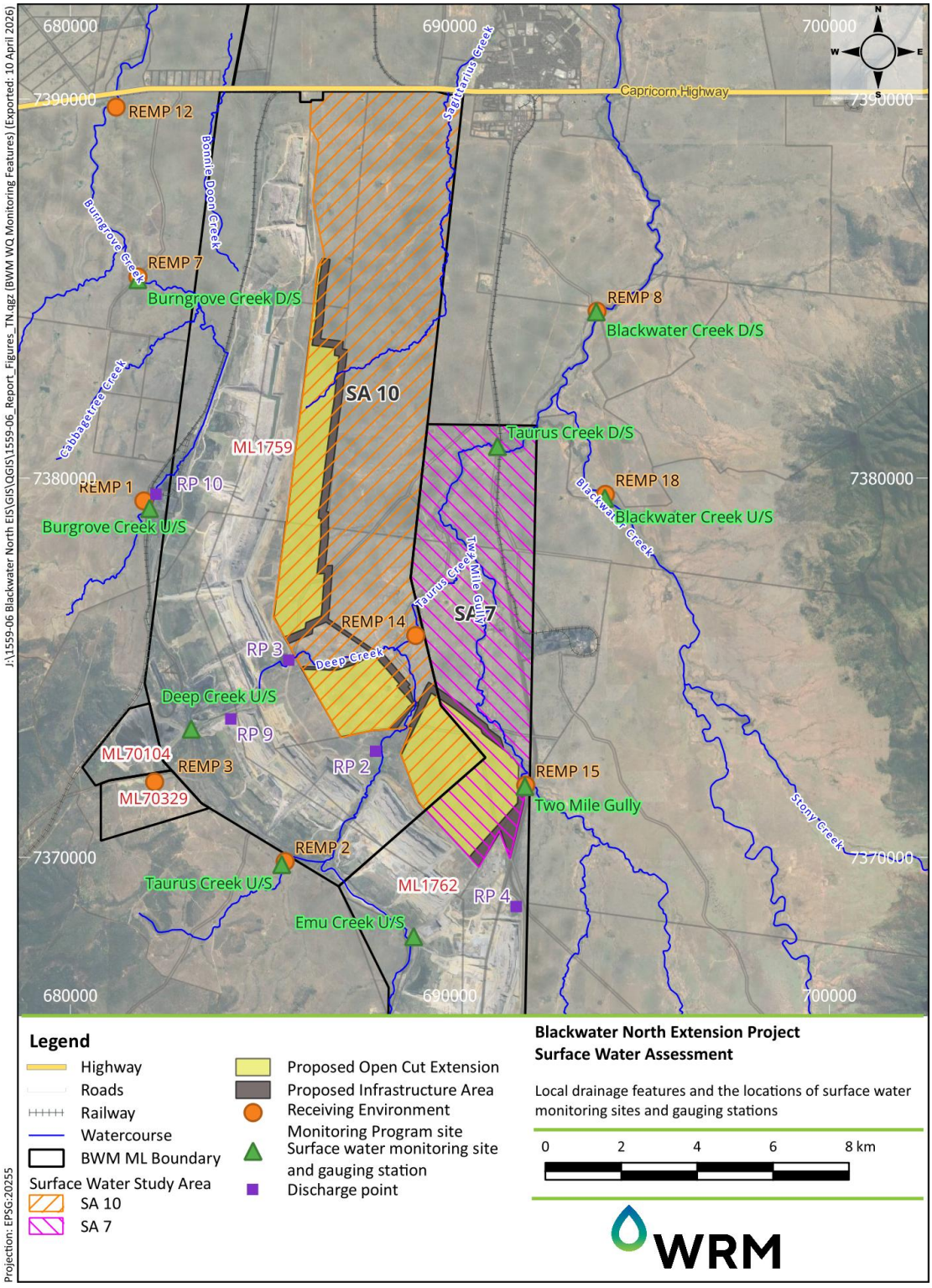


Figure 3.3 **Local drainage features and the locations of surface water monitoring sites and gauging stations**

3.1.3.2 Taurus Creek

Taurus Creek, a major tributary of Blackwater Creek, originates from the east of BWM and drains in a north-easterly direction across BWM. It drains as a stream order three waterway between existing overburden dumps, then between the Deep Creek and Stewarton open cut pits and into the New Taurus Creek Dam. New Taurus Creek Dam is an online water storage dam that forms a key part of the SWMS. Downstream of New Taurus Creek Dam, Taurus Creek continues to drain in a north-easterly direction and becomes a stream order four waterway as it joins Deep Creek immediately downstream of the Project area. Taurus Creek drains to Blackwater Creek approximately 5 km east of the Project area.

3.1.3.3 Emu Creek

Emu Creek, a tributary of Taurus Creek, originates from the west (upstream) of BWM and flows in a north-easterly direction towards BWM. Within the BWM ML, the natural Emu Creek channel has been largely consumed by mining activities. The downstream reaches of Emu Creek have been replaced by the non-regulated Emu Creek Diversion, which diverts the Emu Creek catchment to the north-west into Taurus Creek on the western side of BWM. The Emu Creek diversion is not located on a watercourse as defined under the Water Act. However, it was designed and constructed to be a permanent feature in line with applicable guidelines. Emu Creek, including the Emu Creek Diversion, drains as a stream order two waterway within the BWM ML until it joins Taurus Creek.

3.1.3.4 Deep Creek

Deep Creek, a tributary of Taurus Creek, originates from the west of BWM and drains in a north-easterly direction towards BWM. It drains as a stream order three waterway between existing overburden dumps, then between the Besgrove and Deep Creek open cut pits and into the New Deep Creek Dam. New Deep Creek Dam is an online water storage dam that forms a key part of the SWMS. Downstream of New Deep Creek Dam, Deep Creek continues to drain in a north-easterly direction and then joins Taurus Creek immediately downstream of the Project area.

3.1.3.5 Two Mile Gully

Two Mile Gully, tributary of Taurus Creek, flows in a northerly direction to the east of BWM. It drains as a stream order four waterway adjacent to and along the south-eastern portion of the Project area and then joints Taurus Creek about 5 km east of BWM.

The upper (and western) headwaters of the Two Mile Gully catchment has been consumed by mining activities at BWM. However, the central and lower sections of Two Mile Gully adjacent to the Project area are relatively undisturbed.

3.1.3.6 Sagittarius Creek

Sagittarius Creek, a tributary of Blackwater Creek, flows in a northerly direction along the eastern side of BWM. It drains as a stream order three waterway across the northern BWM ML boundary, passing the western side of Blackwater township and then join Blackwater Creek just downstream of Blackwater township.

The upper headwater of the Sagittarius Creek catchment, comprising several minor streams of order one or two, have been consumed by mining activities. However, the central and lower portions of the Sagittarius Creek catchment are relatively undisturbed.

3.2 STREAMFLOW

Historical flow and water level (river height) monitoring data was assessed to provide an indication of local flow regime in the vicinity of the Project and regional flow regime in the Mackenzie River. Table 3.1 shows the available water level data from two gauges owned by Whitehaven and three gauges owned by the DLGWV in the vicinity of the Project.

Table 3.1 Stream gauging stations

Gauge No.	Gauge name	Catchment area (km²)	Owner	Period of record	Easting (m) (GDA 94)	Northing (m) (GDA 94)
330124	Two Mile Gully	98	Whitehaven	2016 – 2025	692,093	7,372,042
330121	Taurus Creek D/S[a]	246	Whitehaven	2016 – 2025	691,367	7,381,013
130108A	Blackwater Creek at Curragh[b]	777	DLGWV	1972 – 1989	691,299	7,400,395
130108B	Blackwater Creek at Curragh[b]	776	DLGWV	1990 – 2009	691,299	7,400,395
130106A	Mackenzie River at Bingegang	50,860	DLGWV	1971 – present	708,267	7,446,599

[a] D/S = downstream, m = metres

[b] The two Blackwater Creek gauges (130108A and 130108B) are at the same location

Figure 3.4, Figure 3.5, Figure 3.6 and Figure 3.7 present daily discharge exceedance curves of flows (in megalitres per day [ML/d]) in Two Mile Gully, Taurus Creek, Blackwater Creek and the Mackenzie River, respectively, as recorded at the above stream gauging stations.

Figure 3.8, Figure 3.9, Figure 3.10 and Figure 3.11 present monthly box and whisker plots of stream flows (in megalitres per month [ML/month]) in Two Mile Gully, Taurus Creek, Blackwater Creek and the Mackenzie River, respectively, as recorded at the above stream gauging stations. The box and whisker plots show:

- The lower and upper extents of the 'whiskers' show the 10th and 90th percentile recorded monthly flows.
- The box represents the range within which 50% of recorded monthly flows fall. The lower bound of the box is the 25th percentile monthly flow (i.e. 25% of flows are equal to or smaller, 75% of flows are larger) while the upper bound of the box is the 75th percentile flow (i.e. 75% of flows are equal to or smaller, only 25% of flows are larger).
- The middle line in the box represents the median or 50th percentile recorded monthly flow (i.e. 50% of flows are equal to or smaller, 50% of flows are larger).

The data indicates the following:

- At all four watercourses, flows are most likely to occur during the summer months. Stream flows are highly variable, especially during the summer months.

- Two Mile Gully, Taurus Creek and Blackwater Creek are ephemeral streams, where flows occur during the summer months often in short durations, but generally drying out during winter and early spring. Stream flows greater than 10 ML/d occur less than (<) 3% of the time in Two Mile Gully, <6% of the time in Taurus Creek, and <14% of the time in Blackwater Creek. The higher frequency of low flows above 0.1 ML/d in Blackwater Creek at Curragh is likely due to releases from the Blackwater Sewage Treatment Plant, but it could also be due to mine releases.
- The Mackenzie River, around the confluence with Blackwater Creek, exhibits the characteristics of an ephemeral stream. Flows occur more regularly during the summer months and in longer durations, compared to the local creeks in the vicinity of the BWM. However, the river generally dries out during the winter months.

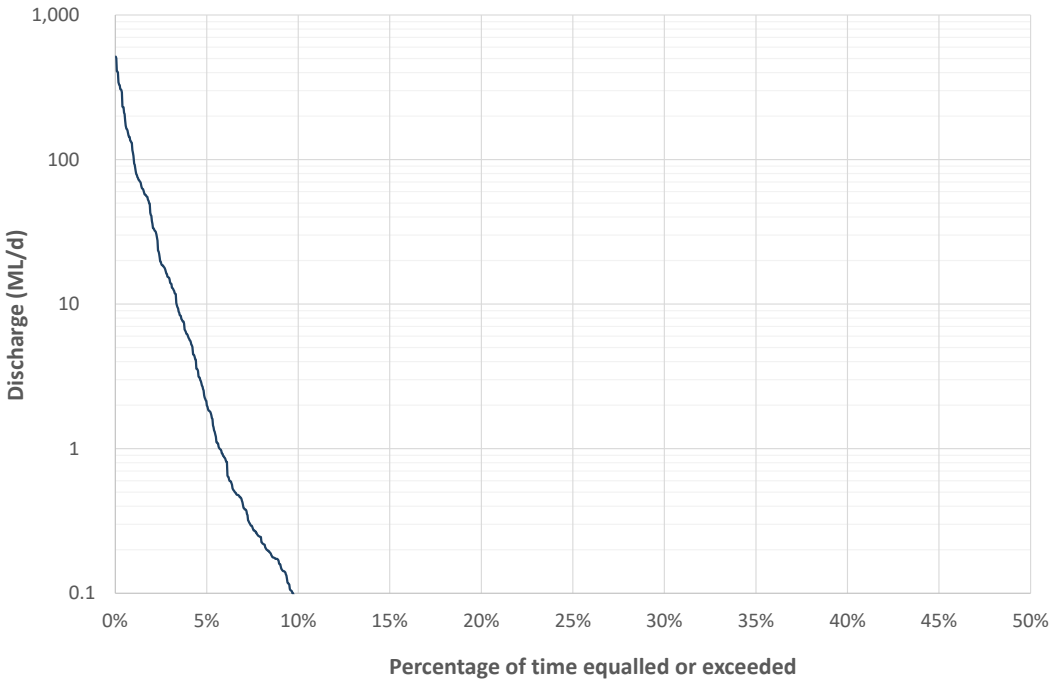


Figure 3.4 Daily discharge exceedance curve (2016 – 2025) at Two Mile Gully (Station No. 330124)

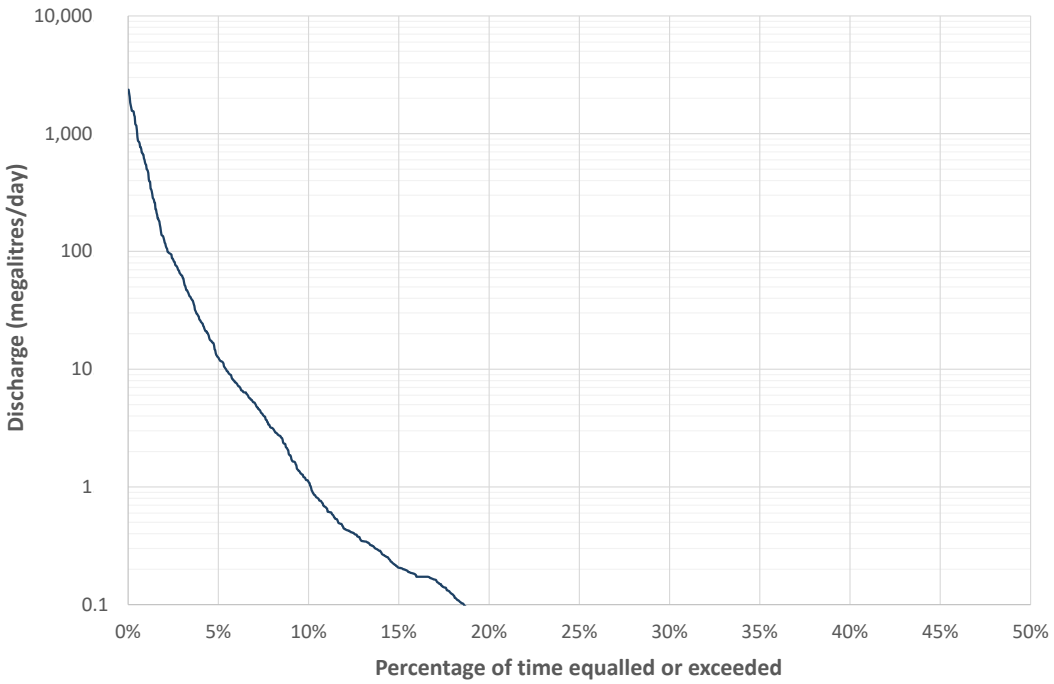


Figure 3.5 **Daily discharge exceedance curve (2016 – 2025) for Taurus Creek at Taurus Creek D/S (Station No. 330121)**

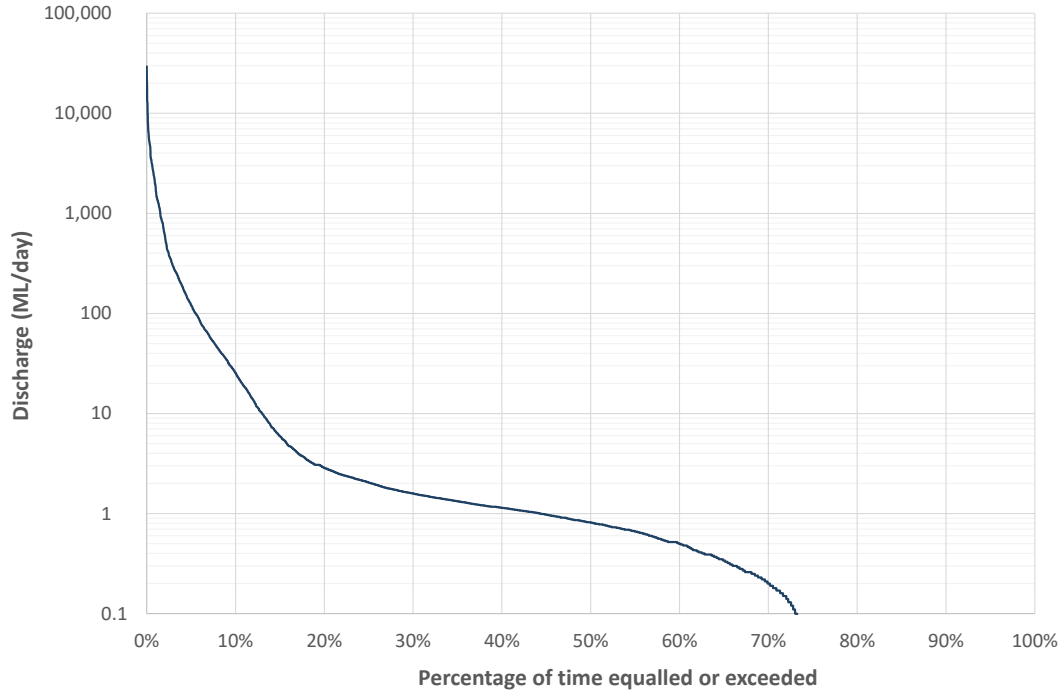


Figure 3.6 **Daily discharge exceedance curve (1971-2023) for Blackwater Creek at Curragh (Station No. 130108A and 130108B)**

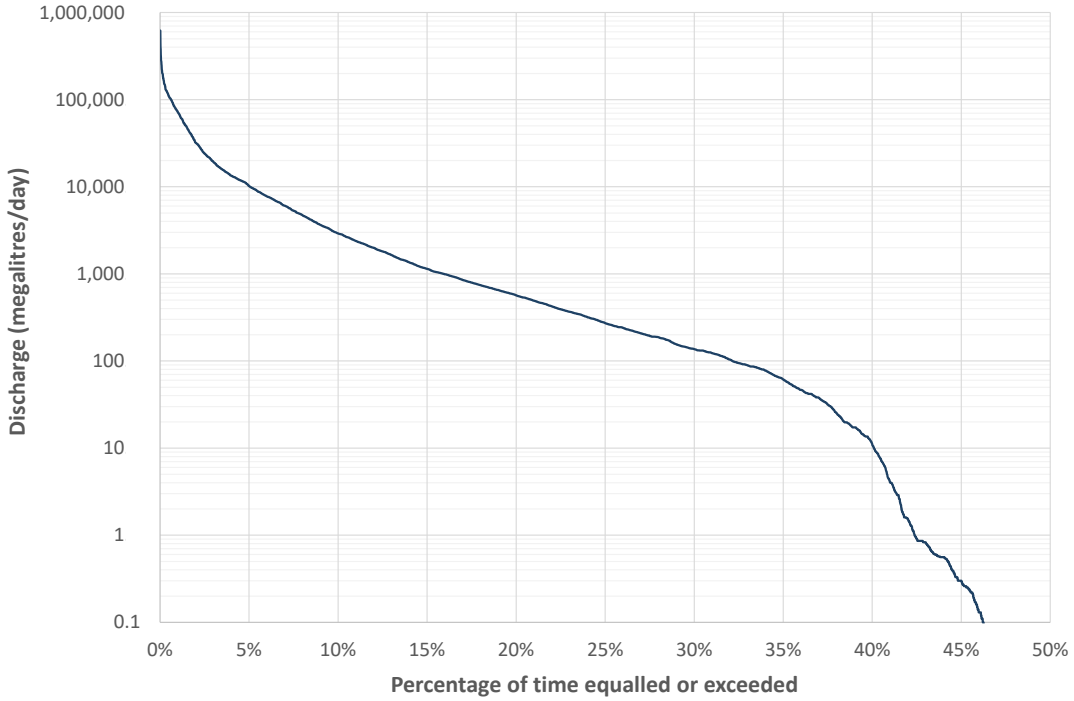


Figure 3.7 **Daily discharge exceedance curve (1971-2023) for the Mackenzie River at Bingegang (Station No. 130106A)**

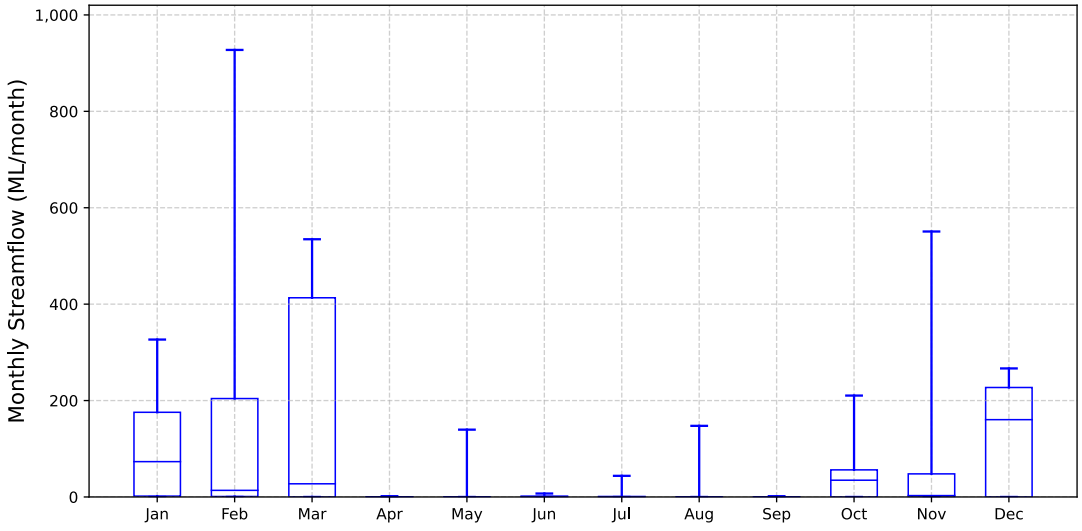


Figure 3.8 **Monthly box and whisker plot of flow volume at Two Mile Gully (Station No. 330124)**

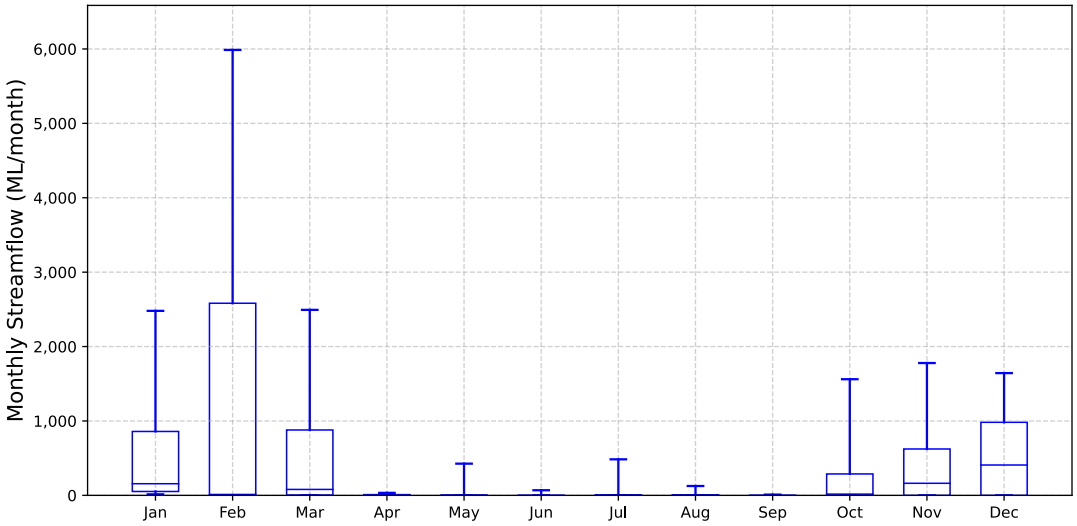


Figure 3.9 **Monthly box and whisker plot of flow volume for Taurus Creek at Taurus Creek D/S (Station No. 330121)**

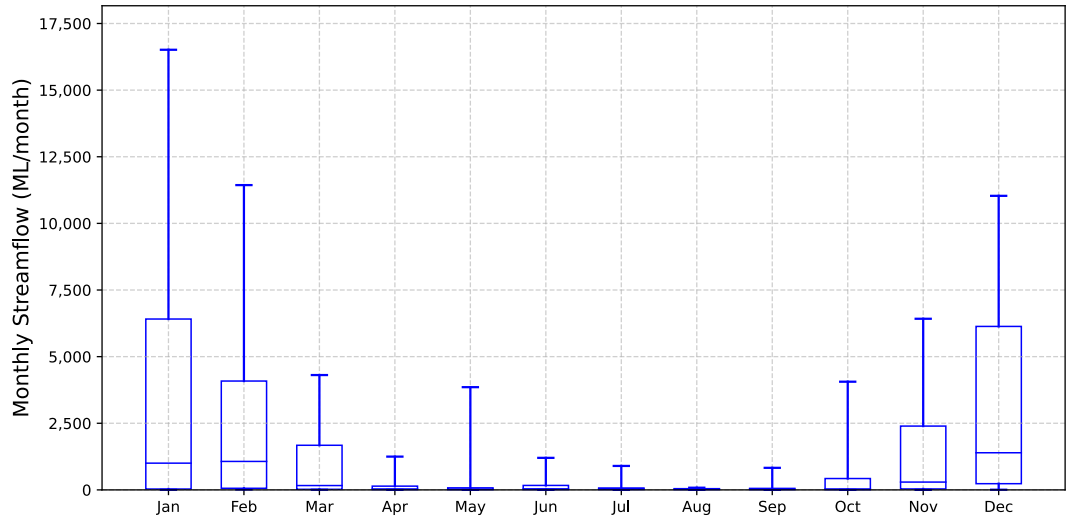


Figure 3.10 **Monthly box and whisker plot of flow volume for Blackwater Creek at Curragh (Station No. 130108A and 130108B)**

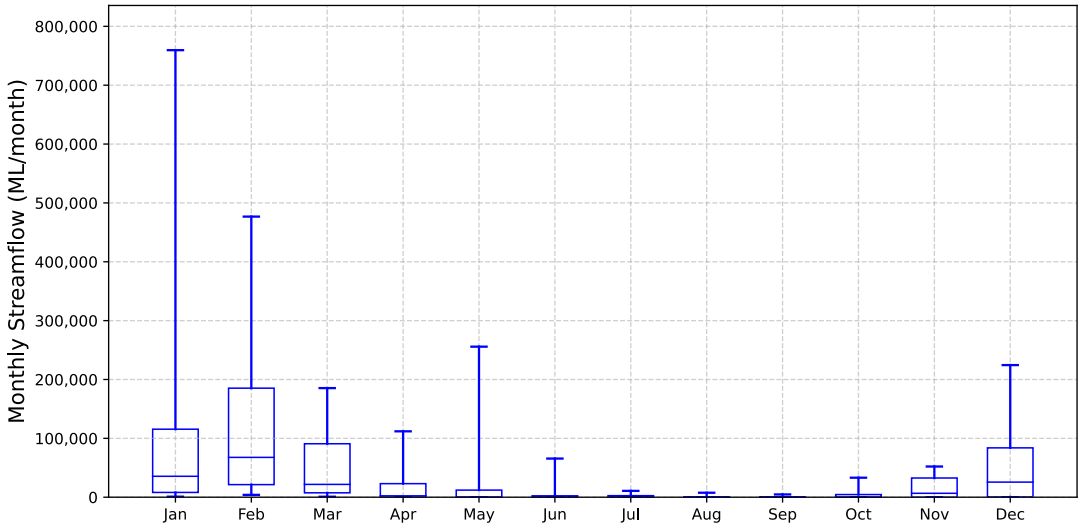


Figure 3.11 Monthly box and whisker plot of flow volume for the Mackenzie River at Bingegang (Station No. 130106A)

3.3 ENVIRONMENTAL VALUES OF RECEIVING WATERS

3.3.1 Overview of environmental values

The EPP Water, which is subordinate legislation to the EP Act, provides a framework for identifying EVs for a waterway and deciding WQOs to protect or enhance those EVs. EVs for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, contaminated runoff and releases and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

The waterways in the vicinity of the Project (Blackwater Creek, Taurus Creek, Two Mile Gully, Deep Creek and Emu Creek) are located within the Mackenzie southern tributaries region of the Mackenzie River Sub-basin (WQ1304).

The EVs selected for protection include:

- aquatic ecosystem protection (slightly to moderately disturbed ecosystems [DEHP, 2009]);
- farm use and stock watering;
- human consumption;
- primary, secondary and visual recreation;
- drinking water;
- industrial use; and
- cultural and spiritual values.

In summary, the key EVs for water that are to be protected are:

- physical, chemical and biological integrity of the watercourses within the catchment and their amenity as potential water sources for human use and to support aquatic ecosystems;
- the qualitive and quantitative integrity of local groundwater as a potential water source for agriculture or other suitable uses; and

- the integrity of raw water supplies and associated infrastructure in the region.

3.3.2 Water quality objectives

The indicators and WQGs relevant to the above EVs are listed in the Queensland Water Quality (QWQ) Guidelines (DEHP, 2009), ANZG (2018) guidelines and the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives (DEHP, 2013) guidelines. The conditions of waterways located in the vicinity of the Project are classified as 'moderately disturbed' ecosystems under DEHP (2013).

Table 3.2 compares the Default Guideline Values (DGVs) nominated in the QWQ Guidelines and the release and receiving waters contaminant trigger levels (trigger values) nominated in the EA (EPML00717813). Table 3.2 also shows the adopted WQOs, which are based on the EA trigger values or the DGVs.

WQOs and DGVs are displayed only for water quality parameters that are nominated in the EA (EPML00717813). The parameters for fine sediments and nutrients, including turbidity, total suspended solids (TSS), total nitrogen (TN) and total phosphorous (TP), have been included as they are the relevant water quality indicators for the GBR.

Table 3.2 Default Guideline Values, EA trigger levels and the adopted water quality objectives

Parameter	Unit	QWQ DGVs (WQ 1304)	EA Trigger Level	Adopted WQO
pH	-	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
EC	µS/cm	310 (baseflow) 210 (high flow)	2,000	2,000
Turbidity	NTU	50	-	50
TSS	mg/L	110	-	110
Sulphate	mg/L	10	To be correlated with EC	To be correlated with EC
Fluoride	µg/L	2,000	2,000	2,000
Nutrients				
Ammonia	µg/L	20	1,000	1,000
Nitrate	µg/L	-	7,600	7,600
TN	µg/L	775	-	775
TP	µg/L	160	-	160
Dissolved Metals				
Aluminium	µg/L	55	1,014	1,014
Cadmium	µg/L	0.2	6	6
Iron	µg/L	300	1,200	1,200
Zinc	µg/L	8	17	17
Boron	µg/L	370	370	370
Molybdenum	µg/L	34	34	34
Selenium	µg/L	5	10	10
Uranium	µg/L	1	1	1
Vanadium	µg/L	10	10	10
Hydrocarbons				
Petroleum hydrocarbons (C6-C9)	µg/L	-	20	20
Petroleum hydrocarbons (C10-C36)	µg/L	-	100	100

Note: µS/cm = microSiemens per centimetre, mg/L = milligrams per litre, EC = electrical conductivity, NTU = Nephelometric Turbidity Unit and µg/L = micrograms per litre.

3.4 SURFACE WATER QUALITY

3.4.1 Monitoring network and data sources

Figure 3.3 shows the locations of monitoring sites along the local creeks in the vicinity of the Project. Figure 3.2 shows the monitoring site in the Mackenzie River at Bingegang, which is located closest to the Project. Descriptions of these monitoring sites are given in Table 3.3.

Existing surface water quality have been characterised for parameters listed in Table F2 of the EA only, based on water quality monitoring results described in the following reports:

- Receiving Environment Monitoring Program (REMP) Annual Report, July 2021 – June 2022 (BMA, 2023);
- Fitzroy Regional Receiving Environment Monitoring Program (FRREMP) Annual Report, July 2022 – June 2023 (Riethmuller et al., 2023); and
- FRREMP Annual Report, July 2023 – June 2024 (Riethmuller et al., 2025).

It should be noted that after June 2022, Whitehaven Blackwater became a participant in the FRREMP and as such, FRREMP reports were not available for the period before June 2022.

Local monitoring stations at BWM that still contribute data to the FRREMP include the Sirius Creek D/S and the Rockland Creek upstream (U/S) gauges, which are not located within the Project area.

Table 3.3 Description of monitoring sites

Name	Reference	Easting (m) (GDA 94)	Northing (m) (GDA 94)	Description
Upstream monitoring sites				
Emu Creek U/S	EM US	689,049	7,367,899	Upstream end of the Emu Creek clean water drain.
Deep Creek U/S	DP US	681,340	7,371,998	Deep Creek upstream of the haul road.
Taurus Creek U/S	TR US	685,570	7,369,801	Taurus Creek upstream of the haul road.
Downstream monitoring sites				
Taurus Creek D/S	TR DS	691,367	7,381,013	Taurus Creek upstream of the railway.
Two Mile Gully	TM DS	692,093	7,372,042	Two Mile Gully downstream of Blackwater Rolleston Road.
Blackwater Creek U/S	BW US	694,201	7,379,648	Blackwater Creek approximately 2.7 km upstream of the Taurus Creek confluence.
Blackwater Creek D/S	BW DS	693,953	7,384,565	Blackwater Creek at Tantallon Road and downstream of the Taurus Creek confluence.
Mackenzie River at Bingegang	130106A / MAC106	708,267	7,446,600	Mackenzie River just upstream of the Bingegang Weir.

3.4.2 Water quality in local creeks

Table 3.4 shows the water quality monitoring results for the three local monitoring sites upstream of the Project. Table 3.4 also shows the adopted WQOs. The water quality monitoring results shown in Table 3.4 reflect existing site conditions excluding the Project. The data indicates that, upstream of BWM:

- Median (50th percentile) physiochemical properties such as EC, TSS, turbidity and fluoride in Taurus Creek and Deep Creek are below the WQOs. In Emu Creek, median EC is below the WQOs, but turbidity and TSS exceed the WQOs.
- For nutrients, median concentrations of ammonia and nitrate are below the WQOs. Based on two samples, TN and TP generally exceed the WQOs at Taurus Creek U/S. Based on one sample, TN exceeds the WQOs while TP is below the WQOs at Deep Creek U/S.
- Median concentrations of metalloids upstream of BWM are generally below the WQOs.

Table 3.5 shows the water quality monitoring results for the four local monitoring sites downstream of the Project. Table 3.5 also shows the adopted WQOs. The water quality monitoring results shown in Table 3.5 reflect existing site conditions excluding the Project. It should be noted that whilst the Blackwater U/S monitoring point is geographically located 'downstream' of BWM, this location is upstream of the Taurus Creek confluence and is therefore unaffected by mining activities. The data indicates that, downstream of BWM:

- For physiochemical properties, median EC and fluoride are below the WQOs. Median TSS and turbidity generally exceed the WQOs and those observed from upstream monitoring sites.
- For nutrients, median concentrations of ammonia and nitrate at Taurus Creek, Two Mile Gully and Blackwater Creek are below the WQOs. Based on one sample, TN and TP in Taurus Creek, Two Mile Gully and Blackwater Creek D/S generally exceed the WQOs and those observed from upstream monitoring sites.
- Median to 80th percentile concentrations of metalloids downstream of BWM are generally below the WQOs.
- Exceedances compared to the WQOs and/or upstream monitoring sites may be due to existing mining activities (excluding the Project) but is also likely due to the larger catchments contributing runoff to these downstream sites.

3.4.3 Regional water quality

Table 3.6 shows the water quality monitoring results for the Mackenzie River at Bingegang (130106A/MAC106). Table 3.6 also shows the local creek WQOs and the Sub-basin WQOs for the Mackenzie River Sub-basin (WQ 1304) (DEHP, 2013). The water quality monitoring results shown in Table 3.6 reflect existing site conditions excluding the Project. The data indicates that, in the Mackenzie River:

- Median physiochemical parameters including EC, turbidity and TSS are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).
- Median nutrient concentrations including ammonia, nitrate, TP and TN are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).
- Median metalloid concentrations are below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).

Physicochemical properties, nutrient concentrations and metalloid concentrations in the Mackenzie River are significantly lower than those recorded at the local monitoring sites closer to BWM. This is

due to significantly higher flows, and hence a much higher level of dilution in the Mackenzie River compared to the local creeks in the vicinity of BWM.

Table 3.4 Local waterways surface water quality monitoring results from monitoring sites upstream (west) of the BWM mine workings

Parameter	Unit	Adopted WQO	Taurus Creek U/S				Deep Creek U/S				Emu Creek U/S			
			Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	39	7.37	7.78	7.99	17	6.95	7.83	7.99	3	7.65	7.88	7.89
EC	µS/cm	2,000	39	154.4	306	389.4	17	149.4	176.5	283.8	3	121.8	132	151.2
Turbidity	NTU	50	37	112	200	364	14	95.2	240	424	5	418	863	1.968
TSS	mg/L	110	38	37.8	75	311	13	28.8	75	181.2	6	290	471	950
Sulphate	mg/L	See note [a]	41	2	6	26	14	2	3	6.8	6	0.5	3	132
Fluoride	µg/L	2,000	33	100	200	300	14	50	100	200	6	100	200	300
Nutrients														
Ammonia	µg/L	1,000	30	10	30	50	11	20	60	90	6	20	35	40
Nitrate	µg/L	7,600	39	28	80	288	14	8	40	144	6	70	130	330
TN	µg/L	775	2	1,380 [b]	-	1,620 [b]	1	-	1.700 [c]	-	-	-	-	-
TP	µg/L	160	2	116 [b]	-	224 [b]	1	-	130 [c]	-	-	-	-	-
Dissolved Metals														
Aluminium	µg/L	1,014	34	102	365	1,100	11	90	340	1.050	6	130	200	290
Cadmium	µg/L	5.6	33	0.05	0.05	0.05	9	0.05	0.05	0.05	6	0.05	0.08	0.25
Iron	µg/L	1,200	34	104	345	748	11	140	320	490	6	150	250	280
Zinc	µg/L	17	34	2.5	2.5	7.4	11	2.5	2.5	2.5	6	2.5	4.75	12.5
Boron	µg/L	370	30	25	60	74	11	25	25	25	6	25	50	60
Molybdenum	µg/L	34	34	0.5	0.5	2	11	0.5	0.5	2	6	0.5	0.5	2.5
Selenium	µg/L	10	30	<5 [d]	<5 [d]	<5 [d]	11	<5 [d]	<5 [d]	<5 [d]	6	<5 [d]	<5 [d]	25
Uranium	µg/L	1	29	<0.5 [d]	<0.5 [d]	<0.5 [d]	11	<0.5 [d]	<0.5 [d]	<0.5 [d]	6	<0.5 [d]	<0.5 [d]	<0.5 [d]
Vanadium	µg/L	10	29	<5 [d]	<5 [d]	<5 [d]	10	<5 [d]	<5 [d]	<5 [d]	6	<5 [d]	<5 [d]	25

[a] – To be correlated with EC.

[b] – Only two samples were analysed. The value shown in the 20th percentile (20%ile) and 80th percentile (80%ile) columns are the minimum and maximum values, respectively.

[c] – Only one sample was analysed, with the value shown in the median column.

[d] – Below the limit of detection.

Table 3.5 Local waterways surface water quality monitoring results from monitoring sites downstream (east) of the BWM mine workings

Parameter	Unit	Adopted WQO	Blackwater Creek U/S				Blackwater Creek D/S				Taurus Creek D/S				Two Mile Gully			
			Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile	Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	13	7.12	7.82	8.04	88	7.1	7.7	7.96	16	6.88	7.3	7.7	18	6.75	7.24	7.82
EC	µS/cm	2,000	13	113.92	144	174.44	88	168.88	224.5	373.8	16	151	185.65	265	18	128.4	164	212.6
Turbidity	NTU	50	7	142	250	300	61	190	450	1,000	8	254	532	2,172	15	222	423	860
TSS	mg/L	110	12	65.2	142	696	72	136.6	269.5	1,041.6	13	164.8	462	1,400	21	236	444	1,280
Sulphate	mg/L	See note [a]	12	0.6	2	2.8	85	4	11	34.4	15	0.5	6	14.2	24	2	4.5	23.6
Fluoride	µg/L	2,000	12	50	100	200	84	100	200	300	14	100	200	340	22	50	100	300
Nutrients																		
Ammonia	µg/L	1,000	11	20	40	40	67	20	40	60	11	20	50	80	17	8	40	50
Nitrate	µg/L	7,600	12	12	40	68	80	60	130	322	13	40	130	230	22	52	95	210
TN	µg/L	775	1	-	100 [b]	-	3	1,360	2,200	4,240	1	-	4,400 [b]	-	1	-	600 [b]	-
TP	µg/L	160	1	-	20 [b]	-	3	312	660	1,332	1	-	1,300 [b]	-	1	-	120 [b]	-
Dissolved Metals																		
Aluminium	µg/L	1,014	11	120	180	800	68	48	150	418	11	120	180	320	18	84	165	296
Cadmium	µg/L	5.6	11	0.05	0.05	0.05	60	0.05	0.05	0.05	9	0.05	0.05	0.05	17	0.05	0.05	0.05
Iron	µg/L	1,200	11	140	240	510	68	94	170	378	11	120	210	300	18	104	175	354
Zinc	µg/L	17	11	2.5	2.5	2.5	68	2.5	2.5	2.5	11	2.5	2.5	2.5	18	2.5	2.5	4.6
Boron	µg/L	370	11	25	25	25	68	25	25	60	11	25	25	25	18	25	25	52
Molybdenum	µg/L	34	11	0.5	0.5	0.5	68	0.5	0.5	1	11	0.5	0.5	0.5	18	0.5	0.5	0.5
Selenium	µg/L	10	11	<5 [c]	<5 [c]	<5 [c]	68	<5 [c]	<5 [c]	<5 [c]	11	<5 [c]	<5 [c]	<5 [c]	19	<5 [c]	<5 [c]	<5 [c]
Uranium	µg/L	1	11	<0.5 [c]	<0.5 [c]	<0.5 [c]	68	<0.5 [c]	<0.5 [c]	<0.5 [c]	11	<0.5 [c]	<0.5 [c]	<0.5 [c]	18	<0.5 [c]	<0.5 [c]	<0.5 [c]
Vanadium	µg/L	10	11	<5 [c]	<5 [c]	<5 [c]	66	<5 [c]	<5 [c]	<5 [c]	11	<5 [c]	<5 [c]	<5 [c]	18	<5 [c]	<5 [c]	<5 [c]

[a] – To be correlated with EC.

[b] – Only one sample was analysed, with the value shown in the median column.

[c] – Below the limit of detection.

Table 3.6 Regional surface water quality sampling results

Parameter	Unit	Adopted WQO	Mackenzie WQ1304 WQO	Mackenzie River at Bingegang (MAC106)			
				Total Samples	20%ile	Median	80%ile
pH	-	6.5 - 8.5	6.5 - 8.5	6	7.3	7.5	7.7
EC	µS/cm	2,000	310	6	163.3	364.7	386.9
Turbidity	NTU	50	50	6	25.7	47.7	208.4
TSS	mg/L	110	110	6	18	21.5	38
Sulphate	mg/L	To be correlated with EC	10	6	2	9	9
Fluoride	µg/L	2,000	-	-	-	-	-
Nutrients							
Ammonia	µg/L	1,000	20	6	5	17.5	30
Nitrate	µg/L	7,600	-	6	10	17.5	170
TN	µg/L	775	775	6	500	750	1200
TP	µg/L	160	160	6	60	125	400
Dissolved Metals							
Aluminium	µg/L	1,014	55	6	10	5	5
Cadmium	µg/L	6	0.2	6	0.05	0.05	0
Iron	µg/L	1,200	300	6	30	25	25
Zinc	µg/L	17	8	6	3	2.5	2.5
Boron	µg/L	370	370	6	25	37.5	60
Molybdenum	µg/L	34	34	6	0.5	0.5	1
Selenium	µg/L	10	5	6	5	5	5
Uranium	µg/L	1	0.5	6	0.5	0.5	1
Vanadium	µg/L	10	6	6	5	5	5

3.5 CLIMATE

3.5.1 Overview

BWM is in a subtropical climate zone, characterised by hot, humid summers and moderately dry winters. Average minimum daily temperatures range from 11.4 degrees Celsius (°C) in July to 22.0°C in January, and average maximum daily temperatures range from 20.7°C in July to 43.7°C in January.

3.5.2 Rainfall

Climate data for the site (latitude 23.74°S, longitude 148.83°E) (easting 686,524, northing 7,373,359 in GDA94) was sourced from the Department of Science, Information Technology and Innovation's (DSITI's) SILO Data Drill (SILO). This dataset provides continuous, gap-free daily records interpolated from the Bureau of Meteorology's (Bureau's) observations.

The historic average annual rainfall from 1957 to 2024 is 536.5 millimetres (mm) (see Figure 3.12). The minimum recorded rainfall during this period was 279 mm in 2019, while the maximum reached 1,403 mm in 2010. The distribution of monthly SILO rainfall is shown in Figure 3.12.

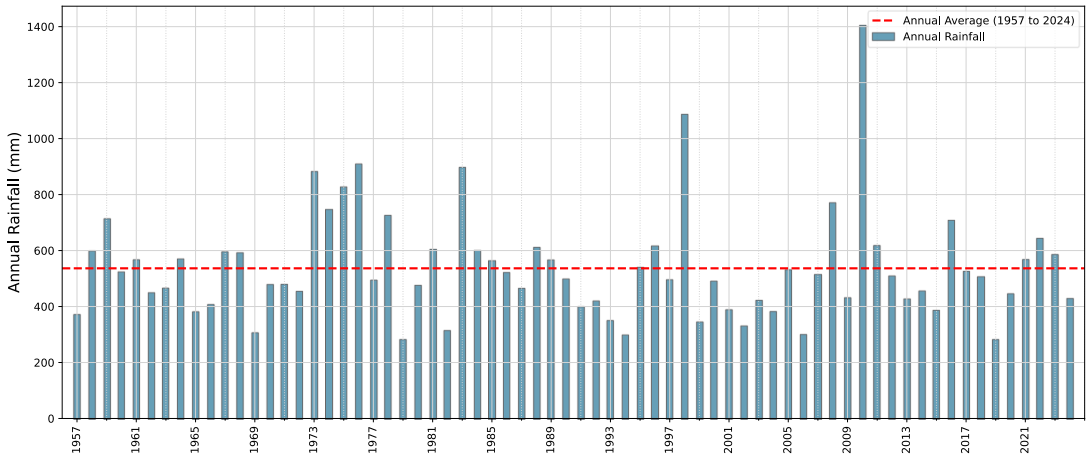


Figure 3.12 Annual rainfall (1957-2024)

Figure 3.13 shows the distribution of monthly rainfalls at the site based on SILO data between 1957 and 2024. Rainfalls predominantly fall during the warmer months from November to March with significantly lower rainfalls recorded during the cooler months.

3.5.3 Evaporation

Figure 3.13 shows the median monthly Class A pan evaporation and rainfall based on SILO data between 1957 and 2024. Evaporation data for the site has been compiled using a combination of synthetic estimates before 1970 and Class A pan evaporation measurements from 1970 onwards. The SILO evaporation estimates were derived using climatological modelling techniques to fill gaps in historical records. Of note:

- Average Annual Pan Evaporation: 2,034 mm.
- Evaporation peaks between October and January, aligning with the warmer months.
- Median monthly evaporation exceeds median monthly rainfall for all months.

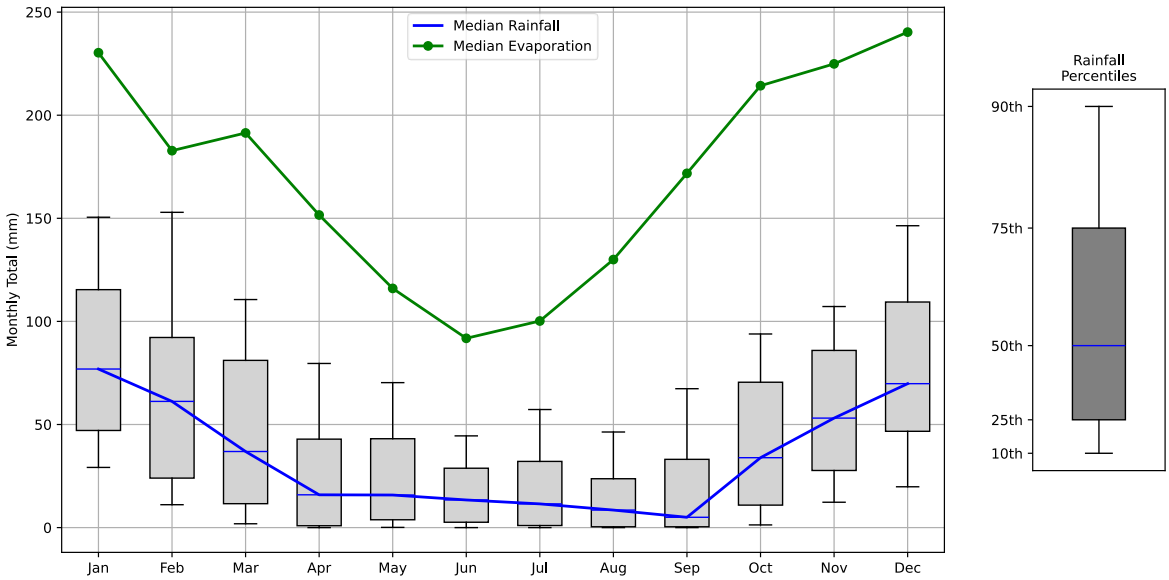


Figure 3.13 Monthly SILO rainfall and evaporation distributions summary

3.5.4 Comparative climate data

Table 3.7 shows long term rainfall, evaporation and temperatures at three nearby Bureau-owned stations and at two on-site weather stations owned by Whitehaven Blackwater, where data is available. The data shows that:

- Silo rainfall and evaporation monthly data is consistent with recorded data at the nearby stations.
- Average annual rainfalls at the two site weather stations are consistent with those recorded at the Bureau's Blackwater Airport station (located adjacent to BWM), but generally lower than those recorded at the Bureau's Springsure and Comet Post Office stations, which are located further away from BWM.

Table 3.7 Rainfall and evaporation monthly averages, minimum and maximum monthly temperature

	Mean monthly rainfall at Bureau rainfall stations (mm)			SILO Data Drill mean monthly rainfall	Mean monthly rainfall at on-site rainfall stations (mm)		Mean Monthly Evaporation (mm)		Average Daily Temperature (°C)	
	Blackwater Airport (35134)	Springsure Creek Junction AL (35276)	Comet Post Office (35021)		Northern Weather Station (330122)	Central Industrial Area Weather Station (330107)	Springsure Comet St (35065)	SILO Data Drill	Blackwater Airport (35134)	
									Min.	Max.
Distance and direction from BWM	1 km	38 km	28 km	-	-	-	85 km	-	1 km	
Period of record	2013 - 2025	2010 - 2025	1895 – 2025	1957 - 2025	2016 - 2025	2016 - 2025	1957 - 2025	1957 - 2025	2013 - 2025	
January	92.3	90.4	99.3	85.5	83.0	81.4	235.5	229.1	21.9	34.7
February	73.1	69.0	88.8	71.8	75.9	82.1	188.9	185.3	21.7	34.3
March	65.6	101.0	59.3	50.4	75.3	72.8	191.0	188.8	21.0	33.3
April	19.7	25.9	32.3	29.3	17.2	12.6	146.3	148.1	16.9	30.3
May	21.0	31.3	29.1	30.6	25.9	29.2	109.8	114.1	13.4	26.8
June	19.0	21.9	27.6	21.1	24.1	23.4	84.5	90.0	10.2	24.2
July	29.9	29.9	25.8	21.7	38.3	31.8	93.4	98.7	9.3	24.0
August	18.4	14.1	17.2	17.5	22.2	16.0	126.5	129.5	10.0	26.2
September	17.5	25.0	21.3	21.8	17.0	16.9	170.8	170.9	13.4	29.5
October	50.3	53.8	36.6	43.6	68.5	58.2	216.0	213.1	17.2	32.4
November	52.4	60.5	54.8	60.4	69.1	72.7	228.8	224.6	19.2	33.8
December	71.3	88.1	81.8	84.2	62.0	67.7	246.4	240.1	21.0	34.8
Annual Average	**534.5**	**572.1**	**578.9**	**536.5**	**529.4**	**516.8**	**2,039.6**	**2,033.8**	-	-

4 EXISTING SITE CHARACTERISTICS

4.1 OVERVIEW

This section describes the objectives and principles of the SWMS for the existing operations at BWM, including a description of the infrastructure and systems that have been designed to achieve the objectives and principles.

4.2 EXISTING SITE OPERATING ACTIVITIES

HydroBalance (2026) describes the existing SWMS in Appendix B. Figure 4.1 to Figure 4.3 show the locations of the existing water storages at BWM. Table 4.1 shows a summary of the existing water storages at BWM including the Operating Capacity (OC) for each of the storages. The OC represents the maximum allowable volume that can be stored in the dam/pit (taking into account factors such as base of weathering). Figure 4.4 to Figure 4.6 shows the existing SWMS schematic.

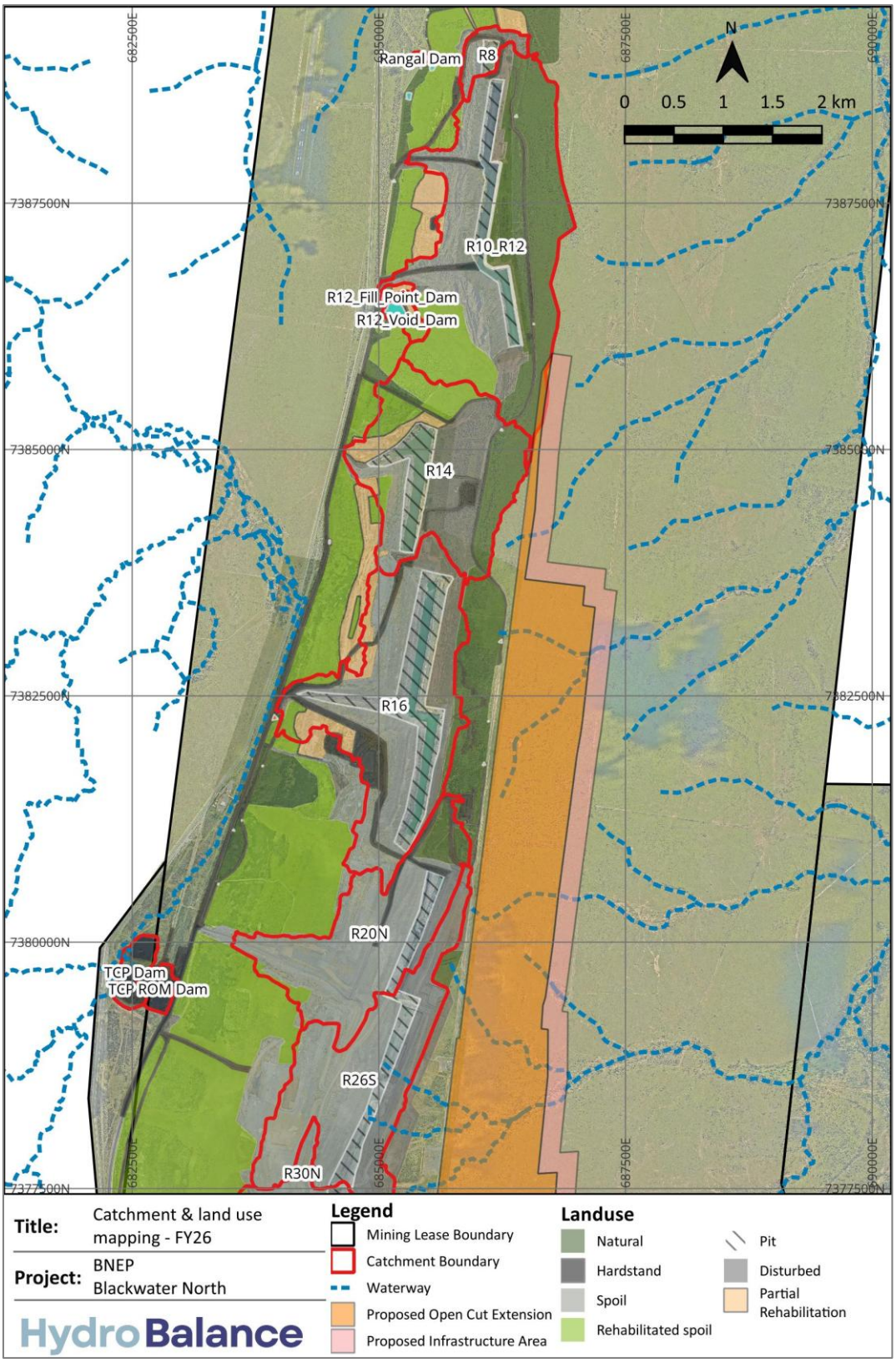


Figure 4.1 **Existing water storages, catchments and land use characteristics – Blackwater North (HydroBalance, 2026)**

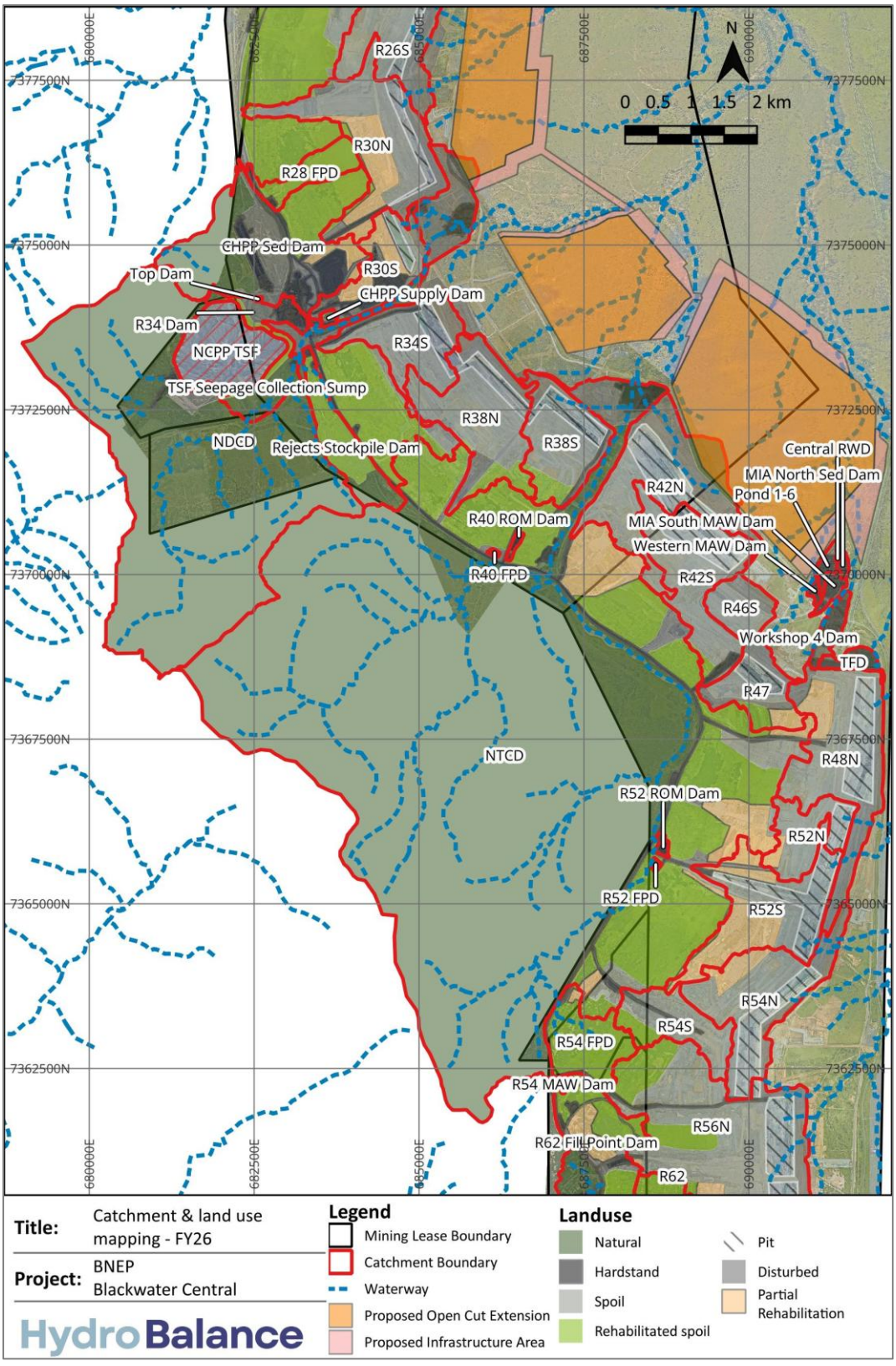


Figure 4.2 **Existing water storages, catchments and land use characteristics – Blackwater Central (HydroBalance, 2026)**

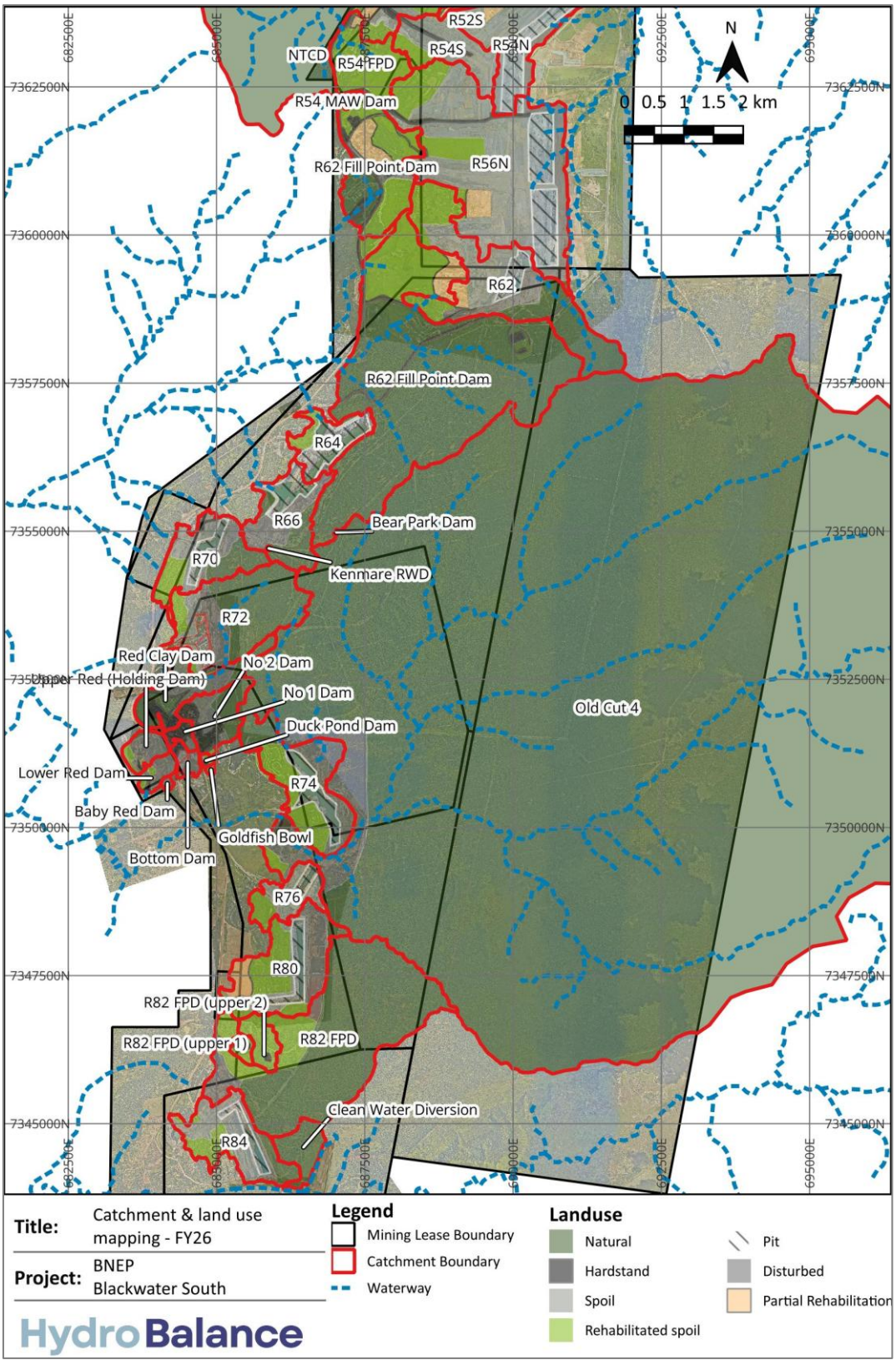


Figure 4.3 **Existing water storages, catchments and land use characteristics – Blackwater South (HydroBalance, 2026)**

Table 4.1 Mine water storage inventory and capacity (HydroBalance, 2026)

Storage name	Operating Capacity (ML)	Overflows to
Dam storages		
Rangal Dam	5	Offsite
TCP Dam	68	Offsite
TCP ROM Dam	15.5	Offsite
Top Dam	100	Offsite
NCHPP WSD	48.7	Offsite
Workshop 4 Dam	13.4	Offsite
South MAW Dam	51.3	Offsite
Sed Dam	39.3	Deep Creek
Rejects Sump	16	Offsite
Tailings Sump	41.3	Offsite
Central RWD	5	Offsite
Kenmare RWD	22	Offsite
Red Claw Dam	113	Offsite
Bear Park Dam	22	Offsite
Holding Dam	113	Red Dam
Red Dam	62	Sirius Creek
Baby Red Dam	0.5	Sirius Creek
No 1 Dam	7.2	Bottom Dam
No 2 Dam	156	Duck Pond
Bottom Dam TSF	0.45	Duck Pond
Duck Pond	61.6	Goldfish Bowl
Goldfish Bowl	15	Sirius Creek
TFD	119	Offsite
R12 Void Dam	242	Offsite
R28 FPD	7.5	Offsite
Old R40 FPD	-	NTCD
R40 FPD	13.1	NTCD
R40 ROM Dam	12.3	NTCD
R48 FPD	29.8	Offsite
R52 FPD	14.9	Offsite
R54 FPD	12	Offsite
R56 FPD	157.2	Speculation Creek
R62 FPD	15.3	Speculation Creek

Storage name	Operating Capacity (ML)	Overflows to
R82 FPD	110.3	Rockland Creek
On-stream storages		
NDCD	268.9	Offsite
NTCD	472	Offsite
Old Cut 4	447.5	Sirius Creek
Rockland Basin	19,200	Rockland Creek
Pit storages		
R14 WSP	4,890	R16
R16	11,999	R20
R64 WSP	6,405	Offsite
R70 WSP	2,154	Offsite
R76 WSP	2,754	Offsite
R80 WSP	7,542	Offsite
R82 WSP	7,563	Rockland Creek
Tailings dams		
R10/R12 WSP (Bonnie Doon)	5,527	Offsite
North CHPP Tailings Dam	738	Offsite
R72 TSD	456	Offsite
R74 TSD	4,225 (FSV) 3,733 (MOV)	Offsite
Pits		
R20/R26	30,644	Offsite
R30N	5,815	R20
R30S	8,983	R30N
R34	2,773	R38
R38	13,264	Offsite
R42	2,000	Offsite
R46N	1,500	R42
R46S	1,500	R46N
R47	1,500	R46S
R48	2,000	Offsite
R52N	569	Offsite
R52S	2,000	Offsite
R54	5,217	Offsite
R56	5,217	Offsite

Storage name	Operating Capacity (ML)	Overflows to
R62	2,000	R62 FPD

Source: HydroBalance (2026)

Note: NCHPP = North CHPP, WSD = water storage dam, MAW = mine-affected water, RWD = raw water dam, TSF = tailings storage facility, TFD = Tannyfoil dam, FPD = fill point dam, NDCD = New Deep Creek Dam, NTCD = New Taurus Creek Dam, WSP = water storage pit, TSD = tailings storage dam, ML = megalitres.

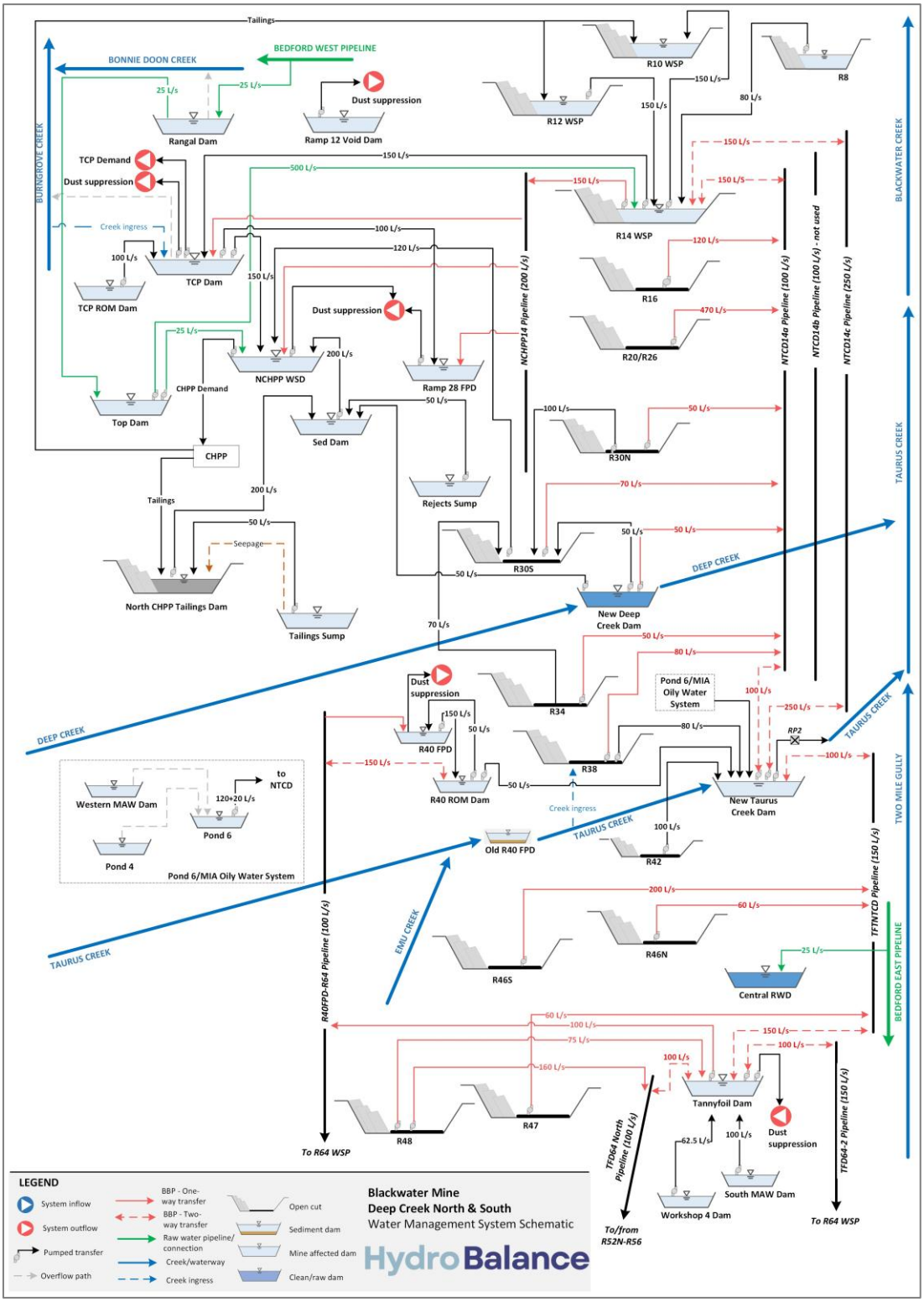


Figure 4.4 Existing SWMS schematic – Deep Creek North and South (HydroBalance, 2026)

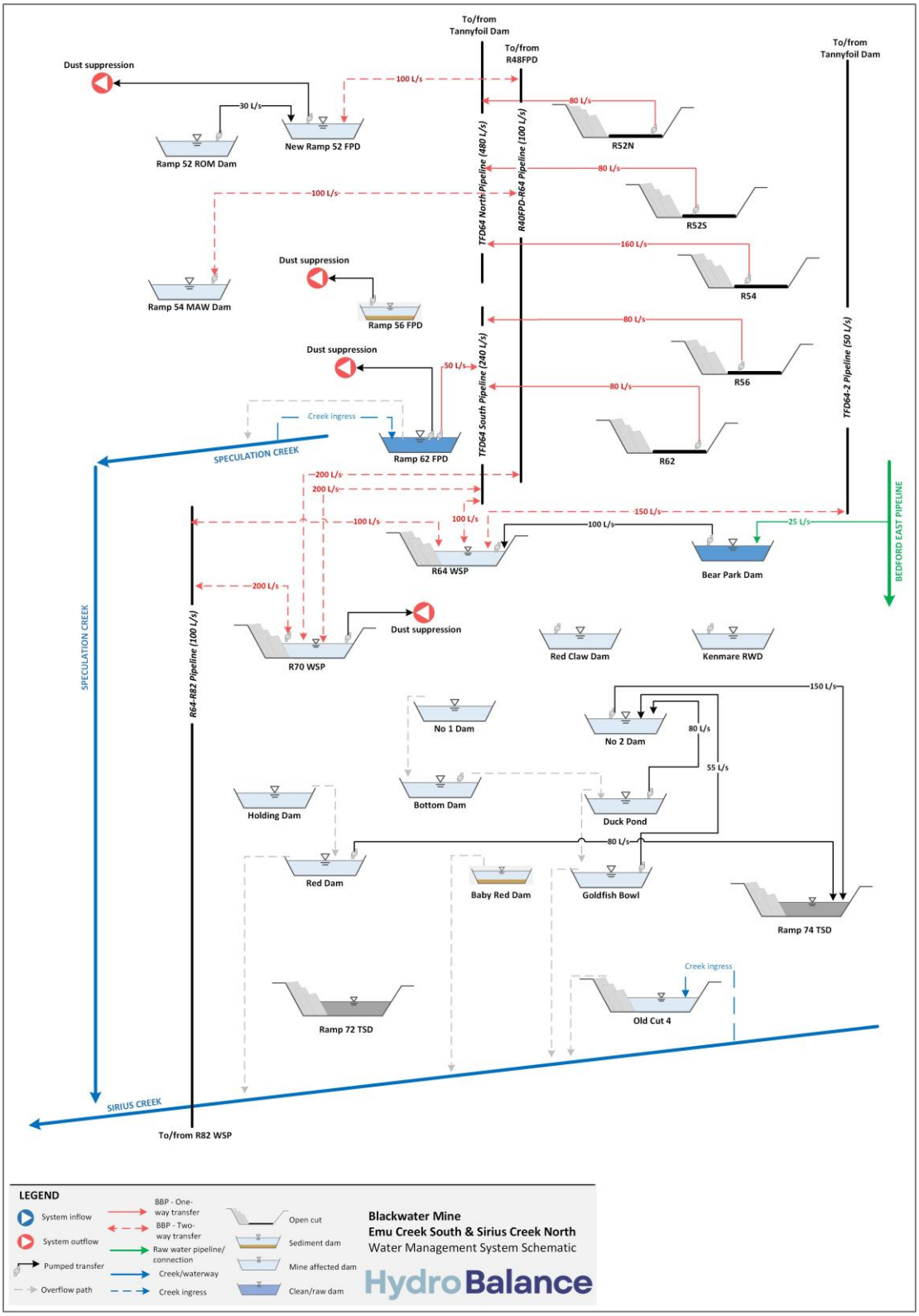


Figure 4.5 Existing SWMS schematic – Emu Creek and Sirius Creek North (HydroBalance, 2026)

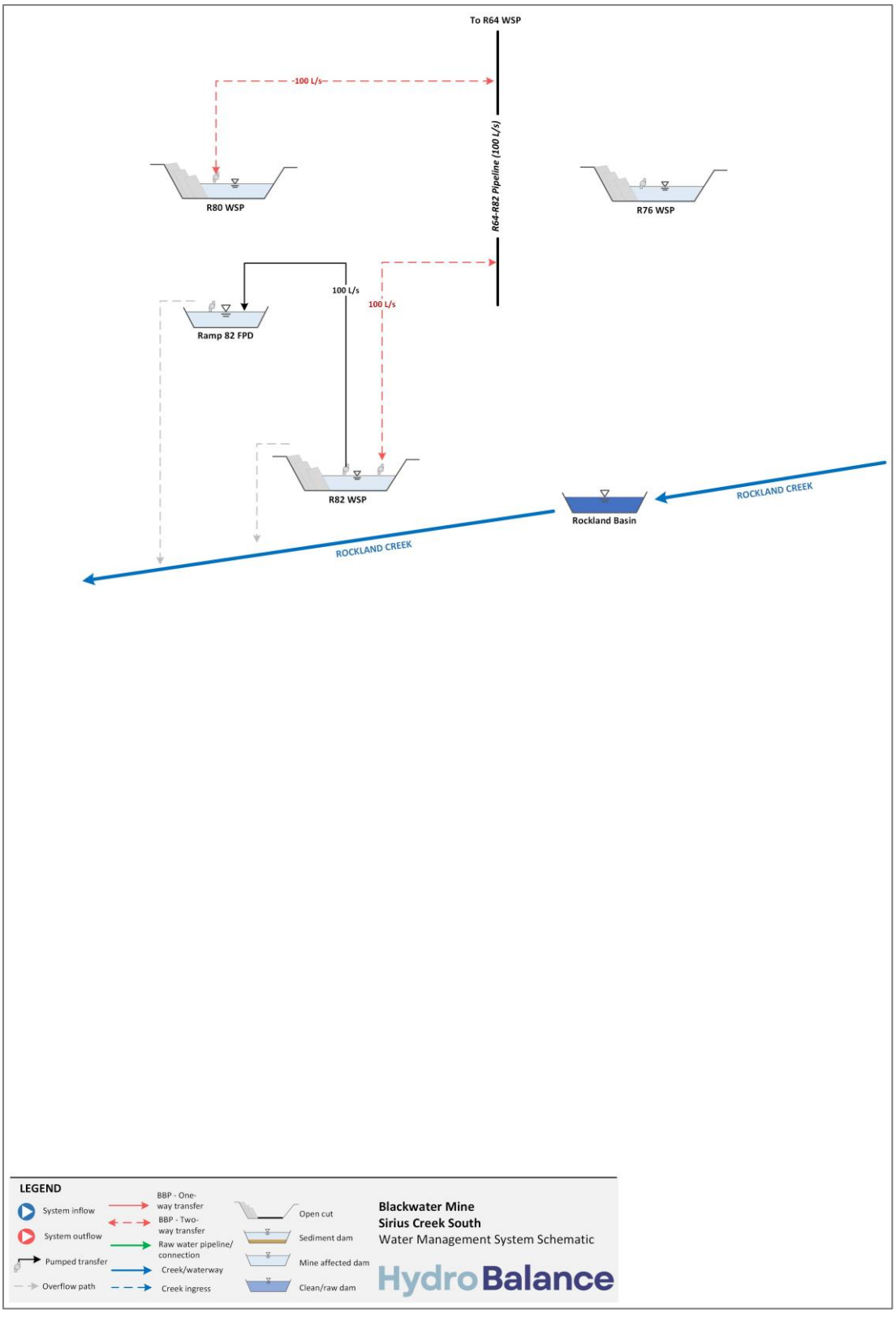


Figure 4.6 Existing SWMS schematic – Sirius Creek South (HydroBalance, 2026)

4.3 TYPES OF WATER GENERATED ON SITE

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff in downstream receiving waters through increased sediment loads. In addition, runoff from active mining areas (including coal stockpiles, etc.) may have increased concentrations of salts and other pollutants when compared to natural runoff. The existing and proposed strategy for the management of surface water at the Project is based on the separation of water from different sources based on anticipated water quality.

Potential sources of contamination include runoff from disturbed and rehabilitated land, release of recycled waters from sewage treatment plants and industrial areas, and release of waters from pits, water storages and dams. Contaminants may include suspended solids, dissolved solids (e.g. sodium, chloride, sulphate), altered pH and metals (Whitehaven, 2025).

Definitions of the types of water generated within the Project are shown in Table 4.2.

Table 4.2 Types of water generated on site

Water type	Definition
MAW	In accordance with the DESI's *Model Mining Conditions (*2024b*)*, MAW means the following types of water: *i) pit water, tailings dam water, processing plant water* *ii) water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the Environmental Protection Regulation 2008 if it had not formed part of the mining activity* *iii) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an Erosion and Sediment Control Plan to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water* *iv) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated* *v) groundwater from the mine dewatering activities* vi) *a mix of mine-affected water (under any of paragraphs i) - v)) and other water.*
Sediment water	Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. EC, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
Clean catchment water	Surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
Raw water	Untreated water, generally from an external water supply, particularly the Burdekin pipeline.

Water type	Definition
Contaminated water	Contaminated water includes runoff from areas containing explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods, as well as flammable and combustible liquids (including petroleum products).
Potable water	Treated water suitable for human consumption.

4.4 SOURCES OF CONTAMINATION

The following are the primary sources of contamination at BWM, along with their potential contaminants and mechanisms (Whitehaven, 2025):

- Spoil areas - large areas of exposed spoil can be a substantial source of salt and sediment during runoff events and also potential seepage.
- Open pits - a large quantity of saline alkaline water collects in operational pits during intense wet periods. This water must be pumped to other storages to enable mining operations to continue.
- Haul roads and Industrial areas - very high runoff coefficient associated with the heavily compacted road surface can exacerbate sediment loads.
- Tailings Dams and Disposal Areas - dams with insufficient freeboard or structural faults can allow coal wastes to escape an impoundment.
- Topsoil stripped areas - subsoils in the area are often saline, hence topsoil stripped areas can generate saline surface runoff as well as high turbidity colloidal suspensions.
- MAW Management System (storage dams, piping and drainage infrastructure) - collection and transfer of MAW from other contaminant sources, providing risk of release to environment via dam spillways and piping infrastructure.
- Coal stockpiles - storm events can generate saline runoff and coal fines and leachate from stockpiles of coal.
- Reject stockpiles - storm events can generate saline runoff and coal fines and leachate from reject areas.
- Rejects disposal areas - drainage from these areas has potential for acid leachate generation.
- Rehabilitation areas - newly developed rehabilitation – e.g. top-soiled and seeded carries high erosion risk until vegetation cover is satisfactory. Potential for significant sediment yield as well as some saline water.

4.5 STORED WATER QUALITY

Whitehaven Blackwater have been recording pH and EC on a subdaily basis (telemetry) at key storages within BWM. Figure 4.7 and Figure 4.8 are box and whisker plots (box plots), which illustrate a statistical summary of pH and EC, respectively, at the following six BWM storages, for the period between January 2016 and April 2025:

- TFD – location of licensed discharge point RP4;
- NTCD – location of licensed discharge point RP2;
- TCP Dam;
- Rejects Drainage Sump; and
- Ramp 34 Storage Dam.

The box plots represent the following:

- the upper and lower 'whiskers' represent the 5th and 95th percentile range of values;
- the upper and lower extents of the green box represent the 25th and 75th percentile of values; and
- the black line in the green box represents the median (50th percentile value).

The monitoring results show that:

- Stored water quality in all six storages is generally alkaline, with median pH ranging between 8.5 and 9.5, which is above the upper threshold of the adopted WQOs.
- Median EC are above the adopted WQOs at all storages except for the Ramp 34 Storage Dam. However, EC at all six storages has mostly remained below 10,000 µS/cm, which is EA's upper limit for controlled releases (discussed in Section 5.6.7).

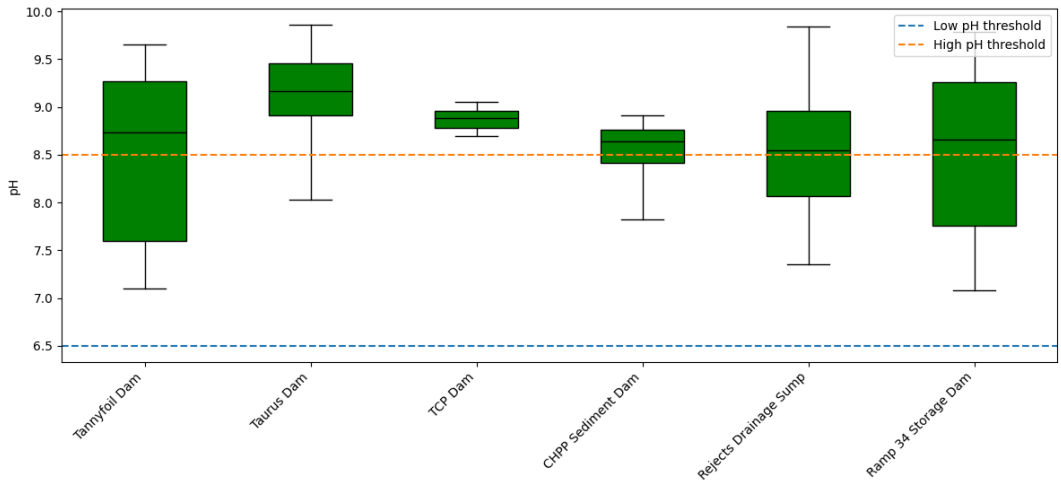


Figure 4.7 Monitoring results for pH at existing BWM storages, 2016 to 2025

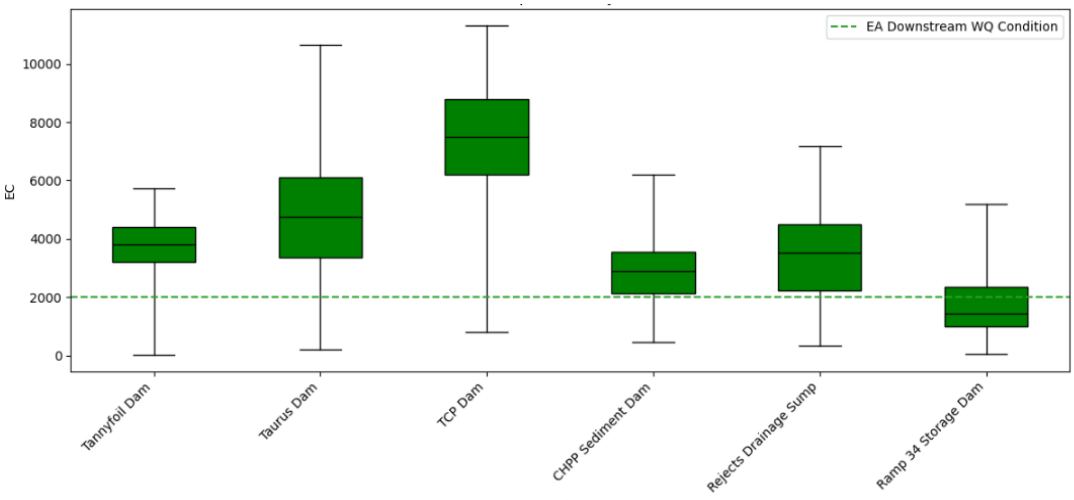


Figure 4.8 Monitoring results for EC (µS/cm) at existing BWM storages, 2016 to 2025

5 SURFACE WATER MANAGEMENT SYSTEM

5.1 OVERVIEW

The SWMS at BWM is designed to manage water resources efficiently while reducing environmental impacts. The system is designed to handle the diverse water sources generated by mining activities, including MAW, tailings runoff, sediment-laden water, and clean catchment water.

The SWMS consists of a network of storage facilities, pipelines, and controlled-release mechanisms. These components work together to ensure compliance with environmental regulations, maintain operational efficiency, and protect local waterways. The SWMS consist of:

- Storage Facilities: The SWMS includes a variety of dams and pits with specific operating capacities. These include dam storages, on-stream storages, tailings dams as well as active and inactive pit storages (refer to Table 4.1). There are no additional storages proposed as part of the Project.
- Pipeline Network: The site has 10 backbone pipelines connecting water storage facilities across the mine (refer to Table 6.2 in Appendix B). There are no additional trunk pipelines proposed as part of the Project.
- Controlled Releases: Controlled releases are permitted under specific conditions. Releases are regulated to ensure minimal impact on downstream water quality. There are no proposed changes to the currently approved controlled release strategy as part of the Project.
- Erosion and Sediment Control: The SWMS includes sediment basins to capture sediment laden runoff from the disturbed areas and provide an area where settlement of suspended sediment in runoff can occur (Whitehaven, 2024). There are no additional sediment basins proposed as part of the Project.

5.2 SURFACE WATER MANAGEMENT DOCUMENTATION

Surface water at BWM is managed in accordance with key guiding documents, including:

- BWM WMP (Whitehaven, 2023): This plan is developed in compliance with the EA EPML00717813 and serves as the primary framework for site water management. It provides comprehensive guidance on operational principles, design considerations, and management strategies to ensure effective and environmentally responsible water handling.
- Erosion and Sediment Control Plan (ESCP) (Whitehaven, 2024): This plan outlines specific measures to prevent erosion and manage sediment-laden water.

The WMP includes detailed strategies for water storage, controlled releases, ESC, and tailings management. It is designed to address the unique hydrological challenges of the BWM site, ensuring that water resources are managed sustainably and in line with regulatory requirements.

5.3 SURFACE WATER MANAGEMENT OBJECTIVES

The SWMS at BWM, including the Project, is designed to ensure operational efficiency while safeguarding EVs. The key objectives of the SWMS, as outlined in the WMP (Whitehaven, 2023), are:

- Prevent uncontrolled discharges: Ensure that MAW is effectively managed to prevent uncontrolled discharges into local waterways, thereby protecting aquatic ecosystems and maintaining water quality.
- Ensure regulatory compliance: Adhere to all EA conditions, including those specified under EPML00717813, to meet statutory requirements and uphold environmental standards.
- Optimise water reuse and recycling: Maximise water reuse and recycling on the mine site to reduce reliance on external water sources and promote sustainable water management practices.

- Minimise downstream impacts: Mitigate the effects of mining activities on downstream water quality and hydrology, ensuring that local waterways remain healthy and functional.
- Implement ESC measures: Deploy effective strategies, such as sediment basins and silt fences, to reduce sedimentation and protect the integrity of local waterways.

5.4 CONTAMINATED WATER MANAGEMENT

5.4.1 Chemical storage

Chemical storage facilities at BWM are designed to prevent contamination of surface water resources. These facilities are equipped with secondary containment systems, such as bunds and spill trays, to capture any accidental spills or leaks. Regular inspections and maintenance are conducted to ensure the integrity of storage tanks and associated infrastructure, as outlined in the WMP (Whitehaven, 2023). Additionally, the EA requires compliance with strict guidelines for chemical storage and handling to minimise environmental risks.

5.4.2 Fuel storage

Fuel storage areas are managed to prevent spills and leaks that could contaminate surface water. These areas are equipped with bunding and spill containment systems to capture any accidental releases. Regular inspections and maintenance are carried out to ensure the structural integrity of storage tanks and associated infrastructure. The EA mandates that all fuel storage facilities meet specific standards to prevent environmental harm (Whitehaven, 2025a).

5.4.3 Sewage

Sewage generated at BWM is treated in accordance with environmental regulations to prevent contamination of surface water resources. The mine operates and maintains three Sewage Treatment Plants (STPs): the Central STP, the Southern Coal Preparation Plant STP, and the Northern Coal Preparation Plant STP. Treated sewage effluent is released only under strict conditions outlined in the EA. Monitoring of treated effluent quality is conducted by a National Association of Testing Authorities registered laboratory, and all data is stored in the PI Vision system for compliance and reporting purposes (Whitehaven, 2025a).

5.5 SEDIMENT WATER MANAGEMENT

5.5.1 Objectives

The sediment water management system at BWM is designed to reduce sediment transport into local waterways, thereby protecting water quality and preserving aquatic ecosystems. This system is a critical component of the SWMS and is implemented in compliance with the EA EPML00717813 (Whitehaven, 2025a).

5.5.2 Operational principles

The sediment water management system employs a range of control measures to capture and treat sediment-laden water before releasing it into the environment. These measures include:

- Sediment Basins: Strategically located basins collect and settle sediment from runoff before discharging into local waterways.
- Silt Fences: Temporary barriers are installed to trap sediment and prevent it from entering watercourses during construction and operational activities.
- Diversion Drains: Clean water is diverted away from disturbed areas to reduce the risk of sediment contamination.

- Vegetative Cover: Rehabilitation of disturbed areas with vegetation helps stabilise soil and reduce erosion, further minimising sediment transport.

5.5.3 Design and planning considerations

The design and planning of sediment water management measures at BWM consider several factors to ensure their effectiveness:

- Size and Location of Sediment Basins: Basins are designed based on the expected volume of sediment-laden water and are placed in areas with high runoff potential.
- Type of Control Measures: The selection of control measures, such as silt fences or sediment traps, is based on site-specific conditions, including soil type, slope, and rainfall patterns.
- Catchment Characteristics: Detailed catchment mapping is used to identify areas with high erosion risk and to plan appropriate sediment control measures (HydroBalance, 2026).
- Monitoring and Maintenance: Regular inspections and maintenance of sediment control structures are conducted to ensure their continued effectiveness, particularly before and after wet seasons (Whitehaven, 2025a).

5.6 MINE WATER MANAGEMENT SYSTEM

5.6.1 Overview of water management system configuration

The SWMS is designed to manage water generated by mining activities and natural processes, including rainfall, catchment runoff, groundwater inflows and external water supplies. The SWMS ensures that water is safely collected, stored, treated, reused and released in a controlled manner.

The SWMS consists of a connected network of storage facilities, pipelines and pumping systems that manage water across the site. The system services a total catchment area of approximately 10,914 hectares (ha), including natural catchments, spoil areas, rehabilitated land, tailings facilities, pits and other disturbed areas.

Water is stored in a combination of dams and pits before reuse or release. Key storage facilities are fitted with infrastructure that allows water to be released in a controlled manner during extreme wet conditions. The SWMS includes 10 main pipelines that transfer water between storage facilities and operational areas across the site.

5.6.2 Site water demands

Operational demands at BWM include haul road dust suppression and coal washing demand. Details for each demand and loss is provided in the following sections below, which, in the absence of metered data, was estimated based on daily rainfall and evaporation data sourced from the SILO (HydroBalance, 2026).

5.6.2.1 Dust suppression

The estimated future annual dust suppression demand is 3,000 megalitres per year (ML/year) with adjustments to the model rules as follows:

- Watered haul road length increased to 40 km.
- Watered haul road width = 55 m.
- Summer application factor = 0.85.
- Winter application factor = 0.9.

Figure 5.1 shows the average monthly forecast dust suppression demand.

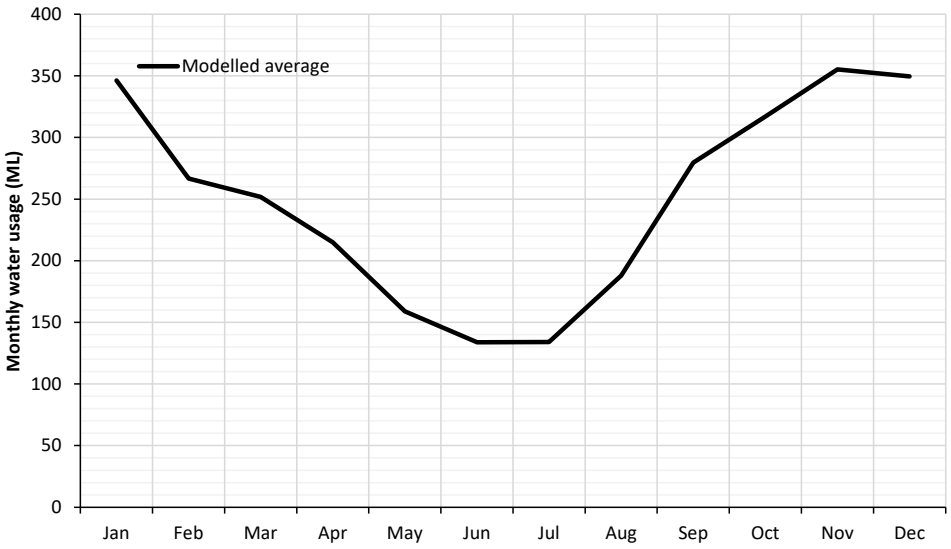


Figure 5.1 Forecast average monthly dust suppression demand (HydroBalance, 2026)

Dust suppression water is sourced from the following storages:

- R14 WSP;
- TCP Dam;
- Top Dam;
- NCHPP WSD;
- R28 FPD;
- R40 FPD;
- TFD;
- R52 FPD;
- R56 FPD;
- R62 FPD; and
- R70 WSP.

5.6.2.2 Coal Handling and Preparation Plant production and demand

CHPP coal processing water demand is generally related to the annual coal production tonnages (HydroBalance, 2026). The estimated net CHPP consumption rate is 188 litres per run-of-mine tonne (L/ROM t) for the coal washed through the BWM CHPP. For bypass coal, the estimated usage is 10 L/ROM t.

The forecast annual production profile for washed and bypass coal between Financial Year (FY)26 and FY55, and the annual net consumption, are summarised in Table 5.1.

The net CHPP process makeup demand is primarily sourced from the MAW system and has minimal raw water demand. MAW continuously supplies CHPP makeup water from NCHPP WSD.

Table 5.1 BWM forecast production profile – washed coal (HydroBalance, 2026)

Period	Washed coal - Annual tonnage (Mtpa)	Washed coal - Annual net CHPP consumption (ML/year)	Bypass coal - Annual tonnage (Mtpa)	Bypass coal - Annual net consumption (ML/year)
FY27	12.6	2,378	2.6	26.1
FY28	13.8	2,603	2.8	27.6
FY29	13.0	2,442	2.0	20.4
FY30	14.1	2,659	1.4	13.9
FY31	15.2	2,858	1.8	18.0
FY32	15.2	2,866	3.8	37.6
FY33	15.2	2,858	3.7	37.2
FY34	15.2	2,858	2.9	29.4
FY35	15.2	2,858	3.8	38.0
FY36	15.2	2,866	3.8	37.6
FY37	15.2	2,858	2.3	23.1
FY38	15.2	2,858	3.8	38.0
FY39	15.2	2,858	3.6	36.2
FY40	15.2	2,866	3.6	35.9
FY41	15.2	2,858	2.1	20.6
FY42	15.2	2,858	3.0	29.8
FY43	15.2	2,858	2.8	28.4
FY44	15.2	2,866	1.9	19.4
FY45	15.2	2,858	2.2	22.3
FY46	15.2	2,866	1.9	19.5
FY47	15.2	2,858	3.6	36.2
FY48	15.2	2,866	0.8	8.0
FY49	15.2	2,858	3.0	30.4
FY50	15.2	2,858	2.7	27.4
FY51	15.2	2,858	2.4	23.7
FY52	15.2	2,866	1.3	12.6
FY53	12.3	2,317	3.3	32.5
FY54	10.0	1,882	3.5	34.7
FY55	11.1	2,081	3.9	39.4

The following CHPP water and solids assumptions have been made:

- ROM coal moisture content: 6.4% weight per weight (w/w).
- Product coal moisture content: 10.7% w/w.
- Product yield (wet): 77.5%.

- Product yield (dry): 69.7%.
- Coarse rejects moisture content: 10.1% w/w.
- Fine tailings moisture content: 71.8% w/w.
- Waste stream split:
  - Coarse rejects fraction (dry): 85.7%.
  - Fine tailings fraction (dry): 14.3%.
- CHPP makeup water requirement: 188 L/ROM t – note this does not account for any decant return water, it is the water needed to balance the adopted tonnages and moisture contents.

5.6.2.3 Thermal Coal Plant demand

The TCP water demand is not metered. As per the previous modelling, a constant demand of 100 ML/year has been adopted for the TCP (HydroBalance, 2026).

5.6.3 External water supply

The raw water for BWM is supplied from the Bedford West and Bedford East pipelines, with annual available allocations of 1,603 ML and 678 ML, respectively (HydroBalance, 2026). Pipeline water is drawn into the site when the site-wide water storage inventory falls below 14,701 ML (Green Trigger Action Response Plan [TARP]).

A minimum raw water import volume was applied to the model as follows, based on Whitehaven's advice:

- Bedford East supply: 27 ML/month (based on March to August 2025 usage).
- Bedford West supply: 11 ML/month (based on August 2025 usage) – this excludes 6 ML/month that is supplied to Pastoral Agreements (based on March to August 2025 usage).

Maximum daily supply rates of 2.5 ML/d (Bedford East) and 10 ML/d (Bedford West) were allocated based on the rate currently achievable at the site, including an allowance for 85% availability.

5.6.4 Tailings management

The BWM Water Balance Model models the tailings waste stream as follows (HydroBalance, 2026):

- All tailings moisture is sent to R10/12 WSP (Bonnie Doon).
- Water is actively dewatered from R10/12 WSP back to the SWMS. The model accounts for losses such as tailings matrix retention, beach and decant pond evaporation, and seepage.

The tailings and reject runoff management system at BWM is designed to manage water generated during coal processing activities. This system operates in conjunction with the SWMS, allowing water to be recovered, reused and managed in a controlled manner and assumes the following:

- All moisture associated with tailings is directed to the R10/12 WSP (also known as Bonnie Doon), which stores and manages water generated from the tailings stream.
- Water is actively dewatered from the R10/12 WSP and returned to the SWMS. Recovered water is reused in site operations, including coal washing and dust suppression.
- For modelling purposes, HydroBalance (2026) adopted tailings decant return of 40%, which also accounts for losses from beach evaporation, decant pond evaporation, and seepage.
- Coarse rejects are transported from the CHPP to approved disposal locations, such as in-pit voids. These areas are progressively capped with topsoil and rehabilitated to reduce long-term environmental impacts.

- Fine tailings consist of fine coal particles and clay materials suspended in water. These materials are stored in semi-permanent tailings cells or approved tailings storage facilities.
- The management of fine tailings is designed to minimise the risk of acid metalliferous drainage and saline drainage, protecting surrounding surface water and groundwater resources.

5.6.5 Inflows from local waterways

A few creeks that flow past or through BWM interact with the site's storages either as direct catchment inflows or as overflows from the creek. These interactions are as follows:

- TCP Dam – receives direct water ingress from Burngrove Creek.
- R40 FPD – receives direct water ingress from Taurus Creek.
- R38 – receives indirect water ingress from Taurus Creek, via R40 FPD overflows.
- R62 FPD – receives direct water ingress from Speculation Creek.
- Old Cut 4 – receives direct water ingress from Sirius Creek.
- Rockland Basin – receives direct water ingress from Rockland Creek.

5.6.6 Groundwater

Groundwater inflow rates to the mine pits have been estimated based on a groundwater model developed by SLR (2026). The groundwater inflows have been adjusted to account for pit face evaporation losses and losses from in-situ coal extraction during mining (HydroBalance, 2026).

Figure 5.2 and Table 5.2 summarise the annual groundwater estimates for the Project over the simulation period between 2026 and 2055. The inflows have been distributed among the open cut pits in accordance with the provided groundwater data.

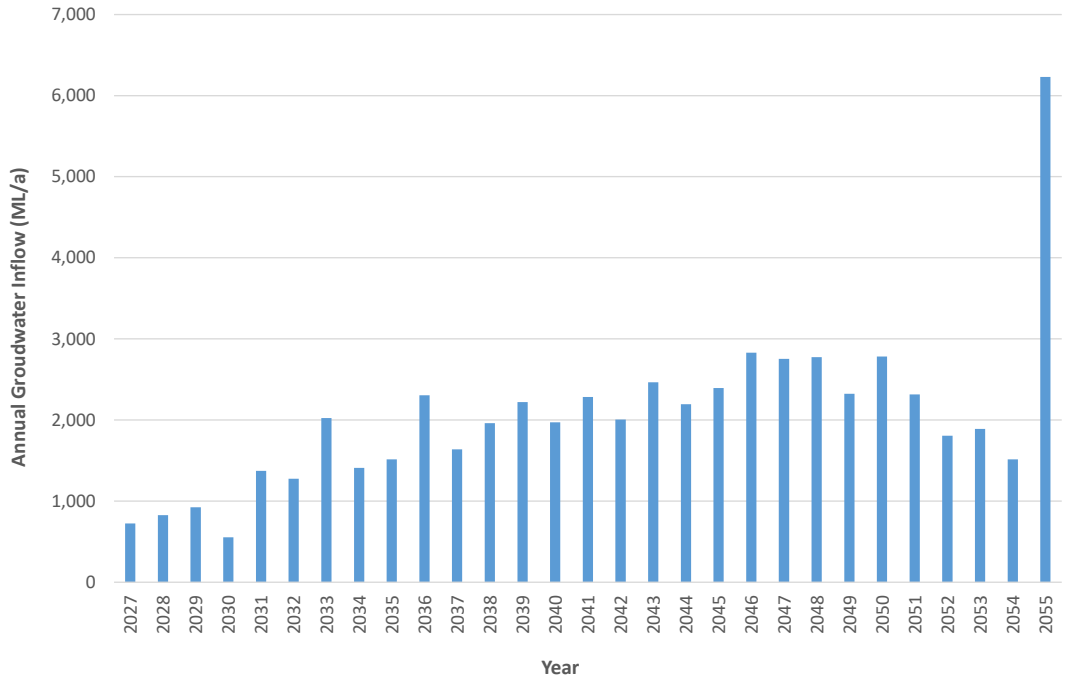


Figure 5.2 Forecast annual groundwater inflow rate (HydroBalance, 2026)

Table 5.2 Adopted groundwater inflow rates (HydroBalance, 2026)

Calendar year	Annual groundwater inflow (ML/year)
2027	725
2028	828
2029	924
2030	553
2031	1,373
2032	1,275
2033	2,025
2034	1,410
2035	1,514
2036	2,306
2037	1,639
2038	1,962
2039	2,220
2040	1,972
2041	2,285
2042	2,006
2043	2,465
2044	2,196
2045	2,395
2046	2,830
2047	2,754
2048	2,774
2049	2,323
2050	2,782
2051	2,316
2052	1,805
2053	1,892
2054	1,515
2055	6,231

5.6.7 Controlled release

Controlled releases are permitted from RP2 via NTCD, RP3 via NDCD and RP4 via TFD. Controlled releases may be undertaken when the following conditions are met per Condition F4 and Conditions F9 to F11 of the current EA :

- For RP2 and RP3:
  - the flow in Blackwater Creek (at Gauging Station 2) is greater than or equal to (≥) 1 cubic metre per second (m^3/s);
  - the EC in the release dam is <10,000 µS/cm;
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm; and
  - Blackwater Creek mixed downstream EC can exceed greater than (>) 2,000 µS/cm during a release if the upstream monitoring point is equal or higher than downstream (i.e. the mine release does not have a measurable impact on downstream water quality during the release).
- For RP4:
  - the flow in Two Mile Gully (at Gauging Station 3) is ≥1 m^3/s;
  - the EC in the release dam is <10,000 µS/cm; and
  - the 80th percentile of the mixed downstream Blackwater Creek EC values (at MP8) is <2,000 µS/cm.

The BWM EA also authorises releases from the following storages, which were not modelled as controlled releases:

- Goldfish Pond;
- Marshmead Pit;
- Old Cut 4;
- R82 FPD;
- NCHPP Sediment Dam;
- Rejects Stockpile Dam; and
- R34.

5.7 TRIGGER ACTION RESPONSE PLAN

The site-wide water security and containment risks at BWM are managed using a TARP. The TARP has been developed by Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide BWM TARP is summarised in Table 5.3.

Table 5.3 BWM site-wide water management TARP (HydroBalance, 2026)

Trigger	Action / Response
Red - Dry	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Yellow - Dry	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Green	• Import water from Bedford pipelines at 50% allocation.
Yellow - Wet	• Cease importing water from Bedford pipelines.

Trigger	Action / Response
	• Maximise dust suppression usage. • Consider controlled release.
Red - Wet	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release. • Allocate emergency storage in pits.

6 SITE WATER BALANCE ASSESSMENT

6.1 OVERVIEW

6.1.1 Water balance assessment methodology

The site water balance assessment for Project (HydroBalance, 2026) provides a detailed evaluation of the water management system's performance under different climatic conditions. This assessment is essential for ensuring the mine's water management system operates effectively and sustainably, even during extreme weather events.

A computer-based operational simulation model was used to assess the dynamics of the BWM water balance under varying rainfall and catchment conditions throughout the duration of the Project. The water balance model developed for this assessment covers the period of July 2025 to June 2055 (30 years in total). The Project commences in 2030, and mining in the Project area ceases in 2055.

The assessment uses the GoldSim model, a dynamic simulation tool, to analyse water inflows and outflows across the site. The model accounts for various water sources and losses, including:

- Inflows: Rainfall, catchment runoff, groundwater inflows, and external water supplies.
- Outflows: Evaporation, seepage, controlled releases, and water usage for operational activities such as coal processing and dust suppression.

6.1.2 Modelled scenarios

The site water balance assessment was undertaken for the following two scenarios:

- Proposed (Project) conditions – This scenario simulates the performance of the BWM SWMS including the increased disturbance footprint by the Project up to June 2055. For this scenario, the performance of the SWMS was assessed in terms of predicted inventory, external water supply requirements, controlled and uncontrolled releases.
- Approved conditions – This scenario represents the Approved BWM operations up to June 2055 excluding the increased disturbance by the Project. This scenario was simulated to compare the predicted volumes of controlled releases from BWM between the proposed (Project) conditions and the Approved operations up to 2055.

6.2 WATER BALANCE MODELLING RESULTS

6.2.1 Overview

Water balance modelling was completed for BWM (incorporating the Project) to assess how the SWMS performs under different climatic conditions. The modelling was undertaken using the GoldSim model and considered system performance over a 30-year simulation period.

The purpose of the modelling was to confirm that water inflows, storage and releases can be managed effectively, while reducing the risk of uncontrolled discharges and environmental impacts.

6.2.2 Water management system inventory

The modelling shows that the combined water inventory, which includes all dam and pit storages, is expected to operate within its available capacity under most climatic conditions.

Figure 6.1 shows the forecast total inventory, which includes all dam and pit storages onsite and is compared to the available SWMS capacity over time. Table 6.1 gives the total SWMS capacity.

The model results show the following:

- For the 5th percentile results (very wet climatic conditions), the peak combined water inventory volume is around 32,000 ML during the first few years of the simulation and around 39,500 ML by the end of the simulation.
- For the 10th percentile results (wet climatic conditions), the peak combined water inventory volume is around 28,000 ML during the first few years of the simulation and around 35,000 ML by the end of the simulation.
- For the 50th percentile results (median climatic conditions), the peak combined water inventory reaches around 17,500 ML during the first few years of the simulation and around 19,000 ML by the end of the simulation.
- The combined water inventory is maintained below the combined water capacity for almost all climatic conditions. There is between a 5% and 10% probability that the combined water inventory will exceed the combined water storage capacity in the first two years of the simulation, and any excess MAW would be temporarily stored in an active pit.

Overall, the results indicate that the SWMS has sufficient storage capacity to manage water over the life of the mine.

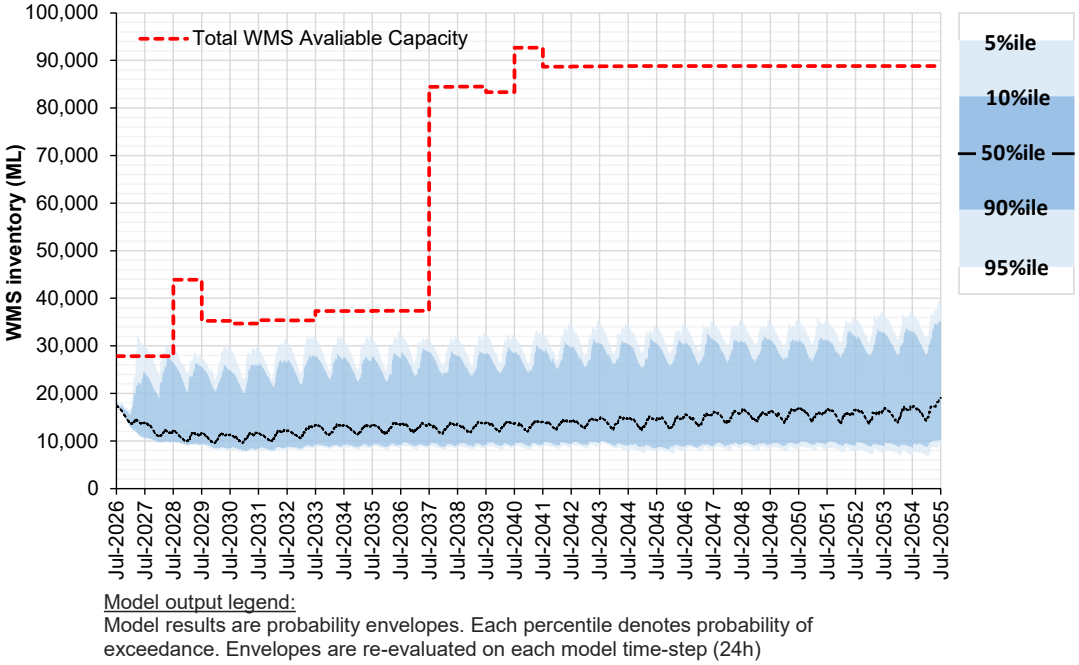


Figure 6.1 Forecast SWMS inventory (HydroBalance, 2026)

Table 6.1 Available storage capacity at BWM (HydroBalance, 2026)

Year/s (inclusive)	Available SWMS storage capacity (ML)
FY27	27,846
FY28	27,846
FY29	43,881
FY30	35,263
FY31	34,665
FY32	35,385
FY33	35,335
FY34	37,311
FY35	37,311
FY36	37,361
FY37	37,361
FY38	84,437
FY39	84,487
FY40	83,311
FY41	92,656
FY42	88,663
FY43	88,713
FY44	88,763
FY45	88,800
FY46	88,750
FY47	88,750
FY48	88,750
FY49	88,750
FY50	88,750
FY51	88,750
FY52	88,750
FY53	88,750
FY54	88,750
FY55	88,750

6.2.3 External water supply

Water imports from the Bedford East and Bedford West pipelines was included in the water balance model to assess operational water demands.

External water supply volumes vary depending on climatic conditions and site water availability. Higher import volumes are generally required during drier conditions, while lower volumes are needed during wetter periods. Figure 6.2 and Figure 6.3 show the forecast annual pipeline import volumes for Bedford East and Bedford West. The following is of note regarding the external water demand:

- The pipelines supply the minimum raw water demands to the site for all climatic conditions (as outlined in Section 3.5).
- For Bedford East pipeline:
  - External water is only imported under median (50th percentile), dry (90th percentile) and very dry (95th percentile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford East external water demands do not exceed the raw water allocation under any climatic conditions.
- For Bedford West pipeline:
  - External water is only imported under median (50th percentile), dry (90th percentile) and very dry (95th percentile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford West external water demands do not exceed the raw water allocation under any climatic conditions.

The existing Bedford West and Bedford East pipeline allocations are sufficient for maintaining operations at BWM. Additional external water supply allocation is not required as a result of the Project.

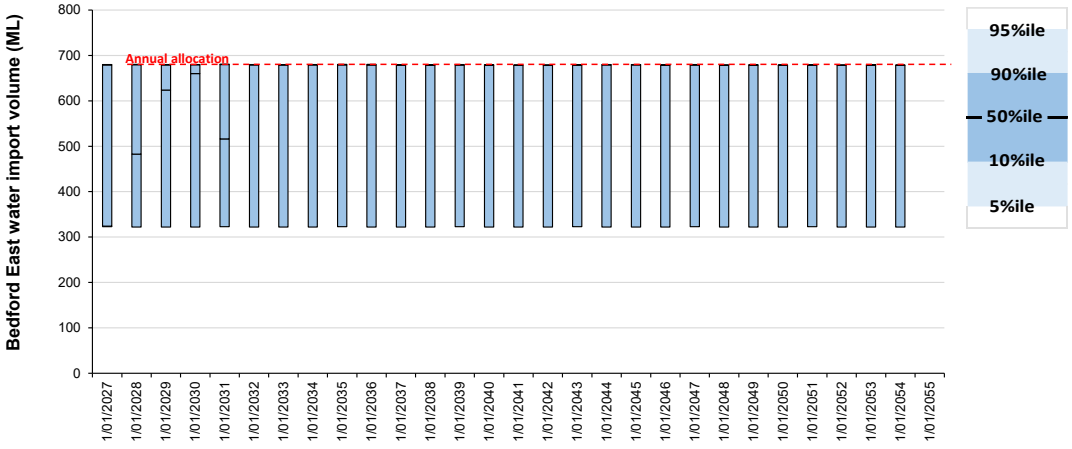


Figure 6.2 Forecast Bedford East pipeline demand (HydroBalance, 2026)

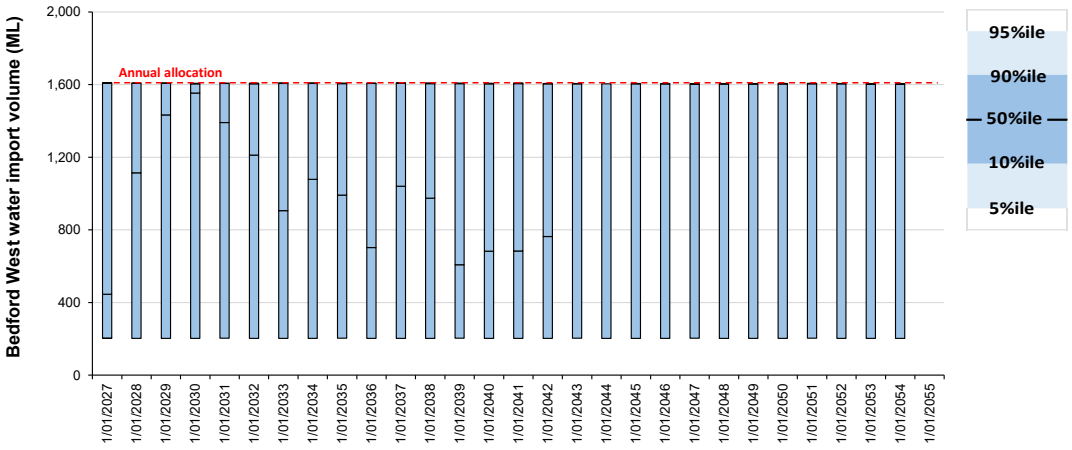


Figure 6.3 Forecast Bedford West pipeline demand (HydroBalance, 2026)

6.2.4 Controlled releases

6.2.4.1 Proposed Project conditions

The forecast annual controlled release volumes, in accordance with EA conditions, are shown in Figure 6.4. The following points are noted in relation to the controlled releases (HydroBalance, 2026):

- Controlled releases are expected to be required in very wet (5th percentile), wet (10th percentile) and median climatic conditions, as well as dry (90th percentile) climatic conditions in some years.
- During very wet climatic conditions (5th percentile), the annual releases volumes range from 2,950 ML to 5,130 ML.
- During wet climatic conditions (10th percentile), the annual releases volumes range from 2,350 ML to 2,930 ML.
- During median climatic conditions (50th percentile), the annual releases volumes range from 760 ML to 1,120 ML.

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

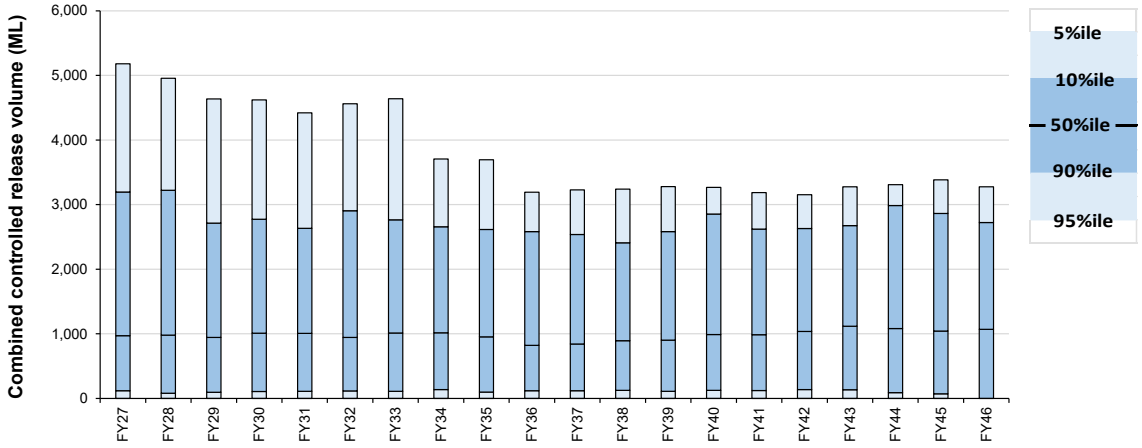


Figure 6.4 Forecast controlled release volumes (HydroBalance, 2026)

6.2.4.2 Comparison against Approved case

The Project results in the following key changes to water inflows within the water management system:

- Estimated 60% increase in groundwater inflows up to Year 2055.
- Minor changes in captured catchment areas.

An assessment of the impact of the Project on controlled release volumes has been undertaken by comparing Project results against an Approved case. The outcomes of this assessment have identified the following changes to controlled releases due to the Project:

- During very wet climatic conditions (5th percentile), the annual releases volumes for the Approved case range from 2,880 ML to 4,940 ML. That is, under very wet climatic conditions (5th percentile), annual controlled release volumes for the Project are predicted to increase by around 2-4% (70-190 ML) compared with the Approved Case.
- During wet climatic conditions (10th percentile), the annual releases volumes for the Approved case range from 2,200 ML to 3,100 ML. That is, under wet climatic conditions (10th percentile), annual controlled release volumes for the Project are predicted to increase by up to 7% (150 ML) compared with the Approved Case.
- During median climatic conditions (50th percentile), the annual releases volumes for the Approved case range from 630 ML to 1,010 ML. That is, under median climatic conditions (50th percentile), annual controlled release volumes for the Project are predicted to increase by around 11-20% (110-130 ML) compared with the Approved Case.

This assessment indicates that the Project will results in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

6.2.5 Uncontrolled releases

The Whitehaven documents *WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water* (Whitehaven, 2024), *BWM Plan – Water Management* (Whitehaven, 2023) and *BWM Plan – Erosion and Sediment Control Plan* (Whitehaven, 2022) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in this standard will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons (HydroBalance, 2026):

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.
- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have been identified as having a higher potential for uncontrolled discharge.
- The Project does not modify the catchments of NTCD or NDCD, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

7 FINAL VOID WATER BALANCE ASSESSMENT

7.1 OVERVIEW

Water levels in the final voids will vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater. A final void GoldSim model (separate to the GoldSim model used for the operational modelling) was used to assess the likely long-term water level behaviour of the final voids.

Condition E10 of the EA stipulates that "residual voids must not cause any serious environmental harm to land, surfaces waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself".

The BWM residual voids would be operated as non-use management areas (NUMAs) as part of the Progressive Rehabilitation and Closure Plan (PRCP).

A final void water balance assessment has been undertaken to evaluate the long-term hydrological behaviour of the residual voids. The GoldSim software platform was used to simulate the long-term water level behaviour for the Project voids. Details of the methodology and results of the final void water balance assessment are provided in the HydroBalance (2026) report (Appendix B). The key outcomes from the HydroBalance (2026) report have been reproduced in the following sections.

The assessment considers how water levels and water quality within the voids may change over time following mine closure. The long-term final void hydrology and water quality behaviour of the proposed final voids has been modelled over a 1,000-year post-closure period to assess whether the final voids would be safe and non-polluting.

7.2 FINAL VOID GEOMETRY

The proposed final landform layout relevant to the Project is presented in Figure 7.1 and Figure 7.2, and includes five residual voids:

- Mimosa/Besgrove;
- Ramp 30;
- Deep Creek;
- Stewarton North; and
- Stewarton South.

These residual voids would remain following the completion of mining and rehabilitation activities and would be managed as follows:

The residual voids would be managed as NUMAs under the PRCP, and the voids would not be used for ongoing water supply or operational purposes after mine closure.

Management of the voids is intended to minimise potential risks to surface water and groundwater, while supporting the long-term safety and stability of the final landform.

The final landform forms during mining, incorporating in-pit backfilled spoil within the mining works. A digital elevation model (DEM) of the final landform (i.e. the final surface expected at the end of the mine life) was provided by Whitehaven.

A summary of the residual void geometries is provided in Table 7.1

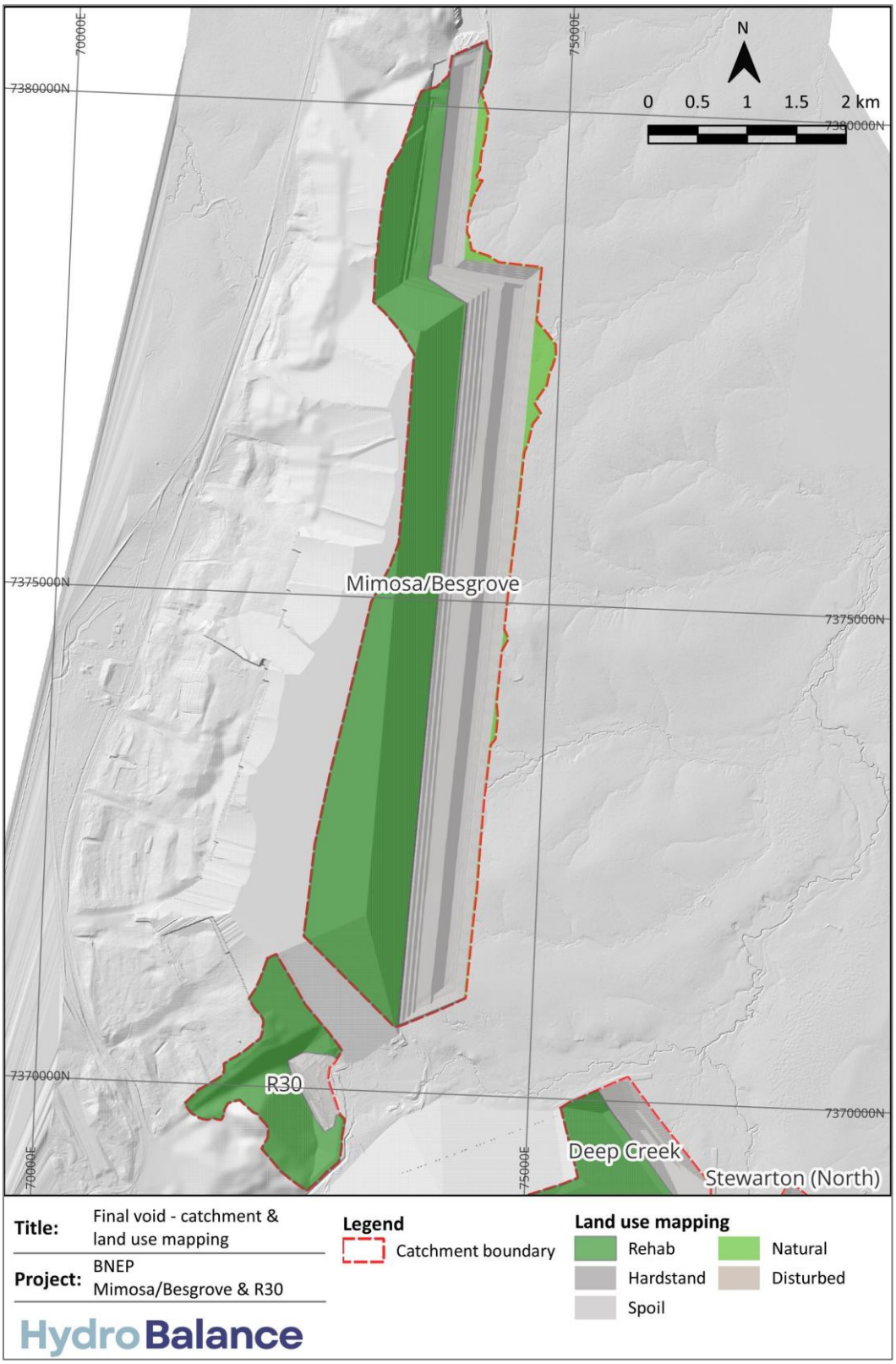


Figure 7.1 Final void configuration – Mimosa/Besgrove & Ramp 30 (HydroBalance, 2026)



Figure 7.2 **Final void configuration – Deep Creek, Stewarton North & South (HydroBalance, 2026)**

Table 7.1 Final void geometries

Void	Floor level (metres Australian Height Datum [mAHD])	Crest level (mAHD)	Depth (m)	Volume to crest (ML)	Surface area at crest (ha)
Mimosa/Besgrove	24	200	176	374,878	597.2
Ramp 30	139	217	78	16,316	59.7
Deep Creek	52	202	150	54,895	109.4
Stewarton North	-4	204	208	302,582	380.1
Stewarton South	92	232	140	42,632	82.5

7.3 CLIMATE DATA

The final void water balance assessment incorporates climate data sourced from the Australian Government Consistent Climate Scenarios (CCS) project. This project provides climate change-adjusted rainfall and evaporation data, transforming historical climate data from 1960 to 2024 into future projections. The CCS project offers daily climate projections across Australia on a 0.05-degree grid, with the grid point closest to the centre of BWM used for this assessment.

The assessment uses the Shared Socioeconomic Pathway (SSP)2-4.5 as the emission pathway, based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) (IPCC, 2014). This pathway assumes moderate global development and environmental policies, leading to moderate greenhouse gas emissions and radiative forcing of 4.5 watts per square metre (W/m^2) by 2100. The year 2070 was selected as the base case for global warming sensitivity, representing a midpoint for the varying void commencement dates (HydroBalance, 2026).

The climate data was adjusted using the following parameters:

- Climate Warming Sensitivity: Assumed to fall within the medium category.
- Future Climate Cluster: High global warming (HP) was selected to represent a high level of warming.
- Long-Term Climate Sequence: Historical climate data was adjusted and looped to create a 1,000-year climate sequence, ensuring robust predictions of rainfall and evaporation patterns. Figure 7.3 shows the long-term monthly averages for the rainfall data and pan evaporation.

The CCS data were used to generate long-term monthly averages for rainfall and pan evaporation. Evaporation data were converted to Morton's Lake (mLake) and Morton's Wet (mWet) evapotranspiration to account for water losses from the pit lake and catchment areas:

- Pan evaporation to mLake factor: 0.883, applied to evaporation on the pit lake surface.
- Pan evaporation to mWet factor: 0.845, applied to evaporation losses from the catchment.

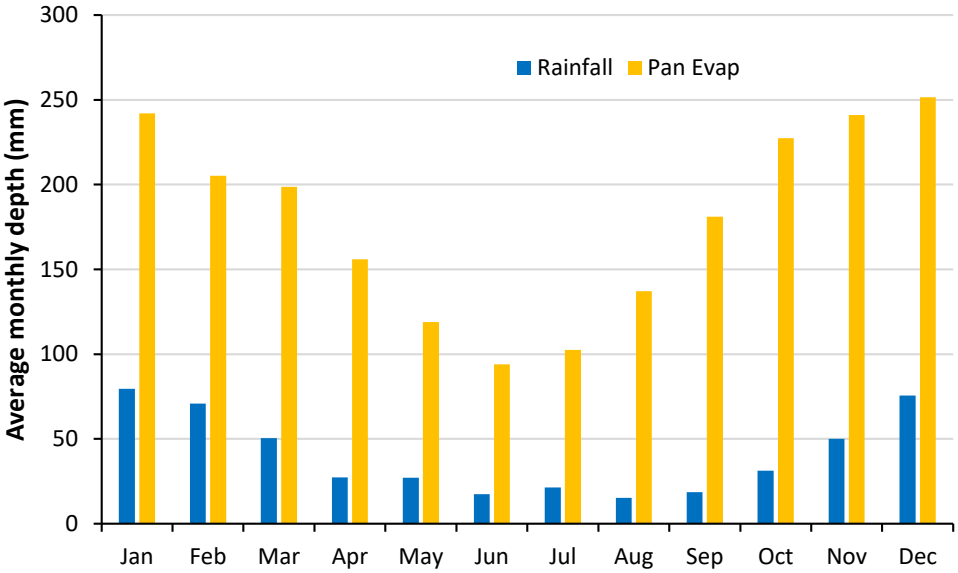


Figure 7.3 **Distribution of monthly rainfall and pan evaporation (CCS 1960 - 2024) (HydroBalance, 2026)**

7.4 CATCHMENT AREAS AND LAND USE MAPPING

Catchment areas and land use maps have been developed for the final voids to predict water inflows and outflows for each void. Each residual void has a specific catchment area that contributes water through rainfall, surface runoff, and groundwater inflows (HydroBalance, 2026). The final landform catchment area was delineated from the final landform surface provided by Whitehaven. The land use of the void floor has been characterised as spoil.

Figure 7.1 to Figure 7.2 show the catchment boundary and land uses adopted for the final void water balance. The catchment and land use values used in the GoldSim model are shown in Table 7.2.

At the completion of mining, surface runoff from rehabilitated in-pit and out of pit waste rock emplacement areas would flow to the receiving environment, with the exception of approximately 2,726 ha (27.3 km^2) which would report to residual voids associated with the Project.

Table 7.2 Final void catchment and land use areas (HydroBalance, 2026)

Void	Area (ha)			
	Undisturbed	Spoil	Rehabilitated spoil	Total
Mimosa/ Besgrove	39.1	596.5	622.4	1,258.0
Ramp 30	0.0	24.1	149.2	173.3
Deep Creek	0.0	52.9	167.3	220.2
Stewarton North	0.0	195.2	678.1	873.3
Stewarton South	0.0	50.9	150.3	201.2

The mapping includes various land use types that influence water flow and quality (HydroBalance, 2026):

- Natural Areas: Undisturbed regions that contribute clean water to the voids.
- Spoil Areas: Disturbed zones where mining waste is stored, which may contribute sediment-laden water.
- Rehabilitated Zones: Areas that have been restored with vegetation to stabilise soil and reduce erosion.
- Tailings Areas: Fine waste material from coal processing is stored, which may contribute water with higher levels of dissolved solids.
- Pit Voids: Active and inactive mining pits that can act as temporary water storage areas.
- Disturbed Areas: Zones affected by mining activities, which may generate sediment-laden runoff.

7.5 GROUNDWATER INFLOWS

Groundwater inflows into the five voids have been provided by the Project groundwater consultants (SLR, 2026). The inflows were provided as a time series over the 1,000 year simulation. Details on the groundwater inflows to the voids are provided in SLR (2026).

7.6 FINAL VOID WATER BALANCE MODELLING RESULTS

7.6.1 Overview

The final void water balance modelling results for Project final landform (HydroBalance, 2026) provide a detailed analysis of the long-term hydrological behaviour of the residual voids. The modelling was conducted using the GoldSim software platform, simulating water levels and salinity over a 1,000-year post-closure period.

The final water levels for the five voids are presented in Figure 7.4 to Figure 7.8. Of the five voids, three are expected by SLR (2026) to become long-term sinks, and the other two are predicted to become flow-through systems reporting to these long-term sinks.

7.6.2 Mimosa/Besgrove void water level

The Mimosa/Besgrove void is expected to reach equilibrium within 100 years post-closure, with a median water level of approximately 83 mAHD. The maximum water level is predicted to be 88.1 mAHD, which is about 112 metres (m) below the pit crest level of 200 mAHD. There is no risk of overtopping or significant water quality impacts during the simulation period (HydroBalance, 2026).

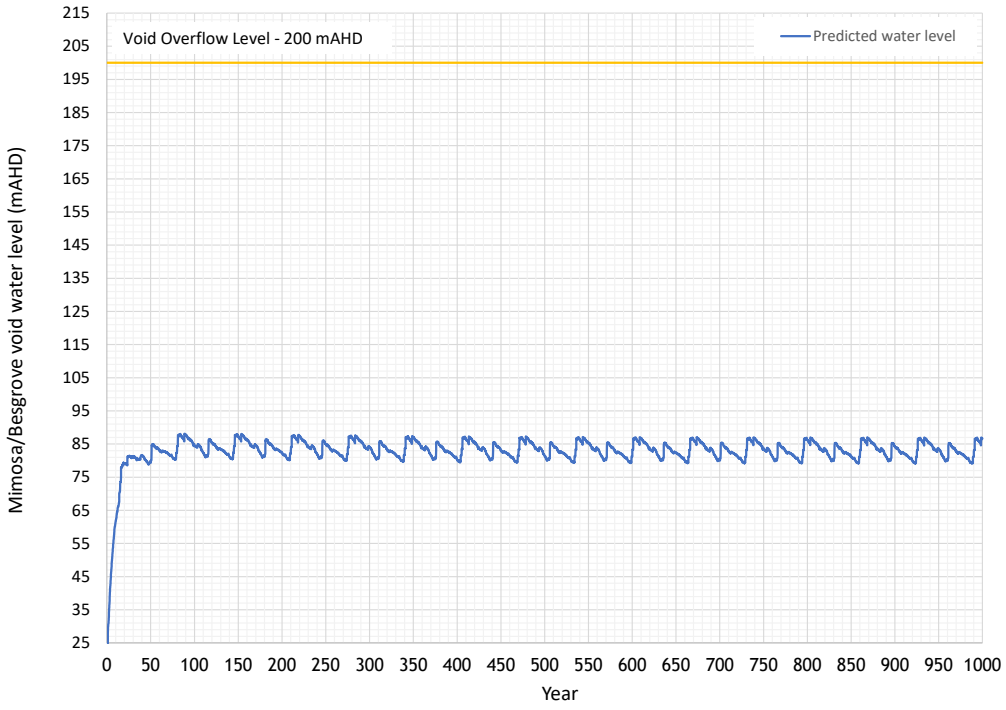


Figure 7.4 Mimosa/Besgrove void – long-term predicted final void water level (HydroBalance, 2026)

7.6.3 Ramp 30 void water level

The Ramp 30 void is expected to achieve equilibrium within 100 years post-closure, with water levels fluctuating between empty (during extended dry periods) and a maximum of around 160 mAHD during wet periods. The maximum water level is 57 m below the pit crest level of 217 mAHD, ensuring no overtopping occurs (HydroBalance, 2026).

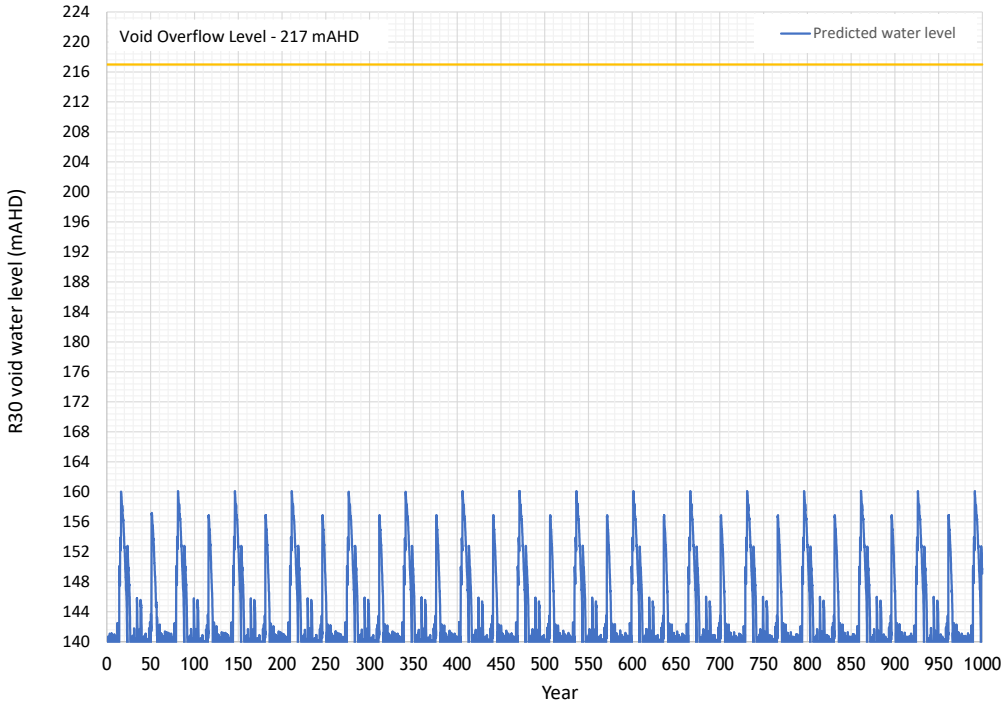


Figure 7.5 Ramp 30 void – long-term predicted final void water level (HydroBalance, 2026)

7.6.4 Deep Creek void water level

The Deep Creek void is anticipated to reach equilibrium within 150 years post-closure, with a median water level of approximately 138 mAHD. The maximum water level is predicted to be 149.8 mAHD, which is 52 m below the pit crest level of 202 mAHD. Water quality parameters are expected to remain within acceptable limits throughout the simulation period (HydroBalance, 2026).

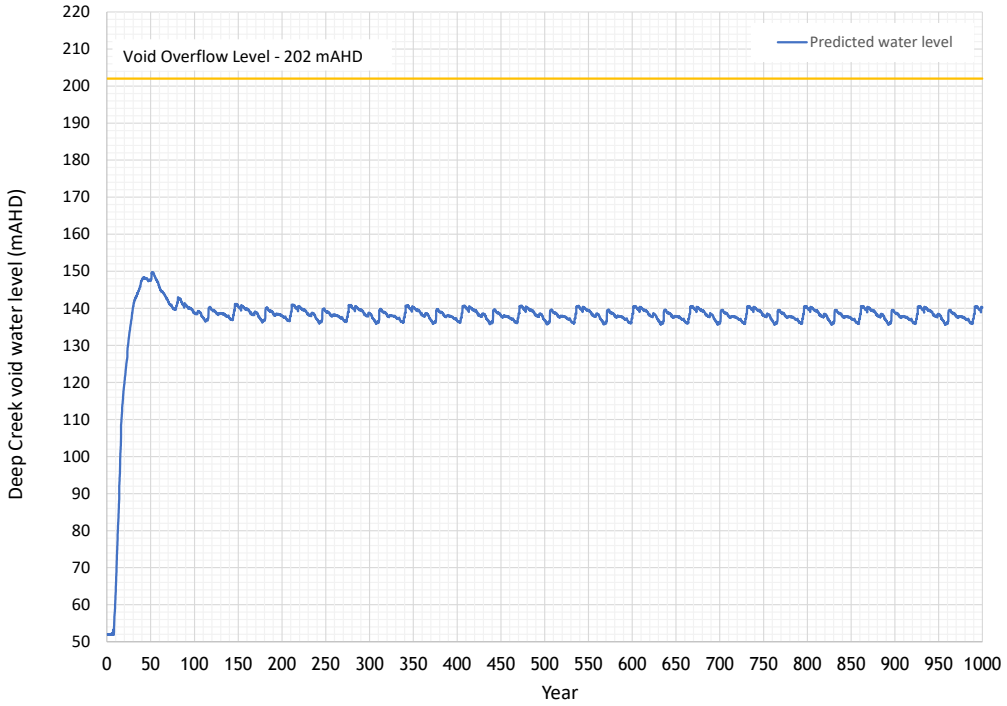


Figure 7.6 Deep Creek void – long-term predicted final void water level (HydroBalance, 2026)

7.6.5 Stewarton North void water level

The Stewarton North void is expected to stabilise within 100 years post-closure, with a median water level of approximately 73 mAHD. The maximum water level is predicted to be 79.4 mAHD, which is 124 m below the pit crest level of 204 mAHD. No significant environmental impacts are anticipated (HydroBalance, 2026).

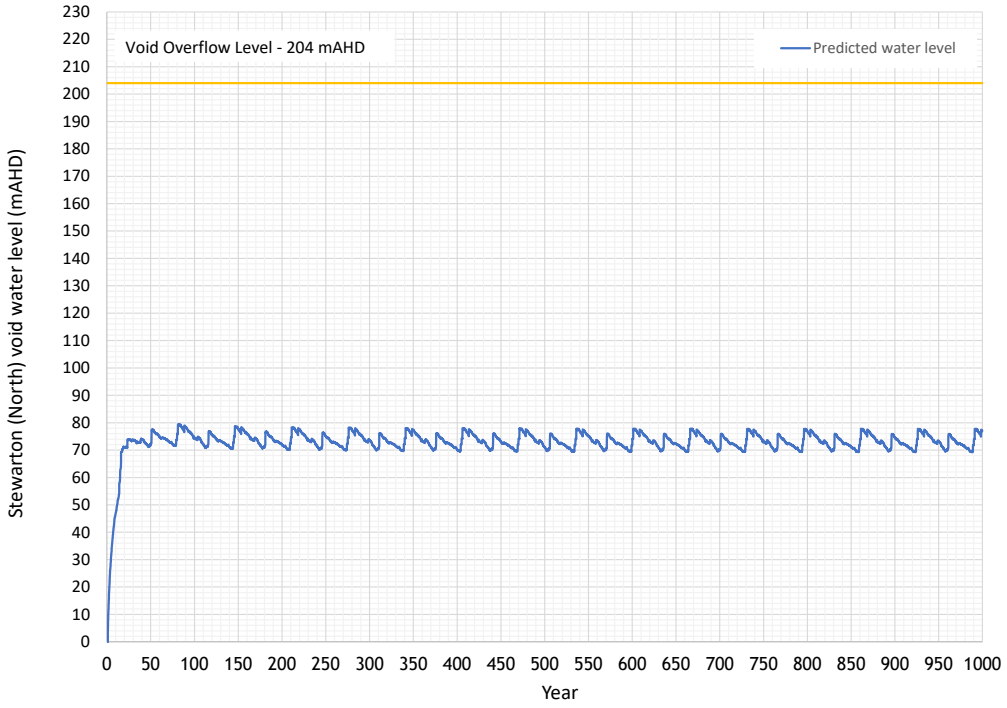


Figure 7.7 Stewarton North void – long-term predicted final void water level (HydroBalance, 2026)

7.6.6 Stewarton South void water level

The Stewarton South void is projected to achieve equilibrium within 100 years post-closure, with a median water level of approximately 104 mAHD. The maximum water level is predicted to be 118.5 mAHD, which is 113 m below the pit crest level of 232 mAHD. Water quality parameters are expected to meet environmental standards throughout the simulation period (HydroBalance, 2026).

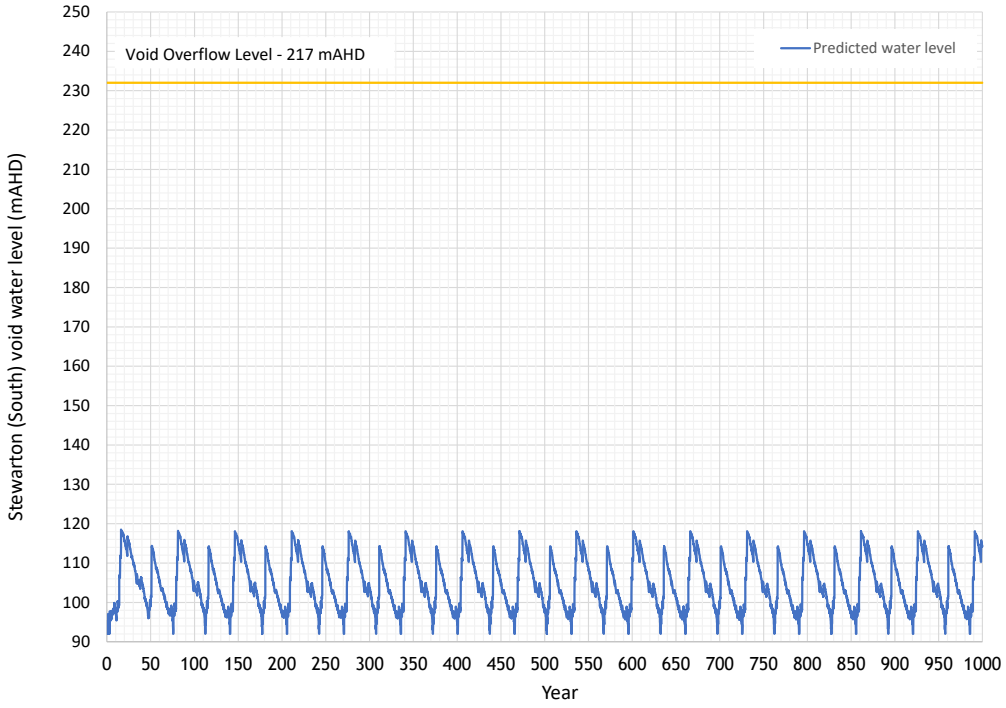


Figure 7.8 Stewarton South void – long-term predicted final void water level (HydroBalance, 2026)

7.6.7 Extreme storm event behaviour

An assessment of the impact of extreme storm events on the water levels in the final voids has been undertaken (HydroBalance, 2026). The potential for discharge of void water during a large storm was assessed for the 1 in 1,000 Annual Exceedance Probability (AEP) (or 0.1% AEP) 72-hour (3 day) design storm. For conservatism, it has been assumed that the extreme storm would occur coincident with the peak modelled long-term water levels.

The results of the storm event analysis are presented in Table 7.3. These results show that, even during extreme short duration storm events, the pit crest would not be overtopped for any of the final voids (HydroBalance, 2026).

Table 7.3 Storm event modelling results

Void	Runoff Volume (ML)	Water level increase (m)	Final Volume (ML)	Final Level (mAHD)	Pit crest level (mAHD)	Freeboard (m)
Mimosa/Besgrove	3,585	3.4	29,316	91.5	200	108.5
Ramp 30	494	6.3	1,124	166.1	217	50.9
Deep Creek	628	2.6	7,884	129.9	202	72.1
Stewarton North	2,489	1.5	59,120	115.0	204	89.0
Stewarton South	573	3.6	4,992	150.0	232	82.0

7.6.8 Salinity

The final void modelled salinity levels for the five voids are presented in Figure 7.9 to Figure 7.13. The long-term salinity generally increases over time, which is expected for closed-loop systems with no mechanism for salt removal. HydroBalance (2026) noted that this assessment is considered conservative, as it:

- Assumes an unlimited source of salt within the catchment and does not include any allowance for potential reduction in the leaching of salts from the catchment over time.
- Does not take into account the potential precipitation of dissolved salts as mineral compounds.

The following is of note regarding these results (HydroBalance, 2026):

- For Mimosa/Besgrove void, the salinity of the pit lake progressively increases, rising to 250,000 µS/cm over the 1,000-year simulation.
- For Ramp 30 void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 5,000 µS/cm.
- For Deep Creek void, the salinity of the pit lake progressively increases, rising to 180,000 µS/cm over the 1,000-year simulation.
- For Stewarton North void, the salinity of the pit lake progressively increases, rising to 195,000 µS/cm over the 1,000-year simulation.
- For Stewarton South void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 10,000 µS/cm.

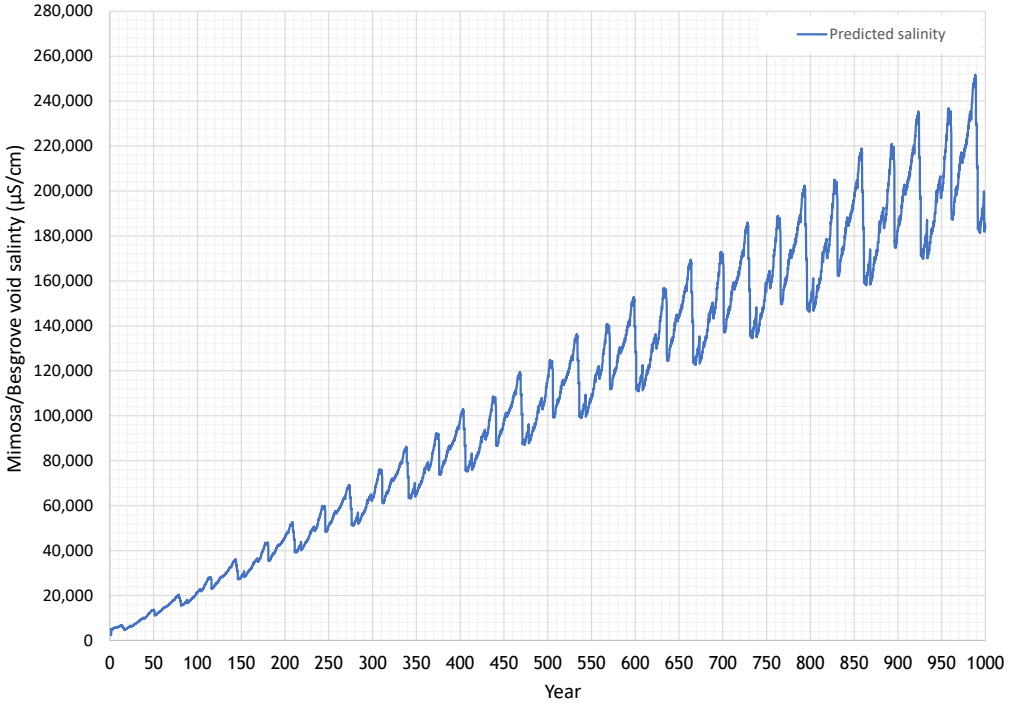


Figure 7.9 Mimosa/Besgrove void – long-term predicted void water salinity (HydroBalance, 2026)

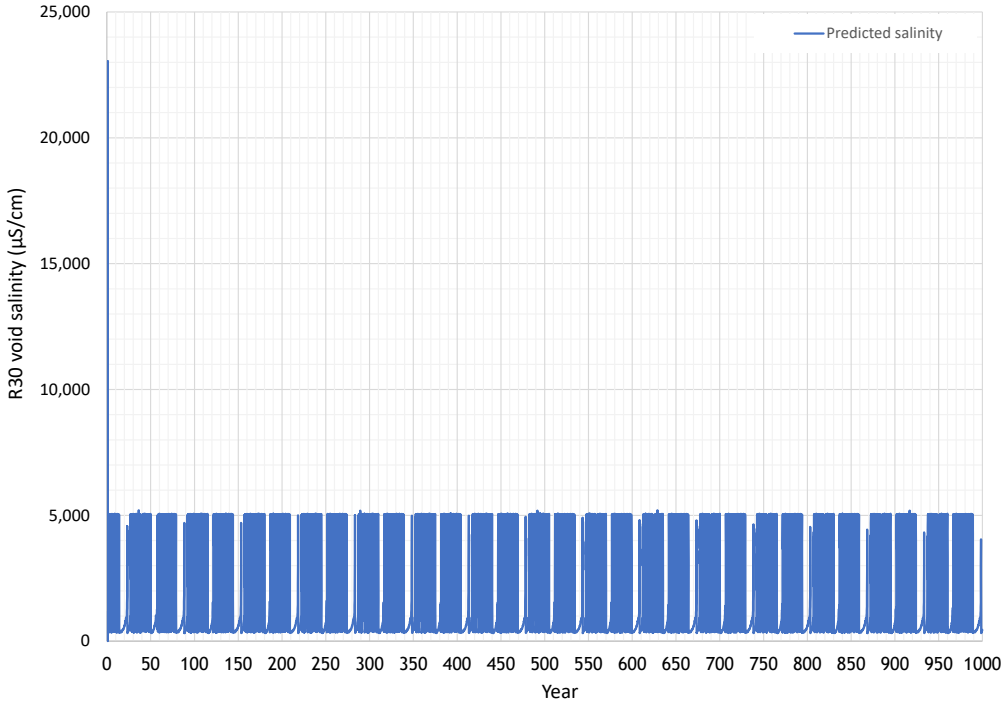


Figure 7.10 Ramp 30 void – long-term predicted final void water salinity (HydroBalance, 2026)

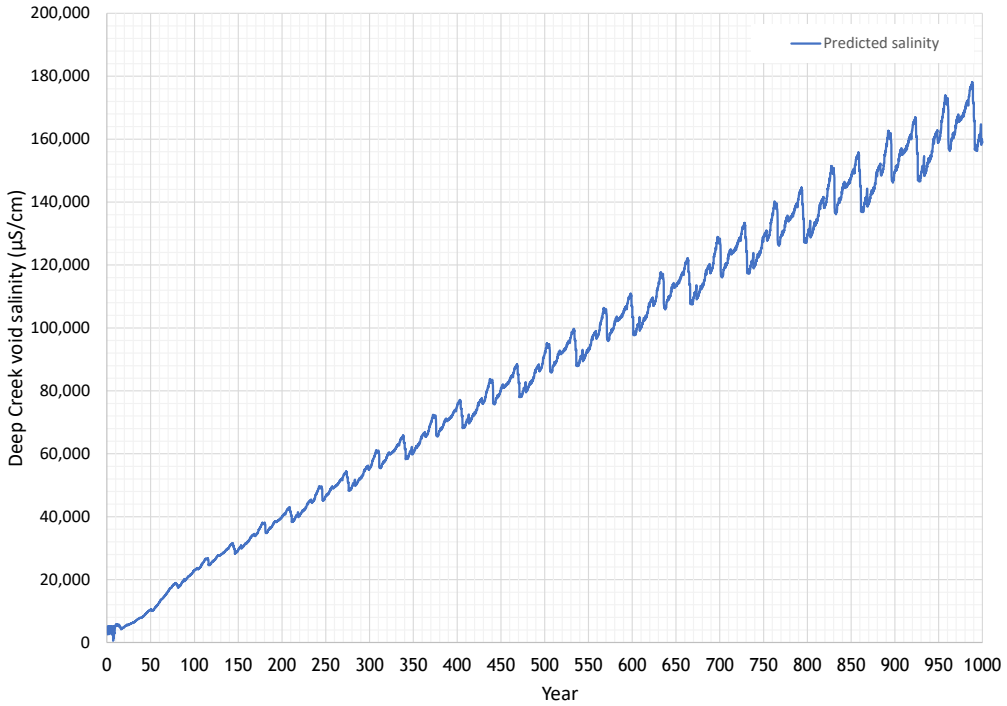


Figure 7.11 Deep Creek void – long-term predicted final void water salinity (HydroBalance, 2026)

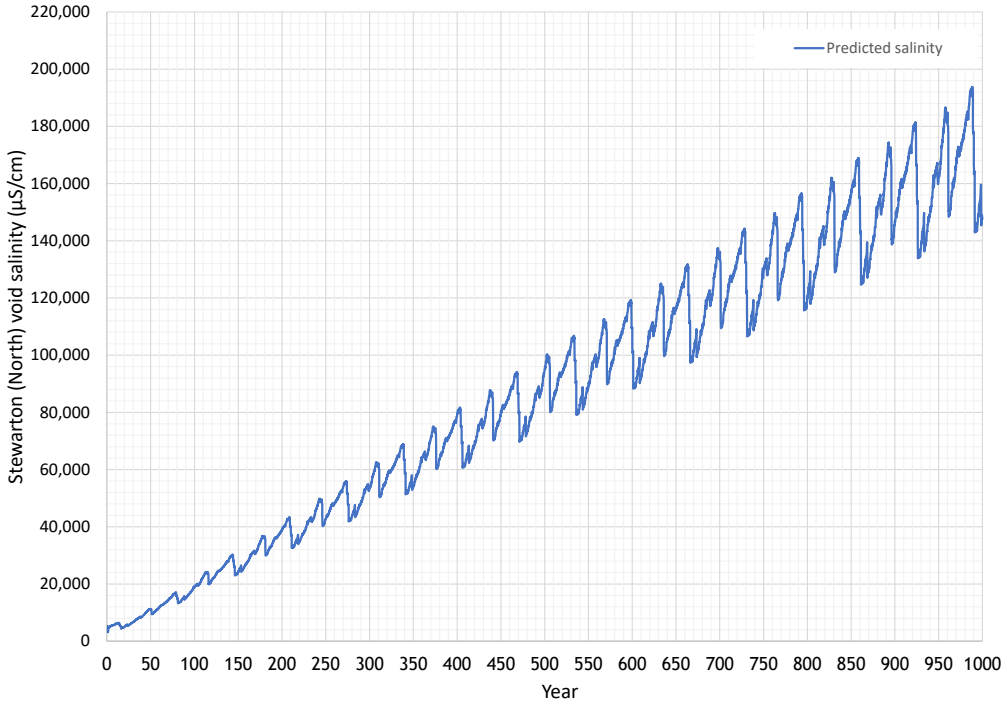


Figure 7.12 Stewarton North void – long-term predicted final void water salinity (HydroBalance, 2026)

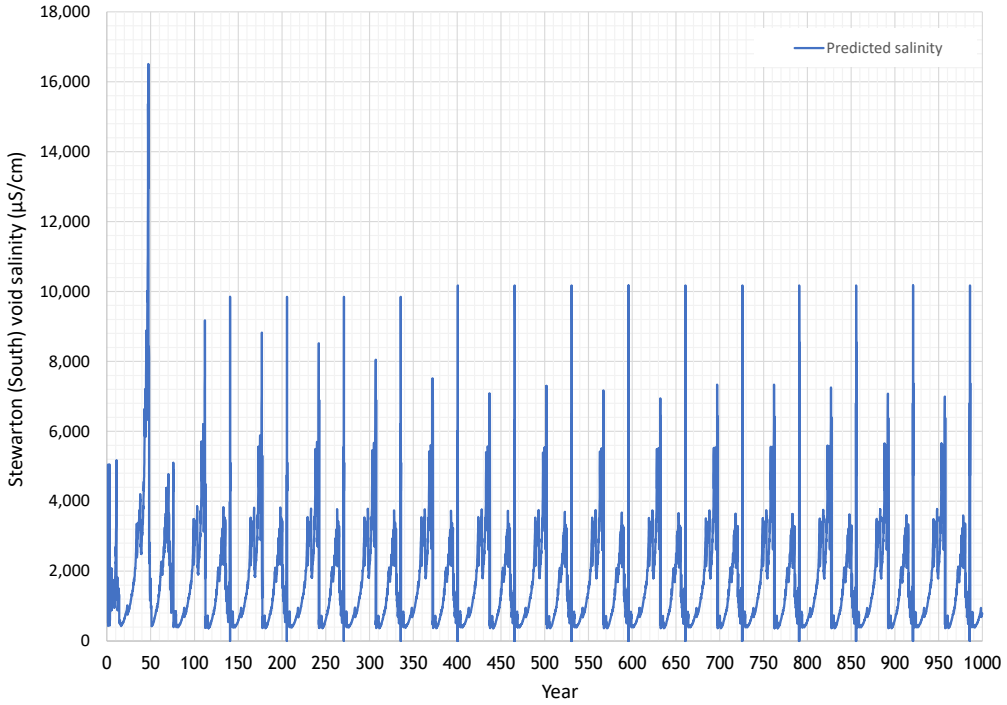


Figure 7.13 Stewarton South void – long-term predicted final void water salinity (HydroBalance, 2026)

8 FLOOD IMPACT ASSESSMENT

8.1 OVERVIEW

8.1.1 Previous studies

Hydrologic models were developed using the Unified River Basin Simulator (URBS) (Carroll, 2024) runoff-routing software to estimate design flood discharges in the vicinity Project for various scenarios. Hydraulic models were developed using the Two-dimensional Unsteady FLOW (TUFLOW) hydrodynamic modelling software (BMT Pty Ltd, 2018) to estimate design flood levels, depths, extents and velocities in the vicinity of the Project for various scenarios.

Whitehaven Blackwater provided the XP-RAFTS hydrologic and TUFLOW hydraulic models used for the *Blackwater Mine Flood Study* (GHD Group Pty Ltd [GHD], 2021) and the *Blackwater Mine Progressive Rehabilitation and Closure Plan – Rehabilitation Flood Assessments* (SLR, 2024). Upon review, the SLR (2024) flood models appear to have been developed based on the GHD (2021) flood models.

8.1.2 Hydrologic and hydraulic modelling approach

8.1.2.1 Overview

The URBS models were calibrated to recorded rainfall and water level data for the March 2017 and January 2020 events where suitable data is available. Design event hydrologic modelling was undertaken in accordance with Australian Rainfall and Runoff (ARR) 2019 Version 4.2 (Ball et al., 2019) and includes the latest guidance on climate change considerations.

The SLR (2024) hydraulic models were modified to incorporate the most recent Light Detection and Ranging (LiDAR) topographic data (obtained after the GHD [2021] and SLR [2024] studies), as well as updated design inflows from the new URBS hydrologic models described in Section 8.2 and Appendix A.

8.1.2.2 Modelled scenarios

The URBS hydrologic and TUFLOW hydraulic models were developed to simulate riverine flooding in the vicinity of the Project for the following three scenarios:

- 'Existing conditions' – This scenario represents the existing BWM configuration and was adopted as the baseline conditions.
- 'Proposed (Project) conditions' – This scenario represents the proposed BWM configuration incorporating the maximum disturbance area associated with the Project and associated flood protection levees. However, areas outside of the Project area are assumed unchanged from existing conditions.
- 'Final landform conditions' – This scenario represents the BWM configuration pot-closure, incorporating the final landform including the final voids.

8.1.3 Flood impact assessment approach

The hydrologic and hydraulic models were used to estimate design flood discharges, levels, depths, extents and velocities for a range of events from 50% (1 in 2) to 0.1% (1 in 1,000) AEP as well as the Probable Maximum Flood (PMF) event. AEP is a standard measure in floodplain management to define the likelihood of flooding. For instance, a 1% AEP flood has a 1% chance of occurring in any one year, which can also be described as having a 1 in 100 chance in any one year.

Table 8.1 provides a summary of the design flood event AEPs, and scenarios modelled in this SWA.

Table 8.1 Summary of modelled design flood event AEPs and scenarios

AEP % (1 in X)	Existing conditions (baseline) (year 2030 climate)	Proposed (Project) conditions (year 2030 climate)	Final landform conditions (year 2100 climate)
50% (1 in 2)	✓	✓	X
5% (1 in 20)	✓	✓	X
2% (1 in 50)	✓	✓	X
1% (1 in 100)	✓	✓	✓
0.1% (1 in 1,000)	✓	✓	✓
PMF	X	X	✓

The existing conditions flood model results was used to establish the baseline conditions at BWM without the Project, for the 50% to 0.1% AEP events (refer to Section 8.4). The proposed (Project) conditions flood model results was used to assess the flood immunity of the extended open cut pits for all events up to 0.1% AEP.

The impacts of the Project on flood levels and velocities were assessed by comparing design flood levels and velocities between existing and proposed (Project) conditions for the 50% AEP to 0.1% AEP events. The flood impact of the Project was not assessed for the PMF event.

The impact of the Project on waterway stability (geomorphology), including a hydraulic assessment of the proposed clean water drain adjacent to the Stewarton Pit expansion area, was assessed for the 50% AEP and 2% AEP events.

The final landform conditions model results for the 1% AEP, 0.1% AEP and PMF events were used to assess the flood immunity of the final voids and the stability of the rehabilitated dump landforms under extreme flooding conditions.

8.2 ESTIMATION OF DISCHARGES

8.2.1 Overview

URBS hydrologic models were developed to estimate design discharges within the Blackwater Creek catchment (including Taurus Creek and Two Mile Gully) and the Sagittarius Creek catchment.

The Blackwater Creek URBS model was calibrated to recorded data for the March 2017 and January 2020 flood events. The Sagittarius Creek URBS model could not be calibrated due to the absence of any stream gauges within the catchment. Design peak discharges from both models were validated against estimates derived using the Rational Method, the Quantile Regression Technique (Palmen and Weeks, 2015) and the Regional Flood Frequency Estimation method.

Details of the URBS model development, calibration and validation are provided in Appendix A.

The URBS hydrologic models were then used to estimate design discharges for the following design flood events:

- 50% (1 in 2) AEP;
- 5% (1 in 20) AEP;
- 2% (1 in 50) AEP;

- 1% (1 in 100) AEP;
- 0.1% (1 in 1,000) AEP; and
- Probable Maximum Precipitation.

8.2.2 Climate change considerations

In August 2024, ARR was updated to include additional guidance on the incorporation of the impacts on climate change on flood estimates. The guidance has been developed from the latest IPCC temperature projections based on SSPs that cover a broad range of potential future development options. The SSPs are designated low (SSP1-2.6), medium (SSP2-4.5), high (SSP3-7.0) and very high (SSP5-8.5) emissions pathways and have been projected out to 2100.

The IPCC guidance is that temperatures have already risen by one degree since the development of the 2016 intensity frequency-duration (IFD) data. As a result, design rainfall IFDs for existing conditions were scaled up using uplift factors obtained from ARR datahub[1], corresponding to the near-term SSP5-8.5 (year 2030) climate scenario. The associated pre-burst rainfalls were also scaled up accordingly. Similarly, design rainfall IFDs and associated pre-burst rainfalls for the final landform conditions were scaled up to the long-term SSP2-4.5 (year 2100) climate scenario.

The SSP5-8.5 climate adjustments account for approximately 1.3°C of predicted global warming for the current and near-term (2021-2040) since the historical baseline period of 1961-1990. The SSP2-4.5 climate adjustments account for approximately 2.4°C of predicted global warming for the current and near-term (2081-2100) for the same historical baseline period.

Table 8.2 shows the corresponding design rainfall uplift factors for various storm durations (as percentage increases compared to the baseline IFD data [Bureau, 2016]).

Table 8.2 Adopted design rainfall uplift factors

Storm duration	Rainfall uplift factor	
	SSP5-8.5 year 2030	SSP2-4.5 year 2100
<1 Hour	20%	41%
1.5 Hours	18%	37%
2 Hours	17%	35%
3 Hours	16%	32%
4.5 Hours	14%	29%
6 Hours	13%	27%
9 Hours	13%	25%
12 Hours	12%	24%
18 Hours	11%	22%
>24 Hours	11%	21%

[1] https://data.arr-software.org/

8.2.3 Design discharges

Table 8.3 and Table 8.4 show the URBS modelled peak design discharges at Taurus Creek (BWC_03) and Two Mile Gully (TMG) (as shown in Figure 8.1). Table 8.4 and Table 8.6 show the corresponding critical storm durations at BWC_03 and TMG, respectively.

Table 8.3 Design discharge estimates at location BWC_03

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)	Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)
50% (1 in 2)	166	n/a
5% (1 in 20)	398	n/a
2% (1 in 50)	488	n/a
1% (1 in 100)	562	863
0.1% (1 in 1,000)	901	1,361
PMF	4,006	6,219

Table 8.4 Adopted critical duration design storms at location BWC_03

AEP (%) (1 in X)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)		Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)	
	Critical duration (hours)	Representative temporal pattern	Critical duration (hours)	Representative temporal pattern
50% (1 in 2)	3	5	n/a	n/a
5% (1 in 20)	3	8	n/a	n/a
2% (1 in 50)	3	1	n/a	n/a
1% (1 in 100)	3	1	2	1
0.1% (1 in 1,000)	3	4	2	4
PMF	2	4	2	2

Table 8.5 Design discharge estimates at location TMG

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)	Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)
50% (1 in 2)	146	n/a
5% (1 in 20)	361	n/a
2% (1 in 50)	440	n/a
1% (1 in 100)	517	625
0.1% (1 in 1,000)	887	1,025
PMF	4,945	5,718

Table 8.6 Adopted critical duration design storms at location TMG

AEP (%)	Existing conditions (m^3/s) (SSP5-8.5 year 2030)		Post-mining conditions (m^3/s) (SSP2-4.5 year 2100)	
	Critical duration (hours)	Representative temporal pattern	Critical duration (hours)	Representative temporal pattern
50% (1 in 2)	3	3	n/a	n/a
5% (1 in 20)	3	8	n/a	n/a
2% (1 in 50)	4.5	9	n/a	n/a
1% (1 in 100)	6	10	3	1
0.1% (1 in 1,000)	6	4	4.5	4
PMF	3	9	2	9

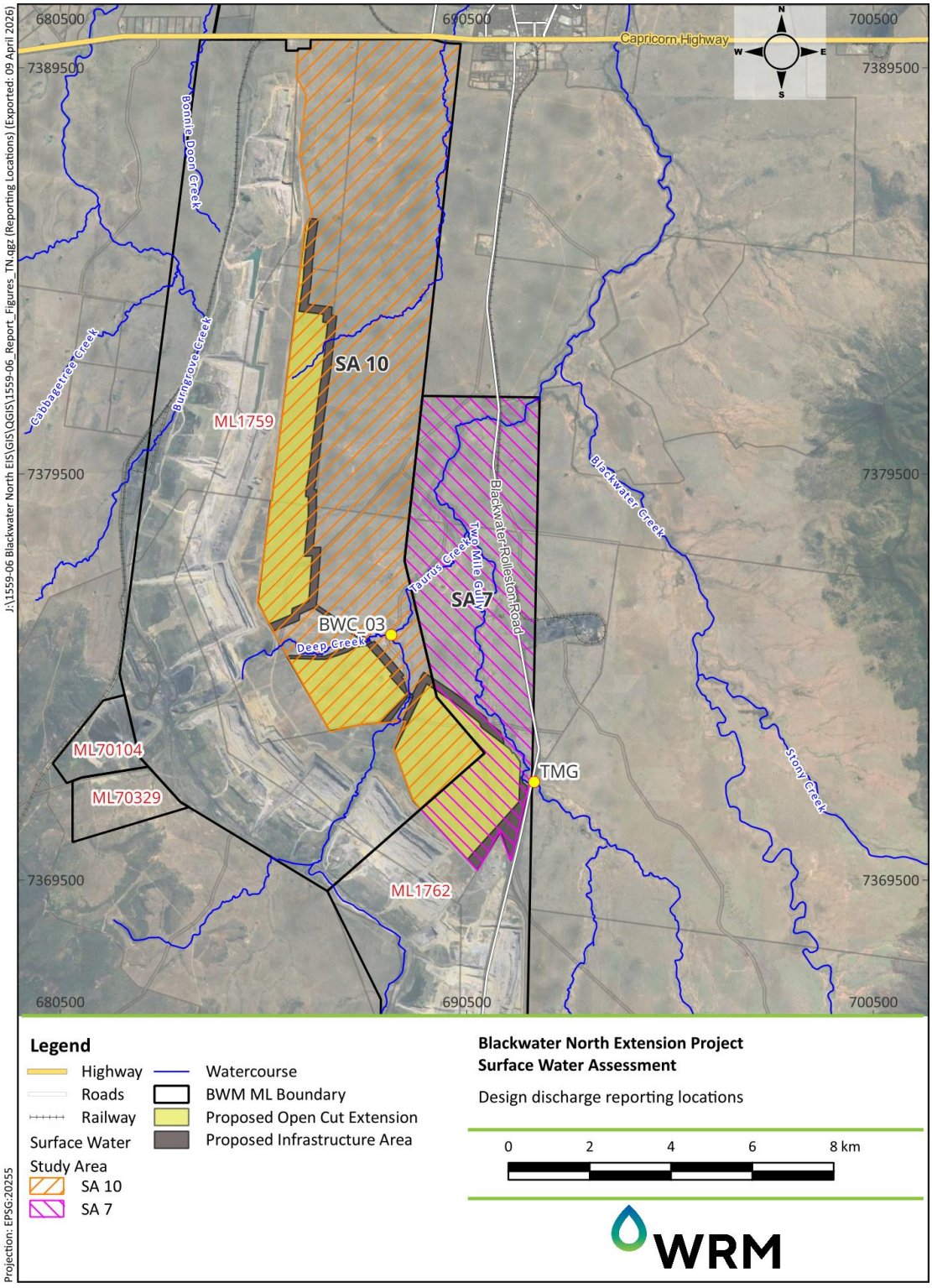


Figure 8.1 Design discharge reporting locations

8.3 HYDRAULIC MODEL DEVELOPMENT

8.3.1 Overview

TUFLOW hydraulic models for Blackwater Creek (including Taurus Creek, Deep Creek and Two Mile Gully) and Sagittarius Creek previously developed by SLR (2024) as part of the BWM PRCP flood assessment, was updated and used for this assessment. Design discharges from the URBS hydrologic models described in Section 8.2 and Appendix A, were applied as inflows to the TUFLOW hydraulic models.

TUFLOW hydraulic models were developed for the following three scenarios:

- 'Existing conditions' – This scenario represents the existing BWM configuration and was adopted as the baseline conditions.
- 'Proposed (Project) conditions' – This scenario represents the proposed BWM configuration incorporating the maximum disturbance area associated with the Project. However, areas outside of the Project area are assumed unchanged from existing conditions.
- 'Final landform conditions' – This scenario represents the BWM configuration post-closure, incorporating the final landform including the final voids within the Project area.

8.3.2 TUFLOW model configuration

8.3.2.1 Extent and topography

The configuration and extent of the TUFLOW hydraulic models developed for this SWA are shown in the following figures:

- For Blackwater Creek (including Taurus Creek and Two Mile Gully):
  - Figure 8.2 for existing conditions;
  - Figure 8.3 for proposed (Project) conditions; and
  - Figure 8.4 for the final landform;
- For Sagittarius Creek:
  - Figure 8.5 for existing conditions; and
  - Figure 8.6 for proposed (Project) conditions.

The TUFLOW models were configured with a grid cell size resolution of 5 m. The base model topography in the models was configured using the following data:

- a 1 m resolution LiDAR data flown in 2024 (the 2024 LiDAR) for the majority of the TUFLOW model extent;
- a 1 m resolution LiDAR data flown in 2025 (the 2025 LiDAR) for areas in the vicinity of the active mining areas, including recent updates to the NTCD;
- a 1 m resolution DEM embedded in previous SLR (2024) hydraulic models provided by Whitehaven Blackwater, for areas not covered by the 2024 and 2025 LiDAR;
- a 30 m resolution Copernicus DEM sourced from the Copernicus Open Access Hub, for areas not covered by the available 1 m LiDAR data; and
- flood protection levees proposed around the proposed Project voids.

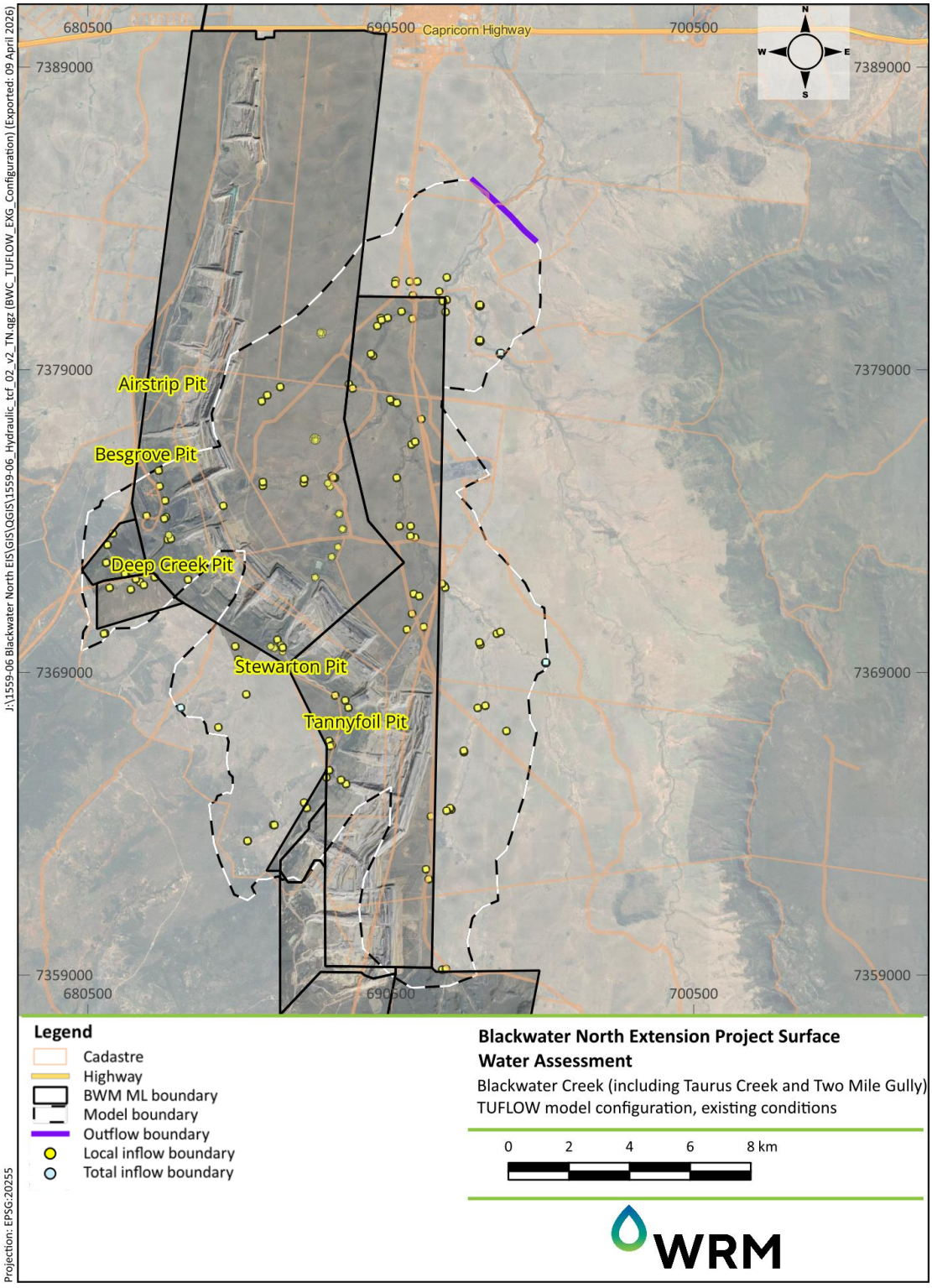


Figure 8.2 **Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, existing conditions**

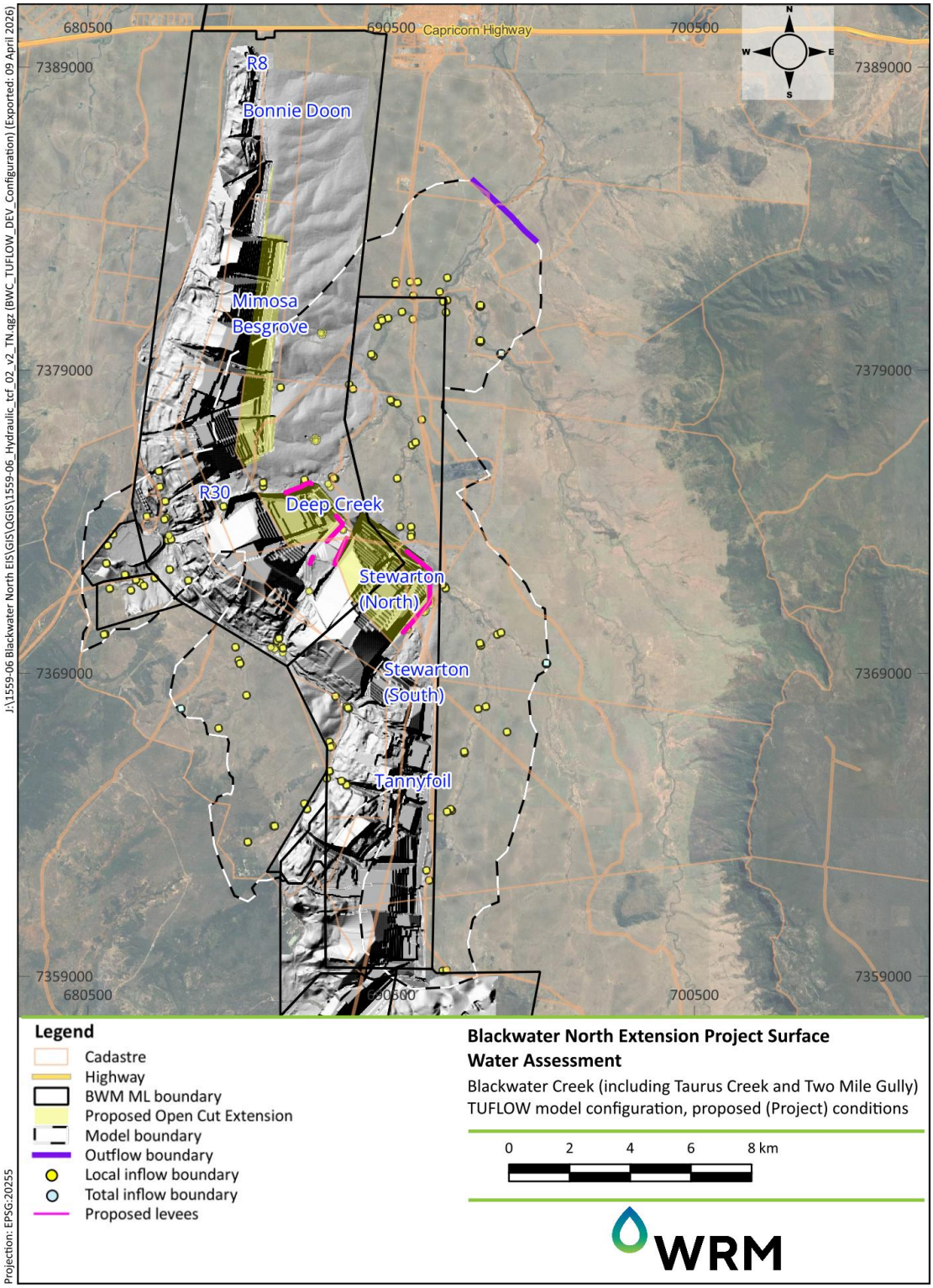


Figure 8.3 **Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, proposed (Project) conditions**

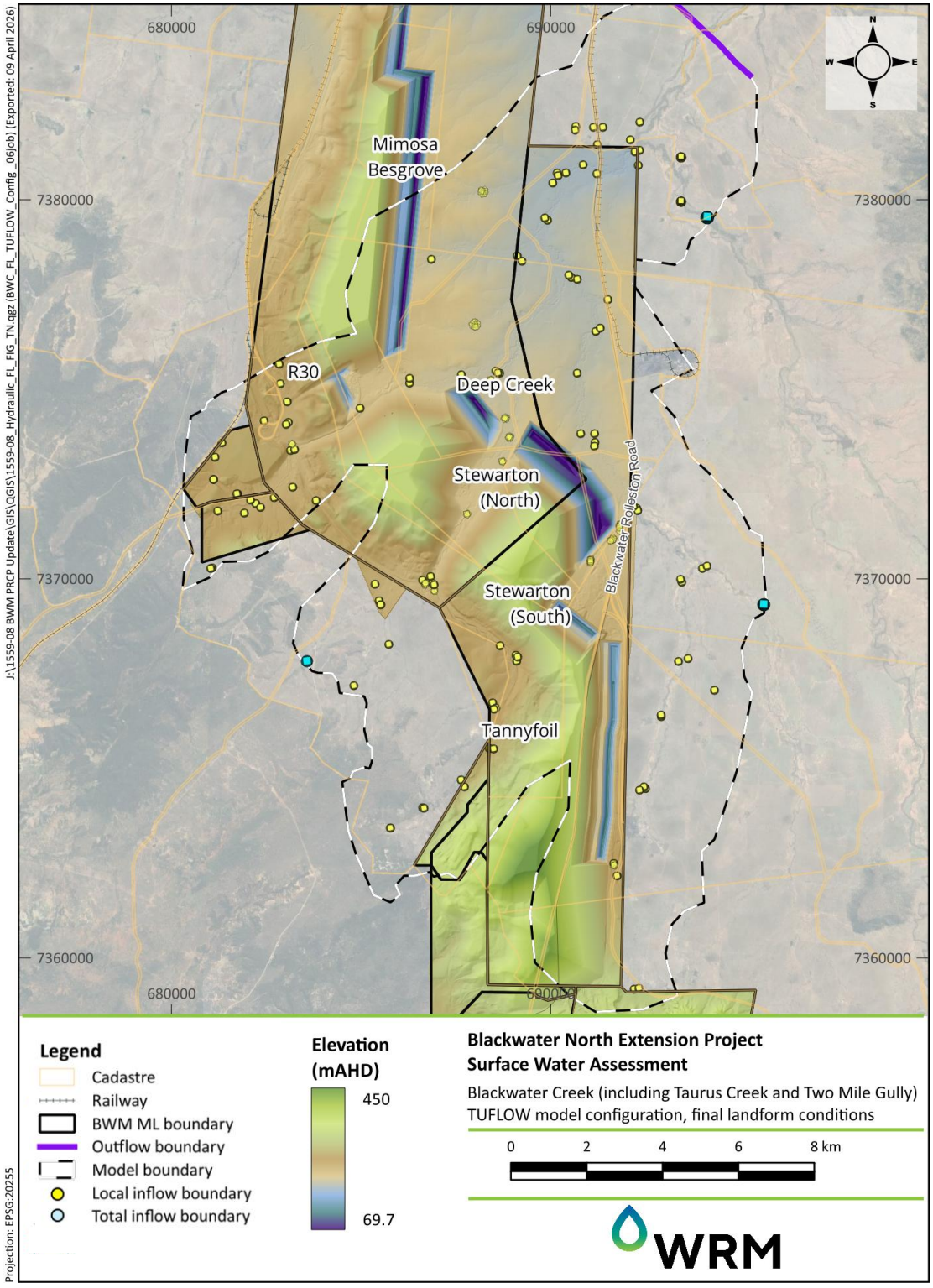


Figure 8.4 **Blackwater Creek (including Taurus Creek and Two Mile Gully) TUFLOW model configuration, final landform conditions**

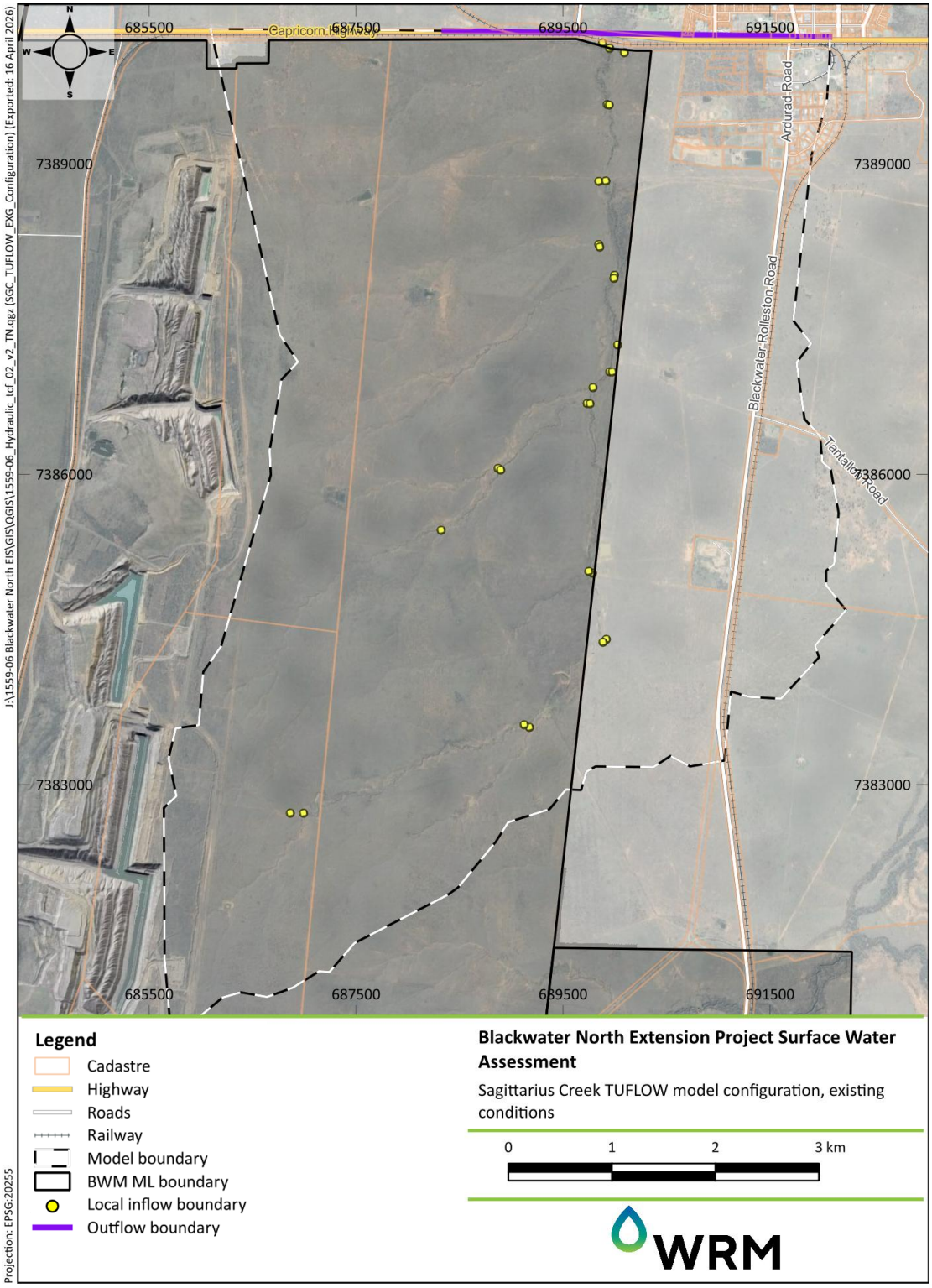


Figure 8.5 Sagittarius Creek TUFLOW model configuration, existing conditions

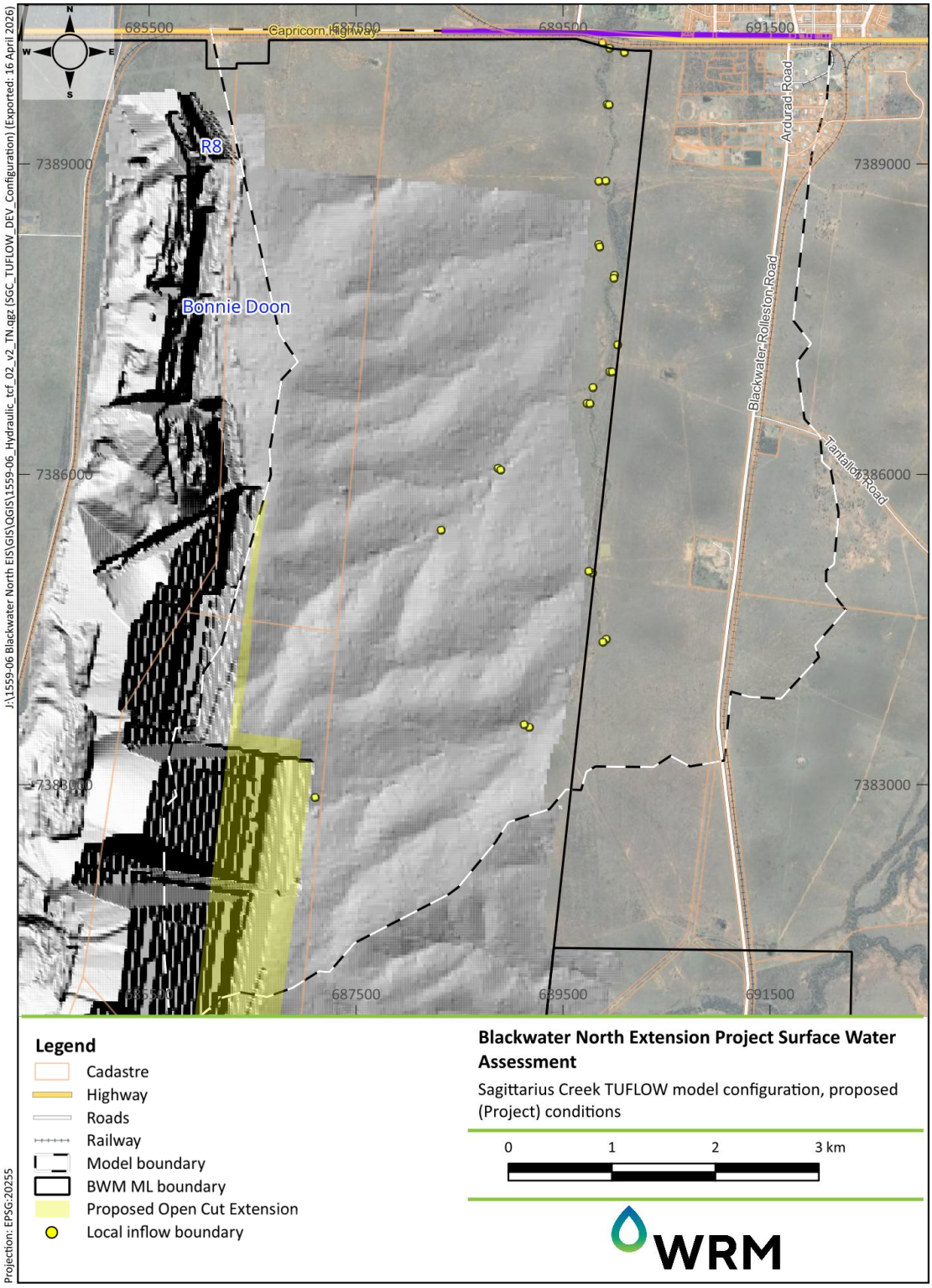


Figure 8.6 **Sagittarius Creek TUFLOW model configuration, proposed (Project) conditions**

8.3.2.2 Inflow and outflow boundaries

Design discharge hydrographs from the URBS hydrologic models (described in Section 8.2 and Appendix A) were applied as inflows to the TUFLOW hydraulic models.

The flow boundaries included in the models are as follows:

1. Blackwater Creek (including Taurus Creek, Deep Creek and Two Mile Gully) (BWC):
    - a total of 129 local inflow boundaries representing inflows from the URBS subcatchments within the hydraulic model boundary;
    - three total inflow boundary representing total inflows from URBS subcatchments outside of hydraulic model boundary; and
    - one 'stage-discharge' downstream outflow boundary, with a fixed downstream flood slope of 0.13%.
2. Sagittarius Creek (SGC):
    - a total of 27 local inflow boundaries representing inflows from the URBS subcatchments within the hydraulic model boundary; and
    - one 'stage-discharge' (HQ) type downstream outflow boundary, with a fixed downstream flood slope of 0.12%.

8.3.2.3 Hydraulic structures

Hydraulic structures including culverts were incorporated into the hydraulic model as one-dimensional network objects embedded within the two-dimensional domain. The hydraulic structures included in the SLR (2024) hydraulic models were maintained in the updated model.

8.3.2.4 Hydraulic roughness

The TUFLOW model uses Manning's 'n' values to represent hydraulic resistance. Table 8.7 shows the adopted Manning's 'n' values in the models.

Table 8.7 Adopted hydraulic roughness coefficients

Land use	Adopted Mannings 'n'
Short grass	0.04
Bare land	0.03
Sparse trees	0.06
Dense trees	0.08
Tailings	0.03
Creeks	0.05
Hardstand	0.02
Access Haul Roads	0.03
Paved Roads	0.02
Rail embankment	0.03
Concrete	0.02
Rehabilitated landform	0.04

8.4 EXISTING CONDITIONS FLOODING

Figure 8.7 to Figure 8.11 are flood maps showing TUFLOW model predicted existing conditions flood extents, levels and depth along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% (1 in 2) AEP to 0.1% (1 in 1,000) AEP design events. Figure 8.12 to Figure 8.16 show the corresponding peak velocities (in metres per second [m/s]).

Figure 8.17 shows the TUFLOW model predicted existing conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.17 shows the corresponding 1% AEP peak velocities.

The model results show that, within the Project area (downstream of the existing mining pits):

- The waterway channels generally have less than 50% AEP flow capacity and overflows from the channel would occur for all modelled events. A significant portion of flood flows would be conveyed along the floodplain for all events ≥50% AEP.
- Peak flood depths along Deep Creek and Tarus Creek (upstream of the Two Mile Gully confluence) are generally less than 1 m along the flood plains and >1 m along the channels for all events up to 1% AEP. Flood depths along Two Mile Gully and Tarus Creek (downstream of the Two Mile Gully confluence) are generally deeper, with larger areas affected by flood depths >1 m for all events up to 1% AEP.
- The existing BWM mining operations are located outside of the Sagittarius Creek flood extent for all modelled events.

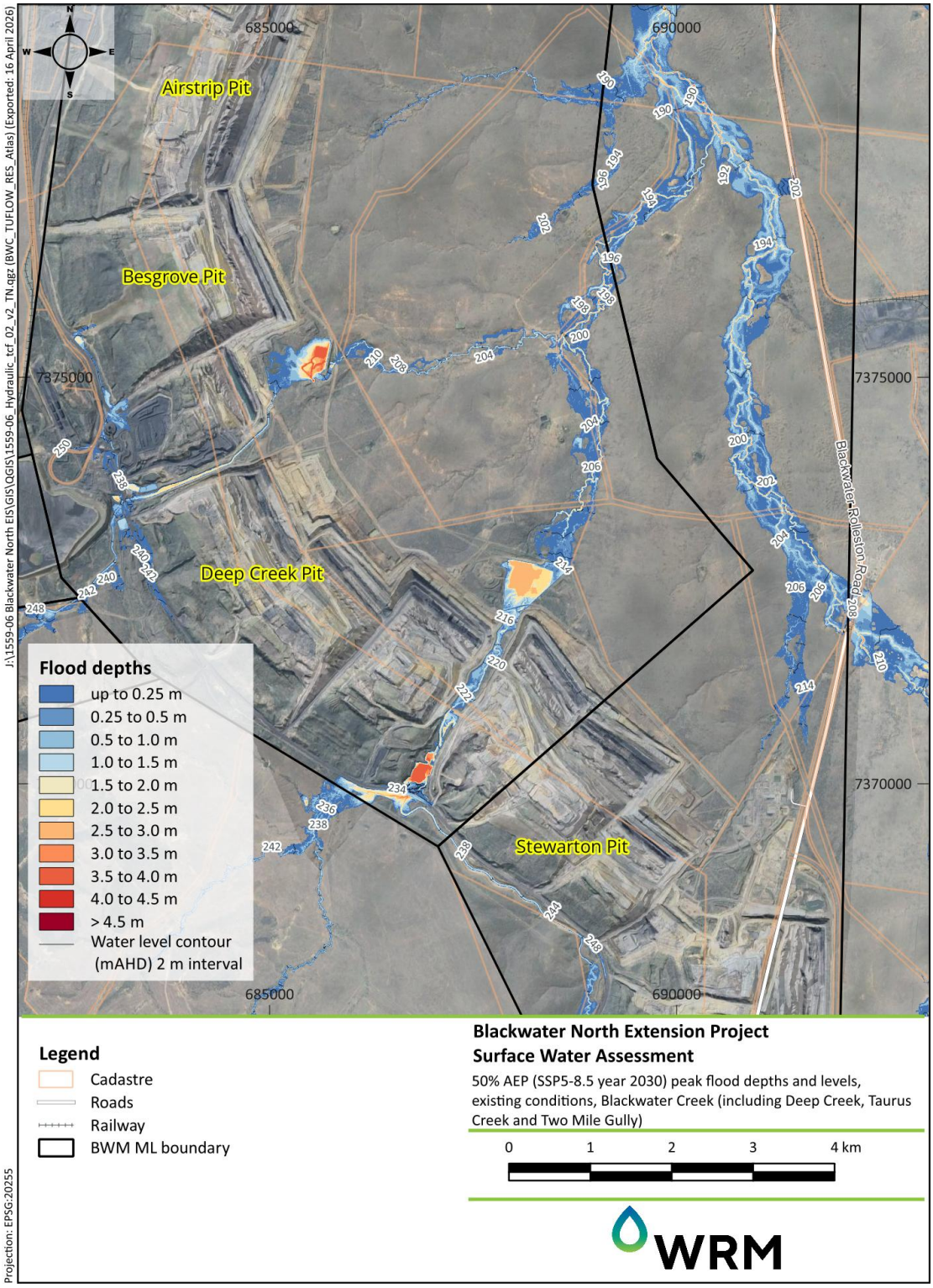


Figure 8.7 **50% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

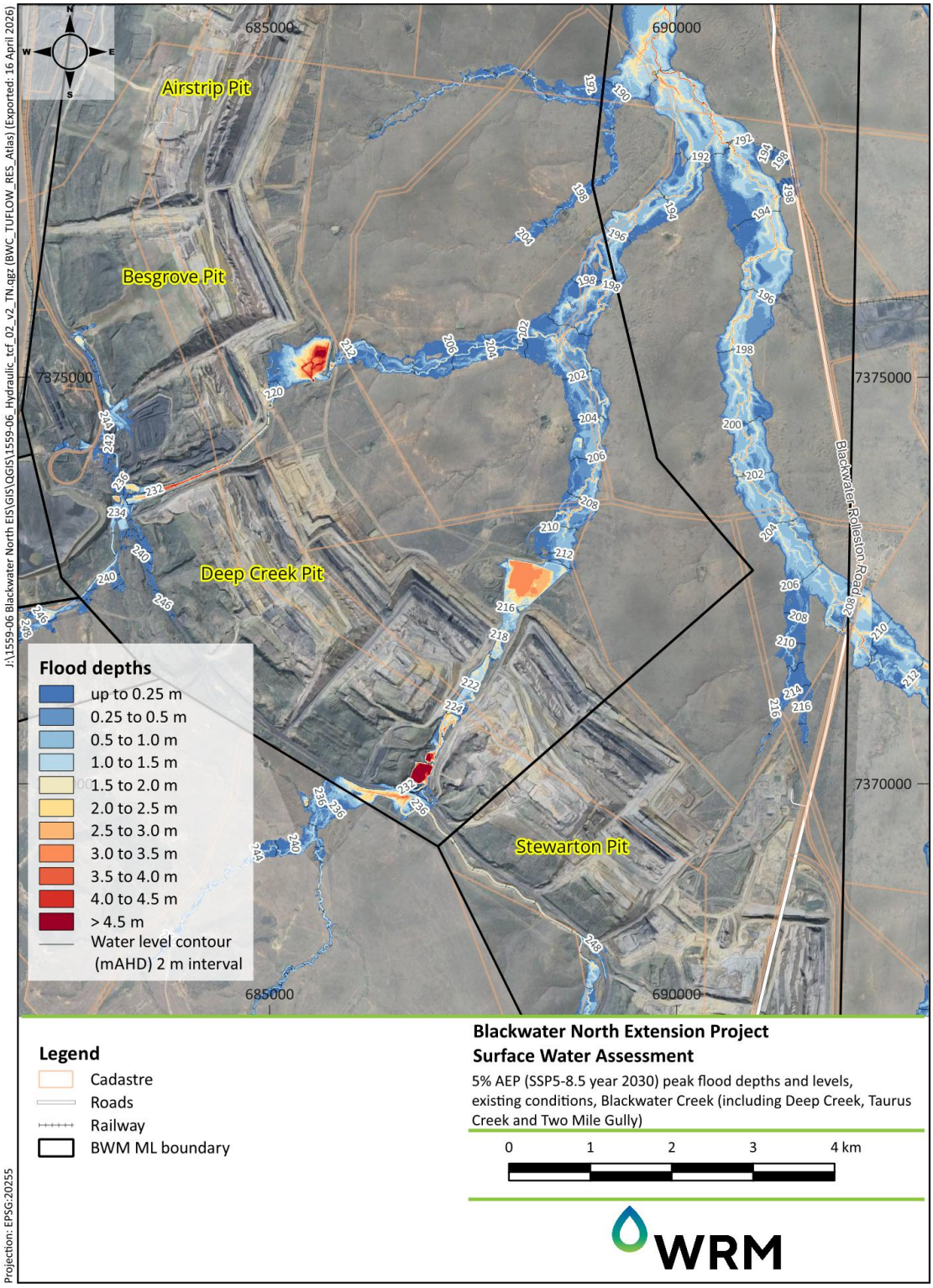


Figure 8.8 **5% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

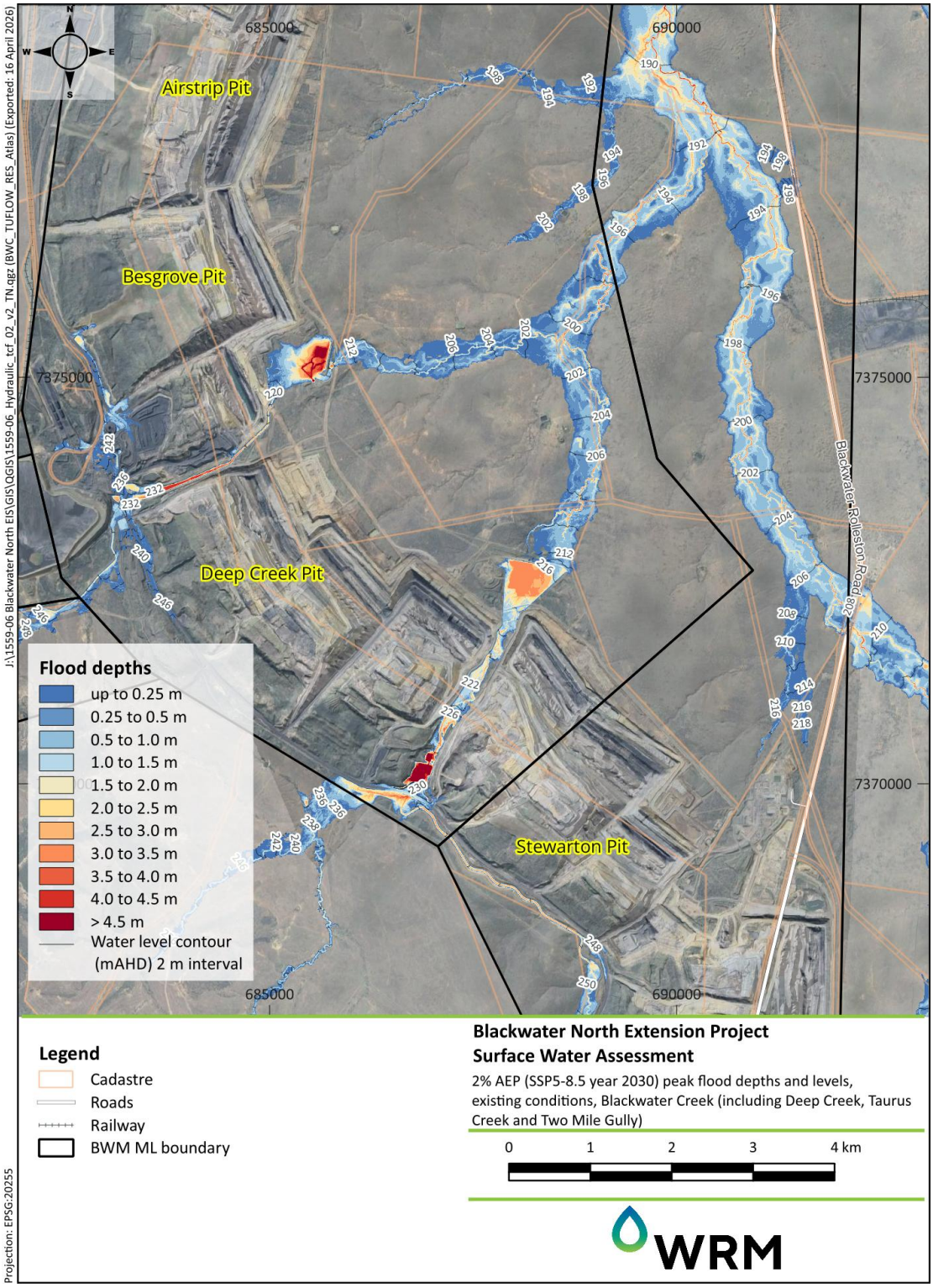


Figure 8.9 **2% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

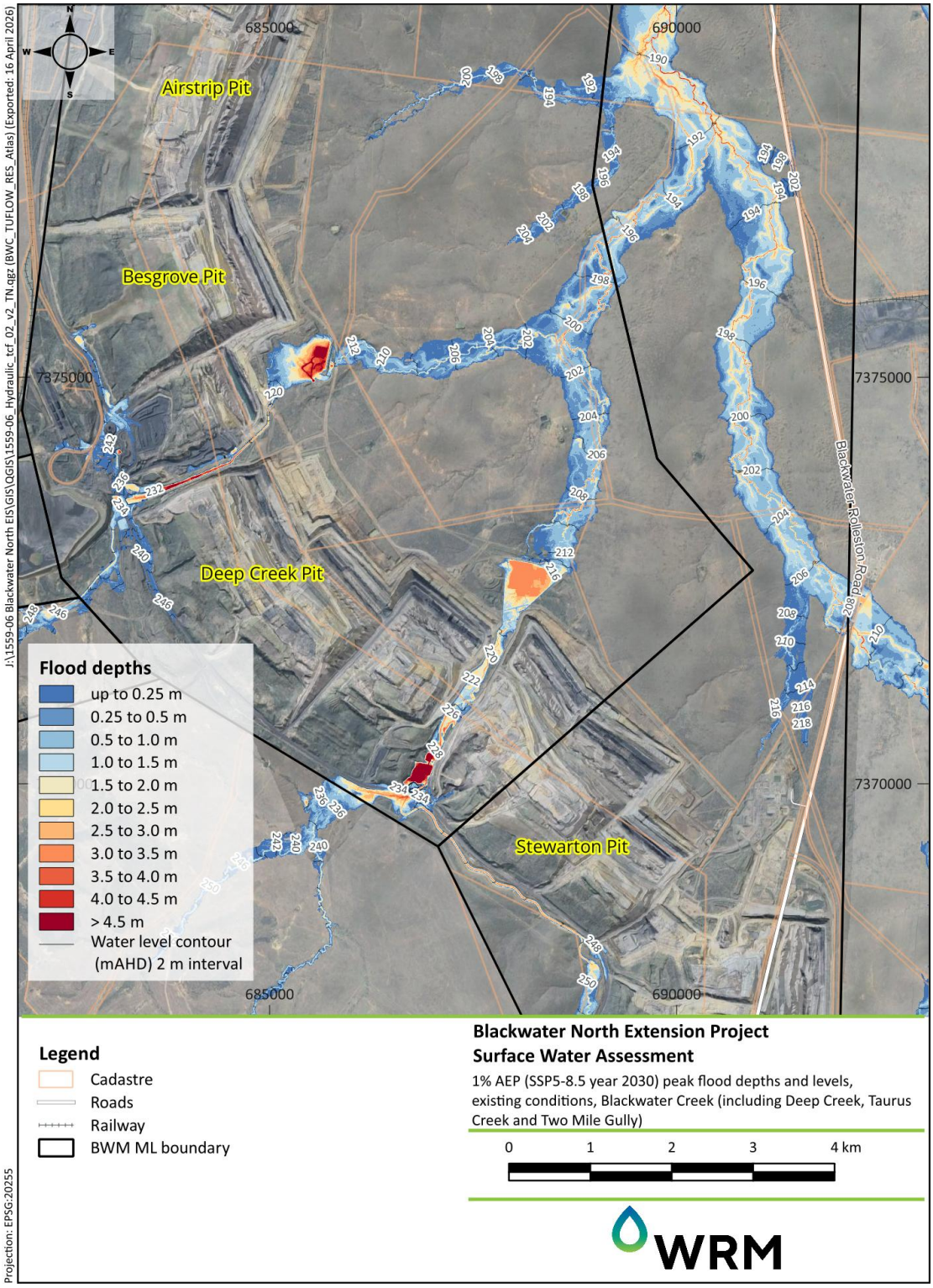


Figure 8.10 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

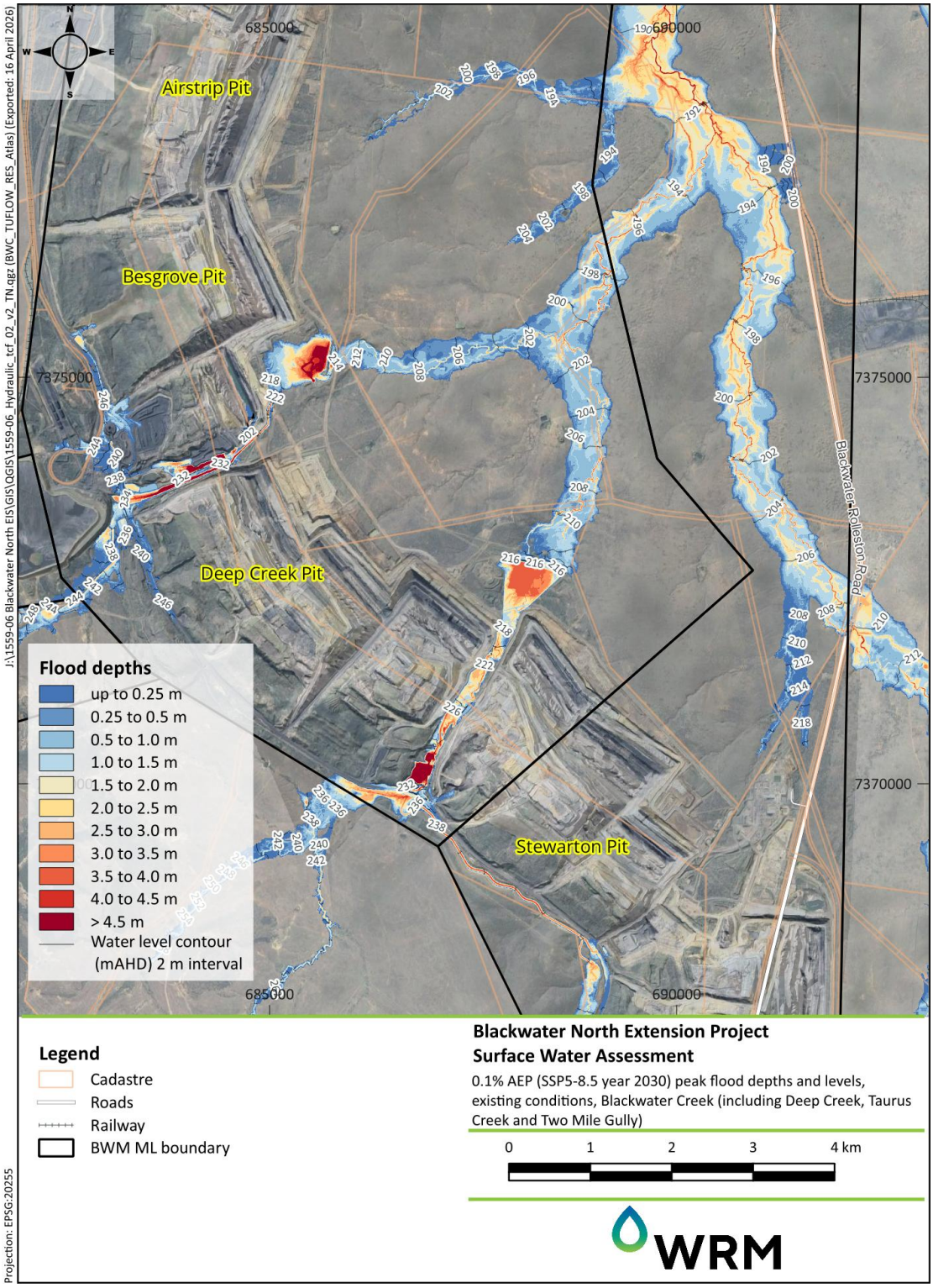


Figure 8.11 **0.1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

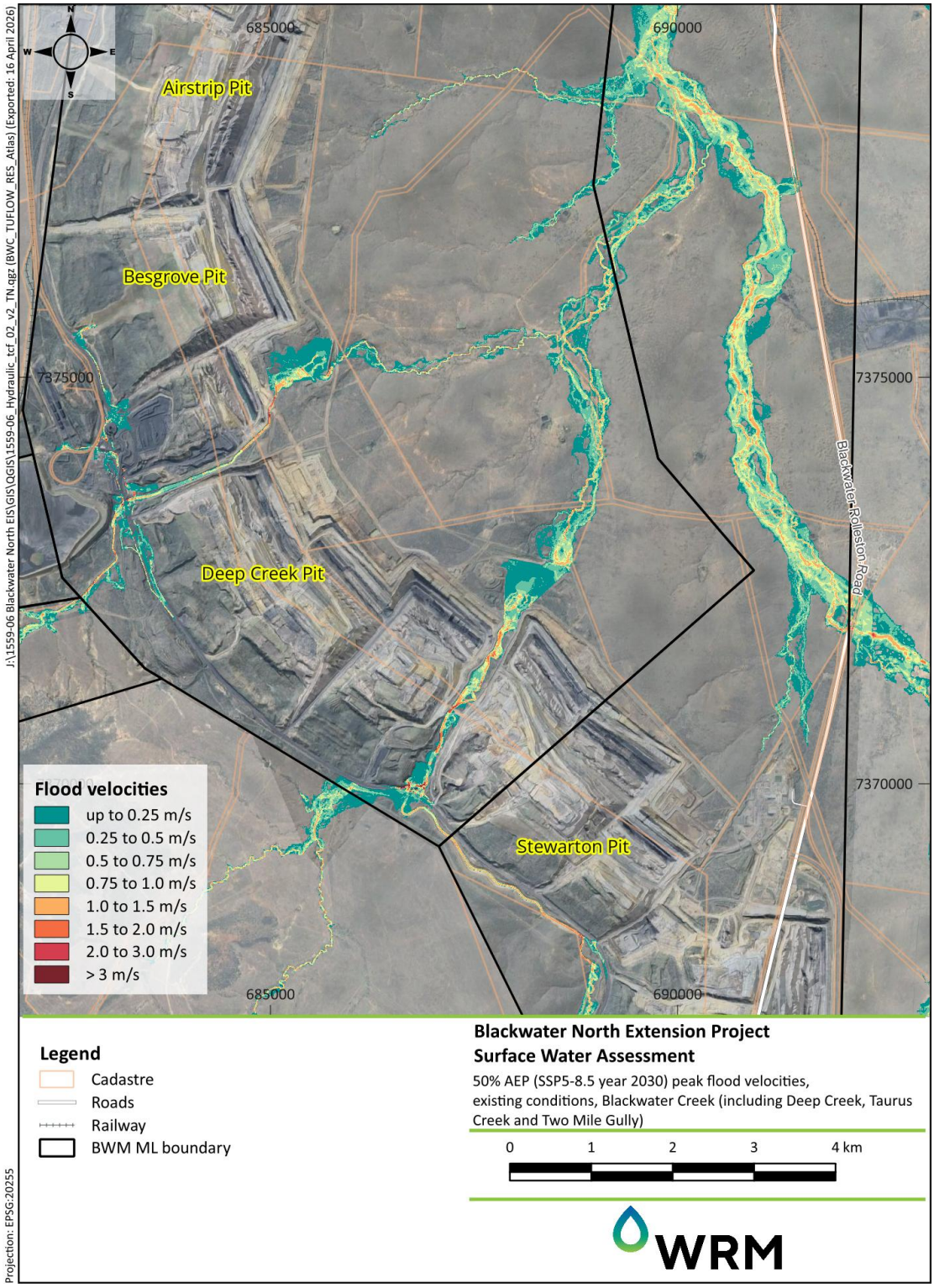


Figure 8.12 **50% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

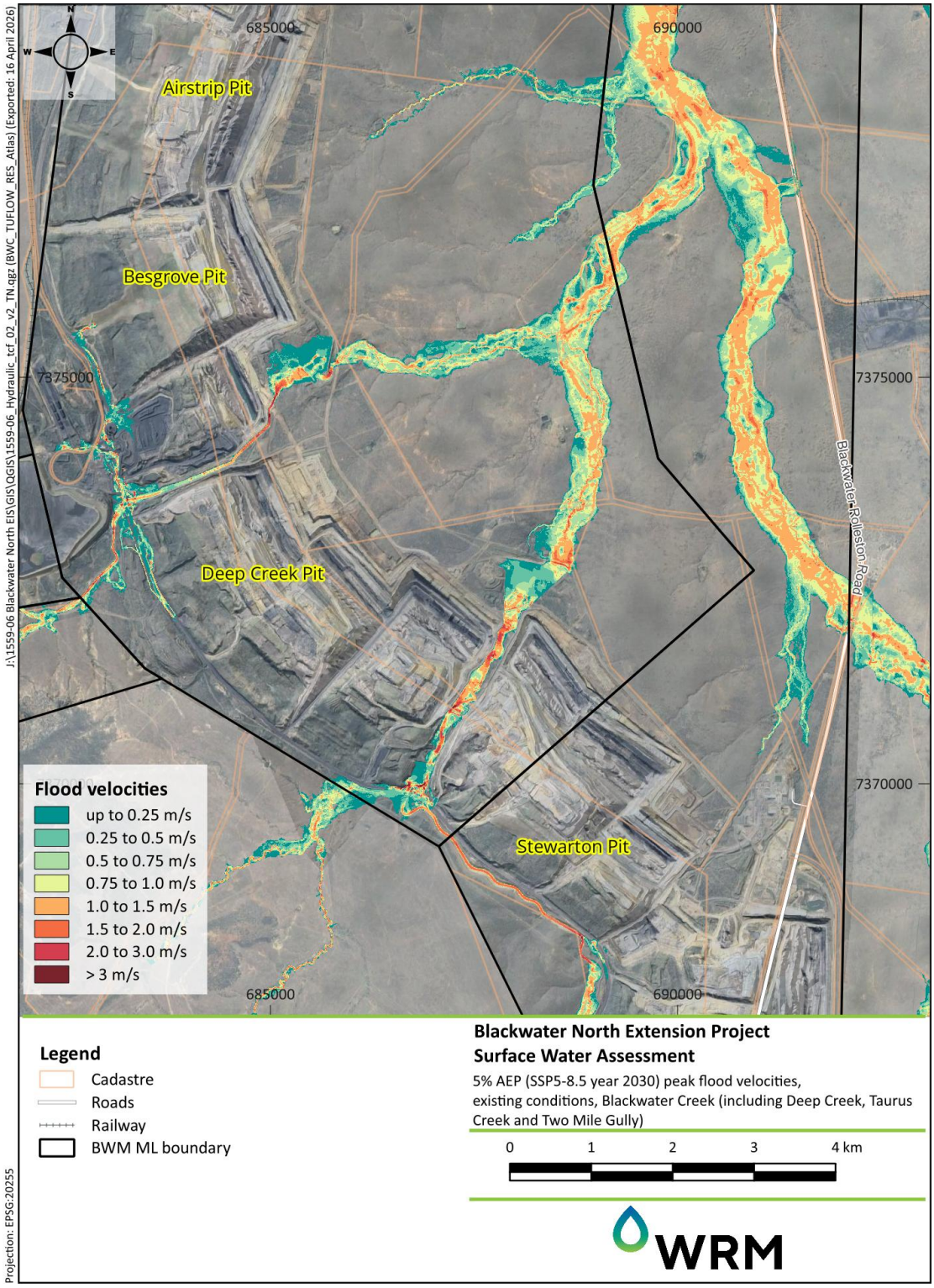


Figure 8.13 **5% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

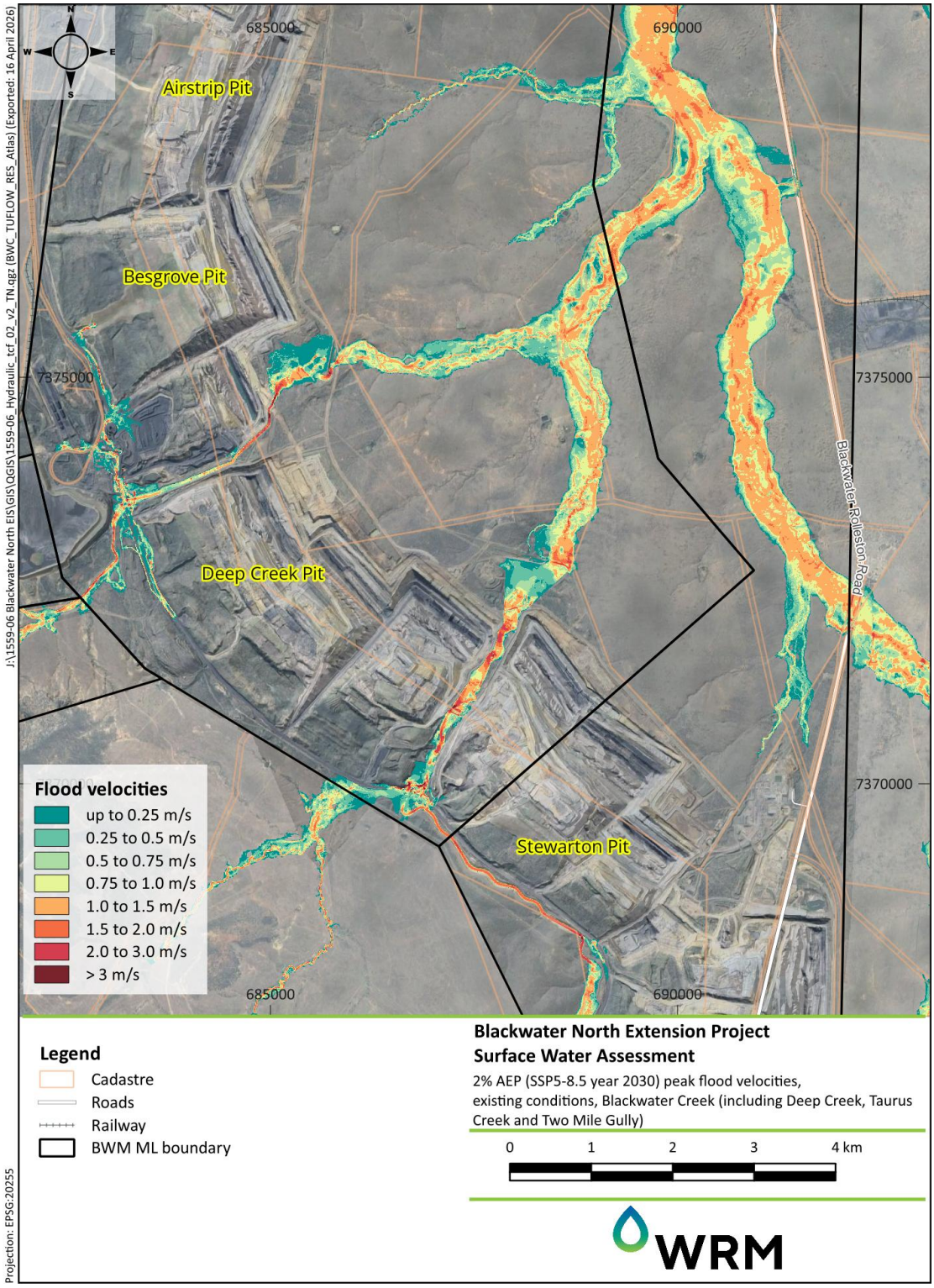


Figure 8.14 **2% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

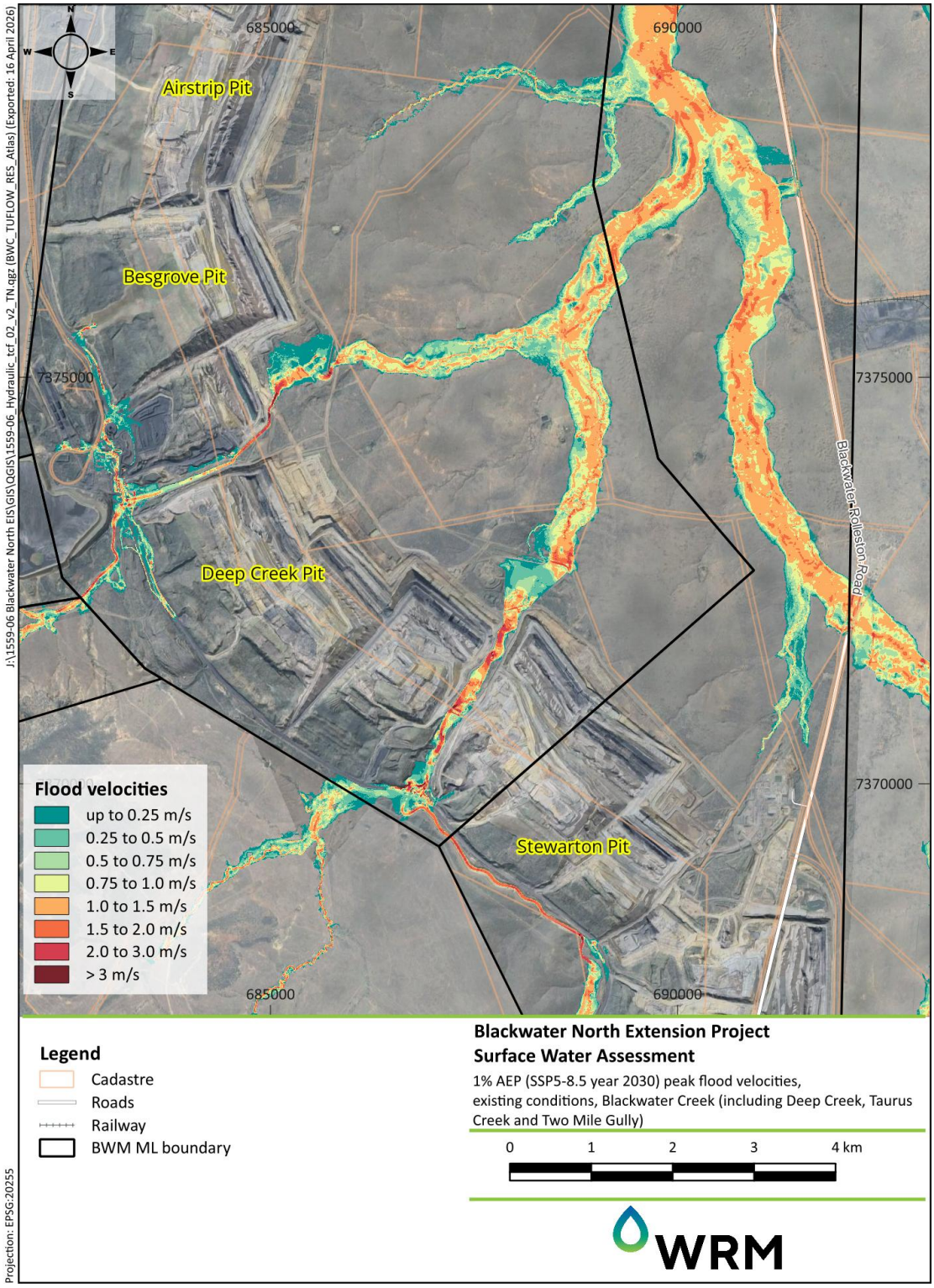


Figure 8.15 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

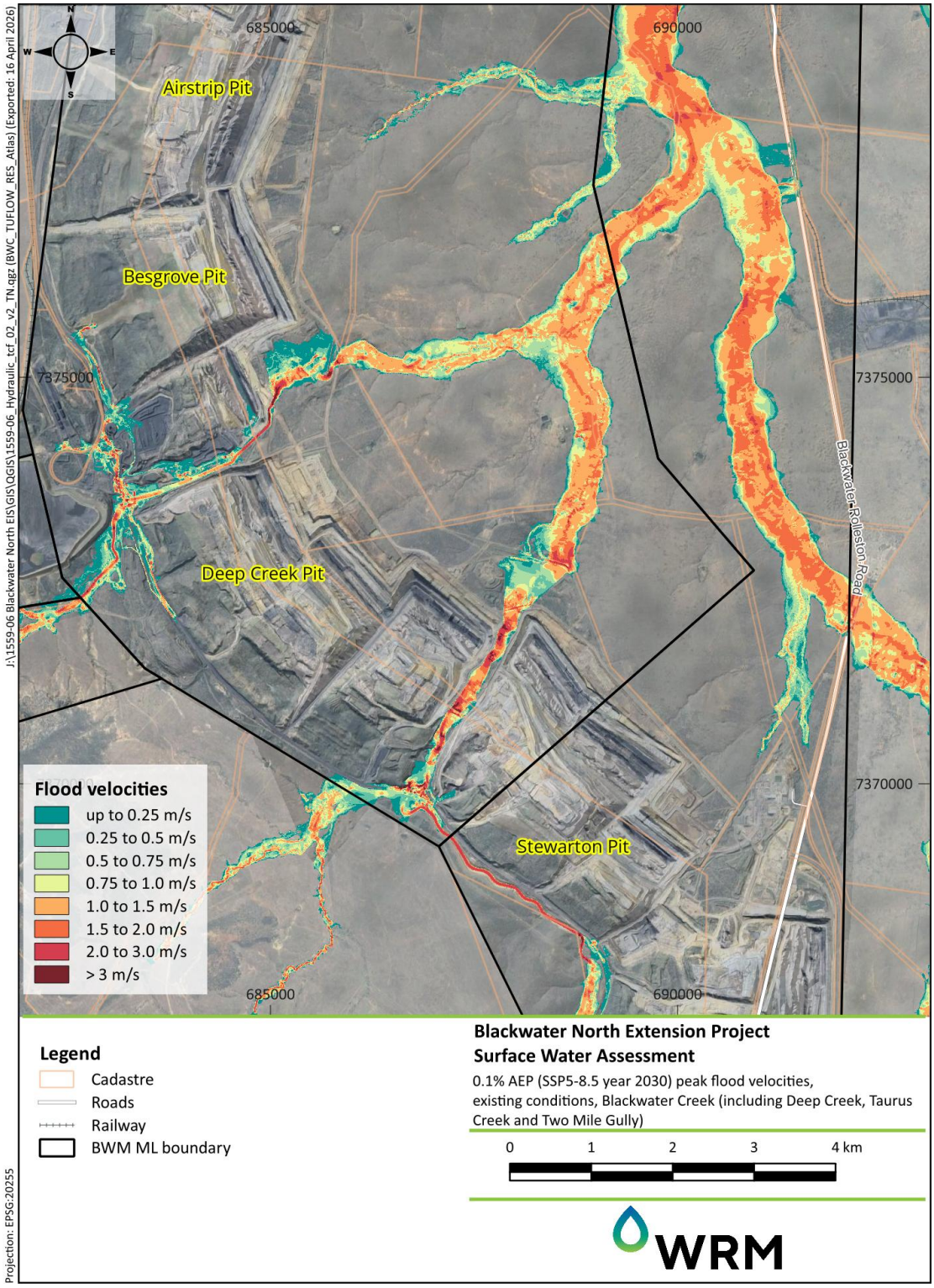


Figure 8.16 **0.1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

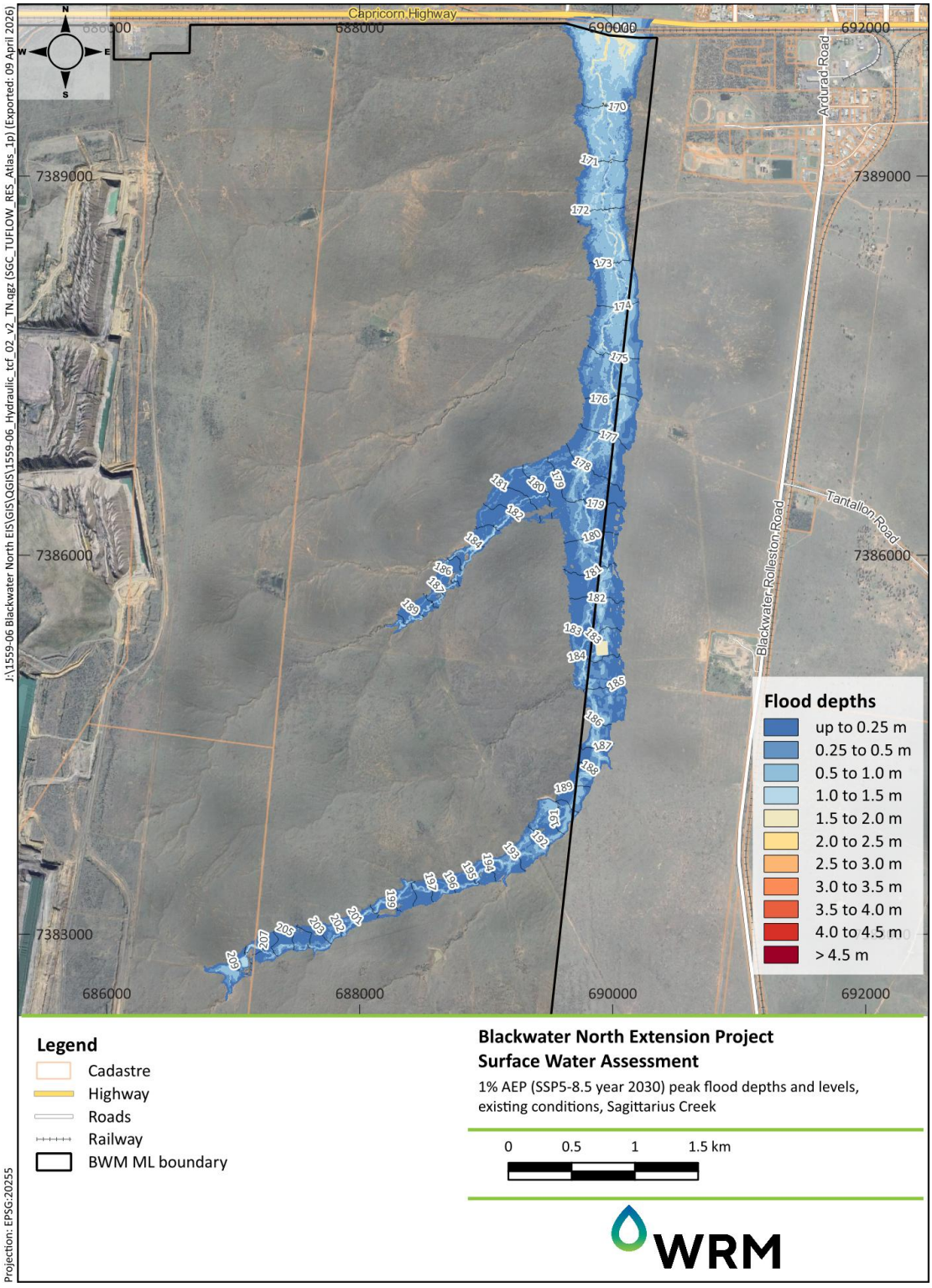


Figure 8.17 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, existing conditions, Sagittarius Creek**

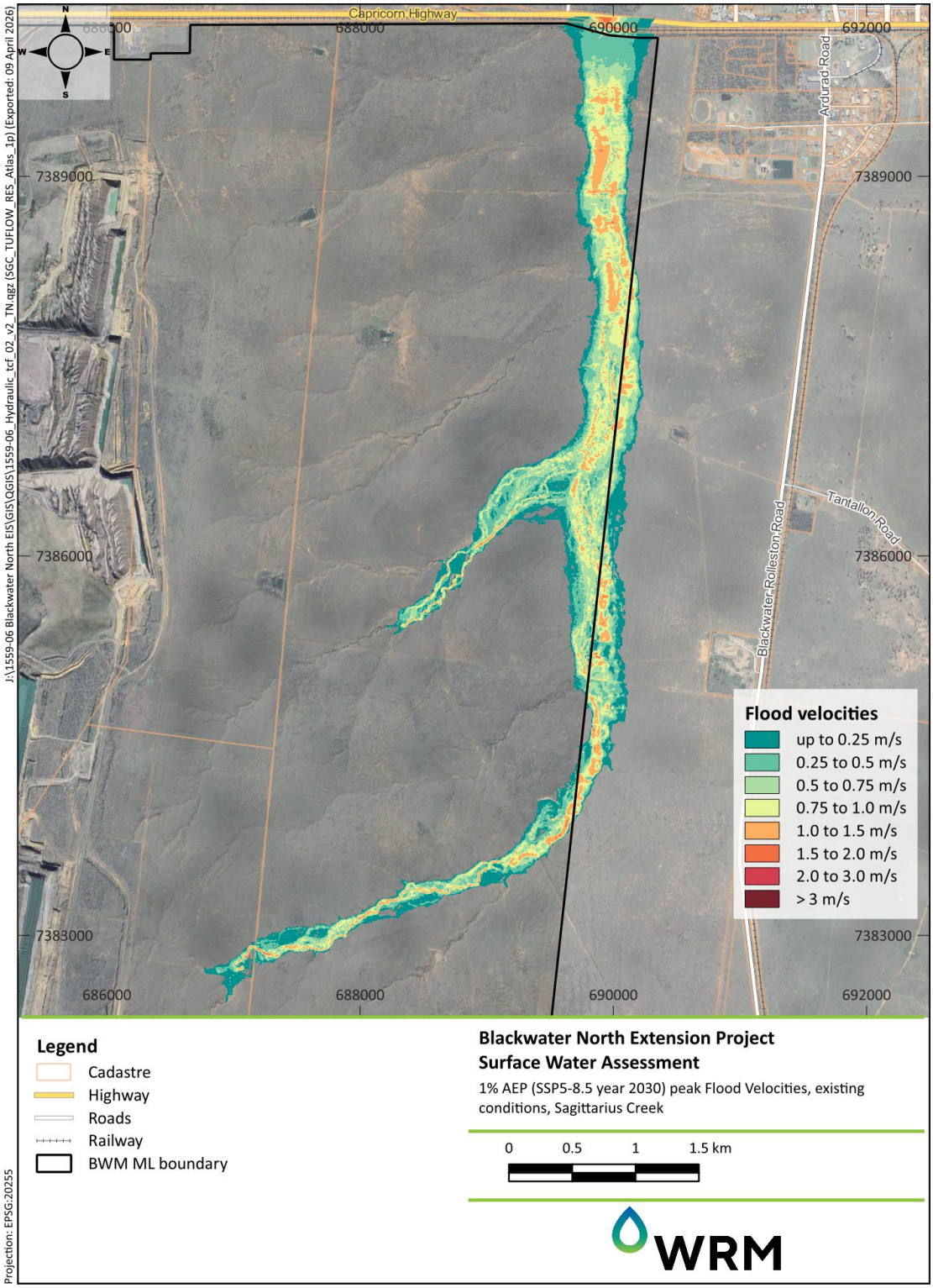


Figure 8.18 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, existing conditions, Sagittarius Creek**

8.5 PROPOSED (PROJECT) CONDITIONS FLOODING

Figure 8.19 to Figure 8.23 are flood maps showing TUFLOW model predicted proposed (Project) conditions flood extents, levels and depth along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% to 0.1% AEP design events. Figure 8.24 to Figure 8.28 show the corresponding peak velocities.

Figure 8.19 to Figure 8.28 shows the locations of the following proposed infrastructure:

- proposed temporary flood protection levees that would be in place during the maximum operational disturbance stage of the Project (year 2055). It was assumed that the proposed temporary levees would be constructed with crest levels at least 1 m above the adjacent 0.1% AEP peak flood level; and
- the proposed clean water drain along the southeastern side of the future Stewarton Pit extent, which would be in place during the operational stage of the Project and would also form part of the final landform post-closure.

Figure 8.29 shows the TUFLOW model predicted proposed (Project) conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.30 shows the corresponding 1% AEP peak velocities.

The model results show that, within the Project area:

- The proposed levees would provide the future mining pits with immunity from flooding for all events up to 0.1% (1 in 1,000) AEP.
- The proposed clean water drain would have capacity to convey flood flows from the unnamed Two Mile Gully tributary catchment, for all events up to and including 0.1% AEP.
- The Project maximum disturbance area is located outside of the Sagittarius Creek flood extent for all modelled events.

An assessment of impacts on peak flood levels, velocities and waterway stability due to the Project is provided in Section 8.6. A hydraulic assessment of the proposed clean water drain is provided in Section 8.7.3.

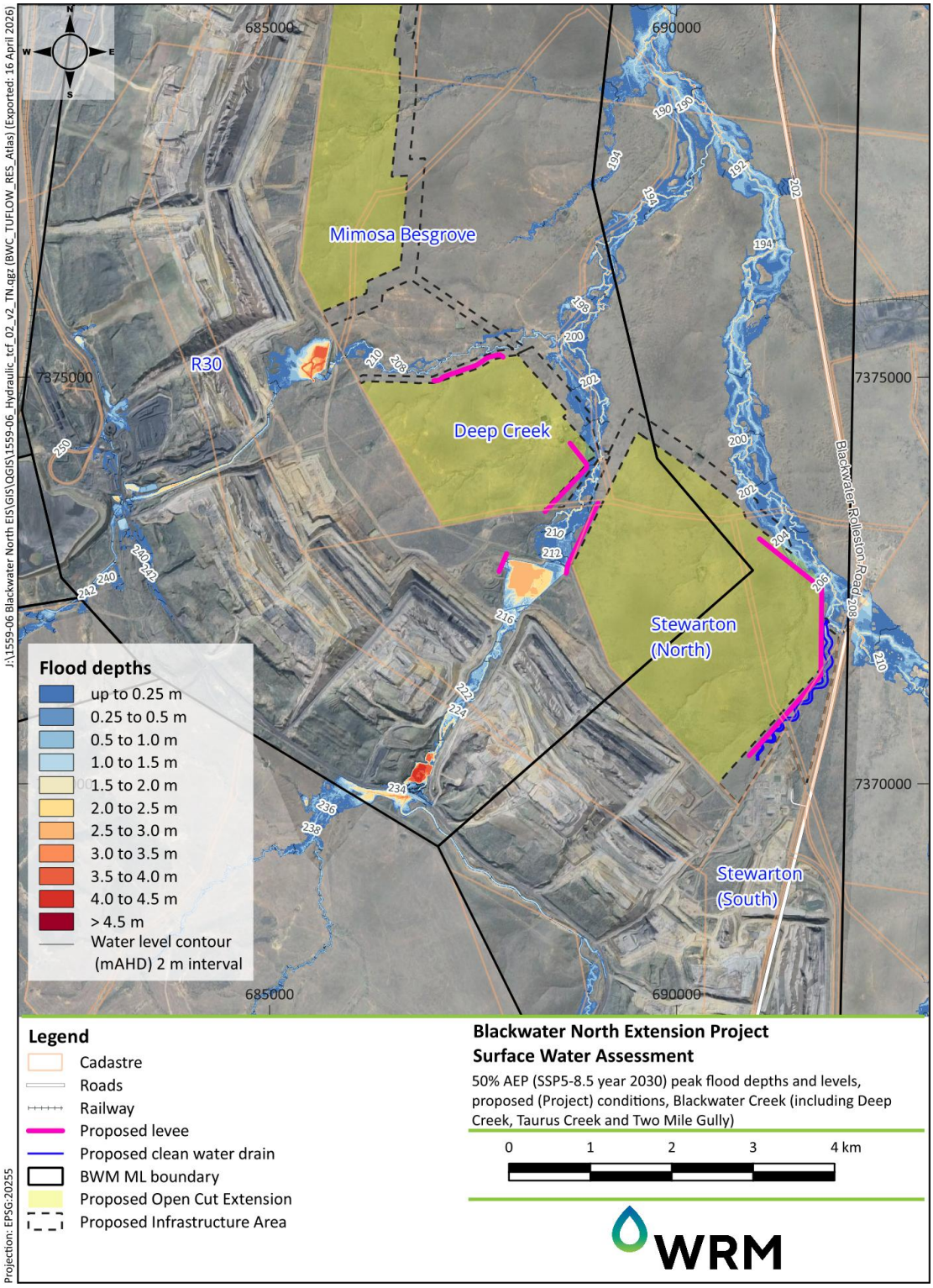


Figure 8.19 **50% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

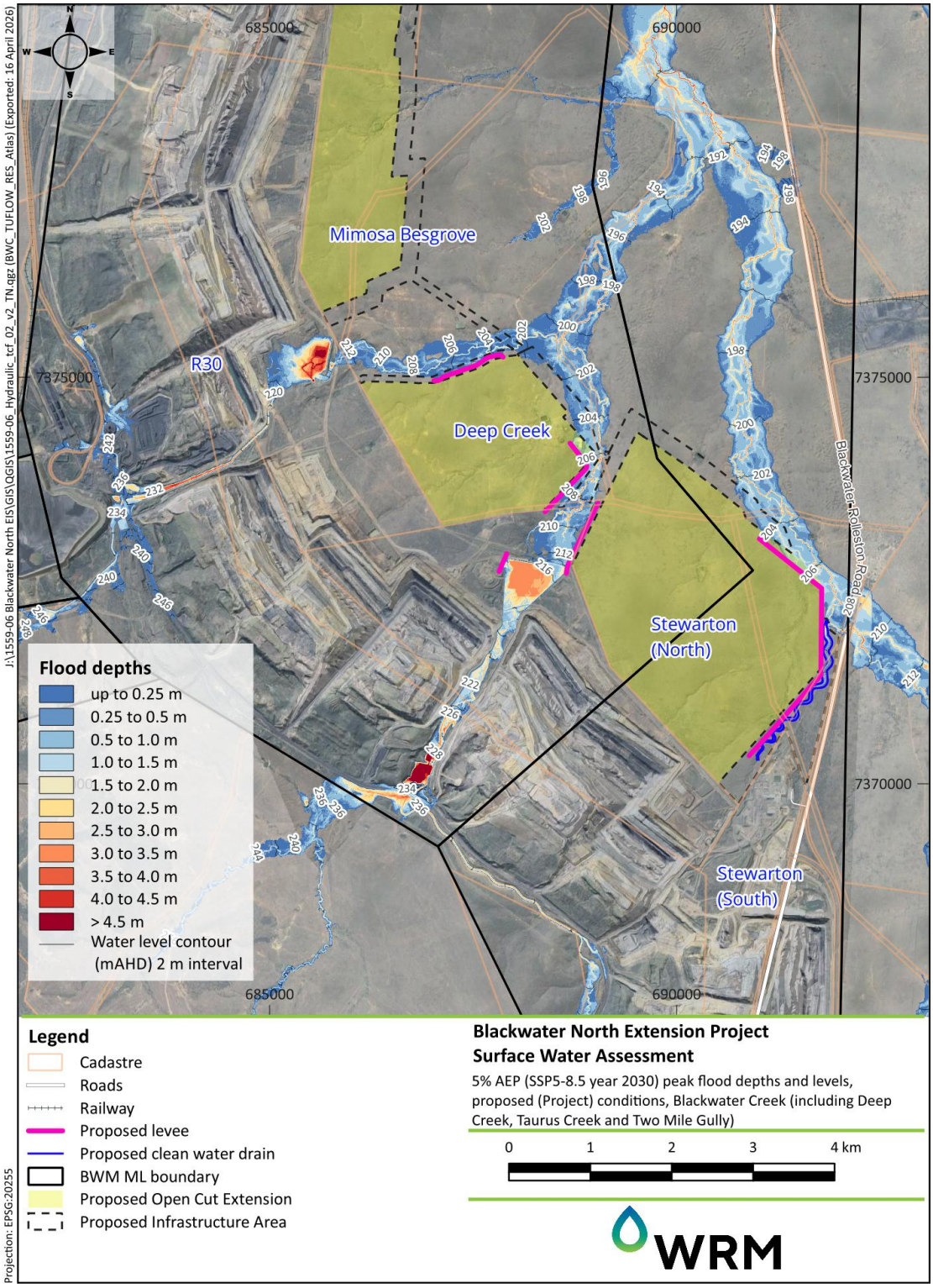


Figure 8.20 **5% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

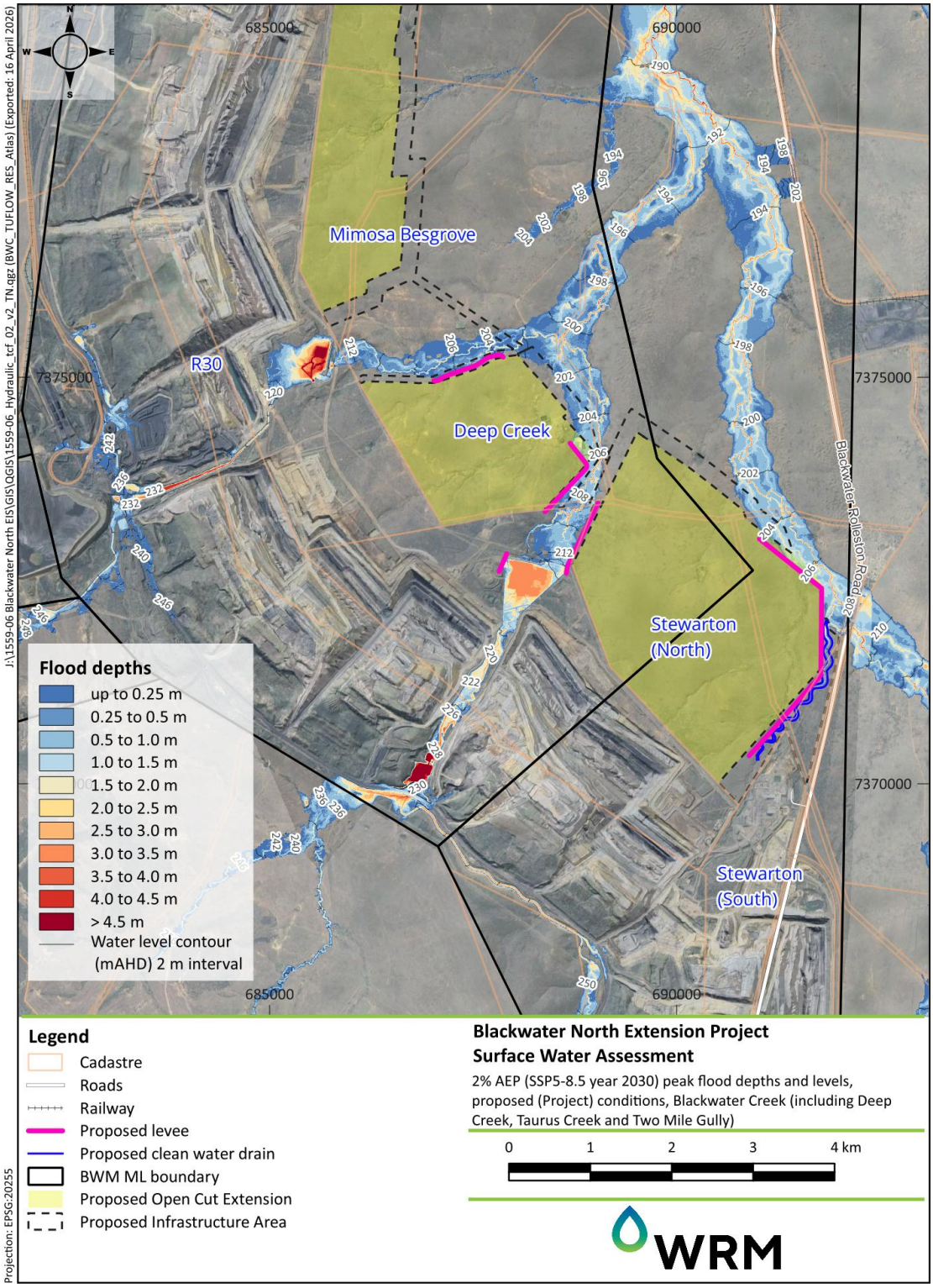


Figure 8.21 **2% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

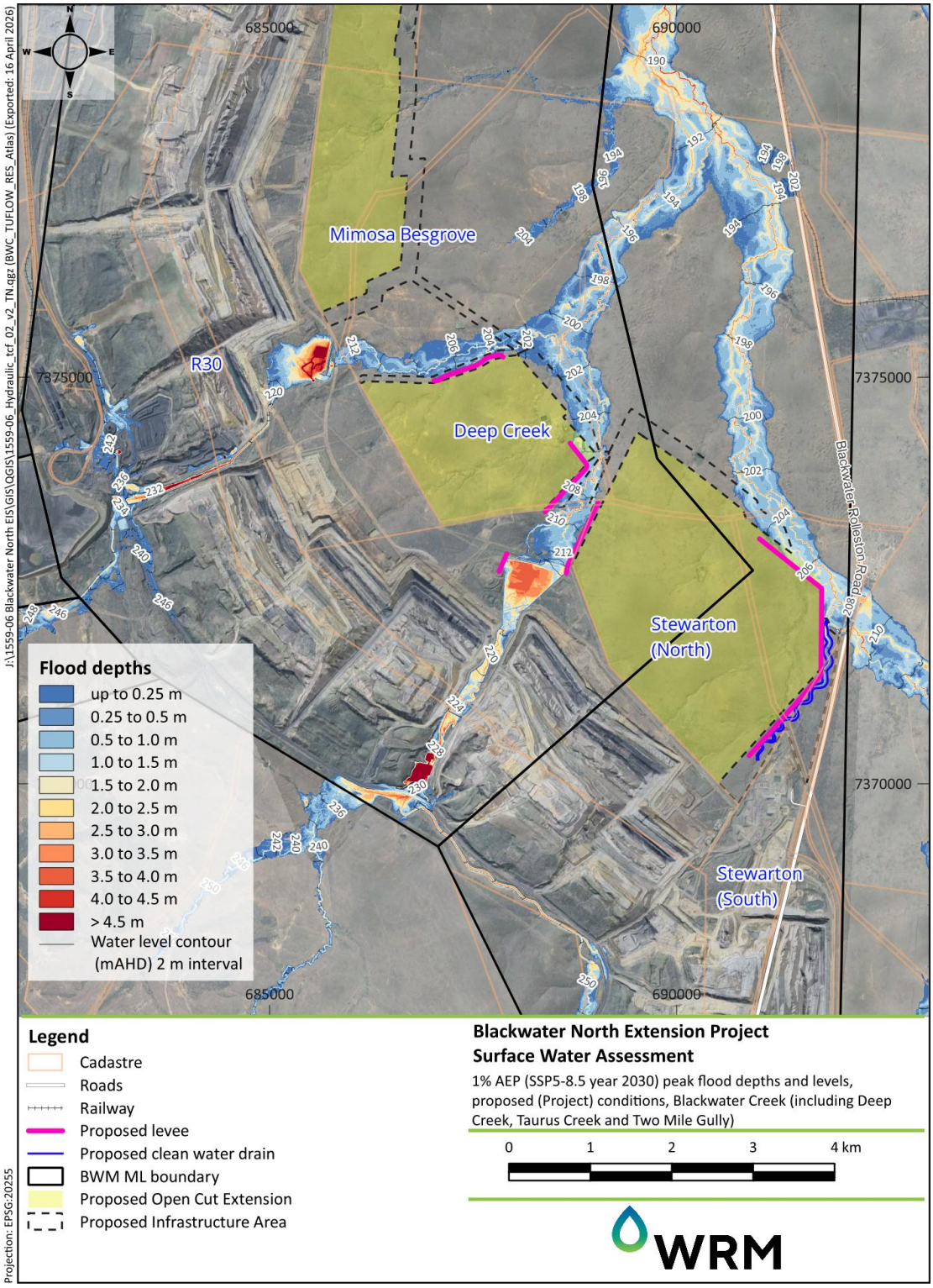


Figure 8.22 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

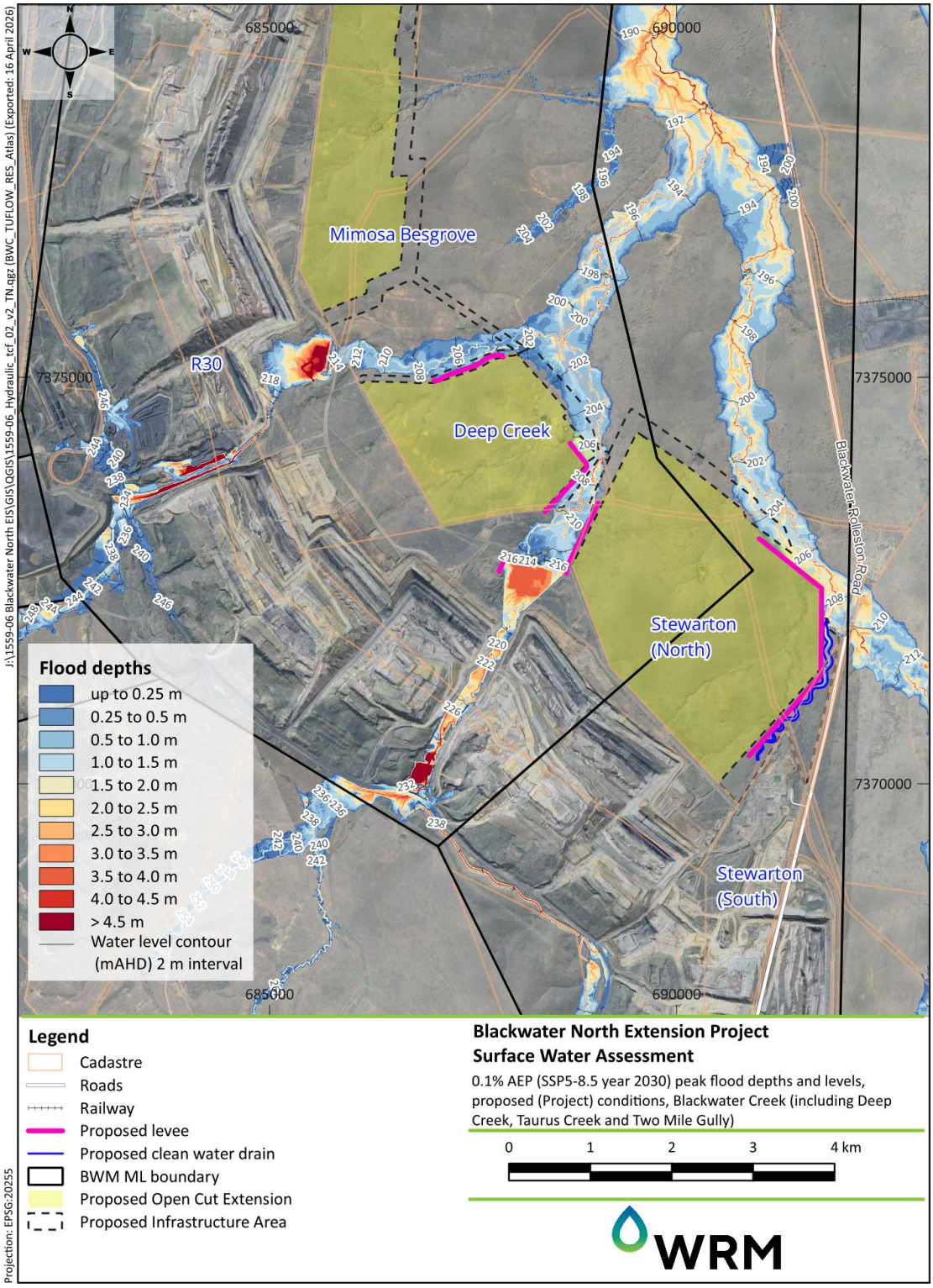


Figure 8.23 **0.1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

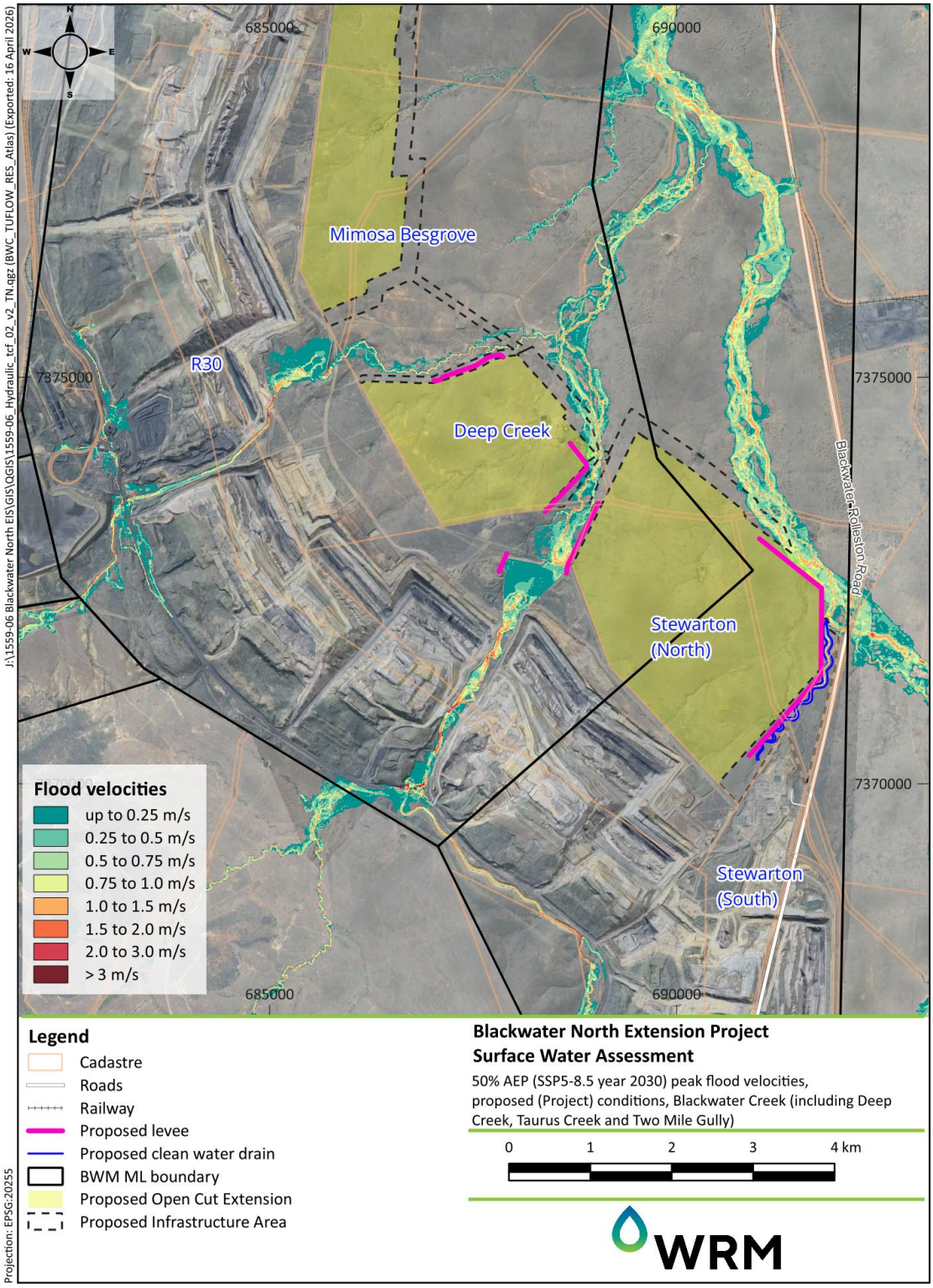


Figure 8.24 **50% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

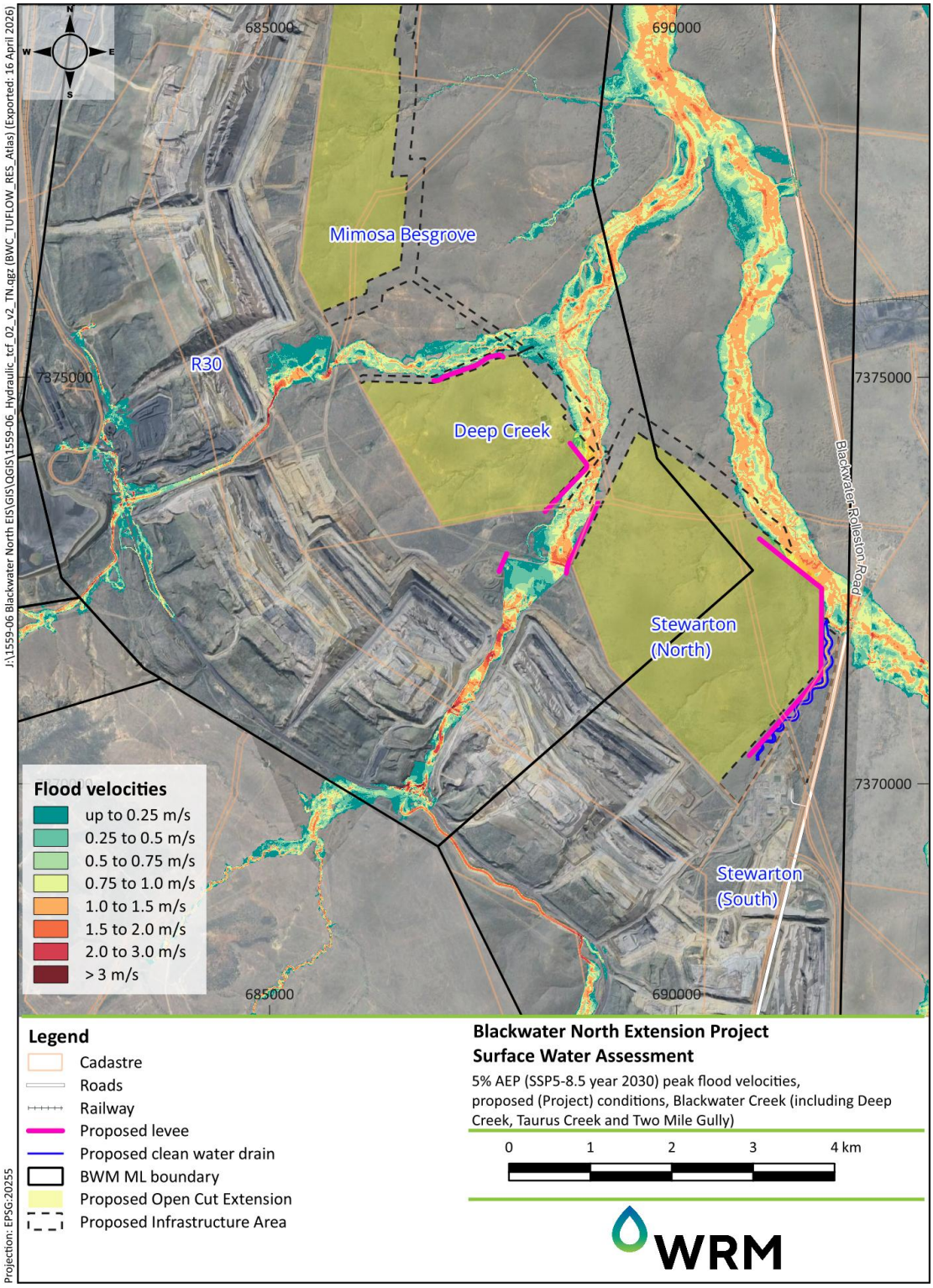


Figure 8.25 **5% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

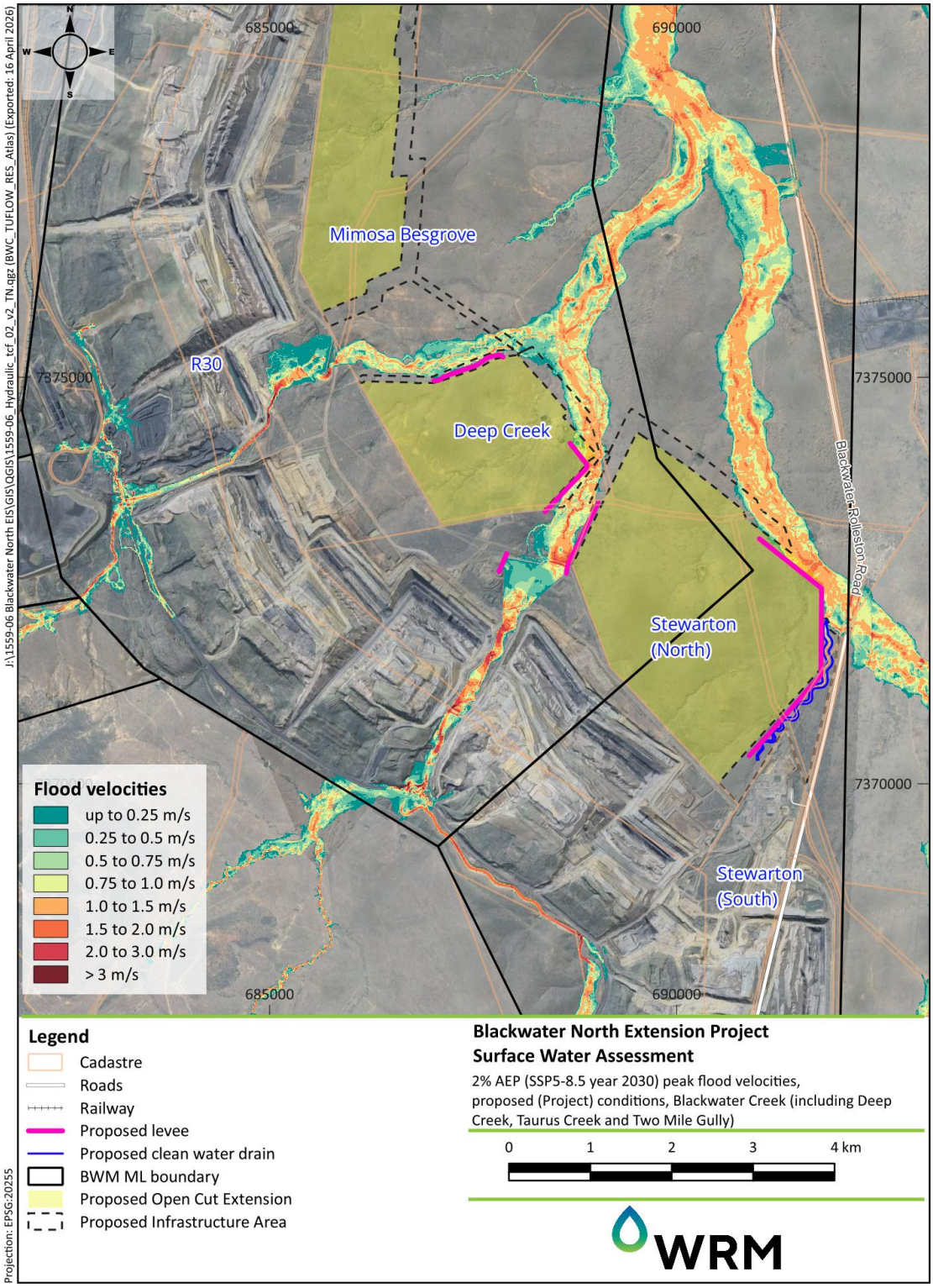


Figure 8.26 **2% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

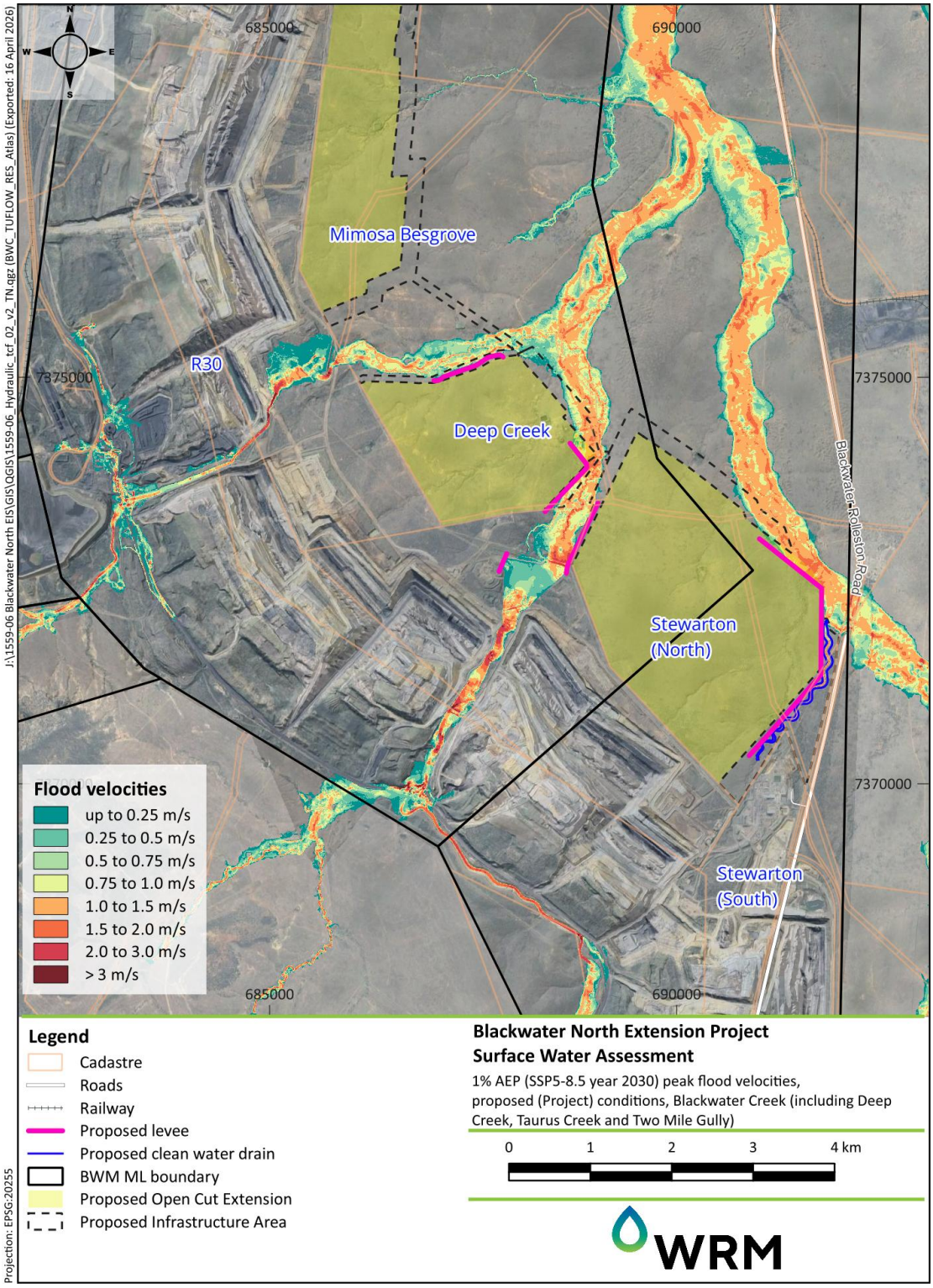


Figure 8.27 **1% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

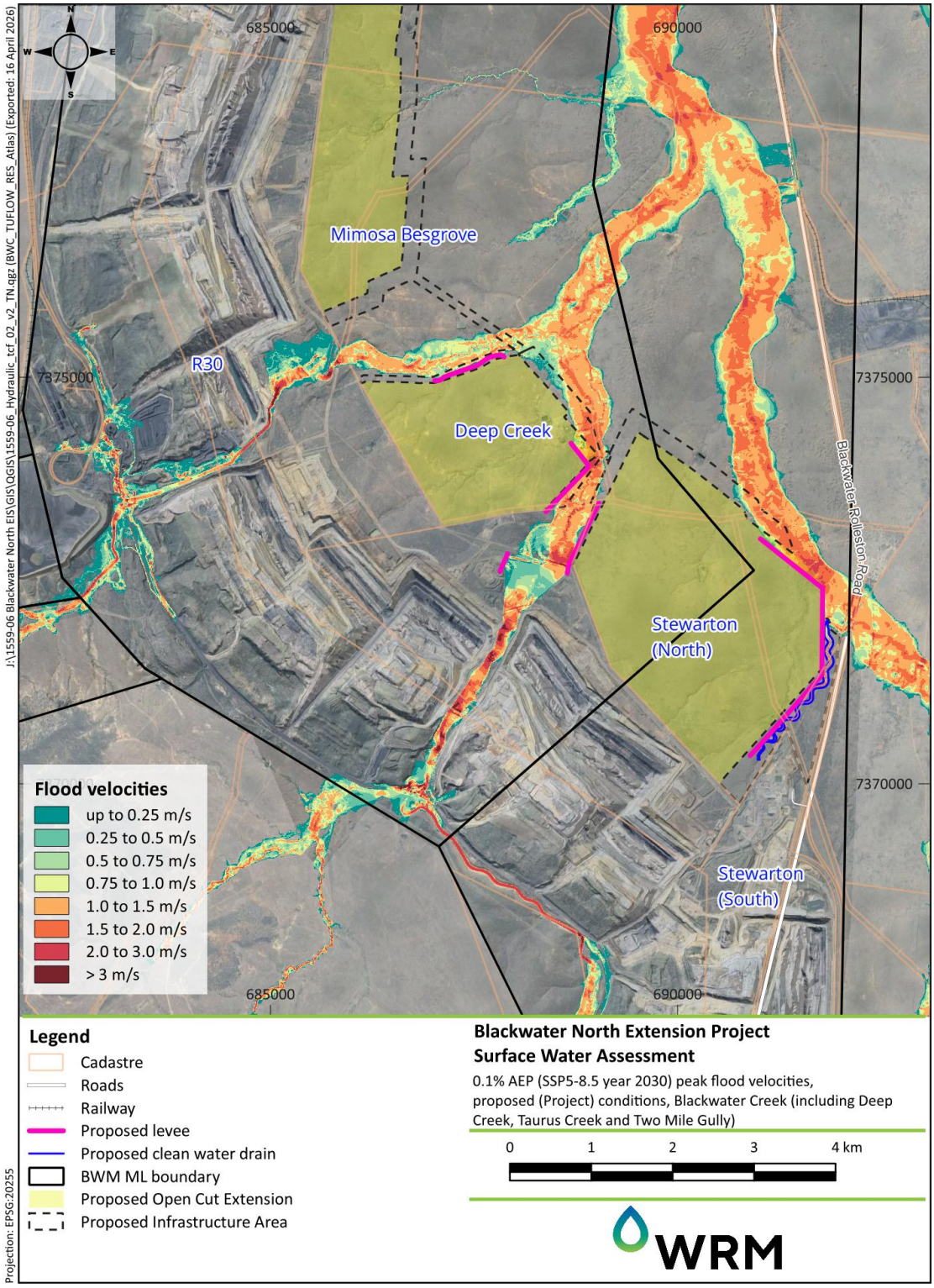


Figure 8.28 **0.1% AEP (SSP5-8.5 year 2030) peak flood velocities, proposed (Project) conditions, Blackwater Creek (including Deep Creek, Taurus Creek and Two Mile Gully)**

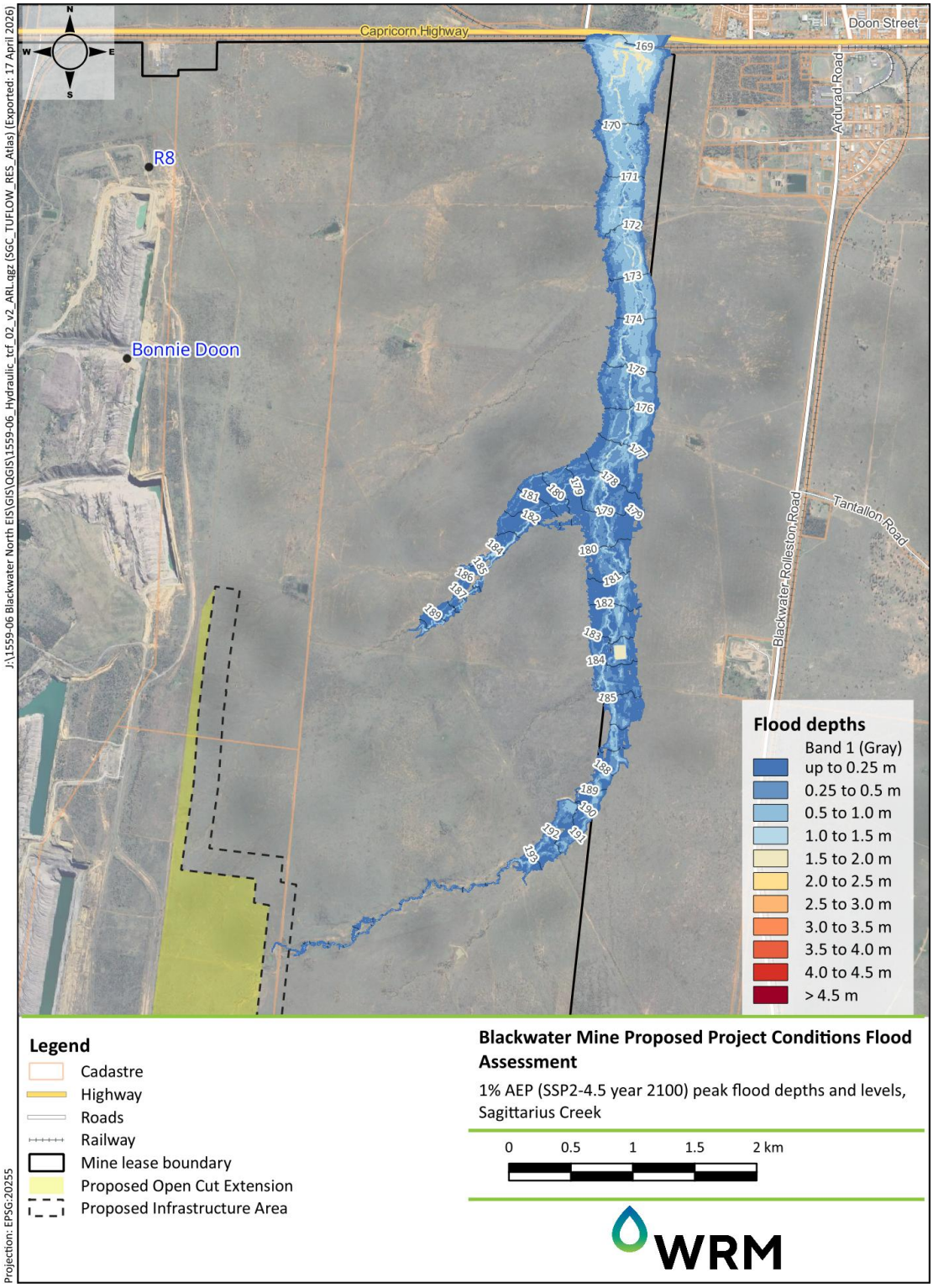


Figure 8.29 **1% AEP (SSP5-8.5 year 2030) peak flood depths and levels, proposed (Project) conditions, Sagittarius Creek**

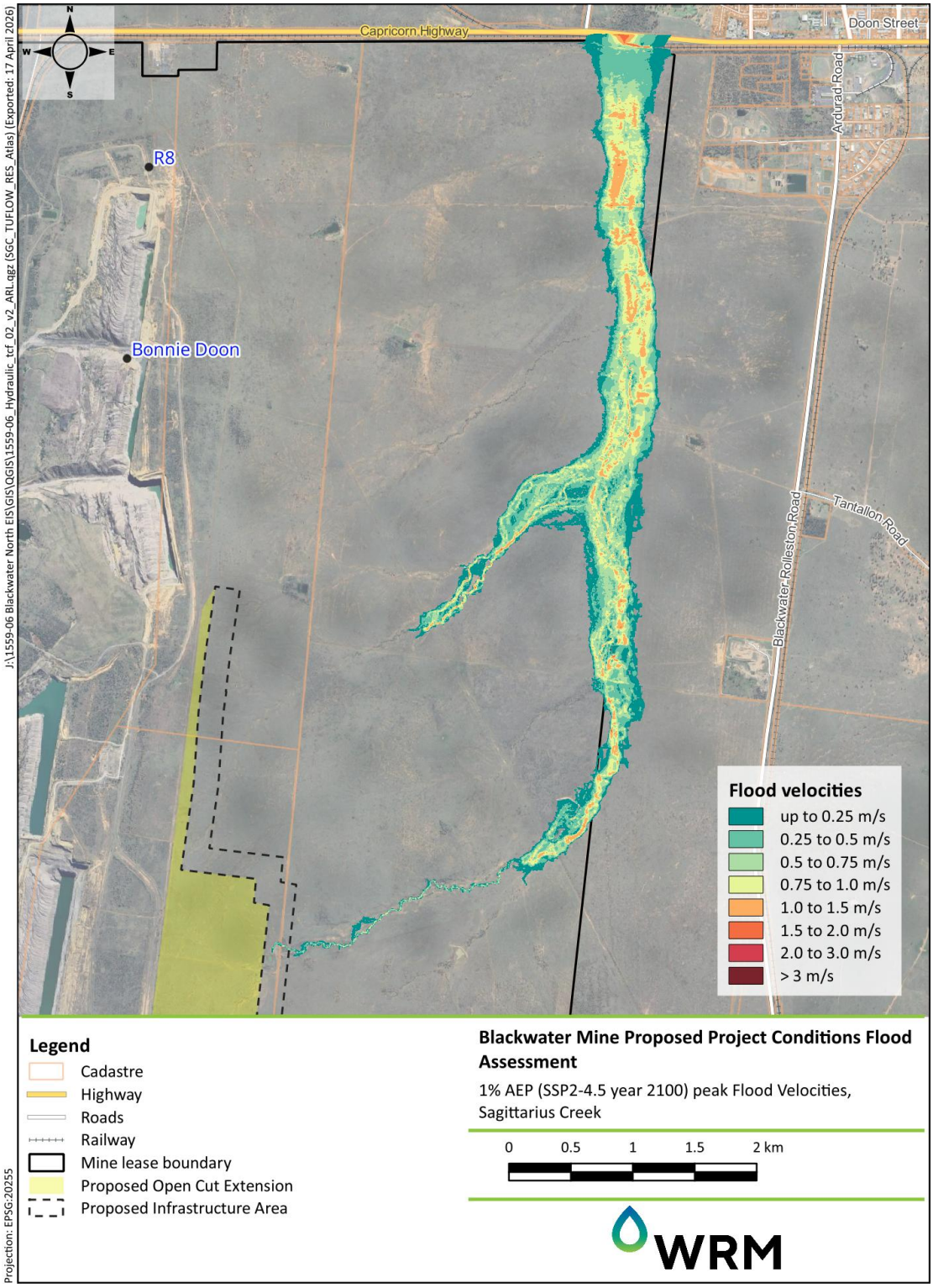


Figure 8.30 **1% AEP (SSP5-8.5 year 2030) peak velocities, proposed (Project) conditions, Sagittarius Creek**

8.6 IMPACTS ON PEAK FLOOD LEVELS AND VELOCITIES

Figure 8.31 to Figure 8.35 are flood maps showing the predicted impacts on peak flood levels (afflux) along Emu Creek, Deep Creek, Taurus Creek, Two Mile Gully, and Blackwater Creek for the 50% to 0.1% AEP design events. Figure 8.36 to Figure 8.40 show the corresponding impacts on peak velocities.

Figure 8.41 shows the TUFLOW model predicted proposed (Project) conditions peak flood extents, levels and depths along Sagittarius Creek for the 1% AEP design event. Figure 8.42 shows the corresponding 1% AEP peak velocities.

The model results show that:

- Predicted increases in peak flood levels are generally minor and contained on-lease for all events up to 0.1% AEP. There are minor off-lease impacts upstream of the confluence between the existing Taurus Creek temporary diversion and the existing Emu Creek diversion. There are no predicted increases in peak flood levels and events at existing dwellings/homesteads in the vicinity of the Project area.
- Downstream of the Project area, peak flood levels are predicted to reduce due to the reduction in design discharges as a result of additional catchment excision from expansion of the mining pits. The predicted reduction in peak flood levels is greatest within a short section in the upper headwaters of Sagittarius Creek as a result of the open cut pit extension.
- Flood level increases are predicted to occur adjacent to the proposed levees due to constriction of the floodplain by these levees. Flood level impacts are also predicted to occur along the Deep Creek and Taurus Creek temporary diversions, due to increased runoff from additional areas of rehabilitation dump landform upstream of mining pits.
- Any predicted increases in peak flood levels are generally <0.1 m along the floodplains within the Project area. Given that existing conditions flood depths are between 0.5 m and 1.5 m for events up to 1% AEP, these predicted flood level increases are not considered significant.
- Increases in flood levels >0.1 m are generally localised to areas adjacent to the proposed levees, and along the Taurus Creek temporary diversion.
- Predicted increases in peak velocities along the floodplains within the Project area generally <0.1 m/s for all events up to 1% AEP. Existing conditions peak velocities along the floodplain typically range between up to 0.5 m/s for the 50% AEP event and up to existing conditions velocities are up to 1 m/s for the 1% AEP event. Hence the predicted velocity impacts are not significant.
- Localised increases in peak velocities of up to 0.5 m/s are predicted adjacent to the proposed levees. The impact of these flood velocity increases on erosion potential and stream stability was assessed and are described in Section 8.7.
- The Project would reduce peak flood levels along the Sagittarius Creek floodplain for all events, due to the reduction in catchment area and flood discharges. Flood impacts along Sagittarius Creek were assessed for the 1% AEP event only. As the Project disturbance area is outside of the Sagittarius Creek flood extent, flood impacts for other events were not assessed.

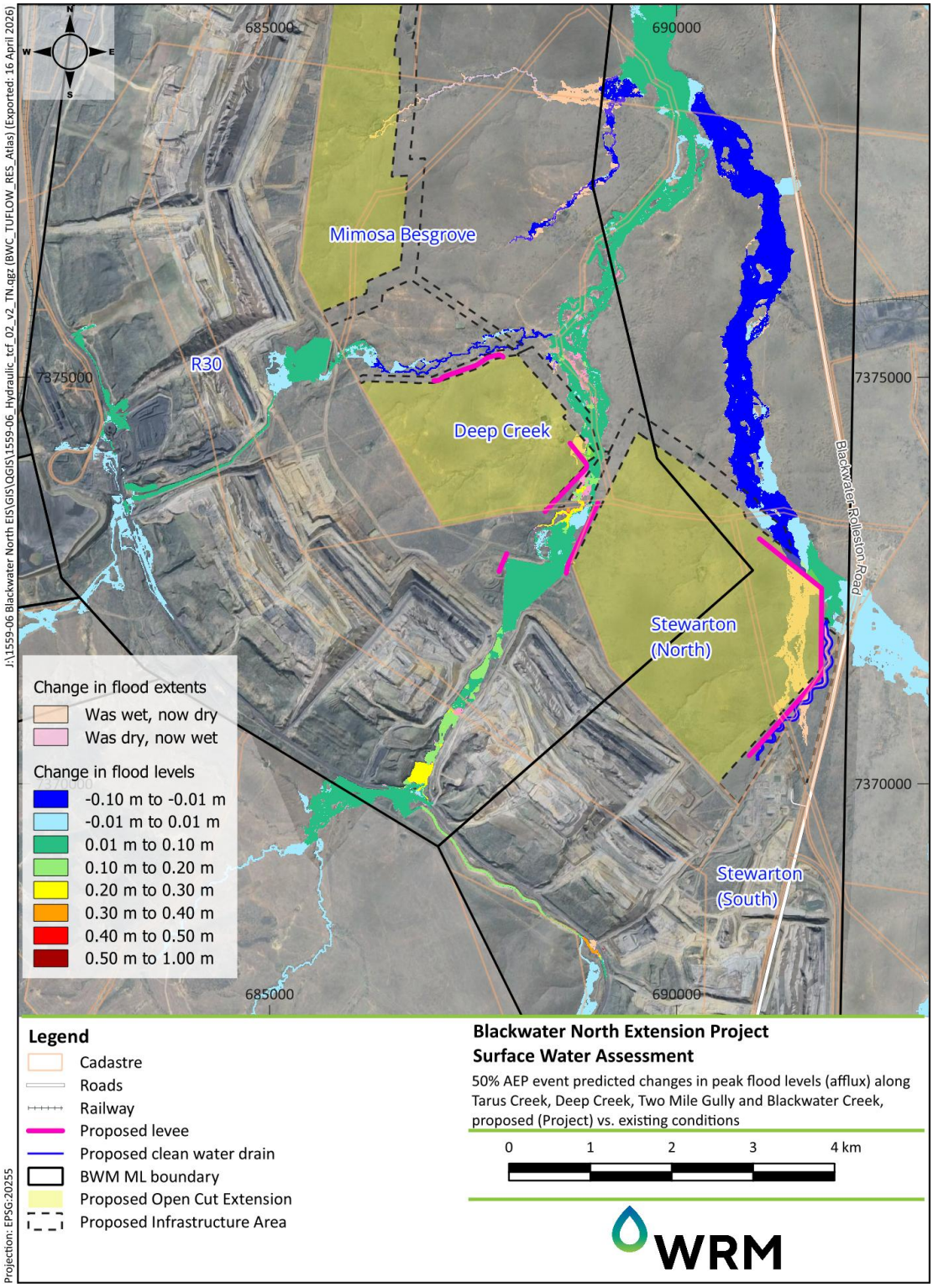


Figure 8.31 **50% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

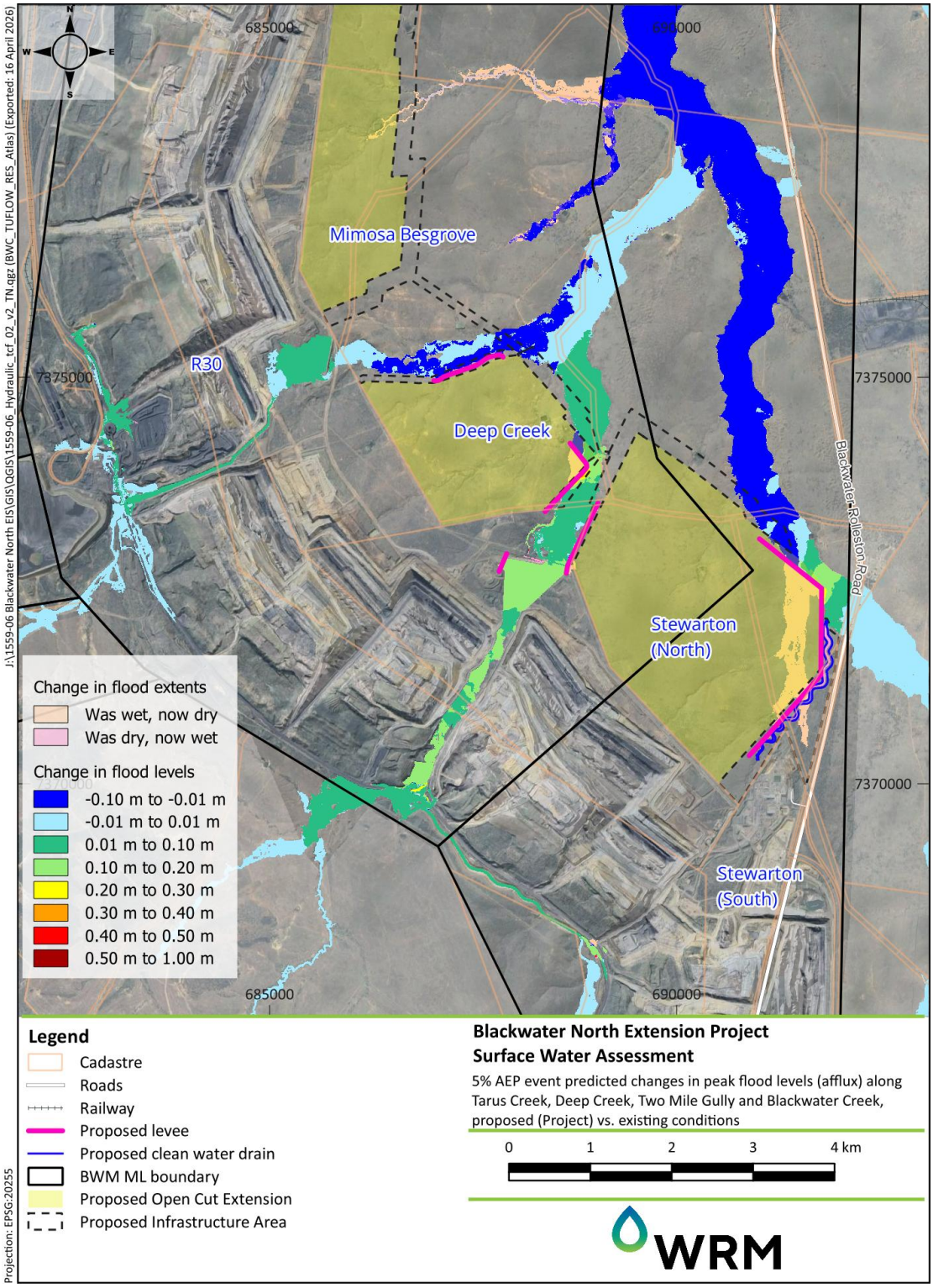


Figure 8.32 **5% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

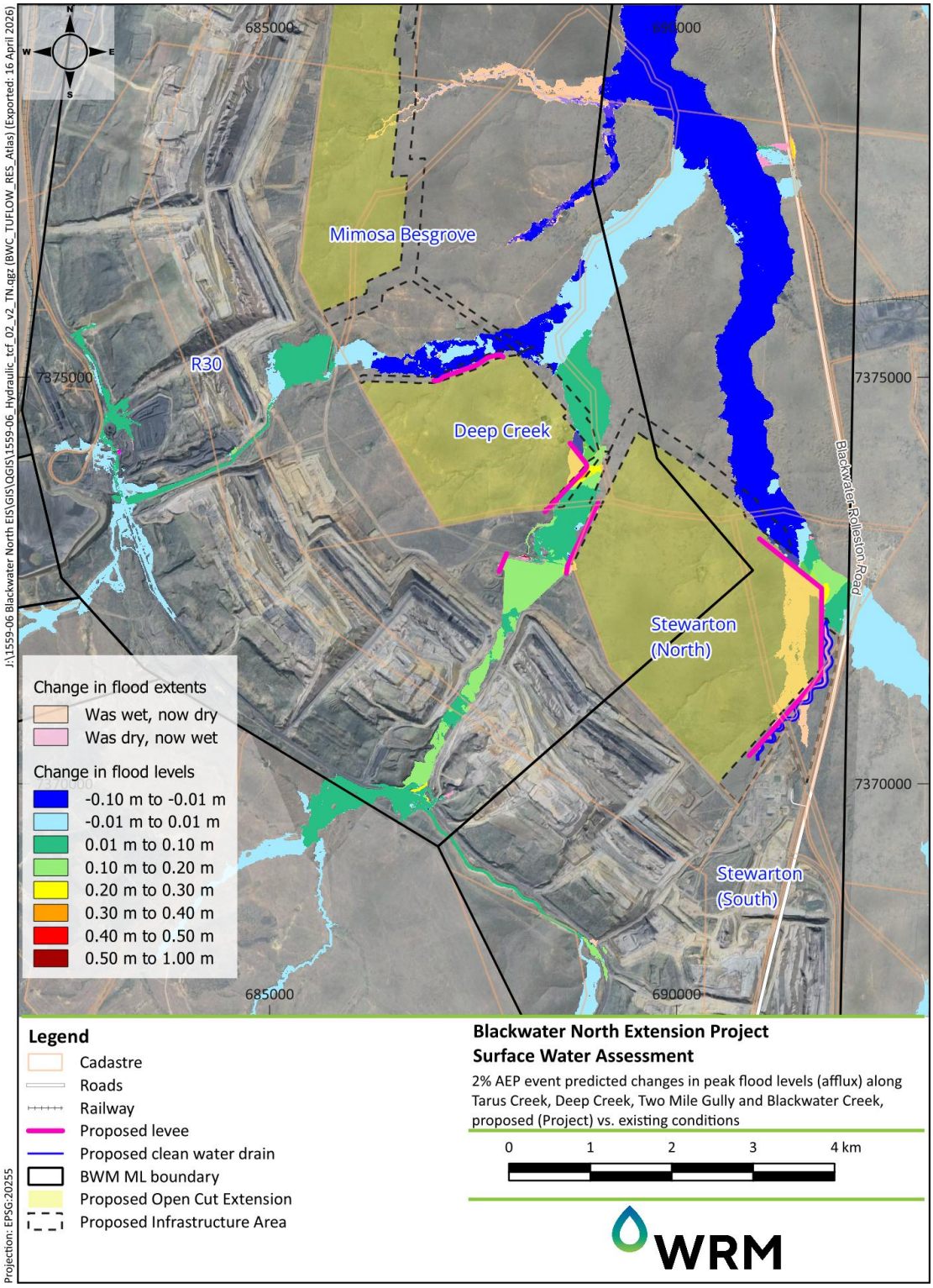


Figure 8.33 **2% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

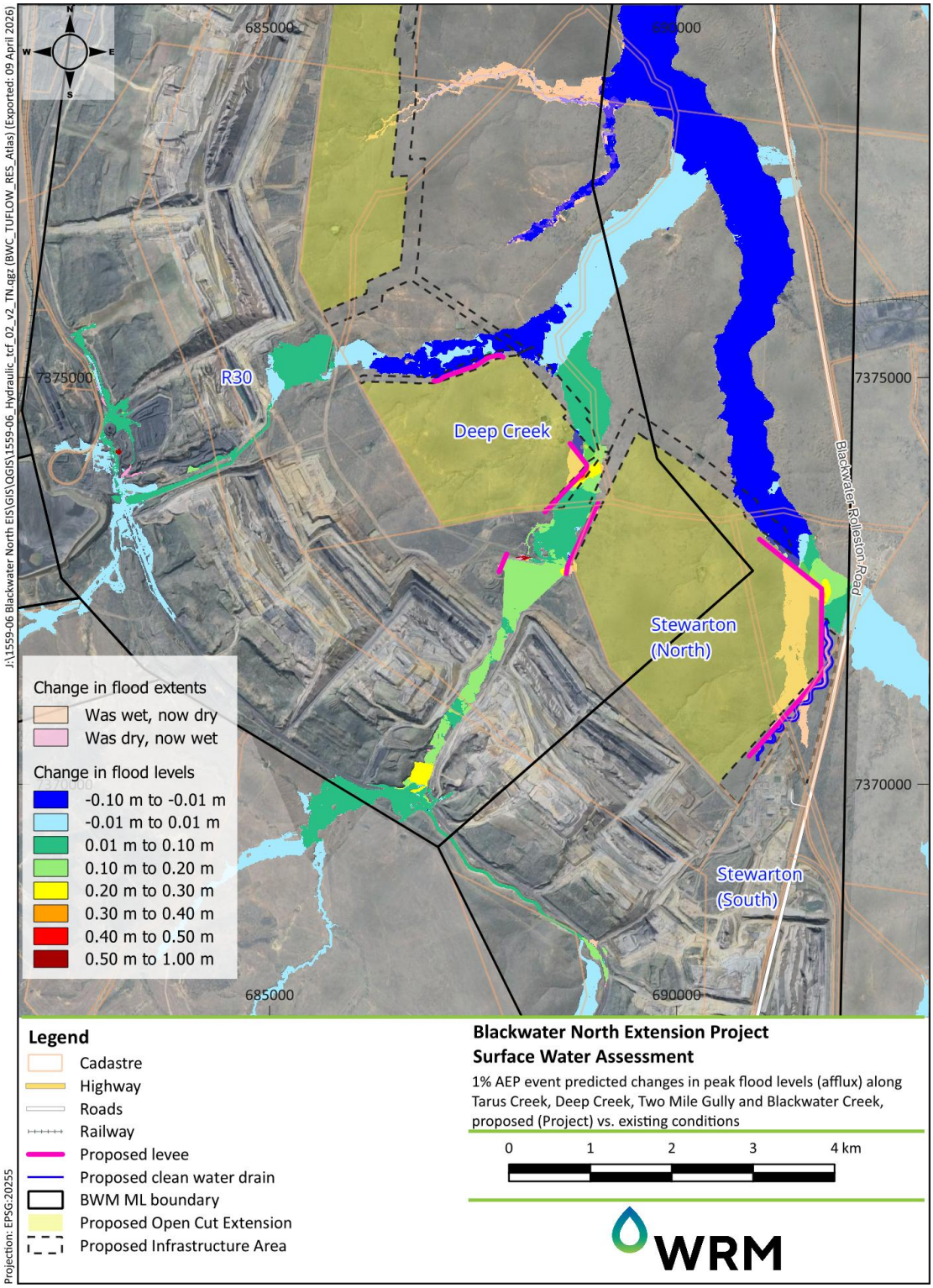


Figure 8.34 **1% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

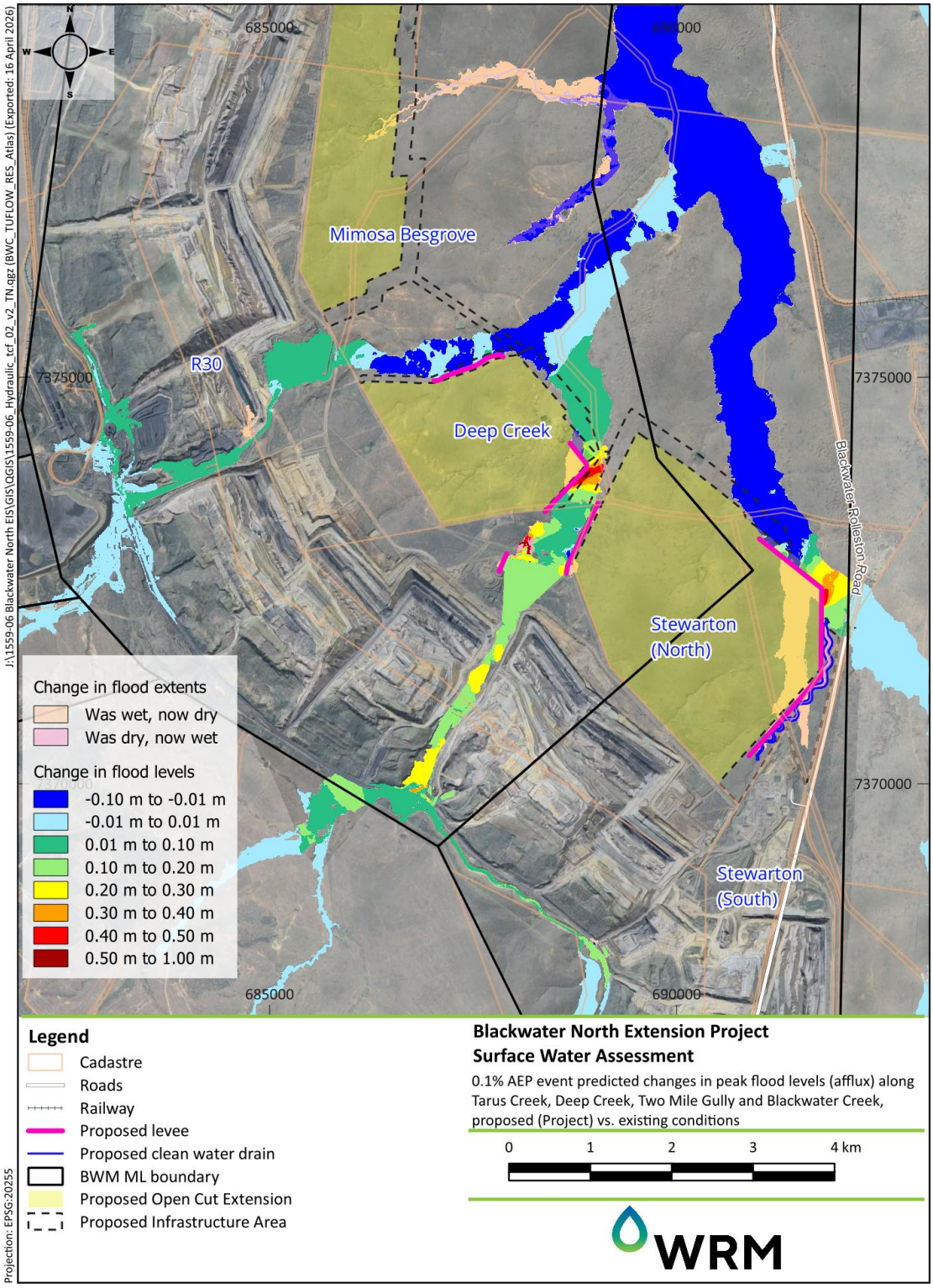


Figure 8.35 **0.1% AEP event predicted changes in peak flood levels (afflux) along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

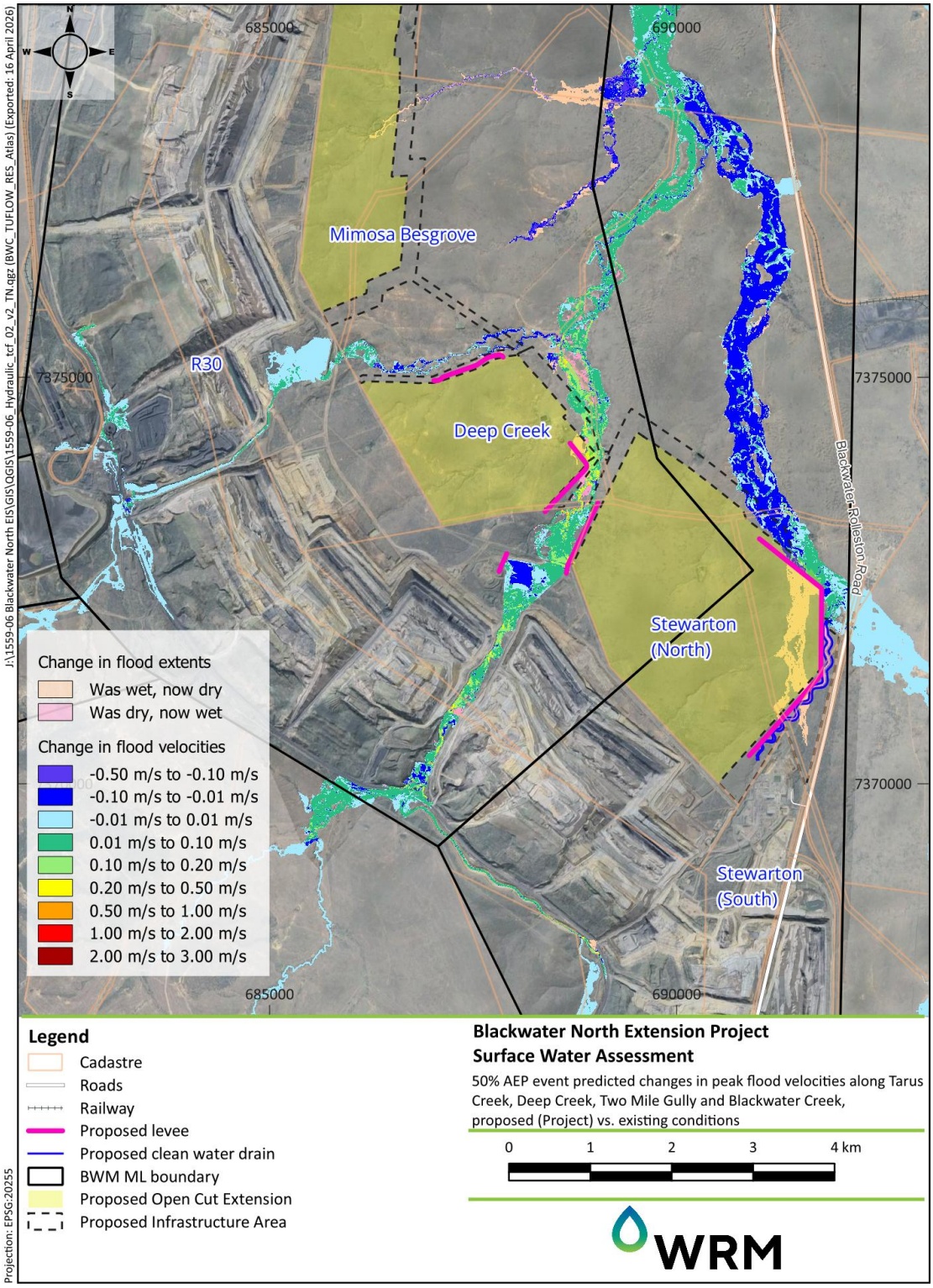


Figure 8.36 **50% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

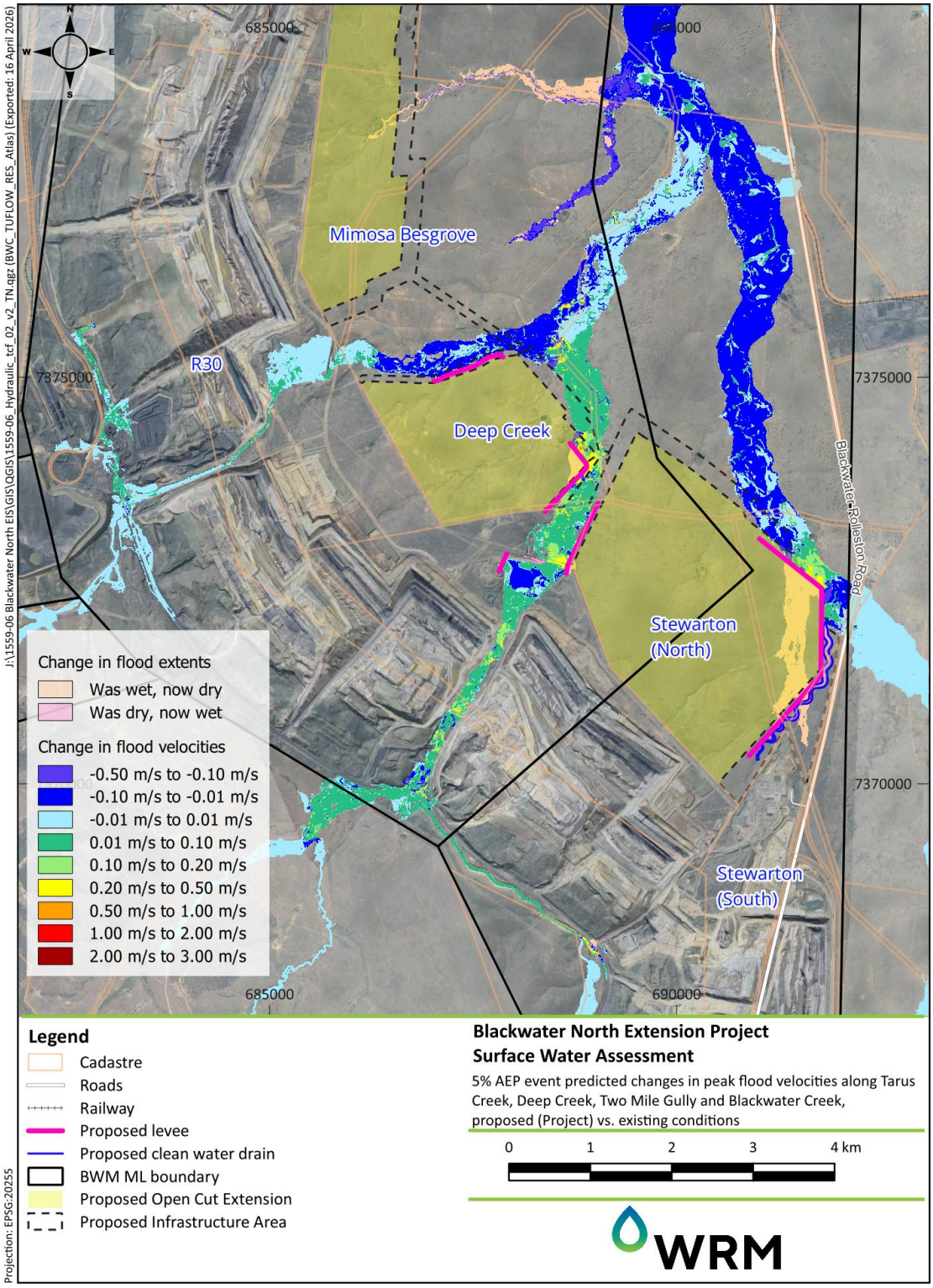


Figure 8.37 **5% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

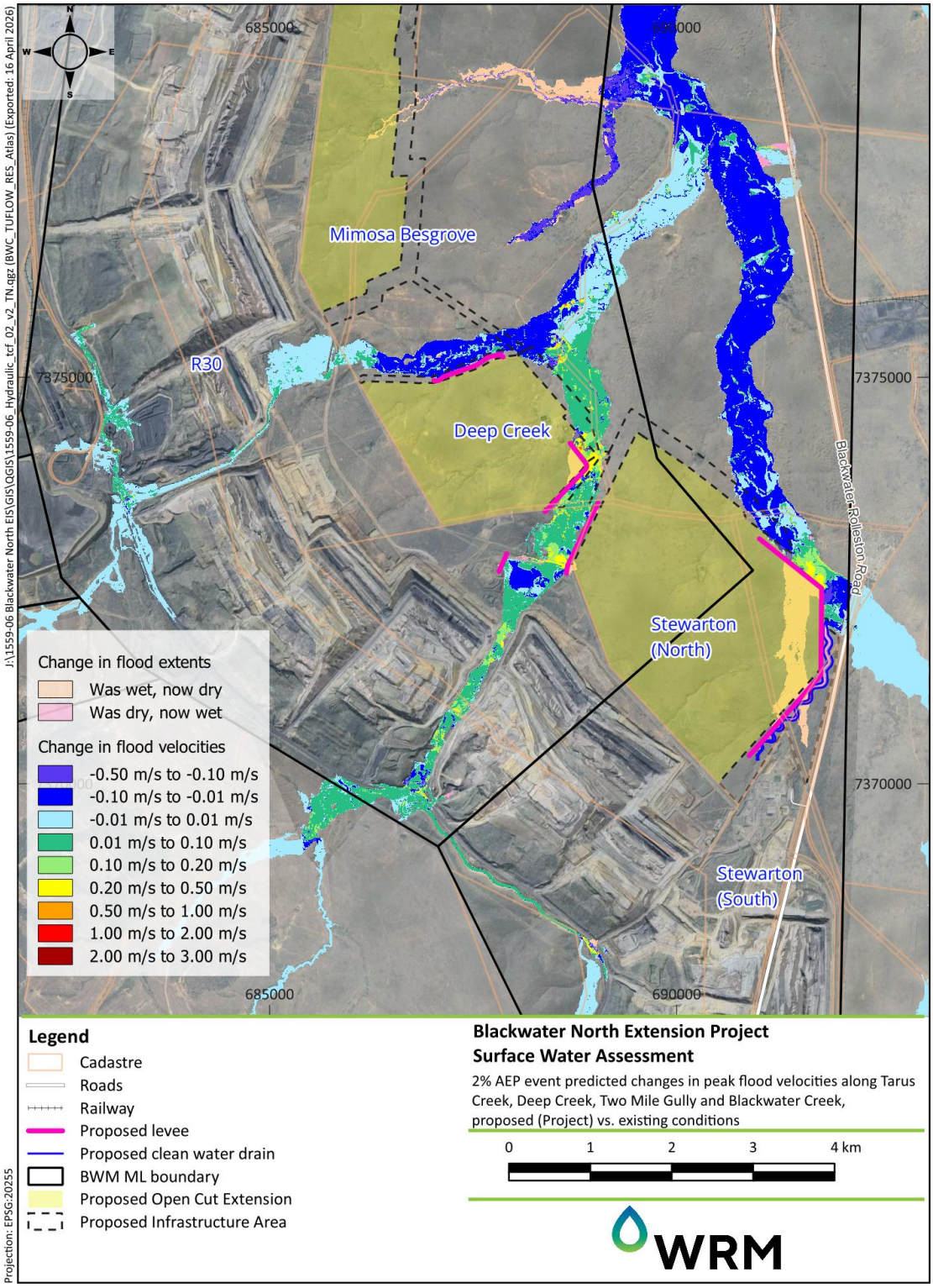


Figure 8.38 **2% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

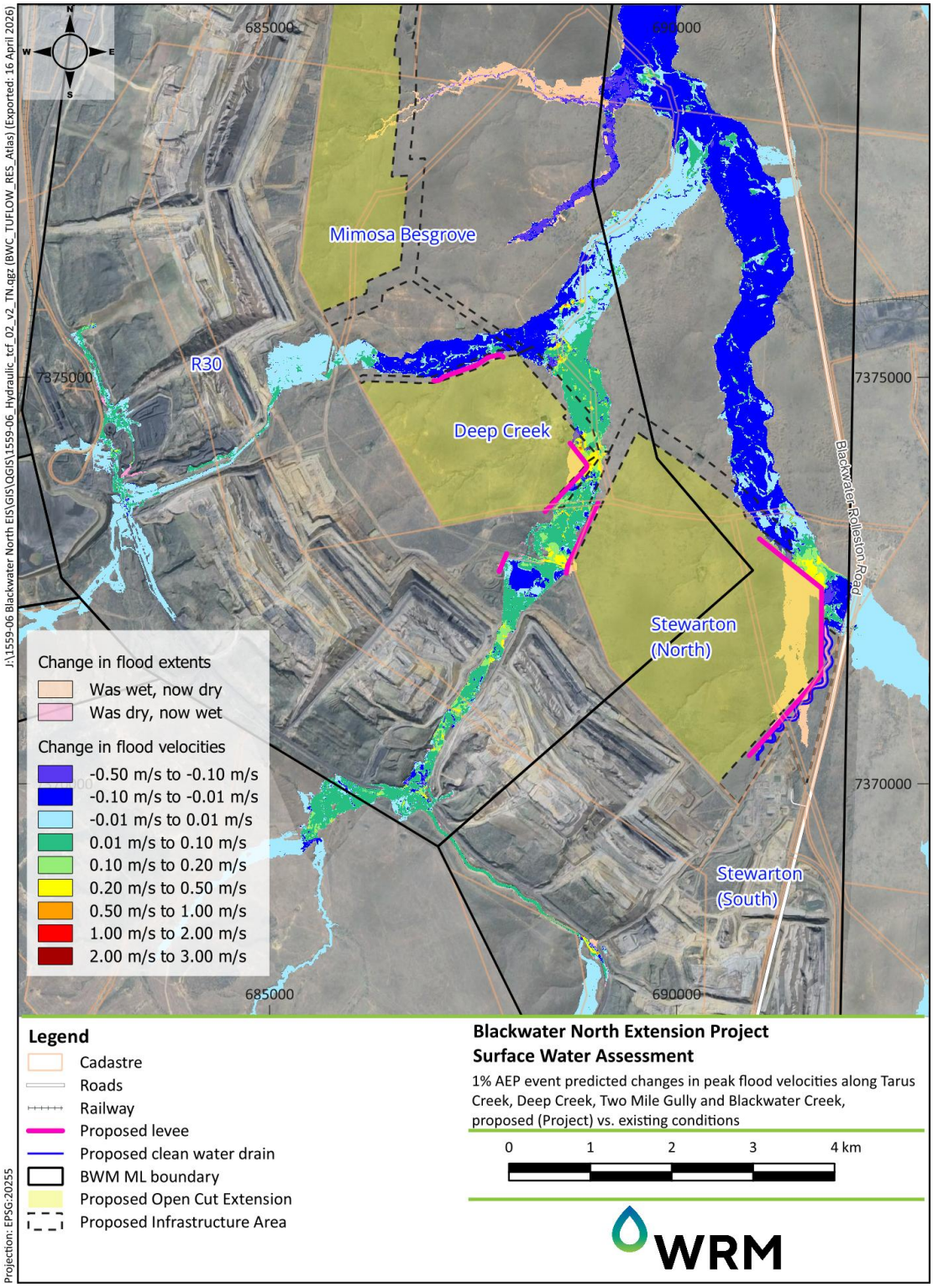


Figure 8.39 **1% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

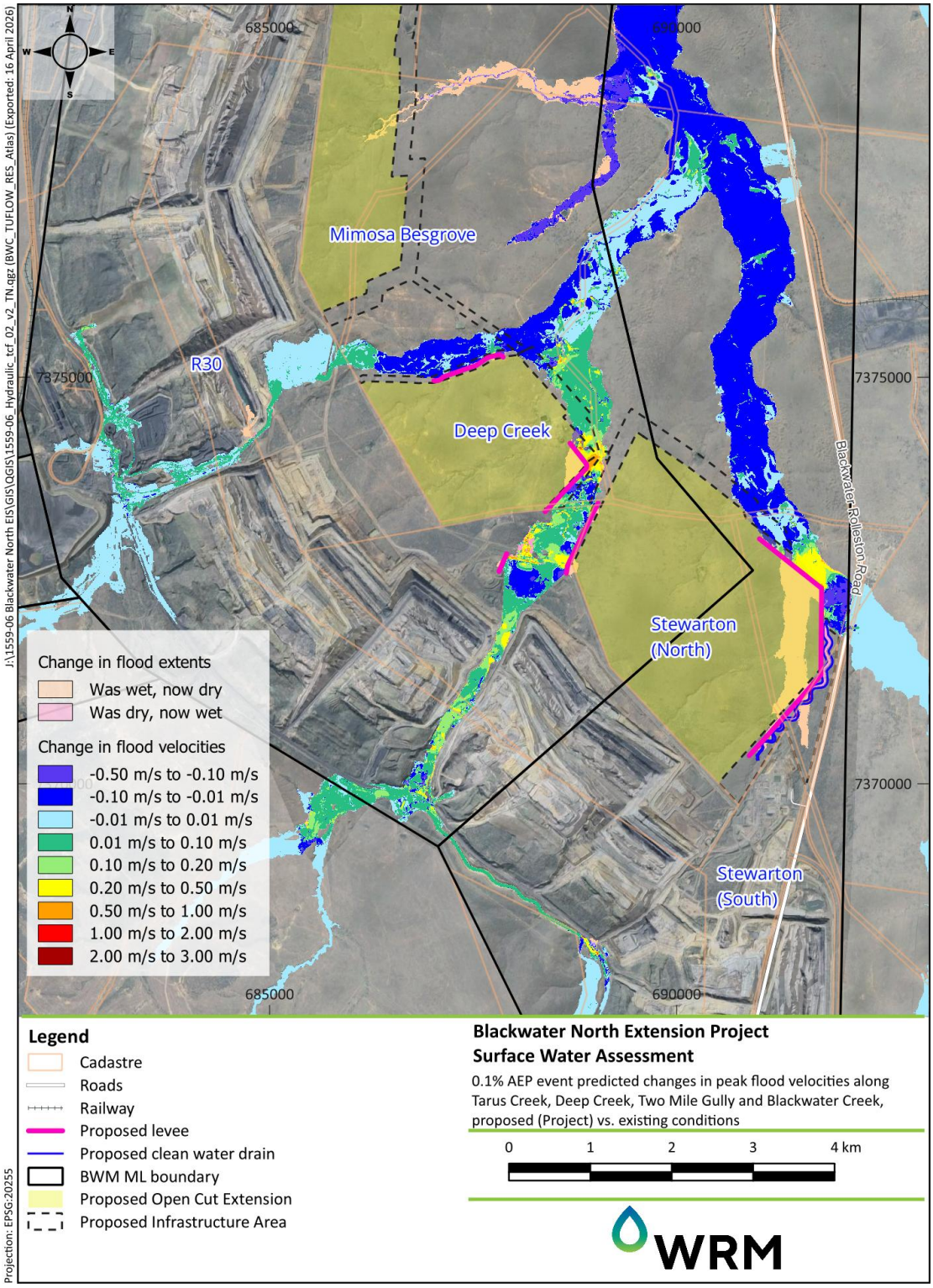


Figure 8.40 **0.1% AEP event predicted changes in peak flood velocities along Taurus Creek, Deep Creek, Two Mile Gully and Blackwater Creek, proposed (Project) vs. existing conditions**

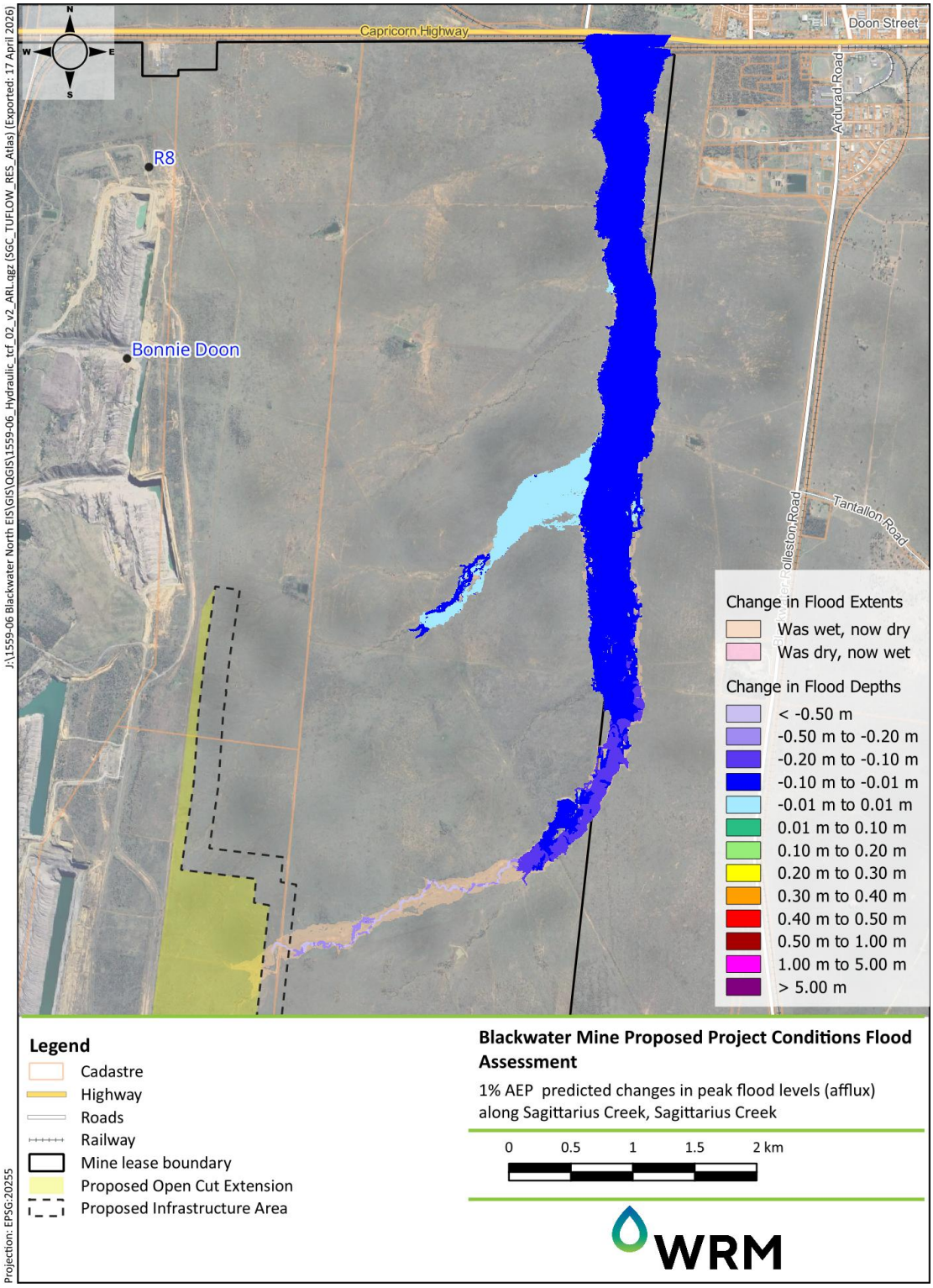


Figure 8.41 **1% AEP event predicted changes in peak flood levels (afflux), proposed (Project) vs. existing conditions, Sagittarius Creek**

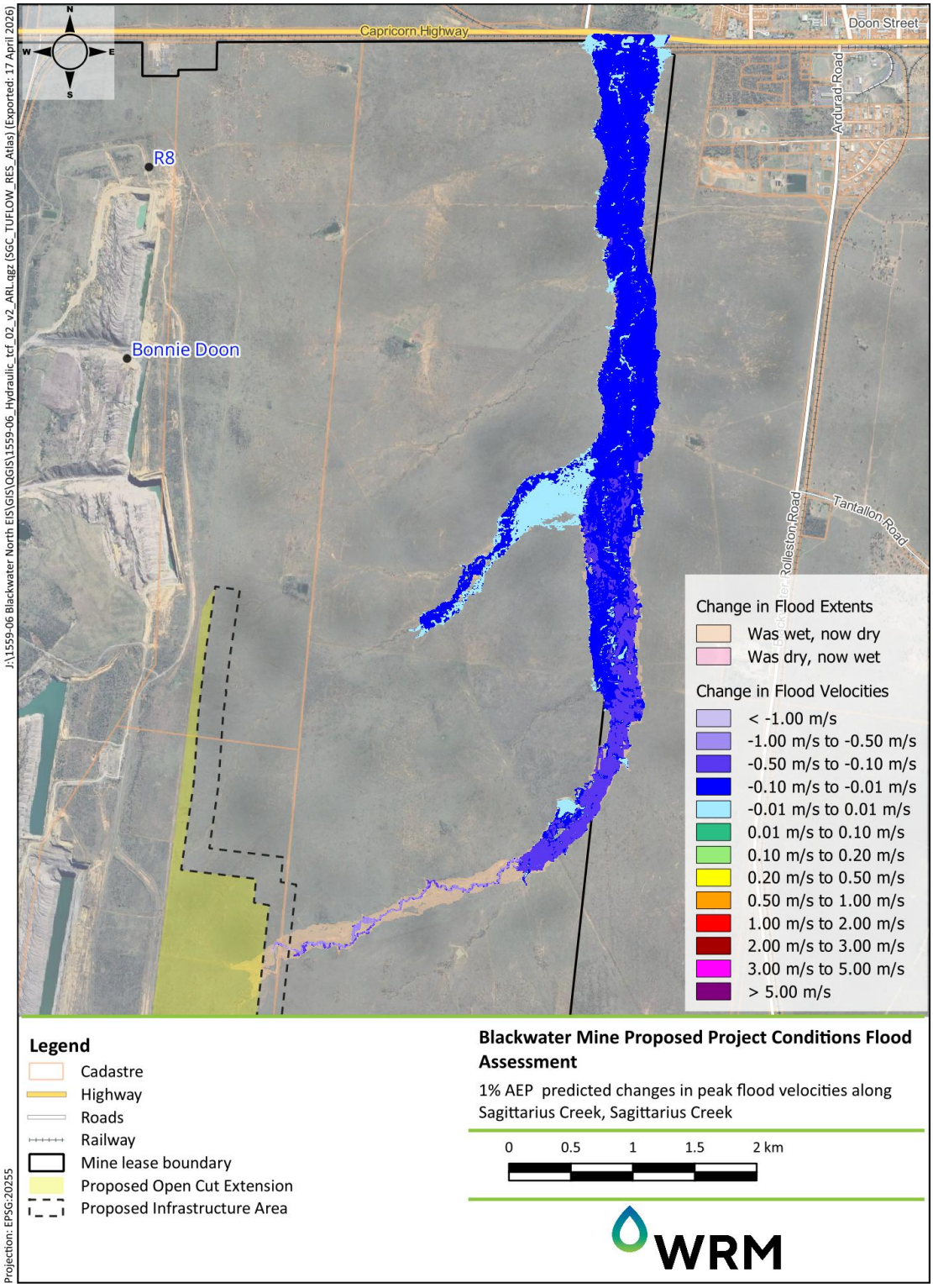


Figure 8.42 **1% AEP event predicted changes in peak flood velocities, proposed (Project) vs. existing conditions, Sagittarius Creek**

8.7 WATERWAY STABILITY ASSESSMENT

8.7.1 Overview

The TUFLOW hydraulic model results were analysed in more detail to assess:

- the potential impacts of increased flood velocities due to the Project (described in Section 8.6) on the channel stability including sediment transport characteristics of the existing creek channels in the vicinity of the Project; and
- the hydraulic characteristics of the proposed clean water drain (adjacent to and southeast of the Stewarton Pit expansion area).

The hydraulic assessment was undertaken based on guidance in *Criteria for Functioning River Landscape Units in Mining and Post Mining Landscapes* (Alluvium Consulting Australia Pty Ltd [Alluvium], 2014). The Alluvium (2014) guideline was developed for the design and assessment of watercourse diversions in the Bowen Basin region of Central Queensland.

The metrics used to assess channel hydraulic characteristics are velocities (in m/s) and stream power (in W/m^2). Stream power is defined in Alluvium (2014) as the rate of energy dissipation against the bed and banks of a river or stream and is used as a surrogate for sediment transport characteristics.

In line with the Alluvium (2014) guideline, channel hydraulic characteristics were assessed for the 50% AEP event (a representative small flow event) and the 2% AEP event (a representative large flow event), for existing and proposed (Project) conditions.

8.7.2 Hydraulic impact assessment of existing creek channels

Figure 8.43 shows locations of six representative creek sections (reaches) where channel hydraulic characteristics were assessed. Figure 8.43 also shows the predicted flood velocity impacts for the 2% AEP event. The six representative sections are described as follows:

- Section 1 – the existing Emu Creek Diversion;
- Section 2 – the Taurus Creek temporary diversion;
- Section 3 – Taurus Creek between the Deep Creek Pit and Stewarton North Pit;
- Section 4 – Taurus Creek downstream of the Deep Creek confluence;
- Section 5 – Two Mile Gully downstream of the Project area; and
- Section 6 – Two Mile Gully east of the Stewarton North pit.

Table 8.8 to Table 8.13 compare the statistical summaries of velocities and stream power along representative Sections 1 to 6 under existing and proposed (Project) conditions, for the 50% and 2% AEP design events. It should be noted that the velocities and stream power shown in Table 8.8 to Table 8.13 are section-averaged values along the six representative reaches.

The model results show that the 25^{th} to 75^{th} percentile range of velocities and stream power along all six representative sections would not be changed significantly as a result of the Project. The 25^{th} to 75^{th} percentile range of channel velocities and stream power would generally be increased by less than 5% and 10%, respectively, for the 39% AEP and 2% AEP events. Therefore, the erosion potential and sediment transport characteristics of the existing waterway channels under proposed (Project) conditions would be similar to existing conditions.

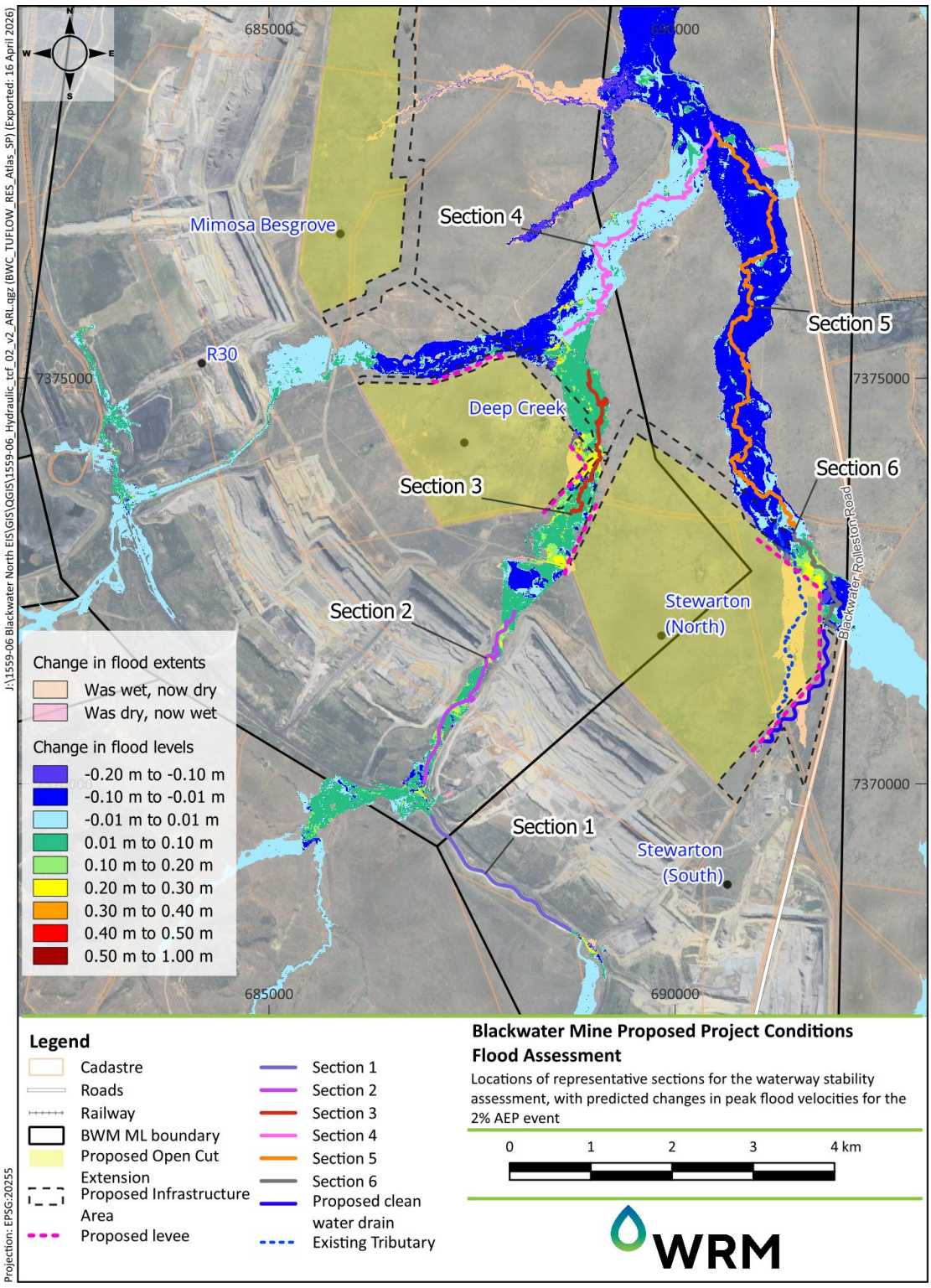


Figure 8.43 **Locations of representative sections for the waterway stability assessment, with predicted changes in peak flood velocities for the 2% AEP event**

Table 8.8 Comparison of velocities and stream power along Section 1 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 1			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	1.4	1.4	38.8	39.9
	50%ile	1.3	1.3	56.4	62.9
	75%ile	1.3	1.4	70.8	76.9
2% AEP	25%ile	2.1	2.1	115.1	118.6
	50%ile	1.9	1.9	150.2	154.6
	75%ile	2.0	2.1	193.2	198.6

Table 8.9 Comparison of velocities and stream power along Section 2 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 1			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.9	0.8	9.6	9.8
	50%ile	1.1	1.1	29.3	30.2
	75%ile	1.4	1.5	64.4	72.3
2% AEP	25%ile	0.9	0.9	14.8	16.4
	50%ile	1.4	1.4	53.0	57.5
	75%ile	1.9	2.0	139.5	156.8

Table 8.10 Comparison of velocities and stream power along Section 3 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 3			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	1.0	0.9	15.9	17.9
	50%ile	0.9	0.9	24.4	26.1
	75%ile	0.8	0.8	29.8	31.1
2% AEP	25%ile	0.9	1.0	19.5	20.4
	50%ile	0.8	0.8	31.9	32.3
	75%ile	0.7	0.7	39.7	39.7

Table 8.11 Comparison of velocities and stream power along Section 4 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 4			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.7	0.7	8.0	8.0
	50%ile	1.0	1.0	16.0	16.3
	75%ile	1.1	1.1	27.6	28.2
2% AEP	25%ile	0.7	0.7	7.0	7.0
	50%ile	1.0	1.0	19.3	19.3
	75%ile	1.2	1.2	35.7	35.7

Table 8.12 Comparison of velocities and stream power along Section 5 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 5			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.7	0.7	7.3	7.4
	50%ile	0.9	0.9	15.0	14.8
	75%ile	1.0	1.0	24.4	24.1
2% AEP	25%ile	0.8	0.8	9.1	9.1
	50%ile	1.1	1.1	21.2	20.9
	75%ile	1.3	1.3	38.1	37.5

Table 8.13 Comparison of velocities and stream power along Section 6 between existing and proposed (Project) conditions, 50% and 2% AEP design events

Event	Statistic	Section 6			
		Velocity (m/s)		Stream power (W/m²)	
		Existing conditions	Proposed (Project) conditions	Existing conditions	Proposed (Project) conditions
50% AEP	25%ile	0.9	0.9	12.8	13.1
	50%ile	1.0	1.0	19.2	20.0
	75%ile	1.2	1.2	27.6	27.9
2% AEP	25%ile	0.8	0.9	8.5	9.4
	50%ile	1.1	1.1	24.2	23.2
	75%ile	1.3	1.4	39.5	43.0

8.7.3 Hydraulic assessment of the proposed clean water drain

8.7.3.1 Overview

The proposed clean water drain would realign an unnamed tributary of Two Mile Gully (referred to as the existing tributary), which is mapped as a second order stream. The existing tributary is not mapped as a watercourse per the Water Act. As such, a functional design assessment and report in accordance with the *Guideline: Works that interfere with water in a watercourse for a resource activity* (Department of Natural Resources, Mines and Energy, 2019) would not be required. Notwithstanding this, a hydraulic assessment was undertaken to assess the stability of the proposed clean water drain due to the following reasons:

- the proposed clean water drain potentially impacts flood flows to Two Mile Gully, which is a fourth order stream and considered a watercourse under the Water Act; and
- the proposed clean water drain would form a permanent feature of the final landform.

The concept design for the proposed clean water drain has been developed to support the environmental approvals for the Project. It is anticipated the design would be further optimised during Preliminary and Detailed Design prior to construction.

Figure 8.44 shows the proposed clean water drain channel extent configuration. Figure 8.45 shows a longitudinal section plot along the proposed clean water drain alignment. Figure 8.46 and Figure 8.47 show cross section plots along representative cross sections A-A and B-B, respectively (cross section locations are shown in Figure 8.44).

The proposed clean water drain will be a trapezoidal channel with base width of 5 m, a maximum top width of 65 m, 1V:5H (vertical rise to horizontal run) internal batter slopes and a longitudinal slope of 0.7%.

In comparison, the existing tributary (that the proposed clean water drain would replace), has a longitudinal slope of 0.35% to 0.61%. The existing tributary channel has a base width between <2 m and up to 5 m, with bank slopes of between 1V:5H to 1V:10H.

In summary, the proposed clean water drain is slightly steeper than the steepest section of the existing tributary that it would replace. The clean water drain channel shape generally would not replicate the existing tributary channel, which is due to the constraints of the site.

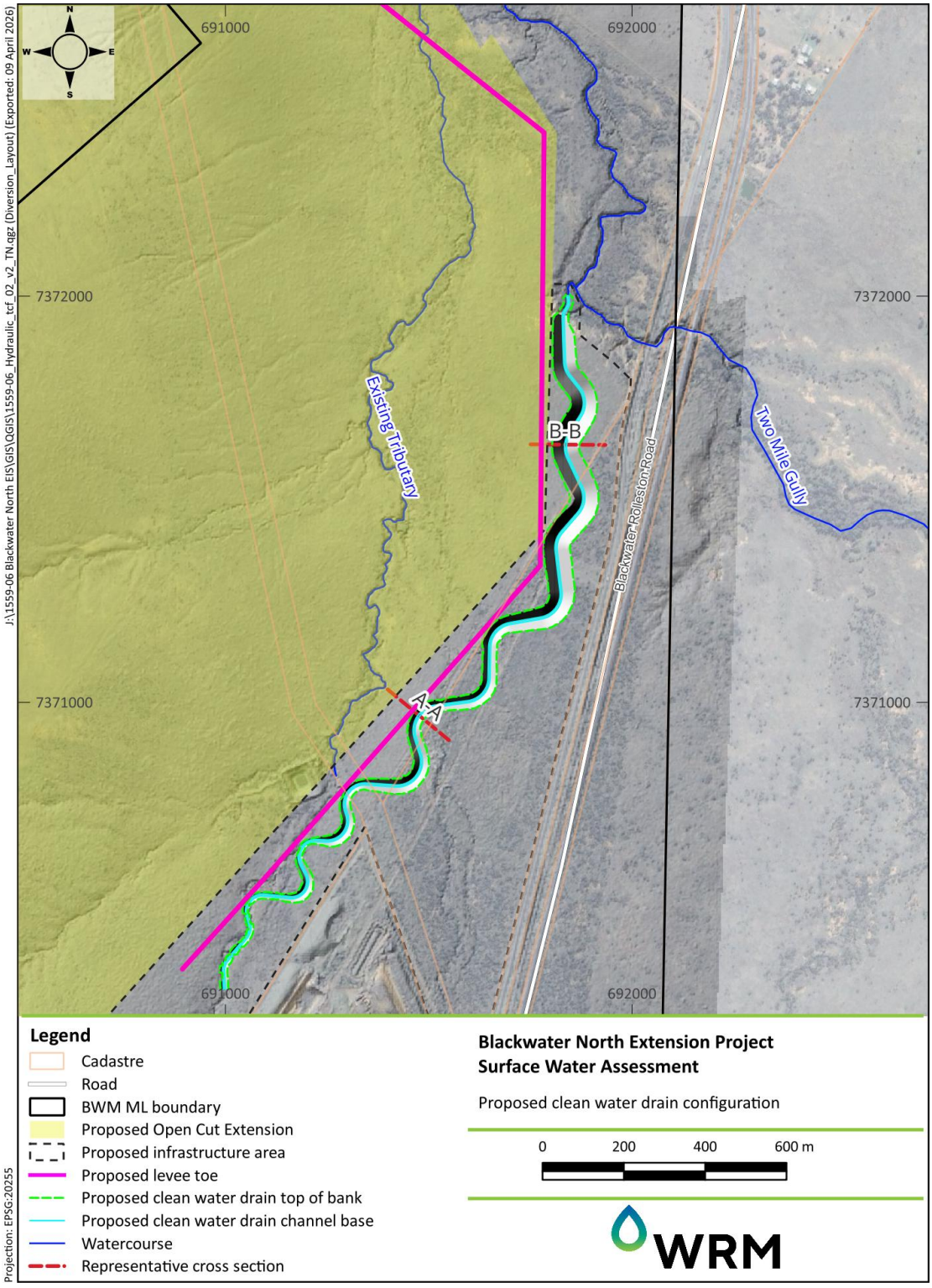


Figure 8.44 Proposed clean water drain configuration

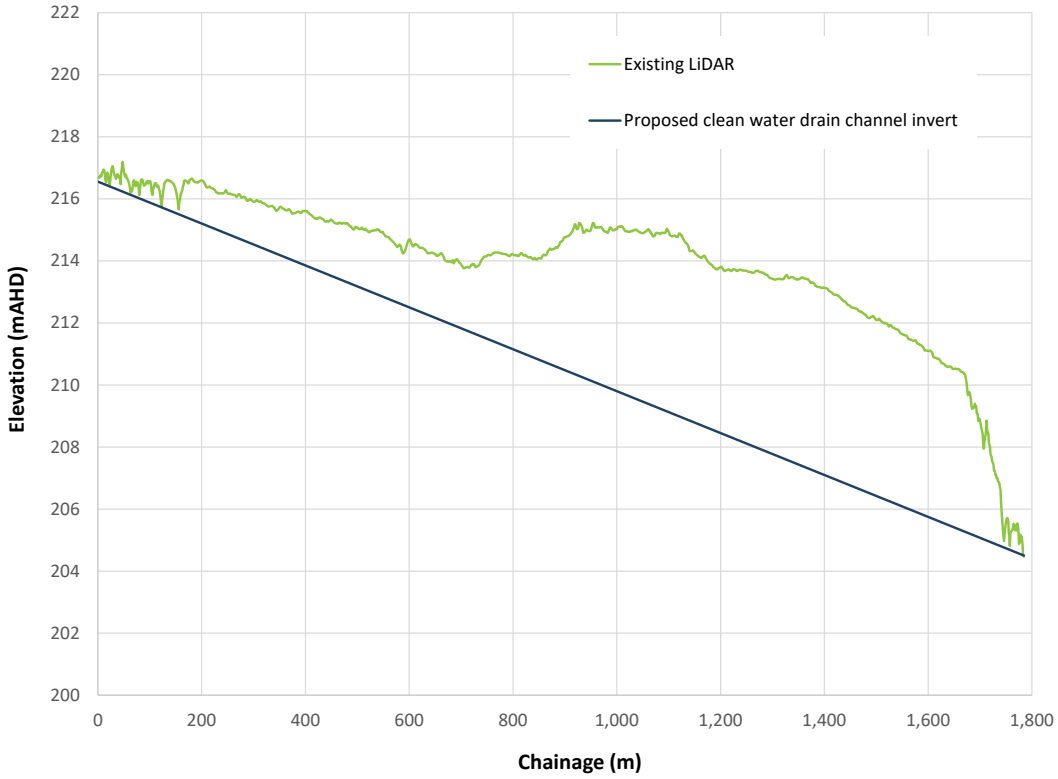


Figure 8.45 Longitudinal section plot along the proposed clean water drain alignment

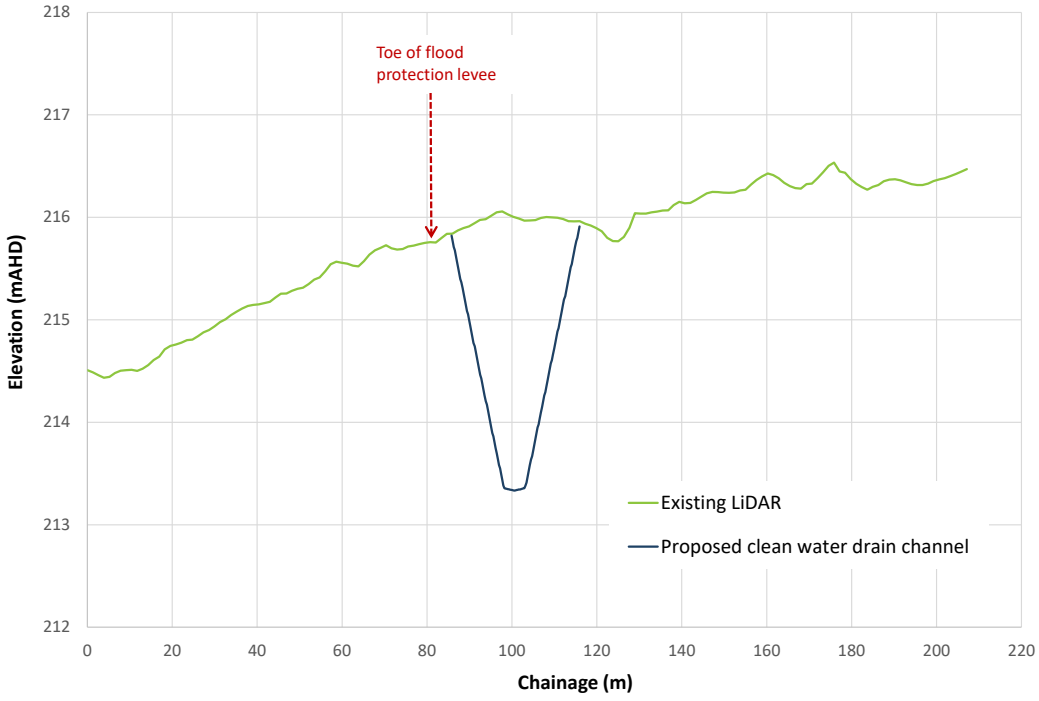


Figure 8.46 Proposed clean water drain cross section A-A (left to right in the direction of flow)

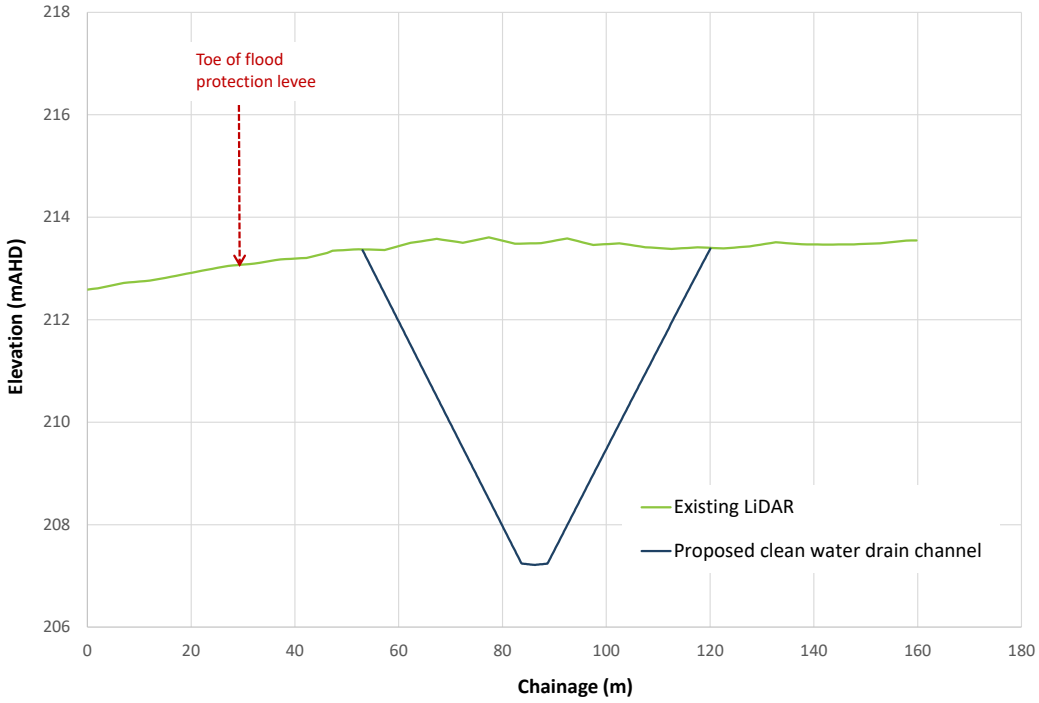


Figure 8.47 Proposed clean water drain cross section B-B (left to right in the direction of flow)

8.7.3.2 Hydraulic design criteria

Alluvium (2014) noted that sediment supply and bed load transport was found to be a critical factor in the performance of diversions. The volume of bed load sediment transported by a watercourse system is controlled by both the amount of sediment delivered to the watercourse and the capacity of the watercourse to transport sediment. Bed load transport in a watercourse can be broadly described as being either supply limited (can transport more sediment than is available) or transport limited (sediment supply exceeds transport capacity) (Alluvium, 2014).

For the purpose of constructed waterway diversion design, Alluvium (2014) recommends that mean reach stream power within a constructed waterway diversion lie within the ranges provided in Table 8.14. Further, Alluvium (2014) recommends that no cross section within a constructed waterway diversion exceed the adopted reach mean stream power by more than 50%.

Alluvium (2014) noted that a large proportion of natural watercourses in the Bowen Basin can be classified as transport limited with elevated and excess sediment supply available within the channel extent. Therefore, the mean reach stream power upper limits for transport limited alluvial streams given in Table 8.14, are applicable to the proposed clean water drain.

The proposed clean water drain would replace a section of the existing tributary during the operational phase of the Project and for the final landform. Therefore, velocities and stream power along the proposed clean water drain (under proposed [Project] conditions) were also compared against those within the existing tributary channel (under existing conditions).

Table 8.14 Mean reach stream power identified for sample stream reaches (Alluvium, 2014)

Stream type	Sediment transport group	Stream power (W/m²)	
		2-year Average Recurrence Interval (ARI) (1 in 1.44 AEP)	50-year ARI (1 in 50 AEP)
Alluvial	Supply limited (low sediment supply)	15 – 35	50 – 100
	Transport limited (high sediment supply)	35 – 60	80 – 150
Prevalent bedrock controls	n/a	50 – 100	100 – 350

8.7.3.3 Hydraulic assessment

Table 8.15 compares the statistical summaries of velocities and stream power along the existing tributary (under existing conditions) and the proposed clean water drain (under proposed [Project] conditions), for the 50% and 2% AEP design events. In the absence of hydraulic modelling for the 2 year ARI (1 in 1.44 AEP) event, the 50% (1 in 2) AEP hydraulic model results were assessed against the 2 year ARI (1 in 1.44 AEP) design criteria in the Alluvium (2014) guideline.

The model results show that the mean and maximum stream power along the proposed clean water drain are within the Alluvium (2014) design criteria for the 2 year ARI (1 in 1.44 AEP) event (35 - 60 W/m^2) and the 50 year ARI (1 in 50 AEP) event (80 – 150 W/m^2), based on transport limited alluvial streams. Therefore, the proposed clean water drain would satisfy the Alluvium (2014) design criteria.

Compared to the hydraulic characteristics of the existing tributary, predicted velocities and stream power in the proposed clean water drain would be higher. This is due to the significant constriction of the floodplain compared to existing conditions. As shown in Figure 8.43, a large proportion of flood flows along the existing tributary would be conveyed along the floodplain, with only a small proportion being conveyed within the existing tributary channel. The design of the clean water drain may be revised during Detailed Design, so that the hydraulic characteristics of the proposed clean water drain can better replicate the existing tributary's hydraulic behaviour.

Whilst the proposed clean water drain cannot replicate the hydraulic characteristics of the existing tributary, predicted velocities and stream power along the proposed clean water drain are well below the Alluvium (2014) upper limits of velocities and stream power for transport limited streams. Therefore, the proposed clean water drain is expected to be a stable and self-sustaining structure during the operational phase of the Project and post-closure. The design of the clean water drain would be improved during Detailed Design.

Table 8.15 Comparison of velocities and stream power along the existing tributary and the proposed clean water drain, 50% and 2% AEP design events

Event	Statistic	Velocity and stream power along the existing tributary and proposed clean water drain				Alluvium (2014) stream power thresholds (W/m²)	
		Velocity (m/s)		Stream power (W/m²)		Supply limited alluvial stream (low sediment supply)	Transport limited alluvial stream (high sediment supply)
		Existing tributary	Proposed clean water drain	Existing tributary	Proposed clean water drain		
50% AEP	25%ile	0.5	1.0	3.0	25.2	15 – 35 [a]	35 – 60 [a]
	50%ile	0.6	1.1	6.2	35.3		
	75%ile	0.8	1.2	11.9	44.9		
	Mean	0.8	1.1	9.3	34.1		
	Max.	1.2	1.3	42.9	75.7		
2% AEP	25%ile	0.7	1.3	8.1	44.4	50 – 100	80 – 160
	50%ile	0.8	1.4	14.9	56.4		
	75%ile	1.1	1.6	26.8	75.5		
	Mean	1.0	1.4	20.5	56.2		
	Max.	1.7	1.7	91.2	107.1		

[a] – Alluvium (2014) provides stream power thresholds for the 2 year ARI event (equivalent to a 39% AEP event). The 50% AEP event hydraulic model results were used as a proxy for the 2 year ARI (39% AEP) event.

8.8 FINAL LANDFORM FLOOD ASSESSMENT

8.8.1 Final landform configuration

Figure 8.48 to Figure 8.50 show the proposed final landform configuration and the extent of flooding for the 1% AEP, 0.1% AEP and PMF design flood events, respectively. The final landform for the Project would include five residual voids as previously described in Section 7.1.

- The final landform around the final voids would be constructed to prevent floodwater from entering. The temporary flood protection levees (in place during mining) adjacent to the Ramp 30, Deep Creek and Stewarton North pits would be removed such that the rehabilitated out-of-pit overburden areas would prevent floodwater from entering the voids.
- The landform features around the proposed voids would be constructed to be at least 60 m wide at the crest.
  - For the Ramp 30 void, the landform feature would have a crest height above the adjacent 0.1% AEP peak flood level in Deep Creek.
  - For the Mimosa/Besgrove, Deep Creek, and Stewarton North and Stewarton South voids, the landform feature would have a crest height above the adjacent PMF peak flood level.
- At the end of mining, the south-eastern corner of the Deep Creek void would be backfilled. As a result, the toe of the landform at this location would be located further away from Deep Creek compared to the maximum Deep Creek Pit extent during operations. This approach provides additional floodplain conveyance for the final landform compared to mining stage.
- Similarly, the south-eastern corner of the Stewarton North pit would be backfilled and as a result, the toe of the landform at this location would be located further away from Taurus Creek

compared to the maximum Stewarton North Pit extent during operations. In addition, the proposed clean water drain described in Section 8.7.3 would be retained for the final landform.

- It is assumed that the final landform, including the out-of-pit overburden dumps, would be rehabilitated to achieve at least 70% vegetal cover (in line with Whitehaven Blackwater's rehabilitation schedule), using erosion resistant materials at the toe of the landform that would be in contact with floodwater.

8.8.2 Assessment methodology

Hydraulic modelling was undertaken for the 1% AEP, 0.1% AEP and PMF design flood events under proposed final landform conditions, and for the SSP2-4.5 (year 2100) future climate scenario.

A summary of the model results is presented in the following sections, focusing on the flood immunity of the proposed voids and the risk of erosion and scour in the vicinity of the proposed final voids and sections of rehabilitated dump landform in contact with floodwater.

8.8.3 Peak flood levels, depths, extents and velocities

Figure 8.48 to Figure 8.50 show the predicted peak flood extents, levels and depths along Taurus Creek, Two Mile Gully, Emu Creek and Deep Creek in the vicinity of the final landform, for the 1% AEP, 0.1% AEP and PMF events. Figure 8.51, Figure 8.52 and Figure 8.53 show the corresponding peak velocities.

The model results indicate that:

- The Mimosa/Besgrove void would be located outside of the riverine flood extents in Sagittarius Creek for all flood events up to the PMF.
- The Deep Creek, Stewarton North and Stewarton South voids would have immunity from flooding for all events up to and including the PMF.
- The Ramp 30 void would have immunity from flooding for all events up to and including the 0.1% AEP event. Floodwater ingress into the Ramp 30 voids is predicted to occur during the PMF event. The predicted depths of overtopping during the PMF event vary at approximately 0.25 m on average up to a maximum of 1 m above the crest of the landform.
- The model predicted flood velocities along the toe of the proposed flood protection landform adjacent to the voids for all events up to 0.1% AEP are as follows:
  - Adjacent to the Ramp 30 void, flood velocities are generally <1 m/s, with higher velocities contained within creek channel further away from the landform.
  - Adjacent to the Deep Creek void, flood velocities are generally <0.5 m/s, with velocities of up to 1.6 m in some sections.
  - Adjacent to the Stewarton void, flood velocities along the Two Mile Gully floodplain range between <0.4 m/s and up to 1.3 m/s.
- Flood velocities along the toe of rehabilitated dumps (adjacent to Deep Creek, Taurus Creek and Emu Creek) are generally <2 m/s for events up to 0.1% AEP.

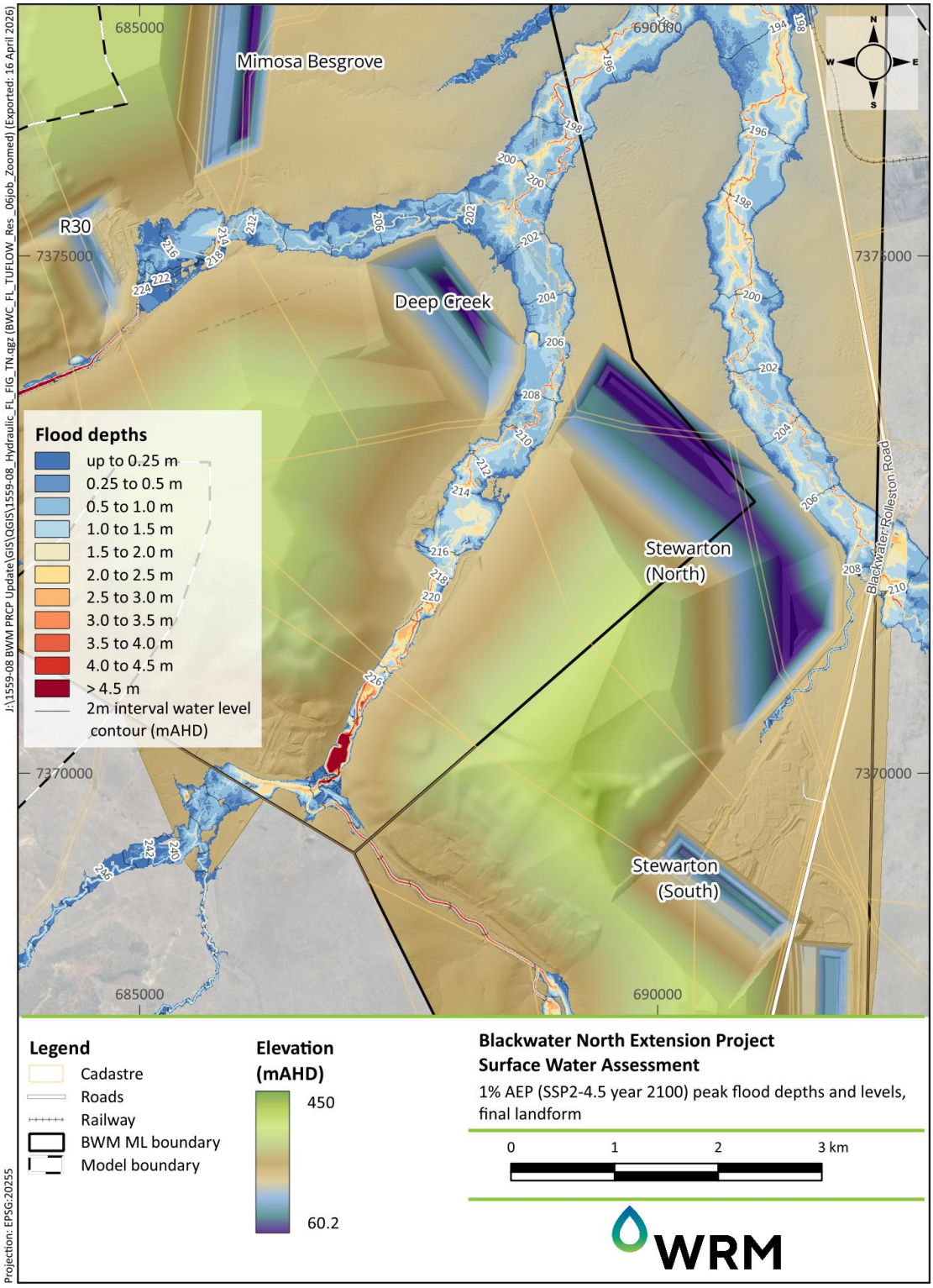


Figure 8.48 1% AEP (SSP2-4.5 year 2100) peak flood depths and levels, final landform

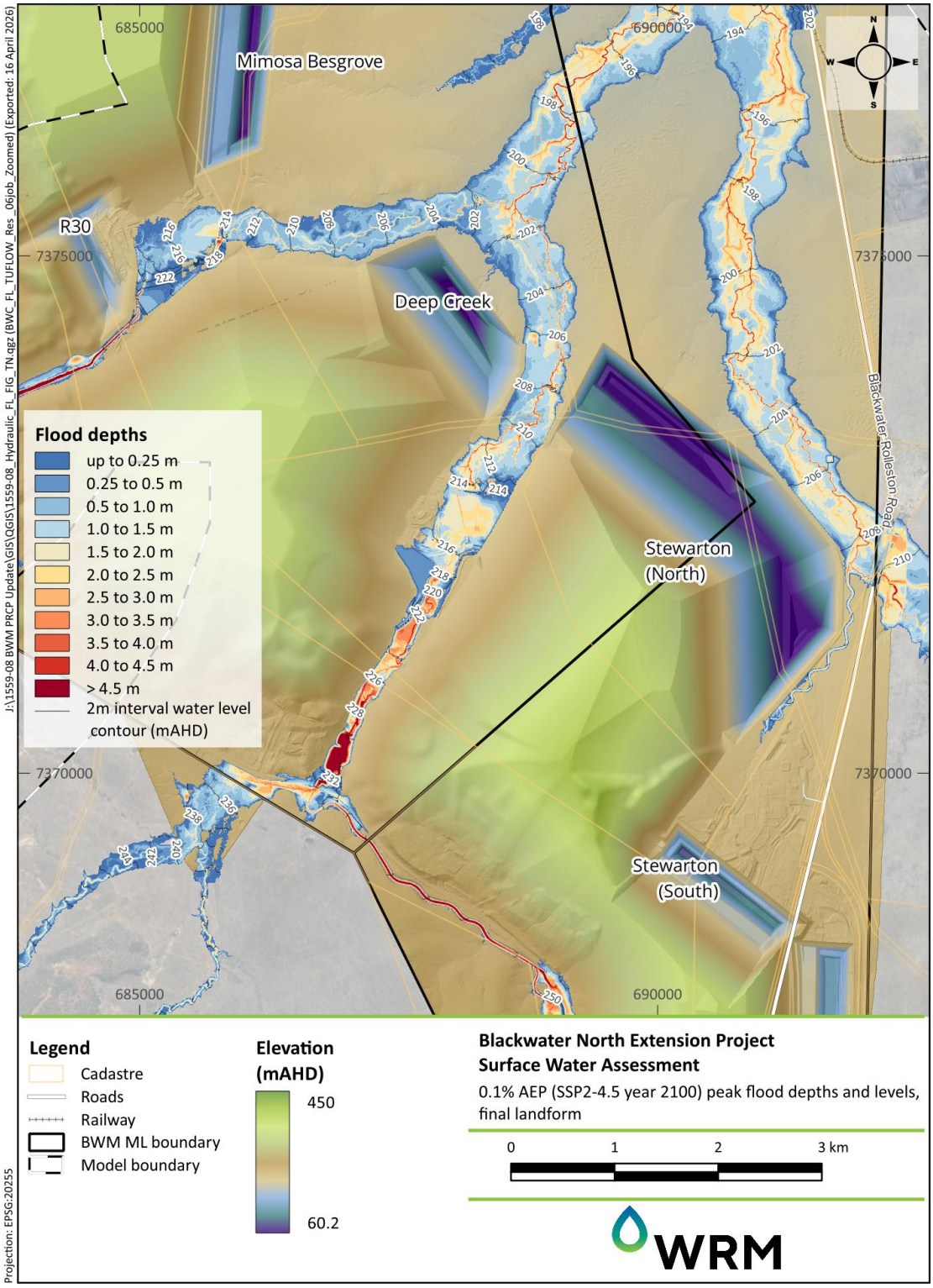


Figure 8.49 0.1% AEP (SSP2-4.5 year 2100) peak flood depths and levels, final landform

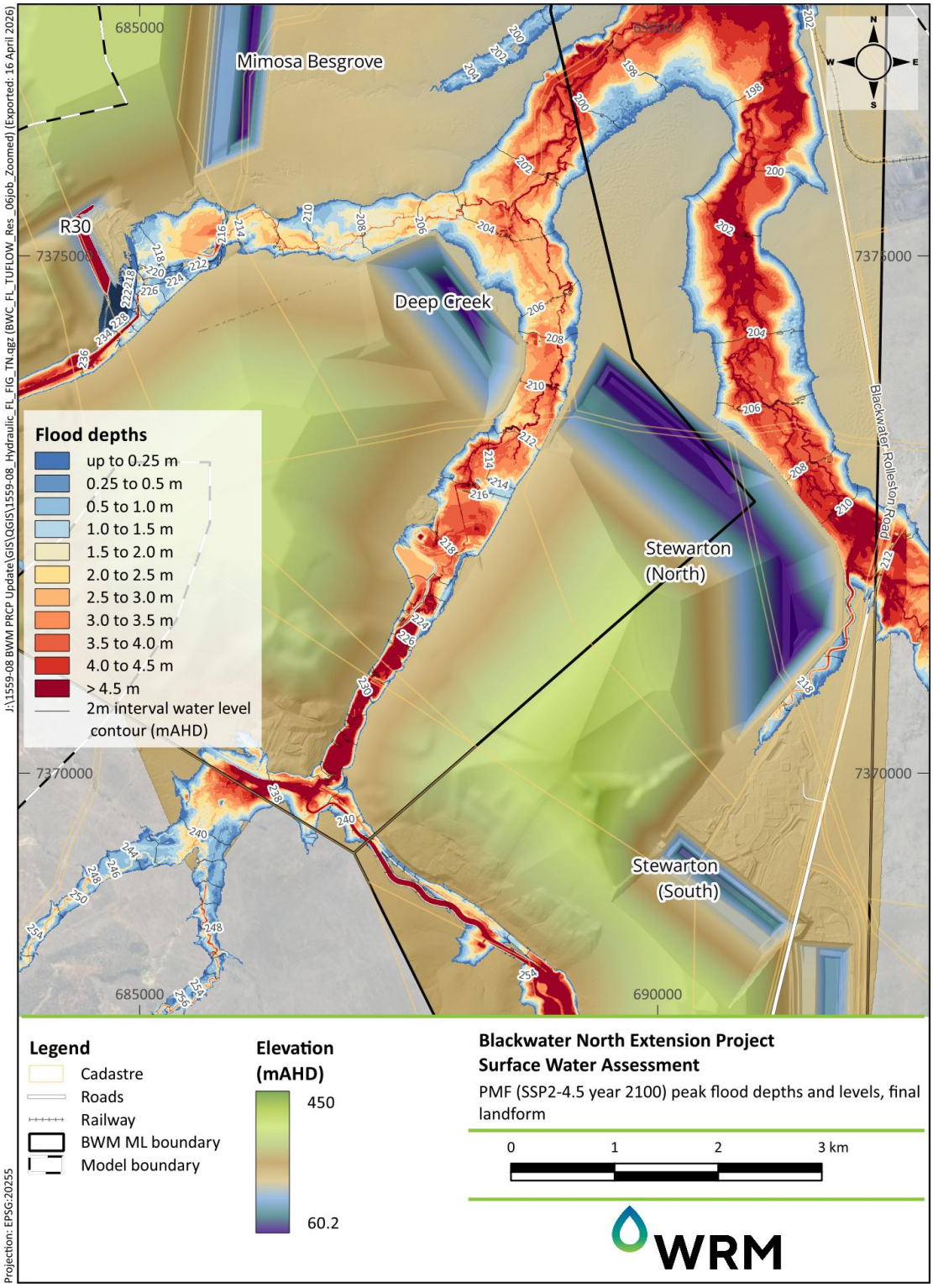


Figure 8.50 PMF (SSP2-4.5 year 2100) peak flood depths and levels, final landform

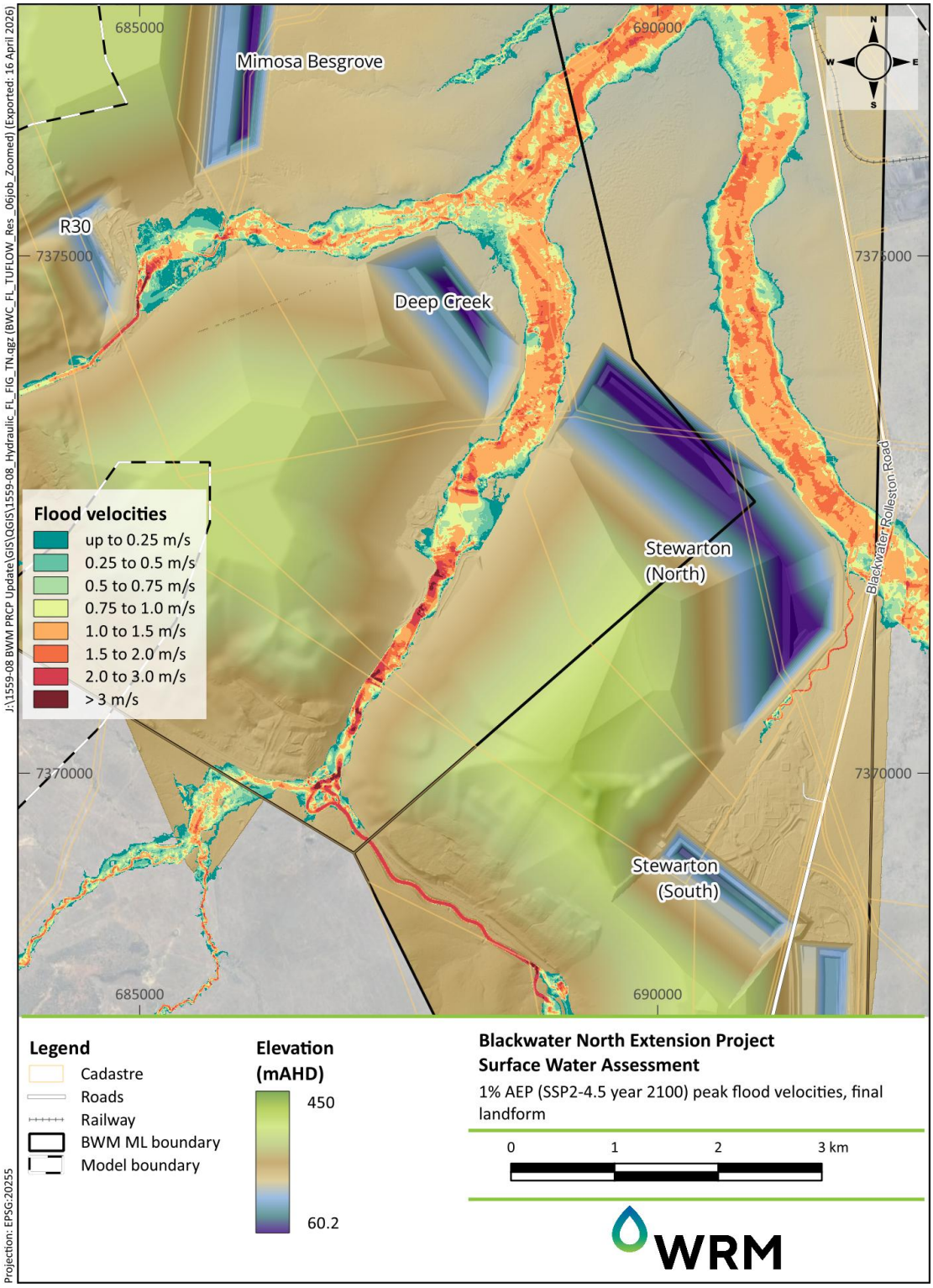


Figure 8.51 1% AEP (SSP2-4.5 year 2100) peak flood velocities, final landform

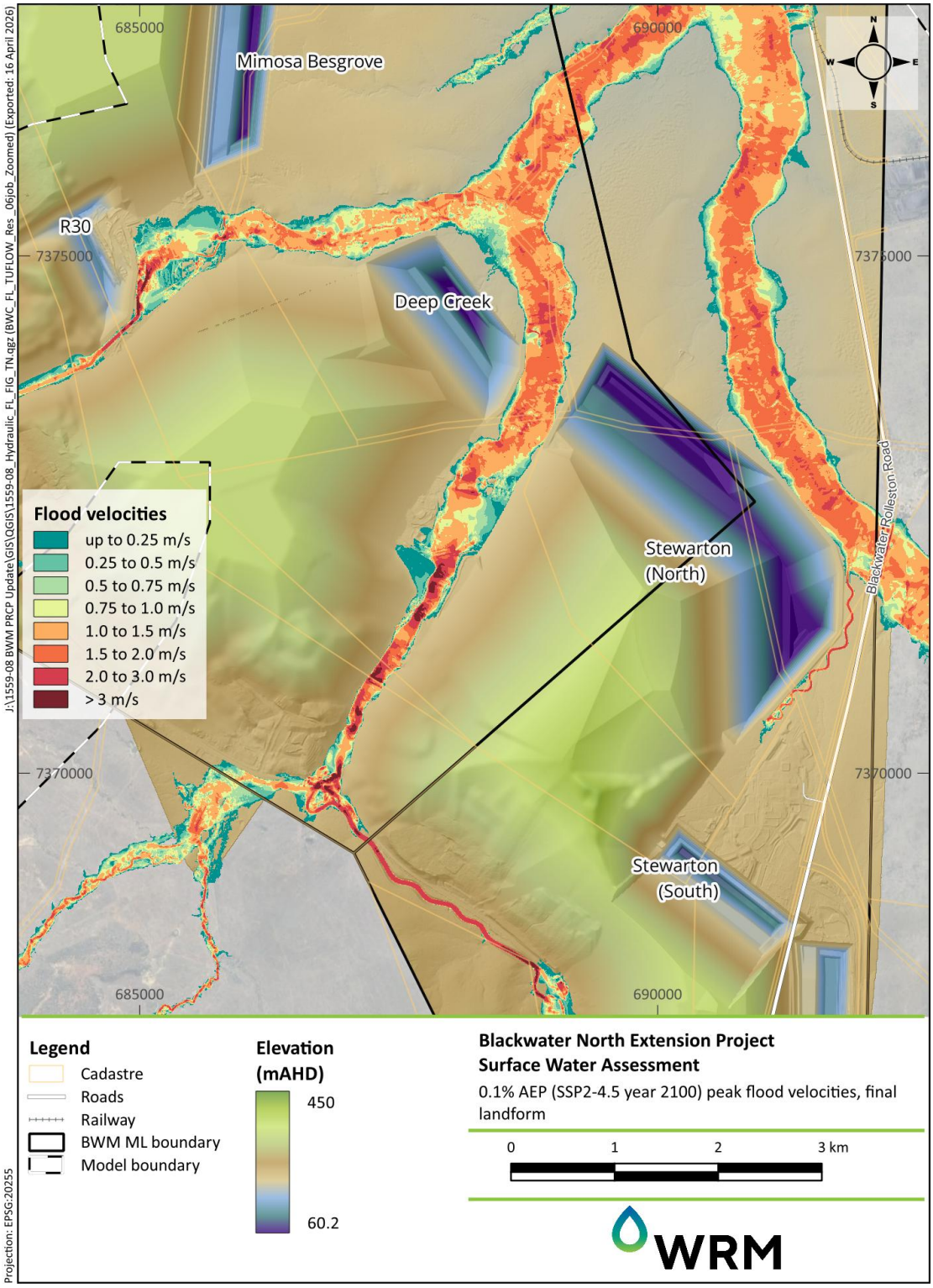


Figure 8.52 0.1% AEP (SSP2-4.5 year 2100) peak flood velocities, final landform

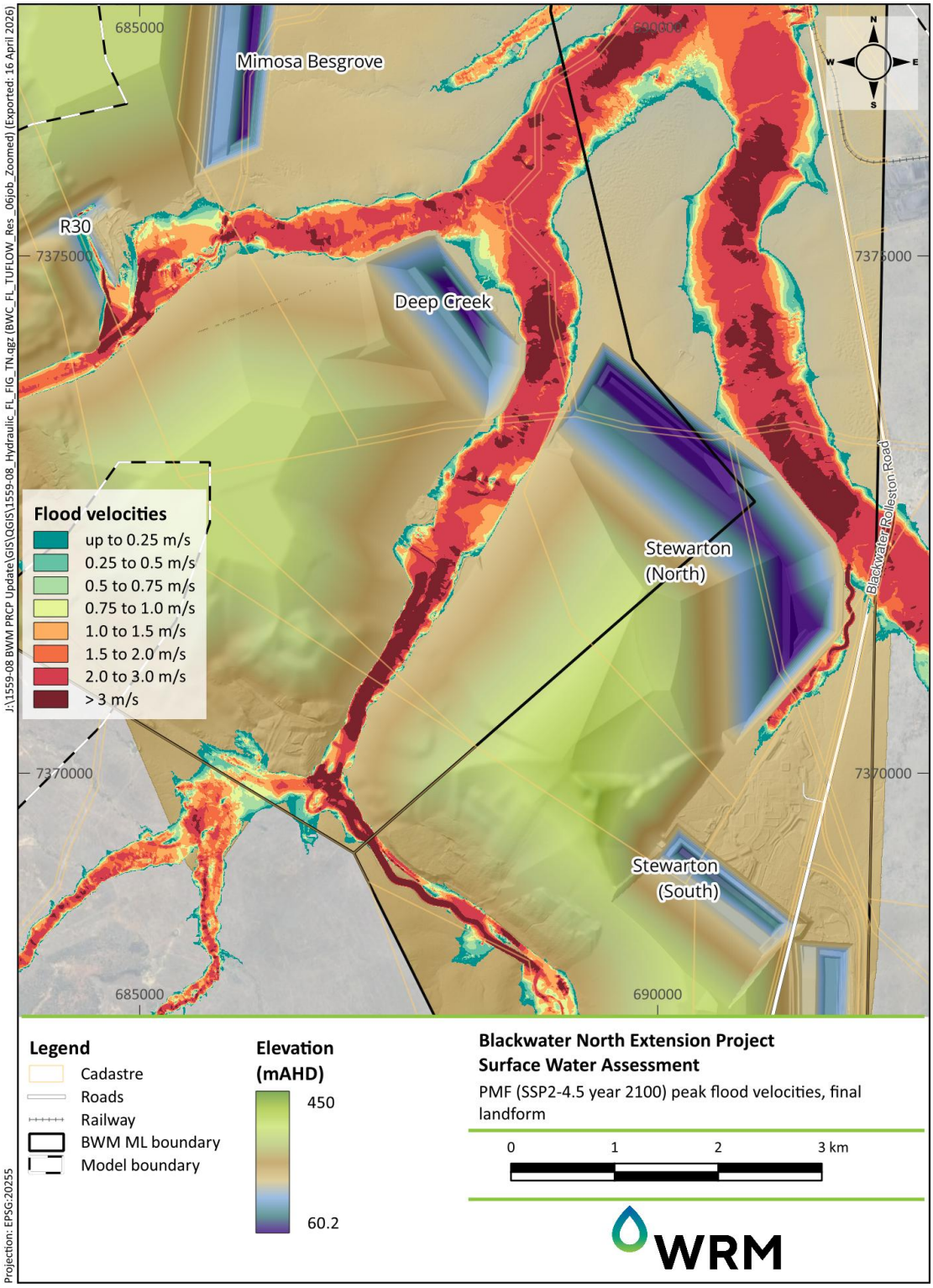


Figure 8.53 PMF (SSP2-4.5 year 2100) peak flood velocities, final landform

8.8.4 Risk of erosion and scour

The risk of erosion on the post-mining rehabilitated landform was assessed by comparing the model-predicted flood velocities adjacent to the final landform against the maximum allowable velocity threshold given in *Book 4 – Best Practice Erosion and Sediment Control* guideline (International Erosion Control Association [IECA], 2008).

Table 8.16 shows the maximum allowable velocities for bare earth and grassed channels obtained from IECA (2008), which are considered applicable to rehabilitated landform surfaces subjected to flooding.

Table 8.16 Adopted criteria for maximum allowable velocities adjacent to rehabilitated landform in contact with floodwater, adopted from IECA (2008)

Channel gradient (%)	Percentage of stable vegetal cover			
	0%	50%	70%	100%
Erosion resistant soils:				
1	0.7	1.6	2.1	2.8
2	0.6	1.4	1.8	2.5
3	0.5	1.3	1.7	2.4
4		1.3	1.6	2.3
5		1.2	1.6	2.2
6			1.5	2.1
8			1.5	2.0
10			1.4	1.9
15			1.3	1.8
20			1.3	1.7
Easily eroded soils:				
1	0.5	1.2	1.5	2.1
2	0.5	1.1	1.4	1.9
3	0.4	1.0	1.3	1.8
4		1.0	1.2	1.7
5		0.9	1.2	1.6
6			1.1	1.6
8			1.1	1.5
10			1.1	1.5
15			1.0	1.4
20			0.9	1.3

2.1 – Adopted velocity threshold above which flood-induced erosion would likely occur

It is assumed that the final landform achieves at least 70% vegetative cover, combined with the use of erosion resistant materials at the toe of the landform, that would be in contact with floodwater during flooding. The topographic gradient along the toe of the landform, in the direct flow, would be <1% in general.

On this basis of the above, the risk of flooding-induced erosion of the rehabilitated landform is expected to be low for velocities up to 2.1 m/s at the toe of the landform in contact with floodwater. Flood velocities towards the centre of the floodplain are generally higher than at the toe of the rehabilitated landform, but these higher velocities would not trigger erosion of the landform itself.

As described in Section 8.8.3, velocities adjacent to the final voids and rehabilitated dump landform are lower than the adopted maximum allowable velocity (2.1 m/s) from IECA (2008). Therefore, the final landform is expected to be stable during flood events up to the 0.1% AEP event.

9 CATCHMENT EXCISION ANALYSIS

9.1 OVERVIEW

The Project would involve an expansion of the mining pits, which would result in the loss of undisturbed catchment reporting to Taurus Creek and Sagittarius Creek. The following sections describe impact of the predicted catchment loss on:

- flow regime in the waterways in the vicinity of the Project; and
- fine sediment and nutrient loads to the GBR catchment waters.

9.2 CATCHMENT LOSS

Figure 9.1 shows the existing Taurus Creek catchment (to Taurus Creek D/S gauge), the existing Sagittarius Creek catchment (to the northern ML boundary) and the existing Two Mile Gully catchment to the Blackwater-Rolleston Road. Figure 9.1 also shows the portions of the existing Taurus Creek and Sagittarius Creek catchments that would be lost as a result of the Project during mining. The changes in catchment areas between existing and proposed (Project) conditions are tabulated in Table 9.1.

The Project would involve an extension of the open cut pit footprint towards the east, which would reduce the Taurus Creek and Sagittarius Creek catchments during mining, as a greater portion of undisturbed land would drain to the open cut pits.

The Project, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and a 7.9% reduction in the Sagittarius Creek catchment compared to existing conditions.

Table 9.1 Analysis of catchment loss due to the Action

Catchment	Catchment area (km^2)		Difference (%)
	Existing conditions	Project conditions	
Taurus Creek to Taurus Creek D/S gauge	250.4	228.2	-8.9
Sagittarius Creek to northern ML boundary	42.7	39.3	-7.9

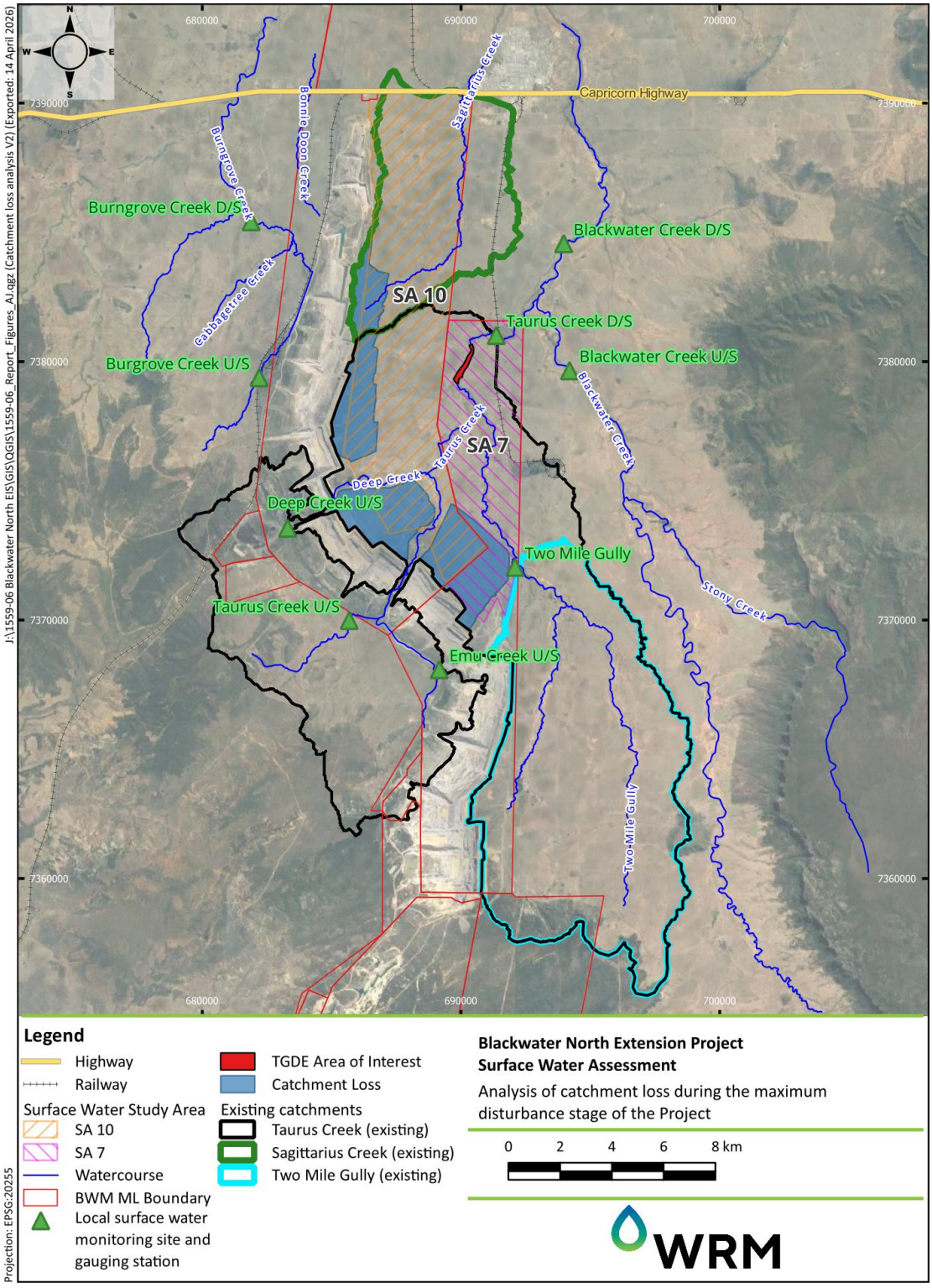


Figure 9.1 Analysis of catchment loss during the maximum disturbance stage of the Project

9.3 IMPACTS ON FLOW REGIME

9.3.1 Taurus Creek

Figure 9.2 shows the derived existing conditions flow-duration relationship for Taurus Creek at the Taurus Creek D/S gauge, based on recorded stream flow data at this gauge. Figure 9.2 also shows the Project conditions flow-duration relationship, which was derived by factoring the recorded flows based on the loss of catchment to the Taurus Creek D/S gauge.

Figure 9.2 shows that Taurus Creek is ephemeral, with flows <0.1 ML/d occurring <19% of the time and flows >1 ML/d occurring <10% of the time. Figure 9.2 also shows the impact of the Project on the magnitude of flows in Taurus Creek is insignificant.

Figure 9.2 also shows the location of an identified Terrestrial Groundwater Dependent Ecosystems (TGDE). The Taurus Creek D/S gauge is located just downstream of the TGDE area of interest and as such, the flow-duration relationship at this gauge is representative of flow characteristics at the TGDE area of interest. The *Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment* (DPM Enviroscience Pty Ltd, 2026) noted that based on the insignificant impact on Taurus Creek flow regime predicted in this surface water assessment, the TGDEs of the Study area are unlikely to be affected by the Project.

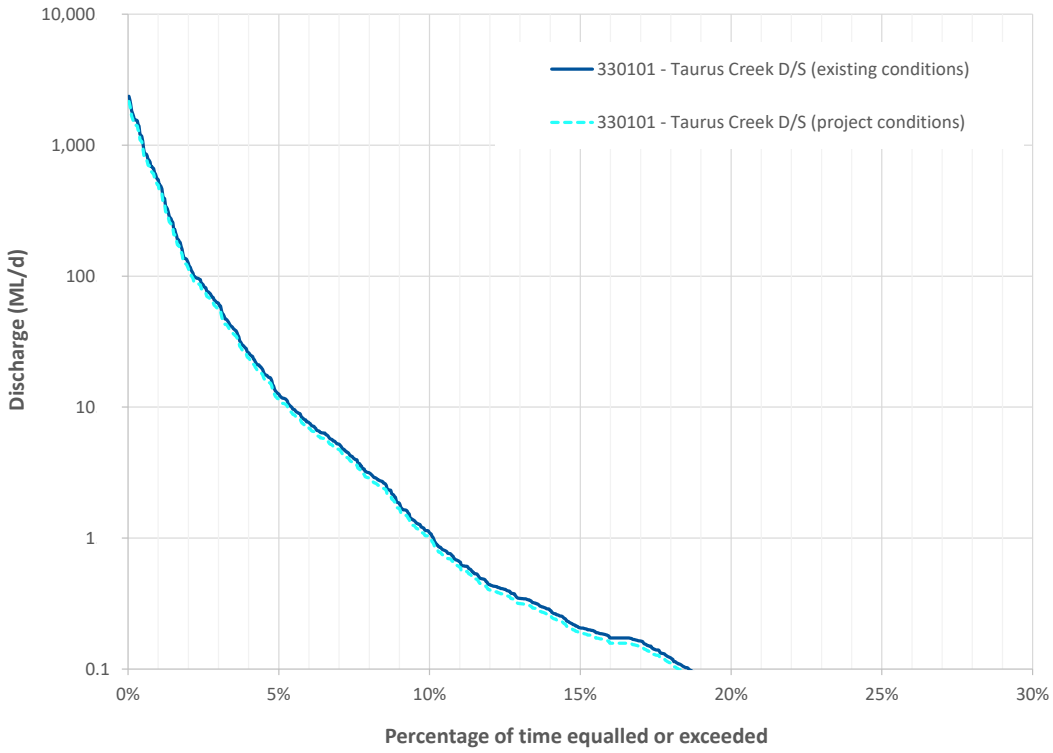


Figure 9.2 Derived flow-duration relationship for Taurus Creek at the Taurus Creek D/S gauge (existing vs. Project conditions)

9.3.2 Two Mile Gully

Figure 9.3 shows the derived existing conditions flow-duration relationship for Two Mile Gully at the Two Mile Gully gauge, based on recorded stream flow data at this gauge.

Figure 9.3 shows that Two Mile Gully is ephemeral, with flows >0.1 ML/d occurring less than 10% of the time and flows >1 ML/d occurring less than 6% of the time. The Two Mile Gully catchment to this gauge would not be changed as a result of the Project, hence the flow regime in Two Mile Gully would be unaffected by the Project.

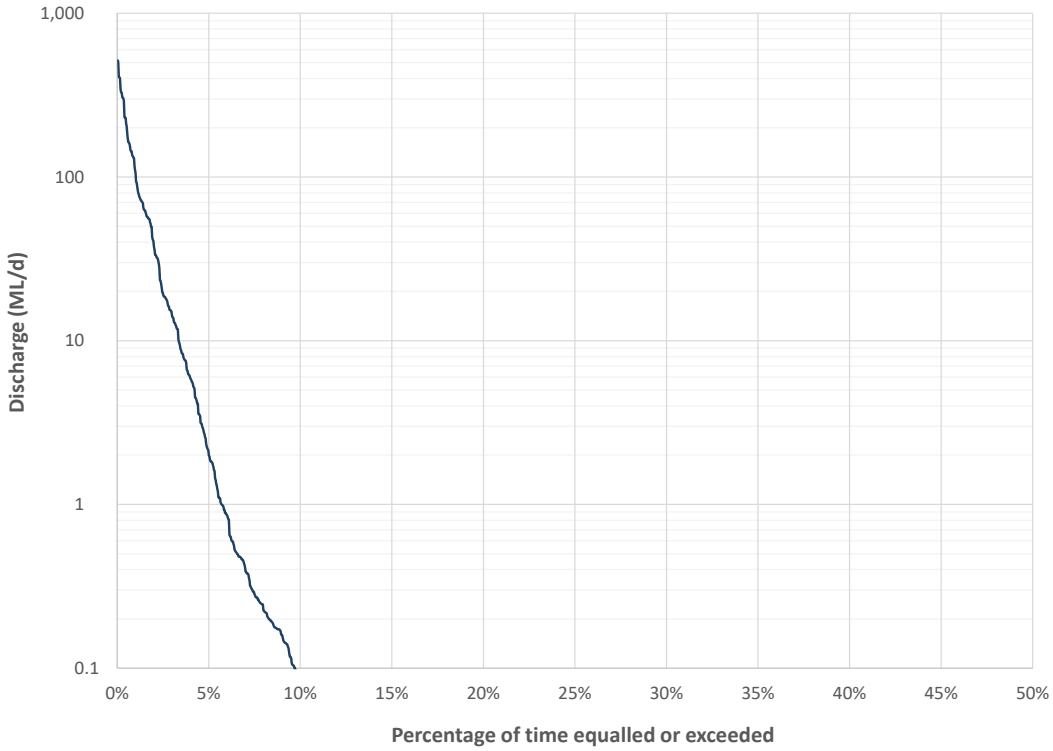


Figure 9.3 Derived flow-duration relationship for Two Mile Gully

9.3.3 Sagittarius Creek

Recorded stream flow data in Sagittarius Creek is not available to generate a data-based flow-duration relationship. Sagittarius Creek is likely to be ephemeral, behaving similarly to Taurus Creek and Two Mile Gully and would only flow after significant rain events.

The predicted percentage loss of Sagittarius Creek catchment due to the Project is similar to, and slightly smaller than, the predicted loss of Taurus Creek catchment (refer to Table 9.1). On this basis, the impact on flow regime in Sagittarius Creek due to the Project is expected to be similar to those predicted in Taurus Creek and is likely to be insignificant.

9.4 IMPACTS TO GREAT BARRIER REEF CATCHMENT WATERS

The Project would result in a reduction in undisturbed catchment runoff volumes which in turn, is expected to reduce the TSS, TN and TP loads to the greater Fitzroy basin and ultimately to the GBR. The assessment demonstrates that the Project would continue to operate within the established surface water management framework that prioritises capture, reuse and controlled release of MAW. There are no proposed changes to the currently approved controlled release strategy (e.g. no new release points) as a result of the Project and as such, controlled releases would continue to be undertaken in accordance with the EA release conditions.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways. The proposed eastward expansion of existing pits would result in catchment changes that are confined to the expanding pits, which drain internally. The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have been identified as having legacy risks of uncontrolled discharge. Additionally, the Project does not modify the catchments of NTCD or NDCD, which have been identified as key legacy risks for uncontrolled discharges due to their on-stream configuration.

A separate SWA memorandum has been prepared to support a Referral for the Project under the EPBC Act (WRM, 2026). This memorandum (provided in Appendix C) specifically addresses the potential for the Project to result in surface water impacts on the GBR.

The Project (during mining) would likely achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters. Similarly, post mining, mining landforms would be rehabilitated and the Project final voids would remain as sinks (or would have flow-through characteristics that report to nearby voids). Accordingly, the Project would not result in long-term water quality impacts downstream of the Project. On this basis, the Project would have no residual impact and therefore complies with section 41AA of the EP Regulation.

10 ASSESSMENT OF SURFACE WATER IMPACTS, MITIGATION AND MANAGEMENT MEASURES

The following sections describe the key potential water management risk and mitigation measures.

10.1 IMPACT ON FLOW REGIME

The Project would result in minor alterations to flow regimes in the local creeks, primarily due to the loss of catchment area draining to Taurus Creek and Sagittarius Creek resulting from the expansion of the mining pits.

The impacts on flow regime in Taurus Creek and Sagittarius Creek are insignificant, and the Project would not impact on flow regime in Two Mile Gully.

The loss of catchment area due to the Project would occur in the middle reaches of Taurus Creek, while the headwaters of the Taurus Creek catchment would be unaffected by the Project. As a result, the duration and frequency of flows would not be materially changed.

10.2 IMPACT ON WATER QUALITY

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of MAW. Surface water management measures include separation of clean and contaminated water, ESC structures, operational water balance controls, and TARPs to prevent uncontrolled releases.

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

The controlled release of MAW is restricted by the EA release conditions (Schedule F) and relevant WQOs. Water balance modelling results indicate that:

- The approved controlled release strategy is sufficient for maintaining excess MAW volumes at BWM during the operational phase of the Project.
- Compared to the Approved operations, the water balance modelling results indicate that the Project would result in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

Controlled releases under Schedule F of the EA would only occur when receiving waterways have recorded a natural flow event in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways. The proposed eastward expansion of existing pits would result in catchment changes that are confined to the expanding pits, which drain internally. The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge. Additionally, the Project does not modify the catchments of NTCD or NDCD, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

In conclusion, the Project is unlikely to substantially affect the quality of surface waters in receiving environments compared to current conditions and the Approved operations.

10.3 IMPACT ON DOWNSTREAM WATER USERS

Given the ephemeral nature of the local waterways in the vicinity of the Project as well as the insignificant impacts on flow regime and water quality in these waterways compared to the approved operations, there would not be any downstream water users that would be impacted by the Project.

10.4 IMPACT ON FLOODING

10.4.1 Flood impacts during mining

Flooding impacts from the Project during mining were assessed for events up to 0.1% AEP. The results show that:

- There would no ingress of floodwater into the mining pits for all events up to the 0.1% AEP design event with the construction of the proposed temporary flood protection levees.
- Predicted increases in peak flood levels are generally minor and mostly contained to the lease area for all events up to 0.1% AEP. There are minor localised off lease impacts upstream of BWM. There are no predicted increases in peak flood levels and events at existing dwellings/homesteads in the vicinity of the Project area.
- Predicted peak velocities on the floodplain remain within acceptable limits.
- The Project is not expected to result in a material change to flood behaviour downstream of the Project.

10.4.2 Waterway stability

Hydraulic modelling results show that the erosion potential and sediment transport characteristics of the existing waterway channels under proposed (Project) conditions would be similar to existing conditions.

The hydraulic characteristics of the proposed clean water drain were analysed, and the results are as follows:

- Compared to the hydraulic characteristics of the existing tributary, predicted velocities and stream power in the proposed clean water drain would be higher. This is due to the significant constriction of the floodplain compared to existing conditions.
- The predicted velocities and stream power along the proposed clean water drain are well below the Alluvium (2014) upper thresholds of velocities and stream power for transport limited streams. Therefore, the proposed clean water drain is expected to be a stable and self-sustaining structure during the operational phase of the Project and post-closure. The design of the clean water drain would be refined during Detailed Design, prior to construction.

10.4.3 Flooding for the final landform

Flooding for the final landform was assessed for a range of events up to the PMF. The results show that:

- There would be no ingress of floodwater into the Mimosa/Besgrove, Deep Creek, Stewarton North and Stewarton South voids for all events up to and including the PMF.
- There would no ingress of floodwater into the Ramp 30 void for all events up to and including the 0.1% AEP event.
- Predicted peak velocities adjacent to the final landform are non-erosive. Therefore, the final landform is expected to be stable and self-sustaining post-closure from a flood perspective.

10.5 IMPACT ON GREAT BARRIER REEF CATCHMENT WATERS

The Project would result in a reduction in undisturbed catchment runoff volumes which in turn, is expected to reduce the TSS, TN and TP loads to the greater Fitzroy basin and ultimately to the GBR.

As described in Section 9.4, there are no proposed changes to the currently approved controlled release strategy as a result of the Project and as such, controlled releases would continue to be undertaken in accordance with the EA release conditions. Additionally, the Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways.

A separate SWA memorandum has been prepared to support a Referral for the Project under the EPBC Act (WRM, 2026). This memorandum (provided in Appendix C) specifically addresses the potential for the Project to result in surface water impacts on the GBR.

The Project (during mining) would likely achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters. On this basis, the Project would have no residual impact on GBR catchment waters and therefore complies with section 41AA of the EP Regulation.

10.6 CUMULATIVE IMPACTS

The proposed release strategy to Blackwater Creek and the Mackenzie River is informed by existing release conditions applied to nearby operating coal mines. These conditions are embedded within a broader strategic framework designed to manage the cumulative impacts of water releases and mining activities. As such, the cumulative effects on surface water quality and associated EVs are expected to be negligible.

The site's water management system has been designed to minimise the need for controlled releases. When releases are required, they are conducted under strict release conditions, ensuring minimal impact on receiving water quality. With the implementation of the proposed mitigation measures, including sediment control, any potential contribution to salinity in the Mackenzie River from sediment dam discharges is expected to be minimal.

Given that the incremental impacts associated with the Project are not expected to be material, these impacts would not compound into significant cumulative impacts and a detailed cumulative impact assessment, including sediment and water releases from other mining operations in the Blackwater Creek catchment, is not considered necessary.

Releases from coal mines typically occur during high-flow conditions, which help dilute discharge concentrations and reduce environmental risks. During the 2023–24 reporting period, 27% of coal mines in the Fitzroy Basin participated in the FRREMP program, with 25 authorised releases recorded. During the 2023–24 reporting period, 27% of coal mines in the Fitzroy Basin participated in the FRREMP program, with 25 authorised releases recorded. The total salinity load discharged in the Mackenzie sub-basin was approximately 1,292 tonnes, primarily during high-flow events. When considering potential discharges from these operations under current release rules, the overall reduction in catchment area and associated streamflow is relatively minor.

Receiving water quality was analysed for the Mackenzie River at Bingegang (refer to Section 3.4.3), which is located downstream of all active mining operations within the Blackwater Creek catchment. The water quality monitoring data indicates that physiochemical parameters and the concentration of nutrients and metalloids in the Mackenzie River at Bingegang have stayed below the adopted local creek WQOs and the Sub-Basin WQOs (WQ 1304).

10.7 FINAL VOID CHARACTERISTICS

The final landform for the Project would include five residual voids. Water balance modelling results for the final landform show that:

- Void water levels would be influenced by groundwater inflow, rainfall, runoff, and evaporation, with equilibrium levels expected below overflow levels at all five residual voids, even after extreme long-duration storm events.
- The salinity of the pit lake in the Mimosa/Besgrove, Deep Creek and Stewarton North voids would increase over time due to evapoconcentration.
- The salinity of the pit lake in the Ramp 30 and Stewarton South voids fluctuates over time as the void empties in cycles.
- The modelling confirms that the residual voids would comply with EA EPML00717813, which requires that voids must not cause serious environmental harm to land, surface waters, or recognised groundwater aquifers, other than the harm constituted by the existence of the void itself.

10.8 MONITORING

The existing water management and monitoring regime for the approved EA would be continued for the Project with ESC as appropriate. Key elements of surface water management and monitoring include:

- The WMP would be updated as mine plans are refined, and new water management infrastructure is designed and constructed.
- Management of erosion and sediment control through implementation of the ESCP.
- Surface water monitoring would continue in accordance with the WMP. Current monitoring locations are sufficient to cover any additional disturbance due to the Project.
- Regular inspections and maintenance of dams, pipelines, and sediment control structures ensure system reliability.
- Real-time monitoring of water inventory, sediment dam overflow, and controlled release volumes ensures timely responses to changing conditions.

10.9 SUMMARY OF MITIGATION MEASURES

The proposed mitigation measures are summarised as follows:

- The controlled release of MAW would continue to be restricted by the existing EA release conditions for the duration of the Project.
- The Project would not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge.
- Temporary flood protection levees would be constructed for the operational stage of the Project to provide flood immunity to the open cut pits for flood events up to and including the 0.1% AEP design event. These temporary flood protection levees would be removed post-closure, and the final landform would be configured such that the rehabilitated out-of-pit overburden areas would prevent floodwater from entering the residual voids.
- A proposed clean water drain along the southeastern side of the future Stewarton Pit expansion area would be in place during the operational stage of the Project and would also form part of the final landform post-closure. The proposed clean water drain has been designed to be geomorphically stable and self-sustaining.
- Whitehaven Blackwater will continue to be a participant in the FRREMP.

- Surface water quality monitoring of receiving waters would continue to be undertaken in accordance with the requirements of EA EPML00717813. Current monitoring locations are sufficient to cover the any additional disturbance because of the Project.
- The existing *BWM Water Management Plan* would be updated, as required as mine plans are refined, to reflect any changes to the site water management system and surface water monitoring locations resulting from the Project.

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Whitehaven, 2024	Whitehaven Coal Limited, 2024, *WHC QLD Standard: Erosion & Sediment Control and Mine Affected Water*.
Whitehaven, 2025	Whitehaven Coal Limited, 2025, *Blackwater North Extension Project Initial Advice Statement*.
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APPENDIX A HYDROLOGIC MODEL DEVELOPMENT

A.1 OVERVIEW

Hydrologic models were developed using the Unified River Basin Simulator (URBS) software package (Carroll, 2024), for the Blackwater Creek catchment (including Deep Creek, Emu Creek, Two Mile Gully and Taurus Creek) and the Sagittarius Creek catchment. The URBS models incorporate the latest climate change guidance from Australian Rainfall and Runoff (ARR) 2019 Version 4.2 (Ball et al., 2019). The following sections describe the development, calibration and validation of the Blackwater Creek and Sagittarius Creek URBS hydrologic models.

A.2 EXISTING DRAINAGE CHARACTERISTICS

The existing drainage characteristics in the vicinity of the Blackwater North Extension Project (the Project) area are described in Section 3.1 and shown in Figure 3.3.

A.3 AVAILABLE DATA

A.3.1 Overview

The following data was provided by Whitehaven Coal Limited (Whitehaven) for this study:

- previous hydrologic and hydraulic studies;
- recorded rainfall and water level data; and
- Light Detection and Ranging (LiDAR) topographic data.

A.3.2 Previous studies

A.3.2.1 Blackwater Mine Flood Study (2021)

The Blackwater Mine (BWM) Flood Study, undertaken by GHD Group Pty Ltd (GHD) (2021), assessed existing flood risks across BWM. XP-RAFTS hydrologic and Two-Dimensional Unsteady FLOW (TUFLOW) hydraulic models were developed for this study. The GHD (2021) study report was provided for this study, but the XP-RAFTS and TUFLOW models were not available.

A.3.2.2 Blackwater Mine Progressive Rehabilitation and Closure Plan (2024)

The XP-RAFTS hydrologic and TUFLOW hydraulic models used by SLR Consulting Australia Pty Ltd for the previous *Progressive Rehabilitation and Closure Plan Rehabilitation flood assessment* (SLR, 2024) were provided for this study. These models appear to have been developed based on the GHD (2021) hydrologic and hydraulic models. Separate models were provided for the Sagittarius Creek and Blackwater Creek catchments.

A.3.3 Rainfall and water level data

Figure A.1 shows the location of three subdaily rainfall (pluviograph) stations and six stream gauging stations across BWM. Table A.1 and Table A.2 show details of these stations.

Within the Project area, the Two Mile Gully (Station Number – 330124) and Taurus Creek downstream (D/S) (Station Number – 330101) stream gauging stations are located within the Blackwater Creek catchment. There are no stream gauging stations within the Sagittarius Creek catchment.

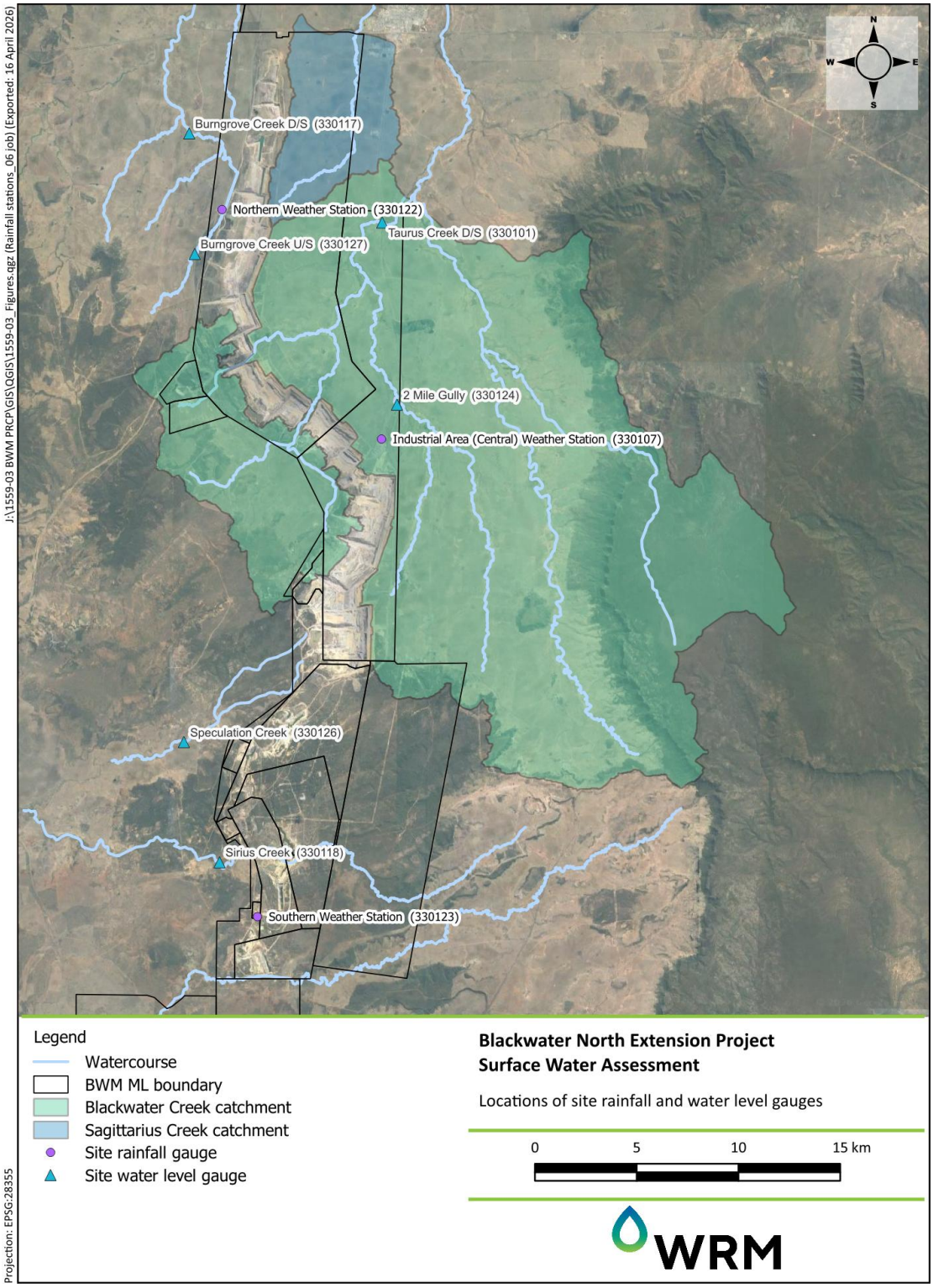


Figure A.1 Locations of site rainfall and water level gauges

Table A.1 Details of available sub-daily rainfall (pluviograph) stations

Station Number	Station Name
330122	Northern Weather Station
330107	Industrial Areal (Central) Weather Station
330123	Southern Weather Station

Table A.2 Details of available stream gauging stations

Station Number	Station Name	Supplied data period
330101	Taurus Creek D/S	January 2016 – January 2025
330118	Sirius Creek D/S	January 2016 – January 2025
330124	Two Mile Gully	January 2016 – January 2025
330126	Speculation Creek	January 2016 – January 2025
330127	Burngrove Creek U/S[a]	January 2016 – January 2025
330117	Burngrove Creek D/S	January 2016 – January 2025

[a] – U/S = upstream

A.3.4 Rating curves

Whitehaven provided rating curves for the Taurus Creek D/S and Two Mile Gully gauges relevant to the Project area (referred to in this report as the Whitehaven rating curves). It was uncertain if the Whitehaven rating curves were derived from actual gaugings or from hydraulic modelling. For this study, the rating curves were verified and then modified and/or extended if necessary, using hydraulic modelling where detailed LiDAR data is available.

Figure A.2 and Figure A.3 compare the Whitehaven rating curves, the TUFLOW model generated rating curves and the final adopted rating curves for the Taurus Creek D/S and Two Mile Gully gauges, respectively. For these four gauges, the “adopted” rating curves were used to convert recorded water levels (in metres AHD [mAHD]) into discharges (in cubic metres per second [m^3/s]) for the hydrologic model calibration.

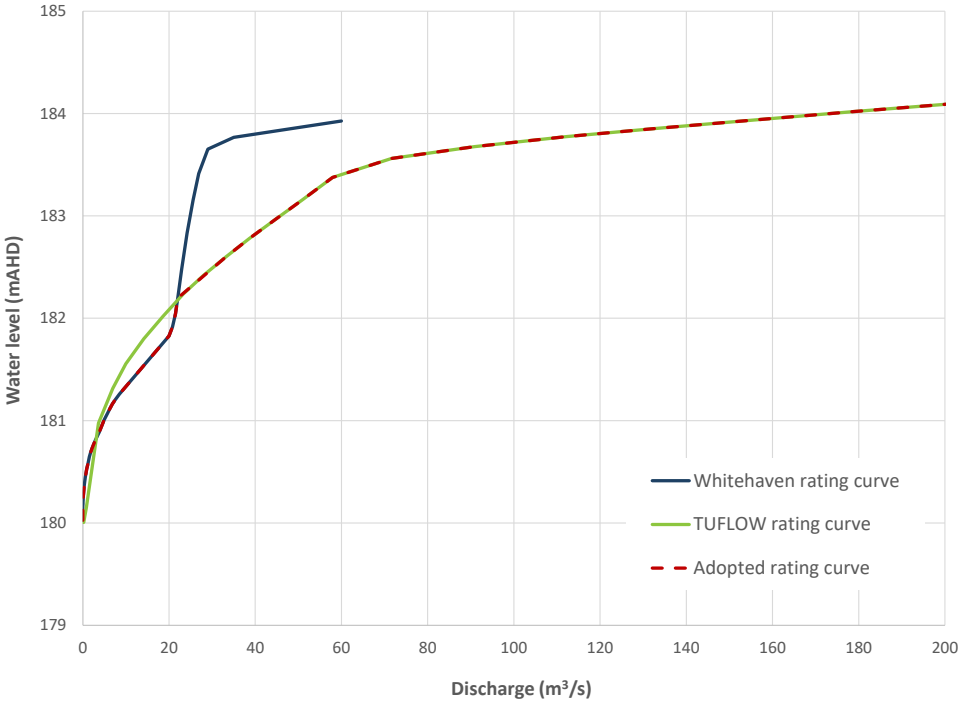


Figure A.2 **Comparison of Whitehaven-supplied, TUFLOW and adopted rating curves, Taurus Creek D/S gauging station**

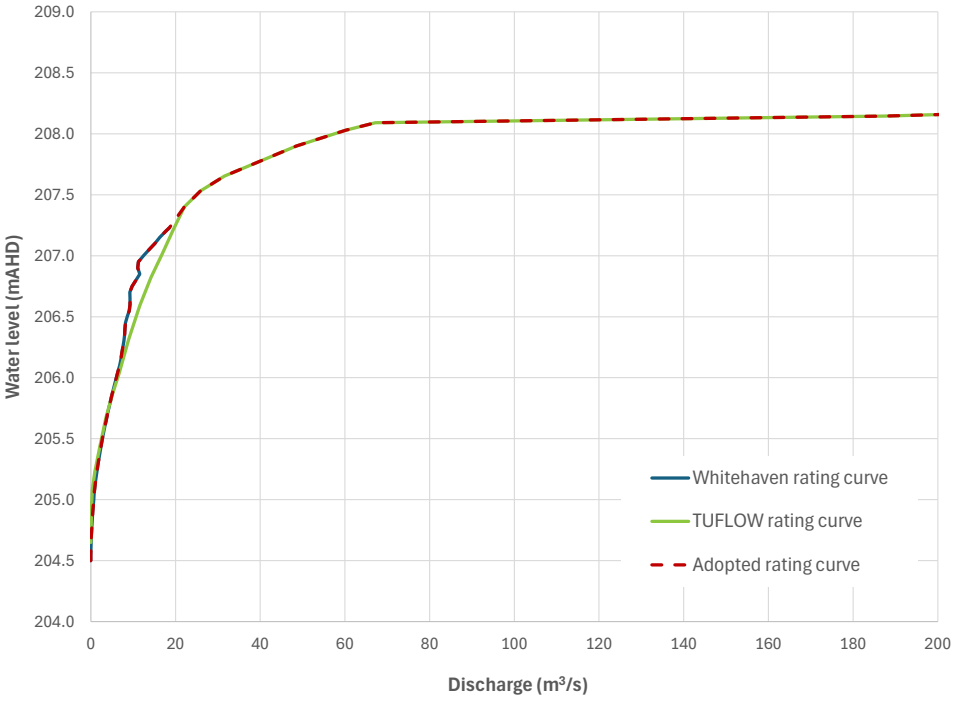


Figure A.3 **Comparison of Whitehaven-supplied, TUFLOW and adopted rating curves, Two Mile Gully gauging station**

A.3.5 Topographic data

The available topographic data used for this study is described as follows:

- A 1 metre (m) resolution LiDAR covering the BWM mining lease area captured in February 2024 (referred to as the 2024 LiDAR data);
- A 1 m resolution LiDAR captured in February 2025, covering the active mining pits of BWM and the recent upgrade to the New Taurus Creek Dam (referred to as the 2025 LiDAR data); and
- A 30 m resolution Copernicus Digital Surface Model (DSM) satellite ground level observation data obtained from the European Space Programme on 31 January 2025 (referred to as the Copernicus DSM data).

A.4 HYDROLOGIC MODEL DEVELOPMENT

A.4.1 Overview

URBS hydrologic models were developed for the Blackwater Creek catchment (including Taurus Creek and Two Mile Gully) and the Sagittarius Creek catchment.

URBS is a runoff-routing computer model that uses a network of conceptual storages to represent the routing of rainfall excess through a catchment. The URBS model was used in the "split mode" which enables the separate simulation of catchment and channel routing.

The URBS split model approach, which separates the channel and catchment storage components of each subcatchment for routing purposes, was adopted. Subcatchment routing was computed using the Aitken's equation, allowing the URBS model to provide higher resolution local subcatchment inflow hydrographs for the TUFLOW hydraulic model.

Routing was undertaken using Laurenson's (1964) procedure based on isochrones. Channel routing link lengths were estimated for each subcatchment in a boundary-boundary approach, and the inflow from the sub-catchment into the channel was assumed to occur at the boundary rather than at the centroid of the subcatchments.

The initial and continuing loss method was adopted for this study. This model assumes that there is an initial loss (IL) in millimetres (mm) before any rainfall becomes runoff. After this, a continuing loss (CL) rate in millimetres per hour (mm/h) is applied to the rainfall.

Full details of the URBS model and its features are given in the URBS User Manual (Carroll, 2024).

The Blackwater Creek URBS model was calibrated to recorded data for the March 2017 and January 2020 flood events. The Sagittarius Creek URBS model could not be calibrated due to the absence of any stream gauges within the catchment.

URBS models were developed for the following scenarios:

- 'Existing conditions' – This scenario was simulated based on year 2030 near-term climate conditions, for the current configuration of BWM (excluding the Project).
- 'Operational (2055) conditions' – This scenario was simulated based on year 2030 near-term climate conditions, for the year 2055 BWM configuration where the Project is it its maximum disturbance footprint.
- 'Final landform conditions' – This scenario was simulated based on year 2100 long-term climate conditions, for the final landform stage of BWM.
- The 'existing conditions' and 'operational (2055) conditions' URBS models were simulated for the following design flood events:
  - 50% (1 in 2) annual exceedance probability (AEP);

- 5% (1 in 20) AEP;
- 2% (1 in 50) AEP;
- 1% (1 in 100) AEP; and
- 0.01% (1 in 1,000) AEP.

- The 'final landform conditions' URBS models were simulated for the following design flood events:
  - 1% (1 in 100) AEP;
  - 0.01% (1 in 1,000) AEP; and
  - Probable Maximum Precipitation (PMP).

The 50% to 1% AEP design discharge estimates (2030 climate conditions) were validated against estimates derived using the Rational Method (RM), the Quantile Regression Technique (QRT) (Palmen and Weeks, 2015) and the Regional Flood Frequency Estimation (RFFE) method.

A.4.2 Model configuration

A.4.2.1 Subcatchment parameters

The URBS model subcatchments were assigned with area, slope, imperviousness, and Pervious Area Manning's 'n' (PERN) parameters. Subcatchment slopes were calculated based on the available topographic data.

Figure A.4 shows the existing conditions URBS model subcatchments adopted for the Sagittarius Creek. The model covers an area of 42.7 square kilometres (km^2) and consists of 28 subcatchments, ranging in size from 0.02 km^2 to 3.34 km^2. Table A.3 shows the subcatchment parameters adopted in the model under existing land use conditions.

Figure A.5 shows the existing conditions URBS model subcatchments adopted for the Blackwater Creek model. The model covers an area of 509.8 km^2 and consists of 226 subcatchments, ranging in size from 0.02 km^2 to 17.8 km^2. Table A.4 shows the subcatchment parameters adopted in the model under existing land use conditions.

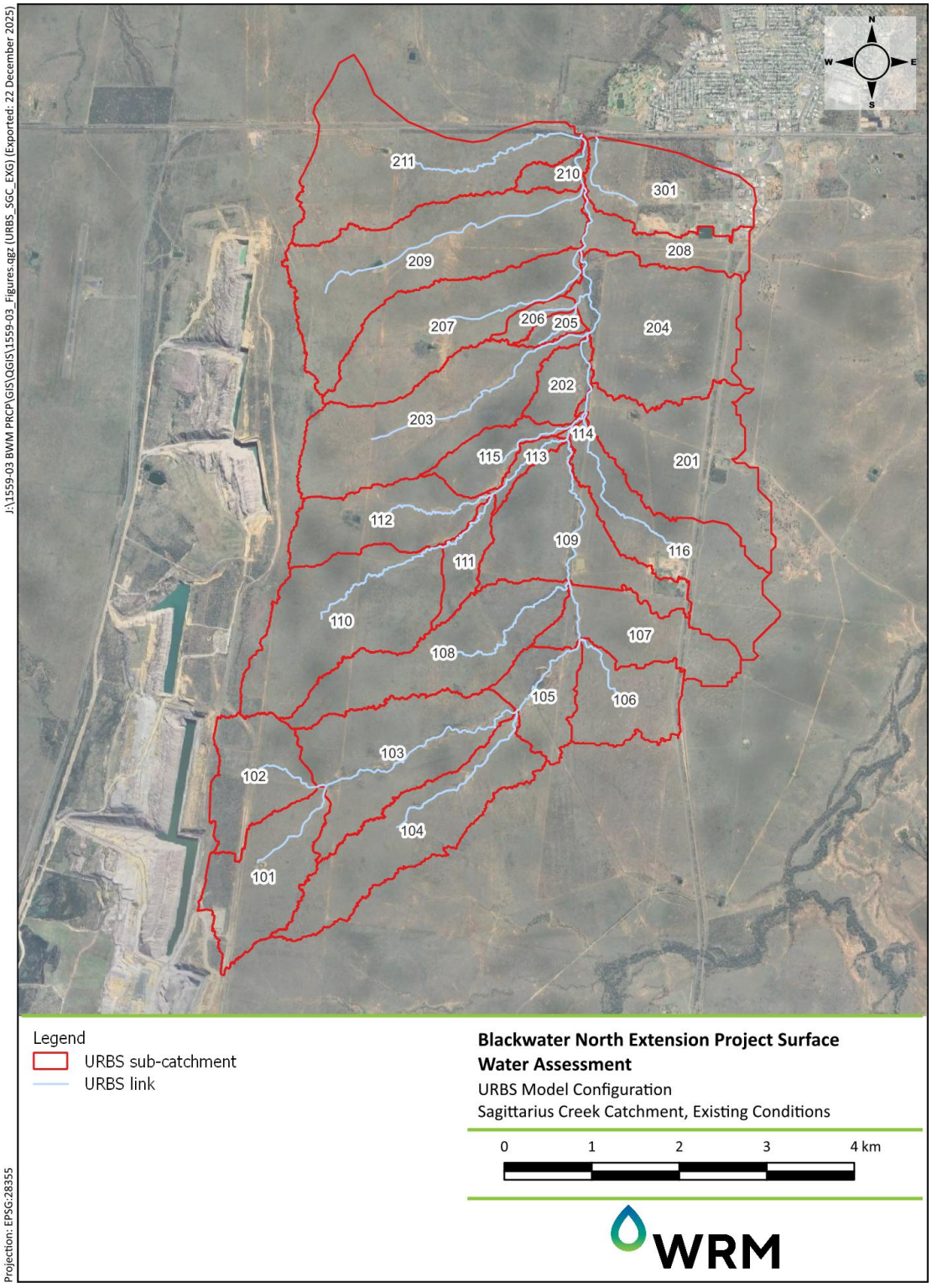


Figure A.4 URBS model configuration, Sagittarius Creek catchment, existing conditions

Table A.3 URBS model subcatchment parameters for the Sagittarius Creek catchment

ID	Area (km^2)	Percentage Impervious (percent [%])	PERN	Catchment Slope (metres per metre [m/m])
101	1.58	0	0.07	0.009
102	1.29	0	0.07	0.008
103	2.37	0	0.07	0.007
104	2.19	0	0.07	0.007
105	0.87	0	0.07	0.007
106	1.14	0	0.07	0.008
107	1.37	0	0.07	0.009
108	2.20	0	0.07	0.008
109	2.02	0	0.07	0.007
110	2.69	0	0.07	0.008
111	0.46	0	0.07	0.009
112	1.46	0	0.07	0.009
113	0.19	0	0.07	0.007
114	0.02	0	0.07	0.005
115	0.63	0	0.07	0.007
116	2.12	0	0.07	0.007
201	2.44	0	0.07	0.010
202	0.51	0	0.07	0.004
203	2.72	0	0.07	0.007
204	2.69	0	0.07	0.010
205	0.17	0	0.07	0.007
206	0.20	0	0.07	0.007
207	2.22	0	0.07	0.008
208	0.81	0	0.07	0.008
209	3.34	0	0.07	0.007
210	0.27	0	0.07	0.003
211	3.14	0	0.07	0.005
301	1.58	0	0.07	0.008

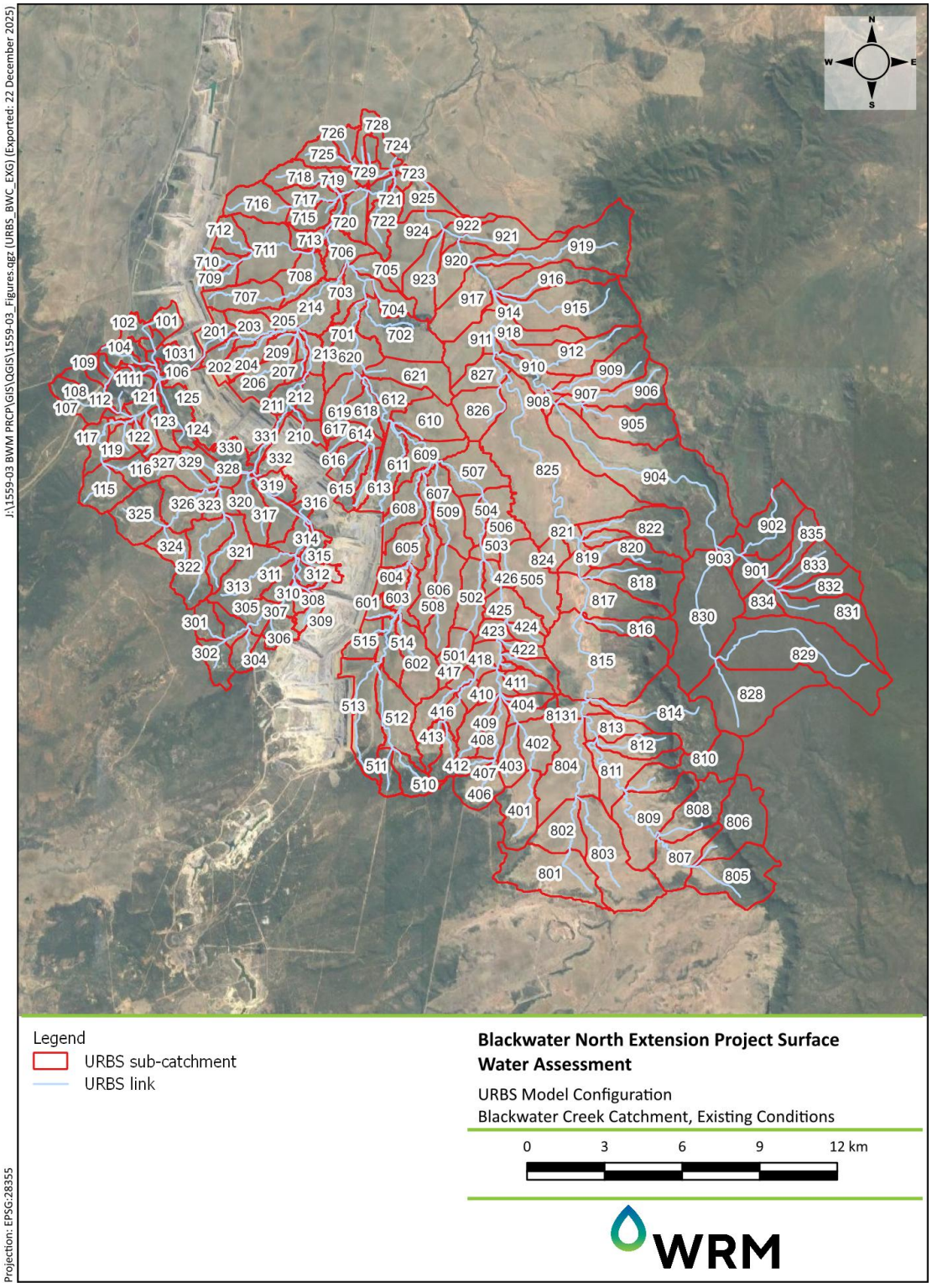


Figure A.5 URBS model configuration, Blackwater Creek catchment, existing conditions

Table A.4 URBS catchment parameters of the Blackwater Creek catchment model

ID	Area (km^2)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
101	1.11	0	0.07	0.019
102	0.88	0	0.07	0.009
103	0.47	0	0.07	0.022
104	0.97	0	0.07	0.028
105	0.51	0	0.07	0.021
106	0.37	0	0.07	0.004
107	2.02	0	0.07	0.030
108	1.10	0	0.04	0.070
109	0.65	0	0.07	0.028
110	0.42	0	0.07	0.044
111	0.02	0	0.07	0.006
112	0.10	0	0.07	0.009
113	1.94	0	0.07	0.005
114	0.33	0	0.07	0.020
115	2.55	0	0.07	0.017
116	1.21	0	0.07	0.015
117	1.61	0	0.07	0.012
118	0.28	0	0.07	0.010
119	1.14	0	0.07	0.036
120	0.50	0	0.07	0.029
121	0.95	0	0.07	0.009
122	0.79	0	0.07	0.023
123	1.05	0	0.07	0.018
124	0.60	0	0.07	0.027
125	1.72	0	0.07	0.013
201	1.45	0	0.07	0.006
202	1.26	0	0.07	0.012
203	1.77	0	0.07	0.007
204	1.65	0	0.07	0.008
205	0.32	0	0.07	0.002
206	2.94	0	0.07	0.008
207	0.46	0	0.07	0.007
208	0.39	0	0.07	0.003
209	0.67	0	0.07	0.008

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
210	0.83	0	0.07	0.010
211	1.36	0	0.07	0.006
212	1.54	0	0.07	0.011
213	1.04	0	0.07	0.004
214	3.78	0	0.07	0.004
301	1.34	0	0.07	0.033
302	1.71	0	0.07	0.018
303	1.05	0	0.07	0.026
304	1.20	0	0.07	0.026
305	1.23	0	0.07	0.009
306	1.29	0	0.07	0.019
307	0.62	0	0.07	0.019
308	0.56	0	0.07	0.037
309	0.83	0	0.07	0.044
310	0.10	0	0.07	0.016
311	1.08	0	0.07	0.015
312	0.69	0	0.07	0.030
313	4.53	0	0.07	0.017
314	1.21	0	0.07	0.004
315	1.44	0	0.07	0.007
316	0.39	0	0.07	0.074
317	1.80	0	0.07	0.009
318	0.78	0	0.07	0.053
319	0.35	0	0.07	0.085
320	2.47	0	0.07	0.013
321	2.35	0	0.07	0.017
322	4.18	0	0.07	0.016
323	1.05	0	0.07	0.013
324	1.70	0	0.07	0.019
325	3.44	0	0.07	0.023
326	3.05	0	0.07	0.013
327	2.58	0	0.07	0.013
328	0.66	0	0.07	0.004
329	1.04	0	0.07	0.015
330	1.44	0	0.07	0.018

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
331	0.80	0	0.07	0.006
332	0.57	0	0.07	0.029
401	3.50	0	0.07	0.015
402	2.59	0	0.07	0.011
403	1.73	0	0.07	0.012
404	0.92	0	0.07	0.017
405	0.74	0	0.07	0.032
406	2.38	0	0.07	0.018
407	0.62	0	0.07	0.027
408	1.72	0	0.07	0.012
409	2.13	0	0.07	0.015
410	1.21	0	0.07	0.007
411	1.35	0	0.07	0.030
412	1.33	0	0.07	0.022
413	1.28	0	0.07	0.024
414	0.97	0	0.07	0.016
415	0.66	0	0.07	0.015
416	1.65	0	0.07	0.013
417	0.55	0	0.07	0.011
418	0.57	0	0.07	0.011
419	0.21	0	0.07	0.018
420	1.00	0	0.07	0.015
421	1.25	0	0.07	0.026
422	0.87	0	0.07	0.015
423	1.00	0	0.07	0.008
424	0.79	0	0.07	0.016
425	2.31	0	0.07	0.009
426	1.00	0	0.07	0.005
501	2.03	0	0.07	0.01
502	2.62	0	0.07	0.006
503	0.56	0	0.07	0.005
504	1.46	0	0.07	0.005
505	4.78	0	0.07	0.007
506	2.93	0	0.07	0.006
507	3.35	0	0.07	0.004

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
508	3.88	0	0.07	0.006
509	3.46	0	0.07	0.006
510	1.80	0	0.07	0.032
511	1.23	0	0.07	0.031
512	3.76	0	0.07	0.015
513	4.77	0	0.07	0.013
514	1.85	0	0.07	0.007
515	1.57	0	0.07	0.012
601	0.63	0	0.07	0.012
602	3.63	0	0.07	0.008
603	1.13	0	0.07	0.005
604	1.69	0	0.07	0.011
605	2.43	0	0.07	0.006
606	2.29	0	0.07	0.007
607	0.69	0	0.07	0.004
608	2.44	0	0.07	0.005
609	2.66	0	0.07	0.006
610	3.38	0	0.07	0.006
611	2.97	0	0.07	0.007
612	2.44	0	0.07	0.006
613	1.09	0	0.07	0.009
614	0.38	0	0.07	0.006
615	1.36	0	0.07	0.007
616	1.19	0	0.07	0.010
617	1.02	0	0.07	0.013
618	1.58	0	0.07	0.003
619	2.57	0	0.07	0.009
620	3.14	0	0.07	0.008
621	3.18	0	0.07	0.009
701	1.23	0	0.07	0.005
702	4.86	0	0.07	0.007
703	1.79	0	0.07	0.005
704	1.35	0	0.07	0.006
705	1.22	0	0.07	0.012
706	2.13	0	0.07	0.005

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
707	2.90	0	0.07	0.008
708	2.27	0	0.07	0.007
709	0.93	0	0.07	0.010
710	0.89	0	0.07	0.012
711	4.49	0	0.07	0.008
712	1.47	0	0.07	0.012
713	1.27	0	0.07	0.004
714	0.55	0	0.07	0.002
715	1.15	0	0.07	0.006
716	2.84	0	0.07	0.011
717	1.89	0	0.07	0.009
718	2.25	0	0.07	0.008
719	0.73	0	0.07	0.007
720	1.69	0	0.07	0.005
721	0.77	0	0.07	0.004
722	2.29	0	0.07	0.009
723	0.36	0	0.07	0.002
724	0.88	0	0.07	0.008
725	1.67	0	0.07	0.007
726	1.07	0	0.07	0.007
727	0.61	0	0.07	0.008
728	0.92	0	0.07	0.012
729	0.52	0	0.07	0.004
730	0.46	0	0.07	0.012
801	6.29	0	0.07	0.011
802	3.02	0	0.07	0.013
803	7.28	0	0.07	0.009
804	6.31	0	0.07	0.009
805	5.39	0	0.07	0.075
806	4.86	0	0.07	0.108
807	3.45	0	0.07	0.040
808	3.68	0	0.07	0.107
809	5.80	0	0.07	0.044
810	4.62	0	0.07	0.106
811	3.55	0	0.07	0.008

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
812	2.30	0	0.07	0.059
813	1.92	0	0.07	0.021
814	7.10	0	0.07	0.074
815	11.57	0	0.07	0.015
816	2.31	0	0.07	0.104
817	4.75	0	0.07	0.072
818	3.83	0	0.07	0.076
819	0.74	0	0.07	0.010
820	3.15	0	0.07	0.039
821	0.75	0	0.07	0.005
822	4.47	0	0.07	0.062
824	1.24	0	0.07	0.010
825	17.8	0	0.07	0.004
826	2.94	0	0.07	0.014
827	2.01	0	0.07	0.008
828	8.08	0	0.07	0.019
829	12.06	0	0.07	0.015
830	10.24	0	0.07	0.009
831	4.87	0	0.07	0.030
832	2.36	0	0.07	0.039
833	2.38	0	0.07	0.070
834	1.62	0	0.07	0.034
835	2.01	0	0.07	0.045
901	2.16	0	0.07	0.037
902	4.27	0	0.07	0.034
903	0.86	0	0.07	0.031
904	15.68	0	0.07	0.028
905	4.65	0	0.07	0.041
906	3.15	0	0.07	0.034
907	0.56	0	0.07	0.006
908	0.42	0	0.07	0.010
909	3.92	0	0.07	0.027
910	2.02	0	0.07	0.005
911	0.34	0	0.07	0.005
912	4.87	0	0.07	0.022

ID	Area (km²)	Percentage Impervious (%)	PERN 'n'	Catchment Slope (m/m)
914	0.39	0	0.07	0.004
915	8.00	0	0.07	0.022
916	3.12	0	0.07	0.022
917	5.05	0	0.07	0.006
918	5.11	0	0.07	0.005
919	7.07	0	0.07	0.030
920	2.75	0	0.07	0.007
921	3.07	0	0.07	0.011
922	0.80	0	0.07	0.002
923	3.09	0	0.07	0.007
924	4.33	0	0.07	0.005
925	2.19	0	0.07	0.002
1031	0.72	0	0.07	0.012
1111	0.44	0	0.07	0.021
3091	0.20	0	0.07	0.036
8131	1.06	0	0.07	0.021
8211	0.76	0	0.07	0.026

A.4.2.2 Adopted global Unified River Basin Simulator model parameters

The global URBS model parameters included channel lag parameter (alpha [α]), catchment storage parameter (beta [β]), catchment non-linearity (M) and channel routing exponent (N). The following global URBS parameters were adopted for all seven models:

- Channel routing α = 0.1
- Catchment routing β = 1.0
- Catchment routing exponent M = 0.715
- Channel routing exponent N = 1.0

Sub-catchment routing was computed using the Aitken's equation, allowing the URBS model to provide local subcatchment inflow hydrographs of reasonable resolution. The non-linear routing parameter 'M' was set to 0.715, as recommended in URBS user manual for when the Aitken's equation is used.

A.4.2.3 Initial and continuing losses

The IL and CL method of accounting for rainfall losses was adopted for this study. For the calibration events, different initial and continuing losses were derived for each calibration event to reflect different antecedent catchment conditions (refer to Section A.5.4). Design event ILs and CLs were derived during the model validation process (refer to Section A.6.2).

A.5 HYDROLOGIC MODEL CALIBRATION

A.5.1 Methodology

The URBS models for the Blackwater Creek catchment was calibrated for the March 2017 and January 2020 flood events. The purpose of the model calibration was to achieve the best possible match between URBS-modelled discharge hydrographs against the recorded discharge hydrographs, using a common set of model parameters between flood events.

A.5.2 Selection of calibration events

A.5.2.1 Overview

The March 2017 and January 2020 flood events were selected for calibration due to the availability of data and because the rainfalls during these events triggered similar responses at adjacent catchments for which data is available. The March 2017 and January 2020 events were also the selected calibration events in the GHD (2021) study.

Table A.5 shows the adopted historical event simulation periods for the calibration events in the URBS model. Table A.6 shows the recorded rainfall depths at each station for the calibration events. Table A.7 shows the recorded peak discharges at each gauging station for the calibration events.

Table A.5 Calibration event simulation periods

Calibration Event	Simulation period
March 2017	28 March (0000 hours) – 1 April (0000 hours) - 4 days
January 2020	24 January (0000 hours) – 27 January (0000 hours) - 3 days

Table A.6 Total rainfall depths recorded during the 2017 and 2020 events

Station Number	Station Name	Rainfall depth (mm)	
		March 2017	January 2020
330107	Central Weather Station	119.0	148.0
330122	Northern Weather Station	139.5	78.5
330123	Southern Weather Station	142.5	49.5

Table A.7 Peak discharges recorded during calibration events

Station Number	Station Name	Peak discharge (m^3/s)	
		March 2017	January 2020
330101	Taurus Creek D/S	117	156.8
330124	Two Mile Gully	16.2	50.4

A.5.2.2 March 2017 event

Figure A.6 and Figure A.7 show the recorded rainfall intensities (in mm/h) at the Northern Weather Station and Central Weather Station site pluviograph stations, respectively, for the March 2017 event. Figure A.8 and Figure A.9 show the recorded water levels (in metres Reduced Level [m]) at the Two Mile Gully and Taurus Creek D/S gauges, respectively, for the March 2017 event.

A.5.2.3 January 2020 event

Figure A.10 and Figure A.11 show the recorded rainfall intensities at the Northern Weather Station and Central Weather Station site pluviograph stations, respectively, for the January 2020 event. Figure A.12 and Figure A.13 show the recorded water levels at the Two Mile Gully and Taurus Creek D/S gauges, respectively, for the January 2020 event.

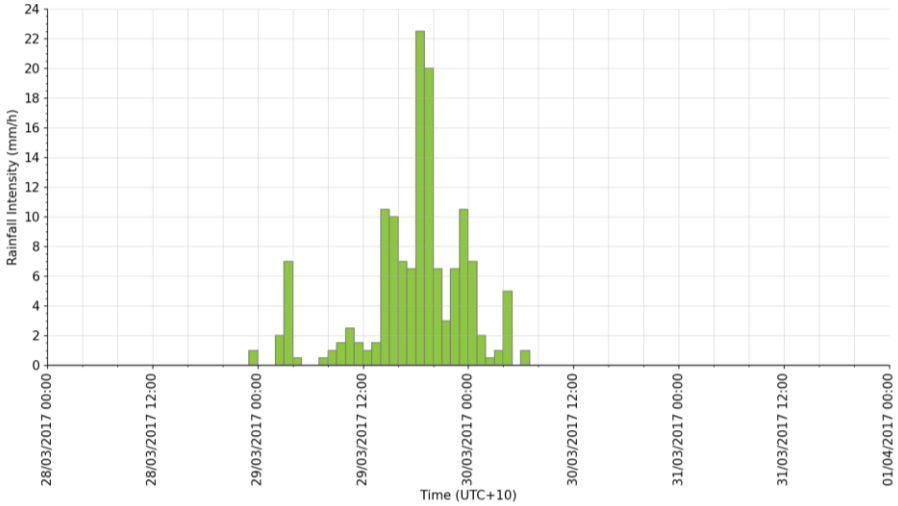


Figure A.6 Recorded rainfall at Northern Weather Station (330122), 2017 event

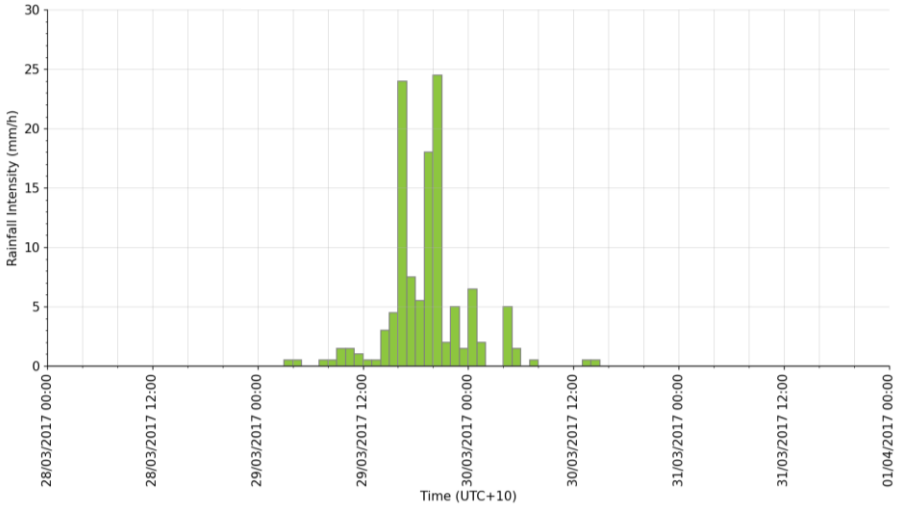


Figure A.7 Recorded rainfall at Central Weather Station (330107), 2017 event

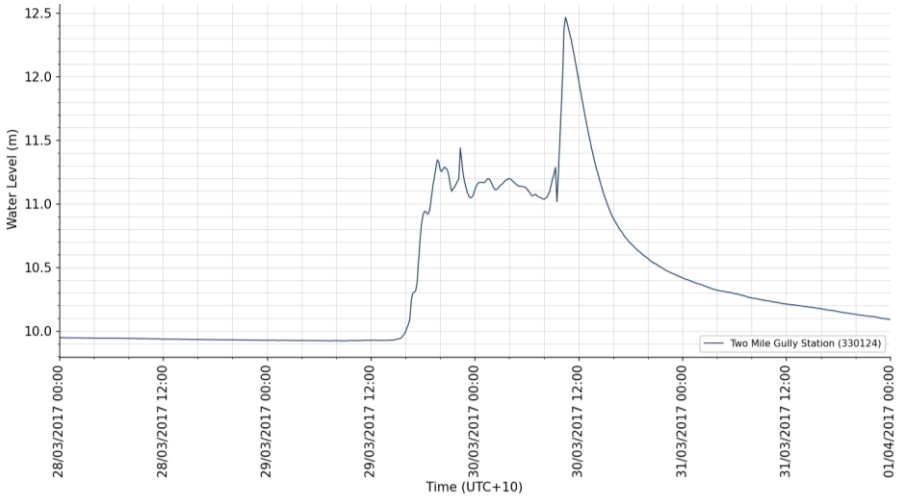


Figure A.8 Recorded water level at Two Mile Gully Station (330124), 2017 event

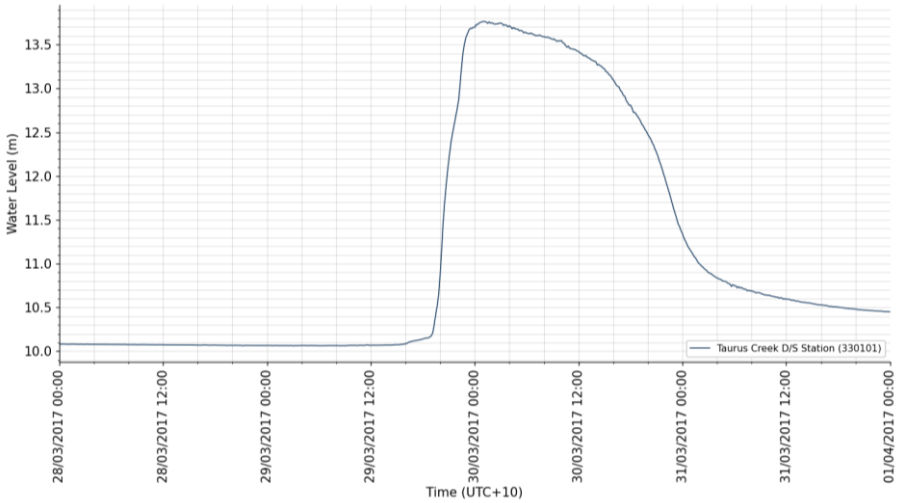


Figure A.9 Recorded water level at Taurus Creek D/S Station (330101), 2017 event

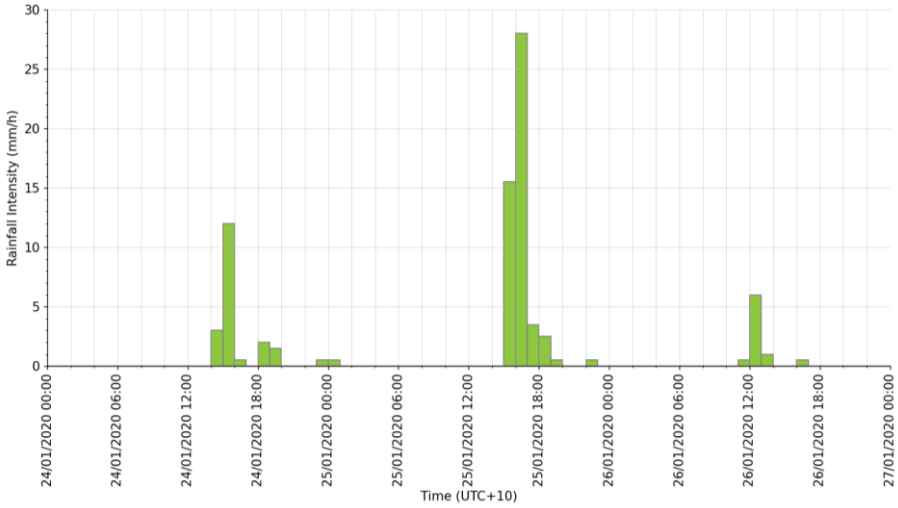


Figure A.10 Recorded rainfall at Northern Weather Station (330122), 2020 event

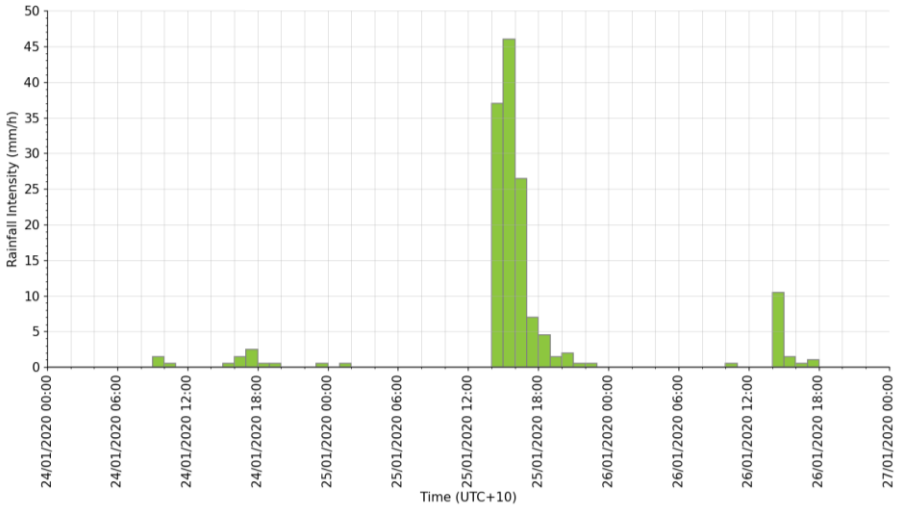


Figure A.11 Recorded rainfall at Central Weather Station (330107), 2020 event

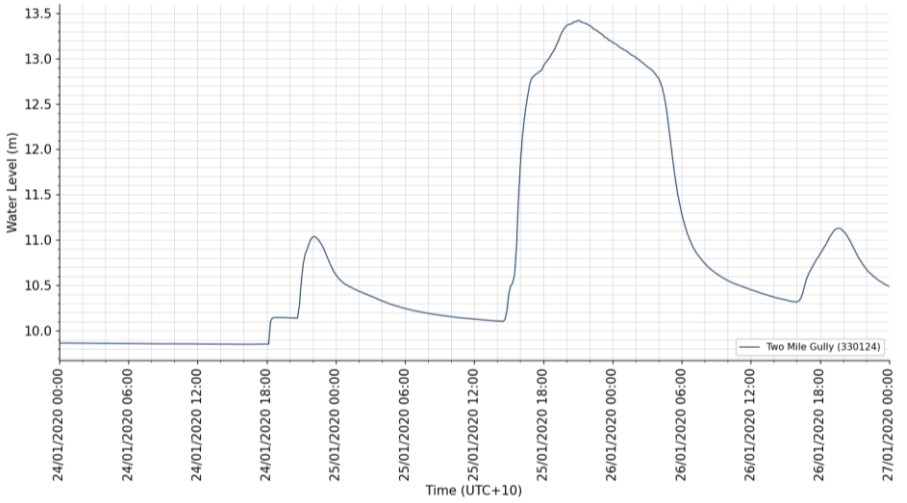


Figure A.12 Recorded water level at Two Mile Gully Station (330124), 2020 event

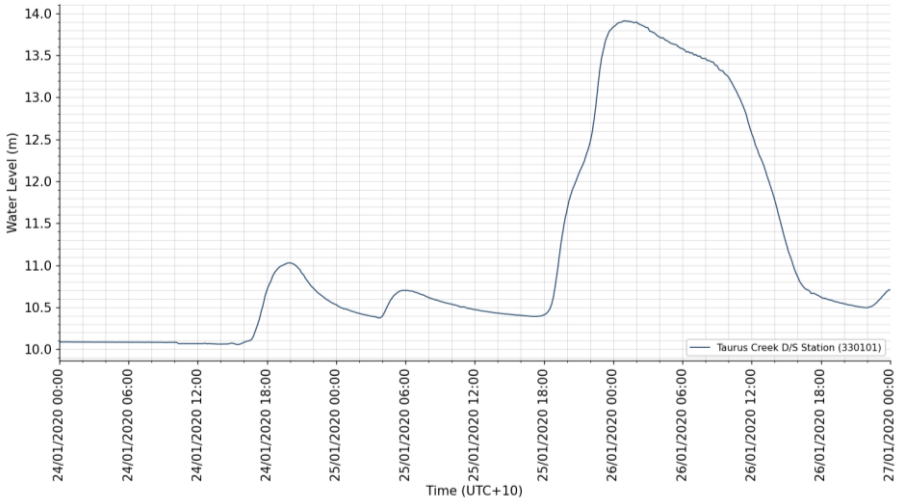


Figure A.13 Recorded water level at Two Mile Gully Station (330124), 2020 event

A.5.3 Assignment of subcatchment rainfalls

Each URBS subcatchment was assigned a rainfall hyetograph based on the three nearest pluviograph stations, using the URBS SUBRAIN utility. The SUBRAIN utility calculates the weighted average rainfall depth for each subcatchment using an inverse distance squared method based on the relative distance between the rainfall station location and the subcatchment centroid.

A.5.4 Initial and continuing losses

Table A.8 shows the IL and CL adopted for the Blackwater Creek catchment for the two calibration events. A CL of 3.5 mm/h was for both events. Different ILs were adopted for each event which reflect the different antecedent conditions prior to each event.

Table A.8 Adopted calibration event initial and continuing losses

March 2017		January 2020	
IL (mm)	CL (mm/h)	IL (mm)	CL (mm/h)
82	3.5	75	3.5

A.5.5 Model calibration results

Table A.9 shows the comparison of the calculated and recorded peak discharges at the two gauging stations within the Blackwater Creek catchment for the 2017 and 2020 events.

Table A.9 Summary of calibration results

Station Number	Station Name	Peak discharge (m^3/s)					
		March 2017			January 2020		
		Calculated	Recorded	Difference (%)	Calculated	Recorded	Difference (%)
330101	Taurus Creek D/S	116.6	117.0	-0.3%	155.6	156.8	-1%
330124	Two Mile Gully	46.9	16.2	189.4%	79.1	50.4	57%

A.5.5.1 March 2017 event calibration results

Figure A.14 and to Figure A.15 compare the modelled/calculated (C – orange) and recorded (R – blue) discharge hydrographs for the March 2017 event.

The modelled (calculated) hydrograph matches well with the recorded hydrograph peak and shape at the Taurus Creek D/S gauge. However, the URBS model could not reproduce the recorded hydrograph shape, peak or timing further upstream at the Two Mile Gully gauge.

The recorded data suggests that the Two Mile Gully gauge appears to have malfunctioned during the event, as indicated by the following:

- The recorded water level hydrograph shape and timing at the Two Mile Gully gauge is inconsistent with the recorded water levels at the Taurus Creek D/S gauge (refer to Figure A.8 and Figure A.9).
- The catchment area to Two Mile Gully is around 27% of the catchment area to the Taurus Creek D/S gauge. Despite this, the recorded peak discharge at Two Mile Gully D/S is only 14% of the recorded peak discharge at Taurus Creek D/S. This indicates that the Two Mile Gully gauge likely did not capture the peak water level (and hence the peak discharge) during this event.

In consideration of the above, the calibration in Two Mile Gully and Taurus Creek is considered acceptable.

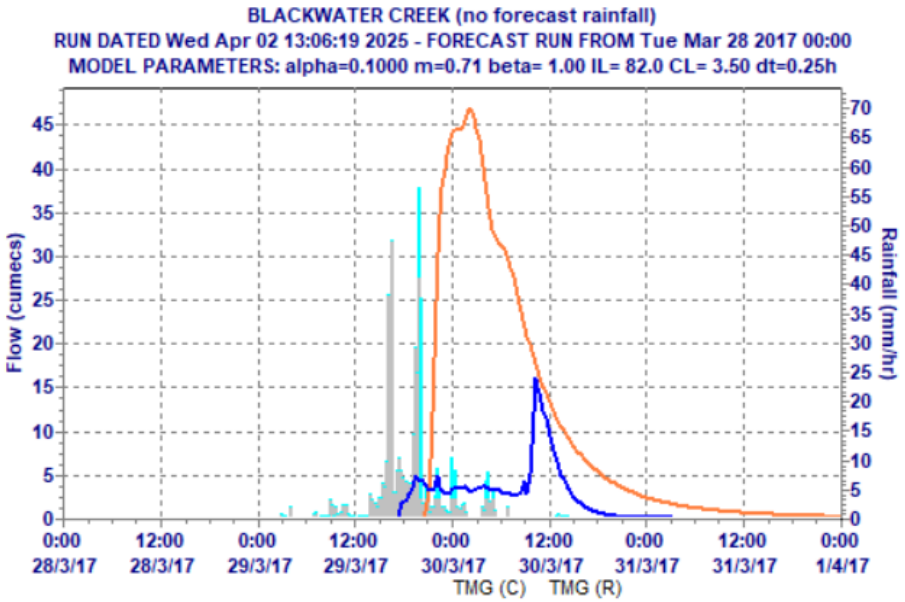


Figure A.14 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for March 2017 event at the Two Mile Gully gauge

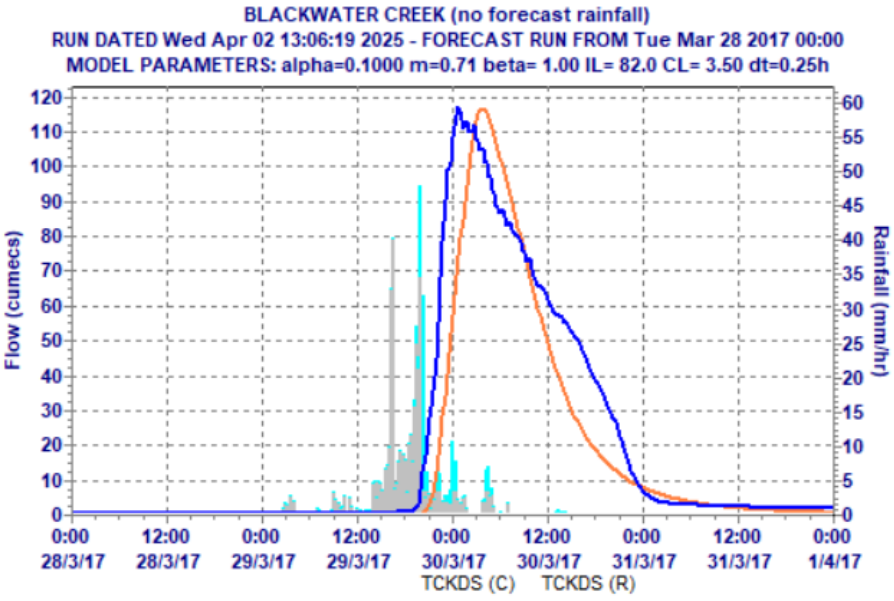


Figure A.15 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for March 2017 event at the Taurus Creek D/S gauge

A.5.5.2 January 2020 event calibration results

Figure A.16 and Figure A.17 compare the modelled/calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event.

The modelled (calculated) hydrograph matches well with the recorded hydrograph peak and shape at the Taurus Creek D/S gauge. However, the URBS model could not reproduce the recorded hydrograph shape, peak or timing further upstream at the Two Mile Gully gauge.

Compared to the March 2017 event, there are similar discrepancies observed between the recorded water level hydrographs at Two Mile Gully and Taurus Creek D/S for the January 2020 event. This suggests that the Two Mile Gully gauge may not have accurately captured the peak flood level (and hence the peak discharge) during the January 2020 event, due to similar reasons described in Section A.5.5.1 for the March 2017 event.

In consideration of the above, the calibration in Two Mile Gully and Taurus Creek is considered acceptable.

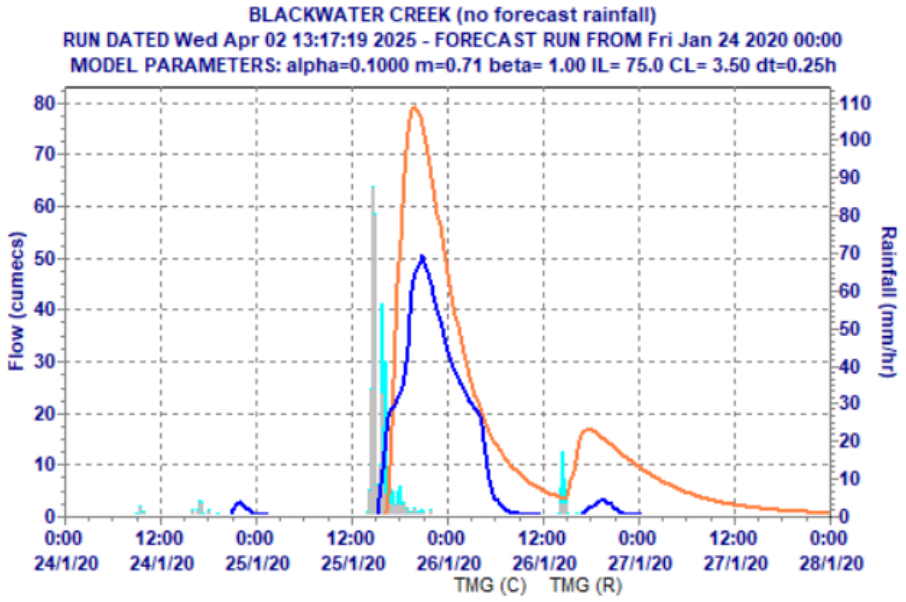


Figure A.16 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event at the Two Mile Gully gauge

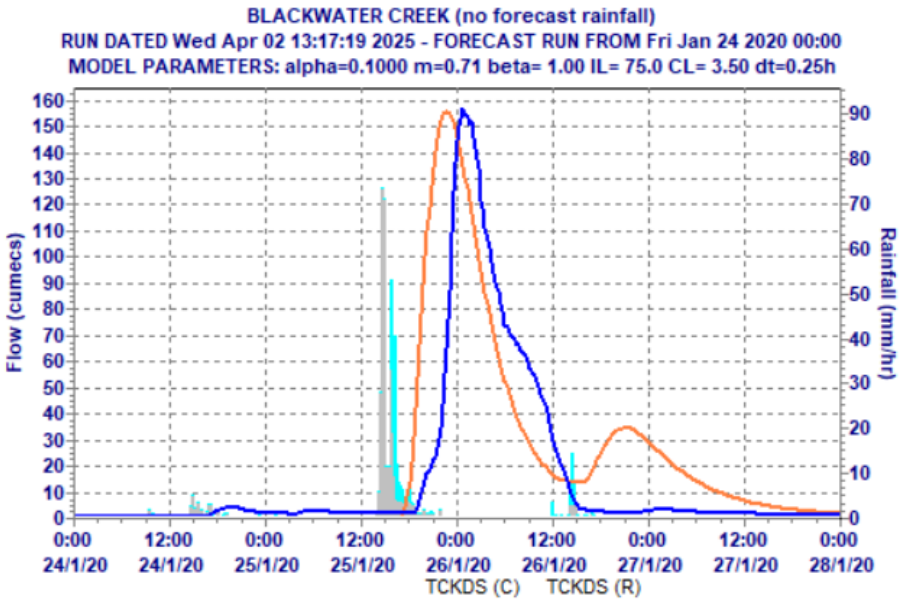


Figure A.17 Calculated (C – orange) and recorded (R – blue) discharge hydrographs for the January 2020 event at the Taurus Creek D/S gauge

A.6 DESIGN DISCHARGE ESTIMATION

A.6.1 Methodology

The URBS models for the Blackwater Creek and Sagittarius Creek catchments were used to estimate design discharges for the 50% (1 in 2) AEP, 5% (1 in 20) AEP, 2% (1 in 50) AEP, 1% (1 in 100) AEP, 0.01% (1 in 1,000) AEP and PMP design flood events. Design event hydrology was undertaken in accordance with ARR 2019 version 4.2 (Ball et al, 2019).

URBS model design discharge estimates were validated against discharge estimates derived using the RM, the QRT and the RFFE methods. Design peak discharges were validated for the 50%, 5%, 2% and 1% AEP events at key validation locations shown in Figure A.18.

The RM is no longer supported in the latest by ARR update as it has been updated by the RFFE method. However, it remains a useful methodology for catchments that are smaller than the dataset that has been used to define the design discharges in the RFFE methodology.

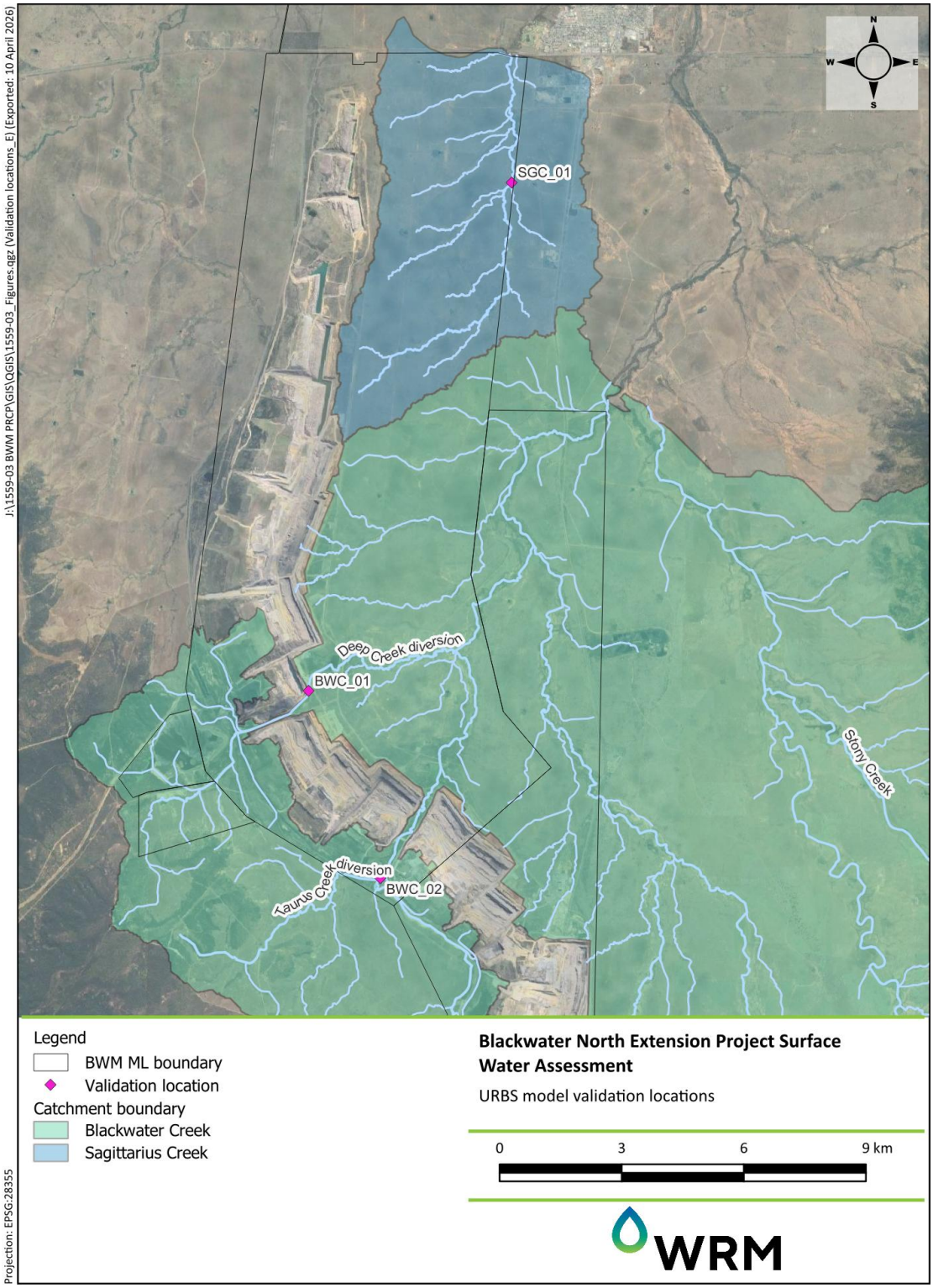


Figure A.18 URBS model validation locations

A.6.2 URBS model parameters

A.6.2.1 Global model parameters

The global URBS model parameters (α, β, M and N) given in Section A.4.2.2 were adopted for design event modelling for all models.

A.6.2.2 Design rainfalls

Desing rainfall depths was obtained from the Bureau of Meteorology (Bureau) for all events up to 0.1% AEP.

PMP rainfall depths for durations up to 6 hours were estimated using the methodology given in *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method* (Bureau, 2003).

PMP rainfall depths for durations 24 hours and longer were estimated using the standard methodology given in the *Generalised Tropical Storm Method – Revised Edition* (Bureau, 2005).

A.6.2.3 Initial and continuing losses

The adopted ILs and CLs adopted for the design event modelling are shown in Table A.10.

For the Blackwater Creek catchment, a CL of 3.5 mm/h was used which is consistent with the adopted CL for the March 2017 and January 2020 calibration events.

The Sagittarius Creek URBS model was not calibrated due the lack of data. A CL of 2.0 mm/h was adopted based on the model validation outcomes (refer to Section C.6.3).

For the extreme events rarer than 1% AEP, minimal losses (IL = 0.0 mm and CL = 1.0 mm/h) were adopted as recommended in ARR.

Table A.10 Adopted design event initial (IL) and continuing (CL) losses

Event	Blackwater Creek URBS model		Sagittarius Creek URBS model	
	IL (mm)	CL (mm/h)	IL (mm)	CL (mm/h)
50% (1 in 2) AEP to 1% (1 in 100) AEP	0.0	3.5	0.0	2.0
0.1% (1 in 1,000) AEP to PMP	0.0	1.0	0.0	1.0

A.6.3 Model validation

Table A.11, Table A.12 and Table A.13 compare the URBS model predicted peak discharges against RM, QRT and RFFE estimates for the 50% (1 in 2) AEP to 1% (1 in 100) AEP events at validation locations BWC_01, BWC_02 and SGC_01, respectively (refer to Figure A.18 for these locations).

The URBS model predicted peak discharges are similar to the RM and QRT peak discharges for the 5% to 1% AEP events. Compared to the RFFE peak discharges, the URBS model predicted peak discharges for the 5% to 1% AEP events are lower but are within the 90% confidence bounds of the RFFE estimates. For the 50% AEP event, the URBS model peak discharges are similar to the RM but are significantly higher than the QRT and RFFE peak discharges, despite adopting minimal losses.

Given the similarities in design peak discharge between URBS, the RM and QRT and the significant uncertainties in the RFFE peak discharges, the validation is considered adequate for the purpose of this flood impact assessment. Therefore, the URBS model would produce reasonable estimates of design discharges within the Blackwater Creek and Sagittarius Creek catchments.

Table A.11 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location BWC_01

AEP % (1 in X)	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	45	52	11	10	4	24
5% (1 in 20)	117	122	88	167	70	359
2% (1 in 50)	147	161	133	315	105	863
1% (1 in 100)	172	191	174	471	130	1,596

Table A.12 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location BWC_02

AEP	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	58	47	12	9	4	24
5% (1 in 20)	135	113	95	179	75	385
2% (1 in 50)	165	149	145	343	113	948
1% (1 in 100)	190	177	189	520	140	1,796

Table A.13 Comparison of URBS model predicted design discharges against RM, QRT and RFFE estimates at location SGC_01

AEP	Design peak discharge (m³/s)					
	URBS	RM	QRT	RFFE (2021)		
				Expected	5%ile	95%ile
50% (1 in 2)	40	44	12	9	3	22
5% (1 in 20)	99	107	92	169	70	367
2% (1 in 50)	125	141	140	339	110	953
1% (1 in 100)	147	168	182	535	141	1,868

A.6.4 Design discharges

The URBS models were used to estimate design discharges for the following scenarios:

- 'Existing conditions' – Design discharge hydrographs were produced as input to the existing conditions TUFLOW hydraulic model (described in Section 8.3) to establish the baseline flooding characteristics in the vicinity of the Project.
- 'Operational (2055) conditions' – Design discharge hydrographs were produced for the local catchments in the vicinity of the Project, reflecting the changes to local catchments due to expansion of the mining pits.
- 'Final landform conditions' – Design discharge hydrographs were produced as input to the final landform conditions TUFLOW hydraulic model (described in Section 8.3) to simulate flooding characteristics in the vicinity of the Project post-closure.

The URBS model predicted design discharges are provided in Section 8.2.

APPENDIX B WATER BALANCE ASSESSMENT REPORT

Blackwater North Extension Project

Water Balance Assessment Report

Whitehaven Blackwater Pty Ltd

Doc. Ref.: WHC-037-C6

Date: 15 April 2026

Rev. No.	Doc Ref.	Report Date	Report Author	Reviewer
7	WHC-037-C7	15 April 2026	MGB	AH

For and on behalf of HydroBalance
Environmental and Mine Water Management Solutions



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1 Introduction

HydroBalance was engaged by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater) to undertake a water balance assessment for the Blackwater North Extension Project (the Project), for incorporation into an application for an Environmental Authority (EA) Amendment and an application for an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval. Whitehaven Blackwater is a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven).

The Project is an extension of mining into Surface Area (SA) 10 on Mining Lease (ML) 1759 and SA7 on ML1762 utilising existing Blackwater Mine (BWM) mining methods, mining fleet, mine infrastructure and facilities.

2 Site water balance assessment overview

A computer-based operational simulation model was used to assess the dynamics of the BWM water balance under conditions of varying rainfall and catchment conditions throughout the development of the Project duration. The water balance model developed for this assessment covers the period of July 2025 to June 2055 (30 years in total). The Project commences in 2030, and mining in the Project area ceases in 2055. GoldSim was selected to represent the operational water balance, enabling dynamic simulation of the site water management system over the assessment period.

The GoldSim model dynamically simulates the operation of the water management system and keeps a complete account of all site water volumes and representative water quality on a daily time step. The model has been configured to simulate the operations of all major components of the water management system. The simulated inflows and outflows included in the model are given in Table 2.1.

Table 2.1 – Simulated inflows and outflows to the water management system

Inflows	Outflow
Direct rainfall on the water surface of storages	Evaporation from the water surface of storages
Catchment runoff	Net Coal Handling and Preparation Plant (CHPP) losses
External water supply (Bedford East and Bedford West pipelines)	Haul road dust suppression losses
Groundwater inflows to pits	Controlled releases
	Dam overflows
	Seepage from storages

Details of the development of the GoldSim model, including a description of the inflows and outflows to the water management system, are provided in the following sections.

3 Mine plan stages

The BWM water balance model includes ten representative stages to represent the progression of mining over the 30-year simulation, as shown in Table 2.1. Stage 0 was used to calibrate the water balance model against data recorded between July 2024 and June 2025. Stage 1 is an interim stage that covers the 1-year period between the end of the calibration and the start of the Project forecast simulation. Stages 2 to 9 have been set up to provide a forecast of the BWM Water Management System (WMS) performance over the simulation period.

The forecast model was run for 107 climatic realisations developed using 136 years of stochastic rainfall data in order to assess a wide range of climatic scenarios.

Table 3.1 – Modelled Life-of-Mine forecast stages

Representative stage	Description	Applied date range	Duration
Stage 0	Calibration	1 July 2024 – 30 June 2025	1 year
Stage 1 (financial year [FY]26)	Interim period	1 July 2025 – 30 June 2026	1 years
Stage 2 (FY27)	Forecast	1 July 2026 – 30 June 2027	1 year
Stage 3 (FY28)	Forecast	1 July 2027 – 30 June 2028	1 year
Stage 4 (FY29)	Forecast	1 July 2028 – 30 June 2029	1 year
Stage 5 (FY30-FY34)	Forecast	1 July 2029 – 30 June 2034	5 years
Stage 6 (FY35-FY40)	Forecast	1 July 2034 – 30 June 2040	6 years
Stage 7 (FY41-FY45)	Forecast	1 July 2040 – 30 June 2045	5 years
Stage 8 (FY46-FY50)	Forecast	1 July 2045 – 30 June 2050	5 years
Stage 9 (FY51-FY55)	Forecast	1 July 2050 – 30 June 2055	5 years

4 Catchment mapping

4.1 Existing conditions mapping

Figure 4.1 to Figure 4.3 show the catchment areas and land use types at BWM for current condition (FY26). A breakdown of catchment land use types and areas reporting to each of the water storages is shown in Table 3.1.

Table 4.1 – Catchment areas by storage for the BWM WMS

Storage	Catchment area per landuse type (hectare [ha])						Total (ha)
	Natural	Spoil	Rehab	Tailings	Hardstand/ pit	Disturbed	
R8	0.0	0.0	6.8	0.0	9.2	7.3	**23.3**
Rangal Dam	0.6	0.0	0.0	0.0	1.0	0.0	**1.6**
R10 WSP	190.7	104.1	61.3	41.4	17.5	24.2	**493.1**
R12 FPD	0.2	0.0	0.7	0.0	0.6	0.0	**1.5**
R12 Void Dam	1.0	0.0	7.1	0.0	2.7	0.0	**10.8**
R14 WSP	48.4	22.4	65.1	0.0	50.4	81.3	**267.6**
R16	23.8	113.4	29.2	0.0	135.5	47.2	**349.1**
R20	23.2	154.1	6.2	0.0	29.8	52.2	**265.5**
R26	0.0	134.8	1.1	0.0	32.4	85.0	**253.2**
Thermal Coal Plant (TCP) Dam	3.8	0.0	0.0	0.0	14.0	1.7	**19.6**
R28 FPD	1.3	0.0	60.0	0.0	4.6	0.0	**65.9**
R30N	0.0	126.9	102.1	0.0	41.5	59.0	**329.5**
R30S	0.9	10.3	44.6	0.0	53.3	29.9	**139.0**
R34	0.0	128.9	1.7	0.0	53.2	45.1	**228.9**
New Deep Creek Dam (NDCD)	1444.7	24.2	255.1	0.0	65.4	122.9	**1,912.4**
Top Dam	0.0	0.0	0.0	0.0	0.6	0.8	**1.4**
NCHPP WSD	1.9	0.0	0.0	0.0	1.4	2.6	**5.9**
Sed Dam	0.0	0.3	0.0	0.0	0.1	1.6	**2.0**
Rejects Sump	27.4	58.3	0.0	0.0	16.0	8.2	**110.0**
North CHPP Tailings Dam	0.0	0.0	0.0	156.7	0.0	0.0	**156.7**
Tailings Sump	2.1	0.0	0.0	14.6	37.0	6.0	**59.8**
New Taurus Creek Dam (NTCD)	3,834.2	74.8	1,106.6	0.0	117.7	77.0	**5,210.3**
R38	0.0	128.7	29.4	0.0	24.1	51.1	**233.4**
R40 FPD	0.0	0.0	0.0	0.0	0.8	0.6	**1.4**
R42	37.8	128.3	0.0	0.0	84.5	84.4	**335.0**
R46N/S	0.0	22.1	0.0	0.0	28.1	40.1	**90.3**

Storage	Catchment area per landuse type (hectare [ha])						Total (ha)
	Natural	Spoil	Rehab	Tailings	Hardstand/ pit	Disturbed	
R47	0.0	25.2	30.4	0.0	26.8	55.5	**137.9**
R48	0.0	115.3	32.7	0.0	76.4	77.8	**302.1**
Tannyfoil Dam (TFD)	0.0	0.0	0.0	0.0	18.7	3.6	**22.3**
Central RWD	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**
R52N	0.0	78.4	9.7	0.0	23.1	13.8	**125.0**
R52S	0.0	45.7	122.2	0.0	82.1	75.9	**325.9**
R52 FPD	0.0	0.0	0.0	0.0	2.0	0.0	**2.0**
R54 FPD	0.0	0.0	114.0	0.0	9.6	0.7	**124.3**
R54	0.0	102.9	31.7	0.0	78.2	46.1	**258.8**
R56	2.7	350.7	123.9	0.0	127.3	72.4	**677.0**
R62	119.8	93.9	95.1	0.0	32.4	38.1	**379.3**
R62 FPD	936.3	3.5	297.4	0.0	61.2	10.9	**1,309.3**
R64 WSP	3.6	0.7	18.8	0.0	62.7	8.0	**93.8**
Kenmare RWD	0.0	0.0	0.0	0.0	0.5	0.0	**0.5**
Red Claw Dam	44.5	0.0	0.0	0.0	22.3	32.0	**98.7**
Bear Park Dam	0.0	0.0	0.0	0.0	0.6	0.0	**0.6**
R70 WSP	40.8	34.4	30.2	0.0	30.2	25.4	**161.0**
Holding Dam	2.0	0.0	6.7	0.0	2.0	26.1	**36.7**
Red Dam	0.0	0.0	4.6	0.0	1.3	20.2	**26.1**
Baby Red Dam	0.0	0.0	0.0	0.0	0.1	3.6	**3.7**
No 1 Dam	0.2	0.0	0.0	0.0	13.2	4.4	**17.7**
No 2 Dam	37.1	0.0	1.6	0.0	26.4	24.8	**90.0**
Bottom Dam	0.0	0.0	0.0	0.0	10.9	9.6	**20.4**
Duck Pond	0.0	0.0	2.6	0.0	0.4	1.1	**4.2**
Goldfish Bowl	0.0	0.0	2.2	0.0	0.3	0.0	**2.5**
Old Cut 4	10,841.8	0.0	9.6	0.0	8.9	192.8	**11,052.7**
R72 TSD	168.0	21.9	24.2	27.4	0.0	45.0	**286.5**
R74 TSD	45.2	0.0	75.9	51.5	0.0	63.9	**236.6**
R76 WSP	0.0	47.0	20.8	0.0	14.9	0.0	**82.6**
R80 WSP	8.5	21.9	102.3	0.0	41.9	58.5	**233.1**
R82 FPD	524.7	0.0	90.3	0.0	1.1	37.3	**653.5**
R84 WSP	23.8	68.9	35.3	0.0	25.2	13.2	**166.3**
TOTAL	**18,441**	**2,442**	**3,059**	**292**	**1,623**	**1,789**	**27,445**

Notes: WSP = Water Storage Pit
FPD = Fill Point Dam
RWD = Raw Water Dam
TSD = Tailings Storage Dam

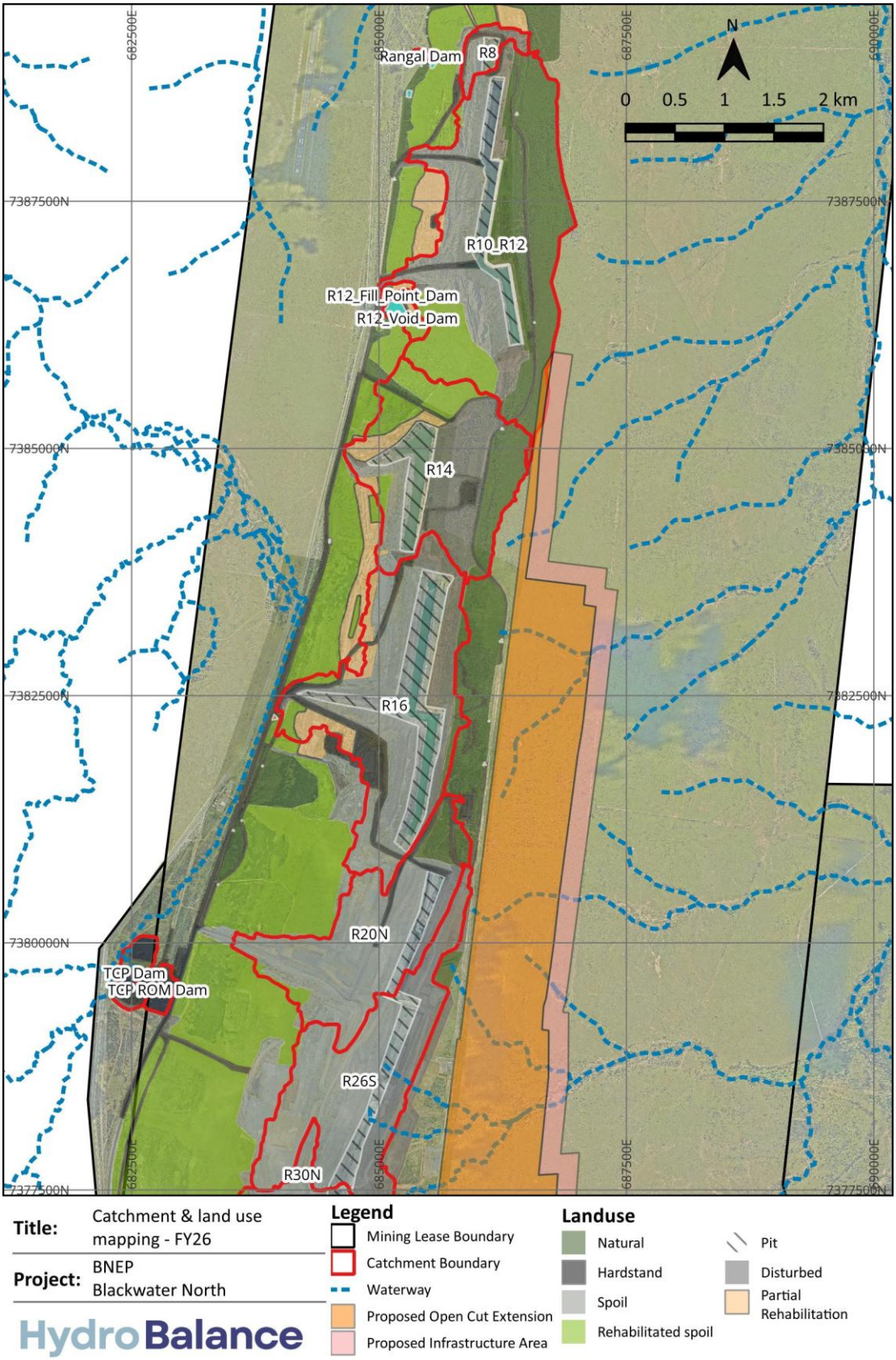


Figure 4.1 - Catchment and land use mapping - Blackwater North (FY26)

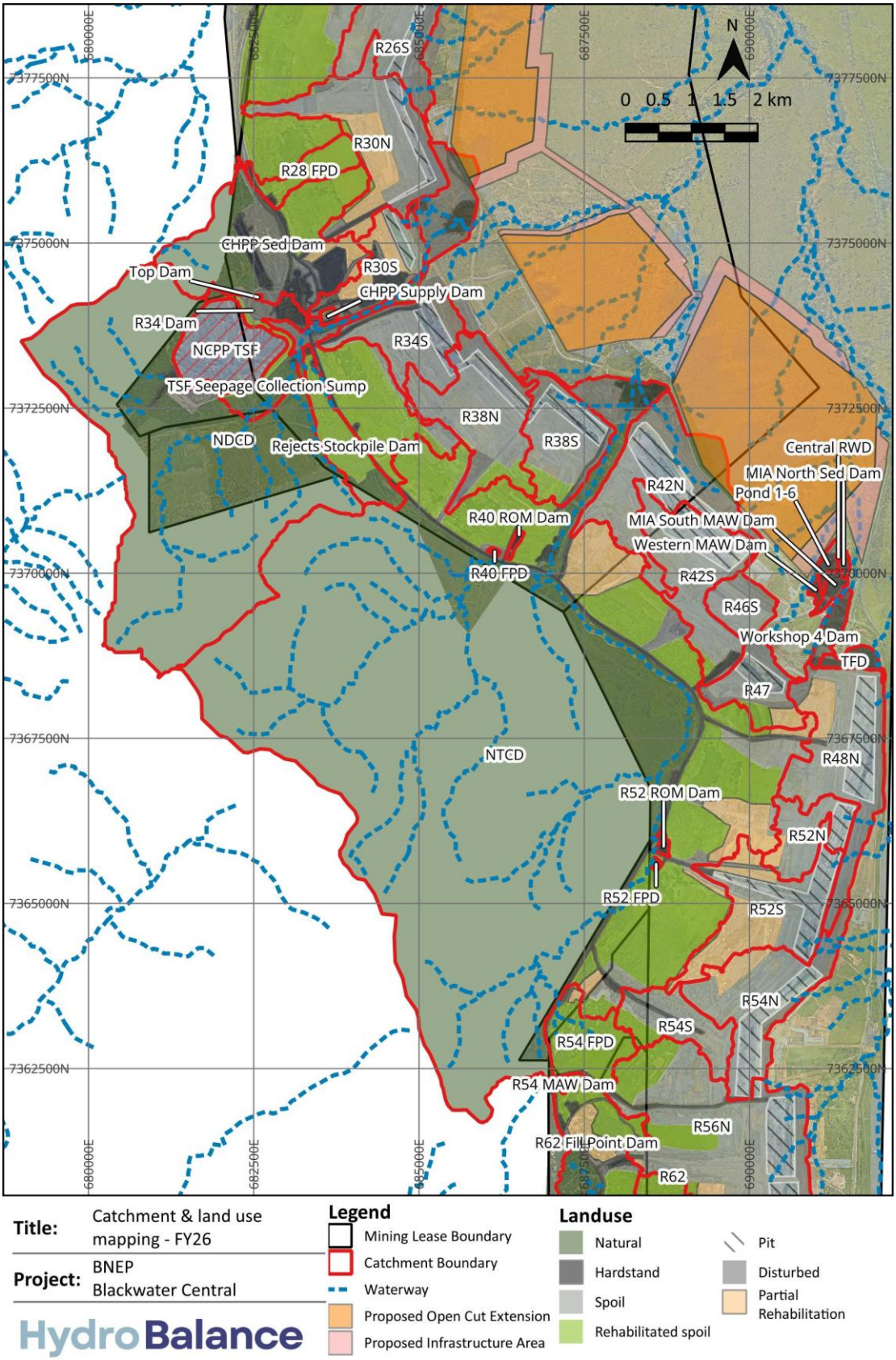


Figure 4.2 - Catchment and land use mapping - Blackwater Central (FY26)

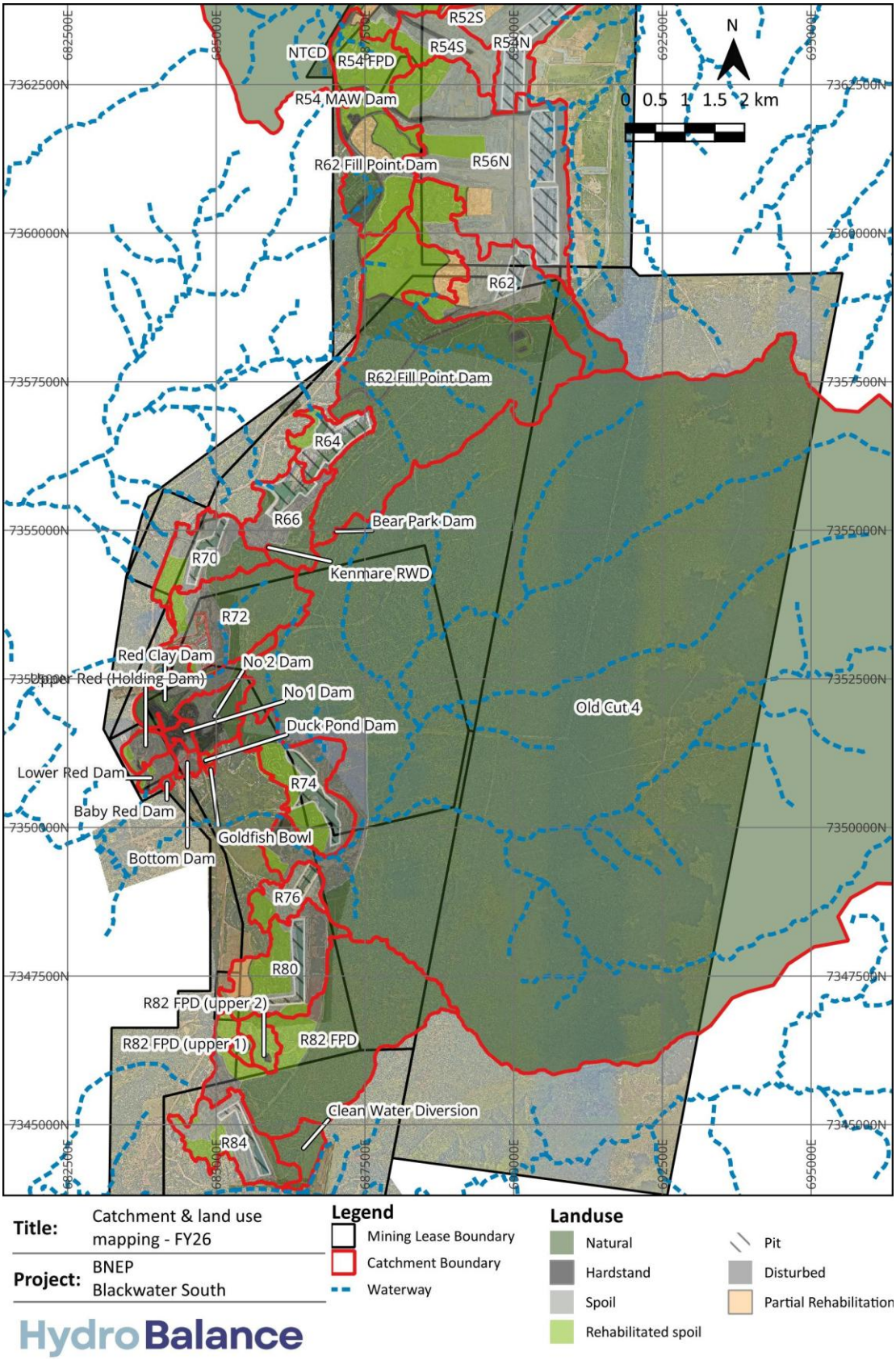


Figure 4.3 - Catchment and land use mapping - South (FY26)

4.2 Forecast mapping

A set of catchment maps have been developed for selected snapshots between FY27 and FY55, in line with the model stages shown in Table 3.1. These maps have been based on staged mine plans provided by Whitehaven.

The catchment mapping for each of the eight future model stages is presented in Figure 4.4 to Figure 4.30.

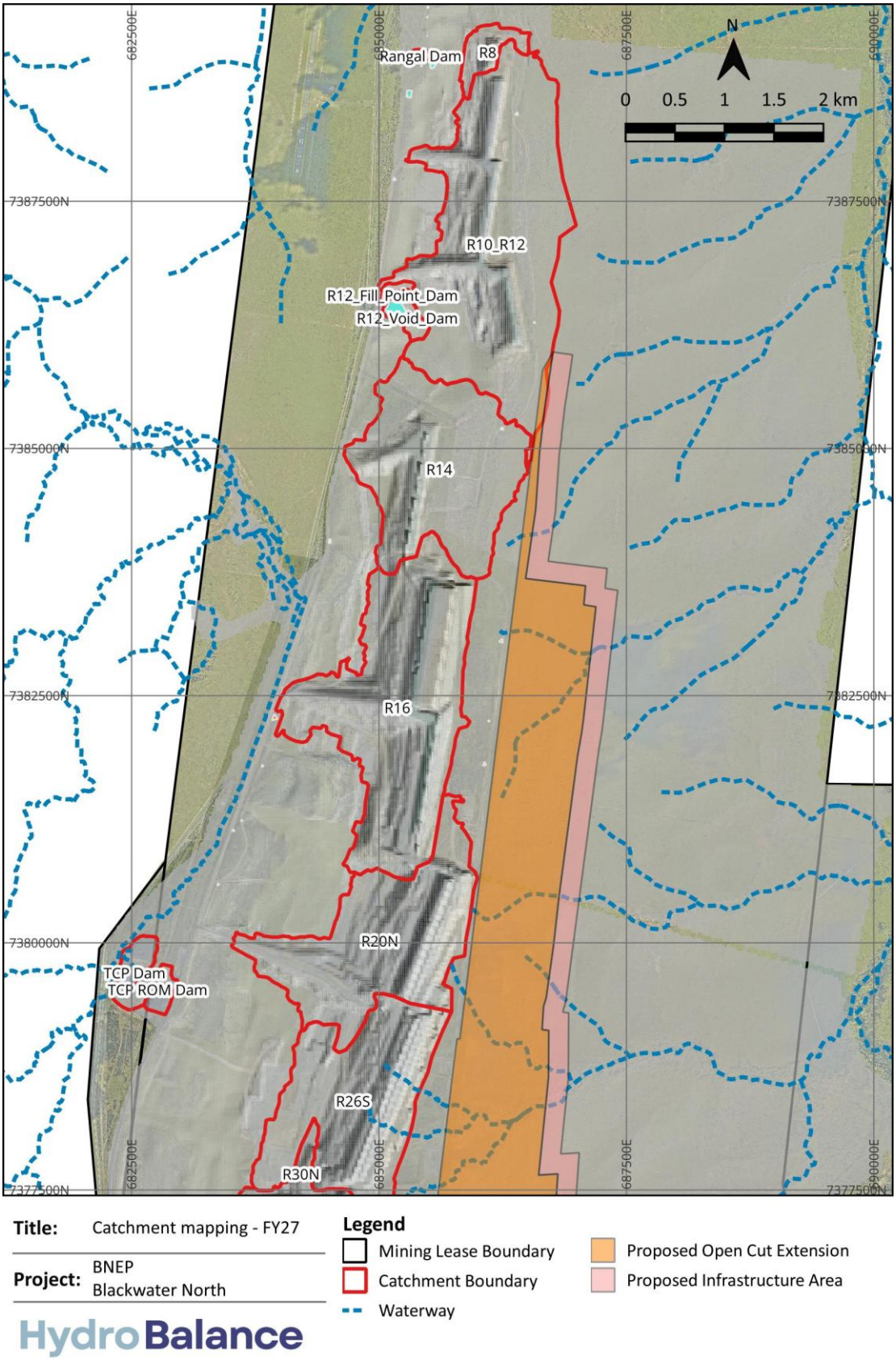


Figure 4.4 - Catchment mapping - Blackwater North - FY27

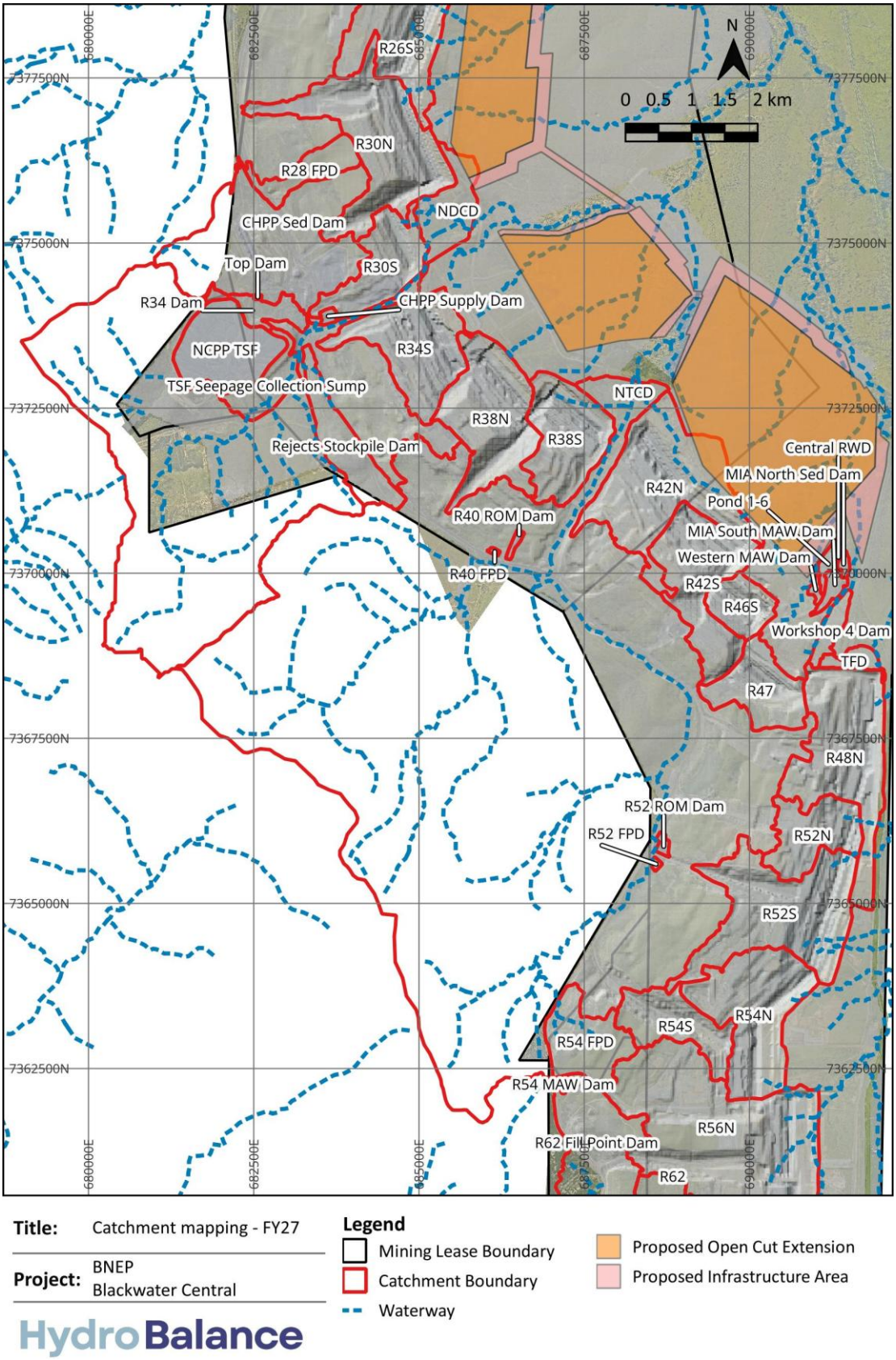
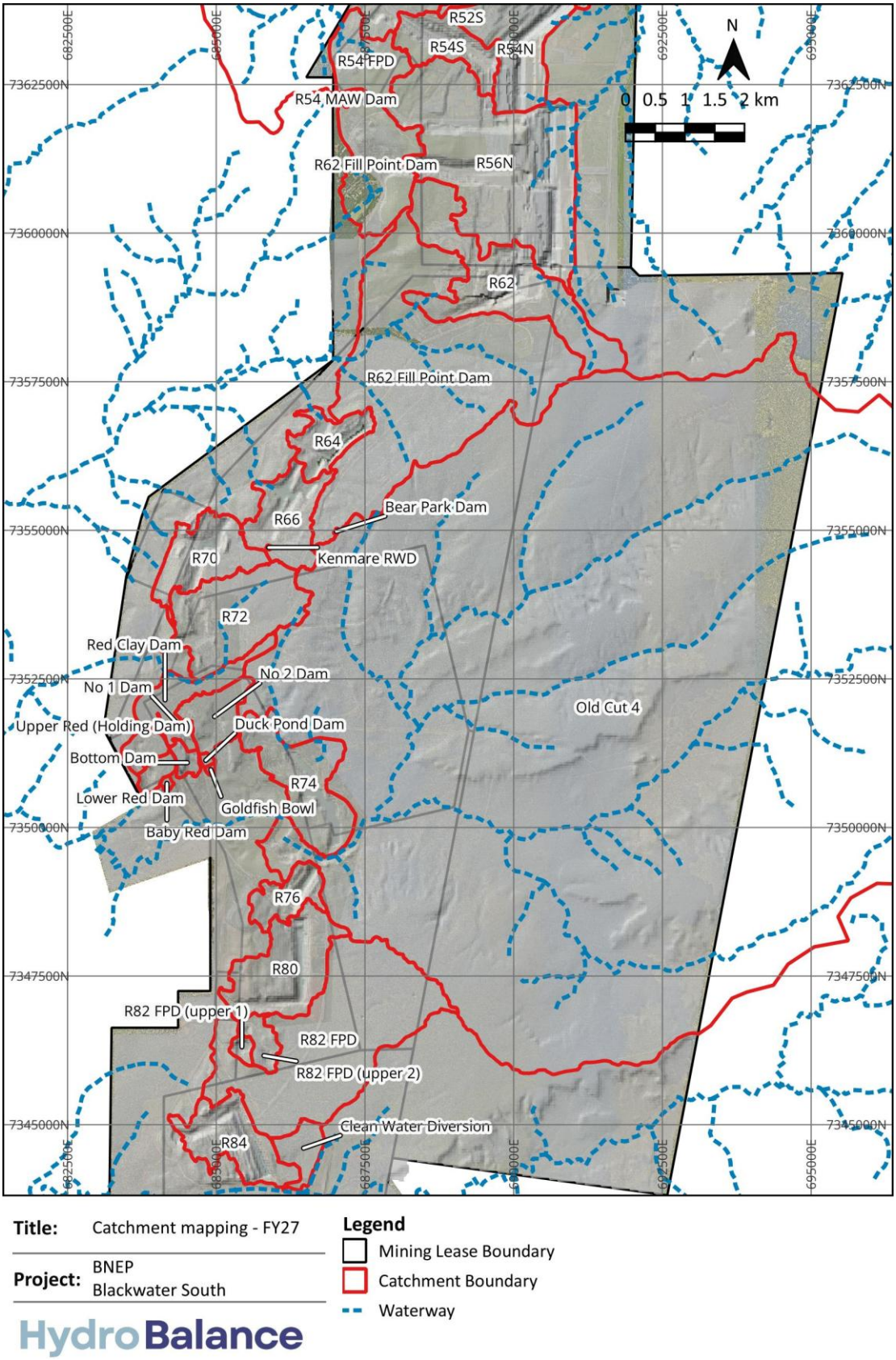


Figure 4.5 - Catchment mapping - Blackwater Central - FY27



Title: Catchment mapping - FY27

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway

Figure 4.6 - Catchment mapping - Blackwater South - FY27

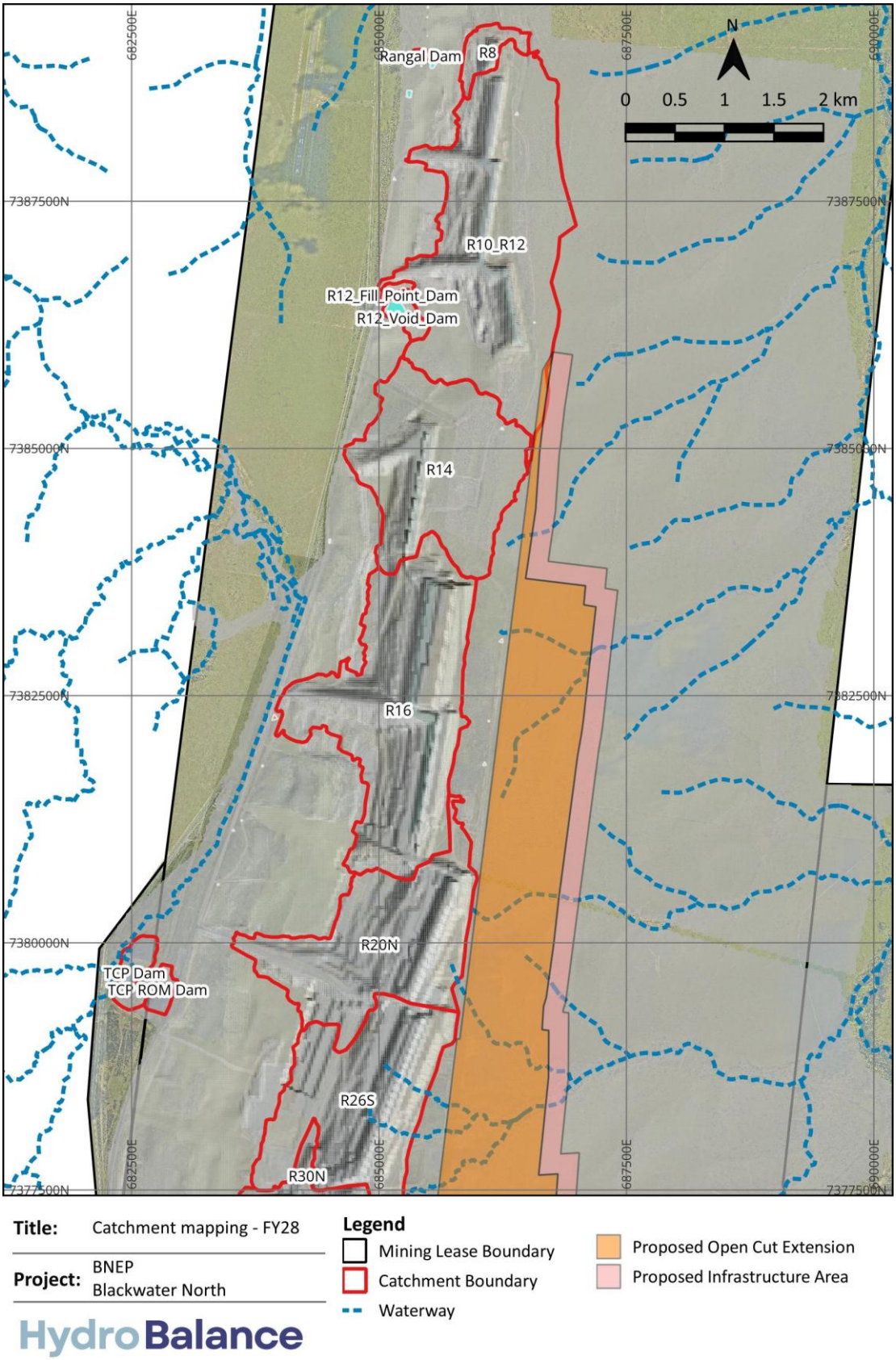


Figure 4.7 - Catchment mapping - Blackwater North - FY28

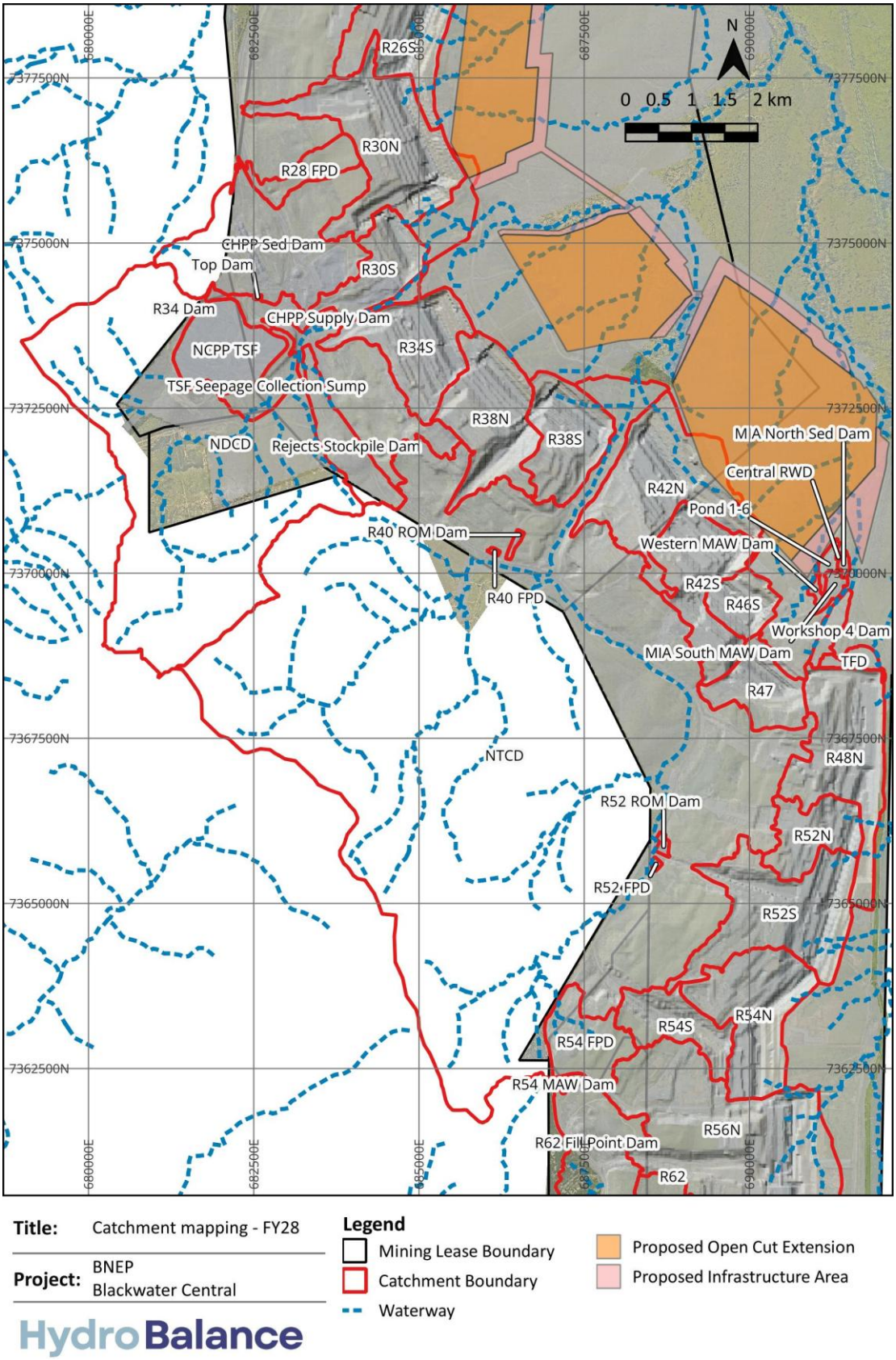


Figure 4.8 - Catchment mapping - Blackwater Central - FY28

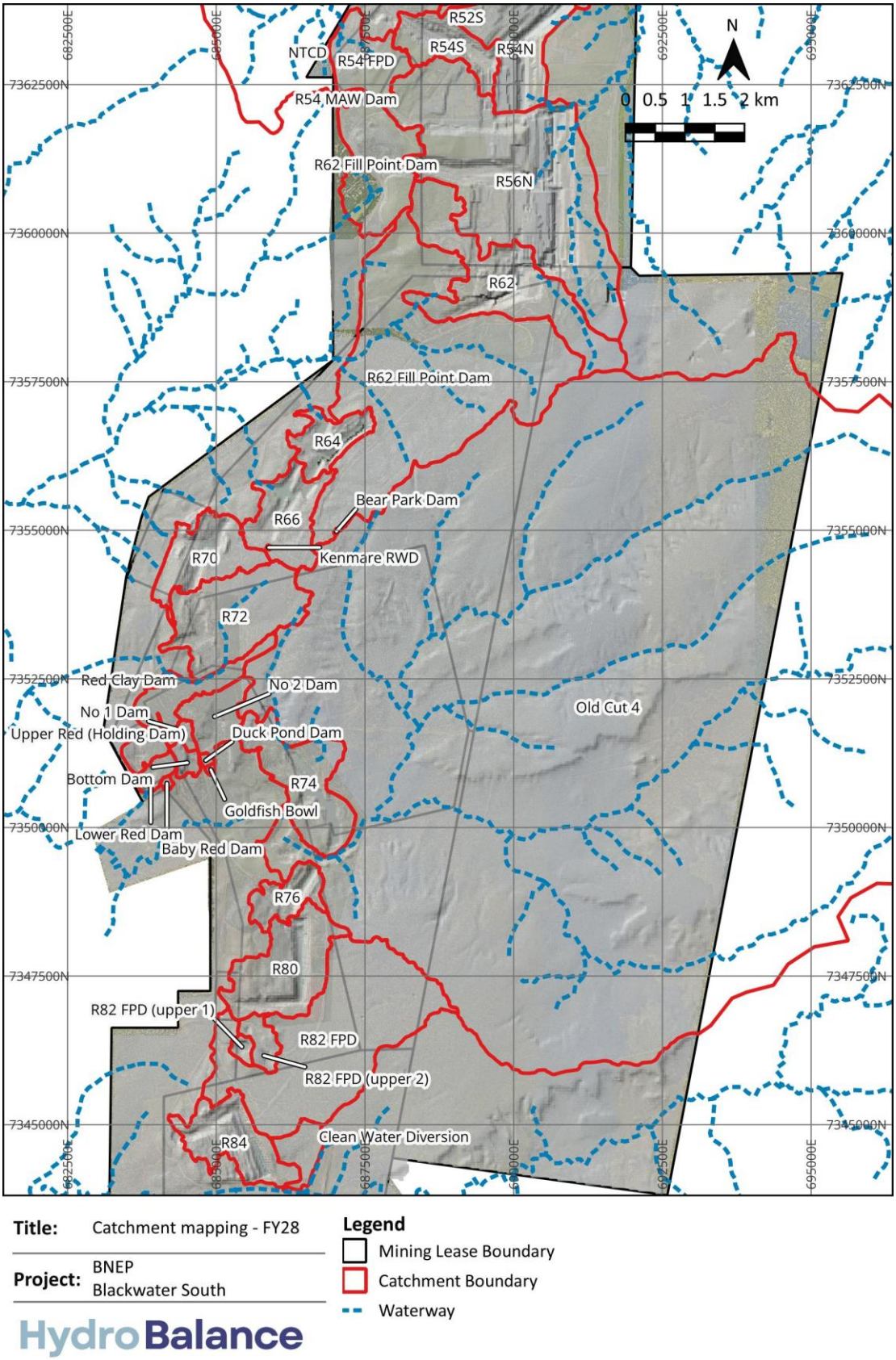


Figure 4.9 - Catchment mapping - Blackwater South - FY28

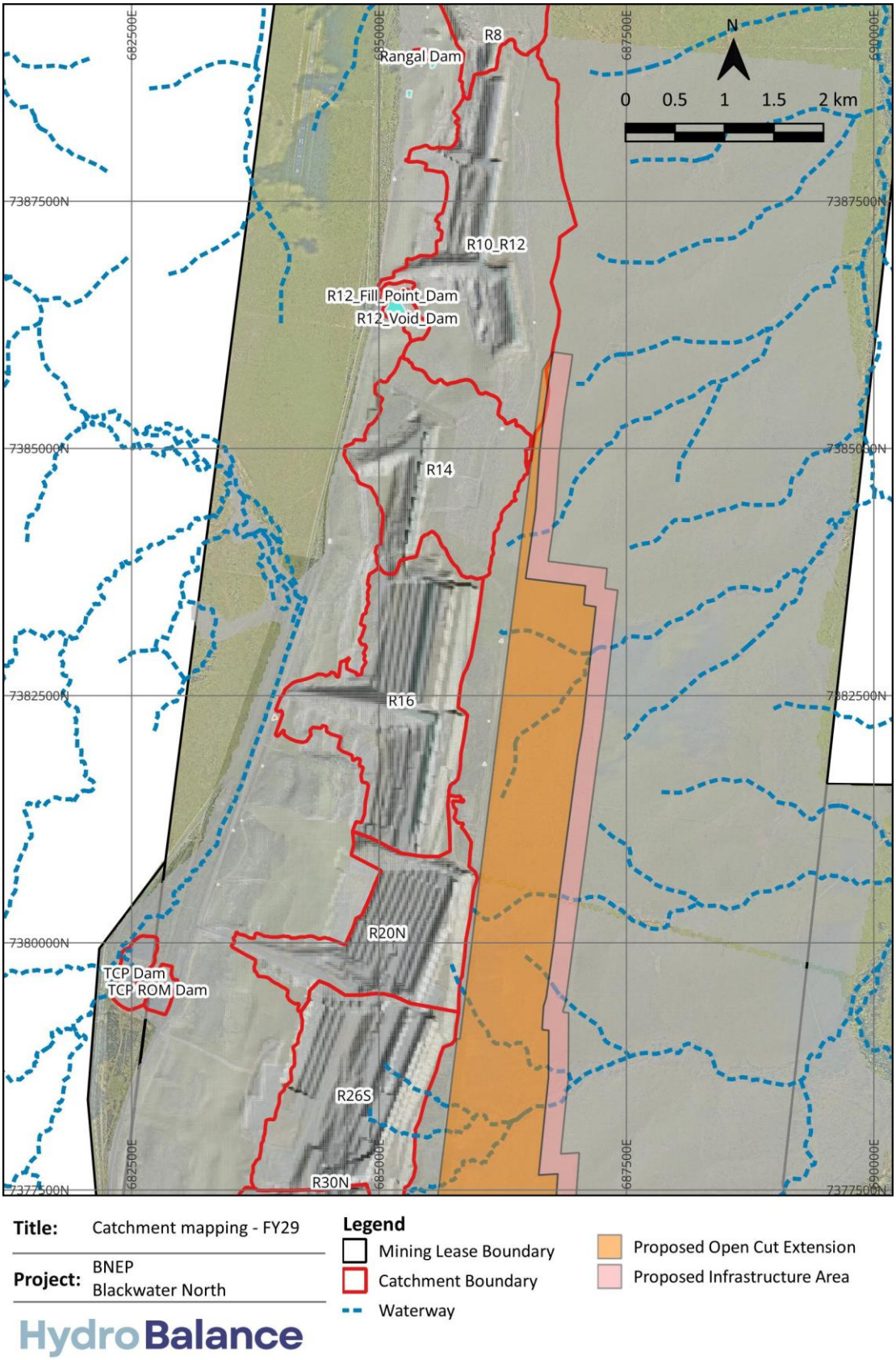


Figure 4.10 - Catchment mapping - Blackwater North - FY29

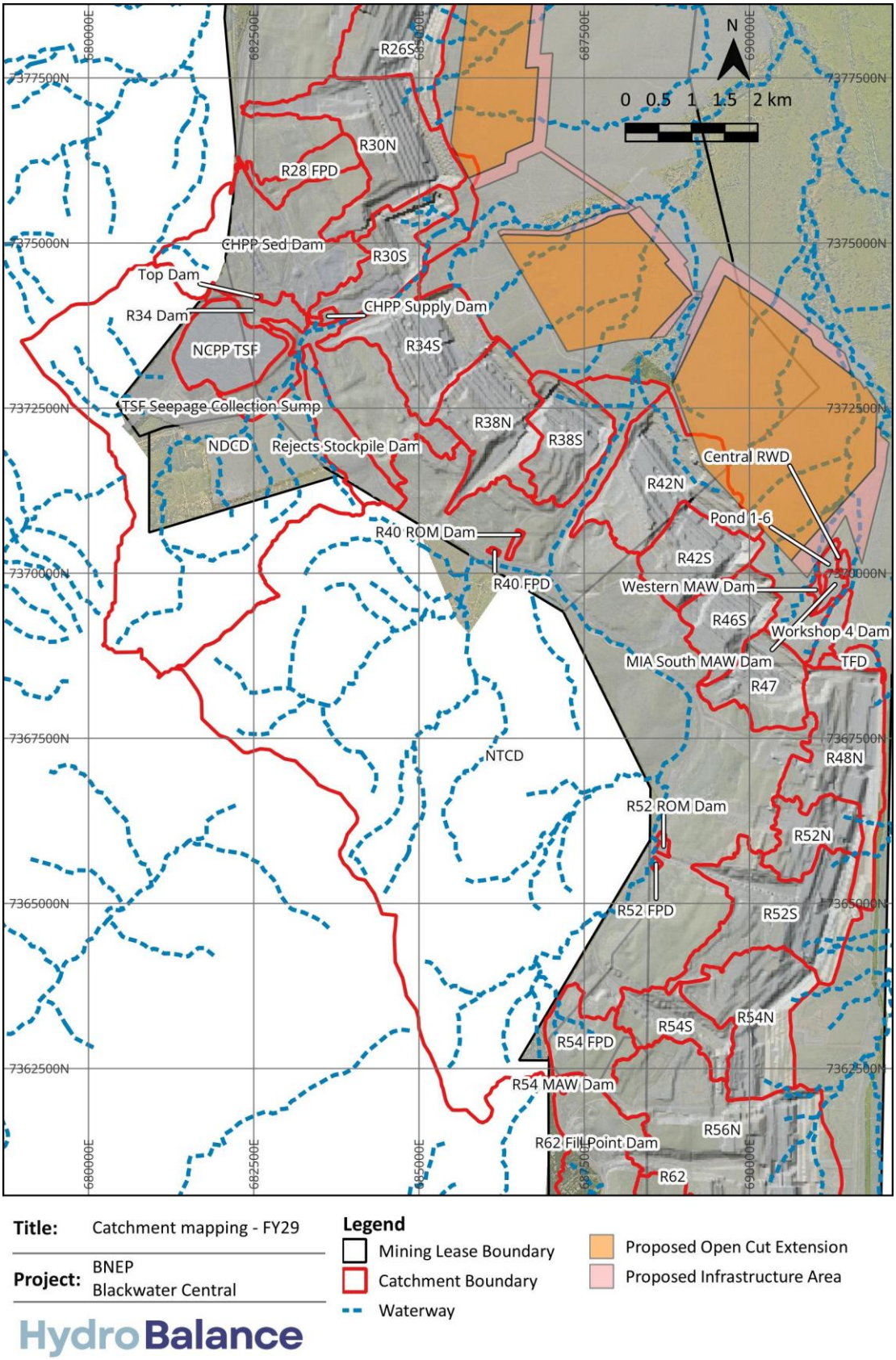


Figure 4.11 - Catchment mapping - Blackwater Central - FY29

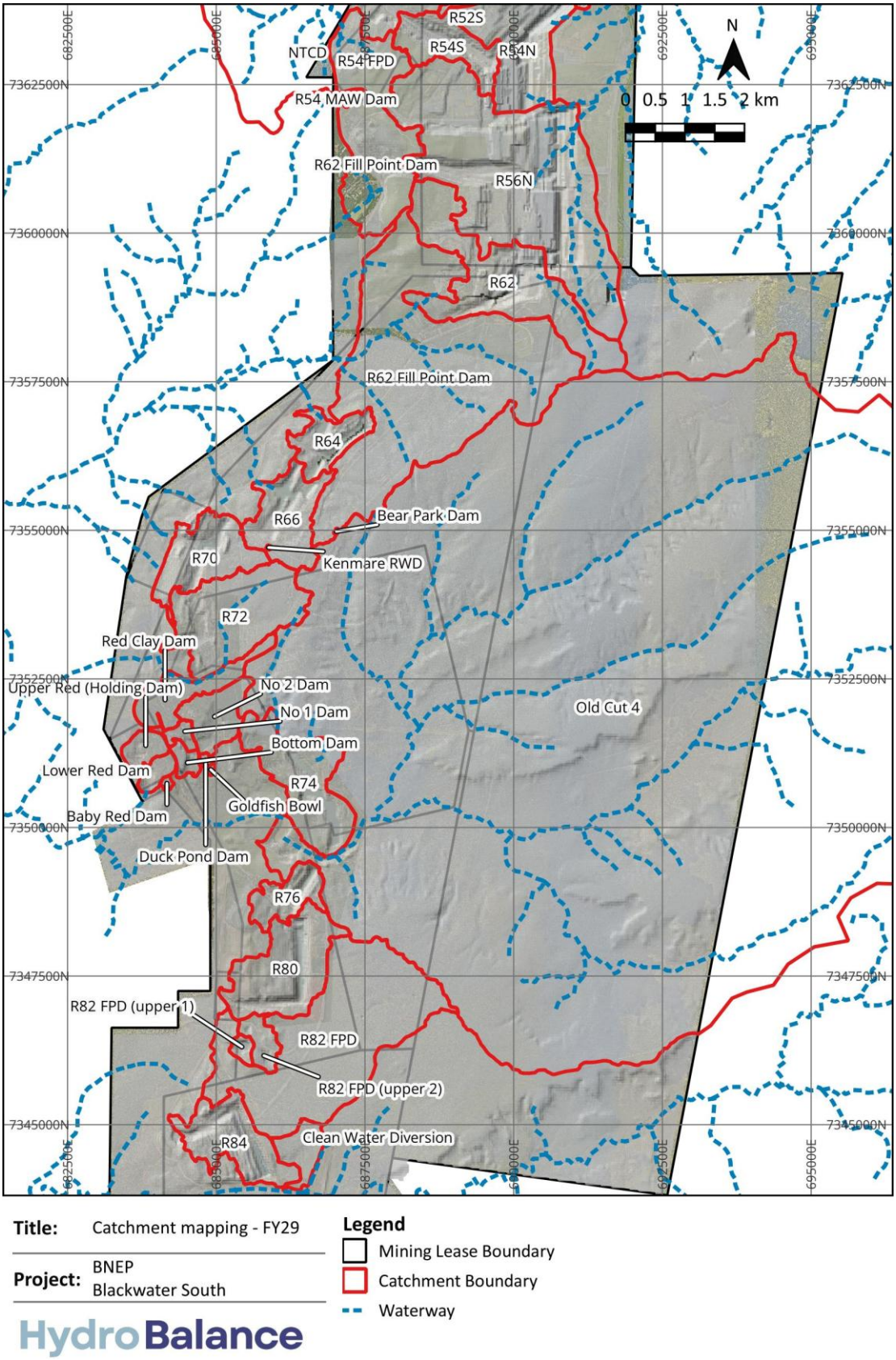


Figure 4.12 - Catchment mapping - Blackwater South - FY29

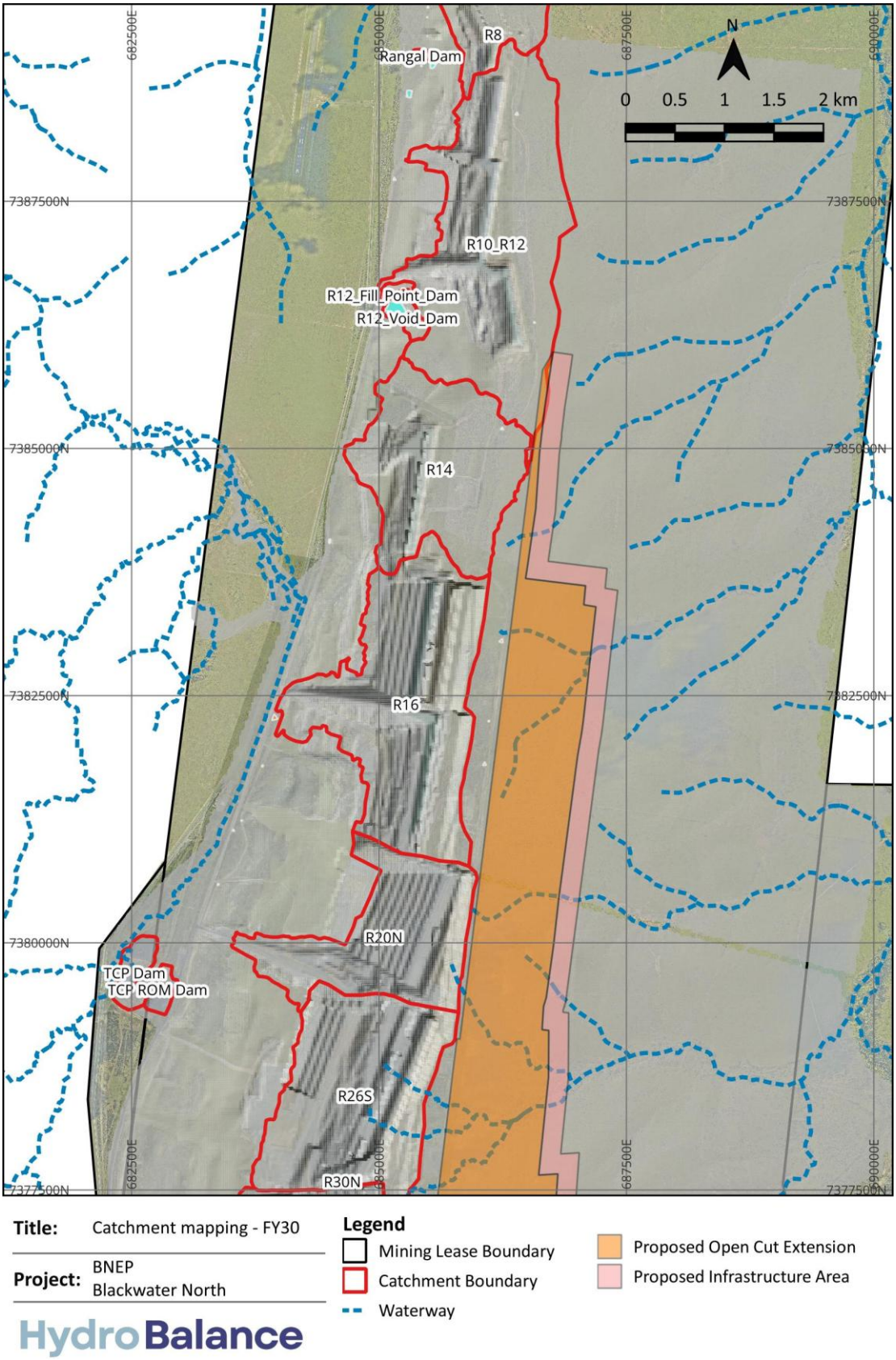
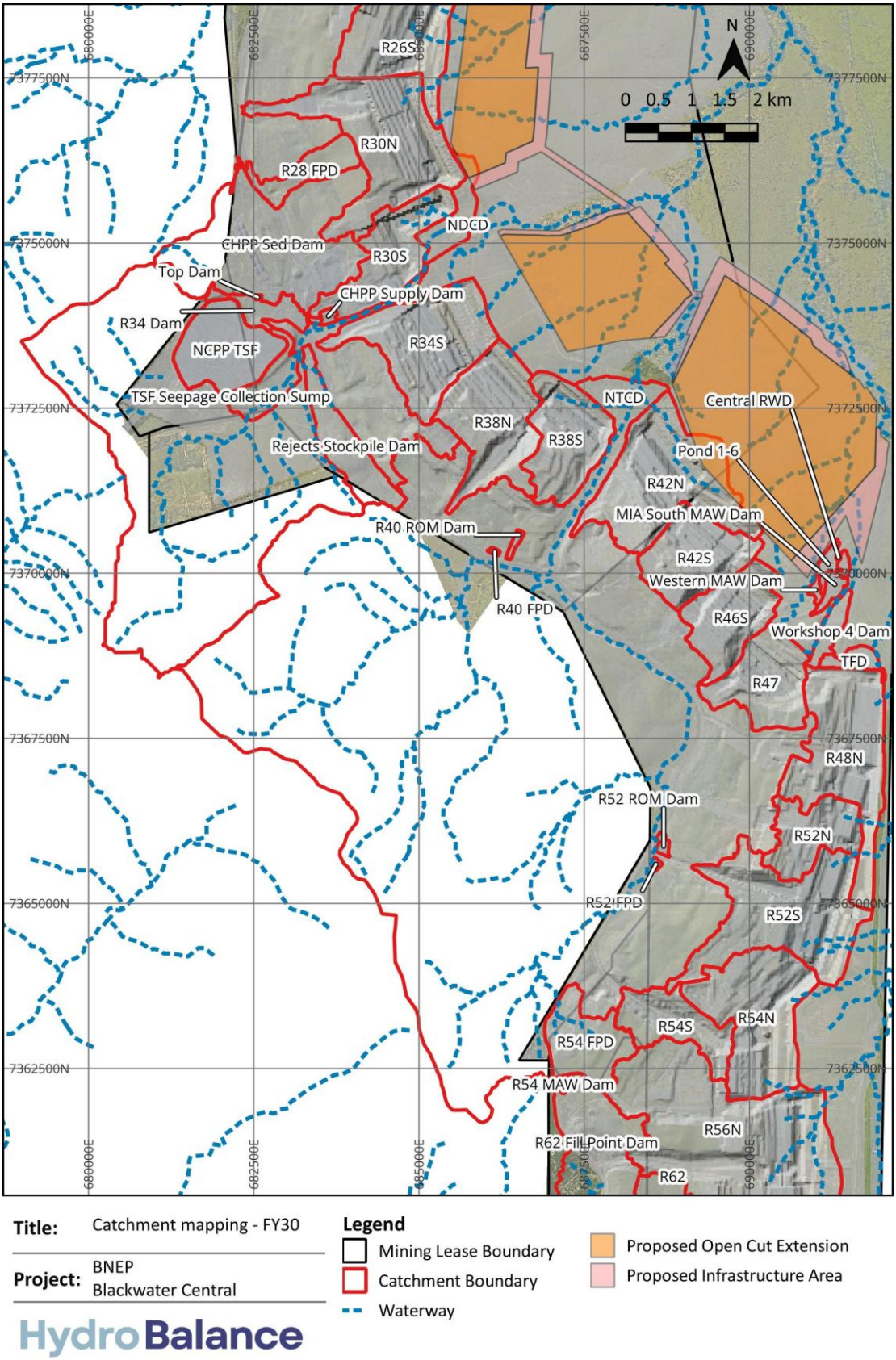


Figure 4.13 - Catchment mapping - Blackwater North - FY30



Title: Catchment mapping - FY30

Project: BNEP Blackwater Central

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway
- Proposed Open Cut Extension
- Proposed Infrastructure Area

HydroBalance

Figure 4.14 - Catchment mapping - Blackwater Central - FY30

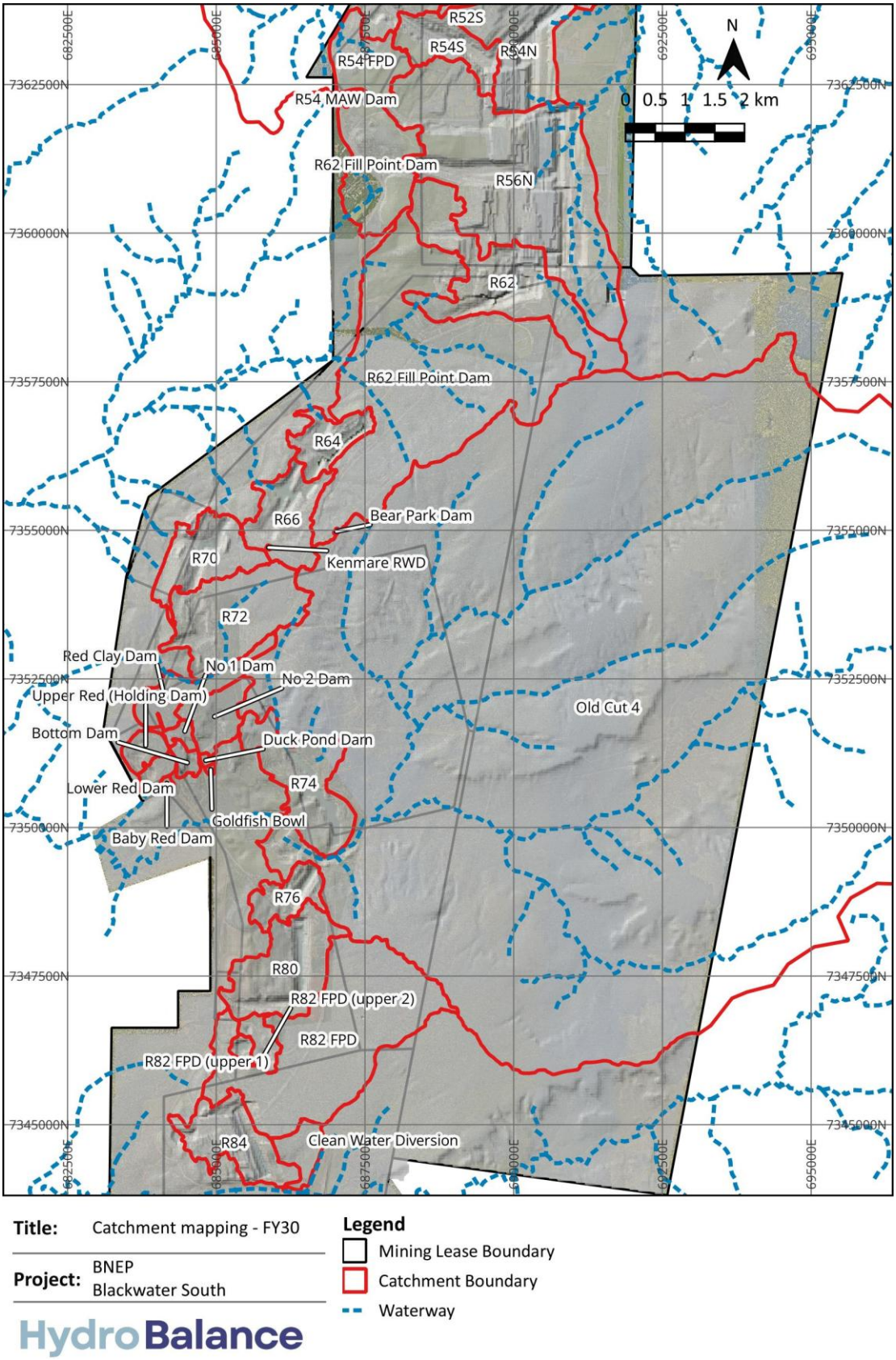


Figure 4.15 - Catchment mapping - Blackwater South - FY30

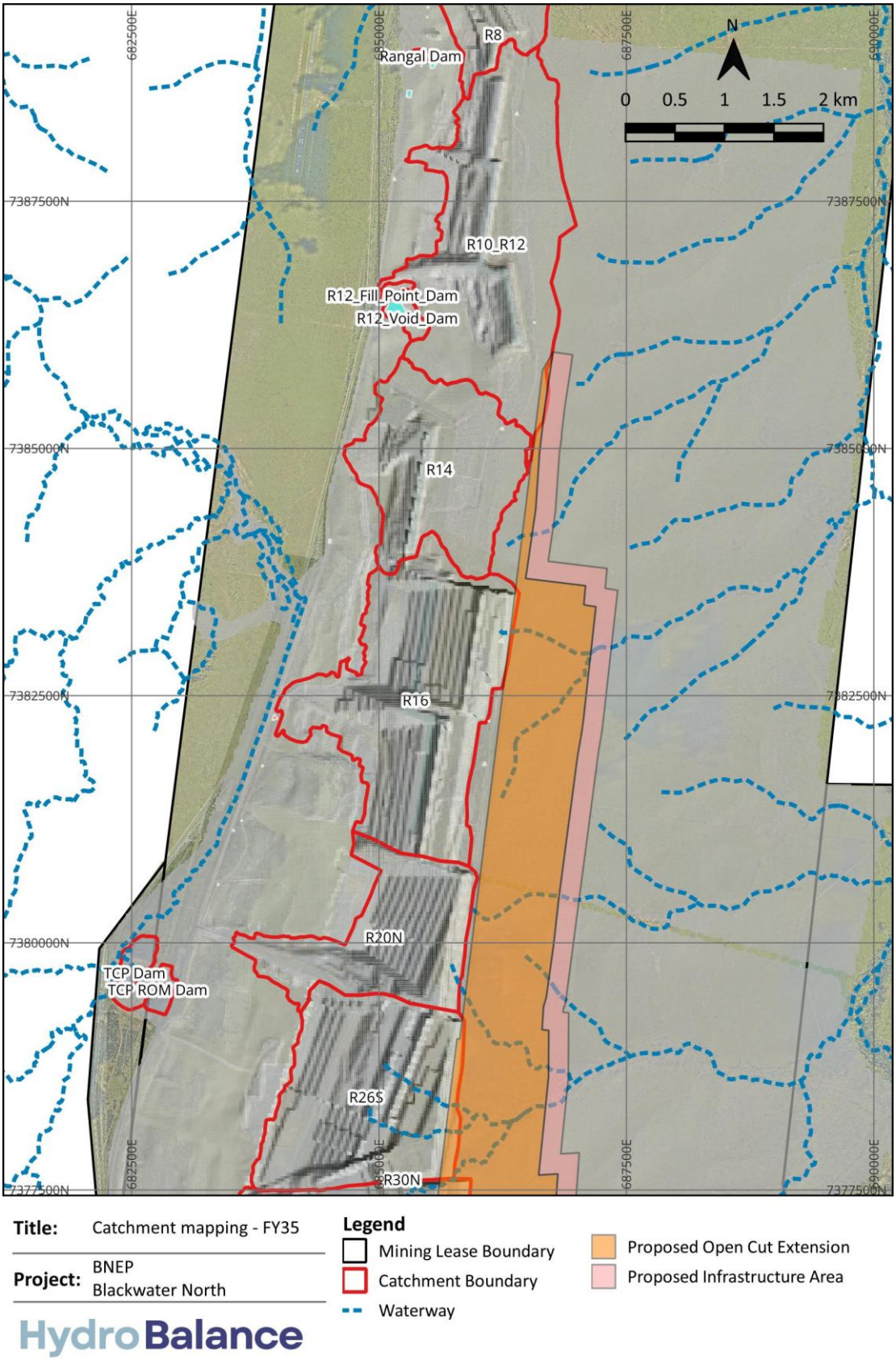


Figure 4.16 - Catchment mapping - Blackwater North - FY35

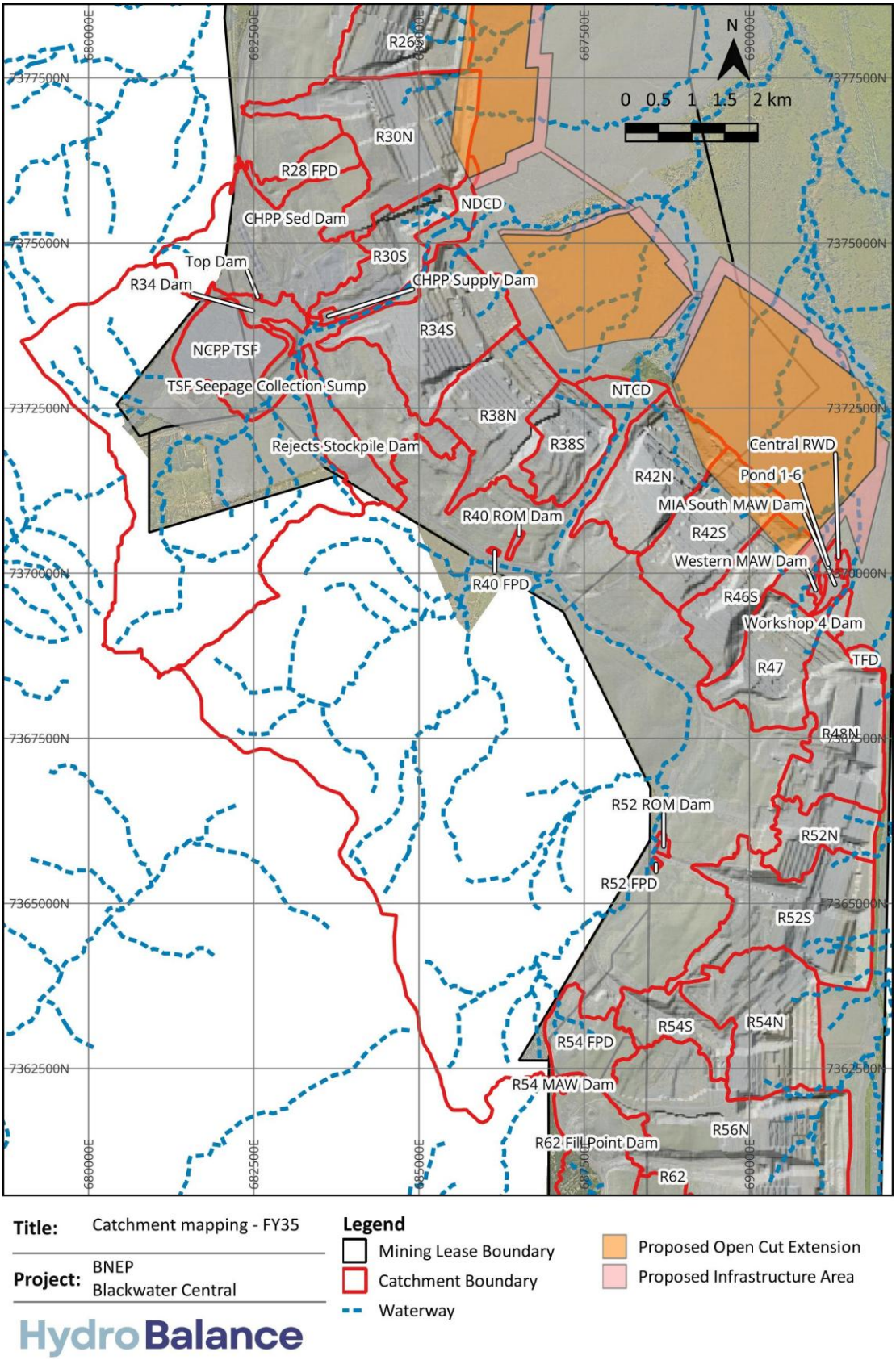
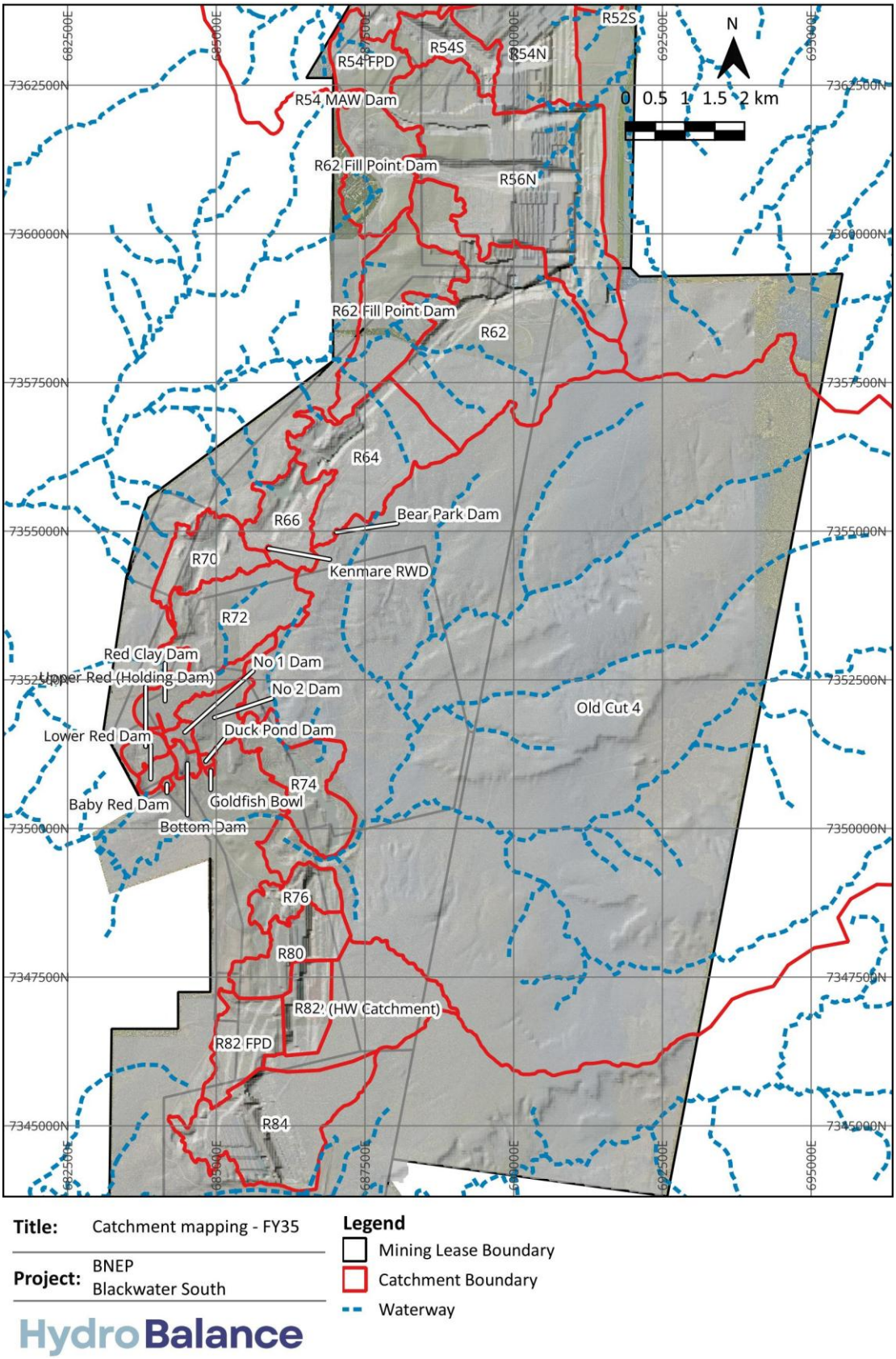


Figure 4.17 - Catchment mapping - Blackwater Central - FY35



Title: Catchment mapping - FY35

Project: BNEP Blackwater South

Legend
- Mining Lease Boundary
- Catchment Boundary
- Waterway

HydroBalance

Figure 4.18 - Catchment mapping - Blackwater South - FY35

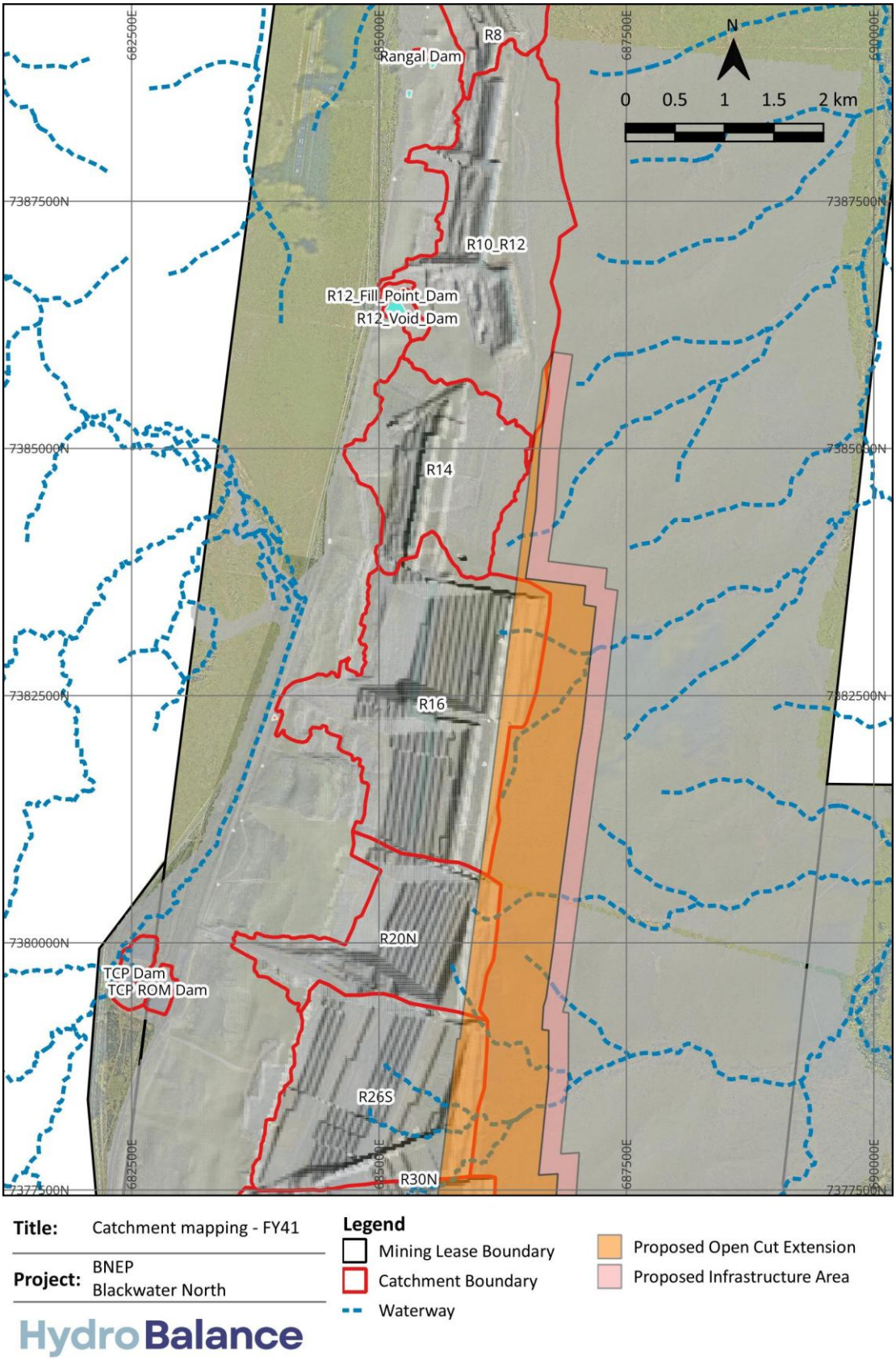


Figure 4.19 - Catchment mapping - Blackwater North - FY41

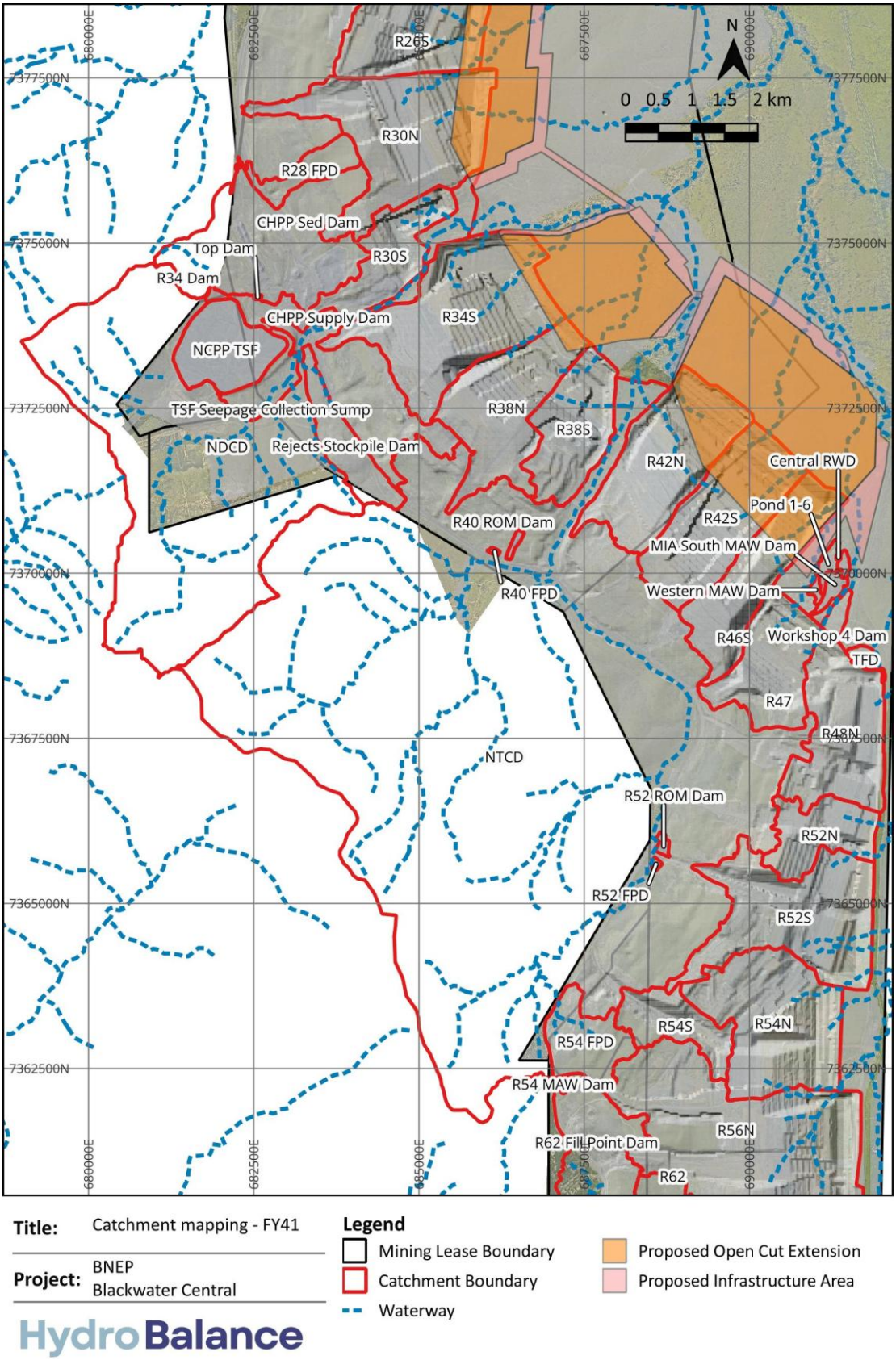
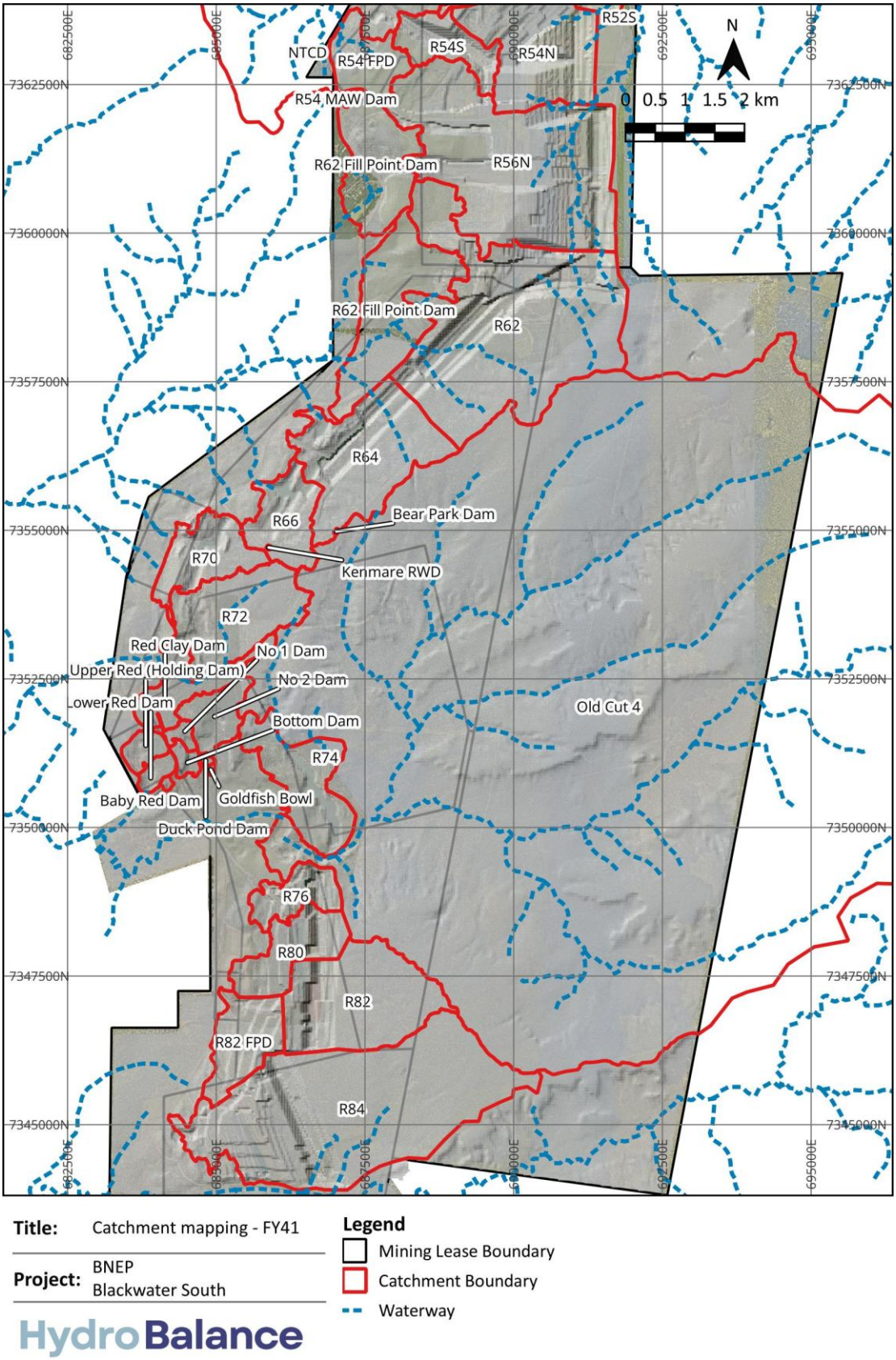


Figure 4.20 - Catchment mapping - Blackwater Central - FY41



Title: Catchment mapping - FY41

Project: BNEP Blackwater South

Legend
- Mining Lease Boundary
- Catchment Boundary
- Waterway

HydroBalance

Figure 4.21 - Catchment mapping - Blackwater South - FY41

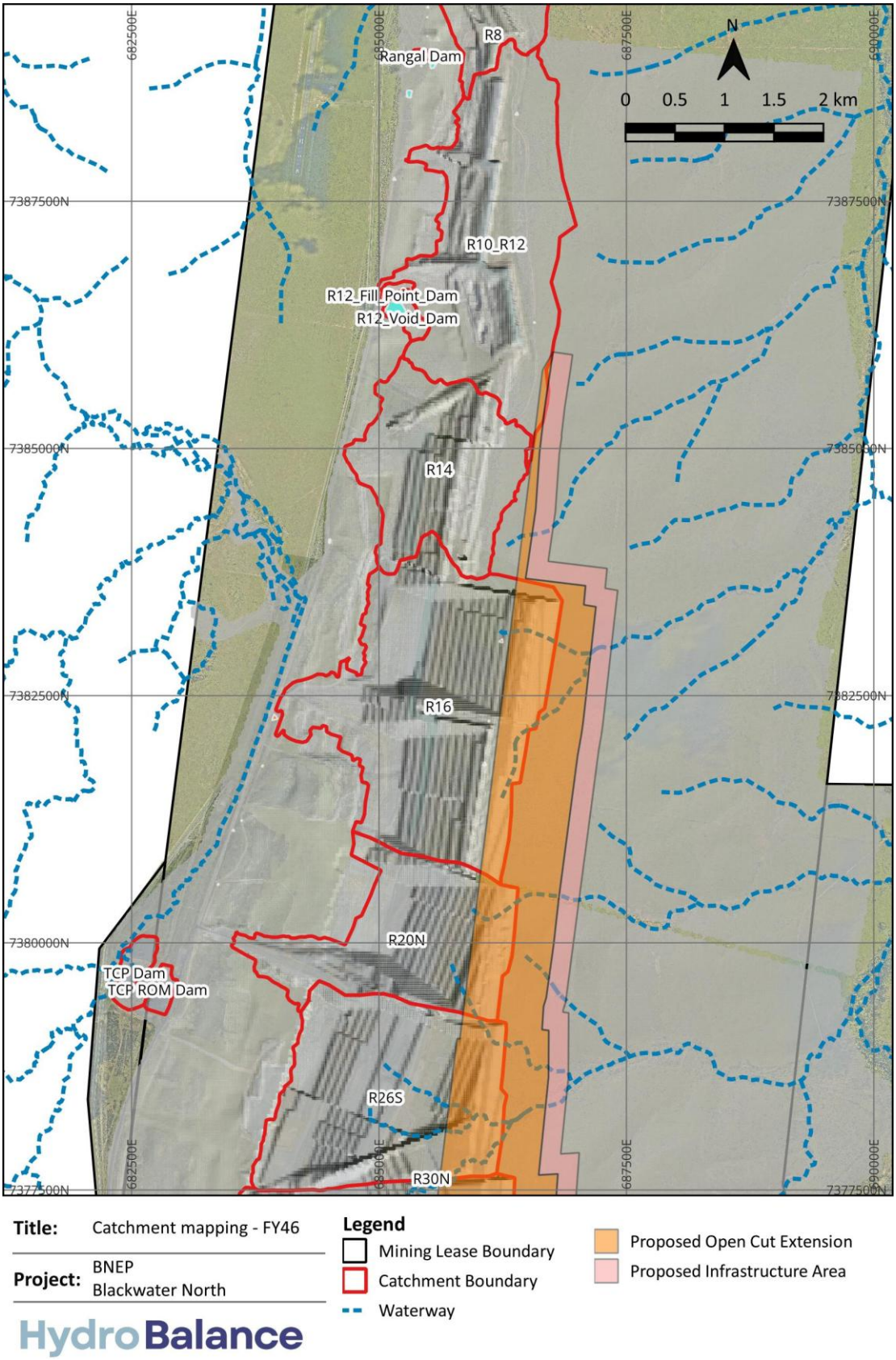


Figure 4.22 - Catchment mapping - Blackwater North - FY46

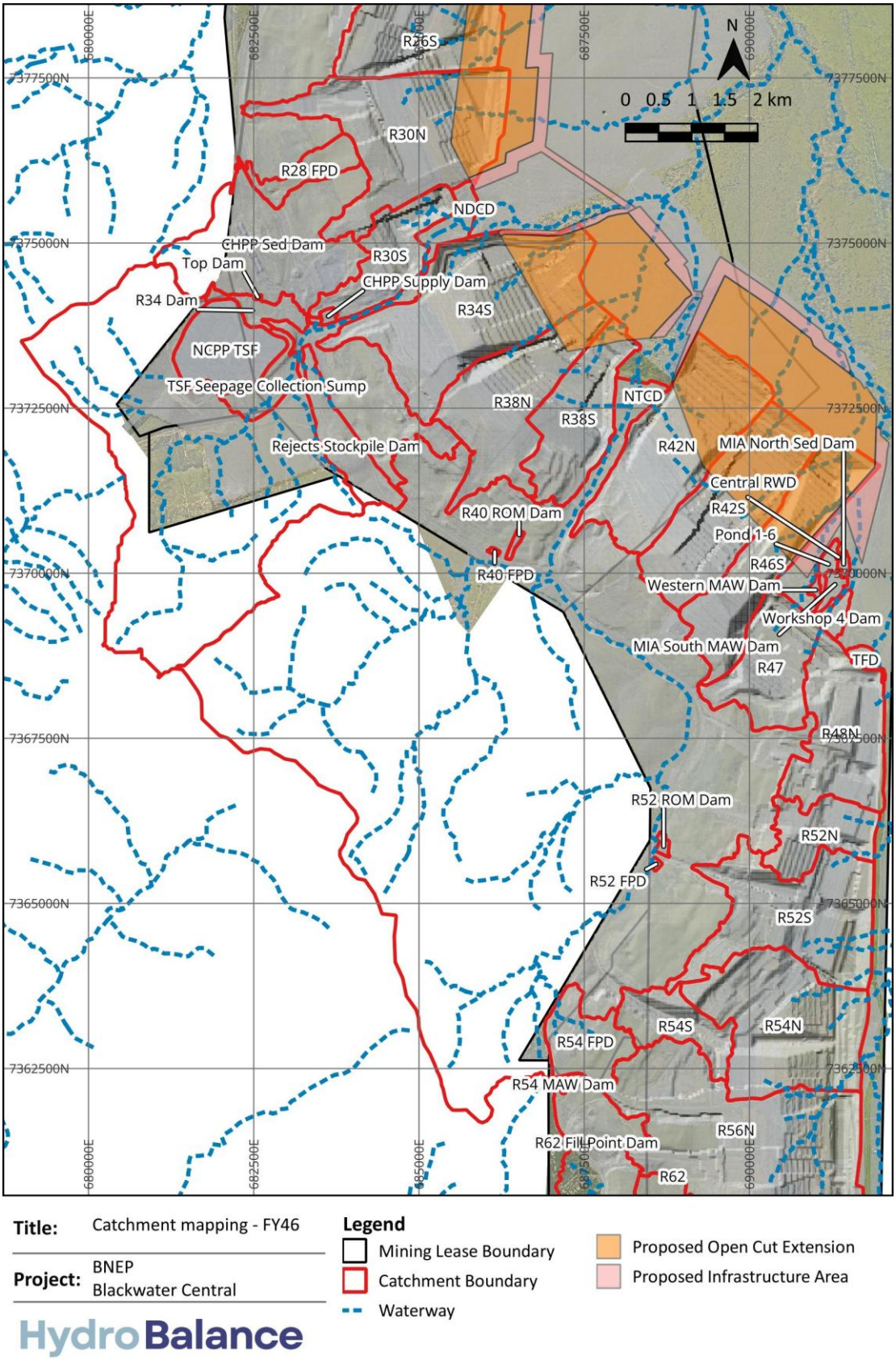


Figure 4.23 - Catchment mapping - Blackwater Central - FY46

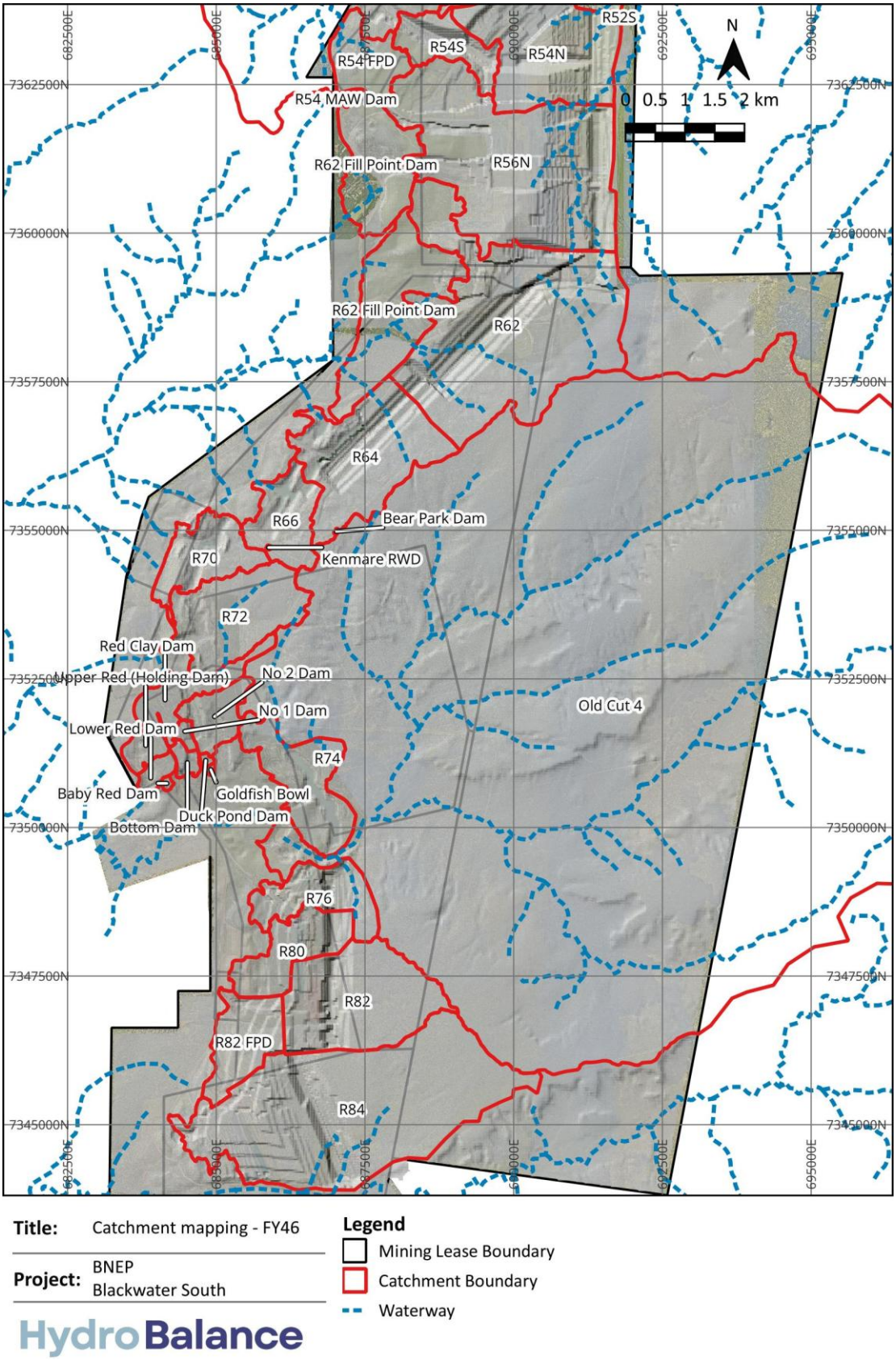


Figure 4.24 - Catchment mapping - Blackwater South - FY46

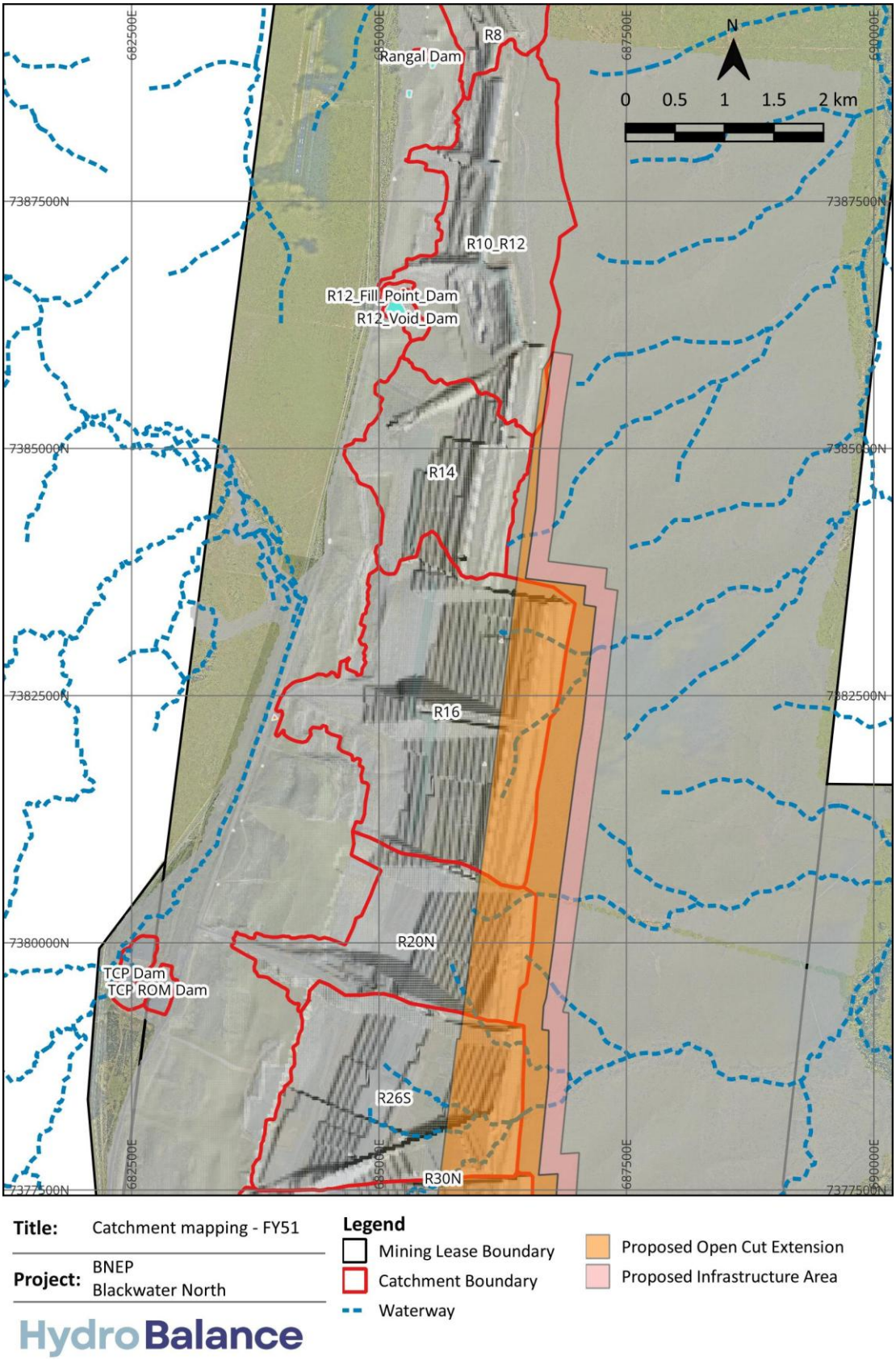


Figure 4.25 - Catchment mapping - Blackwater North - FY51

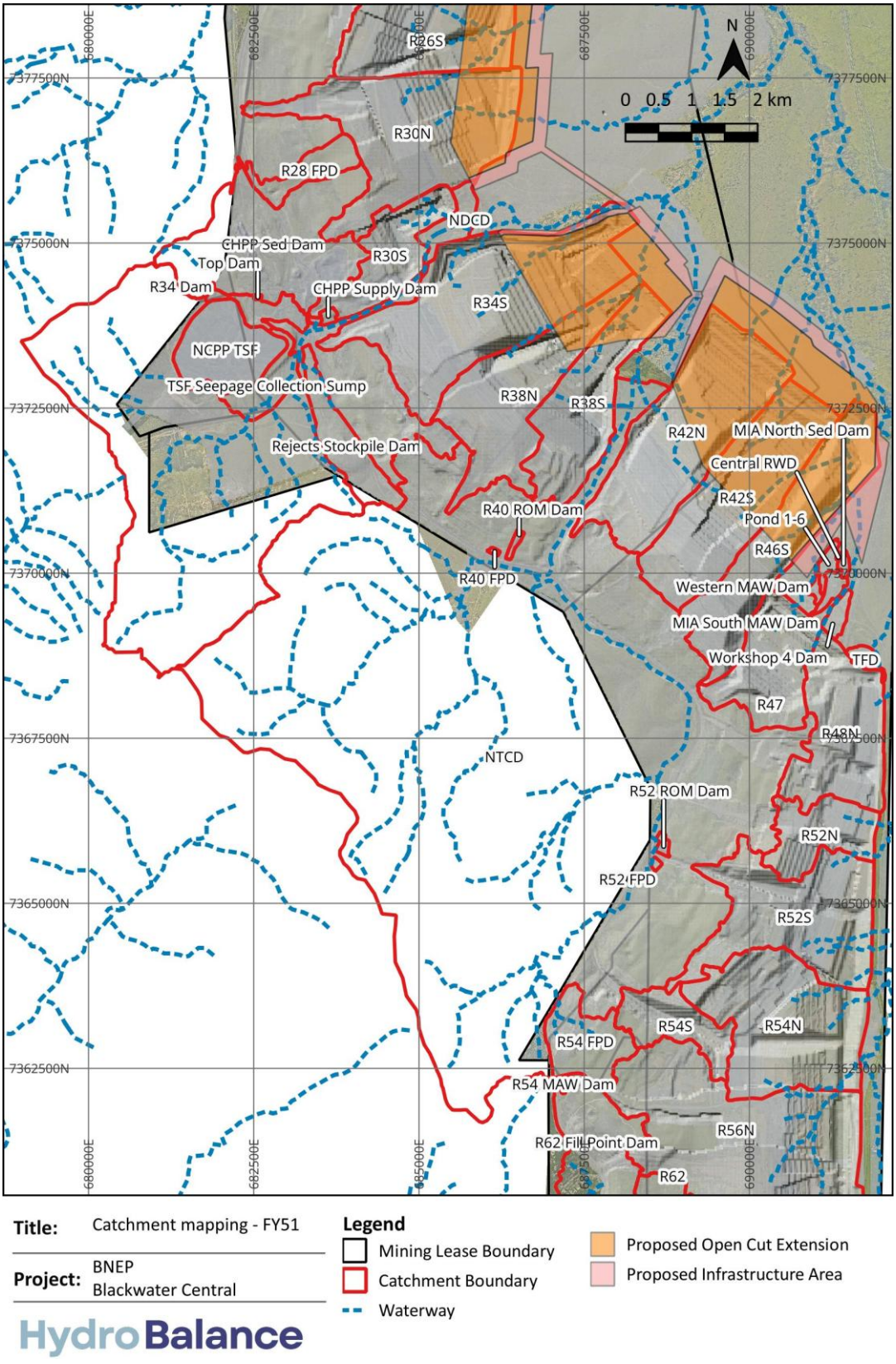
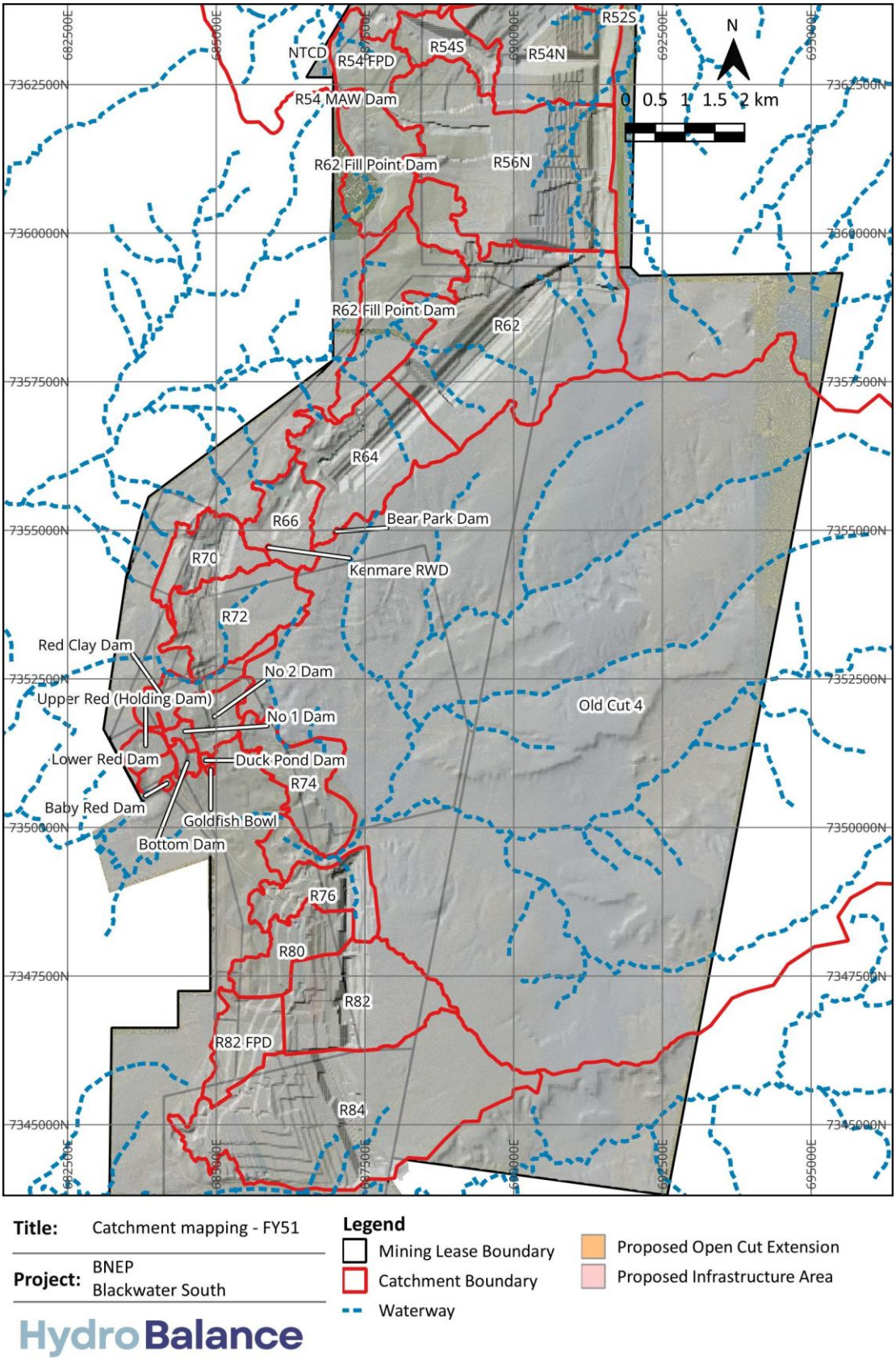


Figure 4.26 – Catchment mapping - Blackwater Central - FY51



Title: Catchment mapping - FY51

Project: BNEP Blackwater South

HydroBalance

Legend

- Mining Lease Boundary
- Catchment Boundary
- Waterway
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Figure 4.27 - Catchment mapping - Blackwater South - FY51

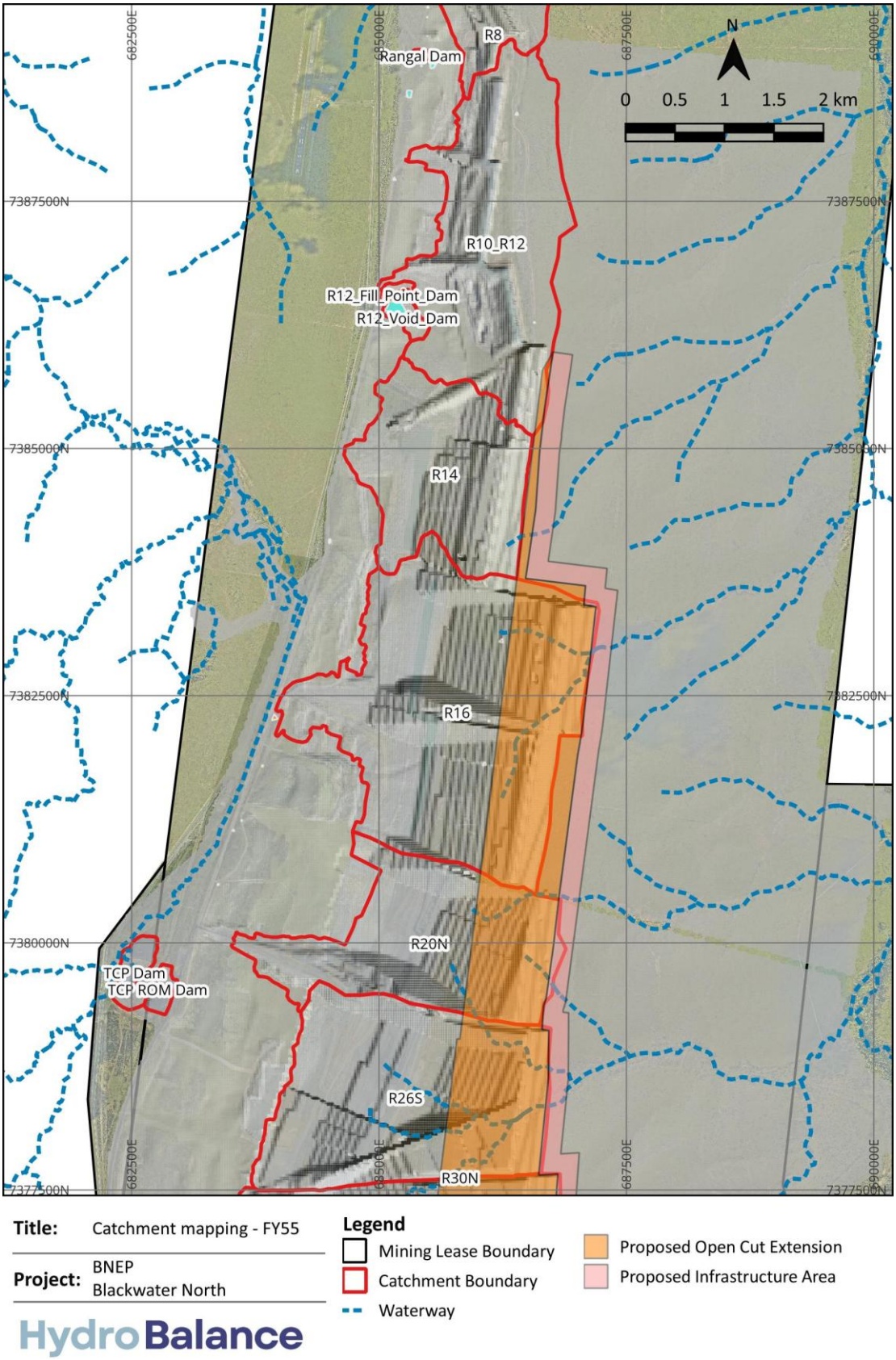


Figure 4.28 - Catchment mapping - Blackwater North - FY55

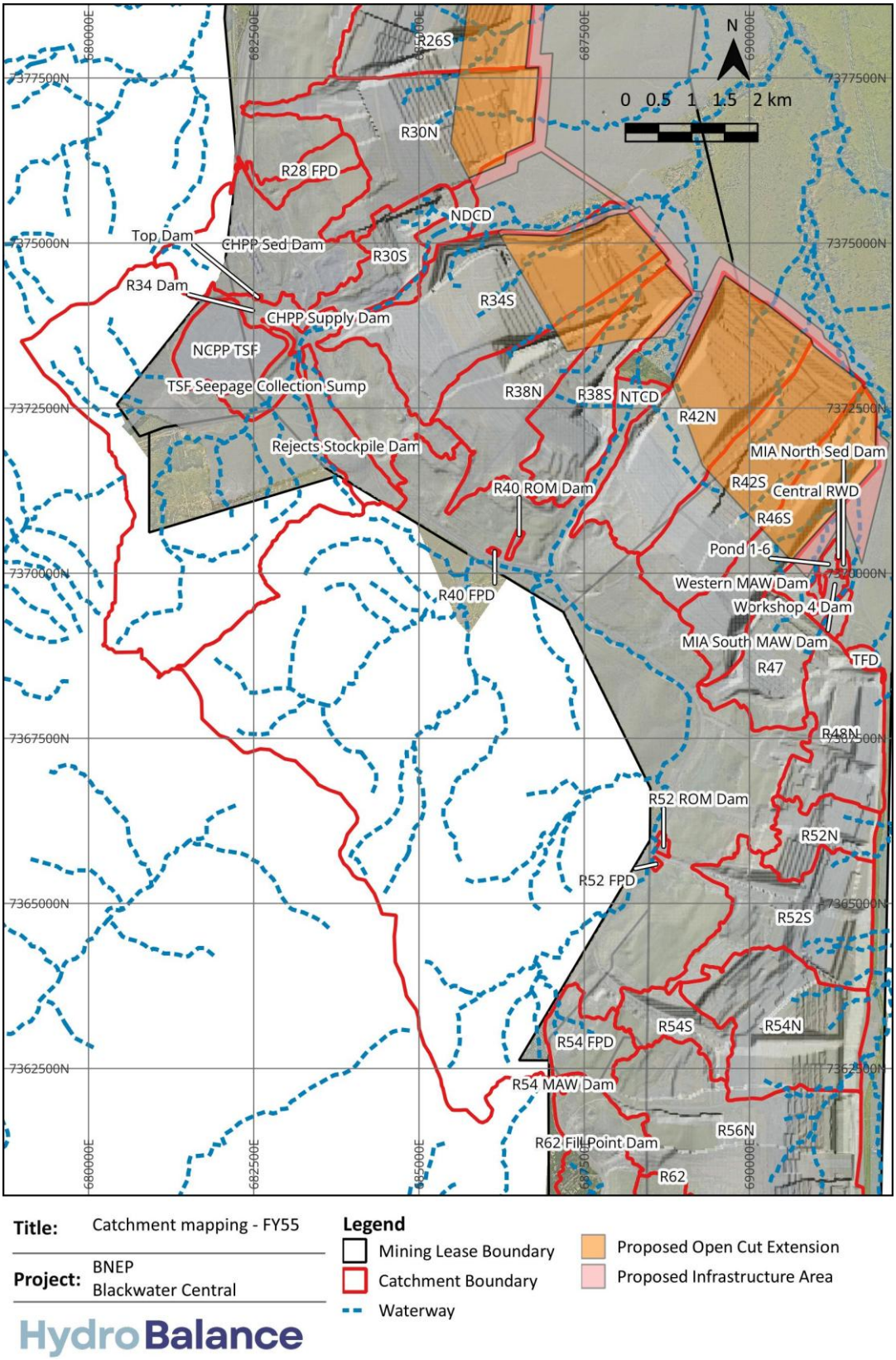
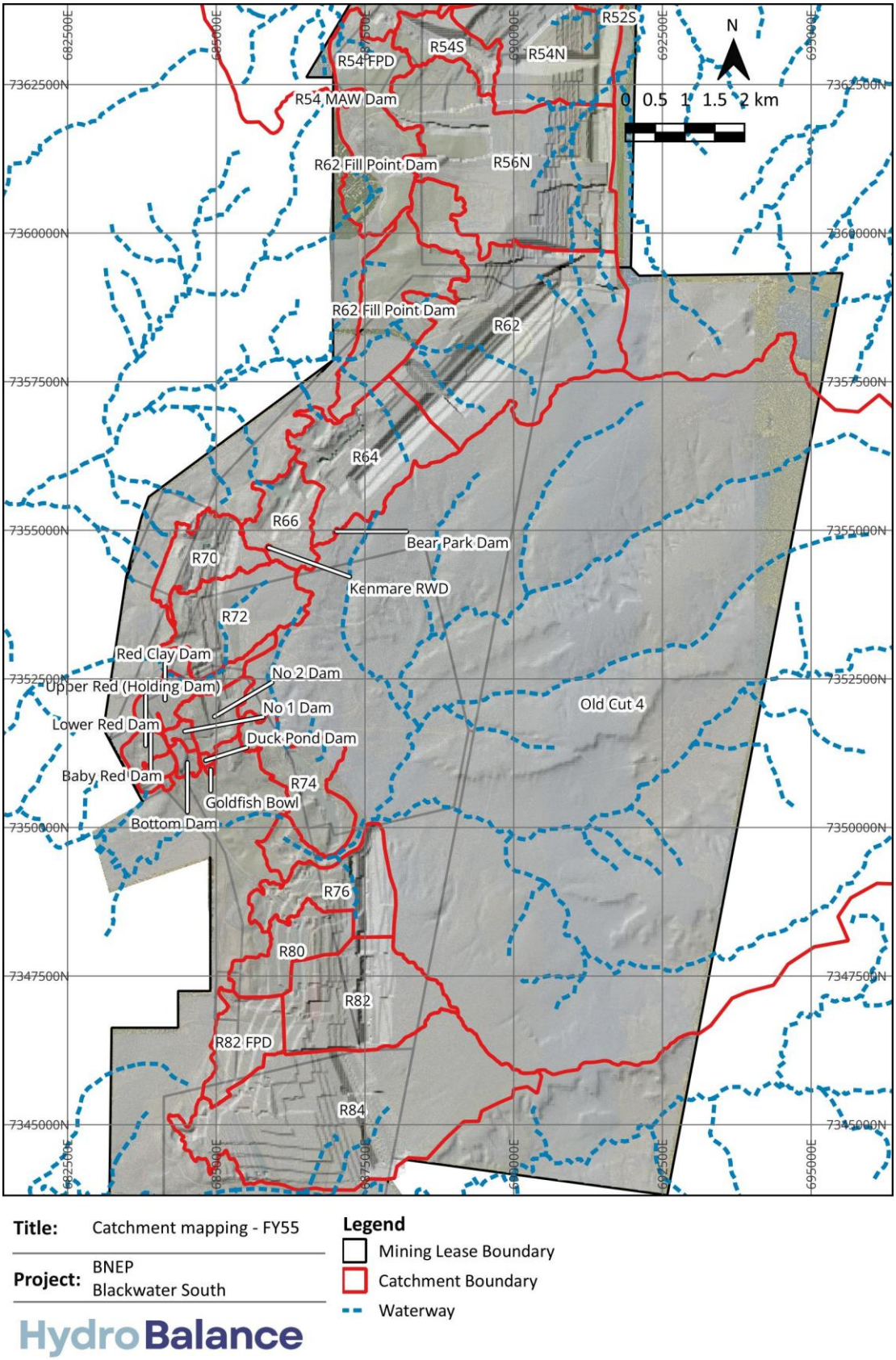


Figure 4.29 – Catchment mapping - Blackwater Central - FY55



Title: Catchment mapping - FY55

Project: BNEP Blackwater South

Legend
- Mining Lease Boundary
- Catchment Boundary
- Waterway

HydroBalance

Figure 4.30 - Catchment mapping - Blackwater South - FY55

5 Model calibration

5.1 Overview

The water balance model was calibrated for the period between July 2024 and June 2025 using site rainfall data, with the water balance model results compared to the recorded site inventories over the calibration period. The calibration was undertaken to improve the confidence of the model predictions for the forecast conditions and the sensitivity of the model parameters.

5.2 Results

Figure 5.1 shows the model calibration results, comparing the observed and modelled total site inventory. The following model parameters were adjusted to achieve this calibration result:

- Net groundwater inflow of 2.25 megalitres per day (ML/d) (821 megalitres [ML] over the calibration period). This was based on Engeny Australia Pty Ltd's (2025) estimate of the BWM 2025 associated water take, which utilised inflow data from the BWM groundwater model developed by SLR Consulting Australia Pty Ltd [SLR].
- An annual haul road dust suppression demand of 1,360 ML over the calibration period. This value was adjusted to better reflect the observed drawdown during dry periods (e.g. August to October 2025).
- A net CHPP consumption of 2,282 ML over the calibration period. This was based on a CHPP water/solids balance using CHPP run-of-mine (ROM) and production data provided by Whitehaven.

The model calibration is satisfactory and represents the performance of the BWM WMS (in terms of total inventory) over the FY25 calibration period. It simulates the drawdown during dry periods and increases during wet periods relatively well.

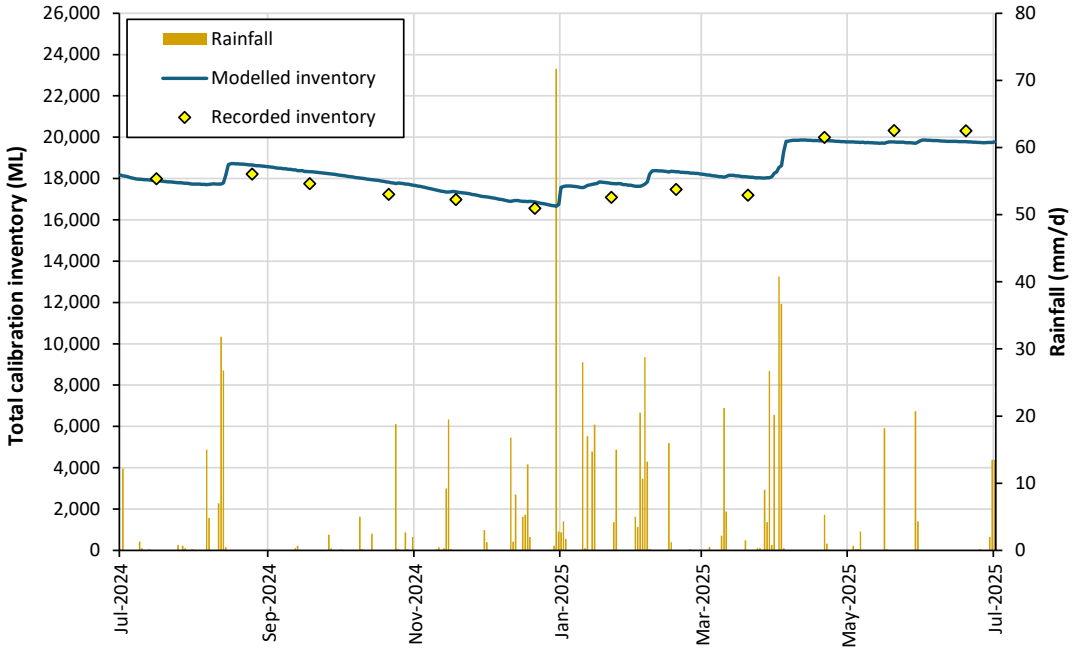


Figure 5.1 - Modelled vs recorded inventory over the calibration period (July 2024 to June 2025)

6 Water management system

6.1 Existing site storages

A summary of the existing storages within the BWM WMS is provided in Table 6.1, including the Operating Capacity (OC) for each of the storages. The OC represents the maximum allowable volume that can be stored in the dam/pit (taking into account factors such as base of weathering).

There are no additional storages proposed as part of the Project.

Table 6.1 - BWM storage details

Storage name	Operating Capacity (ML)	Overflows to
Dam storages		
Rangal Dam	5	Offsite
TCP Dam	68	Offsite
TCP ROM Dam	15.5	Offsite
Top Dam	100	Offsite
NCHPP WSD	48.7	Offsite
Workshop 4 Dam	13.4	Offsite
South MAW Dam	51.3	Offsite
Sed Dam	39.3	Deep Creek
Rejects Sump	16	Offsite
Tailings Sump	41.3	Offsite
Central RWD	5	Offsite
Kenmare RWD	22	Offsite
Red Claw Dam	113	Offsite
Bear Park Dam	22	Offsite
Holding Dam	113	Red Dam
Red Dam	62	Sirius Creek
Baby Red Dam	0.5	Sirius Creek
No 1 Dam	7.2	Bottom Dam
No 2 Dam	156	Duck Pond
Bottom Dam TSF	0.45	Duck Pond
Duck Pond	61.6	Goldfish Bowl
Goldfish Bowl	15	Sirius Creek
TFD	119	Offsite
R12 Void Dam	242	Offsite
R28 FPD	7.5	Offsite
Old R40 FPD	-	NTCD
R40 FPD	13.1	NTCD
R40 ROM Dam	12.3	NTCD
R48 FPD	29.8	Offsite
R52 FPD	14.9	Offsite
R54 FPD	12.0	Offsite
R56 FPD	157.2	Speculation Creek
R62 FPD	15.3	Speculation Creek

Storage name	Operating Capacity (ML)	Overflows to
R82 FPD	110.3	Rockland Creek
On-stream storages		
NDCD	268.9	Offsite
NTCD	472	Offsite
Old Cut 4	447.5	Sirius Creek
Rockland Basin	19,200	Rockland Creek
Pit storages		
R14 WSP	4,890	R16
R16	11,999	R20
R64 WSP	6,405	Offsite
R70 WSP	2,154	Offsite
R76 WSP	2,754	Offsite
R80 WSP	7,542	Offsite
R82 WSP	7,563	Rockland Creek
Tailings dams		
R10/R12 WSP (Bonnie Doon)	5,527	Offsite
North CHPP Tailings Dam	738	Offsite
R72 TSD	456	Offsite
R74 TSD	4,225 (FSV) 3,733 (MOV)	Offsite
Pits		
R20/R26	30,644	Offsite
R30N	5,815	R20
R30S	8,983	R30N
R34	2,773	R38
R38	13,264	Offsite
R42	2,000	Offsite
R46N	1,500	R42
R46S	1,500	R46N
R47	1,500	R46S
R48	2,000	Offsite
R52N	569	Offsite
R52S	2,000	Offsite
R54	5,217	Offsite
R56	5,217	Offsite
R62	2,000	R62 FPD

Notes: MAW = Mine Affected Water
TSF = Tailings Storage Facility
FSV = Full Supply Volume
MOV = Maximum Operating Volume

6.2 Water management system configuration

Figure 6.1 to Figure 6.3 show a conceptual water circuit schematic of the existing BWM WMS. In addition to the linkages shown in these figures, storages will also receive inflows from direct rainfall and losses from evaporation.

There are ten backbone pipelines onsite, connecting a number of storages across the site (from north to south):

- NTCD14a pipeline;
- NTCD14b pipeline;
- NTCD14c pipeline;
- NCHPP14 pipeline;
- TFD NTCD pipeline;
- R40FPD_R64 pipeline;
- TFD64_North pipeline;
- TFD64_South pipeline;
- TFD64_2 pipeline; and
- R64_R82 pipeline.

The backbone pipeline operation rules, source/destination dams and pumping priorities are summarised in Table 6.2.

Table 6.2 – Backbone pipeline operation

Source			Destination		
Storage	Priority	Pump rate (litres per second [L/s])	Storage	Priority	Pump rate (L/s)
NTCD14a pipeline – 100 L/s maximum capacity					
R16	3	120	NTCD	1 (if conditions allow)	100
R20/R26	6	470	Pits	Reverse order of source priority	
R30N	4	50			
R30S	4	70			
R34S	5	50			
R38	2	80			
R14 WSP	1	150			
NTCD14b pipeline – not used					
NTCD14c pipeline – 250 L/s maximum capacity					
R14 WSP	1	150	NTCD	1 (if conditions allow)	250
NCHPP14 pipeline – 200 L/s maximum capacity					
R14 WSP	1	150	NCHPP WSD	1 (if conditions allow)	200
			R28 FPD	1 (if conditions allow)	200
			TCP Dam	1 (if conditions allow)	200
TFDNTCD pipeline – 150 L/s maximum capacity					

Source			Destination		
Storage	Priority	Pump rate (litres per second [L/s])	Storage	Priority	Pump rate (L/s)
NTCD	1	100	TFD	1 (if conditions allow)	150
R46N	2	60			
R46S	2	200			
R47	2	60			
R40FPD_R64 pipeline - 100 L/s maximum capacity					
R40 ROM Dam	1	150	NCHPP WSD	1 (if conditions allow)	100
R64 WSP	1	200	R52 FPD	2 (if conditions allow)	100
TFD	1	100	R54 FPD	3 (if conditions allow)	100
TFD64 North pipeline - 480 L/s maximum capacity					
R48	1	160	TFD	1 (if conditions allow)	480
R52N	1	80			
R52S	1	80			
R54	1	160			
TFD64 South pipeline - 240 L/s maximum capacity					
R56	1	80	R64 WSP	1 (if conditions allow)	240
R62	1	80			
R62_FPD	1	50			
TFD64_2 pipeline - 150 L/s maximum capacity					
TFD	1	100	R64 WSP	1 (if conditions allow)	150
R64-R82 pipeline - 100 L/s maximum capacity					
R64 WSP	1	100	R80 WSP	1 (if conditions allow)	100
R70 WSP	1	200	R82 WSP	1 (if conditions allow)	100

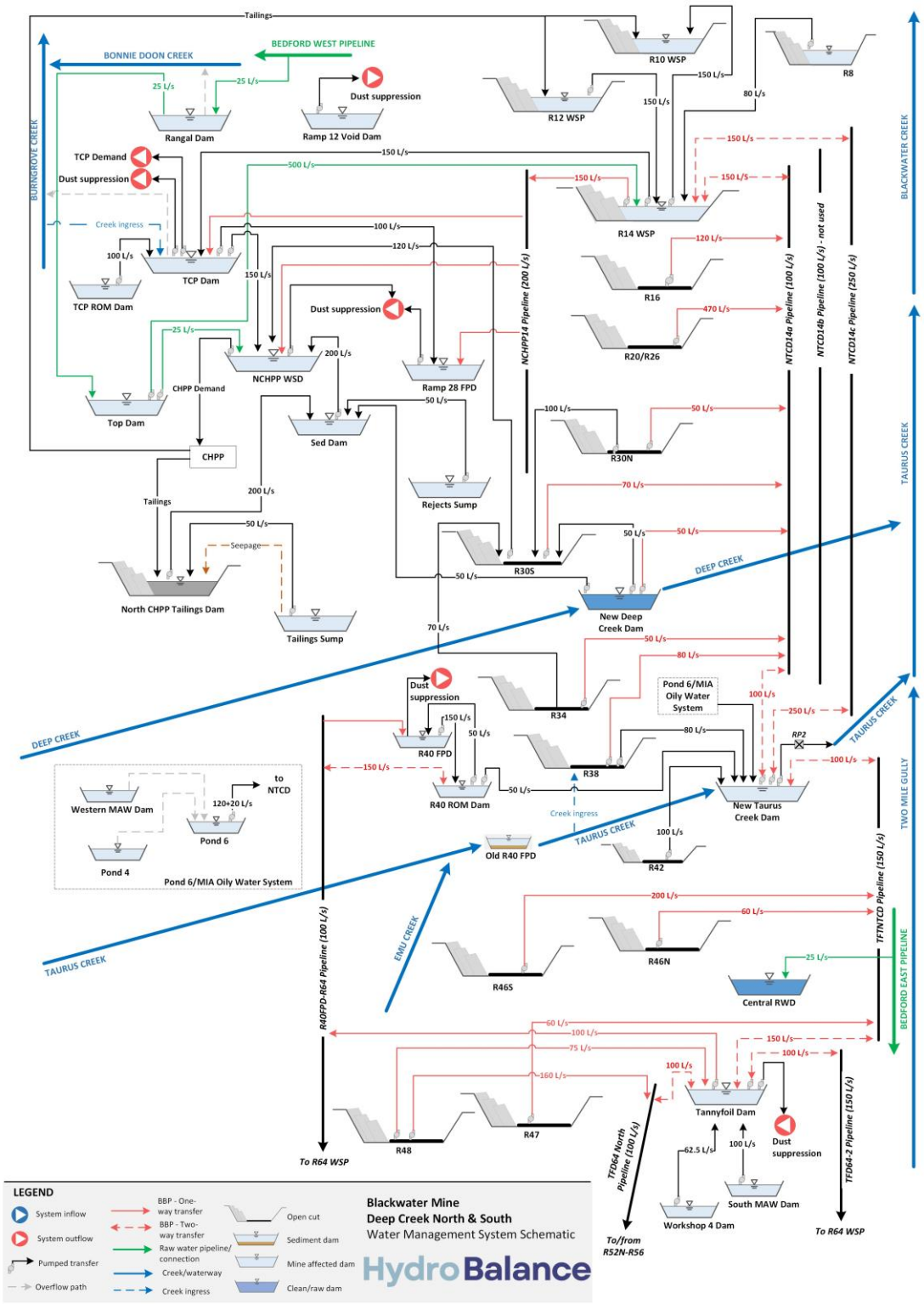


Figure 6.1 – Schematic of BWM WMS – Deep Creek North and South

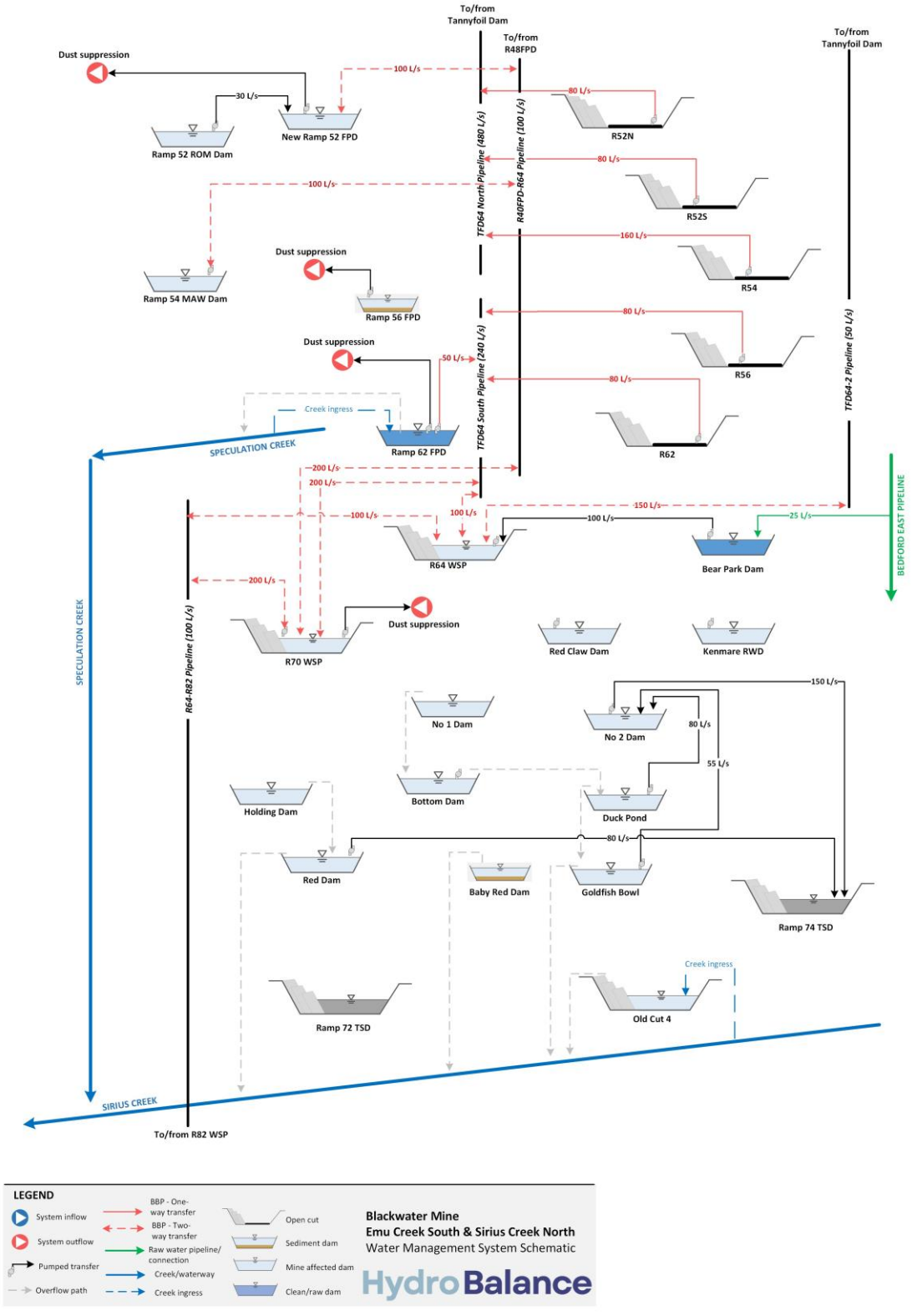
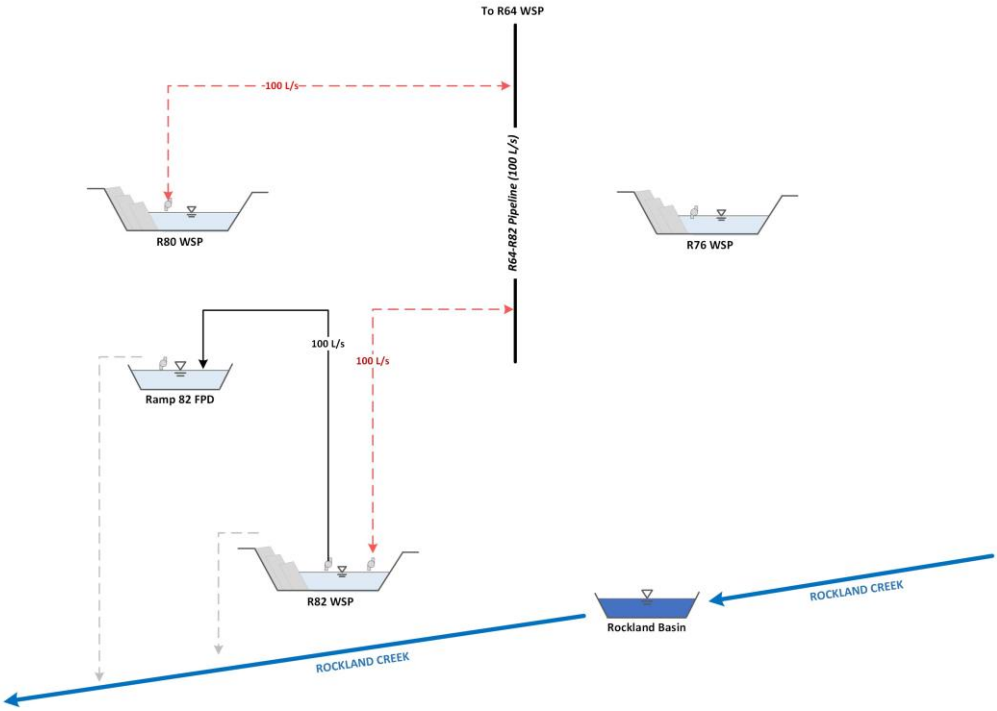


Figure 6.2 – Schematic of BWM WMS – Emu Creek South and Sirius Creek North



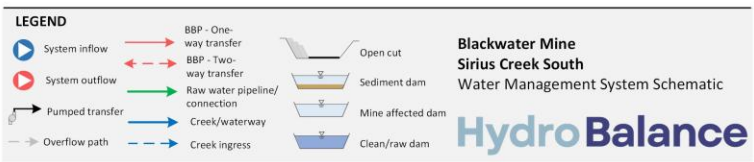


Figure 6.3 – Schematic of BWM WMS – Sirius Creek South

6.3 AWBM rainfall runoff modelling

Table 6.3 shows the adopted rainfall runoff parameters for each catchment land use. Catchment runoff was modelled using the Australian Water Balance Model (AWBM).

Table 6.3 – Adopted AWBM rainfall runoff parameters

Parameter	Natural	Spoil	Rehab (& partial rehab)	Tailings	Hardstand/ pit	Disturbed
C1 (millimetres [mm])	30	100	20	5	10	10
C2 (mm)	180	200	120	15	40	60
C3 (mm)	250	300	180	25	50	100
A1	0.134	0.134	0.134	0.134	0.3	0.3
A2	0.433	0.433	0.433	0.433	0.4	0.4
A3	0.433	0.433	0.433	0.433	0.3	0.3
C_{av}	190.2	229.9	132.6	18.0	34.0	57.0
BFI	-	0.8	0.35	-	-	-
K_{base}	-	0.98	0.98	-	-	-
K_{surf}	-	0.1	0.1	-	-	-
Cv (percent [%])	4.2	1.6	6.5	32.2	23.3	18.2

Notes: C1/C2/C3 – Surface storage capacities
A1/A2/A3 – Partial area fraction
C_{av} – Catchment averaged surface storage capacity
BFI – Baseflow index
K_{base} – Baseflow recession constant
K_{surf} – Surface flow recession constant
C_v – Long-term coefficient of runoff

6.4 Site water demands

Operational demands at BWM include haul road dust suppression and coal washing demand. Details for each demand and loss is provided in the following sections below.

6.4.1 Dust suppression

In the absence of metered data, haul road dust suppression rates have been estimated using daily rainfall and evaporation data sourced from the SILO database (Jeffrey et al., 2001).

The following rules are used to determine the applied dust suppression rate on any given day:

- For a dry day (zero rainfall), the haul road watering rate is equal to the daily evaporation rate.
- For a rain day when rainfall is less than the daily evaporation rate, the watering rate is reduced and is only required to make up the remaining depth to the daily evaporation rate.
- For a rain day when rainfall exceeds the daily evaporation rate, no haul road watering is required.

The estimated future annual dust suppression demand is 3,000 megalitres per year (ML/year). Adjustments to the model rules for the forecast simulation are as follows:

- Watered haul road length increased to 40 kilometres.

- Watered haul road width = 55 metres.
- Summer application factor = 0.85.
- Winter application factor = 0.9.

The average monthly forecast dust suppression demand is shown in Figure 6.4.

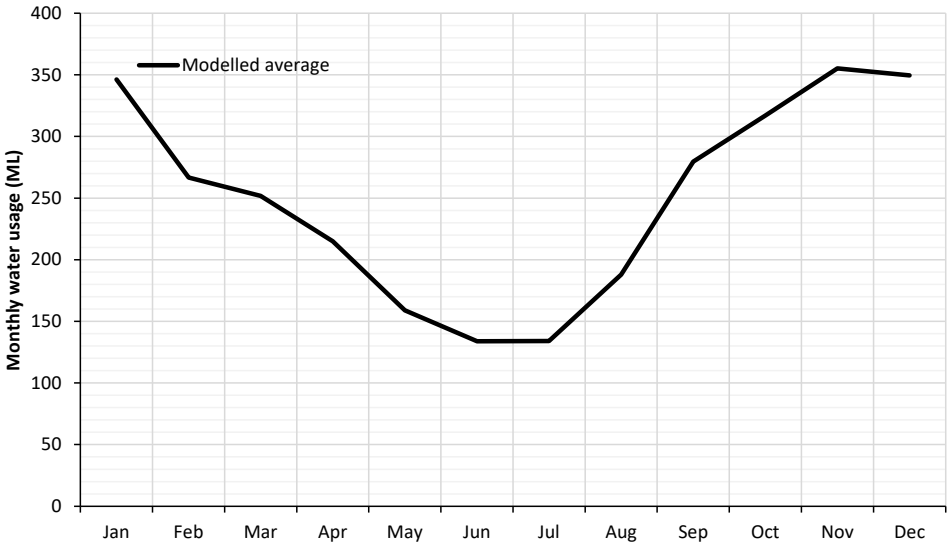


Figure 6.4 – Forecast average monthly dust suppression demand

Dust suppression water is sourced from the following storages:

- R14 WSP;
- TCP Dam;
- Top Dam;
- NCHPP WSD;
- R28 FPD;
- R40 FPD;
- TFD;
- R52 FPD;
- R56 FPD;
- R62 FPD; and
- R70 WSP.

6.4.2 CHPP production and demand

Water is required at the BWM CHPP for coal processing, wash down and other associated uses. The volume of water required for CHPP makeup is generally related to the annual coal production tonnages.

The estimated net CHPP consumption rate is 188 litres per run-of-mine tonne (L/ROM t) for the coal washed through the BWM CHPP. For bypass coal, the estimated usage is 10 L/ROM t.

The forecast annual production profile for washed and bypass coal between FY27 and FY55 and annual net consumption is summarised in Table 6.4.

Table 6.4 - BWM forecast production profile - washed coal

Period	Washed coal		Bypass coal	
	Annual tonnage (Million tonnes per annum [Mt/a])	Annual net CHPP consumption (ML/a)	Annual tonnage (Mt/a)	Annual net consumption (ML/a)
FY27	12.6	2,378	2.6	26.1
FY28	13.8	2,603	2.8	27.6
FY29	13.0	2,442	2.0	20.4
FY30	14.1	2,659	1.4	13.9
FY31	15.2	2,858	1.8	18.0
FY32	15.2	2,866	3.8	37.6
FY33	15.2	2,858	3.7	37.2
FY34	15.2	2,858	2.9	29.4
FY35	15.2	2,858	3.8	38.0
FY36	15.2	2,866	3.8	37.6
FY37	15.2	2,858	2.3	23.1
FY38	15.2	2,858	3.8	38.0
FY39	15.2	2,858	3.6	36.2
FY40	15.2	2,866	3.6	35.9
FY41	15.2	2,858	2.1	20.6
FY42	15.2	2,858	3.0	29.8
FY43	15.2	2,858	2.8	28.4
FY44	15.2	2,866	1.9	19.4
FY45	15.2	2,858	2.2	22.3
FY46	15.2	2,858	1.9	19.5
FY47	15.2	2,858	3.6	36.2
FY48	15.2	2,866	0.8	8.0
FY49	15.2	2,858	3.0	30.4
FY50	15.2	2,858	2.7	27.4
FY51	15.2	2,858	2.4	23.7
FY52	15.2	2,866	1.3	12.6
FY53	12.3	2,317	3.3	32.5
FY54	10.0	1,882	3.5	34.7
FY55	11.1	2,081	3.9	39.4

The net CHPP process makeup demand is primarily sourced from the MAW system and has a minimal raw water demand (see Section 6.5). CHPP MAW make up water is supplied continuously by NCHPP WSD.

6.4.3 Thermal Coal Plant demand

The TCP demand is not metered. As per the previous modelling, we have adopted a constant demand of 100 ML/year for the TCP water demand.

6.5 External water source

The raw water for BWM comes from the Bedford West and Bedford East pipelines, with an annual available allocation of 1,603 ML and 678 ML, respectively. Pipeline water is drawn into the site when the site-wide water storage inventory falls below 14,701 ML (Green Trigger Action Response Plan [TARP]).

A minimum raw water import volume will be applied to the model as follows, based on Whitehaven's advice:

- Bedford East supply: 27 megalitres per month (ML/month) (based on March to August 2025 usage).
- Bedford West supply: 11 ML/month (based on August 2025 usage) – this excludes 6 ML/month that is supplied to Pastoral Agreements (based on March to August 2025 usage).

A maximum daily supply rate of 10 ML/d (Bedford West) and 2.5 ML/d (Bedford East) has been allocated, which is currently what rate is achievable to site including an allowance for 85% availability.

6.6 Tailings management

The BWM Water Balance Model models the tailings waste stream as follows:

- All tailings moisture is sent to R10/12 WSP (Bonnie Doon).
- Water is actively dewatering from R10/12 WSP back to the WMS. The model accounts for loss such as tailings matrix retention, beach and decant pond evaporation, and seepage. The remaining water is then available for decant to the WMS.

The following CHPP water and solids assumptions have been made:

- ROM coal moisture content: 6.4% weight per weight (w/w).
- Product coal moisture content: 10.7% w/w.
- Product yield (wet): 77.5%.
- Product yield (dry): 69.7%.
- Coarse rejects moisture content: 10.1% w/w.
- Fine tailings moisture content: 71.8% w/w.
- Waste stream split:
  - Coarse rejects fraction (dry): 85.7%.
  - Fine tailings fraction (dry): 14.3%.
- CHPP makeup water requirement: 188 L/ROM t – note this does not account for any decant return water, it is the water needed to balance the adopted tonnages and moisture contents.

For tailings decant return, Whitehaven advise that between 30 to 50% of the water sent to Bonnie Doon in the tailings stream is decanted back to the WMS. We have adopted a return rate of 40%, which includes loss associated with beach evaporation, decant pond evaporation and seepage.

6.7 Interactions with local waterways

A number of creeks that flow past or through BWM interact with the site's storages. These interactions are included in the model either as direct catchment inflows, or as creek ingress rating curves. These interactions are as follows:

- TCP Dam – receives creek ingress from Burngrove Creek.
- NDCD – receives direct catchment inflows from Deep Creek.
- NTCD – receives direct catchment inflows from Taurus Creek.
- R38 – receives creek ingress from Taurus Creek.
- R62 FPD - receives creek ingress from Speculation Creek.
- Old Cut 4 - receives creek ingress from Sirius Creek.

- Rockland Basin - receives direct catchment inflows from Rockland Creek.

6.8 Groundwater

The adopted total groundwater inflow rates to the mine pits are based on estimates provided from the groundwater model developed by SLR (2026), covering the simulation period. The groundwater inflows have been adjusted to account for pit face evaporation losses, and losses due to moisture within the in-situ coal being extracted during mining.

Figure 6.5 and Table 6.5 provide a summary of the groundwater estimates that have been provided for the Project over the simulation period as annual inflows between 2026 and 2055. The peak in groundwater inflows modelled in 2055 corresponds to the commencement of mining in three pits (South Marshmead, Kennedy and Comet Downs East), which become active around that time. The inflows have been distributed between the open cut pits in accordance with the provided groundwater data.

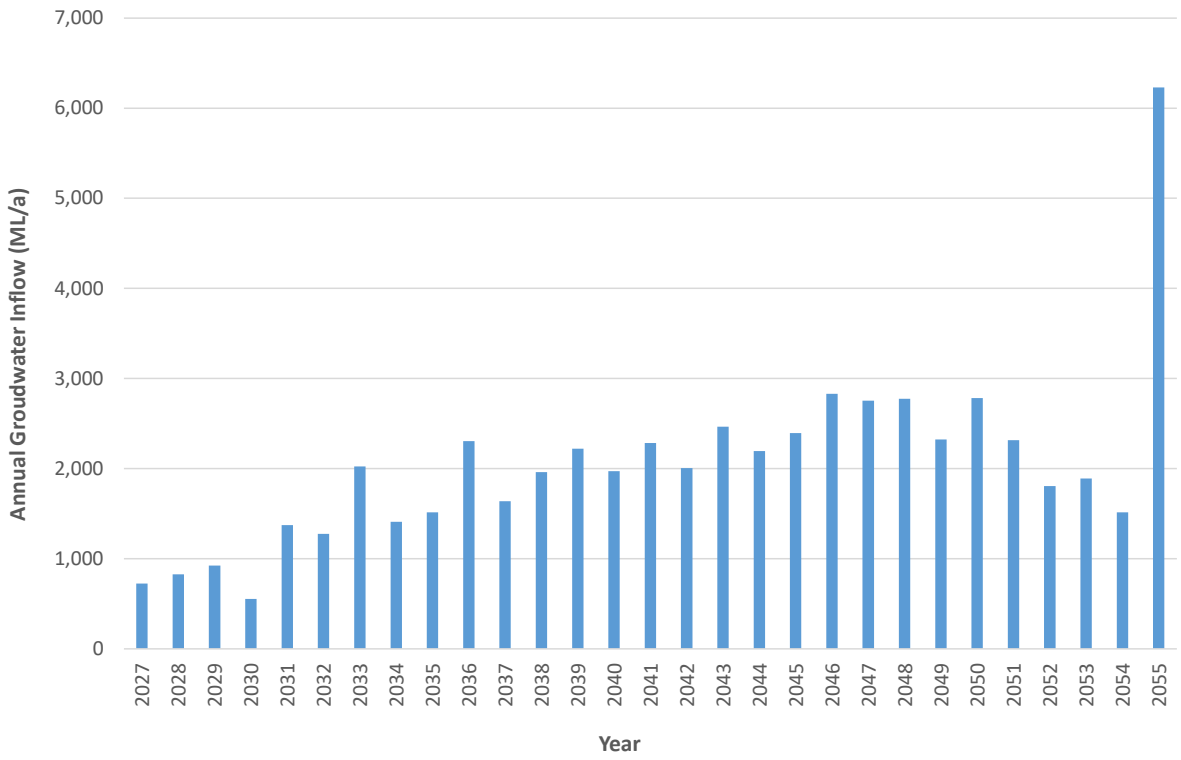


Figure 6.5 - Forecast annual groundwater inflow rate

Table 6.5 - Adopted groundwater inflow rates

Calendar year	Annual groundwater inflow (ML/a)
2027	725
2028	828
2029	924
2030	553
2031	1,373
2032	1,275

Calendar year	Annual groundwater inflow (ML/a)
2033	2,025
2034	1,410
2035	1,514
2036	2,306
2037	1,639
2038	1,962
2039	2,220
2040	1,972
2041	2,285
2042	2,006
2043	2,465
2044	2,196
2045	2,395
2046	2,830
2047	2,754
2048	2,774
2049	2,323
2050	2,782
2051	2,316
2052	1,805
2053	1,892
2054	1,515
2055	6,231

6.9 Controlled releases

Controlled releases are permitted from RP2 via NTCD, RP3 via NDCD and RP4 via TFD. Controlled releases may be undertaken when the following conditions are met per Condition F4 and Conditions F9 to F11 of the current EA (EPML00717813) (the EA):

- For RP2 and RP3:
  - the flow in Blackwater Creek (at Gauging Station 2) is greater than or equal to (≥) 1 cubic metres per second (m^3/s);
  - the electrical conductivity in the release dam is less than (<) 10,000 microSiemens per centimetre (µS/cm); and
  - the 80th percentile of the mixed downstream Blackwater Creek electrical conductivity values (at MP8) is <2,000 µS/cm.
  - Blackwater Creek mixed downstream EC can exceed greater than (>) 2,000 µS/cm during a release if the upstream monitoring point is similar or higher than downstream (i.e. the mine release is not having a measurable impact on downstream water quality during the release).
- For RP4:
  - the flow in Two Mile Creek (at Gauging Station 3) is ≥1 m^3/s;
  - the electrical conductivity in the release dam is <10,000 µS/cm; and
  - the 80th percentile of the mixed downstream Blackwater Creek electrical conductivity values (at MP8) is <2,000 µS/cm.

The EA also authorises releases from the following storages, however these are not modelled as controlled releases:

- Goldfish Pond;
- Marshmead Pit;
- Old Cut 4;
- R82 FPD;
- NCHPP Sediment Dam;
- Rejects Stockpile Dam; and
- R34.

6.10 Trigger Action Response Plan

The site-wide water security and containment risks at BWM are managed using a TARP. The TARP has been developed by Whitehaven personnel, based on the acceptable risk profiles and the measures available to manage water onsite. The site-wide BWM TARP is summarised in Table 5.6.

Table 6.6 - BWM site-wide water management TARP

Trigger	Action / Response
Red [Dry]	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Yellow [Dry]	• Import water from Bedford pipelines at full allocation. • Minimise dust suppression usage. • Investigate use of dust binders.
Green	• Import water from Bedford pipelines at 50% allocation.
Yellow [Wet]	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release.
Red [Wet]	• Cease importing water from Bedford pipelines. • Maximise dust suppression usage. • Consider controlled release. • Allocate emergency storage in pits.

7 Water balance modelling results

7.1 Overview

An assessment of the BWM water management system has been undertaken using the water balance model with the adopted rainfall runoff parameters. Investigation outcomes depend on the accuracy of input assumptions. There is inherent uncertainty with respect to some key site characteristics (e.g. catchment yield/rainfall runoff, groundwater inflows). To manage this uncertainty, a large number of climate sequences are used, reflecting the full range of historical climatic conditions, indicates how system performance may vary under wet, dry and average climatic conditions.

7.2 Interpretation of results

The modelling methodology of a forecast simulation is described in Section 2. The results provide a statistical analysis of the water management system's performance over the next year based on 107 different climatic realisations.

The 50th percentile probability envelope represents the median results; the 10th percentile represents 10% exceedance (i.e. wet conditions) and the 90th percentile represent 90% exceedance (i.e. dry conditions). There is an 80% chance that the result will fall within the 10th and 90th percentiles, and a 98% chance that the result will fall between the 1st and 99th percentiles. Importantly, note that a percentile envelope shows the percentage chance of exceeding particular value on any specific day, and does not represent continuous results from a single model realisation (e.g. the 90th percentile trace does not represent a single continuous 90th percentile climate scenario, rather it shows the volume/rate exceeded by 90% of the 107 realisations on each day of the simulation).

7.3 Water management system inventory

Figure 7.1 shows the forecast total WMS inventory, which includes all dam and pit storages onsite and is compared to the available WMS capacity over time. The total WMS capacity is provided in Table 7.1.

The model results show the following:

- For the 5%ile results (very wet climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 32,000 ML during the first few years of the simulation and reaching around 39,500 ML by the end of the simulation.
- For the 10%ile results (wet climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 28,000 ML during the first few years of the simulation and reaching around 35,000 ML by the end of the simulation.
- For the 50%ile results (median climatic conditions), the peak inventory for the combined WMS inventory reaches a volume of around 17,500 ML during the first few years of the simulation and reaching around 19,000 ML by the end of the simulation.
- The combined WMS inventory is maintained below the combined WMS capacity for almost all climatic conditions. There is between a 5% and 10% probability that the combined WMS inventory will exceed the combined WMS capacity in the first two years of the simulation. This means there is a low (5-10% AEP) probability that excess MAW would need to be temporarily stored within an active pit for a short period of time

Table 7.1 – Available storage capacity at BWM

Year/s (inclusive)	Available WMS storage capacity (ML)
FY27	27,846
FY28	27,846
FY29	43,881
FY30	35,263
FY31	34,665
FY32	35,385
FY33	35,335
FY34	37,311
FY35	37,311
FY36	37,361
FY37	37,361
FY38	84,437
FY39	84,487
FY40	83,311
FY41	92,656
FY42	88,663
FY43	88,713
FY44	88,763
FY45	88,800
FY46	88,750
FY47	88,750
FY48	88,750
FY49	88,750
FY50	88,750
FY51	88,750
FY52	88,750
FY53	88,750
FY54	88,750
FY55	88,750

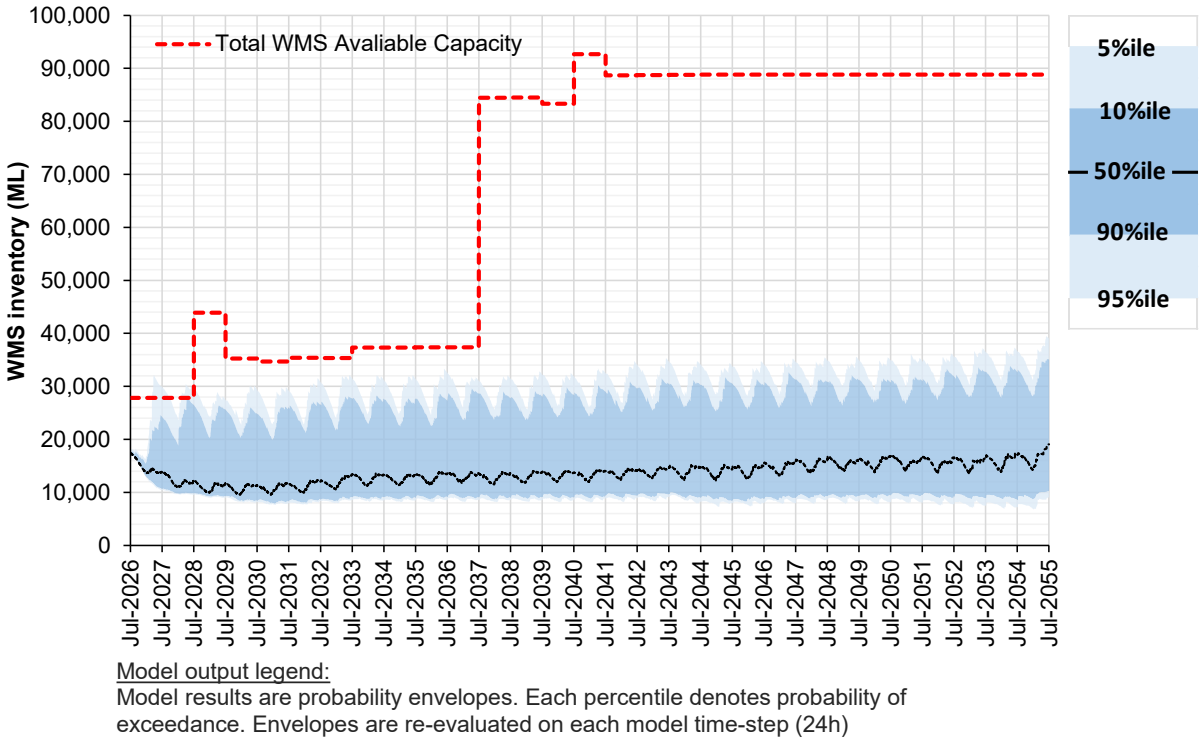


Figure 7.1 – Forecast WMS inventory

7.4 External water supply

The forecast annual Bedford East and Bedford West pipeline importation volumes are shown in Figure 7.2 and Figure 7.3. The following is of note regarding the external water demand:

- The pipelines supply the minimum raw water demands to the site for all climatic conditions (as outlined in Section 6.5).
- For Bedford East pipeline:
  - External water is only imported under median (50%ile), dry (90%ile) and very dry (95%ile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford East external water demands do not exceed the raw water allocation under any climatic conditions.
- For Bedford West pipeline:
  - External water is only imported under median (50%ile), dry (90%ile) and very dry (95%ile) climatic conditions, in addition to the minimum raw water demands.
  - The annual Bedford West external water demands do not exceed the raw water allocation under any climatic conditions.

The existing Bedford West and Bedford East pipeline allocations are sufficient for maintaining operations at BWM. Additional external water supply allocation is not required as a result of the BNEP.

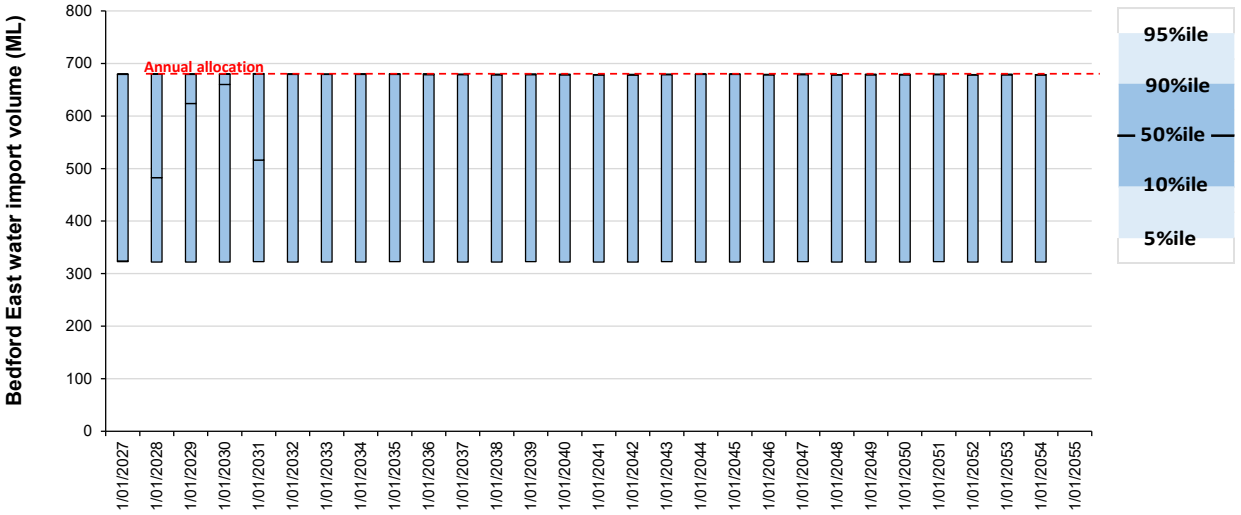


Figure 7.2 - Forecast Bedford East pipeline demand

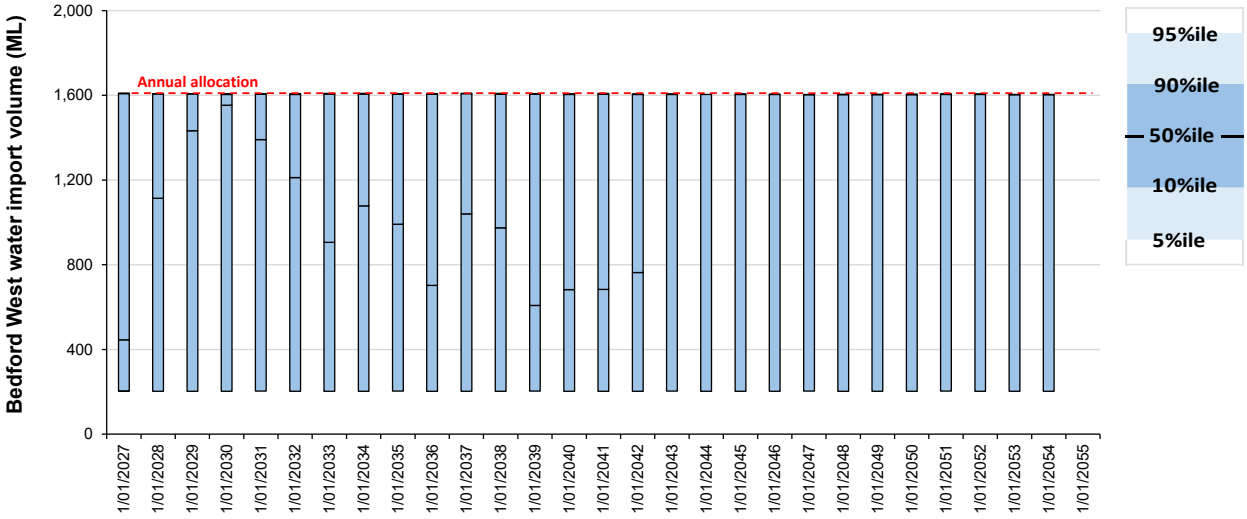


Figure 7.3 - Forecast Bedford West pipeline demand

7.5 Controlled releases

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of MAW. Surface water management measures include separation of clean and contaminated water, sediment and erosion control structures, operational water balance controls, and TARPs to prevent uncontrolled releases.

Modelling of site water balances and flooding behaviour indicates that controlled releases, where required, would occur in accordance with existing EA conditions (Schedule F) and relevant water quality objectives.

Controlled releases under Schedule F of EA EPML00717813 would only occur when receiving waterways have recorded a natural flow event in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher

velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

The forecast annual controlled release volumes, in accordance with EA conditions, are shown in Figure 7.4. The following points are noted in relation to the controlled releases:

- Controlled releases are expected to be required in very wet (5%ile), wet (10%ile) and median climatic conditions, as well as dry (90%) climatic conditions in some years.
- During very wet climatic conditions (5%ile), the annual releases volumes range from 2,950 ML to 5,130 ML.
- During wet climatic conditions (10%ile), the annual releases volumes range from 2,350 ML to 2,930 ML.
- During median climatic conditions (50%ile), the annual releases volumes range from 760 ML to 1,120 ML.

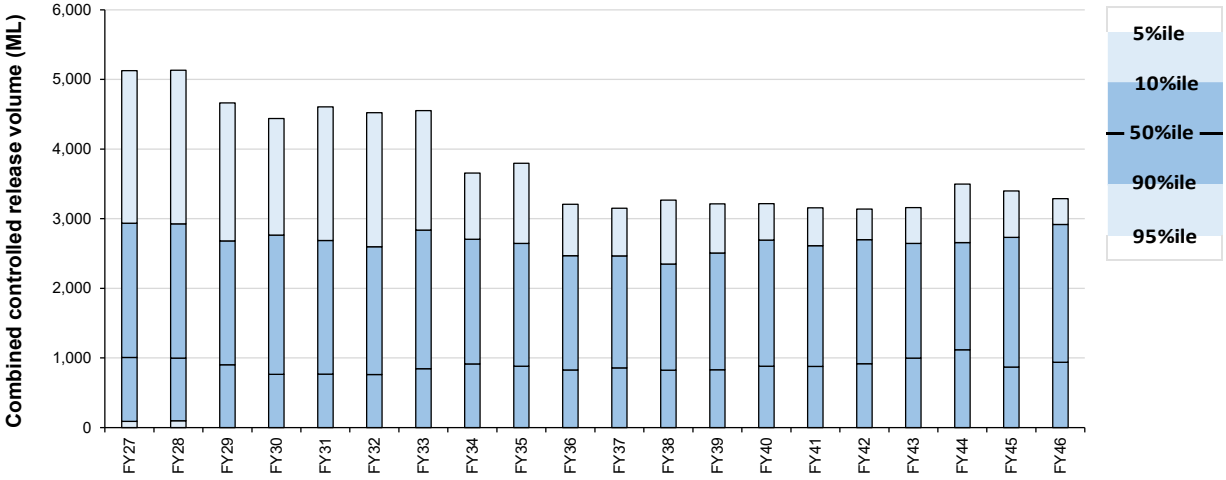


Figure 7.4 - Forecast controlled release volumes - Project

There are no proposed changes to the currently approved controlled release strategy as a result of the Project. In addition, there are no proposed changes to release infrastructure (release dams and pipelines).

7.5.1 Comparison against Approved case

The Project results in the following key changes to water inflows within the water management system:

- Estimated 60% increase in groundwater inflows up to Year 2055.
- Minor changes in captured catchment areas.

An assessment of the impact of the Project on controlled release volumes has been undertaken by comparing the Project results against an Approved case. The outcomes of this assessment have identified the following changes to controlled releases due to the Project:

- During very wet climatic conditions (5%ile), the annual releases volumes for the Approved case range from 2,880 ML to 4,940 ML. That is, under very wet climatic conditions (5%ile), annual controlled release volumes for the Project are predicted to increase by around 2-4% (70-190 ML) compared with the Approved Case.
- During wet climatic conditions (10%ile), the annual releases volumes for the Approved case range from 2,200 ML to 3,100 ML. That is, under wet climatic conditions (10%ile), annual controlled release volumes for the Project are predicted to increase by up to 7% (150 ML) compared with the Approved Case.

- During median climatic conditions (50%ile), the annual releases volumes for the Approved case range from 630 ML to 1,010 ML. That is, under median climatic conditions (50%ile), annual controlled release volumes for the Project are predicted to increase by around 11-20% (110-130 ML) compared with the Approved Case.

This assessment indicates that the Project would result in relatively small volumetric changes to annual release volumes. The release water quality is not expected to change as a result of the Project.

7.6 Uncontrolled releases

The Whitehaven documents "*WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water*" (Whitehaven, 2024), "*BWM Plan – Water Management*" (Whitehaven, 2023) and "*BWM Plan – Erosion and Sediment Control Plan*" (Whitehaven, 2022) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in these documents will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons:

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.
- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have a higher potential for uncontrolled discharge.
- The Project does not modify the catchments of New Taurus Creek Dam or New Deep Creek Dam, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

8 Final void behaviour

8.1 Overview

Water levels in the final voids will vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater. A final void GoldSim model (separate to the GoldSim model used for the operational modelling) was used to assess the likely long-term water level behaviour of the final voids.

The proposed final landform layout relevant to the Project is presented in Figure 8.1 and Figure 8.2, and includes five residual voids:

- Mimosa/Besgrove (MB);
- Ramp 30 (R30);
- Deep Creek (DC);
- Stewarton North (ST-N); and
- Stewarton South (ST-S).

BWM is operated under Environmental Authority EPML00717813 (EA). Condition E10 of the EA stipulates that "residual voids must not cause any serious environmental harm to land, surfaces waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself".

The BWM residual voids will be operated as non-use management areas (NUMAs) as part of the Progressive Rehabilitation Closure Plan (PRCP).

The long-term final void hydrology and water quality behaviour of the proposed final voids has been modelled over a 1,000-year post-closure period to assess whether the final voids would be safe and non-polluting. This report outlines the methodology and assessment of the expected final void pit lake behaviour, which has been modelled using the GoldSim water balance simulation software.

8.2 Final void geometry

The proposed Project final landform incorporates five residual voids that span across the reaches of the Sagittarius Creek, Blackwater Creek, Taurus Creek and Two Mile Gully catchments.

This final landform would form during mining, incorporating in-pit backfilled spoil sitting atop a mined pit shell. A digital elevation model (DEM) of the final landform (i.e. the final surface expected at the end of the mine life) was provided by Whitehaven.

A summary of the residual void geometries is provided in Table 7.1, including the year that the void commences.

Table 8.1 - Final void geometries

Void	Floor level (metres Australian Height Datum [mAHD])	Crest level (mAHD)	Depth (m)	Volume to crest (ML)	Surface area at crest (ha)
MB	24	200	176	374,878	597.2
R30	139	217	78	16,316	59.7
DC	52	202	150	54,895	109.4
ST-N	-4	204	208	302,582	380.1
ST-S	92	232	140	42,632	82.5

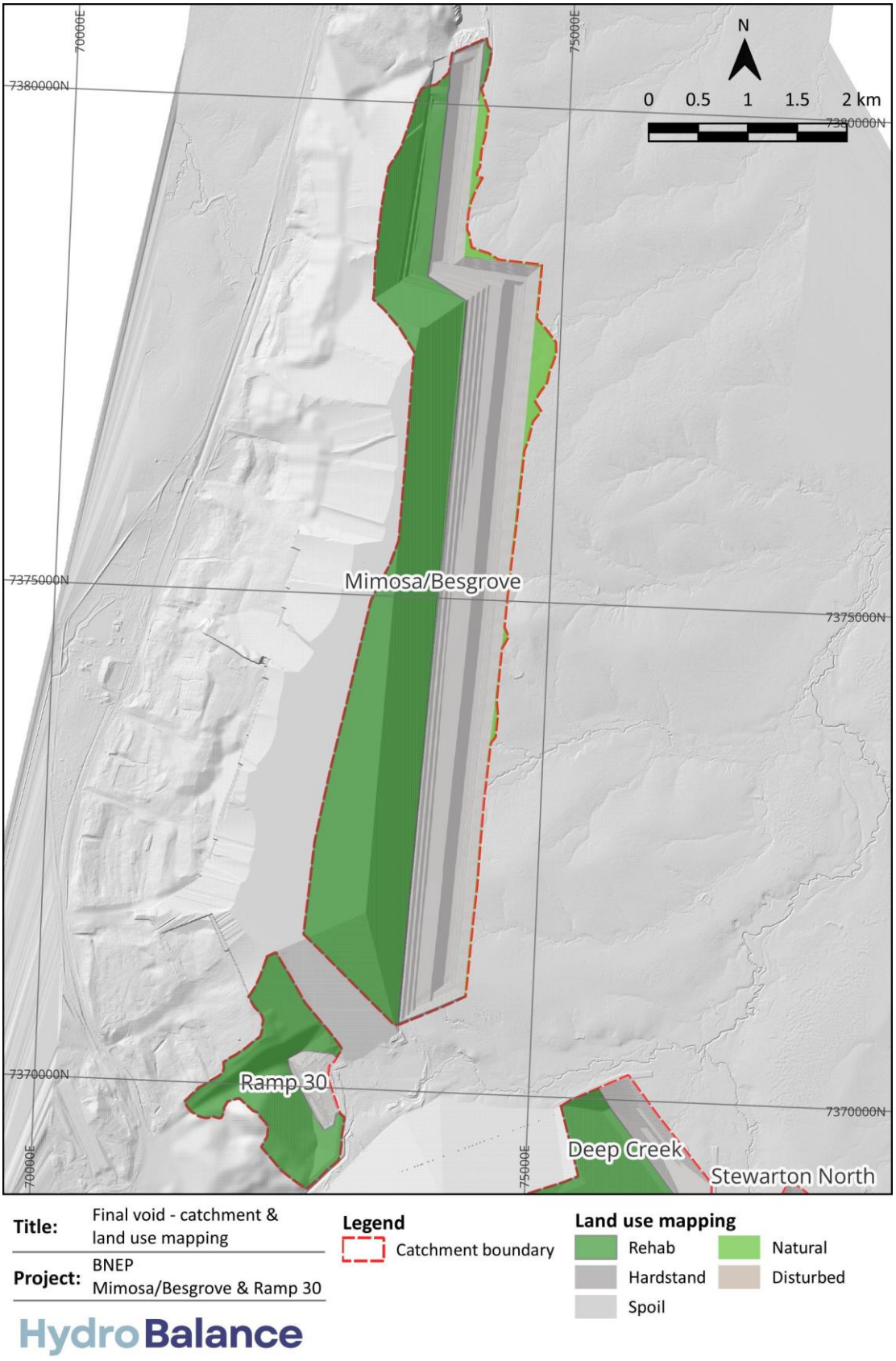


Figure 8.1 - Final void configuration - Mimosa/Besgrove & Ramp 30

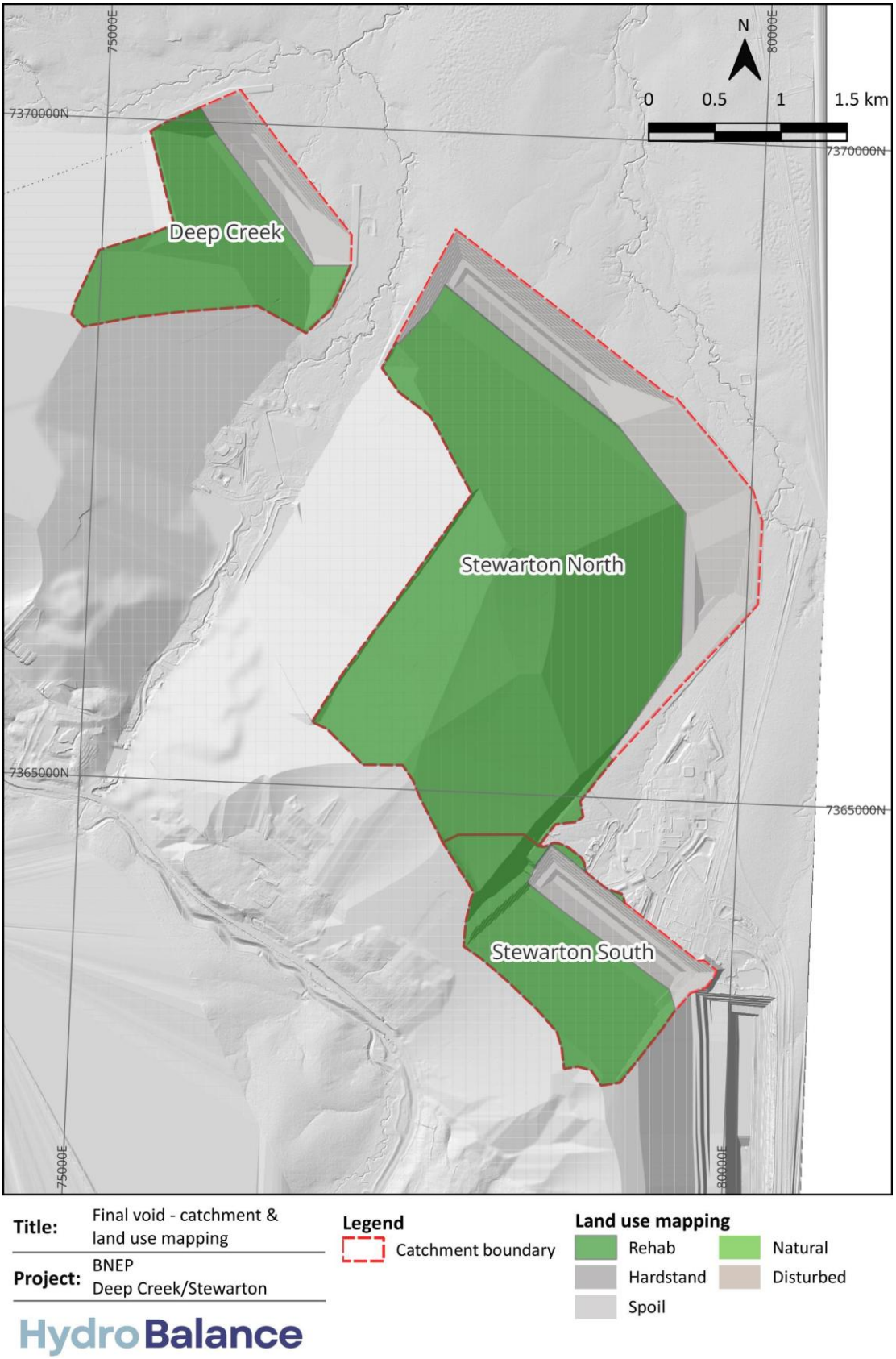


Figure 8.2 -Final void configuration - Deep Creek, Stewarton North & South

8.3 Model configuration

8.3.1 Modelling approach

The GoldSim software platform was used to simulate the long-term water level behaviour for the five Project voids. Water levels in the residual voids would vary over time, depending on the prevailing climatic conditions, and the balance between evaporation losses and inflows from rainfall, surface runoff, and groundwater.

The GoldSim model was used to simulate the generation, movement, and loss of water on a daily time-step within the final void, over a 1,000-year period. The volume of water in the voids was calculated at each time step as the sum of direct rainfall to the void surface, catchment runoff, and groundwater flux, less evaporation losses. The model also tracks the quantity of salt captured and stored within the system.

Key components of the model are summarised in the following sub-sections, including descriptions of key model inputs, assumptions, and sensitivity parameters.

8.3.2 Climate data

The Australian Government Consistent Climate Scenarios (CCS) project was used to generate climate change adjusted rainfall and evaporation data, which transformed historical climate data from the period between 1960 and 2024 (64 years). The CCS project provides climate projections as a daily time series across Australia on a 0.05-degree grid. The grid point closest to the central of BWM was used for this assessment.

The Shared Socioeconomic Pathway SSP2-4.5 was selected as the emission pathway for the Intergovernmental Panel on Climate Change (IPCC) assessment report AR5, with a base case global warming sensitivity for the Year 2070. The Year 2070 was selected as it represents a general mid-point for the varying void commencement dates.

SSP2-4.5 assumes that global development and environmental policies will continue along their current trajectories, and represents a moderate path where social, economic and technological trends do not shift markedly from historical patterns. It leads to moderate greenhouse gas emissions and radiative forcing of 4.5 Watts per square metre (W/m^2) by 2100.

The climate data was selected according to the following climate sensitivity and climate change model composites:

- climate warming sensitivity assumed to fall in the medium category; and
- the representative future climate cluster was selected as HP, which represents a high level of global warming.

The 64 years of historical climate data adjusted rainfall and evaporation data was looped to create a long-term (1,000-year) climate sequence.

Figure 8.3 shows the long-term monthly averages for the rainfall data and pan evaporation.

Pan evaporation has been converted to Morton's Lake (mLake) and Morton's Wet (mWet) evapotranspiration to account for evapotranspiration losses from the pit lake and catchment as follows:

- Pan evaporation to mLake factor: 0.883 – applied to the evaporation acting on the surface of the pit lake.
- Pan evaporation to mWet factor: 0.845 – applied to the evaporation.

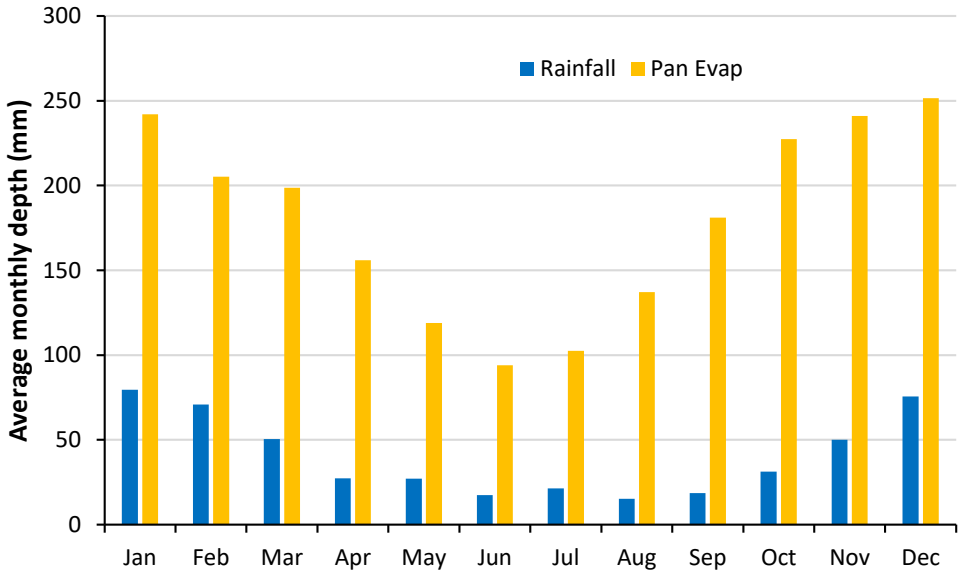


Figure 8.3 - Distribution of monthly rainfall and pan evaporation (CCS 1960 - 2024)

8.4 Catchment runoff

8.4.1 Catchment areas

The final landform catchment area was delineated from the final landform surface provided by Whitehaven. The landuse of the void floor has been characterised as spoil. Figure 8.1 to Figure 8.2 show the catchment boundary and land uses adopted for the final void water balance. The catchment and land use values used in the GoldSim model are shown in Table 8.2.

Table 8.2 - Final void catchment and land use areas

Void	Catchment area (ha)			
	Undisturbed	Spoil	Rehabilitated spoil	Total
MB	39.1	596.5	622.4	1,258.0
R30	0.0	24.1	149.2	173.3
DC	0.0	52.9	167.3	220.2
ST-N	0.0	195.2	678.1	873.3
ST-S	0.0	50.9	150.3	201.2

8.4.2 AWBM parameters

The final void GoldSim model uses the same AWBM parameters as per the operational model. Refer to Section 6.3 for further details.

8.4.3 Groundwater inflows

Groundwater water inflows into the five voids have been provided by the project groundwater consultants (SLR, 2026). The inflows were provided as a time series over the 1,000 year simulation. Refer to SLR (2026) for further details on the groundwater inflows to the voids.

8.5 Final void model results

8.5.1 Water level

The final void modelled water levels for the five voids are presented in Figure 8.4 to Figure 8.8. The following is of note regarding these results:

- MB void reaches equilibrium within 100 years post mining, with a median water level of around 83 mAHD. The maximum void water level (88.1 mAHD) is 112 m below the pit crest level (200 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- R30 void reaches equilibrium within 100 years post mining, with an inventory cycling between empty (during extended dry periods) and a maximum void water level of around 160 mAHD during extended wet periods. The maximum void water level (160.1 mAHD) is 57 m below the pit crest level (217 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- DC void reaches equilibrium within 150 years post mining, with a median water level of around 138 mAHD. The maximum void water level (149.8 mAHD) is 52 m below the pit crest level (202 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- ST-N void reaches equilibrium within 100 years post mining, with a median water level of around 73 mAHD. The maximum void water level (79.4 mAHD) is 124 m below the pit crest level (204 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.
- ST-S void reaches equilibrium within 100 years post mining, with a median water level of around 104 mAHD. The maximum void water level (118.5 mAHD) is 113 m below the pit crest level (232 mAHD). The pit crest does not overtop at any point in the 1,000-year simulation.

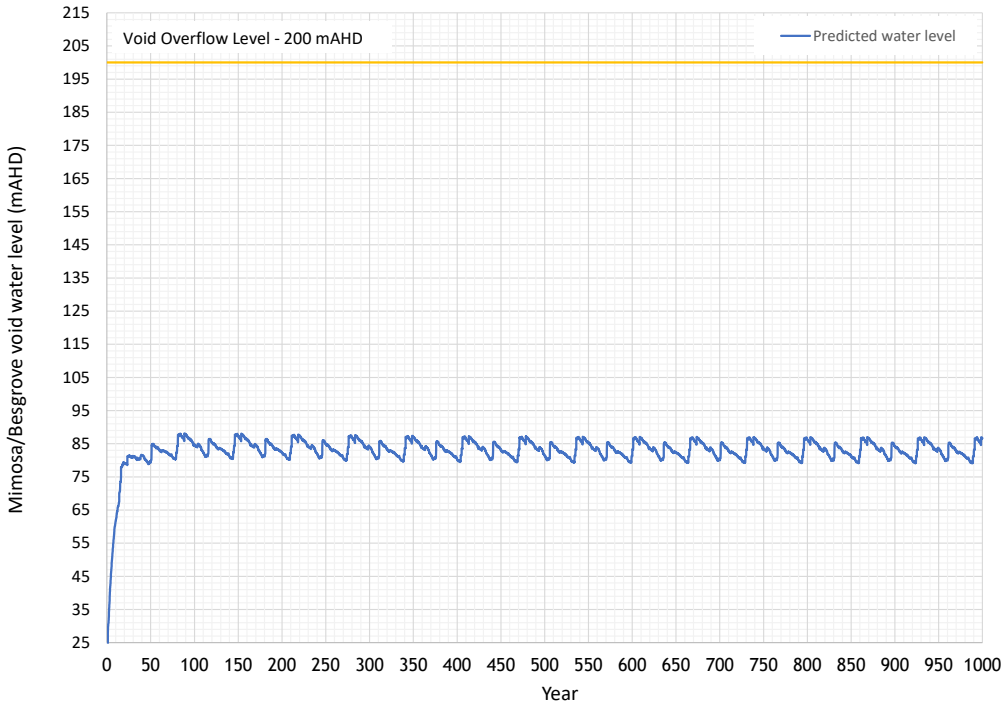


Figure 8.4 - Mimosa/Besgrove void - long term predicted final void water level

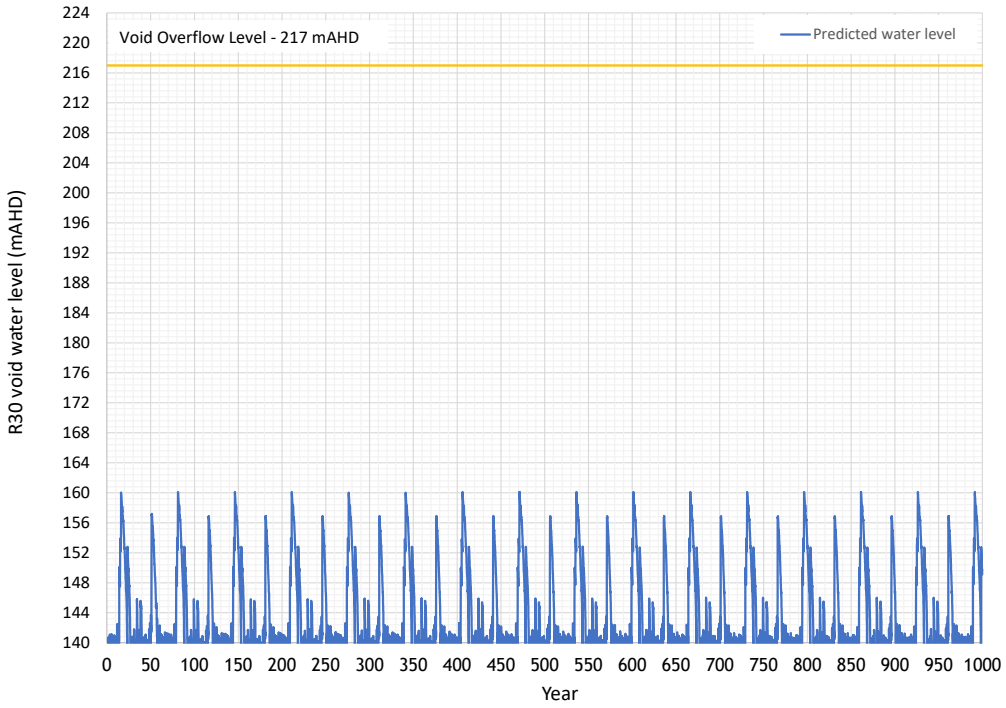


Figure 8.5 - Ramp 30 void - long term predicted final void water level

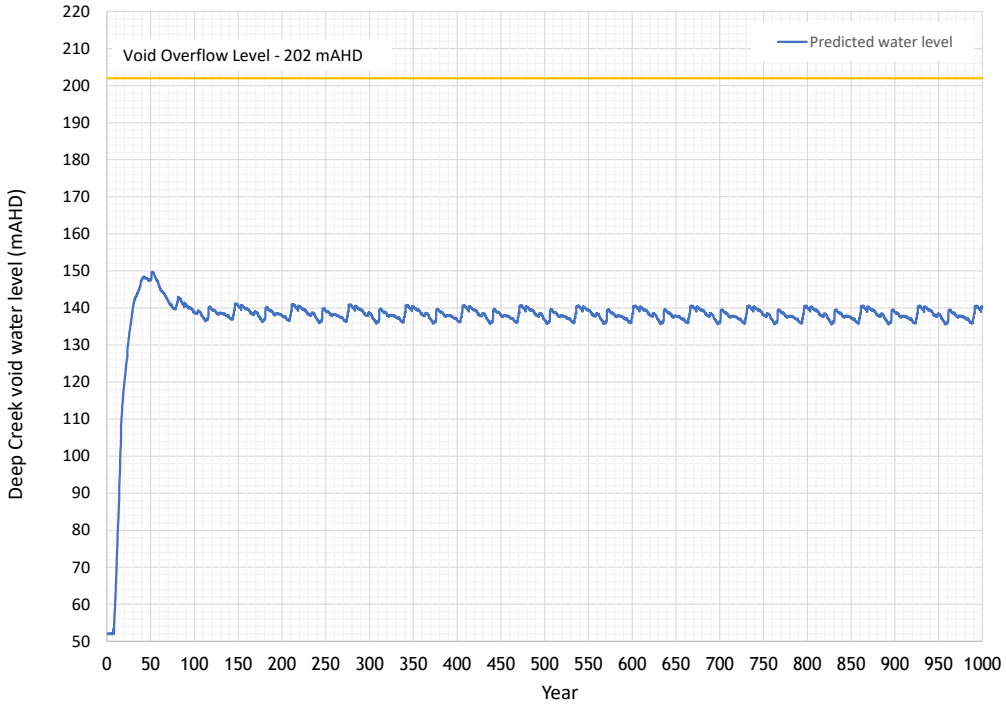


Figure 8.6 - Deep Creek void - long term predicted final void water level

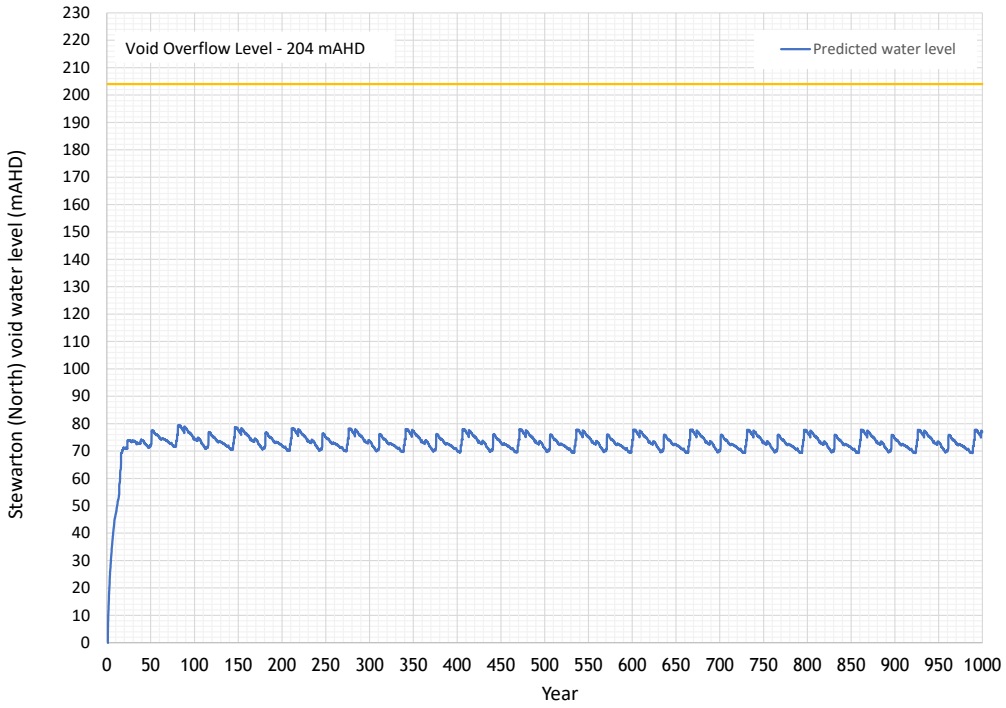


Figure 8.7 - Stewarton North void - long term predicted final void water level

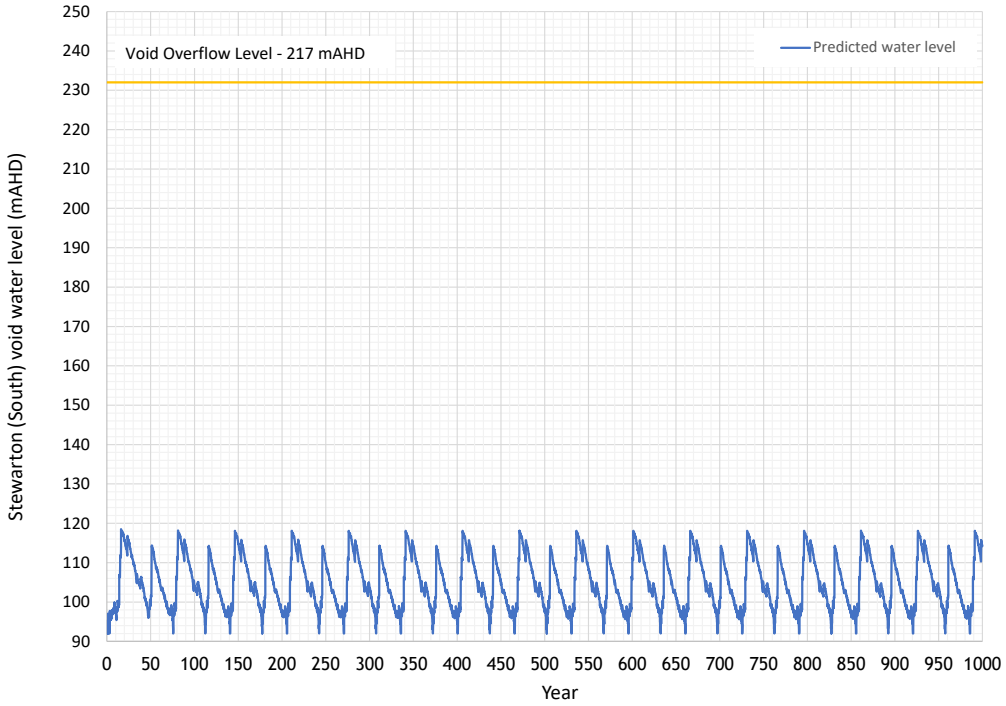


Figure 8.8 - Stewarton South void - long term predicted final void water level

8.5.2 Salinity

The final void modelled salinity levels for the five voids are presented in Figure 8.9 to Figure 8.13. The long-term salinity generally increases over time, which is expected for closed-loop systems with no mechanism for salt removal. This assessment is considered conservative, as it:

- Assumes an unlimited source of salt within the catchment and does not include any allowance for potential reduction in the localised leaching of salts from the catchment over time.
- Does not take into account the potential precipitation of dissolved salts as mineral compounds.

The following is of note regarding these results:

- For Mimose/Besgrove void, the salinity of the pit lake progressively increases, rising to 250,000 µS/cm over the 1,000-year simulation.
- For Ramp 30 void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 5,000 µS/cm.
- For Deep Creek void, the salinity of the pit lake progressively increases, rising to 180,000 µS/cm over the 1,000-year simulation.
- For Stewarton North void, the salinity of the pit lake progressively increases, rising to 195,000 µS/cm over the 1,000-year simulation.
- For Stewarton South void, the salinity of the pit lake fluctuates over time as the void empties in cycles. The peak salinity during these cycles is around 10,000 µS/cm.

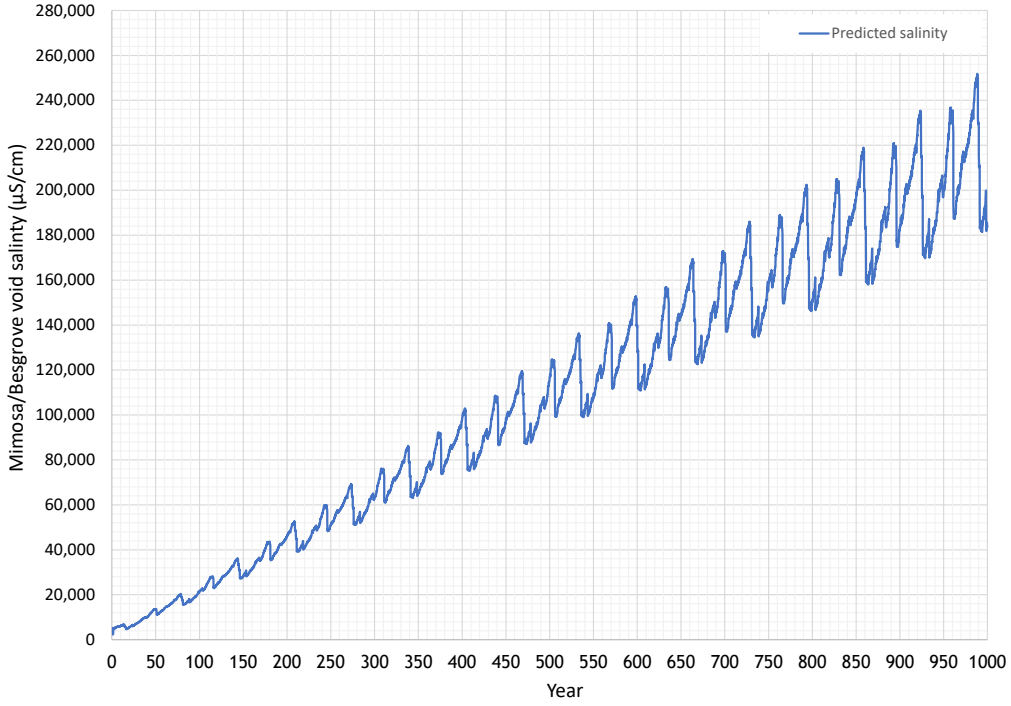


Figure 8.9 - Mimosa/Besgrove void - long term predicted void water salinity

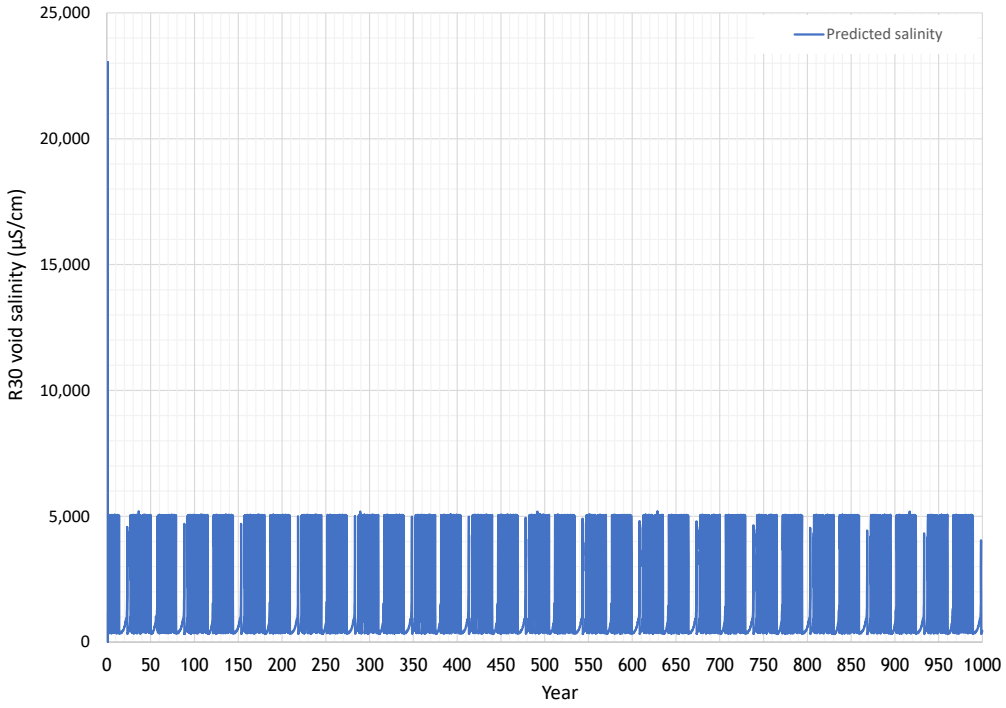


Figure 8.10 - Ramp 30 void - long term predicted final void water salinity

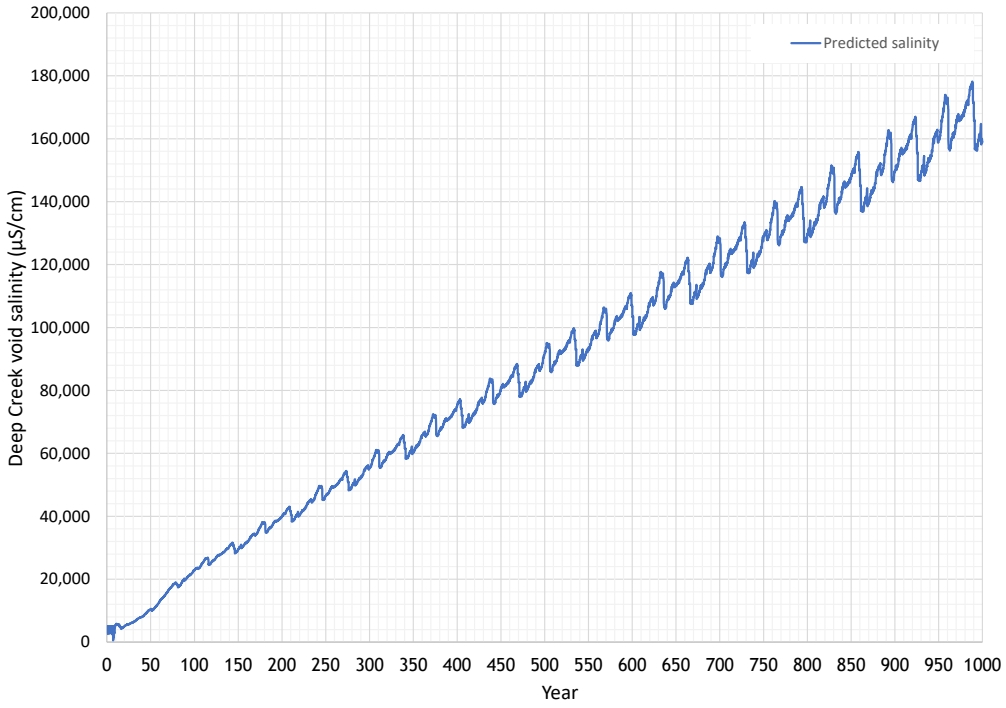


Figure 8.11 - Deep Creek void - long term predicted final void water salinity

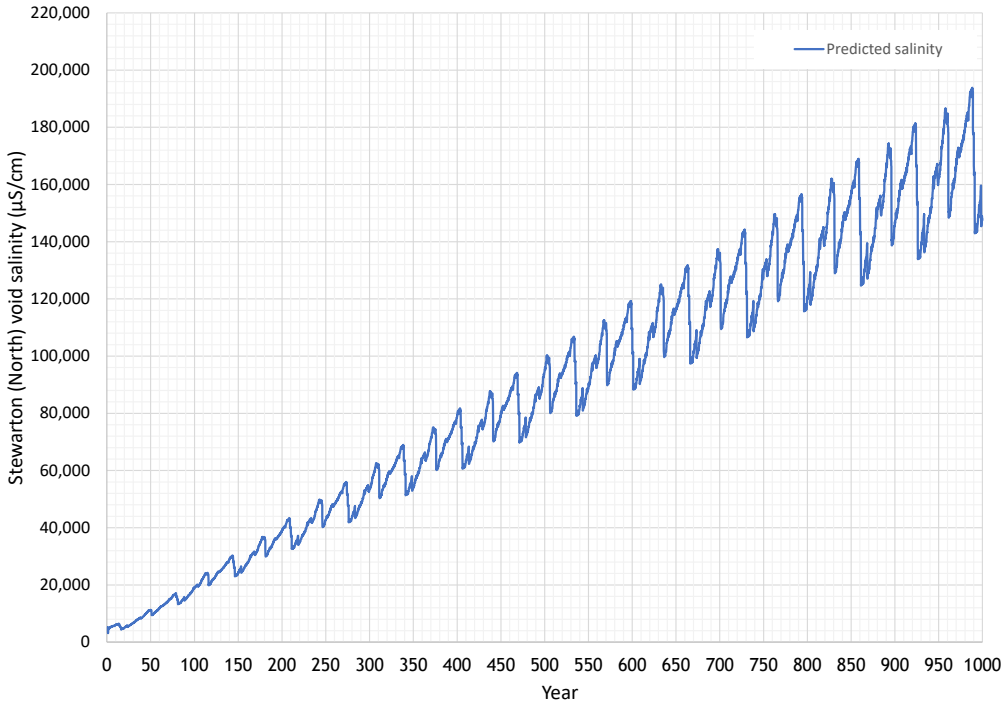


Figure 8.12 – Stewarton North void – long term predicted final void water salinity

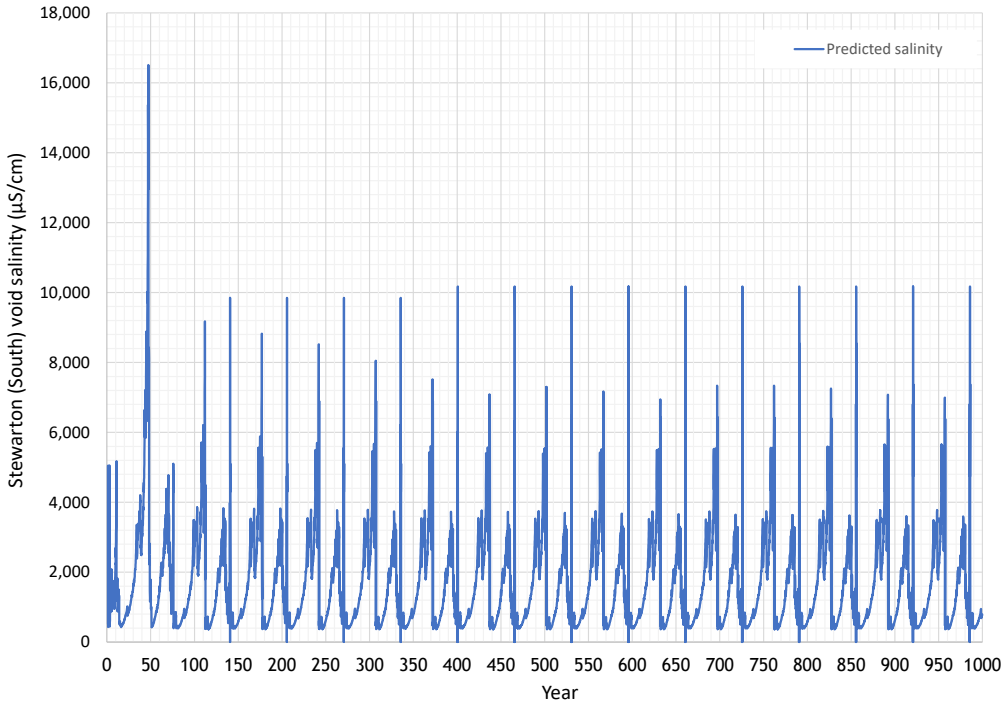


Figure 8.13 – Stewarton South void – long term predicted final void water salinity

8.6 Extreme storm event behaviour

8.6.1 Methodology

An assessment of the impact of extreme storm events on the water levels in the final voids has been undertaken. The potential for discharge of void water during a large storm was assessed for the 1 in 1,000 Annual Exceedance Probability (AEP) (or 0.1% AEP) 72-hour (3 day) design storm. For conservatism, it has been assumed that the extreme storm would occur coincident with the peak modelled long-term water levels.

Design rainfall depths for the above events were estimated using standard procedures in Australian Rainfall and Runoff (ARR) (Ball et al., 2019). The runoff generated from the storm events has been conservatively calculated assuming 100% of runoff reports to the voids (i.e. no losses) from the surface catchment reporting to the voids.

8.6.2 Results

The results of the storm event analysis are presented in Table 8.3. These results show that, even during extreme short duration storm events, the pit crest would not be overtopped for any of the final voids.

Table 8.3 – Storm event modelling results

Void	Runoff Volume (ML)	Water level increase (m)	Final Volume (ML)	Final Level (mAHD)	Pit crest level (mAHD)	Freeboard (m)
MB	3,585	3.4	29,316	91.5	200	108.5
R30	494	6.3	1,124	166.1	217	50.9
DC	628	2.6	7,884	129.9	202	72.1
ST-N	2,489	1.5	59,120	115.0	204	89.0
ST-S	573	3.6	4,992	150.0	232	82.0

9 References

Ball et al. (2019)	Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (Editors) (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation*. Commonwealth of Australia (Geoscience Australia), Canberra.
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Whitehaven (2023)	Whitehaven Coal Limited. (2023). *BWM Plan – Water Management*.
Whitehaven (2024)	Whitehaven Coal Limited. (2024). *WHC QLD Standard: Erosion & Sediment Control and Mine Affected Water*.

APPENDIX C GREAT BARRIER REEF SURFACE WATER IMPACT ASSESSMENT MEMORANDUM

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WRM
WATER +
ENVIRONMENT

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ABN 96 107 404 544

MEMORANDUM

Date	17 April 2026
Attention	Brendan Dillon
Company	Whitehaven Blackwater Pty Ltd
WRM ref.	1559-11-B3
Subject	Blackwater North Extension Project – Great Barrier Reef (GBR) surface water impact assessment

Dear Brendan,

1 INTRODUCTION

1.1 BACKGROUND

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) southwest of Blackwater, Central Queensland (refer to Figure 1.1). The BWM produces up to 17.6 million tonnes per annum (Mtpa) of product coal, predominantly high-quality coking coal for use in steelmaking as well as high energy thermal coal. The BWM is currently owned and operated by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven Coal Limited (Whitehaven), and operates under Environmental Authority (EA) EPML00717813.

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759 (refer to Figure 1.2). The Project would involve an indicative mining rate of up to 19 Mtpa of run-of-mine coal. Figure 1.2 shows the general arrangement of the Project site, including the open cut pit extents within SA 7 and SA 10.

1.2 PURPOSE AND SCOPE

This surface water assessment was prepared to support the Referral for the Project under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It addresses the potential for the Project to result in surface water impacts on the Great Barrier Reef World Heritage Property, National Heritage Place, and Marine Park, which are listed as Matters of National Environmental Significance under the following sections of the EPBC Act:

- sections 12 and 5A – World Heritage Property;
- sections 15B and 15C – National Heritage Place; and
- sections 24B and 24C – Great Barrier Reef Marine Park.

For the purpose of this assessment, the Project is also referred to as 'the Action', defined broadly in the EPBC Act as either 'a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things.'

This assessment addresses whether the potential surface water impacts associated with the Action on the Great Barrier Reef Marine Park meets the 'substantial cause' requirement of an indirect impact as outlined in section 527E(2) of the EPBC Act.

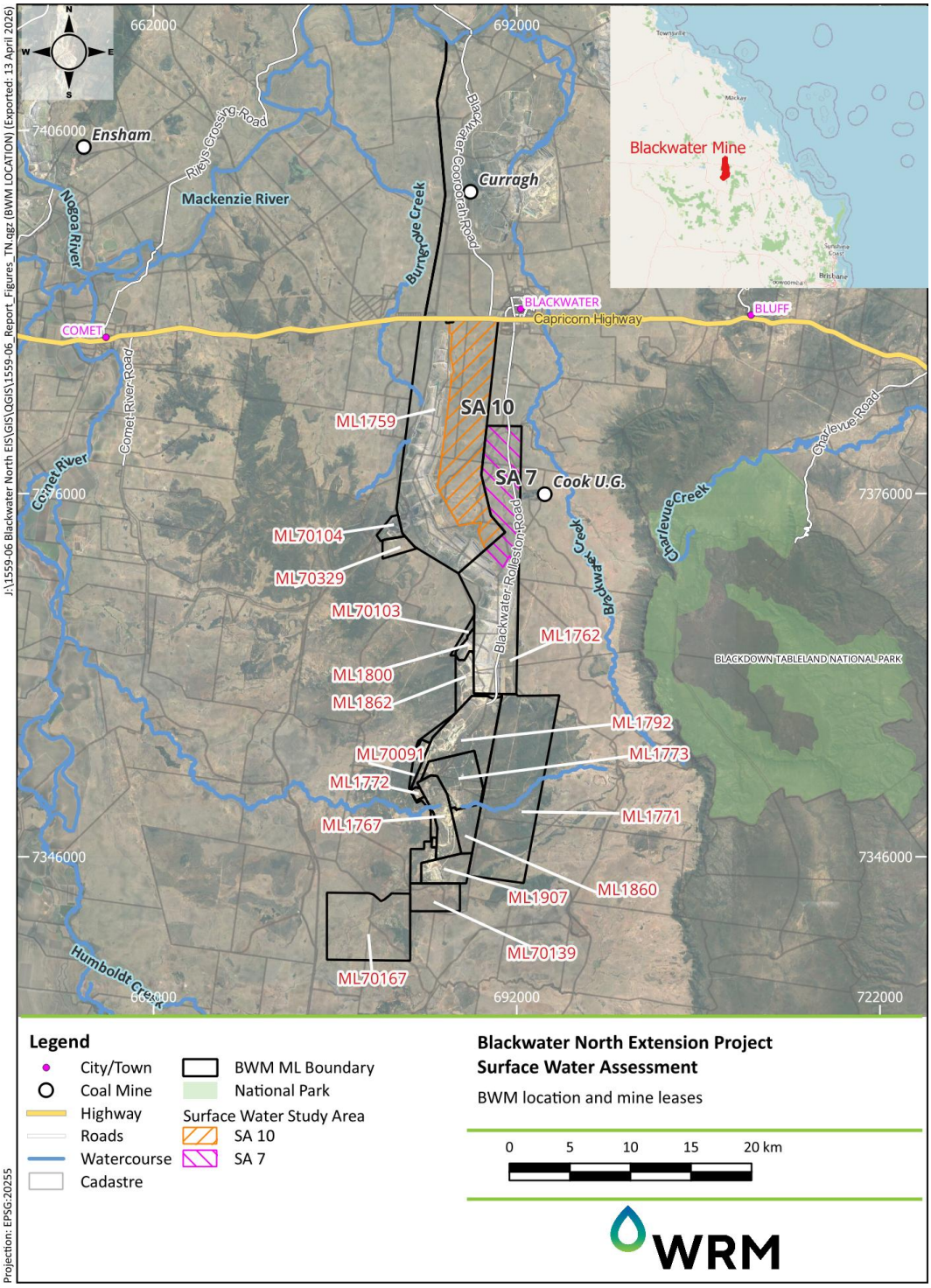


Figure 1.1 BWM locality

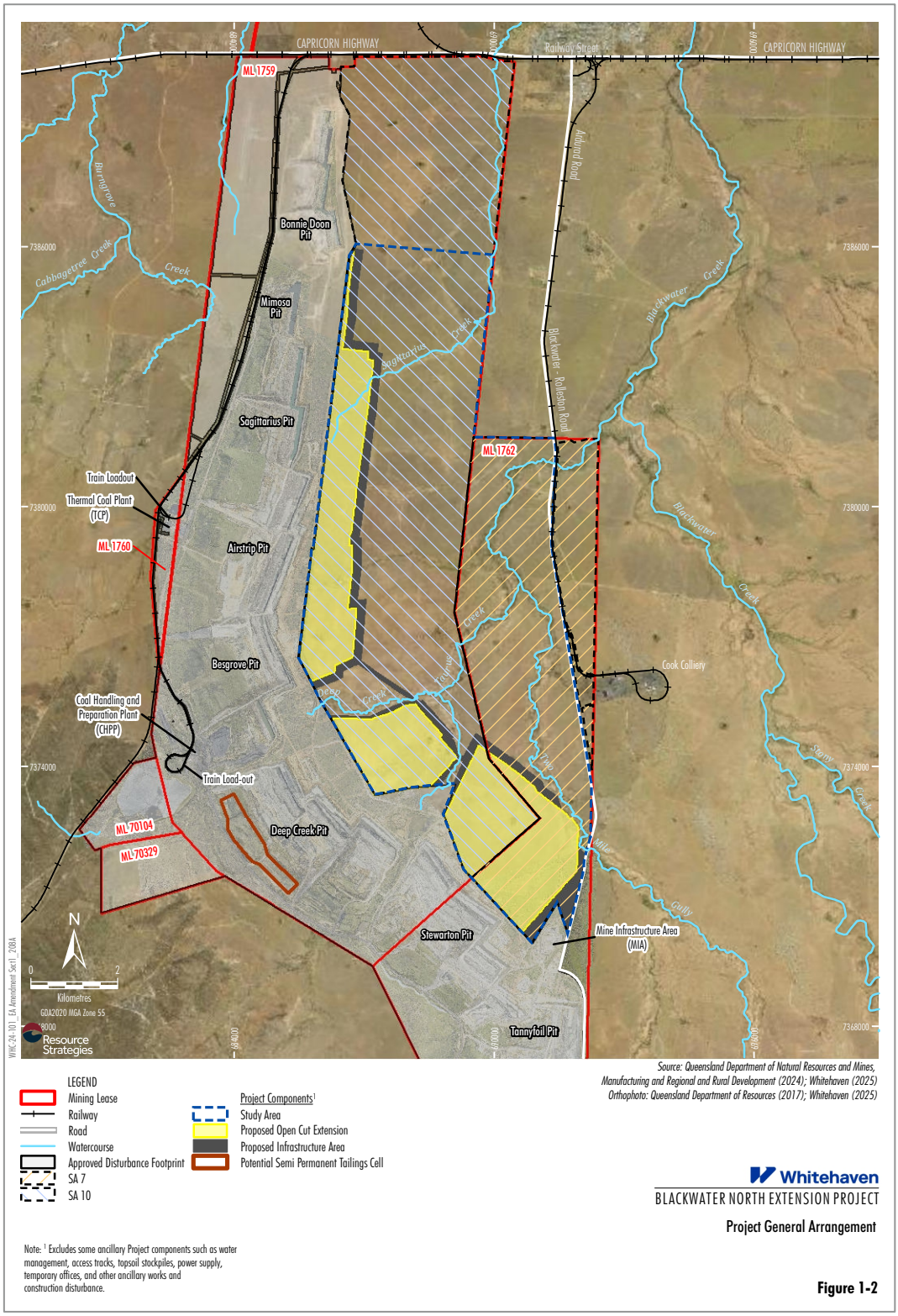


Figure 1.2 Project General Arrangement

2 REGULATORY FRAMEWORK

2.1 OVERVIEW

This memorandum has been prepared in consideration of the following:

- *EPBC Act 1999 Referral Preparation Guideline* (Commonwealth Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2024);
- *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (Commonwealth of Australia, 2013);
- *Significant Impact Guidelines 1.3 Coal Seam Gas and Large Coal Mining Developments — Impacts on Water Resources* (Commonwealth of Australia, 2022);
- *EPBC Act Referral Guidelines for the Outstanding Universal Value of the Great Barrier Reef World Heritage Area* (Commonwealth of Australia, 2014);
- *Reef 2050 Water Quality Improvement Plan 2017–2022* (Queensland Government, 2018);
- *Reef Water Quality Report Card 2021 and 2022* (Queensland Government, 2024);
- *Environmental Protection Act 1994 Guideline – Reef discharge standards for industrial activities* (DESI, 2024); and
- *Best Practice Erosion and Sediment Control* (International Erosion Control Association [IECA], 2008).

2.2 COMMONWEALTH

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The Action is being referred to the Commonwealth Minister for the Environment and Water for consideration as to whether the Project is a 'controlled action' and requires approval under the EPBC Act. This memorandum forms part of the Referral.

With regards to the Great Barrier Reef (GBR) World Heritage property, National Heritage Place and Marine Park, the *Significant Impact Guidelines 1.1* (Commonwealth of Australia, 2013) identifies that:

- *Approval under the EPBC Act is required for any action occurring within or outside a declared World Heritage property that has, will have, or is likely to have a significant impact on the World Heritage values of the World Heritage property.*
- *An action will require approval if:*
    - *the action is taken in the Great Barrier Reef Marine Park and the action has, will have, or is likely to have a significant impact on the environment, or*
    - *the action is taken outside the Great Barrier Reef Marine Park and the action has, will have, or is likely to have a significant impact on the environment in the Great Barrier Reef Marine Park.*

The GBR is located approximately 600 river km downstream (and 210 km east "as the crow flies") of the Action (as shown in Figure 2.1). As such, the Action would not result in any direct impacts to the GBR. Therefore, this assessment was prepared to assess the potential indirect impacts of the Action due to runoff and surface water releases.

Regarding indirect impacts, section 527E of the EPBC Act describes that an event or circumstance is considered an 'impact' of an Action only if the Action is a 'substantial cause' of that event or circumstance.



Figure 2.1 Map of Great Barrier Reef Region, Marine Park and World Heritage Area (Commonwealth of Australia, 2024)

2.3 QUEENSLAND

2.3.1 Environmental Protection Act 1994

In addition to approval of the Action under the EPBC Act, Whitehaven Blackwater is currently seeking to obtain an EA Amendment for the Project (including the Action) under the *Environmental Protection Act 1994* (EP Act).

The EP Act and the *Environmental Protection Regulation 2019* (EP Regulation) specify the regulatory requirements for prescribed environmentally relevant activities (ERAs). Regarding the potential impacts to the 'GBR catchment waters', section 41AA of the EP Regulation states:

3. *The administering authority must refuse to grant the application if the authority considers that –*
    a. *the relevant activity will, or may, have a residual impact; and*
    b. *having regard to the matters mentioned in the water quality offset policy, the residual impact will not be adequately counterbalanced by offset measures for the relevant activity.*
4. *A residual impact of a relevant activity is the presence of fine sediment (FS), or dissolved inorganic nitrogen (DIN), in Great Barrier Reef catchment waters, that –*
    a. *was released to the water because of the relevant activity; and*
    b. *remains, or is likely to remain in the water despite mitigation measures for the relevant activity.*

The intent of section 41AA of the EP Regulation is to achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters as outlined in the *Reef discharge standards for industrial activities* (DESI, 2024).

3 EXISTING SURFACE WATER ENVIRONMENT

3.1 DRAINAGE CHARACTERISTICS

3.1.1 Regional drainage features

The GBR receives runoff from six natural resource management regions and 35 catchments which drain 424,000 square kilometres (km^2) of coastal Queensland (Department of Environment, Tourism, Science and Innovation [DETSI], 2025). Grazing is the dominant agricultural land use (77 percent [%]), particularly in the Burdekin and Fitzroy regions.

Figure 3.1 shows the regional drainage characteristics in the vicinity of the Action. Figure 3.1 also shows the locations of surface water monitoring sites that are active as part of the Fitzroy Regional Receiving Environment Monitoring Program (FRREMP) and are relevant to the Action.

The Action is located within the Mackenzie River catchment, part of the greater Fitzroy Basin, and is approximately 600 river km upstream of the GBR. The Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, ultimately discharging into the Coral Sea southeast of Rockhampton, near Port Alma. The total Fitzroy River catchment is 142,665 km^2.

Blackwater Creek, a tributary of the Mackenzie River, is the main watercourse in the vicinity of the Action and flows in a northerly direction to the east of the Action. Figure 3.2 shows the Blackwater Creek catchment to the Mackenzie River.

The catchment area of Blackwater Creek, encompassing the Action, is approximately 1,100 km^2. This represents around 0.8% of the overall Fitzroy River catchment. The disturbance footprint of the Action is approximately 23 km^2 and represents 2% of the Blackwater Creek catchment and 0.016% of the overall Fitzroy River catchment area.

3.1.2 Local drainage features

Figure 3.3 shows the local drainage features in the vicinity of the Action. Figure 3.1 also shows the locations of local surface water monitoring sites in the vicinity of the Action.

The Action is drained by several tributaries of Blackwater Creek, including Deep Creek, Taurus Creek, Emu Creek, Two Mile Gully and Sagittarius Creek. These local tributaries generally drain in a northeasterly direction and join Blackwater Creek to the east of the Action.

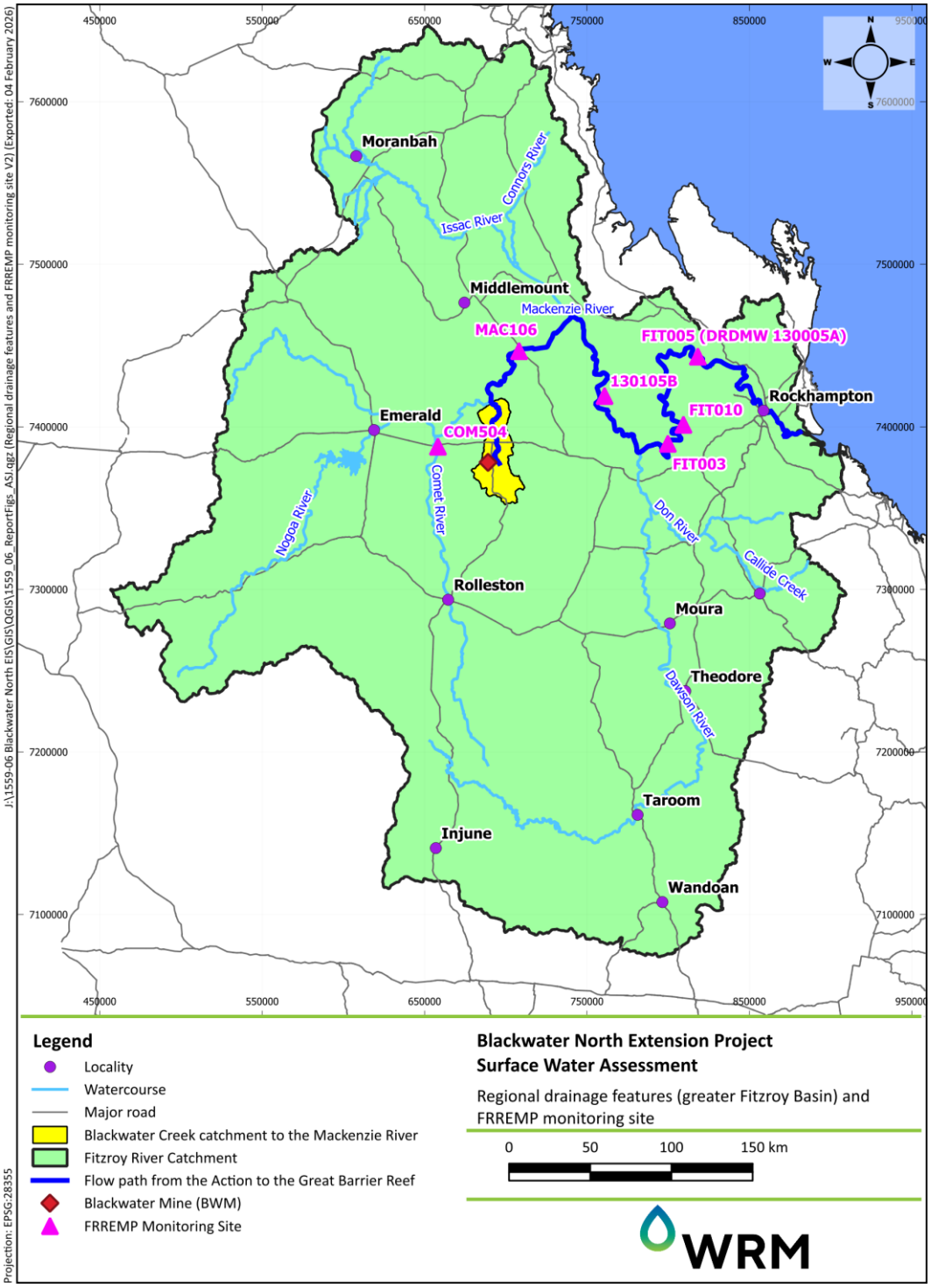


Figure 3.1 Regional drainage features (greater Fitzroy basin) and FREEMP monitoring sites

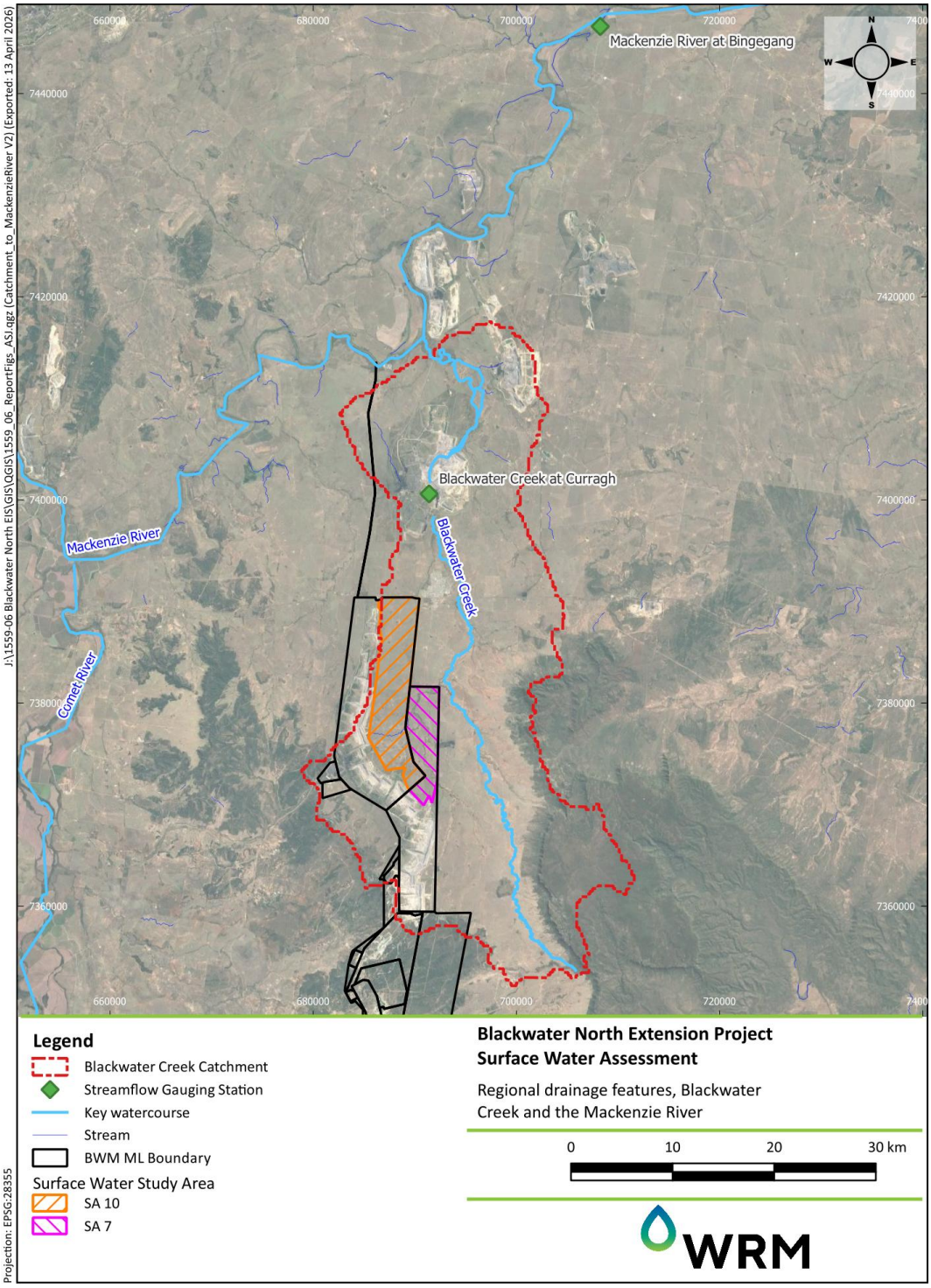


Figure 3.2 Regional drainage features, Blackwater Creek and the Mackenzie River

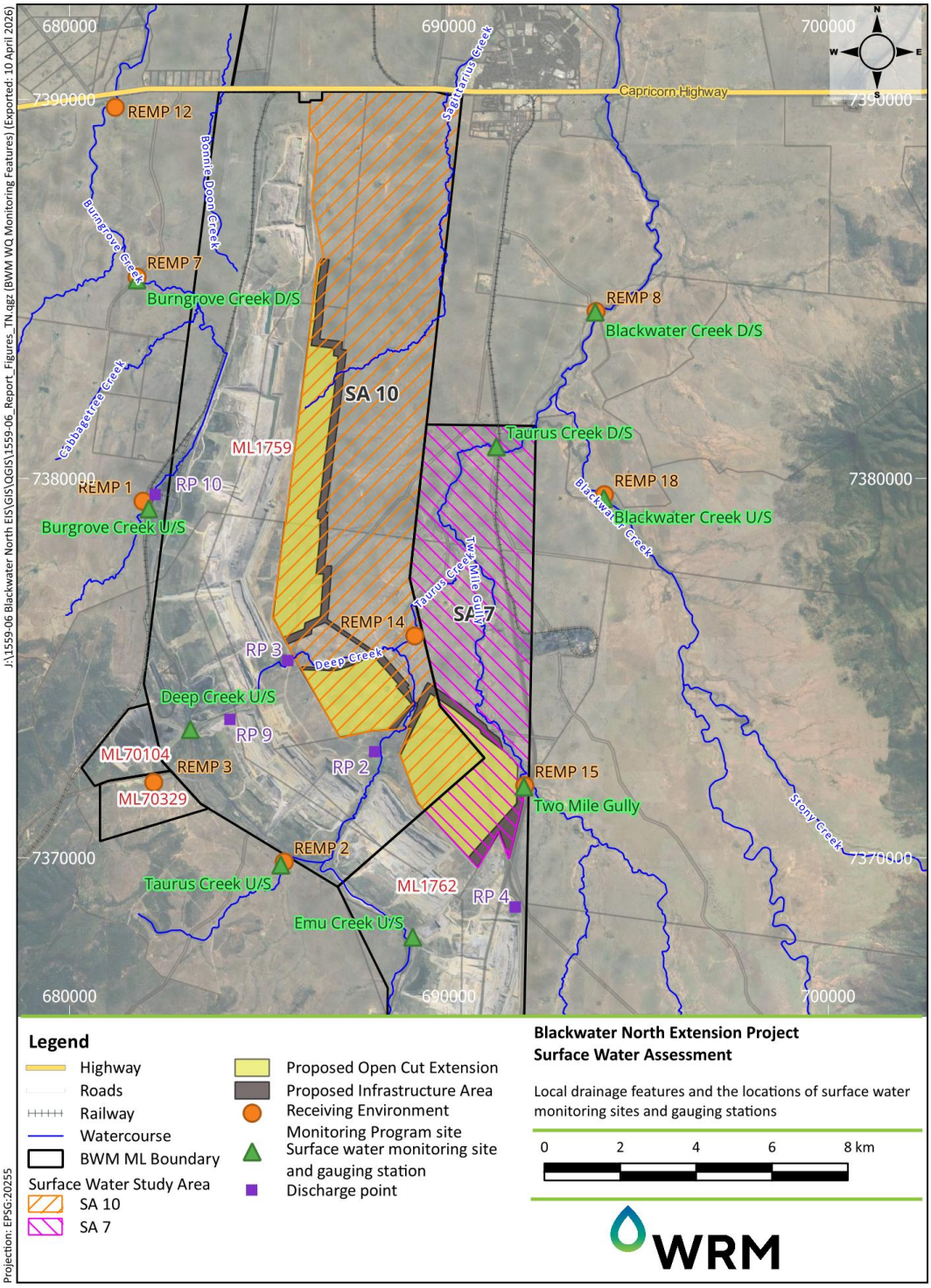


Figure 3.3 Local drainage features and surface water quality monitoring locations

3.2 STREAMFLOW

Historical flow and water level (river height) monitoring data was assessed to provide an indication of local flow regime in the vicinity of the Action and regional flow regime in the Fitzroy River at the following locations:

- Taurus Creek at Taurus Creek D/S gauge (WHC station no. 330101) (2016 – 2025) (refer to Figure 3.3);
- Blackwater Creek at Curragh (DRDMW station no. 130108A/130108B) (1972 – 2009) (refer to Figure 3.2); and
- Fitzroy River at The Gap (DRDMW station no. 130005A) (1971-2025) (refer to Figure 3.1).

Figure 3.4, Figure 3.6 and Figure 3.8 present daily discharge exceedance curves of flows (in megalitres per day) in Taurus Creek, Blackwater Creek and the Fitzroy River as recorded at the above three stream gauging stations.

Figure 3.5, Figure 3.7 and Figure 3.9 present monthly box and whisker plots of stream flows in Taurus Creek, Blackwater Creek and the Fitzroy River as recorded at the above three stream gauging stations. The box and whisker plots show:

- The lower and upper extents of the 'whiskers' show the 10th and 90th percentile recorded monthly flows.
- The box represents the range within which 50% of recorded monthly flows fall. The lower bound of the box is the 25th percentile monthly flow (i.e. 25% of flows are equal to or smaller, 75% of flows are larger) while the upper bound of the box is the 75th percentile flow (i.e. 75% of flows are equal to or smaller, only 25% of flows are larger).
- The middle line in the box represents the median or 50th percentile recorded monthly flow (i.e. 50% of flows are equal to or smaller, 50% of flows are larger).

The data indicates the following:

- At all three watercourses, flows are most likely to occur during the summer months. Stream flows are highly variable, especially during the summer months.
- Taurus Creek and Blackwater Creek are ephemeral streams, where flows to the greater Fitzroy basin occur during the summer months often in short durations, but generally drying out during winter and early spring. Stream flows greater than 10 megalitres per day occur less than 6% of the time in Taurus Creek, and less than 14% of the time in Blackwater Creek.
- The Fitzroy River, located in the lower Fitzroy basin, is more perennial, providing permanent flows entering the GBR Marine Park.

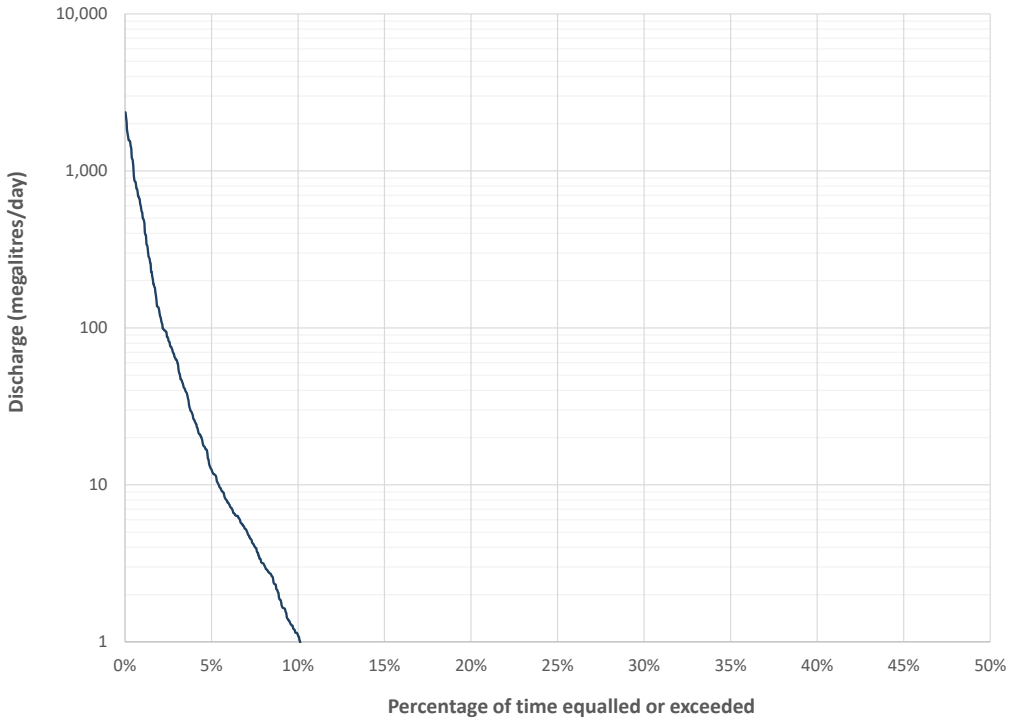


Figure 3.4 Daily discharge exceedance curve (2016 – 2025) for Taurus Creek at the Taurus Creek D/S gauge

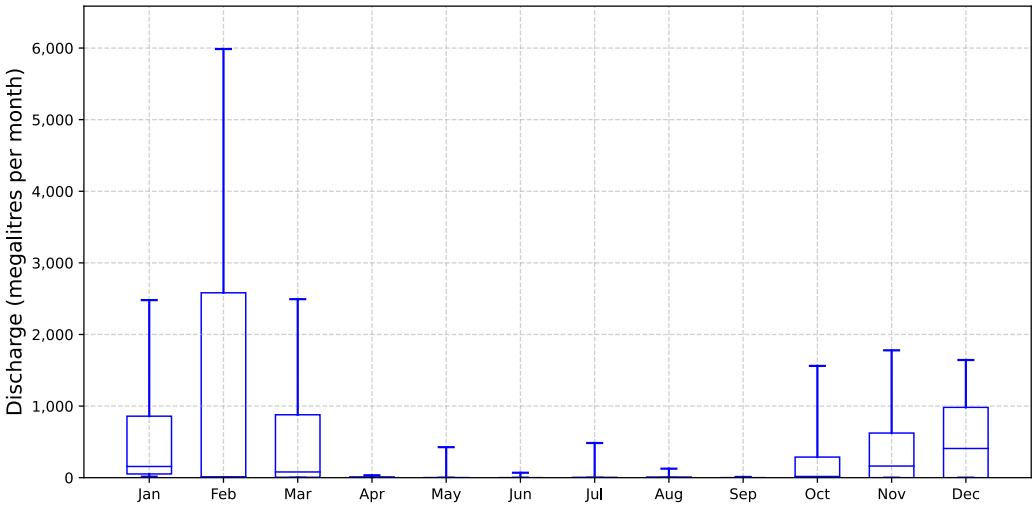


Figure 3.5 Monthly box and whisker plot of flow volume (2016 – 2025) for Taurus Creek at the Taurus Creek D/S gauge

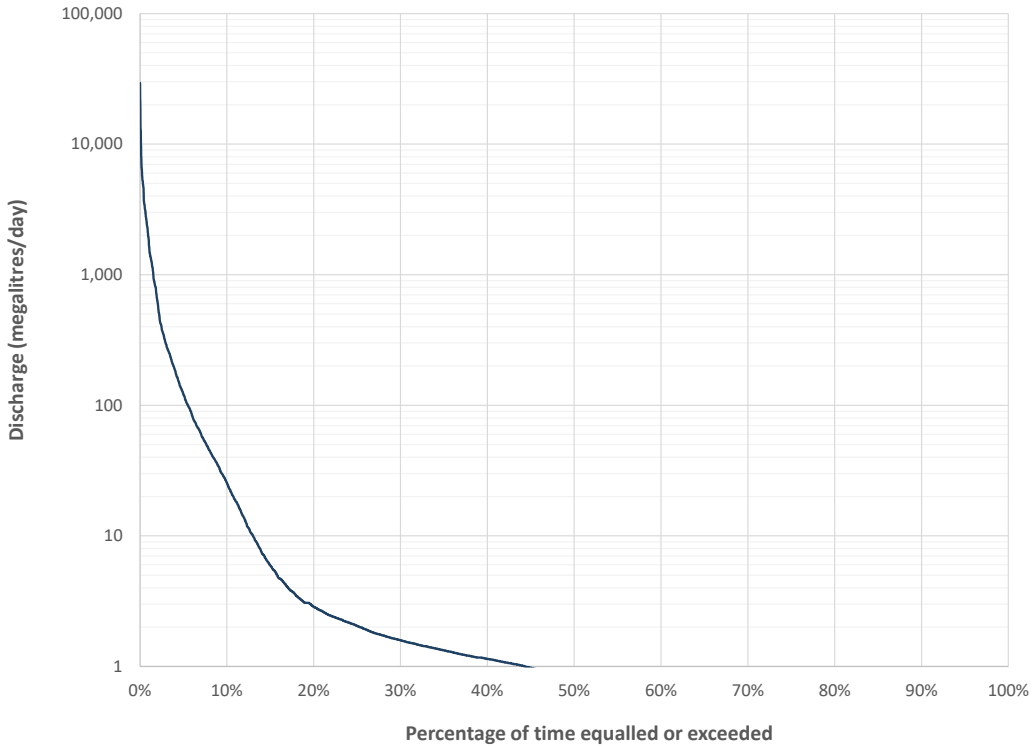


Figure 3.6 Daily discharge exceedance curve (1972 – 2009) for Blackwater Creek at Curragh (DRDMW station No. 130108A and 130108B)

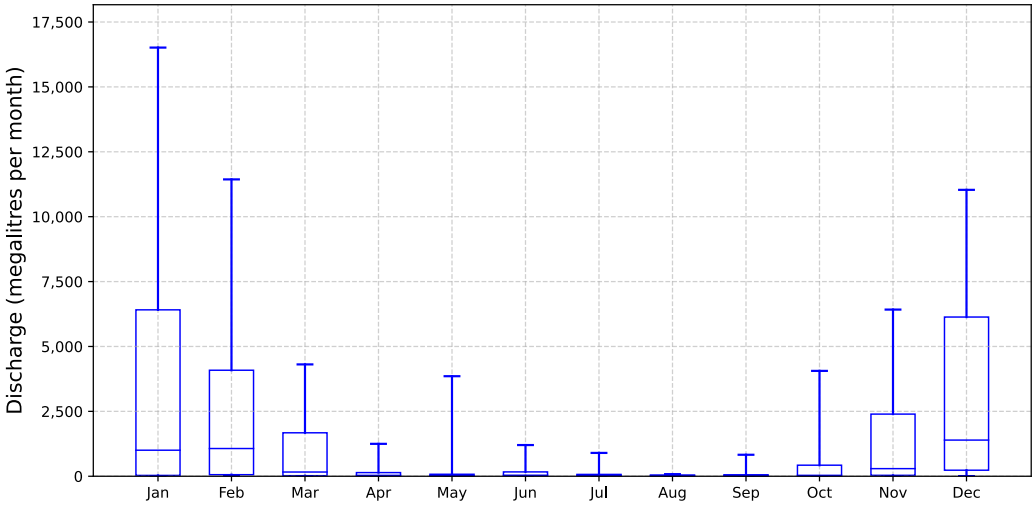


Figure 3.7 Monthly box and whisker plot of flow volume (1972 – 2009) for Blackwater Creek at Curragh (DRDMW station No. 130108A and 130108B)

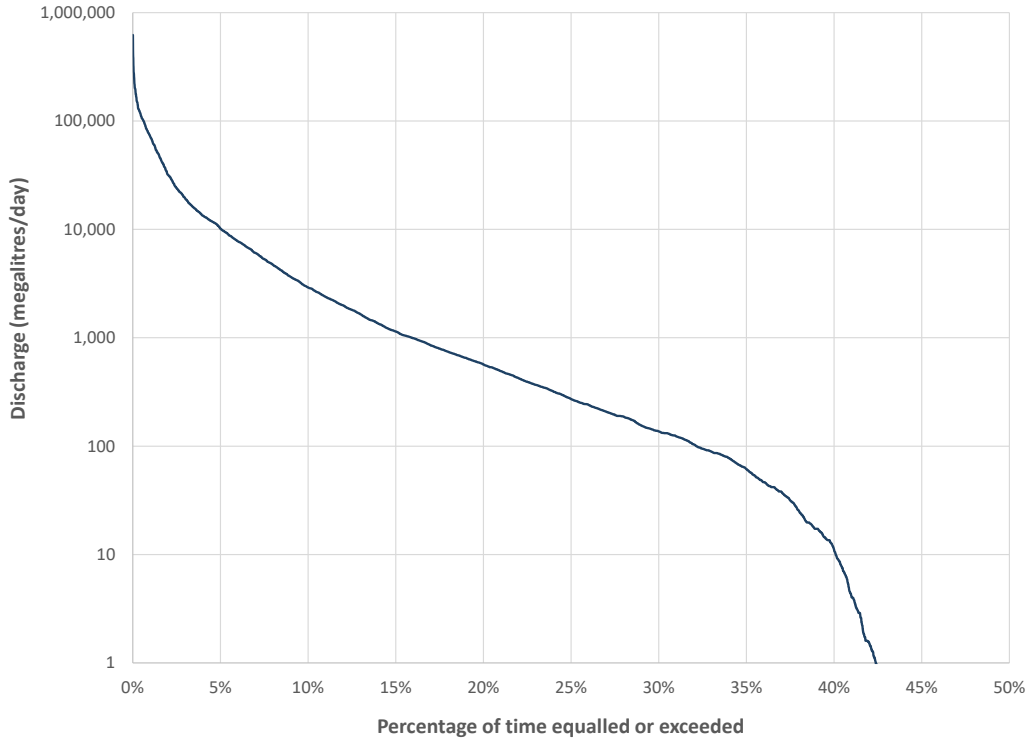


Figure 3.8 Daily discharge exceedance curve (1971 – 2025) for the Fitzroy River at the Gap stream gauging station

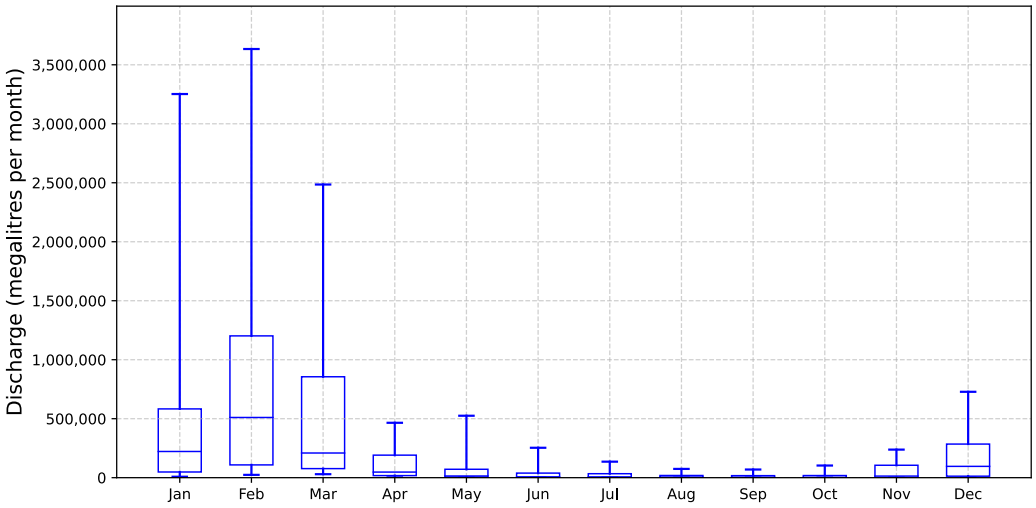


Figure 3.9 Monthly box and whisker plot of flow volume (1971 – 2025) for the Fitzroy River at the Gap stream gauging station

3.3 SURFACE WATER QUALITY

3.3.1 Overview

The following sections describe the water quality characteristics of the local creeks and regional waterways in the vicinity of the Action, based on surface water quality monitoring results.

The *Reef 2050 Water Quality Improvement Plan*, prepared by the Queensland Government (2018) states that the greatest water quality risks to the GBR are from nutrients, fine sediments and pesticides. Water quality targets have been set for dissolved inorganic nitrogen (DIN), fine sediment (which is measured as total suspended solids [TSS]), particulate phosphorous and particulate nitrogen. This report also states that:

'There is insufficient science to set quantitative water quality targets for other pollutants, including plastics. As the science is refined, quantitative measures can be developed for other pollutants.'

Further, the *Reef discharge standards for industrial activities* (DESI, 2024) states that:

'In the absence of data or information on DIN that would be sufficient to support an application, the administering authority may consider the use total nitrogen (TN) as the contaminant of interest for the purposes of section 41AA of the EP Reg. This will ensure that the intent of 'no net decline' of DIN to GBR catchment waters is met.'

In consideration of the above and the availability of data, existing surface water quality have been characterised for TSS, total nitrogen (TN) and total phosphorus (TP) only, based on water quality monitoring results described in the following reports:

- *Receiving Environment Monitoring Program (REMP) Annual Report, July 2021 – June 2022* (BMA, 2023);
- *Fitzroy Regional Receiving Environment Monitoring Program Annual Report, July 2022 – June* 2023 (FRREMP, 2023); and
- *Fitzroy Regional Receiving Environment Monitoring Program Annual Report, July 2023 – June 2024* (FRREMP, 2025).

It should be noted that after June 2022, Whitehaven Blackwater became a participant in the FRREMP and as such, FRREMP reports were not available for the period before June 2022.

Local monitoring stations at BWM that still contribute data to the FRREMP include the Sirius Creek downstream (D/S) and the Rockland Creek upstream (U/S) gauges, which are not located within the Project area (including the Action). However, data from these local monitoring sites reported in the FRREMP (2023 and 2025) is limited to electrical conductivity and pH and does not include TSS, TP and TN.

3.3.2 Sub-basin Water Quality Objectives

The *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water)), which is subordinate legislation to the EP Act, provides a framework for identifying environmental values (EVs) for a waterway and deciding Water Quality Objectives (WQOs) to protect or enhance those EVs.

WQOs from the following documents, pursuant to the EPP (Water), are relevant for the Action:

- *the Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin, September 2011* (DEHP, 2013a).
- *the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin, September 2011* (DEHP, 2013b).
- *the Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Fitzroy River Sub-basin, September 2011* (DEHP, 2013c).

The "Sub-basin WQOs" from the above documents have also been referred to in the FRREMP (2025) report.

3.3.3 Water quality in local creeks

Table 3.1, Table 3.2 and Table 3.3 show the water quality monitoring results for the local monitoring sites in the vicinity of the Action for TSS, TN and TP respectively. These tables also show the Sub-basin WQOs for the Comet River Sub-basin (Water Quality [WQ] 1307), the Mackenzie River Sub-basin (WQ 1304) and the Fitzroy River Sub-basin (WQ 1305), obtained from the FRREMP (2025).

The water quality monitoring results shown in Table 3.1, Table 3.2 and Table 3.3 reflect existing site conditions excluding the Action. The data indicates that:

- At the two local reference sites not affected by mining activities (Taurus Creek U/S and Deep Creek U/S), the median (50th percentile) concentrations of TSS, TN and TP generally exceed the WQOs. At Emu Creek U/S, median pollutant concentrations are even higher.
- Median concentrations of TSS, TN and TP at gauges downstream (east) of BWM are generally higher than concentrations upstream (west) of BWM, which may be due to existing mining activities (excluding the Action), but is also likely due to the larger catchments contributing runoff to these downstream sites.

3.3.4 Regional water quality

Table 3.1, Table 3.2 and Table 3.3 show the water quality monitoring results for the regional FRREMP monitoring sites for TSS, TN and TP, respectively. The statistical summary of the FRREMP data is presented separately for the July 2022 to June 2023 and the July 2024 to June 2025 reporting periods, as that is how the data was reported in the FRREMP annual reports.

The water quality monitoring results shown in Table 3.1, Table 3.2 and Table 3.3 reflect existing site conditions excluding the Action. The data indicates that at the FRREMP monitoring sites:

- Median TSS concentrations are generally below the WQOs.
- Median TN concentrations generally exceed the WQOs.
- Median TP concentrations are generally within or slightly above the WQOs in the Mackenzie and Fitzroy rivers for the 2022/23 reporting period. However, TP concentrations in the Mackenzie and Fitzroy rivers are significantly higher for the 2023/24 reporting period. The reason for elevated TPs during the 2023/24 period compared to the previous year is unknown.
- Median concentrations of TSS, TN and TP in the Mackenzie and Fitzroy rivers are significantly lower than those recorded at the local monitoring sites closer to the Action. This is due to significantly higher flows, and hence a much higher level of dilution in the Mackenzie and Fitzroy rivers compared to the local creeks in the vicinity of the Action.

Table 3.1 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total suspended solids

Monitoring site	Analyte	Sub-Basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min	Max	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	38	75	496	8	10,000	38	311
Deep Creek U/S					13	75	399	12	3,850	29	181
Emu Creek U/S					6	471	895	248	2,940	290	950
Sites downstream (east) of BWM											
Blackwater Creek U/S	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	12	142	622	8	3,620	65	696
Blackwater Creek D/S					72	270	716	6	6,010	137	1,042
Taurus Creek D/S					13	462	795	42	2,420	165	1,400
Two Mile Gully					21	444	722	21	2,340	236	1,280
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	6	31	99	10	382	18	122
Mackenzie River at Bingegang (MAC106)					6	38	45	3	86	28	62
Mackenzie River at Coolmaringa (130105B)					6	26	51	7	146	10	92
Fitzroy River at Riverslea (FIT003)					6	20	33	9	90	16	46
Fitzroy River at The Gap (FIT005)					5	27	58	10	178	19	80
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TSS (mg/L)	< 30 mg/L	< 110 mg/L	< 85 mg/L	6	33	-	3	372	12	92
Mackenzie River at Bingegang (MAC106)					6	22	-	11	69	18	38
Fitzroy River at Riverslea (FIT010)					6	22	-	10	103	16	42
Fitzroy River at The Gap (FIT005)					5	27	-	11	146	16	88

Note: mg/L = milligrams per litre

Table 3.2 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total nitrogen

Monitoring site	Analyte	Sub-basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min.	Max.	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	2	-	1,500	1,300	1,700	-	-
Deep Creek U/S					1	-	1,700	1,700	1,700	-	-
Emu Creek U/S					n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sites downstream (east) of BWM											
Blackwater Creek U/S	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	1	-	100	100	100	-	-
Blackwater Creek D/S					3	2,200	2,867	800	5,600	1,360	4,240
Taurus Creek D/S					1	-	4,400	4,400	4,400	-	-
Two Mile Gully					1	-	600	600	600	-	-
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	6	950	1,000	400	1,900	800	1,000
Mackenzie River at Bingegang (MAC106)					6	850	830	500	1,200	500	1,100
Mackenzie River at Coolmaringa (130105B)					6	850	820	500	1,200	600	900
Fitzroy River at Riverslea (FIT003)					6	500	570	400	800	400	800
Fitzroy River at The Gap (FIT005)					5	800	960	500	1,500	580	1,420
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TN (µg/L)	< 500 µg/L	< 775 µg/L	< 500 µg/L	6	600	-	400	1,800	600	1,600
Mackenzie River at Bingegang (MAC106)					6	750	-	400	4,200	500	1,200
Fitzroy River at Riverslea (FIT010)					6	950	-	400	1,200	500	1,000
Fitzroy River at The Gap (FIT005)					5	900	-	500	1,000	580	1,000

Note: µg/L = micrograms per litre

Table 3.3 Comparison of sub-basin Water Quality Objectives and water quality monitoring results for total phosphorus

Monitoring site	Analyte	Sub-basin WQO			Surface water quality monitoring results						
		Comet (WQ 1307)	Mackenzie (WQ 1304)	Fitzroy (WQ 1305)	Total samples	Median	Mean	Min.	Max.	20%ile	80%ile
Sites upstream (west) of BWM											
Taurus Creek U/S	TP (µg/L)	< 50 µg/L	< 160 µg/L	< 50 µg/L	2	-	170	80	260	-	-
Deep Creek U/S					1	-	130	130	130	-	-
Emu Creek U/S					n/a	n/a	n/a	n/a	n/a	n/a	n/a
Sites downstream (east) of BWM (East)											
Blackwater Creek U/S	TP (µg/L)	< 50 µg/L	<160 µg/L	< 50 µg/L	1	-	20	20	20	-	-
Blackwater Creek D/S					3	660	840	80	1,780	312	1,332
Taurus Creek D/S					1	-	1,300	1,300	1,300	-	-
Two Mile Gully					1	-	120	120	120	-	-
FRREMP monitoring sites (July 2022 – June 2023)											
Comet River at Comet Weir (COM504)	TP (µg/L)	< 50 µg/L	<160 µg/L	< 50 µg/L	6	95	107	30	180	60	180
Mackenzie River at Bingegang (MAC106)					6	55	90	5	260	30	160
Mackenzie River at Coolmaringa (130105B)					6	20	61	5	220	20	80
Fitzroy River at Riverslea (FIT003)					6	55	73	10	200	30	90
Fitzroy River at The Gap (FIT005)					5	60	60	5	80	49	80
FRREMP monitoring sites (July 2023 – June 2024)											
Comet River at Comet Weir (COM504)	TP (µg/L)	< 50 µg/L	<160 µg/L	< 50 µg/L	6	190	-	40	700	80	290
Mackenzie River at Bingegang (MAC106)					6	125	-	20	500	60	400
Fitzroy River at Riverslea (FIT010)					6	245	-	30	360	40	350
Fitzroy River at The Gap (FIT005)					5	220	-	50	370	146	330

Note: µg/L = micrograms per litre

4 SURFACE WATER IMPACT ASSESSMENT

4.1 OVERVIEW

The following sections assessed the potential changes to TSS, TN and TP loads to the GBR as a result of the Action during the maximum disturbance stage of its mining operations, to ultimately determine if the Action would cause an 'impact' to the GBR as defined in section 527E of the EPBC Act.

4.2 CATCHMENT LOSS ANALYSIS

Figure 4.1 compares the Taurus Creek catchment (to Taurus Creek D/S gauge) and the Sagittarius Creek catchment (to the northern ML boundary) under existing and Project conditions (including the Action during mining). The changes in catchment areas are tabulated in Table 4.1.

The Action would involve an extension of the open cut pit footprint towards the east, which would reduce the Taurus Creek and Sagittarius Creek catchments during mining, as a greater portion of undisturbed land would drain to the open cut pits.

The Action, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and a 7.9% reduction in the Sagittarius Creek catchment. The Action would result in a reduction in catchment runoff volumes which in turn, is expected to reduce the TSS, TN and TP loads to the greater Fitzroy basin and ultimately to the GBR.

Table 4.1 Analysis of catchment loss due to the Action

Catchment	Area (km^2)		Difference (%)
	Existing conditions	Project conditions (including the Action)	
Taurus Creek to Taurus Creek D/S gauge	250.4	228.2	-8.9
Sagittarius Creek to northern ML boundary	42.7	39.3	-7.9

Whitehaven Blackwater is committed to undertaking progressive rehabilitation as land becomes available. Rehabilitation would include re-establishing the majority of the Taurus Creek and Sagittarius Creek catchments.

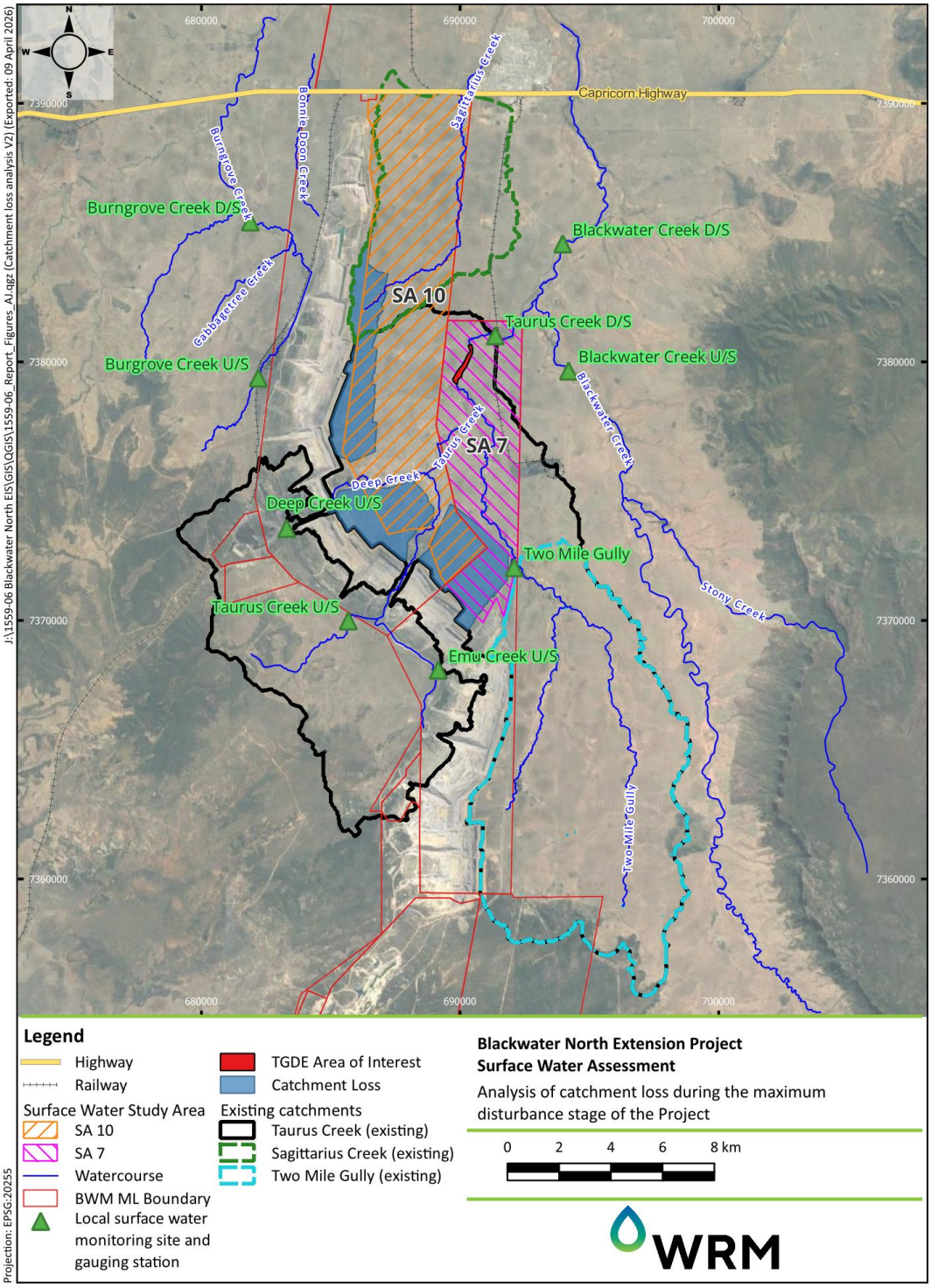


Figure 4.1 Analysis of catchment loss due to the Action during the maximum disturbance stage of its mining operations

4.3 SIMPLIFIED ESTIMATION OF TSS, TN AND TP LOAD REDUCTONS

4.3.1 Water quality targets

The *Reef 2050 Water Quality Improvement Plan*, prepared by the Queensland Government (2018), describes end-of-catchment water quality targets for nutrients and sediments based on the GBR Marine Park Authority's *Water Quality Guidelines for the Great Barrier Reef Marine Park*. They are expressed as end-of-catchment load reductions (see Table 4.2).

The 2025 end-of-catchment water quality targets are expressed as percentage reductions of anthropogenic loads and the required reduction is also shown in tonnes (or kilotonnes for fine sediment).

Table 4.2 End-of-catchment anthropogenic water quality targets for the Reef catchments by 2025 and relative priorities for water quality improvement

Region	Catchment / Basin	Area (ha)	Targets							
			Dissolved inorganic nitrogen		Fine sediment		Particulate phosphorus		Particulate nitrogen	
			tonnes	% reduction	kilotonnes	% reduction	tonnes	% reduction	tonnes	% reduction
Fitzroy	Styx River	301,340	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Shoalwater Creek	360,180	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Waterpark Creek	183,650	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL
	Fitzroy River	14,254,470	MCL	MCL	390	30	380	30	640	30
	Calliope River	224,060	MCL	MCL	15	30	54	30	107	30
	Boyne River	249,630	MCL	MCL	6	40	5	40	9	40

Note: MCL = maintain current load

Source: Queensland Government (2018)

4.3.2 Simplified calculation methodology

Section 4.2 demonstrated that the Action, during its operational phase, would result in a 8.9% reduction of the Taurus Creek catchment and 7.9% reduction in the Sagittarius Creek catchment. This would result in a reduction in catchment runoff from undisturbed land that would otherwise report directly to Taurus Creek and Sagittarius Creek.

A simplified analysis was undertaken to estimate the expected TSS, TN and TP loads (in tonnes or kilotonnes) that would be loss as a result of the Action during mining, based on recorded flow data (described in Section 3.2) and water quality monitoring data (described in Section 3.3).

The simplified calculation was undertaken based on the following assumptions:

- The Action, during mining, would result in a net loss of approximately 25.5 km^2 of undisturbed land that currently contributes runoff, including fine sediments and nutrients, to the GBR.
- An annual median runoff volume from these 'loss' undisturbed areas was estimated based on the total of the recorded median monthly flow volumes in Taurus Creek at the Taurus Creek D/S gauge (as shown in Figure 3.5), which were factored down in proportion to the catchment area that would be loss.
- Representative pollutant concentrations were adopted for TSS (496 mg/L), TN (1,700 micrograms per litre [µg/L]) and TP (170 µg/L), based on the highest mean concentration of samples between the Taurus Creek U/S and Deep Creek D/S local monitoring sites given in Table 3.1, Table 3.2 and Table 3.3. Runoff reporting to these local monitoring sites is relatively unaffected by mining activities and is therefore representative of 'undisturbed' land.

4.3.3 Results

Table 4.3 shows the estimated annual reduction of TSS, TN and TP loads (in tonnes) as a result of the Action. The Action would result in minor reductions in TSS, TN and TP loads which is in line with the Queensland Government (2018) end-of-catchment water targets.

The loss of undisturbed catchment to the GBR adds additional catchment reporting to the BWM water management system (WMS). However, current investigations indicate that the Action would not result in material changes to the frequency and volume of releases from the BWM due to the additional catchment reporting to the WMS.

Table 4.3 Simplified calculation of predicted reduction in annual total suspended solids, total nitrogen and total phosphorus loads to the Great Barrier Reef

Loss of median annual discharge volume (ML/a)	TSS		TN		TP	
	Representative concentration (mg/L)	Load reduction (kilotonnes)	Representative concentration (µg/L)	Load reduction (tonnes)	Representative concentration (µg/L)	Load reduction (tonnes)
73.9	496	0.04	1,700	0.13	170	0.01

Note: ML/a = megalitres per annum

4.4 WATER RELEASES

4.4.1 Overview

The Project would continue to operate within an established and regulated surface water management framework that prioritises the capture, reuse and controlled release of Mine Affected Water (MAW). Surface water management measures include separation of clean and contaminated water, sediment and erosion control structures, operational water balance controls, and Trigger Action Response Plans (TARPs) to prevent uncontrolled releases.

4.4.2 Controlled release strategy

Controlled release of MAW is currently authorised under the EA. Releases shall only occur in compliance with the EA release conditions to ensure no environmental impacts from MAW to the receiving environment. Within the Taurus Creek catchment, controlled release of MAW can occur (in compliance with the EA release conditions) at "Licensed Discharge Points" RP2 (Taurus Dam), RP3 (New Deep Creek Dam) and RP4 (Tannyfoil Dam), as shown in Figure 3.3.

Modelling of the site water balance (HydroBalance, 2026) and flooding behaviour (WRM, 2026) indicates that controlled releases, where required, would occur in accordance with existing EA conditions (Schedule F) and relevant WQOs.

Controlled releases under Schedule F of the EA EPML00717813 would only occur during periods when receiving waterways have recorded a natural flow in excess of the minimum flow trigger in response to rainfall-generated catchment runoff. At these times, local creeks would be exhibiting elevated, event-driven flows characterised by increased water levels, higher velocities and short-duration runoff pulses which would likely include natural turbidity and sediment transport reflecting storm conditions.

There are no proposed changes to the currently approved controlled release strategy as a result of the Action. In addition, there are no proposed changes to release infrastructure (release dams and pipelines). In summary, controlled releases would continue to be undertaken in accordance with the EA release conditions.

4.4.3 Uncontrolled releases

The Whitehaven documents *WHC QLD Standard – Erosion & Sediment Control and Mine Affected Water* (Whitehaven, 2024), *BWM Plan – Water Management* (Whitehaven, 2023) and *BWM Plan – Erosion and Sediment Control Plan* (Whitehaven, 2022) outline the strategies and design objectives currently implemented at BWM to manage legacy risks associated with uncontrolled discharges from MAW storages and sediment dams. The management strategies described in this standard will continue to apply to the Project.

The Project is not expected to increase the risk of uncontrolled discharges from site storages to receiving waterways for the following reasons (HydroBalance, 2026):

- The proposed changes to the Project footprint are limited to the eastward expansion of existing pits. Resulting catchment changes are confined to the expanding pits, which drain internally.
- The Project does not alter the contributing catchments or drainage arrangements of existing MAW storages or sediment dams that have been identified as having potential for uncontrolled discharge.
- The Project does not modify the catchments of New Taurus Creek Dam or New Deep Creek Dam, which have a higher potential for uncontrolled discharges due to their on-stream configuration.

4.5 EROSION AND SEDIMENT CONTROL STRATEGY

4.5.1 Erosion and Sediment Control Plan

The *BWM Erosion and Sediment Control Plan* (ESC Plan) by Whitehaven (2022), outlines the current ESC strategy for BWM. The selection of sediment control requirements is guided by the catchment 'risk matrix' shown in Table 4.4 and Table 4.5 (Whitehaven, 2022). Catchments are assigned a risk rating ranging between 'Very Low', 'Low', 'Medium', 'High', 'Very High' and 'MAW' depending on the catchment characteristics.

For catchments classified as 'Very Low' to 'Low' risk rating, small-scale or supplementary sediment controls or supplementary sediment controls may be appropriate controls on a temporary basis during small-scale, short-term construction/exploration stages prior to implementing erosion protection measures such as revegetation. Typical supplementary sediment controls are listed in the *Best Practice Erosion and Sediment Control Guidelines* (IECA, 2008), but may include:

- excavated sediment traps;
- rock check dams; and
- sediment fencing/bunds.

For catchments classified with a risk rating of 'Medium' or higher, sediment basins are used as a sediment control measure. BWM currently have two sediment dams in the vicinity of the Action (shown in Table 4.6 and Figure 4.2) to capture sediment laden runoff from the disturbed areas and provide an area where settlement of suspended sediment in runoff can occur.

The Action would not increase the catchment draining southwest into Deep Creek and Taurus Creek (downslope of the overburden dumps) during mining, compared to current conditions. As such, no additional sediment dams are proposed as part of the Action.

Table 4.4 Catchment risk assessment criteria

Risk Rating	Soil/spoil category	Disturbed Catchment area (ha)	Duration of disturbance	Average catchment slope
Very Low	Competent material	Less than 0.5 ha	Less than 3 months	Less than 1%
Low		0.5 to 1 ha	3 to 6 months	1% to 3%
Medium	Non-dispersive topsoil	1 to 4 ha	6 months to 2 years	3% to 10%
High	Dispersive topsoil	Greater than 4 ha	Greater than 2 years	Greater than 10%
	Non-dispersive spoil			
Very High	Dispersive spoil	Any	Any	Any
MAW	Per MAW definition in Section 2.2	Any	Any	Any

Source: Whitehaven (2022)

Table 4.5 Sediment control design standard

Risk Rating	Sediment control design standard
Very Low	No controls
Low	Supplementary sediment controls
Medium	FT[a] Sediment basin (80%ile 5 day)
High	FT[a] Sediment basin (90%ile 5 day)
Very High	Containment basin (95%ile 5 day)
MAW	MAW Dam (Section 3)

[a] – flow-through basin

Source: Whitehaven (2022)

Table 4.6 Existing sediment dams at BWM in the vicinity of the Action

Sediment dam	Easting (AGD66)	Northing (AGD66)
North MIA Sediment Dam	691,373	7,370,009
R12 Void Dam	685,045	7,386,244

Source: Whitehaven (2022)

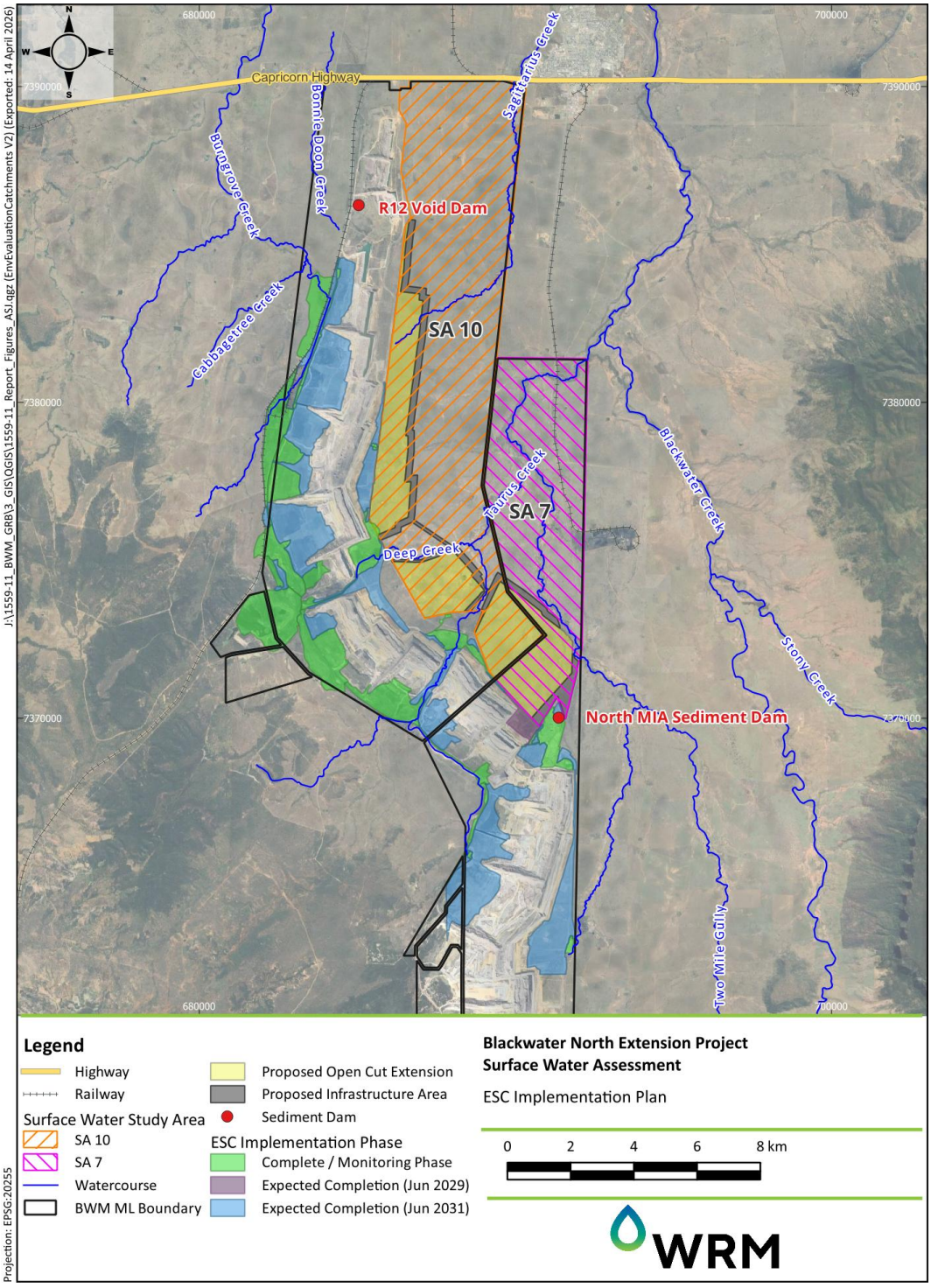


Figure 4.2 ESC Implementation Plan

4.5.2 ESC implementation plan

The *Blackwater Mine Water Management Plan* (WMP) by Whitehaven (2025), outlines the BWM's ESC 'implementation plan', which include the actions to mitigate potential environmental harm for each catchment discharging to Burngrove Creek, Deep Creek, Taurus Creek, and Emu Creek during rainfall events. The Water Management Plan (WMP) states that these actions include both permanent controls and temporary mitigating works, which may be undertaken while further studies and design work are completed to inform the final permanent controls required.

Figure 4.2 shows the catchments included in the ESC implementation plan and whether ESC measures are in place or proposed in each catchment (Whitehaven, 2025). As operations at the mine progress, these catchments are likely to change. Figure 4.2 shows that ESC measures are already in place in the catchments immediately adjacent to receiving waterways. Rehabilitation and/or installation of appropriate erosion and sediment controls is planned to be completed over significant areas of the BWM by June 2031.

In summary, the ESC implementation plan as described in the WMP would minimise the release of fine sediments to the receiving waterways and ultimately to the GBR, resulting from currently approved operations as well as the Action (Whitehaven, 2025).

4.6 POST-CLOSURE

At the completion of mining, surface runoff from rehabilitated in-pit and out of pit waste rock emplacement areas would flow to the receiving environment, with the exception of approximately 27.3 km^2 which would report to five residual voids associated with the Project (WRM, 2026).

There would be no releases from the Action post-closure. SLR (2026) predicted that of the five residual voids, three are expected to become long-term sinks, and the other two are predicted to become flow-through systems reporting to these long-term sinks.

5 SUMMARY

The GBR is located approximately 600 river km downstream (and 210 km east) of the Action. As such, the Action would not result in any direct impacts to the GBR. Therefore, only the potential indirect impacts of the Action due to runoff and surface water releases were assessed.

The greatest water quality risks to the GBR are from nutrients, fine sediments and pesticides. Water quality targets have been set for DIN, fine sediment (which is measured as TSS), particulate phosphorous and particulate nitrogen. Based on the availability of data, potential impacts on surface water quality were assessed for TSS, TN and TP only.

The Action, during mining, would result in an 8.9% reduction of the Taurus Creek catchment and 7.9% reduction in the Sagittarius Creek catchment. The Action would result in a reduction in catchment runoff volumes which in turn, is expected to reduce the TSS, TN and TP loads to the Greater Fitzroy Basin and ultimately to the GBR. The minor loss of annual TSS, TN and TP loads to the GBR as a result of the Action is in line with the Queensland Government (2018) end-of-catchment water targets.

There are no proposed changes to the currently approved controlled release strategy as a result of the Action. In addition, there are no proposed changes to release infrastructure (release dams and pipelines). Controlled releases would continue to be undertaken in accordance with the EA release conditions.

The ESC implementation plan as described in the WMP (Whitehaven, 2025) would minimise the release of fine sediments to the receiving waterways and ultimately to the GBR, resulting from currently approved operations as well as the Action (Whitehaven, 2025).

In summary, the potential surface water impacts associated with the Action on the GBR Marine Park would be insignificant and would not meet the 'substantial cause' requirement of an indirect impact as outlined in section 527E(2) of the EPBC Act. Additionally, the Action (during mining), would achieve a 'no net decline' in water quality from the release of waters into the GBR catchment waters. On this basis, the Action would have no residual impact and therefore complies with section 41AA of the EP Regulation.

Regards,

Ardianto Notodirdjo

Principal Engineer

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Blackwater North Extension Project

Appendix C
Groundwater Impact Assessment



Blackwater North Extension Project

Groundwater Impact Assessment

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Whitehaven Blackwater Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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Appendices

Appendix A- 80th Percentile Summary Statistics and Comparison to Guideline Values (BWM EA Bores)

Appendix B Groundwater Modelling Technical Report

Acronyms and Abbreviations

ADWG	Australian Drinking Water Guidelines
ATP	Authority to Prospect
BoM	Bureau of Meteorology
BMA	BM Alliance Coal Operations Pty Ltd
BWM	Blackwater Mine
CHPP	Coal Handling and Preparation Plant
CRD	Cumulative Rainfall Departure
CSG	Coal Seam Gas
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DETSI	Department of Environment, Tourism, Science and Innovation
DRDMW	Department of Regional Development, Manufacturing and Water
EA	Environmental Authority
EP Act	Environmental Protection Act 1994
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EV	Environmental Value
GABORA	Great Artesian Basin and Other Regional Aquifers
GDE	Groundwater Dependent Ecosystems
GMA	Groundwater Management Area
GWDB	Registered Groundwater Bore Database
HES	High Ecological Significance
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Development
MNES	Matter of National Environmental Significance
NGIS	National Groundwater Information System
NHMRC	National Health and Medical Research Council
RCM	Rangal Coal Measures
ROM	Run of Mine
SILO	Scientific Information for Landowners
SLR	SLR Consulting Australia Pty Ltd
TDS	Total Dissolved Solids
TLF	Train Loadout Facilities
TSF	Tailings Storage Facility
UWIR	Underground Water Impact Report
VWP	Vibrating Wire Piezometer



Water Act	*Water Act 2000*
WQO	Water Quality Objective
WRP	Water Resource Plan

1.0 Introduction

1.1 Overview

SLR Consulting Australia Pty Ltd (SLR) was engaged by Whitehaven Blackwater Pty Ltd (Whitehaven) to assess the potential impacts of the proposed Blackwater Mine - North Extension Project (the Project) on groundwater values.

The assessment has been prepared to support the assessment of the Project under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and to support an application to amend the existing Environmental Authority (EA) for the Blackwater Mine (BWM) under the Queensland *Environmental Protection Act 1994* (EP Act).

The scope of this study is to:

- Describe the existing hydrogeological environment of the Project area and surrounds.
- Assess the potential impacts of the proposed extension of open cut mining on the groundwater system.
- Propose measures to manage or mitigate impacts on groundwater environmental values.

The study area for the purpose of this assessment is shown on **Figure 1-1** and is defined as the extent of the groundwater model domain (refer to **Section 6.0** for a description and extent), which includes the Project area and surrounds. The scope of this groundwater impact assessment is focused on the open cut mining operations proposed within the Project area, with cumulative impacts considered from other mines in the study area.

1.2 Project Background

The BWM is located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (**Figure 1-1**).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the EP Act.

The BWM is approved to produce up to approximately 19 million tonnes per annum of (Mtpa) of Run-of-Mine (RoM) coal equating to approximately 16 Mtpa of product coal. The BWM strike length includes mining occurring in a number of separate and/or adjoining pits (**Figure 1-2**). Existing infrastructure is located primarily on ML1760 and includes a Train Load-out Facility (TLF) and coal stockpiles, RoM stockpiles, Coal Handling and Preparation Plant (CHPP), water management infrastructure and supporting infrastructure (i.e., roads, powerlines, laydown areas, workshop and administration areas).

The EA applies to the following Mining Leases (MLs) (**Figure 1-2**):

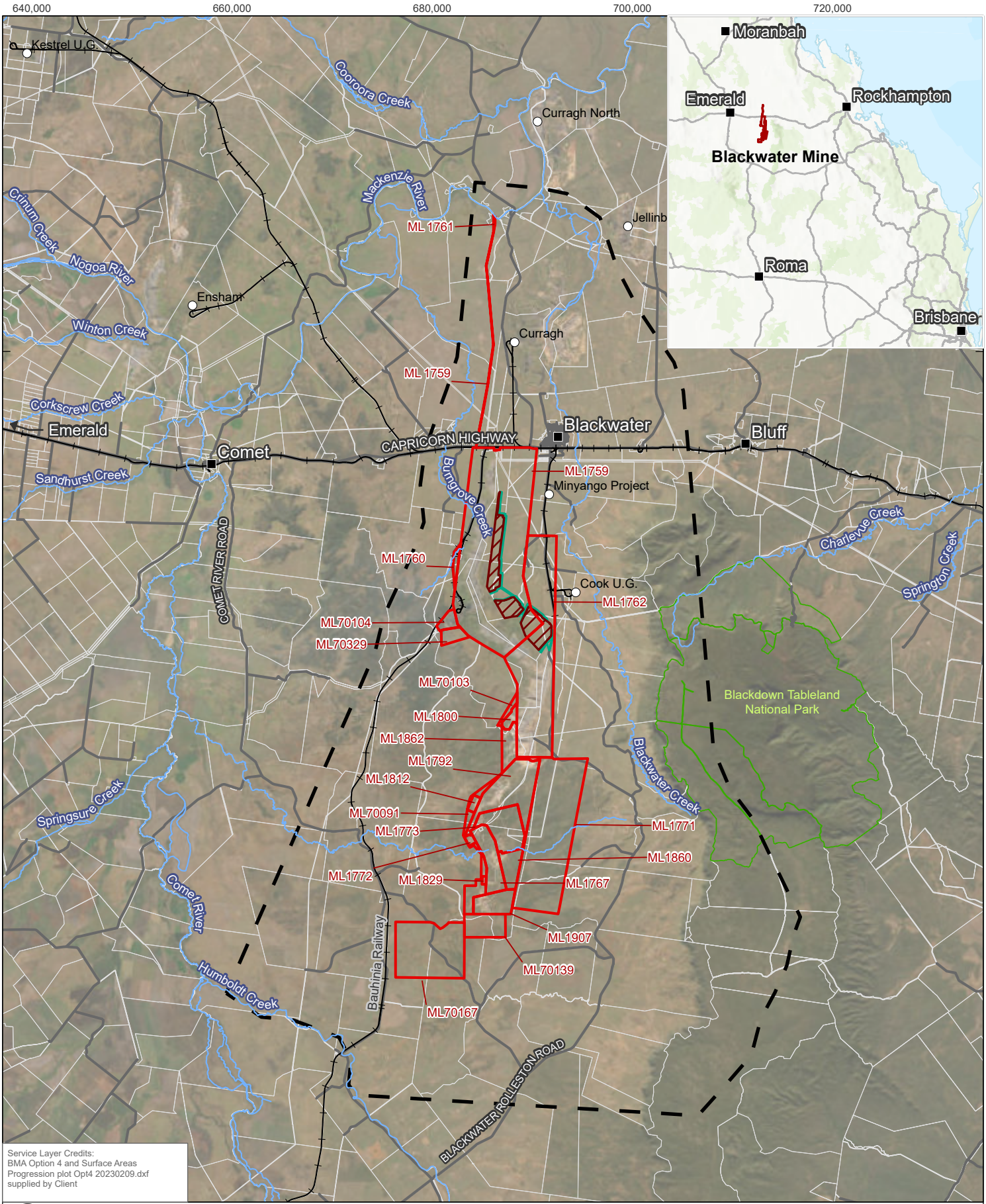
- ML1759
- ML1760
- ML1761
- ML1762
- ML1767
- ML70329
- ML1771
- ML1772
- ML1829
- ML1860
- ML1862
- ML1773
- ML1792
- ML1800
- ML1812
- ML1907
- ML70091
- ML70103
- ML70104
- ML70139
- ML70167

Whitehaven Blackwater seeks relevant State and Federal approvals to extend the current mining operation through the Blackwater North Extension Project (the Project). The Project would extend the mining area of the existing BWM to within Surface Area (SA)10 on ML1759 and SA7 on ML1762 (**Figure 1-2** and **Figure 1-3**). Importantly, the Project should be viewed in the context that it is an extension and continuation of ongoing mining operations on a portion of the significantly larger BWM mining operation.

The key elements of the Project include, but are not limited to, the following:

- extension of open cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 Mt (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

SA7 on ML1762 and SA10 on ML1759 cover a total area of approximately 9,010 hectares (ha). The extent of the proposed Project open cut mining area and out of pit disturbance areas is approximately 2,317 ha of additional disturbance.



BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

PROJECT LOCATION

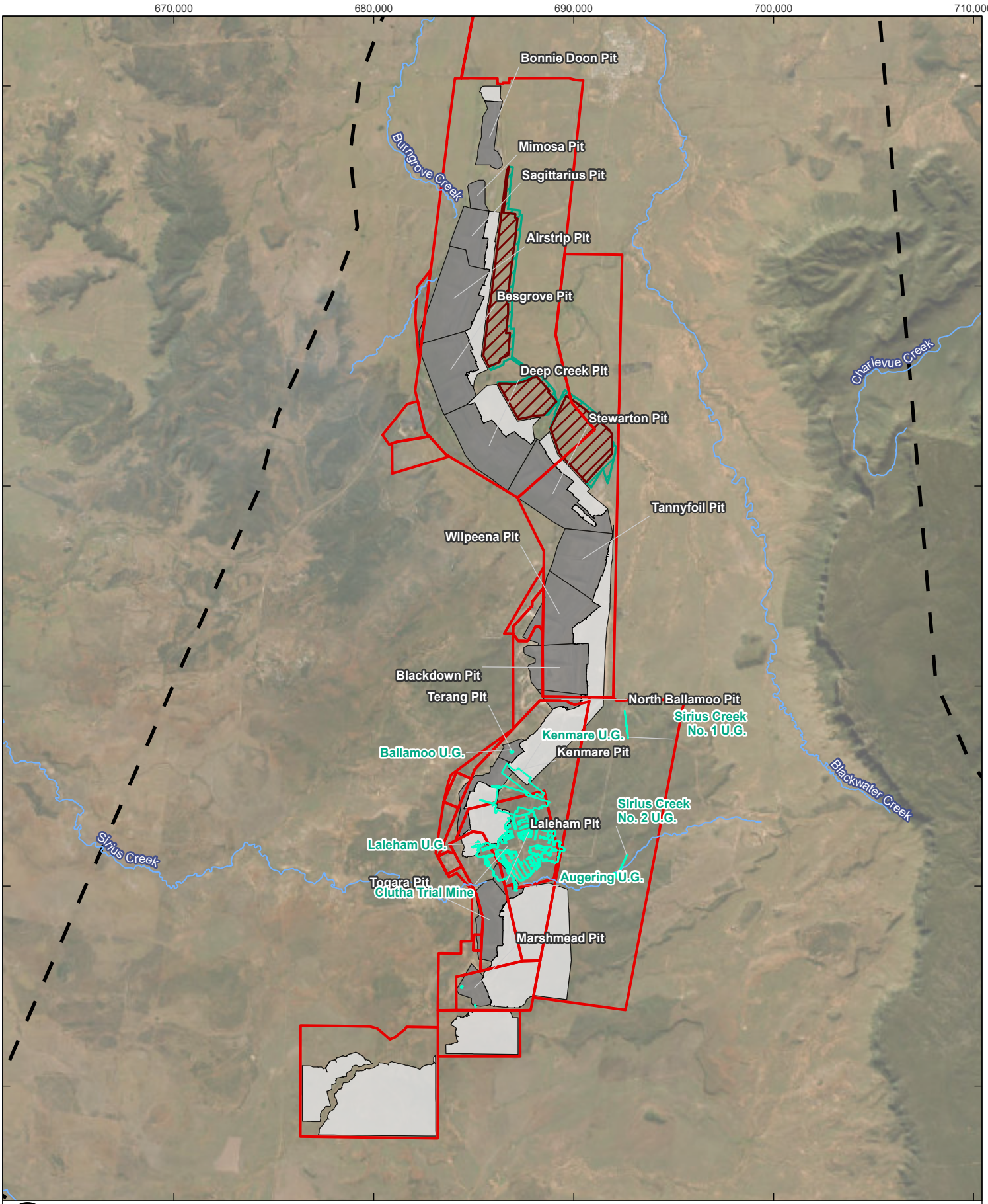
Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

SLR

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FIGURE 1-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_01_Project Location



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Watercourse
- Historical Underground Mine
- BWM Mining Lease
- GIA Study Area
- Future Pit Extent
- Historical Pit Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT

GROUNDWATER ASSESSMENT

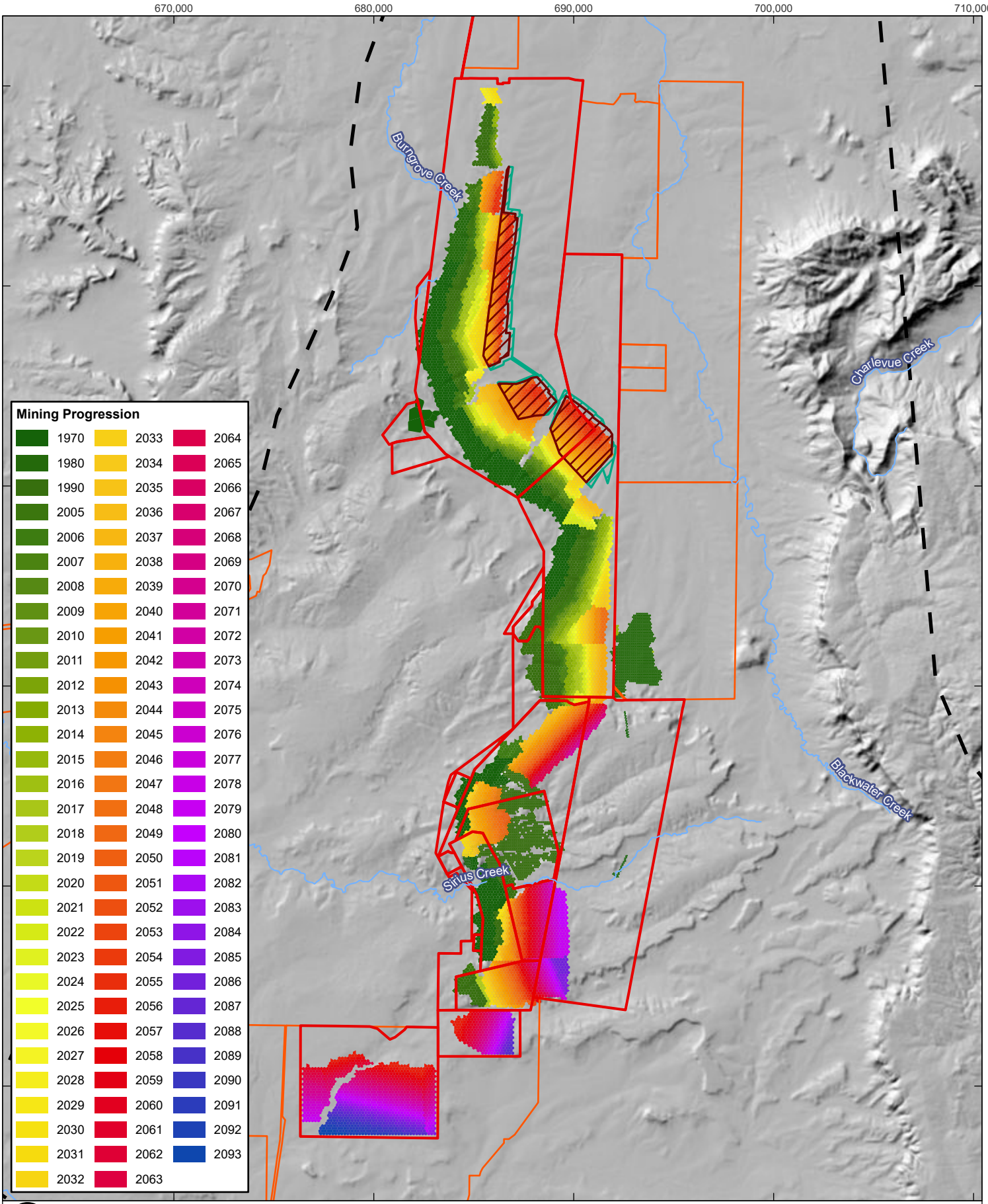
BWM MINING AREAS

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FIGURE 1-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_02_BWM_Mining_Areas



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area

BLACKWATER NORTH PROJECT EIS
GROUNDWATER ASSESSMENT

MINING PROGRESSION

SLR

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FIGURE 1-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F01_03_Mining Progression

1.3 Study Objectives

This groundwater assessment was undertaken in accordance with the Queensland government requirements under Chapter 3 of the *Water Act 2000* (Qld) (Water Act), the EP Act and the Commonwealth government requirements under the EPBC Act, (specifically the Water Trigger, refer to **Section 2.1.1**).

To achieve regulatory requirements the groundwater assessment includes:

- A description of the existing hydrogeological environment.
- An assessment of the potential impacts of mining on the groundwater environment.
- Proposed management and mitigation measures.

In compiling these elements of the groundwater assessment, the scope of work detailed in this report was to:

- Summarise the relevant Queensland and Commonwealth environmental regulatory framework.
- Review relevant groundwater, geotechnical and environmental reports to characterise the geological and hydrogeological setting of the Project.
- Review publicly available hydrogeological data such as the Queensland Government's spatial data system (Queensland Globe) and the Bureau of Meteorology's (BoM) National Groundwater Information System (NGIS).
- Characterise the existing groundwater resources, including properties and quality.
- Conceptualise the groundwater regime of the Project area and study area.
- Assess the potential interaction between surface water and groundwater.
- Construct and calibrate a numerical groundwater flow model suitable for the assessment of potential impacts of the Project, in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).
- Perform predictive modelling for the scale and extent of mining impacts upon groundwater levels, groundwater quality and groundwater users at various stages during mine operations and post-mining.
- Perform predictive modelling of the cumulative impacts of the Project and surrounding mines.
- Assess the extent of groundwater impacts to groundwater users and environmental values due to the Project, including through long-term impacts on regional groundwater interception, groundwater drawdown, incidental water impact and post mining equilibrium.
- Document any groundwater dependent ecosystems (GDEs) in the vicinity of the Project that could be impacted by the Project resulting from short and/or long-term changes in the quantity and quality of groundwater.
- Assess potential third-party impacts (i.e. privately-owned bores) as a result of changes to the regional groundwater system due to the Project.
- Develop reasonable and practicable mitigation and management strategies where potential adverse impacts are identified.
- Outline proposed groundwater monitoring network and groundwater management.



2.0 Legislative Requirements and Relevant Guidelines

2.1 Legislation

Relevant legislation in relation to taking or interfering with groundwater resources in the study area is as follows:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Queensland *Water Act 2000* (Water Act):
  - Water Plan (Fitzroy Basin) 2011.
- Queensland *Environmental Protection Act 1994* (EP Act):
  - *Environmental Protection Regulation 2019.*
  - *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water and Wetland Biodiversity).

The following sections summarise Commonwealth and Queensland groundwater legislation and policy relevant to the Project.

2.1.1 Commonwealth Environment Protection and Biodiversity Act 1999

The EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). The EPBC Act is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES). Under the EPBC Act, potentially significant impacts on groundwater resources are included where they pertain to a coal seam gas (CSG) or large coal mine development, known as the 'water trigger'.

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory committee established under the EPBC Act that provides scientific advice to the Commonwealth Environment Minister and relevant State ministers. Guidelines have been developed in order to assist the IESC in reviewing CSG or large coal mining development proposals that are likely to have significant impacts on water resources. This includes completion of an independent peer review of numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The IESC information requirements checklist is presented in **Table 2-1**, with details on where aspects have been addressed and documented within the report.

Table 2-1 IESC Information Requirements Checklist

Assessment Aspect and Checklist Item	Report Section Addressed
Description of the proposed project	
General	
Provide a regional overview of the proposed project area, including a description of the geological basin, coal resource, surface water catchments, groundwater systems, water-dependent assets (including terrestrial and aquatic GDEs), and past, present and reasonably foreseeable coal mining and CSG developments.	**Section 1.2**
Describe the proposal's location, purpose, scale, duration and disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	
Assess the frequency (and time lags, if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	
Regulatory Context	
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	**Section 2.0**
Describe how potentially impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g., water planning rules) for the surface water catchments and groundwater basins within which the development proposal is based.	
Describe public health, recreation, amenity, Indigenous, tourism and/or agricultural values for each water resource, and the plans relevant to their management and protection.	
Groundwater Context	
Describe and map the geology at an appropriate level of horizontal and vertical resolution, including: • definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data • identification of hydrogeological sequences and characteristics.	**Sections 4.0** and **5.0**
Define and describe or characterise significant geological structures (e.g., faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. • Provide geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace (e.g., Murray and Power 2021). • Include discussion of how the faults potentially influence regional-scale groundwater conditions.	
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	

Assessment Aspect and Checklist Item	Report Section Addressed
• Identify current stressors, including impacts from any currently approved projects.	
Describe the existing water quality of all aquifers in the project area. • Where groundwater is to be used for a given purpose such as irrigation, compare the data with relevant guideline values (ANZG 2018) and regional and local water quality objectives.	
Environmental impact assessment	
General	
Describe the intensity, duration, magnitude, timing and geographic extent of each potential impact, specifying the impact's significance and consequences, especially on the environmental condition and human values of each water resource.	**Sections 7.1**, **7.2**, **7.3** and **7.4**
For proposed expansions or modifications, distinguish potential impacts from those of the existing project, and include the likely contribution of the proposed expansion to potential cumulative impacts.	
Assess the significance of each impact with reference to the range of system behaviour found under pre-development conditions and natural environmental and climatic variability.	
Risk-based assessment	
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk-assessment approach, consideration should be given to the complexity of the project and the probability and potential consequences of the project's impacts.	**Section 7.6**
Describe the consultation with relevant stakeholders and regulators about the likely risks to water resources and water-related assets. This initial engagement should include agreement about the nature of the action, which assets (including water resources) may be impacted, and the likely sources of impacts and the receptors that may be affected.	N/A
The risk assessment should include a systematic and evidence-based assessment of: • the sources of environmental impacts in the project area • the exposure pathways by which impacts may be transferred from these sources to water resources (receptors), presented as one or more IPDs based on ecohydrological conceptualisation • the likely response of each receptor, especially when the impact(s) may be severe and likely to cause irreversible damage (posing a high risk) • 'hot spots', or areas in the project area (e.g., where vulnerable receptors occur close to impact sources) where risks are especially high • 'hot moments', or periods during and after the project (e.g., when activities are likely to generate major impact) when risks are especially high.	**Section 6.9**
Specify where and how each risk can be avoided or mitigated (or, as a last resort, requires appropriate offsets and/or a conservation payment), and: • provide evidence (preferably from equivalent activities and regions) for the feasibility and effectiveness of mitigation or offset methods	**Section 8.0**

Assessment Aspect and Checklist Item	Report Section Addressed
• describe how monitoring will be able to demonstrate the effectiveness of the mitigation measures.	
Describe the risks of potential cumulative impacts of all past, present and reasonably foreseeable actions and activities that are likely to impact on water resources, including from multiple stressors arising from the proposed action.	**Sections 7.1**, **7.2**, **7.3** and **7.4**
Specify all sources of uncertainty in the assessments of each risk and describe how information has been and will be collected to reduce this uncertainty.	See Groundwater Modelling Technical Report (Appendix B)
Investigate relevant context for the risk assessment, such as bioregional assessments, Commonwealth and state water resource plans (e.g., Murray-Darling Basin Plan, Hunter River Salinity Trading Scheme) and state processes such as those that apply in the Surat Cumulative Management Area and the Commonwealth's Joint Industry Framework on Coal Seam Gas.	**Sections 2.0** and **7.6**
Assess residual risks remaining after the implementation of the proposed mitigation and management options, to determine whether these effectively reduce risks to an acceptable level based on the identified environmental objectives.	**Sections 7.6** and **8.0**
Groundwater	
Undertake groundwater modelling in accordance with the *Australian groundwater modelling guidelines* (Barnett et al. 2012), including independent peer review.	**Section 6.0** and Groundwater Modelling Technical Report (Appendix B)
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and hydraulic linkages between units, if any.	
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	
Select and justify appropriate boundary conditions across the model domain to enable a comparison of groundwater model outputs to seasonal field observations.	
Where possible, calibration should incorporate measurements of both potentiometric head (or pressure) and flux, such as measured mine inflows or measured discharges to streams or springs.	
Undertake sensitivity analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model. Where the interaction between surface water and groundwater is important, parameters describing their connectivity, such as riverbed conductance, should be assessed.	
Assess the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: • any hydrogeological units that will be directly or indirectly dewatered or depressurised (including lateral effects), interactions between water resources (inter-aquifer connectivity), and connectivity with sea water	

Assessment Aspect and Checklist Item	Report Section Addressed
• the magnitude, extent and change over time of drawdown/mounding, including the time for post-development equilibrium to be reached • the extent of impacts on surface water/groundwater connectivity, water-dependent assets, flow direction and surface topography, including resultant impacts on the groundwater balance • the potential range of drawdown at each affected bore, and clearly articulate the spatial and temporal scales of impacts on other water users • the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units • the possible fracturing of and other damage to confining layers.	
Undertake an uncertainty analysis of key predictive outputs (i.e., quantities of interest as per Peeters and Middlemis, 2023).	
For each relevant hydrogeological unit, describe the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.	
Closure, rehabilitation and post-development final landforms and voids	
Describe the timing and processes planned for cessation of operations and the closure of the development, particularly any risks of impacts on water-dependent assets that may arise during this phase (e.g., when dismantling and removing infrastructure). Explain how such risks will be avoided or mitigated.	Addressed in a separate PRCP report to be prepared for the Project
If appropriate, qualitatively describe the various final landform options that were considered and their likely legacy impacts on water resources. This context will be useful for justifying the choice of the proposed final landform and how it avoids or mitigates risks of legacy impacts on water resources.	
Ideally, describe how land disturbed by mining activities will be progressively rehabilitated to a safe and stable landform that does not cause environmental harm to water resources and is able to sustain one or more approved post-mining land uses (PMLUs). Give details of the consultation with regulators and the community about the intended PMLUs, the targets associated with their achievement, and how achievement of these targets may be hampered by, for example, site geology and climatic extremes.	
If requested by regulators, specify and justify the methods and techniques that will be used to achieve particular rehabilitation targets and milestones. Explain how these methods may be constrained by project-specific features (e.g., topography, climate, geology and hydrology).	
If appropriate, describe how the effectiveness of the proposed rehabilitation methods and techniques for protecting or restoring water resources will be monitored, and present details (e.g., parameters, sampling frequency) of a monitoring program for demonstrating successful achievement of the targeted PMLUs across the project area after mining or CSG extraction has finished. These monitoring programs should be linked to explicit milestones for completion of progressive stages of rehabilitation, and should include appropriate baseline data against which to judge the effectiveness of the rehabilitation.	

Assessment Aspect and Checklist Item	Report Section Addressed
Describe the final landform and any voids that may remain after closure, and specify the predicted legacy impacts that may persist, such as ongoing effects on surface water and groundwater movements and water quality, erosion and sedimentation, and habitat fragmentation of water-dependent species and communities. Evaluate the adequacy of the modelling underlying these predictions, especially all sources of uncertainty.	
Assess qualitatively the likely long-term risks of impacts on water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: • stability (e.g., resistance to erosion and slumping), soil geochemistry and quality (relevant for post-closure establishment of vegetation) and the likely effects of the final landform on long-term surface water and groundwater behaviour (e.g., fluxes and runoff) and on water quality, including salinity, pH, toxicity and concentrations of contaminants • geochemistry and its potential effects on seepage through waste rock (e.g., fully or partially refilled voids, remnant rock dumps) and on the quality of water exiting from mine adits and other post-closure sources • groundwater behaviour and rate and depths of water table recovery, including timeframe and final levels of stabilisation • available measures (and their likely effectiveness and feasibility) to avoid or mitigate legacy impacts from the final landform and any voids on water resources and water-dependent assets.	
Baseline data	
For groundwaters, surface waters and ecological water-dependent assets that have been identified in the risk-based assessment, present data that are sufficient to establish pre-development (baseline) conditions and that have been collected at an appropriate sampling frequency and spatial coverage of monitoring sites, ideally over a period sufficiently long to characterise the impacts of climatic variability.	**Section 5.1** and **5.3**
Groundwater	
Provide data from surveyed boreholes to demonstrate the varying depths of the hydrogeological units and associated standing water levels or potentiometric heads, including directions of groundwater flow, contour maps and hydrographs.	**Section 5.0**
Present information from site-specific studies (e.g., geophysical, coring/wireline logging) to characterise the local stress regime and fault structure (e.g., damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays).	
Provide site-specific values for hydraulic parameters (e.g., vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics, including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	
Provide hydrochemical characterisation (e.g., acidity/alkalinity, electrical conductivity, metals and major ions) and a suitable suite of environmental tracers (e.g., heat; stable isotopes of water; tritium, helium, strontium isotopes) (e.g., Kurukulasuriya et al. 2022; OWS 2020) commensurate with the risks of the proposed development to water resources and water-dependent assets.	

Assessment Aspect and Checklist Item	Report Section Addressed
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes. This should include time-series data for water levels and water quality that represent seasonal and climatic cycles.	
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	
Monitoring and management	
Describe the rationale for selected monitoring parameters and their sampling duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor large-scale impacts. Target monitoring programs to address key areas of uncertainty, especially for valued assets and water resources that are at greater risk of impacts from the proposed development.	**Section 8.0**
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy guidelines (ANZG 2018) and relevant legislated state protocols (e.g., Queensland Government 2018).	
Identify and justify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts. Match suitably replicated control and reference sites (BACI design, Downes et al. 2002) to enable detection and monitoring of potential impacts.	
Describe the processes employed to determine impact thresholds for water-dependent assets (e.g., threshold at which a significant impact on an asset may occur).	
Describe proposed mitigation and management actions, and their adequacy, for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts, and provide evidence of the likely success of these measures (e.g., case studies).	
Propose adaptive management measures and management responses, giving details of trigger action response plans (TARPs) for valued assets and water resources that are at greater risk of impacts from the proposed development.	
Groundwater	
Describe a robust groundwater monitoring program using dedicated groundwater monitoring bores – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing information on the groundwater regime and on recharge and discharge processes and identifying changes in quantities and quality of groundwater over time.	**Section 8.0**
Where reinjection schemes are proposed to manage wastewater (e.g., managed aquifer recharge), the monitoring program should include components specifically targeted at identifying any potential impacts from this management action.	N/A
Cumulative impacts	

Assessment Aspect and Checklist Item	Report Section Addressed
Assess the condition and likely responses of all water-dependent assets and water resources likely to be cumulatively impacted by the proposed development combined with all developments (past, present and/or reasonably foreseeable) and other water-intensive activities.	**Sections 6.6.2.2**, **7.1**, **7.2** and **7.3**
Assess the cumulative impacts on potentially affected water-dependent assets and water resources, considering: • the full extent of potential impacts from the proposed project (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts) • all stages of the development, including exploration, operations and post-closure/rehabilitation • the likely spatial magnitude and timeframe over which cumulative impacts will occur (ensuring that the analysis has sufficiently broad geographic and temporal boundaries to include all potentially significant impacts) • opportunities to work with other water users to avoid or mitigate potential cumulative impacts to meet specified environmental objectives.	

2.1.2 Queensland Water Act 2000

The Water Act, supported by the subordinate *Water Regulation 2016*, is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

The statutory right of a tenure holder to take or interfere with underground water is granted as part of the ML approval under the *Mineral Resources Act 1989* (Qld) (MR Act), if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the mineral resource. This water is termed ‘associated water’. In developing the Project, Whitehaven is proposing to exercise its underground water rights as part of planned mining activities. Chapter 3 of the Water Act then deals with the management of water related impacts resulting from such an exercise of underground water rights, including where the exercise of underground water rights had happened prior to the commencement of the Water Legislation Amendment Act 2016 per s1283 of the Water Act 2000 (Qld). As this occurred on ML1759 and ML1762 (per correspondence to the Department of Environment and Heritage Protection (DEHP) (now the Department of Environment, Tourism, Science and Innovation [DETSI]) on 3 March 2017), no additional water licence or Underground Water Impact Report (UWIR) is required to be prepared for the Project.

2.1.2.1 Management Framework Relevant to the Project

Water resources within the Project area are managed under the *Water Act 2000* (Qld) through statutory water plans and supporting implementation instruments. The Water Plan (Fitzroy Basin) 2011 provides primary framework for the sustainable management of surface water, overland flow and groundwater resources across the majority of the Project area. The water plan establishes outcomes, objectives and performance indicators, and defines Groundwater Management Areas (GMAs) and their component groundwater units .

The Water Plan is implemented through water management protocols, and where applicable residual resource operation plans, in accordance with the *Water Regulation 2016*. These instruments set out the operational rules for water access, allocation and use, including

requirements for authorisation to take non-associated groundwater from regulated GMAs and groundwater units. Permitted purposes for taking non-associated groundwater are defined under the relevant water plan, the *Water Regulation 2016* or applicable local water management policies.

Surface water resources within the Project area fall within the Water Plan (Fitzroy Basin) 2011, Upper Mackenzie River catchment.

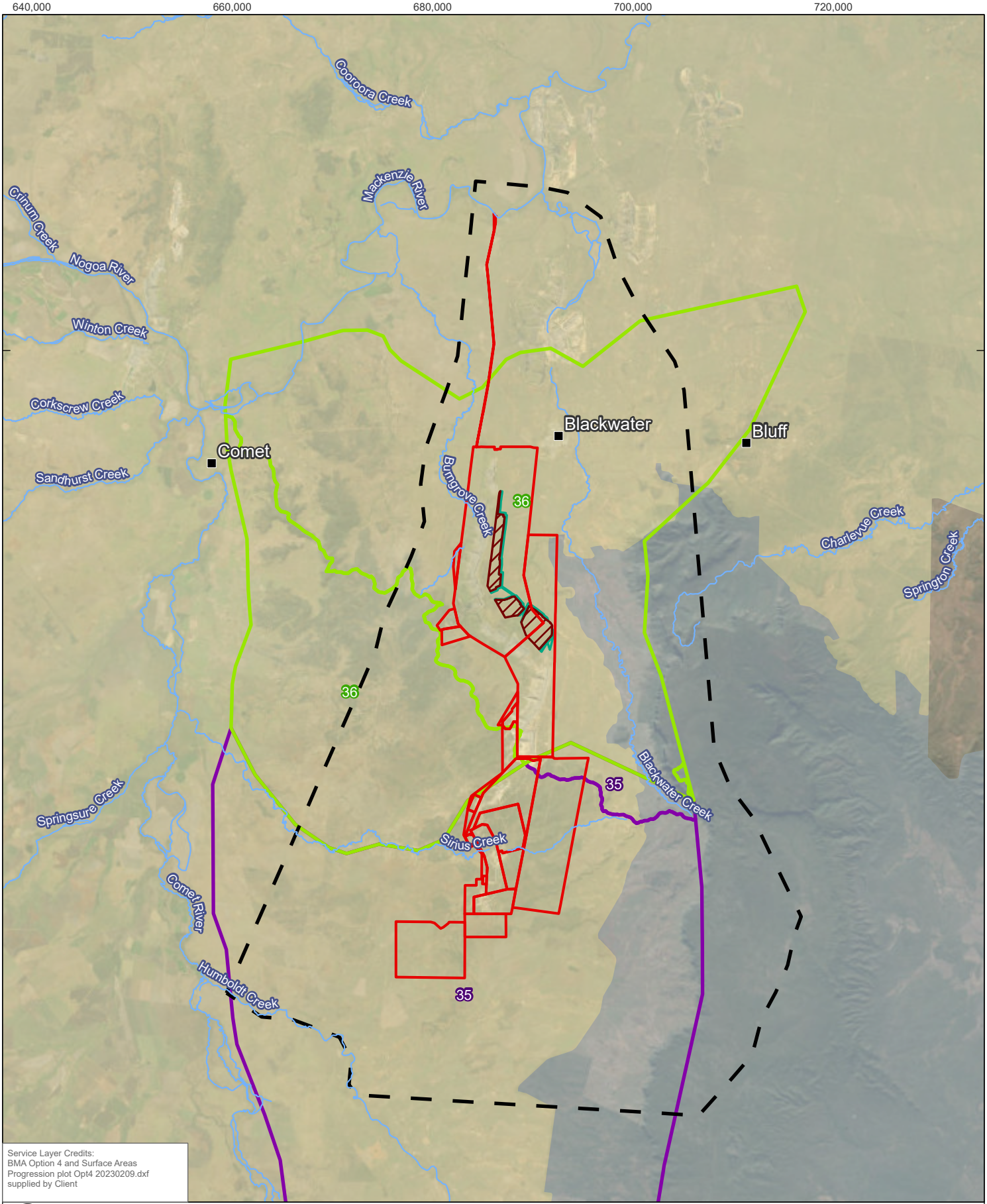
The *Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017* (GABORA) applies to groundwater resources outside the Fitzroy Basin plan area. The BWM MLs are predominantly located within the Fitzroy Basin plan area, however a small portion of ML 1762 (but not within the Project area) intersects the GABORA water plan area. Groundwater resources within that area are therefore subject to the provisions of the GABORA water plan, while the remainer of the BWM MLs are regulated under the Water Plan (Fitzroy Basin) 2011.

As part of the Project, Whitehaven is proposing to continue to exercise underground water rights during the period in which resource activities will be carried out within ML1759 and ML1762. The Project will affect groundwater within the Highlands GMA under the Water Plan (Fitzroy Basin) 2011, as shown on **Figure 2-1**. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers).

2.1.2.2 Water Act Declared Watercourses and Drainage

The Water Act includes criteria for determining watercourses that require authorisation under the Water Act to take water, interfere with the flow of water, take quarry material or excavate and place fill in a watercourse. The Water Act also includes criteria for drainage features that may require authorisation to take or interfere with overland flow. In the vicinity of the Project area, Blackwater Creek, the lower part of Taurus Creek and Sagittarius Creek, and Burngrove Creek are defined as a watercourse under the Water Act criteria, and several small tributaries of these watercourses that traverse the Project area are defined as drainage features.

These watercourses and drainage features may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MANAGEMENT AREAS AND CHEMISTRY ZONES

SLR

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FIGURE 2-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F02_01_Groundwater Management Areas and Chemistry Zones

2.1.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP Water and Wetland Biodiversity aims to achieve objectives set out by the EP Act, and is applicable to all Queensland waters. Environmental values (EVs) and water quality objectives (WQOs) are determined for Queensland waters, in alignment with the EPP Water and Wetland Biodiversity.

EPP Water and Wetland Biodiversity provides a framework to achieve the water and wetland objectives that are set out by the EP Act through:

- Identifying environmental values and management goals for Queensland waters.
- Providing state water quality guidelines and WQOs to enhance or protect the environmental values.
- Providing a framework for making consistent, equitable and informed decisions.
- Monitoring and reporting on the condition of Queensland waters.

Groundwater resources within the vicinity of the Project are scheduled under the EPP Water and Wetland Biodiversity as Schedule 1 Plan WQ1310 Groundwaters. The Project falls under groundwater chemistry Zone 36 of this Plan. The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems.
- Human use EVs:
    - Suitability of water supply for irrigation.
    - Farm water supply/use.
    - Stock watering.
    - Drinking water supply.
    - Industrial use.
    - Cultural and spiritual values.

The EPP Water and Wetland Biodiversity also provides limited water quality objectives for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP Water and Wetland Biodiversity are classified by groundwater depth and regional chemistry zone.

Surface water resources within the vicinity of the Project study area are scheduled under the EPP Water and Wetland Biodiversity as:

- Waters of the Mackenzie southern tributaries of the Upper Mackenzie Sub-basin (WQ1304).
- Waters of the Comet River eastern tributaries of the Comet River Sub-basin (WQ1307).

The legislated EVs for these surface waters are:

- Biological integrity of aquatic ecosystems.
- Human use EVs:
    - Suitability of water supply for irrigation (not for WQ1304).
    - Farm water supply/use.
    - Stock watering.



- Human consumption.
- Primary recreation.
- Secondary recreation.
- Visual recreation.
- Drinking water supply.
- Industrial water supply.
- Cultural and spiritual values.

The surface water WQOs for the Waters of the Mackenzie southern tributaries of the Upper Mackenzie Sub-basin (WQ1304) may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.

2.1.4 Environmental Authority

Under the EP Act, an environmental assessment is required as part of the application for an Environmental Authority (EA), or the application for an amendment to an existing EA, to undertake an environmentally relevant activity. The process assesses the potential environmental impacts of the Project, and how impacts should be avoided, minimised and managed. DETSI is responsible for the administration and delivery of applications for an EA, and amendment applications. The current operations are approved under EA EPML00717813.

2.2 Relevant Guidelines

There are several available guidelines designed to assist proponents to meet the relevant legislative requirements to complete a groundwater assessment for coal mining proposals such as the Project. These guidelines are:

- IESC (2024). *Information guidelines for proponents preparing coal seam gas and large coal mining development proposals* – EPBC Act.
- IESC (2024). *Information Guidelines Explanatory Note: Using impact pathway diagrams based on ecohydrological conceptualisation in environmental impact assessment.* Commonwealth of Australia.
- Murray, T.A. and Power, W.L. (2021). *Information Guidelines Explanatory Note: Characterisation and modelling of geological fault zones*. Commonwealth of Australia. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Agriculture, Water and the Environment, Commonwealth of Australia.
- Peeters LJM and Middlemis H (2023). *Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling, A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Climate Change, Energy, the Environment and Water*, Commonwealth of Australia.
- Doody, T.M., Hancock, P.J. & Pritchard, J.L. (2019). *Information Guidelines Explanatory Note. Assessing groundwater-dependent ecosystems* – EPBC Act.
- Barnett et al., (2012). *Australian Groundwater Modelling Guidelines.* Waterlines report. National Water Commission, Canberra.

3.0 Existing Conditions

3.1 Climate

The climate of the study area is sub-humid/sub-tropical, with a distinct wet and dry season. Historical climate data was obtained for the period from January 1970 to July 2025 from the Scientific Information for Landowners (SILO) database (Queensland Government, 2025). Data from the BWM weather station is limited to a relatively short record of rainfall data. Therefore, the SILO climate record for grid point data located at latitude -23.70, and longitude 148.85, which lies within the EA Boundary, is used to understand long-term climate trends. Rainfall data from the BWM site weather station is available from January 2016 to January 2025. A comparison between monthly rainfall, as recorded at the BWM site weather station, and monthly rainfall from the SILO climate record is presented on **Figure 3-1** for the most recent year of available data. The two data sets generally correlate well over the overlapping period, which justifies using the SILO climate record data to understand long-term climate trends and the climate input for the Project groundwater modelling (**Section 6.0**).

Long-term average monthly rainfall, Morton's areal actual evapotranspiration and Class A Pan evaporation from SILO is presented in **Table 3-1**. The study area is characterised by a long-term average rainfall of approximately 549 mm per year, with wetter conditions during the summer months of December, January and February and relatively dry conditions during the remainder of the year. As shown in **Figure 3-2** average monthly evaporation and evapotranspiration exceed rainfall in all months. Within the study area, the highest rate of evapotranspiration occurs along creek lines, where the water table is closer to ground surface and deeper-rooted vegetation is present.

To place rainfall over the years into an historical context, cumulative rainfall departure (CRD) was calculated for the period of January 1970 to July 2025 (**Figure 3-3**). This is a summation of the monthly departures of rainfall from the long-term average monthly rainfall. A rising slope in the CRD plot indicates periods of rainfall above the long-term average, as is the case from March 2022 to December 2022, whereas a falling slope indicates periods when rainfall is below the long-term average (e.g. February 2018 to September 2021). Rainfall volumes over the more recent period of the record (i.e. December 2022 to July 2025) have been predominantly average, as is indicated by the roughly horizontal trend in the CRD (**Figure 3-3**).

In addition, the CRD is used to assess the recharge of groundwater via rainfall. Where observed groundwater level trends mimic the pattern of the CRD curve, it is considered that natural fluctuations in the groundwater table can result from temporal changes in rainfall recharge to groundwater systems. Typically, changes in groundwater elevation can reflect the deviation between the long-term monthly (or yearly) average rainfall, and the actual rainfall, as illustrated by the CRD. The CRD and observed groundwater levels are discussed as a means to characterise climatic conditions within the assessment of groundwater levels (see **Section 5**).



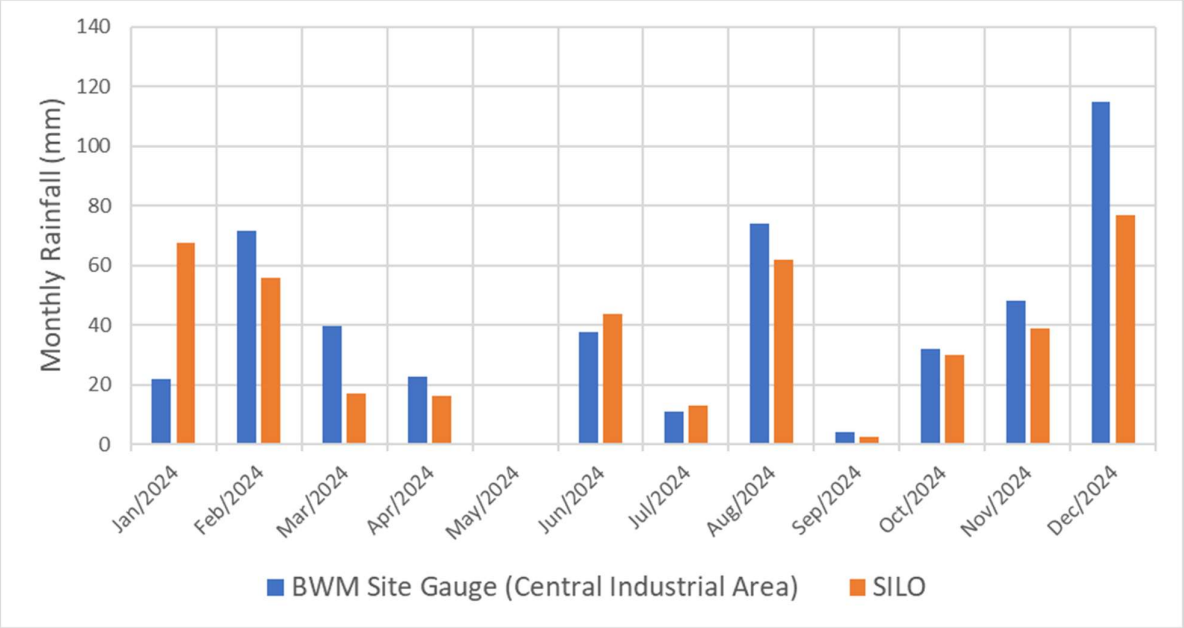


Figure 3-1 Monthly Rainfall at the BWM Site Station and SILO Data Location (2024)

Table 3-1 Total Monthly Rainfall, Evaporation and Evapotranspiration (January 1970 to July 2025)

Average Total Monthly[1]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Rainfall (mm)	88	74	49	29	32	23	22	17	24	45	62	84	549
Evaporation (class A Pan) (mm)	229	186	189	148	114	91	98	130	171	213	225	241	2036
Evapotranspiration (Morton's areal actual) (mm)	134	113	106	68	43	31	35	52	71	98	115	134	999

1 SILO (Queensland Government, 2025)

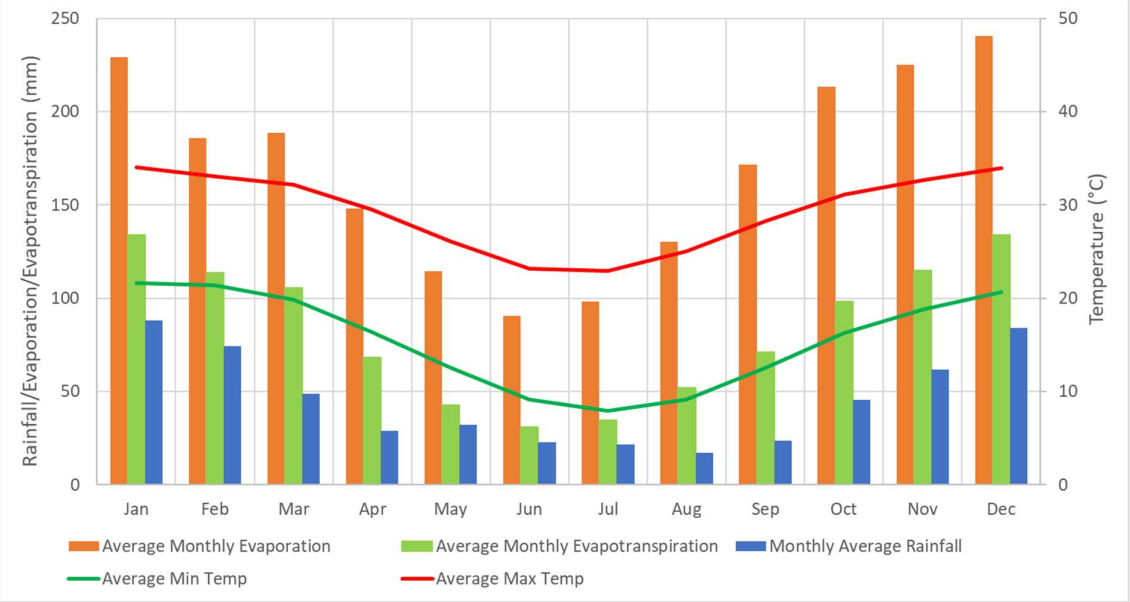


Figure 3-2 Average Monthly Evaporation, Evapotranspiration, Rainfall and Temperature (January 1970 to July 2025)

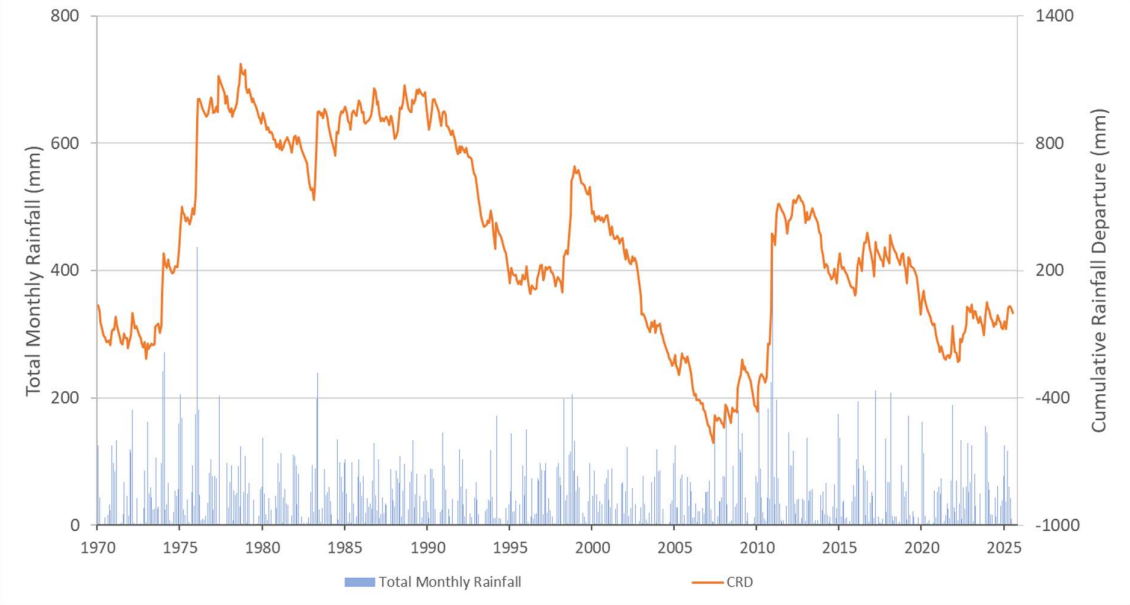


Figure 3-3 Cumulative Rainfall Departure and Total Monthly Rainfall

3.2 Topography and Drainage

The study area topography is relatively flat, with elevations of 280 mAHD in the south to around 150 mAHD in the north, at an average gradient of between 1:100 and 1:240. To the south of BWM, there are hills with elevations around 350 mAHD, which form the catchment divide between the Mackenzie and the Comet sub-catchments (**Figure 3-5**).

Approximately 10 to 15 km to the east of BWM, toward the eastern boundary of the study area, there is an outcrop of the Clematis Group sandstone, which reaches an elevation up to 750 mAHD.

BWM is located across two surface sub-catchments of the Water Plan (Fitzroy Basin) 2011:

- The Upper Mackenzie sub-catchment, which is located within the northern portion of BWM.
- The Comet sub-catchment, which is located within the southern portion of BWM.

The surface drainage comprises several ephemeral creeks that are tributaries of the Mackenzie and Comet Rivers. Creeks that flow in the Upper Mackenzie sub-catchment drain from south to north towards the Mackenzie River, whilst creeks that flow in the Comet sub-catchment drain from east to west towards the Comet River. The Project area is located in the Mackenzie sub-catchment and the most prominent drainage feature in the area is Blackwater Creek.

The ephemeral creeks have intermittent flow and typically contain water after high intensity rainfall events (AGE, 2003). **Figure 3-4** shows the average daily water level measurements in Blackwater Creek (Blackwater Creek D/S monitoring point as shown on **Figure 3-5**) compared to the daily rainfall (SILO climate record, refer to **Section 3.1**)**.** After large rainfall events, generally considered to exceed approximately 30 mm/day, the creek records flow. The flows subsequently recede during drier periods.

Groundwater interaction with ephemeral creeks is considered unlikely within the study area for the alluvium and underlying Regolith. Groundwater and surface water interaction is discussed in more detail in **Section 5.6.2**.

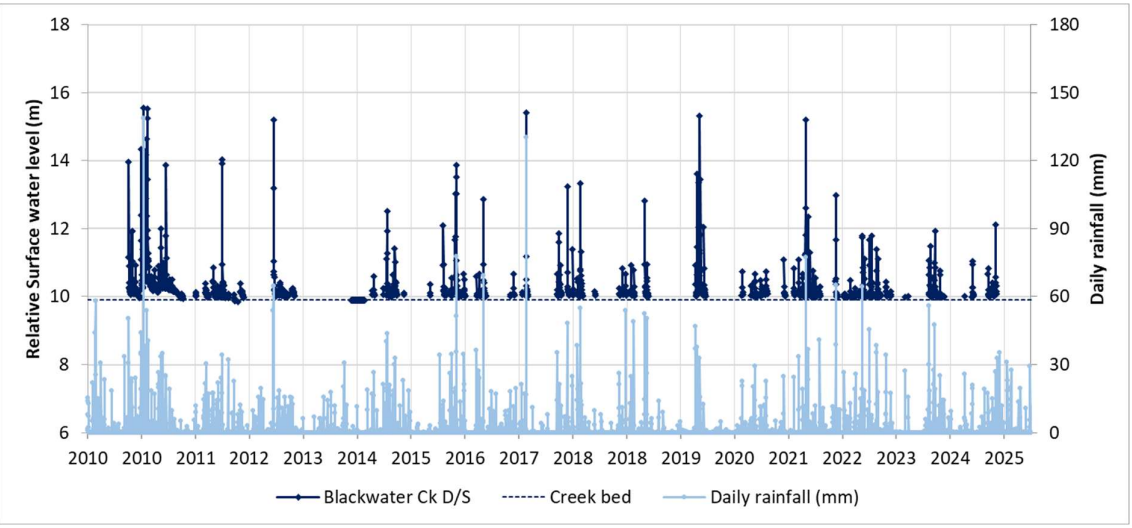
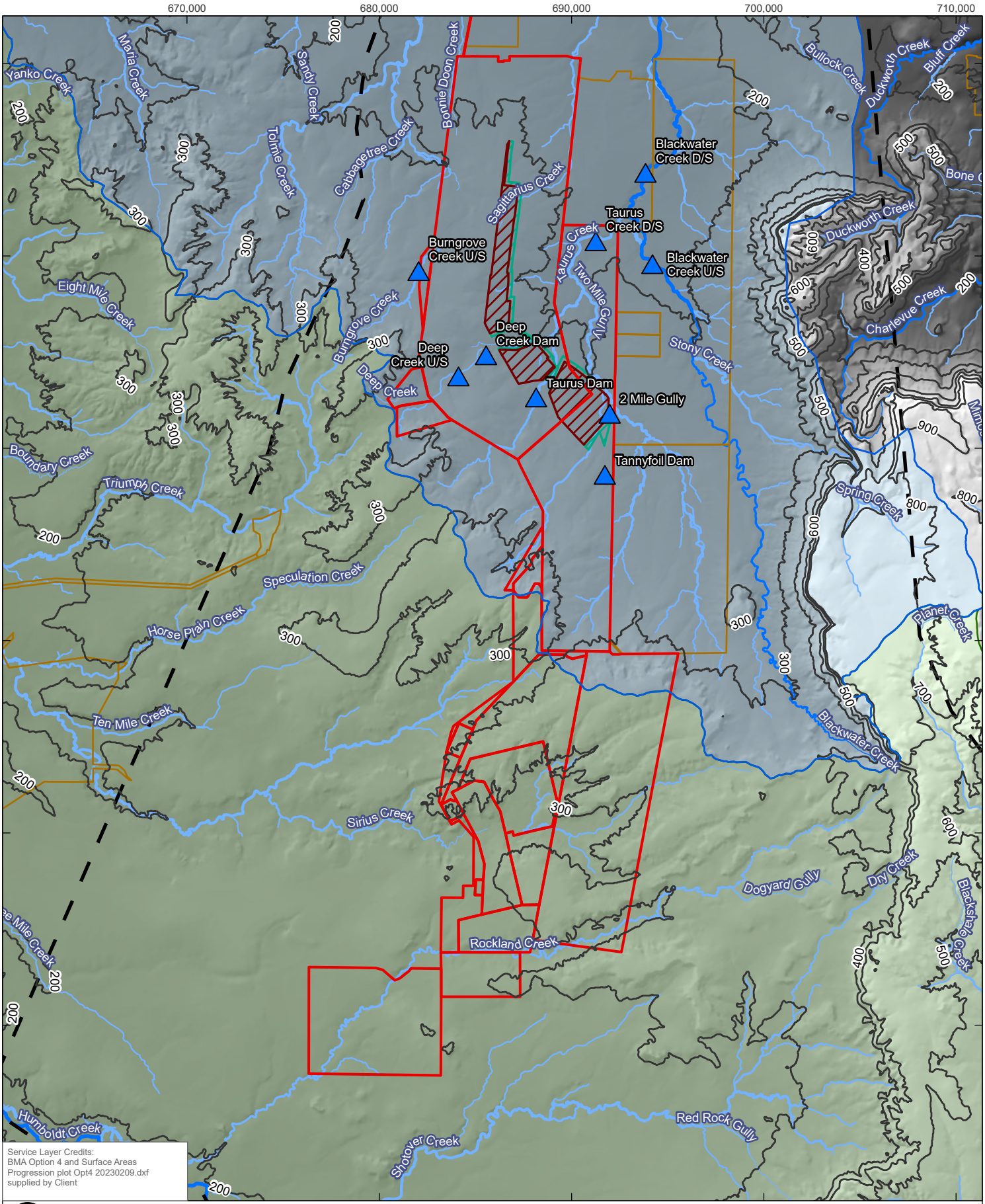


Figure 3-4 Average Daily Water Levels in Blackwater Creek D/S plotted against Daily Rainfall



BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

TOPOGRAPHY, DRAINAGE AND WATER PLANS

SLR

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FIGURE 3-5

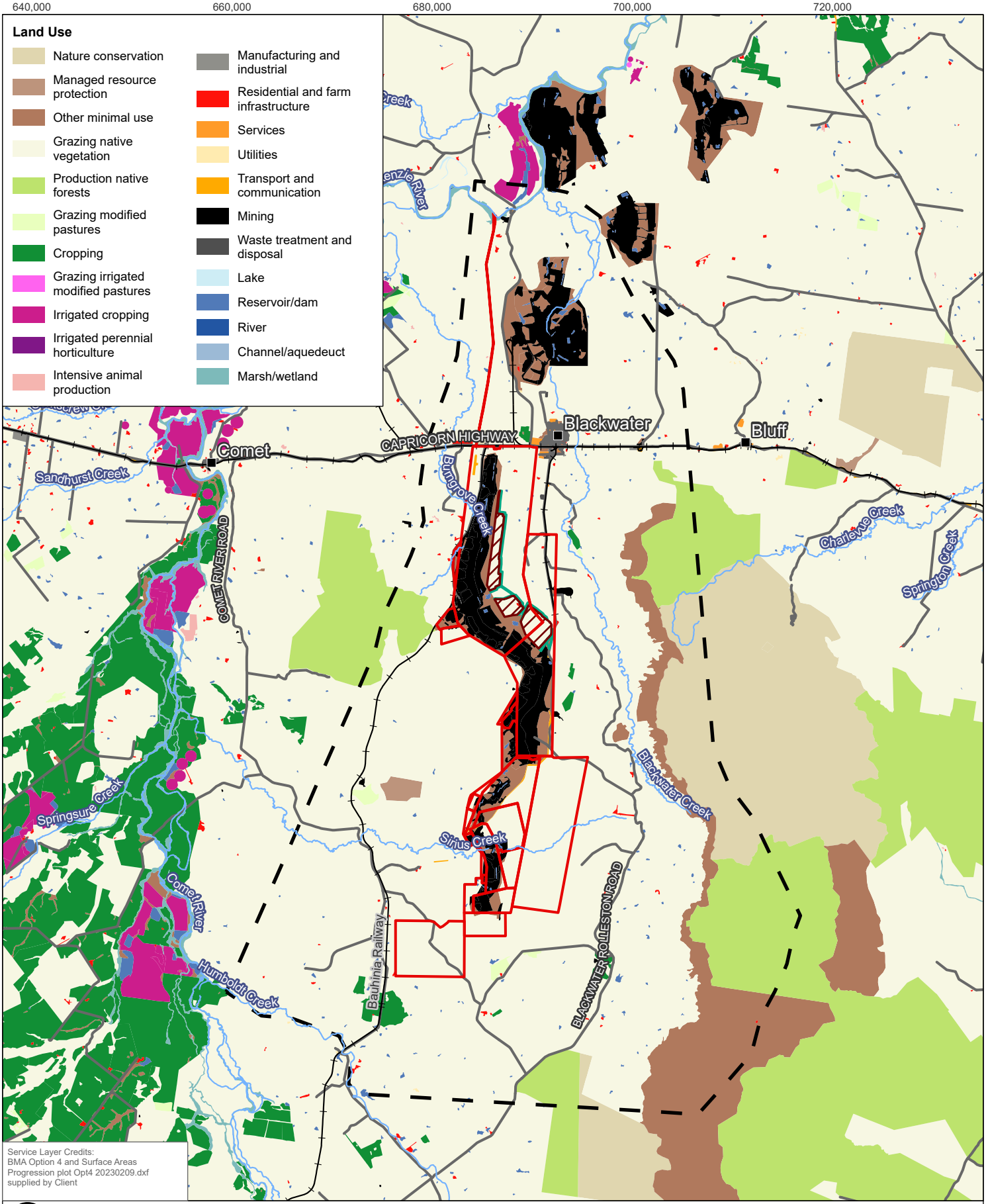
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_05_Topography, Drainage and Water Plans

3.3 Land Use

Land use in the study area (**Figure 3-6**) is predominately coal mining, CSG exploration, and agriculture in the form of cattle grazing. These land uses are discussed in the sections below.

3.3.1 Agriculture

The mapped land use in the study area and surrounds is shown on **Figure 3-6.** The predominant agricultural use is grazing, with a few scattered small cropping areas. No intense agricultural uses were mapped. Agricultural use within the Project area is predominantly “grazing native vegetation”.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:500,000 at A4
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LEGEND

- City/Town
- Watercourse
- Railway
- Road
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

SURROUNDING LAND USES

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FIGURE 3-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_06_Surrounding Land Uses

3.3.2 Mining

The Project lies within an existing mining precinct with several coal mines operating nearby. **Table 3-2** lists operating mines, advanced projects and mines in care and maintenance within 50 km of the study area. Operating mines and advanced projects which are located within 50 km from the Project are shown on **Figure 3-7.** Mines that have been included in the cumulative impact assessment are discussed in more detail in **Section 3.3.2.1** to **3.3.2.3**.

3.3.2.1 Cook Colliery

Cook Colliery adjoins the Project and is an underground mine owned by QCoal following its acquisition from Bounty Mining in 2020. The underground metallurgical mine had been in care and maintenance since December 2019 until its return to operational status in February 2022. Cook Colliery went back into care and maintenance in November 2025.

The mine is located to the east of BWM. . When the mine was operational, mining took place within the Argo coal seams of the Rangal Coal Measures (RCM). The Argo average thickness is 4.5 m although is variable ranging from 0.5 m to 10 m due to faulting. The depth of the Argo Seam varies from 150–170 m in the western areas to 270–290 m depth in the seam split zone. Cook Colliery was placed under ‘care and maintenance’ following partial water inundation in March 2017 that flooded some sections of the underground workings. Following the flooding event, a change was adopted and Cook Colliery operated as a Bord and Pillar mine. Underground workings occurred within 500 m of open-cut BWM workings.

3.3.2.2 Minyango Mine

The Minyango Mine, owned by Constellation Mining, also adjoins the Project and is a proposed underground mine located on ML80173. The Minyango Project Approvals proposed to extract coal from the Aries and Pollux coal seams of the RCM and is anticipated to have a peak production of 9 Mtpa of ROM coal and a mine life of approximately 25 years (AGE, 2013). At present, the Minyango Mine is not in operation.

3.3.2.3 Curragh Mines

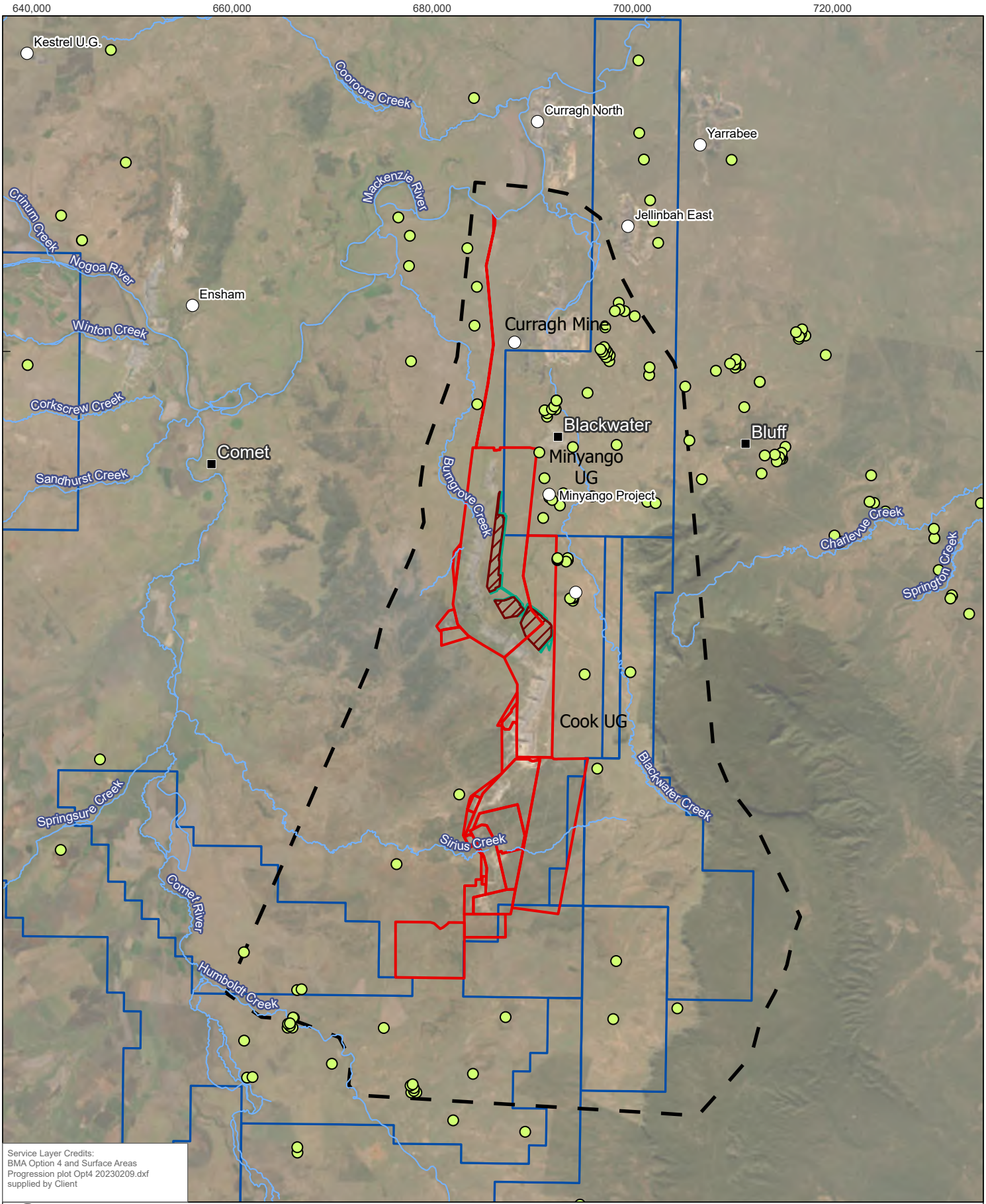
Coronado currently operates the Curragh coal mine complex, which is located adjacent to the Project and approximately 8 km north of Blackwater Township. The complex comprises two open cut mines (Curragh North and Curragh South) and an underground mine (Mammoth Underground). The open cut operations began in 1983, extracting coal from the Aries, Pisces, Castor and Pollux coal seams of the RCM, while the underground mine started in 2024.

Table 3-2 Current Mining Operations and Advanced Projects within 50 km of the Project

Mine	Status	Type	Planned Start	Planned End	Distance from Project (km)	Target Coal	Surface Water Catchment
Curragh South, Curragh North*	Operating	Open cut	1983	2046	20	Rangal Coal Measures	Upper Mackenzie
Mammoth Underground Mine	Operating	Underground	2024	2046	20	Rangal Coal Measures	Upper Mackenzie
Bluff Coal Mine	Care and Maintenance	Open cut	2013	2031	30	Rangal Coal Measures	Lower Mackenzie
Jellinbah Coal Mine	Operating	Open cut	1989	Unknown	35	Rangal Coal Measures	Upper Mackenzie
Ensham Mine	Operating	Open cut and Underground	1993	2037	40	Rangal Coal Measures	Nogoa
Yarrabee Coal Mine	Operating	Open cut	1982	Unknown	45	Rangal Coal Measures	Upper Mackenzie
Springsure Creek Coal Mine	Advanced Project	Underground	Unknown	Unknown	50	Rangal Coal Measures	Comet
Minyango Coal Project*	Advanced Project	Underground	2015 (yet to commence)	2040	Adjoining	Rangal Coal Measures	Upper Mackenzie
Comet Ridge Project	Advanced Project	Open cut	Unknown	Unknown	16	Rangal Coal Measures	Comet
Cook Colliery*	Care and Maintenance	Underground	1973	2025	Adjoining	Rangal Coal Measures	Upper Mackenzie

Notes: * mine included in the cumulative impact assessment (calibration and/or prediction phase).




640,000
660,000
680,000
700,000
720,000
7,420,000
7,400,000
7,380,000
7,360,000
7,340,000
7,320,000
Kestrel U.G.
Cooroora Creek
Curragh North
Yarrabee
Mackenzie River
Jellinbah East
Crinum Creek
Nogoa River
Ensham
Winton Creek
Curragh Mine
Corkscrew Creek
Blackwater
Bluff
Comet
Minyango UG
Sandhurst Creek
Bungrove Creek
Minyango Project
Charlevue Creek
Springton Creek
Cook UG
Blackwater Creek
Springsure Creek
Sirius Creek
Comet River
Humboldt Creek
Service Layer Credits:
BMA Option 4 and Surface Areas
Progression plot Opt4 20230209.dxf
supplied by Client
0
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km
LEGEND
City/Town
Coal Mine
CSG Bore
Watercourse
BWM Mining Lease
Authorities to Prospect
GIA Study Area
Proposed Open Cut Extension
Proposed Infrastructure Area
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:500,000 at A4
Project Number: 640.031809.00001
Date Drawn: 09-Apr-2026
Drawn by: AS
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
SURROUNDING MINES
AND CSG BORES
SLR
DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.
FIGURE 3-7
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F03_08_Surrounding Mines and CSG Bores

3.3.3 Petroleum

Currently, there are no active CSG fields within 30 km of the Project. **Table 3-3** lists the Authority to Prospect (ATP) within a 10 km buffer of ML1759 and ML1762. These ATPs have the potential to be developed into CSG extraction leases in the future, however, given there are no licences or firm plans in place to extract gas, CSG activities were not included in this study's cumulative impact assessment. **Figure 3-7** shows the regional ATPs and CSG wells (exploration only). No CSG extraction or monitoring bores were identified within 20 km of the BWM mining lease area.

Table 3-3 Exploration Permits within 10 km of ML1759 and ML1762

Allocation Type	Permit Number	Purpose	Expiry Date	Holder
Authority to Prospect	ATP 1025	Petroleum	2033	BOW CSG PTY LTD
Authority to Prospect	ATP 2063	Petroleum	2027	COMET RIDGE MAHALO FAR EAST PTY LTD
Authority to Prospect	ATP 2072	Petroleum	2030	COMET RIDGE MAHALO FAR EAST PTY LTD

4.0 Geology

The Project is located in the Bowen Basin, which is one of five major foreland sedimentary basins which were formed along the eastern side of Australia during the Permian geologic period. The Bowen Basin is the largest productive coal basin in Australia. The north-south oriented Bowen Basin stretches from Townsville in the north, to the Queensland-New South Wales border in the south.

The stratigraphic sequence of the study area is presented in **Table 4-1**. From youngest to oldest, the stratigraphic sequence across the study area comprises of unconsolidated Quaternary aged sediments unconformably overlying consolidated Permian and Triassic aged sequences (**Figure 4-1**). The Permian and Triassic strata form regular layered fluvio-deltaic sedimentary sequences, while the Quaternary sediments are more complex and irregular. The coal deposits extracted from BWM are found within the RCM, which is the uppermost Permian unit (**Figure 4-2**). Tertiary aged basalts, in the form of remnant lava flows, are found to the south but are not present in the study area.

The RCM at BWM outcrop in the western portion of the pits and dip down to the east of the pits. In the Project area, the strike is along the north-south direction. West of the pits is an anticline structure, which means that further west, the coal seams dip to the west (**Figure 4-2**).

The surface geology of the study area is dominated by the outcropping Rangal Coal Measures to the west of BWM and the overlying Rewan Group in the east of the BWM (**Figure 4-1**). Overlying these basal units, Tertiary Sediments and Quaternary alluvium are present as cover. At the eastern extents of the study area, the Clematis Group outcrops with a dramatic change in topography associated with the comparatively weathering resistant sandstones of that geologic unit.

Figure 4-3 shows an east to west geological cross section through the Project area. For the location of the cross section refer to **Figure 4-2** (Cross Section A-A). Note the depth extent of the Fair Hill Formation to the west is unknown, and not relevant to this assessment.

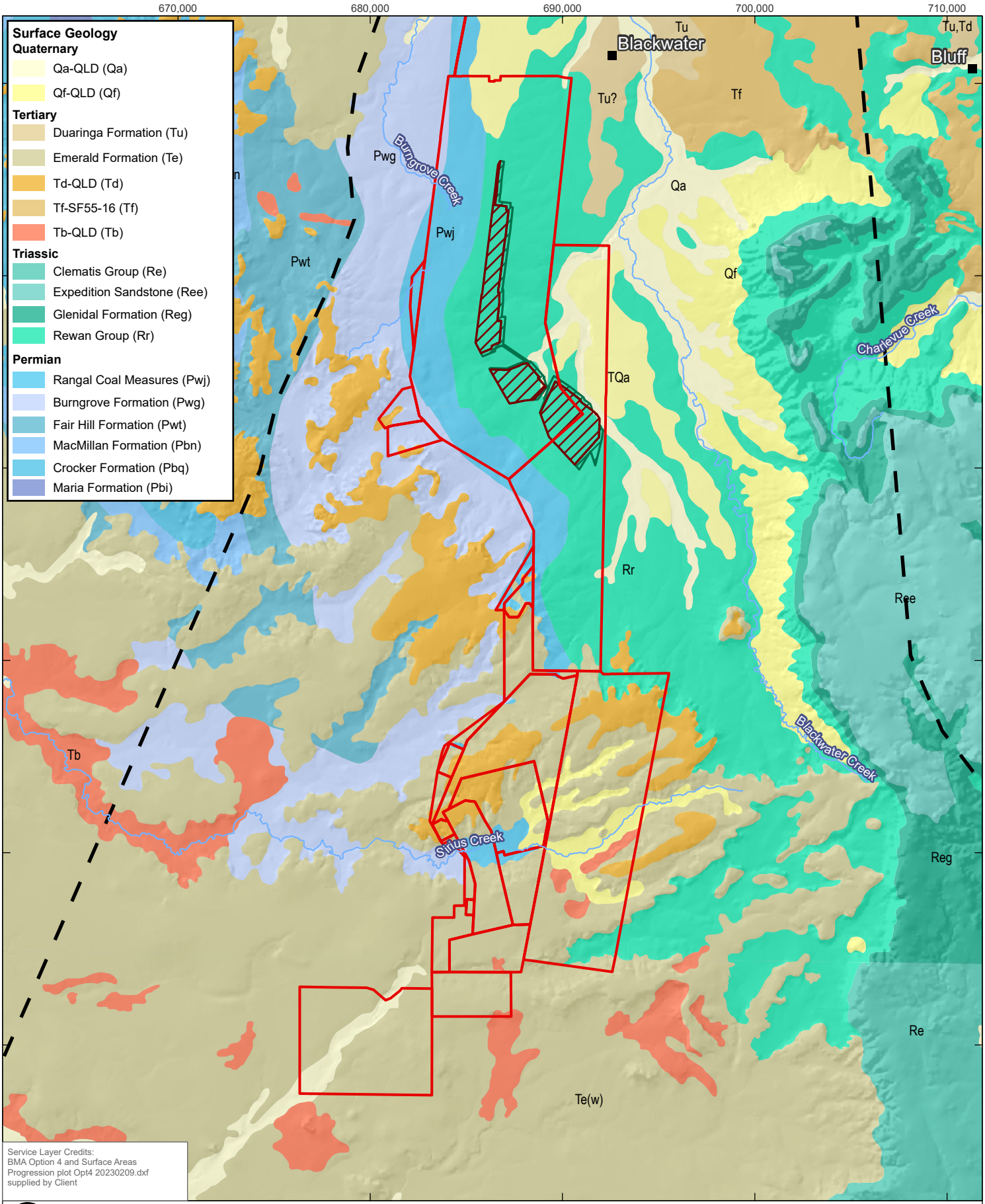
Each of the main stratigraphic units, relevant to the Project, is discussed in **Section 4.1** to **Section 4.5**, and details on the structural geology is provided in **Section 4.7**.

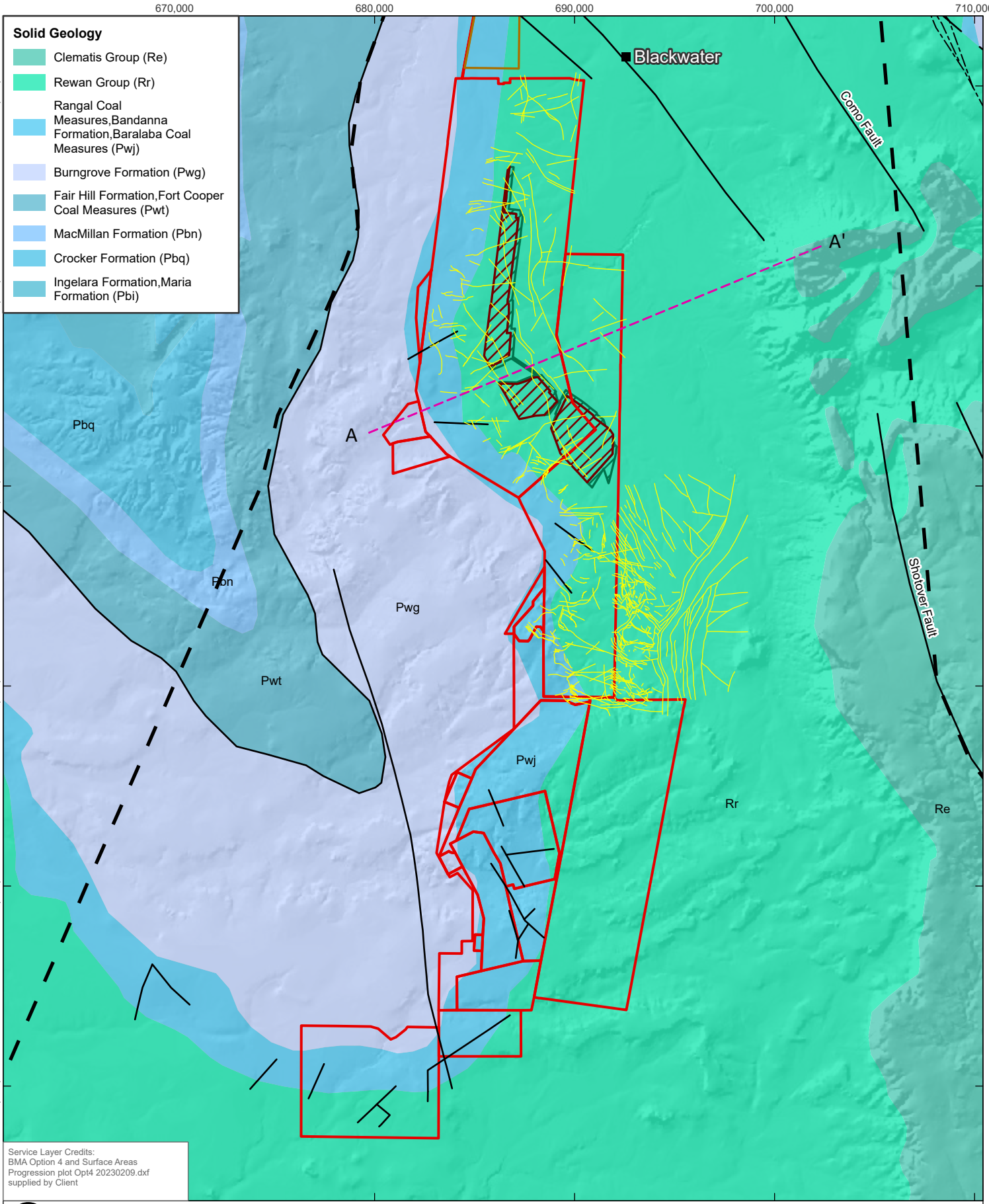
Table 4-1 Summary of Stratigraphy in the Study Area

Age	Unit	Thickness (m)	Description
Quaternary	Alluvium	0.5–12	Alluvium - silt, clay, sand and gravel.
Tertiary	Basalt	30	Weathered basalt soils, residual basalt. Moderately weathered and fresh basalt. Does not outcrop.
	Sediments	30	Clays, sandstones, sands, gravels, often poorly consolidated (Tu, Te(w), Tf and TQa). Regional mapping shows highly weathered Tertiary Sediments display some areas of duricrust (Td) and partially cemented fanglomerate (Tf).
Triassic	Clematis Sandstone	100–800	Weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate.
	Rewan Group	50–300	Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate (at base); deposited in a fluvial-lacustrine environment. Occur 2 m to 6 m above the Aries seam.

Age	Unit	Thickness (m)	Description
Permian	Rangal Coal Measures	100	Feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Coal seams include the Aries, Castor, Pollux and Orion and Pisces seams. The Pollux and Orion seams commonly coalesce into a single seam, which is referred as the Argo seam.
	Burngrove Formation	170	Sandstones, siltstones and mudstones, and banded coal seams frequently interbedded with tuff and tuffaceous mudstones - coal seams include the Virgo and Leo seams.

Note: Source AGE (2008), AGE (2013) and EMM (2019).


670,000
680,000
690,000
700,000
710,000
7,390,000
7,380,000
7,370,000
7,360,000
7,350,000
7,340,000
Surface Geology
Quaternary
Qa-QLD (Qa)
Qf-QLD (Qf)
Tertiary
Duaringa Formation (Tu)
Emerald Formation (Te)
Td-QLD (Td)
Tf-SF55-16 (Tf)
Tb-QLD (Tb)
Triassic
Clematis Group (Re)
Expedition Sandstone (Ree)
Glenidal Formation (Reg)
Rewan Group (Rr)
Permian
Rangal Coal Measures (Pwj)
Burngrove Formation (Pwg)
Fair Hill Formation (Pwt)
MacMillan Formation (Pbn)
Crocker Formation (Pbq)
Maria Formation (Pbi)
Blackwater
Bluff
Tu
Tu?
Tf
Tu,Td
Pwg
Burngrove Creek
Pwj
Pwt
Qa
Qf
Chanlevue Creek
TQa
Rr
Ree
Blackwater Creek
Tb
Sirius Creek
Reg
Re
Te(w)
Service Layer Credits:
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Progression plot Opt4 20230209.dxf
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0
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km
LEGEND
City/Town
Watercourse
GIA Study Area
BWM Mining Lease
Proposed Open Cut Extension
Proposed Infrastructure Area
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:260,000 at A4
Project Number: 640.031809.00001
Date Drawn: 08-Apr-2026
Drawn by: AS
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
SURFACE GEOLOGY
SLR
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FIGURE 4-1
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F04_01_Surface Geology



BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

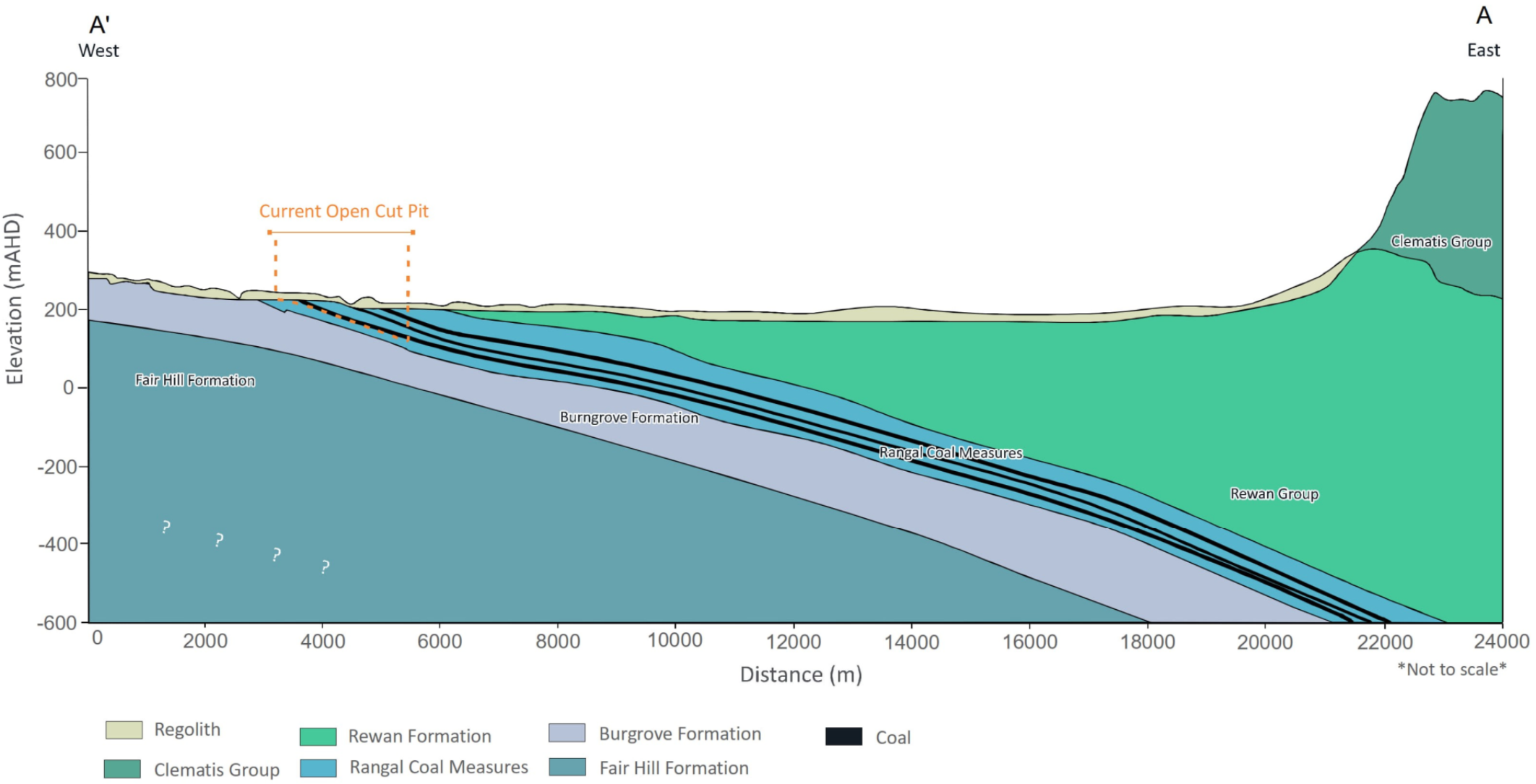
SOLID GEOLOGY

SLR

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FIGURE 4-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F04_02_Solid Geology



Date Drawn: 26-Nov-2023

BLACKWATER NORTH EXTENSION PROJECT
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GEOLOGICAL CROSS SECTION ACROSS THE STUDY AREA

FIGURE 4-3

Path: H:\Projects-SLR\620-BNE\620-BNE\620.014601.00001 Blackwater NEP\08 GIS\BWM NEP Pro\BWM NEP Pro.aprx\620014601_GW_F04_3_Geological Cross Section

4.1 Quaternary Sediments

The Quaternary alluvial sediments unconformably overlie the Triassic Rewan Group and Rangal Coal Measures. The unit consists of a thin surficial cover of generally unconsolidated clays, silts, sands and gravels associated with floodplains of the major drainage channels, primarily Blackwater Creek. Drilling data from within the study area shows that the alluvial sequence varies from approximately 0.5 to 16 m thick.

Recent drilling at BWM has shown that alluvium associated with the creeks, is not always present and extents are limited. In 2020, four bores were attempted to be installed into the alluvium near north BWM (Taurus Creek, Sagittarius Creek and Two Mile Gully), however only one drillhole at Taurus Creek found sufficient alluvial sediments which was completed as a dry bore (AGE, 2020). In 2021 another bore targeted the alluvium at Sagittarius Creek, however upon drilling, the alluvial sediments were again deemed insufficient at the site, so the bore was installed into the underlying Rewan Group instead (HydroFS, 2021). Based on these investigations, it is considered that the extent of the alluvium within the study area is likely smaller than mapped on the regional surface geology map (**Figure 4-1**).

4.2 Tertiary Sediments and Basalt

Tertiary Sediments and basalts unconformably overlay the Triassic and Permian units. The unit consists primarily of unconsolidated/weathered Tertiary Sediments and weathered claystone, siltstone and sandstones. The unit varies in thickness, typically ranging from 5 to 50 m with a maximum thickness of 115 m, typically thicker to the south. To the south and southwest of the study area, basalt flows are present (**Figure 4-1**). The basalts have been described as having varying degrees of weathering and thickness, from moderately weathered thin flows (intersected in ML 70167 the Humboldt area – see **Figure 1-1**) to thicker and more fresh flows (intersected slightly further north in ML 70139 in the South Marshmead area – see **Figure 1-1**). The basalt flows vary in thickness ranging from 10 to 42 m (AGE, 2003). The basalt occurs in the study area (groundwater model domain), but not in the Project area, and hence is not discussed in detail in the subsequent conceptualisation.

4.3 Triassic Clematis Group

The Clematis Group unconformably overlies the Rewan Group and outcrops on the eastern margins of the study area, where it forms an elevated plateau and escarpment (**Figure 4-2**).

The unit is comprised of weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate. In the study area, the Clematis Group is made up of the Glenidal Formation and Expedition Sandstone members which are estimated to form an average thickness in the range of 100 to 800 m (Geoscience Australia, 2021).

4.4 Triassic Rewan Group

The Rewan Group overlies the Rangal Coal Measures and occurs as in-fill material, thickening to the east with the dip of the coal measures and thin to the west where the coal measures occur at outcrop (**Figure 4-3**). Where present, the Rewan Group has a distinct greenish tint (non-marine deposits containing glauconite) in colour and is composed of siltstone and mudstone, with interbeds of lithic and volcanic sandstones.

Based on exploration drill holes and groundwater bore holes in the study area, the Rewan Group is comprised of siltstone and mudstone, with interbeds of lithic and volcanic sandstones and is of variable thickness ranging between 50 and 300 m.

4.5 Rangal Coal Measures

The RCM underlie the Rewan Group and outcrop to the west of the mine (**Figure 4-3**). This unit consists of interbedded sandstone, siltstone, mudstone, and coal with tuff (towards the base) and has a thickness of up to 100 m in the study area. The three main economic coal seams are the Aries, Castor and Pollux Seam. This naming convention applied regionally. For operational reasons, the coal seams follow a different naming convention at BWM: Aries Seam is referred to as the Top Seam, the Castor Seam is referred to as the Middle Seam and the Pollux Seam is referred to as the Lower Seam.

The splitting and occurrence of seams is shown in **Figure 4-4**. The principal coal seams in the BWM area in descending order are the Top Seam (also known as TFULL), Middle Seam (MFULL) and Middle split (MB), Lower Seam (LFULL) and Lower split (L01). Minor seams include the Upper Top (UT), Top Rider (TR), Middle Rider (MR) and Lower and Upper Rider (LUR) seams.

The Pollux and Orion seams create the thick Argo seam (CD) in the southern portion of the BWM. To the north, the Orion and Pollux Seams coalesce into the Lower (LFULL) Seam. This seam splits into the lower split (L01) and the Middle seam (MFULL). Between the Deep Creek/Wilpeena and Blackwater pit areas the Middle Seam coalesces with the Aries and Castor Seams.

4.6 Burngrove Formation

The Burngrove Formation is comprised of mudstone, siltstone, sandstone, coal and tuff. The RCM conformably overlie the coal bearing Burngrove Formation. The Burngrove Formation is considered the basement formation for this assessment.

4.7 Structural Geology

The structural geology in the region is characterised by gently folded consolidated sediments and a major north to north-west striking fault system which forms the Jellinbah thrust fault (AGE, 2013). A series of easterly dipping thrust faults occur parallel to the Jellinbah thrust, including the Shotover Fault (occurring to the east of the study area where the Clematis Group outcrops) and the Como Fault that runs through the Curragh Mine (**Figure 4-5**) (Mallet et al., 1985). Regionally the structure is defined as a faulted monoclinal limb (AGE, 2013).

The strata in the vicinity of the BWM are heavily influenced by a series of easterly dipping north to northwest striking faults (AGE, 2008). The Shotover Fault is of major importance as there is a displacement of up to 3,000 m (AGE, 2013). Locally, thrust faulting that occurs within the BWM may be attributed to thrusts occurring in the footwall of the Shotover Fault. Local structure is influenced by strike slip movement of basement rocks. Local fault displacement is reported to be less than five meters on average but can reach up to 20 m (AGE, 2008). **Figure 4-5** shows the numerous local faults mapped within the study area. The local faults were mapped by historical tenement holders (BM Alliance Coal Operations Pty Ltd [BMA]) and the regional faults were sourced from the public database (Qld Government, 2004).

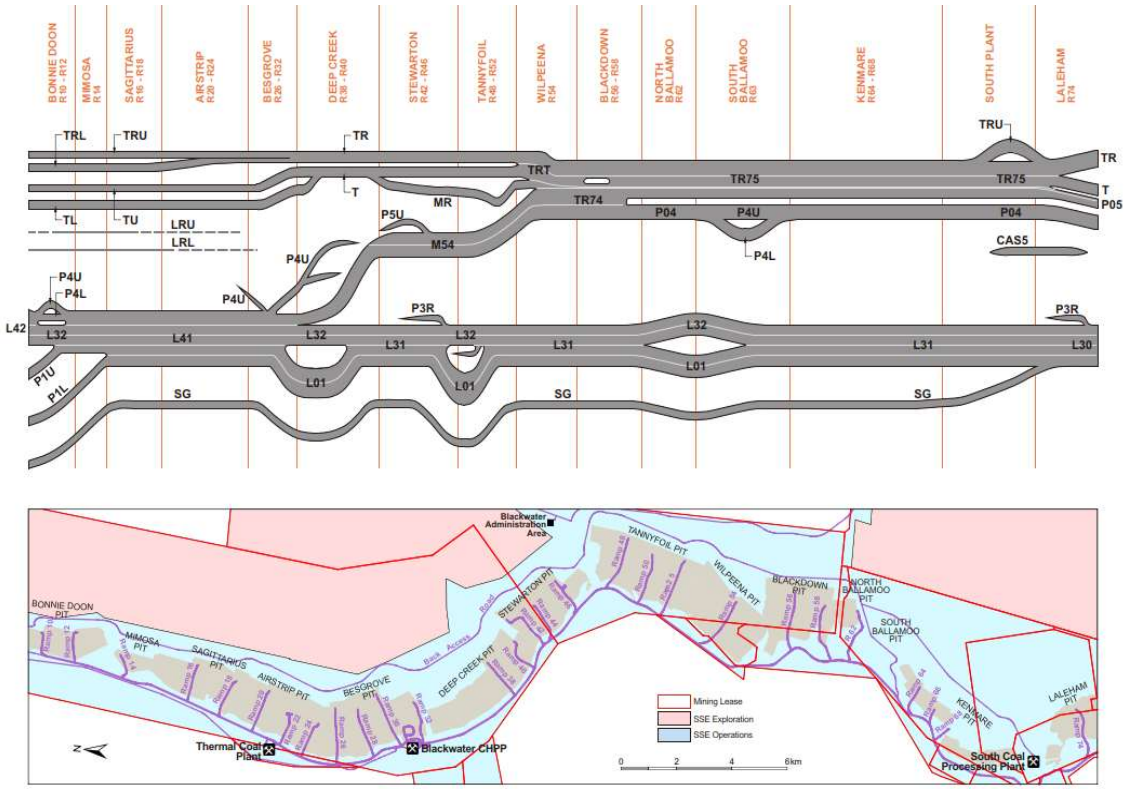
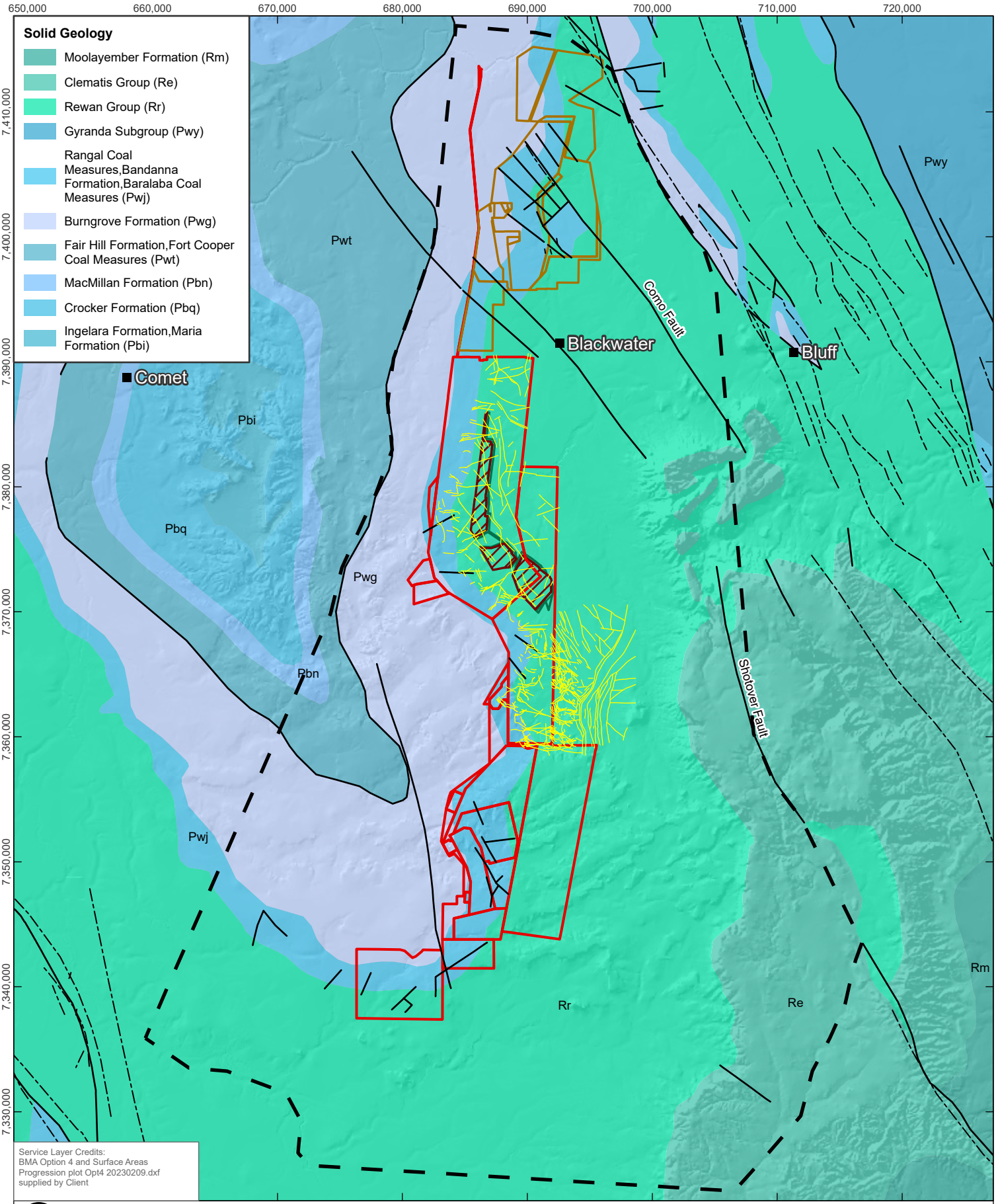


Figure 4-4 Schematic Seam Stratigraphy and Split Diagram (BMA, 2014)



Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- City/Town
- Local Fault
- Basin Scale Fault (1995)
- Basin Scale Fault
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Proposed Open Cut Area
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

LOCAL AND REGIONAL FAULTS

SLR

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FIGURE 4-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F04_05_Model Faults

5.0 Hydrogeology

This section discusses each of the hydrogeological units relevant to the Project, describing groundwater hydrology (groundwater occurrence, hydraulic gradients, recharge and discharge), hydraulic properties, groundwater quality, and groundwater use and management. The conceptual hydrogeological model for the study area, refined with the most recent groundwater monitoring dataset with a focus on the Project, is summarised in **Section 5.6**.

The local hydrostratigraphic units are described below, from the shallowest (Alluvium) to the deepest (Burngrove Formation):

- **Alluvium** - Alluvial deposits are associated with local creeks. In recent years, the alluvium local to the study area has been found dry.
- **Tertiary Sediments and Basalt** - Unconsolidated surface layer of weathered rock (also referred to as regolith) which may provide a preferential flow pathway for groundwater if levels exceed the base of weathering.
- **Clematis Group** - Outcrops on the eastern margins of the study area, where it forms an elevated plateau. The unit is comprised of weathering resistant medium to coarse grained quartzose to sublabile and micaceous sandstone, siltstone, mudstone and conglomerate.
- **Rewan Group** - A regional scale aquitard comprising mudstones interbedded with siltstone and fine to medium grained labile sandstone. However, permeability testing indicates hydraulic conductivity values may be higher in the upper weathered zone of the unit.
- **Rangal Coal Measures (RCM)** - Previous investigations (EMM, 2021) identified this formation as a regional aquifer. Groundwater flow is primarily within the coal seams (via interconnected cleats and fractures), which are confined by low permeability overburden and interburden that essentially form aquitards. The coal measures are highly faulted resulting in “compartmentalisation” with coal seams juxtaposed against lower permeability interburden. Recharge to this unit occurs via direct infiltration where the unit outcrops or sub-crops.
- **Burngrove Formation** - Outcrops to the west of BWM and dips east below the RCM. It is largely regarded an aquitard comprising interbedded siltstone, carbonaceous and tuffaceous shales, mudstone, and thin coal seams. However, several landholder bores are apparently screened within this formation locally (assuming the registered bore database aquifer attribution is correct) suggesting it includes permeable horizons that can support low yields. This formation is considered the basement for the purposes of this assessment.

5.1 Groundwater Monitoring

Figure 5-1 to **Figure 5-8** and **Table 5-1** to **Table 5-8** show the BWM groundwater monitoring network bores for which data is available for this assessment. Data used for this assessment has been collected from 144 monitoring bores and four Vibrating Wire Piezometers (VWPs). The period for which groundwater quality and groundwater level data is available from these bores is also listed in the tables below.

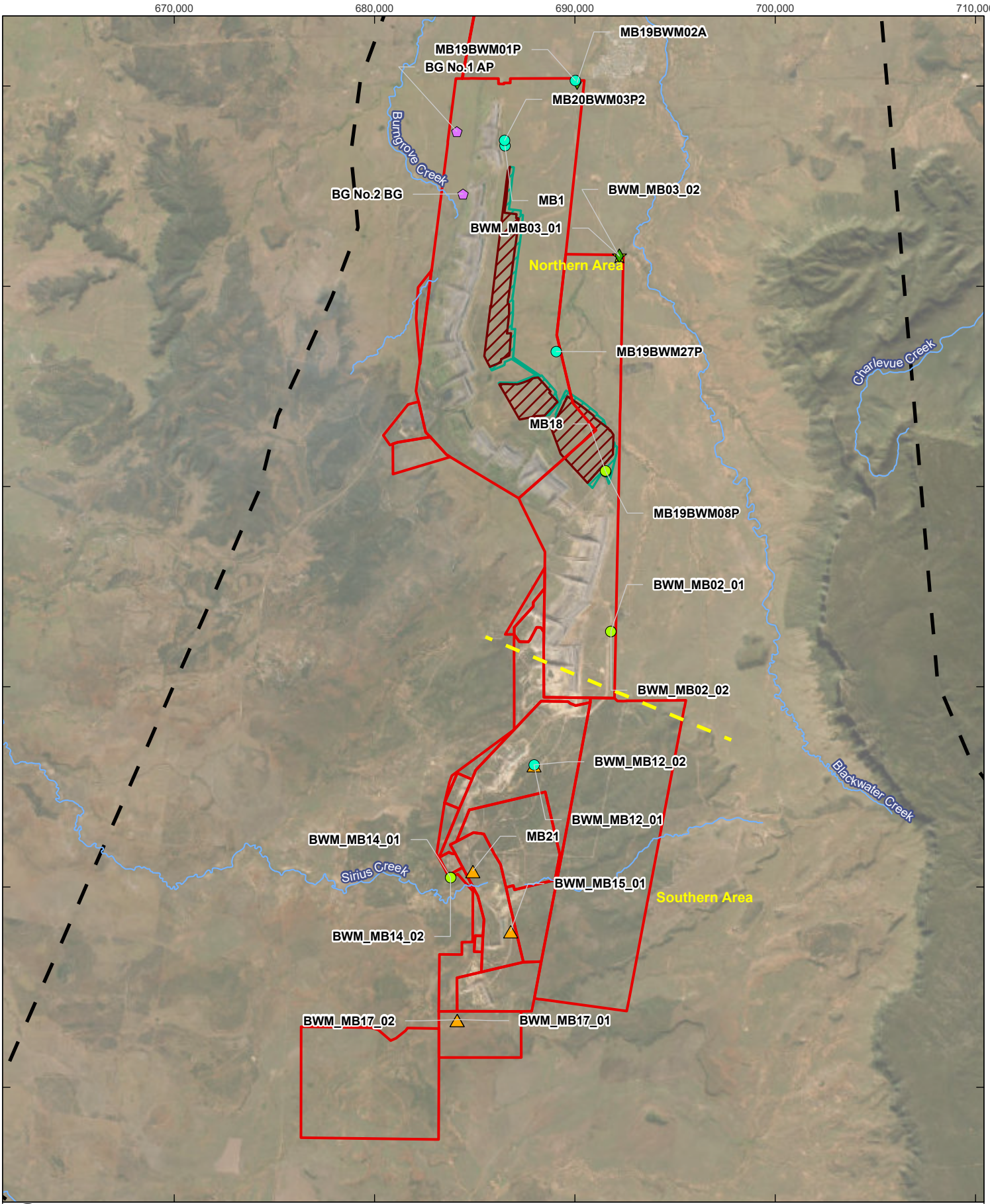
5.1.1 BWM EA Monitoring Bores

There is a total of 21 EA monitoring bores across BWM. Details of these bores are shown in **Table 5-1** with their locality shown in **Figure 5-1**.

Table 5-1 EA Monitoring Bores

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB03_01	692223	7381510	181.98	12	8 - 11	Alluvium	BWM South	Active (dry)	26/11/2024	26/11/2024	-	-
BWM_MB12_01	687961	7356102	332.79	24	16-22	Tertiary	BWM South	Active (dry)	30/05/2022	30/01/2025	-	-
BWM_MB15_01	686794	7347807	321.39	16.43	10.43 - 16.43	Tertiary	BWM South	Active	22/05/2022	4/03/2025	23/08/2023	4/03/2025
BWM_MB17_01	684127	7343376	262.29	18	12 - 18	Tertiary Basalt	BWM South	Active (dry)	22/08/2022	4/03/2025	-	-
BWM_MB17_02	684119	7343373	262.38	29	22 - 28	Tertiary	BWM South	Active	22/08/2022	4/03/2025	25/08/2023	4/03/2025
MB21	684905	7350813	264.23	31	25 - 31	Tertiary Sediments	BWM South	Active	31/08/2009	4/03/2025	31/08/2009	4/03/2025
MB19BWM02A	690112	7390183	168.87	15	12 - 15	Weathered Rewan	BWM North	Active	17/12/2019	5/03/2025	30/06/2020	5/03/2025
BWM_MB03_02	692220	7381519	182.13	42	35 - 41	Rewan	BWM South	Active	21/08/2023	26/11/2024	21/08/2023	8/03/2025
BWM_MB02_01	691791	7362760	259.73	28.4	22.3 - 28.3	RCM (OB)	BWM North	Active	16/08/2023	28/01/2025	16/08/2023	8/03/2025
MB18	691528	7370782	221.41	40.6	37.6 - 40.6	RCM (Sandstone OB)	BWM North	Active	1/09/2009	8/03/2025	1/09/2009	8/03/2025
BWM_MB14_01	683797	7350477	267.75	25	18 - 24	RCM (IB)	BWM South	Active	28/01/2023	4/03/2025	14/06/2022	4/03/2025
BWM_MB14_02	683798	7350466	267.74	152	144 - 150	RCM (Sandstone OB)	BWM South	Active	21/04/2022	4/03/2025	14/06/2022	4/03/2025
MB1	686514	7387022	201.16	60	54 - 60	RCM (Aries)	BWM North	Active	1/09/2009	3/03/2025	1/09/2009	3/03/2025
MB19BWM01P	690024	7390277	168.58	171	168 - 171	RCM (Aries)	BWM North	Active	17/12/2019	26/11/2024	15/06/2020	26/11/2024
MB19BWM27P	689070	7376739	197.35	189	180 - 189	RCM (Aries & siltstone)	BWM North	Active	19/12/2019	6/03/2025	30/06/2020	6/03/2025
MB20BWM03P2	686490	7387289	199.62	109	98 - 107	(RCM, Castor and Pollux)	BWM North	Active	25/02/2021	3/03/2025	10/02/2021	3/03/2025
BWM_MB02_02	691803	7362756	259.85	153.5	144 - 150	RCM (Castor)	BWM North	Active	16/08/2023	31/01/2025	29/09/2020	8/03/2025
MB19BWM08P	691544	7370740	221.67	190	184 - 190	RCM (Aries Seam & Siltstone)	BWM North	Active	29/06/2020	25/11/2024	30/06/2020	8/03/2025
BWM_MB12_02	687969	7356097	333.56	159	155 - 158	RCM (Castor)	BWM South	Active	30/05/2022	30/01/2025	17/08/2023	8/03/2025
BG No.1 AP	684107	7387742	200.46	72.9	63.6 - 72.9	Burngrove	BWM North	Active	19/01/2012	5/03/2025	28/12/2011	5/03/2025
BG No.2 BG	684414	7384622	211.79	38.5	32.3 - 38.5	Burngrove	BWM North	Active	19/01/2012	5/03/2025	28/12/2011	5/03/2025

O/I = overburden/interburden
1 Coordinates GDA 2020 Zone 55



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Alluvium
- Tertiary
- Rewan
- RCM (Coal)
- RCM Overburden/Interburden
- Burngrove

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- BWM EA BORES

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FIGURE 5-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_01_Groundwater Monitoring Network (BWM EA Bores)

5.1.2 BWM Non-EA Monitoring Bores

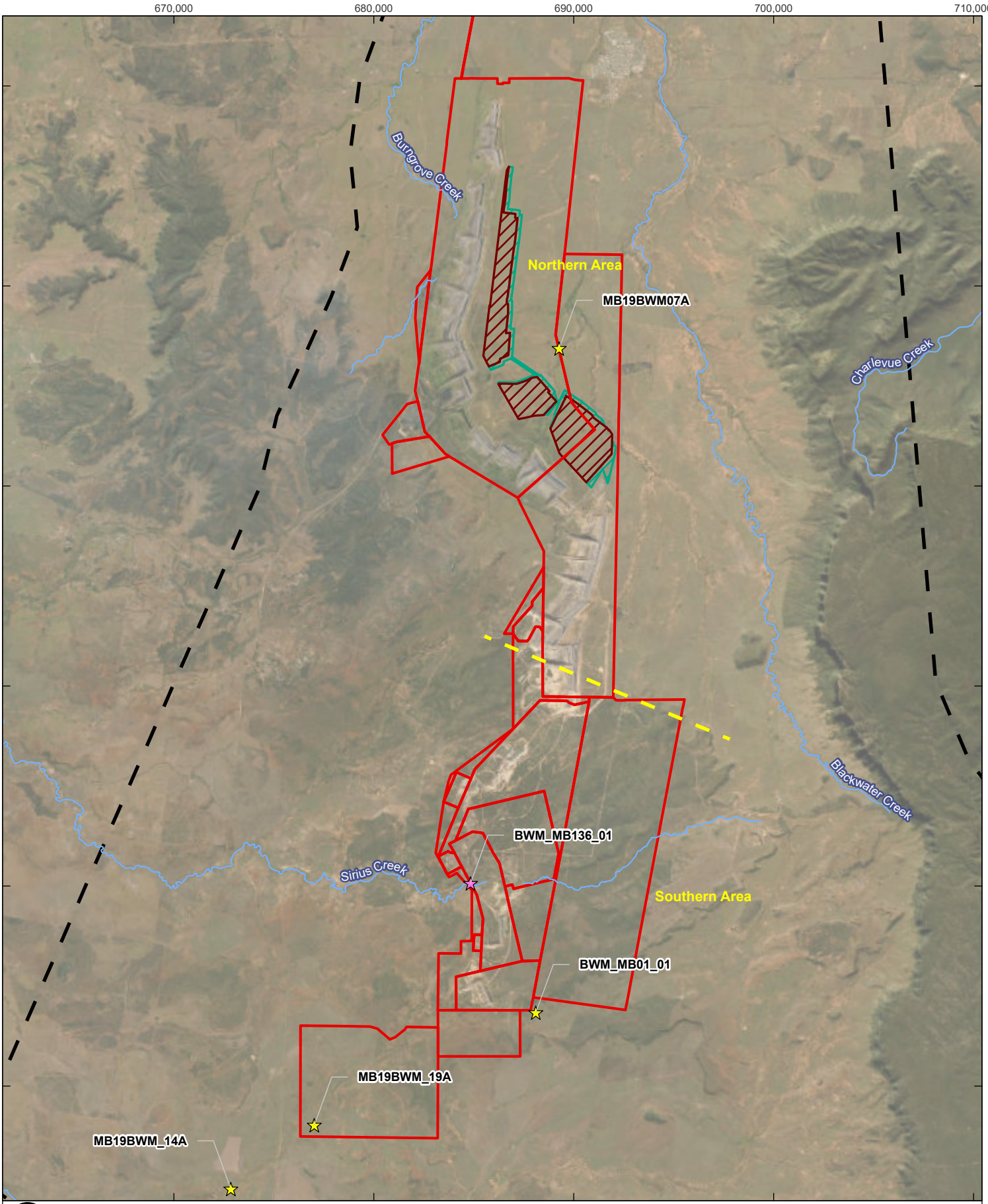
5.1.2.1 Quaternary Sediments

The BWM non-EA groundwater monitoring network for the alluvium is shown in **Table 5-2** and **Figure 5-2**. The monitoring network comprises a total of six monitoring bores (one of which is a current EA listed bore and describe above), installed at depths ranging from 7 to 16 metres below ground level (mBGL), with available data between 2019 and 2025. All excluding one, which was located to the south of the BWM operations, are observed to be dry.

Table 5-2 Quaternary Sediments Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB19BWM07A	689271	7376875	196.5	7	4 - 7	Alluvium	BWM North	Active (dry)	18/12/2019	22/06/2023	30/06/2020	22/06/2023
BWM_MB01_01	688102	7343664	271.04	16	10 - 16	Alluvium	BWM South	Active	17/03/2023	20/11/2024	17/03/2023	20/07/2023
MB19BWM_14A	672849	7334846	205.84	7.5	6 - 7	Alluvium	BWM South	Active (dry)	4/08/2022	27/06/2023	-	-
MB19BWM_19A	677022	7338038	224.72	14.5	9 - 12	Alluvium	BWM South	Active (dry)	4/08/2022	27/06/2023	-	-
BWM_MB136_01	684837	7350128	256.26	8.3	4.0 - 7.0	Alluvium/ Burngrove	BWM South	Active (dry)	18/10/2024	31/01/2025	-	-

1 Coordinates GDA 2020 Zone 55



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Alluvium
- Alluvium/ Burngrove

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- QUATERNARY SEDIMENTS

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FIGURE 5-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_02_Groundwater Monitoring Network (Quaternary Sediments)

5.1.2.2 Tertiary Sediments and Basalt

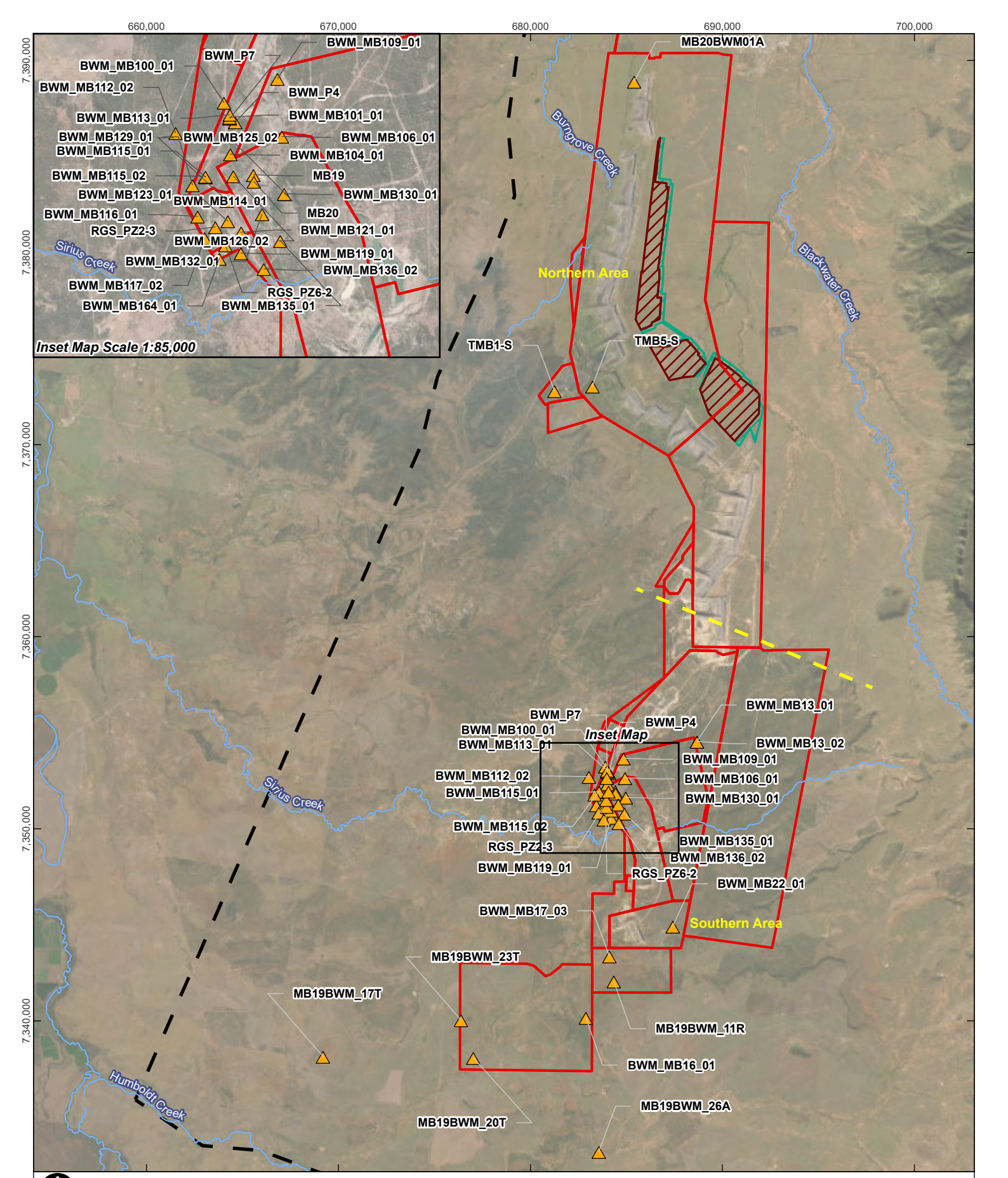
The BWM non-EA groundwater monitoring network for the Tertiary Sediments and Basalt is shown in **Table 5-3** and **Figure 5-3**. This network includes a total of 7 monitoring bores, of which five are current EA listed bores (Table 5-1 and excluded here), installed at depths ranging from 4.5 to 56 mBGL, with available data between 2009 and 2025. Of these, 24 bores are currently dry.

Table 5-3 Tertiary Sediments and Basalt Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB20BWM01A	685396	7388908	187.76	9.5	6.5 - 9.5	Tertiary	BWM North	Active	21/06/2023	30/01/2025	-	-
TMB5-S	683230	7373039	239.06	15	12 - 15	Tertiary	BWM North	Active	17/01/2024	27/11/2024	27/11/2024	27/11/2024
TMB1-S	681249	7372800	259.53	16	13 - 16	Tertiary	BWM North	Active	18/01/2024	29/11/2024	29/11/2024	29/11/2024
BWM_MB13_01	688667	7354548	301.14	4.5	2.5 - 4.5	Tertiary	BWM South	Active (dry)	23/08/2022	29/01/2025	-	-
BWM_MB13_02	688672	7354546	300.53*	22	16 - 22	Tertiary	BWM South	Active (dry)	21/08/2022	29/01/2025	-	-
BWM_MB16_01	682882	7340174	283.63	56	49 - 55	Tertiary	BWM South	Active	19/08/2022	20/11/2024	-	-
BWM_MB17_03	684111	7343371	262.46	46	40 - 46	Tertiary	BWM South	Active	22/08/2022	25/09/2024	-	-
BWM_MB22_01	687412	7344924	286.17	26.5	21 - 26.5	Basalt	BWM South	Active	17/03/2023	20/11/2024	17/03/2023	17/03/2023
BWM_P4	684098	7352908	284.44	15.5	12.5 - 15.5	Tertiary (clay)	BWM South	Active	26/01/2023	10/09/2024	26/01/2023	28/09/2023
BWM_P7	684002	7352973	284.95	15.5	12.4 - 15.4	Tertiary (clay)	BWM South	Active	26/01/2023	10/09/2024	26/01/2023	28/09/2023
MB19	684418	7351975	310.7	19.7	13.7 - 19.7	Tertiary	BWM South	Unknown	31/08/2009	31/01/2025	31/08/2009	30/05/2012
MB19BWM_11R	684338	7342067	290.92	41.4	35.43 - 41.43	Tertiary (Basalt)	BWM South	Active (dry)	2/02/2023	27/06/2023	-	-
MB19BWM_17T	669191	7338149	226.31	32.5	26 - 32	Tertiary	BWM South	Active (dry)	6/11/2022	27/06/2023	-	-
MB19BWM_20T	677019	7338087	224.5	30.5	24 - 30	Tertiary (Sandstone with minor basalt)	BWM South	Active (dry)	20/09/2022	27/06/2023	-	-
MB19BWM_23T	676379	7340051	238.87	43.5	36.26 - 42.26	Tertiary	BWM South	Active (dry)	19/08/2022	27/06/2023	-	-
MB19BWM_26A	683558	7333194	226.86	15.5	9 - 15	Tertiary	BWM South	Active	26/05/2022	20/11/2024	-	-
MB20	684428	7351856	311.58	31.6	25.6 - 31.6	Tertiary	BWM South	Active (dry)	20/10/2009	31/01/2025	27/07/2009	11/02/2021
RGS_PZ2-3	683745	7351052	285.56	10.5	6 - 10.5	Tertiary	BWM South	Active	29/01/2023	11/06/2024	29/01/2023	26/09/2023
RGS_PZ6-2	683925	7350731	276.64	6.5	3.5 - 6.5	Tertiary Clays (fractured zone)	BWM South	Active	30/01/2023	12/06/2024	30/01/2023	29/09/2023
BWM_MB100_01	683897	7353255	304.36	17.5	10.5 - 16.5	Tertiary	BWM South	Active (dry)	23/08/2022	15/10/2024	-	-
BWM_MB101_01	683996	7352990	285	28	19 - 28	Tertiary (Clays, weathered sandstone)	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB104_01	684011	7352341	309.2	20	13.5 - 19.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB106_01	684923	7352654	307.81	32.5	26 - 32	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB109_01	684845	7353676	316.31	36	29.5 - 35.5	Tertiary	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-
BWM_MB112_02	683041	7352718	269.92	21.4	15 - 21	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB113_01	684003	7353042	285.51	13.5	7 - 10	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB114_01	683973	7352659	295.95	20.4	12.3 - 16.3	Tertiary	BWM South	Active	15/10/2024	15/10/2024	-	-
BWM_MB115_01	683572	7351933	310.44	12	8.5 - 11.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB115_02	683570	7351947	310.48	25.3	18.5 - 24.5	Tertiary	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB116_01	683431	7351240	304.83	12.9	9.4 - 12.4	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB117_02	683557	7350857	302.84	29.5	21.9 - 27.9	Tertiary	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB119_01	684198	7350590	281.36	19	15.5 - 18.5	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB121_01	684202	7350959	307.11	18.5	10.5 - 16.5	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB123_01	683965	7351157	307.03	8.8	5.2 - 8.2	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB125_02	683948	7351517	307.97	42.5	36 - 42	Tertiary	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB126_02	684063	7351953	312.14	32.5	26 - 32	Tertiary	BWM South	Active	8/11/2024	8/11/2024	-	-

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB129_01	683340	7351795	306.52	20.4	14 - 20	Tertiary	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-
BWM_MB130_01	684963	7351640	281.62	18	14.0 - 17.0	Tertiary into RCM OB	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB132_01	684573	7351281	288.66	19	12.5 - 18.5	Tertiary	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-
BWM_MB135_01	684895	7350808	263.75	12	6.5 - 9.5	Tertiary	BWM South	Active (dry)	18/10/2024	18/10/2024	-	-
BWM_MB136_02	684603	7350311	255.41	21.5	15.0 - 21.0	Tertiary	BWM South	Active	18/10/2024	18/10/2024	-	-
BWM_MB164_01	683816	7350493	269.25	15.3	8.5 - 14.5	Tertiary (Silty clay)	BWM South	Active	16/10/2024	16/10/2024	-	-

OB = Overburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Tertiary

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- TERTIARY

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FIGURE 5-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_03_Groundwater Monitoring Network (Tertiary)

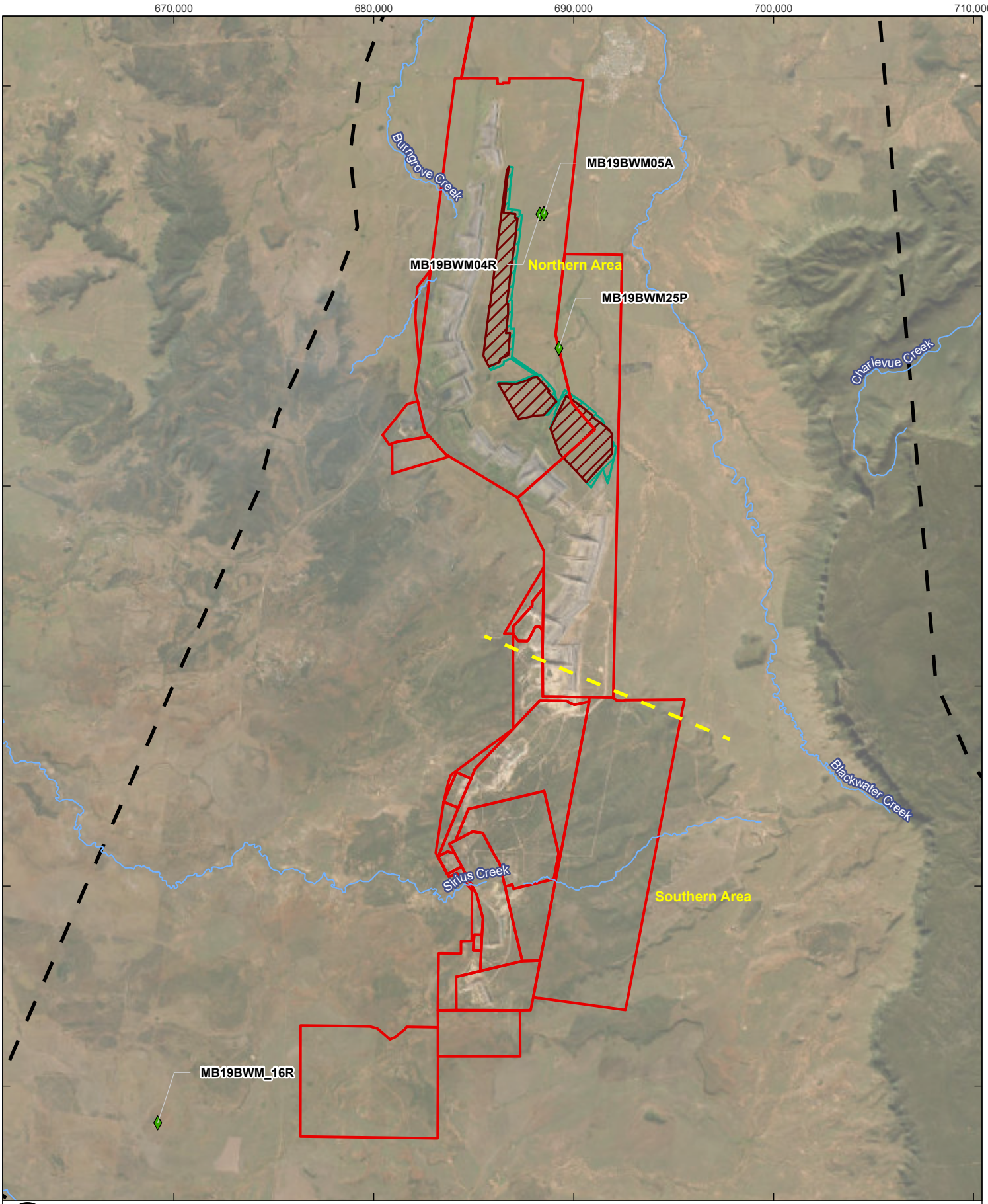
5.1.2.3 Triassic Rewan Group

The BWM non-EA groundwater monitoring network for the Triassic Rewan Group includes a total of four monitoring bores, one of which is currently dry. Bores are installed at depths ranging from 15 to 95 mBGL, with available data between 2023 and 2025. Bore details and their locality are shown in **Table 5-4** and **Figure 5-4** respectively.

Table 5-4 Triassic Rewan Group Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB19BWM04R	688307	7383595	200.9	80	71 - 80	Rewan	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	26/09/2023
MB19BWM05A	688507	7383623	199.57	15	9 - 15	Weathered Rewan	BWM North	Active (dry)[2]	18/12/2019	21/06/2023	30/06/2020	21/06/2023
MB19BWM25P	689262	7376881	196.42	20	17 - 20	Rewan	BWM North	Active	1/07/2020	22/06/2023	30/06/2020	26/09/2023
MB19BWM_16R	669188	7338156	226.26	95	87 - 93	Rewan	BWM South	Active	6/11/2022	19/11/2024	31/01/2023	12/09/2023

1 Coordinates GDA 2020 Zone 55
2 Bore forms part of the groundwater network and is currently monitored, however, it is currently dry



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Rewan
- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH PROJECT EIS
GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- REWAN GROUP

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FIGURE 5-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_04_Groundwater Monitoring Network (Rewan Group)

5.1.2.4 Rangal Coal Measures

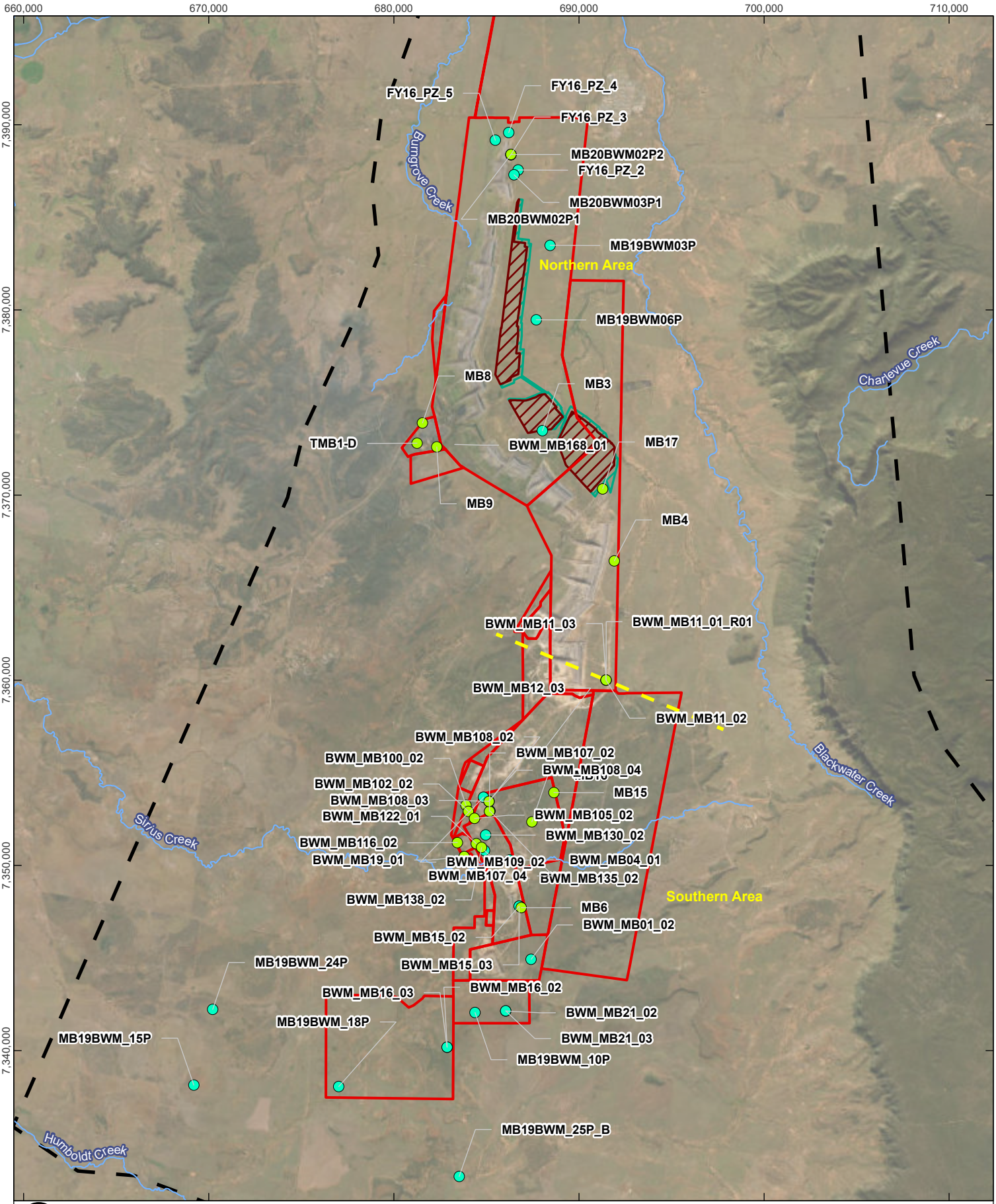
BWM non-EA groundwater monitoring bores targeting the Rangal Coal Measures are shown in **Table 5-5** and **Figure 5-5** and comprises a total of 51 monitoring bores. The bores are installed at depths ranging from 17 to 231.5 mBGL, with available data between 2009 and 2025, and six observed as dry.

Table 5-5 Rangal Coal Measures Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
FY16_PZ_2	686714	7387555	200.03	104.7	100.7 - 103.7	Pollux	BWM North	Active	26/11/2020	21/06/2023	26/11/2020	27/09/2023
FY16_PZ_3	686322	7388372	193.48	82.5	72.5 - 81.5	Pollux	BWM North	Active	25/11/2020	30/01/2025	23/03/2021	21/06/2023
FY16_PZ_4	686206	7389577	191	54	50 - 53	Pollux	BWM North	Active	25/11/2020	30/01/2025	25/11/2020	27/09/2023
FY16_PZ_5	685482	7389168	186.97	53.5	49.5 - 52.5	Pollux	BWM North	Active	25/11/2020	30/01/2025	25/11/2020	27/09/2023
MB19BWM03P	688442	7383483	199.39	231.5	222.5 - 231.5	Aries & Siltstone	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	26/09/2023
MB19BWM06P	687694	7379464	209.64	186	180 - 186	Siltstone & Aries	BWM North	Active	30/06/2020	21/06/2023	30/06/2020	21/06/2023
MB20BWM02P1	686325	7388395	192.86	36	30 - 36	IB (Sandstone)	BWM North	Active	24/03/2021	30/01/2025	24/03/2021	21/06/2023
MB20BWM02P2	686321	7388395	192.92	66	60 - 66	Castor	BWM North	Active	25/02/2021	30/01/2025	25/02/2021	27/09/2023
MB20BWM03P1	686489	7387296	199.44	86	80 - 86	Castor	BWM North	Active	24/03/2021	30/01/2025	10/02/2021	27/09/2023
MB3	688026	7373479	219.99	78.2	73.6 - 78.2	Aries	BWM North	Active	1/09/2009	6/11/2022	12/01/2010	15/05/2023
MB8	681544	7373895	271.76*	17	14 - 17	OB/IB?	BWM North	Unknown	1/09/2009	14/06/2024	1/09/2009	29/11/2023
MB9	682318	7372602	249.08	18	15 - 18	OB/IB?	BWM North	Active	1/09/2009	22/11/2024	1/09/2009	22/11/2024
TMB1-D	681252	7372802	259.56	36	31 - 36	IB	BWM North	Active	18/01/2024	29/11/2024	29/11/2024	29/11/2024
BWM_MB11_01_R01	691464	7360014	300.66	90.4	85 - 88	OB	BWM Central	Active	2/05/2022	22/01/2024	-	-
BWM_MB11_02	691466	7360007	300.85	115.25	112.25 -115.25	Castor	BWM Central	Active	4/05/2022	23/01/2025	23/01/2025	23/01/2025
BWM_MB11_03	691459	7360009	300.62	136.2	121.2 - 127.2	Pollux	BWM Central	Active	29/04/2022	23/01/2025	23/01/2025	23/01/2025
MB17	691280	7370333	227.2	67	-	OB (Sandstone)	BWM Central	Decommissioned	1/09/2009	26/02/2020	1/09/2009	26/02/2020
MB4	691908	7366445	250.25	49.8 (52)	Unknown	OB (Sandstone)	BWM Central	Decommissioned	31/08/2009	28/11/2019	31/08/2009	28/11/2019
BWM_MB01_02	687411	7344932	286.32	128	120 - 122	Castor	BWM South	Active	17/02/2023	20/11/2024	18/02/2023	16/08/2023
BWM_MB04_01	686247	7350296	259.3*	28.5	22 - 28	Castor	BWM South	Unknown	29/01/2023	12/06/2024	29/01/2023	28/09/2023
BWM_MB12_03	687977	7356091	334.03	180	172.72-178.28	Pollux	BWM South	Active	24/05/2022	29/01/2025	-	-
BWM_MB15_02	686779	7347804	321.21	126	114 - 120	Pollux	BWM South	Active	22/05/2022	24/01/2025	24/01/2025	24/01/2025
BWM_MB15_03	686768	7347802	320.93	84.9	78.9 - 84.9	Castor	BWM South	Active	22/05/2022	24/01/2024	24/01/2025	24/01/2025
BWM_MB16_02	682883	7340184	283.25	86	79 - 85	Castor	BWM South	Active	19/08/2022	20/11/2024	-	-
BWM_MB16_03	682875	7340188	283.29	113	106.5 - 112.5	Pollux	BWM South	Active	27/11/2022	20/11/2024	31/01/2023	12/09/2023
BWM_MB168_01	683280	7372735	241.21	26.5	20 - 26	Coal		Active	-	-	-	-
BWM_MB19_01	683803	7350482	267.87	42	34 - 40	OB	BWM South	Active	18/03/2023	24/05/2023	18/03/2023	24/05/2023
BWM_MB21_02	686043	7342140	305.08	129.4	123 - 129	Aries	BWM South	Active	6/03/2023	21/11/2024	3/03/2023	3/03/2023
BWM_MB21_03	686041	7342148	305.1	163.9	153 - 159	Pollux	BWM South	Active	6/03/2023	21/11/2024	2/03/2023	2/03/2023
MB15	688648	7353936	296.89	140	None, open borehole 51.8-140	Coal in Laleham UG area (EMM, 2021)	BWM South	Decommissioned	20/10/2009	17/08/2022	20/10/2009	18/02/2023
MB16	687458	7352353	281.51	109	None, open borehole 23.6-109	OB in Kenmare UG goaf area (EMM, 2021)	BWM South	Decommissioned	20/10/2009	6/11/2022	20/10/2009	18/02/2023
MB19BWM_10P	684383	7342058	291.38	103	96.5-102.5	Aries	BWM South	Active	28/02/2023	21/11/2024	28/02/2023	15/05/2023
MB19BWM_15P	669194	7338140	226.52	140	131.7 - 137.7	Aries	BWM South	Active	1/10/2022	11/12/2023	31/01/2023	12/09/2023
MB19BWM_18P	677019	7338061	224.57	85	78.5 - 84.5	Aries	BWM South	Active	31/07/2022	11/12/2023	1/02/2023	12/09/2023
MB19BWM_24P	670211	7342228	229.43	68.5	62 - 68	Aries	BWM South	Active	1/02/2023	19/11/2024	1/02/2023	12/09/2023
MB19BWM_25P_B	683532	7333206	227	133.5	127 - 133	Aries	BWM South	Active	11/06/2022	12/12/2023	31/01/2023	7/09/2023

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
MB6	686881	7347723	320.21	19.36 (49.7)	12.6 - 26.5	OB	BWM South	Unknown	31/08/2009	6/11/2022	31/08/2009	6/11/2022
BWM_MB122_01	684453	7351176	317.52	39.5	35 - 38	OB	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB130_02	684959	7351646	281.68	29.5	23.0 - 29.0	Pollux	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB135_02	684899	7350805	263.92	33	17.0 - 23.0	Aries	BWM South	Active	18/10/2024	18/10/2024	-	-
BWM_MB138_02	684736	7350972	276.26	26	19.5 - 25.5	IB	BWM South	Active	19/10/2024	19/10/2024	-	-
BWM_MB100_02	683897	7353250	304.38	38.5	31.5 - 37.5	IB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB102_02	684026	7352919	284.31	46	39 - 45	IB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB105_02	684356	7352543	308.04	20.4	14 - 20	Weathered OB	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB107_02	685169	7352920	314.82	34.5	29.5 - 32.5	Weathered OB	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB107_04	685192	7352941	315.81	87	80.5 - 86.5	Weathered RCM (Pollux 32/31/L01 seam)	BWM South	Active	20/10/2024	20/10/2024	-	-
BWM_MB108_02	685140	7353456	314.71	33	27 - 33	Weathered OB	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB108_03	685137	7353463	314.67	59.5	47.35 - 59.35	Aries	BWM South	Active (dry)	20/10/2024	20/10/2024	-	-
BWM_MB108_04	685132	7353470	314.72	89	80 - 86	Pollux	BWM South	Active	20/10/2024	20/10/2024	-	-
BWM_MB109_02	684843	7353684	316.18	77	65 - 71	Pollux	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB116_02	683430	7351232	304.88	24.5	18.8 - 22.8	Weathered OB	BWM South	Active	16/10/2024	16/10/2024	-	-

OB = Overburden, IB = Interburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:270,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- RCM (Coal)
- RCM Overburden/Interburden

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- BWM North Extension Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- RANGAL COAL MEASURES

SLR

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FIGURE 5-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_05_Groundwater Monitoring Network (Rangal Coal Measures)

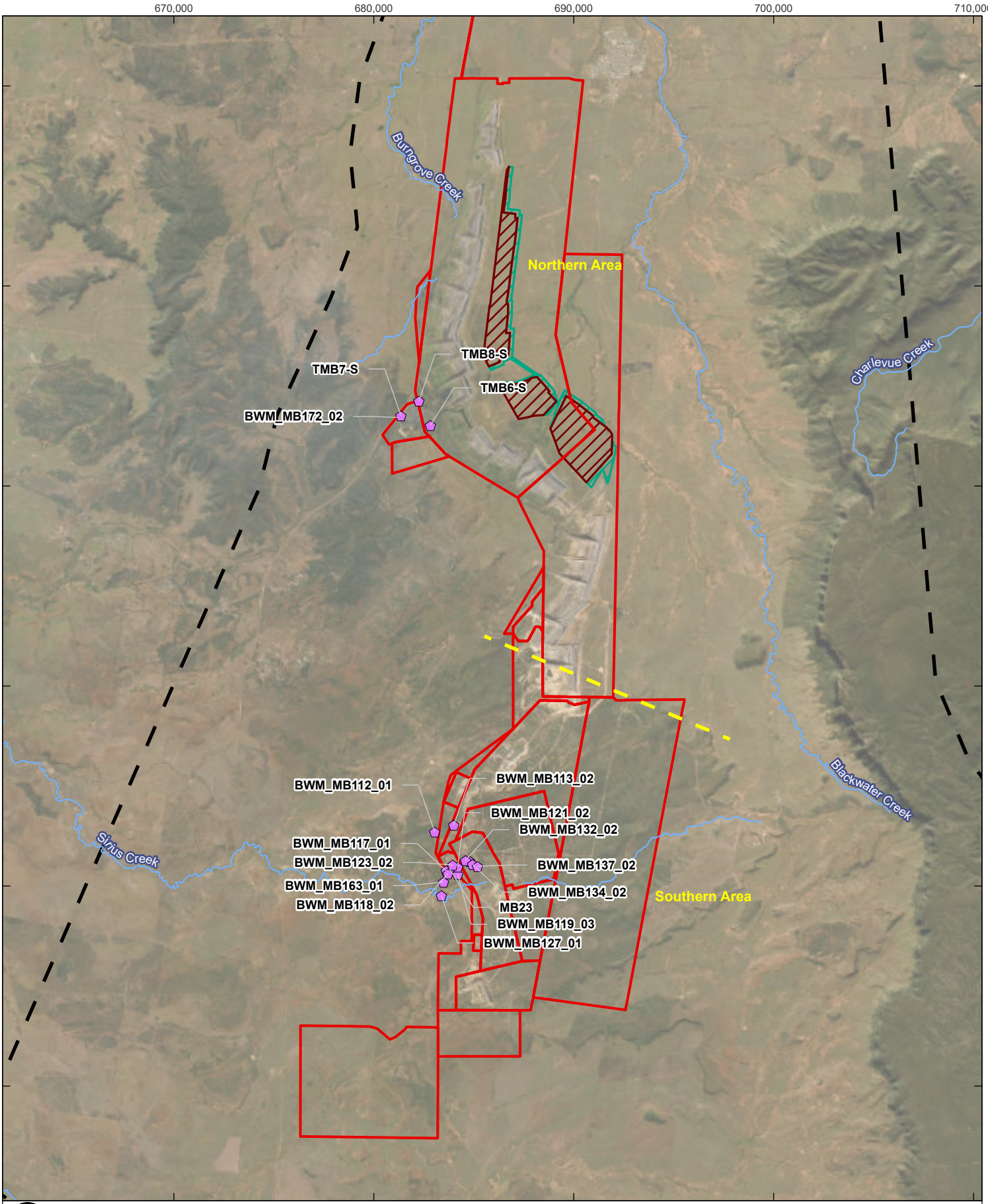
5.1.2.5 Burngrove Formation

The BWM non-EA groundwater monitoring network for the Burngrove Formation is shown in **Table 5-6** and **Figure 5-6**. The network consists of a total of 18 monitoring bores. The bores are installed at depths ranging from 8 to 72.9 mBGL, with available data between 2012 and 2025, with five observed as dry.

Table 5-6 Burngrove Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB172_02	681182.8	7373429	270.3	59.5	49.5-58.5	Burngrove	BWM North	Active	-	-	-	-
MB23	683792	7350850	278.95	24	18 - 24	Burngrove	BWM South	Active	27/01/2023	14/08/2024	27/01/2023	27/09/2023
TMB6-S	682831	7373037	242.09	10	8 - 10	Burngrove (weathered mudstone)	BWM North	Active	17/01/2024	30/11/2024	30/11/2024	30/11/2024
TMB7-S	681355	7373520	263.51	10	7 - 10	Weathered Burngrove	BWM North	Active	18/01/2024	14/06/2024	-	-
TMB8-S	682255	7374259	257.4	36	30 - 36	Burngrove	BWM North	Active	18/01/2024	27/11/2024	27/11/2024	27/11/2024
BWM_MB112_01	683043	7352714	270.06	12.5	9 - 12	Burngrove	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB113_02	683999	7353052	285.64	30.5	20 - 29	Burngrove (Mudstone and siltstone)	BWM South	Active (dry)	15/10/2024	15/10/2024	-	-
BWM_MB117_01	683622	7350774	302.25	39.3	32.8 - 38.8	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB118_02	683708	7350621	278.28	28	21.5 - 27.5	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB119_03	684197	7350597	281.48	29.3	25.8 - 28.8	Burngrove (sandstone)	BWM South	Active (dry)	16/10/2024	16/10/2024	-	-
BWM_MB121_02	684196	7350960	307.29	32.5	23 - 32	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB123_02	683946	7351056	303.87	30	23 - 29	Burngrove (sandstone)	BWM South	Active	16/10/2024	16/10/2024	-	-
BWM_MB127_01	683379	7349529	248.26	11.5	7.9 - 10.9	Burngrove (sandstone)	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-
BWM_MB131_02	684803	7351242	279.25	23	14.5 - 20.5	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB132_02	684591	7351283	288.83	29.5	23.0 - 29.0	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB134_02	684943	7351085	277.8	39.5	36.0 - 39.0	Burngrove (sandstone)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB137_02	685185	7350987	280.35	30	23.5 - 29.5	Burngrove	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB163_01	683486	7350205	257.4	8	3 - 6	Weathered Burngrove	BWM South	Active (dry)	5/11/2024	5/11/2024	-	-

O/I = overburden/interburden
1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Burngrove

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- BURNGROVE FORMATION

SLR

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FIGURE 5-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_06_Groundwater Monitoring Network (Burngrove Formation)

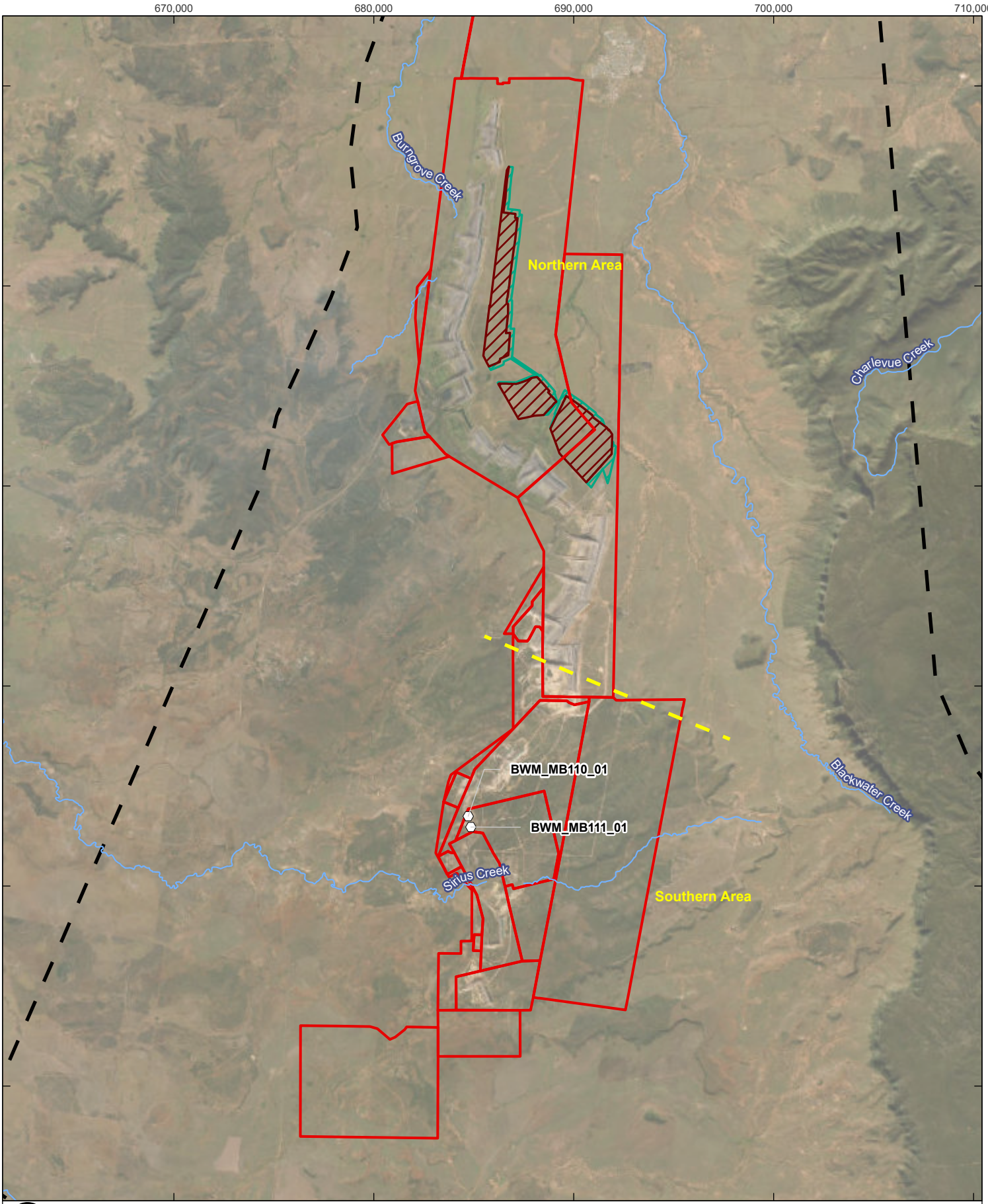
5.1.2.6 Spoil

Groundwater monitoring bores targeting spoil are shown in **Table 5-7** and **Figure 5-7** and include a total of two bores (one of which is dry), installed at depths ranging from 26 to 35.5 mBGL, with available data in 2024.

Table 5-7 Spoil Groundwater Monitoring Network

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Screened Interval (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
BWM_MB110_01	684722	7353488	288.47	36	26 - 32	Mine spoil (tailings)	BWM South	Active	22/10/2024	22/10/2024	-	-
BWM_MB111_01	684855	7352949	304.65	39	26.5 - 35.5	Mine spoil (tailings)	BWM South	Active (dry)	22/10/2024	22/10/2024	-	-

1 Coordinates GDA 2020 Zone 55
* Ground Level



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- Spoil
- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- SPOIL

SLR

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FIGURE 5-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_07_Groundwater Monitoring Network (Spoil)

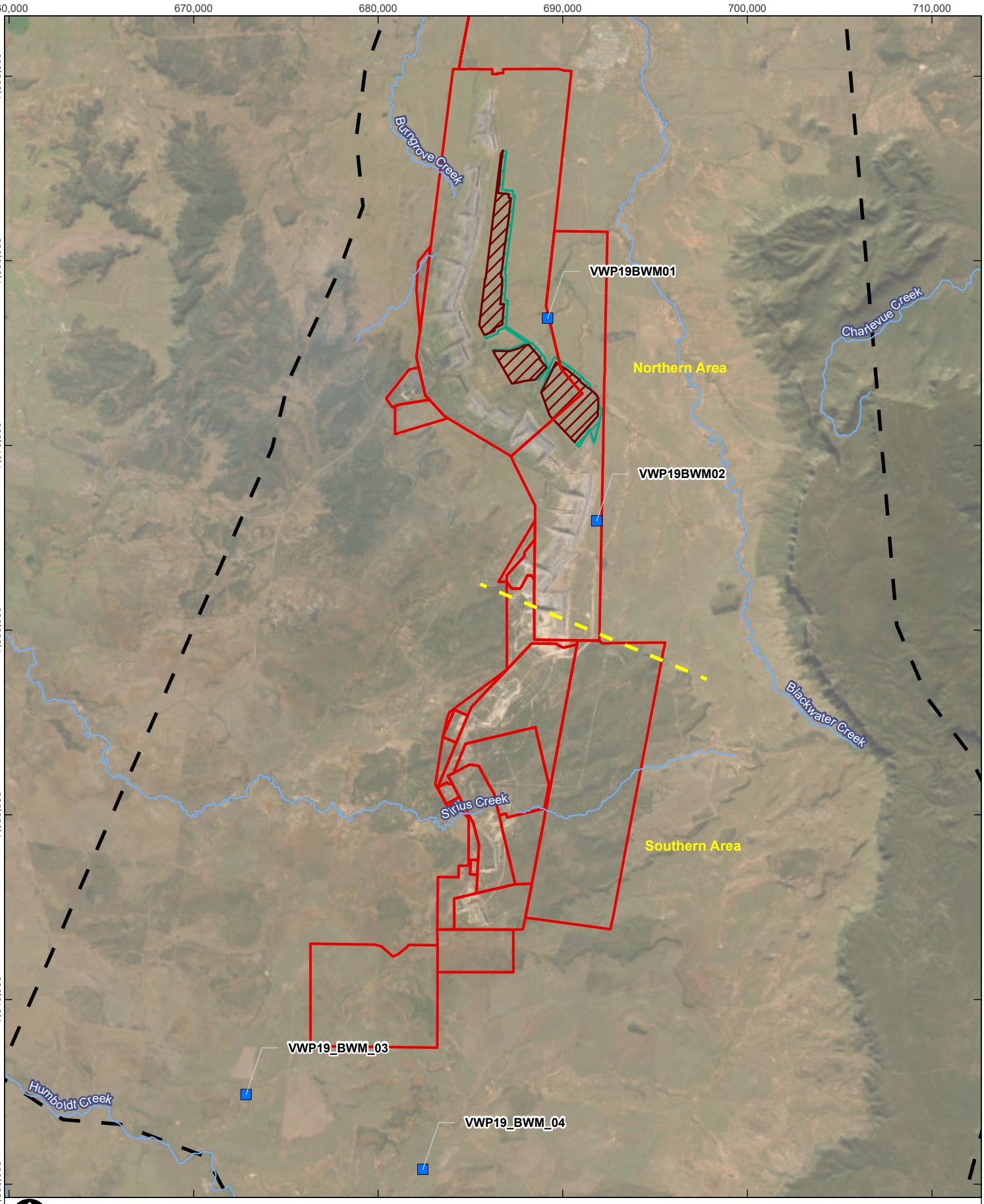
5.1.2.7 Vibrating Wire Piezometers

Four Vibrating Wire Piezometers (VWPs) are installed at BWM, two of which are located in the north and two in the south of BWM. Details for the VWPs, including the sensor depths, are provided in **Table 5-8** with their locality shown in **Figure 5-8**.

Table 5-8 Vibrating Wire Piezometers

Bore	Easting[1]	Northing[1]	TOC (mAHD)	Depth (mBGL)	Sensor Depths (mBGL)	Monitored Unit	BWM Area	Status	Data Availability (dates)			
									min WL	max WL	min WQ	max WQ
VWP19BWM01	689179	7376894	198	271.5	46 / 104 / 125 / 154 / 186	RCM OB / RCM OB / Aries / RCM IB / Pollux	BWM North	Unknown[2]	22/12/2019	22/11/2022	-	-
VWP19BWM02	691840	7365921	249	174	87.5 / 101 / 112 / 127 / 149	RCM OB / Aries / Castor / Pollux / Orion	BWM North	Unknown	22/04/2020	22/07/2022	-	-
VWP19_BWM_03	672843	7334855	206.57	190.75	40 / 100 / 155.5 / 160 / 182.5	Rewan / RCM OB / Aries / Castor / Argo	BWM South	Active	15/08/2022	15/02/2024	-	-
VWP19_BWM_04	682417	7330805	226.16	190.75	42 / 88 / 112.5 / 143.5 / 153.5	Rewan / Rewan/ Aries / Castor / Argo	BWM South	Active	15/09/2022	15/02/2024	-	-

1 Coordinates GDA 2020 Zone 55
2 Status unknown, as the feature is not currently monitored, and was not identified in the most recent survey



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:270,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

Groundwater Monitoring Location

- VWP

- Watercourse
- Area
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MONITORING NETWORK- VIBRATING WIRE PIEZOMETERS

SLR

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FIGURE 5-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_08_Groundwater Monitoring Network (Vibrating Wire Piezometers)

5.2 Hydraulic Properties

Hydraulic properties of hydraulic conductivity and storativity have been measured by various techniques at different locations in the vicinity of BWM. Results can differ depending on the techniques employed. Falling head or slug tests are at best an approximation of hydraulic conductivity and provide an estimate generally within one order of magnitude. Packer testing conducted during drilling programs is considered a more reliable measure of hydraulic conductivity, providing an estimate over the interval tested. Test pumping is the most reliable method of measuring hydraulic conductivity and has the advantage of identifying recharge or barrier boundaries if they are present. In addition, if during test pumping drawdown is measured in observation bores, the aquifer storativity can be calculated.

Within the study area, the coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. Sedimentary consolidation processes cause the coal seams to display dual porosity characteristics, with a primary matrix porosity and a secondary (dominant) porosity provided by diagenic fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures.

5.2.1 Northern Area

In the BWM Northern Area, two field hydraulic testing campaigns were recently undertaken (AGE, 2020 and HydroFS, 2021). The results for estimated hydraulic conductivities from slug tests are presented in **Table 5-9**. Results for the Rewan Group show higher hydraulic conductivities in the shallowed weathered zone, and lower hydraulic conductivity in the deeper part of the unit considered more representative of the true formation. The results for the RCM are predominantly representative of coal (Aries Coal Seam). One test was taken at a zone with coal and interburden present. The geometric mean of the coal hydraulic conductivity is estimated at 0.003 m/day, however the results span over three orders of magnitude (0.00003 m/day to 0.056 m/day). The locations of the bores tested in these campaigns are shown on **Figure 5-9**.

Table 5-9 Blackwater Northern Area Slug Test Results

Bore	Aquifer Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)	Source
Rewan Group				
MB19BWM02A	Siltstone (Weathered Rewan)	15	0.39	AGE, 2020
MB19BWM25P	Sandstone (Weathered Rewan)	20	0.002	AGE, 2020
MB19BWM04R	Sandstone (Rewan)	80	0.0008	AGE, 2020
Rangal Coal Measures				
MB20BWM02P2	Permian (coal)	66	0.00028	HydroFS, 2021
MB20BWM03P1	Permian (coal and sandstone interburden)	86	0.056	HydroFS, 2021
MB20BWM03P2	Permian (coal)	109	0.015	HydroFS, 2021
MB19BWM01P	Aries Coal Seam	171	0.033	AGE, 2020

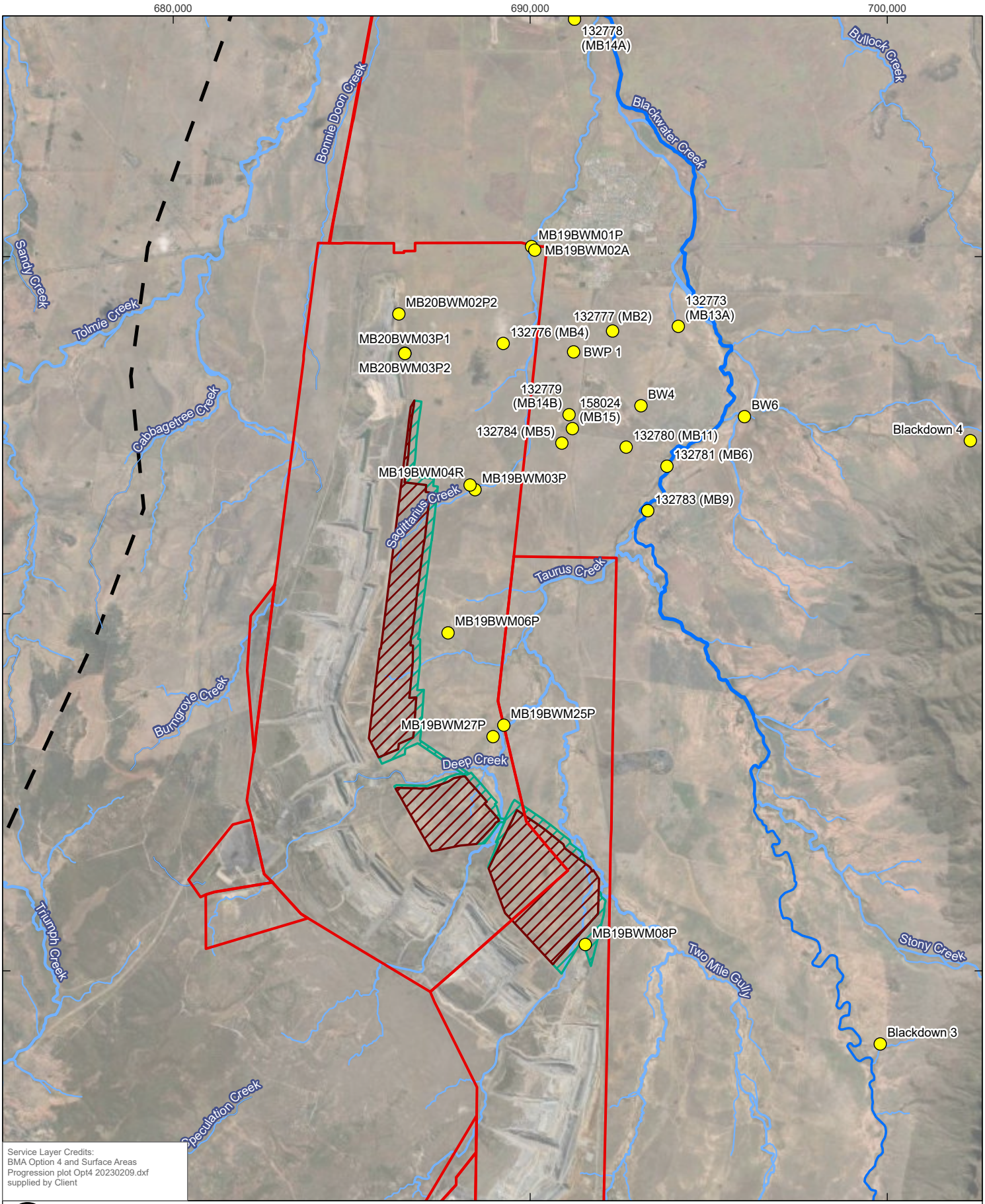
Bore	Aquifer Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)	Source
MB19BWM06P	Aries Coal Seam	186	0.00007	AGE, 2020
MB19BWM27P	Aries Coal Seam	189	0.027	AGE, 2020
MB19BWM08P	Aries Coal Seam	198	0.024	AGE, 2020
MB19BWM03P	Aries Coal Seam	231.5	0.00003	AGE, 2020

Falling-head tests were undertaken on several monitoring bores within ML80173 as part of the proposed Minyango Project (AGE, 2013). The hydraulic conductivity derived from the falling-head tests are summarized in **Table 5-10**. The Blackwater Creek alluvium has the highest estimated hydraulic conductivity of 0.4 m/day, with the Rewan Group estimated hydraulic conductivity ranging over two orders of magnitude between 0.00015 and 0.055 m/day. The measured hydraulic conductivity of one sample from the Aries Seam was 0.003 m/day which is within the range of results obtained for the Rewan Group. The locations of the tested bores are shown on **Figure 5-9**.

Table 5-10 Minyango Falling-Head Tests

Bore	Unit	Bore Depth (m)	Hydraulic Conductivity (m/day)
132783 (MB9)	Blackwater Creek Alluvium	13	0.4
132776 (MB4)	Rewan Group	33	0.015
132784 (MB5)	Rewan Group	47	0.00015
132781 (MB6)	Rewan Group	41	0.0075
132780 (MB11)	Rewan Group	53	0.055
132773 (MB13A)	Rewan Group	16	0.01
132778 (MB14A)	Rewan Group	35	0.0058
132779 (MB14B)	Rewan Group	23	0.0008
158024 (MB15)	Rewan Group	23	0.055
132777 (MB2)	Aries Seam	226	0.003

In addition, several campaigns of drill stem testing of the coal seams within the north and centre of Blackwater have previously been undertaken. Aquifer parameters derived from drill stem tests are summarised in **Table 5-11** (EMM, 2019). The locations of the tested bores are shown on **Figure 5-9.**



Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:140,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Hydraulic Testing Location
- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

HYDRAULIC TESTING DATA LOCATIONS

SLR

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FIGURE 5-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_09_Hydraulic Testing Data Locations

Table 5-11 Drill stem Test Results (EMM, 2019)

Bore	Coal Seam	Test Depth (m)	Hydraulic Conductivity (m/day)
Blackdown 3	Aries/Castor	574	0.00014
	Virgo	657	0.000017
	Leo/Aquarius	713	0.000017
Blackdown 4	Aries	861	0.000058
	Castor	873	0.000042
BW6	Aries	348–355	0.00019
BW4	Pollux	222–235	0.081
BWP 1	Aries	252–258	0.149
	Castor	265–270	0.094
	Pollux	280=–288	0.032

5.2.2 Southern Area

A series of test pumping programs have been previously undertaken on the coal bearing strata in the South Blackwater area. **Table 5-12** shows the resulting estimated hydraulic parameters including hydraulic conductivity and storativity, collated from these investigations (EMM, 2019).

Table 5-12 Hydraulic Parameters (South Blackwater Area)

Area	Method	Unit	Hydraulic Conductivity (m/day)	Storativity
Kennedy Pit Area	Pumping Test	Argo Seam	3.2 to 8.1	$1.3x10^{-4}$ to $3.4x10^{-4}$
		Aries and Castor Seam	5	$1.3x10^{-4}$ to $3.4x10^{-4}$
		Fresh overburden and interburden	0.75 to 1.75	$3.5x10^{-5}$ to $9.1x10^{-5}$
		Overburden – Weathered and Tertiary	0.7	$3.0x10^{-3}$
		Floor Strata	0.05	$3.5x10^{-5}$ to $9.1x10^{-5}$
Kennedy Pit Area	Pumping Test	Pollux/Argo Seam	6.4	-
Laleham Pit Area	Unknown	Argo Seam	1.3 to 1.9	$1.0x10^{-4}$
South Marshmead	Unknown	Argo Seam	1.5	-



Test pumping conducted by AGC in 1990 was undertaken over 48 hours at a rate of 2.3 L/s with water levels recorded in several observation bores. Drawdown was observed in all bores with the furthest located 820 m from the pumping bore, recording a maximum drawdown of 0.15 m (EMM, 2019).

AGE (2003) conducted test pumping of the Pollux/Argo seam within the Kennedy pit area. The test pumping program was conducted at a rate of 1.5 L/s for 72 hours. The recorded drawdown after 72 hours of pumping was 2.11 m and 0.855 m at distances of 612 m and 1,150 m respectively. Analysis of the test pumping data indicated a hydraulic conductivity of 6 m/day. The exact location of the pumping bore is not known.

Douglas and Partners (1997) reported the hydraulic parameters for the Argo Seam within the Laleham and South Marshmead pit area. The type of testing and location of the test bores are not reported.

5.2.3 Faults

The mapped local faults (**Figure 4-5**) show a displacement of a maximum of 5 m (EMM, 2021). Site specific testing of the faults has not been undertaken to derive hydraulic properties of the fault zones or assess whether the faults act as conduits or barrier to groundwater flow. However, they are anticipated to act more as barriers than conduits because the faults compartmentalise the coal seam geology and Permian groundwater flow is dominated by water movement within these seams.

As identified by Jourde *et al*. (2002), faulting can result in higher permeabilities within strata parallel with the fault plane, and lower permeabilities within strata perpendicular to the fault plane. However, this can also be dependent on whether faults are currently active (Paul *et al.*, 2009). Faulting has been inactive within the Bowen Basin for over 140 million years (Clark *et al.*, 2011), indicating that the fault zones are less likely to act as conduits to flow; this relates to filling of the fractured pore spaces over time through hydrothermal alteration and mineralisation (Uysal *et al.*, 2000). Drill core logs from the Bowen Basin generally show that where fractures and faults have been geologically logged, many fractures are “healed” with calcite and siderite. This indicates that although the system contains a fracture network, many of the existing fractures are cemented, which reduces the effective permeability of the fracture when compared to any open fracture network (Uysal,2000).

Based on a detailed literature review of the effect of faulting on groundwater flow, Coffey (2014) has developed a conceptual model for fault zone hydraulic characterisation in the Bowen Basin (**Figure 5-10**), largely based on Jourde *et al.* (2002) and Flodin *et al.* (2001). This conceptualisation provides a means of inferring hydraulic conductivities of the fault core and the fault damage zone from regional hydraulic conductivity, with the fault core typically one to three orders of magnitude lower conductivity than the regional host rock, and the damage zone approximately an order of magnitude higher.

For this assessment, only one major fault, the Shotover Fault, was included in the groundwater model (refer to **Section 6.0**). The Shotover Fault is located approximately 15 km east of the EA boundary, near the eastern edge of the model boundary (**Figure 4-5**). It is an east dipping thrust fault with a displacement of up to 3,000 m (Mallet, 1988). As mentioned above, fault zones within the model boundary are likely to be “healed” with mineralisation, reducing effective permeability. This suggests that the Shotover Fault is more likely to act as a hydraulic barrier. In line with the IESC (2021) Explanatory Note: Characterisation and Modelling of Geological Fault Zones (Murray & Power, 2021), the Shotover Fault has been classified under Scenario A2: a fault acting as a barrier based on conceptual evidence, as no site-specific hydraulic testing has been undertaken. This



classification reflects the current understanding that the fault core has significantly lower hydraulic conductivity than the surrounding host rock, and supports its representation as a no-flow boundary in the groundwater model.

This fault, the Shotover Fault, was included as a no flow boundary, based on the understanding that the fault core has a lower hydraulic conductivity than the host rock.

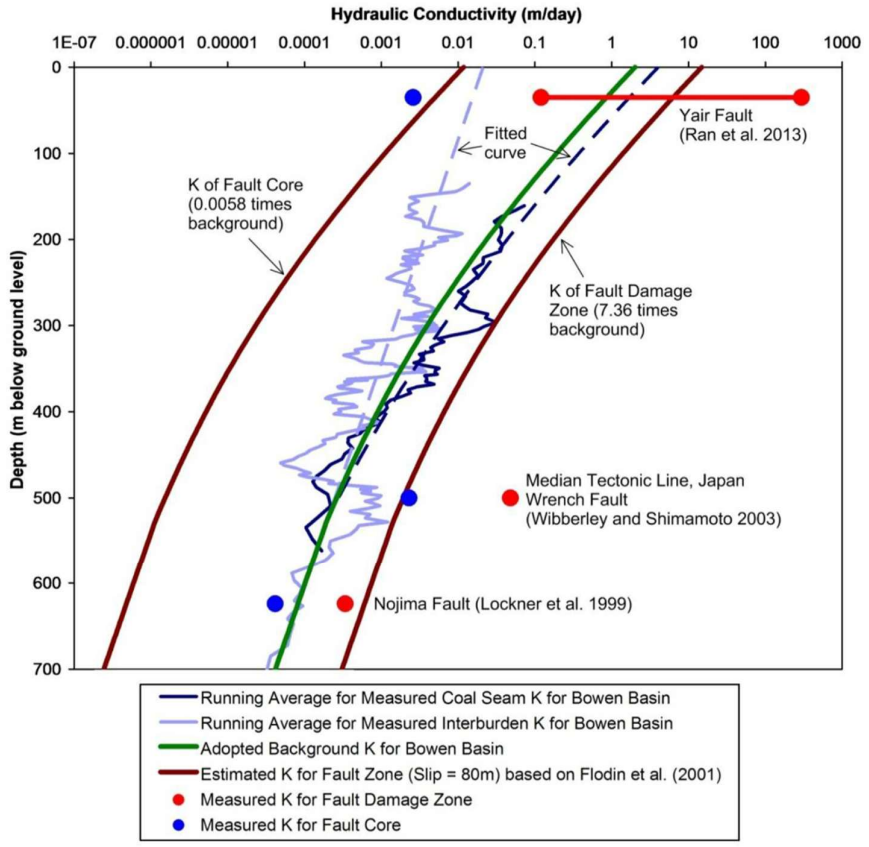


Figure 5-10 Faulting Conceptual Model Developed by Coffey (2014)

5.3 Groundwater Distribution, Flow, Recharge and Discharge

5.3.1 Quaternary Sediments (Alluvium)

Based on recent drilling at BWM, it is considered that the horizontal extent of the Quaternary alluvium within the Study Area is likely smaller than mapped on the regional surface geology map (**Figure 4-1**).

Recent drilling campaigns targeting the alluvium in the north of BWM (2020 and 2021) revealed either an absence of alluvium, and/or dry conditions. In 2020, four bores were planned to be installed into the alluvium at north BWM, however only one of the four locations (bore MB19BWM07A at Taurus Creek) was able to be installed into the alluvium, which was then found to be unsaturated (AGE, 2020). Two bores were planned to be installed into the Two Mile Gully alluvium but did not intersect alluvium and were grouted up. A further two bores targeting the Sagittarius Creek alluvium were attempted to be installed, with one intersecting alluvium (MB19BWM02A) that was found to be unsaturated, and the

other (MB19BWM05A) intersecting possible alluvium or possible Tertiary sediments that were also unsaturated.

These two drillholes in Sagittarius Creek were converted to monitoring bores targeting the shallow weathered Rewan Group instead, where first shallow groundwater was found. Another bore (BWM_MB03_01) installed into the Taurus Creek alluvium, drilled in 2020 (EMM, 2021) has also been dry since installation.

In 2021, during an additional drilling campaign, bore MB20BWM01A initially targeted alluvium (near a small unnamed tributary of Bonnie Doon Creek) but again due to the lack of alluvial sediments at the site, the bore was installed into the water table in the shallow Rewan Group (HydroFS, 2021). In 2023, five additional bores were installed in the alluvium of Rockland Creek (four bores) and Shotover Creek (one bore) in the south of BWM, two of which (MB19BWM_14A and MB19BWM_19A) found the alluvium to be unsaturated.

Drilling results indicate that where the alluvium is present, it is generally dry, with saturated areas found in few locations. There are six active BWM monitoring bores screened in the alluvium that have been considered for this assessment (**Figure 5-2**), however only one is saturated BWM_MB01_01 at Rockland Creek, just outside (approximately 300 metres [m]) the eastern edge of the EA boundary. (**Figure 5-11** and **Figure 5-12**). It is noted however that there is no mapped alluvium in this area, rather the surface geology in the area is mapped as Tertiary sediments. Furthermore, the bore log shows the screened interval to be “clay sand, weathered” indicating that the bore may actually be screened in the Tertiary sediments or weathered Permian, rather than alluvium. The short data record available for this bore shows groundwater level elevation to range between approximately 15 to 16 mBTOC (255 to 256 mAHD) (**Figure 5-11** and **Figure 5-12**). The relatively deep recorded depth to groundwater of approximately 15 m below ground level where alluvial groundwater is encountered indicates a distinct lack of connection with any surface water features, and is also likely beyond the rooting depth of any terrestrial vegetation species.

Due to the general lack of saturated monitoring locations in the alluvium, and the limited period of data available, it is not possible to assess correlation with rainfall (and therefore recharge) based on these bores. However, based on a review of available groundwater level data for the neighbouring Minyango Project that was conducted by AGE (2013), recharge to the alluvium is suggested to be limited. Of the four bores installed into the alluvium at Minyango Project, three were also dry. The only bore that encountered water (Minyango-MB9) revealed a limited saturated thickness of less than 0.8 m, with a depth to water level of 10.8 mBGL. The monitoring data for MB9 showed a steady decline between December 2012 to September 2013, and showed no correlation with rainfall. AGE (2013) determined that, for bore MB9, recharge is likely limited by the surficial clay above alluvium and that the alluvium is likely compartmentalised, with limited connectivity between saturated alluvium areas, separated by clay lenses and outcropping bedrock. Where saturated, the alluvium may facilitate recharge to underlying geological units. Discharge from this aquifer is generally considered to be via evapotranspiration and leakage to underlying aquifers.



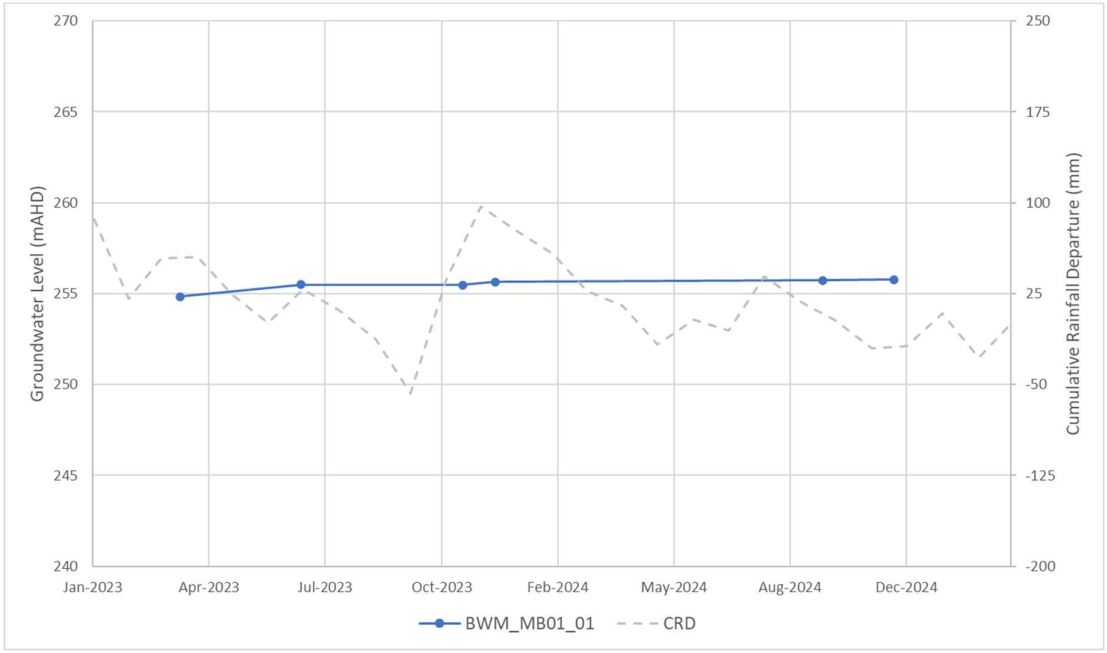


Figure 5-11 Groundwater Level (mAHD) – Alluvium

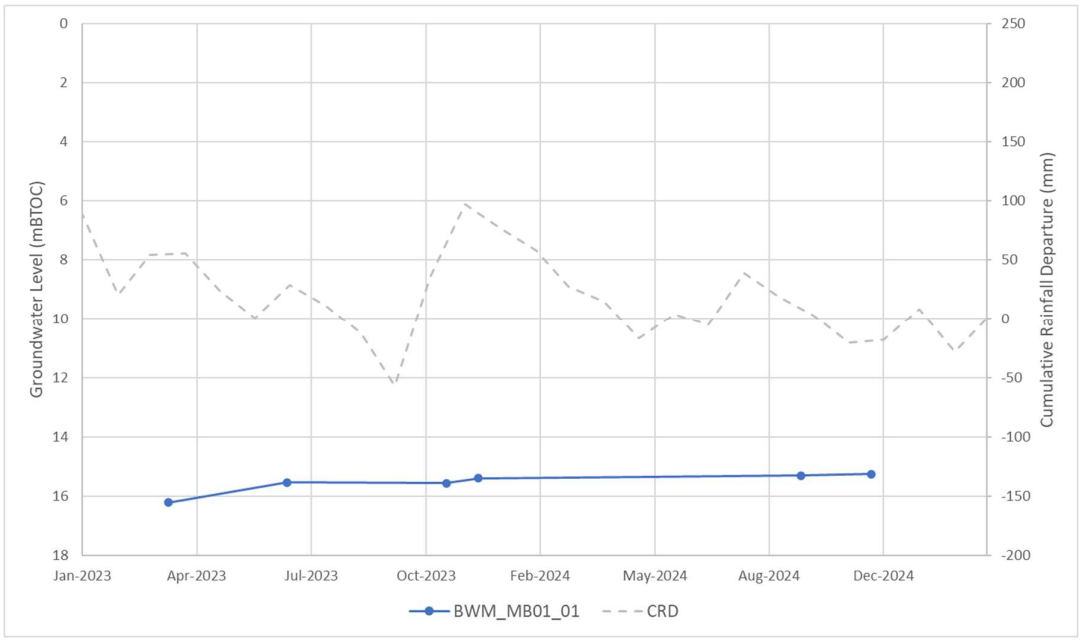


Figure 5-12 Groundwater Level (mBTOC) – Alluvium

Due to the general lack of saturated monitoring locations in the alluvium within the study area, it is not possible to map groundwater contours for this unit, nor is it likely that a widespread flow system in the alluvium exists. However, where saturation does exist, groundwater flow in the alluvium is expected to be controlled by topography and mimic surface water flow directions, with flow towards the north at North Blackwater and towards the southwest at South Blackwater.

5.3.2 Tertiary Sediments

The Tertiary unit forms the surficial (water table) aquifer, where the groundwater table exceeds the base of the unit (that is, in some locations at BWM the Tertiary unit is 'dry' and therefore does not form an aquifer). Groundwater level data for the Tertiary EA listed bores is provided as two separate figures - **Figure 5-13** and **Figure 5-14**, for visualisation purposes due to the elevation difference between the groundwater levels.

Bores BWM_MB12_01 and BWM_MB17_01 are also Tertiary EA listed bores but have been recorded as dry since installation so do not appear on the figures.

Groundwater levels in the Tertiary EA listed bores range from approximately 242 to 306 mAHD and 15 to 20 mBTOC. The longest monitoring record is available from MB21, which shows there has been a steady decrease in groundwater level since 2011, interrupted periodically by relatively short-term responses to large rainfall events. This long-term decline reflects a long-term response following the very high rainfall observed in 2011. Groundwater levels in BWM_MB15_01 and BWM_MB17_02 over the relatively short monitoring period have remained stable, showing no response to rainfall trends or any mine-related influences. This is consistent with the conceptualisation of the Tertiary unit, where recharge from rainfall infiltration is expected to be low due to the presence of surficial clays. Notably, bore BWM_MB15_01 sits at the highest ground elevation of any of the Tertiary EA listed bores and hence has the highest groundwater level elevation of any of the Tertiary EA listed bores, noting that the natural water table elevation typically forms a subdued reflection of topography.

47 bores are screened in the Tertiary Sediments, with MB20BWM01A located in the Northern area, east of the Bonnie Doon Pit and the remaining bores located within the Southern area (**Figure 5-3**). Five of these bores are current EA listed bores.

Northern Area

MB20BWM01A was drilled in 2020 and has remained dry since instillation. In this area the Tertiary Sediments are relatively thin (i.e. less than 15 m thick) and underlain by the Rewan Group (east of the mining area), the Permian units of the RCM (within the mining area) and the Burngrove Formation (west of the mining area). The Tertiary Sediments primarily consist of highly to extremely weathered sandstone and mudstone of the Duaringa Formation and forms the bulk of the Regolith. In the Northern Area, the Tertiary Sediments are expected to be mostly dry, as indicated by recent drilling (AGE, 2020 and HydroFS, 2021) as well as historical observations at Minyango (AGE, 2013). As per the alluvium, recharge is expected to be low due to the presence of surficial clays. Although no groundwater monitoring data is available, groundwater flow in the Tertiary Sediments is expected to mirror topography and flow towards the north.

Southern Area

Based on drilling results, the Tertiary Sediments in the Southern Area are thicker on average than in the Northern Area. In this area they primarily consist of claystone, siltstones, sandstones and interbedded basalt of the Emerald Formation.



Groundwater levels for the three monitoring bores screening the Tertiary Sediments vary from approximately 240 mAHD (BWM_MB17_02) to 305 mAHD (BWM_MB15_01) (**Figure 5-13** and **Figure 5-14**).

Following the commencement of water level measurement, BWM_MB17_02 and MB21 have seen a very slight albeit relatively steady decrease in water level, while BWM_MB15_01 has remained stable. These trends are intermittently interrupted only by relatively short-term response to large rainfall events. The bores display levels that are consistent with the assumed flow pattern for the regional Tertiary units, following a subdued reflection of topography.

Groundwater quality (**Section 5.4**) is generally saline, which would suggest a low to very low recharge rate for the Tertiary Sediments. However, there is significant variability in salinity levels for some of the identified bores of the Southern Area bores.

Discharge is considered to be primarily through evapotranspiration and leakage to underlying aquifers.

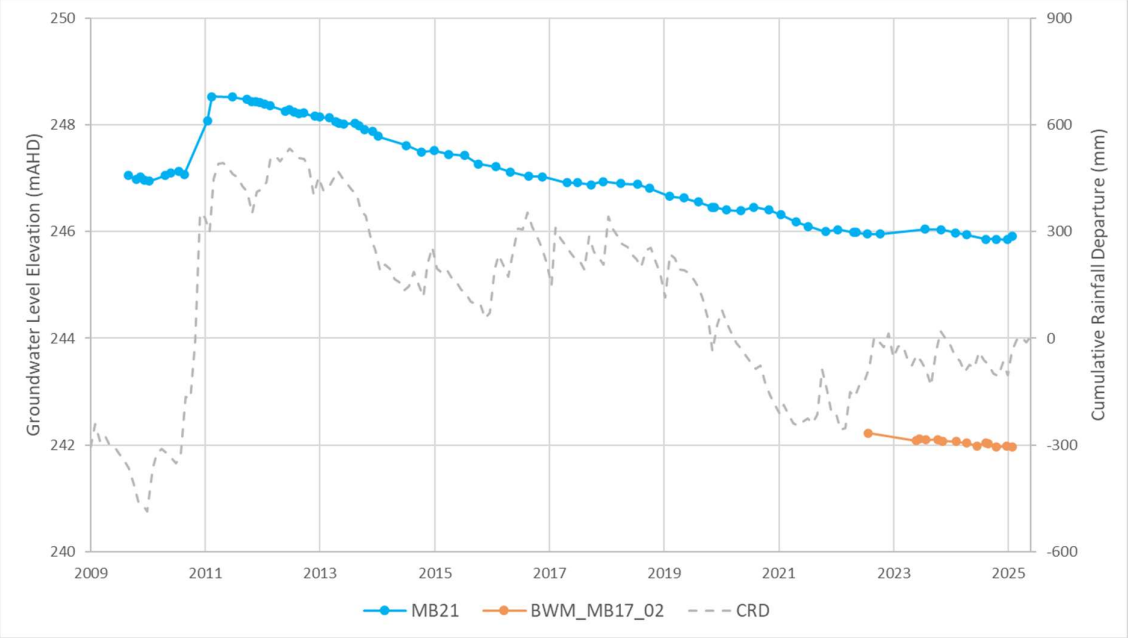


Figure 5-13 Groundwater Levels – Tertiary EA Listed Bores (MB21 and BWM_MB17_02)

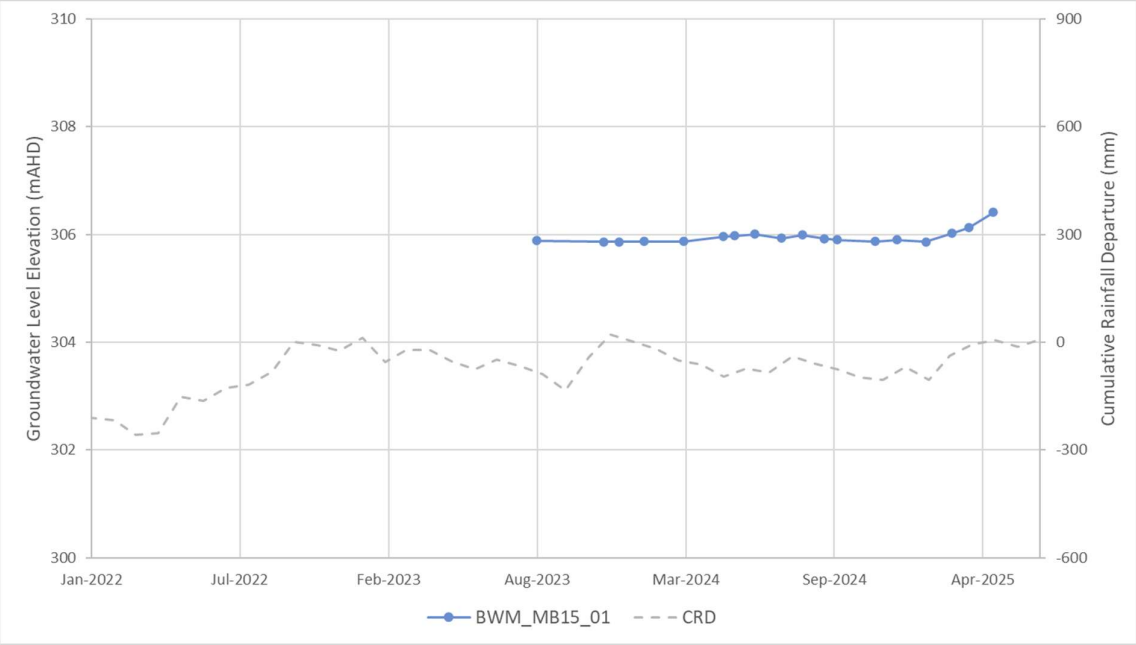


Figure 5-14 Groundwater Levels – Tertiary EA Listed Bores (continued) (BWM_MB15_01)

5.3.3 Clematis Group

The aquifer forming Clematis Group sandstones are distinguished by coarse grain size, with less interbedded shale and siltstone than the non-aquifer forming Clematis Group units. There are no registered bores within the Clematis Group sandstone, as the sandstone outcrops in elevated rugged areas in Arthur's Bluff State Forest, Shotover State Forest and Blackdown Tableland National Park. Claystones of the Rewan Group directly underlie the Clematis Group, forming an aquitard between the Clematis Group and the deeper Rangal Coal Measures.

5.3.4 Rewan Group

Regionally across the Bowen Basin, the Rewan Group is considered an aquitard (DNRM, 2016), given its low yielding nature, with any groundwater having limited potential for beneficial use due to the typically fine-grained, clay-bound nature of the sediments.

Groundwater level data for the two BWM EA listed bores installed into the Rewan Group is provided as (**Figure 5-15**). The monitoring data shows groundwater levels in these bores range between approximately 161 to 170 mAHD.

Both bores show stable groundwater levels with little variation in groundwater level over the monitoring record, approximately 1 m for MB19BWM02A and 0.1 m for BWM_MB03_02. The small 1 m increase occurring in MB19BWM02A between mid-2020 and early 2023 appears to be a subdued response to a relatively sustained period of above average rainfall. MB19BWM02A and BWM_MB03_02 generally show stable water levels over the monitoring record with no response to short term rainfall CRD peaks, indicating a degree of insulation from short term recharge events.

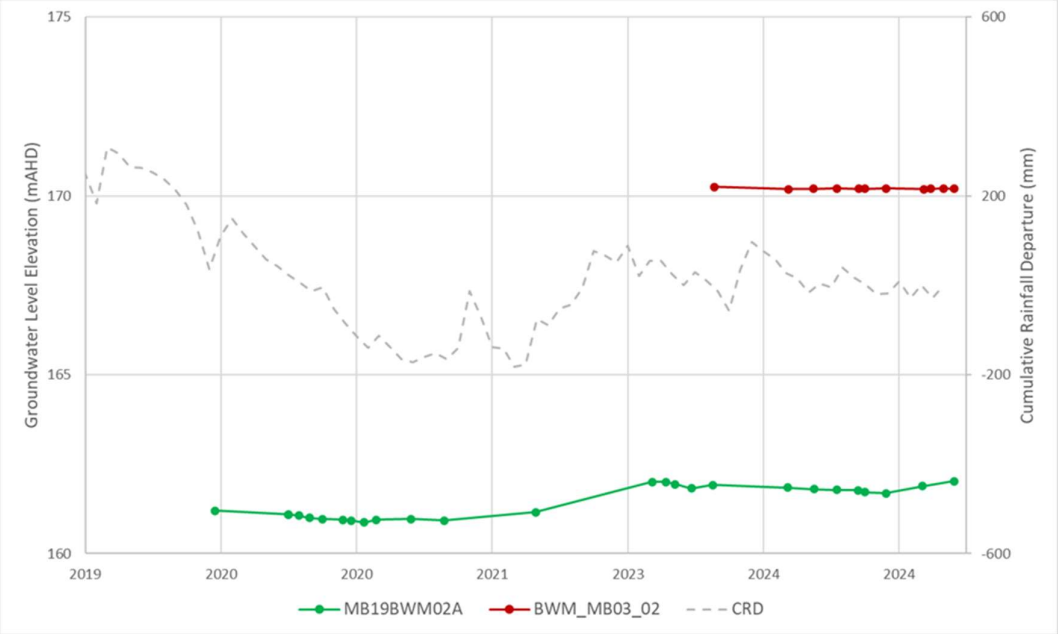


Figure 5-15 Groundwater Levels – Rewan Group

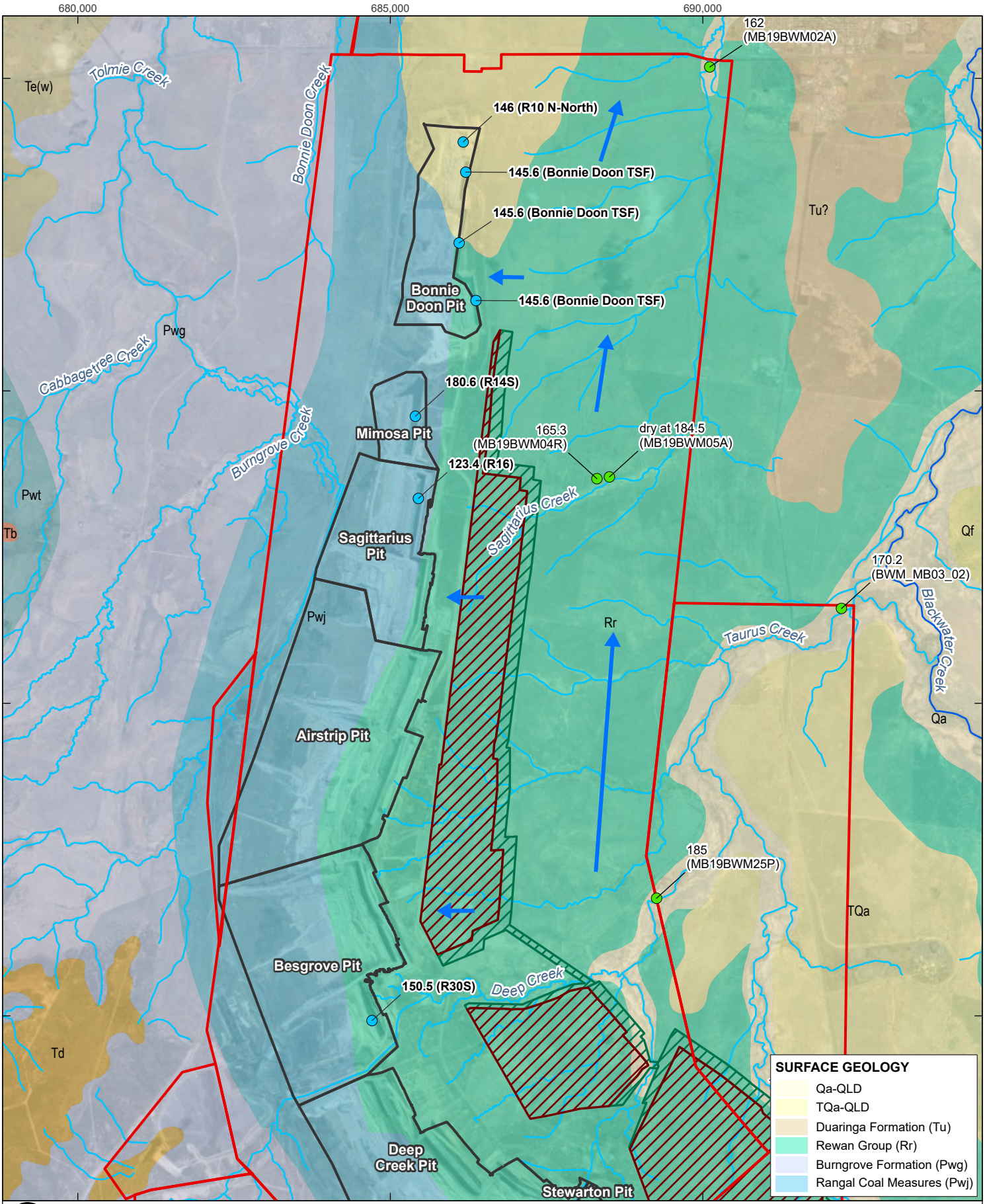
Recharge to the Rewan Group is expected to occur via leakage from the overlying Quaternary and Tertiary units. Recharge rates are likely very low due to the low hydraulic conductivity of the interbedded fine grained clay horizons restricting infiltration. This is

supported by elevated salinity (see **Section 5.4**) which is consistent with high groundwater residence times concentrating salts.

Outflow from this unit is expected to be through lateral flow, with low vertical hydraulic conductivity limiting potential leakage to underlying units. The suggested insulation of this unit from recharge events makes it unlikely that there would be short term (post-rainfall) groundwater pressure increases sufficient as to discharge to surface water features.

Available groundwater levels from the monitoring bores grouped in the northern area indicate a flow toward the north of BWM (i.e. consistent with topographical gradients) and potentially (if the Rewan Group is saturated in this area) also locally towards the pits that report lake levels significantly below the groundwater levels in the nearest bores screened in the Rewan Group (**Figure 5-16**). As shown on **Figure 5-4** there is one bore screened in the Rewan Group in BWM South however, groundwater flow in the southern portion of BWM is also expected to follow topography, with a flow direction towards the south and southwest.





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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER FLOW DIRECTION IN THE REWAN GROUP (BWM NORTH)

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FIGURE 5-16

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_16 Groundwater Flow Direction in the Rewan Group (BWM North)

5.3.5 Rangal Coal Measures

The following conceptualisation of groundwater distribution, flow, recharge and outflow for the RCM is discussed separately for the North (**Section 5.3.5.1**) and South (**Section 5.3.5.2**). This division is a reflection of the very large north-south strike length of BWM and fact that, broadly, the Permian groundwater system appears divided across BWM on the basis of the broad scale topographically driven surface water catchments, being the upper Mackenzie River sub-catchment for North and Central BWM and the Comet River sub-catchment for South BWM.

5.3.5.1 BWM North Area

Groundwater level data for the RCM EA listed bores in the BWM North area is shown on **Figure 5-17**. Groundwater levels from these bores range from approximately 143 to 245 mAHD.

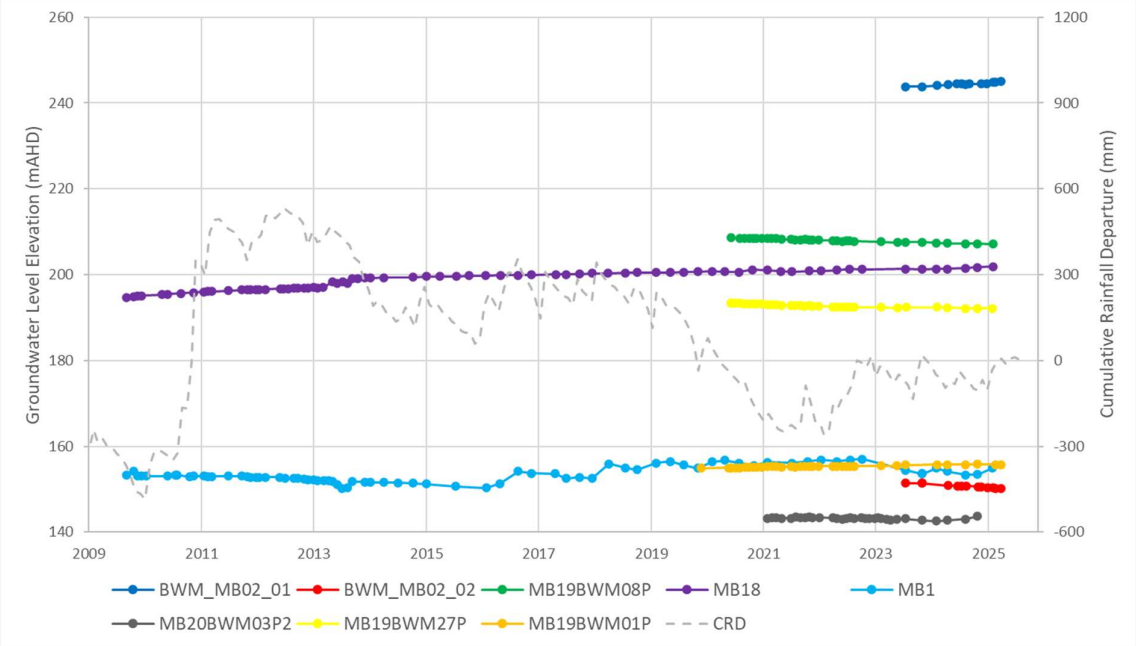


Figure 5-17 Groundwater Levels – Rangal Coal Measures EA Listed Bores (BWM North Area)

A comparison of the groundwater level trends shown against the CRD indicates that the groundwater regime in the RCM is somewhat insulated from short term climatic effects. As shown on **Figure 5-17**, groundwater elevation at MB1 (monitoring the Aries seam, and located approximately 400 m east of the Bonnie Doon highwall), which has the longest monitoring record, gradually but marginally increased between the cessation of Bonnie Doon Pit mining in 2016 and the beginning of 2023, before declining slightly in 2024 but remaining relatively steady thereafter. Given this bore has a groundwater elevation well above the nearby pit water levels, this is considered to be a hydraulic response of the RCM recovering following the removal of dewatering stressors, rather than an indication of recharge from pit lakes. The monitoring record at MB20BWM03P2 (monitoring the Castor/Pollux seams) which also monitors the area of the RCM immediately east of the Bonnie Doon Pit / in-pit Tailings Storage Facility (TSF) area shows relatively stable groundwater levels over its monitoring

record. Groundwater levels here are potentially influenced by the tailings dam design and construction. MB19BWM01P and MB19BWM27P also monitor the Aries seam and show little variation in water level over the monitoring record, with MB19BWM01P steadily increasing approximately 0.8 m and MB19BWM27P steadily declining approximately 1.2 m. Groundwater elevation at MB19BWM27P is notably higher than the other EA listed bores monitoring in the Aries seam (i.e. MB1 and MB19BWM01P), reflective of an overall south to north inferred groundwater flow direction. Groundwater elevation is also lowest at MB20BWM03P2 monitoring the Castor/Pollux seams below the Aries seam, indicating a downwards hydraulic gradient (and flow potential) from the Aries seam to the Castor/Pollux seams.

Of note, BWM_MB02_02 reports the second lowest groundwater levels and given its location between BWM's Blackdown and Wilpeena Pits to the west of the bore, and the Cook Colliery underground mine to the east outside of the BWM mining lease and EA boundary, indicates a drawdown influence from mining activities. Bore MB18, which is screened in the RCM overburden, has the longest monitoring record and shows an overall increasing trend in groundwater level from 2010 to current. MB19BWM08P shows a groundwater level of around 207 mAHD, whereas the groundwater level at adjacent shallower MB18 is around 202 mAHD, indicating an upwards hydraulic gradient from the confined coal seams into the aquitard overburden material. BWM_MB02_02 (Castor Seam) and BWM_MB02_01 (screened in the shallow overburden) show approximately 90 m of head separation, indicating a downwards hydraulic gradient and flow potential.

5.3.5.2 BWM South Area

Groundwater level data for the RCM EA listed bores in the BWM South area is shown on **Figure 5-18**. Groundwater levels from these bores range from approximately 234 to 275 mAHD, and display a relatively stable monitoring record. Likewise with the RCM bores across BWM North, the comparison of the groundwater level trends shown against the CRD indicate that the groundwater regime in the RCM is somewhat insulated from short term climatic effects. BWM_MB12_02 monitors the castor seam and shows little variation in water level over the monitoring record, with approximately 1.9 m increase between 2022 and 2023, and around 0.1 m variation since. BWM_14_01 and BWM_14_02 both monitor the overburden and also show little variation in water level, with both bores steadily increasing approximately 0.3 m over the monitoring record. Notably, BWM_14_01 (shallow overburden) and BWM_14_02 (deep overburden) show approximately 12 m of head separation, indicating a downwards hydraulic gradient.

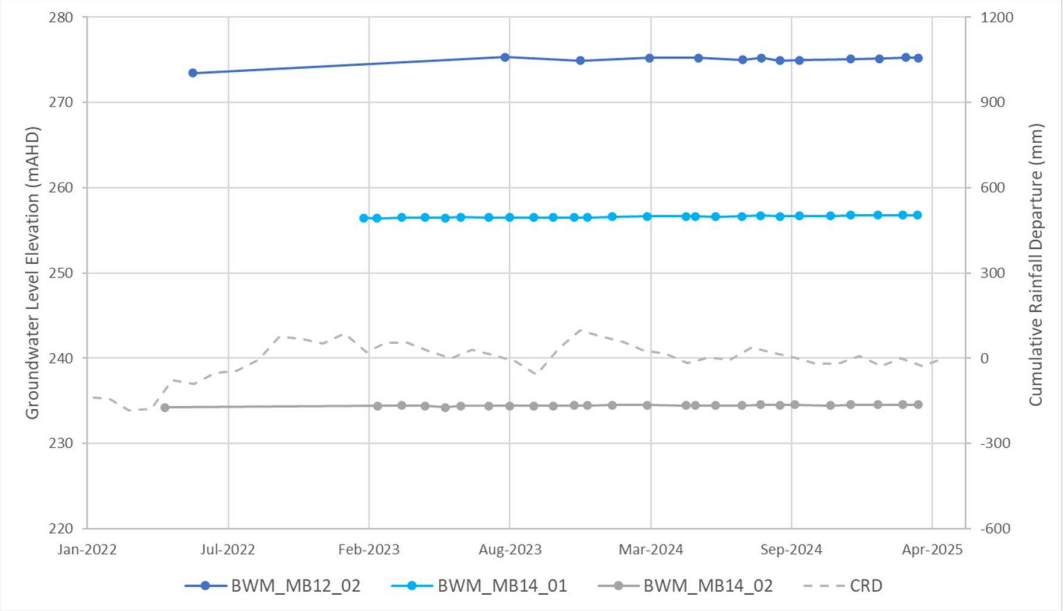


Figure 5-18 Groundwater Level (mAHD) – Rangal Coal Measures (Southern Area)

Available groundwater levels for the now decommissioned bore MB16 are shown in **Figure 5-19**. MB16 is suggested by EMM (2021) to monitor the Aries Seam (or Aries Seam workings) within the extent the historic Laleham Underground Mine, which extracted coal from the Aries to the Pollux Seams (Byrnes Geotechnical, 2024). Groundwater levels at MB16 were approximately 223 mAHD (58 mBGL) prior to 2015, after which a gradual increase in water level occurred to approximately 243 (38 mBGL) mAHD to 2018 before stabilising. This water level increase of approximately 19 m is likely to be related to partial recovery of water in the underground workings (EMM, 2021), i.e. reflooding.

Groundwater levels at MB16 are noted to remain significantly lower in elevation than water storage elevations within the Kenmare pit (287.4 to 276.6 mAHD), suggesting there remains the potential for groundwater movement towards the underground workings from water stored in this pit. The groundwater levels at MB16 are also marginally lower in elevation than the most recent pit lake level recorded within the Ramp 74/Laleham pit (246.4 mAHD), though the difference is relatively small and suggests that the underground workings may have essentially reached close to hydraulic equilibrium with the Ramp 74/Laleham pit.

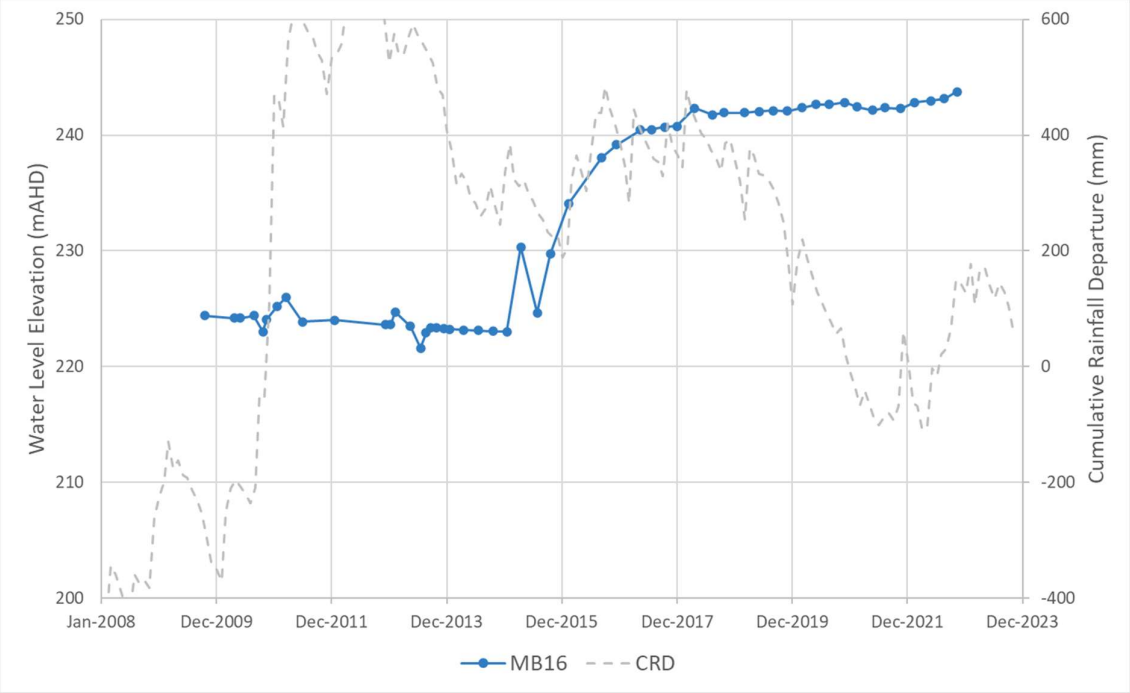


Figure 5-19 MB16 Groundwater Level (mAHD) – (Laleham Underground Mine)

5.3.5.3 Summary

A comparison of groundwater level trends for all BWM bores screened in the RCM coal seams against the CRD indicates that the groundwater regime in the RCM coal seams is somewhat insulated from short term climatic effects, though depth and conductivity of the monitored horizon clearly influences this response. Through hydraulic connection with the mining areas, it is apparent that there is some minor response in regional groundwater levels to mining depressurisation.

Groundwater quality in the RCM coal seams is mostly saline (**Section 5.4**), which suggests long residence times related to low recharge rates and increased water-rock interaction.

Recharge to the coal seams is expected to occur primarily via leakage from the overlying Quaternary and Tertiary units, with greater recharge occurring in areas where the seams subcrop and outcrop. Based on the inferred hydraulic gradients between overburden and coal seams, this is likely limited to the overburden horizons, with coal seam recharge occurring through mine surface water storages where the seams are hydraulically connected to the storages. Outflow from the RCM is considered to be primarily through inflow to active mining areas, within the cone of depression. Where groundwater is not influenced by the cone of depression, outflow will occur downdip following regional flow path to the east.

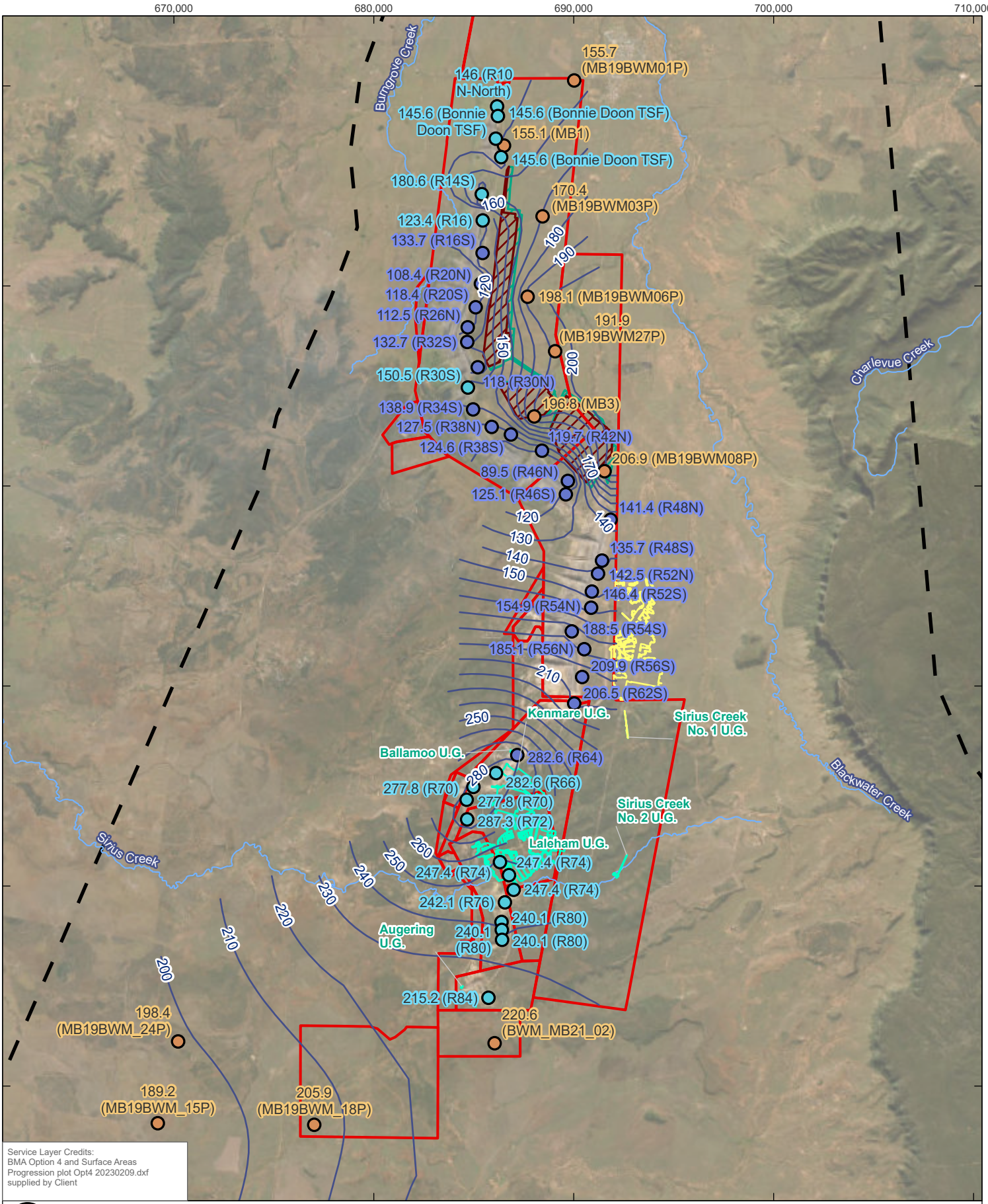
Groundwater level contours for the Aries Seam are shown on **Figure 5-20**. The Aries Seam was selected as it has the highest number of data points and most recent data available for analysis, and it is expected that other coal seams would exhibit similar flow patterns. The contours are based on the most recently available groundwater level measurements from bores screened in the Aries Seam. The most recent available pit water levels are also included in the mapping to assist with the interpretation of RCM groundwater flow direction as it provides an indication of the groundwater level in the RCM directly adjacent to the pit, since there is direct hydraulic connection between the pits and the RCM. Where there are no



in-pit water storages, the base elevation of the pits (based on most recently available LiDAR in February 2024) are also shown as groundwater levels must be below the base of the pits in the case of dry pits, with any groundwater inflow passively managed through evaporation and the use of in pit sumps.

As shown on **Figure 5-20**, the groundwater flow direction in the BWM North area is locally predominantly towards the mine pits, consistent with discharge to the active mine pits. In the southern area of BWM, the flow direction within the Aries Seam is dominated by the local influence of elevated in-pit water storages at Kenmare Pit. In the far south, the potentiometric mapping indicates a groundwater divide present just north of Sirius Creek, consistent with the surface catchment divide, with groundwater flow from northeast to southwest. As mentioned above, it is expected that the lower coal seams would exhibit similar flow patterns, however this does not apply to the Castor, Pollux and Orion seams in the area of the Cook Colliery. In this area the groundwater flow direction in these seams would be dominated by the local influence of dewatering, with the local groundwater flow direction therefore predominantly towards Cook Colliery.





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BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

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LEGEND

Elevation (mAHD)

- Base Elevation - mAHD (Pit Ramp)
- Base of Pit - mAHD (Pit)
- Water Level - mAHD (Bore)
- Water Level - mAHD (Pit)
- Groundwater Elevation Contour (mAHD)
- Watercourse
- Current Underground Mine
- Historical Underground Mine
- GIA Study Area
- BWM Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER LEVEL CONTOURS – ARIES SEAM

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FIGURE 5-20

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_20_GWL Levels Aries Seam

5.3.6 Burngrove Formation

There are two monitoring bores installed in the Burngrove Formation, both are located to the northwest of the Project. **Figure 5-21** show the groundwater levels in these bores, 'BG-1' and 'BG-2'.

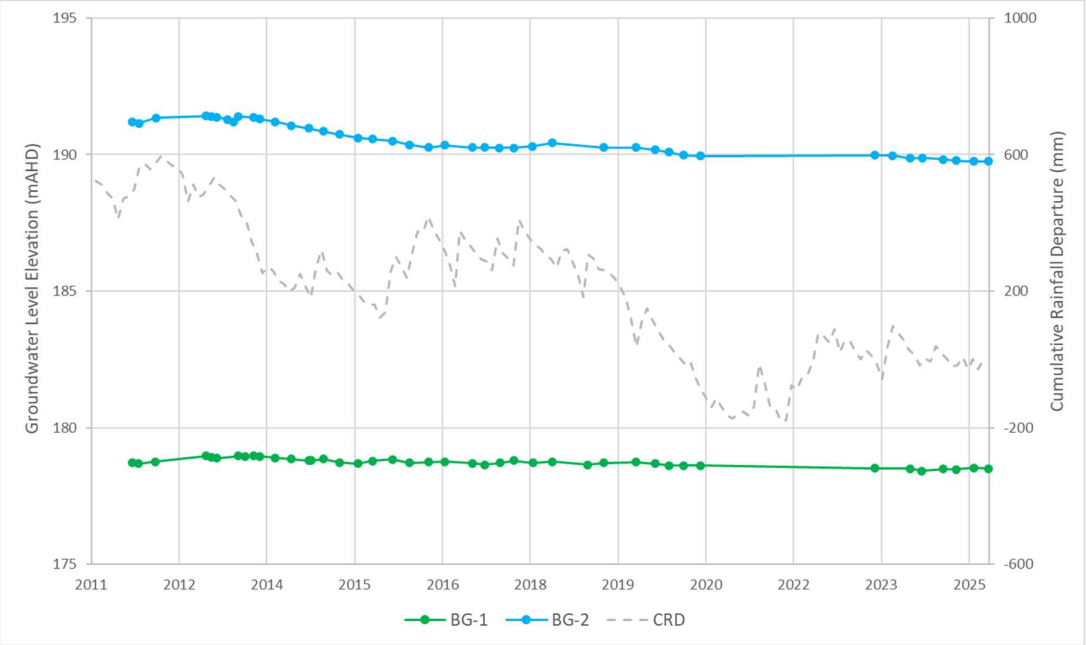
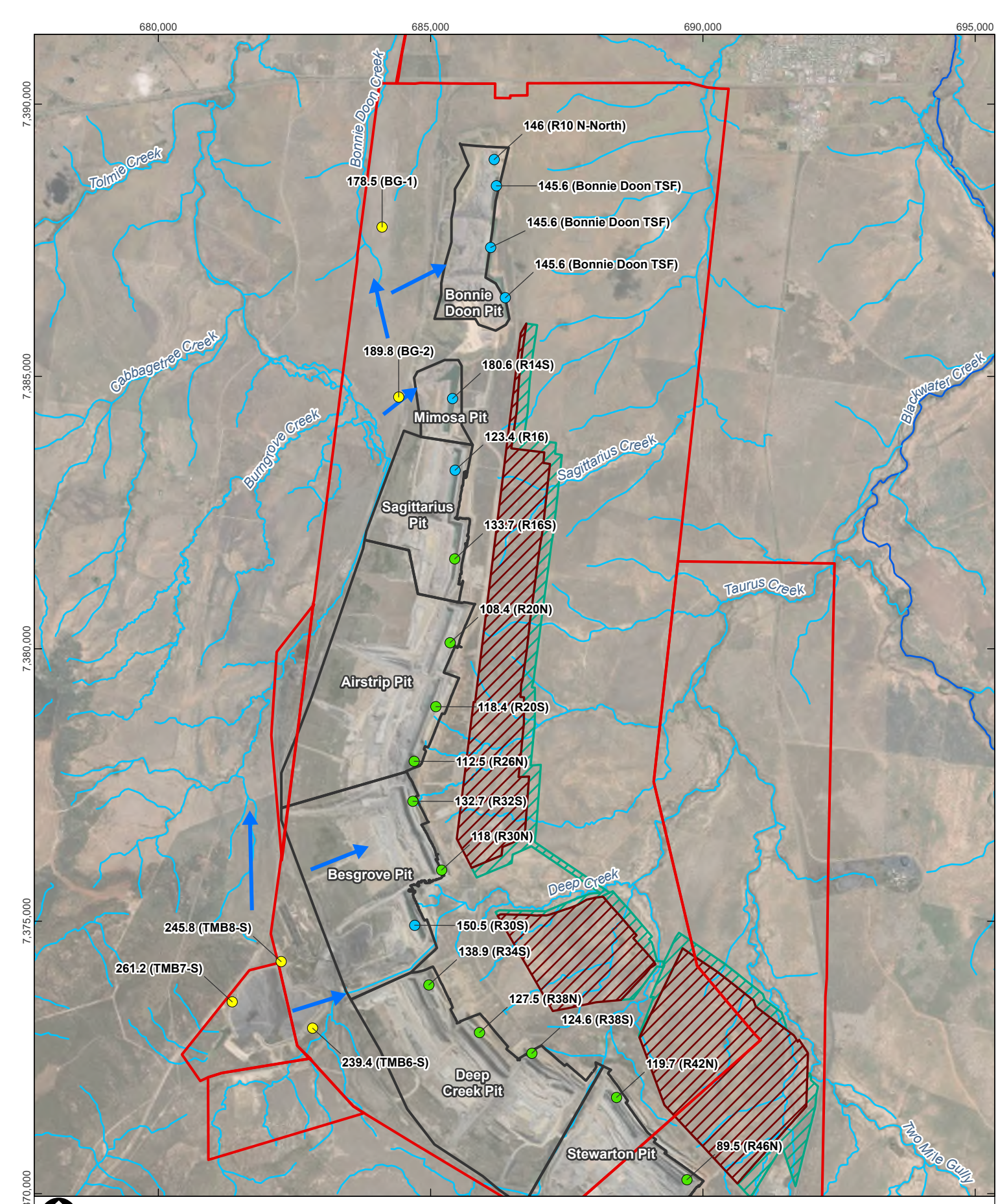


Figure 5-21 Standing Water Level in the Burngrove Formation

The monitoring data shows groundwater levels in these bores range between approximately 178 to 191 mAHD. Both bores show little variation in groundwater level over the monitoring record, approximately 0.5 m for BG-1, and 1 m for BG-2. These variations at both bores are consistent with the overall long-term decline of the CRD over the corresponding monitoring record, with the trend being more pronounced at BG-2. Groundwater levels in these bores do not seem to respond to short term increases in the CRD, suggesting low rates of rainfall-derived recharge in these areas. Recharge to the Burngrove Formation would occur primarily where the formation outcrops along the west of the Project Area (**Figure 4-1**). Outflow from this formation is expected to be through lateral flow in the direction of regional groundwater flow, with some upwards leakage to the depressurised RCM.

The groundwater flow direction at BWM North is inferred to be overall towards the north-northwest consistent with topographical gradients and surface water flow patterns. The local flow direction near the pits is towards the northeast, consistent with the concept of local groundwater discharge to the pits. It is noted that the magnitude of the local hydraulic gradient towards the pits (east-northeast) is much greater than the north-northwest flow component as inferred by the larger head difference between data points over a shorter distance. This indicates that the magnitude of groundwater flow towards the pits is significantly greater than groundwater flow to the north-northwest. In the area of the NCPP, the local flow direction is towards the east, consistent with the drainage line that runs towards Deep Creek. The other bores screened in the Burngrove Formation in BWM South are grouped closely around the Red Dam area and hence are not useful in inferring regional flow direction, however, groundwater flow in the southern portion of BWM is expected to follow topography, with a flow direction towards the south and southwest.



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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER FLOW DIRECTION IN THE BURNGROVE FORMATION (BWM NORTH)

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FIGURE 5-22

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_21_GW Flow Direction in the Burngrove Formation (BWM North)

5.3.7 Vertical Flow between Units

Two VWPs were installed in the BWM North Area, VWP19BWM01 and VWP19BWM02 (AGE, 2020). VWPs are groundwater level (pressure) monitoring infrastructure with multiple sensors installed at different depths allowing for collection of groundwater levels from multiple groundwater bearing zones in a single borehole. From the water pressure at each sensor, potential interactions between the groundwater bearing units can be interpreted. These VWPs are no longer operational, with no recent data available. It is reported that VWP19BWM02 was damaged via blasting, although the timing of this is not confirmed.

VWP19BWM01 is located on ML1759 in the Northern Area, around 4 km east of the closest open-cut pit, which has a water level (or sump level) of 130 mAHD. The water level data for the VWP is presented in **Figure 5-23**, together with the CRD. Since the start of the recording in December 2019, the water levels in all sensors have declined continually. An exception is Sensor VW4 (Interburden 154 mBGL). The water level at that bore followed the shallower sensors (VWP1-3) closely, then increased in water levels, and has been stable at 196 mAHD since 2020. It is unknown whether this reflects the water levels in the interburden or if an instrument error is the cause for the difference in water levels. Furthermore, the Pollux seam monitoring (VW5 Pollux Seam 186 mBGL) shows flat response inconsistent with relative changes in rest of the monitoring profile and this sensor is not considered representative. **Figure 5-23** shows that the Aries Seam (VW3 Aries Seam 125 mBGL) and two vertical locations of the overburden (VW1 Overburden 46 mBGL and VW3 Overburden 104 mBGL) show similar water levels. Higher water level in the stable Aries Seam sensor (VW3 Aries Seam 125 mBGL) data post-2021 indicates that there is an upwards vertical gradient (confined aquifer) in the coal seams. This is consistent with the nested bore data discussed in **Section 5.3.5**. It is unclear if the water levels in the VWP follow a climatic pattern or are influenced by mining.

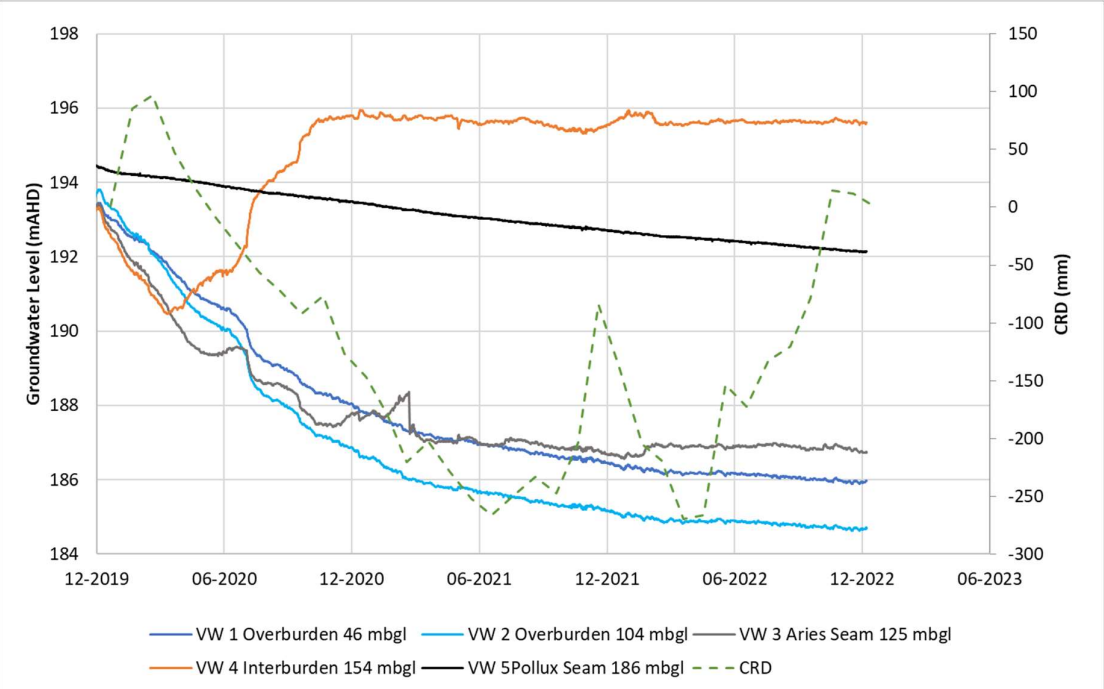


Figure 5-23 Groundwater Levels at VWP19BWM01 and CRD

VWP19BWM02 is located on ML1762 in the Central Area, around 500 m away from the closest pit (Ramp 52N). The water level data for the VWP is presented in **Figure 5-24**, together with the CRD. For this location the overburden (VW1) has a 30 m higher water level than the coal seams, which suggest a downward vertical flow gradient. In late 2022, the water level in all sensors sharply increases before fluctuating until the end of the monitoring record in a consistent pattern across all sensors (**Figure 5-24**). The similarity in responses across many of the sensors, and the timing of these responses broadly in line with when significant rainfall events or changes in mine water management may have occurred, could lead to the conclusion that these changes are climate related. However, standpipe bore MB4, which is located close by and is screened in the same formation, has historically not responded to climatic events, and hence it is more likely that the increase in water levels in late 2022 is related to a sensor error rather than a recharge event at depth.

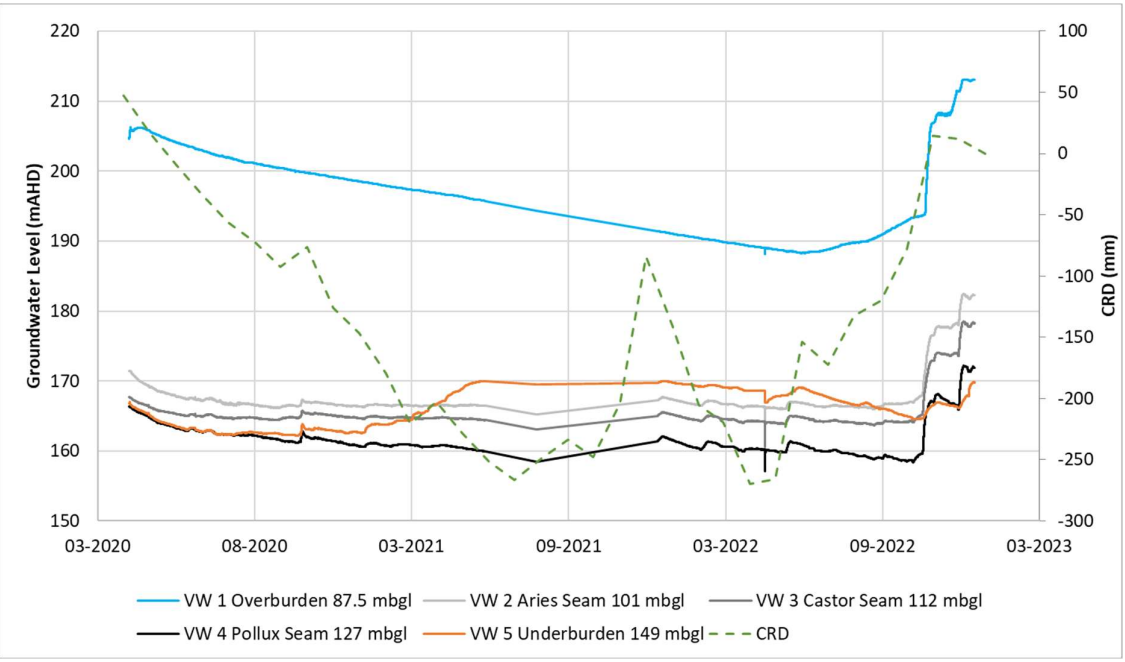


Figure 5-24 Groundwater Level at VWP19BWM02P and CRD

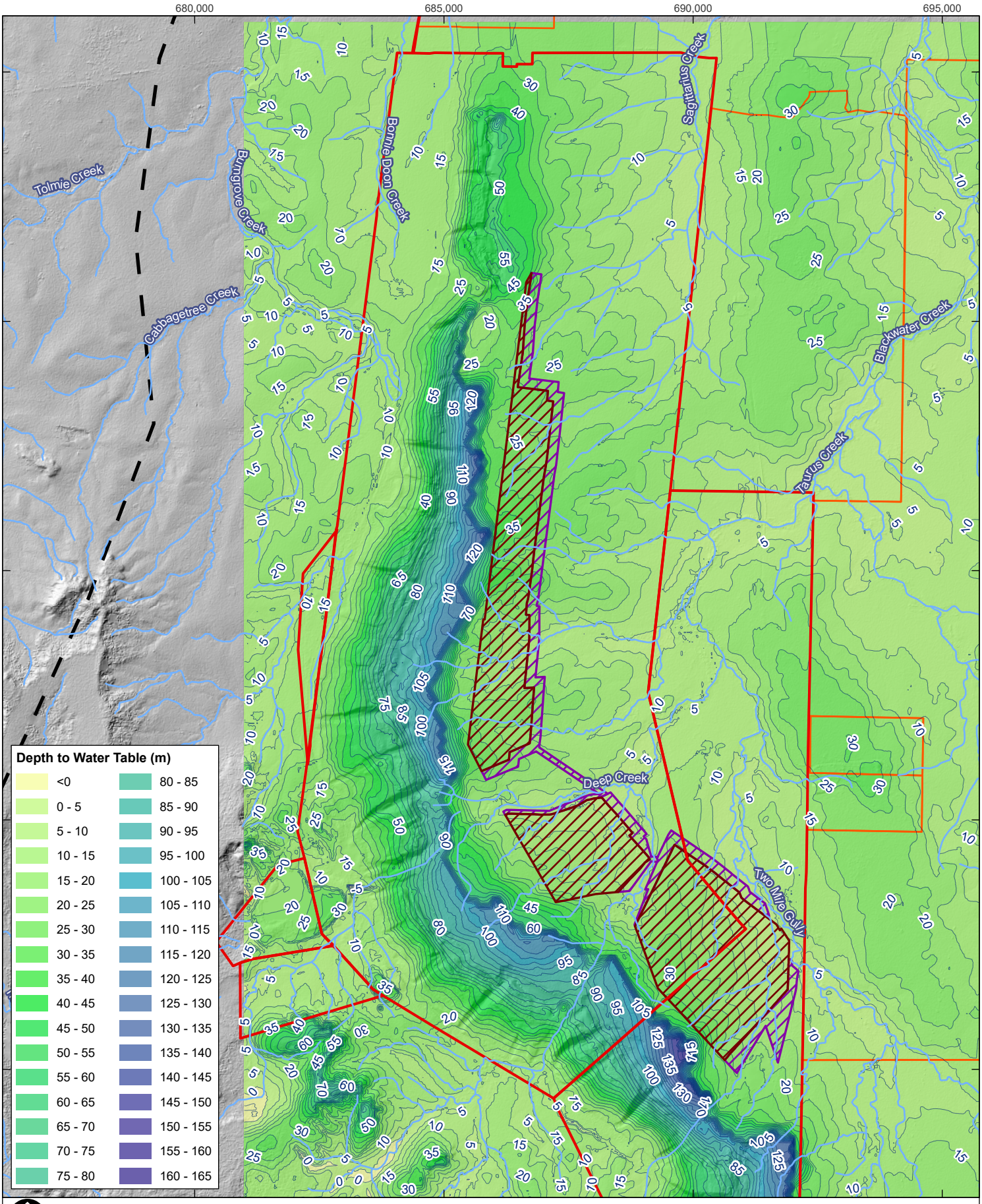
In addition to the VWP data, there are grouped standpipe bores where different levels within the stratigraphy are monitored with screened sections that are offset from one another vertically. These also contribute to the understanding of potential vertical groundwater gradients. Water level observations (most recent available – April 2020 to December 2022) and inferred vertical flow are presented in **Table 5-13**. The shallowest bore for both groups was found dry since installation in 2020 and for all subsequent monthly monitoring rounds. For both groups, the water levels in the Permian Coal Seam bores are higher than in the Rewan Group bores. This indicates that the Rewan Group is acting as a confining unit consistent with it being an aquitard. Groundwater pressure data shows consistent upwards gradient from the coal seams into the Rewan Group.

Table 5-13 Water Levels at Grouped Standpipe Bores

Group	Bore Name	Formation / Unit	Bore Depth (m)	Water Level (mAHD)
Group 1	MB19BWMB05A	Weathered Rewan	15	Dry
	MB19BWMB04R	Rewan Group	80	166–168
	MB19BWMB03P	Permian Coal Seam	231	172–178
Group 2	MB19BWMB07A	Alluvium	7	Dry
	MB19BWMB25P	Weathered Rewan	20	179–181
	MB19BWMB17P	Permian Coal Seam	189	193–194

5.3.8 Depth to Water Table Mapping

The depth to water table defined in the numerical groundwater model at the end of the calibration period is provided in **Figure 5-25**.



0 1 2 km

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Scale:	1:100,000 at A4
Project Number:	640.031809.00001
Date Drawn:	15-Apr-2026
Drawn by:	RB

LEGEND

- Depth to Water Table (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

DEPTH TO WATER TABLE

SLR

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FIGURE 5-25

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_FXX_Depth to Water Table

5.3.9 Groundwater–Surface Water Interactions

Based on the water level data collected to date, and conceptualisations of groundwater flow within the Project area, groundwater interaction with ephemeral creeks is considered to be unlikely. As discussed in **Section 5.3.1**, the extent of alluvium is limited, both horizontally and vertically, suggesting dry conditions for most of that unit and water tables significantly below the creek beds. The Regolith (i.e. weathered Tertiary Sediments and weathered Rewan Group) is also unlikely to host significant groundwater. Where saturated, water levels in the Regolith are several meters below the base of the creek bed (**Section 5.3.4**).

At Blackwater South, intermittent hydraulic connectivity between the Regolith and surface drainages is inferred, however generally, there is no continual baseflow from the groundwater into the creeks given their ephemerality.

There is also the potential for interaction between mine surface water storages such as dams and pits, and the hydrogeological units hydraulically connected to them, as indicated by the inferred groundwater contours (**Figure 5-20**) in the Aries coal seam.



5.4 Groundwater Quality

5.4.1 Groundwater Typing

The proportions of major anions and cations were used to determine the hydrochemical facies of groundwaters sampled at BWM. The anion-cation balance, pH and EC of historical data from BWM monitoring bores is displayed on the Durov diagrams in **Figure 5-26** to **Figure 5-31**. The diagrams are split by aquifer and area, including bores in the alluvium (**Figure 5-26**), Tertiary (**Figure 5-27**), Rewan Group (**Figure 5-28**) and RCM at BWM North (**Figure 5-29**), RCM at BWM South (**Figure 5-30**) and the Burngrove Formation (**Figure 5-31**). There is a high degree of observed variability in groundwater quality between hydrostratigraphic units, and between individual bores within individual hydrostratigraphic units.

Records from alluvium groundwater quality sampling include one bore across three samples (**Figure 5-26**). The data from this bore shows a Na-Cl groundwater type with a neutral pH and variable EC results ranging from 6,900 to 23,800 µS/cm.

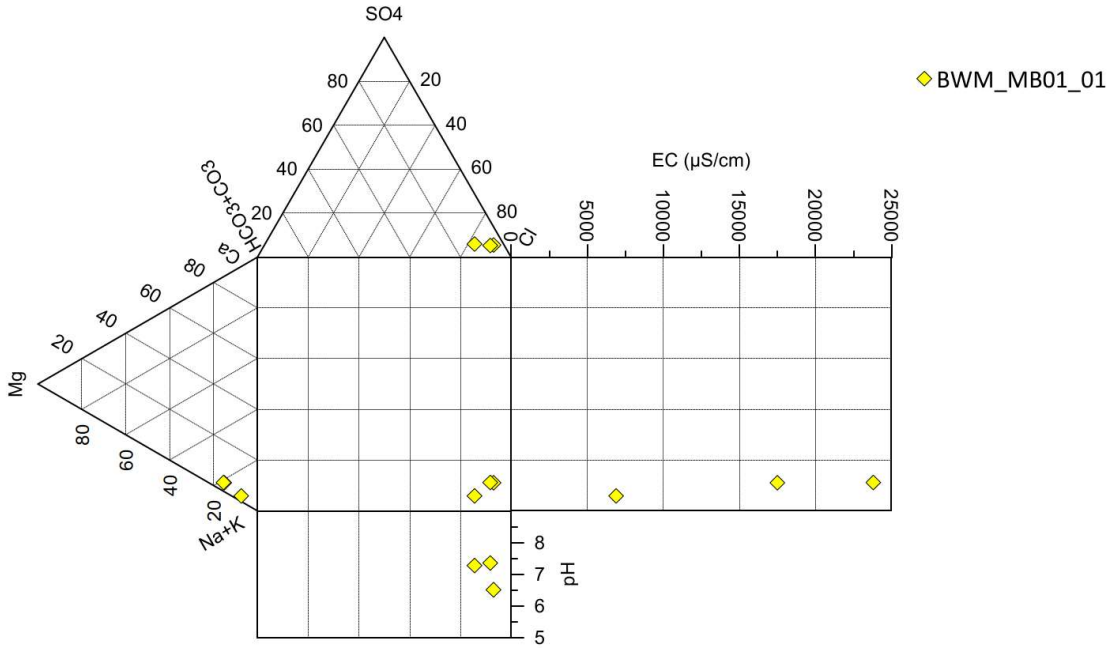


Figure 5-26 Durov Diagram – Alluvium

A Durov diagram for the monitoring bores screened within the Tertiary strata is presented as **Figure 5-27**. The bores are screened within the sediments/weathered strata of the Tertiary and located at BWM South. Bores MB21 and BWM_MB15_01 records a Na-Cl type groundwater, while BWM_MB17_02 records a Na-CO3-HCO3 water type.

The influence of HCO3 on the water chemistry of BWM_MB17_02 records, along with the comparatively fresh EC (500 µS/cm) is suggestive of direct rainfall recharge at this location. This direct recharge may be an influence of infiltration from Rockland Creek, located 150 m north of the bore.

Historical groundwater data from the Tertiary strata bores shows an EC range of from 500 to 16,800 µS/cm with a median of 13,500 µS/cm. pH data ranges from 3.3 to 8.4 with a median of 7.4. Bore BWM_MB15_01 has a notably low pH of 3.3 and relatively saline EC value (6160 µS/cm).

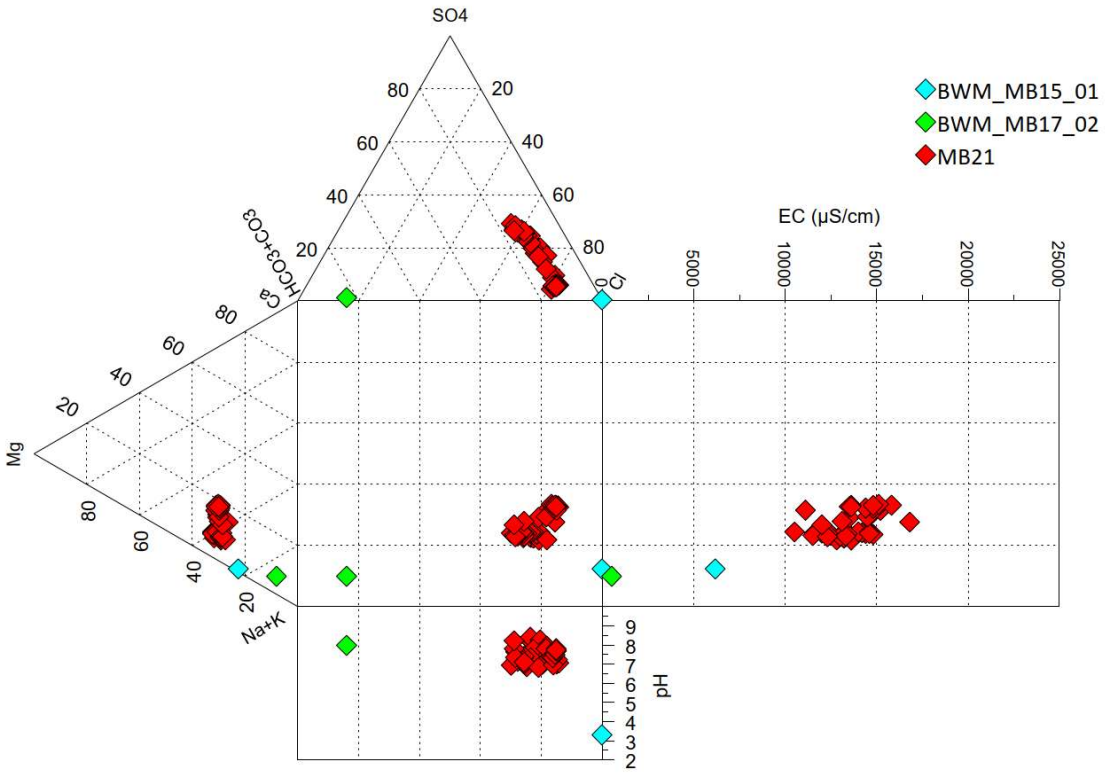


Figure 5-27 Durov Diagram – Tertiary Strata

Bores BWM_MB03_02 and MB19BWM02A are screened within the Rewan Group and record Na-Cl type groundwaters (**Figure 5-28**). Both bores record relatively high EC values ranging approximately 30,500 to 40,000 µS/cm. Recorded pH from bores in the Rewan Group ranges from mildly acidic to mildly alkaline (pH range 6.8 to 7.8), with a median pH of 7.2.

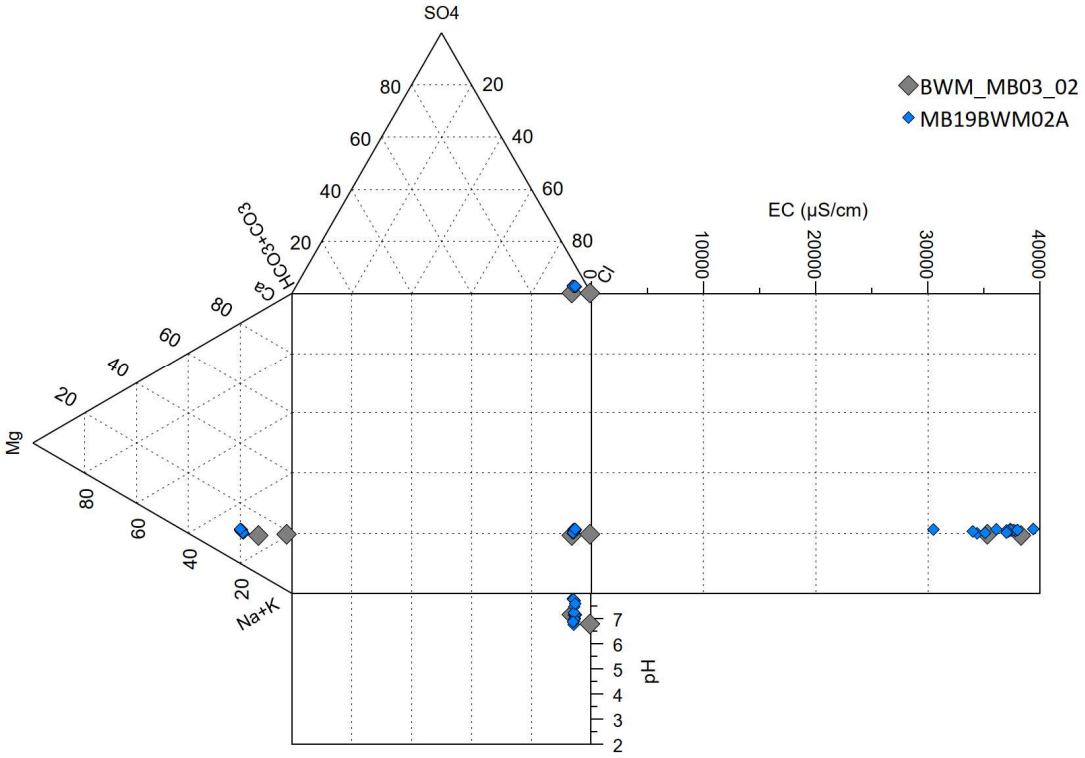


Figure 5-28 Durov Diagram – Rewan Group

The chemical analysis of groundwater from 11 bores targeting the RCM is shown on **Figure 5-29** to **Figure 5-30**. Results from these bores indicate that groundwater within this unit is generally Na-Cl water type. Exceptions to this are bores BWM_MB02_01, BWM_MB12_02, MB19BWM08P, MB19BWM27P, and BWM_MB14_02. These bores show distinctly different groundwater types, plotting as Na-Cl-HCO3 types.

Groundwater in the RCM generally has a median EC of 17,300 µS/cm, but ranges from 1,870 to 36,900 µS/cm. Recorded pH is generally neutral (median value of 7.7), however the data ranges from values between 6.9 to 11.9. Outliers occur, with high pH (of between 9 and 12) at bores MB19BWM01P and BWM_MB02_02. The elevated pH at these bores is likely unrepresentative of natural conditions and may be due to water interaction with residual cement grout from the bore construction, and they have consequently been removed from the plot.

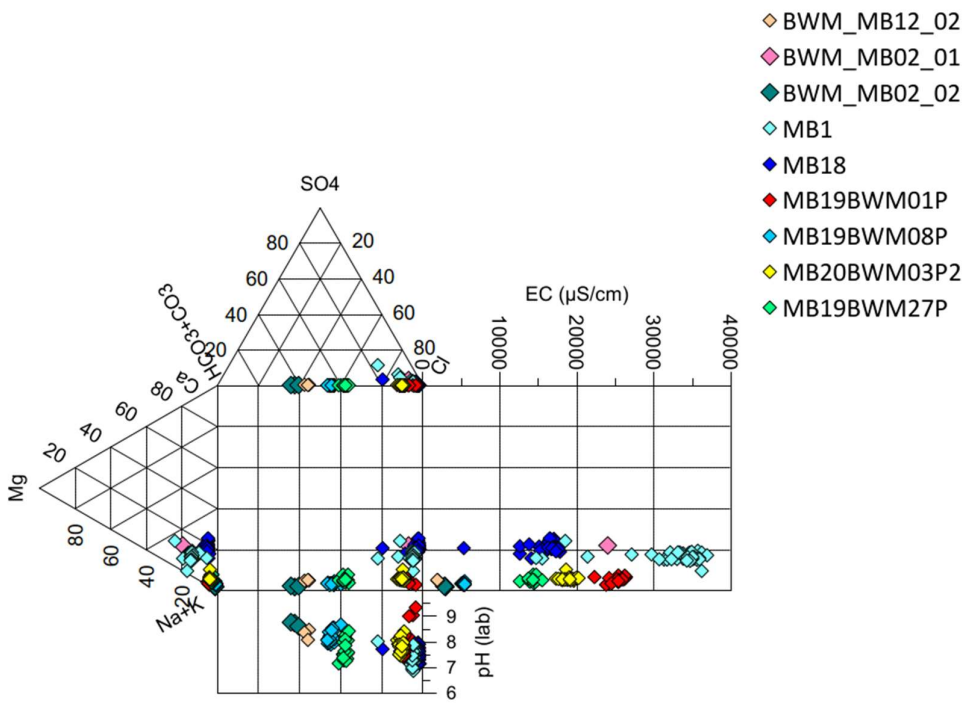


Figure 5-29 Durov Diagram – RCM (North BWM)

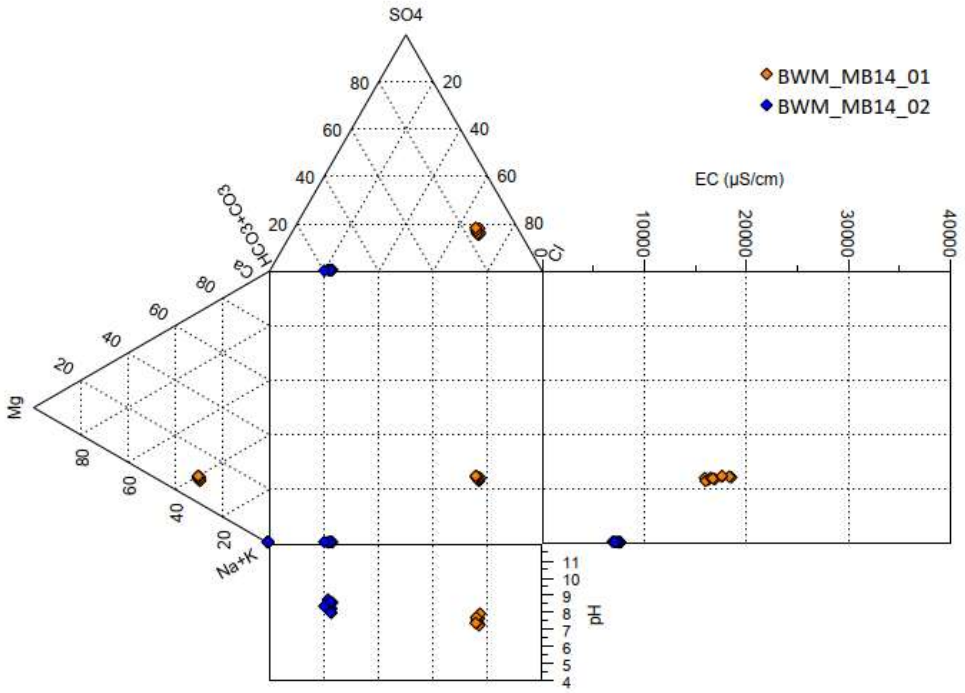


Figure 5-30 Durov Diagram – RCM (South BWM)

Groundwater from two bores screened in the Burngrove Formation record Na-Cl groundwater type (**Figure 5-31**). The results are tightly clustered which suggests that groundwater in the Burngrove Formation has a distinct water chemistry. Groundwater has a median EC of 12,500 µS/cm and ranges from 6,190 to 21,500 µS/cm. pH data shows a range from 7.1 to 8.9, with a median value of 8 indicating the groundwater pH is generally around neutral to slightly alkaline.

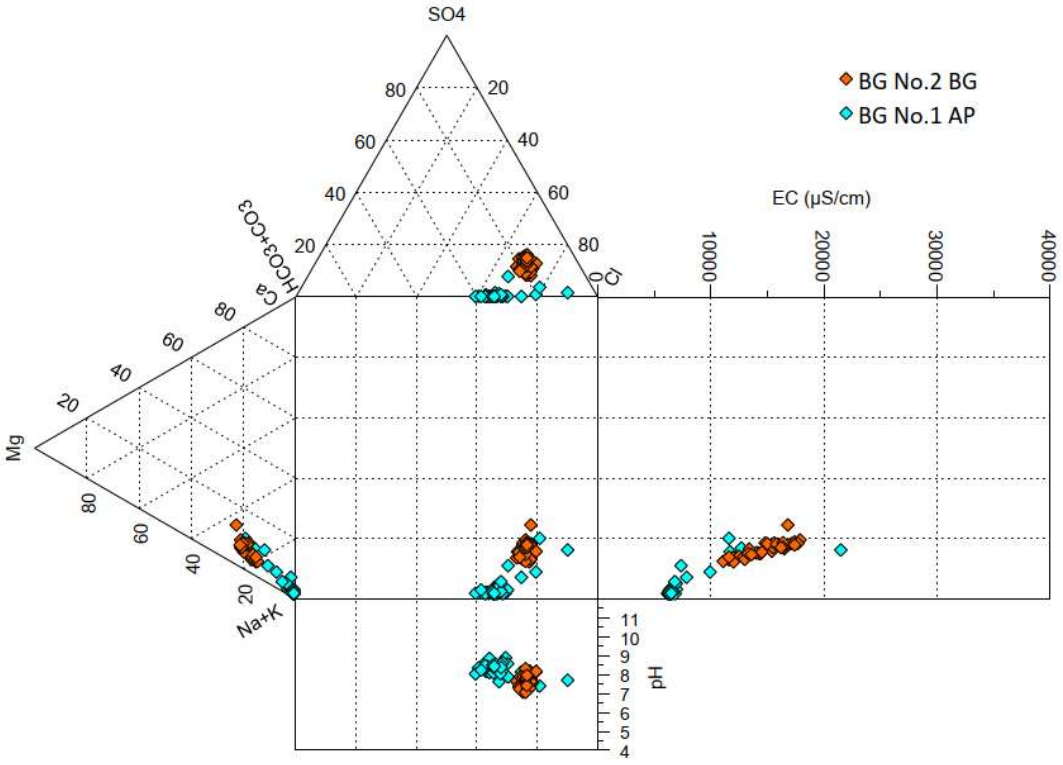


Figure 5-31 Durov Diagram – Burngrove Formation

5.4.2 Salinity

Salinity is a key constraint to water management and groundwater use by receptors and can be described by total dissolved solid (TDS) concentrations. **Figure 5-32** presents the TDS data associated with waters screened in the various hydrostratigraphic units for BWM monitoring bores. Salinity ranges represented on **Figure 5-32** are defined by the Food and Agriculture Organization of the United Nations (FAO, 2013).

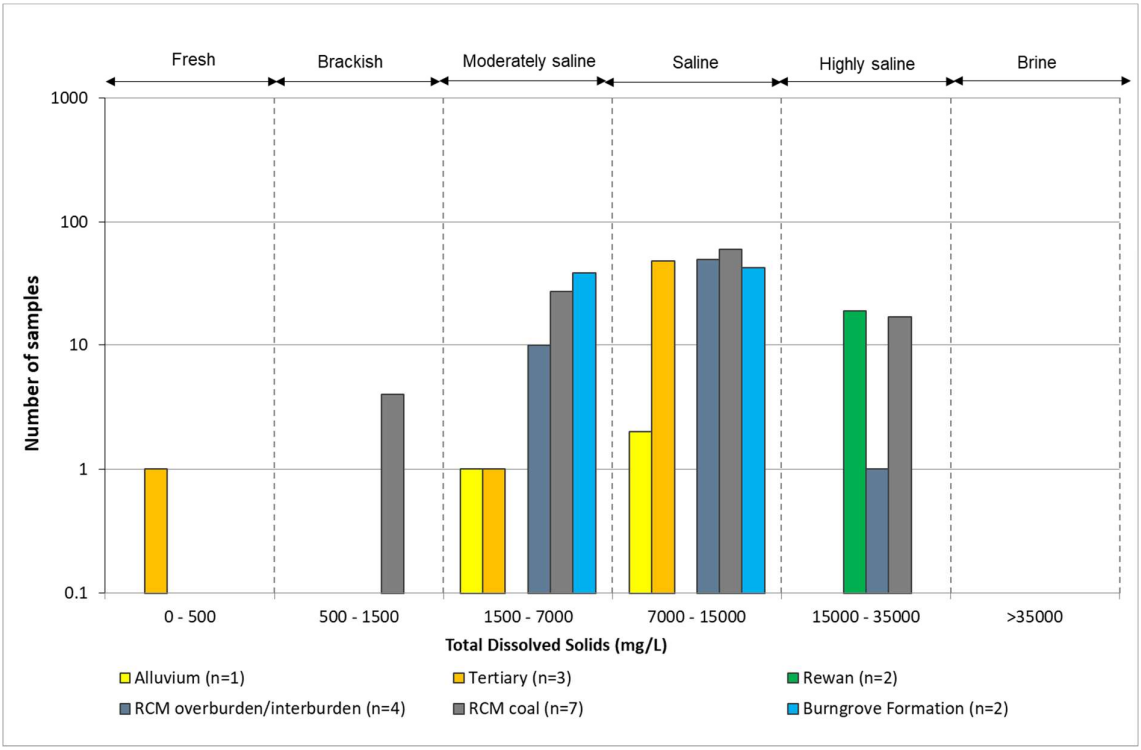
The graph shows that available data from one bore in the alluvium records TDS ranging from moderately saline to saline, with an average TDS of 8,983 mg/L and range between 4,250 mg/L and 11,600 mg/L.

Groundwater in the Tertiary strata ranges from fresh to saline, with an average TDS of 9,427 mg/L and range between 363 and 11,700 mg/L.

In the Rewan Group, groundwater ranges from moderately saline to saline, with an average TDS of 25,126 and range between 19,600 and 30,800 mg/L.

Within the RCM, groundwater ranges from brackish to highly saline, with bores that screen coal seams recording an average TDS of 9,481 and range between 1,000 to 17,000 mg/L, and bores screening interburden/overburden recording average TDS of 10,400 and range between 3,250 to 18,500 mg/L.

In the Burngrove Formation, groundwater ranges from moderately saline to saline, with an average TDS of 6,964 mg/L and range between 3,250 and 14,400 mg/L.



Note: n = number of bores

Figure 5-32 Salinity Ranking by Hydrostratigraphic Unit

5.4.3 Beneficial Groundwater Use

5.4.3.1 Potentially Relevant Environmental Values and Guidelines

BWM lies mainly within the Highlands Groundwater Management Area (GMA) of the Fitzroy Basin under the *Water Plan (Fitzroy Basin) 2011* (**Figure 5-33**). The Highlands GMA consists of the following:

- Highlands Groundwater Unit 1, containing the aquifers of the Quaternary alluvium associated with the Sandy Creek Alluvium sub-area (to the distant northwest of BWM but not located within the study area); and
- Highlands Groundwater Unit 2, containing all subartesian aquifers within the Highlands GMA other than the aquifers included in Highlands Groundwater Unit 1.

Volumetric limits apply to extraction of groundwater within the GMA for non-stock and domestic purposes.

Groundwater resources in the Study Area are also scheduled under the EPP Water and Wetland Biodiversity, as Comet Groundwaters (for the southern part of BWM within the Comet sub-catchment (DEHP, 2011a)) and Mackenzie Groundwaters (for the northern part of BWM within the Upper Mackenzie sub-catchment (DEHP, 2011b)) of the Fitzroy Basin water plan (WQ1310) (**Figure 5-33**). The legislated environmental values (EVs) for these Groundwaters (**Table 5-14**) are:

- Aquatic ecosystems;
- Irrigation;
- Farm supply/use;
- Stock water;
- Primary recreation (Comet Groundwaters only);
- Drinking water;
- Industrial use; and
- Cultural and spiritual values.

Also shown in **Table 5-14** is a comparison of those WQOs that are potentially applicable based on the results of the EMM (2019) bore census (see **Section 5.5**). EMM (2021) concluded that based on the bores that were surveyed in the 2019 bore census *"the environmental values for groundwater in the area are limited to farm supply/use, stock water and industrial use (i.e. mining). Aquatic ecosystems may also be associated with shallow alluvial systems" (***Table 5-14**).

Table 5-14 Environmental Values of Comet and Mackenzie Groundwaters of the Fitzroy Basin

Environmental Values (DEHP, 2011a, 2011b)												
Fitzroy Basin Water Plan (WQ1310) Sub-catchment	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human Consumer	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking water	Industrial use	Cultural and spiritual values
Comet Groundwaters	☑	☑	☑	☑			☑			☑	☑	☑
Mackenzie Groundwaters	☑	☑	☑	☑						☑	☑	☑
Potentially Locally Applicable based on EMM (2019) bore census	☑		☑	☑							☑	

The EPP Water and Wetland Biodiversity provides WQOs for the scheduled EVs in WQ1310. WQOs are long-term goals for water quality management and the purpose of the



WQOs is to support and protect EVs. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Where groundwater quality analysis results exceed a particular WQO for a particular EV, it is considered indicative that the groundwater may be unsuitable for supporting that particular EV.

The WQ1310 WQOs for groundwater relevant to BWM are shown **Table 5-15**.

Table 5-15 Water Quality Objectives for Fitzroy Sub-basin Environmental Values

Water Quality Indicator	Unit	ADWG Guidelines[1]		Mackenzie River Sub-basin EVs			Comet River Sub-basin EVs		
		ADWG Guidelines Health	ADWG Guidelines Aesthetic	Irrigation[2]	Stock[3]	Aquatic 95%[4]	Irrigation[5]	Stock[6]	Aquatic 95%[4]
pH	-	-	6.5 to 8.5	-	-	6.5 to 8.5	-	-	6.5 to 8.5
TDS	mg/L	-	600		5000[7]	-		5000[7]	-
Chloride	mg/L	-	250	-	-	-	-	-	-
Sodium	mg/L	-	180	-	-	-	-	-	-
Aluminium	mg/L	-	0.2	5	5	0.055	5	5	0.055
Arsenic	mg/L	0.01	-	0.1	0.5	0.024	0.1	0.5	0.024
Beryllium	mg/L	0.06	-	0.1	-	-	0.1	-	-
Boron	mg/L	4	-	0.5	5	-	0.5	5	-
Cadmium	mg/L	0.002	-	0.01	0.01	0.0002	0.01	0.01	0.0002
Chromium	mg/L	0.05	-	0.1	1	0.001	0.1	1	0.001
Cobalt	mg/L	-	-	0.05	1	-	0.05	1	-
Copper	mg/L	2	1	0.2	1[6]	0.0014	0.2	1[6]	0.0014
Fluoride	mg/L	1.5	-	1	2	-	1	2	-
Iron	mg/L	-	0.3	0.2	-	-	0.2	-	-
Lead	mg/L	0.01	-	2	0.1	0.0034	2	0.1	0.0034
Lithium	mg/L	-	-	2.5	-	-	2.5	-	-
Manganese	mg/L	0.5	0.1	0.2	-	1.9	0.2	-	1.9
Mercury	mg/L	0.001	-	0.002	0.002	0.0006	0.002	0.002	0.0006
Molybdenum	mg/L	0.05	-	0.01	0.15	-	0.01	0.15	-
Nickel	mg/L	0.02	-	0.2	1	0.011	0.2	1	0.011
Selenium	mg/L	0.01	-	0.02	0.02	0.005	0.02	0.02	0.005
Silver	mg/L	0.1	-	-	-	0.05	-	-	0.05
Uranium	mg/L	0.02	-	0.01	0.2	-	0.01	0.2	-
Vanadium	mg/L	-	-	0.1	-	-	0.1	-	-
Zinc	mg/L	-	3	2	20	0.008	2	20	0.008

1. NHMRC (2025) Australian Drinking Water Guidelines
2. Table 9 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)
3. Table 10 and Table 11 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Stock value)
4. ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% for protection and 99% for bioaccumulating contaminants)
5. Table 9 of DEHP (2011a) Comet River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value)
6. Table 10 and Table 11 of DEHP (2011a) Comet River Sub-basin Environmental Values and Water Quality Objectives: Stock value
7. Relevant guideline value for cattle

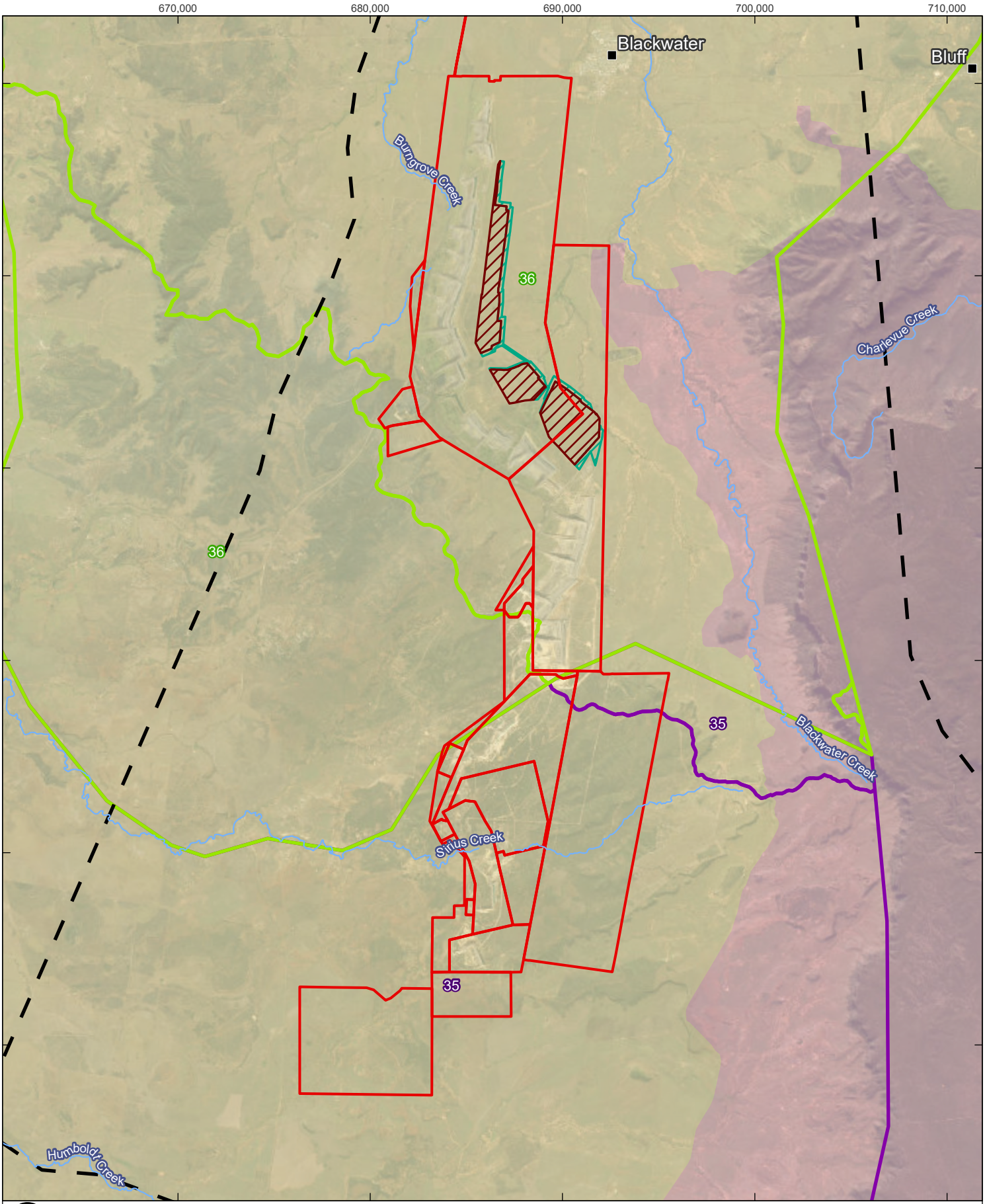


The EPP Water and Wetland Biodiversity also provides limited WQOs specifically for underground aquatic ecosystem protection in the WQ1310 Fitzroy Basin Groundwater Zones (BWM straddles the Mackenzie WQ1304 and Comet River WQ1307 Sub-Basins of the Fitzroy basin, the Project area is within the Mackenzie WQ1304 Sub-Basin). These WQOs vary across the Fitzroy Basin and are defined on the basis of groundwater Chemistry Zones. The applicable Chemistry Zones for BWM include the Fitzroy Groundwater Zone 35 in the south and Zone 36 in the north (**Figure 5-33** and **Table 5-16**) which are characterised as sodic dominant at levels of dissolved material that classify general water quality as low to moderate salinity (Zone 36) and saline (Zone 35).

These WQOs are classified by groundwater depth ('shallow' being <30 m depth, and 'deep' being >30 m depth) and are summarised below. The management intent of each WQO zone is to maintain each of 20th, 50th and 80th percentile values.

Table 5-16 Fitzroy Basin Zone 35 and Zone 36 WQOs for groundwater resources (aquatic ecosystem protection) (DEHP, 2011a and 2011b)

Water Quality Indicator	Unit	Zone 35 Shallow Groundwater (<30m)			Zone 35 Deep Groundwater (<30m)			Zone 36 Shallow Groundwater (<30m)			Zone 36 Deep Groundwater (<30m)		
Percentile	-	20th	50th	80th	20th	50th	80th	20th	50th	80th	20th	50th	80th
EC	(µS/cm)	84	870	1983	4103	9375	13604	3100	6300	7410	3475	4150	7255
Hardness as $CaCO_3$	(mg/L)	37	124	430	401	1216	1905	323	363	528	288	354	619
pH	(mg/L)	7.59	7.6	7.93	7.37	7.6	8.01	7.7	7.80	8.35	8.21	8.3	8.66
Alkalinity	(mg/L)	122	320	556	92	189	311	316	600	843	460	572	1322
Ca	(mg/L)	6	14	81	33	146	366	42	53	105	23	45	75
Mg	(mg/L)	3	27	58	45	204	226	46	56	72	44	74	106
Na	(mg/L)	59	113	256	465	1750	2555	590	1404	1511	520	830	1748
Cl	(mg/L)	54	86	392	1079	3316	5368	610	1885	2373	793	1000	1945
SO_4	(mg/L)	5	11	25	0	20	122	2	5	120	84	115	210
HCO_3	(mg/L)	42	333	646	126	268	376	372	732	1021	541	640	1549
NO_3	(mg/L)	0.15	1.4	9.6	0	0.1	0.5	1	4.25	7.50	0.65	2	2.9
SiO_2	(mg/L)	43	68	72	9	18	76	25	43	60	32	43	81
F	(mg/L)	0.1	0.2	0.5	0.06	0.3	0.5	0.285	0.3	0.39	0.31	0.4	1.12
Fe	(mg/L)	-	-	-	0	0.01	0.047	0.02	0.02	0.02	0.02	0.02	0.047
Mn	(mg/L)	-	-	-	0.01	0.04	2.495	0.02	0.045	0.07	0.02	0.02	0.047
Zn	(mg/L)	-	-	-	0.01	0.14	0.27	-	-	-	-	-	-
Cu	(mg/L)	-	-	-	0	0.005	0.01	-	-	-	-	-	-



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:260,000 at A4
Project Number:	640.031809.00001
Date Drawn:	18-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

EPP Groundwater Zone

- Zone 35
- Zone 36

Groundwater Management Area

- Carnarvon Groundwater Management Area
- Highlands Groundwater Management Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER MANAGEMENT AREAS AND CHEMISTRY ZONES

SLR

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FIGURE 5-33

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_32_Groundwater Management Areas, Fitzroy Basin Groundwater Zones, and Chemistry Zones

5.4.3.2 Comparison of Groundwater Quality to Potentially Relevant Guidelines

In order to understand the possible utilisation of groundwater resources within the study area, given the scheduled EVs discussed above, the available groundwater quality data have been compared to the:

- Australian Drinking Water Guidelines (ADWG) (NHMRC, 2025).
- ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% for protection and 99% for bioaccumulating contaminants).
- Fitzroy Basin Groundwater Water Quality Objectives: Aquatic ecosystems (Zones 35 and Zone 36).
- Mackenzie and Comet River Sub-basin Environmental Values and Water Quality Objectives: stock and irrigation.

A comparison of these guidelines to the 80th percentile of available historical water quality data for each BWM monitoring bore is presented as **Appendix A**. **Table 5-17** summarises **Appendix A** by showing the percentage of analysed bores where the 80th percentile concentration for at least one analyte exceeds the relevant guideline. This is further discussed in detail in the below text.

Table 5-17 Percentage of Analysed Bores in Aquifer with 80th Percentile Groundwater Quality Data Above Relevant Guideline for one or more Analyte (refer Appendix A)

Aquifer	Number of bores Analysed	ADWG Guidelines Health[1]	ADWG Guidelines Aesthetic[1]	Irrigation[2]	Stock[3]	Aquatic 95%[4]	80th %ile WQO limit
Alluvium	1	100%	100%	100%	100%	100%	100%
Tertiary	3	100%	33%	100%	100%	67%	100%
Rewan	2	100%	100%	100%	100%	100%	100%
RCM North	9	100%	44%	100%	100%	78%	44%
RCM South	2	100%	100%	100%	100%	50%	100%
Burngrove Formation	2	100%	50%	100%	50%	50%	100%

1. NHMRC (2025) Australian Drinking Water Guidelines
2. Table 9 of DEHP (2011a) Comet River Sub-basin / Table 9 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Irrigation water (Long term value).
3. Table 10 and Table 11 of DEHP (2011b) Mackenzie River Sub-basin Environmental Values and Water Quality Objectives: Stock.
4. ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection).

Quaternary Sediments

Water quality data from one bore in the alluvium with available data shows that concentrations from most analytes are generally higher than the relevant Fitzroy Basin WQOs for aquatic ecosystem protection. Alluvium groundwater data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to copper and zinc.



The 80th percentile concentrations of the alluvium data also indicate the alluvial groundwater is generally unsuitable to support the Drinking Water EV with respect to chloride, sodium and manganese and TDS, the Irrigation EV with respect to boron, manganese and uranium, and the Stock Watering EV with respect to TDS (salinity).

Tertiary Sediments

Groundwater quality data, where groundwater is present in the Tertiary sediments/regolith, shows that collectively it is not considered a suitable groundwater resource for drinking and irrigation due to exceedances above Fitzroy Basin WQOs with respect to beryllium, nickel, lead, fluoride and manganese or TDS and boron, iron, manganese, fluoride and molybdenum respectively (see **Appendix A**). Monitoring data from the Tertiary bores show that analyte concentrations exceed the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection across all three analysed bores, particularly for dissolved metals (see **Appendix A**). The monitoring data also shows that of the two Tertiary bores, one showed water quality above the Stock EV guideline with respect to fluoride, aluminium and TDS (see **Appendix A**).

Triassic Rewan Group

Groundwater quality data from two bores screened in the Rewan Group shows that most analyte concentrations are generally higher than the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection. The data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to most relevant metal concentrations (**Appendix A**). The monitoring bore data also suggests that it is generally not suitable for supporting the Drinking Water, Stock, Irrigation EVs (**Appendix A**).

Rangal Coal Measures

As with the Alluvium, Tertiary and Rewan Group, RCM monitoring bore data shows concentrations of most analytes are generally higher than the relevant Fitzroy Basin WQOs for Aquatic Ecosystem protection. RCM monitoring bore data generally suggests that RCM groundwater at BWM is unsuitable to support the Aquatic Ecosystems EVs with respect to pH, cadmium, chromium, copper, nickel, lead, selenium or zinc and the Drinking Water EV with respect to selenium, manganese or fluoride (see **Appendix A**). The RCM monitoring bore data also generally suggests that RCM groundwater at BWM is also unsuitable to support the irrigation water EV with respect to boron, iron, molybdenum, manganese, selenium or uranium. The monitoring bore data shows water quality generally above the Stock water EV guideline with respect to selenium and TDS (**Appendix A**).

Burngrove Formation

Groundwater quality data is available from two bores screened in the Burngrove Formation namely bores BG No.1 AP and BG No.2 BG located in the Northern area of BWM.

Burngrove Formation groundwater data also indicates it is generally not suitable for supporting the Aquatic Ecosystems EV with respect to selenium and nickel. Groundwater does not meet the Drinking Water EV criteria with respect to pH, iron, manganese, sodium, chloride or TDS and the Irrigation EV with respect to boron or iron. The monitoring bore data indicates one exceedance in TDS at bore BG No.2 BG above the Fitzroy Basin WQOs for Stock Watering.



Summary

In summary, the comparison of available groundwater quality data from the BWM monitoring bores shows that all hydrostratigraphic units at BWM generally exhibit water quality that exceeds some of the relevant parameter criteria for the scheduled EVs.

5.5 Groundwater Use and Management

The study area lies within the Highlands and Carnarvon GMAs under the *Water Plan (Fitzroy Basin) 2011*, a subordinate statutory instrument made under the *Water Act 2000* (Qld), as discussed in **Section 5.4.3**.

Environmental Values pertinent to the Project are listed in DEHP (2011b) as:

- Aquatic ecosystems.
- Irrigation.
- Farm supply/use.
- Stock water.
- Primary recreation (Comet Groundwaters only).
- Drinking water.
- Industrial use.
- Cultural and spiritual values.

As presented in **Section 5.4**, the groundwater quality in the vicinity of BWM is typically brackish to saline and generally not suitable for drinking.

Although groundwater in the vicinity of BWM may have cultural and spiritual values, none were identified in the literature reviewed.

5.5.1 Groundwater Dependent Ecosystems

5.5.1.1 National Atlas of Groundwater Dependent Ecosystems

A GDE is a natural ecosystem that requires “access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services” (Richardson, S., et al., 2011).

The BoM’s National Atlas of Groundwater Dependent Ecosystems (GDE Atlas) (BoM, 2017) classifies ecosystems based on the potential for dependence on groundwater through multiple lines of scientific evidence. Ecosystems have been mapped as either:

- High potential for groundwater dependence (indicating a strong possibility the ecosystem is interacting with groundwater);
- Moderate potential for groundwater dependence; or
- Low potential for groundwater dependence (indicating it is relatively unlikely the ecosystem will be interacting with groundwater and will include ecosystems that are not interacting with groundwater).

Desktop mapping of potential aquatic and terrestrial GDEs (TGDEs) indicates that areas with possible high, moderate, and low potential for groundwater interaction occur in the vicinity of the Project Area.



5.5.1.2 Local GDE Studies

Field investigations to verify the groundwater dependence of potential GDEs identified in the BoM GDE Atlas desktop mapping (i.e. ground-truthing investigations) have been undertaken in the vicinity of north BWM by EMM (2023a) for potential TGDEs, and EMM (2023b) for potential aquatic GDEs, E2M Pty Ltd (E2M) (2026) for TGDEs, and DPM Enviroscienses Pty Ltd (DPM Enviroscienses) (2026) for GDEs. The outcome of these investigations is summarised below. No ground-truthing local investigations have been undertaken in the vicinity of south BWM.

5.5.1.2.1 2023 Studies

Field surveys were undertaken that identified and characterised remnant regional ecosystem terrestrial vegetation within the vicinity of north BWM. EMM (2023a) then utilised depth to groundwater table mapping prepared by RDM Hydro et al. (2023) and information on maximum plant rooting depths for the identified vegetation species to assess whether the groundwater table was within the potential rooting depths of the vegetation, and thus if the vegetation may be reliant at least in part on groundwater. The results of the work indicated that the riparian terrestrial vegetation associated with Taurus Creek (a tributary of Blackwater Creek) on the eastern margin of the Project Area and a very small area along Sagittarius Creek to the north of the Project Area may represent a TGDE. The terrestrial vegetation in this area consists of narrow linear communities that fringe the creek, with potential TGDE vegetation types consisting primarily of poplar box (*Eucalyptus populnea*), forest red gum *(Eucalyptus tereticornis*), or river red gum (*E. camaldulensis*) (EMM, 2023a).

Assessments to verify mapped potential aquatic GDEs include the field survey undertaken by EMM (2023b) in the vicinity of BWM North. The outcome of this survey is summarised by EMM (2023b) in the Aquatic Ecology Baseline Assessment Report as:

"Prolonged dry conditions in the lead-up to the December 2019 surveys provided ideal conditions for identifying surface expressions of groundwater (i.e. aquatic GDEs). However, no flows, salt seeps, hydrophytes, or other obvious indicators of aquatic GDEs were encountered. Further, the concentration and relative proportion of major anions and cations in surface water samples collected from the survey area in December 2019 and May 2020 showed no obvious groundwater influence. Field verification of riparian vegetation and aquatic habitats of the survey area found no obvious on-ground indicators of aquatic GDEs."

That is, the field verification of aquatic habitats in the vicinity of north BWM found no indicators of aquatic GDEs (EMM, 2023b) indicating that the BoM GDE Atlas mapping of potential GDEs in this area is potentially erroneous.

5.5.1.2.2 2026 Studies

DPM Enviroscienses completed an assessment in early 2026 to describe the aquatic values of the Project area (the Study Area), identify any conservation significant species under the EPBC Act and Queensland *Nature Conservation Act 1992*, identify the potential for GDEs to occur, identify and describe any aquatic Matters of State or National Environmental Significance, assess impacts of the Project on aquatic and GDE values. The assessment of GDEs concluded:

"*Terrestrial GDEs occur within the Study Area in part of the riparian corridor of Taurus Creek. There is no evidence of surface expression or subterranean GDEs within the Study Area, both of which are unlikely to occur. The presence of stygofauna in an aquifer would indicate a subterranean GDE; however, no stygofauna were detected from five bores and five micropiezometers sampled as part of a pilot survey in both July and October 2025, and*



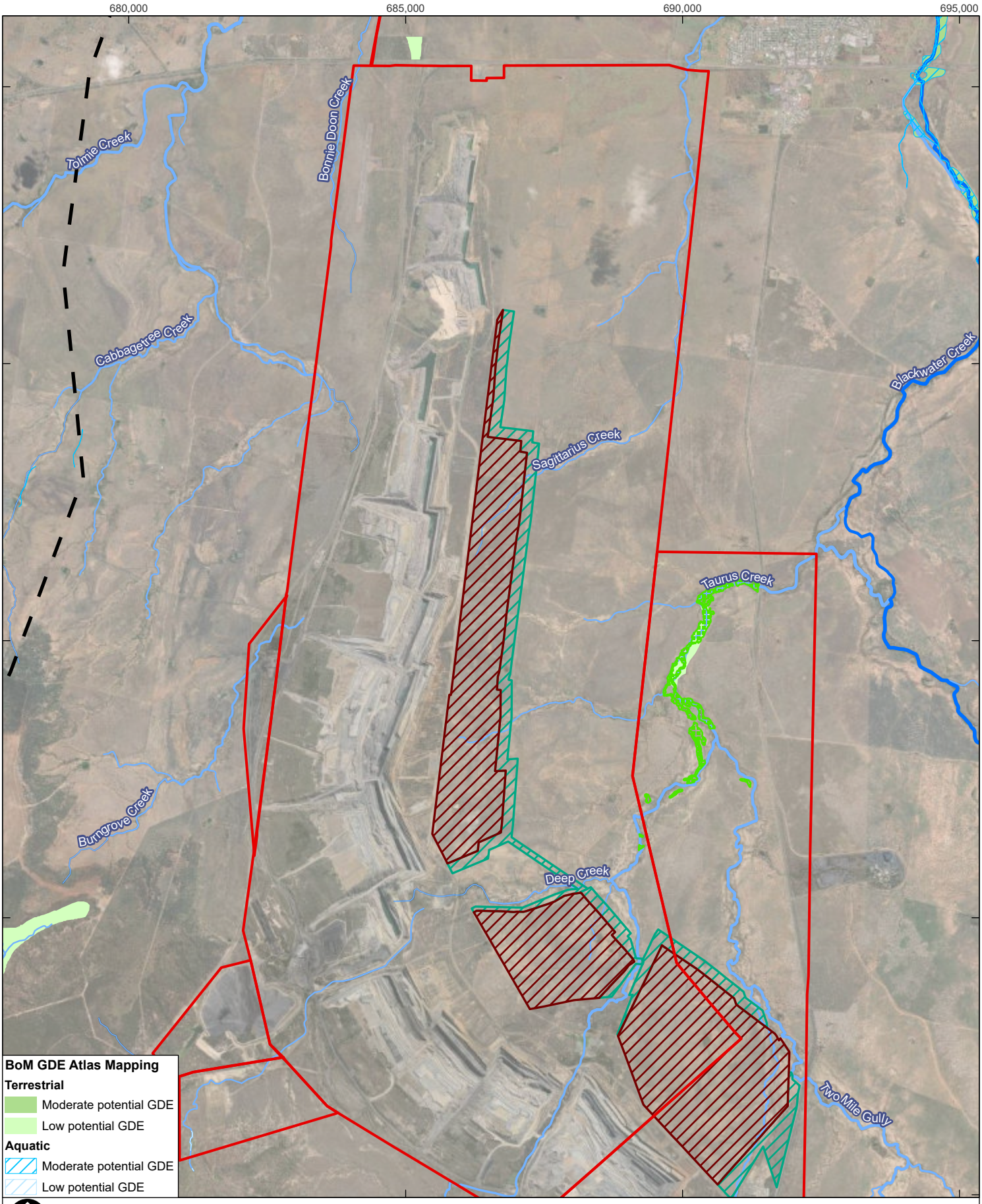
there is no evidence of stygofauna having previously been detected from within 5 km of the Study Area" (DPM Enviros ciences, 2026).

This study generated the most up-to-date and comprehensive mapping of GDEs within the Study Area and this mapping has been adopted for the GDE assessments herein (**Figure** 5-34).

E2M completed a Terrestrial Ecological Assessment including a further review of TGDEs within the Study Area based on the outcomes of the DPM Enviros ciences (2026) study. Preliminary desktop assessments identified potential TGDEs in the central extent of the Study Area around Taurus Creek, via the BoM GDE mapping, as previously identified. A field assessment of potential TGDEs defined by DPM Enviros ciences (2026) concluded the following:

"Based on the species composition of these communities, areas of these REs potentially access groundwater during dry periods, given the presence of E. coolabah and E. populnea, which can be facultative groundwater dependent species (Eamus et al., 2006; Kath et al., 2014; Roberts & Marston, 2000). Remnant vegetation on Two Mile Gully and further upstream on Taurus Creek is unlikely to constitute terrestrial GDEs as they generally contained species that do not represent ground-water dependent vegetation such as Acacia harpophylla and Terminalia oblongata. These species typically have a horizontal root system and are considered unlikely to be dependent on access to groundwater for long-term survival (DES, 2017)" (E2M, 2026).

Areas of TGDEs identified in the Study Area are depicted in **Figure 5-34** (based on DPM Enviros ciences, 2026).



0 1 2 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential GDE (DPM, 2026)

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

GROUNDWATER DEPENDENT ECOSYSTEM MAPPING (BWM NORTH)

SLR

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FIGURE 5-34

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_33_Groundwater Dependent Ecosystem Mapping (BWM North)

Springs

A search with the QSpatial Database showed that there are no registered springs within a 10 km buffer of the Project area. The closest registered spring is located approximately 14.8 km southeast from the Project area, a distance considered significant in the context of the Project's potential groundwater related impacts such that this spring is not relevant to the Project's impact assessment.

5.5.2 Wetlands

A wetlands search was conducted using data downloaded from the QSpatial Catalogue. The downloaded dataset shows High Ecological Significance (HES) wetlands that are matters of state environmental significance. The dataset did not show any wetlands within a 10 km buffer of the Project area. The closest wetland is located approximately 19.7 km southeast from the Project area, a distance considered significant in the context of the Project's potential groundwater related impacts such that this wetland is not relevant to the Project's impact assessment.

5.5.3 Anthropogenic Groundwater Users (Landholder Bores)

A search of the Queensland Government's Registered Groundwater Bore Database (GWDB) (Department of Local Government, Water and Volunteers, 2026) and the BoM's National Groundwater was carried out for registered bores within 5 km of the EA boundary. The search returned 451 registered bores with registered uses as mine monitoring (322 bores), petroleum exploration (3 bores), sub-artesian monitoring (24 bores), industrial (2), water resources investigation (3 bores), water supply (33 bores), stock (3), domestic (1), un-known (23 bores) and decommissioned (37 bores).

A landholder bore census was conducted at BWM by EMM (2019). A total of 32 bores were visited during the census, including 20 registered bores and 12 unregistered bores. Of the 12 unregistered bores visited during the census, all but one are located west of BWM. The results of the survey indicated that 10 of the unregistered bores were in use while the other two were not in use.

Of the 20 registered bores visited during the census, the results of the survey showed that eight of the bores were in use, while the other 12 were not in use.

Overall, the bore census identified that of the bores visited (including both the unregistered and registered bores) a total of 20 bores were in use and equipped with pumping infrastructure. The results of the survey showed that these bores were used for stock and farm supply purposes and are screened across either Tertiary basalt or the RCM.

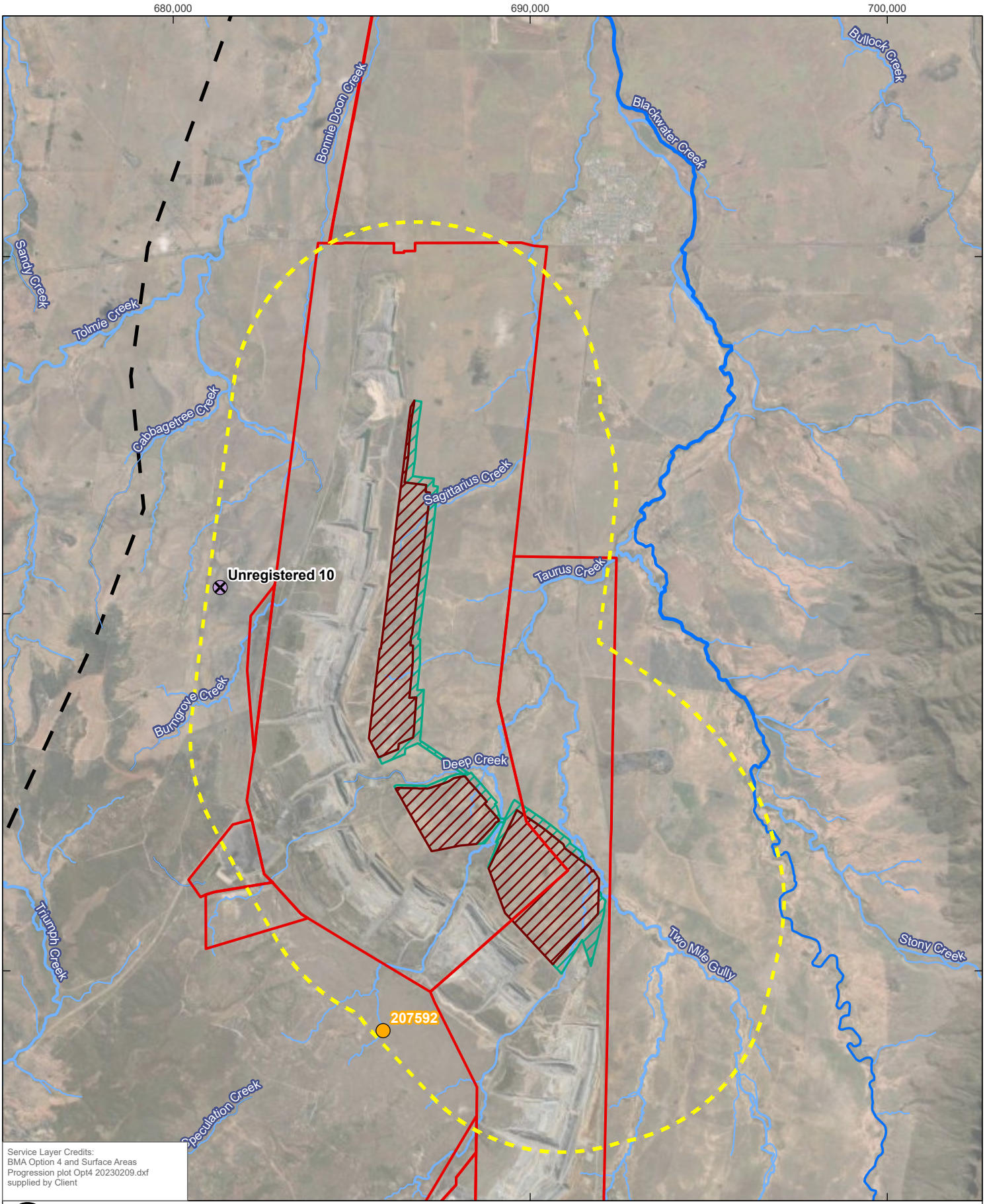
The results of the review of the GWDB search and bore census identified two potential private water supply bores within 5km of the proposed Project area (**Table 5-18** and **Figure 5-35**).

Table 5-18 Potential Private Water Supply Bores within 5km Buffer of the Northern Extension

Bore ID	Easting[1]	Northing[1]	Source	Use	Bore Depth (mBGL)	Assigned Strata
RN207592	685880	7368329	GWDB	Stock	36	RCM
Unregistered 10	681315	7380737	EMM Survey	Not in use	49	RCM

1 Coordinates GDA 2020 z55





Service Layer Credits:
BMA Option 4 and Surface Areas Progression plot Opt4 20230209.dxf supplied by Client

0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:140,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Major Watercourse
- Minor Watercourse
- BWM Mining Lease
- GIA Study Area
- 5km Buffer from SA7/10
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Groundwater Database Bore

- Stock

Bore Census Registered Bores EMM (2019)

- Not in Use

Bore Census Unregistered Bores EMM (2019)

- Not in Use

BLACKWATER NORTH EXTENSION PROJECT

GROUNDWATER ASSESSMENT

PRIVATE BORES

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FIGURE 5-35

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_35_Private Bores

5.6 Conceptual Hydrogeological Model

A conceptual hydrogeological model of the groundwater regime has been developed based on the review of the hydrogeological data for the Project and surrounds. It is important to note that the conceptual hydrogeological model presented herein represents an evolution of the hydrogeological understanding at BWM, building on a previous conceptualisation presented by AGE (2013), and further studies at BWM.

The Project is located within the southern part of the Bowen Basin, which comprises Permian aged coal measures that have been folded into a syncline structure that strikes in a north-west to south-east direction.

From youngest to oldest, the main hydrostratigraphic units underlying the Project area are:

- Quaternary alluvium including sand, silt clay, basal gravels.
- Tertiary Sediments / Regolith.
- Triassic Clematis Group.
- Triassic Rewan Group.
- Rangal Coal Measures – Target formation for mining.
- Burngrove Formation – considered the basement layer for this assessment.

The principal coal seams in the BWM area in descending order are the Aries (also known Top Seam), Castor (also known as (Middle Seam) and Pollux (also known as Lower Seam).

The coal seams are the main groundwater bearing units within the Permian sequences, with low hydraulic conductivity interburden generally confining the individual seams. The coal seams are dual porosity with a primary matrix porosity and a secondary (dominant) porosity provided by fractures (joints and cleats). Hydraulic conductivity of the coal decreases with depth due to increasing overburden pressure reducing the aperture of fractures.

5.6.1 Groundwater Levels and Flow

Groundwater level data within the alluvium is limited. The alluvium is often found to be limited in extent and thickness, and unsaturated, but may become saturated following rainfall recharge and occasional inflow from ephemeral creeks. Groundwater levels in the unconfined alluvium, where saturated, are expected to be a subdued reflection of topography, with flow toward the north of the Project at North Blackwater and towards the southwest at South Blackwater. If there are times when the alluvium is saturated, flow would still be restricted as the coarser grained alluvium (that could transmit water) is separated by clay lenses and outcropping bedrock, with limited connectivity between areas of saturated alluvium.

Recharge to the alluvium is considered to be mostly from occasional ephemeral stream flow or flooding (i.e. losing streams), with direct infiltration of rainfall also occurring rapidly where there are no substantial clay barriers in the shallow subsurface. However, recharge is expected to be low due to the presence of surficial clays. On a regional scale, discharge occurs via evapotranspiration from vegetation growing along creek beds, drawing on soil moisture or shallow perched water tables rather than the deeper regional water table. This mechanism is limited because the alluvium is often unsaturated and only temporarily saturated after significant rainfall or flooding. Minor short duration baseflow events after significant rainfall/flooding are possible, however there was no data available to support or reject this hypothesis.



Within the Tertiary Sediments and Regolith, the strata is typically unsaturated at north Blackwater but saturated in the south Blackwater area. In the southern area groundwater levels in the Tertiary Sediments are variable, ranging from 2 to 32 mBGL, and groundwater flow is towards the south.

The Triassic Rewan Group is known as a regional scale aquitard, though still may contain low yielding groundwater. There is limited hydraulic connection between the Rewan Group and underlying Rangal Coal Measures due to the low vertical hydraulic conductivity nature of the strata and the overlying Triassic units confine the underlying Permian sediments. In the Rangal Coal Measures, the lower permeability interbedded claystone and shale horizons (interburden) significantly reduce vertical leakage causing most groundwater flow within the Coal Measures to be along the coal seams themselves. In the Project area, groundwater flow within Permian coal seams was inferred to be towards the north for pre-mining conditions. However, with many open-cut pits in the area, groundwater within the Coal Measures now generally flows towards these pits.

Recharge is limited to areas with relatively higher hydraulic conductivity units (e.g. coarse grained sandstone and coal seams) and in areas of outcrop. Coal seam recharge is expected to occur primarily via leakage from the overlying Quaternary and Tertiary units, where the Triassic formation is not present or significantly thinned. As such, the areas with greatest control of Permian formation recharge are proximal to seam outcrops. Some recharge to the coal measures also occurs through mine surface water storages where the seams are hydraulically connected to the storages such as mining pits and waste spoil.

5.6.2 Groundwater – Surface Water Interaction

Groundwater interaction with ephemeral creeks is likely to be limited within the Project area for the alluvium and underlying Regolith, due to the limited extent and saturation of these units, and ephemeral nature of creek flow. Interaction is likely in terms of stream flow leakage to the underlying geology during sporadic creek flow events. Where saturated, water levels in the Tertiary Sediments and Regolith appear to be several meters below the base of the creek bed, thus there would be no groundwater discharge to the creeks.

5.6.3 Groundwater Quality

Groundwater quality within the alluvium across the study area is variable both spatially and temporally ranging from fresh to brackish but is typically brackish. The 80th percentile concentrations of the alluvium data also indicate the alluvial groundwater is generally unsuitable to support the Drinking Water EV with respect to chloride, sodium and manganese and TDS, the Irrigation EV with respect to boron, manganese and uranium, and the Stock Watering EV with respect to TDS (salinity). Field pH results indicate groundwater is moderately acidic.

Groundwater quality in the Tertiary sediments is variable but typically more saline than the shallower alluvial groundwater.

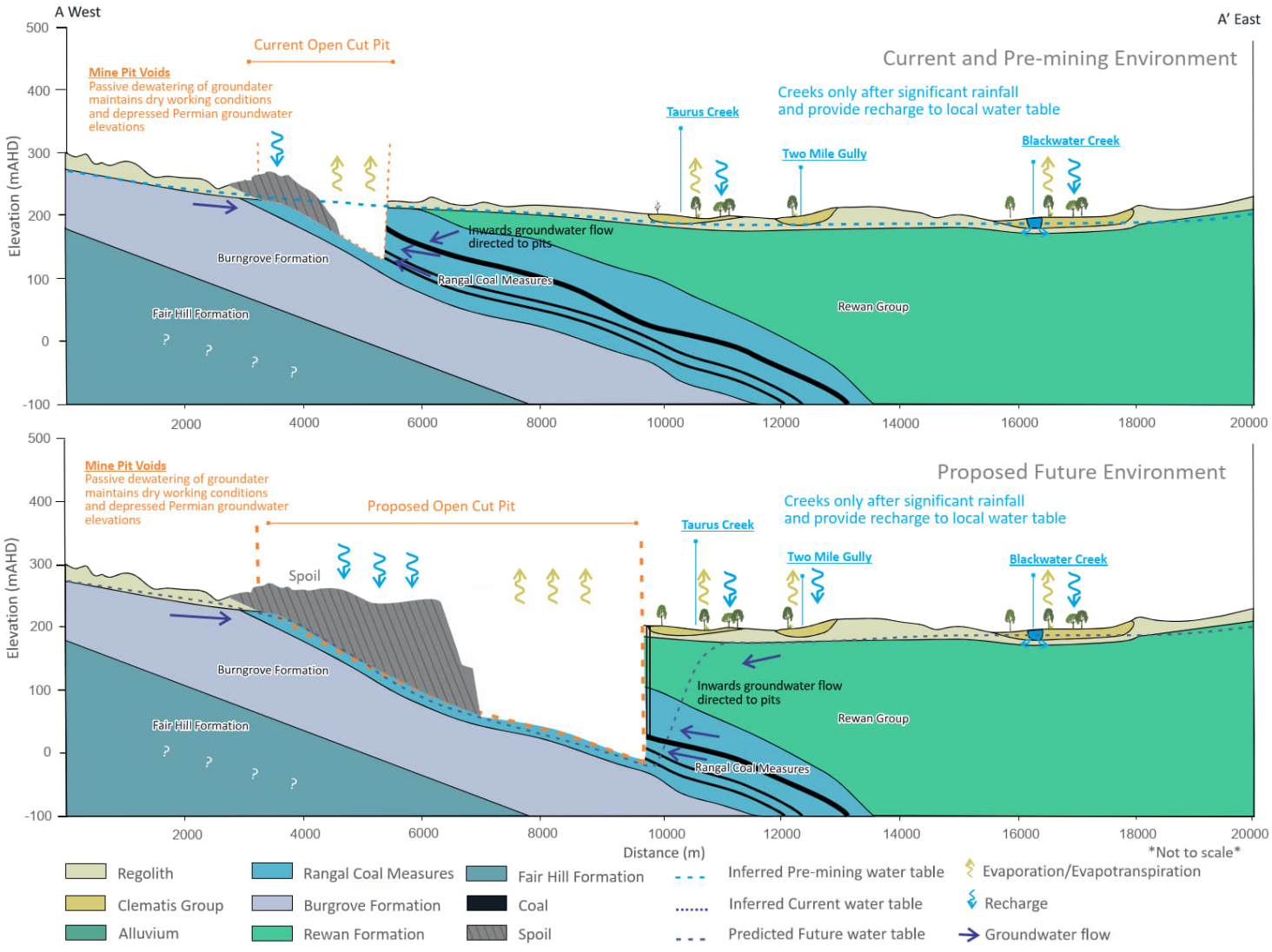
Groundwater quality within the Rewan Group and Permian coal measures is variable, ranging from brackish to highly saline. Groundwater within the coal measures of the Project area is not considered suitable for some livestock.

5.6.4 Mining Impacts

A conceptual hydrogeological cross section was developed for this assessment, showing the current open cut pit and proposed expanded open cut pit is presented in **Figure 5-36**. The current open cut pit is shown with the pre-mining water table and the current inferred water



table. Also shown is the proposed open cut pit with the expanded pit void extending into the Rewan Group to the east. A larger footprint of spoil is depicted on the ground surface and also infilling the western part of the pit. The predicted future water table is shown to be at the base of the RCM and then rising outside the western part of the pit as the influence of dewatering decreases. Throughout both scenarios the hydrogeological environment around Blackwater Creek remains unchanged.



Date Drawn: 08-Apr-2026

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

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CONCEPTUAL HYDROGEOLOGICAL SECTION OF THE PROJECT AREA AND SURROUNDINGS

FIGURE 5-36

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F05_35_Conceptual Hydrogeological Section

5.7 Conceptual Ecohydrogeological Models

RDM Hydro et al. (2023) presents conceptual ecohydrological models (TGDE types and functions) which are likely to be found in the BWM area and the wider Bowen Basin based on the findings of the desktop study and previous field assessments of other GDE studies in the Bowen Basin.

The conceptual ecohydrological models include perched aquifers in alluvium (Types A and B) and systems exhibiting interactions with Tertiary and Permo-Triassic sediments (coal seams and alluvium) (Types C and D). A description of the types and function of the conceptual ecohydrological models summarised from RDM Hydro et al. (2023) is provided below.

As described in the guideline, ecohydrological expectations describe how TGDEs interact with groundwater under natural conditions, and impact pathways identify how mining activities could alter these interactions. For Type A and B conceptual models, the primary pathway relates to the disturbance of shallow perched aquifers, and temporary loss of short-term water availability for riparian vegetation. For Types C and D, the pathways are more significant as the risk relates to drawdown in the coal seams, which can propagate through connected formations, reducing groundwater availability and increasing salinity stress for TGDEs. These pathways highlight that Type C and D TGDEs present higher risk of potential impact compared to Types A and B, consistent with the IESC (2024) ecohydrological expectations

The Quaternary Alluvium formations, which includes Taurus Creek, groundwater occurs as ephemeral, discontinuous perched aquifers in sandier material; with clayey material forming aquitards (RDM Hydro et al., 2023). The alluvial sediments are of limited extent and thickness but are likely to be episodically recharged by rainfall run-off when the watercourse hosts water, resulting in the presence of perched aquifers associated with the alluvium, aligning with GDE Type A.

A description of the Type A conceptual ecohydrological models summarised from RDM Hydro et al. (2023) is provided below.

Type A: A simplified perched seasonal groundwater system that is commonly associated with alluvium comprising sediments with higher levels of hydraulic conductivity (sandy loams and sand) is depicted in **Figure 5-37** (from RDM Hydro et al., 2023). The characteristics of Type A are as follows (RDM Hydro et al., 2023):

- Groundwater is recharged during channel flow/flooding and diminishes as the system dries through evapotranspiration or leakage into Permo-Triassic sediments below. Following recharge, groundwater perches on Permo-Triassic sediments (or another aquitard layer) at the base of the alluvium, where it is utilised by fringing riparian vegetation. Generally, groundwater depletes during drier periods, and trees then rely on residual soil moisture to support transpiration.
- These systems are relatively common features along larger drainage lines and do not provide a sustained moisture source to support riparian vegetation during drier periods, utilising groundwater during wetter periods when groundwater is present. Consequently, this means that the vegetation does not rely on a deep continuous water table aquifer, but is using shallow, perched water that was discharged after surface water flow events.
- Type A GDE features are relatively low risk from a management perspective, although may be impacted when stream channels are breached during construction with localised impacts to TGDEs.





Figure 5-37 Type A - Conceptual ecohydrological model - perched aquifers in alluvium (from RDM Hydro et al. 2023)

5.7.1 Validation of the Conceptual Ecohydrogeological Models

The potential TGDEs of Taurus Creek are dominated by coolibah (*Eucalyptus coolabah*) on the channel whilst brigalow (*Acacia harpophylla*) dominates further out on the floodplain. RDM Hydro et al. (2023) identify that the coolibah is likely to utilise groundwater only when groundwater is <5 mBGL and moisture availability in the vadose zone is extremely limited. Brigalow (*Acacia harpophylla*) is also prevalent within the State-mapped TGDE polygon, particularly on the floodplain away from the channel. However, brigalow is not considered to represent groundwater-dependent vegetation.

Two field validation events were undertaken by DPM Enviros ciences (2026), and found:

- June 2025: 5 of 12 coolibah trees showed Leaf Water Potential (LWP) ≥ –0.55 megapascals (MPa), indicating access to a saturated water source. Noting saturated sediments present within the upper 1 m of channel bed sediments with drier conditions observed within the upper 2 m of adjoining floodplain sediments.
- October 2025: All 17 trees sampled (coolibah, ironbark, poplar box) recorded LWP < –0.55 MPa, indicating no groundwater uptake at this time and likely reliance solely on soil water.

The facultative TGDE comprising riparian (including floodplain) vegetation of Taurus Creek would likely exist without groundwater input but is known to utilise groundwater on occasion (episodic or opportunistic GDEs, not obligate GDEs) (DPM Enviros ciences, 2026).

6.0 Numerical Modelling

This section outlines the numerical groundwater modelling that has been undertaken to evaluate the potential impacts of the proposed north extension of open cut mining (the Project) on the groundwater system.

6.1 Model Details

The BWM numerical groundwater model was adopted for the hydrogeological assessment supporting the Project. The BWM numerical groundwater model was built in 2025, based on the most recently available site data (i.e. geological models, groundwater bore data, etc). This section provides a summary of the design, development and use of the BWM numerical groundwater model. Full details of the BWM numerical groundwater model utilised in this hydrogeological assessment are included within SLR (2026), provided in Appendix B.

The BWM numerical groundwater model was deemed appropriate for the purposes of this assessment for the following reasons:

- Adoption of the MODFLOW-USG code in the model allows for sufficient refinement of the model grid around the entire of BWM operations such that the limitations of a regional model in terms of the grid design are mitigated.
- The model incorporates the full BWM geological framework with model layer representation consistent with the three site geological models covering BWM.
- The model is robustly calibrated to BWM specific monitoring data (recently updated and detailed quality assurance completed to early 2025).
- The model incorporates key regional influences that may interact with the BWM groundwater system, including operations at the Curragh mine to the north (open-cut and underground), underground mining at Cook Colliery east of BWM that are both considered to have a potential to interact with groundwater in the BWM Area given their proximity.
- The BWM model adopted for this assessment is the latest numerical model for BWM, developed for the Blackwater Transitional PRC Plan (PRCP) hydrogeology assessment (SLR, 2025a).

6.2 Model Objectives

Numerical modelling was undertaken in support of this hydrogeology assessment to evaluate the potential impacts of the proposed extension of open cut mining (the Project) on the groundwater regime. The objectives of the predictive modelling were to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing.
- Simulate the extent of maximum groundwater drawdown/depressurisation due to the Project and also with respect of cumulative impacts.
- Simulate and predict the change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores and GDEs) due to the Project and also with respect of cumulative impacts.
- Simulate the direct and indirect take of groundwater and surface water (baseflow) due to the Project.

- Simulate the long-term impacts by running the post-mining scenario with the proposed final landform and void lakes.

6.3 Model Design

The numerical model was developed using a Geographic Information System (GIS) in conjunction with MODFLOW-USG (Panday et al. 2013), which is distributed by the United States Geological Survey (USGS). MODFLOW-USG is a recent version of industry standard MODFLOW code (McDonald and Harbaugh, 1988) developed by the USGS. MODFLOW is the most widely used code for groundwater modelling and has long been considered an industry standard.

Model layering is discretised into 17 layers as listed in **Table 6-1**. Those layers identified in the table as not present across the entire model domain are 'pinched out' within the MODFLOW-USG code.

Table 6-1 Model Layers and Thicknesses

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium/Tertiary	Surface cover and Tertiary	8.5
2	Alluvium/ Weathered zone	Weathered zone / Regolith	13.1
3	Clematis Group	Triassic	372.9
4	Rewan Group (Upper)	Triassic	309.4
5	Rewan Group (Middle)	Triassic	180.9
6	Rewan Group (Lower)	Triassic	114.9
7	Rangal Coal Measures	Overburden	51.5
8		Aries seam	1.7
9		Interburden	15.2
10		Castor seam	1.7
11		Interburden	16.3
12		Pollux seam	4.2
13		Interburden	16.2
14		Orion seam	0.8
15		Underburden	17.9
16	Burngrove Formation	Permian	159.4
17	Basement	Permian and/or below	100

6.4 Model Calibration

The model includes a steady state and a transient calibration (from January 2005 to December 2024). In all, the calibration used 1,789 target heads from 108 bores. The transient warm up calibration captures historical mining at BWM, Curragh mine, Cook Colliery underground mine, Kenmare underground, Laleham underground and Sirius Creek No. 1 and 2 underground mines, while the transient calibration captures historical mining at BWM and Curragh mine. The number of bores associated with each model layer and associated target unit are provided in **Table 6-2**.

Mining was represented in the model using the MODFLOW drain package, with the drain cells set to the base of the target coal seam for each pit, and within the target coal seam for underground mines. Calibration of the model was carried out with the objective being to replicate the measured groundwater levels in accordance with Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Calibration for the model achieved a 11.6 m root mean square (RMS) error, equating to a 6.6% scaled root mean square (SRMS) error, which is within the recommended range (i.e. up to 10%) in the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 6-2 Model Calibration Targets

Model Layer	Target Unit	Number of Bores
2	Weathered zone / Regolith	18
5	Rewan Group (Middle)	1
6	Rewan Group (Lower)	6
7	RCM Overburden	14
8	Aries seam	13
9	RCM Interburden	3
10	Castor seam	9
11	RCM Interburden	3
12	Pollux seam	18
13	RCM Interburden	1
14	Orion seam	2
16	Burngrove Formation	20
	Total	**108**

6.5 Model Performance and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001) and the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023).

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al. 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- Usable -- Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and

the effects of potential bias. The relevant Quantities of Interests (QoI) in this context are the groundwater inflows (active mining and final voids), drawdown due to mining and fluxes changes due to mining.

- Reliable -- Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations, and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous uncertainty analysis was undertaken to further improve confidence in the modelling outputs.
- Feasible -- Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project. This study is a rebuild of historical model variations (i.e. 2021 and 2023) demonstrating multiple model reviews/revisions and inclusion of the latest available data. The model has been peer reviewed for each revision. This model build and associated review process is deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the BWM groundwater model, as presented in **Table 6-3.**

Overall, the model captures depressurisation due to active mining. The model is numerically stable with an acceptable mass balance error. The model shows a good fit between observed and modelled groundwater levels. A depth dependence function was used for hydraulic conductivity, with the calibrated values showing a good fit to observed data as (see SLR, 2026, Appendix B). Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 6.2** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.

The model sensitivity was explored for an array of parameters. This showed that these parameters were generally well constrained by the calibration. Parameters are likely to contribute the most to predictive uncertainty (Type IV) were also identified. See Appendix B for a detailed discussion on sensitivity.

The uncertainty analysis was undertaken to add a likelihood estimate to the prediction for the quantities of interest.

Table 6-3 Groundwater Model Data and Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site LiDAR data.
		Fit for purpose	Representation of alluvium based on the CSIRO Regolith mapping Wilford et al (2016) and refined based on site drill data.
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (BWM Mine geology model), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. Geophysical surveys across the Project area have identified minor faulting in the BWM area. Faulting is typically confined to the coal seams of the Rangal Coal Measures. The minor faults show a displacement of up to 5m. Hence, no geological structures (i.e. faults) have been included within the Project area in the model other than through layer displacements from the site geological model. The main regional fault (Shot over fault) was included as the eastern model boundary. Displacements of up to 3,000m are reported at this fault (**Section 4.7**). The Permian coal measures outcrop along the western edge of the site. Therefore, how this is captured within the model influences the model predictions. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model shows a good fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation is provided in **Section 5.5.1**.
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The groundwater -surface water interactions are conceptualised as limited. Due to the gauged creeks to be classified as ephemeral (**Section 0**), no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater and after such recharge events, some minor baseflow contributions back into the creeks is possible.



Type	Part	Status	Comment
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose future improvements possible	Site monitoring network includes one bore mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets. However, the alluvium in the area was found dry at this location. Other attempts to drill into the alluvium were abandoned, as either no alluvium was found or the alluvium was dry, or the bores were installed into the Rewan instead. The modelled groundwater levels in alluvium have hence no comparison available.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose,	Spatial variability of hydraulic parameters in the Alluvium and Regolith has been incorporated in this model version by adding pilot points in both layer 1 and 2. This enhancement has allowed representing the heterogeneity in the alluvial system, improving the model's ability to replicate water level measurements in these units.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the area. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adopted using the previous studies.
	Rivers	Fit for purpose, future improvements possible	Blackwater Creek stage height is changed temporally in the historical calibration model based on observed levels from site stream gauges, and long term annual average level assumed in the predictive model. Blackwater Creek records flow only for a few days per year. The simulation of river stage height involves representing it as the average stage over the entire model stress period. However, since the stress periods (i.e., time slices) in the model are quarterly or annual, the stage height for Blackwater Creek persists in the model for a much longer period than it does in reality. This conservative design approach results in the simulation of what is naturally an ephemeral river reach as a perennial river in the model. Consequently, this leads to an overprediction of water levels in the alluvium along Blackwater Creek. All other watercourses within and in the vicinity of the Project area are ephemeral and only flow briefly after rainfall. Therefore, river stage height of zero was assigned to these watercourses in the model.



Type	Part	Status	Comment
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Verification of landholder bore details may be required in future.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient warm-up (1970-2005) and transient (2005 to 2024) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST) and manual methods.
	Predictive	Fit for purpose	Model captures approved and proposed open cut mining at BWM. The model also includes future mining at Blackwater South and Curragh mines, mainly based on publicly available data. The actual future mine progression for these sites may vary.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis has been conducted using PEST IES. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow.



6.6 Predictive Modelling

Transient predictive modelling was undertaken to simulate both the proposed mining at the Project and surrounding mines from January 2025 to December 2093. The model timing used annual stress period durations as mining progressed into the future. Transient predictive models have been developed for three model scenarios:

- Cumulative Scenario – all approved and foreseeable mining in the model area and at BWM plus the Project.
- Approved Scenario – all approved and foreseeable mining in the model area and at BWM without the Project.
- Null Run – no mining within in the model area.

The Project effects (i.e. the incremental changes) are determined by the difference between the Cumulative and Approved scenarios.

6.6.1 Predicted Groundwater Interception

The predicted inflows for the Cumulative inflows (Approved mining and the Project) and the Incremental inflows (the Project only) are presented in **Figure 6-1**. The peer reviewer recommended use of the TVM2 model parameter set-up for calculation of pit inflows (please refer Section 6.4 of the modelling technical report (SLR, 2026) for parametrisation set-up discussion.

The cumulative inflows (Approved mining and Project) are predicted to reach a maximum in year 2056 at 12,585 ML/year. Cumulative inflows are predicted to remain between 2,290 ML/year and 10,790ML/year between year 2025 and 2055, with inflows then decreasing after 2056 until end of mining. The average cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day). The spike in cumulative inflows in 2056 is due to the commencement of the southern mining operations, which are not part of the BNEP and thus the incremental is 0 ML/year.

The incremental inflows into the mine pits on SA 7 and SA 10 are predicted to reach a maximum in year 2055, with a peak just above 8,200 ML/year (22.5 ML/day). The average project mine inflow rate for the Project (2025 to 2055) is 2,272 ML/year (6.2 ML/day).

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following:

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium).
- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium at any of the proposed pits. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

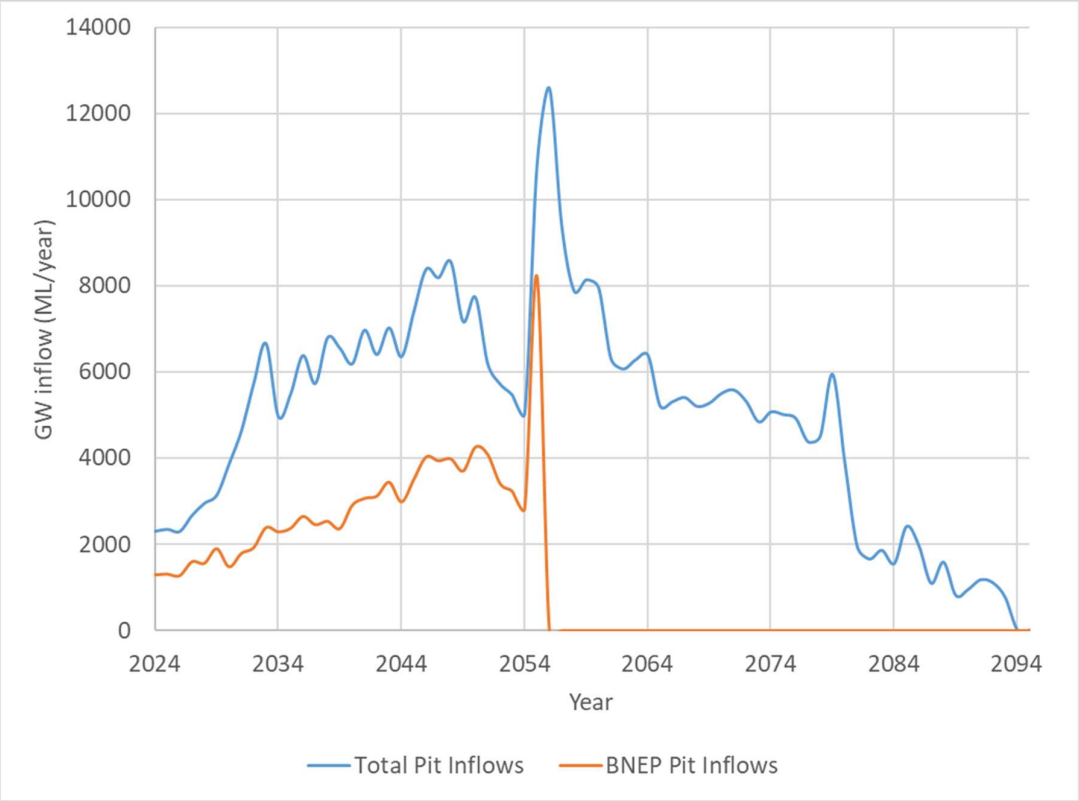


Figure 6-1 Predicted Cumulative and Incremental Project Pit Inflows

6.6.2 Predicted Maximum Drawdowns

The process of mining directly removes water from the groundwater system and reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coalface and decreases with distance from the mine.

6.6.2.1 Incremental Drawdown

Maximum incremental drawdown refers to the drawdown impact associated with the Project and is obtained by subtracting the predicted maximum aquifer groundwater drawdown for the Approved model scenario (No Mining – Approved) over the model duration from the predicted maximum aquifer groundwater drawdown for the Cumulative model scenario (No Mining – Project) over the model duration. The maximum drawdown represents the maximum drawdown values recorded at each model cell. Predicted incremental drawdown figures are presented in **Figure 6-2** to **Figure 6-6**.

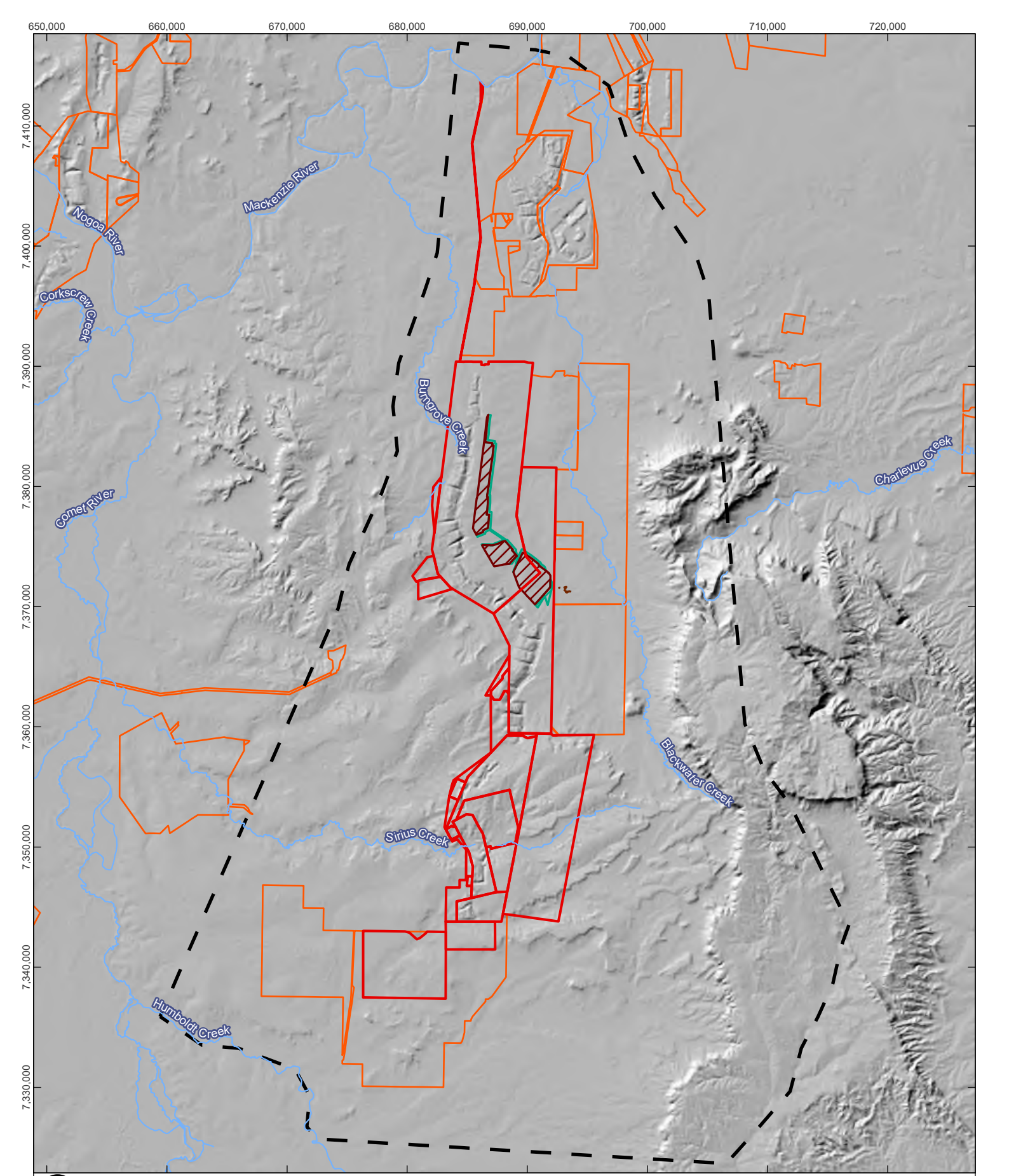
Figure 6-2 shows that no incremental drawdown greater than 1 m are predicted for the alluvium as a result of mining at the Project. For a discussion on the potential incidental water impacts on the alluvium, see **Section 6.6.3.1**.

The maximum predicted incremental drawdowns associated with the Project within the weathered zone is shown in **Figure 6-3**. The incremental drawdown extent within the

weathered zone (Layer 2) is largely confined to near the pit and is influenced by the distribution of predicted saturated zones in the weathered zone.

The Permian coal seams are the primary aquifers targeted by the Project and would experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 6-4** and **Figure 6-5** show the maximum predicted incremental drawdown for the Aries and Pollux Seams in the Rangal Coal Measures, respectively. The figures show that to the west, the extent of maximum predicted incremental drawdown of the Permian coal measures is limited in its extent, maintaining proximity to the pit due to the structural geology (i.e., coal seams subcrop). The extent of maximum predicted incremental drawdown in the coal seams towards the east extends laterally to Blackwater Creek, however at depth, not vertically into the shallow formations, such as alluvium or Tertiary.

Maximum predicted incremental drawdown for the Burngrove is shown in **Figure 6-6**. The figure shows that maximum predicted incremental drawdown is similar to the drawdown in the coal seams and is limited to the coal seam outcrop.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

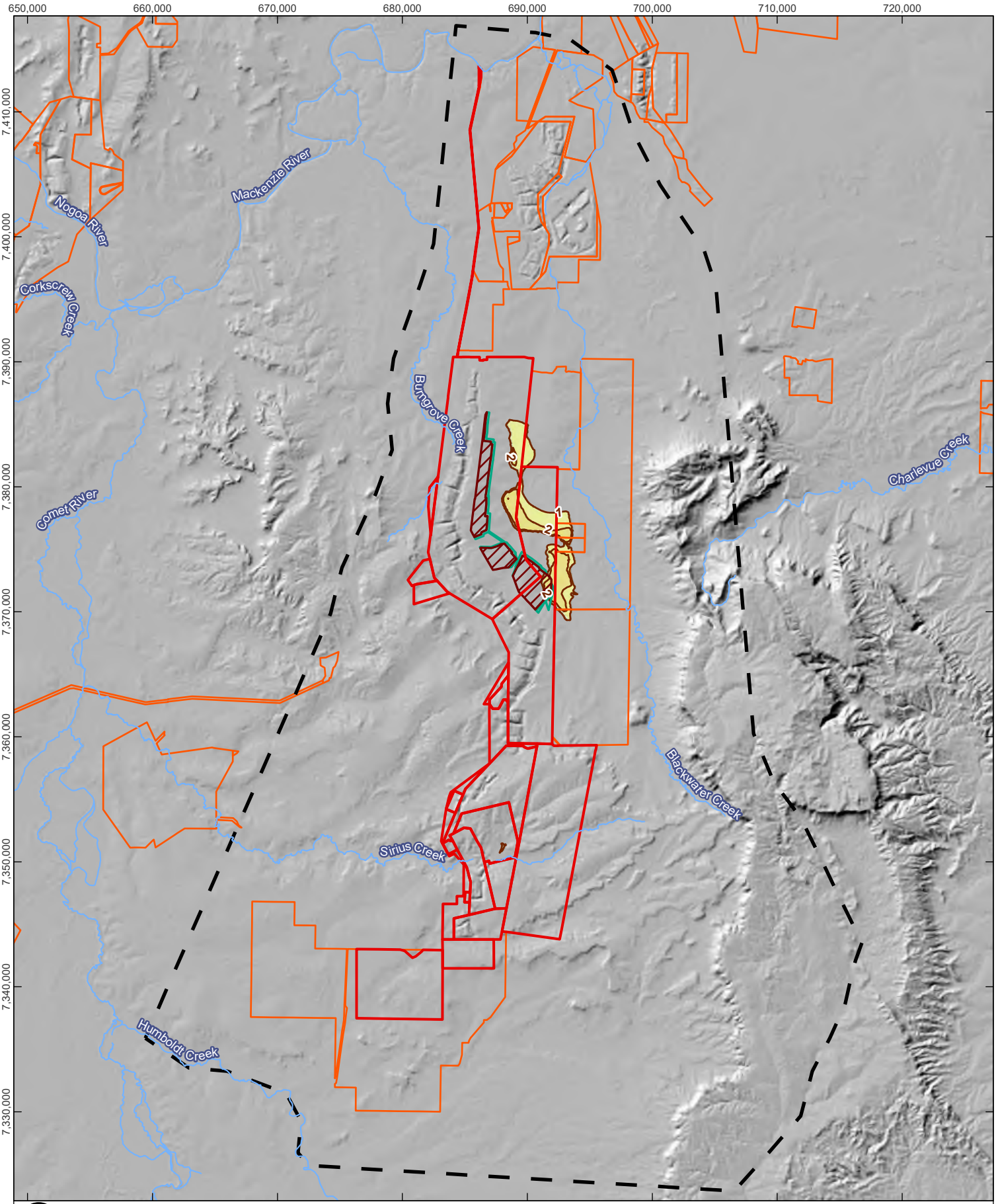
MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

SLR

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FIGURE 6-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_02_Maximum Incremental Drawdown in the Alluvium and Tertiary (Layer 1)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

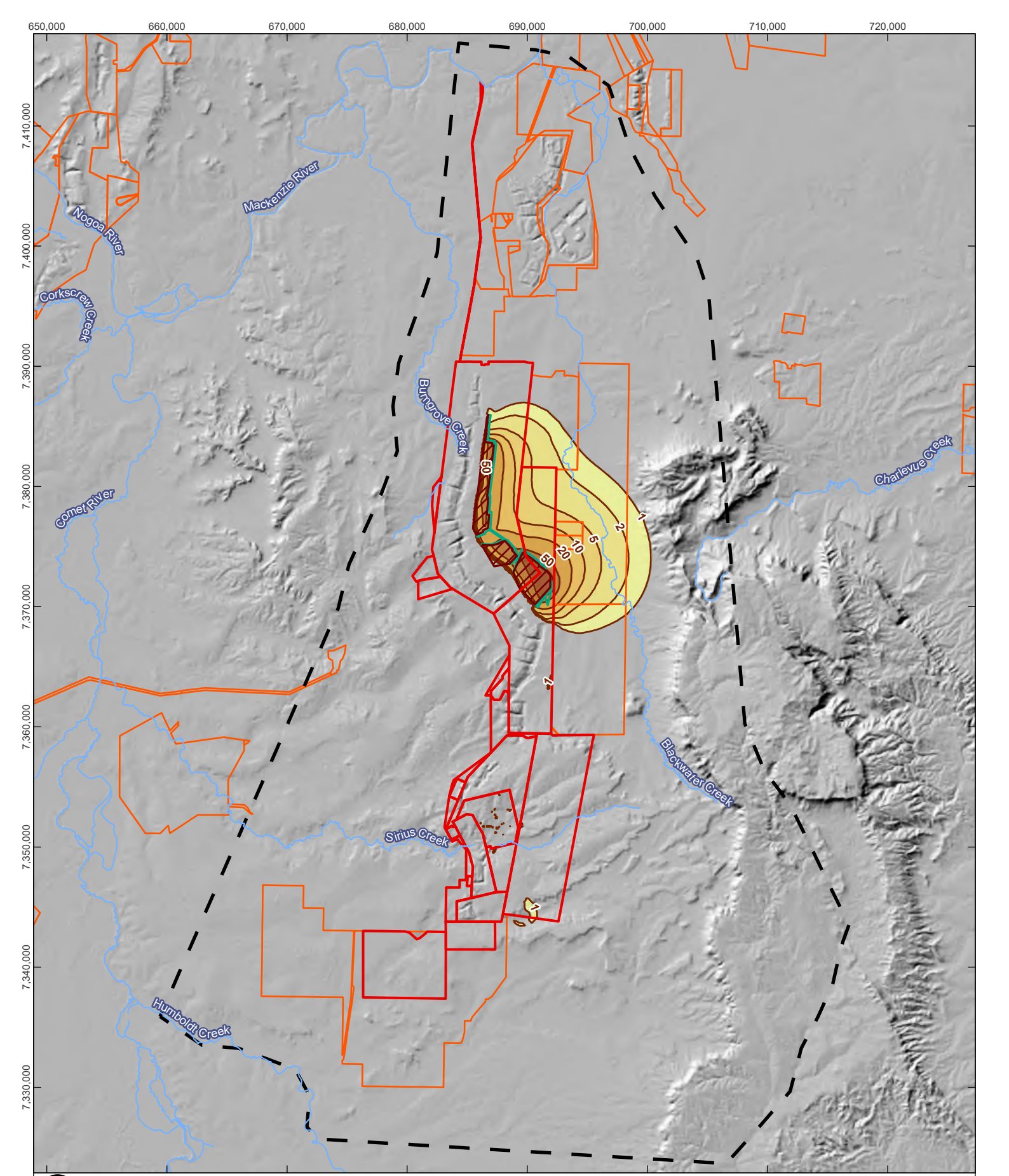
MAXIMUM INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

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FIGURE 6-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_03_Maximum Incremental Drawdown in the Alluvium and Weathered Zone (Layer 2)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

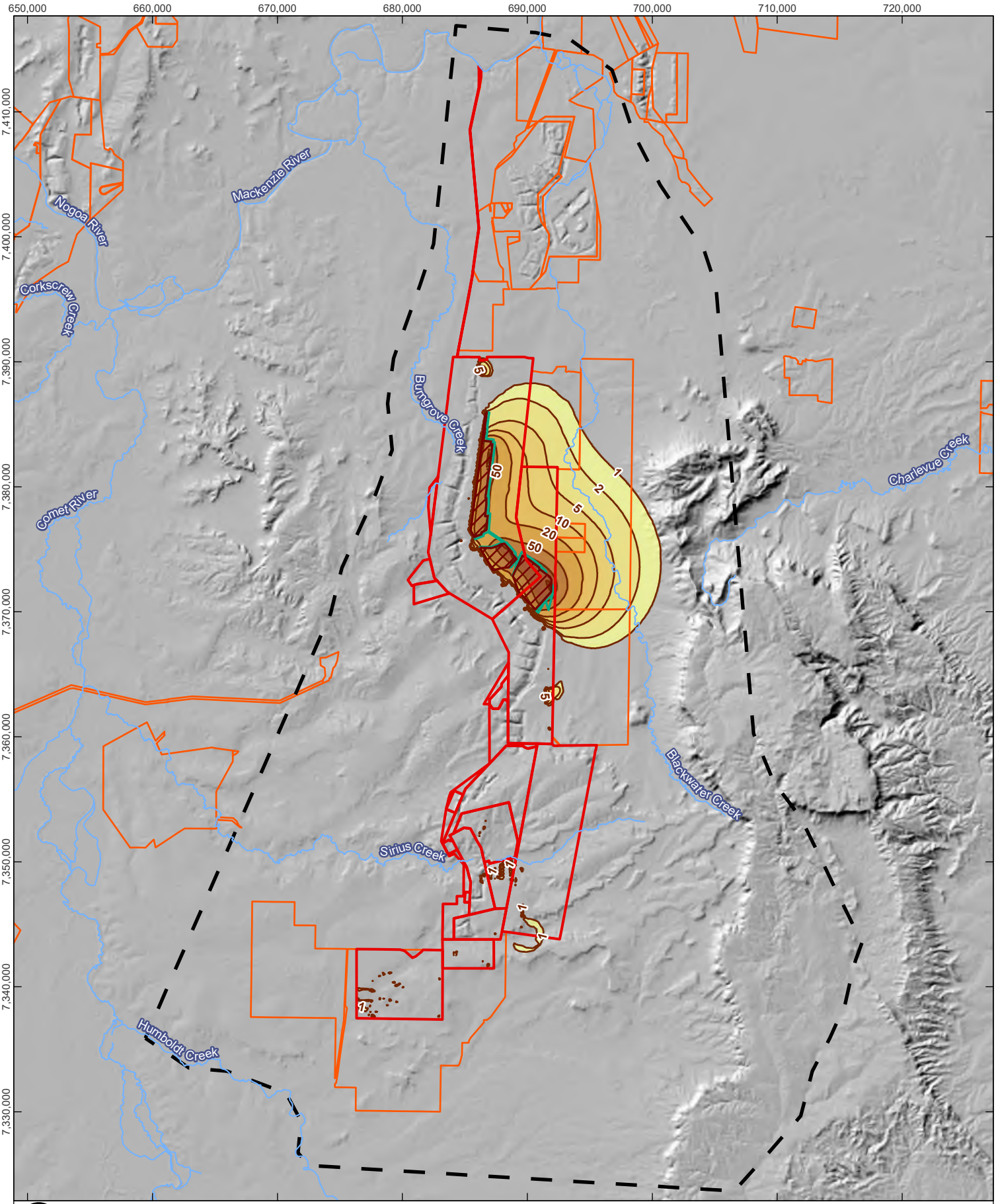
MAXIMUM INCREMENTAL DRAWDOWN IN THE ARIES SEAM (LAYER 8)

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FIGURE 6-4

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0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

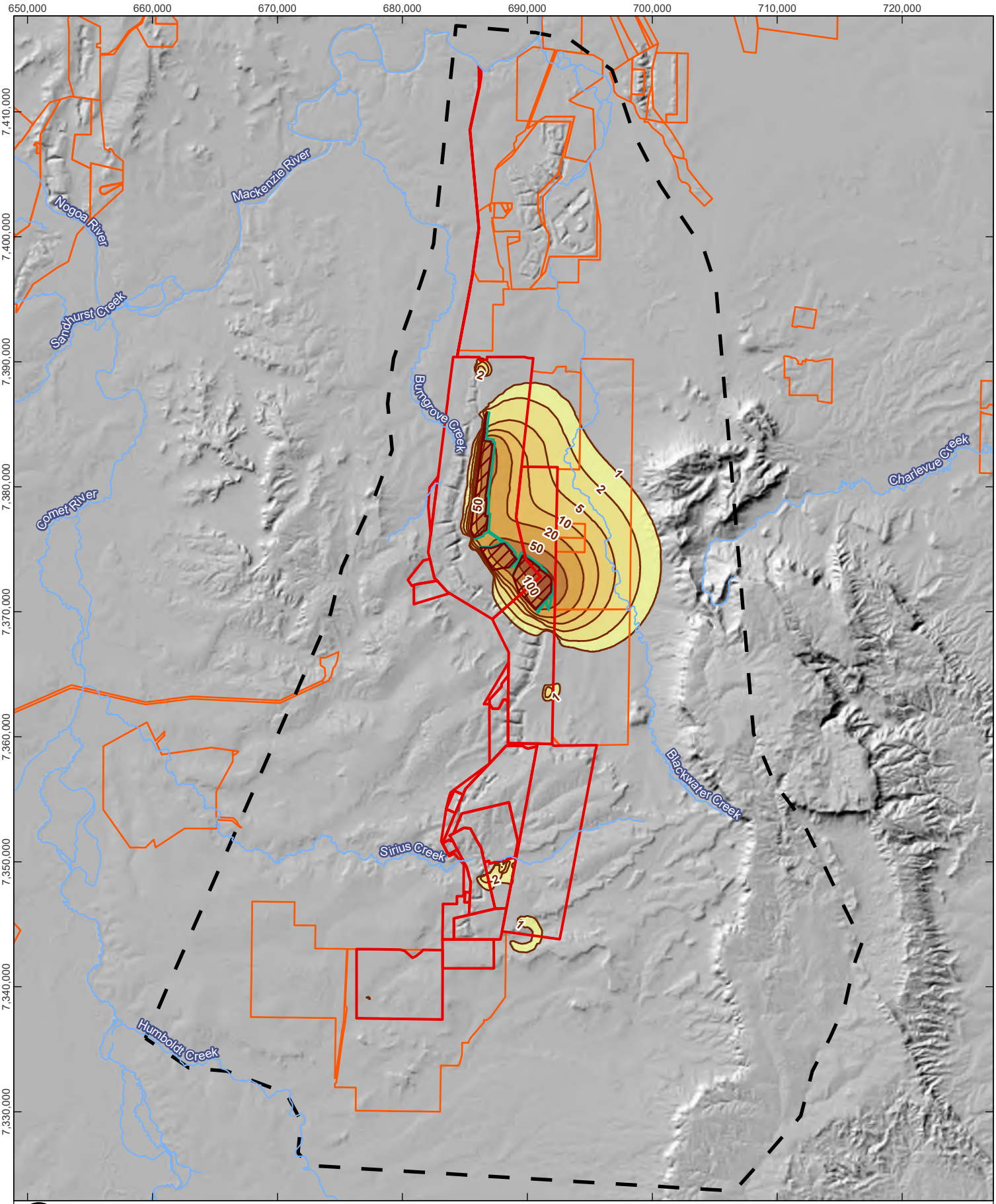
MAXIMUM INCREMENTAL DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

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FIGURE 6-5

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0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

MAXIMUM INCREMENTAL DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

SLR

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FIGURE 6-6

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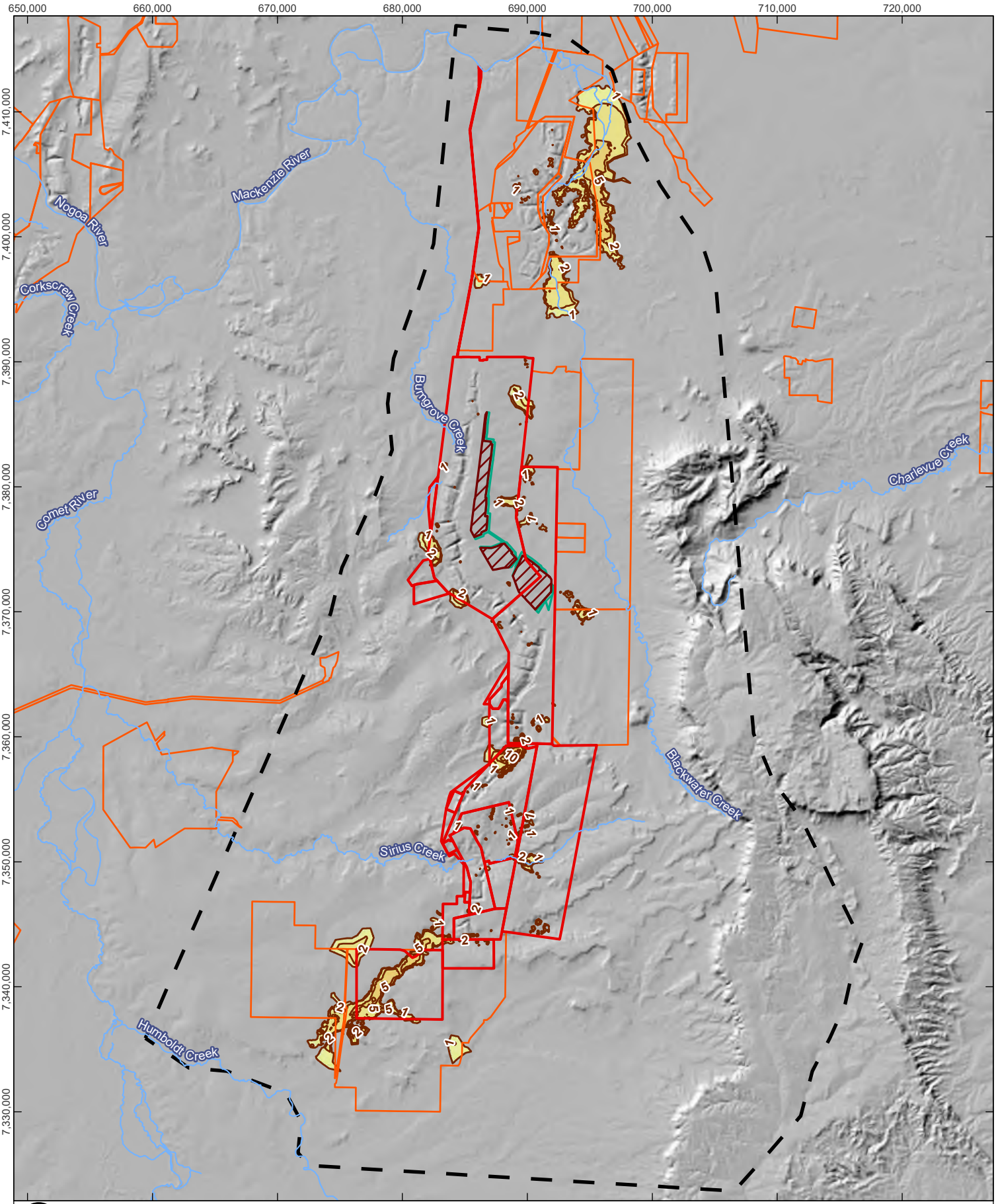
6.6.2.2 Maximum Cumulative Drawdowns

Maximum cumulative drawdown predicted impacts are shown in **Figure 6-7** to **Figure 6-11**. These drawdowns represent the total impact of mining by all current mining and foreseeable mining, including the Project. The cumulative drawdown is derived by calculating the maximum difference in the groundwater levels for the Cumulative scenario with those in a theoretical “No Mining” or Null Run scenario, for all times during the predictive model period.

Cumulative drawdown impacts for the Alluvium and Tertiary (**Figure 6-7**) show that maximum predicted cumulative drawdown impacts are in the north near Blackwater Creek. Cumulative impacts within the weathered zone (**Figure 6-8**) can be seen connecting to the drawdown in the Tertiary.

Figure 6-9 and **Figure 6-14** show the maximum predicted cumulative drawdown in the Aries and Pollux seams in the Rangal Coal Measures. As shown in the figures the maximum cumulative drawdown is bounded on the western side by the coal seam outcrop and predicted to extend generally a distance of 5-7 km east of the mining areas. The cumulative drawdown reached the model boundary in the northeast, which coincides with a major fault (Shotover Fault). An extension of the model in that area would still result in the same drawdown, as the fault is expected to act as a barrier to flow.

Figure 6-11 shows the maximum predicted cumulative drawdown in the Burngrove Formation. The maximum cumulative drawdown for Burngrove is similar to the drawdowns expected in the Permian coal measures and predicted to extend approximately 5-7 km east of the mining areas.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

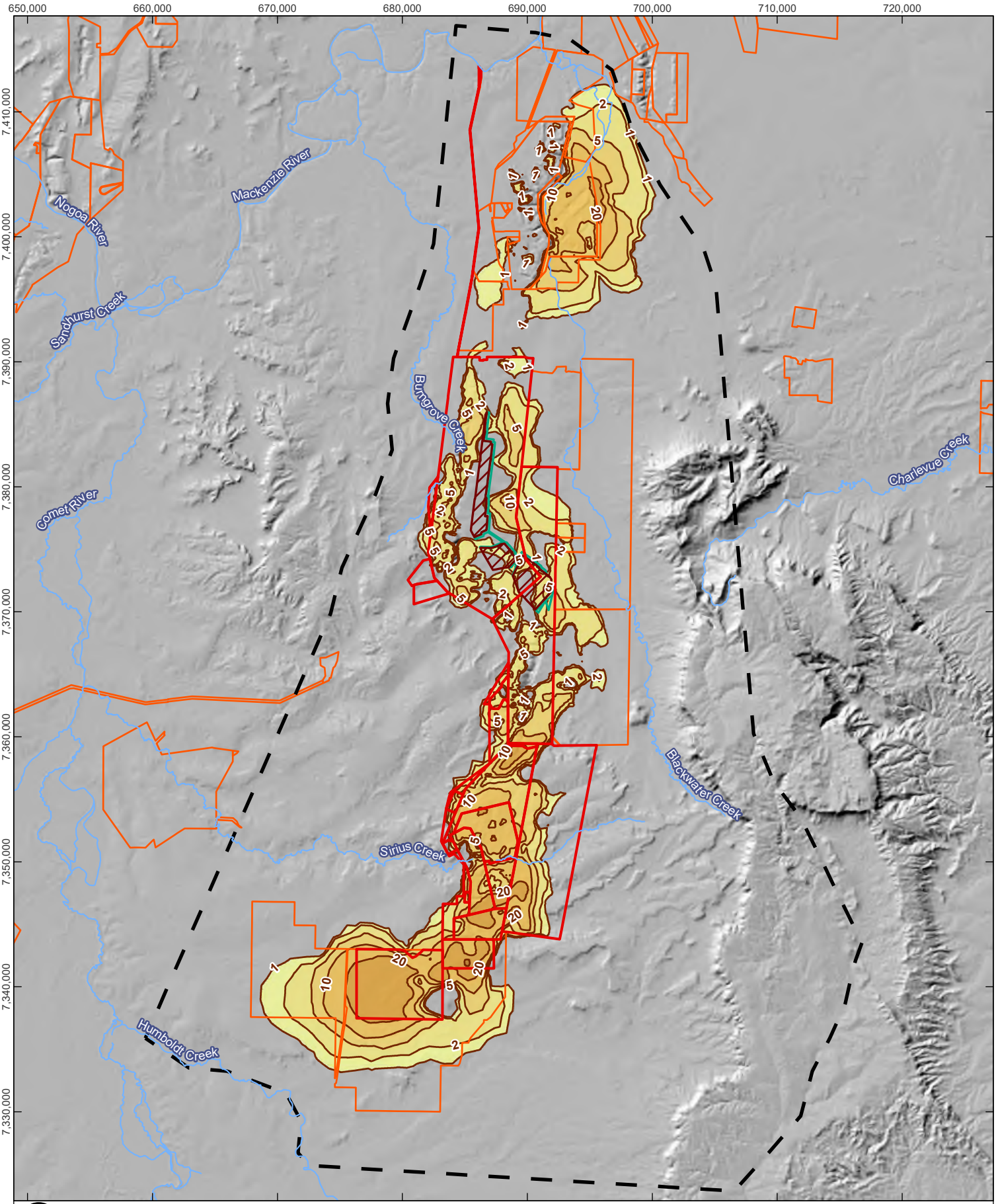
MAXIMUM CUMULATIVE DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

SLR

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FIGURE 6-7

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0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
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Drawn by:	AS

LEGEND

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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

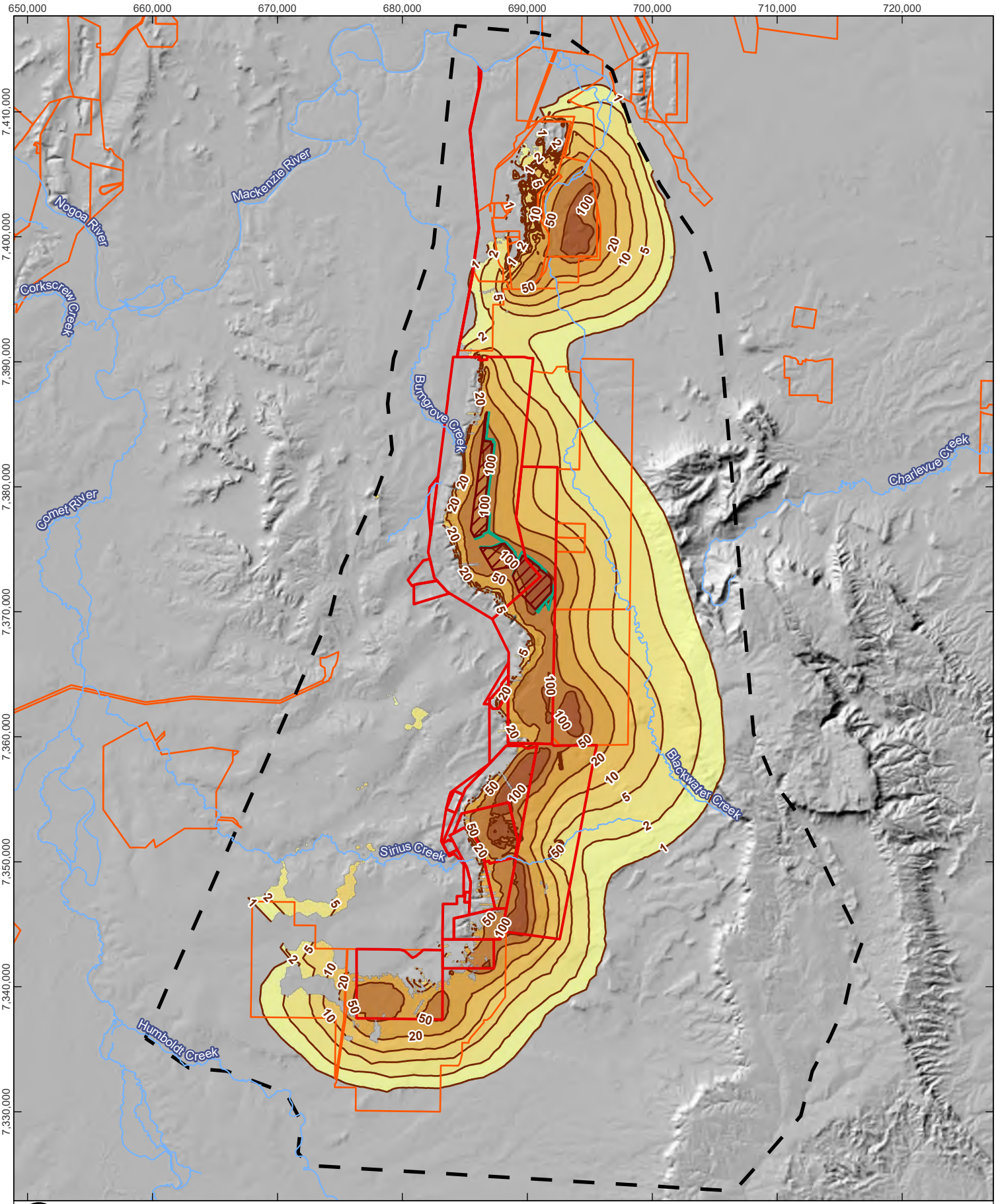
MAXIMUM CUMULATIVE DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

SLR

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FIGURE 6-8

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0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
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- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

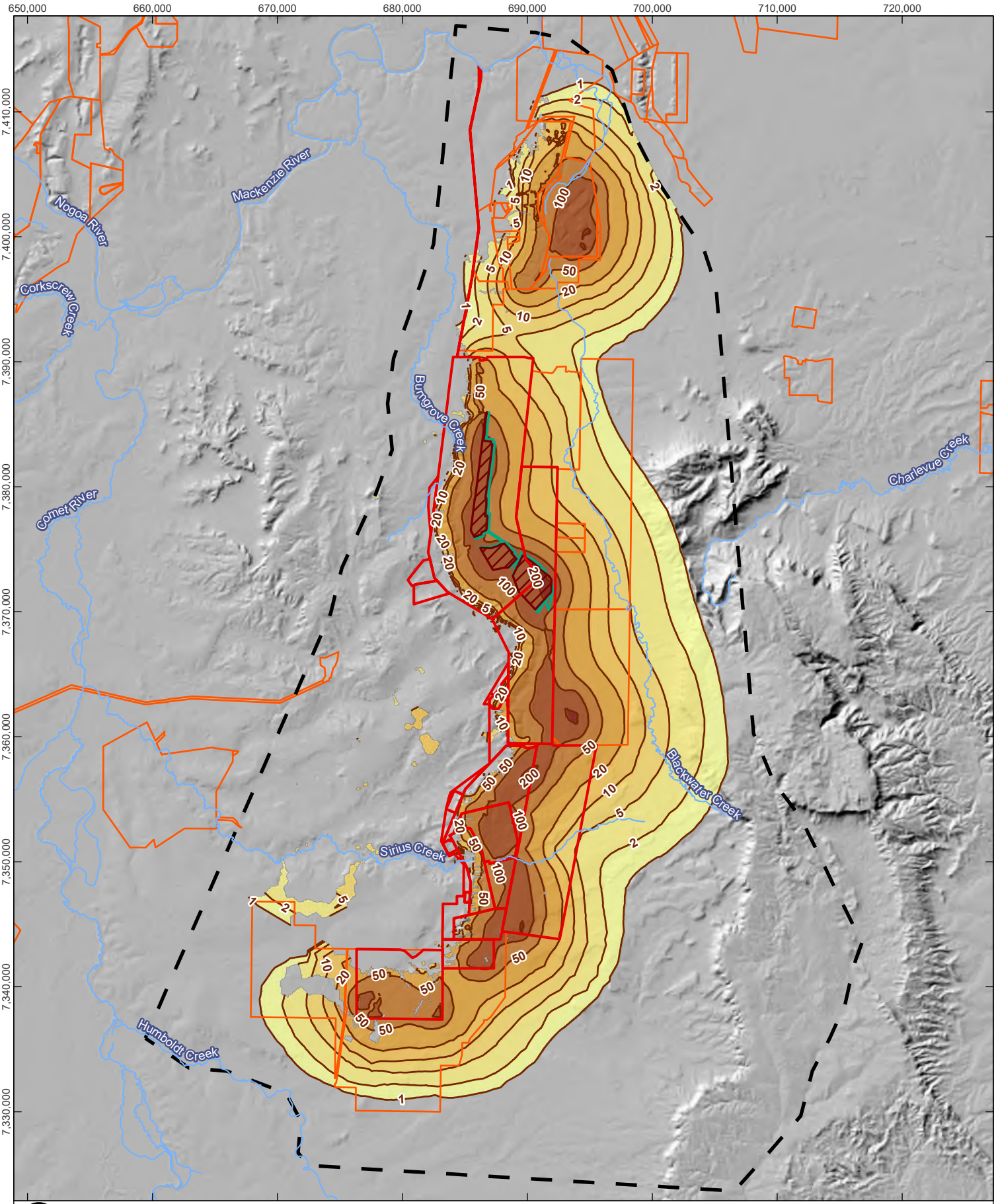
MAXIMUM CUMULATIVE DRAWDOWN IN THE ARIES SEAM (LAYER 8)

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FIGURE 6-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_09_Maximum Cumulative Drawdown in the Aries Seam (Layer 8)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
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BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

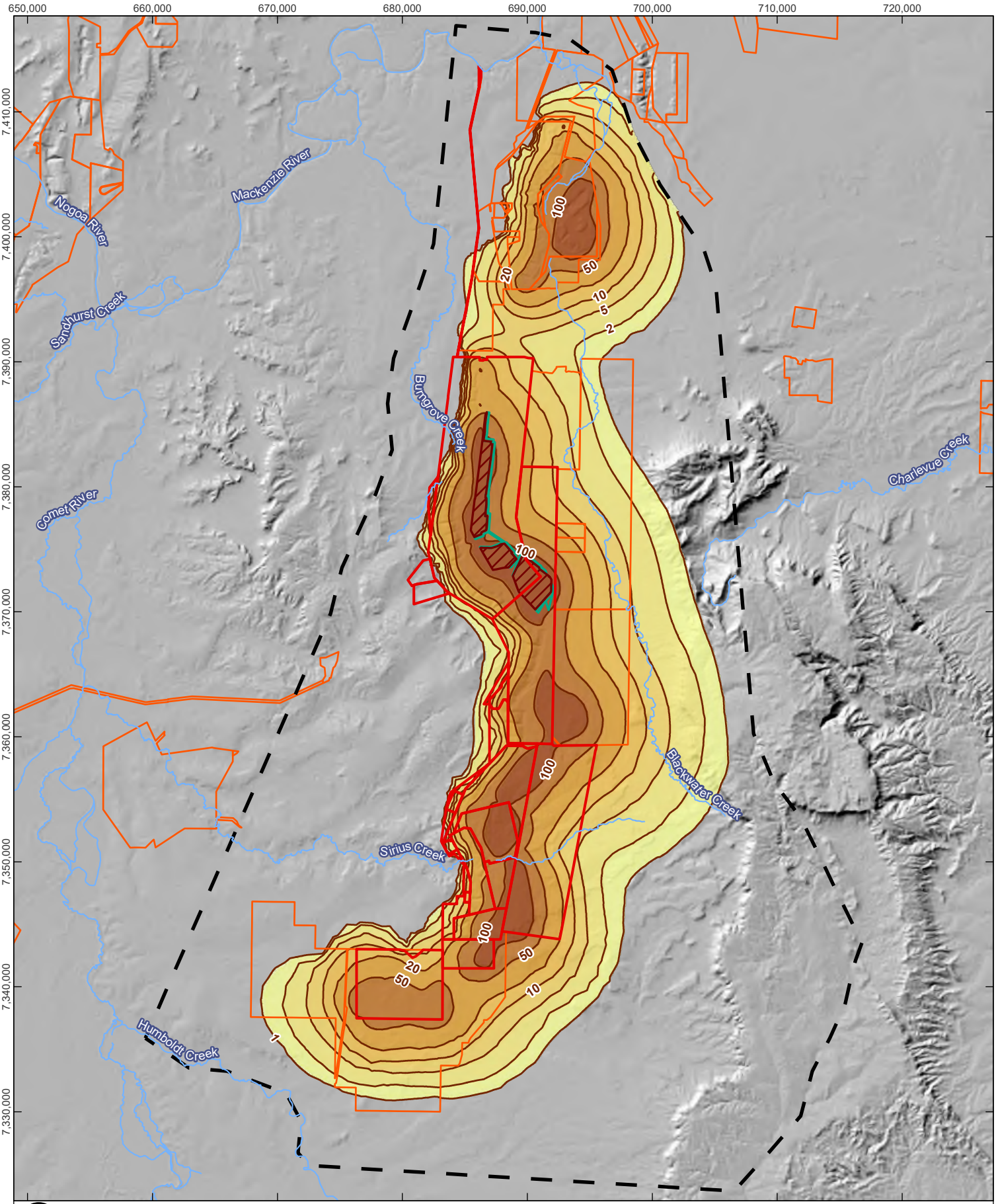
MAXIMUM CUMULATIVE DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

SLR

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FIGURE 6-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_10_Maximum Cumulative Drawdown in the Pollux Seam (Layer 12)



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	02-Mar-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

MAXIMUM CUMULATIVE DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

SLR

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FIGURE 6-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F06_11_Maximum Cumulative Drawdown in the Burngrove Formation (Layer 16)

6.6.3 Incidental Water Impact

6.6.3.1 Influence on Alluvium

The change in alluvial water resources was estimated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model. Interference of the alluvial groundwater can occur due to reduced upward leakage from Permian Coal Measures that are depressurised because of mining activities. Over the extent of Quaternary alluvium of Blackwater Creek, there is a maximum flow reduction of 0.5 ML/day from the underlying formation into alluvium as a result of the Project. This reduction represents a regional-scale response, as no specific areas of alluvium are predicted to experience drawdown greater than 1 m.

6.6.3.2 Influence on Blackwater Creek

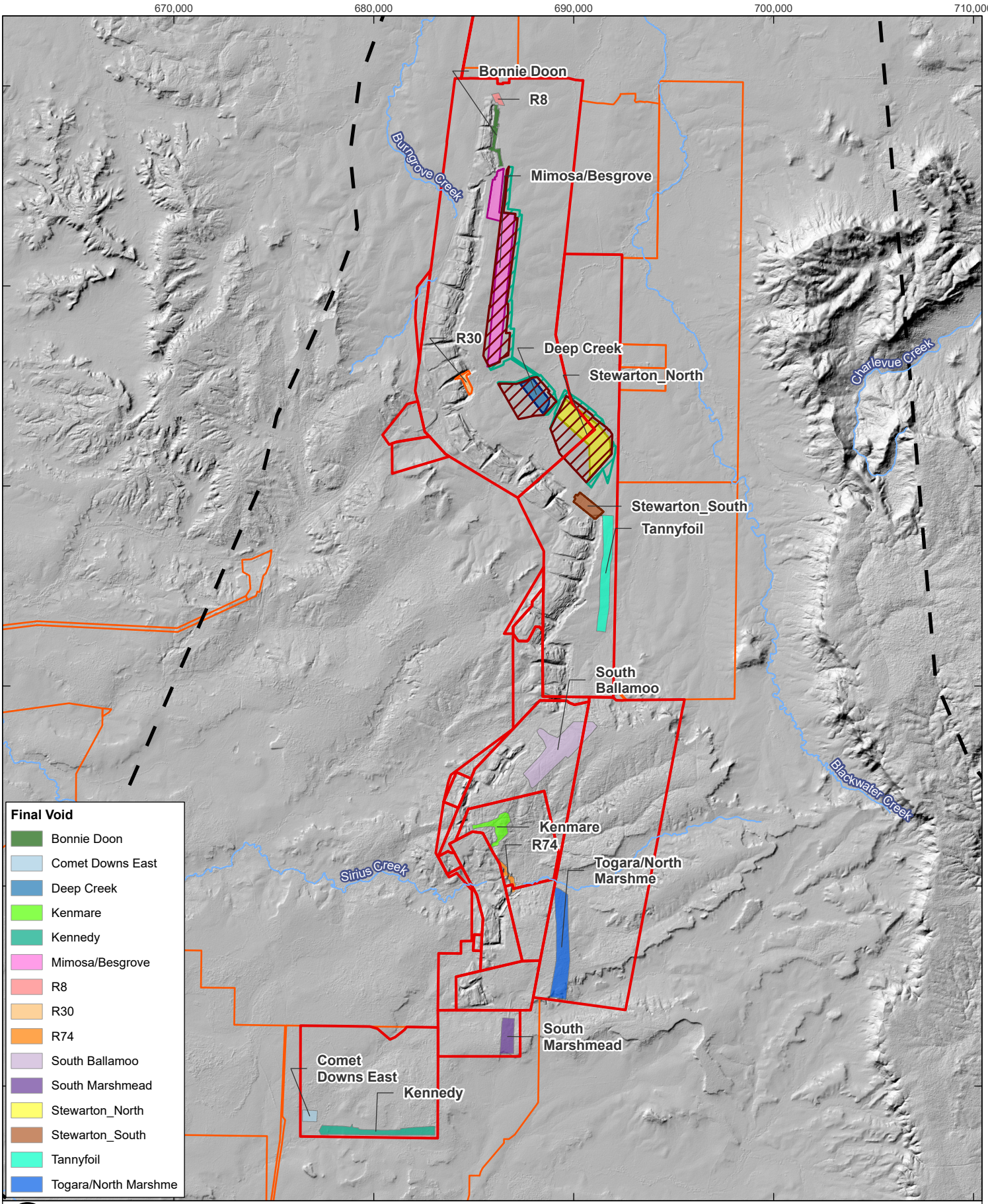
The net groundwater flow to Blackwater Creek is very close in all three scenarios (0.02 ML/day with rounding). All scenarios indicate the flow is generally from groundwater to the Creek, however this flow is very minor (and shows that Blackwater Creek does not receive continuous amounts of baseflow).

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario. This calculation showed that over the life of mine, the maximum change of groundwater flow to Blackwater Creek is negligible (~0.001 KL/d), or 0.005% reduction to the 0.02 ML/day of net groundwater flow to Blackwater Creek.

6.7 Post-mining Predictions

6.7.1 Model set up

The potential post mining impacts of the Project were investigated through a post mining period, commencing at the end of mining at the Project and extending for 1,947 years until the model reached equilibrium. A transient model was created to ascertain post-mining void inflows, with all predictive model drain cells (representing mining) removed. At the end of mining at the Project, the properties of the final void cells were converted to values representative of a void. The void cells were assigned high horizontal and vertical hydraulic conductivities (1,000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m^{-1}), to simulate free water movement within the final void. This approach is often referred to as a ‘high-K’ lake. The indicative location of the 15 final voids (with five voids in the vicinity of the Project) is provided in **Figure 6-12**.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

INDICATIVE FINAL VOID LOCATIONS

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FIGURE 6-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_01_Indicative Final Void Locations

The recovery model was run transiently with no direct recharge and evaporation onto the open void areas. From this model run, the groundwater inflows to the final voids were incorporated in the site water balance model for the Project's Surface Water Assessment prepared by WRM (2026).

A transient pit lake recovery level time series predicted by the surface water balance modelling was then incorporated into the final groundwater model recovery run. The recovery curves in the five void areas (in the vicinity of the Project) derived from the surface water modelling were integrated into the numerical groundwater model using the time variant constant head boundary condition (CHD).

6.7.2 Long-term Water Levels

Figure 6-13 shows the predicted surface water level at each of the five voids in the vicinity of the Project, used as the CHD for the groundwater model. As shown in the figure, the equilibrated final void water levels are 104.6 mAHD, 74.1 mAHD, 138.7 mAHD, 143.5 mAHD and 83.8 for the Stewarton South, Stewarton North, Deep Creek, R30 and Mimosa/Besgrove voids respectively.

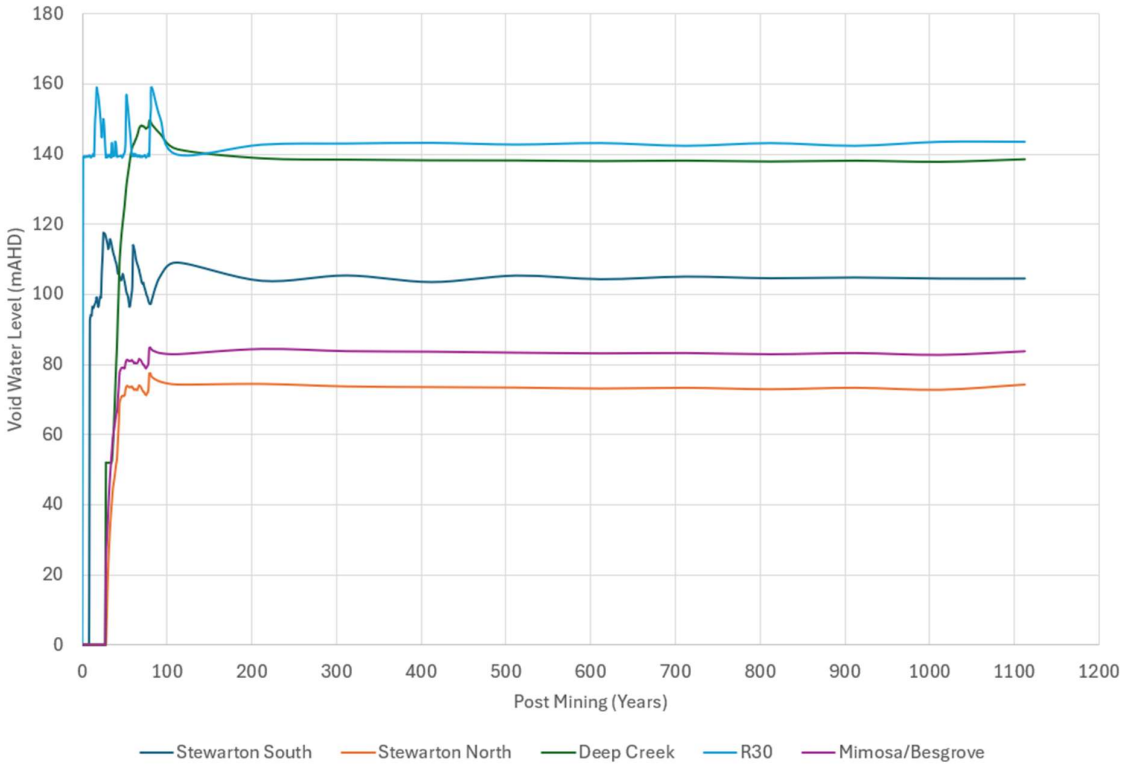


Figure 6-13 Predicted final void water level recovery in the vicinity of the project over time

The equilibrated final void water levels are listed in **Table 6-4**. **Table 6-4** also lists the recovered water table to the east of the pits, at a distance of approximately 250 m. The head difference between the groundwater and the pit lake ranges between -21.88 m and 55.89 m for all pits.

Table 6-4 Final Voids – Equilibrium Water Levels and Groundwater Levels (From North to South)

Component	Equilibrium Void Water Level (mAHD)	Groundwater level (mAHD)[1]	Head difference (m)[2]
R8	144.98	150.56	5.58
Bonnie Doon	159.11	156.79	-2.32
Mimosa/Besgrove	83.8	131.1	47.3
R30	143.46	123.83	-19.63
Deep Creek	138.67	138.84	0.17
Stewarton North	74.31	108.19	33.88
Stewarton South	104.63	143.08	38.45
Tannyfoil	143.17	176.17	33
South Ballamoo	140.27	158.59	18.32
Kenmare	215.48	193.6	-21.88
R74	234.19	244.34	10.15
Togara/North Marshmead	163.86	219.75	55.89
South Marshmead	170.09	181.13	11.04
Comet Downs East	189.24	188.68	-0.56
Kennedy	160.8	173.06	12.26

Note: [1] Groundwater level extracted from the recovered water level map, read out approximately 250m away from each pit to the east. [2] A positive number indicates gradient towards the void, a negative number would indicate a gradient away from void.

6.7.3 Long-term Void Net Flows

Final void inflows are shown for all five voids in the vicinity of the Project from **Figure 6-14** to **Figure 6-18**. A positive flow value indicates a net inflow to the void while a negative value indicates a net outflow, from the void toward the local groundwater system. For each void, the net flux to the void is categorised based on its origin: Fluxes from spoil material to the void is shown as “Spoil to void”, while fluxes from the in-situ native rock to the void is show as “native rock to void”. As shown in the figures, final void Stewarton South and R30 show a constant negative net flux, indicating that water in the void primarily flow toward the local groundwater. The fate of these water fluxes is further discussed in **Section 6.7.4**.

The predicted final groundwater water levels are presented in **Figure 6-19**.

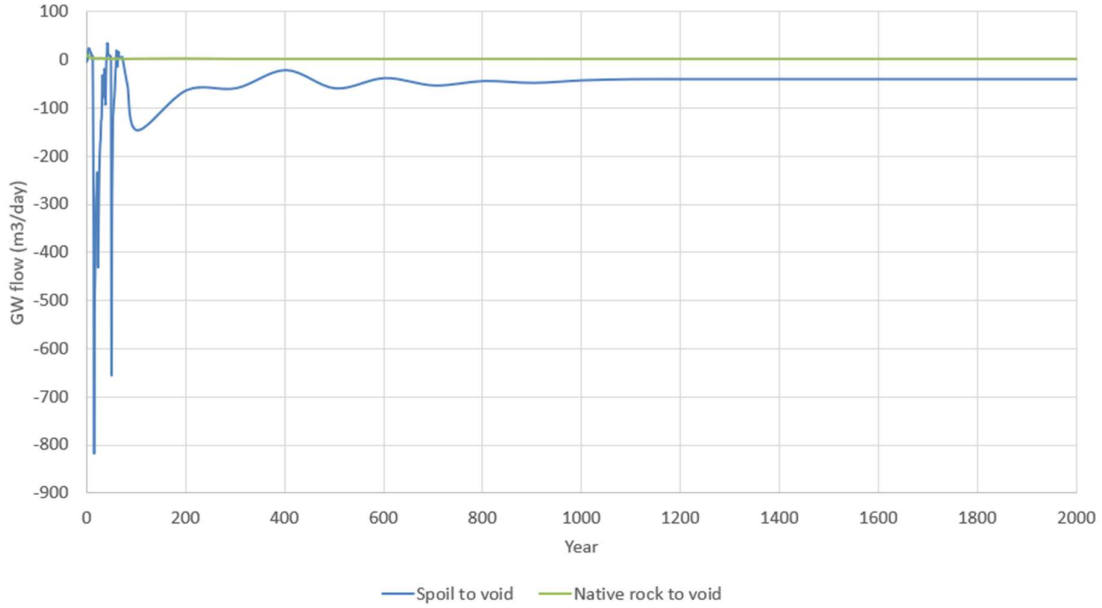


Figure 6-14 Post mining Groundwater inflows to Stewarton South

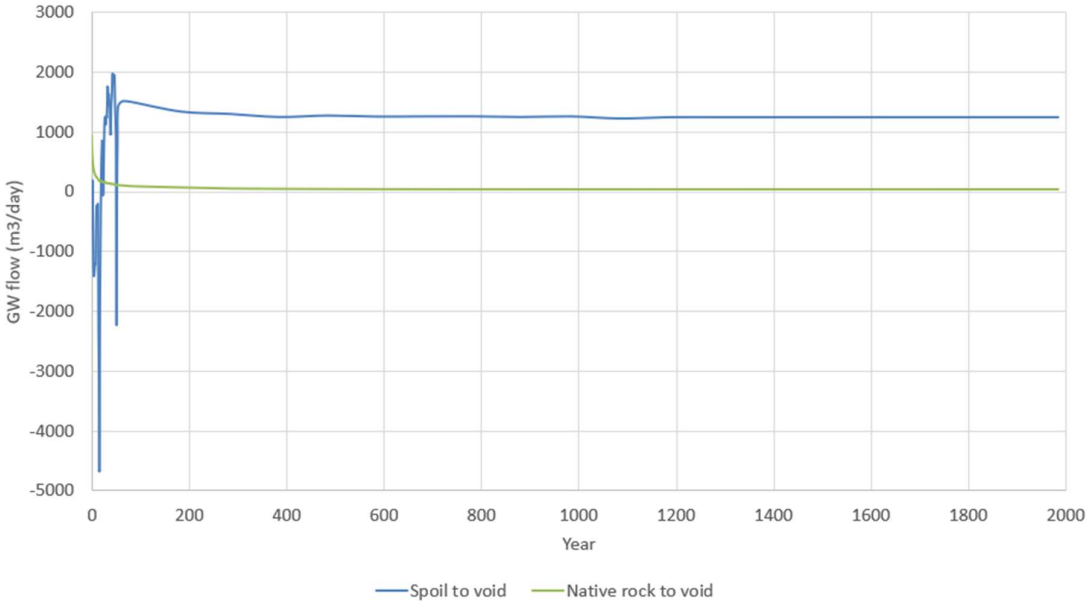


Figure 6-15 Post mining Groundwater inflows to Stewarton North

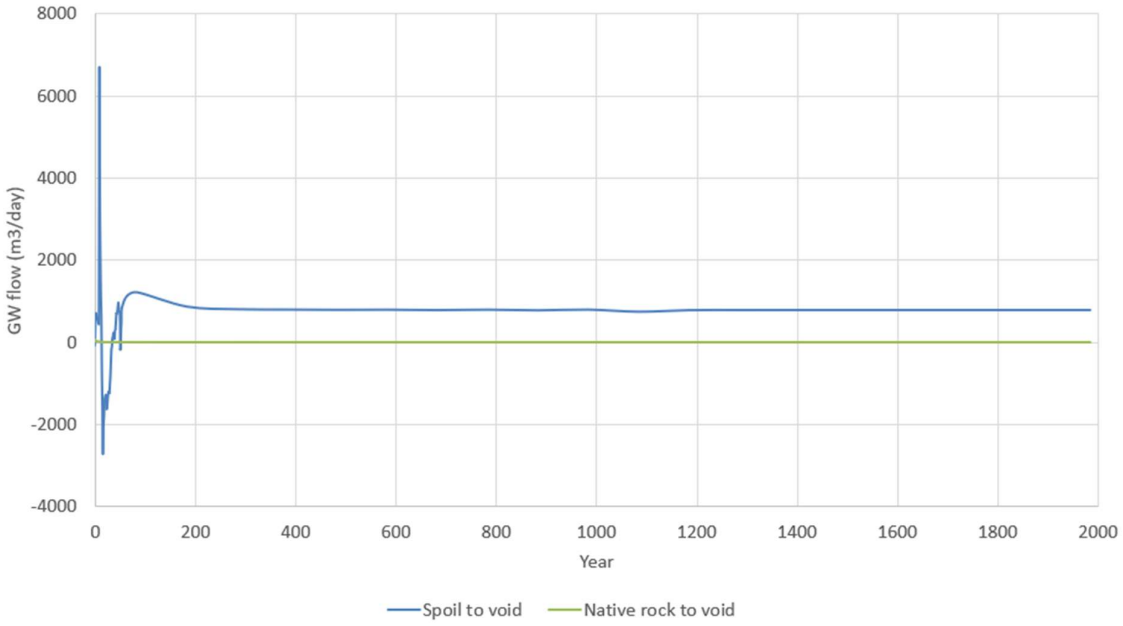


Figure 6-16 Post mining Groundwater inflows to Deep Creek

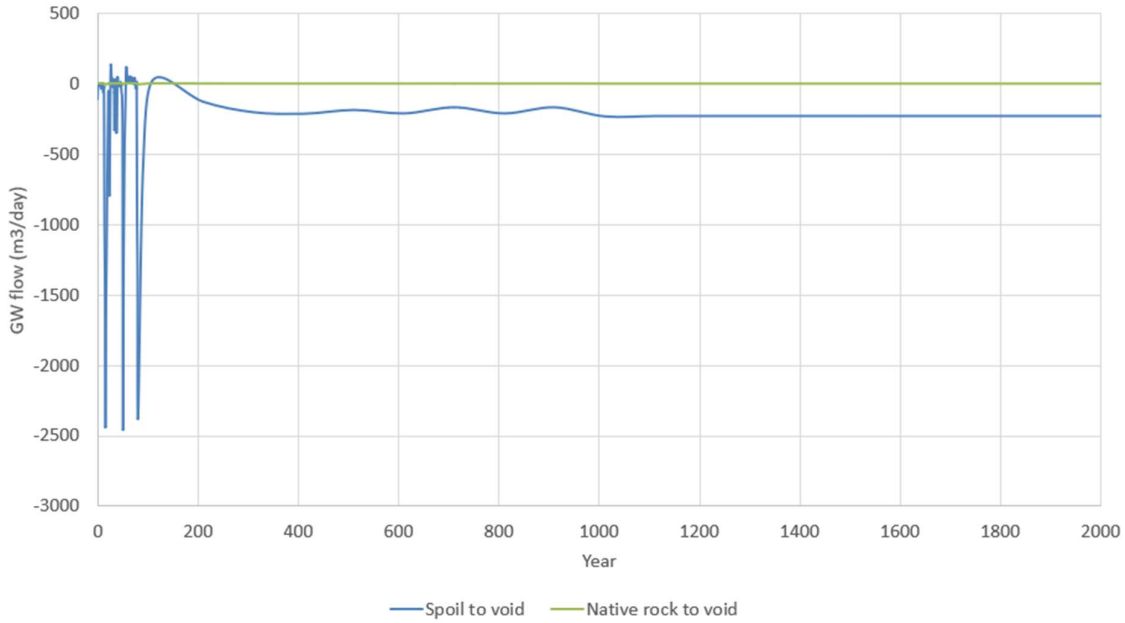


Figure 6-17 Post mining Groundwater inflows to R30

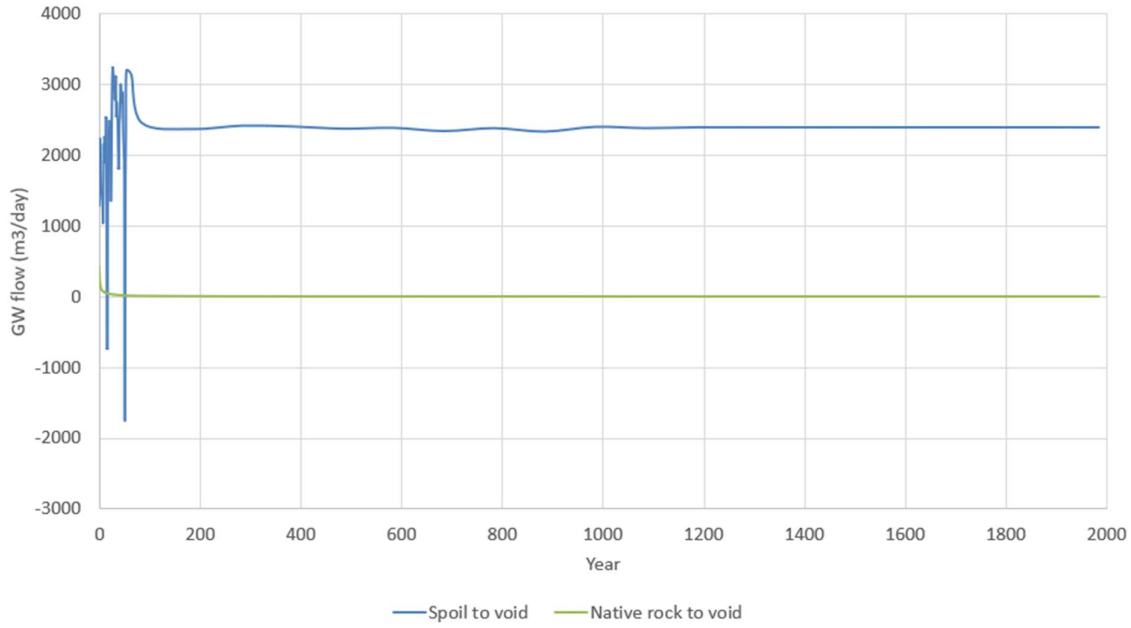
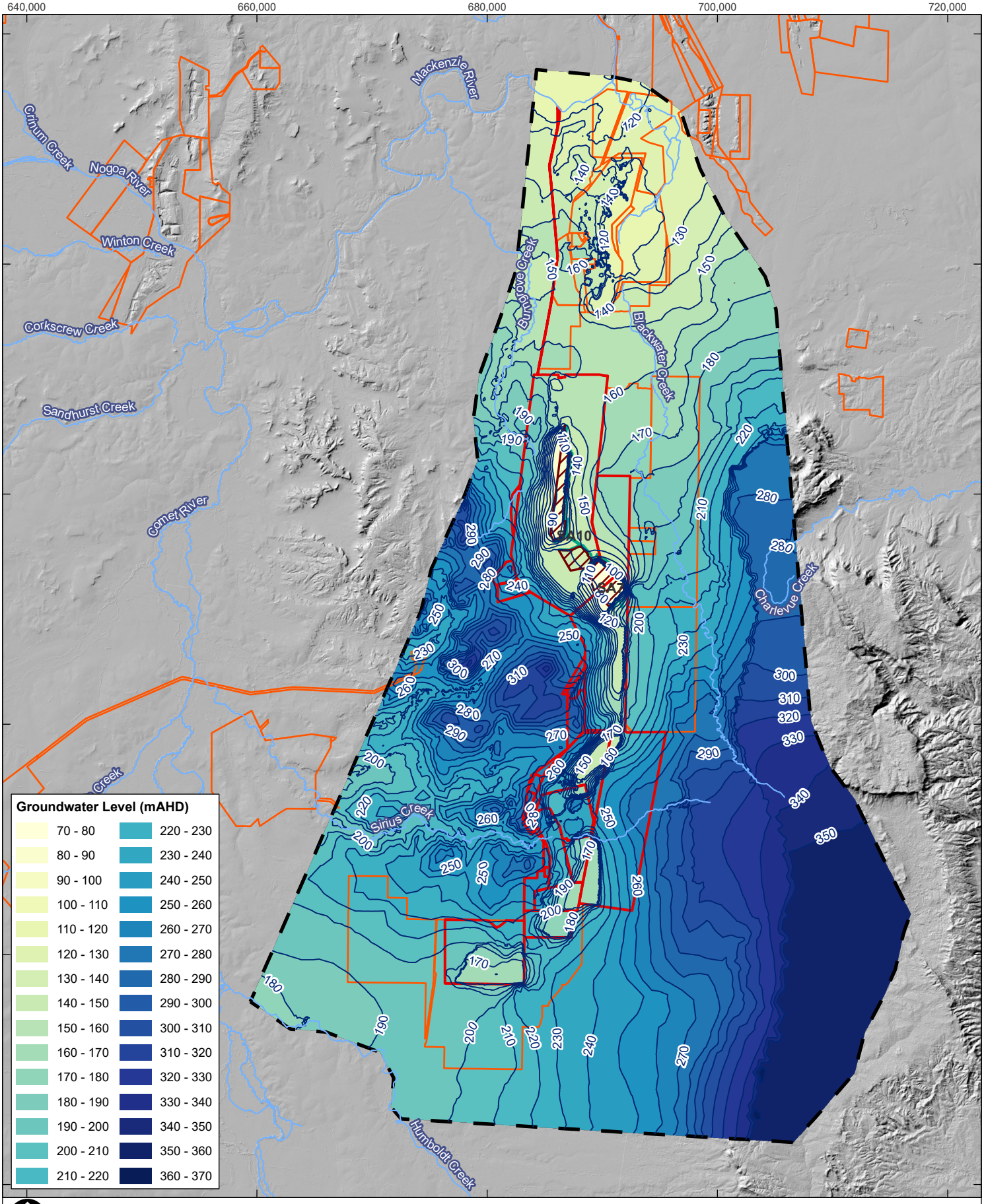


Figure 6-18 Post mining Groundwater inflows to Mimosa Besgrove


640,000
660,000
680,000
700,000
720,000
7,420,000
7,400,000
7,380,000
7,360,000
7,340,000
7,320,000
Mackenzie River
Crhum Creek
Nogoa River
Winton Creek
Corkscrew Creek
Sandhurst Creek
Comet River
Creek
Sirius Creek
Humboldt Creek
Burngrove Creek
Blackwater Creek
Charlevue Creek
Groundwater Level (mAHD)
70 - 80
80 - 90
90 - 100
100 - 110
110 - 120
120 - 130
130 - 140
140 - 150
150 - 160
160 - 170
170 - 180
180 - 190
190 - 200
200 - 210
210 - 220
220 - 230
230 - 240
240 - 250
250 - 260
260 - 270
270 - 280
280 - 290
290 - 300
300 - 310
310 - 320
320 - 330
330 - 340
340 - 350
350 - 360
360 - 370
0
5
10
km
LEGEND
Groundwater Level Contour (m)
Watercourse
BWM Mining Lease
Mining Lease
GIA Study Area
Proposed Open Cut Extension
Proposed Infrastructure Area
Coordinate System: GDA2020 MGA Zone 55
Scale: 1:433,846 at A4
Project Number: 640.031809.00001
Date Drawn: 16-Feb-2026
Drawn by: RB
BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT
GROUNDWATER TABLE RECOVERY
(POST-MINING)
SLR
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FIGURE 6-19
Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_08_Groundwater Table Recovery (post-mining)

6.7.4 Flow Path Simulation

An analysis of the water movement within the final landform was undertaken to simulate and assess the movement and fate of water particles through the groundwater system post-mining. A number of particles were placed on the final landform and within the residual voids in the recovery groundwater model and the mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2018) was used to simulate particle pathways along the groundwater flow field during recovery (i.e., 1,947 years). To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flow path lines.

The particles were placed on the final landform (Landform 4.1) and within the residual voids (**Figure 6-20**), at the surface of the model (with the exception of particles placed within the underground mine workings adjacent to Laleham). Particles placed at the surface of the model are automatically moved to the shallowest saturated layer at the commencement of the simulation. Mod-PATH3DU was configured to release the particles at the midpoint between the base of the first saturated layer and the water table. As shown on **Figure 6-20** for many of the particles this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the BWM Area at the commencement of the post-mining simulation. The particles placed in the underground mines were configured to begin their simulation in the Pollux seam (Layer 12) to simulate the fate of water beginning in the flooded underground workings after mine closure.

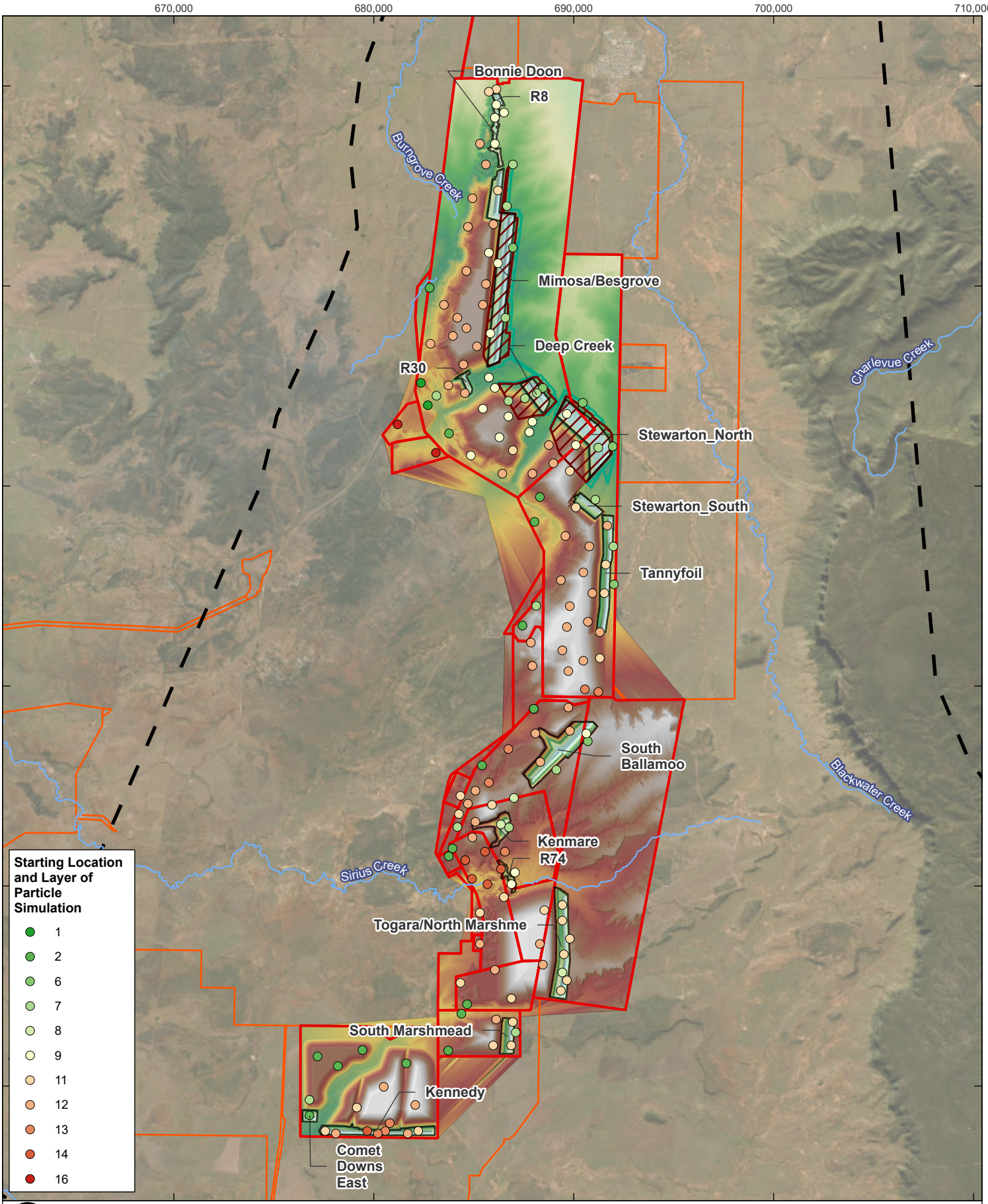
To estimate flow paths from the end of mining until post mining equilibrium, particles were released at the start of the post mining period (year 2093) and tracked until the end of the post mining simulation period (year 4040). **Figure 6-21** shows the predicted movement of water particles in the 1,947-year post mining simulation. The colours along the predicted particle flow paths provide the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallow to deep model layers.

The colour changes along the paths on **Figure 6-21** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures has been mined out) over the post-mining period. However, particles that begin in the Pollux seam (Layer 12) and other deeper layers often are observed to move upwards to shallower layers over the course of the recovery simulation, as the saturated water levels in the spoil and aquifers adjacent to the residual voids recover to their long-term post-mining equilibrium state. The flow path analysis indicates the particles generally move toward the void lakes, with the majority of the particles captured in the voids.

As discussed in **Section 6.7**, in the vicinity of the Project, both Stewarton South and Ramp 30 voids are showing a negative net inflow. However, particle tracking indicates that fluxes from these voids do not flow to the regional groundwater and instead flow toward neighbouring voids. As shown on **Figure 6-21**:

- Particles released into Stewarton South are captured by Stewarton North; and
- Particles released into Ramp 30 are captured by Mimosa/Besgrove.

As shown on **Figure 6-21**, no particles are predicted to permanently remain outside of the mine lease in the post mining simulation.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- GIA Study Area
- Void Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Final Landform Elevation (mAHD)

450

-5

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

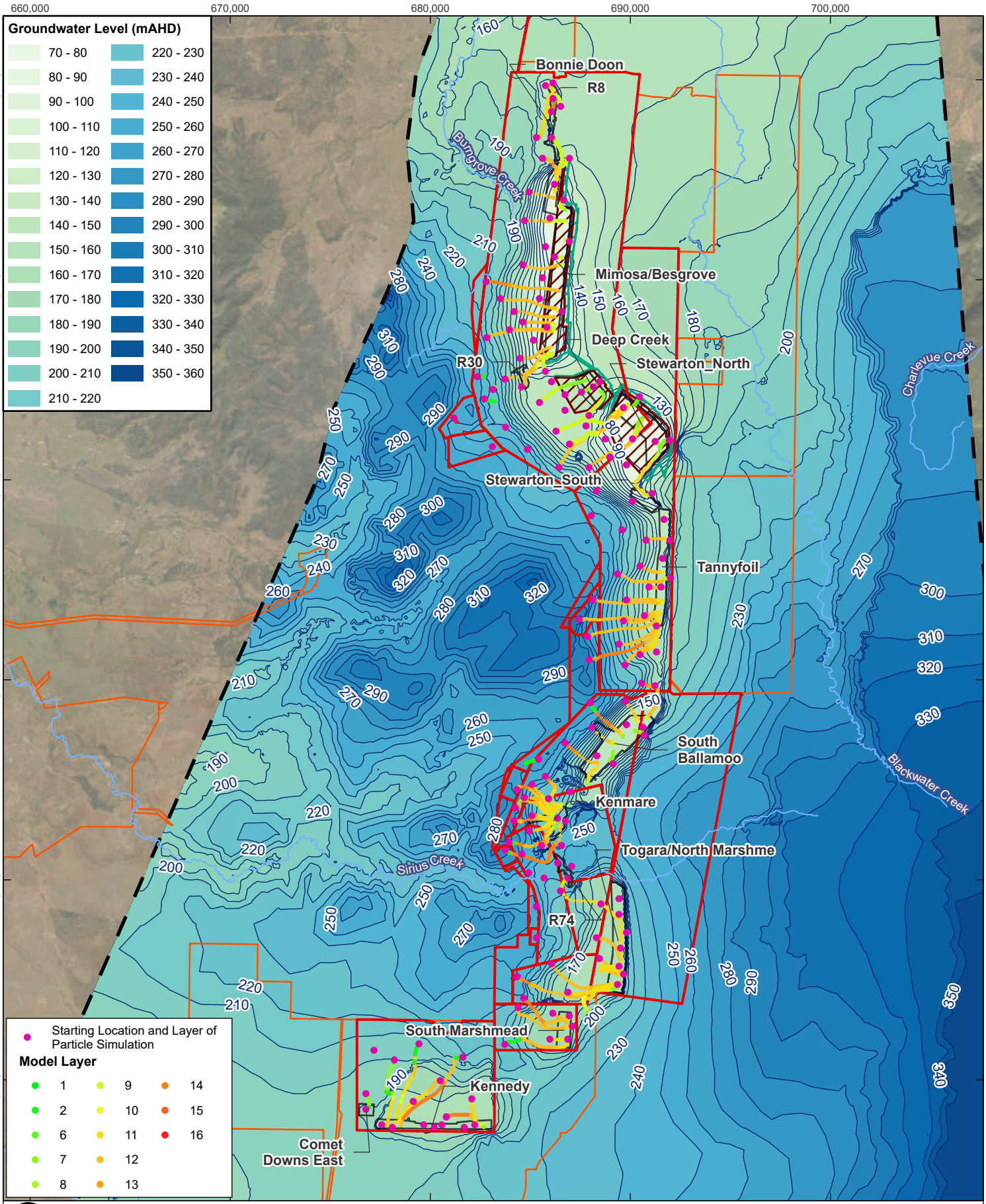
STARTING LOCATION OF PARTICLES

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FIGURE 6-20

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_09_Particle Starting Location



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	17-Feb-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER ASSESSMENT

PREDICTED MOVEMENT OF PARTICLES – POST MINING (2093 – 4040)

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FIGURE 6-21

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_10_Predicted Movement of Particles

6.7.5 Long-term Water Quality

As presented in the previous section, of the five voids near the Project Area, three are predicted to become long-term sinks, and the other two are predicted to be flow through systems reporting to those long-term sinks.

Water within the final voids would evaporate from the final void water body surface and draw in groundwater from the surrounding strata, the two flow-through voids and runoff from the final void catchment areas. As the final voids would act as a sink, evaporation from the final void water bodies would overtime concentrate salts in the final void water bodies. However, the gradual increase in salinity of the final void water bodies is unlikely to pose a risk to the surrounding groundwater regime, as the final voids would remain as a groundwater sink in perpetuity.

Notwithstanding, the Site Water Balance Assessment prepared by Hydrobalance (2026) for the Project has modelled the equilibrated water levels as well as the potential accumulation of salt in the final void. The salinity of Ramp 30 and Stewarton South fluctuates over time, with peak values of 5,000 µS/cm and 10,000 µS/cm, respectively, over the 1,000-year simulation. In contrast, salinity at Deep Creek, Stewarton North and Mimosa/Besgrove increases over time, reaching approximately 180,000 µS/cm, 195,000 µS/cm and 250,000 µS/cm, respectively, over the same period.

6.8 Sensitivity Analysis

As part of this assessment, a calibration sensitivity, calibration identifiability and prediction identifiability were undertaken. The sensitivity analysis suggest that most parameters in the model are adequately constrained by the calibration process. It also highlighted several parameters that contribute to predictive uncertainty and that are likely to be poorly conditioned by the calibration process (Type IV parameters). Details are presented in **Appendix B** (Groundwater Modelling Technical Report).

6.9 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis.

A total of 75 calibrated realisations were selected from the last iteration and regarded as sufficient. The predictions included in the uncertainty analysis were:

- Maximum drawdown.
- Predicted open cut mine inflow.
- Alluvium water take.
- Change in river baseflow.

SLR conducted statistical analyses of predictive results to assess if additional realisations were likely to provide results that would significantly change reported results. SLR calculated the 95 percent confidence interval for the predictive results. It was found that additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions. This conclusion is drawn based upon the combination of two factors:

1 The rate of change per additional realisation is small.

2 The magnitudes of the confidence interval are small and well below reasonable expectation of the predictive ability of a numerical model.

The full summary of uncertainty analysis findings can be found in Section 7, of the Appendix B report.

7.0 Potential Impacts on Groundwater Resources

7.1 Highlands Groundwater Management Area

The Project does not directly intercept groundwater from Highlands Groundwater Unit 1 (Quaternary alluvium) under the Water Plan (Fitzroy Basin) 2011, meaning, all direct groundwater taken by the open cut pits for the Project is from Highlands Groundwater Unit 2 (sub-artesian aquifers).

The predicted groundwater take (i.e., inflow into the pits directly associated with mining) over time is presented in **Section 6.6.1**. The licensable take has been derived and indicates that the cumulative groundwater take would remain between 2,290 ML/year and 10,790ML/year between year 2025 and 2055, with inflows then decreasing after 2056 until end of mining. The average cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day).

7.2 Potential Impacts on Groundwater Users

7.2.1 Private Supply Bores

Chapter 3 of the Water Act 2000 provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers, to aid in the assessment of impacts to third party bore users. These criteria have been adopted for the assessment herein.

The impact assessment evaluated the drawdown at the two landholder bores identified within a 5 km radius of the Project area. **Table 7-1** lists the bores, location, assumed screened formation and use. The last two columns present the maximum incremental and cumulative drawdown predicted to occur at each location for the model base case.

There are no predicted incremental or cumulative drawdowns at any of the identified bores that exceed the Water Act bore trigger thresholds as a result of the Project. As shown in **Table 7-1** incremental drawdown from the Project is not predicted at either bore. A maximum cumulative drawdown of 1 m is predicted at RN207592, while none is predicted at the other bore.

Table 7-1 Drawdown Impact on Landholder Bores (Base Case Scenario)

Registered RN (ID)	Easting[1]	Northing[1]	Assumed Formation	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
207592	685877	7368329	Permian	36	Stock	0.0	1.0
Unregistered 10	681315	7380737	Permian	49	Not in use	0.0	0.0

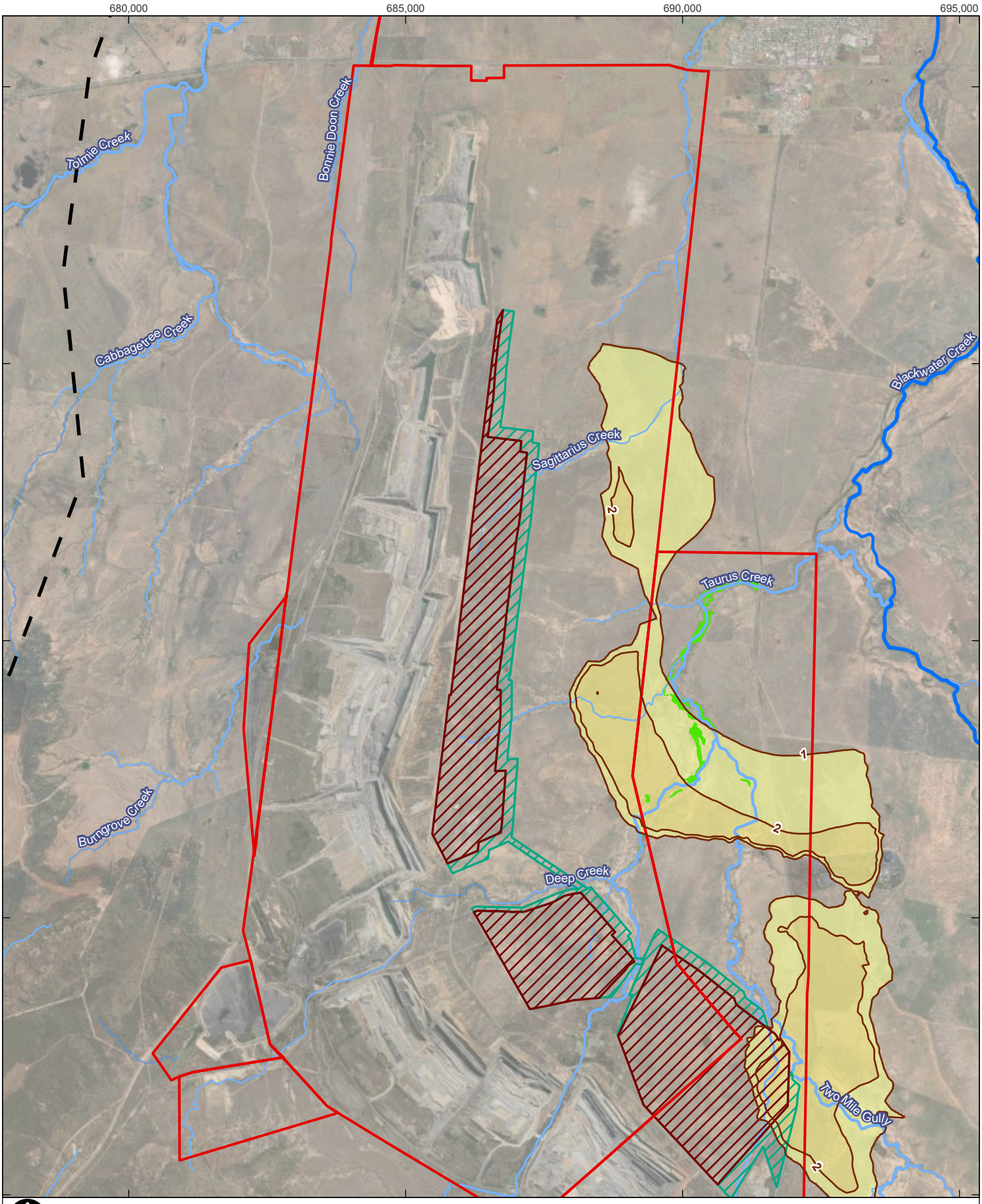
1 GDA 94 z55

7.2.2 Groundwater Dependent Ecosystems

The presence of potential GDEs is described in detail in **Section 5.5.1**. The mapped GDEs from the most recent and comprehensive study has been utilised for this assessment (DPM Envirosciences, 2026). In summary, the ground-truthing works indicated that only the riparian terrestrial vegetation associated with Taurus Creek (a tributary of Blackwater Creek) on the eastern margin of the Project Area and a very small area along Sagittarius Creek to the north of the Project Area may represent a TGDE.

The predicted incremental drawdown in the shallow layers, Layers 1 and 2, are shown on **Figure 6-2** and **Figure 6-3**, respectively. There is no mapped incremental drawdown in Layer 1, representing the Alluvium and Tertiary in the BWM North region. The minor incremental drawdown predicted in Layer 2, the alluvium and weathered zone, has been overlain on the potential GDEs mapped in BWM North, and is shown in **Figure 7-1**.

There is some expected drawdown to occur in Layer 2, beneath a small area of the mapped GDEs. The maximum predicted drawdown is 2 meters, and given its limited extent, the overall impact to the potential GDE is expected to be minimal (and within likely natural fluctuations the vegetative species could adapt to).



LEGEND

- Major Watercourse
- Minor Watercourse
- Potential GDE
- BWM Mining Lease
- GIA Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- 200 - 300

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:90,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER ASSESSMENT

POTENTIAL GDES (BWM NORTH) AND PREDICTED INCREMENTAL DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

SLR

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FIGURE 7-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_F07_01_Potential GDEs (BWM North) and predicted inc dd in the alluvium and Weathered Zone (Layer 2)

7.3 Potential Impacts on Surface Drainage

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario. This calculation showed that over the life of mine, the maximum incremental change of groundwater flow to Blackwater Creek is negligible (~0.001 KL/d), or 0.005% reduction to the 0.02 ML/day of net groundwater flow to Blackwater Creek. Given the Blackwater Creek is highly ephemeral, the alluvium is not contributing large amounts of water and this reduction due to the Project is deemed insignificant.

7.4 Potential Impacts on Groundwater Quality

This section describes the potential sources and pathways of groundwater contamination associated with the Project.

7.4.1 In Pit Waste Rock Emplacement Areas

The Project would involve progressively rehabilitating the site via backfilling the open cut pit, creating in-pit waste rock emplacement areas, as space becomes available. Over time, with groundwater recovery in the post-mining environment, these in pit waste rock emplacement area will assimilate with native rock groundwater levels.

7.4.2 Semi-permanent Tailings Cells

Semi-permanent tailing cells, located within the extent of the original pit development, would be utilised for disposal of fine rejects during operations. The use of these tailings cells would occur during operations, in which active dewatering would be occurring, consequently capturing any water seepage.

In the post closure environment, the pit lakes would remain as active sinks and would capture seepage, as confirmed by the particle tracking, indicating no flux out from the voids (see Section 6.7.4).

7.4.3 Final Void

There are five proposed final voids in the vicinity of the Project area to remain post-closure. The predicted final groundwater water levels are presented in **Figure 6-19**. As discussed in **Section 6.7**, in the vicinity of the Project, both Stewarton South and Ramp 30 voids are showing a negative net inflow. However as demonstrated in **Section 6.7.4**, any outwards flux is recaptured by the voids in the long-term post-mining due to the hydraulic gradient between adjacent voids.

7.4.4 Workshops and Storage

All workshop and fuel/chemical storage areas at BWM are developed in accordance with current Australian Standards. This includes refuelling areas and chemical storage areas designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, there is considered to be limited potential for groundwater contamination to occur with relation to workshops and fuel/chemical storage.

7.5 Climate Change

The climate impact was implicitly included during the Uncertainty Analysis (refer to Appendix B). The changes in recharge for the UA model runs are believed to represent



variable climatic conditions, including extreme conditions as well as expected climate change conditions.

The final void assessment conducted by Hydrobalance (2026), utilised climate data for projections selected according to the following climate sensitivity and climate change model composites:

- climate warming sensitivity assumed to fall in the medium category; and
- the representative future climate cluster was selected as HP, which represents a high level of global warming.

Under projected climatic conditions, the final void lakes will remain as sinks.

7.6 Key Receptor Risk Assessment

A risk assessment matrix has been developed to summarise the potential risks on key receptors arising from the Project's groundwater impacts discussed in the previous report sections. For each of the key groundwater related risks identified, the following were considered and recorded as part of the risk assessment:

- Brief description of the risk.
- Likely cause.
- Potential consequence.
- Potential likelihood.
- Risk rating and rank.

To undertake the risk assessment, it is useful to define (in a descriptive sense) the various levels of consequence of a particular event and the likelihood of such an event occurring. Descriptions of the categories that were used to rank the consequence and the likelihood of a risk are provided in **Table 7-2** and **Table 7-4** respectively.

The level of risk for each potential impact was determined by combining consequences defined in **Table 7-2** with likelihood as defined in **Table 7-3**. The numerical modelling uncertainty analysis discussed in SLR (2026) (Appendix B) allows quantification of the likelihood of a particular impact occurring. The resulting risk analysis matrix (combining consequence and likelihood) is presented in **Table 7-5**.

Table 7-2 Consequence Assessment

Rating		Description
5	Severe	Environmental damage or effect (permanent; >10 years)
4	High	Long term (2 to 10 years) impact
3	Moderate	Medium term (<2 years) impact
2	Low	Short term (<1 year) impact
1	Negligible	No lasting environmental damage or effect

Table 7-3 Likelihood Assessment

Likelihood	Probability	Basis of Rating
A	Highly Likely	Expected to occur
B	Likely	More likely to occur than not to occur
C	Possible	As likely to occur as not to occur
D	Unlikely	More likely to not occur than to occur
E	Highly Unlikely	Very unlikely to occur

Table 7-4 Risk Analysis Matrix

		Likelihood				
		E	D	C	B	A
Consequence	5	Insignificant	Low	High	High	High
	4	Insignificant	Low	Moderate	High	High
	3	Insignificant	Low	Moderate	Moderate	Moderate
	2	Insignificant	Low	Low	Low	Low
	1	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

Table 7-5 Risk Assessment

Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence (pre-mitigation)	Likelihood	Risk Rating
Third party bores.	Loss of supply (yield) from third party bores.	Drawdown of groundwater levels in the bore source aquifer.	Reduction in, or complete loss of, supply (yield) from third party bores.	High (4). Drawdown and therefore reduction or loss of bore yield may persist in the long term.	Highly Unlikely (E). Modelling results indicate no registered third-party water supply bores or unregistered (census) bores will be subject to incremental drawdowns exceeding the relevant *Water Act 2000* bore trigger threshold.	Insignificant
Third party bores.	Reduction in water quality at third party bores.	Release of contaminants (including salts) to the groundwater system from the Project that enter the bore source aquifer and migrate to the bore.	Bore water quality no longer suitable for the intended use.	High (4). Water quality change may persist in the long term.	Highly Unlikely (E). The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids. Therefore, there would be no mechanism for potential contaminants in groundwater to migrate to a third party bore.	Insignificant
Surface water systems.	Reduction in flow in surface water systems.	Drawdown of groundwater levels in the shallow groundwater system either reduces baseflow to the surface water system or increases leakage out of the surface water system.	Impact to environmental receptors reliant on flow in surface water systems.	High (4). Surface flow changes may persist in the long term.	Highly Unlikely (E). Modelling indicates the maximum change of groundwater flow to Blackwater Creek is negligible.	Insignificant
Surface water systems.	Reduction in water quality in	Release of contaminants (including salts) to	Surface water quality no longer suitable for	High (4). Water quality change may	Highly Unlikely (E).	Insignificant



Potential Receptor	Risk Description	Likely cause	Potential Impact	Consequence (pre-mitigation)	Likelihood	Risk Rating
	surface water systems.	the groundwater system from the Project that then enter the surface water systems.	environmental users.	persist in the long term.	The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids.	
TGDEs	Loss of groundwater availability to TGDEs.	Drawdown of groundwater levels in the perched groundwater system utilised by TGDEs.	Decline in health of TGDEs.	High (4). Drawdown resultant from the project may decrease water availability supporting TGDEs.	Highly Unlikely (E). Numerical modelling indicates negligible incremental drawdown in the alluvial/tertiary/weathered layers (layers 1 and 2).	Insignificant
TGDEs	Reduction in water quality used by TGDEs.	Release of contaminants (including salts) to the groundwater system from the Project that then enter the perched groundwater system utilised by TGDEs.	Decline in health of TGDEs.	High (4). Change is shallow groundwater on which TGDEs are dependent would impact health of receptor.	Highly Unlikely (E). The modelling indicates that in the vicinity of the Project any outwards flux would be recaptured by voids (not persistent in shallow groundwater systems).	Insignificant



8.0 Management and Mitigation Measures

8.1 Mitigation Measures

8.1.1 Mine Affected Water

The mine plan for the Project includes strategies to manage mine affected water for the life of the Project.

Groundwater inflows to the open cut pits during mining operations would be pumped out (along with any surface water) via in-pit sumps if the groundwater doesn't passively evaporate on the pit face or from the pit floor. The groundwater inflows would be collected and contained within the mine water management system.

Waste rock material would be emplaced in-pit as the space becomes available and will in some areas form the walls of the final voids. As outlined in **Section 6.7.4**, groundwater would not leave the mine lease permanently with the final voids anticipated to act as a groundwater sink, capturing water associated with in-pit rejects.

8.1.1.1 Semi-permanent Tailings Cells

Semi-permanent tailing cells, located within the extent of the original pit development, would be utilised for disposal of fine rejects during operations. The use of these tailings cells would occur during operations, in which active dewatering would be occurring, consequently capturing any water seepage. The existing on site water management processes (i.e capture of pit water) would manage any water captured in the pits.

In the post closure environment, the pit lakes would remain as active sinks and would capture seepage, as confirmed by the particle tracking, indicating no flux out from the voids (see **Section 6.7.4**).

8.1.2 Groundwater Users

The potential impacts on groundwater users (privately-owned bores) are described in **Section 7.2.1**. The incremental drawdown at privately-owned bores is not predicted to exceed relevant bore trigger thresholds in the Chapter 3 of the Water Act, and therefore there are no existing privately-owned bores that would be impacted by the Project to a degree that may require mitigation.

If risk was identified, mitigation measures by way of 'make-good' strategies would be implemented to manage any potential consequence (i.e. reduction in yield).

8.2 Groundwater Monitoring and Management Program

Table I1 under Schedule I, Condition I5, of the current EA (effective 6 March 2026) defined 21 bores at which groundwater must be monitored and the frequency, as reproduced here as Table 8-1.

Although not officially included in Table I1 of the EA, bores BWM_MB125_02, BWM_MB164_01, BWM_MB172_02 and BWM_MB168_01 are included in **Table 8-1** as they are currently monitored by Whitehaven as per conditions I17 and I18 of the EA:

- Condition I17 (Bores BWM_MB125_02 and BWM_MB164_01): *"Groundwater monitoring bores must be installed upgradient and downgradient of Red Dam by 31 December 2024 for inclusion in the groundwater monitoring bore network."*

- Condition I18 (Bores BWM_MB172_02 and BWM_MB168_01): “Groundwater monitoring bores must be installed upgradient and downgradient of the NCPP Tailings Dam by 30 June 2025 for inclusion in the groundwater monitoring bore network.”

Table 8-1 Groundwater Monitoring Locations and Frequencies (EA Table I1)

Monitoring Points	Easting[1]	Northing[1]	Monitoring Frequency
BWM_MB03_01	692223	7381510	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB12_01	687961	7356102	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB15_01	686794	7347807	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB17_01	684127	7343376	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB17_02	684119	7343373	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB21	684905	7350813	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM02A	690112	7390183	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB03_02	692220	7381519	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB02_01	691791	7362760	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB18	691528	7370782	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB14_01	683797	7350477	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB14_02	683798	7350466	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB1	686514	7387022	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM01P	690024	7390277	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM27P	689070	7376739	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB20BWM03P2	686490	7387289	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB02_02	691803	7362756	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
MB19BWM08P	691544	7370740	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB12_02	687969	7356097	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter



Monitoring Points	Easting[1]	Northing[1]	Monitoring Frequency
BG-1	684107	7387742	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BG-2	684414	7384622	Monthly until Final Contaminant Limits are reflected in EA, then Quarterly thereafter
BWM_MB125_02[2]	683948	7351517	N/A
BWM_MB164_01[3]	683816	7350493	N/A
BWM_MB172_02[4]	681183	7373429	N/A
BWM_MB168_01[5]	683281	7372735	N/A

[1] GDA2020 z55
[2] Bore upgradient of Red Dam (as per condition I17).
[3] Bore downgradient of Red Dam (as per condition I17).
[4] Bore upgradient of NCPP Tailings Dam (as per condition I18).
[5] Bore downgradient of NCPP Tailings Dam (as per condition I18).
N/A A monitoring frequency has not yet been designated for these bores.

The BWM monitoring network has an additional 122 monitoring bores installed, as detailed in Section 5.1.2. Whitehaven Coal is currently undertaking a full review of the network to establish a network suitable for long-term monitoring.

As part of the network review five new monitoring bores have been proposed in the BWM North region, as outlined in **Table 8-2**.

Table 8-2 Proposed additional monitoring bores in BWM North

Monitoring Points	Target Aquifer	Reason for Inclusion into the network
Drilling location 3	Aries Seam	The bore is located ~1.5 km east of Bonnie Doon TSF, replacement for current EA bores adjacent the highwall.
Drilling location 4	Aries Seam	The bore is located east of future mining.
Drilling location 5	Burngrove Formation	The bore is located between mining footprint and third-party water supply bores also installed into the Burngrove Formation.
Drilling location 7	First water[1]	Spatial coverage of shallow aquifer for EA purposes. Confirm depth to water table in areas identified as potentially hosting TGDEs.
Drilling location 8	First water[1]	Spatial coverage of shallow aquifer for EA purposes. Confirm depth to water table in areas identified as potentially hosting TGDEs.

[1] Bore to be installed at the depth where first groundwater is encountered during drilling

A Groundwater Monitoring and Management Program (GMMP) (WSP, 2024) exists for BWM. The purpose of the GMMP is to monitor the magnitude and distribution of actual changes to groundwater resources due to existing operations at BWM and to provide early detection of any unforeseen impacts to groundwater levels or groundwater quality. The GMMP reports the groundwater trigger levels (as per the EA) and defines the exceedance procedures, replicated here in **Figure 8-1**.



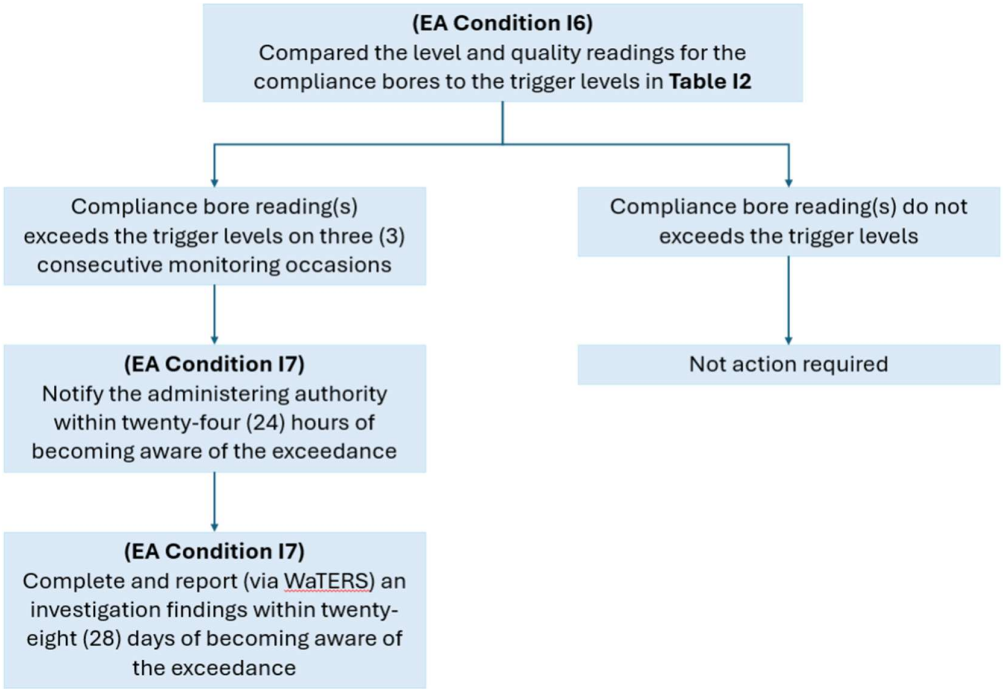


Figure 8-1 Exceedance procedure summary, as per conditions I6 and I7 of the EA (WSP, 2024)

The current GMMP "Whitehaven Coal Groundwater Monitoring and Management Program 2024" was reviewed by SLR (2025b) and is currently being updated.

During the life of the Project, data collected through the GMMP would be used to review and, if deemed necessary, update and refine the Project groundwater model and its impact predictions, to reflect the actual activities undertaken on site (e.g. mine development) and the results of regular groundwater monitoring.

9.0 References

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Appendix A- 80th Percentile Summary Statistics and Comparison to Guideline Values (BWM EA Bores)

Blackwater North Extension Project

Groundwater Impact Assessment

Whitehaven Blackwater Pty Ltd
SLR Project No.: 640.031809.00001

9 April 2026

Appendix A - 80th Percentile Summary Statistics and Comparison to Guideline Values

WQO Zone	Monitored Unit	Bore	pH (20th)	pH (80th)	TDS	EC	Ca	Cl	Na	Mg	SO4	Hardness as CaCO3	Alkalinity as CaCO3	HCO3	Nitrate as N	SiO2	Fluoride	Al (Diss)	Be (Diss)	B (Diss)	Cd (Diss)	Cr (Diss)	Co (Diss)	Cu (Diss)	Fe (Diss)	Pb (Diss)	Li (Diss)	Mn (Diss)	Hg (Diss)	Mo (Diss)	Ni (Diss)	Se (Diss)	Ag (Diss)	As (Diss)	U (Diss)	V (Diss)	Zn (Diss)
Units			-	-	mg/L	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Australian Drinking Water Guidelines (Aesthetic) (NHMRC, NRMMC, 2011)			6.5	8.5	600	-	-	250	180	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	1	0.3	-	-	0.1	-	-	-	-	-	-	-	3
Australian Drinking Water Guidelines (Health) (NHMRC, NRMMC, 2011)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	-	0.06	4	0.002	0.05	-	2	-	0.01	-	0.5	0.001	0.05	0.02	0.01	0.1	0.01	0.02	-	-
Aquatic Ecosystem (95% Protection) (ANZG, 2018)			6.5	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	0.055	-	-	0.0002	0.001	-	0.0014	-	0.0034	-	1.9	0.0006	-	0.011	0.005	0.05	0.024	-	-	0.008
Irrigation (Fitzroy Basin WQO)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	5	0.1	0.5	0.01	0.1	0.05	0.2	0.2	2	2.5	0.2	0.002	0.01	0.2	0.02	-	0.1	0.01	0.1	2
Stock (Fitzroy basin WQO)			-	-	5000	-	-	-	-	-	-	-	-	-	-	-	2	5	-	5	0.01	1	1	1	-	0.1	-	-	0.002	0.15	1	0.02	-	0.5	0.2	-	20
Zone 35 Shallow Groundwater (<30m)			7.59	7.93	-	1983	81	392	256	58	25	430	556	646	9.6	72	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zone 35 Deep Groundwater (>30m)			7.37	8.01	-	13604	366	5368	2555	226	122	1905	311	376	0.5	76	0.5	-	-	-	-	-	-	0.01	0.047	-	-	2.495	-	-	-	-	-	-	-	0.27
Zone 36 Shallow Groundwater (<30m)			7.7	8.35	-	7410	105	2373	1511	72	120	528	843	1021	7.5	60	0.39	-	-	-	-	-	-	-	0.02	-	-	0.07	-	-	-	-	-	-	-	-
Zone 36 Deep Groundwater (<30m)			8.21	8.66	-	7255	75	1945	1748	106	210	619	1322	1549	2.9	81	1.12	-	-	-	-	-	-	-	0.047	-	-	0.047	-	-	-	-	-	-	-	-
Zone 35 shallow	Alluvium	BWM_MB01_01	6.7	7.1	11400	21280	124.2	6005	3412	341	475		828.6	828.6	0.04		0.76	0.005	0.0005	2.04	0.0001	0.0005	0.0056	0.0016		0.0005	0.08	0.534	0.00005	0.004	0.005	0.005	0.0005	0.0014	0.0468	0.005	0.0536
Zone 35 shallow	Tertiary	BWM_MB15_01	3.1	3.2	3980	6354	14	1980	816	122	8		1	1	1.12		2.90	49.120	0.12	1.8	0.0004	0.012	0.06	0.063	0.184	0.011		0.2286	0.00005	0.0005	0.148	0.005	0.005	0.004	0.0070	0.005	0.195
Zone 35 shallow	Tertiary	BWM_MB17_02	7.2	7.3	363	570	8	60.8	118	6	10		194	194	0.01		0.7	0.011	0.00005	0.50	0.00005	0.0005	0.0005	0.0005	0.286	0.0005		0.144	0.00005	0.0024	0.006	0.005	0.005	0.002	0.0005	0.005	0.003
Zone 35 shallow	Tertiary	MB21	6.4	6.9	10300	14700	520.6	4806	2258	584	1944		573.6	574	0.01		0.20	0.010	0.0005	0.6	0.00005				3.056			0.3266	0.0001	0.001	0.004	0.01	0.001	0.002			0.017
Zone 36 shallow	Rewan Group	BWM_MB03_02	7.2	7.4		39140	1960	13000	6220	145	3							0.025		0.25					1.578			6.638	0.00025	0.0025	0.0214	0.025		0.0025			0.0241
Zone 36 shallow	Rewan Group	MB19BWM02A	6.2	6.4	29000	38000	1001.2	13500	7086	1064	511	6862	454	454	0.01	12.9	0.10	0.050	0.005	0.70	0.0005	0.005	0.005	0.031	0.368	0.005	0.14	0.103	0.00025	0.005	0.014	0.05	0.005	0.005	0.0025	0.050	0.2400
Zone 36 shallow	RCM north	BWM_MB02_01	6.668	6.7	18500	25080	608.6	8896	4076	607.4	372		346	346	0.01		0.05	0.005	0.0005	0.30	0.00005	0.0005	0.0005	0.0005	2.846	0.0005		0.597	0.00005	0.0005	0.0156	0.005	0.005	0.0025	0.0005	0.005	0.0156
Zone 36 deep	RCM north	MB1	6.55	6.8	26500	35800	756.8	12940	6886	704.4	372		368	368	0.01		0.05	0.050	0.0025	0.25	0.00025	0.0025	0.0025	0.0025	3.944	0.0025		0.144	0.0001	0.005	0.014	0.05	0.005	0.005	0.0025	0.025	0.0125
Zone 36 deep	RCM north	MB19BWM01P	6.992	9.8	16600	26000.6	243	9214	5800	138.4	7	1180	657	660	0.01	22.7	0.30	0.050	0.005	0.45	0.0004	0.004	0.004	0.005	1.548	0.004	1.21	0.121	0.0001	0.0336	0.005	0.035	0.0035	0.005	0.0013	0.050	0.072
Zone 36 deep	RCM north	MB19BWM27P	6.63	6.8	9348	14700.4	119	4440	3390	54	1	529	1896	1896	0.01	23.4	0.4	0.010	0.001	1.36	0.0002	0.001	0.007	0.0058	2.28	0.001	1.70	0.275	0.0001	0.004	0.013	0.01	0.001	0.0122	0.0005	0.010	1.292
Zone 36 deep	RCM north	MB20BWM03P2	6.89	7.0	12260	19820	167	6878	4276	104	3	957	584	584	0.01	20.8	0.4	0.005	0.0005	0.42	0.00005	0.0005	0.004	0.0164	1.288	0.0005	1.71	0.0968	0.00005	0.005	0.005	0.005	0.0005	0.0025	0.0020	0.005	0.3236
Zone 36 deep	RCM north	MB18	6.68	7.2	12160	17360	645.8	6370	2970	117	3		120	120	0.02		0.20	0.010	0.0005	0.48	0.00005	0.0005	0.0005	0.0005	2.558	0.0005		2.328	0.0001	0.001	0.009	0.01	0.001	0.001	0.007	0.0005	0.005	0.026
Zone 36 deep	RCM north	MB19BWM08P	7.446	7.6	3468	5411	33	1370	1216	6	2	109	788	799	0.01	17.8	0.50	0.010	0.001	1.56	0.0001	0.001	0.001	0.001	0.202	0.001	0.68	0.048	0.0001	0.003	0.003	0.01	0.001	0.001	0.0005	0.010	0.1216
Zone 36 deep	RCM north	BWM_MB02_02	8.08	9	10000	3420	8	715.6	704.4	6	4		17					0.008		1					0.06			0.011	0.00005	0.0268	0.0005	0.005	0.0005	0.002			0.0025
Zone 35 deep	RCM north	BWM_MB12_02	8.174	9.4		1952	14	423.8	405	6	25							0.009		0.20					0.062			0.003	0.00005	0.024	0.0005	0.005		0.004			0.0025
Zone 35 shallow	RCM south	BWM_MB14_01	6.5	6.6	13100	17780	374	5344	2784	717	1892		865.6	865.6	0.01		0.05	0.012	0.0005	0.80	0.00005	0.0005	0.002	0.0005	5.61	0.0005		1.418	0.00005	0.001	0.0192	0.005	0.0005	0.0066	0.0040	0.005	0.0158
Zone 35 deep	RCM south	BWM_MB14_02	7.6	7.7	4732	7408	7	1100	1980	8	26		2730	2856	0.01		1.8	0.014	0.0005	0.30	0.00005	0.0005	0.0007	0.0005	0.36	0.0005		0.011	0.00005	0.0005	0.001	0.005	0.0005	0.004	0.0005	0.005	0.0025
Zone 36 deep	Burngrove Formation	BG No.1 AP	7.17	7.9	4060	6950	37	1930	1504	21.6	28		670	691	0.01		0.60	0.010	0.0005	0.5	0.00005	0.0005	0.0005	0.0005	0.08	0.0005		0.017	0.0001	0.001	0.0005	0.01	0.001	0.001	0.0005	0.005	0.0060
Zone 36 deep	Burngrove Formation	BG No.2 BG	6.572	7.3	11140	17200	303.8	5238	3078	472.8	1510		875	875	0.01		0.20	0.010	0.0005	0.9	0.00005	0.0005	0.0005	0.0005	0.43	0.0005		0.195	0.0001	0.001	0.0348	0.01	0.001	0.001	0.0005	0.005	0.0025

Highlight cell indicates 80th Percentile is above criteria:

- Australian Drinking Water Guidelines (Aesthetic) (NHMRC, NRMMC, 2011)
- Australian Drinking Water Guidelines (Health) (NHMRC, NRMMC, 2011)
- Aquatic Ecosystem (95% Protection) (ANZG, 2018)
- Irrigation (Fitzroy Basin WQO)
- Stock (Fitzroy basin WQO)
- Zone 35 Shallow Groundwater (<30m)
- Zone 35 Deep Groundwater (>30m)
- Zone 36 Shallow Groundwater (<30m)
- Zone 36 Deep Groundwater (<30m)
- Multiple of above

Appendix B Groundwater Modelling Technical Report

Blackwater North Extension Project

Groundwater Impact Assessment

Whitehaven Blackwater Pty Ltd
SLR Project No.: 640.031809.00001

9 April 2026

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

Level 31, 12 Creek Street
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SLR Project No.: 640.031809.00001

9 April 2026

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3.0	09 April 2026	Haili Jia	Brian Rask	Brian Rask

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Whitehaven Blackwater Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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Appendices

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Appendix B Calibration Hydrographs
Appendix C Predictive Period Timing
Appendix D Sensitivity Analysis Plots
Appendix E Parameter Distribution Plots for Sampled Prior and Calibrated Ensemble
Appendix F Uncertainty in 1 m Drawdown Contours

1.0 Introduction

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) was engaged by Whitehaven Blackwater Pty Ltd, a wholly owned subsidiary of Whitehaven Coal Limited to undertake a Groundwater Impact Assessment for the Blackwater North Extension Project (the Project), for incorporation into an application for an Environmental Authority (EA) Amendment and an application for an *Environment Protection and Biodiversity Conservation Act 1999* Approval.

The Project is an extension of mining into Surface Area (SA) 10 on Mining Lease (ML) 1759 and SA 7 on ML 1762 utilising existing Blackwater Mine (BWM) mining methods, mining fleet, mine infrastructure and facilities.

As part of the Groundwater Impact Assessment, a numerical groundwater model for the BWM has been developed to predict impacts of the Project on the local groundwater regime.

1.2 This Report

This report outlines the technical details of the BWM numerical groundwater model development to support the BWM groundwater assessment.

The conceptualisation provides a simplified overview of the groundwater regime (i.e., the distribution and flow of groundwater) based on available data and expert knowledge. Maintaining consistency between the numerical model results and the conceptual understanding of the groundwater regime enhances the credibility of the model's predictions. The numerical model presented in this report was developed in line with the conceptual framework described in the BWM Groundwater Assessment report (SLR, 2026).

1.3 Model Objectives

Numerical modelling was undertaken in support of the hydrogeological assessment to evaluate the potential impacts of the Project on the groundwater regime. The overall objectives of this modelling are to:

- Assess the groundwater inflow to the mine workings as a function of mine position and timing.
- Simulate the extent of maximum groundwater drawdown/depressurisation due to the Project and also with respect to cumulative impacts.
- Simulate and predict the change in groundwater levels at identified groundwater users (i.e. registered bores, landholder bores and groundwater dependent ecosystems [GDEs]) due to the Project and also with respect to cumulative impacts.
- Simulate the direct and indirect take of groundwater and surface water (baseflow) due to the Project.
- Simulate the long-term impacts in the post-mining environment utilising the proposed final landform and void lakes.



2.0 Model Construction

2.1 Model Code

MODFLOW-USG Transport was used as the model code (Panday et al. 2013). MODFLOW-USG is a recent version of industry standard MODFLOW code and was determined to be the most suitable modelling code for accomplishing the model objectives. MODFLOW-USG optimises the model grid and increases numerical stability by using unstructured, variably sized cells. These cells take any polygonal shape, with variable size constraints allowing for refinement in areas of interest.

Where previous MODFLOW versions restricted interlayer flow to vertical connectivity, MODFLOW-USG offers lateral connectivity between model layers. Lateral connectivity enables more accurate representations of hydrostratigraphic units, particularly those that pinch out, outcrop or cross geological faults.

MODFLOW-USG is also able to simulate unsaturated conditions, allowing progressive mine dewatering and post mining rewetting to be represented by the model. For the BWM model, vadose zone properties have been excluded, and the unsaturated zone was simulated using the upstream-weighting method.

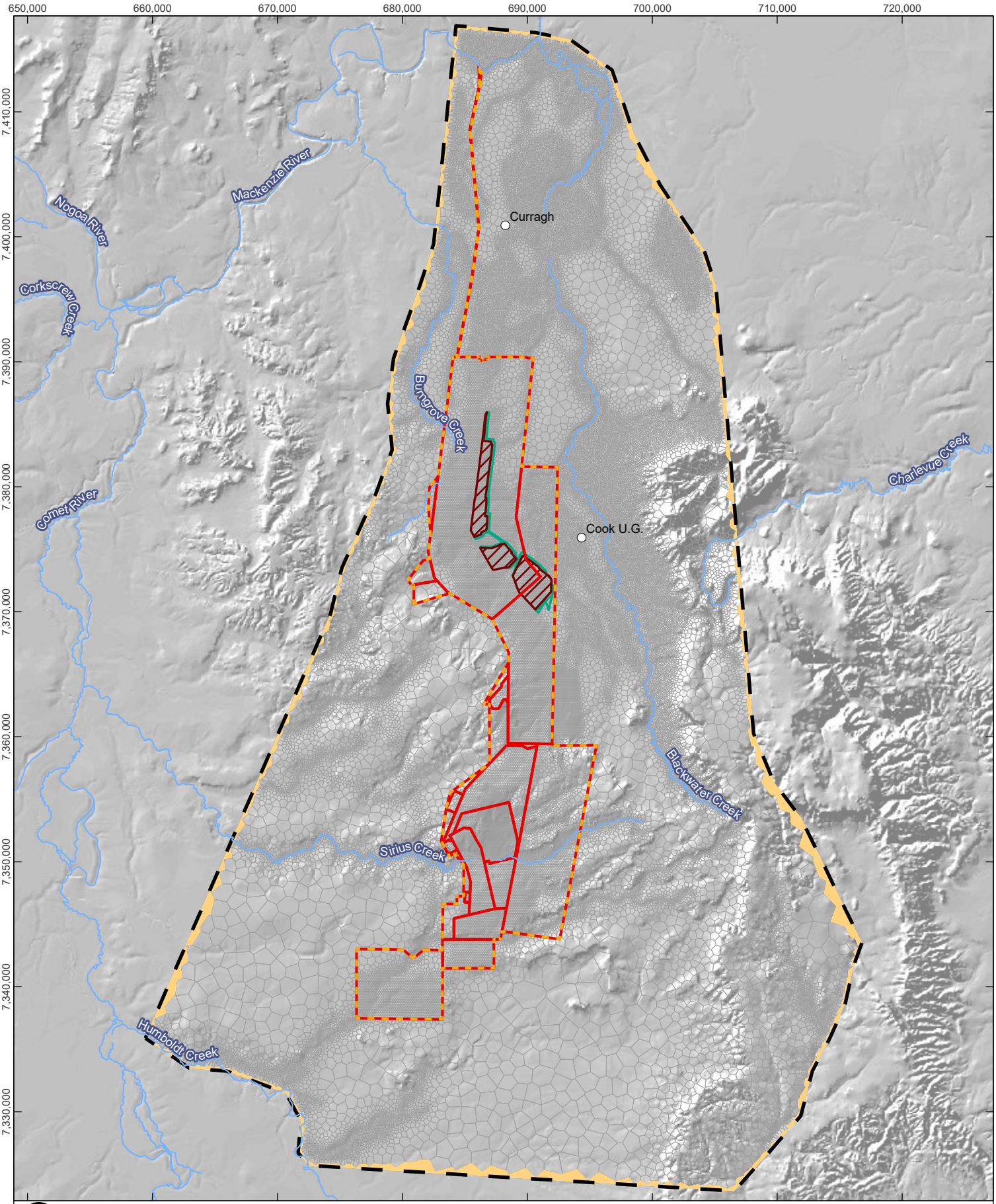
In-house Python codes and a MODFLOW-USG edition of the Groundwater Data Utilities (Watermark Numerical Computing) were used to construct the MODFLOW-USG input files.

2.2 Model Extent and Mesh Design

The model domain and mesh are presented on **Figure 2-1**. Both the northern and southern BWM geological models were adopted to set up the groundwater model layers. The model incorporates regional influences that have interacted with the local groundwater system in the past (during the calibration period) and may continue to interact with it in the future, including during the predictive mining and post-mining periods. These regional influences include operations at the Curragh Mine to the north (open cut) and underground mining at Cook Colliery to the east of BWM, both of which are considered to have a potential to interact with groundwater in the BWM area due to their proximity.

The model domain is intended to place boundary conditions sufficiently distant from the BWM site to allow the extent of potential impacts from mining activities on the groundwater system to be assessed. At its widest extents, the model is approximately 57 kilometres (km) west-east by 93 km north-south. The model domain was selected based on the following considerations:

- The western boundary is represented by the outcrop boundary of the Burngrove Formation, which underlies the Rangal Coal Measures (RCM) and is considered the basement formation for the purpose of this modelling.
- The northern boundary extends to include the open cut Curragh Mine and is 25 km north of the Project area.
- The southern boundary is set approximately 12 km south of the BWM site and is expected to be far outside the range of predicted BWM related drawdown.
- The eastern boundary is set along the Shotover fault which is located approximately 20 km to the east of the Project area. This boundary is expected to be far outside the range of predicted Project related drawdown.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Coal Mine
- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- Greater Head Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MODEL MESH AND BOUNDARY CONDITIONS

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 2-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_01_Model Mesh and Boundary Conditions

To allow stable numerical modelling of the large spatial area of the model domain, an unstructured grid with varying Voronoi cell sizes was designed using Algomesh (HydroAlgorithmics Pty Ltd, 2014). Varying Voronoi cell sizes allowed refinement around areas of interest, while a coarser resolution elsewhere reduces the total cell count to a manageable size. Compared with the previous model, the current mesh includes additional refinements around the bottom dam and underground mines. The refinement scale was also adjusted to ensure a reasonable total cell count.

Vertically, the model domain was vertically discretised into 17 layers, each layer comprising a cell count of up to 64,880. The total number of cells in the model is 815,467. This is after pinching out areas in layers 3 to 15 where layers are not always present based on the mapped geology. The current model also incorporates updated geological elevation data in South Blackwater, which were largely assumed in the previous model.

The following features have been included in the grid design:

- Open cut mining for the BWM including the historical mine and proposed extension is represented with a 150 metres (m) cell size constraint.
- Open cut mining for the historical Curragh mine is represented with a 200 m cell size constraint.
- Underground mining at Cook Colliery and Laleham projects has an oriented regular grid of 100 m width squares to represent longwalls.
- Underground mining at Sirius Creek No. 1 and 2 (ML 1771) are represented with a 50 m cell size constraint.
- Bottom dam area is represented with a 50 m cell size constraint.
- Alluvium areas are represented with a 200 m cell size constraint.
- Rivers, including major rivers and minor creeks and drains, are represented with a 100 m cell size constraint.
- The northwest-southeast striking faults within the model domain are represented with a 200 m cell size constraint.

2.3 Model Layers

The topography within the model domain has been defined using high-resolution (1 m) Digital Elevation Model data for pre-mining surface of the BWM area. Public domain 1-second Shuttle Radar Topography Mission data was used to define the topography in the remainder of the model domain.

The model domain is discretised into 17 layers, as listed in **Table 2-1**. Model layer extents (lateral and vertical) have been defined using data from the following sources:

- BWM site geological model.
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Regolith depth survey (Wilford et al, 2016).
- Queensland Globe bore hole logs.
- Queensland surface geology and basement geological maps.
- Office of Groundwater Impact Assessment (2019) model layers.

Layer 17 was designed as a basement layer to mitigate the risk of abnormal model behavior caused by the thin thickness of the Burngrove Formation in the western part of the model.

Table 2-1 presents the average thickness across the model domain for each layer.

Table 2-1 Model Layers and Thicknesses

Model Layer	Formation	Unit	Average Thickness (m)
1	Alluvium/Tertiary	Surface cover and Tertiary	8.5
2	Alluvium/Weathered zone	Weathered zone/Regolith	13.1
3	Clematis Group	Triassic	372.9
4	Rewan Group (Upper)	Triassic	309.4
5	Rewan Group (Middle)	Triassic	180.9
6	Rewan Group (Lower)	Triassic	114.9
7	RCM	Overburden	51.5
8		Aries seam	1.7
9		Interburden	15.2
10		Castor seam	1.7
11		Interburden	16.3
12		Pollux seam	4.2
13		Interburden	16.2
14		Orion seam	0.8
15		Underburden	17.9
16	Burngrove Formation	Permian	159.4
17	Basement	Permian and/or below	100.0

The regional site geology model (BM Alliance Coal Operations Pty Ltd, 25 m grid) provides the surfaces for tertiary and weathering zone within the BWM area. These surfaces were used to assign the bottom of layers 1 (i.e. Tertiary) and 2 (i.e. weathering) in the model. Outside the geology model extent, CSIRO Regolith survey depths (i.e. weathering depth) was used to define the base of layers 1 and 2. In doing so, the CSIRO Regolith depth was divided into two with each layer covering 50 percent (%) of total depth. Both Layers 1 and 2 are fully extensive across the model. The depth of alluvium was calculated from the site monitoring bores, drill holes, and available public Queensland Globe bore logs. Similar to weathering zone, layers 1 and 2 each cover 50% of total alluvium thickness, where present.

The underlying Rewan and Permian layers are present only to their outcrop extents, with some inference made for the presence of older units beneath the surface outcrop due to folding and faulting. The bottom of layers 3 to 16 was constructed based on the BWM geology model. Outside of the geology model extent, the surface geology map was used to define the location of outcrops of each unit. The average thicknesses were then extrapolated out into the extended model area to cover the layer outside the geology model.

As it is not practical to represent every individual coal seam in a regional groundwater model, a “combined thickness” totalling the individual seam thicknesses for each relevant seam has been simulated. The coal seams of the RCM were combined into four major coal seams: the Aries, Castor, Pollux and Orion seams.

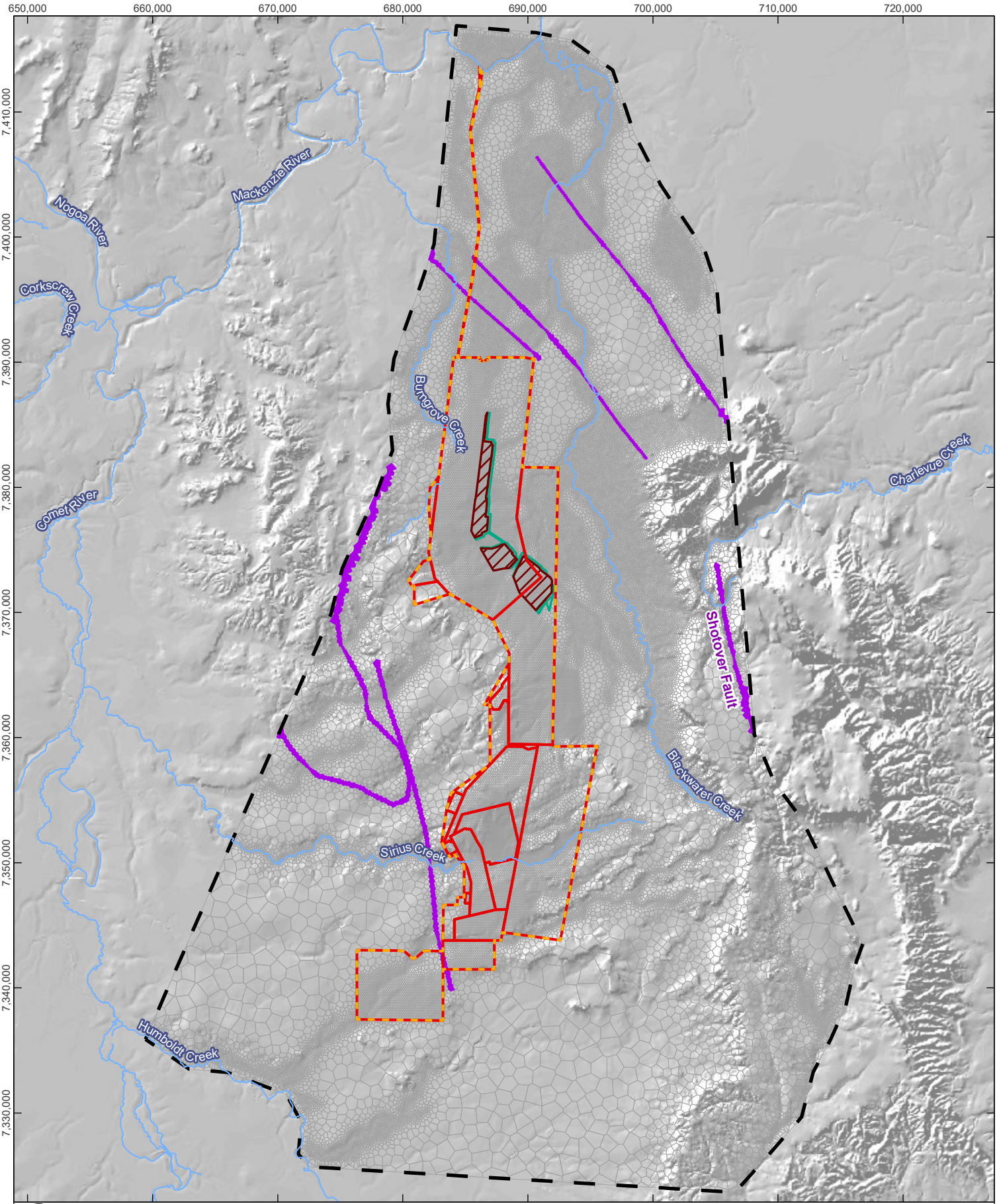
The Burngrove Formation is considered the regional low-permeability basement for the purpose of this modelling. However, due to its thin thickness in the western part of the model

and to prevent abnormal model behaviour, an extra layer, Layer 17, with a uniform thickness of 100 m, was added to define the base of the model and the western and eastern model boundaries.

2.3.1 Geological Structures

Mapped faults and geological structures in the vicinity of the Project area are shown in **Figure 2-2**. The most significant feature is the Shotover Fault, an east-dipping thrust fault with a displacement of up to 3,000 m (Mallet et al., 1988), located approximately 20 km east of the Project area and incorporated along the model's eastern boundary. Numerous smaller local faults are also mapped within the extent of the BWM and its proposed extension, with throws typically less than (<) 5 m, but reaching up to 20 m in some areas (Jeuken, 2011). These faults can fully offset coal seams and potentially act as barriers to groundwater flow, however, their hydraulic impacts are currently not well understood.

To reflect the structural complexity shown in **Figure 2-2**, the model grid was refined in areas where faults are present. While the faults were not assigned distinct hydraulic properties (e.g., reduced permeability or barrier features) due to the lack of site-specific hydrogeological data, their influence is implicitly incorporated through the layering and geometry in the refined grid. Should further data become available, the model could be updated to include fault-specific hydraulic characteristics.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- Fault Cell
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

FAULTS IN THE MODEL

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FIGURE 2-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_02_Faults in the Model

2.4 Timing

The model timing includes a combined transient warm up, steady state and transient calibration periods (**Table 2-2**).

To help with convergence in the steady state, a warmup transient stress period of 5 years from January 1966 to December 1969 was added to the timing as stress period 1. The calibration period includes a combined steady state (pre-mining) period and a transient historical period from January 1970 to January 2005. The transient calibration period runs from January 2005 to December 2024 with quarterly time intervals to replicate influence of historical mining.

To assist the model in overcoming numerical difficulties, MODFLOW-USG Adaptive Time-Stepping (ATS) option was used. The ATS option of MODFLOW automatically decreases time-step size when the run fails to converge. Once the run converged with a reduced time-step size, it increases the time-step size for the next time step to speed up the model run time. The minimum time step size used in the simulations was one day.

Table 2-2 Model Timing

Stress Period	Date Start	Date End	Mining Period	Max Stress Period Length (days)	Max Time Step Length (days)
1	01-01-1966	31-12-1969	Transient Warmup	1,460	1,460
2	-	-	Steady State	1	1
3 - 5	01-01-1970	31-12-2004	Historical	12,784	5,479
6 - 85	01-01-2005	31-12-2024	Calibration	7,305	92

2.5 Parameterisation

The modelled hydraulic zones are reflective of the conceptual (and geological) model. The site conceptualisation, as presented in SLR (2024), describes the hydraulic conductivity (K) data sources and the horizontal (Kx) and vertical (Kz) hydraulic conductivity parameter ranges for each stratigraphic unit as derived from field data. Overall, a broadly declining K with depth is noted for most of the solid geology stratigraphic units.

In the model, the decrease in hydraulic conductivity of the RCM, Rewan Group and Burngrove Formation is simulated to decrease exponentially with depth according to the following equation:

$$HC = HC_0 \times e^{(Slope \times dep \quad)}$$

where: HC = horizontal hydraulic conductivity at the specific depth

HC_0 = horizontal hydraulic conductivity at depth of 0 m

Slope = term representing slope of the formula (steepness of the curve)

Depth = depth of the floor of the layer (thickness of the cover material)

Note: The hydraulic conductivity at zero depth (HC_0) is estimated in the calibration.

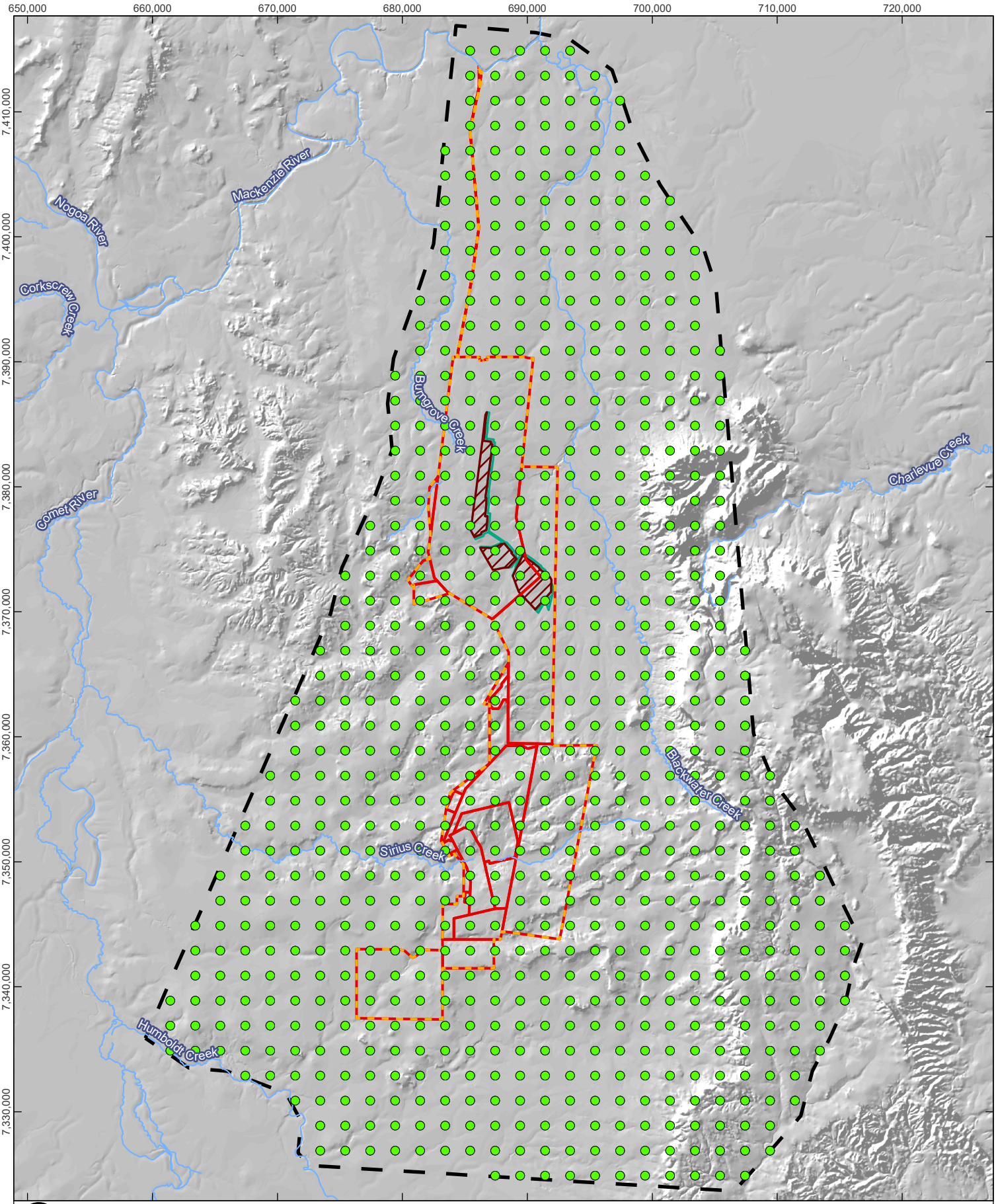
To allow spatial variability in unconsolidated units and the Clematis Group, pilot points were used from layer 1 to layer 3 (**Figure 2-3**). Pilot points were spaced uniformly. PEST++ use its PLPROC utility to interpolate between the pilot point values and creates a surface across the model domain for a targeted model parameter. This surface of model parameter values is then interrogated to provide a value at each model cell.

Hydraulic parameter zones and spatial variation options (e.g. pilot points, depth dependent equation or factor) are summarised on **Table 2-3**.

Table 2-3 Hydraulic Property Zones

Hydraulic Zone	Model Layer	Formation	Unit	Spatial Variation Options			
				Kx	Kz	Sy[1]	Ss[2]
1	1	Alluvium/Tertiary	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
2	1	Regolith	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
3	2	Alluvium/ Weathered zone	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
4	2	Regolith	Surface cover	Pilot Point	Pilot Point	Pilot Point	Constant
5	3	Clematis Group	Triassic	Pilot Point	Pilot Point	Pilot Point	Constant
6	4	Rewan Group (Upper)	Triassic	Eq.1	Factor Kx	Constant	Constant
7	5	Rewan Group (Middle)	Triassic	Eq.1	Factor Kx	Constant	Constant
8	6	Rewan Group (Lower)	Triassic	Eq.1	Factor Kx	Constant	Constant
9	7	RCM	Overburden	Eq.1	Factor Kx	Constant	Constant
10	8	RCM	Aries seam	Eq.1	Factor Kx	Constant	Constant
11	9	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
12	10	RCM	Castor seam	Eq.1	Factor Kx	Constant	Constant
13	11	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
14	12	RCM	Pollux seam	Eq.1	Factor Kx	Constant	Constant
15	13	RCM	Interburden	Eq.1	Factor Kx	Constant	Constant
16	14	RCM	Orion seam	Eq.1	Factor Kx	Constant	Constant
17	15	RCM	Underburden	Eq.1	Factor Kx	Constant	Constant
18	16	Burngrove Formation	Permian	Eq.1	Factor Kx	Constant	Constant
19	17	Burngrove Formation	Permian	Eq.1	Factor Kx	Constant	Constant

Note: [1]Sy = Specific yield, [2]Ss = Specific storage



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Pilot Point
- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PILOT POINTS LOCATIONS

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FIGURE 2-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_03_Pilot Points Used in the Model

2.6 Model Stresses and Boundary Conditions

2.6.1 Regional Groundwater Flow

General Head Boundaries (GHB) have been specified along the perimeter of the model domain, as represented in **Figure 2-1**.

The GHB boundary condition was used to represent regional groundwater inflow and outflow across the model domain. GHB cells were assigned along the perimeter of the model area in all layers except where river cells are present. For each GHB cell, the head was estimated during the steady state calibration.

Groundwater enters the model where the GHB head exceeds the modelled head in the adjacent cell and leaves the model when the water level is lower in the GHB. GHB conductance is calculated using the hydraulic conductivity and the dimensions of each GHB cell and is therefore variable in this model due to variable cell size.

2.6.2 Watercourses

2.6.2.1 Natural Watercourses

The largest local creek (Blackwater Creek), along with selected higher-order tributaries, was incorporated into the model using the MODFLOW-USG River (RIV) package. The rivers within the model that were included in the RIV package are presented in **Figure 2-4,** and were categorized into 10 zones based on their scales and spatial distribution within the model domain. Only higher-order streams were included in the RIV package to represent the primary surface water–groundwater interactions. Lower-order stream segments were not incorporated. As a result, some streams (e.g., Rockland Creek) appear to terminate at or near the mine lease boundary in the model representation.

River boundaries were also applied to the southwestern and southeastern parts of the model where the boundary cells intersect with Humboldt Creek and Planet Creek, both of which are tributaries of the Fitzroy River.

After reviewing water stage data from several stations via the Water Monitoring Information Portal, it was determined that all rivers within the model domain are ephemeral. Consequently, the stage level was set to 0 for all river cells, effectively replicating the behaviour of the DRN package. River widths were assumed to be fixed for each river in the model. The river conductance was calculated using river width, river length, riverbed thickness, and the vertical hydraulic conductivity of riverbed material (**Table 2-4**).

2.6.2.2 Mining Infrastructure

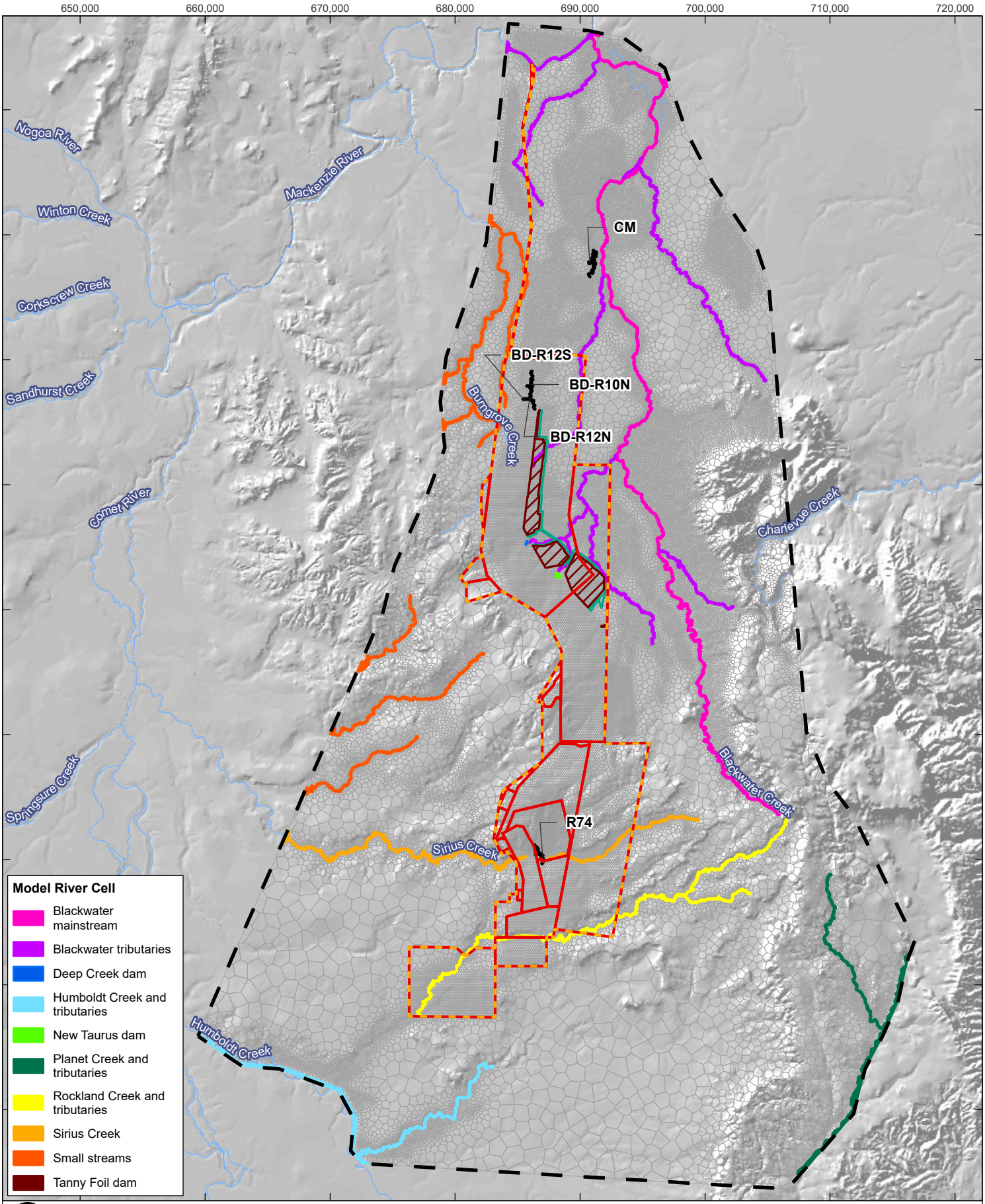
The RIV package was also used to represent dams and tailing storage facilities within the area, with dams presented in **Table 2-4.** Tailings dams are listed **Table 2-5** and their location is presented on **Figure 2-4**.

Table 2-4 River and Surface Water Features in the Model

Zone	Vertical K (meters per day [m/day])	River Width (m)	River Bed Thickness (m)	Name
1	0.05	5	1	Blackwater mainstream
2	0.05	1	1	Blackwater tributaries
3	0.05	2	1	Sirius Creek
4	0.05	1	1	Rockland Creek and tributaries
5	0.05	1	1	Humboldt Creek and tributaries
6	0.05	1	1	Planet Creek and tributaries
7	0.05	1	1	Small streams
8	0.001	1	1	Deep Creek dam
9	0.001	1	1	New Taurus dam
10	0.001	1	1	Tannyfoil dam

Table 2-5 Mining Infrastructure in the Model

Tailing Dams	Kz (m/day)	Stage
BD-R10N	5.0×10^{-1}	Deposited from July 2023 until 2040
BD-R12N	5.0×10^{-1}	Deposited from July 2023 until 2040
BD-R12S	5.0×10^{-1}	Deposited from July 2023 until 2040
R74	5.0×10^{-1}	Deposited from Jan 2025 until 2040
Curragh Mine (CM)	5.0×10^{-1}	Deposited from Jan 2007 until 2023



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Model Grid
- TSF Cell
- Proposed Open Cut Extension
- Proposed Infrastructure Area

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RIVER CELLS

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FIGURE 2-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_04_River Cells

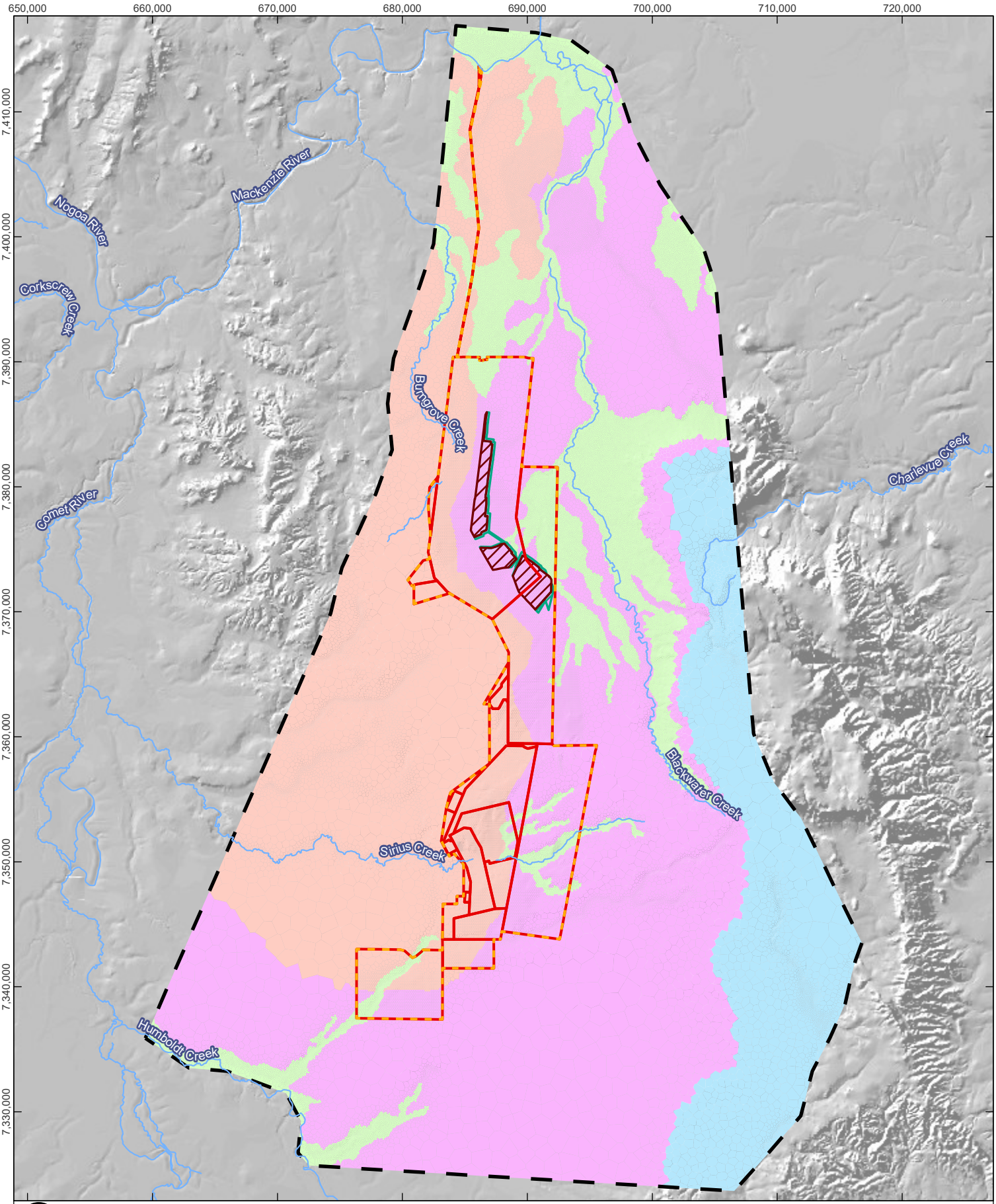
2.6.3 Rainfall Recharge

Diffuse infiltration of rainfall through the soil profile and subsequent deep drainage to underlying groundwater systems were represented using the MODFLOW-USG Recharge package (RCH). For the period from January 1970 to December 2024, recharge rate data was sourced from the Bureau of Meteorology's Australian Water Resources Assessment Landscape model, which simulates deep drainage, and introduces seasonality to the modelled recharge rates for the quarterly stress periods used during calibration. The recharge rate for the steady state condition was calculated using the long-term average daily recharge rate from January 1911 to December 1967. For the subsequent stress periods, daily recharge rates were calculated based on the average daily recharge rate over the corresponding date range within each stress period.

Multipliers were then utilised during the calibration process. Separate multipliers are used for each recharge zone. Rainfall recharge was imposed as a percentage of actual rainfall from the Scientific Information for Land Owners (SILO) Grid Point observations. Long-term average rainfall was used for the steady-state model. The historical rainfall data were averaged on an annual basis (2000 to 2004) and on a quarterly basis (2004 to 2024) for the transient calibration model. Also, the averages of the historical rainfall data from 1980 to 1990 and from 1990 to 2000 were used for these periods. For the predictive model, long-term average rainfall was used.

The model includes 4 recharge zones, as presented in **Figure 2-5**:

- Zone 1 - Quaternary Alluvium.
- Zone 2 - Regolith.
- Zone 3 - Weathered Clematis.
- Zone 4 - Weathered Permian.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Recharge Zone

- Zone 1 - Alluvium
- Zone 2 - Regolith
- Zone 3 - Weathered Clematis
- Zone 4 - Weathered Permian

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

RECHARGE ZONES

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FIGURE 2-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_05_Recharge Zones

2.6.3.1 Mining Induced Recharge

Enhanced recharge via spoil was simulated by progressively introducing a fifth recharge zone for the spoil. That zone expands as mining progresses and spoil is deposited in the open cut pits.

The calibrated recharge rates for all zones are discussed in **Section 3.4.3.1**.

2.6.4 Evapotranspiration

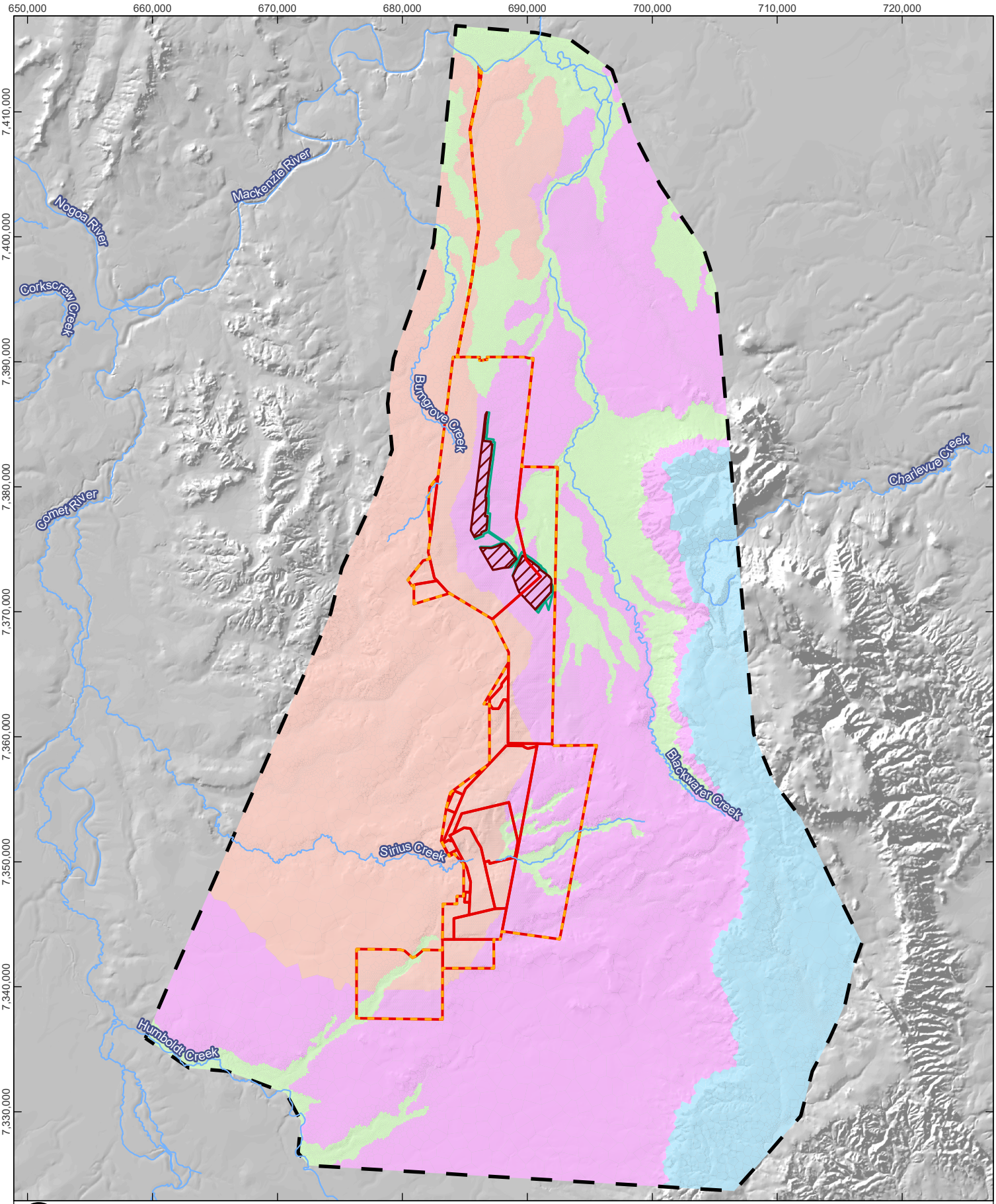
Evapotranspiration (ET) from the shallow water table was simulated using the Evapotranspiration package (EVT). ET was represented in the upper most cells of the model domain, with the extinction depth varied spatially based on the estimated rooting depths of regionally vegetation type.

In this model, EVT is excluded from cells that also contain RIV or GHB conditions. This approach is taken to avoid double-counting groundwater discharge in locations where other boundary conditions already represent flow out of the aquifer. Applying EVT in the same cells could result in non-physical water losses and distort the water balance by allowing multiple boundary conditions to compete for the same volume of groundwater. Excluding these cells from the EVT zone ensures that each type of boundary condition represents a distinct and non-overlapping physical process.

Same zones as recharge were assigned as EVT zones (refer to **Figure 2-6**):

- Zone 1 - Quaternary Alluvium.
- Zone 2 - Regolith.
- Zone 3 - Weathered Clematis.
- Zone 4 - Weathered Permian.

The maximum ET rate was derived from the SILO Grid Point series (Queensland Government, 2023). A single value of 0.0045 m/day was applied in the model for the steady-state and initial stress periods preceding the calibration period, and also the predictive period. Varied rates were applied to the calibration periods, while a single value was used for the first two stress periods, as well as the predictive period. An ET rate of zero was assigned to model cells representing rivers.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Evapotranspiration Zones

- Alluvium
- Regolith
- Weathered Clematis
- Weathered Permian

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

EVAPOTRANSPIRATION ZONES

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FIGURE 2-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_06_Evapotranspiration Zones

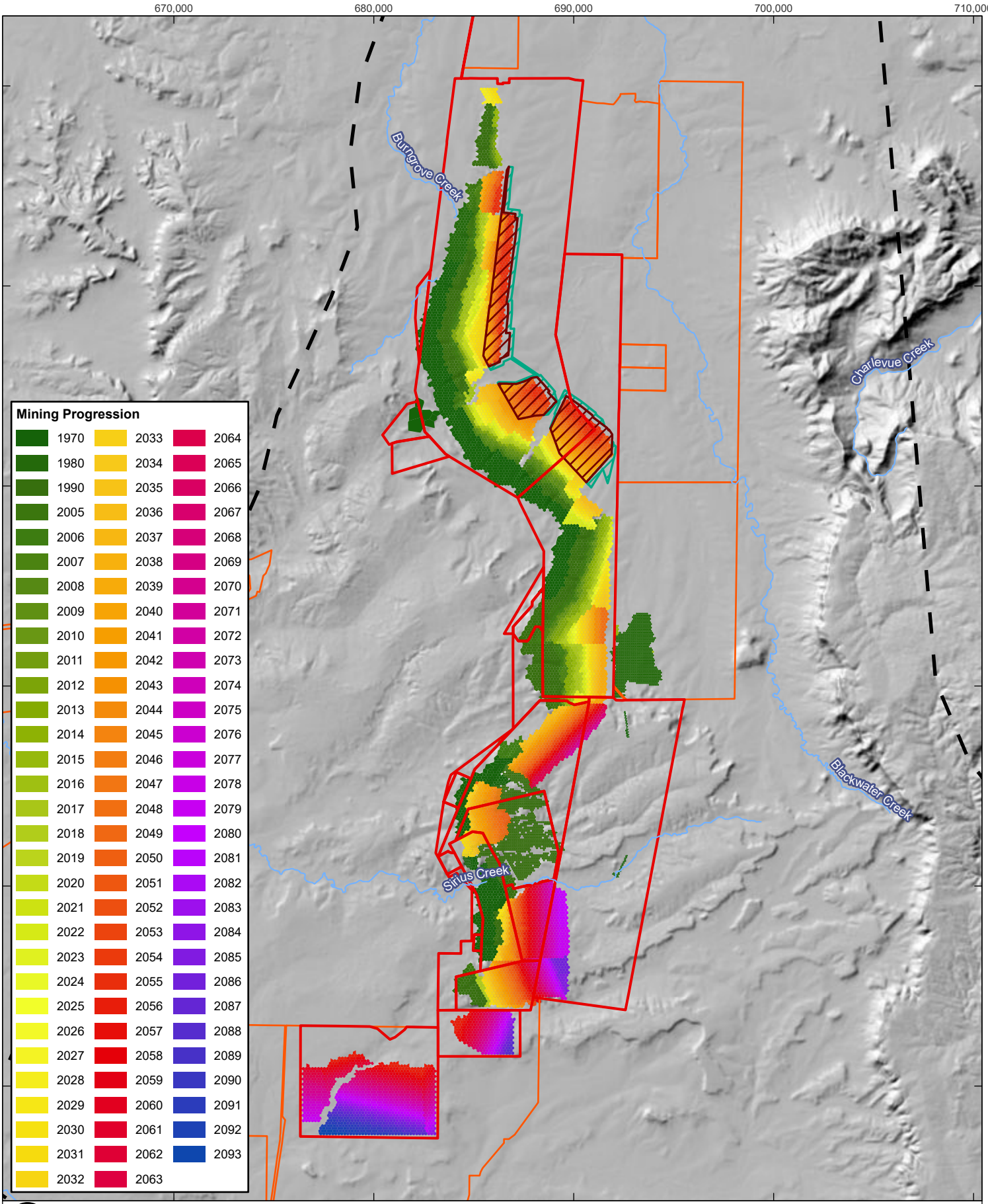
2.6.5 Mining

All mines included in this assessment, namely BWM, BWM South (Kenmare and Laleham), Cook Collieries, and Curragh Mines are targeting the RCM, hence a cumulative assessment of impacts is carried out. The location of both the open pit and underground mines is shown in **Figure 2-7**.

2.6.5.1 Dewatering

The MODFLOW Drain (DRN) package is used to simulate mine dewatering in the model for the Project and surrounding mines. Boundary conditions for drain cells allow one-way flow of water out of the model. When the computed head drops below the pre-defined stage elevation of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

To simulate BWM open cut pits in the model, drain cells are applied to all active layers from the surface to the base of the lowermost mined seam, which is the Pollux seam (Layer 12). The drain cells representing the surrounding open cut mines were interpolated from previous reports, publicly available Environmental Impact Statement documentation and aerial photography.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- GIA Study Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MINING PROGRESSION

SLR

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FIGURE 2-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F02_07_Mining Progression

2.6.5.2 Variation in Hydraulic Properties due to Mining

Two types of mining have been considered; open cut and underground.

For open cut mining, Hawkins (1998) and Mackie (2009) indicate that spoil and waste rock are more permeable than the undisturbed strata. Completed open cut mining areas will be backfilled with waste overburden as the extraction proceeds. Backfilling of open cut mine areas with spoil was modelled using the MODFLOW-USG Time-Variant Material (TVM) package. The model cell properties were updated to spoil properties guided by operational mine plans. Horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield and specific storage of the spoil were adjusted during the calibration process. Hydraulic conductivity (Kx and Kz) change within the stress period when mining (DRN) is activated, and storage properties are activated in the stress period when DRNs become inactive.

Several tailings storage areas were defined by the proponent, with tailing hydraulic properties applied in the model and adjusted during the calibration process.

For the underground mines, the hydraulic properties were changed with time in the goaf and overlying fractured zone directly above each longwall panel. The TVM package was used to simulate changes to aquifer properties in response to mining within the overlying strata and fracture zone. Calculated multipliers were used to enhance hydraulic conductivities within the fracture zone overlying coal extraction areas, with multipliers generally following a ramp function, so that the multipliers with highest values are applied to the units closest to the mined seam and then gradually decrease as the units become close to the maximum height of connective cracking. The fracture zone multipliers are listed in **Table 2-6**.

The maximum height of connective cracking was derived using the Ditton/Merrick equation (Ditton and Merrick, 2014). The fracture heights over the Pollux seam in the underground mines ranged from 57 m to 154 m, with an average fracture height of 119 m and no fracturing of the surface is expected.

Table 2-6 Fracture Zone Multipliers

Layer	Unit	Average Kx Multipliers	Average Kz Multipliers
1	Alluvium/Tertiary	1	1
2	Alluvium/Weathered zone	1	1
6	Rewan Group (Lower)	1	1
7	RCM - Overburden	44	51
8	RCM - Aries seam	6	30
9	RCM - Interburden	1	2
10	RCM - Castor seam	1	1.3
11	RCM - Interburden	12	295

3.0 Calibration

3.1 Calibration Method

Automated calibration utility PESTPP-IES (White et al, 2020) was used to match the available water level data. The numerical algorithm that is implemented by PESTPP-IES is referred to as an “iterative ensemble smoother”. The job of an ensemble smoother is to assimilate data in a “batch” sense. To accomplish this, PESTPP-IES begins the model parameterisation process with a collection of random parameter fields drawn from the prior parameter probability distribution. Through a series of iterative adjustments, PESTPP-IES modifies the parameter realisations that make up the ensemble to satisfy calibration constraints. The results presented in this section are from the realisation that yielded the lowest simulated error (sum of squares). However, where possible, results have been provided for all realisations within the ensemble. The model variables included in the calibration were:

- Aquifer parameters, including horizontal and vertical hydraulic conductivity, specific storage and specific yield by zone.
- Pilot point multiplications for horizontal and vertical hydraulic conductivity, and specific yield.
- RCH rate factors by zone.
- EVT rate factors and extinction depths by zone.
- Vertical conductivity of RIV cells. Additionally, tailing dams were modelled using the RIV package, with their vertical hydraulic conductivities also parameterized.
- Hydraulic properties of spoils and tailings, including horizontal and vertical hydraulic conductivity, specific storage, and specific yield, with vertical conductivity linked to horizontal conductivity.

The calibration methodology for the BWM model involved running the model numerous times with different parameter sets to identify those that yielded the best calibration statistics. The process began with 500 initial realisations, sampled within the defined parameter ranges by PESTPP-IES. After 10 iterations, 75 realisations were optimized to achieve satisfactory calibration performance. The ensemble size was deemed sufficient based on a review of uncertainty convergence on predicted fluxes (**Section 7.1**)

The calibration statistics were calculated for each realisation and the realisation that produced the lowest Scaled Root Mean Square (SRMS) error was considered to be the best-calibrated model for the purposes of the BWM. This model is referred to as “Best Calibrated Model” (BCM) and calibration results are presented for the BCM herein.

3.2 Calibration Dataset

The groundwater levels recorded between Aug 2009 to Dec 2024 were used as calibration targets. They were processed into two groups – initial water level and drawdowns from the initial water levels for each bore. In all, 1,789 observation targets, including 108 initial heads and 1,681 drawdowns, were established for 108 bores from the BWM area.

Groundwater targets were selected where valid information on bore construction or geology information was available for the site. Targets were manually reviewed to ensure the measurements were realistic.

Details on each of the observation points are presented in **Appendix A** of this report.



3.2.1 Groundwater Levels

Table 3-1 summarizes the initial groundwater levels measured from 108 observation points, which have been used as the first group of calibration targets for the groundwater model. The groundwater levels from various geological formations, including the weathered zone, Rewan Group, RCM overburden/interburdens and RCM coal seams.

Table 3-1 Summary of Initial Groundwater Levels used for Calibration Targets

Model Layer	Target Unit	Number of Bores
2	Weathered zone/Regolith	18
5	Rewan Group (Middle)	1
6	Rewan Group (Lower)	6
7	RCM Overburden	14
8	Aries seam	13
9	RCM Interburden	3
10	Castor seam	9
11	RCM Interburden	3
12	Pollux seam	18
13	RCM Interburden	1
14	Orion seam	2
16	Burngrove Formation	20
	Total	**108**

3.2.2 Drawdown

Table 3-2 summarizes the drawdowns used as calibration targets for the groundwater model. These values are derived by subtracting the initial groundwater level from the subsequent measurements taken from the same observation bores. A total of 1,681 drawdowns across 107 bores were converted from the measured water levels. The data spans multiple geological layers, including the weathered zone, Rewan Group, RCM overburden/interburdens, RCM coal seams and Burngrove Formation, offering a comprehensive view of the groundwater system's response.



Table 3-2 Summary of Drawdowns Used for Calibration Targets

Model Layer	Target Unit	Number of Bores	Number of Observations
2	Weathered zone/Regolith	18	167
5	Rewan Group (Middle)	1	7
6	Rewan Group (Lower)	6	137
7	RCM Overburden	14	433
8	Aries seam	13	354
9	RCM Interburden	3	74
10	Castor seam	9	95
11	RCM Interburden	3	38
12	Pollux seam	18	190
14	Orion seam	2	21
16	Burngrove Formation	20	165
	Total	**107**	**1681**

3.2.3 Calibration Weighting

During calibration, each groundwater bore in each group (initial water level or head difference) was assigned a base weight of 1, and the weight for each observed target was calculated as $1/\sqrt{n}$, where n is the total number of observations recorded at that bore.

3.3 Calibration Performance

3.3.1 Calibration Statistics

An industry-standard approach for assessing the calibration of a model is to analyse statistics related to the calibration. One way of doing this is by comparing the simulated differential (i.e. error) between the simulated and observed (measured) water levels, which is often expressed as the root mean square (RMS). The RMS value is calculated by taking the square root of the mean of the squared differences between the simulated and observed water levels. RMS is expressed as:

$$\mathrm{RMS} = \left[\frac{1}{\mathrm{n}}\sum(\mathrm{h_o} - \mathrm{h_m})_\mathrm{i}^{\,2}\right]^{0.5}$$

where: n = number of observations

h_o = observed water level

hm = simulated water level

Another option for measuring the goodness of fit is the SRMS error. SRMS is computed by dividing the RMS by the range of measured heads and expressing it as a percentage. When the goal is to fit historical measurements of water levels, SRMS provides a valuable indicator of the goodness of fit (Barnett et al., 2012). This is primarily due to its ability to compare errors in the simulated values against the total head changes in the system. If the errors are small relative to the total head change, they can be considered negligible.

The PESTPP-IES ensemble calibration process was initiated with 500 randomly generated realisation and 75 calibrated realisations from the final iteration were retained as sufficient for assessing uncertainty in the quantities of interest (QOIs). A summary of statistical analyses of the error residual between simulated and observed water level elevation for all calibrated realisations is provided in **Table 3-3.**

Although there is no universal recommendation for an acceptable SRMS error, Barnett et al. (2012) suggest that establishing SRMS targets, such as 5% or 10%, may be appropriate in certain circumstances. In this study, RMS error calculated for the Best Calibrated Realisation within the ensemble is 11.6 m. The total measured head change across the model domain is 177.3 m, leading to a SRMS value of 6.6%. For the ensemble, the maximum SRMS is 7.4% (**Table 3-3**).

Figure 3-1 presents the observed and simulated groundwater levels graphically as a scattergram for the historic transient calibration (1990 to 2024), for the BCM. As can be seen in **Figure 3-1**, hydraulic gradients are well reproduced across the calibration dataset.

Table 3-3 Calibration Statistics

Statistic	Minimum	Median	Maximum	Best Calibrated Realisation
Mean Residual (m)	1.3	3.7	5.5	3.8
Mean Absolute Residual (m)	8.8	9.3	10.2	9.1
Standard Deviation (m)	10.9	11.5	12.6	11.0
Sum of Squares (square metres [m^2])	242581.2	259575.5	308003.7	242581.2
RMS error (m)	11.6	12.1	13.1	11.6
Minimum Residual (m)	-51.6	-33.3	-26.5	-30.2
Maximum Residual (m)	29.0	33.1	39.4	34.2
Number of Observations	1789	1789	1789	1789
Range in Observations (m)	177.3	177.3	177.3	177.3
Scaled Standard Deviation (%)	6.2	6.5	7.1	6.2
Scaled Absolute Mean (%)	5.0	5.3	5.8	5.1
SRMS (%)	6.6	6.8	7.4	6.6

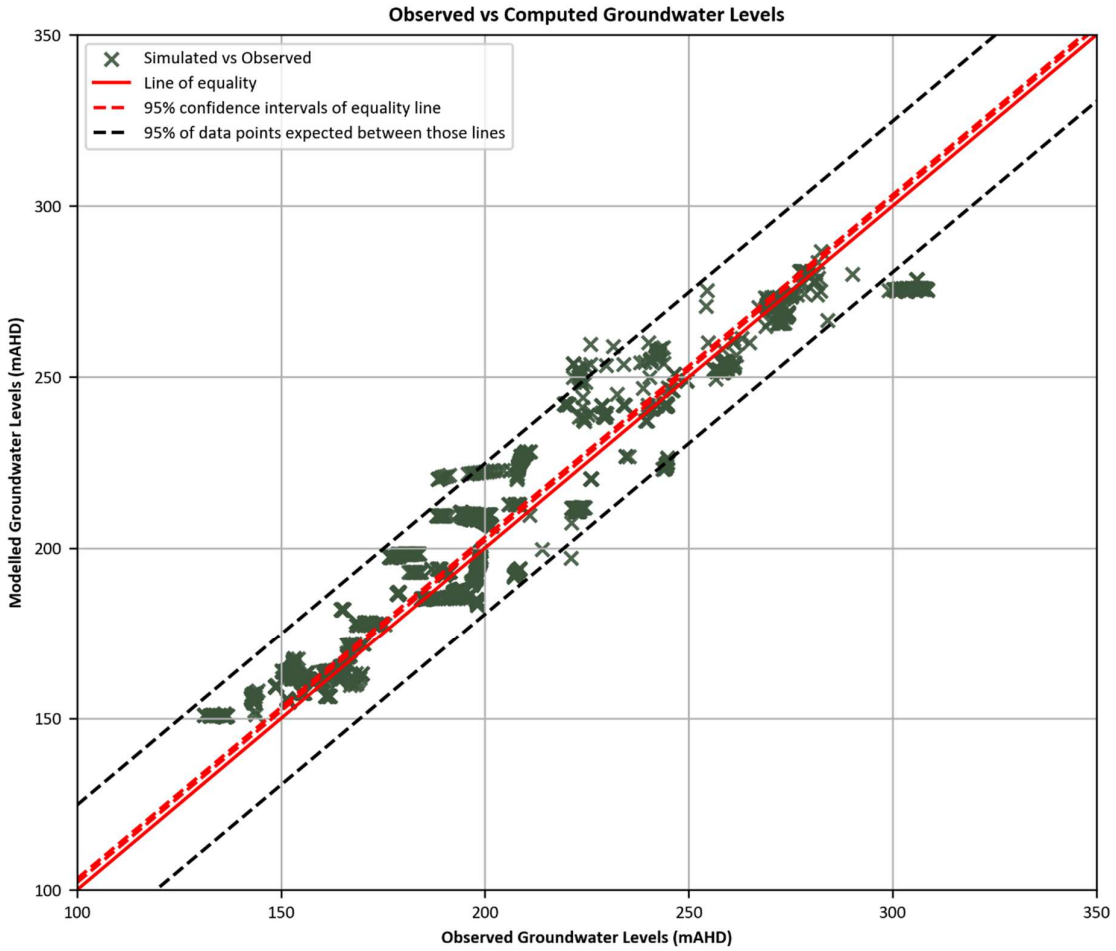


Figure 3-1 Calibration Scattergram

Figure 3-2 shows the distribution of calibration residuals for the BCM. As shown in the figure the calibration residuals in majority of the calibration data points are within ± 10 m. **Figure** 3-2 indicates that in general, the model tends to slightly overpredict groundwater levels.

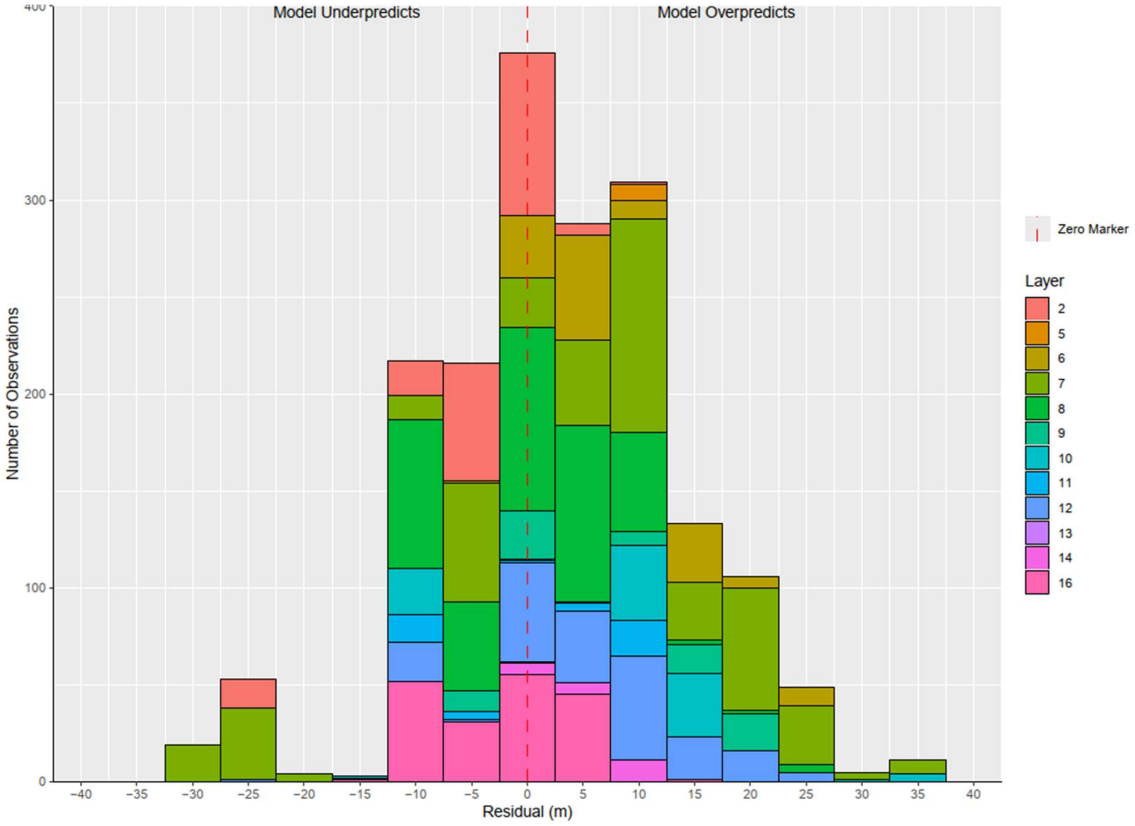


Figure 3-2 Calibration Residual Histogram

Table 3-4 shows the average calibration residual and absolute average residual per model layer, for the BCM. The residual is the difference between the measured and the modelled water level at each bore. A negative residual represents an over estimation of water levels, while a positive residual represents an underestimate.

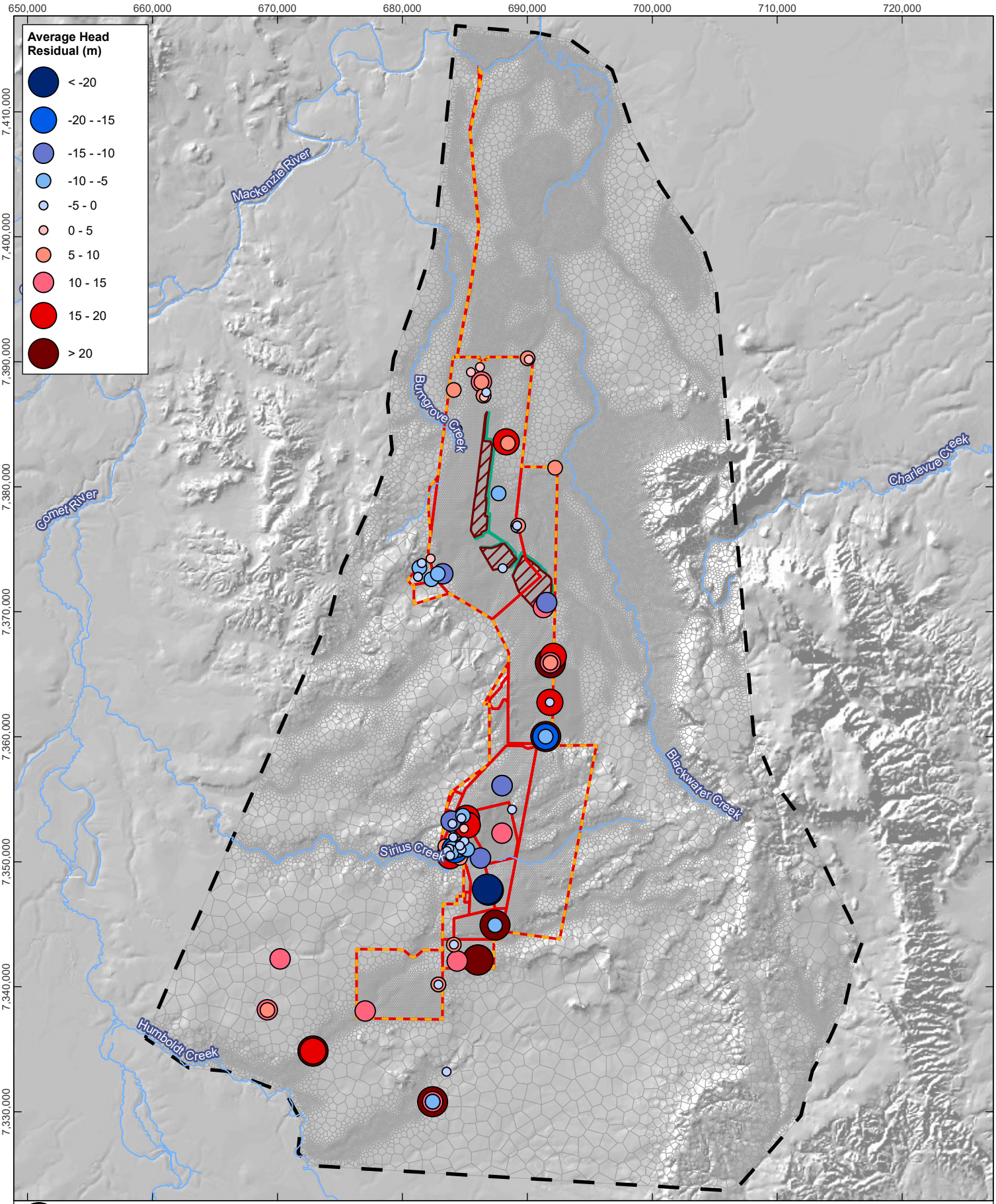
Table 3-4 shows a general overestimation of water level in the model layers except for the Alluvium/weathered zone, some interburden and the Burngrove formation. The overestimation is greater for the Rewan Group (9.5 m on average).

Table 3-4 Average Residual by Model Layer

Model Layer*	Formation	Unit	Average Residual (m)	Average Absolute Residual (m)	Number of Observation Targets	Number of bores
2	Alluvium/ Weathered zone	Surface cover	-3.6	4.6	185	18
5	Rewan Group (Middle)	Triassic	9.8	9.8	8	1
6	Rewan Group (Lower)	Triassic	8.9	9.0	143	6
7	RCM	Overburden	5.6	13.8	447	14
8		Aries seam	1.0	6.4	367	13
9		Interburden	7.7	9.8	77	3
10		Castor seam	10.7	13.1	104	9
11		Interburden	1.9	9.1	41	3
12		Pollux seam	7.5	9.5	208	18
13		Interburden	-2.4	2.4	1	1
14		Orion seam	7.1	7.1	23	2
16	Burngrove Formation	Permian	-1.5	5.1	185	20

*There are no observation bores in Layers 1, 3, 4, 15 and 17.

The spatial distribution of average residuals for each bore from the transient calibrated model is shown in **Figure 3-3**. The size of the bore symbol in **Figure 3-3** is proportional to the residual (i.e. larger residual has a larger symbol size). **Figure 3-3** shows regionally there is a good match between the observed and simulated groundwater levels.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- Model Grid
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

TRANSIENT CALIBRATION
AVERAGE HEAD RESIDUALS (m)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F03_03_Transient Calibration Average Head Residuals (m)

3.3.2 Calibration Hydrographs

This section provides discussion on the modelled to observed groundwater level trends (calibration hydrographs) for key bores across the BWM site. Calibration hydrographs for the full calibration dataset are presented in **Appendix B**.

3.3.2.1 Alluvium and Regolith

There are no bores with valid observation data in the Alluvium and Regolith (Layer 1) in the model area.

Figure 3-4 presents the fit between simulated and observed heads in BWM_MB17_02, BWM_P4, BWM_P7 within the Alluvium and Weathered zone (Layer 2). BWM_MB17_02 is located at the edge of the South Marshmead Pit, whereas BWM_P4 and BWM_P7 are located along the western edge of the Kenmare Pit. The hydrographs for these bores generally show a close match between the simulated and measured groundwater levels.

However, as shown in the hydrographs in **Appendix B**, regionally there is a relatively good match between the simulated and measured groundwater levels in regolith bores.

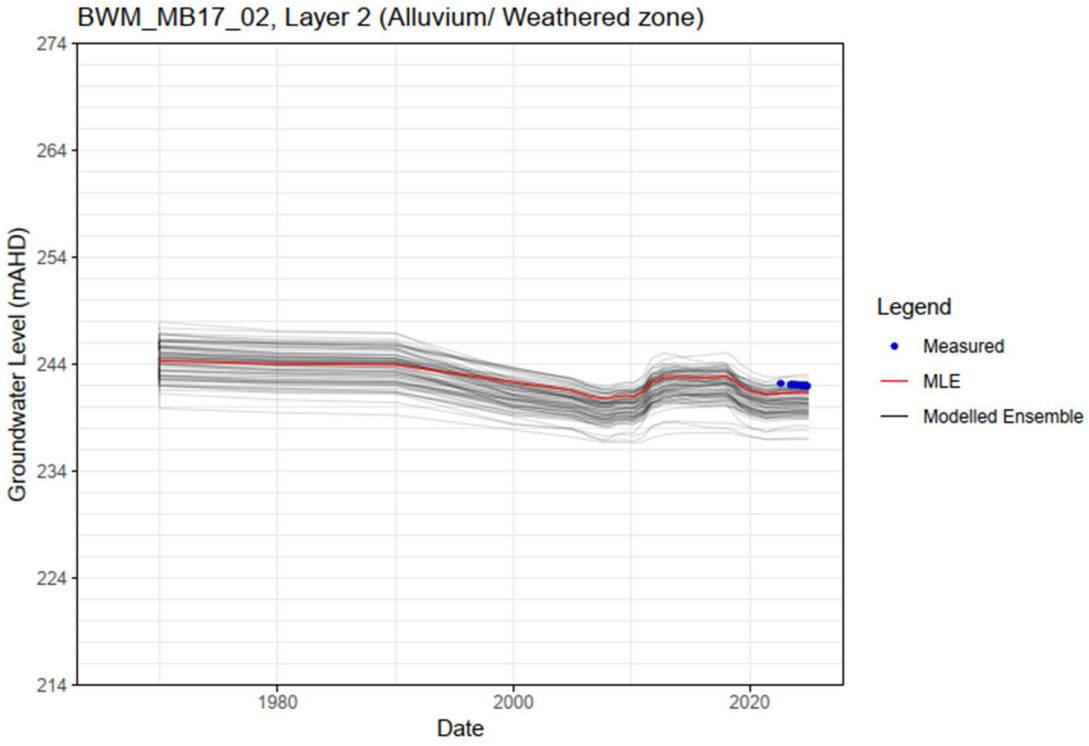


Figure 3-4 Calibration Fit - Alluvium and Regolith Bores

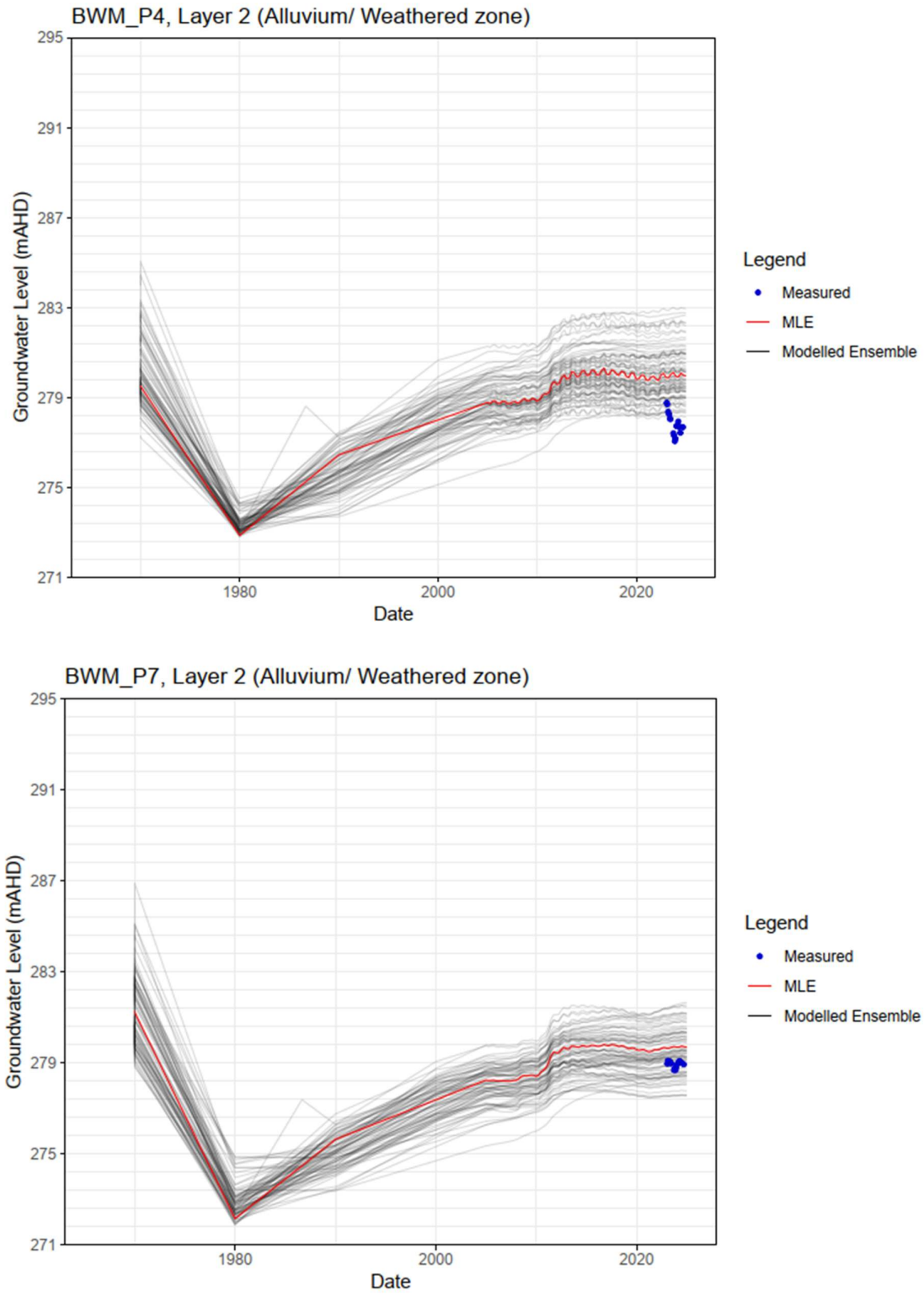


Figure 3-4 (continued) Calibration Fit - Alluvium and Regolith Bores

3.3.2.2 Interburden

The hydrographs for some of the Interburden bores are shown in **Figure 3-5** for bores VWP19BWM01-5 and VWP19BWM02-3 in the Interburden layers, located to the east of the Besgrove Pit and in the Tannyfoil Pit respectively, show that the model results in a reasonable (± 3 m) fit between modelled and observed groundwater. Trends are also relatively well reproduced.

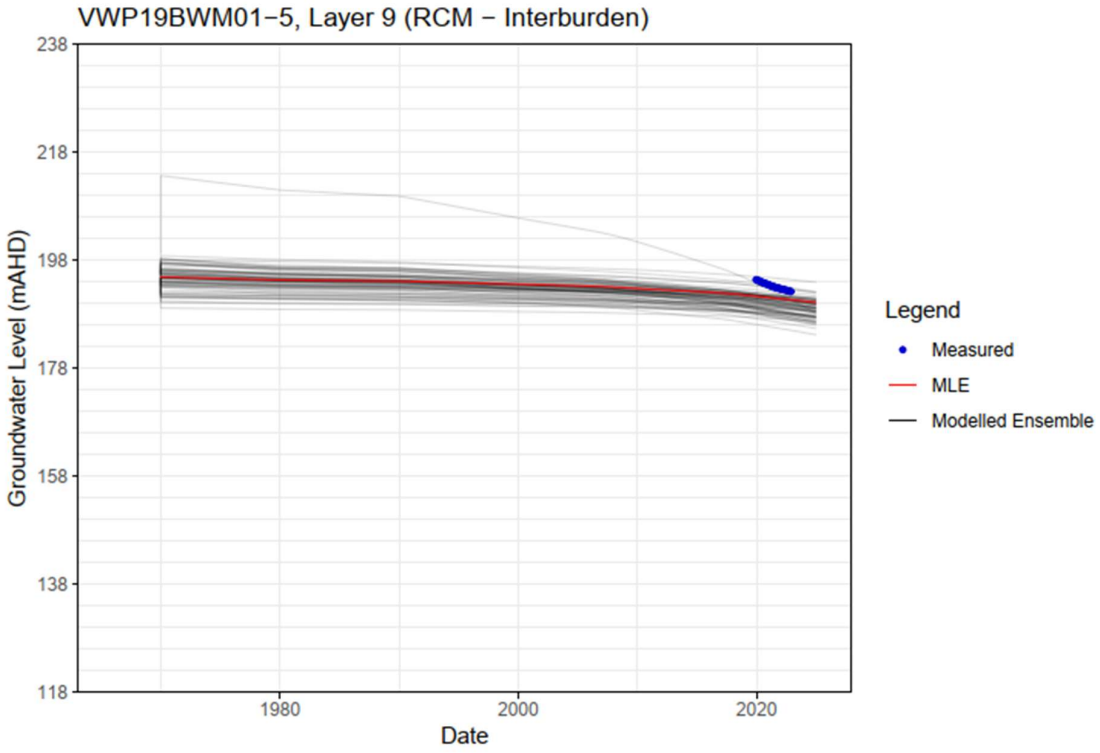


Figure 3-5 Calibration Fit - Interburden Bores

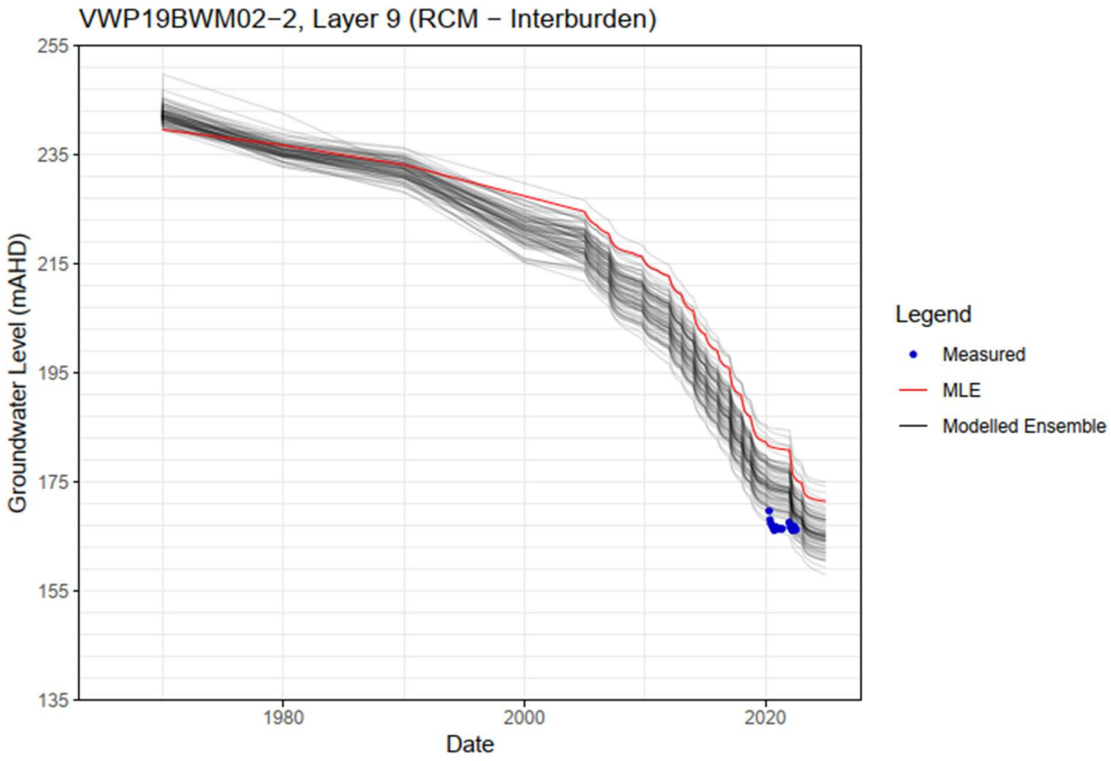


Figure 3-5 (continued) Calibration Fit - Interburden Bores

3.3.2.3 Coal Seams

The hydrographs for bores MB3, MB20BWM03P1, FY16_PZ_2 and VWP19BWM02_5 located in the Aries, Castor, Pollux and Orion seams respectively are shown in **Figure 3-6** and **Figure 3-7**. The hydrographs show that the model results in a reasonable (± 3 m) fit between modelled and observed groundwater levels for these bores. Trends are also relatively well reproduced.

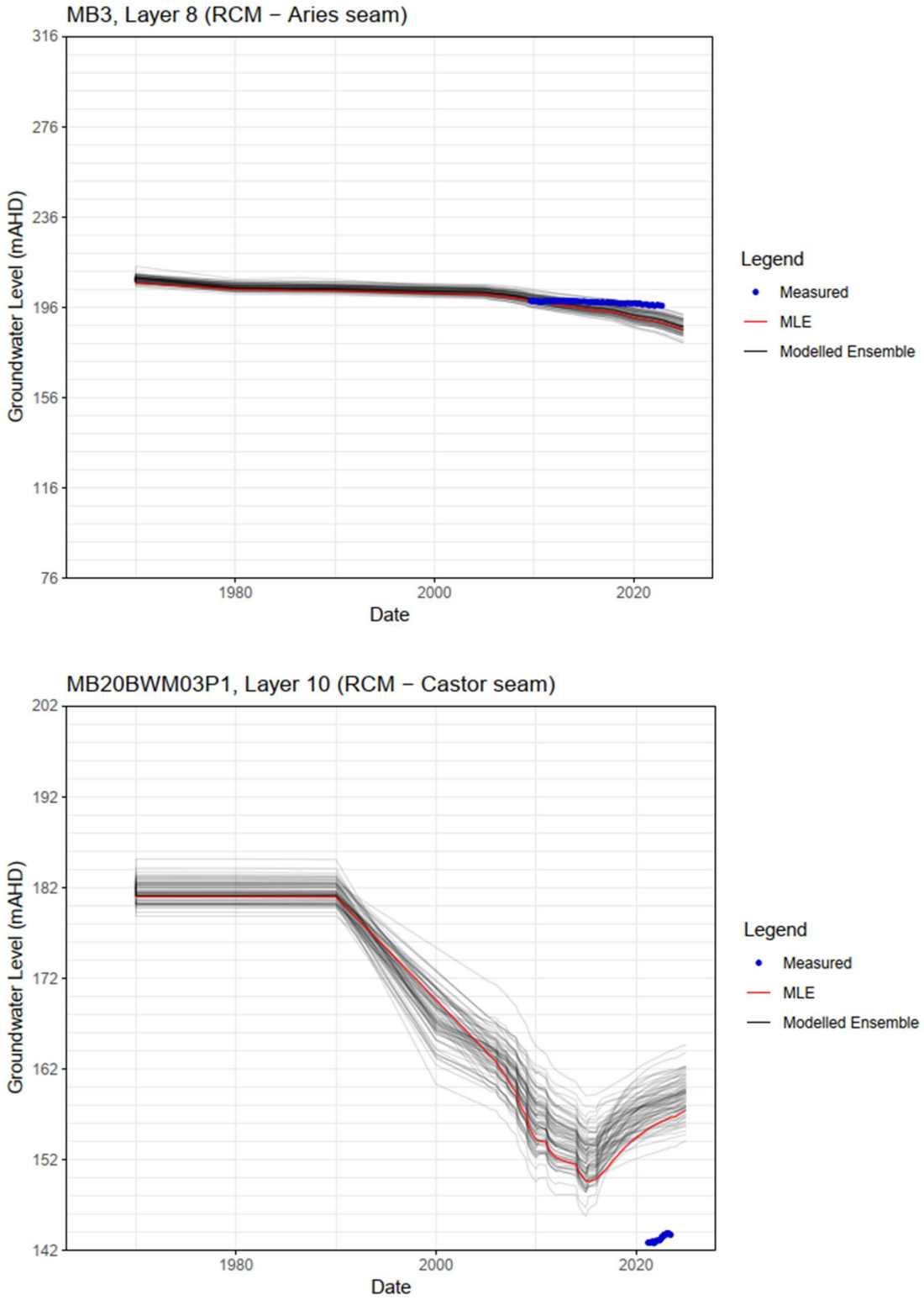


Figure 3-6 Calibration Fit – Coal Seams Bores (Aries and Castor)

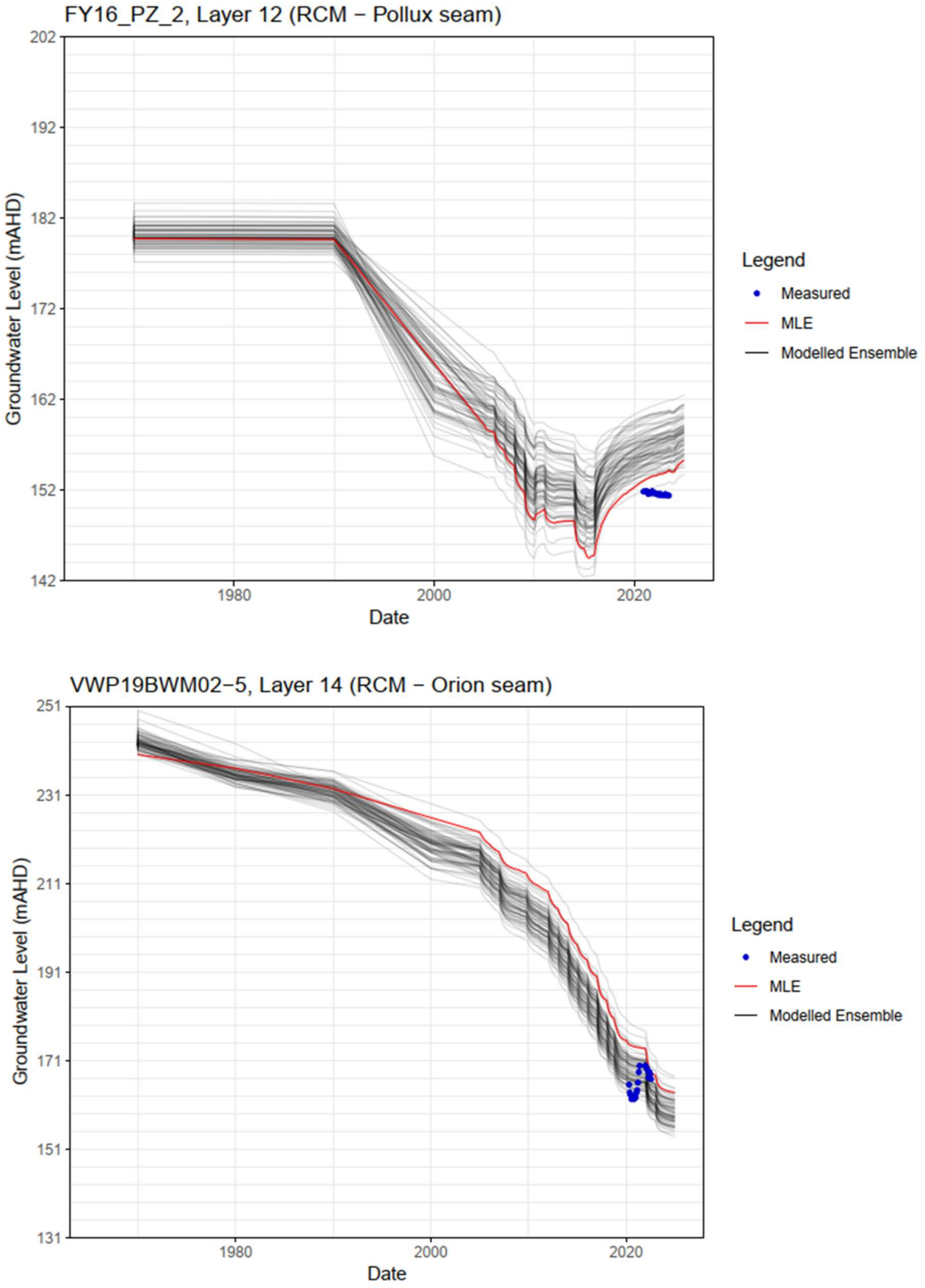


Figure 3-7 Calibration Fit – Coal Seams Bores (Pollux and Orion)

3.4 Calibration Results

3.4.1 Calibrated Fluxes

3.4.1.1 Steady State Water Balance

The water balance for the steady state model calibration is shown in **Table 3-5**. The results indicate that recharge is the dominant inflow contributor (61.8 Megalitres per day [ML/day]). ET is the highest groundwater outflow (61.6 ML/day), indicating that groundwater primarily leaves the model domain through ET. Other outflow components, such as river and GHBs, contributed only minimally. The mass balance error for the steady state calibration is 0.03%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 3-5 Steady-State Model Water Balance

Component	Inflow (ML/d)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	61.8	100.0	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	61.6	99.8
River (RIV)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.0	0.0	0.1	0.2
Mines (DRN)	0.0	0.0	0.0	0.0
Storage	0.0	0.0	0.0	0.0
Total	**61.8**	**100.0**	**61.8***	**100.0**

* Total values may not exactly equal the sum of individual components due to rounding.

3.4.1.2 Transient Water Balance

The model water balance for the transient simulation averaged over the duration of the calibration period is presented in **Table 3-6** and **Figure 3-8**.

The water balance for the transient calibration period indicates that recharge to the groundwater system within the model averages 63.8 ML/day. Approximately 56.6 ML/day is lost to ET in areas where the water table is within a few metres of the land surface.

The net flux from the GHB component is -0.4 ML/day indicating that groundwater leaves the model domain through this boundary. 10 ML/day is removed from the model by the Drain boundary condition that represents mining in the model.

The mass balance error recorded for each stress period of the transient calibration is between -0.45% and 0.08%, within the error threshold recommended by the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

Table 3-6 Transient Model Water Balance

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total Outflow (%)
Recharge (RCH)	63.8	88.0	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	56.6	78.1
River (RIV)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.2	0.3	0.6	0.8
Mines (DRN)	0.0	0.0	10.0	13.8
Storage	8.5	11.7	5.3	7.3
Total	**72.5**	**100.0**	**72.5**	**100.0**

The ET response (ET Out) to increases in recharge (Recharge In) are the largest components of outflow and inflow respectively.

Water coming out of storage (Storage In) shows peaks are associated with mine dewatering (Drains Out) peaks. Water going into storage (Storage Out) shows peaks associated with large rainfall events.

Contributions from regional boundary flow (GHB In and Out) and rivers (Riv In and Out) are small overall (**Figure 3-8**).

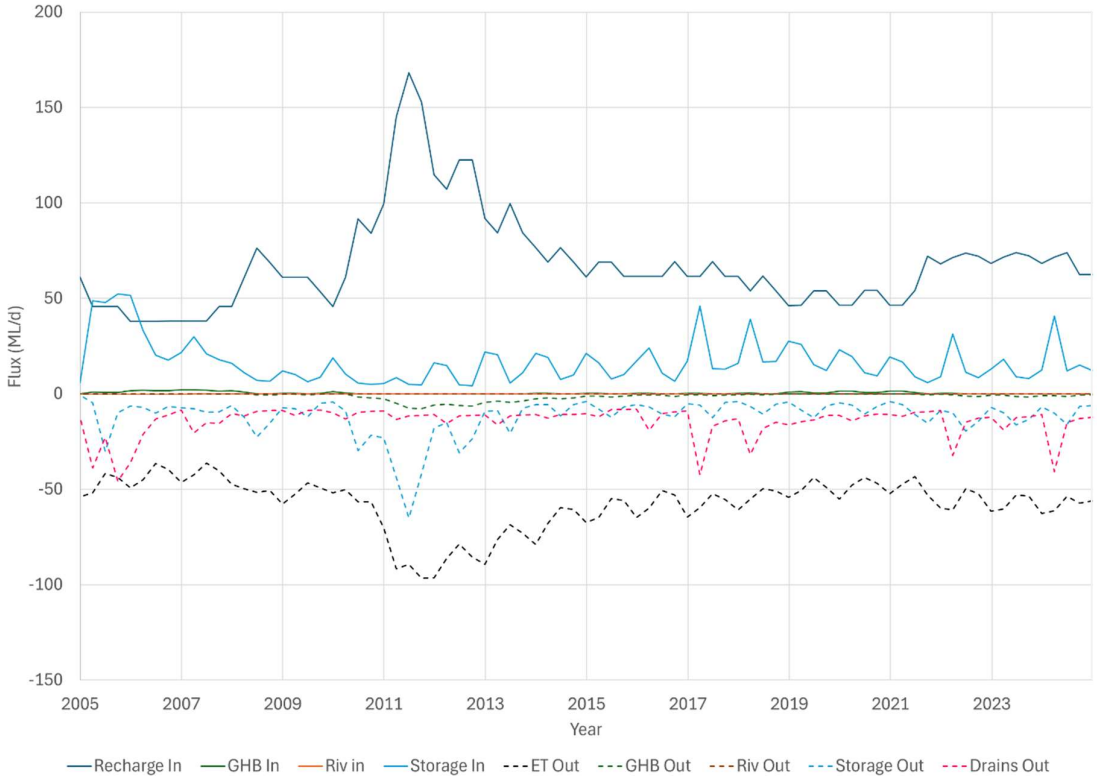


Figure 3-8 Transient Water Balance

3.4.2 Calibrated Hydraulic Parameters

3.4.2.1 Calibrated Hydraulic Conductivities

Table 3-7 provides a summary of the model layer parameter values for horizontal and vertical hydraulic conductivity.

3.4.2.1 Calibrated Storage Properties

Table 3-8 summarises the calibrated values of specific storage and specific yield for the hydrostratigraphic units.

Table 3-7 Calibrated Hydraulic Conductivity

Model Layer	Formation	Unit	Kx min (m/day)	Kx max (m/day)	Kx mean (m/day)	Kx BCM (m/day)	Kz min (m/day)	Kz max (m/day)	Kz mean (m/day)	Kz BCM (m/day)
1	Alluvium/Tertiary	Surface cover	8.7E-02	6.4E+00	1.3E+00	8.7E-02	2.2E-03	1.9E-01	3.8E-02	2.2E-03
1	Alluvium/Tertiary	Tertiary	2.1E-01	1.8E+00	8.6E-01	1.1E+00	6.7E-03	6.9E-02	2.8E-02	3.6E-02
2	Alluvium/Weathered zone	Weathered zone	9.9E-01	2.2E+01	5.6E+00	4.7E+00	1.8E-02	7.5E-01	1.6E-01	7.9E-02
2	Alluvium/Weathered zone	Regolith	3.7E-01	2.1E+00	1.3E+00	8.8E-01	9.0E-03	6.7E-02	3.5E-02	2.5E-02
3	Clematis Group	Triassic	4.2E-02	1.7E+00	6.2E-01	1.4E+00	3.5E-03	2.0E-01	3.9E-02	1.0E-01
4	Rewan Group (Upper)	Triassic	9.0E-04	1.3E+00	1.7E-01	4.7E-02	2.4E-05	6.2E-01	2.2E-02	3.8E-04
5	Rewan Group (Middle)	Triassic	2.5E-05	4.4E-02	9.2E-03	1.4E-03	6.6E-07	1.3E-02	1.2E-03	3.9E-05
6	Rewan Group (Lower)	Triassic	2.1E-05	1.1E-01	1.3E-02	1.2E-02	6.0E-07	1.2E-02	2.0E-03	8.3E-04
7	RCM	Overburden	1.3E-04	1.3E-02	2.0E-03	1.6E-03	1.0E-05	1.8E-03	1.1E-04	1.3E-04
8		Aries seam	2.3E-05	3.4E-04	6.1E-05	2.3E-05	1.7E-07	1.3E-06	4.0E-07	6.6E-07
9		Interburden	9.6E-04	1.5E-02	6.0E-03	1.4E-02	5.5E-05	1.2E-02	5.9E-04	1.5E-04
10		Castor seam	7.5E-05	8.6E-02	7.9E-03	2.2E-02	9.5E-07	5.0E-03	5.0E-04	4.0E-04
11		Interburden	4.2E-04	3.6E-02	6.6E-03	3.8E-03	5.0E-06	1.6E-04	3.4E-05	1.4E-05
12		Pollux seam	5.0E-05	2.6E-02	3.8E-03	7.7E-04	3.5E-06	6.0E-03	5.4E-04	2.2E-04
13		Interburden	1.6E-04	2.4E-02	5.0E-03	1.1E-03	1.5E-05	4.5E-03	6.0E-04	1.7E-04
14		Orion seam	3.1E-05	2.8E-01	2.3E-02	2.8E-01	2.7E-06	2.0E-01	1.0E-02	2.0E-01
15		Underburden	1.6E-05	1.1E-02	1.0E-03	4.0E-04	4.3E-08	1.6E-03	1.3E-04	1.1E-04
16	Burngrove Formation	Permian	2.4E-05	6.8E-03	8.8E-04	5.0E-05	2.4E-05	1.3E-03	1.6E-04	4.1E-05
17	Basement	Permian and/or below	1.2E-05	1.9E-03	5.0E-04	3.1E-04	3.6E-07	1.2E-03	5.2E-05	4.3E-06



Table 3-8 Calibrated Storage Parameters

Model Layer	Formation	Unit	Sy min (-)	Sy max (-)	Sy mean (-)	Sy BCM (m/day)	Ss min (m^{-1})	Ss max (m^{-1}))	Ss mean (m^{-1})	Ss BCM (m^{-1})
1	Alluvium/Tertiary	Surface cover	3.5E-02	7.2E-02	4.9E-02	5.0E-02	5.0E-07	2.7E-05	4.7E-06	5.8E-06
1	Alluvium/Tertiary	Tertiary	2.5E-02	4.0E-02	3.2E-02	2.8E-02	5.9E-07	3.7E-05	8.4E-06	3.0E-06
2	Alluvium/Weathered zone	Weathered zone Regolith	2.8E-02	6.7E-02	4.8E-02	4.0E-02	8.0E-07	4.6E-05	1.3E-05	5.5E-06
2	Alluvium/Weathered zone	Regolith	2.8E-02	4.2E-02	3.5E-02	3.6E-02	5.0E-07	1.4E-05	3.4E-06	1.7E-06
3	Clematis Group	Triassic	2.7E-03	5.3E-03	3.9E-03	3.4E-03	1.0E-07	2.1E-06	4.9E-07	8.4E-07
4	Rewan Group (Upper)	Triassic	1.4E-03	2.6E-02	8.5E-03	8.9E-03	1.3E-07	3.6E-06	1.0E-06	2.8E-07
5	Rewan Group (Middle)	Triassic	1.7E-03	2.4E-02	8.1E-03	3.9E-03	1.0E-07	2.5E-06	6.9E-07	4.6E-07
6	Rewan Group (Lower)	Triassic	3.0E-03	3.0E-02	1.4E-02	2.7E-02	1.3E-07	3.9E-06	9.4E-07	6.1E-07
7	RCM	Overburden	1.3E-03	1.5E-02	5.2E-03	2.9E-03	1.9E-07	4.5E-06	1.4E-06	1.7E-06
8		Aries seam	1.1E-03	2.4E-02	7.6E-03	4.2E-03	1.0E-07	3.2E-06	6.8E-07	2.1E-07
9		Interburden	2.1E-03	3.0E-02	1.1E-02	6.9E-03	2.2E-07	5.0E-06	2.1E-06	2.8E-06
10		Castor seam	1.1E-03	2.7E-02	5.8E-03	2.2E-03	2.3E-07	5.0E-06	1.5E-06	2.0E-06
11		Interburden	2.6E-03	3.0E-02	1.1E-02	4.7E-03	1.2E-07	3.1E-06	6.3E-07	1.4E-07
12		Pollux seam	1.1E-03	1.6E-02	5.9E-03	8.2E-03	1.5E-07	4.5E-06	8.0E-07	5.2E-07
13		Interburden	1.1E-03	2.3E-02	5.6E-03	2.9E-03	1.9E-07	5.0E-06	1.1E-06	5.7E-07
14		Orion seam	1.3E-03	2.3E-02	7.1E-03	2.7E-03	1.2E-07	4.5E-06	9.5E-07	1.1E-06
15		Underburden	1.1E-03	1.7E-02	6.0E-03	1.7E-02	1.1E-07	3.1E-06	8.2E-07	1.3E-06
16	Burngrove Formation	Permian	1.1E-03	2.2E-02	6.7E-03	8.0E-03	1.0E-07	2.2E-06	4.4E-07	2.7E-07
17	Basement	Permian and/or below	1.7E-03	2.8E-02	9.9E-03	1.4E-02	1.0E-07	1.2E-06	3.9E-07	3.6E-07



3.4.3 Calibrated Boundary Conditions

3.4.3.1 Calibrated Recharge

Table 3-9 presents the calibrated recharge rates for each zone in the model. The mean annual rainfall was assumed to be 546 millimetres per year (mm/year), based on SILO gridded data. This value was used to convert deep drainage to an equivalent annual rainfall.

Table 3-9 Calibrated Rainfall Recharge

Model Recharge Zone	Percentage of Rainfall (%)				Long-term Average Rainfall Recharge (mm/year)			
	Min	Max	Mean	BCM	Min	Max	Mean	BCM
Alluvium Quaternary	0.1	0.9	0.3	0.2	0.6	5.2	1.8	1.1
Regolith	0.0	0.3	0.1	0.1	0.1	1.7	0.4	0.4
Weathered Clematis	0.2	4.2	1.3	1.1	1.0	23.1	7.1	6.0
Weathered Permian	1.5	5.1	3.8	4.0	8.1	28.1	20.7	21.9
Spoil	1.0	5.4	2.8	3.0	5.6	29.7	15.3	16.1
Tailing	0.0	2.5	0.4	0.2	0.1	13.8	2.0	1.1

3.4.3.2 Calibrated Evapotranspiration

Table 3-10 presents the calibrated EVT rates and extinction depth. The mean annual potential ET was assumed to be 1,644 mm/year, based on SILO gridded data. This value was applied to the steady-state and predictive periods, while a time-varying series was applied during the transient calibration period.



Table 3-10 Calibrated Evapotranspiration Rate and Extinction Depth Bounds

Model EVT Zone	EVT factor of PAN				EVT Depth (m)				Long-term Potential EVT (mm/year)	Long-term Average EVT (mm/year)			
	Min	Max	Mean	BCM	Min	Max	Mean	BCM		Min	Max	Mean	BCM
Alluvium Quaternary	0.5	0.9	0.7	0.6	1.7	13.7	6.6	5.0	1644.0	845.6	1543.9	1105.2	1041.6
Regolith	0.5	0.9	0.7	0.8	0.7	11.2	3.3	4.5		897.6	1557.7	1198.5	1361.8
Weathered Clematis	0.5	0.8	0.7	0.6	0.6	12.5	3.6	4.3		822.7	1372.4	1077.7	1044.1
Weathered Permian	0.5	0.8	0.6	0.6	6.6	14.9	11.5	12.7		821.3	1350.1	1028.7	1025.5
Spoil	0.5	0.9	0.6	0.5	0.5	2.5	1.2	1.3		821.3	1404.9	1056.4	821.3
Tailing	0.5	0.9	0.7	0.6	0.5	2.9	1.2	1.2		838.2	1471.0	1102.5	903.4

3.4.3.3 Calibrated River Boundary

Calibrated river vertical conductivity are presented in **Table 3-11** and calibrated tailing deposition vertical conductivity are presented in **Table 3-12**.

Table 3-11 Calibrated River Vertical Conductivity

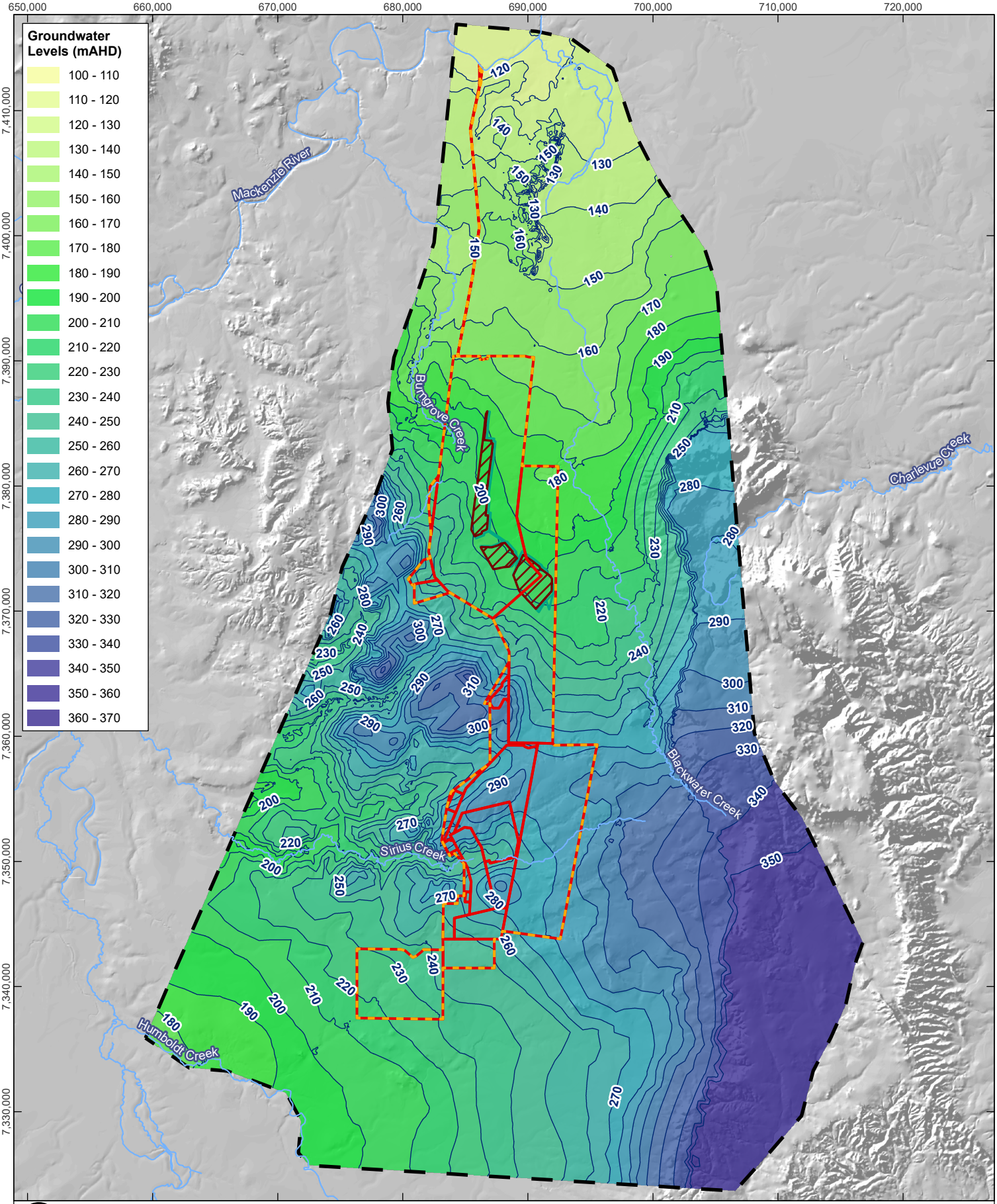
Zone	Vertical K (m/day)				River Name
	Min	Max	Mean	BCM	
1	1.2E-05	1.6E-01	1.5E-02	8.9E-03	Blackwater mainstream
2	8.5E-04	1.0E+00	3.6E-01	2.1E-01	Blackwater tributaries
3	1.0E-05	1.9E-01	7.7E-03	3.7E-03	Sirius Creek
4	5.3E-05	5.6E-01	3.2E-02	2.7E-03	Rockland Creek and tributaries
5	2.1E-05	7.9E-01	3.8E-02	1.5E-02	Humboldt Creek and tributaries
6	9.0E-05	7.4E-01	8.3E-02	2.5E-02	Planet Creek and tributaries
7	1.0E-05	2.8E-01	1.5E-02	3.8E-05	Small streams
8	1.1E-05	1.5E-01	7.3E-03	7.4E-05	Deep Creek dam
9	1.0E-05	6.7E-02	4.2E-03	8.8E-04	New Taurus dam
10	3.7E-05	6.2E-01	3.8E-02	1.7E-04	Tannyfoil dam

Table 3-12 Calibrated Tailing Deposition Vertical Conductivity

Tailings	Kz (m/day)				Stage
	Min	Max	Mean	BCM	
BD-R10N	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
BD-R12N	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
BD-R12S	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from July 2023 until 2040
R74	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from Oct 2015 until 2023
Curragh Mine	2.7E-06	9.5E-05	2.5E-05	4.9E-05	Deposited from Jan 2007 until 2023

3.4.4 Calibrated Water Table Elevation

The calibrated water table elevation is presented for steady state period (**Figure 3-9**) and the end of the calibration period (**Figure 3-10**).



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- Groundwater Level Contour (10mAHD)
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

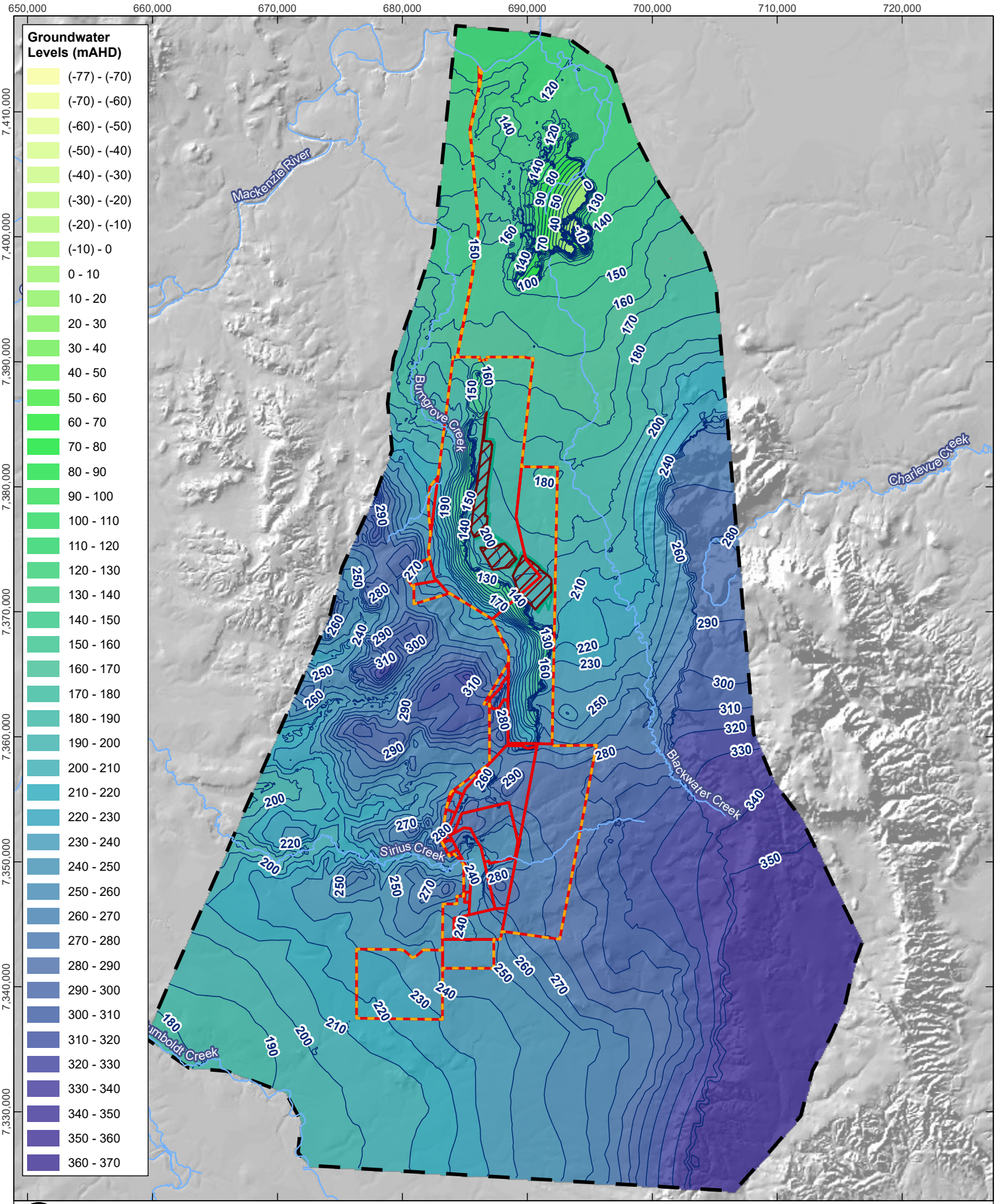
CALIBRATED WATER TABLE ELEVATION, STEADY STATE

SLR

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FIGURE 3-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F03_09_Calibrated Water Table Elevation - Steady State Period



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- Groundwater Level Contour (10mAHD)
- BWM Mining Lease
- Project Area (Environmental Authorities boundary)
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

CALIBRATED WATER TABLE ELEVATION - END OF CALIBRATION

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FIGURE 3-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F03_10_Calibrated Water Table Elevation - End of Calibration

4.0 Predictive Modelling – Mining Period

4.1 Timing and Mining

Transient predictive modelling was used to simulate the proposed mining at the Project as well as mining at other approved and foreseeable mines within the model domain. The cumulative assessment was undertaken for BWM (northern portion), the Project (SA 7 and SA 10), BWM (southern portion), Curragh Mine (operating mine), and Cook Collieries. The simulated predictive mine progression for BWM, including the Project, is presented in **Figure 4-1**.

The predictive part of the model comprises annual stress periods, commencing January 2025 through until December 2093. The predictive model stress period setup is detailed in **Appendix C** alongside simulated mine timings.

Transient predictive models have been developed for three scenarios:

- Cumulative Scenario– all approved and foreseeable mining in the model area and at BWM plus the Project.
- Approved Scenario– all approved and foreseeable mining in in the model area and at BWM without the Project.
- Null Run – no mining within the model area.

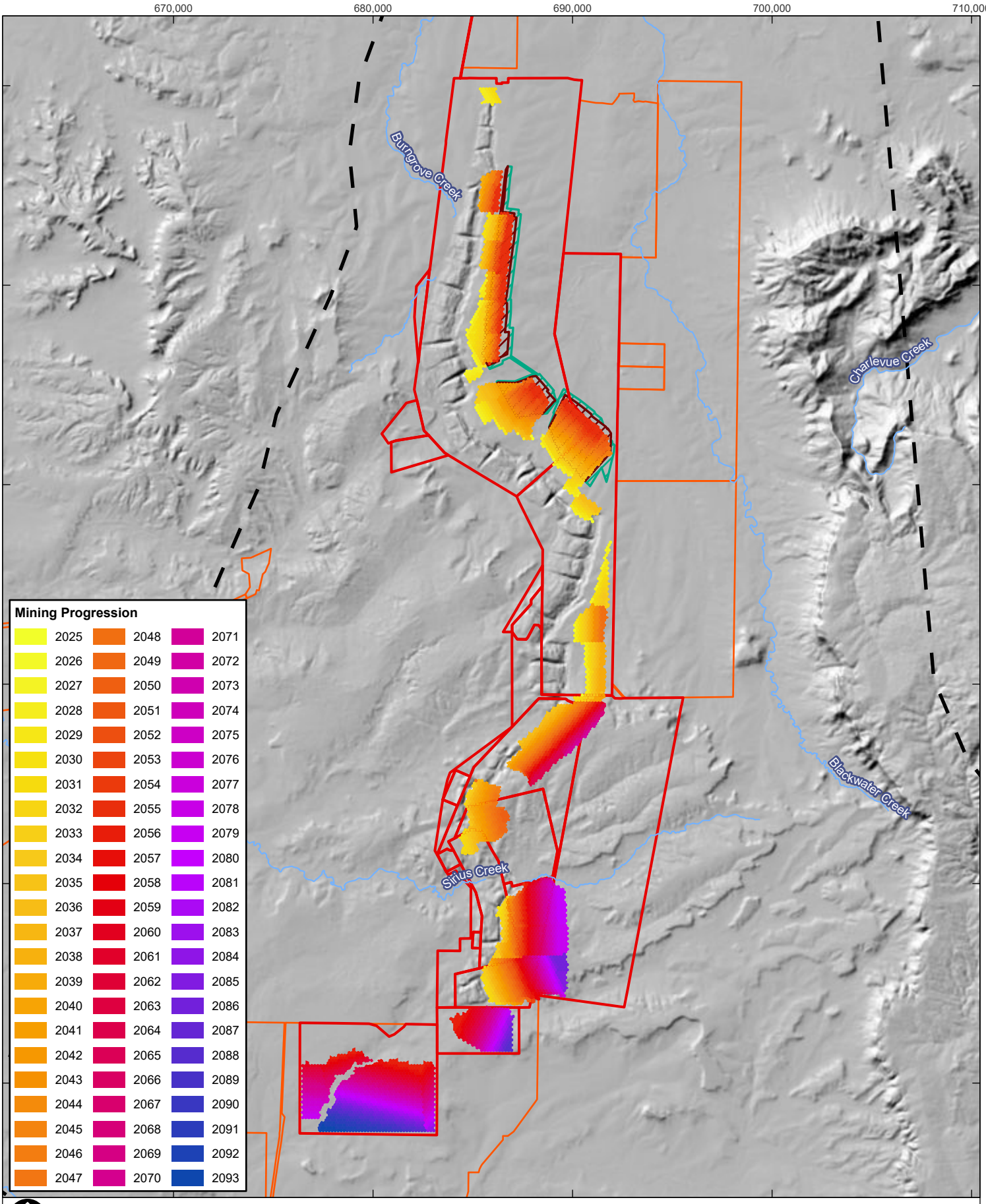
The Project effects (i.e. the incremental changes) are estimated by the difference between the Cumulative and Approved scenarios. Mining cells progressed annually and drain cells simulating the mining were projected down to the base of the lowermost target coal seam (i.e. the Pollux seam).

To define the active drainage period for the mining cells at the project, rather than assuming a fixed period of 1 or 2 years, an in-house script that dynamically calculates this period by referencing adjacent mining cells was utilised. For each cell, the script identifies the nearest mined neighbour in the same pit and compares their mining time. The difference determines how long the cell should be draining, providing a more realistic and spatially responsive representation of pit dewatering. After the drains were removed the TVM package was used to assign spoil/void/tailing properties to the cells depending on their spatial location.

Appendix C presents the simulated mine timings for the Project and surrounding mines used in the predictive model. BWM (including the Project) was included for the predictive run, as all other mines have either been in closure or care and maintenance or the future mining sequence was not available. The cumulative impact assessment however will consider those mines as they were included in the calibration period up to end of 2024. The following applies:

- Cook Colliery underground mining: in closure, active during calibration period and included as such.
- Curragh Mine: Coronado currently operates the Curragh Coal Mine Complex, which is located adjacent to the Project and approximately 8 km north of Blackwater Township. The complex comprises two open cut mines (Curragh North and Curragh South) and an underground mine (Mammoth Underground). The open cut operations began in 1983, extracting coal from the Aries, Pisces, Castor and Pollux coal seams of the RCM, while the underground mine started in 2024.

All mines included in the model were simulated using the DRN package. A nominally high drain conductance of 100 square metres per day (m²/day) was applied to drain cells to simulate rapid removal of water from the system.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

PROJECT INDICATIVE MINE PROGRESSION

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FIGURE 4-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_01_Project Indicative Mine Progression

4.2 Water Balance

Table 4-1 to **Table 4-3** provide average flow rates (January 2025 until December 2093) for water transfer into and out of the groundwater model domain for the three predictive scenarios; the Cumulative, Approved and Null Run. The cumulative mass balance error over the entire simulation period is < 0.1% for all three scenarios.

The tables show that simulated recharge increased from 61.8 ML/day in the Null scenario to 64.5 ML/day and 62.7 ML/day in the Cumulative scenario and the Approved scenario respectively. The increase in recharge is due to the presence of open cut mining and enhanced recharge through the spoil to the groundwater system in the Approved and Cumulative scenarios.

Table 4-1 to **Table 4-3** and **Figure 4-2** to **Figure 4-4** show that in all three predictive scenarios, groundwater leaves the model through regional groundwater flow (GHB). The GHB inflow and outflow are < 0.4% of the total inflow and outflow in water balance for all the scenarios indicating the model boundary conditions do not have a significant influence on the model predictions.

ET decreased from 56.6 ML/day in the Null Scenario to 51.4 ML/day and 51.7 ML/day in the Project and Approved scenarios. The ET decline is primarily due to the mining activities and decline of water levels within the saturated shallow areas such as voids, pits or outcropping areas.

The net groundwater flow to Blackwater Creek is 0.02 ML/day in all three scenarios. All scenarios indicate the flow is generally from groundwater to the Creek, however this flow is very minor (and shows that Blackwater Creek does not receive continuous amounts of baseflow).

Groundwater outflow from the model occurs predominantly via drain cells, used to simulate open cut and underground mining activity in the model. **Table 4-1** and **Table 4-2** show that the Cumulative scenario resulted in an increase in the average drain outflow (to 14.5 ML/day from 11.8 ML/day predicted for the Approved scenario). The storage component in the table refers to changes in the water level over the transient simulation timeframe. Changes in the storage between the Approved and Cumulative Scenarios relate to the change in mine footprint and added recharge through spoil.

Table 4-1 Average Simulated Water Balance over the Predictive Period - Cumulative

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	64.5	75.4	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	51.4	60.0
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	6.9	8.1	5.2	6.1
Regional Groundwater Flow (GHB)	0.3	0.4	0.1	0.2
Mines (DRN)	0.0	0.0	14.5	16.9
Storage	13.8	16.1	14.3	16.8
Total	**85.5**	**100.0**	**85.6**	**100.0**

Table 4-2 Average Simulated Water Balance over the Predictive Period – Approved

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	62.7	77.2	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	51.7	63.6
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	6.0	7.5	7.9	9.8
Regional Groundwater Flow (GHB)	0.3	0.4	0.1	0.2
Mines (DRN)	0.0	0.0	11.8	14.5
Storage	12.2	15.0	9.6	11.9
Total	**81.2**	**100.0**	**81.2**	**100.0**

Table 4-3 Average Simulated Water Balance over the Predictive Period - Null Run

Component	Inflow (ML/day)	Percent of Total Inflow (%)	Outflow (ML/day)	Percent of Total outflow (%)
Recharge (RCH)	61.8	99.6	0.0	0.0
ET (from GW) (EVT)	0.0	0.0	61.8	99.7
Surface Drainages (RIV)	0.0	0.0	0.0	0.0
Pit Lakes and dams (CHD)	0.0	0.0	0.0	0.0
Regional Groundwater Flow (GHB)	0.0	0.0	0.2	0.2
Mines (DRN)	0.0	0.0	0.0	0.0
Storage	0.2	0.4	0.0	0.0
Total	**62.0**	**100.0**	**62.0**	**100.0**



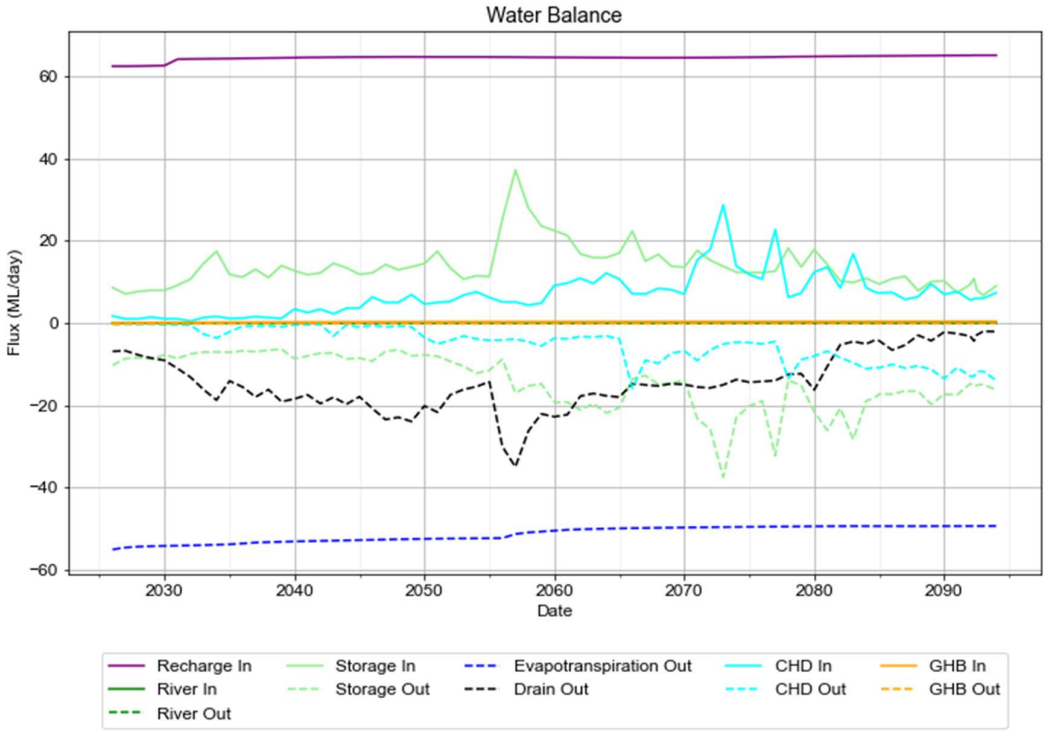


Figure 4-2 Transient Water Balance Over the Prediction Period – Cumulative

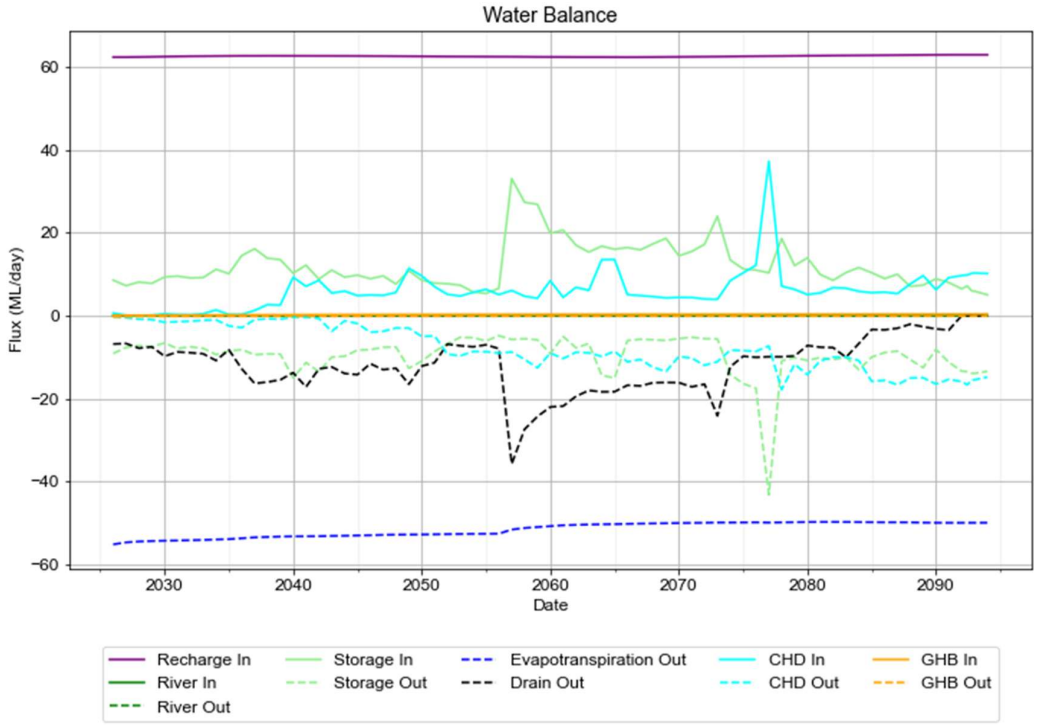


Figure 4-3 Transient Water Balance Over the Prediction Period - Approved

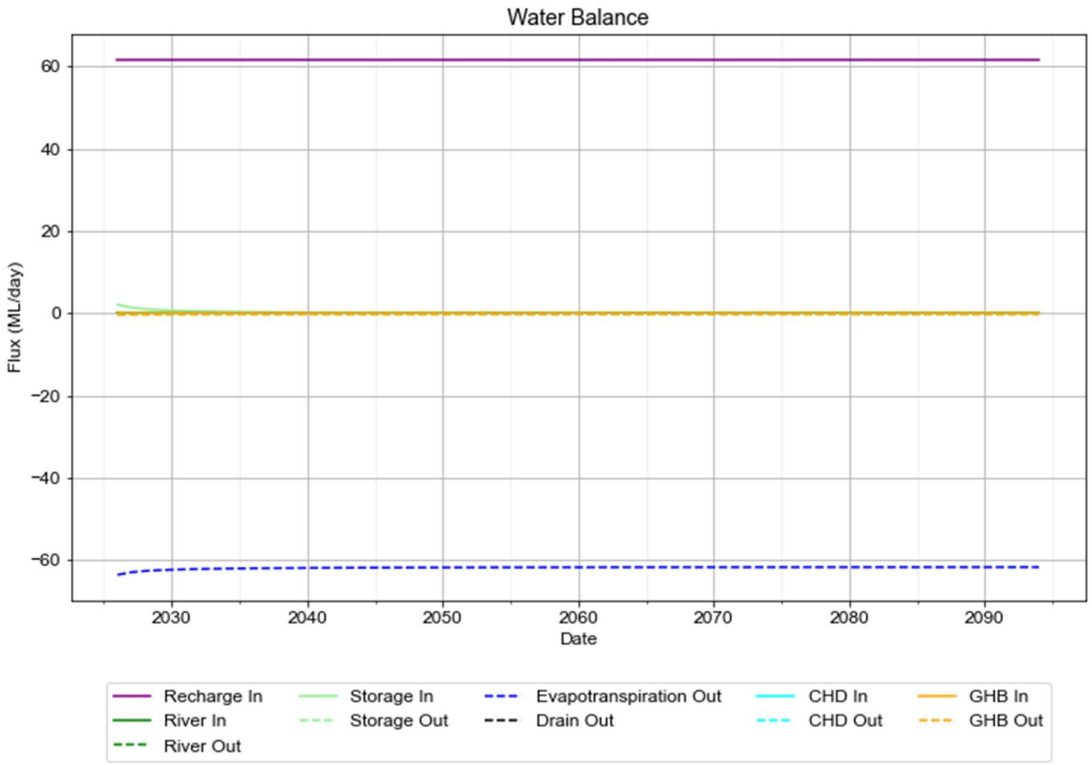


Figure 4-4 Transient Water Balance Over the Prediction Period – Null Run

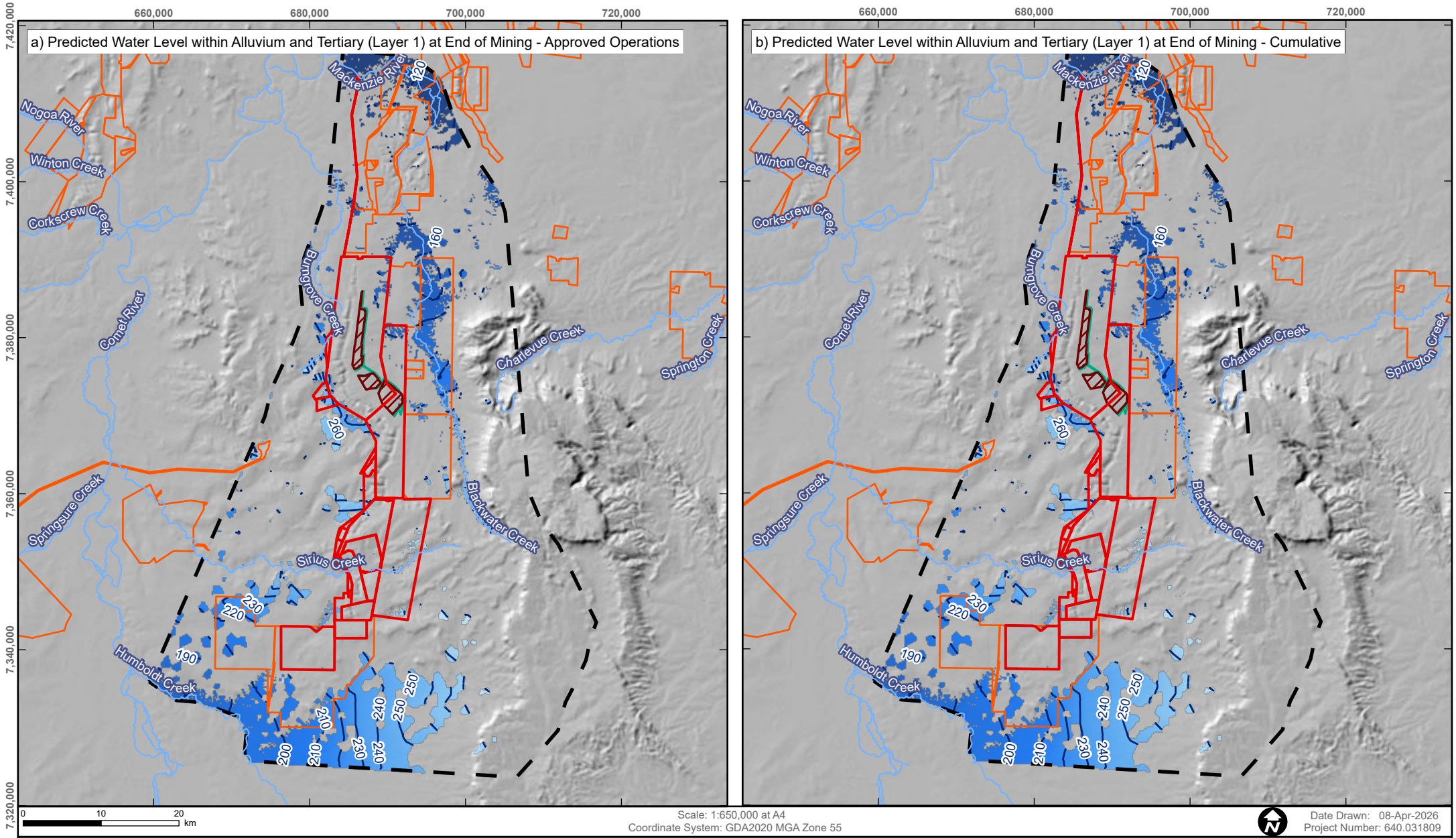
4.3 Predicted Groundwater Levels

Predicted groundwater levels at the end of the modelling timeframe for the Approved and Cumulative scenarios are provided in **Figure 4-5** to **Figure 4-8**. In these four figures, the Approved scenario is presented on the left side, and the Cumulative scenario is presented on the right side. The grey cells in the water level grids represent unsaturated areas (i.e., where the simulated water level elevation is below the base of cell) or an area where the layer is not present.

Minimal changes to alluvium/tertiary (Layer 1) groundwater levels are observed between the Approved and Cumulative mining scenarios (**Figure 4-5**). **Figure 4-6** shows that the dewatering of the weathered zone (Layer 2) caused by the Project occurs particularly within the area immediately to the east of the Project area. **Figure 4-6** also shows that there are no significant changes to the water levels along Blackwater Creek between the Approved and Cumulative Scenarios.

Figure 4-7 shows the predicted groundwater levels in the Clematis sandstone (Layer 3). The Clematis Sandstone is presenting as an outcrop at the eastern side of the model and is disconnected from the Permian coal measures by the Rewan formation. **Figure 4-7** also shows that there are no significant changes to the water levels between the Approved and Cumulative scenarios, indicating that the Clematis sandstone would not be impacted by the Project.

Figure 4-8 show the predicted water levels in the Permian coal measures (Layer 12) at the end of mining for the Approved and Cumulative mining scenarios. **Figure 4-8** shows that the groundwater flow is generally from southeast and south towards Blackwater Creek in the centre and north of the model. Zones of depressurisation at the Project and surrounding mines are shown to cause localised interruptions to the regional flow gradient.



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 08-Apr-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

332

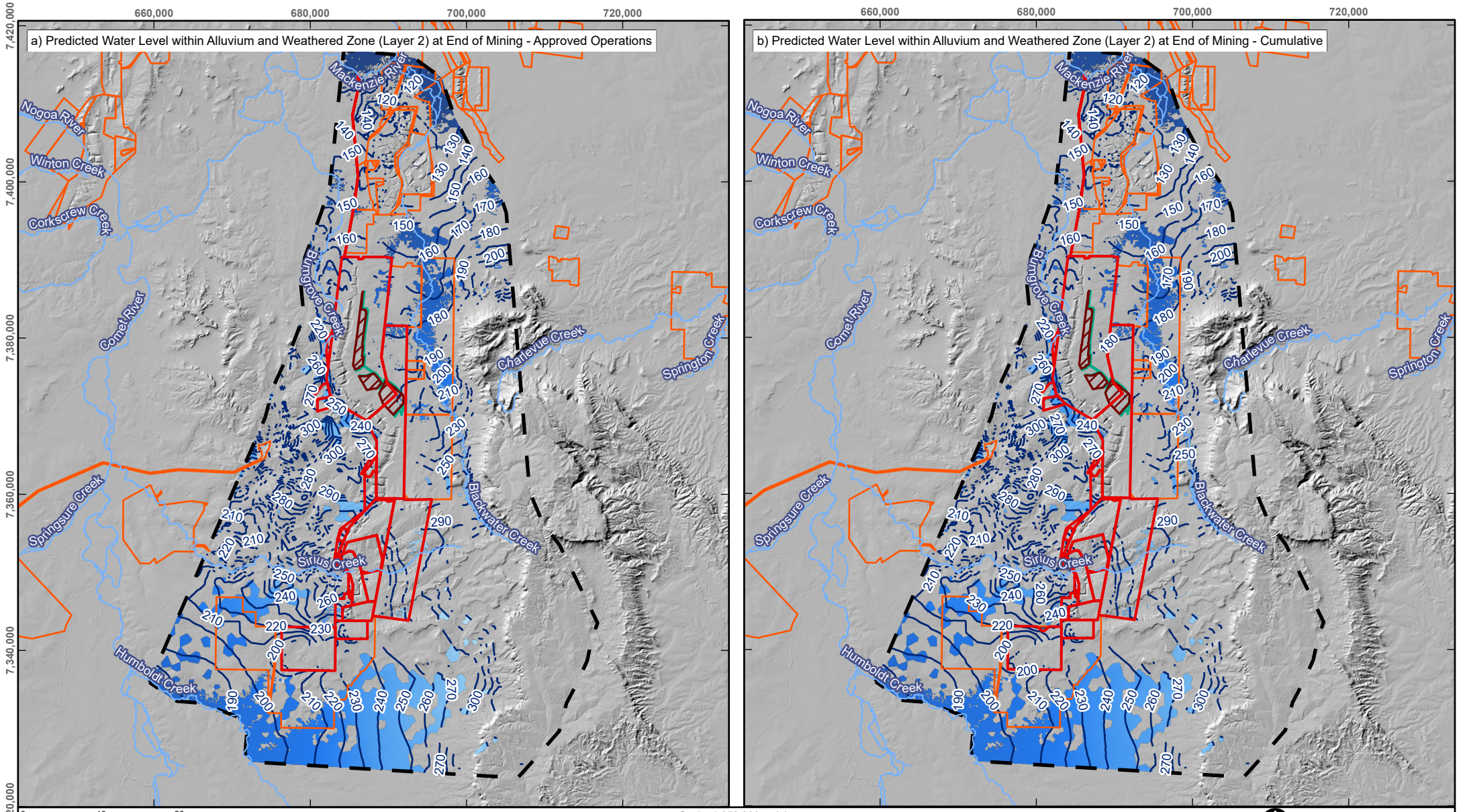
90

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE ALLUVIUM AND TERTIARY (LAYER 1) AT THE END OF MINING

FIGURE 4-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_05_Predicted Water Level within the Alluvium and Tertiary (Layer 1) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:
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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

334

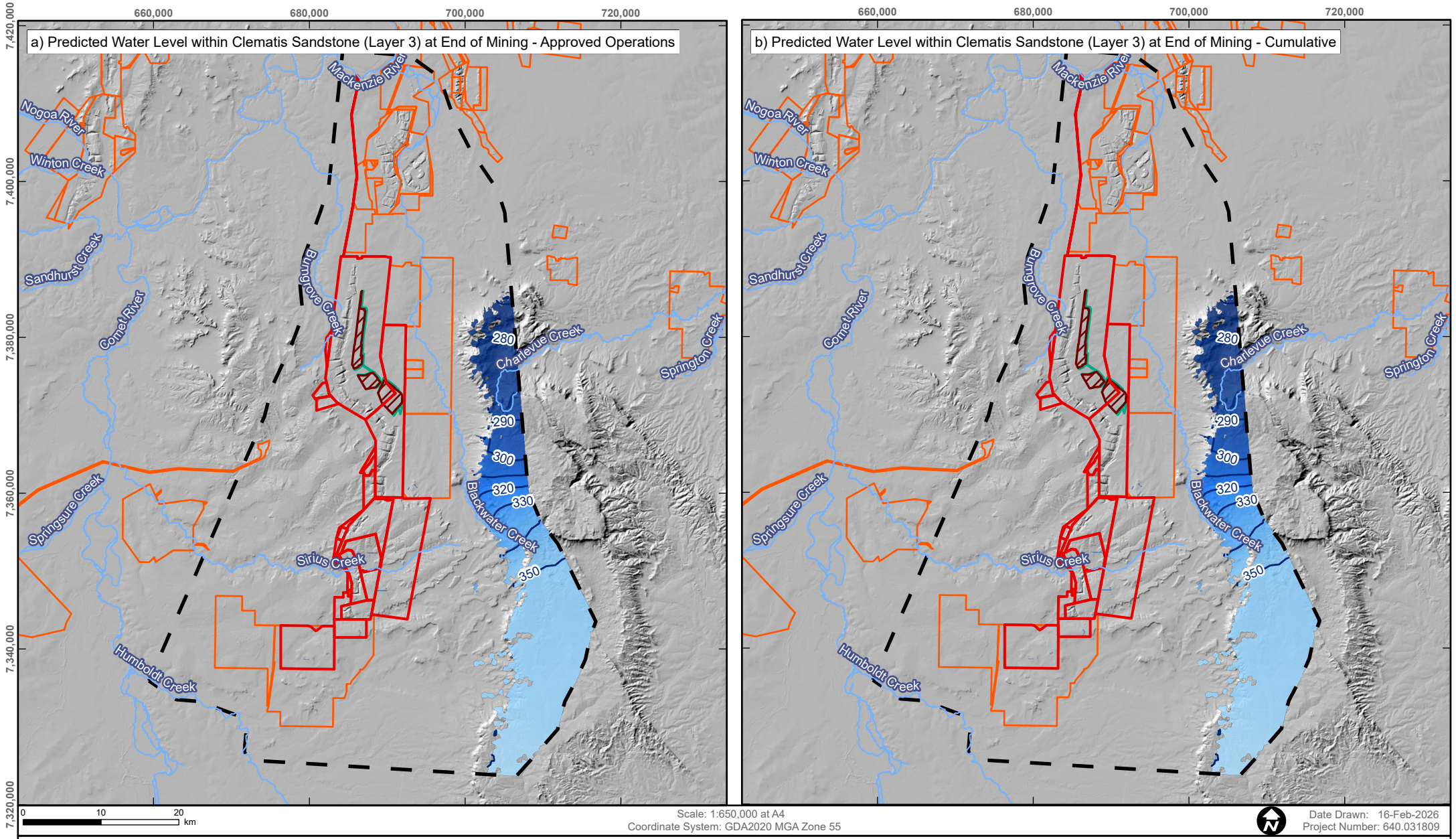
90

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2) AT THE END OF MINING

FIGURE 4-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_06_Predicted Water Level within the Alluvium and Weathered Zone (Layer 2) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

363

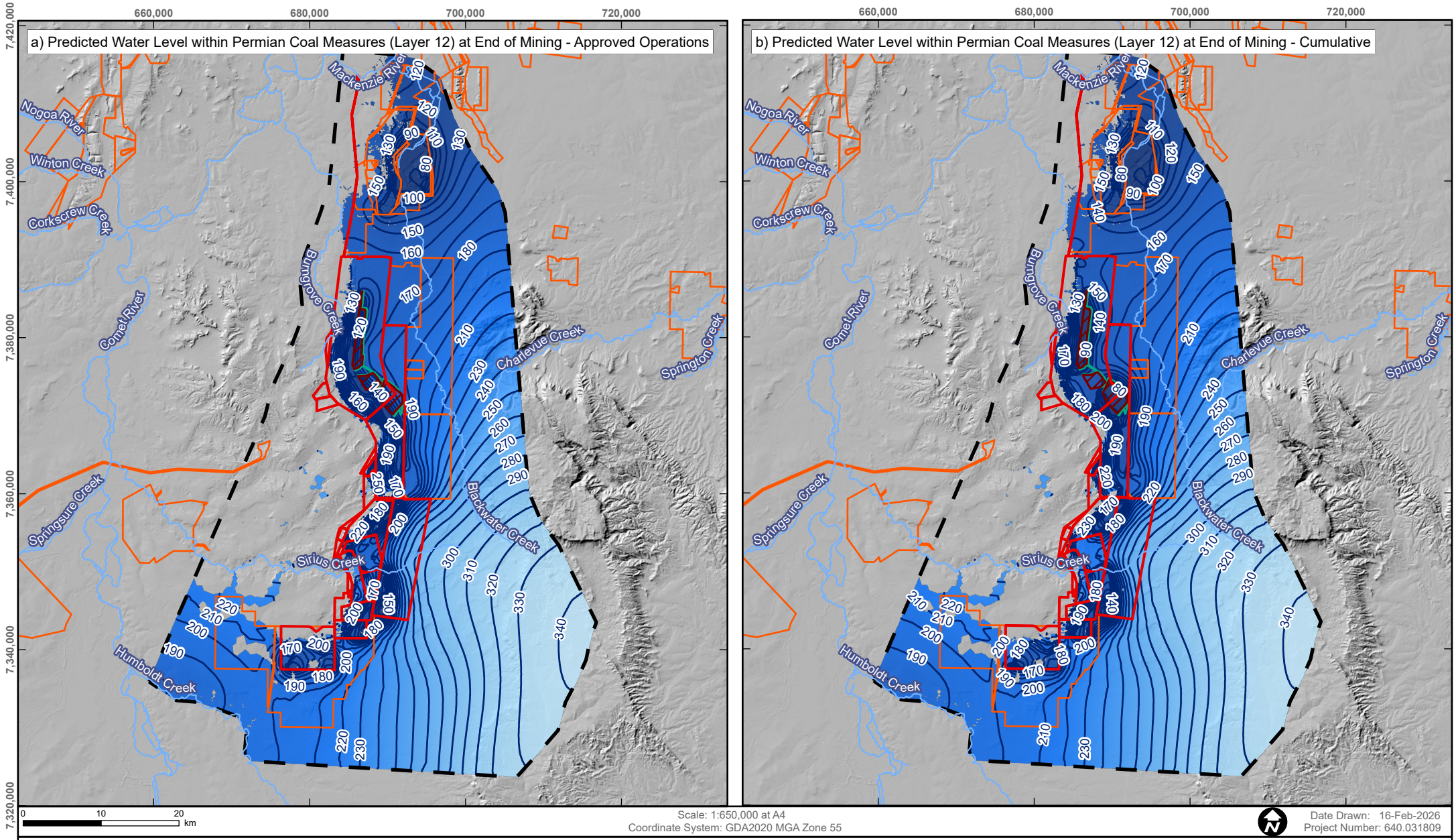
256

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE CLEMATIS SANDSTONE (LAYER 3) AT THE END OF MINING

FIGURE 4-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_07_Predicted Water Level within the Clematis Sandstone (Layer 3) at the EOM



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Groundwater Contour (mAHD)

Groundwater Level (mAHD)

342

68

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED WATER LEVEL WITHIN THE PERMIAN COAL MEASURES (LAYER 12) AT THE END OF MINING

FIGURE 4-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_08_Predicted Water Level within the Permian Coal Measures (Layer 12) at the EOM

4.4 Maximum Predicted Drawdowns

The process of mining directly removes water from the groundwater system and reduces water levels in surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. Aquifer drawdown is greatest at the working coalface and decreases with distance from the mine.

4.4.1 Maximum Incremental Drawdowns

Maximum incremental drawdown refers to the drawdown impact associated with the Project and is obtained by subtracting the predicted maximum aquifer groundwater drawdown for the Approved model scenario (Null – Approved) over the model duration from the predicted maximum aquifer groundwater drawdown for the Cumulative model scenario (Null – Project) over the model duration. The maximum drawdown represents the maximum drawdown values recorded at each model cell. Predicted incremental drawdown figures are presented in **Figure 4-9** to **Figure 4-13**, on the left side.

Figure 4-9 (a) shows that no incremental drawdown greater than (>) 1 m are predicted for the alluvium as a result of mining at the Project. For a discussion on the potential incidental water impacts on the alluvium, see **Section 4.6.1**. The maximum predicted incremental drawdowns associated with the Project within the weathered zone is shown in **Figure 4-10** (a). The incremental drawdown extent within the weathered zone (Layer 2) is largely confined to near the pit and is influenced by the distribution of predicted saturated zones in the weathered zone.

The Permian coal seams are the primary aquifers targeted by the Project and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. **Figure 4-11** (a) and **Figure 4-12** (a) show the maximum predicted incremental drawdown for the Aries and Pollux Seams in the RCM, respectively. The figures show that to the west, the extent of maximum predicted incremental drawdown of the Permian coal measures is limited to near the pit due to the structural geology (i.e., coal seams subcrop). The extent of maximum predicted incremental drawdown in the coal seams towards the east extends laterally to Blackwater Creek, however at depth, not vertically into the shallow formations, such as alluvium or Tertiary.

Maximum predicted incremental drawdown for the Burngrove Formation is shown in **Figure 4-13** (a). The figure shows that maximum predicted incremental drawdown is similar to the drawdown in the coal seams and is limited to the coal seam outcrop.

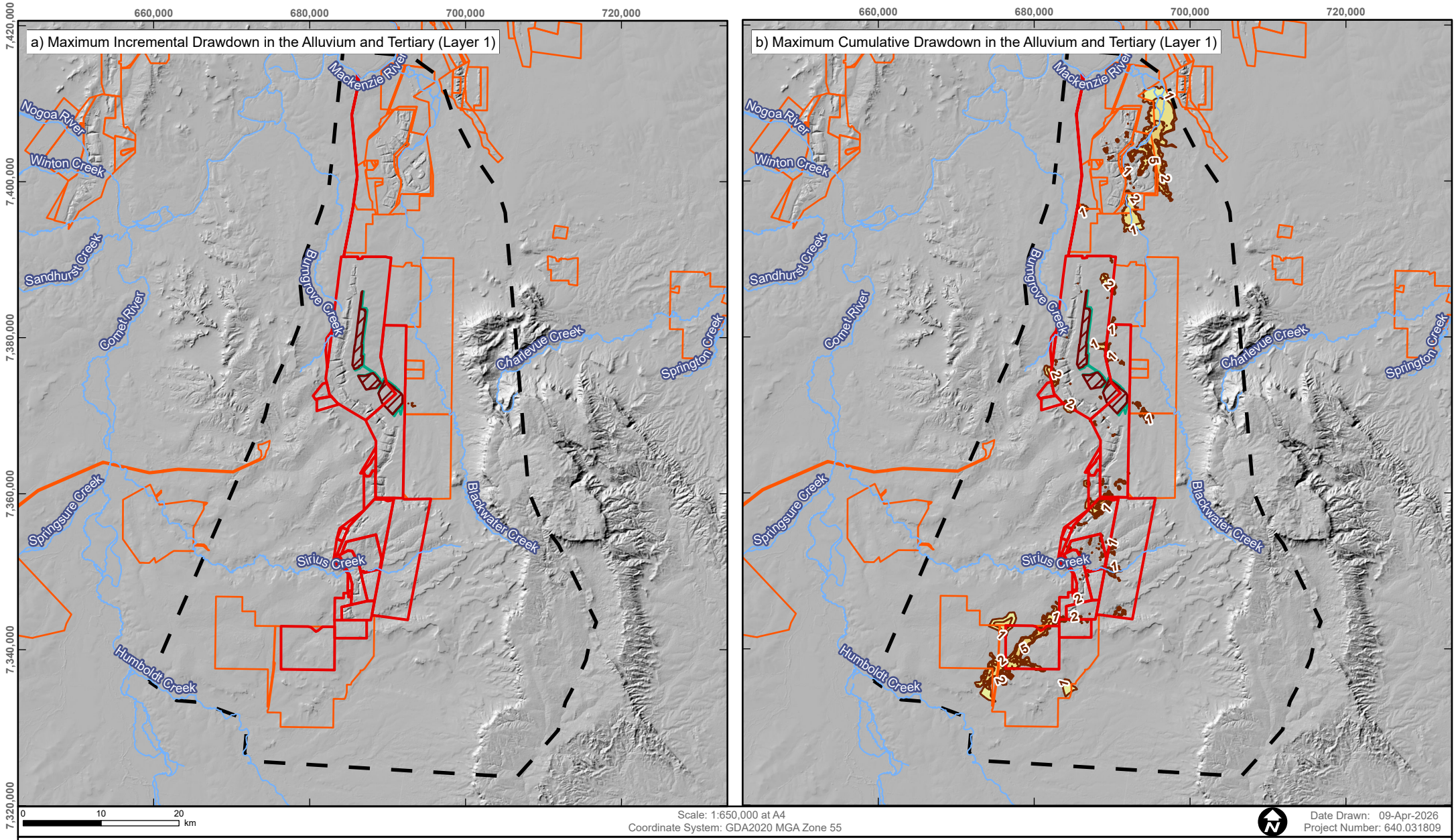
4.4.2 Maximum Cumulative Drawdowns

Maximum cumulative drawdown predicted impacts are shown in **Figure 4-9** to **Figure 4-13**, on the right side. These drawdowns represent the total impact of mining by all current mining and foreseeable mining, including the Project. The cumulative drawdown is derived by calculating the maximum difference in the groundwater levels for the Cumulative scenario with those in a theoretical “No Mining” or Null Run scenario, for all times during the predictive model period.

Cumulative drawdown impacts for the Alluvium and Tertiary (**Figure 4-9**, [b]) show that maximum predicted cumulative drawdown impacts are in the north near Blackwater Creek. Cumulative impacts within the weathered zone (**Figure 4-10**, [b]) can be seen connecting to the drawdown in the Tertiary.

Figure 4-11 (b) and **Figure 4-12** (b) show the maximum predicted cumulative drawdown in the Aries and Pollux seams in the RCM. As shown in the figures the maximum cumulative drawdown is bounded on the western side by the coal seam outcrop and predicted to extend generally a distance of 5-7 km east of the mining areas. The cumulative drawdown reached the model boundary in the northeast, which coincides with a major fault. An extension of the model in that area would still result in the same drawdown, as the fault is expected to act as a barrier to flow.

Figure 4-13 (b) shows the maximum predicted cumulative drawdown in the Burngrove Formation. The maximum cumulative drawdown for Burngrove is similar to the drawdowns expected in the Permian coal measures and predicted to extend approximately 5-7 km east of the mining areas.



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 09-Apr-2026
Project Number: 640.031809

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

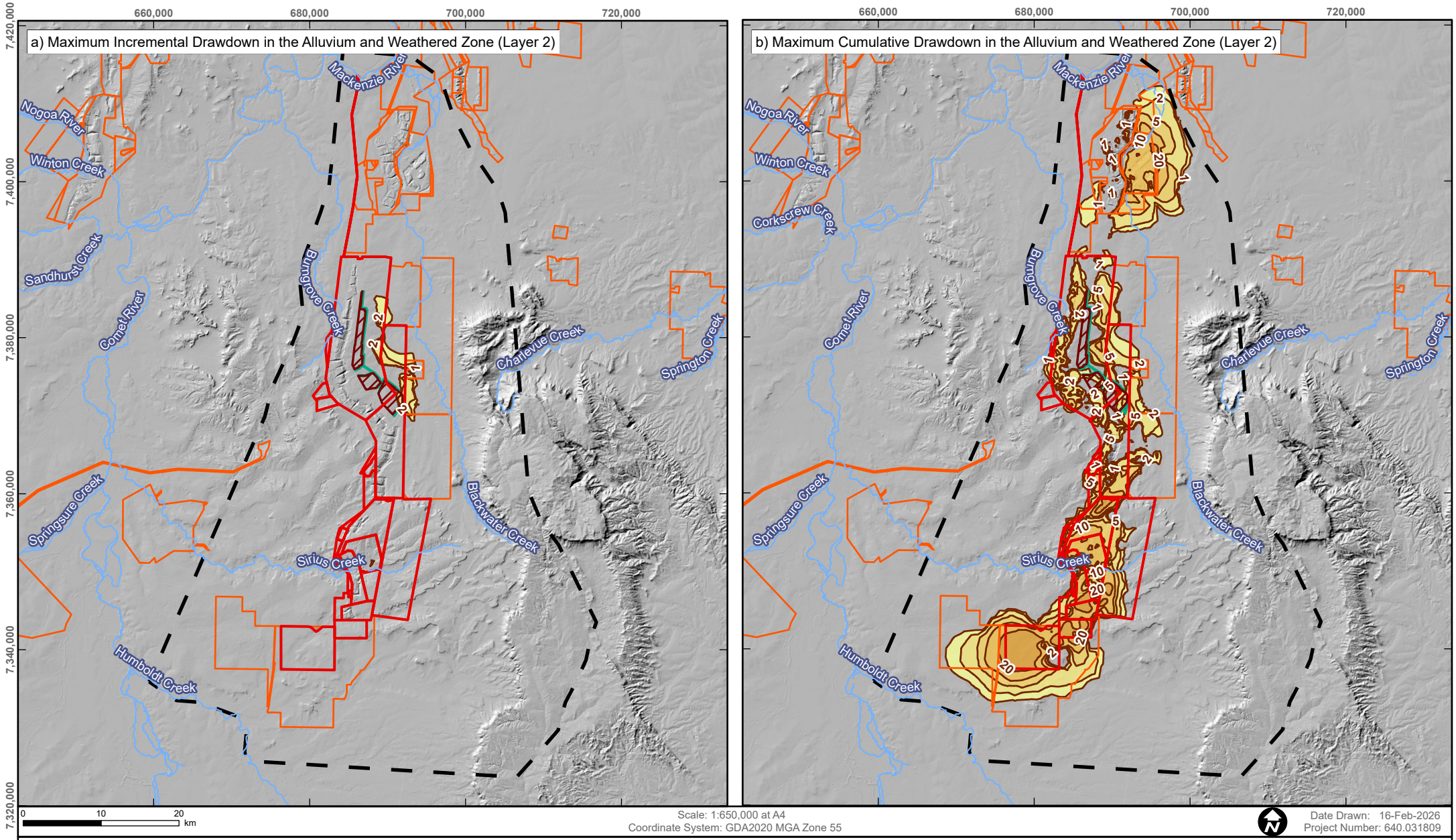
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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ALLUVIUM AND TERTIARY (LAYER 1)

FIGURE 4-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_09_Maximum Incremental (a) and Cumulative (b) Drawdown in the Alluvium and Tertiary (Layer 1)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 16-Feb-2026
Project Number: 640.031809

LEGEND

- Watercourse
- BWM Mining Lease
- Model Boundary
- Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

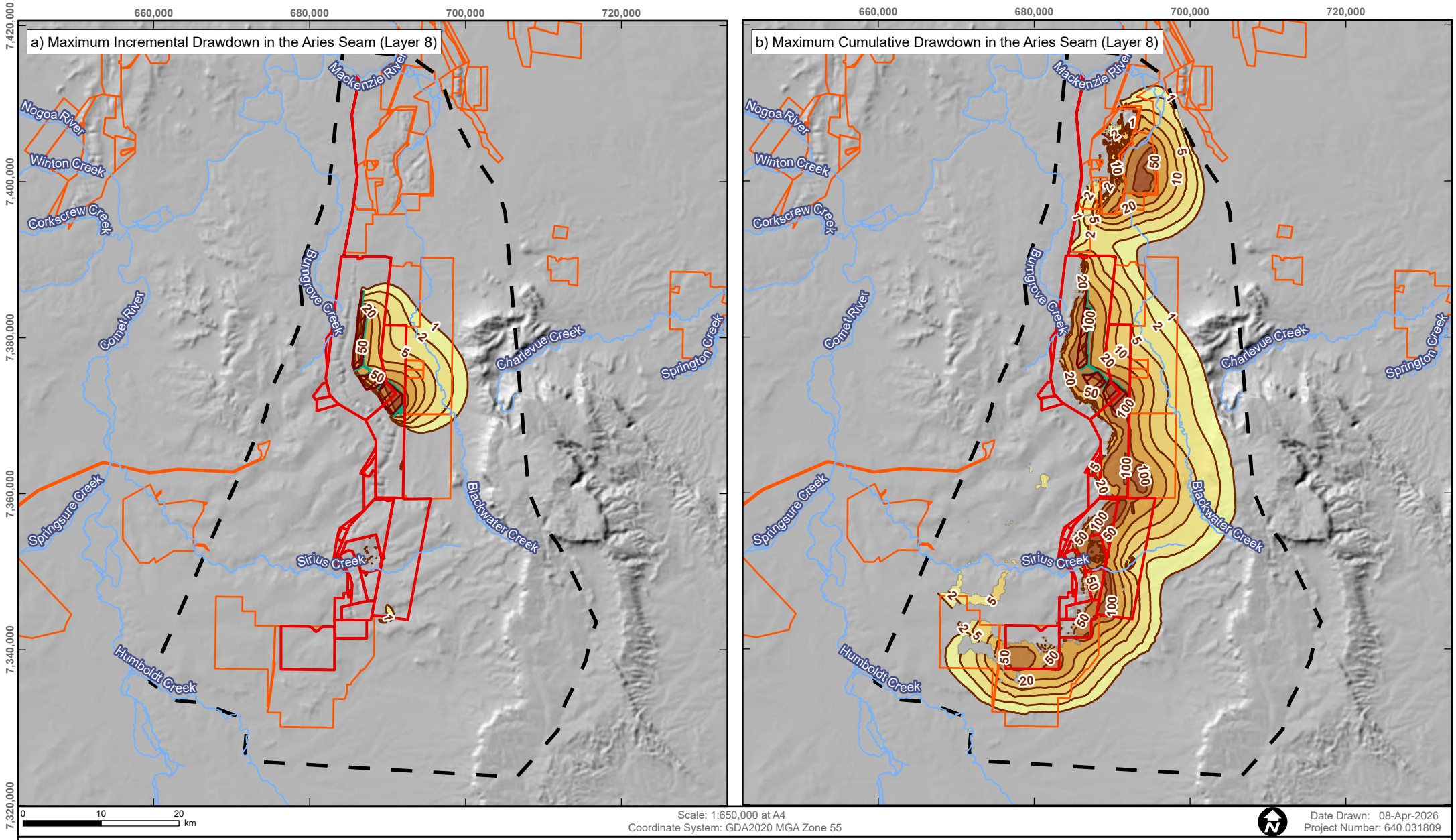
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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ALLUVIUM AND WEATHERED ZONE (LAYER 2)

FIGURE 4-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_10_Maximum Incremental (a) and Cumulative (b) Drawdown in the Alluvium and Weathered Zone (Layer 2)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 08-Apr-2026
Project Number: 640.031809

SLR

Service Layer Credits:

Credits:

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LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

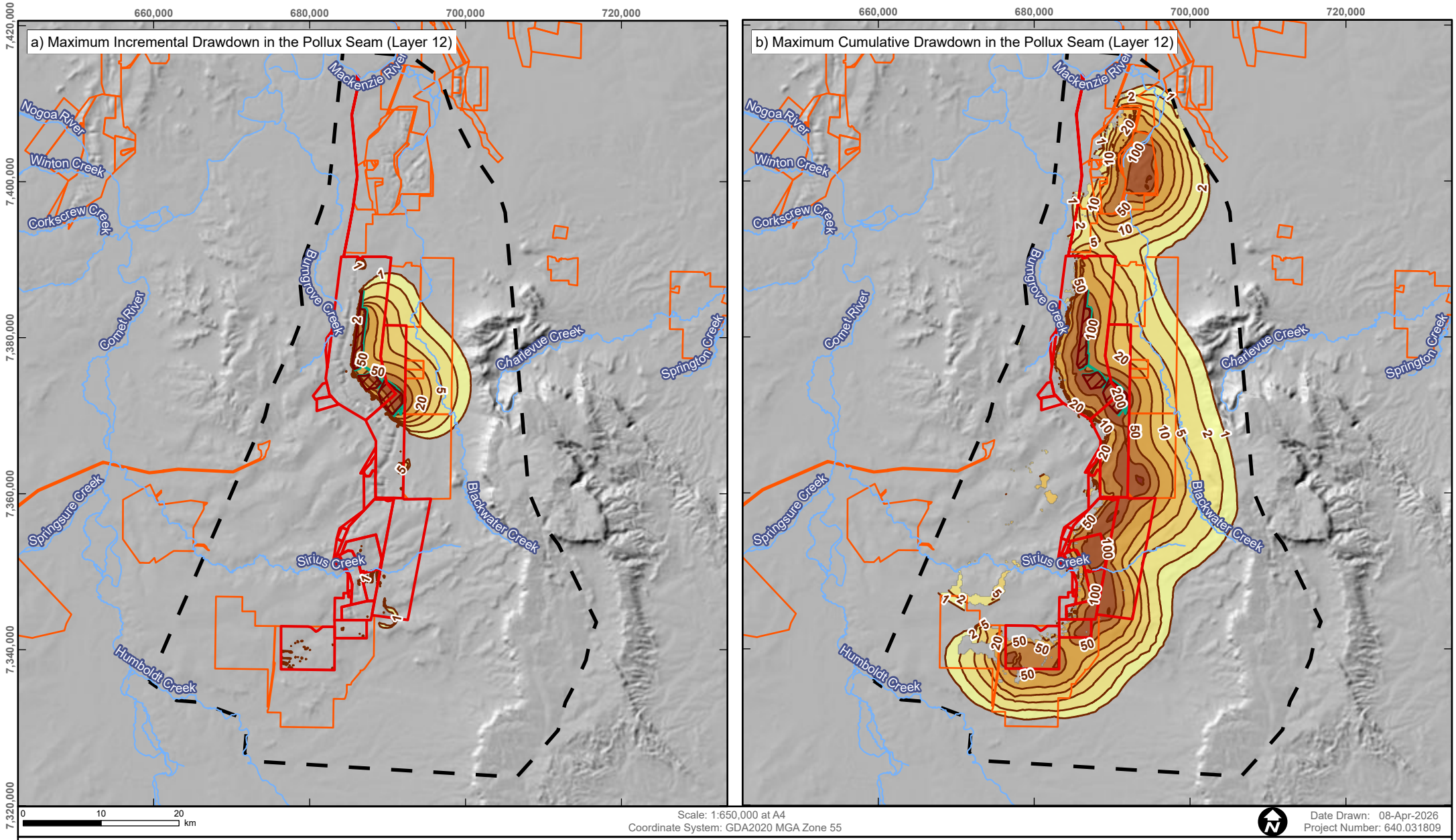
1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE ARIES SEAM (LAYER 8)

FIGURE 4-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_11_Maximum Incremental (a) and Cumulative (b) Drawdown in theAries Seam (Layer 8)



Scale: 1:650,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 08-Apr-2026
Project Number: 640.031809

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

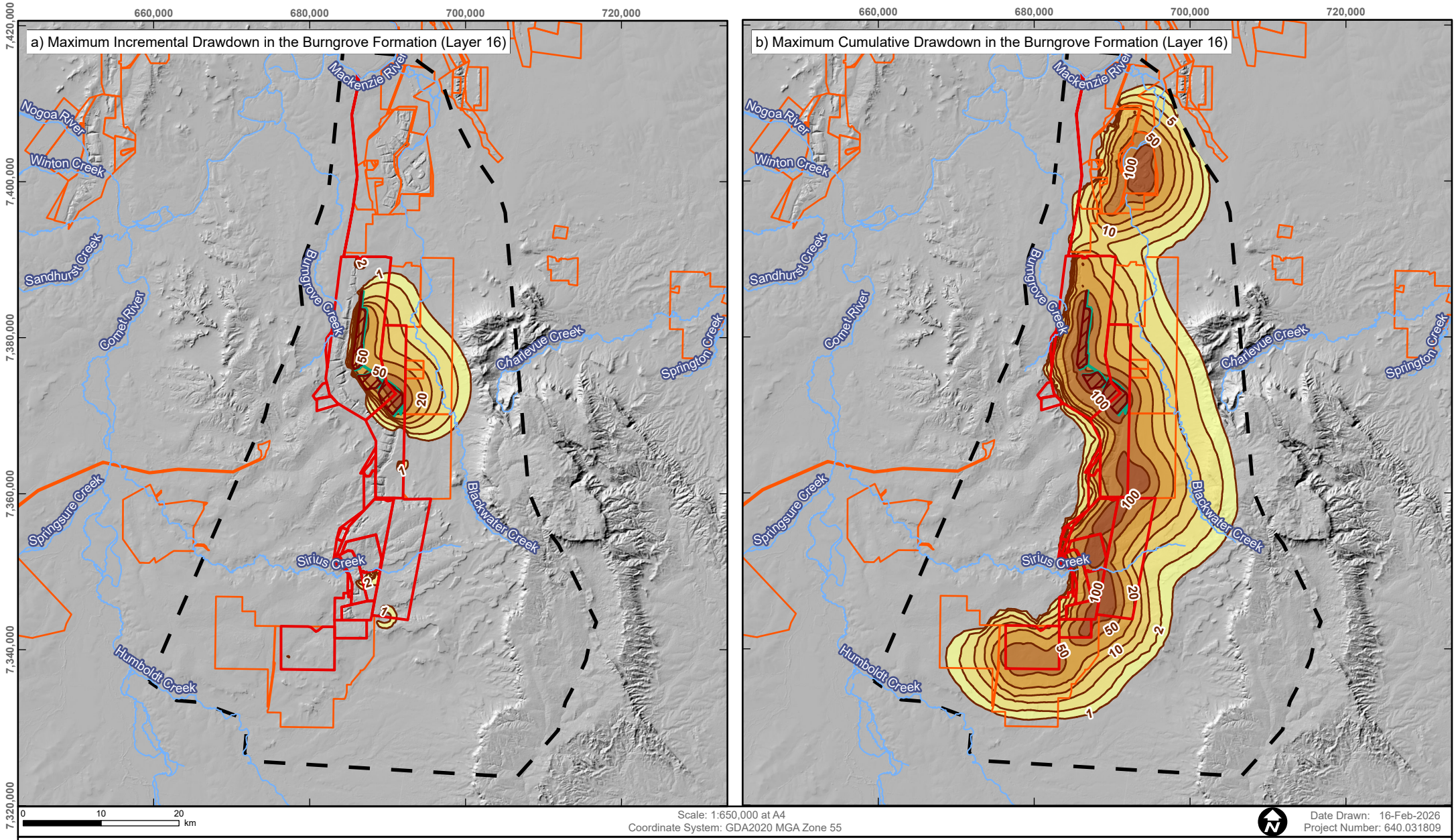
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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE POLLUX SEAM (LAYER 12)

FIGURE 4-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_12_Maximum Incremental (a) and Cumulative (b) Drawdown in the Pollux Seam (Layer 12)



LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Drawdown Contour (m)

Drawdown (m)

1 - 2	20 - 50
2 - 5	50 - 100
5 - 10	100 - 200
10 - 20	200 - 300

SLR

Service Layer Credits:

Credits:

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BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

MAXIMUM INCREMENTAL (A) AND CUMULATIVE (B) DRAWDOWN IN THE BURNGROVE FORMATION (LAYER 16)

FIGURE 4-13

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F04_13_Maximum Incremental (a) and Cumulative (b) Drawdown in the Burngrove Formation (Layer 16)

4.5 Predicted Groundwater Interception

The mine inflow volumes have been calculated as time weighted averages of the outflow reported by Zone Budget software for the relevant drain cells. The predicted inflows for the Cumulative inflows (Approved mining and the Project) and the Incremental inflows (the Project only) are presented in **Figure 4-14**.

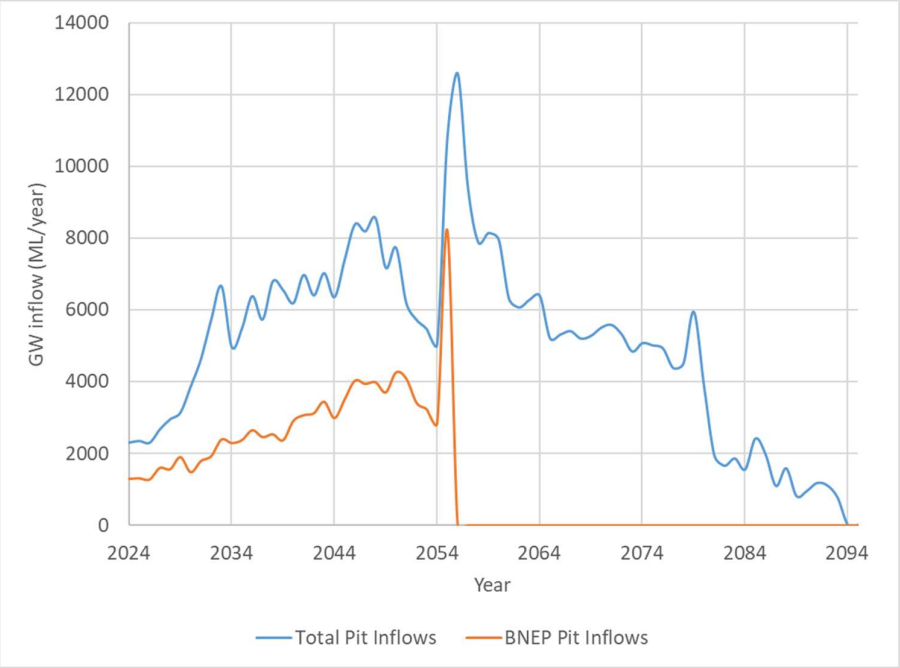


Figure 4-14 Predicted Cumulative and Incremental Project Mine Inflows

Cumulative inflows are predicted to range between 2,290 ML/year and 12,585ML/year from year 2025 and 2056, peaking in 2056, then decreasing until end of mining. The average predicted cumulative mine inflow rate (2025 to 2093) is 5,139 ML/year (14.1 ML/day). The spike in cumulative inflows in 2056 is due to the commencement of the southern mining operations, which are not part of the BNEP and thus the incremental is 0 ML/year.

The incremental inflows into the mine pits on SA 7 and SA 10 are predicted to reach a maximum in year 2055, with a peak just above 8,200 ML/year (22.5 ML/day). The average project mine inflow rate for the Project (2025 to 2055) is 2,272 ML/year (6.2 ML/day).

The Water Plan (Fitzroy Basin) 2011 groundwater area consists of the following:

- Groundwater Unit 1 (containing aquifers of the Quaternary alluvium).
- Groundwater Unit 2 (sub-artesian aquifers).

Planned mining operations at the Project will not intercept Quaternary alluvium at any of the proposed pits. As such, all direct groundwater take predicted by the model is from Groundwater Unit 2.

4.6 Incidental Water Impacts

4.6.1 Alluvium Take

The change in alluvial water resources was estimated by comparing water budgets for alluvial zones using the Approved and Cumulative scenarios of the predictive model. Interference of the alluvial groundwater can occur due to reduced upward leakage from Permian coal measures that are depressurised because of mining activities. Over the extent of Quaternary alluvium along Blackwater Creek, there is a maximum flow reduction of 0.5 ML/day (500 kilolitres per day [KL/day]) from underlying formation to alluvium as a result of the Project (**Figure 4-15**). This reduction represents a regional-scale response, as no specific areas of alluvium are predicted to experience drawdown > 1 m Layer 1 - Alluvium and Tertiary.

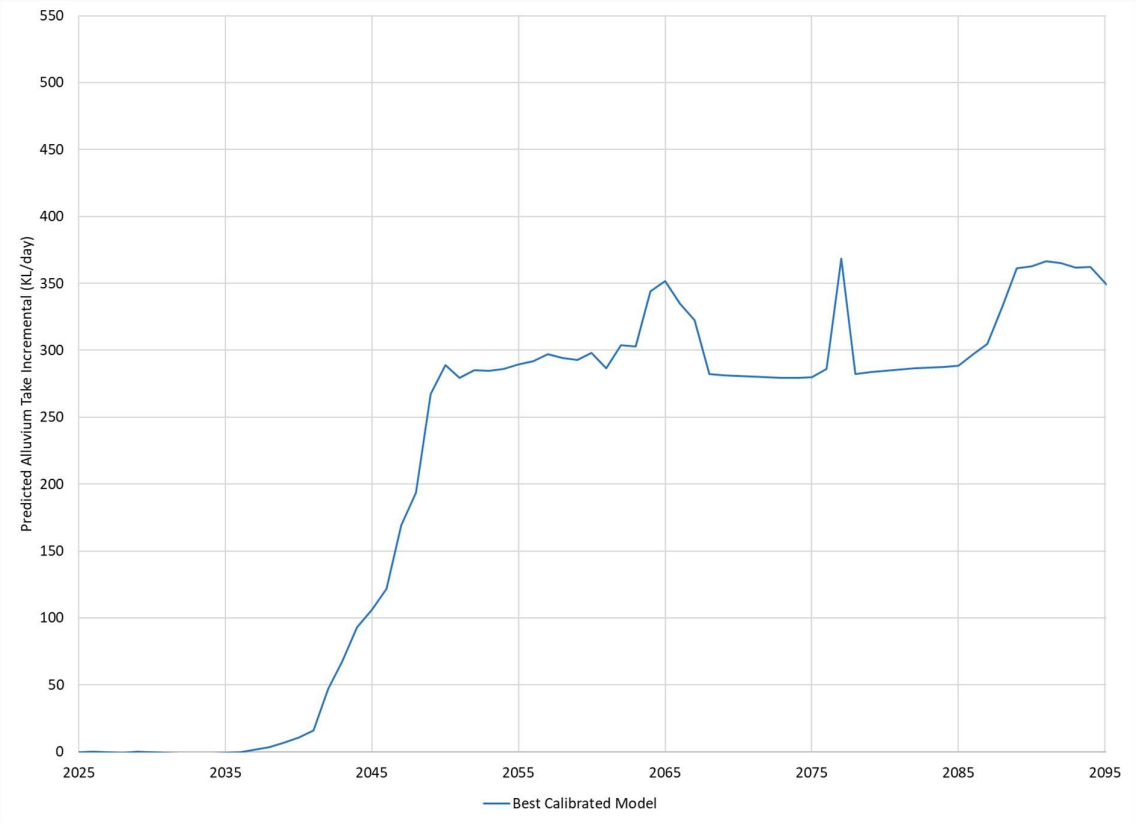


Figure 4-15 Predicted Alluvium Incremental Take

4.6.2 Groundwater – Surface Water Interaction

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario (**Figure 4-16**). This calculation showed that over the life of mine, the maximum change of groundwater flow to Blackwater Creek is negligible (0.001 KL/day).

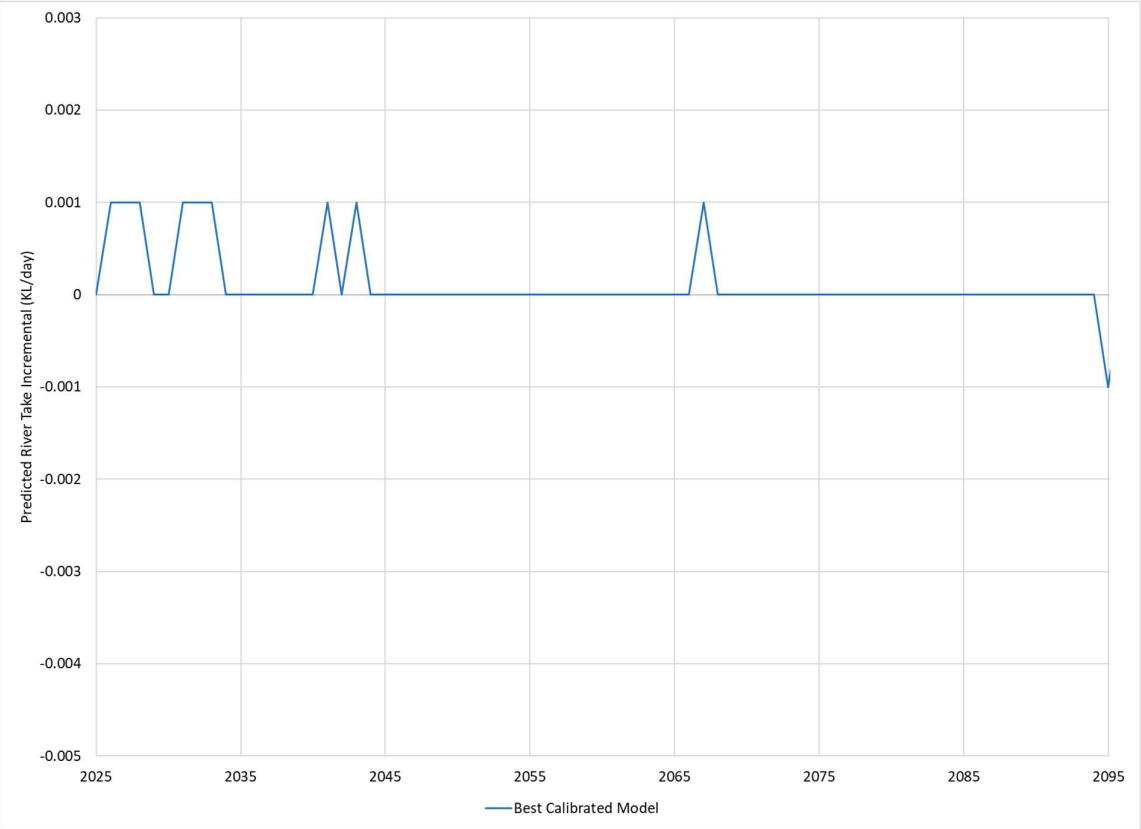


Figure 4-16 Predicted Incremental Loss in River Baseflow (Blackwater Creek)

4.6.3 Drawdown at Landholder Bores

Drawdown was assessed for landholder bores identified in a 5 km radius of the Project area. **Table 4-4** lists the bores with their name, location, screened formation and use. The last two columns present the maximum incremental and cumulative drawdown predicted to occur at each location. Incremental drawdown from the Project is not predicted to be > 0.5 m at any bore. Only bores with casing depth information, and therefore, able to be assigned to a model layer, were assessed.

Table 4-4 Drawdown Impact on Landholder Bores

Registered RN (ID)	Bore name	Easting (GDA94 z55)	Northing (GDA94 z55)	Assumed Model Layer	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
38998	-	681119	7391492	Permian	36.6	Unknown	0	0
43097	-	681800	7392230	Permian	22.8	Water Supply	0	0
43459	Top Bore	683719	7395787	Permian	54.9	Unknown	0	0
57410	House well	674936	7345038	Weathered zone/Regolith	24.4	Unknown	0	0.2
57421	Home well	675898	7343916	Weathered zone/Regolith	30.5	Water Supply	0	4.7
57423	Mikes Bore	677244	7341916	Weathered zone/Regolith	38	Water Supply	0	23.2
57424	Plain Bore (OLD)	675422	7336214	Weathered zone/Regolith	39.6	Water Supply	0.5	13.7
57425	Plain Bore (NEW)	675596	7336268	Weathered zone/Regolith	39.6	Water Supply	0.5	14.6
57461	House Bore	692896	7340485	Triassic	28.9	Unknown	0	14.6
57462	Kulla well (1)	694367	7340239	Surface cover and Tertiary	4.9	Unknown	0	0
57463	Kulla well (2)	694678	7340159	Surface cover and Tertiary	7.6	Unknown	0	0
62660	Thomas Bore	672542	7339045	Interburden	100	Unknown	0.1	9.4
62663	Kevanaghs Bore	675228	7346704	Permian	43	Unknown	0	0
84221	-	683596	7390708	Permian	24	Unknown	0	0



Registered RN (ID)	Bore name	Easting (GDA94 z55)	Northing (GDA94 z55)	Assumed Model Layer	Bore Depth (m)	Use	Maximum Incremental Drawdown (m)	Maximum Cumulative Drawdown (m)
90446	-	686300	7340827	Permian	220	Water Supply	0	62.6
90447	-	685251	7340020	Permian	200	Water Supply	0	41.4
103345	-	684091	7363016	Permian	47	Water Supply	0	0.1
103347	-	678897	7350341	Permian	35	Water Supply	0	0
103348	-	678064	7347791	Permian	38	Water Supply	0	0
103349	-	679152	7345733	Permian	43	Water Supply	0	0.3
103388	-	687575	7340715	Triassic	32	Water Supply	0	21.3
103469	Walro Bore	673410	7335977	Interburden	171.13	Water Supply	0.3	9.5
111709	-	680013	7390877	Permian	72	Water Supply	0	0
132075	-	692910	7340474	Weathered zone/Regolith	9	Water Supply	0	0
158911	-	695505	7341762	Triassic	90	Unknown	0	10.3
165937	-	694749	7341252	Triassic	52	Water Supply	0	12
207590	-	683925	7368395	Surface cover and Tertiary	30	Domestic	0	0
207592	-	685877	7368329	Permian	36	Stock	0	1
208967	-	694466	7340032	Triassic	18	Stock	0	9.9
Unregistered 1	-	671980	7343932	Weathered zone / Regolith	33	Stock	0	0.1
Unregistered 10	-	681315	7380737	Permian	49	Not in use	0	0



5.0 Predictive Modelling – Post Mining

5.1 Timing

The potential post mining impacts of the Project were investigated through a post mining period, commencing at the end of mining at the Project and extending for 1,947 years until the model reached equilibrium. The stress period lengths for the post mining periods are shown in **Table 5-1**. In total, there are 38 stress periods of varying lengths.

Table 5-1 Stress Period Set-up for Post Mining Model

Stress Period	Date Range	Time Interval
155 - 167	01/01/2094 – 31/12/2110	Annual
168	01/01/2111 – 31/12/2120	10 years
169	01/01/2121 – 31/12/2140	20 years
170 - 189	01/01/2141 – 31/12/4040	50 years and greater

The above post mining stress periods were added to the predictive model to ascertain post-mining inflows, with all drain cells removed.

5.2 Final Voids Inflows

The indicative location of the 15 final voids (with three voids in the Project area and two voids in the immediate vicinity of the Project area) at the Project is provided in **Figure 5-1**. The cells were assigned high horizontal and vertical hydraulic conductivities (1000 m/day) and storage parameters based on the compressibility of water (specific yield of 1.0, storage coefficient of 5.0×10^{-6} m^{-1}), to simulate free water movement within the final voids. This approach is often referred to as a 'high-K' lake. There are 10 other final voids, not located in the immediate vicinity of the Project area (but within the BWM site), which have also been modelled.

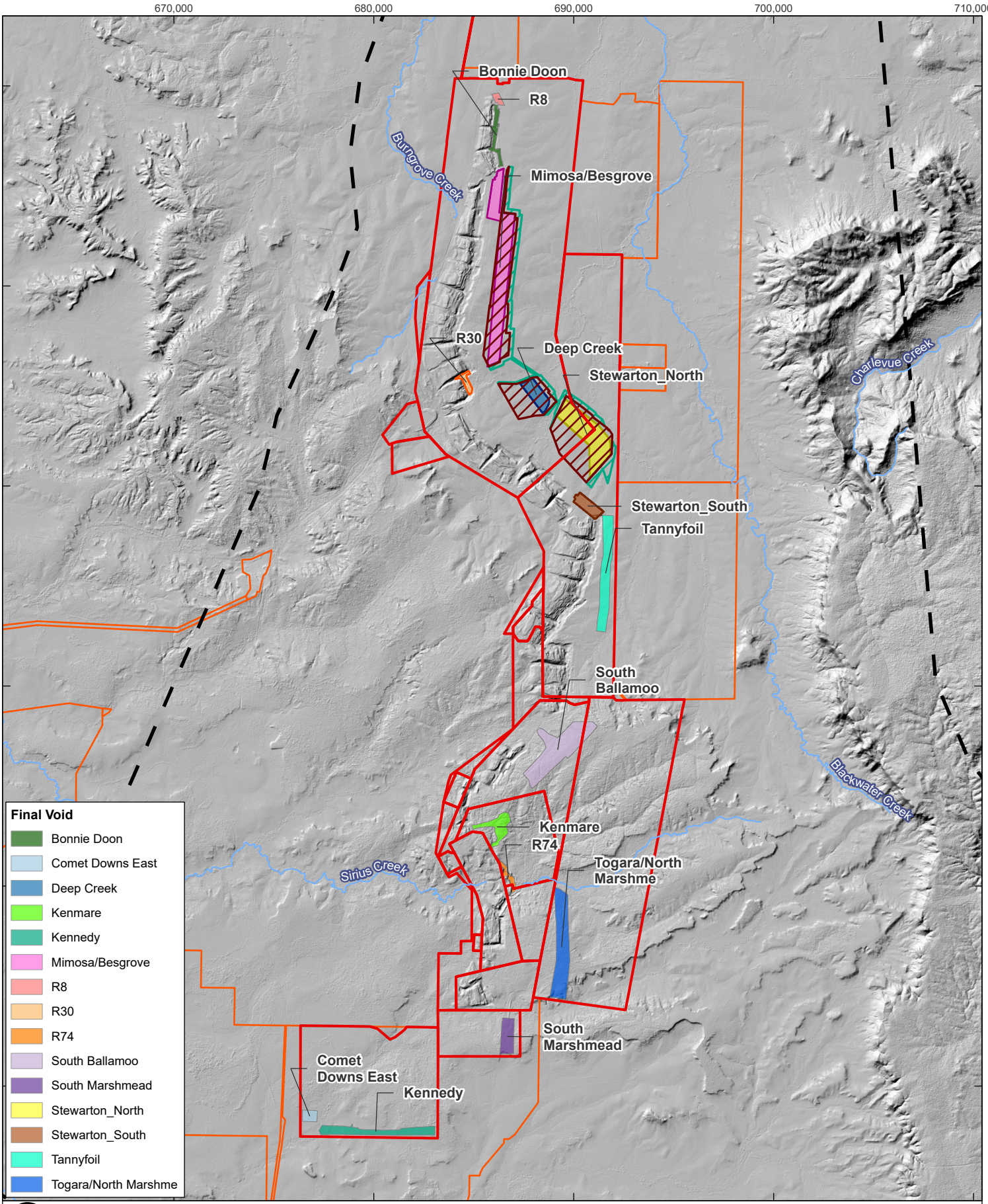
5.2.1 Methodology

The following methodology was used to allow convergence between the groundwater and water balance models with respect to void lakes. The groundwater modelling methodology involves a stepwise iterative process with the water balance model:

1. Initial predicted groundwater inflows with time to the voids from the groundwater model were incorporated in the initial water balance model.
2. The pit lake recovery levels and timings were then predicted by the water balance model, incorporating both groundwater and surface water fluxes and processes.
3. The void water elevations and recovery timings derived from the water balance modelling were then replicated within the numerical groundwater recovery model using the time variant constant head boundary (CHD) condition, to refine the groundwater model prediction of void groundwater inflows and lake recovery.
4. Assessment was made to check that the refined groundwater model predictions for fluxes to the voids agree with what was used as input to the water balance modelling.

To avoid iterating many times between the groundwater model and the water balance model before reaching agreement, SLR used an automated process (using python code) that iterates between the groundwater model and the water balance model until a predefined convergence criteria is reached (Xiao et al., 2025). Not only does this automated process

save time, it also allows reaching full convergence between the groundwater and the water balance model, increasing confidence in the modelling process.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	16-Feb-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

FINAL VOID LOCATIONS

SLR

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FIGURE 5-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_01_Indicative Final Void Locations

5.2.2 Results

Once the convergence was achieved, the resulting pit lake recovery curves (HydroBalance, 2026) for the five voids (**Figure 5-2**) were applied within the numerical groundwater model using time-variant constant head boundary conditions (CHD) to represent long-term equilibrium conditions. The groundwater model was subsequently run for 1,947 years.

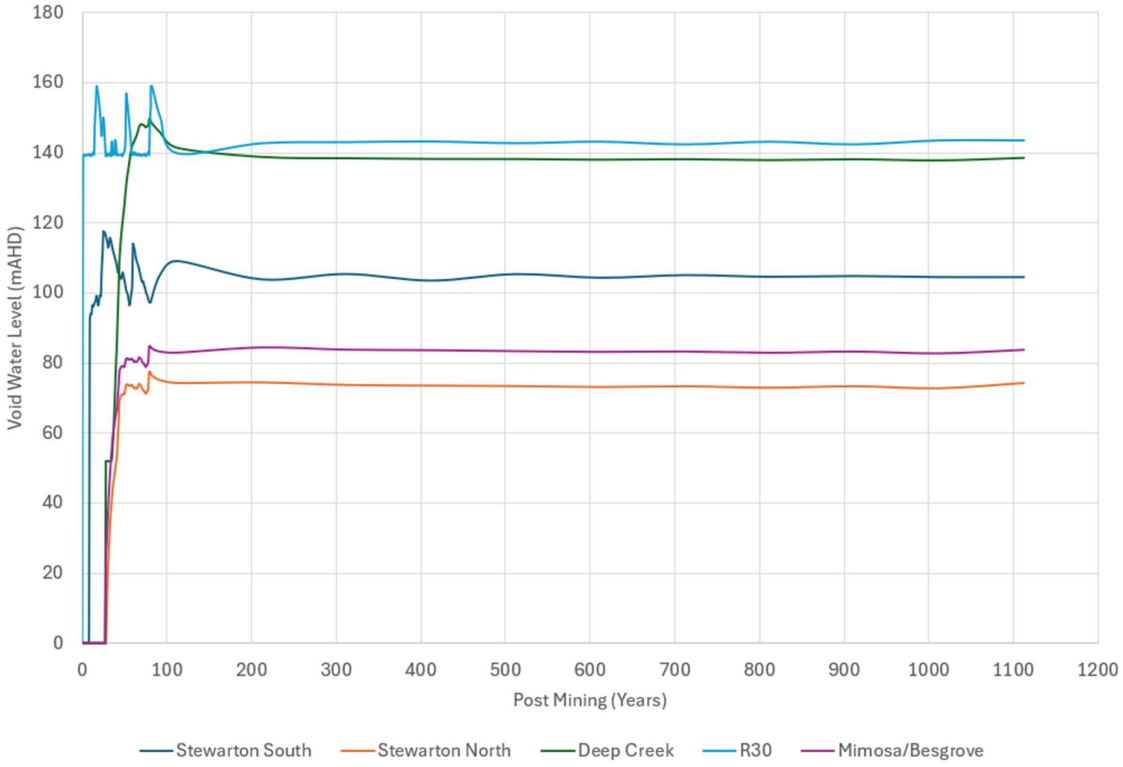


Figure 5-2 Final Void Recovery Curves

The equilibrated final void water levels are listed in **Table 5-2**. **Table 5-2** also lists the recovered water table to the east of the pits, at a distance of approximately 250 m. The head difference between the groundwater and the pit lake ranges between -21.88 m and 55.89 m for all pits.

Final void inflows are shown for all five voids from **Figure 5-3** to **Figure 5-7**. A positive flow value indicates a net inflow to the void while a negative value indicates a net outflow, from the void toward the local groundwater system. For each void, the net flux to the void is categorised based on its origin: Fluxes from spoil material to the void is shown as “Spoil to void”, while fluxes from the in-situ native rock to the void is show as “native rock to void”.

Final void Stewarton South and R30 show a constant negative net flux, indicating that water in the void primarily flow toward the local groundwater. The fate of these water fluxes is further discussed in **Section 5.3**.

Table 5-2 Final Voids – Equilibrium Water Levels and Groundwater Levels (From North to South)

Component	Equilibrium Void Water Level (mAHD)	Groundwater Level (mAHD)[1]	Head Difference (m)[2]
R8	144.98	150.56	5.58
Bonnie Doon	159.11	156.79	-2.32
Mimosa/Besgrove	83.8	131.1	47.3
R30	143.46	123.83	-19.63
Deep Creek	138.67	138.84	0.17
Stewarton_North	74.31	108.19	33.88
Stewarton_South	104.63	143.08	38.45
Tannyfoil	143.17	176.17	33
South Ballamoo	140.27	158.59	18.32
Kenmare	215.48	193.6	-21.88
R74	234.19	244.34	10.15
Togara/North Marshmead	163.86	219.75	55.89
South Marshmead	170.09	181.13	11.04
Comet Downs East	189.24	188.68	-0.56
Kennedy	160.8	173.06	12.26

Note: [1] Groundwater level extracted from the recovered water level map, read out approximately 250 m away from each pit to the east. [2] A positive number indicates gradient towards the void, a negative number would indicate a gradient away from void.

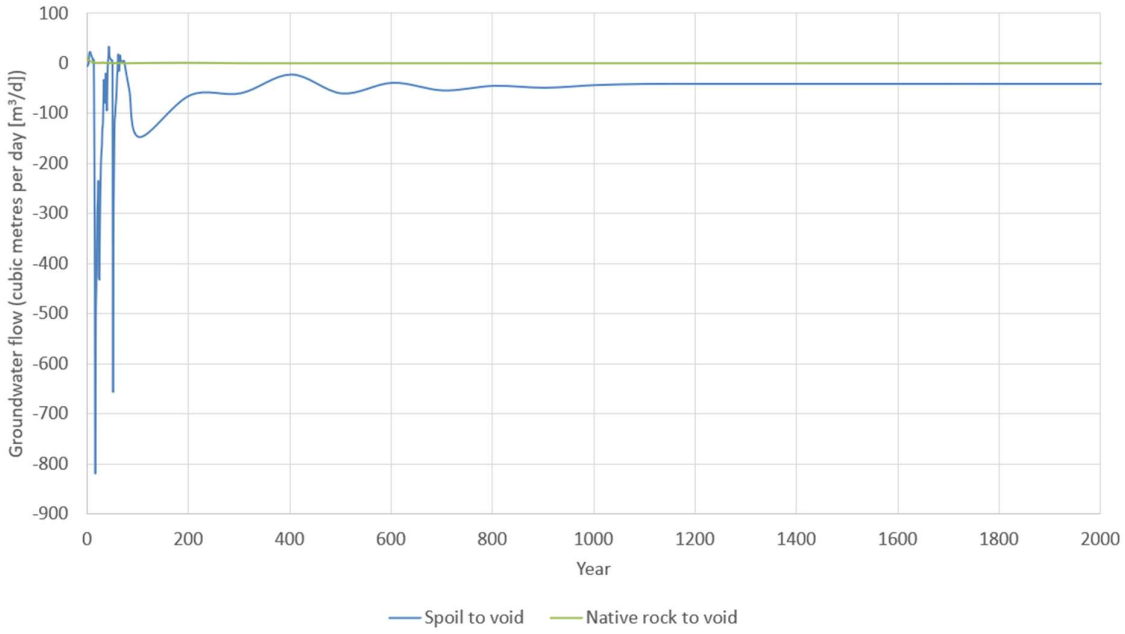


Figure 5-3 Post-mining Groundwater Inflows to Stewarton South

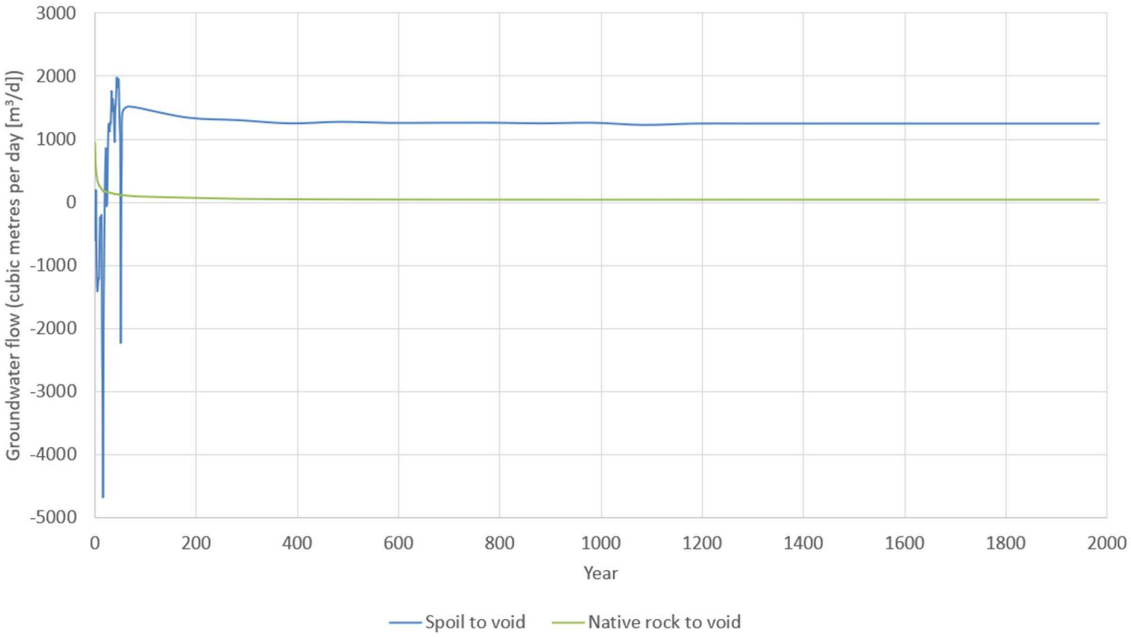


Figure 5-4 Post-mining Groundwater Inflows to Stewarton North

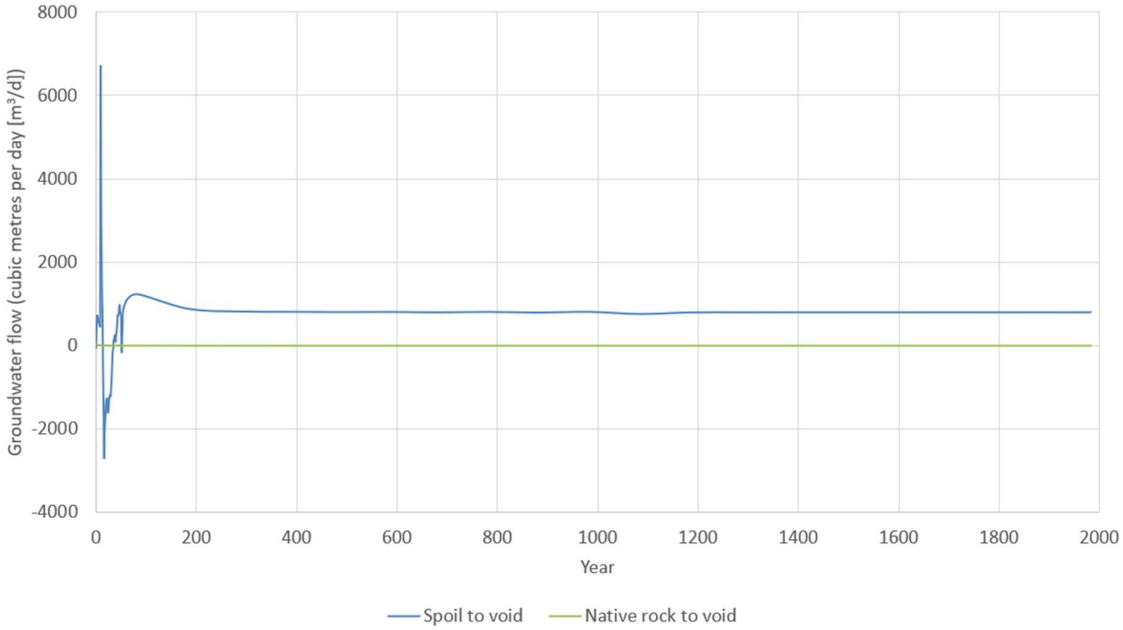


Figure 5-5 Post-mining Groundwater Inflows to Deep Creek

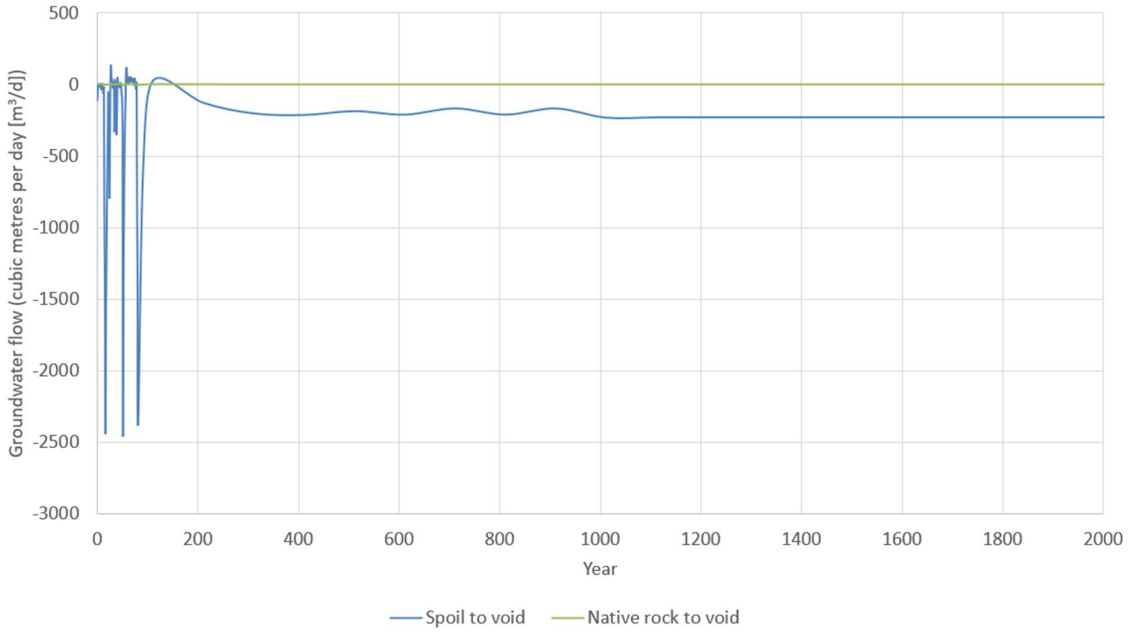


Figure 5-6 Post-mining Groundwater Inflows to R30

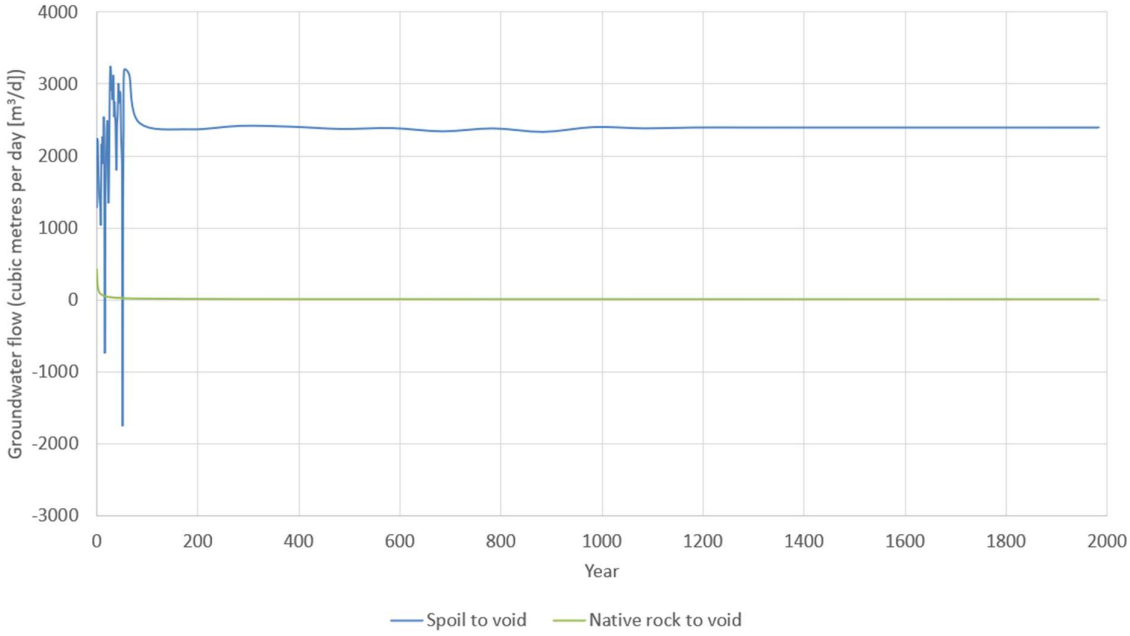
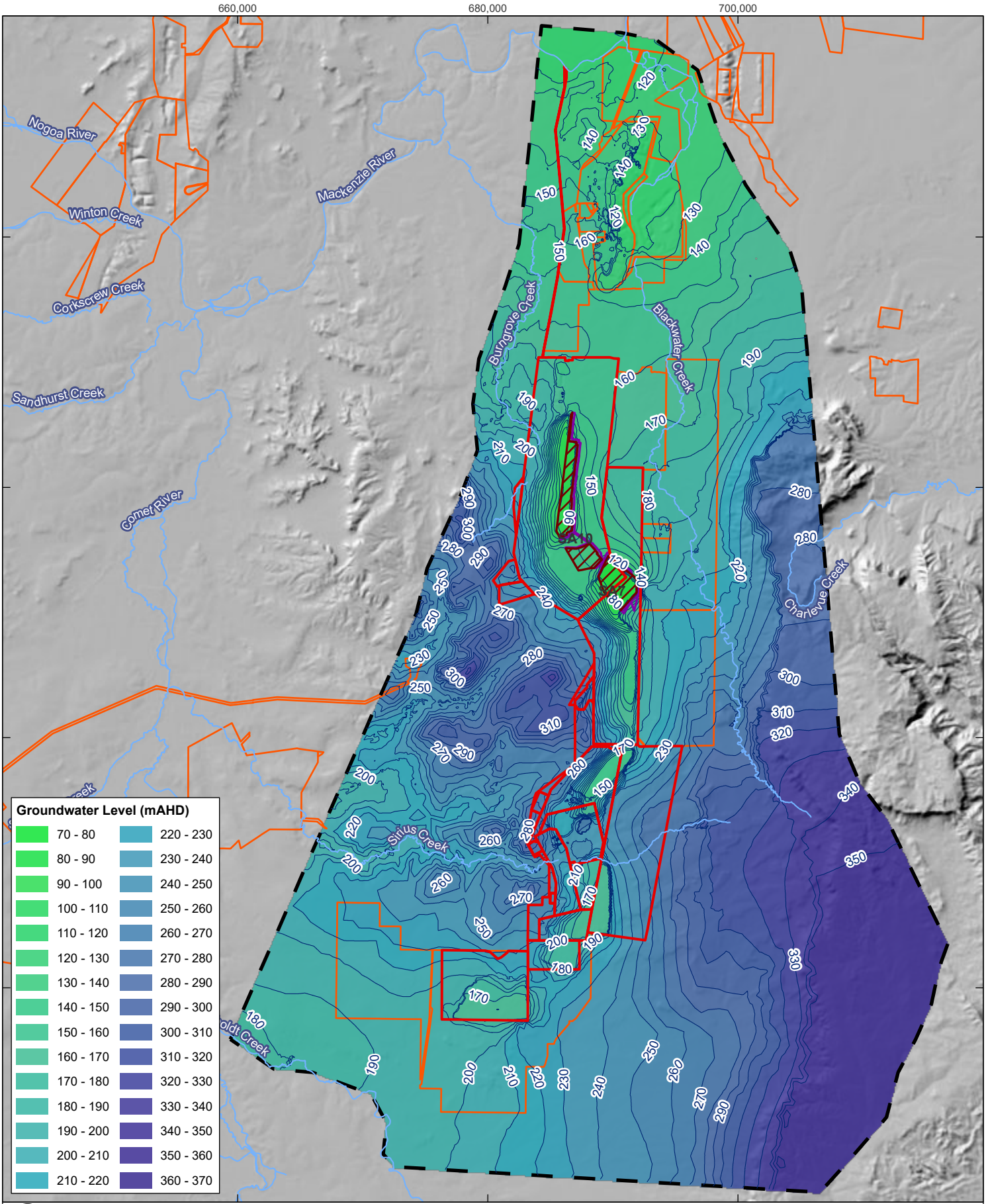


Figure 5-7 Post-mining Groundwater Inflows to Mimosa Besgrove

The predicted final groundwater water levels are presented in **Figure 5-8**.



0 5 10 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Groundwater Level Contour (m)
- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

GROUNDWATER TABLE RECOVERY (POST-MINING)

SLR

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FIGURE 5-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_08_Groundwater Table Recovery (post-mining)

5.3 Particle tracking

The mod-PATH3DU code (S.S. Papadopulos & Associates, Inc., 2020) was used to simulate particle pathways along the groundwater flow field post mining. To run the mod-PATH3DU code the transient head outputs from the groundwater flow model were used by mod-PATH3DU to simulate particle flow path lines.

The particles were placed on the final landform (landform 4.1) and within the residual voids (**Figure 5-9**), at the surface of the model (with the exception of particles placed within the underground mine workings adjacent to Laleham). Particle placed at the surface of the model are automatically moved to the shallowest saturated layer at the commencement of the simulation. Mod-PATH3DU was configured to release the particles at the midpoint between the base of the first saturated layer and the water table. As shown on **Figure 5-9** for many of the particles this represents the Permian layers (including areas of spoil backfill in model layers that represent Permian units pre-mining) as the shallow layers (Layers 1 and 2) are unsaturated across much of the BWM Area at the commencement of the post-mining simulation. The particles placed in the underground mines were configured to begin their simulation in the Pollux seam (Layer 12) to simulate the fate of water beginning in the flooded underground workings after mine closure.

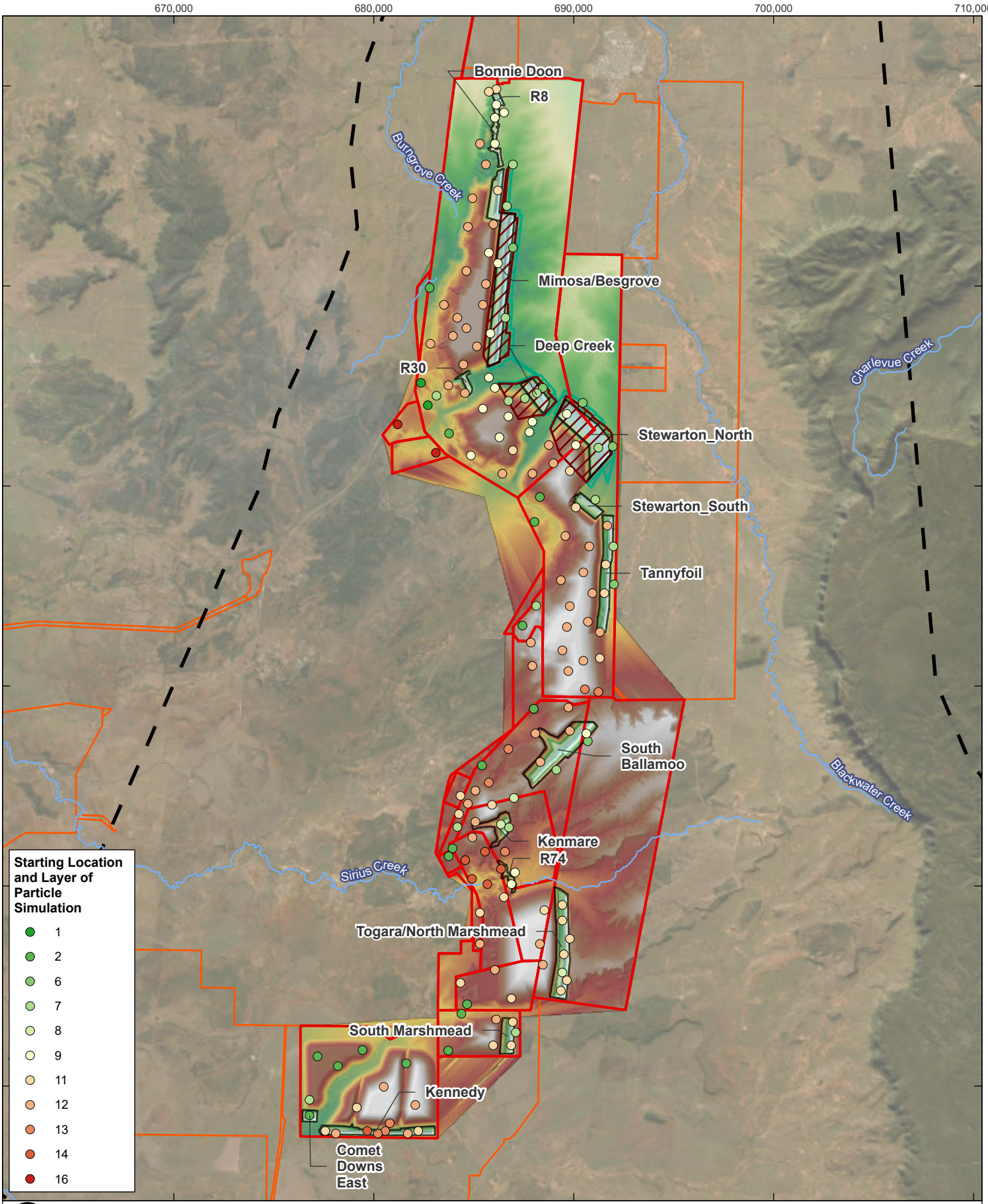
To estimate flow paths from the end of mining until post mining equilibrium, particles were released at the start of the post mining period (year 2093) and tracked until the end of the post mining simulation period (year 4040). **Figure 5-10** shows the predicted movement of water particles in the 1,947-year post mining simulation. The colours along the predicted particle flow paths provide the model layer the particle was simulated to be moving through, with the green to red scale classification representing particles moving from shallower to deeper model layers.

The colour changes along the paths on **Figure 5-10** indicate that particles situated within the shallower saturated layers at the beginning of the post-mining simulation generally move progressively toward deeper layers representing the Permian coal measures (or backfilled spoil where the coal measures has been mined out) over the post-mining period. However, particles that begin in the Pollux seam (Layer 12) and other deeper layers often are observed to move upwards to shallower layers over the course of the recovery simulation, as the saturated water levels in the spoil and aquifers adjacent to the residual voids recover to their long-term post-mining equilibrium state. The flow path analysis indicates the particles generally move toward the void lakes, with the majority of the particles captured in the voids.

As discussed in **Section 5.2,** both Stewarton South and Ramp 30 are showing a negative net inflow; However, particle tracking indicates that fluxes from these voids do not flow to the regional groundwater and instead flow toward neighbouring voids. As shown on **Figure 5-10**:

- particles released into Stewarton South are captured by Stewarton North; and
- particles released into Ramp 30 are captured by Mimosa/Besgrove.

No particles are predicted to travel outside of the mine lease in the post-mining simulation.



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Void Extent
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Final Landform Elevation (mAHD)

450

-5

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

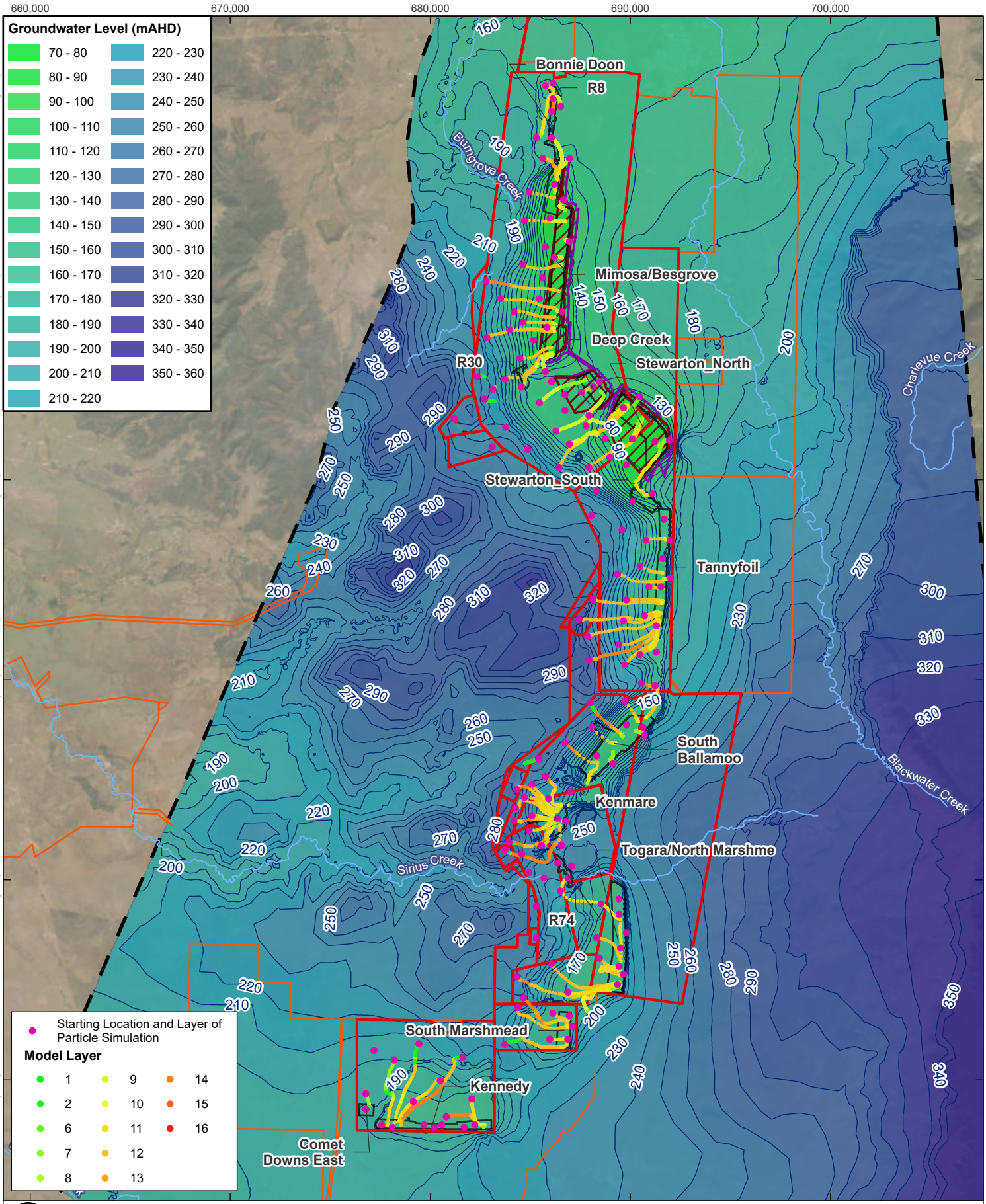
STARTING LOCATION OF PARTICLES

SLR

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FIGURE 5-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_09_Particle Starting Location



Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	AS

BLACKWATER NORTH EXTENSION PROJECT
GROUNDWATER MODELLING TECHNICAL REPORT

PREDICTED MOVEMENT OF PARTICLES – POST MINING (2093 – 4040)

SLR

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FIGURE 5-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_F05_10_Predicted Movement of Particles

6.0 Sensitivity Analysis

6.1 Purpose

Quantifying the sensitivity of both calibration performance and model predictions to input parameters provides critical insight into model behaviour and uncertainty. The combined sensitivity analysis presented in this section supports two primary objectives:

1 **Assessing parameter conditioning through calibration sensitivity**: Parameters that have a strong influence on calibration performance metrics are more likely to be conditioned by the calibration process. In contrast, parameters with low sensitivity to calibration performance are less likely to be conditioned by the calibration process, meaning that their posterior distributions will likely remain broad regardless of the amount or quality of calibration data.

2 **Understanding prediction sensitivity to parameter uncertainty**: When model predictions are highly sensitive to specific parameters, it indicates that uncertainties in those parameters have a strong influence on predictive outcomes. Conversely, if predictions are insensitive to a given parameter, then uncertainty in that parameter has limited influence on the modelled forecast.

Comparing calibration and predictive sensitivity allows for distinguishing between parameters that are constrained during calibration, and parameters that drive predictive uncertainty, which may or may not overlap. Such insights support decision-making in model refinement, data collection prioritisation and risk-based scenario analysis.

6.2 Methodology

To evaluate how variations in model parameters affect calibration and prediction outcomes, SLR employed two complementary global sensitivity analysis methods:

- Spearman rank correlation; and
- standardised linear regression coefficients.

These two methods assess different aspects of the input-output relationship and are well-suited to the often non-linear and complex behaviour of hydrogeological systems. They are commonly used in hydrological and environmental modelling due to their simplicity, interpretability and relatively low computational demand (Saltelli et al., 2008; Pianosi et al., 2016).

6.2.1 Data Aggregation and Standardisation

Pilot points were excluded from the sensitivity analysis to reduce parameter dimensionality since they are highly spatially correlated parameters, which can obscure the identification of key model controls and violate assumptions of parameter independence. The analysis therefore focused on primary hydrogeological parameters to better represent conceptual model behaviour rather than calibration-specific detail.

Parameter and observation data were pre-processed and standardised. Parameters using a log normal distribution were converted to $\log_{10}$ values.

Calibration performance was assessed using Mean Residual for this analysis because it aligns more closely with linear regression interpretation than other statistics that use squaring or absolute functions that change the linear relationship of parameter changes and calibration metrics.

For predictive sensitivity, predictive data included four groups: total alluvium take, total area with drawdown > 1 m, mine groundwater inflow (active mining) and total river take.



Parameter values (one group), calibration data (two groups) and prediction data (four groups) were standardised (zero mean, unit variance) independently (i.e. per group) to enable consistent comparison across variables and groups.

6.2.2 Spearman Rank Correlation Coefficient

Spearman rank correlation measures the monotonic relationship between input parameters and model outputs. It identifies whether changes in a parameter consistently increase or decrease a model output, regardless of the exact functional form of the relationship. This is especially useful in groundwater models where non-linearities are common due to boundary conditions, storage terms or non-linear recharge responses (van Griensven et al., 2006).

Given a parameter vector X and a model response vector Y, Spearman's rank correlation coefficient ρ is calculated as:

$$\rho = 1 - \frac{6\sum_{i=1}^{n}(R_i - S_i)^2}{n(n^2-1)}$$

where: R_i = rank of parameter X for sample *i*

S_i = rank of the corresponding model output Y

N = number of realisations

6.2.3 Linear Regression Sensitivity Coefficient

Linear regression sensitivity quantifies how much the output changes *on average* with a unit change in a parameter, assuming a linear relationship. It describes the *magnitude* of influence a parameter has on model outputs under the assumption of a linear relationship.

The relationship is represented as:

$$Y = X\beta + \epsilon$$

where: Y = model output

X = a matrix of standardized parameter values

β = vector of estimated sensitivity coefficients

ϵ = model error

The coefficient β represents the average change in model output (Y) for a one standard deviation change in model parameter (X) and is interpreted as a direct measure of sensitivity magnitude, specifically how the variance of the parameter uncertainty contributes to the variance of the predictive or calibration uncertainty. This method assumes linearity and additivity but remains useful as a first-order sensitivity metric (Helton et al., 2006).

6.2.4 Interpretation

There is no single universally accepted threshold for Spearman or regression coefficients in sensitivity analysis. However, some thresholds are often used as pragmatic benchmarks based on the practical significance of parameter influence rather than strict statistical cutoffs. For this analysis, moderate sensitivity was selected for an absolute ρ score > 0.2 and for an absolute β value > 0.1.

This dual-method framework supports robust sensitivity diagnostics by capturing both the consistency and strength of parameter influence. The combined use of both metrics enables us to distinguish between parameters that:

- have a strong and consistent effect;
- have an effect only in a narrow range (local sensitivity); and/or



- behave non-monotonically and inconsistently.

A comparison of the interpretive value of each method is provided in **Table 6-1**.

Table 6-1 Comparison of Spearman and Regression in Sensitivity Analysis

Sensitivity Scenario (S)	Impact of Parameter Changes on Model Outcome	Spearman	Regression	Interpretation
S1	Strong, consistent linear effect	> 0.2	> 0.1	Parameter is influential and predictable
S2	Consistent but nonlinear effect	> 0.2	< 0.1	Parameter is influential but not well described by linear models
S3	Local or inconsistent effect	< 0.2	> 0.1	Large effect in a narrow range
S4	Non-influential	< 0.2	< 0.1	Parameter has minimal influence

6.3 Results

The results are presented as bar charts in **Appendix E** and discussed in **Section 6.3.1** and **Section 6.3.2** for both Spearman rank correlation coefficient and Linear regression sensitivity coefficient.

6.3.1 Calibration Sensitivity (Parameter Conditioning)

Parameter with a ρ score > 0.2 and/or a β value > 0.1 (scenarios S1, S2 or S3 in **Table 6-1**) are likely to be conditioned through the calibration process.

As presented on **Appendix E** the calibration process is likely to be conditioning:

- Horizontal hydraulic conductivity (Kx) of the Clematis Group, Rewan formation (upper and middle), interburden, Pollux seam (lower) and tailings; as well as spatial locations associated with pilot points.
- Vertical hydraulic conductivity (Kz) of the interburden and tailings; as well as spatial locations associated with pilot points.
- Specific yield (Sy) of the Rewan Formation (upper); as well as spatial locations associated with pilot points.
- Riverbed Kz (Riv_vk) of the Humboldt Creek and tributaries.
- ET coefficient (evt) for the spoil and depth (exdp) for the alluvium.

The calibration process in unlikely to be conditioning the majority of:

- Recharge coefficients (rch).
- ET coefficient and depth (evt and exdp).
- Spoil hydraulic properties (spl_kx, spl_kz, spl_ss and spl_sy).

6.3.2 Predictive Sensitivity

Parameters with a ρ score > 0.2 and/or a β value > 0.1 (scenarios S1, S2 or S3 in **Table 6-1**) are likely to influence model predictions.



As presented in **Appendix E,** these parameters are:

- **For Mine associated drawdown:** Horizontal hydraulic conductivity of the regolith, Rewan formation (lower, middle and upper) and interburden; vertical hydraulic conductivity of the coal seams (lower); storage of the Rewan Formation (upper), interburden, coal seams, and spoil; recharge over the alluvium, regolith and weathered Clematis zones and spoil; ET rate and depth for the alluvium and regolith.
- **For Mine groundwater inflow (active mining):** Horizontal hydraulic conductivity of the regolith and Burngrove formation; vertical hydraulic conductivity of the coal seams, Burngrove formation and spoil; storage of regolith, Rewan formation, underburden and spoil; recharge over the weathered Clematis and weathered Permian zone, riverbed conductance of the Rockland Creek and tributaries.
- **For alluvium take:** Horizontal hydraulic conductivity of the alluvium, regolith, Clematis, Rewan formation (upper), overburden, interburden, underburden, Burngrove formation and spoil; vertical hydraulic conductivity of interburden, interburden, and Burngrove formation; storage of regolith, Clematis, overburden, interburden, coal seams, Burngrove formation, and spoil; recharge over the alluvium, regolith, and weathered Permian zones; ET depth for the alluvium, regolith, weathered Clematis and weathered Permian zones.
- **For River take:** Horizontal hydraulic conductivity of the alluvium, regolith, Rewan formation (upper and lower), overburden, interburden, Castor coal seam, and Burgrove formation; vertical hydraulic conductivity of the Rewan formation (middle and lower), interburden, coal seams, underburden and Burngrove formation; storage of regolith, Rewan formation, overburden, coal seams, underburden and spoil; recharge over the regolith and weathered Permian zones; ET depth for the alluvium; riverbed conductance of the Blackwater main stream and small streams.

6.3.3 Type I-IV Analysis

The Murray Darling Basin Commission (MDBC) Groundwater Flow Modelling Guideline (MDBC, 2001) recommends classifying sensitivity by the resultant changes (or contribution) to the model calibration and predictions. According to this process models can be classified as one of the four main types:

- Type I: Insignificant changes to calibration (low calibration sensitivity) and prediction (low predictive sensitivity).
- Type II: Significant changes to calibration (high calibration sensitivity) – insignificant changes to predictions (low predictive sensitivity).
- Type III: Significant changes to calibration (high calibration sensitivity) – significant changes to predictions (high predictive sensitivity).
- Type IV: Insignificant changes to calibration (low calibration sensitivity) – significant changes to predictions (high predictive sensitivity).

Types I-III are of less concern, as these Types have an insignificant impact on model predictions or conditioned by calibration. Type IV is classed as ‘a cause for concern’ as non-uniqueness in a model input might allow a range of valid calibrations but the choice of value impacts significantly on a prediction (MDBC, 2001).

To classify the sensitivity contribution to the model calibration and predictions for each model parameter, the calibration and prediction sensitivities were compared against each other for each parameter.



To allow comparing calibration and prediction sensitivity in one graph, a combined sensitivity value was calculated for each sensitivity group as:

$$Combined_{(i,g)} = 0.5 * | \beta_{(i,g)} | + 0.5 * | \rho_{(i,g)} |$$

where: $\beta_{(i,g)}$ = standardised regression coefficient for parameter *i* and group *g*.

$\rho_{(i,g)}$ = Spearman rank correlation coefficient between parameter and group *g*.

For this analysis, the threshold value for a sensitive parameter was set at 0.15, as the average of the threshold for *β and ρ* (see **Section 6.2.4**).

Comparison plots are presented for the alluvium take (**Figure 6-1**), drawdown (**Figure 6-2**) and mine groundwater inflow (active mining) (**Figure 6-3**), and Isaac River take (**Figure 6-4**). Type IV parameters are summarised in **Table 6-2.**

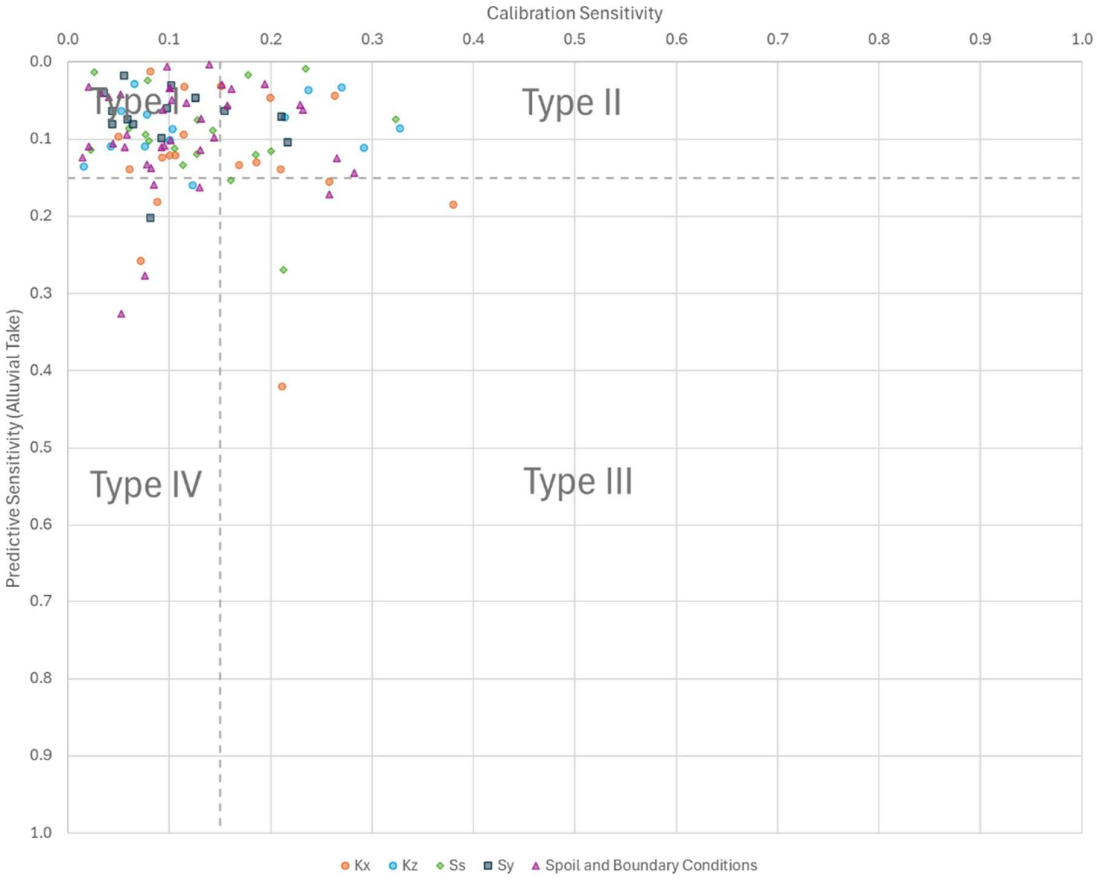


Figure 6-1 Predictive Sensitivity (Alluvium Take) Versus Calibration Sensitivity

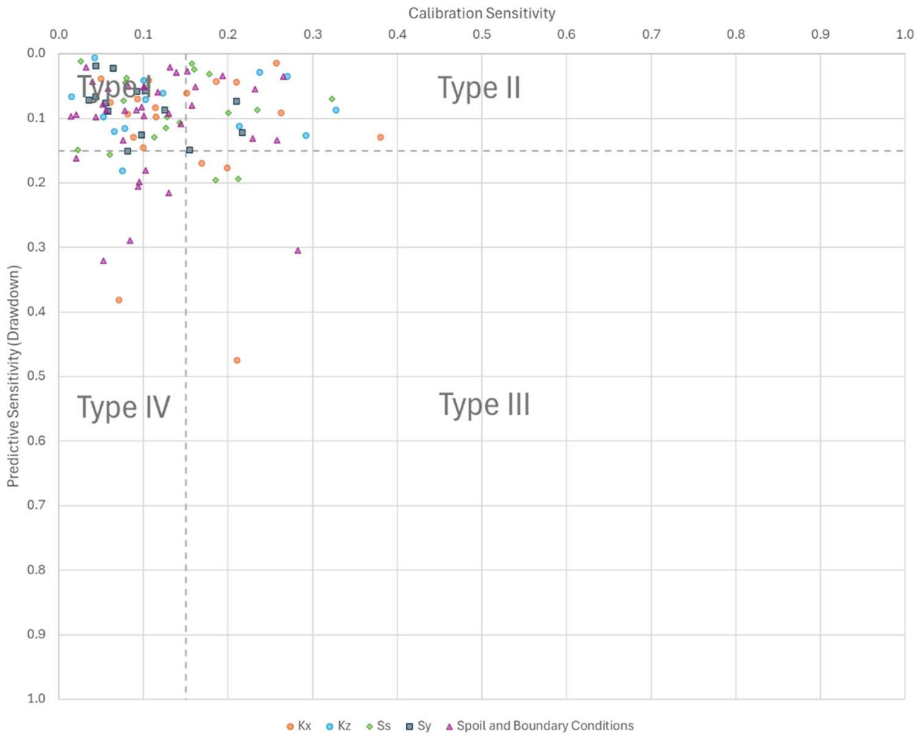


Figure 6-2 Predictive Sensitivity (Drawdown) Versus Calibration Sensitivity

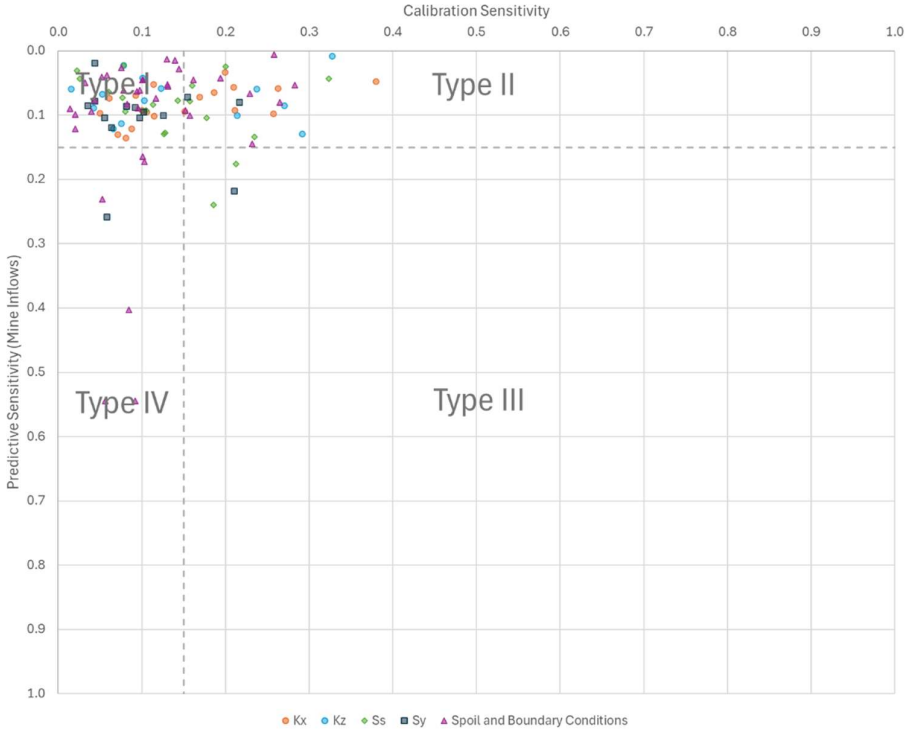


Figure 6-3 Predictive Sensitivity (Mine Inflow) Versus Calibration Sensitivity

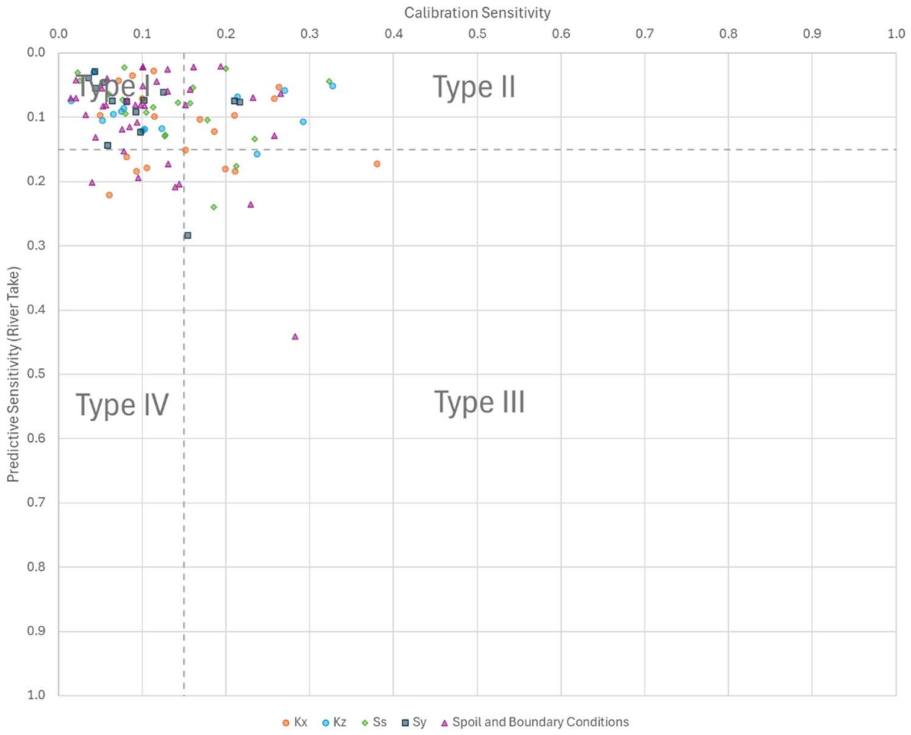


Figure 6-4 Predictive Sensitivity (River Take) Versus Calibration Sensitivity

Table 6-2 Type IV Parameters

Parameter	Description	Associated Prediction
kx_z04	Weathered zone	Alluvium Take, Drawdown
kzf_z18	Burngrove formation	Drawdown
rchf_z03	Weathered Clematis	Drawdown, Mine Inflow
rchf_z04	Weathered Permian	Alluvium Take, Drawdown, Mine Inflow
rivk_z02	Blackwater tributaries	Drawdown
rivk_z10	Tanny Foil dam	Drawdown
spl_rchf_z01	Spoil	Alluvium Take, Drawdown
spl_sy_z01	Spoil	Alluvium Take, Drawdown, Mine Inflow
ss_z02	Tertiary	Drawdown
sy_z13	Interburden	Alluvium Take, Drawdown
tl_rchf_z01	Tailing	Drawdown, River Take
exdp_z02	Regolith	Alluvium Take
kx_z18	Burngrove formation	Alluvium Take
kzf_z15	Interburden	Alluvium Take
rivk_z04	Rockland Creek and tributaries	Mine Inflow
spl_kx_z01	Spoil	Mine Inflow
spl_kz_z01	Spoil	Mine Inflow
evtf_z02	Regolith	River Take
kx_z02	Tertiary	River Take
kx_z03	Alluvium	River Take

Parameter	Description	Associated Prediction
kx_z11	Interburden	River Take
kx_z19	Fair Hill formation	River Take
rchf_z02	Regolith	River Take
rivk_z01	Blackwater mainstream	River Take
rivk_z07	Small streams	River Take
spl_ss_z01	Spoil	River Take
ss_z04	Weathered zone	River Take
ss_z08	Rewan lower	River Take
ss_z10	Aries seam	River Take
sy_z09	Overburden	River Take

6.3.4 Conclusion

The sensitivity analysis suggests that most parameters in the model are adequately constrained by the calibration process. It also highlighted several parameters that contribute to predictive uncertainty and that are less conditioned by the calibration process (Type IV parameters).

6.4 Mine Inflows

Following peer review, it was noted that the modelled inflows (**Section 4.5**) were higher than observed pit inflows. These observations were typically 2.25 ML/day (Engeny Australia Pty Ltd, 2025), which are lower than the average cumulative mine inflow rate (2025 to 2093) of 5,139 ML/year (14.1 ML/day) (**Section 4.5**).

The peer reviewer requested that a couple of sensitivity simulations be conducted to test the sensitivity of the predicted mine inflows to the timing setup of when TVM activates the changes in parameters from host material properties to post-mining properties (i.e. spoil or void).

The model results presented outside this section use what will be referred to herein in the sensitivity assessment as the TVM3 setup. The TVM3 setup has hydraulic conductivity (Kx and Kz) change within the stress period when mining (DRN) is activated, and storage properties are activated in the stress period when DRNs become inactive.

MODFLOW USG does not instantaneously change parameter values at the beginning of the activated stress period. Instead, it either linearly or on a log transform basis changes the parameters over the stress period length such that only at the end of the stress period is the full change implemented. An example for how TVM3 is implemented would be:

- Assume a mining DRN cell becomes active in stress period 50 and is active for 1 stress period (i.e. is inactive in stress period 51).
- Hydraulic conductivity values would be transformed (SLR uses the log transform option) over the duration of stress period 50 such that by the end of mining the hydraulic properties would be equal to the spoil properties and therefore full spoil properties for the beginning of stress period 51 when DRNs are inactive.
- Storage properties would not begin to change until stress period 51 and would be fully transformed by the end of stress period 51, one year after mining was completed.

The peer reviewer requested two sensitivity simulations that vary the start timing of the TVM operations.

- TVM2 – this option has all parameters begin to change in the stress period following the mining. In the above example, this would mean no change to how storage was handled but would push the change of hydraulic conductivity values to begin the stress period after mining has ceased (stress period 51) with full implementation of the changes by the end of stress period 51.
- TVM1 - this option has all parameters begin to change in the stress period when the mining is activated. In the above example, this would mean no change to how hydraulic conductivities were handled but would push the change of storage values to begin the stress period when mining commences (stress period 50) with full implementation of the changes by the end of stress period 50.

The results for estimated total pit inflows are provided for TVM2 and TVM3 in **Figure 6-5**. The results for TVM1 were exactly the same as those for TVM3 and therefore are not explicitly represented in **Figure 6-5**.

The predicted mine inflows are insensitive to the timing of when storage properties are changed.

The predicted mine inflows are sensitive to the timing of when hydraulic conductivity properties are changed. By delaying when the hydraulic properties are changed to the year after mining was completed reduces predicted pit inflows. The reduction in inflows is closer to the observed values; however, it is noted that neither model result has been corrected for



evaporation that would occur on the highwalls and pit floors, and as such would be expected to be greater than observed ingress and or values estimated from operational site water balance models.

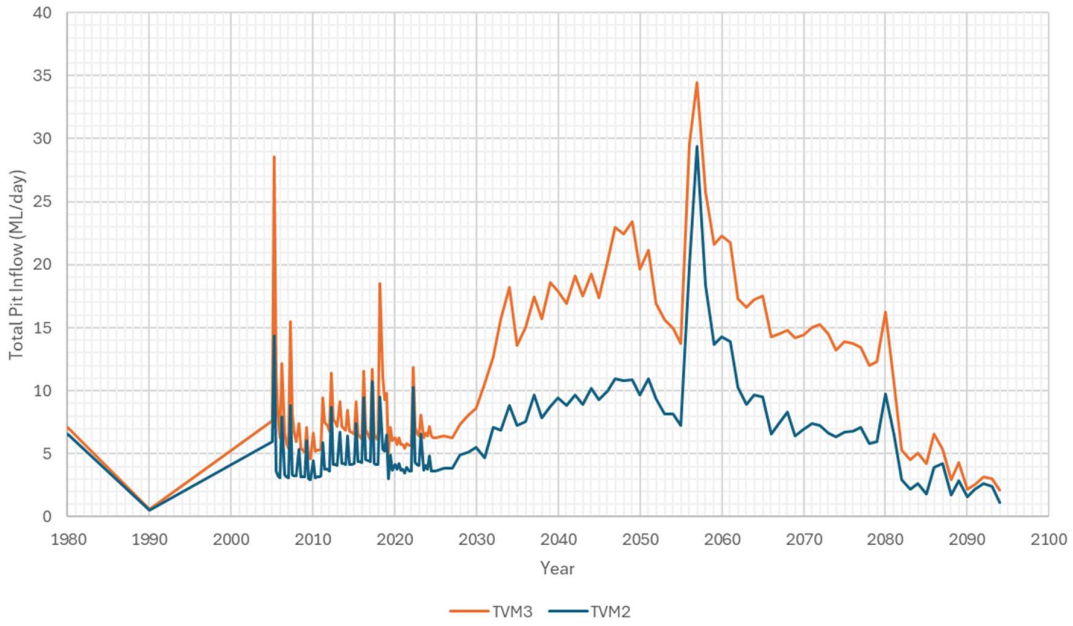


Figure 6-5 TVM Sensitivity Analysis – Predicted Cumulative Mine Inflows

7.0 Uncertainty Analysis

A Type 3 Monte Carlo uncertainty analysis was undertaken to estimate the uncertainty in the future impacts predicted by the model. This method operates by generating numerous alternative sets of input parameters to the deterministic groundwater flow model (realisations), executing the model independently for each realisation, and then aggregating the results for statistical analysis. This approach is consistent with guidance provided by the Independent Expert Scientific Committee (IESC) (2018) for uncertainty analysis within a groundwater modelling risk management framework.

The first step in Monte Carlo analysis is to define the parameter distribution and range. For this project, the software PESTPP-IES (part of the PEST suite) was used to generate parameter ensembles based on a provided range of plausible value. The parameter distributions for the sampled prior and the calibrated ensemble are shown in **Appendix D**.

PESTPP-IES uses an “ensemble smoother” method that enable optimising each realisation in order to obtain an ensemble (suite of realisations) that:

- covers the range of plausible parameters distribution; and
- is calibrated to historical water level data.

As discussed in **Section 3.1**, a total of 75 calibrated realisations were selected from the last iteration and regarded as sufficient.

The predictions included in the uncertainty analysis were:

- maximum drawdown;
- predicted open cut mine inflow;
- alluvium water take; and
- change in river baseflow.

7.1 Uncertainty Convergence

SLR conducted statistical analyses of predictive results to assess if additional realisations were likely to provide results that would significantly change reported results. SLR calculated the 95% confidence interval for the predictive results.

The confidence intervals are presented sequentially as more realisations are added. For example, the confidence interval of the predicted alluvium take and total dewatering rates was calculated using the results from two realisations, three realisations, sequentially up to the total number of realisations.

Figure 7-1 and **Figure 7-2** show the median and maximum confidence intervals of alluvium take and total dewatering rates respectively, as well as the variance of the confidence intervals as more realisations are added. To calculate the statistics shown, the following steps are taken:

1 The model results of interest, total dewatering rates for this example, are first processed for all realisations.

2 The 95% confidence interval is then calculated sequentially as more realisations (i.e. results) are added, creating a sequential progression of confidence intervals as new realisations are added.

3 Median and maximum values of confidence intervals are then calculated at each interval of realisations being added.

4 Variance is calculated from the confidence intervals at each interval of realisations being added.

As indicated in **Figure 7-1** and **Figure 7-2**, additional realisations are unlikely to significantly increase or decrease the confidence intervals of predictions. This conclusion is drawn based upon the combination of two factors:

1 The rate of change per additional realisation is small.

2 The magnitudes of the confidence interval are small and well below reasonable expectation of the predictive ability of a numerical model.



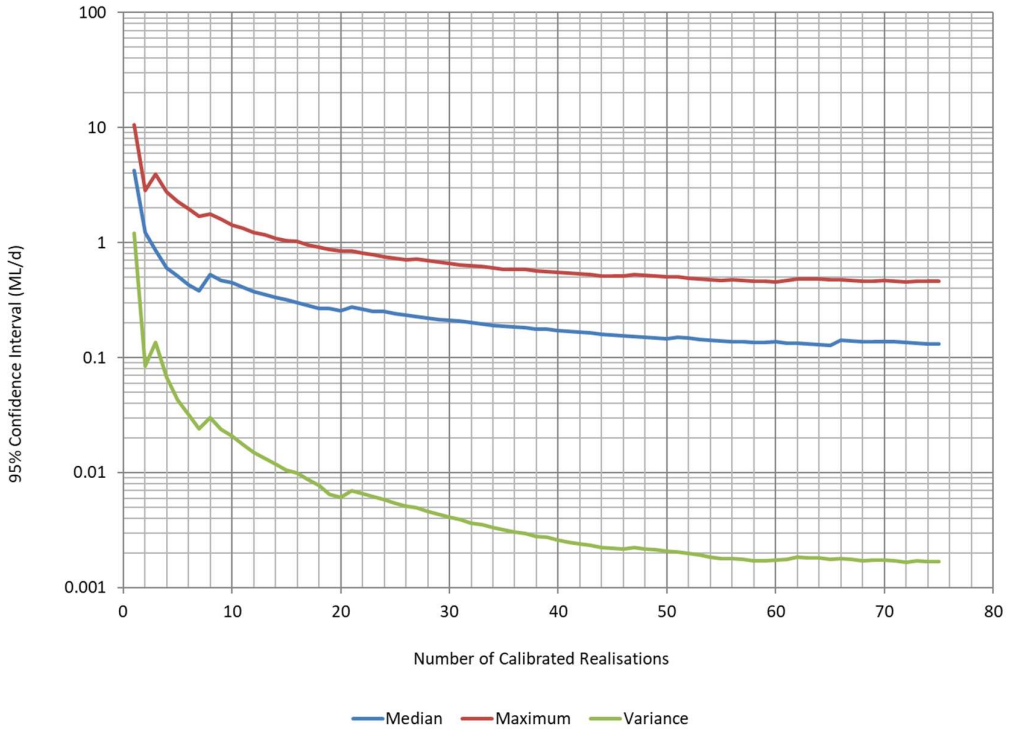


Figure 7-1 Predictive Uncertainty Convergence – Alluvium Take

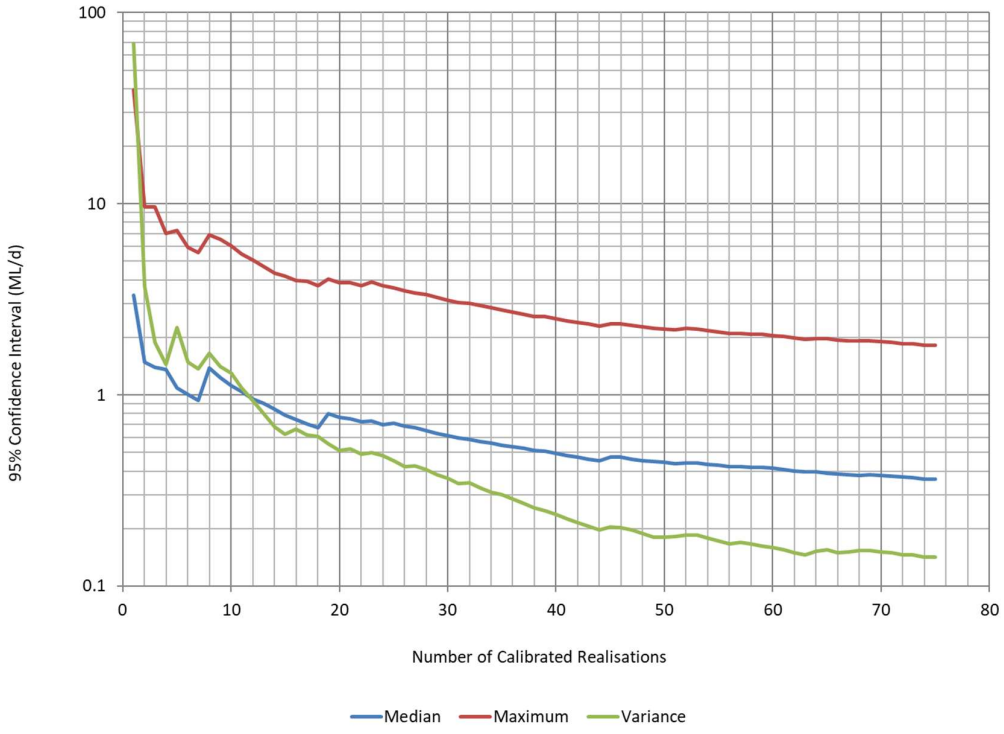


Figure 7-2 Predictive Uncertainty Convergence – Dewatering Rate

The “converged” values shown in Figures 7-1 to 7-2 for alluvium take and total dewatering rate do not represent physical dewatering or water take rates at a specific point in time. Instead, they reflect the reduction in predictive uncertainty as more realisations are included. In other words, convergence indicates that additional realisations do not significantly change the spread of model predictions. Therefore, this value is a statistical measure of prediction stability rather than an actual pumping rate.

7.2 Uncertainty Results

7.2.1 Uncertainty in Mine Inflows

The uncertainty in groundwater inflow into the open cut mine (active take) from the start of the predictive model (2025) to the end of mining (2093), is shown for the cumulative Scenario (**Figure 7-3**). The predicted inflows are shown for the BCM and different percentiles prediction ranges. These represent the:

- Minimum to 5th percentile indicates it is very likely the outcome is larger than this range.
- 5th – 33th indicates it is likely that the outcome is larger than this range.
- Median indicate it is as likely as not that the outcome is larger or smaller than this value.
- 33th - 67th indicates it is likely that the outcome is within that range.
- 67th – 95th indicates it is unlikely that the outcome is larger than this range.
- 95th percentile indicates it is very unlikely the outcome is larger than this value.

Overall, the results indicate that the BCM is representative of the median estimated mine inflows. From 2056, the BCM is more representative of the 67th to 95th percentile band.

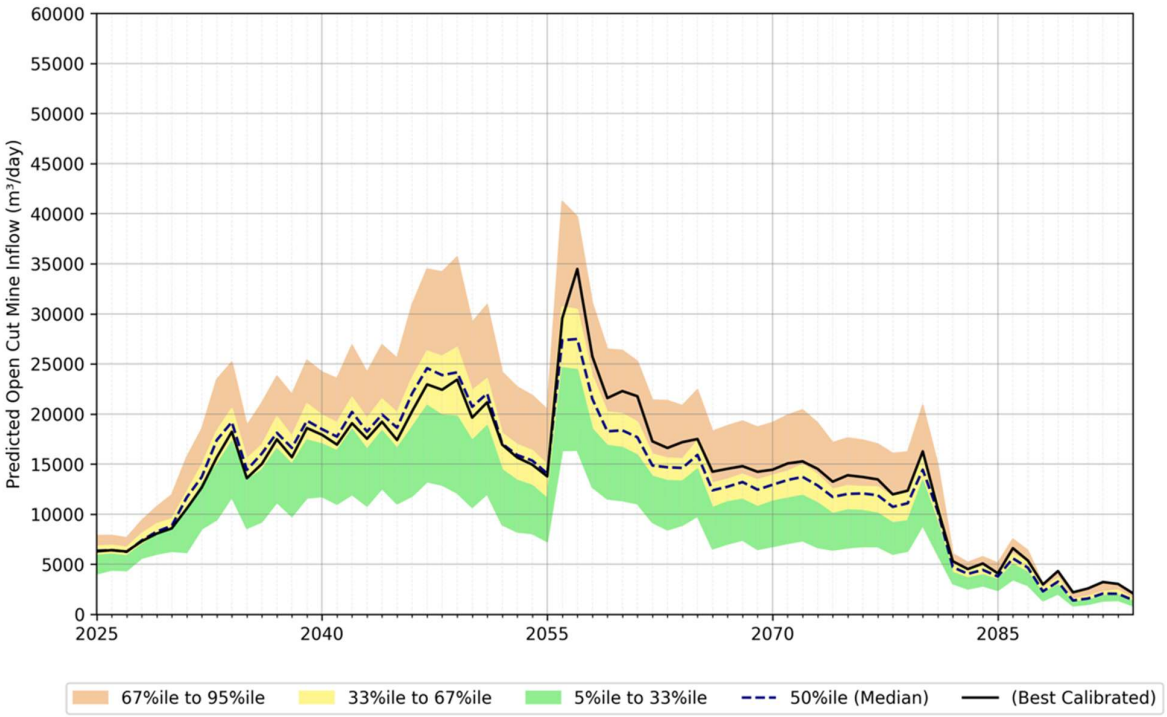


Figure 7-3 Predicted Open Cut Inflow Uncertainty - Cumulative Scenario

7.2.2 Uncertainty in Alluvium Take

The uncertainty in alluvium take for the alluvium associated with the Blackwater Creek is shown for the incremental scenario (**Figure 7-4**) and the cumulative scenario (**Figure 7-5**). Negative values indicate a reduction in alluvium take while positive values indicate an increase in alluvium take.

The BCM is representative of the median for the incremental alluvium take and the 5th to 33th percentile for the cumulative alluvium take.

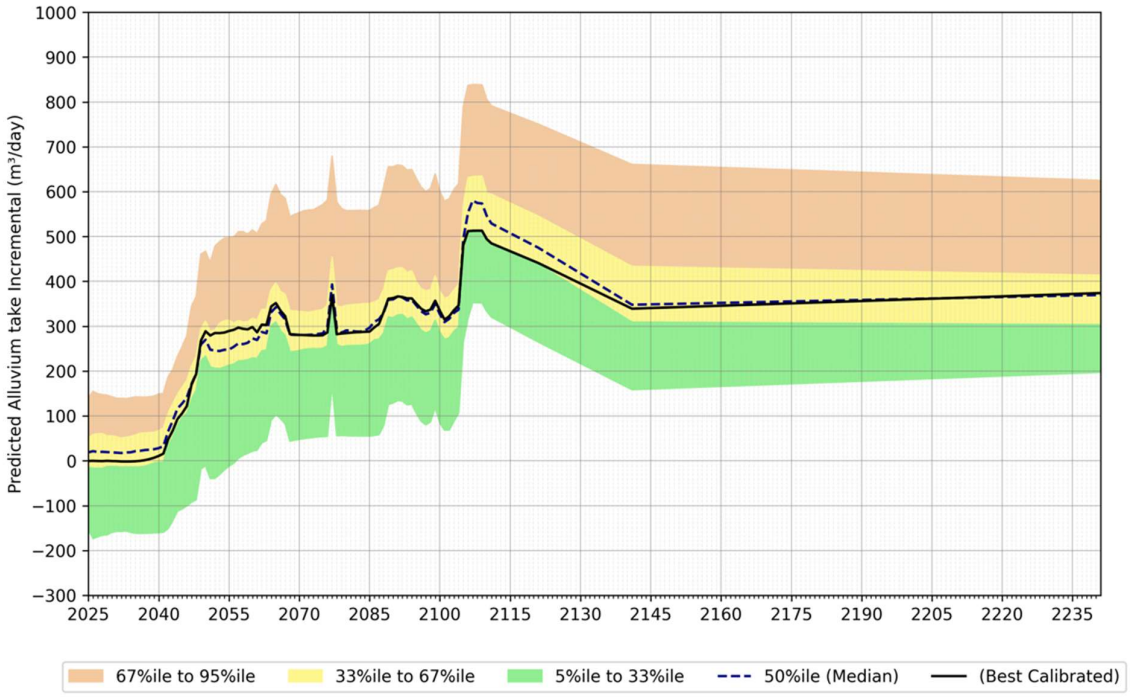


Figure 7-4 Uncertainty in Incremental Alluvium Take

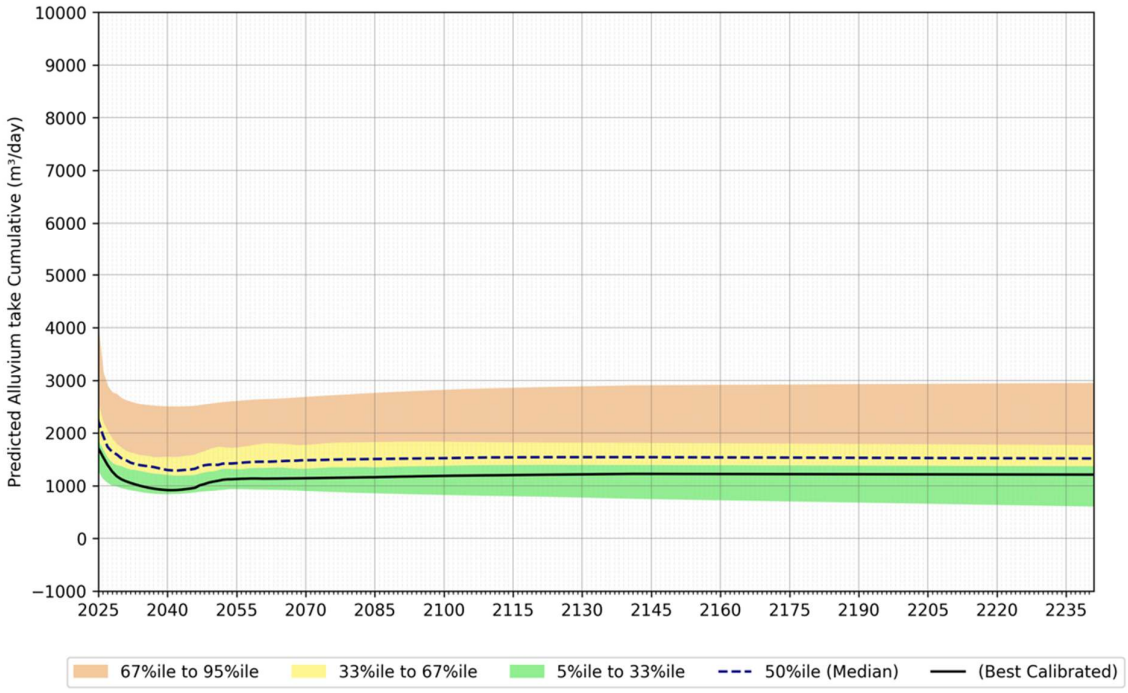


Figure 7-5 Uncertainty in Cumulative Alluvium Take

7.2.3 Uncertainty on Surface Water Flow

The change in groundwater flow to Blackwater Creek due to the Project was calculated by comparing the river flow budgets for Blackwater Creek in the Cumulative scenario against the Approved scenario.

The uncertainty in change in groundwater flow to Blackwater Creek is shown for the incremental scenario on **Figure 7-6**. Negative values indicate an increase in groundwater fluxes to Blackwater Creek while positive values indicate a decrease in groundwater fluxes to Blackwater Creek. The BCM is representative of the median.

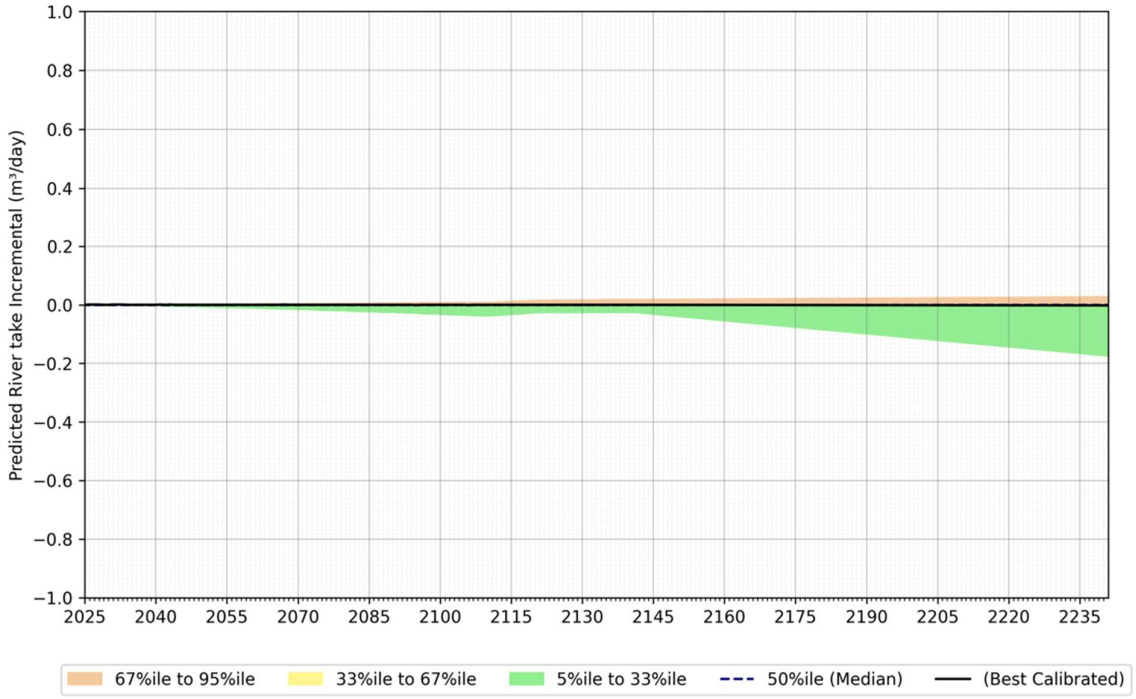


Figure 7-6 Uncertainty in Incremental River Baseflow Loss

7.2.4 Uncertainty in Drawdown

To illustrate the level of uncertainty in the extent of predicted mine induced drawdown (1 m contours), the 50th percentile maximum drawdown extent were compared to the maximum drawdown extent for the 5th and 95th percentiles (**Appendix F**). Both cumulative and incremental drawdown were calculated to demonstrate the impacts of mining on groundwater levels across different model layers. Incremental drawdown is generally limited in extent within model layers 1 and 2; however, the 95th percentile drawdown extent expands to the model boundary in the deeper layers.

8.0 Model Confidence and Limitations

The groundwater modelling was conducted in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), the MDBC Groundwater Flow Modelling Guideline (MDBC, 2001) and the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023).

The model confidence level (Class 1, Class 2 or Class 3 in order of increasing confidence) based on the Australian Groundwater Modelling Guidelines (Barnett et al. 2012) was previously widely used in the industry. The latest version of the IESC Explanatory Note for Uncertainty Analysis (Peeters and Middlemis, 2023) introduces a new concept on how model confidence can be assessed. The document also indicates that this change will follow in the next iteration of the Australian Modelling Guidelines and the new concept for assessing model confidence is hence applied for this model.

The latest version of the IESC Explanatory Note for Uncertainty Analysis defines a model fit for purpose when model results are:

- **Usable:** Relevant to the decision-making process, providing information about the uncertainty in conceptualisations and modelling simulations in a way that allows decision-makers to understand the effects of uncertainty on project objectives and the effects of potential bias. The relevant QoIs in this context are the groundwater inflows (active mining and final voids), drawdown due to mining and fluxes changes due to mining.
- **Reliable:** Demonstrate that the range of model outcomes is consistent with the system knowledge and honours historical observations, and provides objective evidence that uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated. The calibration performance was deemed acceptable, and a rigorous uncertainty analysis was undertaken to further improve confidence in the modelling outputs.
- **Feasible:** Trade-offs due to budget, time and technical constraints are reasonable and justifiable within the risk context of the project. This study is an update of a 2021 model variation, which shows that there are several model revisions and the latest data has been included. The model has been peer reviewed for each revision. This model build and associated review process is deemed commensurate with the Project related risk to the groundwater environment.

In order to assess these three points above, the four sources of scientific uncertainty (structural, parametrisation, measurement error, predictions) have been qualitatively assessed with regards key aspects of the BWM groundwater model, as presented in **Table 8-1**.

Overall, the model captures depressurisation due to active mining. The model is numerically stable with an acceptable mass balance error. The model shows a good fit between observed and modelled groundwater levels. A depth dependence function was used for hydraulic conductivity. Overall, the model is considered fit for purpose to achieve the objectives outlined in **Section 1** based on the data provided and the Project timeframe. Updates could be conducted in future to further refine the model, but this would be dependent on the purpose of the modelling and availability of data to inform future changes.

The model sensitivity was explored for an array of parameters. This showed that these parameters were generally well constrained by the calibration. Parameters are likely to contribute the most to predictive uncertainty (Type IV) were also identified.

The uncertainty analysis was undertaken to add a likelihood estimate to the prediction for the quantities of interest.



Table 8-1 Groundwater Model and Data Limitations

Type	Part	Status	Comment
Structural/ Conceptual	Grid and Model Extent	Fit for purpose	The model has an unstructured Voronoi grid that includes detailed cell refinement around site, neighbouring mines and along drainage features.
	Layers	Fit for purpose	Top of layer 1 incorporates site Light Detection and Ranging data.
		Fit for purpose	Representation of alluvium based on the CSIRO Regolith mapping Wilford et al (2016) and refined based on site drill data.
	Conceptualisation – Geological Structure	Fit for purpose, future improvements possible where new data collected	The local structure of the geology is based on detailed data at site (BWM geology model), and regional model geometry (outside of site) interpolated based on publicly available data, such as geological mapping and the CSIRO Regolith data set. Geophysical surveys across the Project area have identified minor faulting in the BWM area. Faulting is typically confined to the coal seams of the RCM. The minor faults show a displacement of up to 5 m. Hence, no geological structures (i.e. faults) have been included within the Project area in the model other than through layer displacements from the site geological model. The main regional fault (shot over fault) was included as the eastern model boundary. Displacements of up to 3,000 m are reported at this fault. The Permian coal measures outcrop along the western edge of the site. Therefore, how this is captured within the model influences the model predictions. The structure of the coal seams was checked to ensure it matches observed and mapped geology. The predictions of drawdown adjacent to mining was checked and the model shows a good fit between modelled and observed trends.
	Conceptualisation – GDEs	Fit for purpose, future improvements possible	A GDE conceptualisation is provided in SLR (2026).
	Conceptualisation – Surface Water Groundwater Interactions	Fit for purpose	The groundwater - surface water interactions are conceptualised as limited. Due to the gauged creeks to be classified as ephemeral (SLR, 2026), no long-term baseflow contribution from the groundwater is expected. Rather, surface water is expected to recharge the groundwater and after such recharge events, some minor baseflow contributions back into the creeks is possible.



Type	Part	Status	Comment
	Conceptualisation – Saturated Extent of Alluvium and Regolith	Fit for purpose future improvements possible	Site monitoring network includes one bore mapped within alluvium that was used to inform saturated extent of alluvium locally at site and for calibration targets. However, the alluvium in the area was found dry at this location. Other attempts to drill into the alluvium were abandoned, as either no alluvium was found or the alluvium was dry, or the bores were installed into the Rewan instead. The modelled groundwater levels in alluvium have hence no comparison available.
Parameterisation	Hydraulic Conductivity – Shallow layers	Fit for purpose	Spatial variability of hydraulic parameters in the Alluvium and Regolith have been incorporated in this model version by adding pilot points in both layer 1 and 2. This enhancement has allowed representing the heterogeneity in the alluvial system, improving the model's ability to replicate water level measurements in these units.
	Hydraulic Conductivity – Depth Dependence	Fit for purpose	Field testing of hydraulic conductivity (horizontal and to a lesser extent vertical) has been conducted in the area. Hydraulic conductivity test results from the other sites within the model domain were also considered. The data shows a general decline in hydraulic conductivity with depth that is replicated in the model.
	Spoil Properties	Fit for purpose, future improvements possible	Limited site-specific data is available for the spoil. Spoil properties were adopted using the previous studies.
	Rivers	Fit for purpose, future improvements possible	Blackwater Creek stage height is changed temporally in the historical calibration model based on observed levels from site stream gauges, and long term annual average level assumed in the predictive model. Blackwater Creek records flow only for a few days per year. The simulation of river stage height involves representing it as the average stage over the entire model stress period. However, since the stress periods (i.e., time slices) in the model are quarterly or annual, the stage height for Blackwater Creek persists in the model for a much longer period than it does in reality. This conservative design approach results in the simulation of what is naturally an ephemeral river reach as a perennial river in the model. Consequently, this leads to an overprediction of water levels in the alluvium along Blackwater Creek. All other watercourses within and in the vicinity of the Project area are ephemeral and only flow briefly after rainfall. Therefore, river stage height of zero was assigned to these watercourses in the model.



Type	Part	Status	Comment
	Recharge	Fit for purpose	Recharge zonation is based on mapped surface geology and calibrated recharge rates.
Measurement Error	Observation Data Quality	Fit for purpose	Bore logs and construction details available for most site bores, and long-term site water level data available for various units.
	Landholder Bore Data Quality	Fit for purpose, future improvements possible	Impacts on registered landholder bores are influenced by the assumptions of the bore design, target geology and use. Verification of landholder bore details may be required in future.
	Temporal spread	Fit for purpose	Timeseries water level data from the site as well as for the tertiary and Permian coal measures.
Scenario Uncertainties Future stresses/ conditions	Calibration	Fit for purpose	Transient warm-up (1970-2005) and transient (2005 to 2024) calibration model set up and a depth dependence function used and calibration to water levels conducted using automated (PEST) and manual methods.
	Predictive	Fit for purpose	Model captures approved and proposed open cut mining at BWM. The model also includes future mining at BWM South and Curragh mines, mainly based on publicly available data. The actual future mine progression for these sites may vary.
	Sensitivity and uncertainty	Fit for purpose	Uncertainty analysis has been conducted using PESTPP-IES. The uncertainty analysis quantified the variability in predictions with changes in maximum predicted drawdowns, mine inflows, impact on alluvium flow and impacts on surface water flow.



8.1 Conclusions

The numerical groundwater model developed for the Project successfully achieved the modelling objectives, as outlined in **Section 1**. Model calibration statistics are within suggested guidelines (Barnett et al., 2012) and mass balance errors remain low, through the model calibration and predictive modelling. Model construction considers all available data, including the current site mine plan and site geological model for the Project area. The uncertainty analysis has demonstrated a low likelihood for the Project to impact on alluvial water levels, with Project related drawdown primarily contained within the Project area. The model serves as a suitable representation of possible transient groundwater conditions within the Study Area, over the life of the Project, however, the uncertainty in predictions should be acknowledged.

Limited site-specific information on hydraulic conductivities and storage parameters were available during calibration. As more site-specific hydraulic data becomes available, new data should be compared with the calibrated parameters achieved and the validity of the model calibration should be assessed. Additional site-specific data is expected to “tighten” uncertainty bounds for model prediction results.

Predictive sensitivity indicates that mine inflows are sensitive to spoil hydraulic parameters. However, calibration sensitivity to these parameters is relatively low. Future work should consider opportunities to further constrain values of these parameters.



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Appendix A Calibration Residuals

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

9 April 2026

ID	Easting	Northing	Layer	Average Residual	Min	Max
BG No.1 AP	684107	7387742	16	-6.37	-6.64	-6.21
BG No.2 BG	684414	7384622	16	0.77	-1.79	3.86
BWM_MB01_02	687411	7344932	10	-32.48	-33.38	-29.14
BWM_MB02_01	691791	7362760	7	4.28	3.43	4.73
BWM_MB02_02	691803	7362756	10	-19.82	-20.36	-19.34
BWM_MB03_02	692220	7381519	5	-9.80	-9.83	-9.74
BWM_MB04_01	686247	7350296	10	15.26	13.07	16.69
BWM_MB100_01	683897	7353255	2	10.95	10.95	10.95
BWM_MB106_01	684923	7352654	2	-3.17	-3.17	-3.17
BWM_MB107_04	685192	7352941	12	-17.47	-17.47	-17.47
BWM_MB108_04	685132	7353470	12	-21.74	-21.74	-21.74
BWM_MB109_02	684843	7353684	12	0.69	0.69	0.69
BWM_MB110_01	684722	7353488	11	-2.59	-2.59	-2.59
BWM_MB113_01	684003	7353042	2	1.37	1.37	1.37
BWM_MB114_01	683973	7352659	2	-2.47	-2.47	-2.47
BWM_MB116_02	683430	7351232	16	-7.23	-7.23	-7.23
BWM_MB117_01	683622	7350774	16	-4.44	-4.44	-4.44
BWM_MB117_02	683557	7350857	2	3.63	3.63	3.63
BWM_MB118_02	683708	7350621	16	-2.75	-2.75	-2.75
BWM_MB11_01_R01	691468	7360018	7	-27.53	-30.77	-24.28
BWM_MB11_02	691462	7360012	10	3.78	-2.49	10.05
BWM_MB11_03	691458	7360008	12	16.79	11.89	21.69
BWM_MB121_02	684196	7350960	16	16.79	16.79	16.79
BWM_MB122_01	684453	7351176	7	10.01	10.01	10.01
BWM_MB123_02	683946	7351056	16	6.89	6.89	6.89
BWM_MB126_02	684063	7351953	16	1.90	1.90	1.90
BWM_MB12_02	687969	7356097	10	-1.03	-1.81	-0.44
BWM_MB12_03	687977	7356091	12	-3.34	-3.38	-3.30
BWM_MB130_01	684963	7351640	7	-2.90	-2.90	-2.90
BWM_MB130_02	684959	7351646	12	1.77	1.77	1.77
BWM_MB131_02	684803	7351242	16	6.65	6.65	6.65
BWM_MB132_02	684591	7351283	16	4.75	4.75	4.75
BWM_MB134_02	684943	7351085	16	7.27	7.27	7.27
BWM_MB135_02	684899	7350805	14	-7.49	-7.49	-7.49
BWM_MB136_02	684603	7350311	16	-5.65	-5.65	-5.65



ID	Easting	Northing	Layer	Average Residual	Min	Max
BWM_MB137_02	685185	7350987	16	9.19	9.19	9.19
BWM_MB138_02	684736	7350972	13	2.42	2.42	2.42
BWM_MB15_01	686794	7347807	2	25.82	25.78	25.90
BWM_MB15_02	686779	7347804	12	-11.83	-17.56	-6.11
BWM_MB15_03	686768	7347802	10	-15.47	-19.04	-11.90
BWM_MB164_01	683816	7350493	2	4.01	4.01	4.01
BWM_MB16_01	682882	7340174	2	0.79	-0.11	1.25
BWM_MB16_02	682883	7340184	10	-9.65	-9.85	-9.31
BWM_MB16_03	682875	7340188	12	-8.73	-8.93	-8.35
BWM_MB17_02	684119	7343373	2	0.56	-1.34	0.92
BWM_MB17_03	684111	7343371	2	-7.25	-7.43	-6.95
BWM_MB19_01	683803	7350482	16	-17.23	-17.23	-17.23
BWM_MB21_02	686043	7342140	8	-22.34	-22.79	-21.89
BWM_MB21_03	686041	7342148	12	-22.97	-23.38	-22.60
BWM_MB22_01	687412	7344924	2	5.12	5.02	5.18
BWM_P4	684098	7352908	2	-2.13	-2.95	-1.12
BWM_P7	684002	7352973	2	-0.75	-1.03	-0.55
FY16_PZ_2	686714	7387555	12	-2.03	-2.78	-1.18
FY16_PZ_3	686322	7388372	12	-11.22	-12.19	-6.15
FY16_PZ_4	686206	7389577	12	-7.77	-8.13	-7.47
FY16_PZ_5	685482	7389168	12	-2.78	-3.12	-2.52
MB1	686528	7387172	8	-6.22	-10.85	-1.07
MB15	688772	7354180	7	0.31	-4.92	4.89
MB16	687966	7352289	7	-13.18	-25.78	4.22
MB17	691280	7370333	7	-11.70	-14.22	-10.07
MB18	691528	7370782	7	-7.71	-12.53	-3.55
MB19BWM01P	690024	7390277	8	-6.82	-7.22	-6.32
MB19BWM02A	690112	7390183	6	-0.60	-1.13	0.02
MB19BWM03P	688442	7383483	8	-7.40	-10.97	-3.31
MB19BWM04R	688307	7383595	6	-16.58	-17.11	-16.27
MB19BWM06P	687694	7379464	8	9.68	8.96	10.74
MB19BWM08P	691544	7370740	8	8.63	8.45	9.15
MB19BWM25P	689262	7376881	6	-5.66	-6.01	-5.16
MB19BWM27P	689070	7376739	8	1.30	0.98	1.71
MB19BWM_10P	684383	7342058	12	-13.09	-13.22	-12.97



ID	Easting	Northing	Layer	Average Residual	Min	Max
MB19BWM_15P	669194	7338140	8	-5.94	-7.40	-5.09
MB19BWM_16R	669188	7338156	6	-10.61	-12.19	-9.15
MB19BWM_18P	677019	7338061	8	-11.22	-13.01	-10.33
MB19BWM_24P	670211	7342228	8	-11.82	-11.95	-11.69
MB19BWM_25P_B	683532	7333206	8	3.15	3.04	3.34
MB20BWM02P2	686321	7388395	10	-15.11	-17.87	-5.71
MB20BWM03P1	686489	7387296	10	-12.75	-13.20	-12.53
MB20BWM03P2	686490	7387289	12	-10.62	-12.21	-9.73
MB23	683792	7350850	16	-0.59	-0.77	-0.36
MB3	688026	7373479	8	3.12	0.11	7.54
MB4	692072	7366435	7	-19.36	-20.81	-12.30
MB6	686881	7347723	7	25.74	20.88	30.20
MB8	681544	7373895	2	1.56	-0.75	4.19
MB9	682318	7372602	16	7.38	6.97	7.67
RGS_PZ2-3	683745	7351052	2	3.20	3.00	3.41
RGS_PZ6-2	683925	7350731	2	8.53	7.91	9.78
TMB1-D	681252	7372802	16	-0.02	-0.12	0.07
TMB1-S	681249	7372800	2	3.95	3.82	4.05
TMB5-S	683230	7373039	2	11.23	10.85	11.80
TMB6-S	682831	7373037	16	1.31	1.08	1.51
TMB7-S	681358	7373521	16	4.09	4.09	4.09
TMB8-S	682254	7374255	16	-5.18	-5.27	-5.06
VWP19BWM01-2	689179	7376894	6	-3.66	-5.83	2.95
VWP19BWM01-4	689179	7376894	7	4.08	-0.20	5.27
VWP19BWM01-5	689179	7376894	9	2.18	1.51	3.09
VWP19BWM02-1	691840	7365921	7	-27.96	-34.15	-19.66
VWP19BWM02-2	691840	7365921	9	-13.04	-15.10	-9.05
VWP19BWM02-3	691840	7365921	11	-10.18	-12.01	-6.05
VWP19BWM02-4	691840	7365921	12	-11.87	-14.27	-8.33
VWP19BWM02-5	691840	7365921	14	-7.06	-12.05	-0.77
VWP19BWM03-2	672843	7334855	7	-23.30	-23.97	-21.56
VWP19BWM03-4	672843	7334855	9	-20.39	-22.05	-18.40
VWP19BWM03-5	672843	7334855	12	-18.64	-20.24	-16.54
VWP19BWM04-1	682417	7330805	6	-22.83	-24.10	-20.93
VWP19BWM04-2	682417	7330805	7	-12.17	-13.11	-11.01



ID	Easting	Northing	Layer	Average Residual	Min	Max
VWP19BWM04-3	682417	7330805	8	9.38	8.91	9.94
VWP19BWM04-4	682417	7330805	11	8.25	7.18	9.59
VWP19BWM04-5	682417	7330805	12	9.52	9.11	10.32

Appendix B Calibration Hydrographs

Blackwater North Extension Project

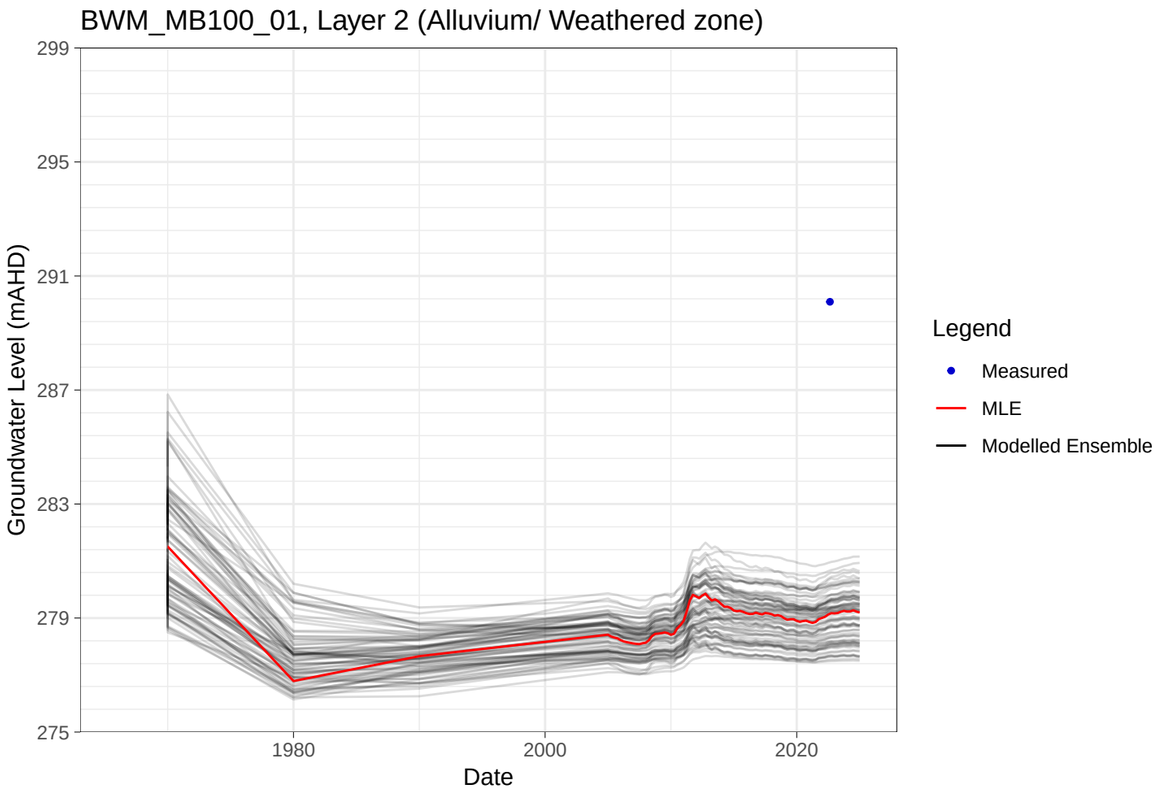
Groundwater Modelling Technical Report

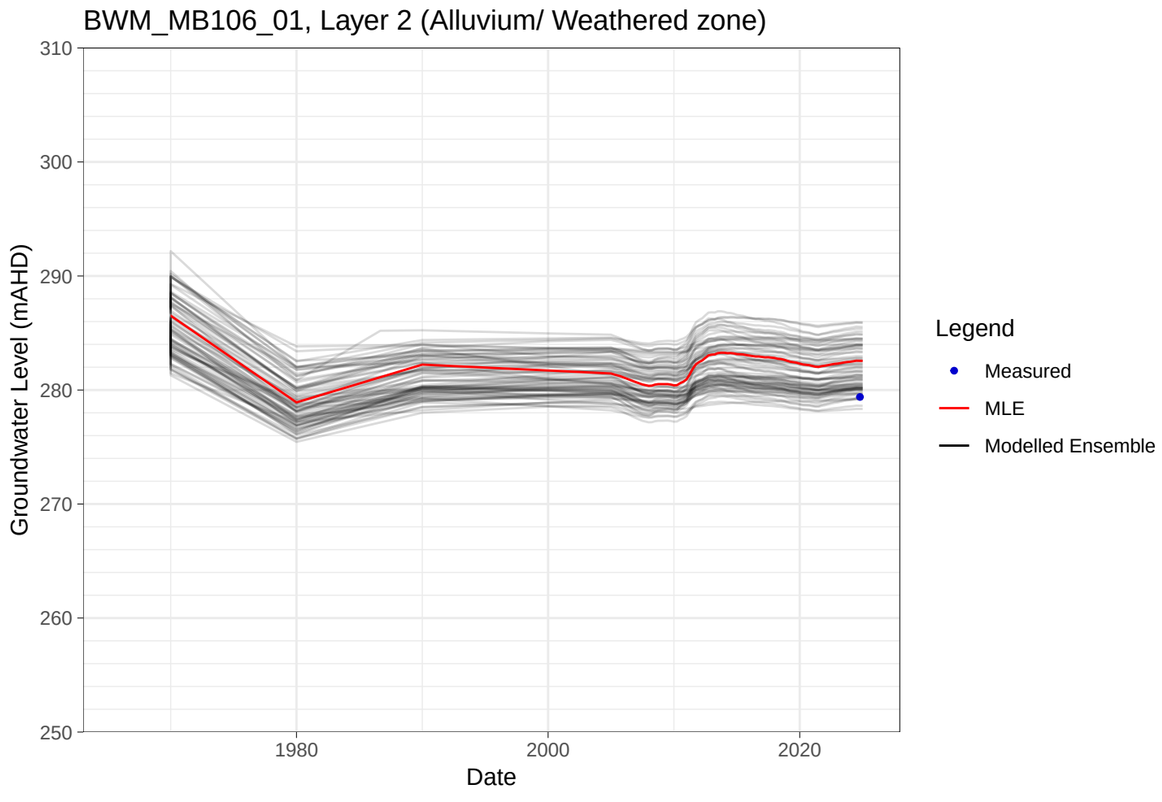
Whitehaven Blackwater Pty Ltd

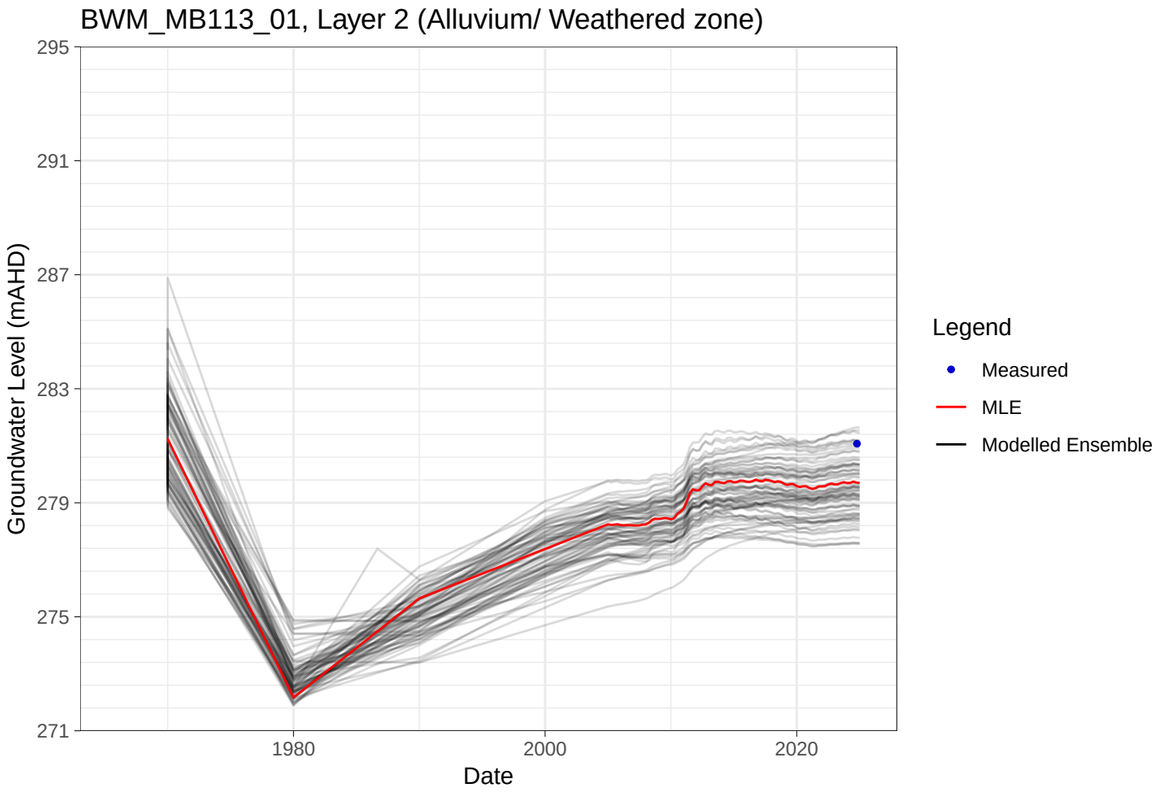
SLR Project No.: 640.031809.00001

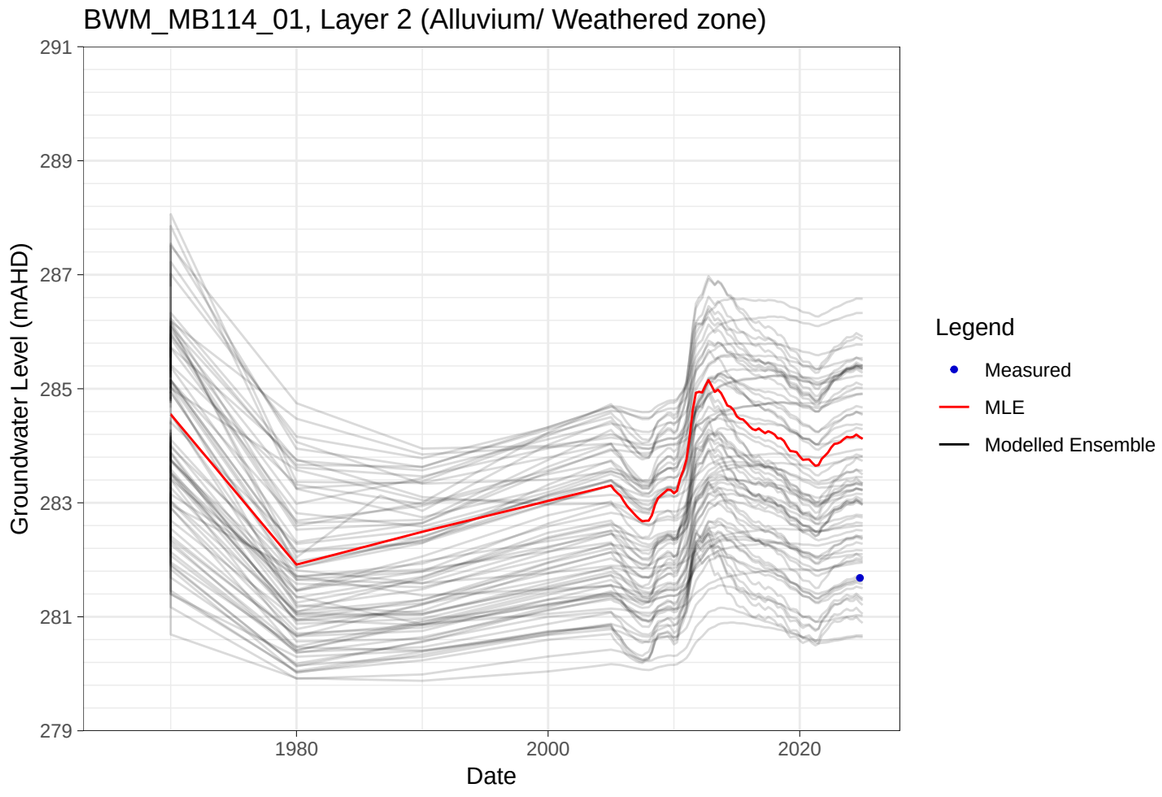
9 April 2026

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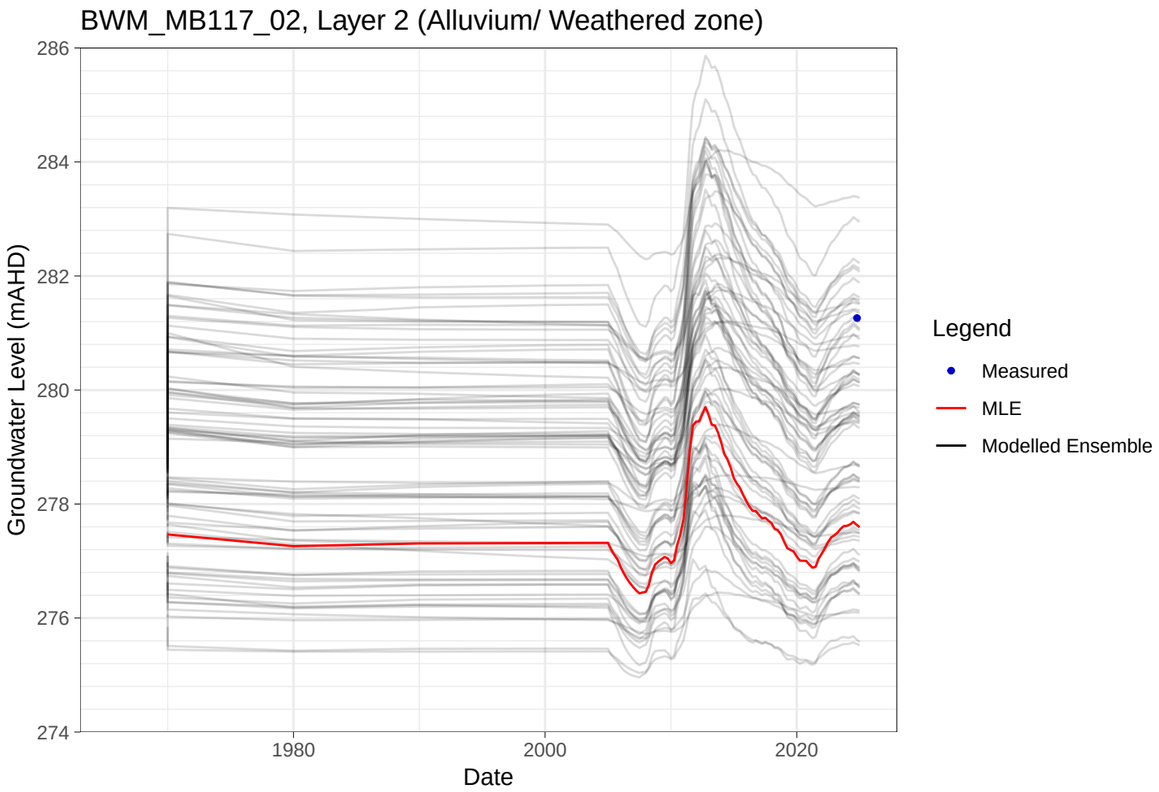

BWM_MB100_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
299
295
291
287
283
279
275
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

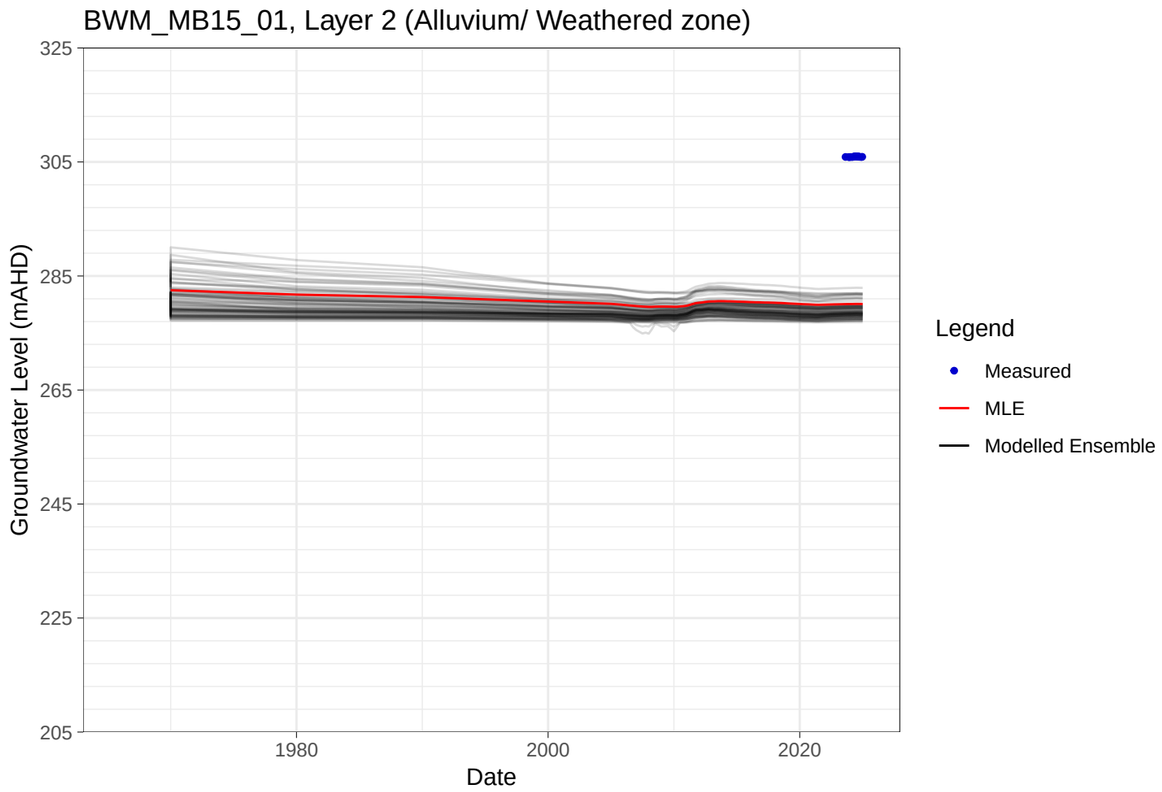

BWM_MB106_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
310
300
290
280
270
260
250
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

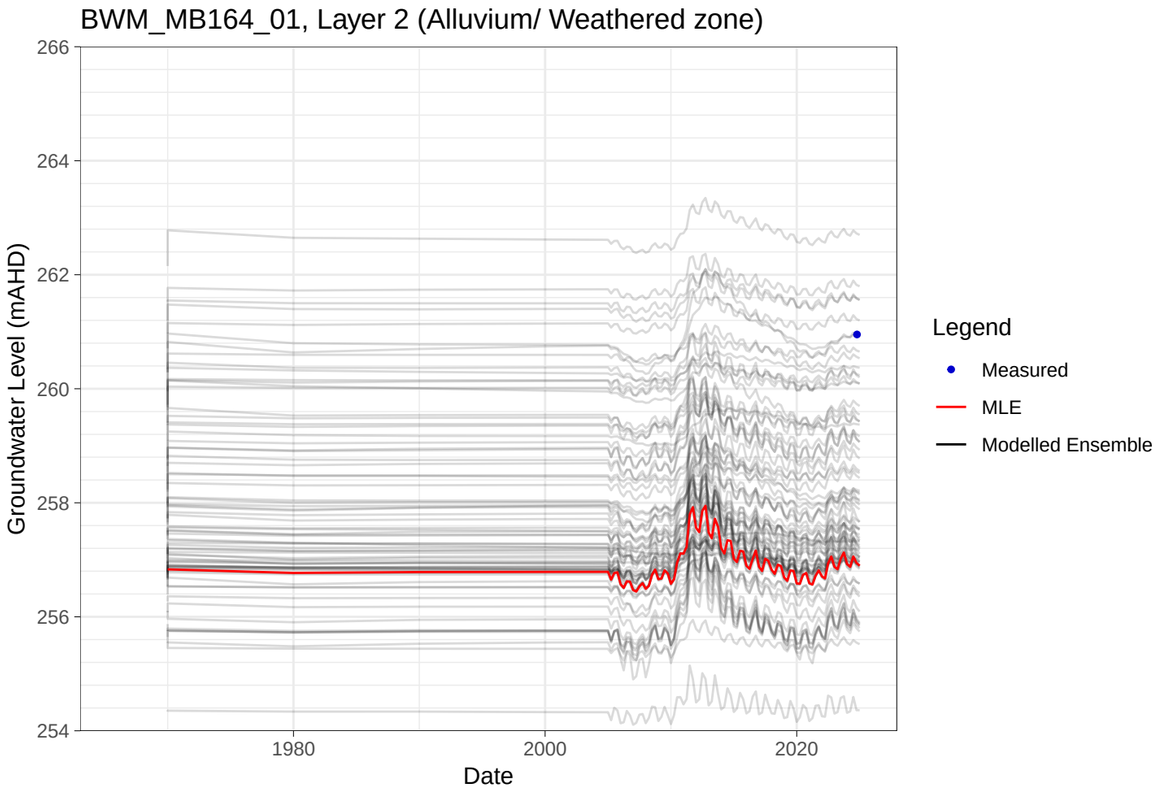

BWM_MB113_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

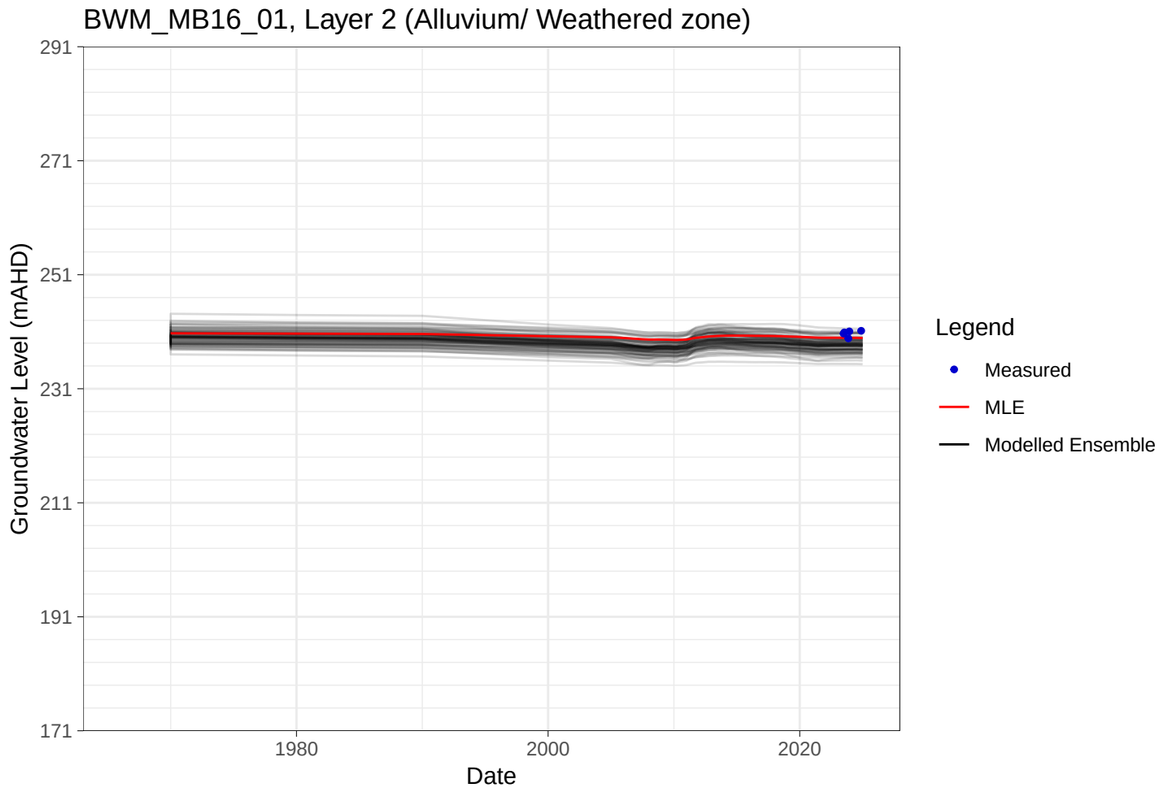

BWM_MB114_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
291
289
287
285
283
281
279
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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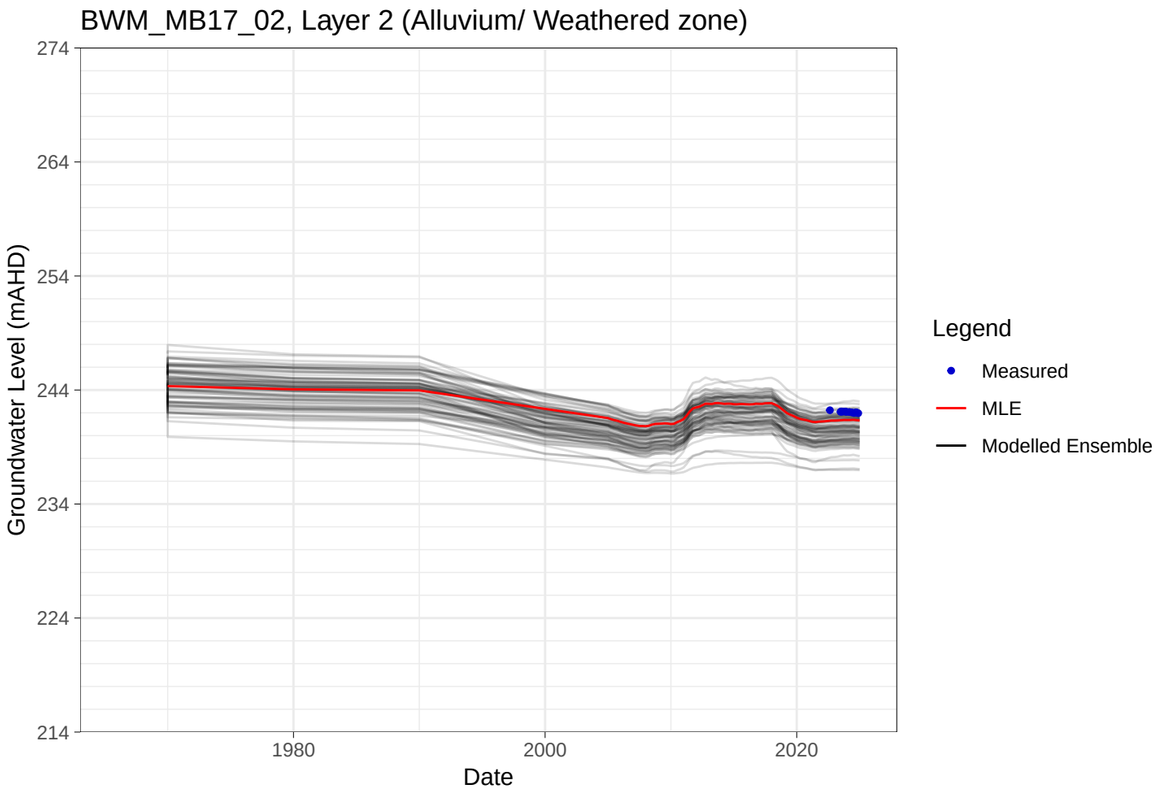

BWM_MB117_02, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
286
284
282
280
278
276
274
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

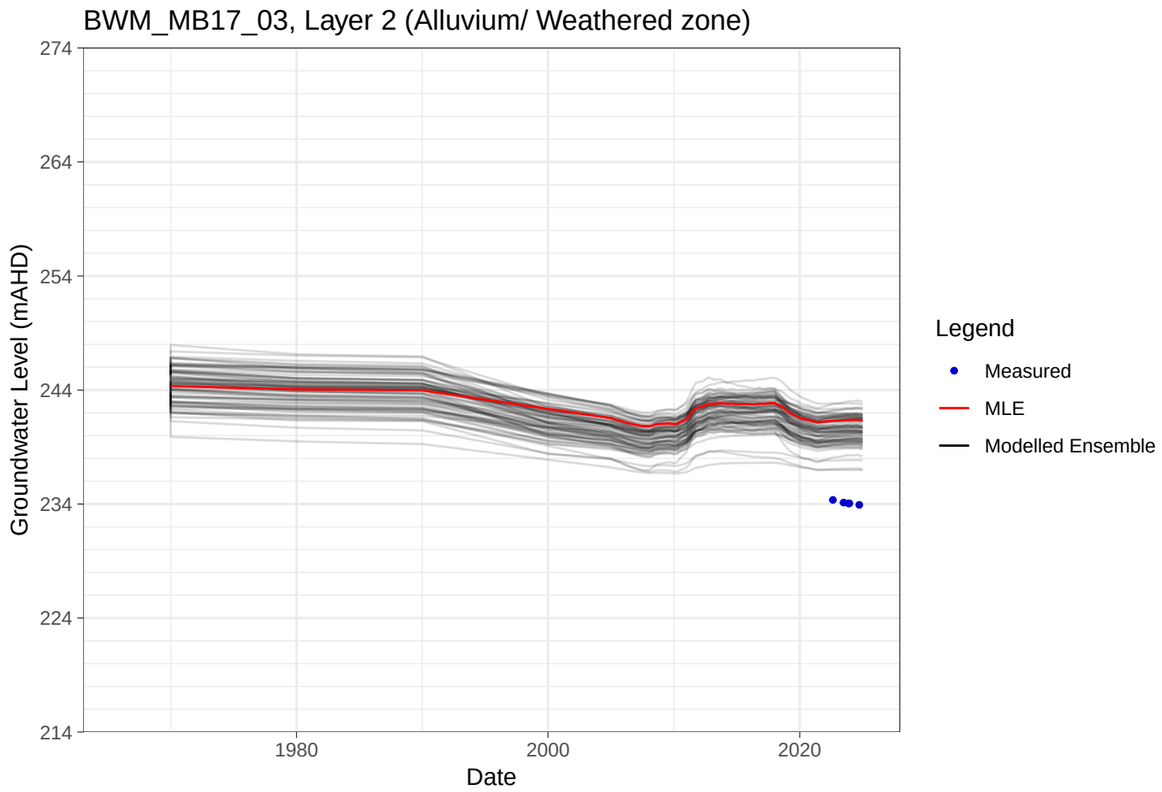

BWM_MB15_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
325
305
285
265
245
225
205
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

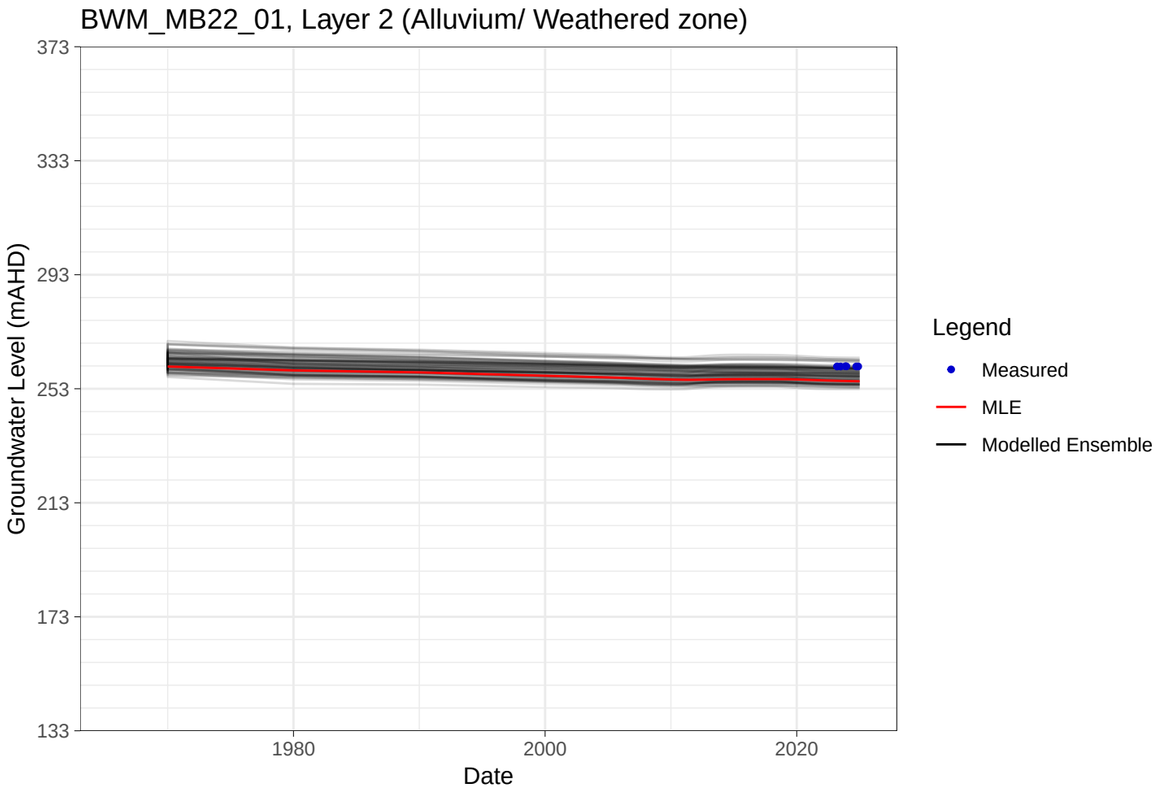

BWM_MB164_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
266
264
262
260
258
256
254
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

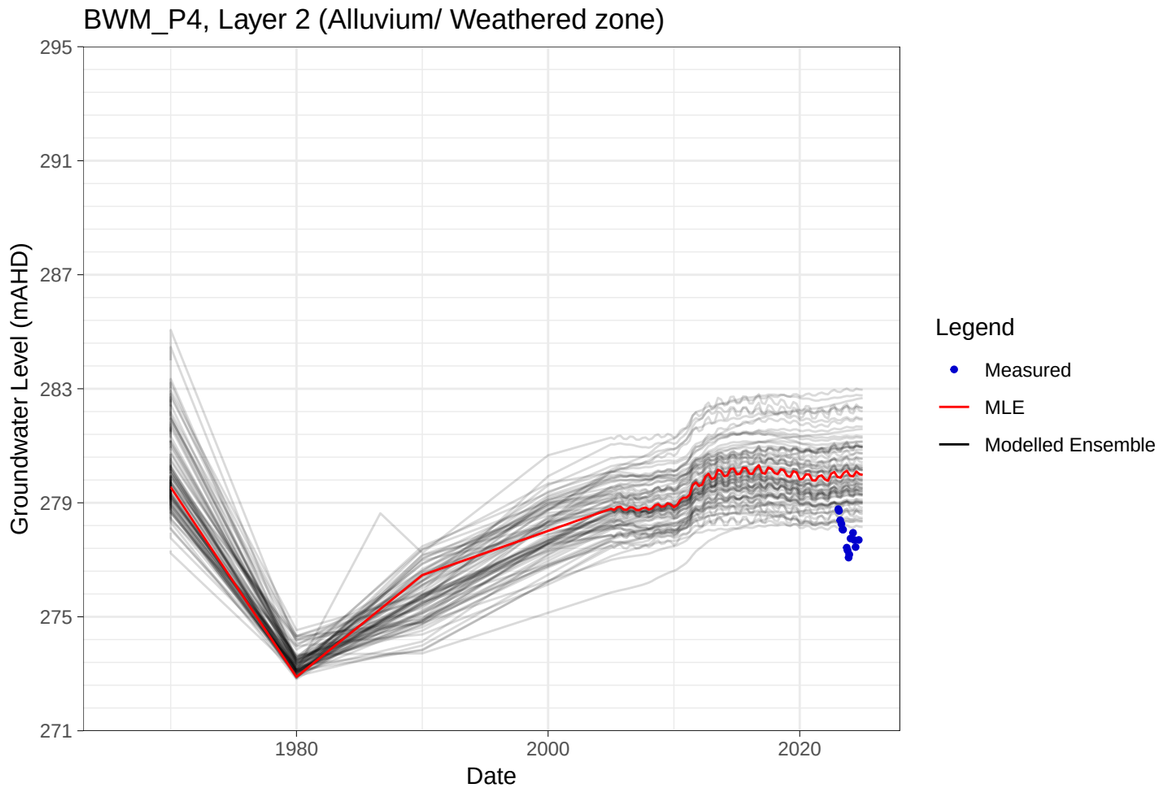

BWM_MB16_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
291
271
251
231
211
191
171
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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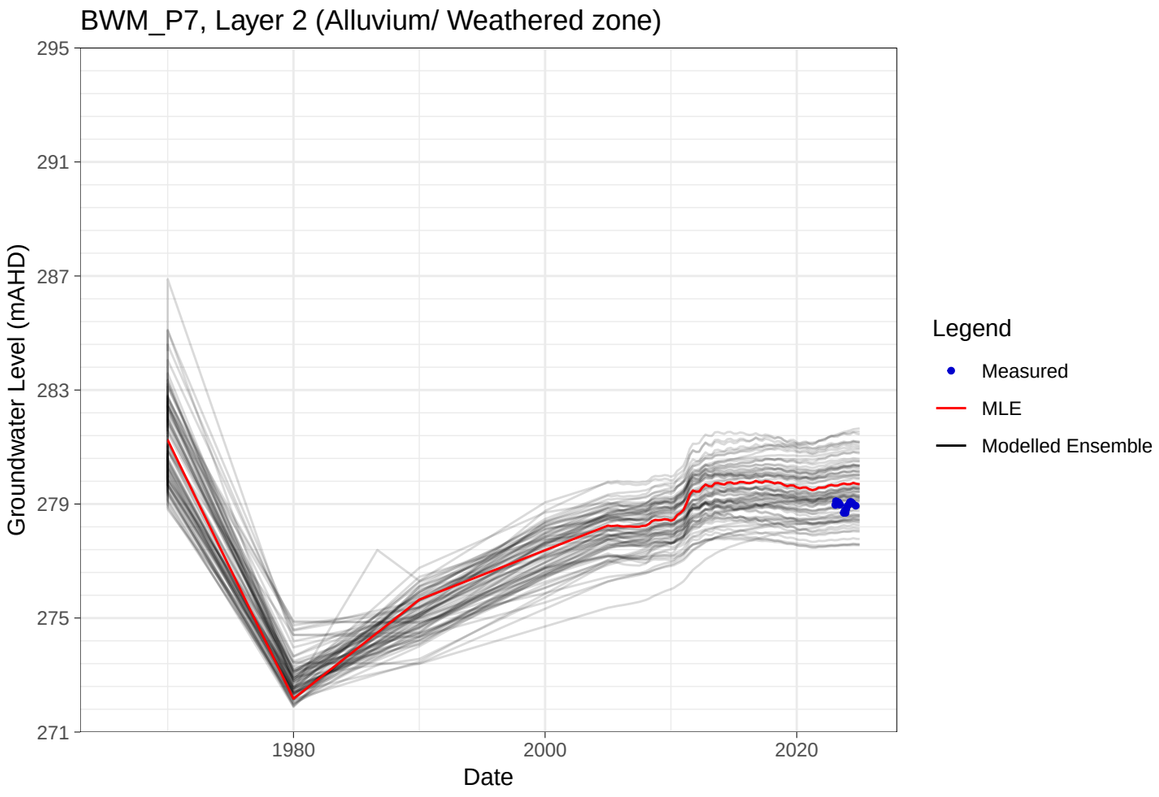

BWM_MB17_02, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
274
264
254
244
234
224
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

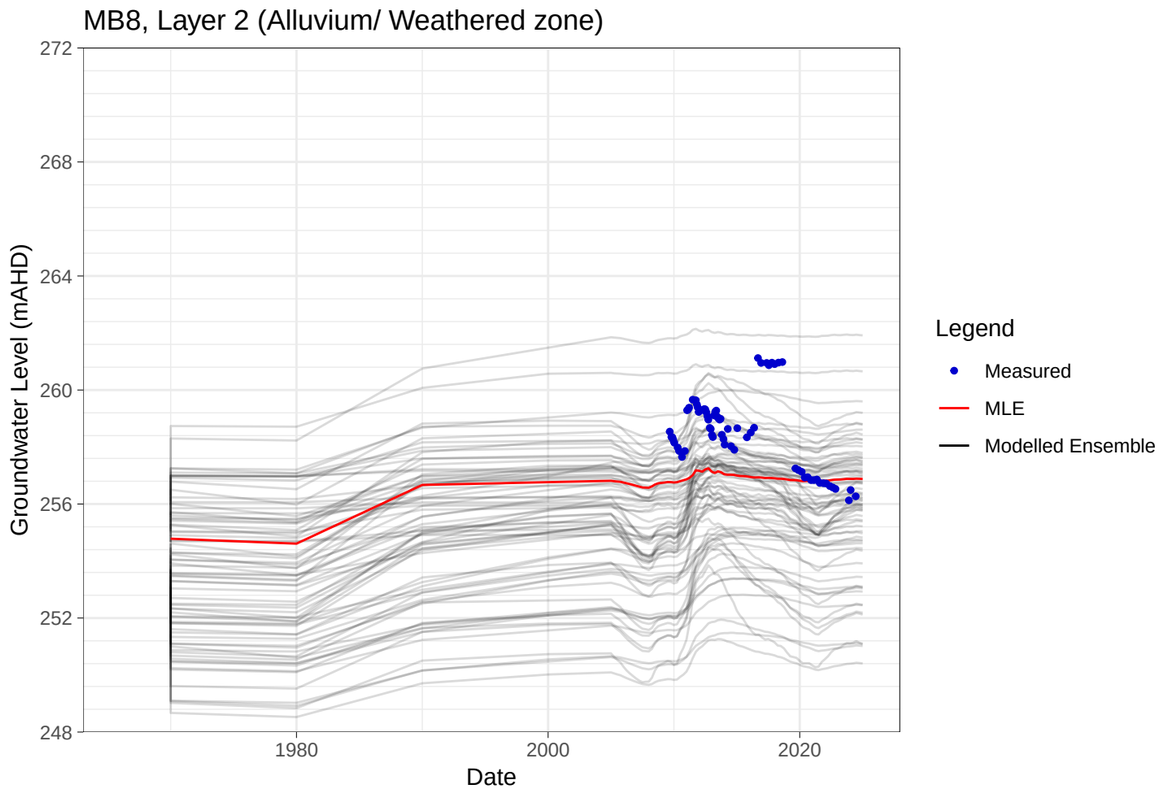

BWM_MB17_03, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
274
264
254
244
234
224
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

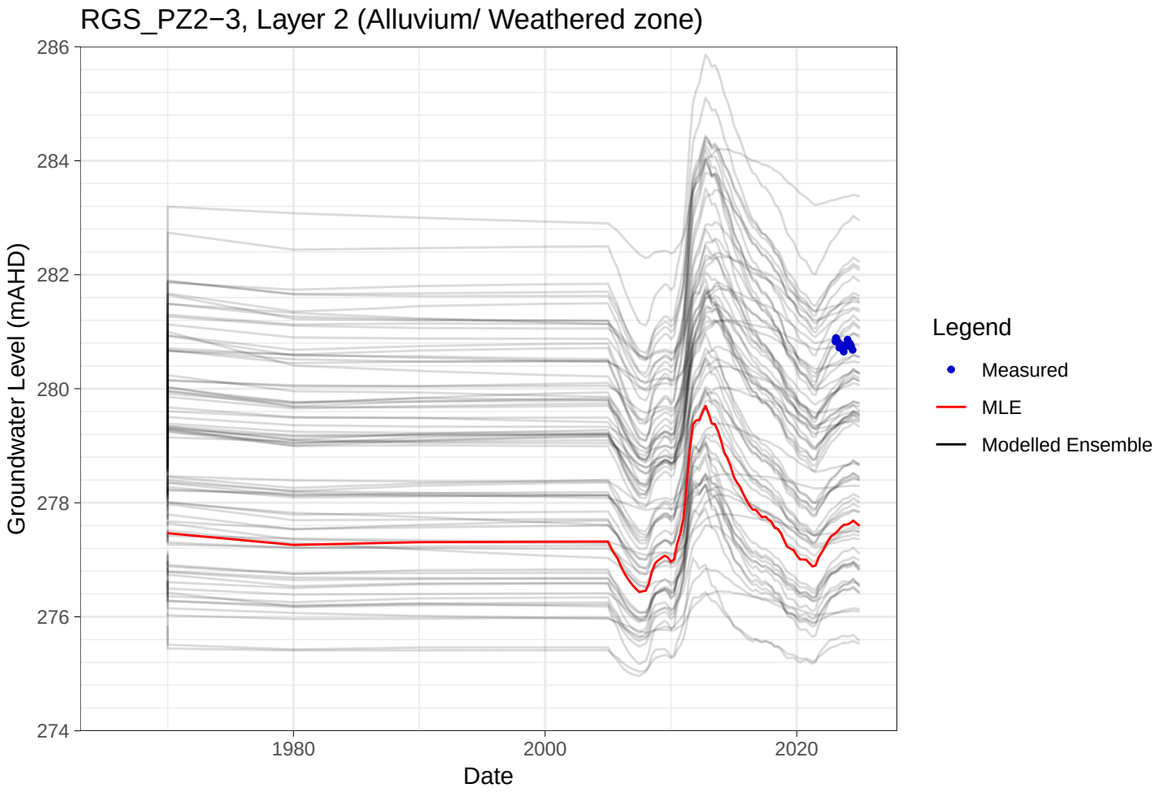

BWM_MB22_01, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
373
333
293
253
213
173
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

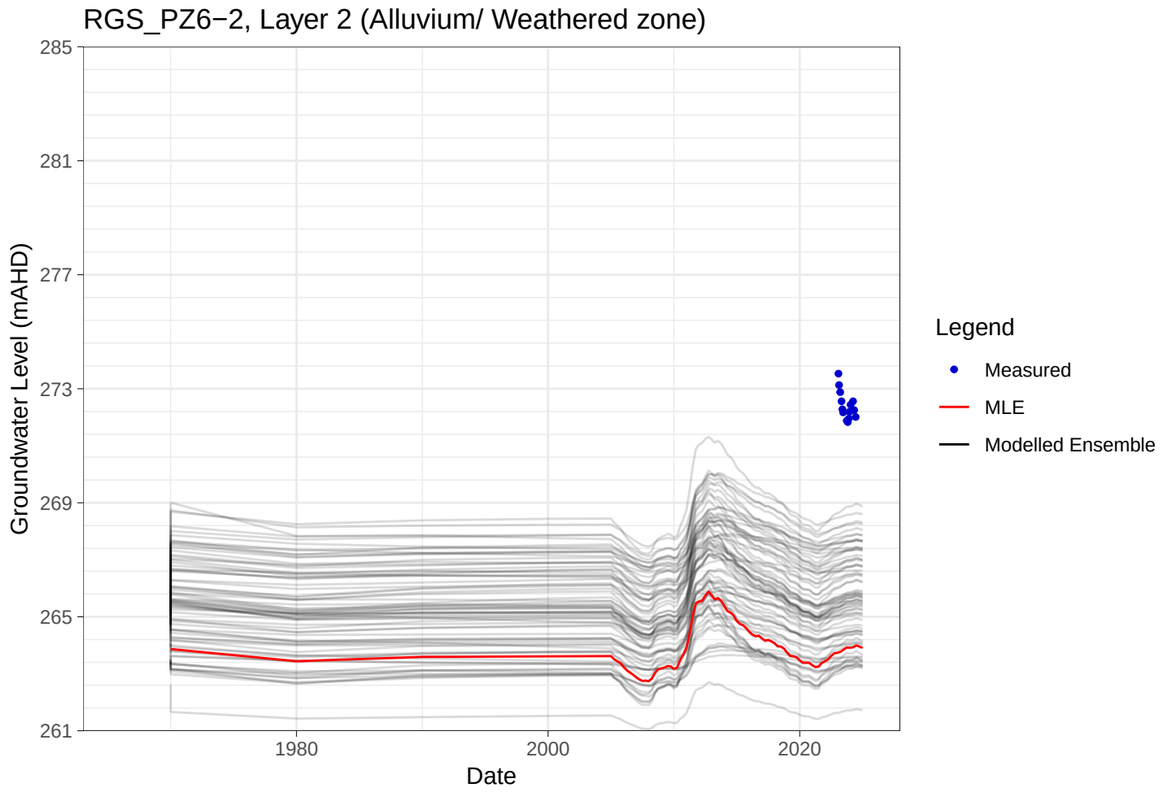

BWM_P4, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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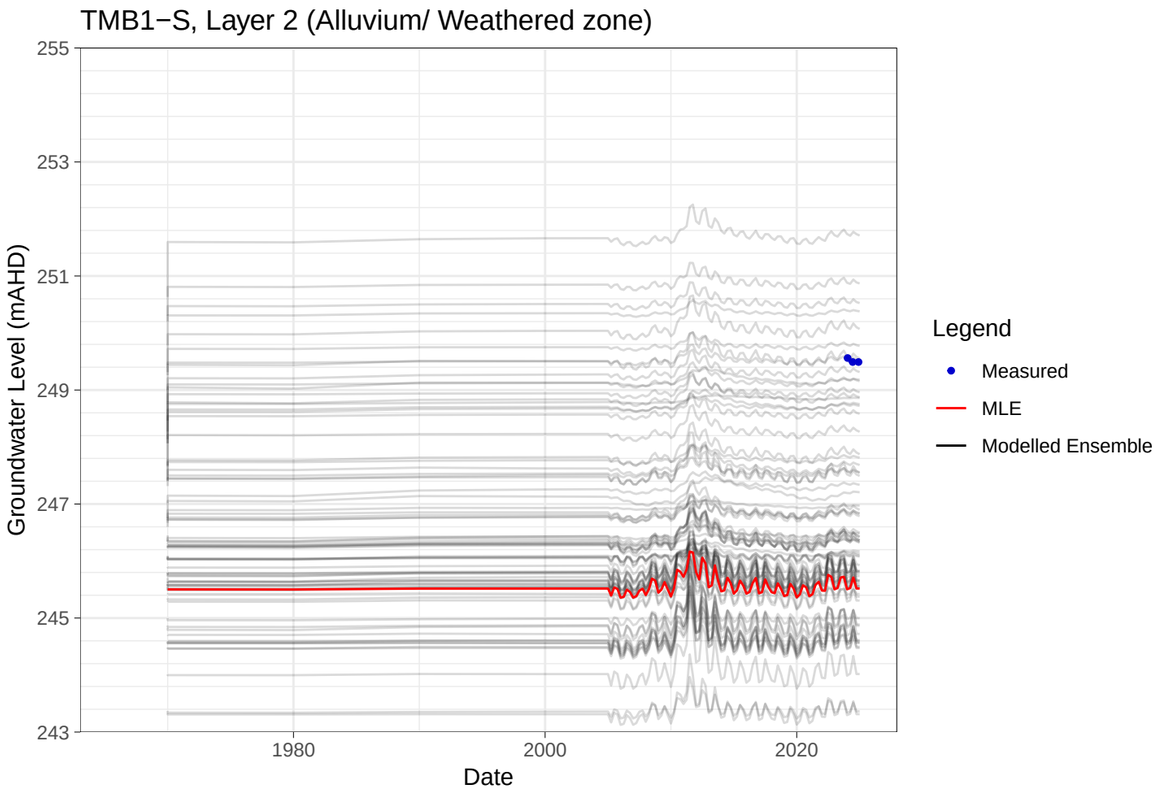

BWM_P7, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
295
291
287
283
279
275
271
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

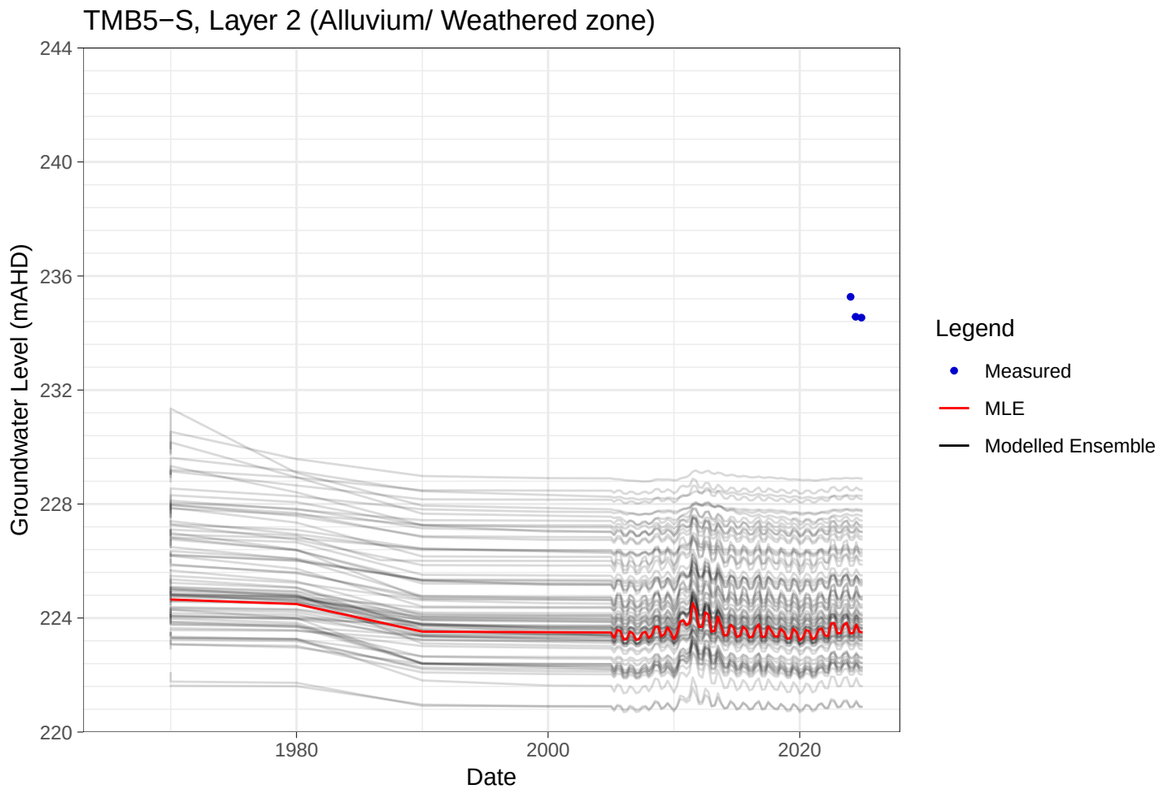

MB8, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
272
268
264
260
256
252
248
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

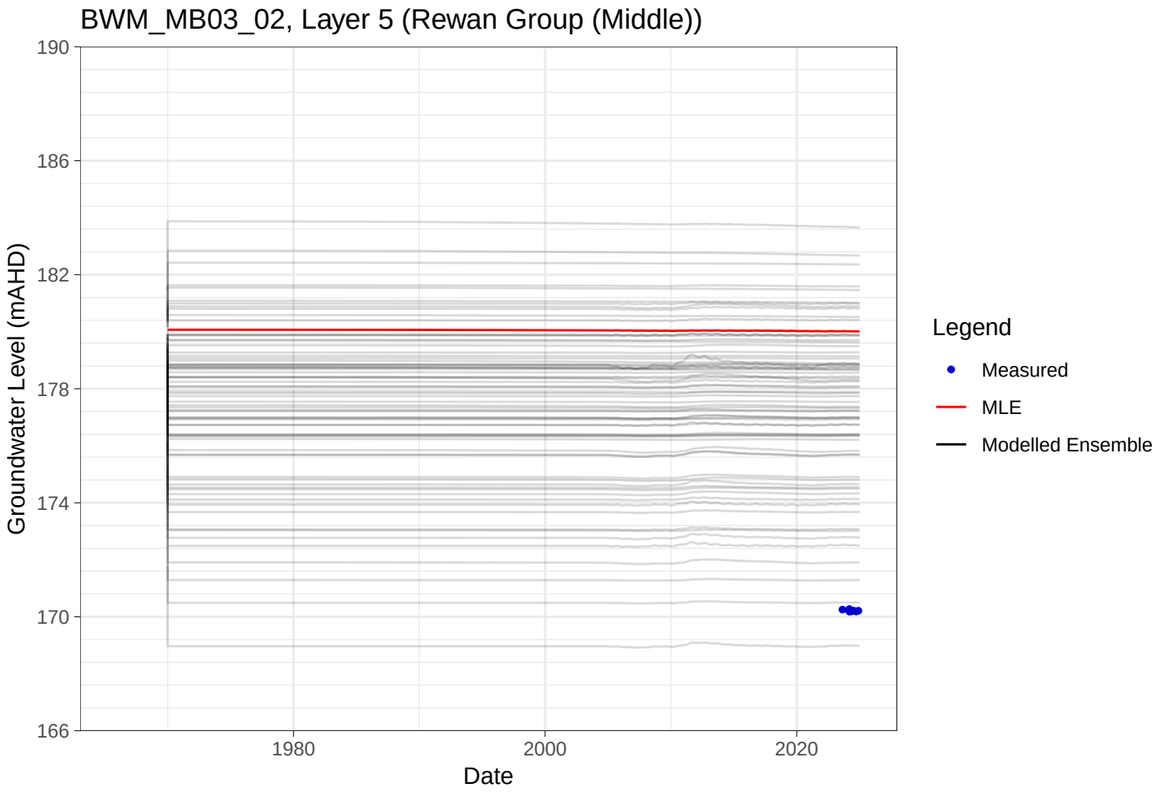

RGS_PZ2−3, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
286
284
282
280
278
276
274
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

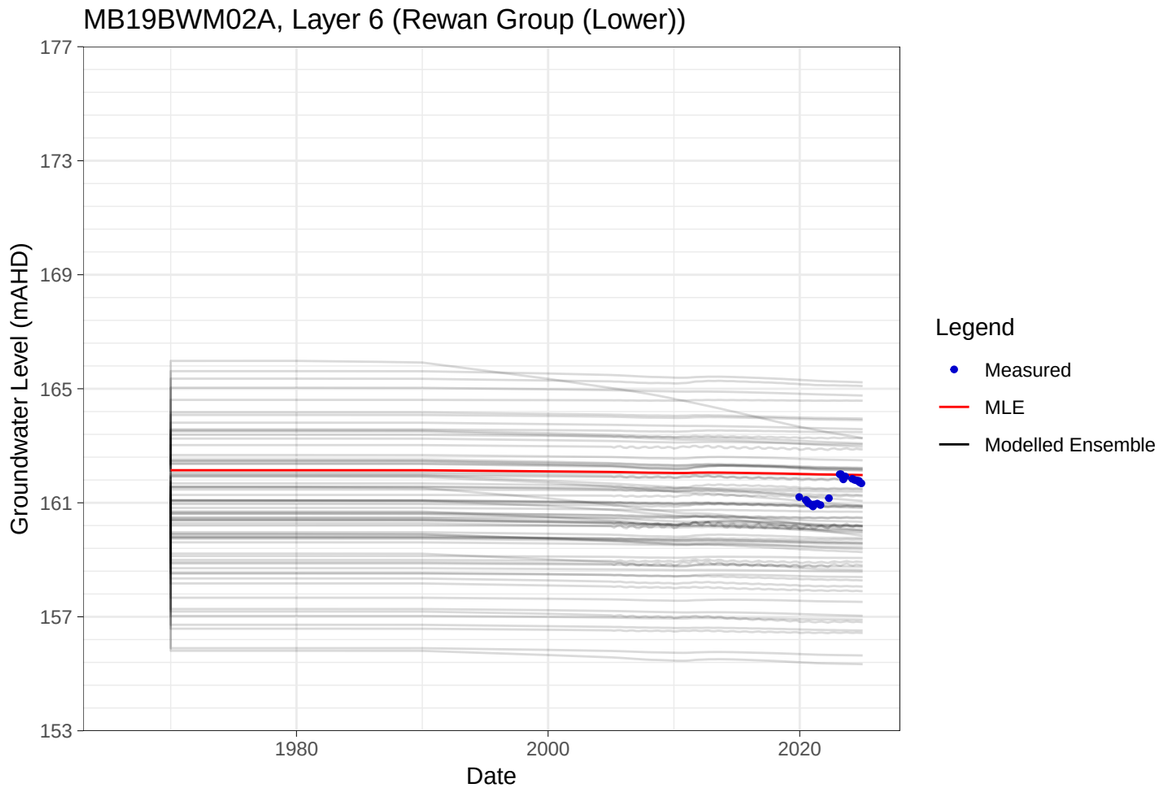

RGS_PZ6−2, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
285
281
277
273
269
265
261
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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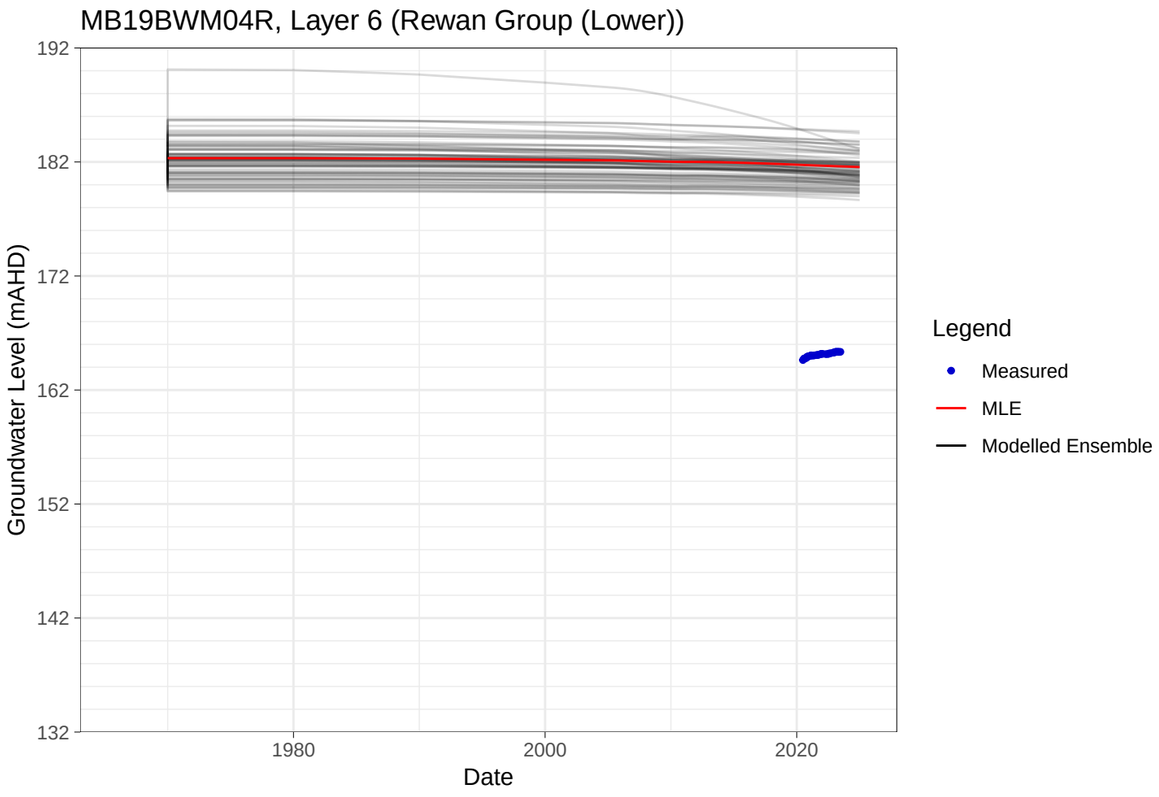

TMB1−S, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
255
253
251
249
247
245
243
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

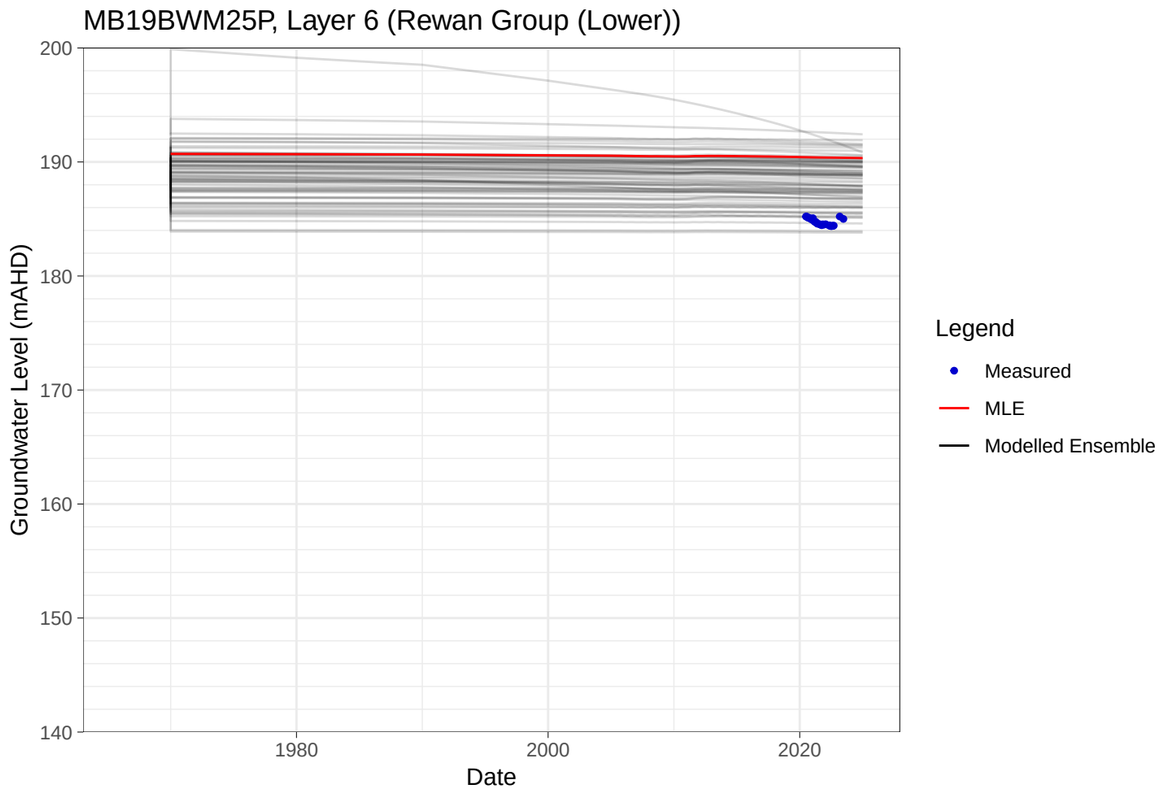

TMB5−S, Layer 2 (Alluvium/ Weathered zone)
Groundwater Level (mAHD)
244
240
236
232
228
224
220
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

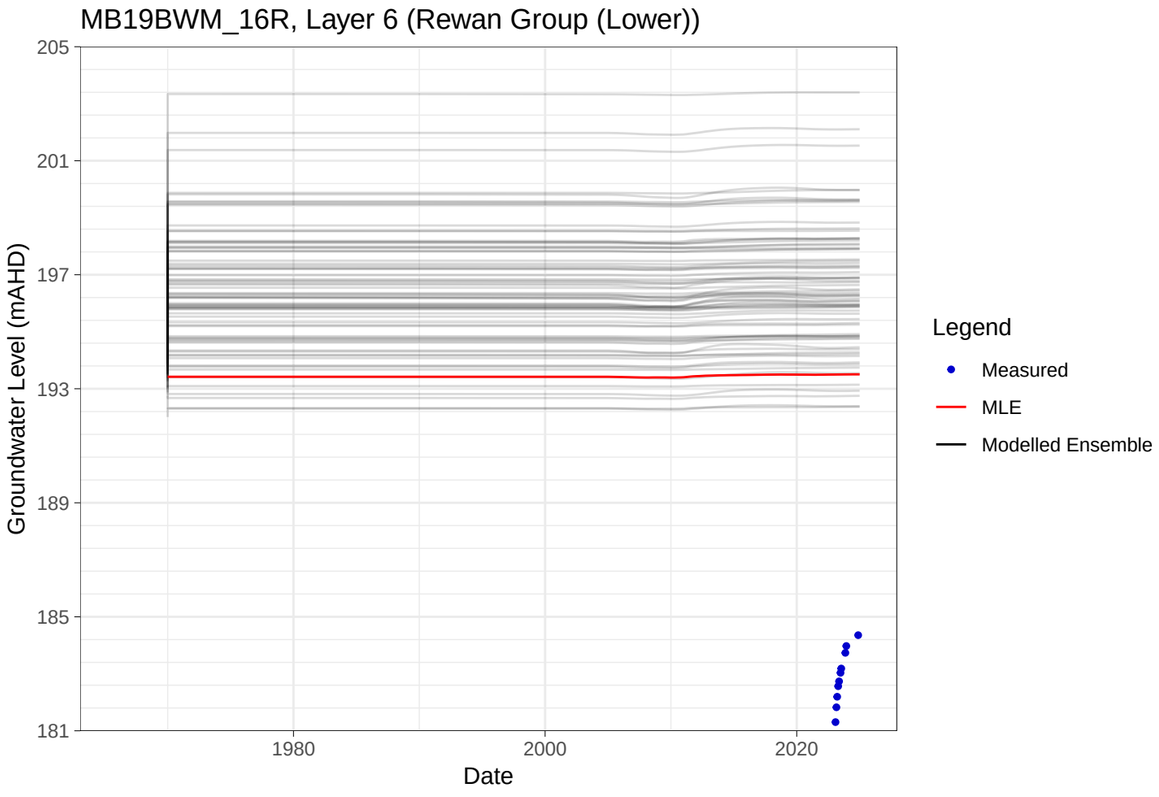

BWM_MB03_02, Layer 5 (Rewan Group (Middle))
Groundwater Level (mAHD)
190
186
182
178
174
170
166
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

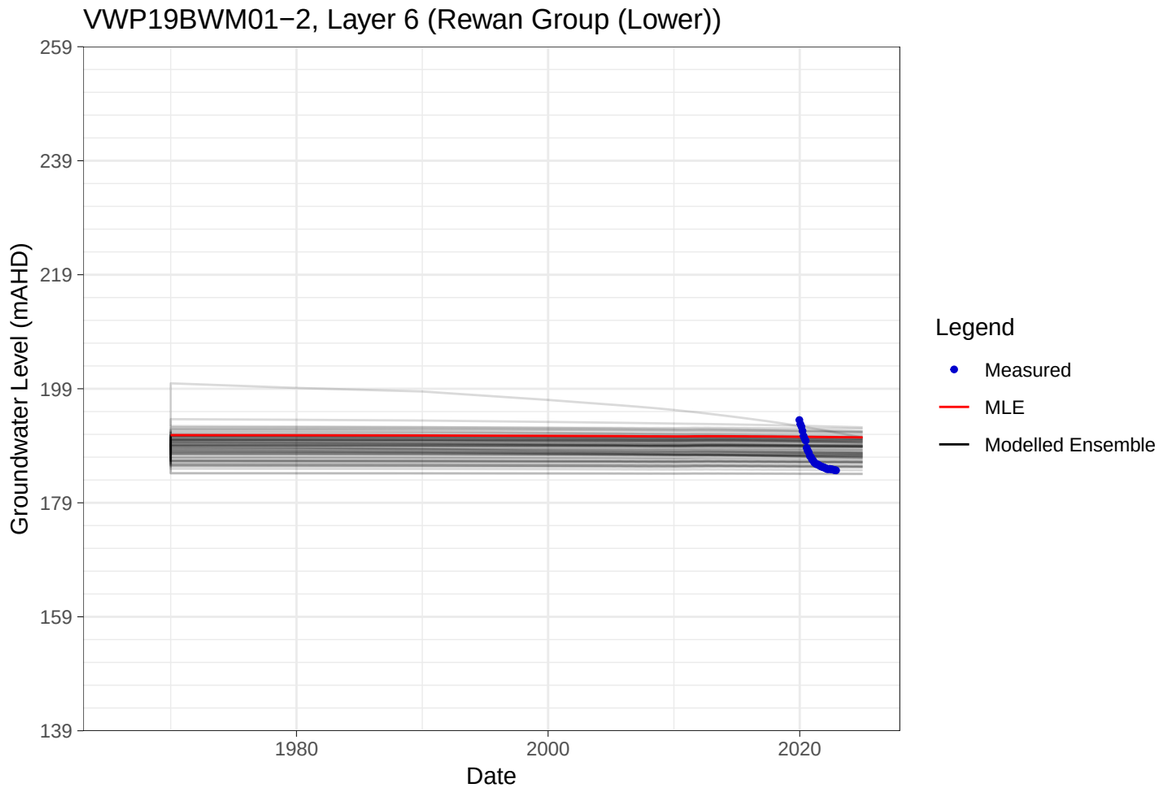

MB19BWM02A, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
177
173
169
165
161
157
153
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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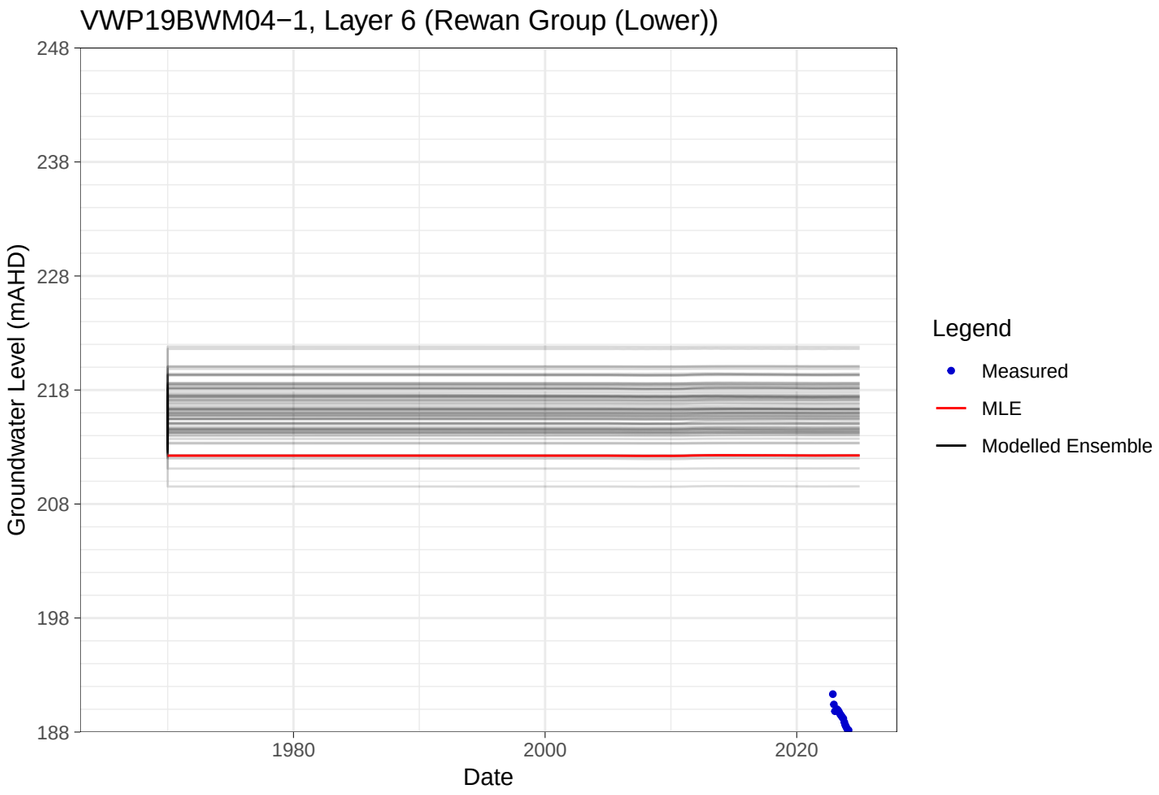

MB19BWM04R, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
192
182
172
162
152
142
132
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

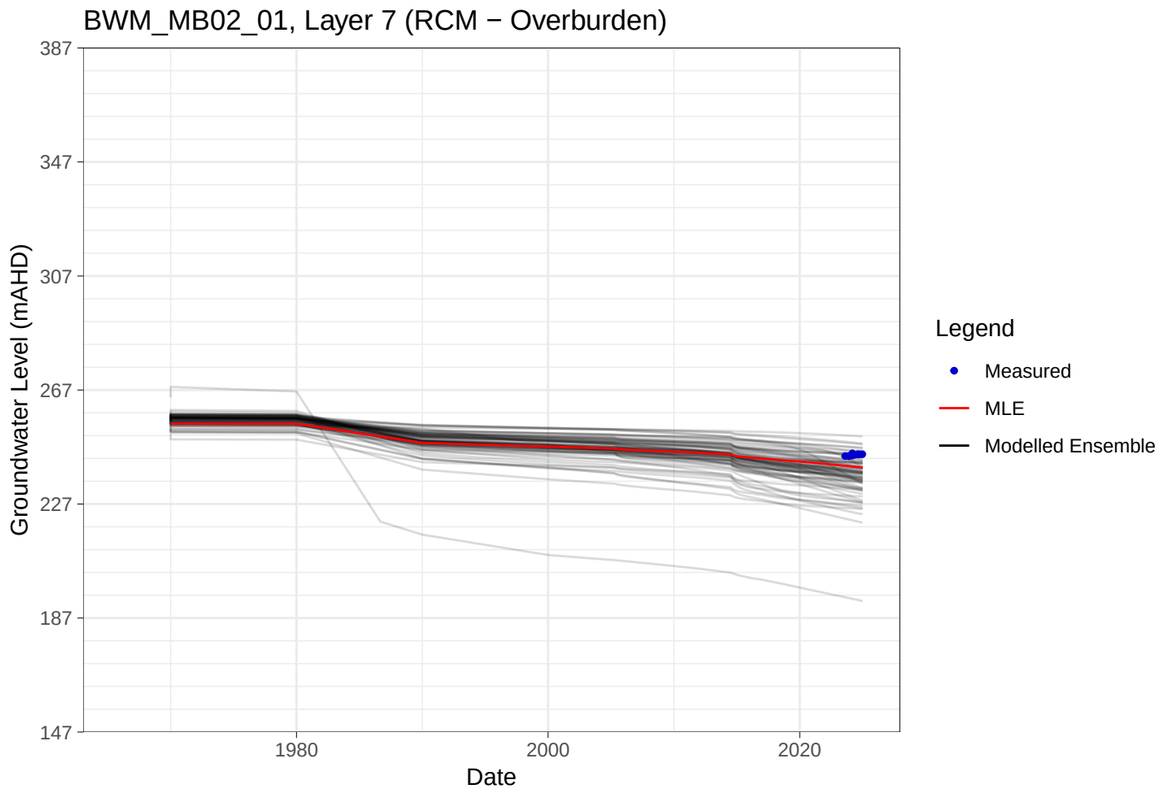

MB19BWM25P, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
200
190
180
170
160
150
140
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

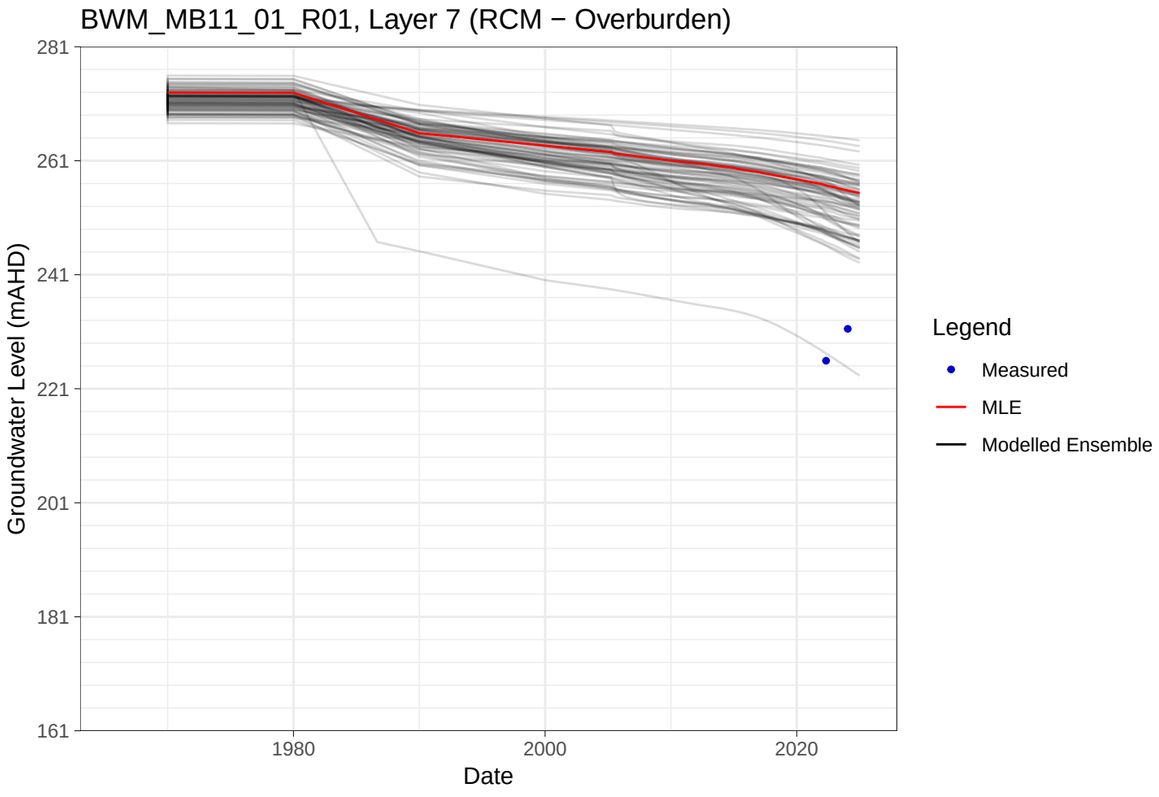

MB19BWM_16R, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
205
201
197
193
189
185
181
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

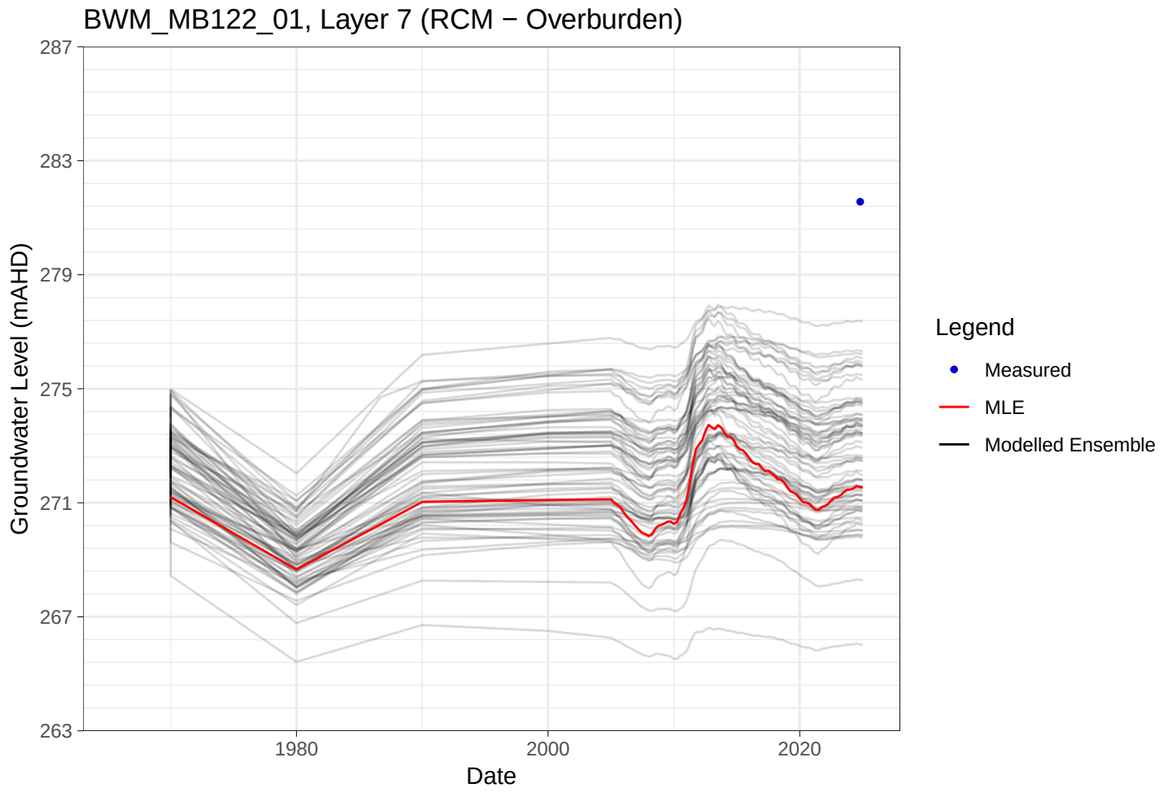

VWP19BWM01−2, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
259
239
219
199
179
159
139
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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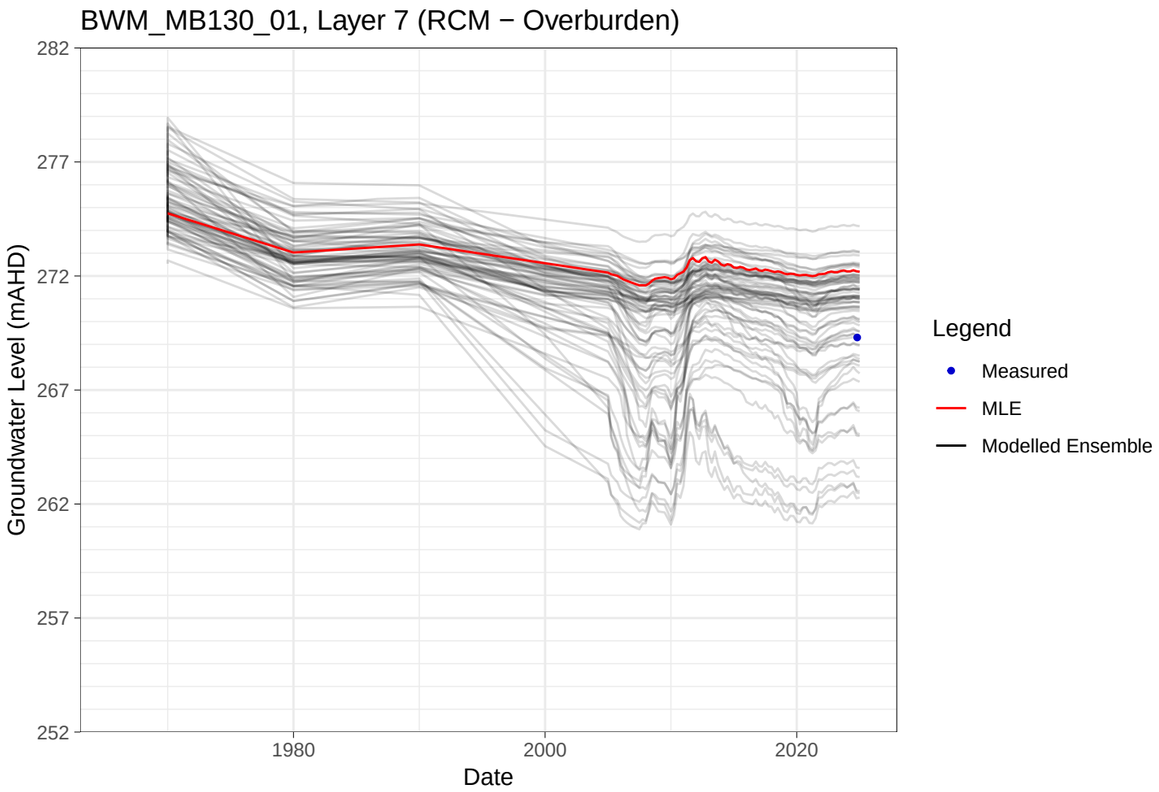

VWP19BWM04−1, Layer 6 (Rewan Group (Lower))
Groundwater Level (mAHD)
248
238
228
218
208
198
188
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

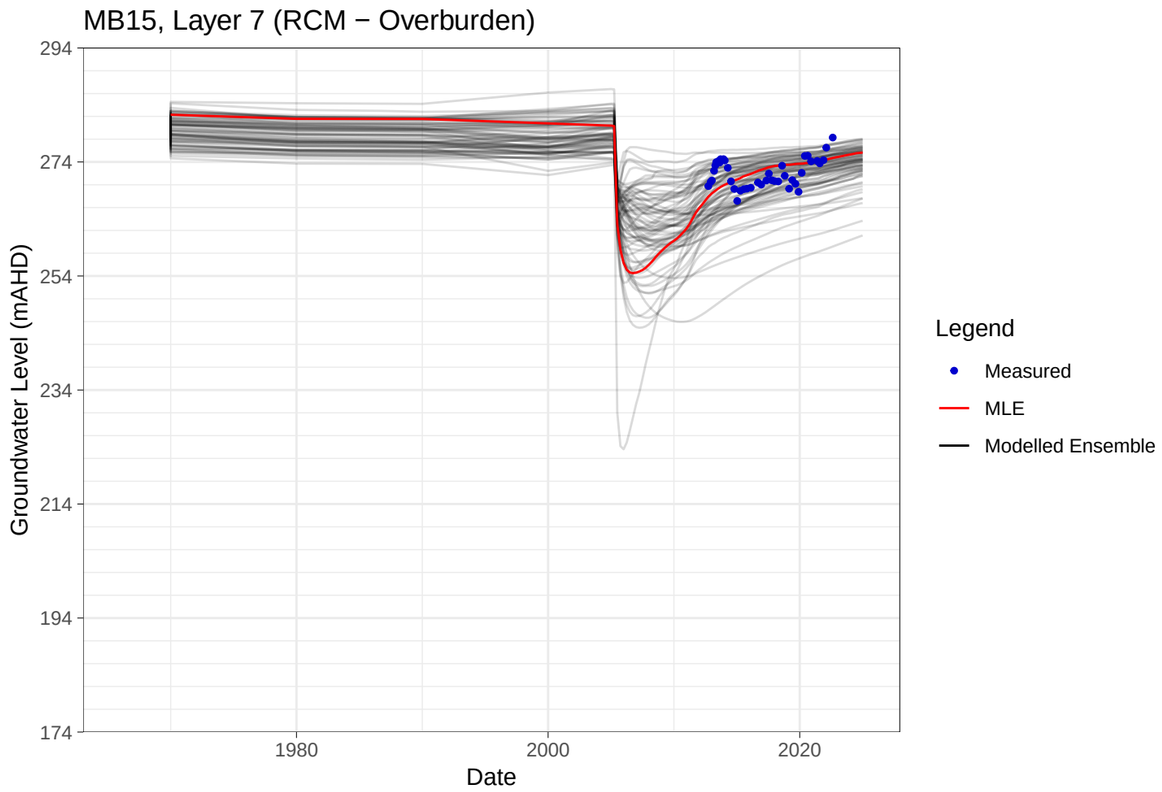

BWM_MB02_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
387
347
307
267
227
187
147
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

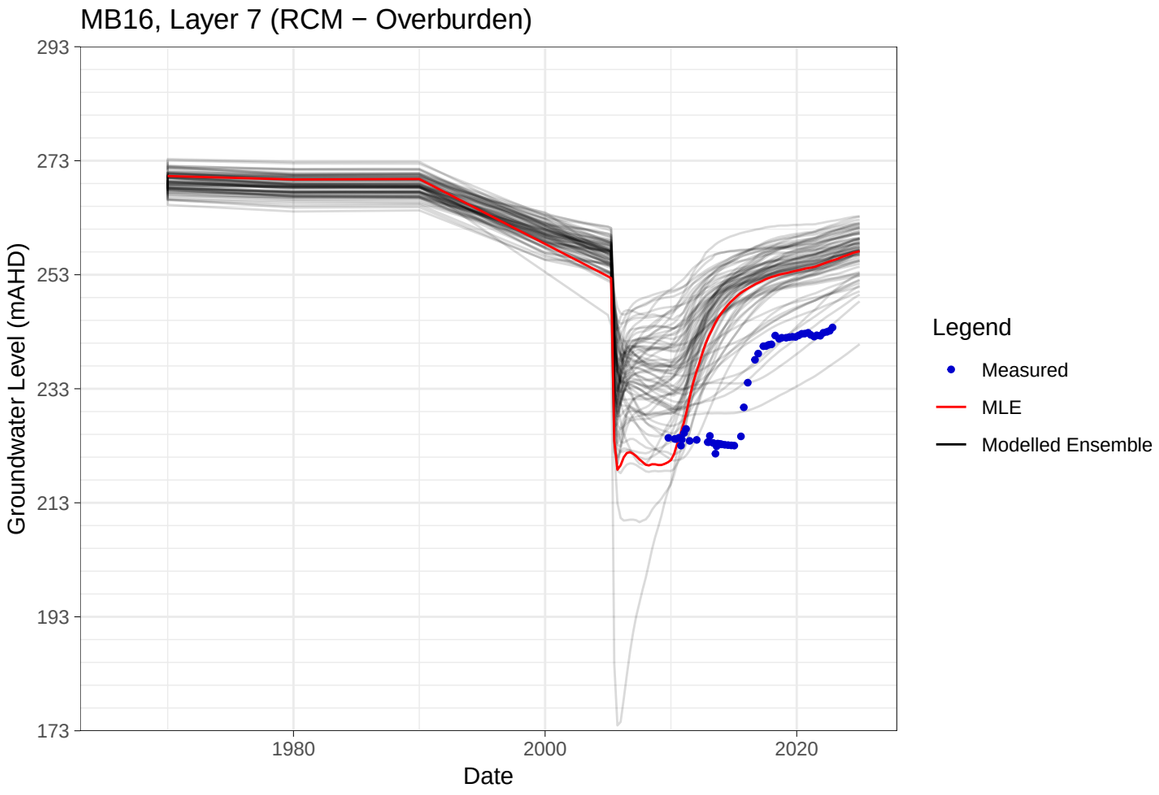

BWM_MB11_01_R01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
281
261
241
221
201
181
161
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

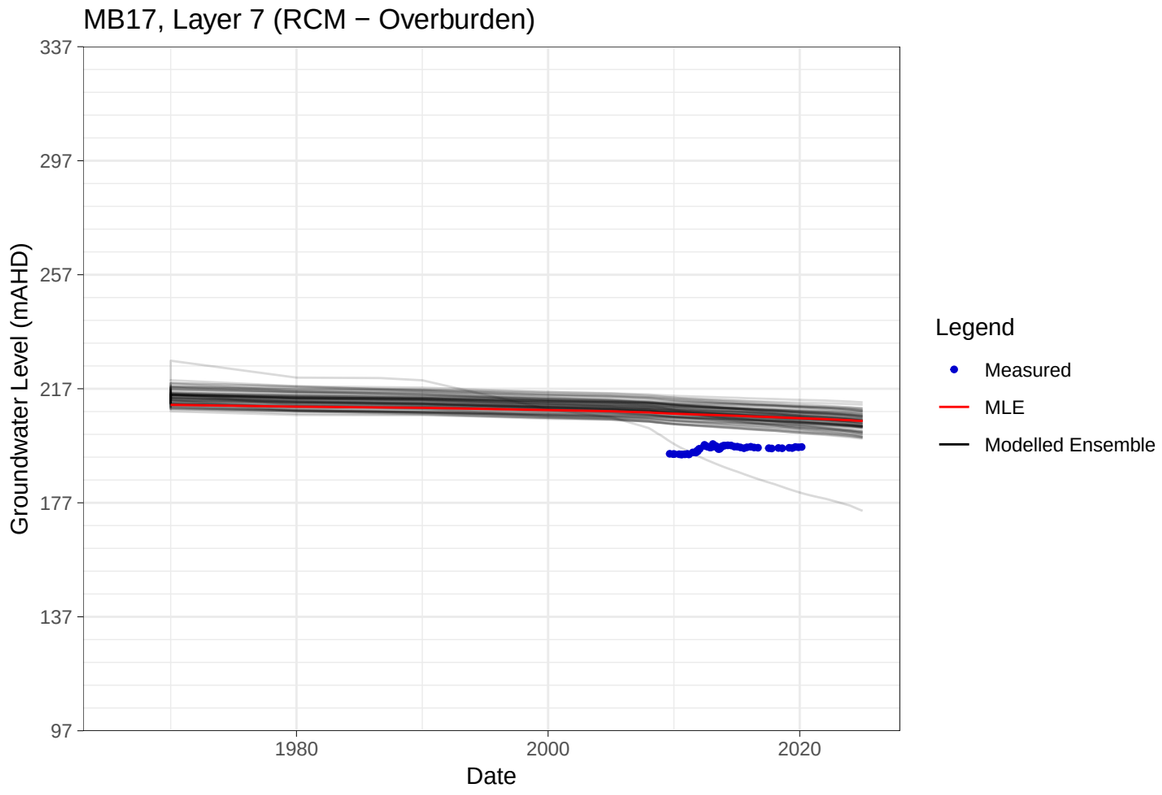

BWM_MB122_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
287
283
279
275
271
267
263
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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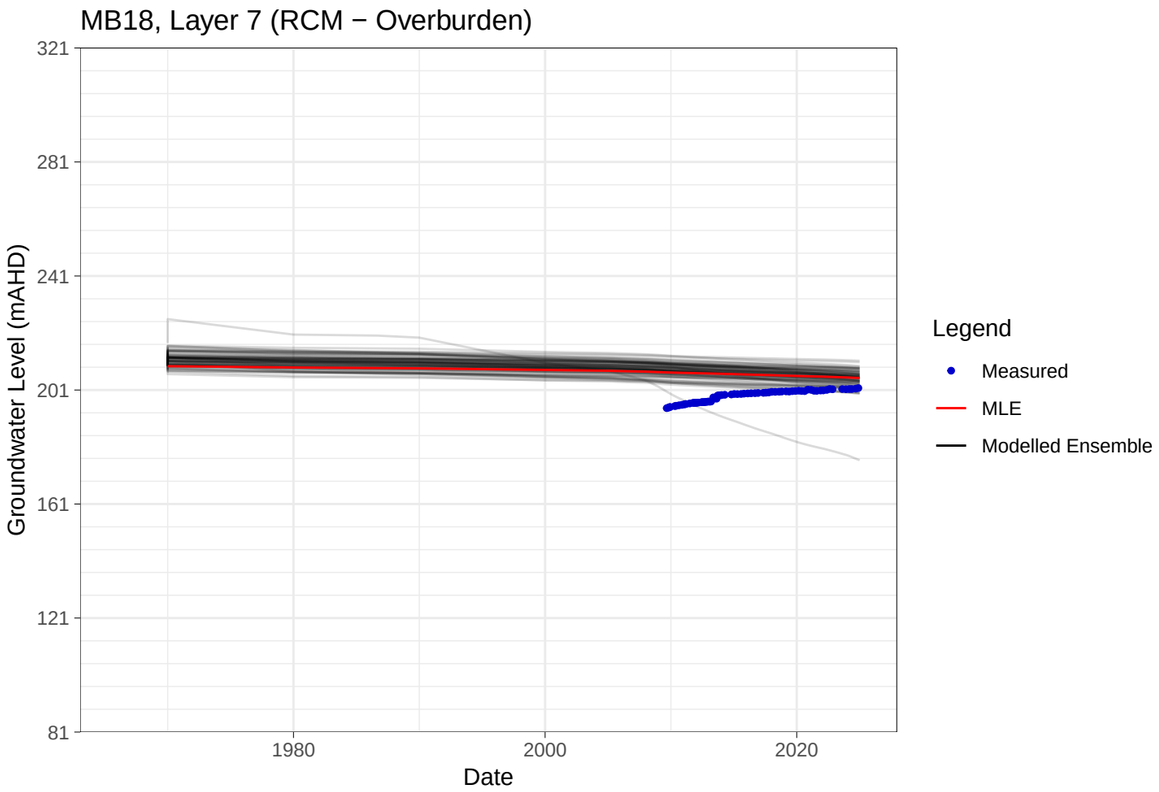

BWM_MB130_01, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
282
277
272
267
262
257
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

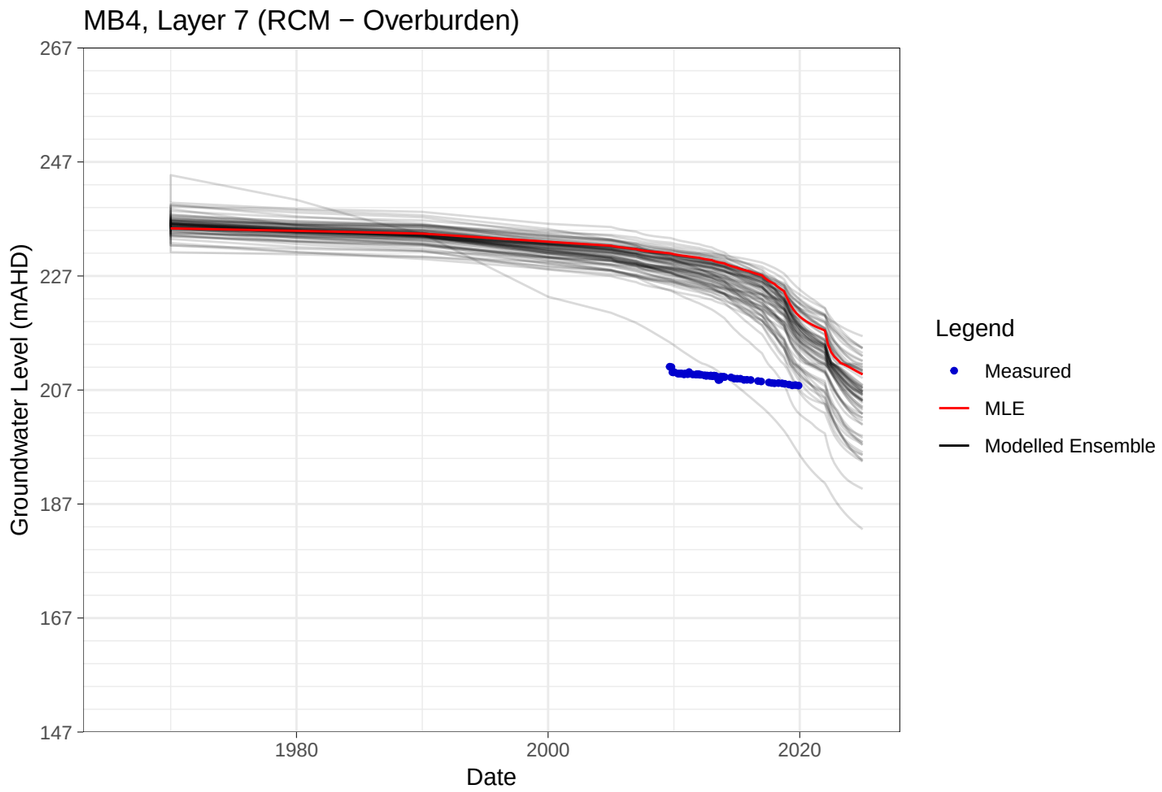

MB15, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
294
274
254
234
214
194
174
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

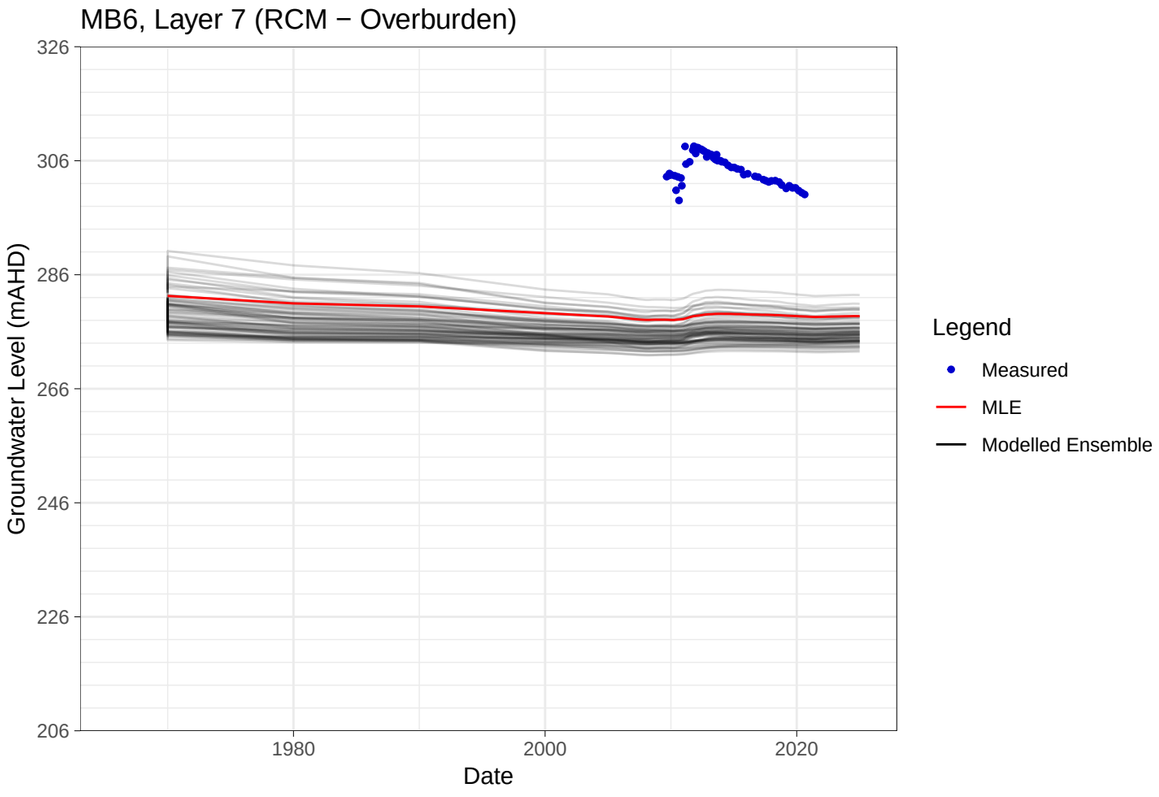

MB16, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
293
273
253
233
213
193
173
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

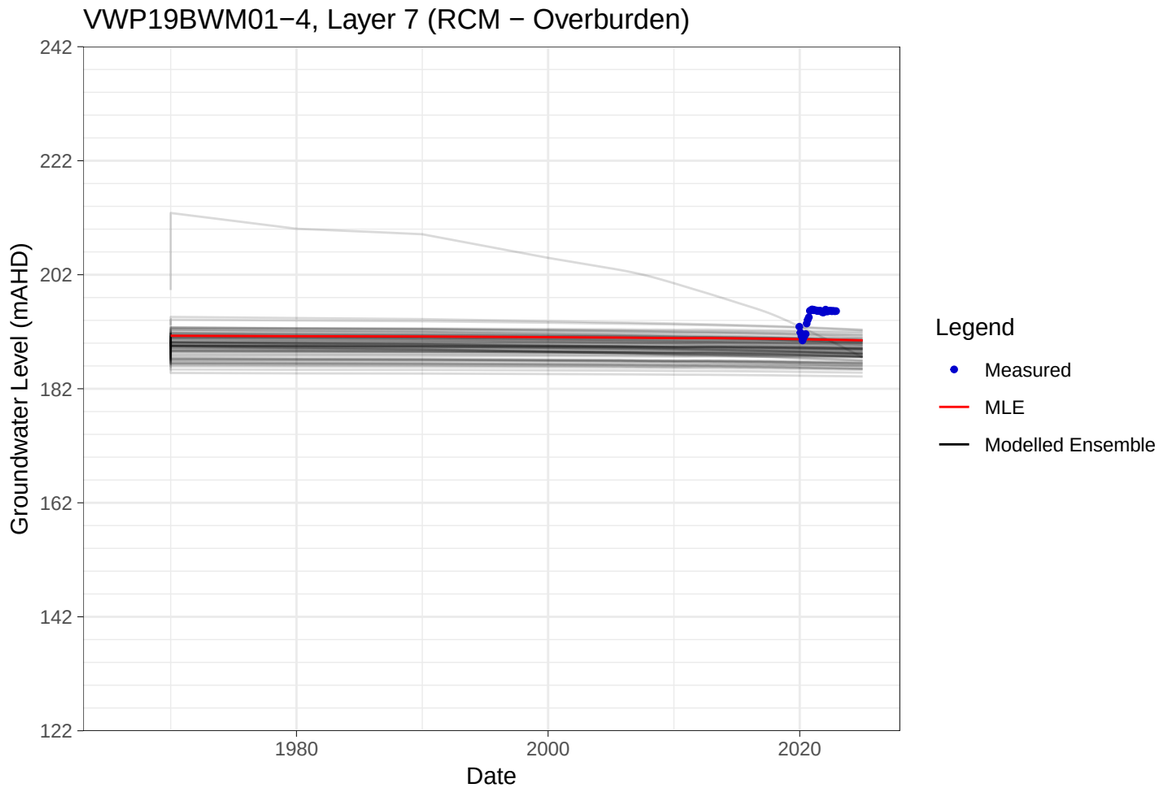

MB17, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
337
297
257
217
177
137
97
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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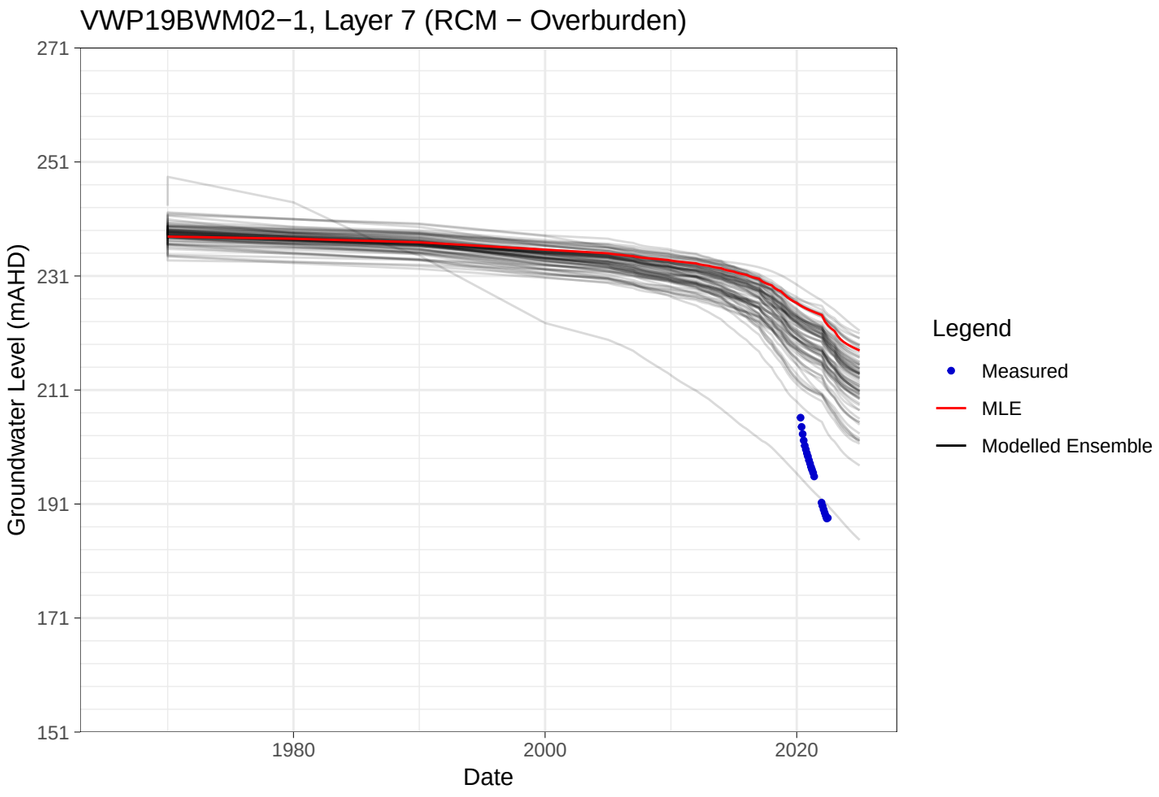

MB18, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
321
281
241
201
161
121
81
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

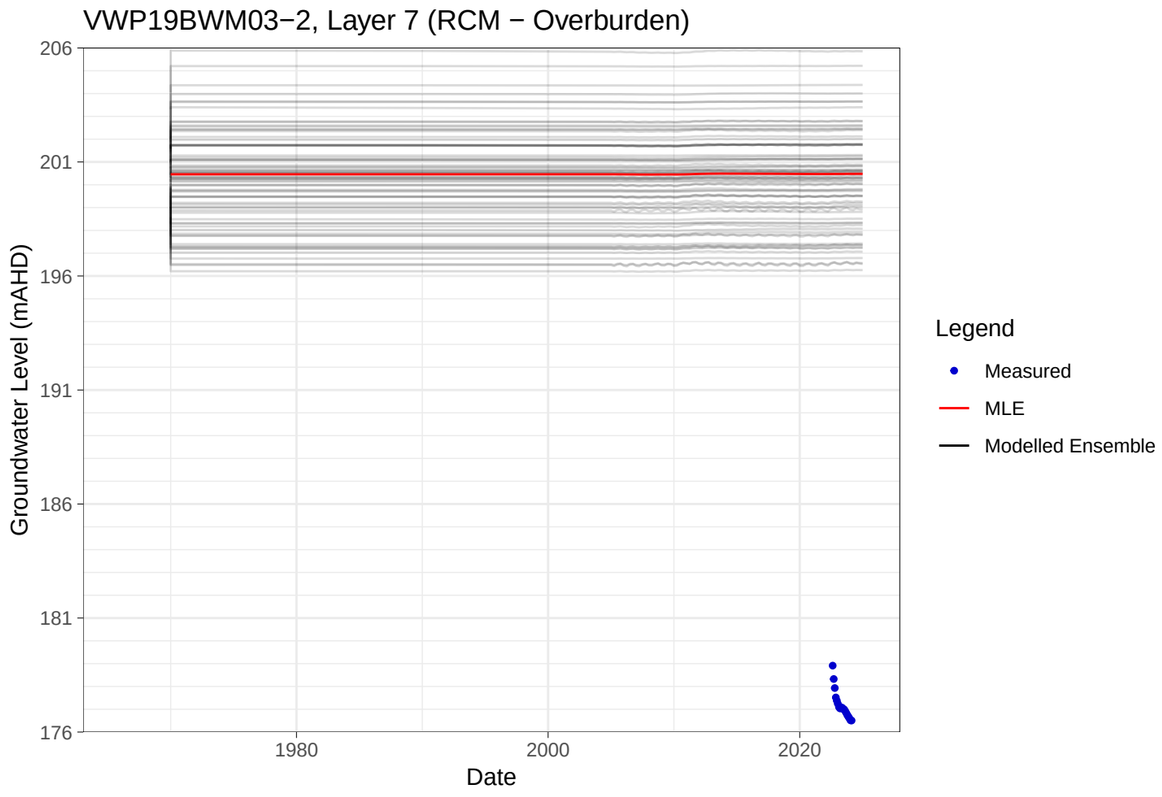

MB4, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
267
247
227
207
187
167
147
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

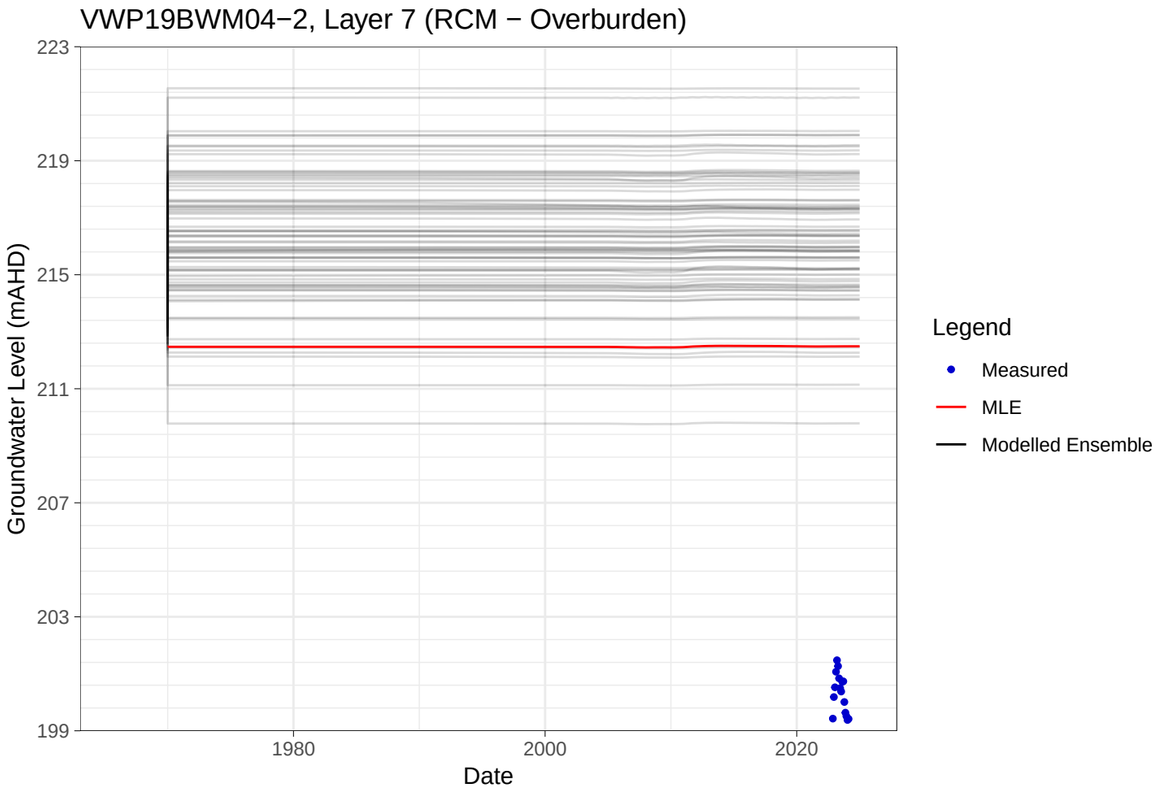

MB6, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
326
306
286
266
246
226
206
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

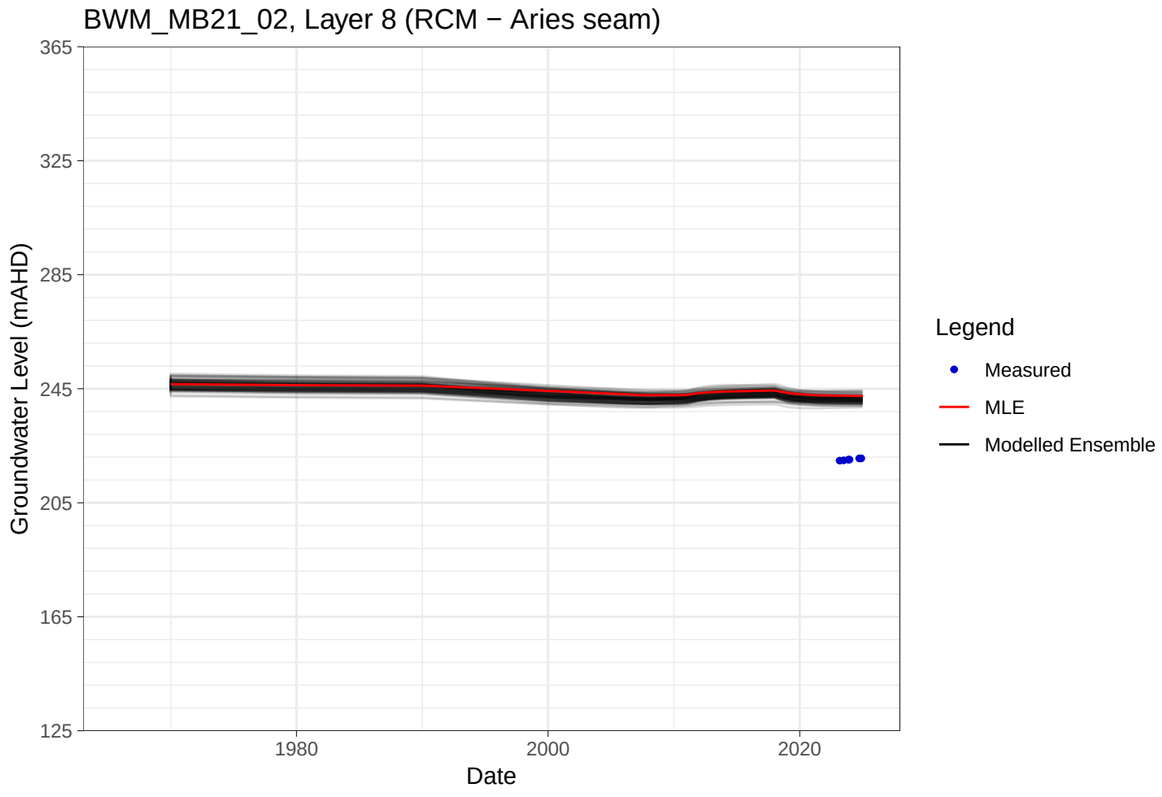

VWP19BWM01−4, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
242
222
202
182
162
142
122
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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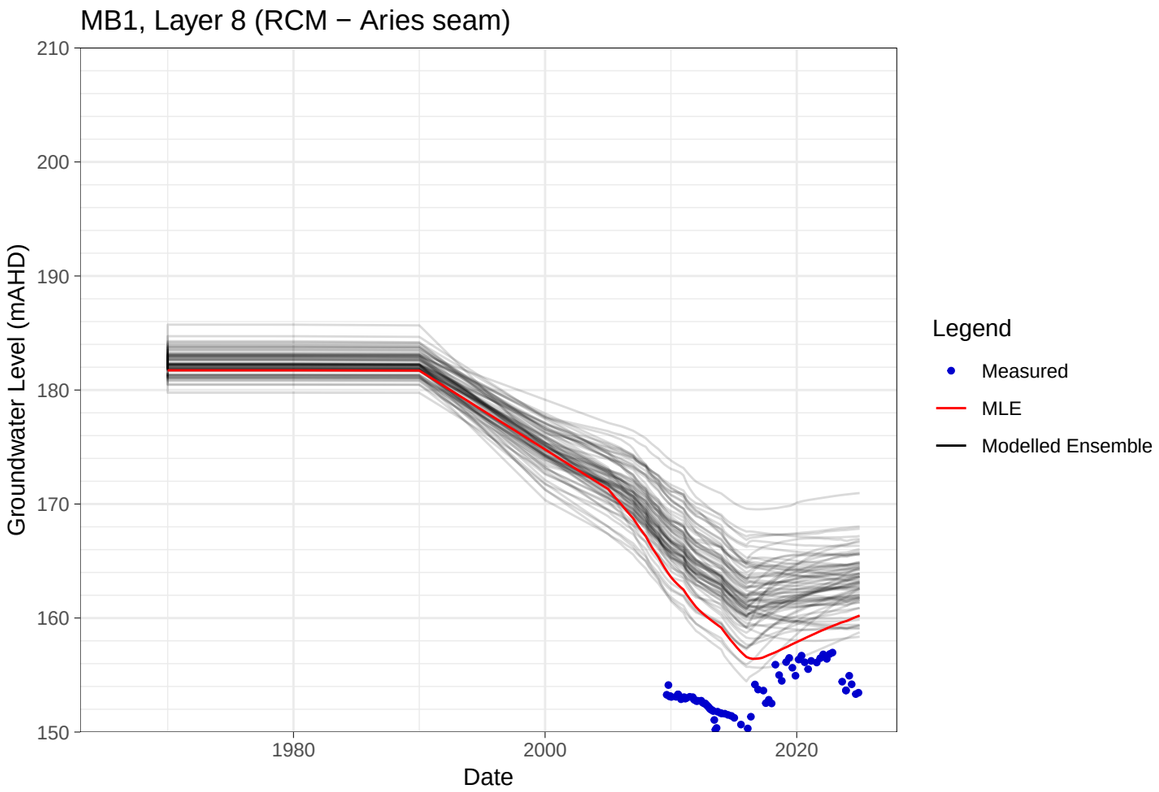

VWP19BWM02−1, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
271
251
231
211
191
171
151
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

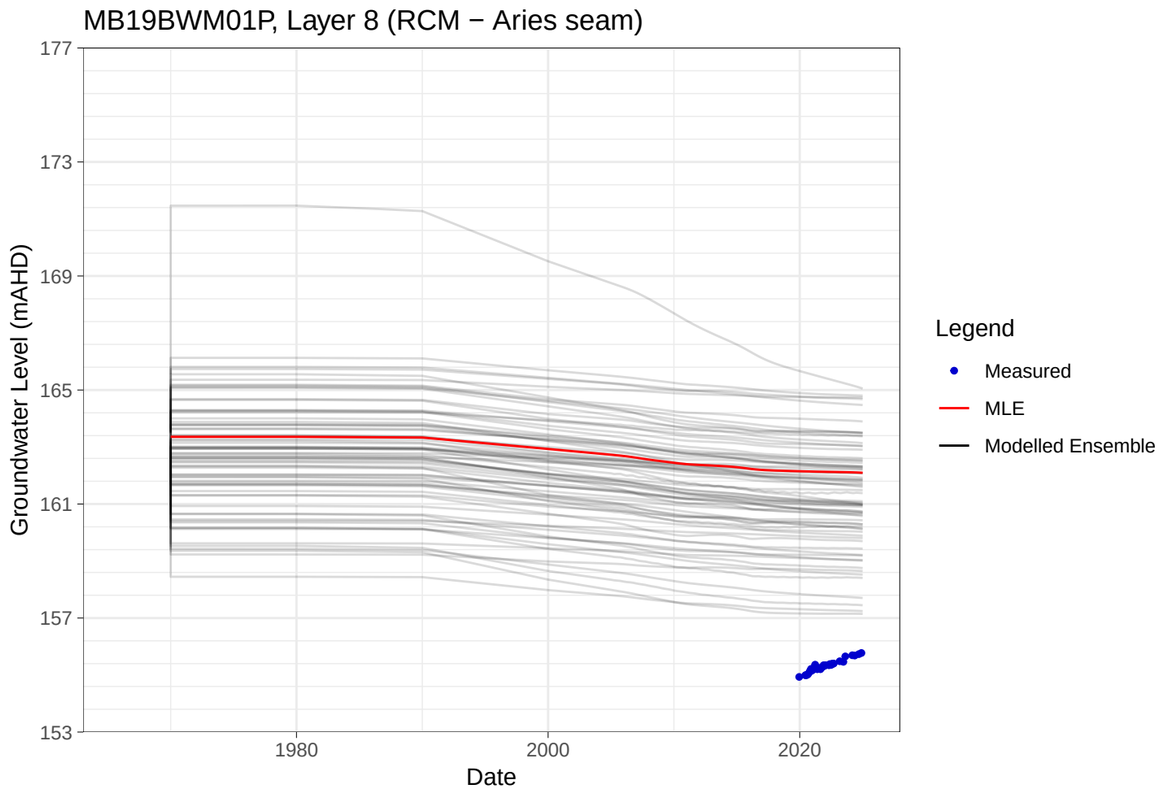

VWP19BWM03−2, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
206
201
196
191
186
181
176
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

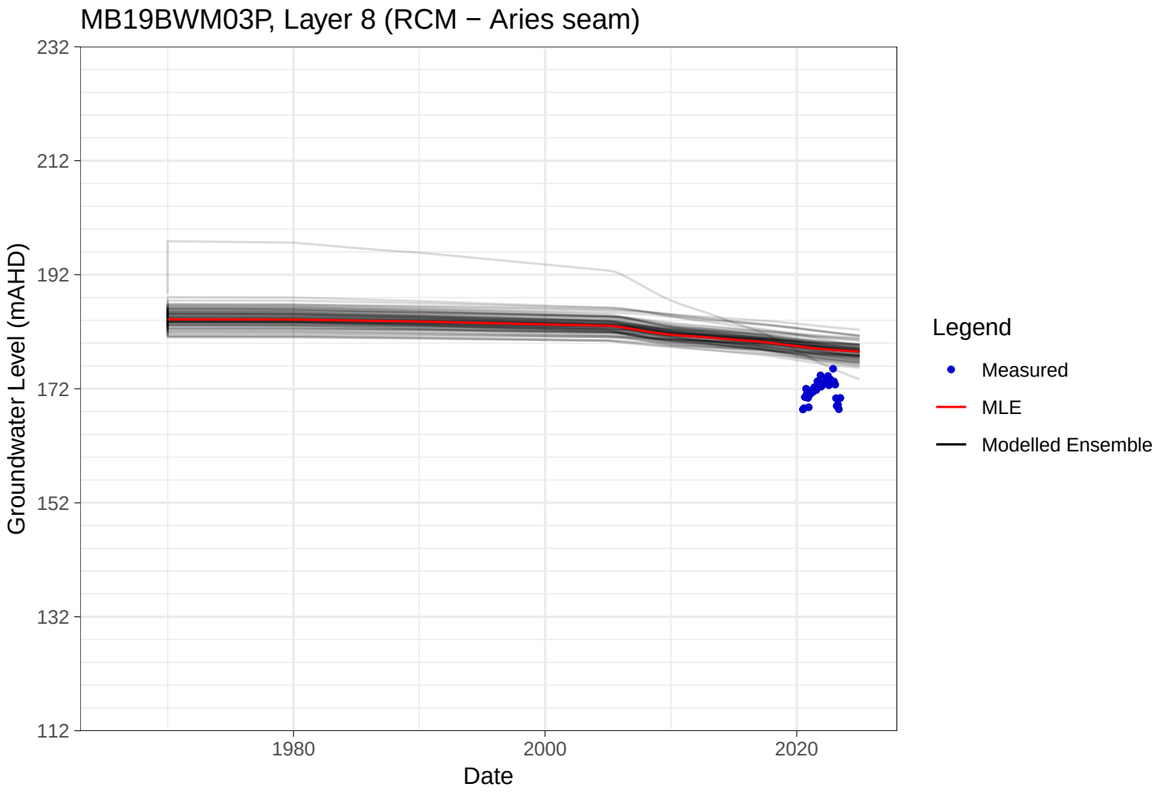

VWP19BWM04−2, Layer 7 (RCM − Overburden)
Groundwater Level (mAHD)
223
219
215
211
207
203
199
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

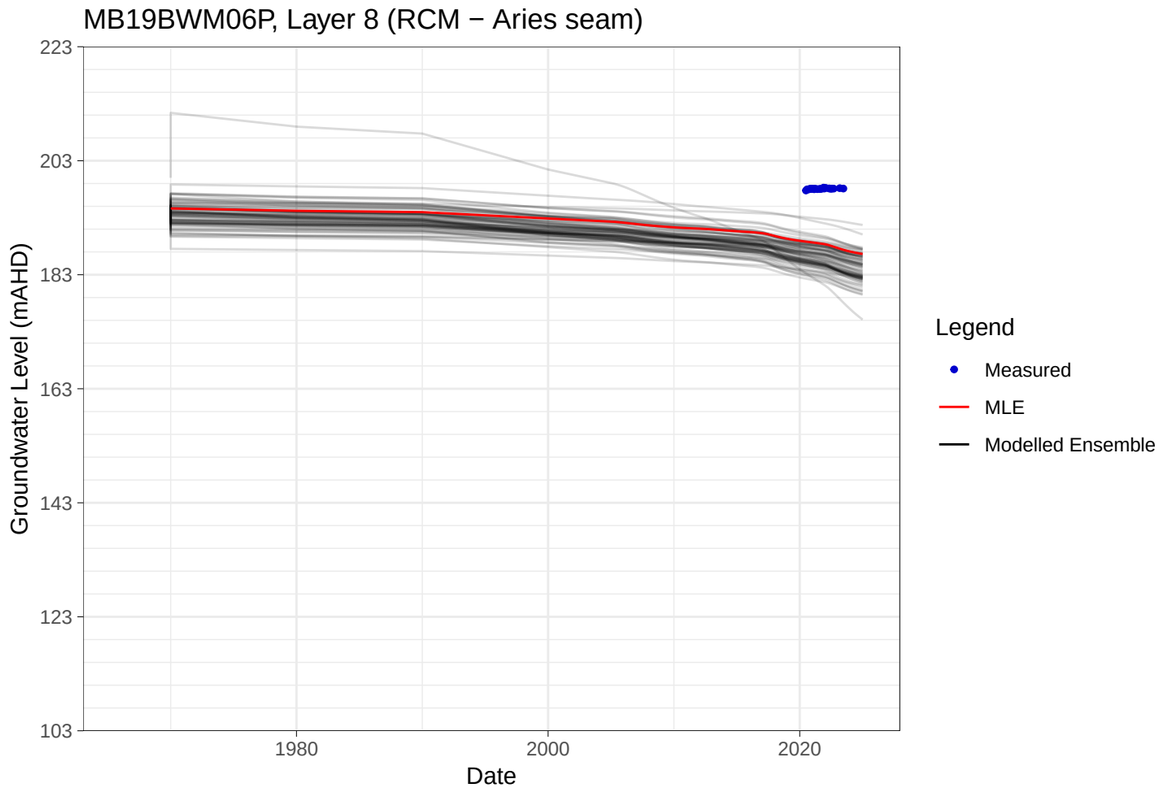

BWM_MB21_02, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
365
325
285
245
205
165
125
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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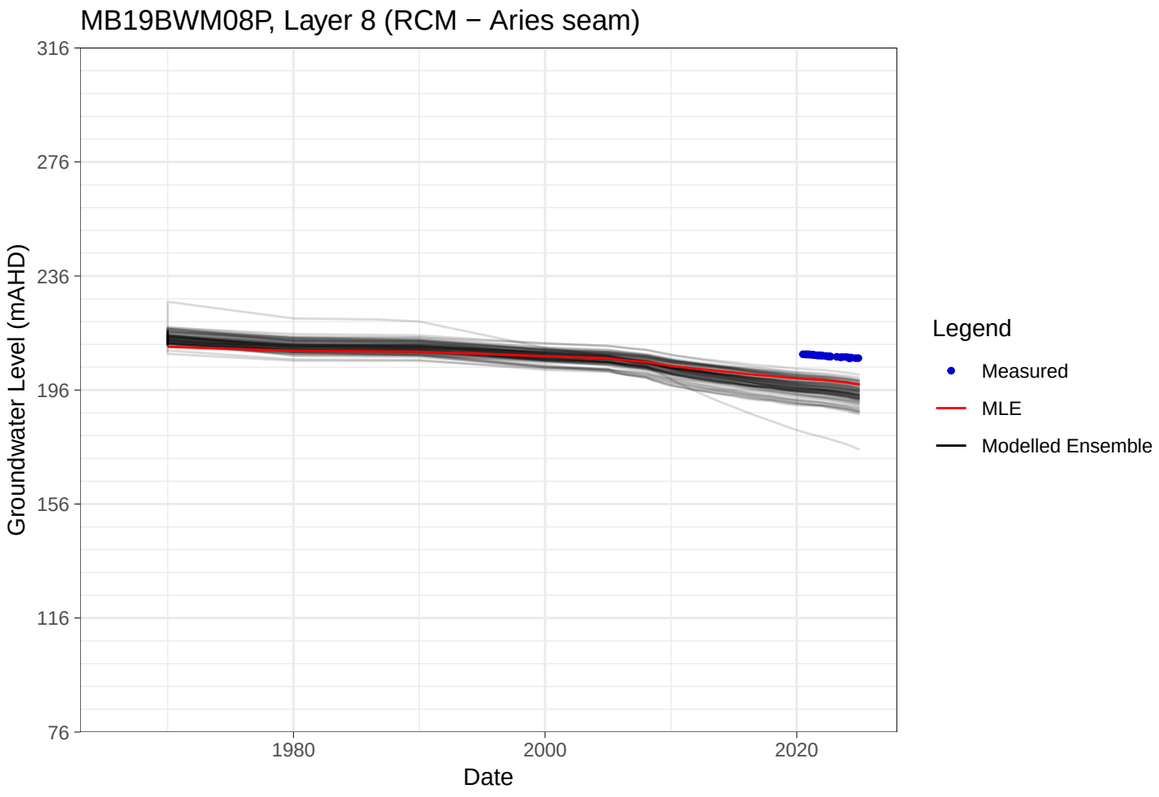

MB1, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
210
200
190
180
170
160
150
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

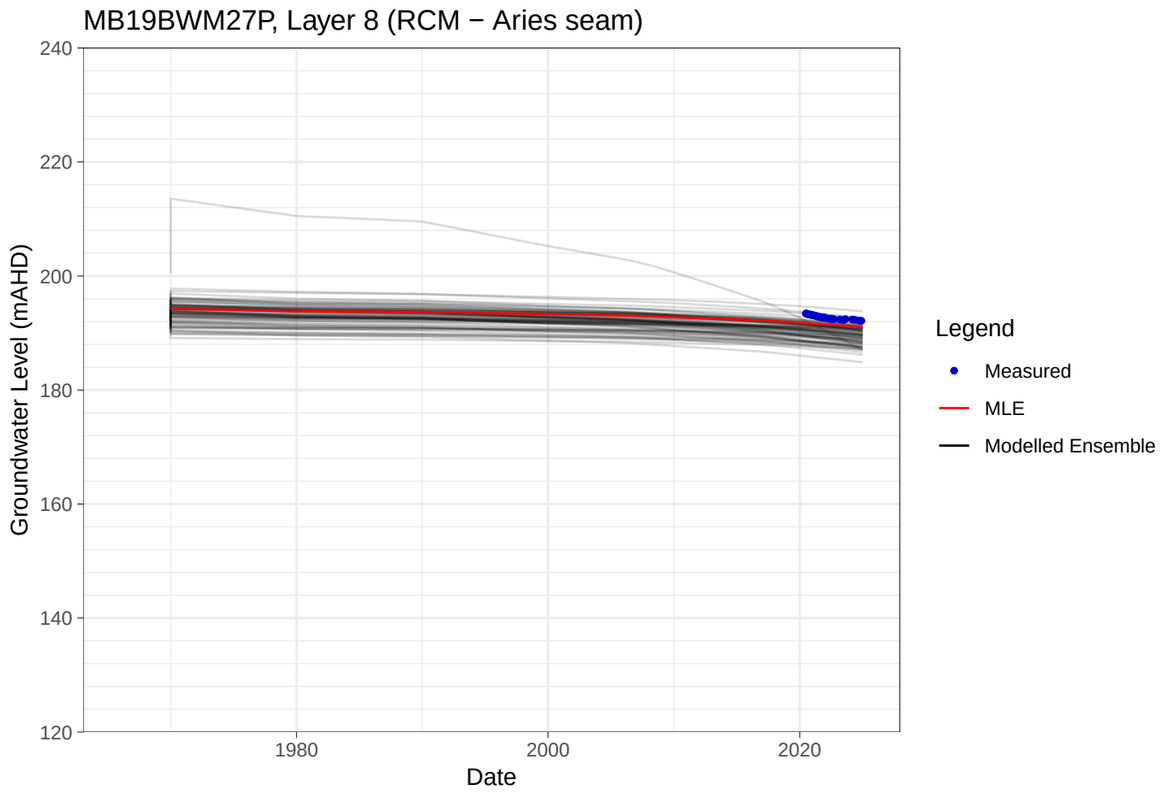

MB19BWM01P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
177
173
169
165
161
157
153
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

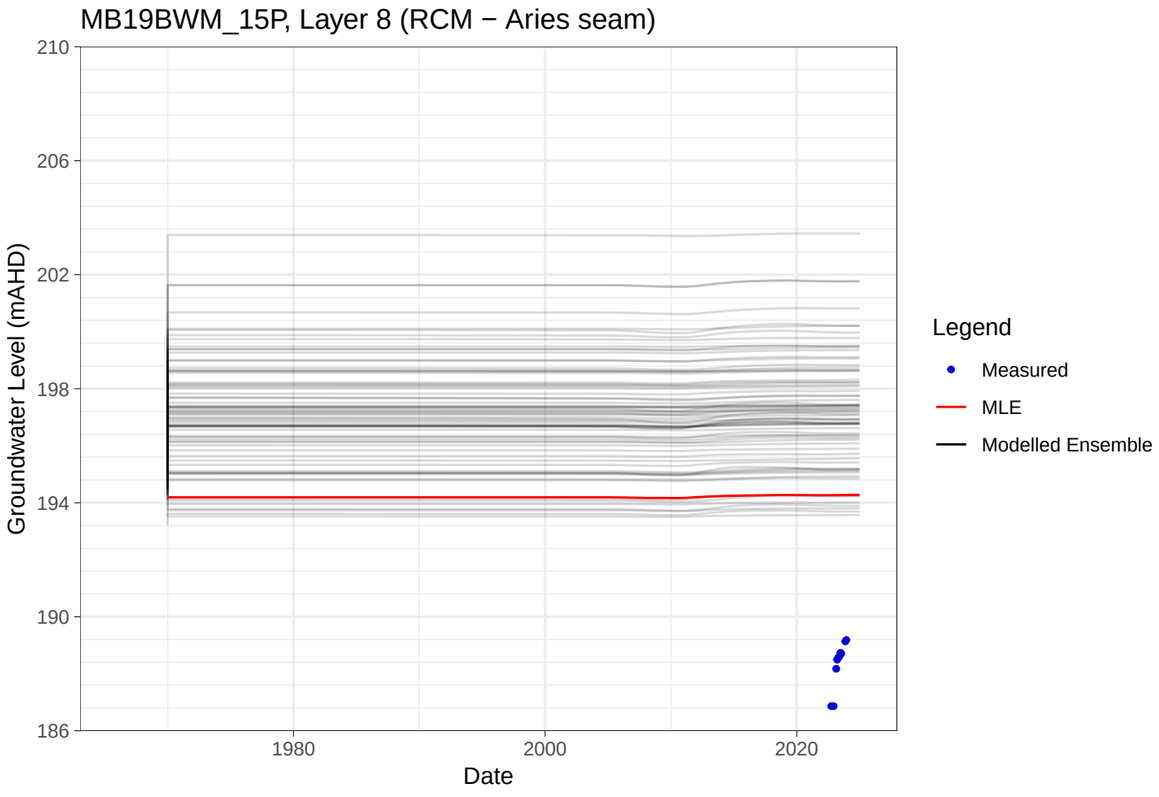

MB19BWM03P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
232
212
192
172
152
132
112
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

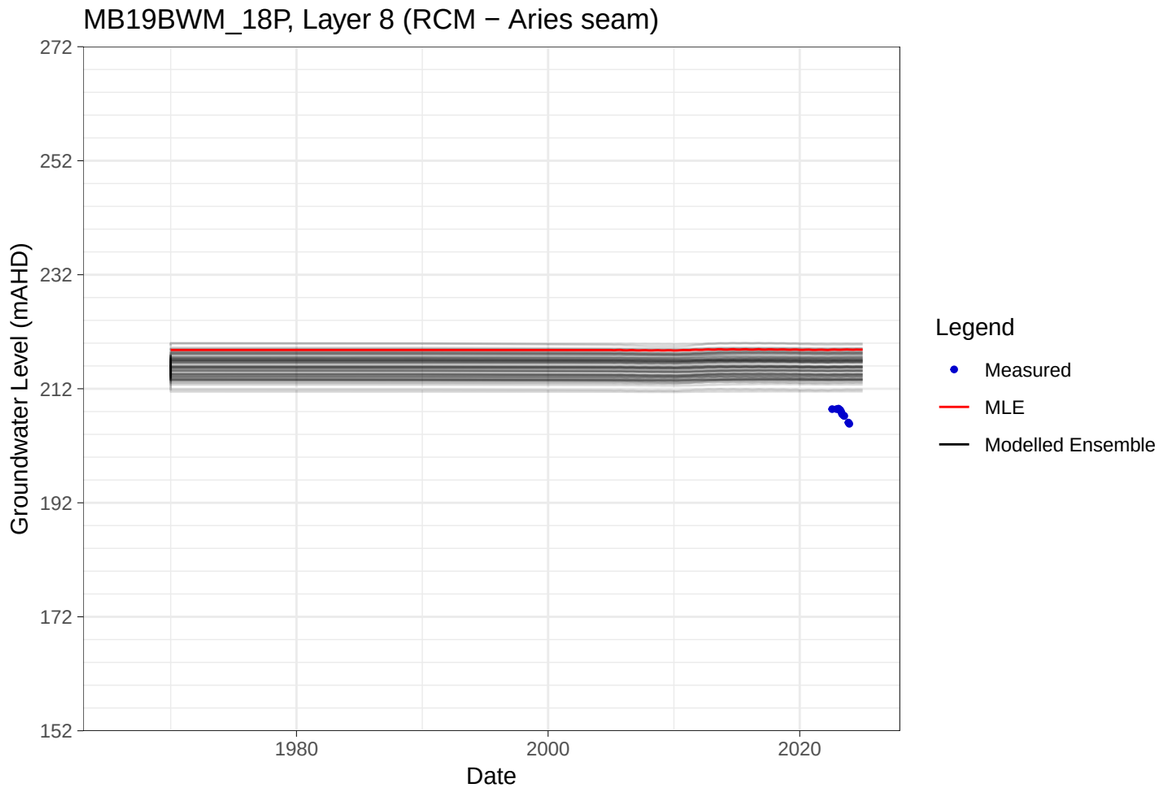

MB19BWM06P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
223
203
183
163
143
123
103
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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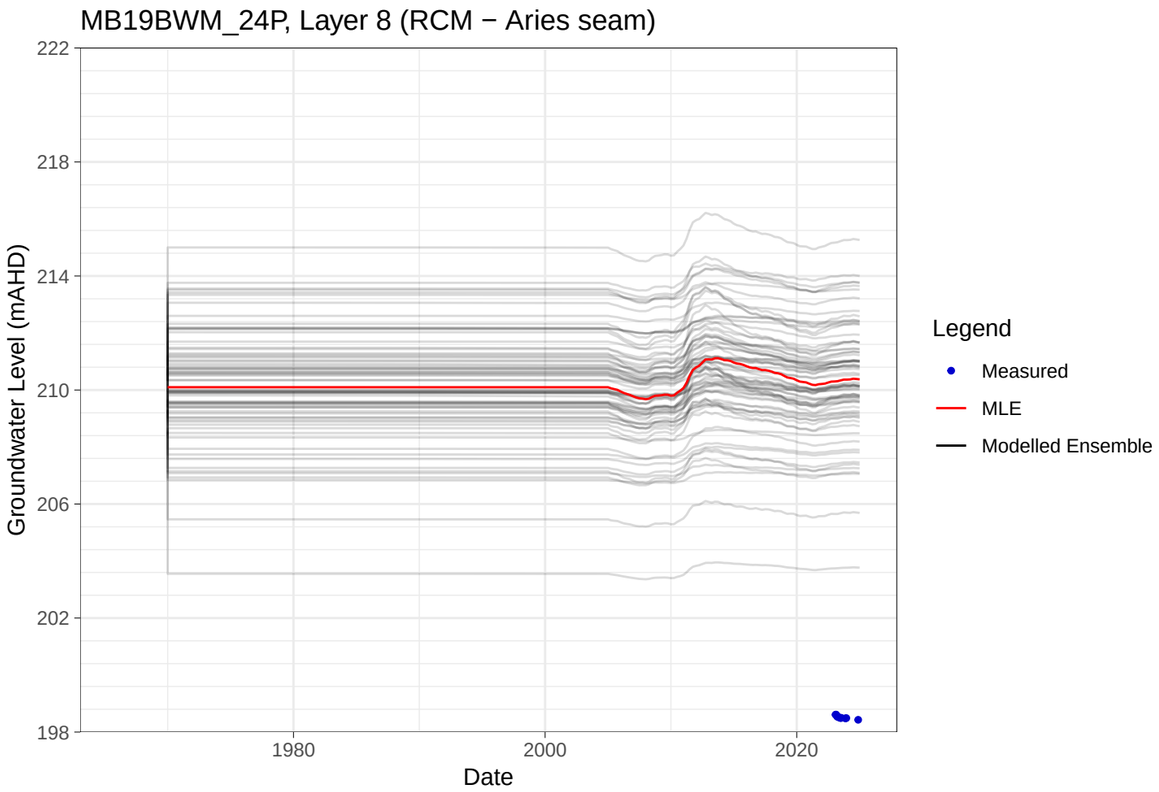

MB19BWM08P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
316
276
236
196
156
116
76
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

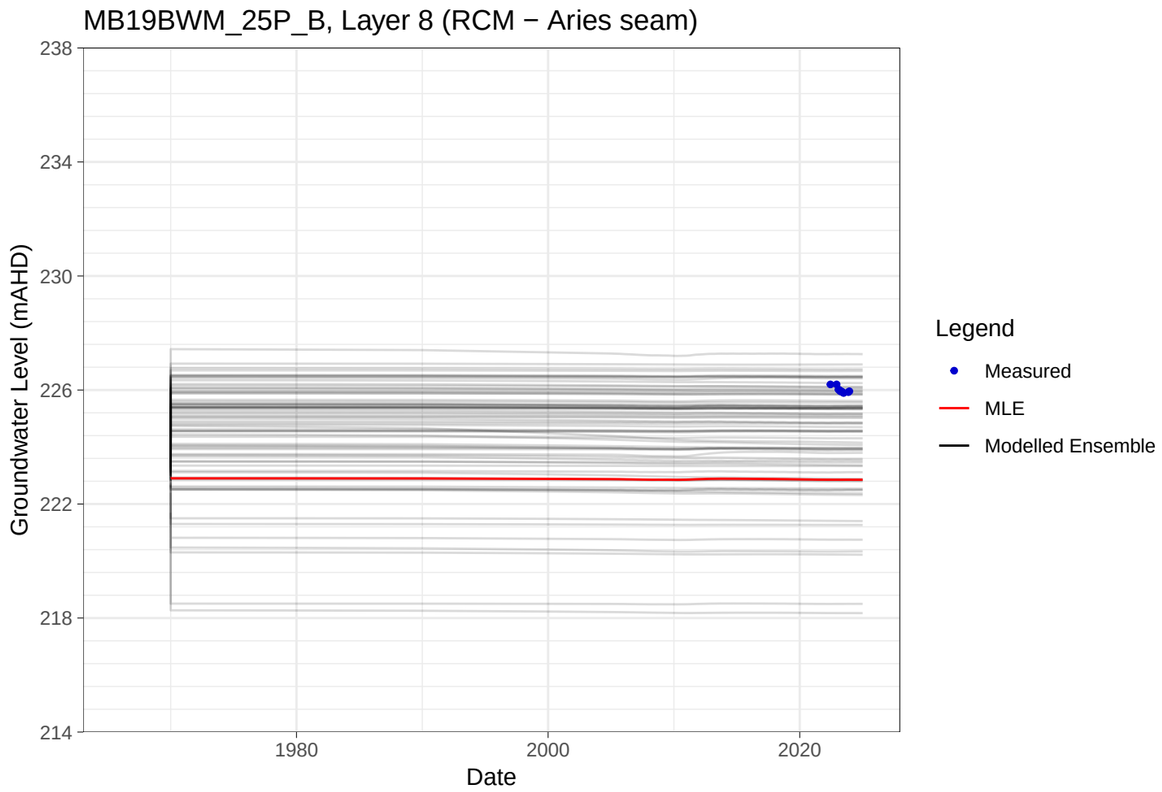

MB19BWM27P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
240
220
200
180
160
140
120
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

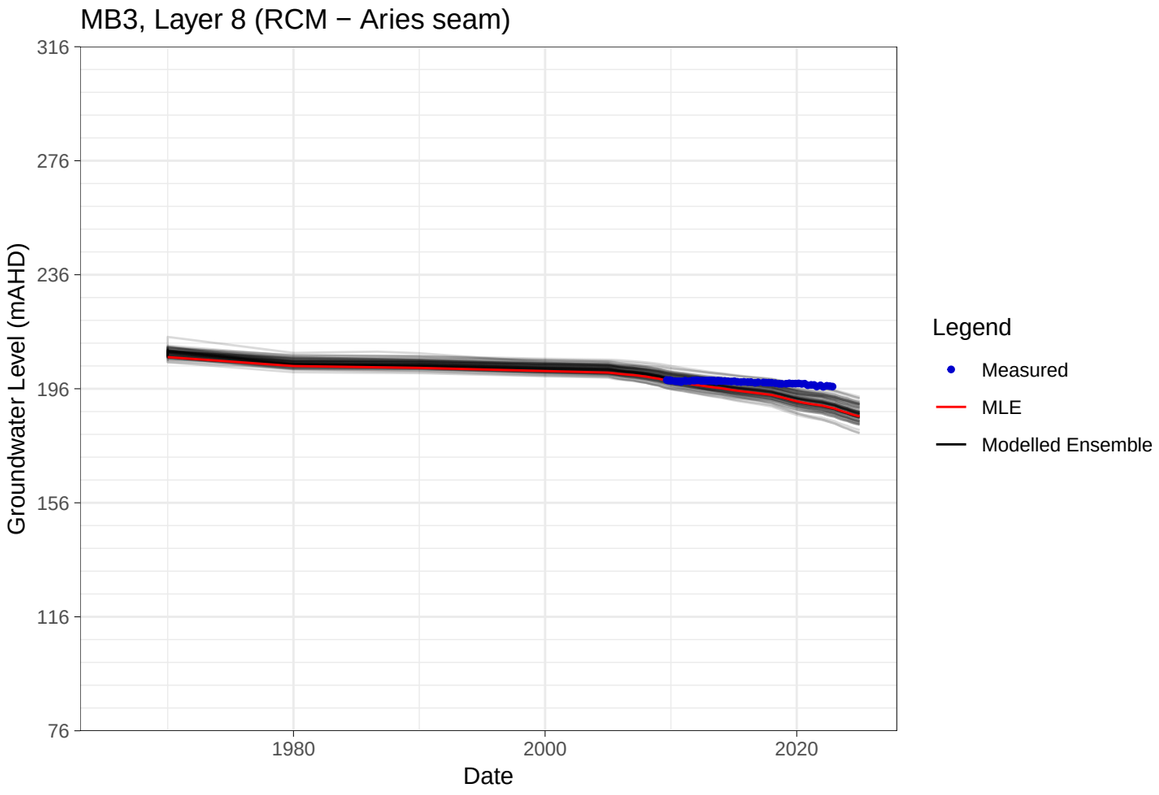

MB19BWM_15P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
210
206
202
198
194
190
186
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

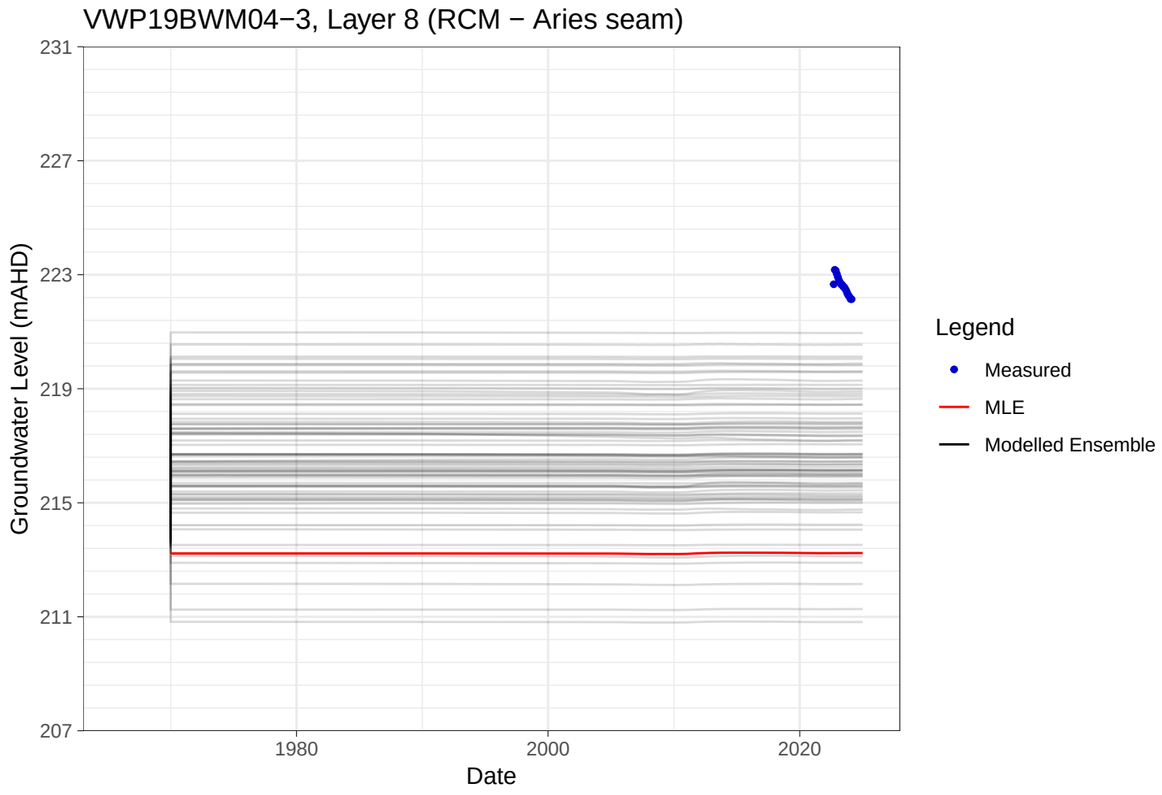

MB19BWM_18P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
272
252
232
212
192
172
152
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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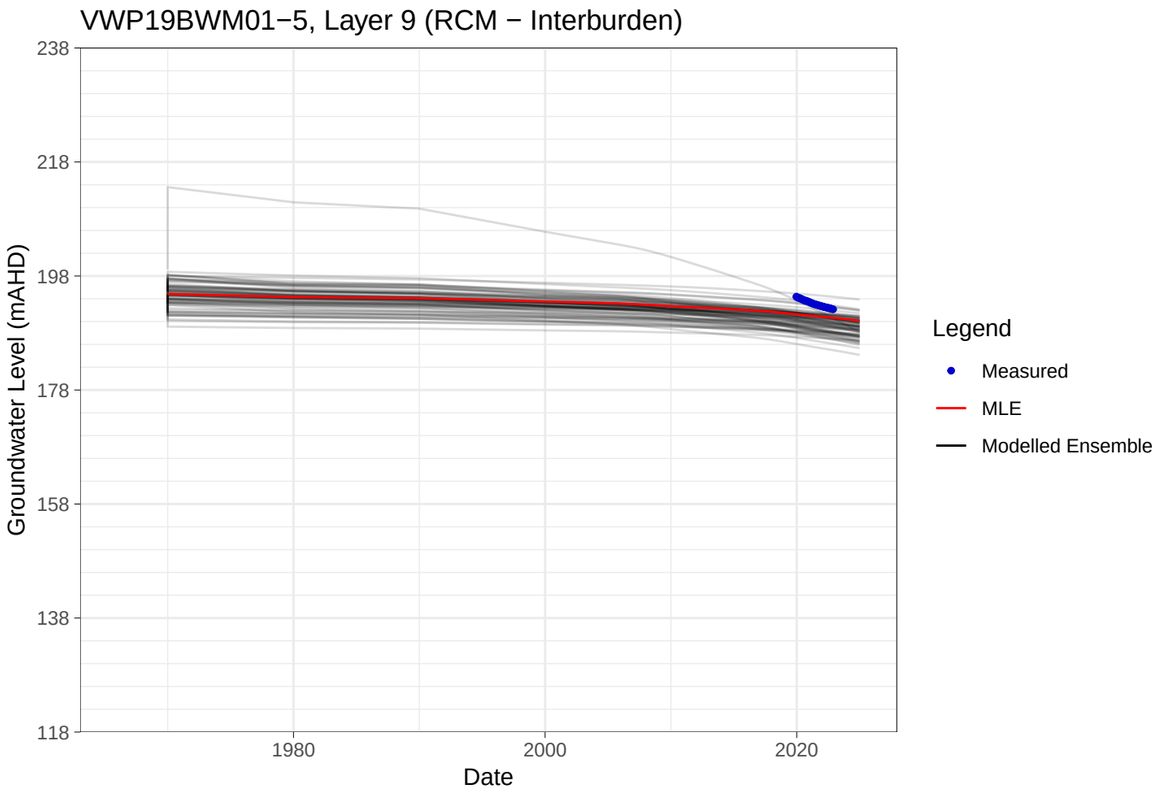

MB19BWM_24P, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
222
218
214
210
206
202
198
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

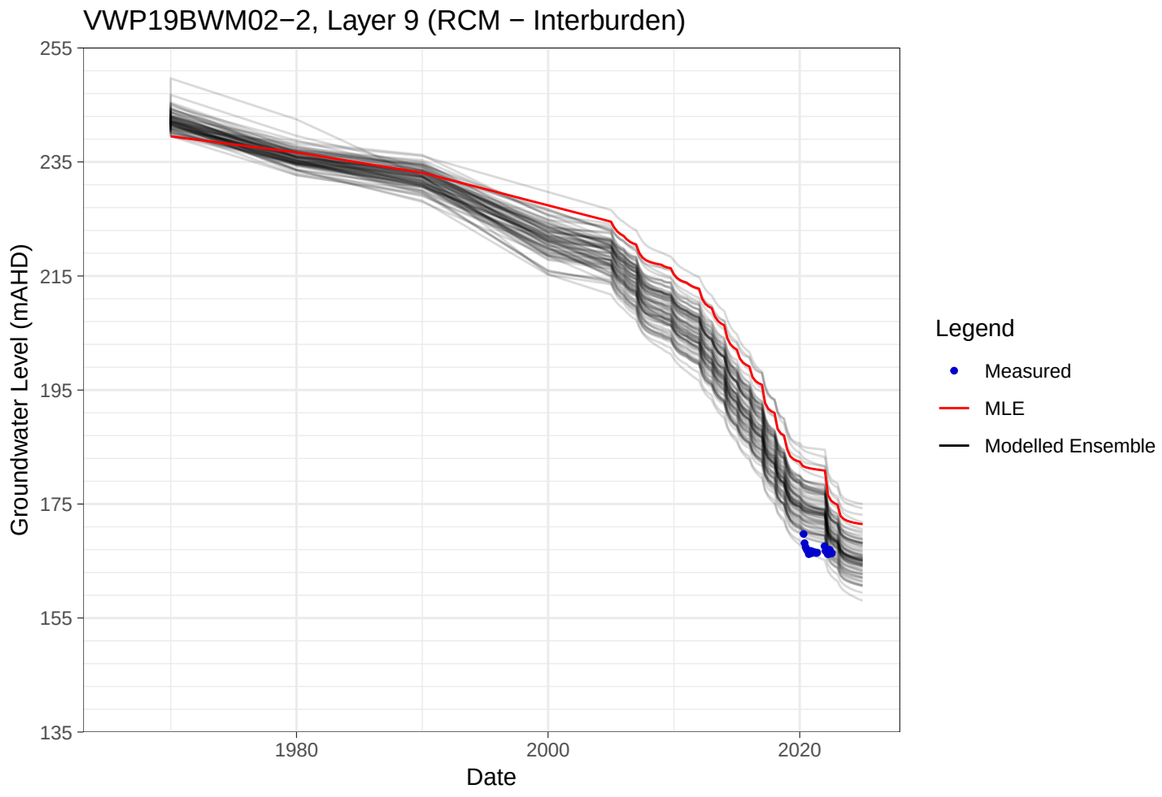

MB19BWM_25P_B, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
238
234
230
226
222
218
214
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

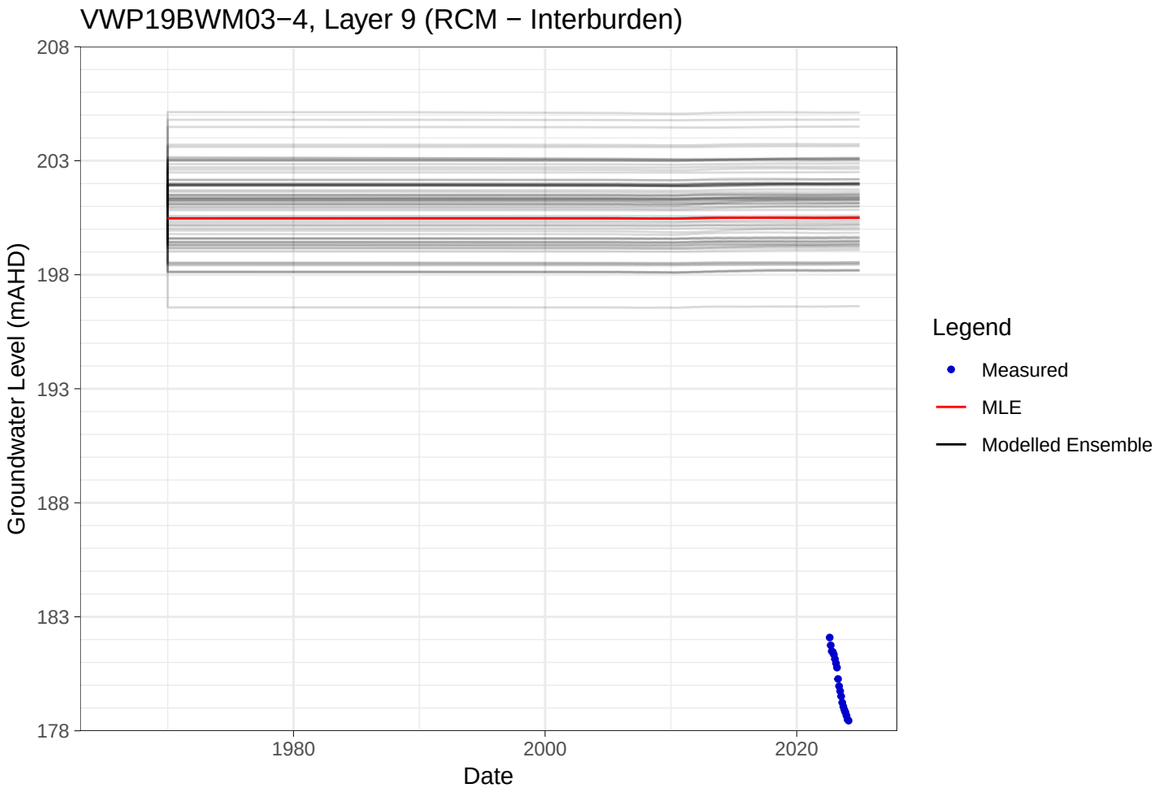

MB3, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
316
276
236
196
156
116
76
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

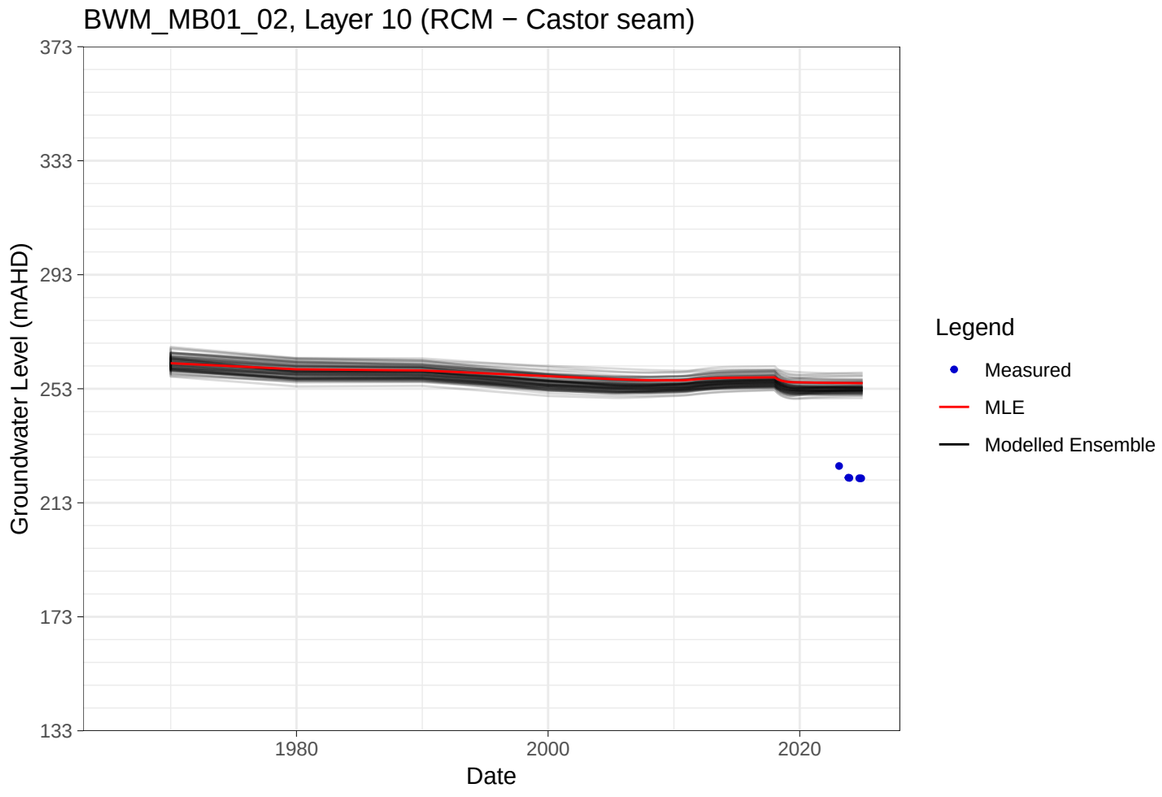

VWP19BWM04−3, Layer 8 (RCM − Aries seam)
Groundwater Level (mAHD)
231
227
223
219
215
211
207
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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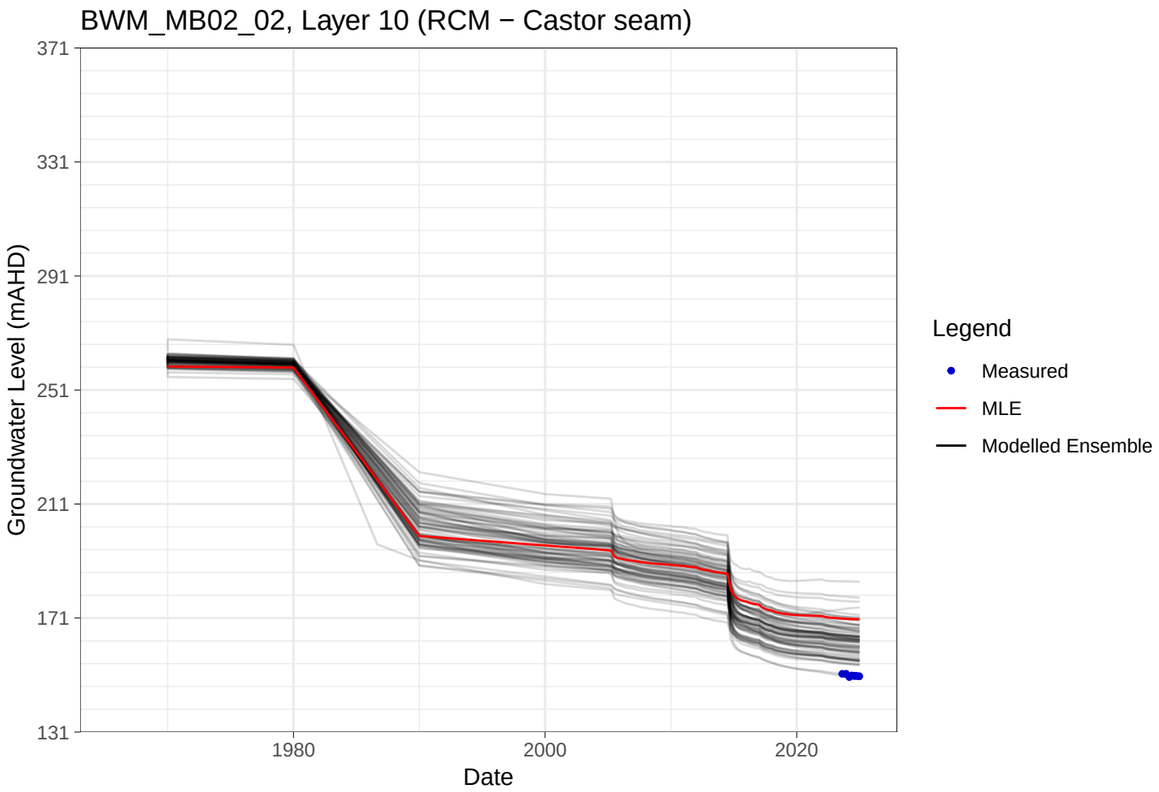

VWP19BWM01−5, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
238
218
198
178
158
138
118
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

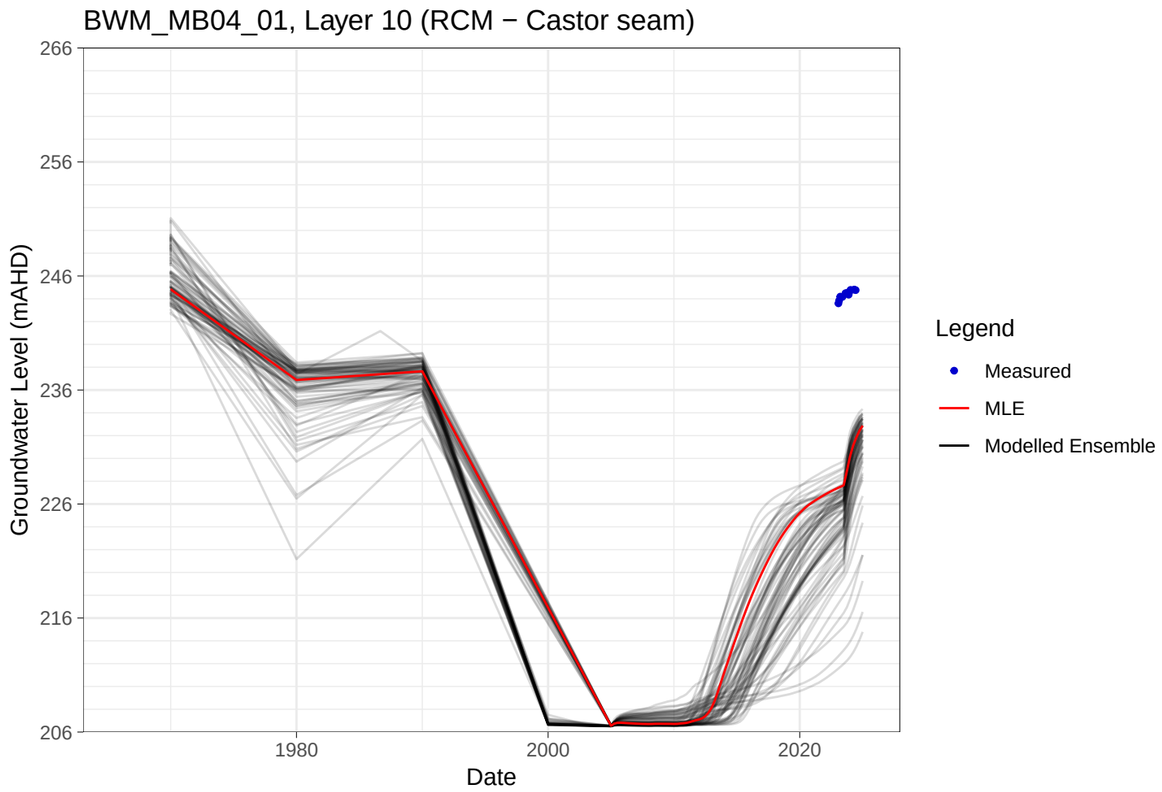

VWP19BWM02−2, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
255
235
215
195
175
155
135
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

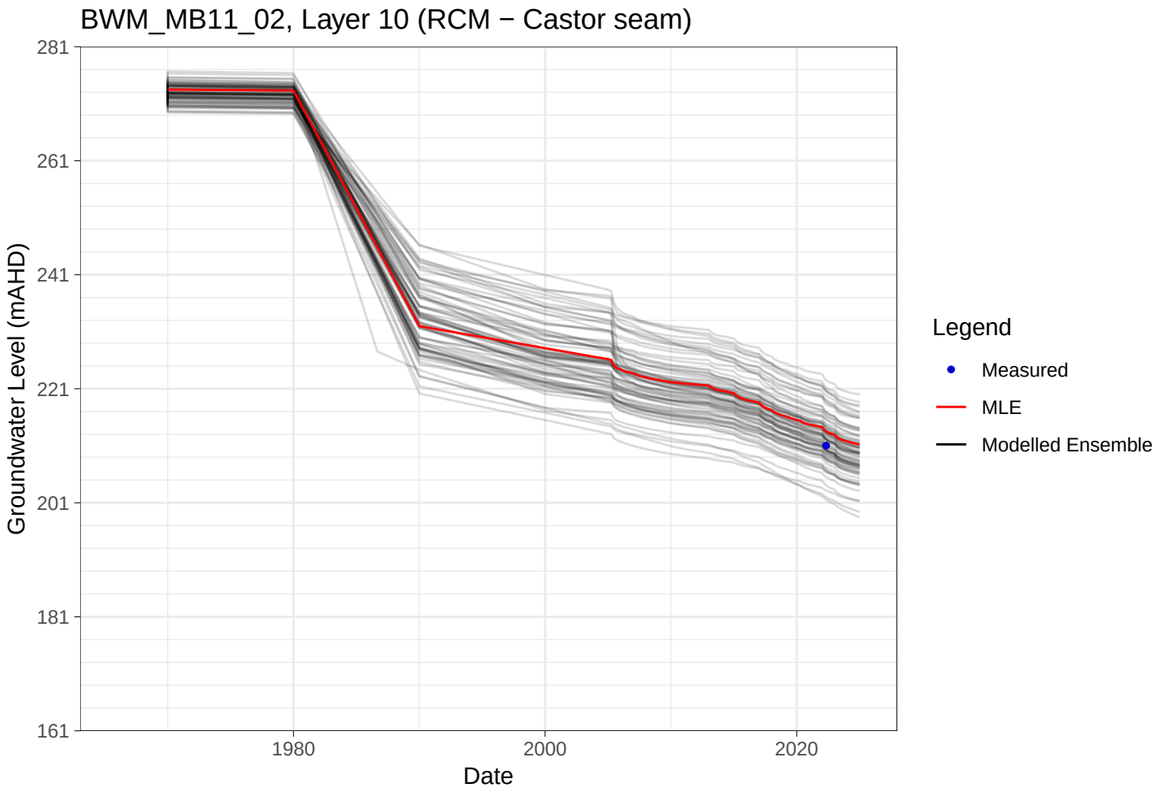

VWP19BWM03−4, Layer 9 (RCM − Interburden)
Groundwater Level (mAHD)
208
203
198
193
188
183
178
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

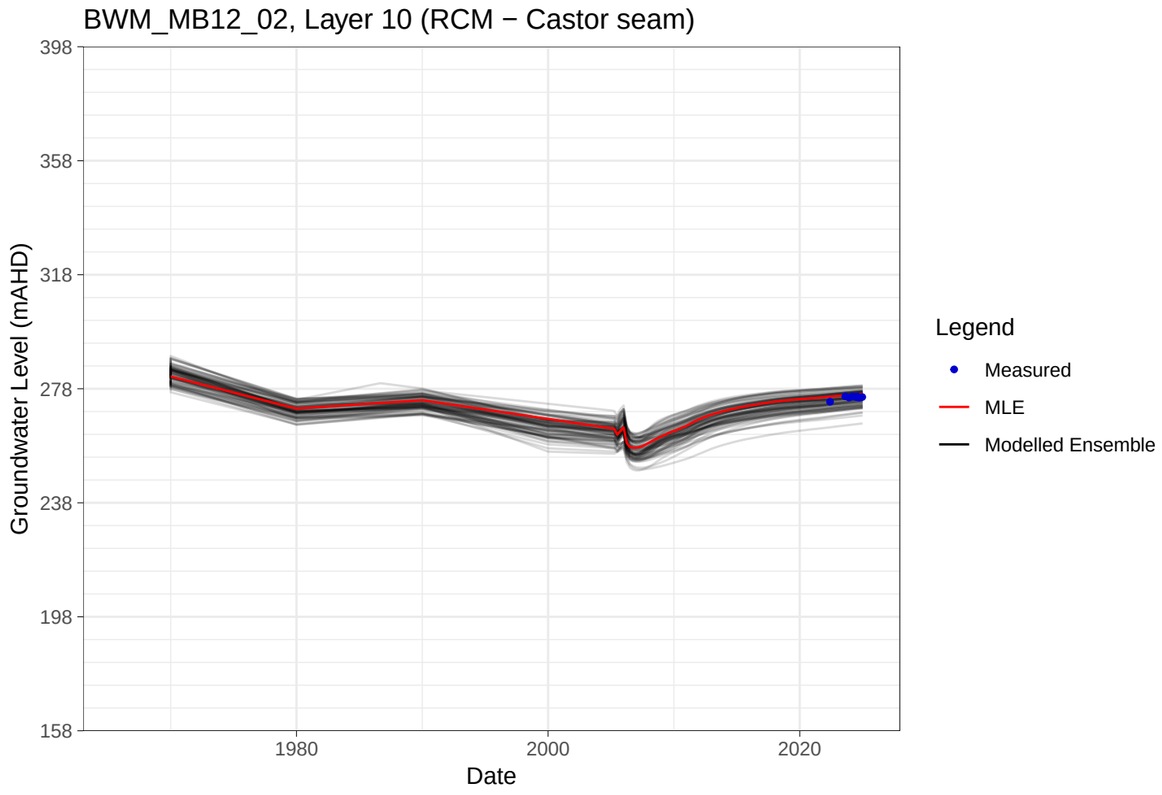

BWM_MB01_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
373
333
293
253
213
173
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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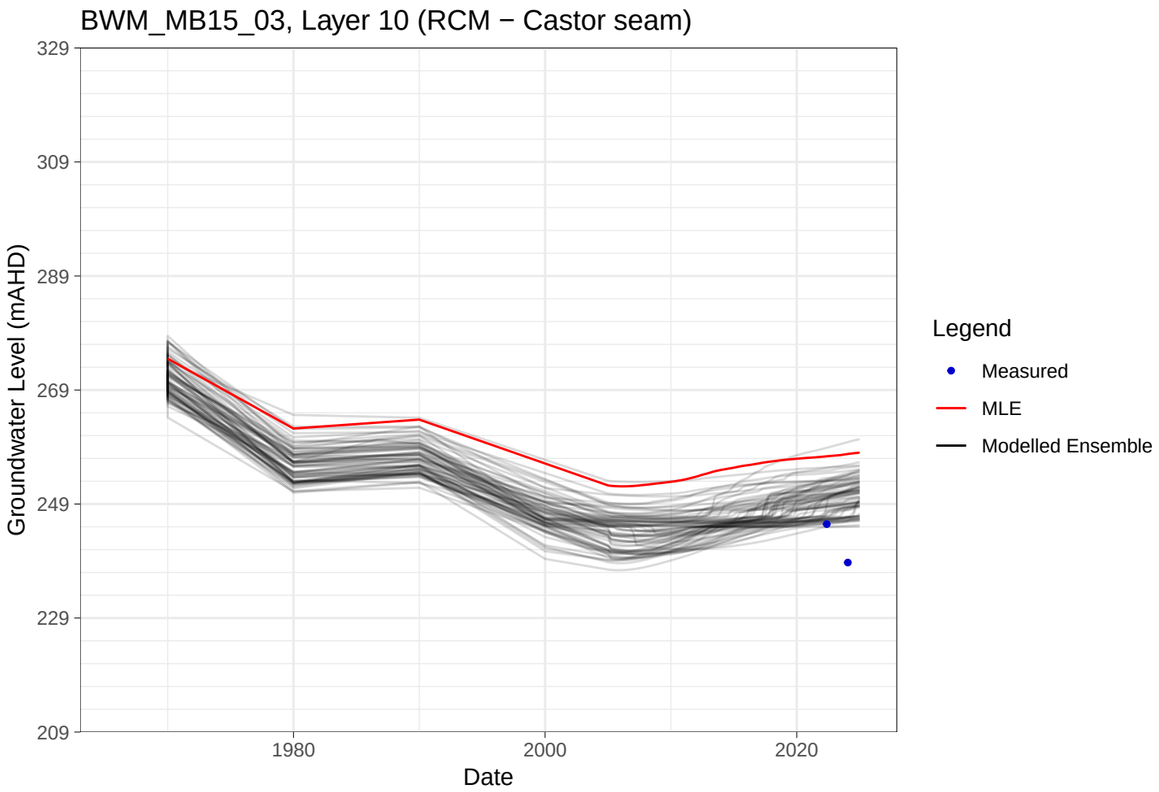

BWM_MB02_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
371
331
291
251
211
171
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

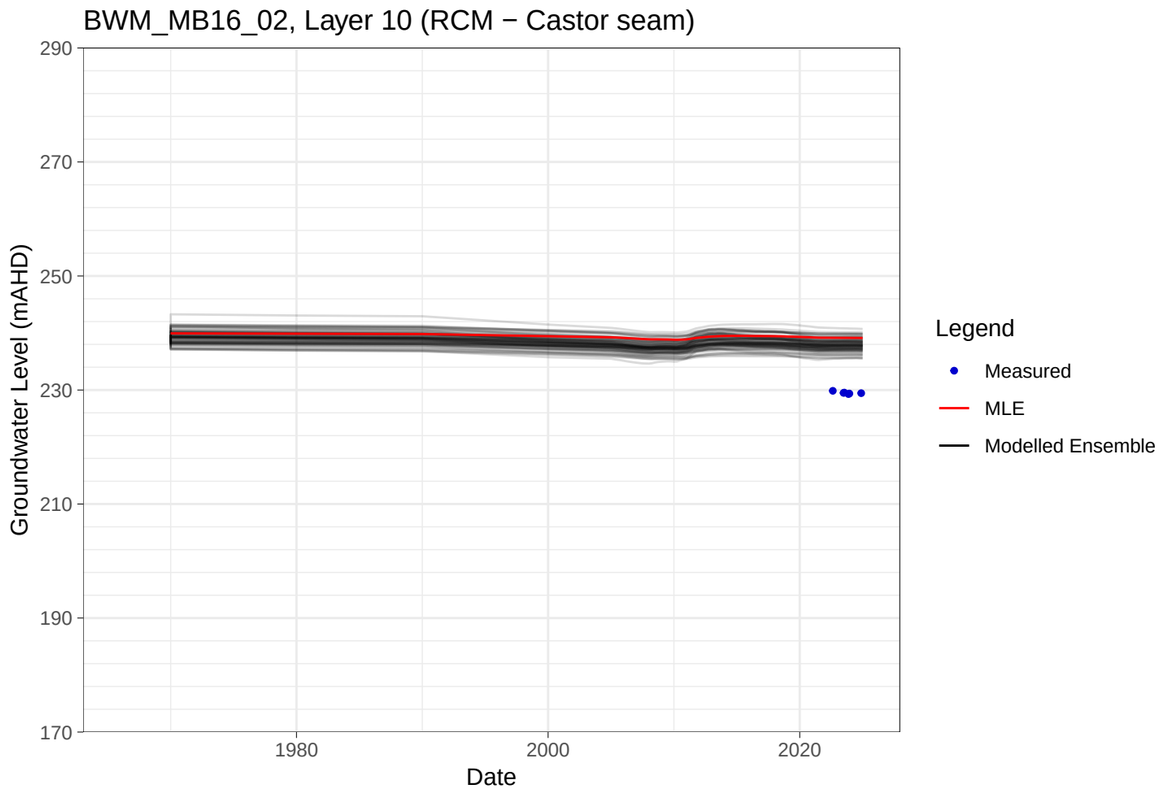

BWM_MB04_01, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
266
256
246
236
226
216
206
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

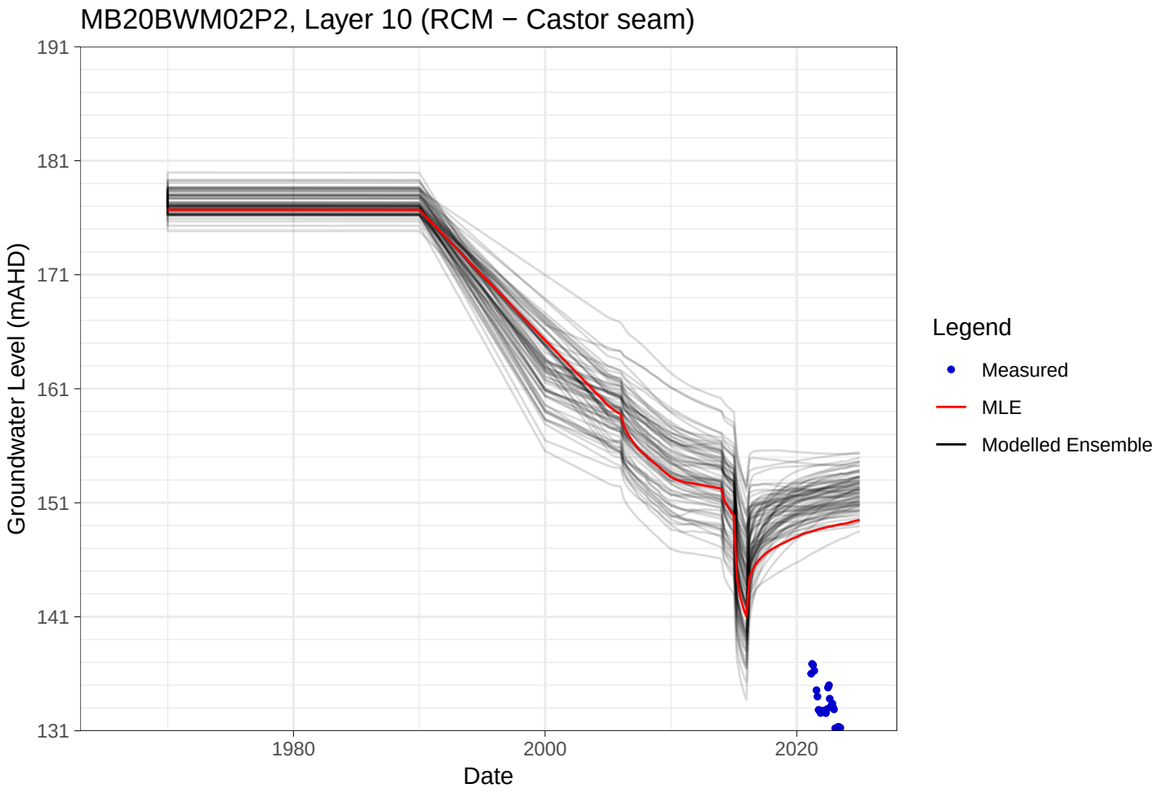

BWM_MB11_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
281
261
241
221
201
181
161
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

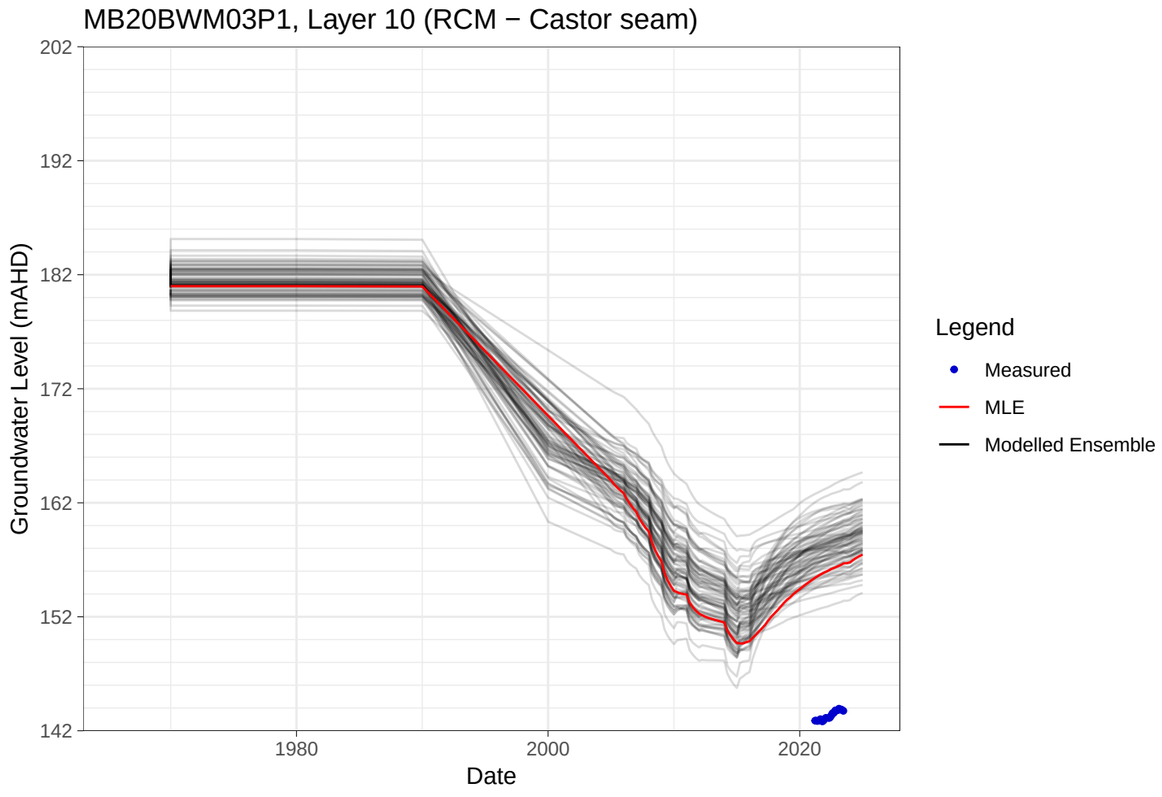

BWM_MB12_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
398
358
318
278
238
198
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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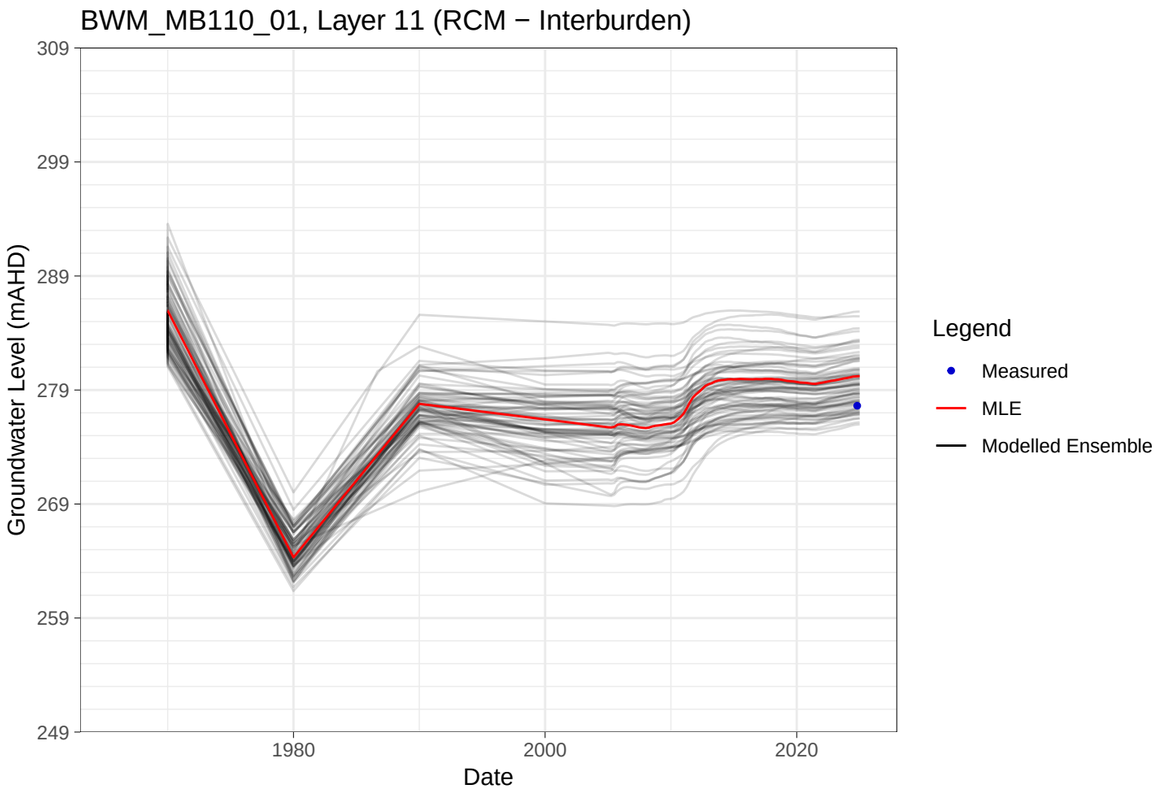

BWM_MB15_03, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
329
309
289
269
249
229
209
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

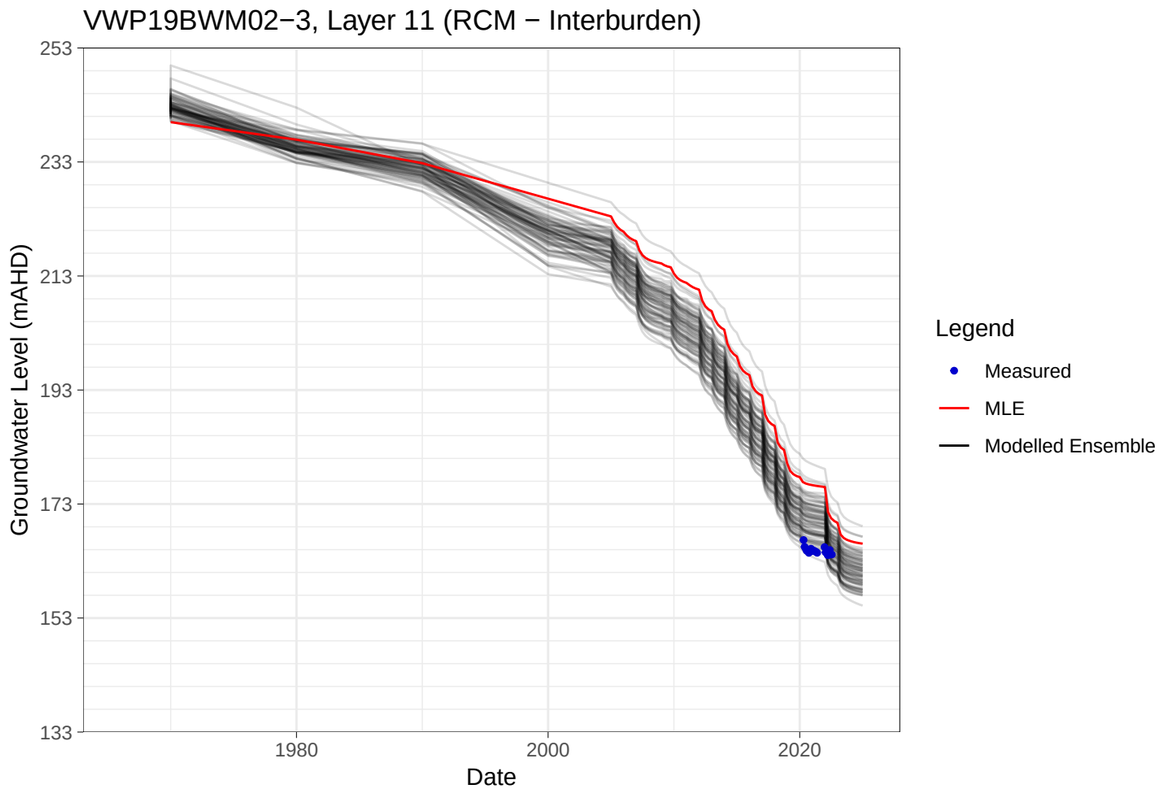

BWM_MB16_02, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
290
270
250
230
210
190
170
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

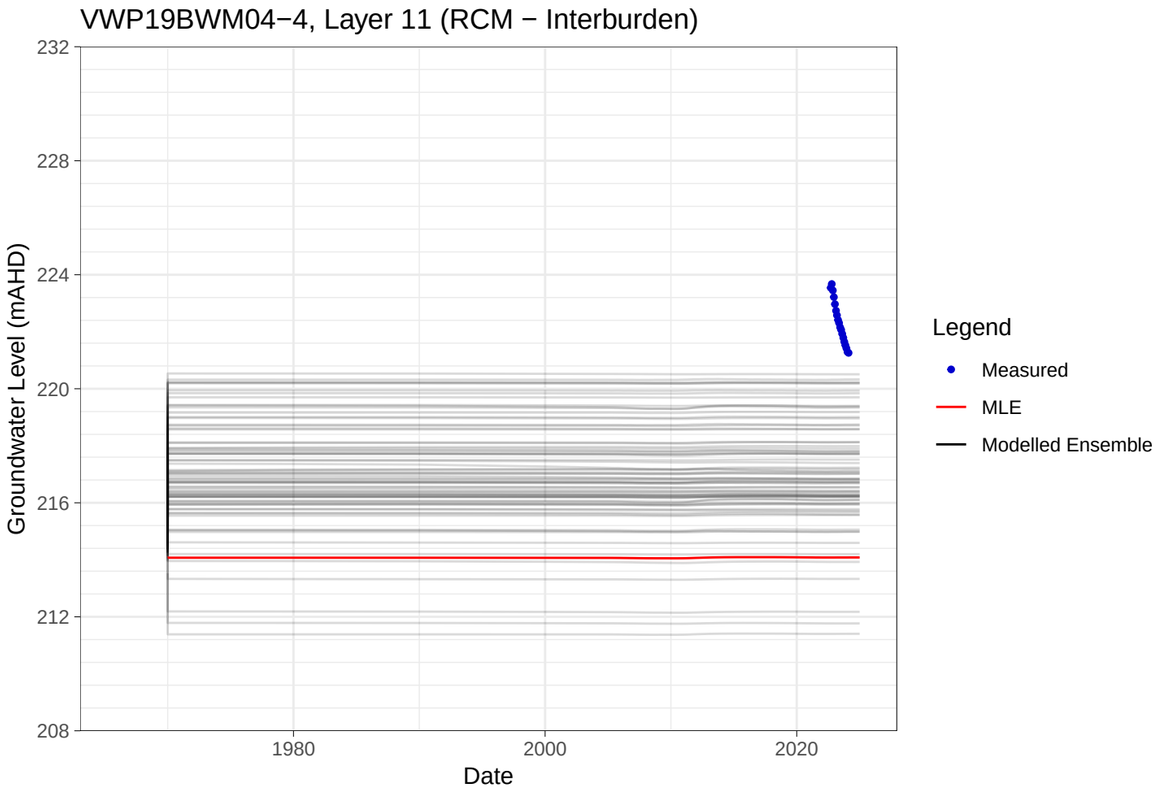

MB20BWM02P2, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
191
181
171
161
151
141
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

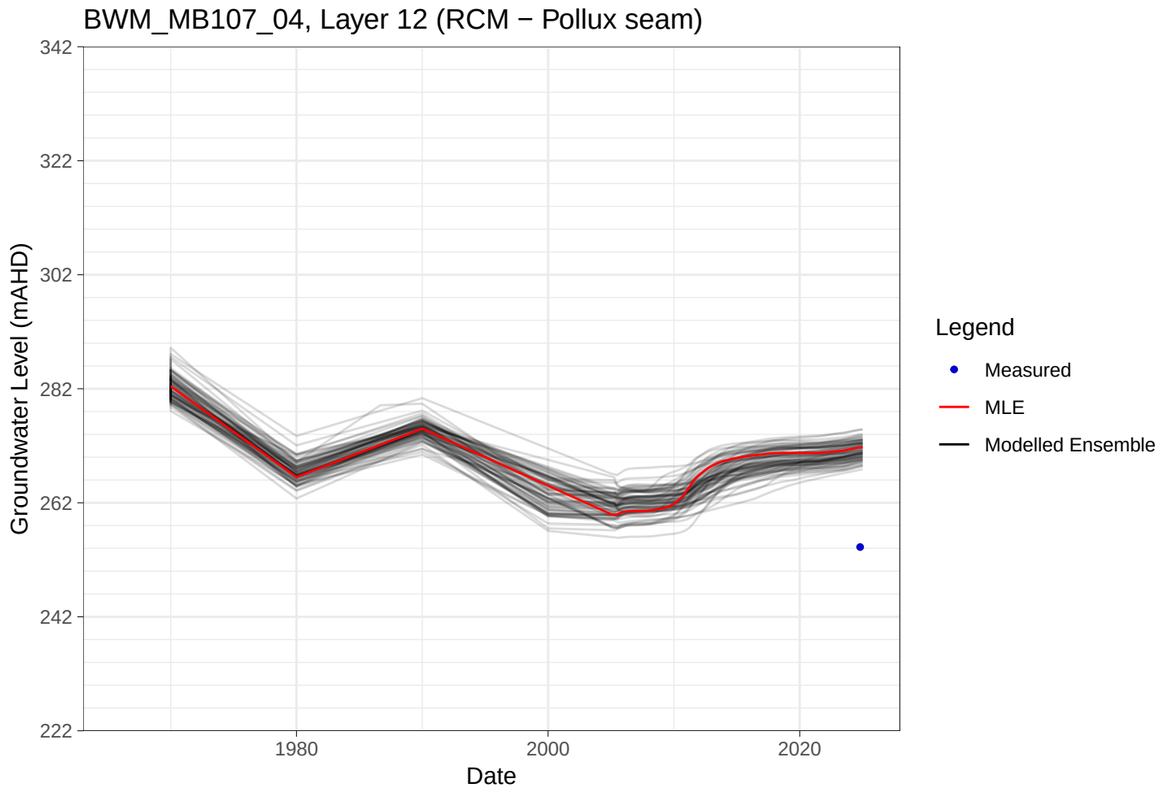

MB20BWM03P1, Layer 10 (RCM − Castor seam)
Groundwater Level (mAHD)
202
192
182
172
162
152
142
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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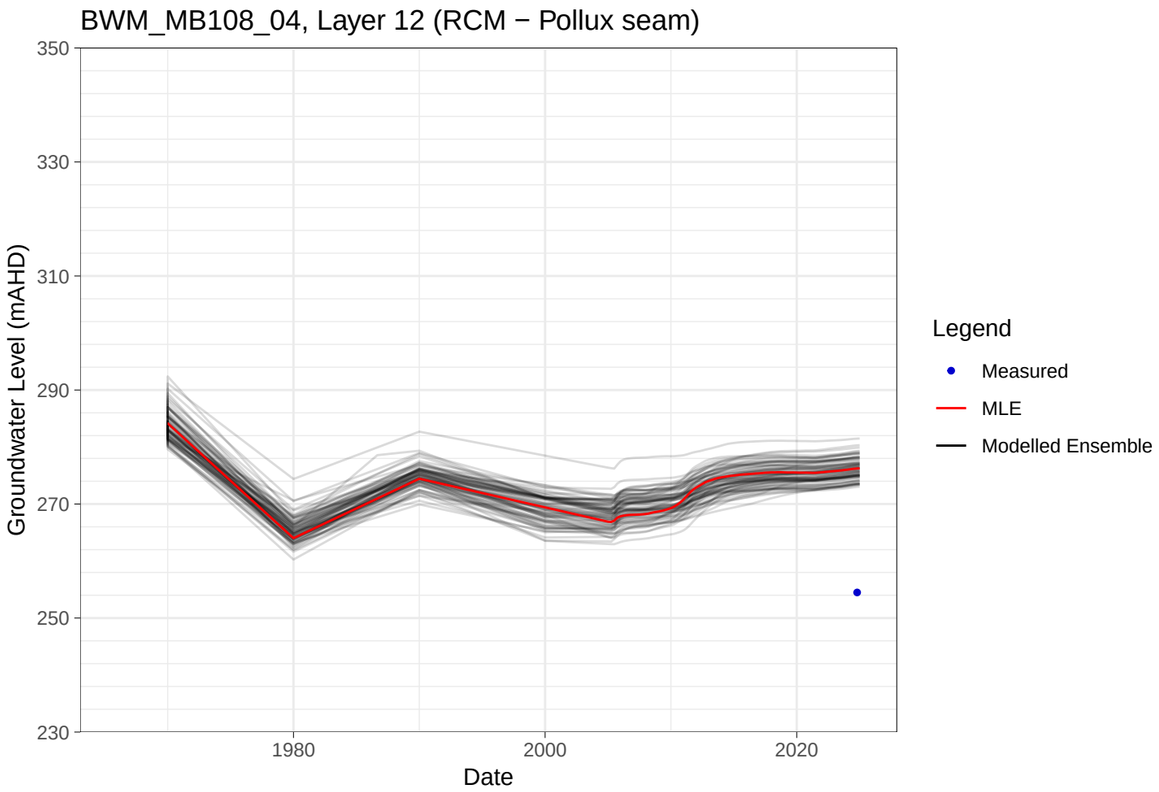

BWM_MB110_01, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
309
299
289
279
269
259
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

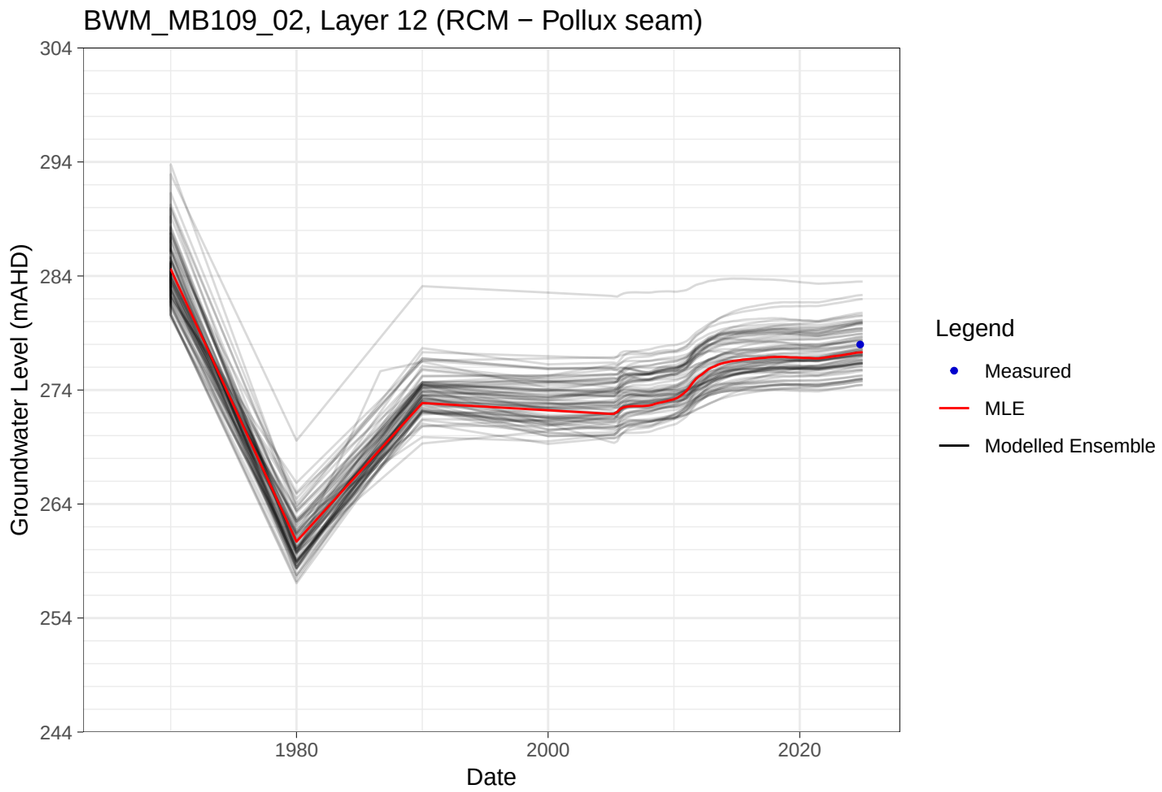

VWP19BWM02−3, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
253
233
213
193
173
153
133
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

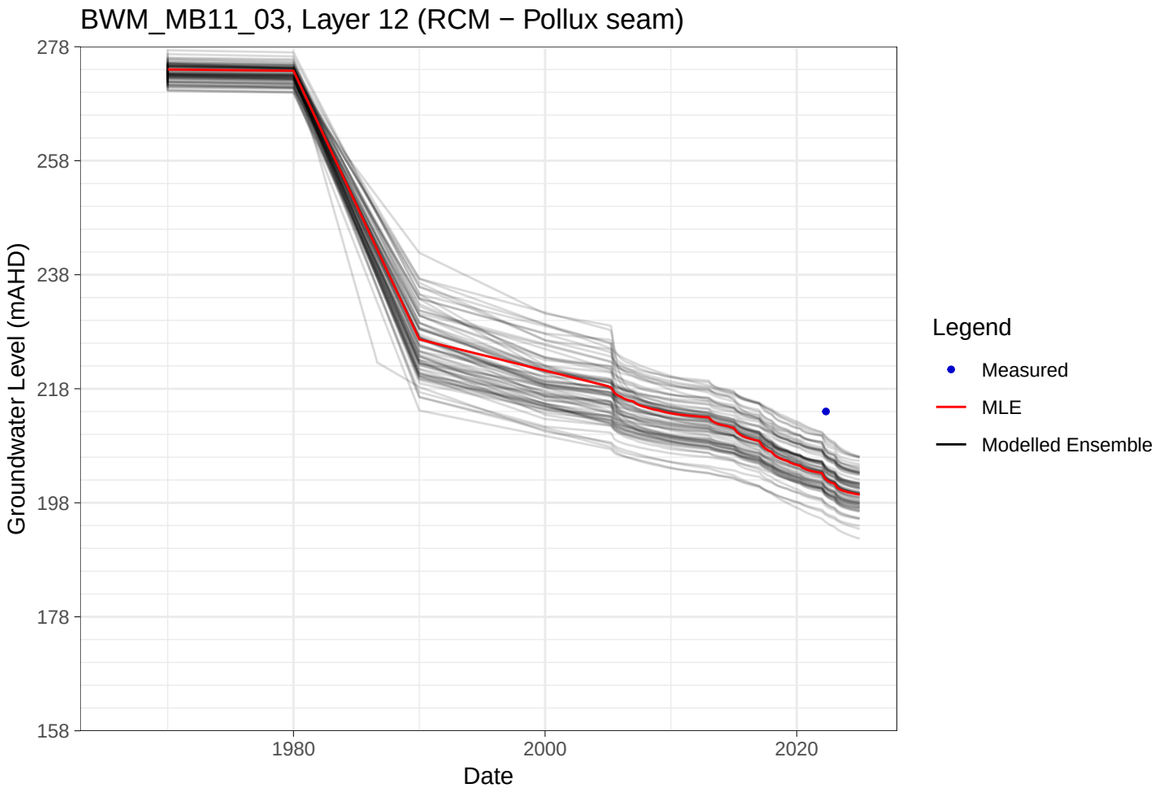

VWP19BWM04−4, Layer 11 (RCM − Interburden)
Groundwater Level (mAHD)
232
228
224
220
216
212
208
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

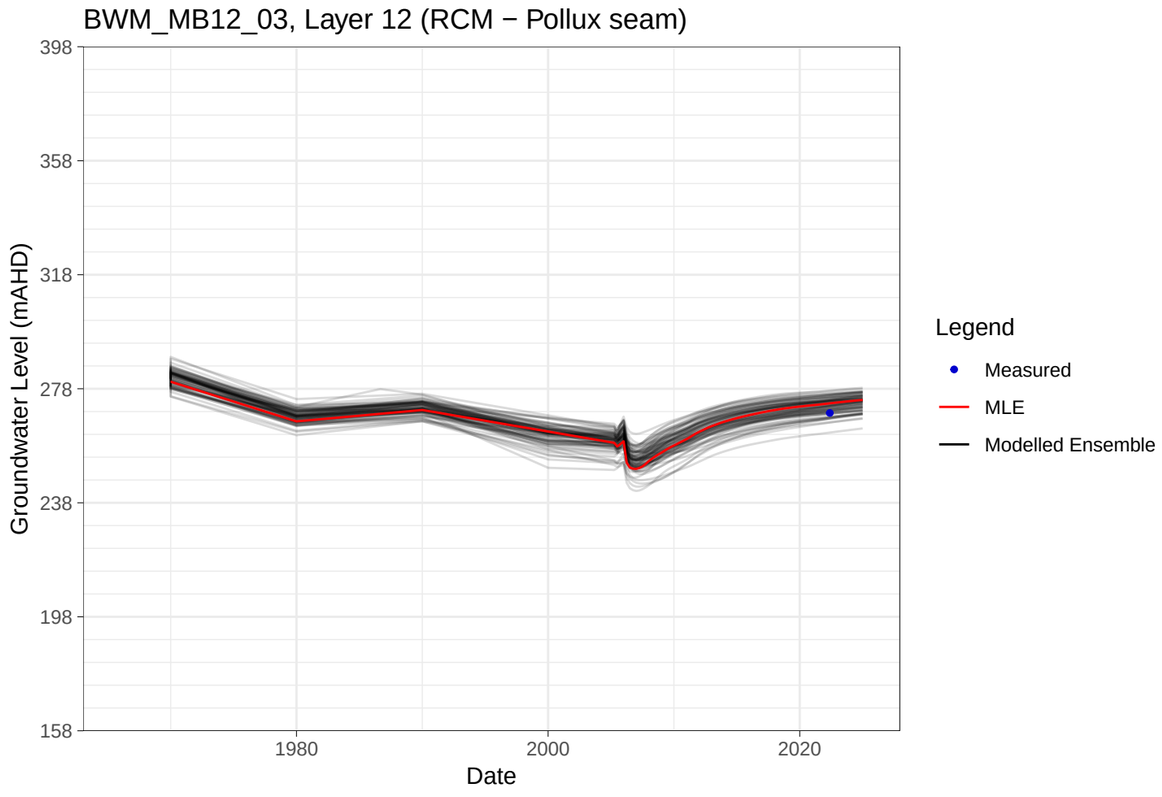

BWM_MB107_04, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
342
322
302
282
262
242
222
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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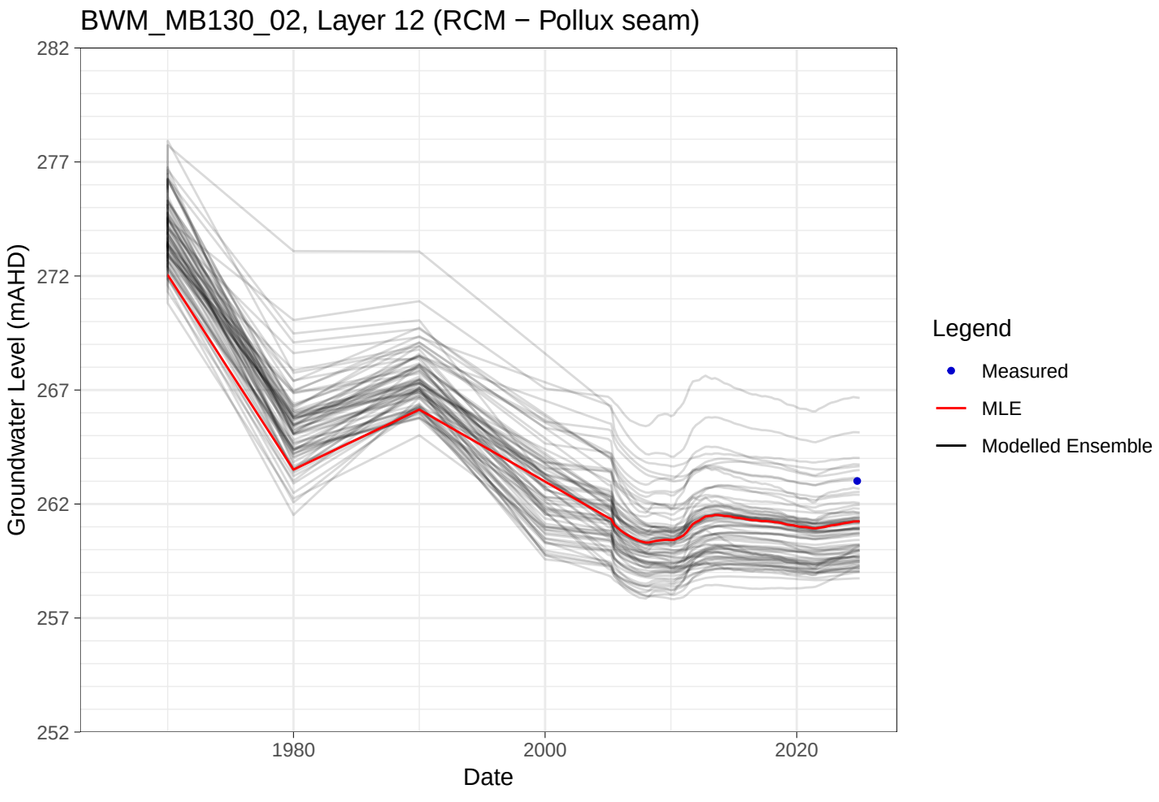

BWM_MB108_04, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
350
330
310
290
270
250
230
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

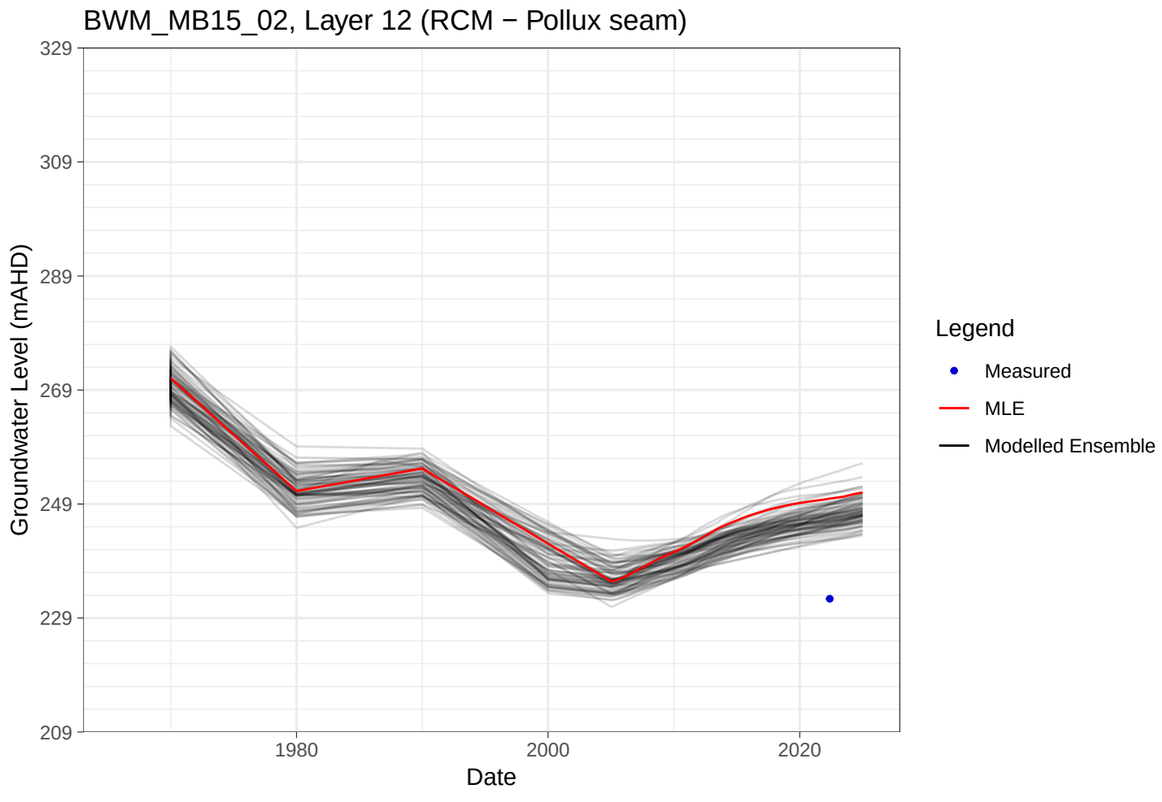

BWM_MB109_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
304
294
284
274
264
254
244
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

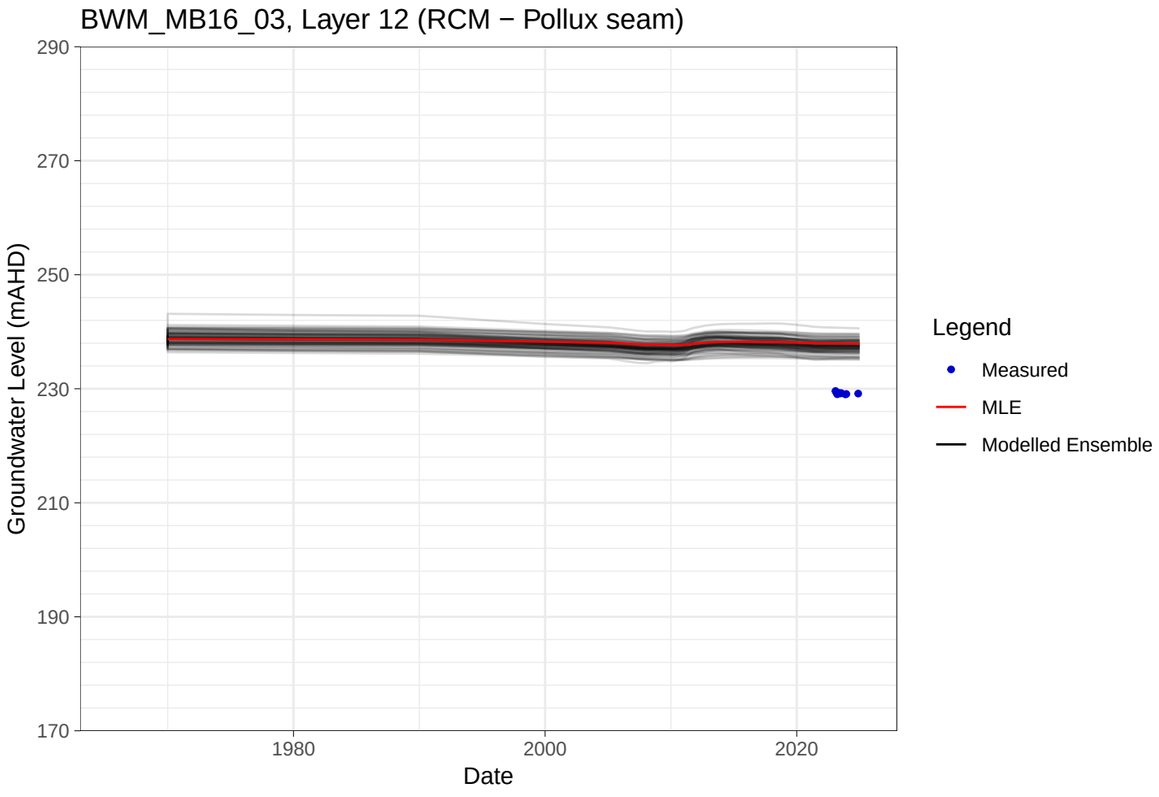

BWM_MB11_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
278
258
238
218
198
178
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

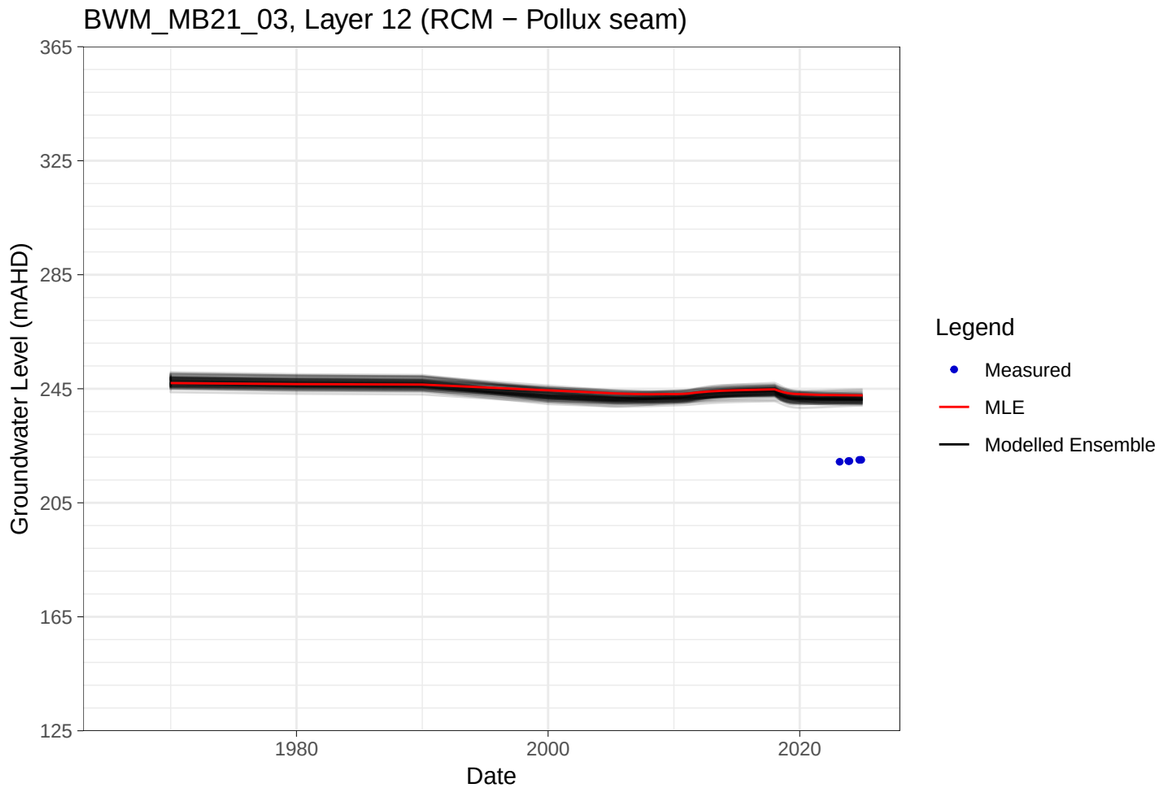

BWM_MB12_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
398
358
318
278
238
198
158
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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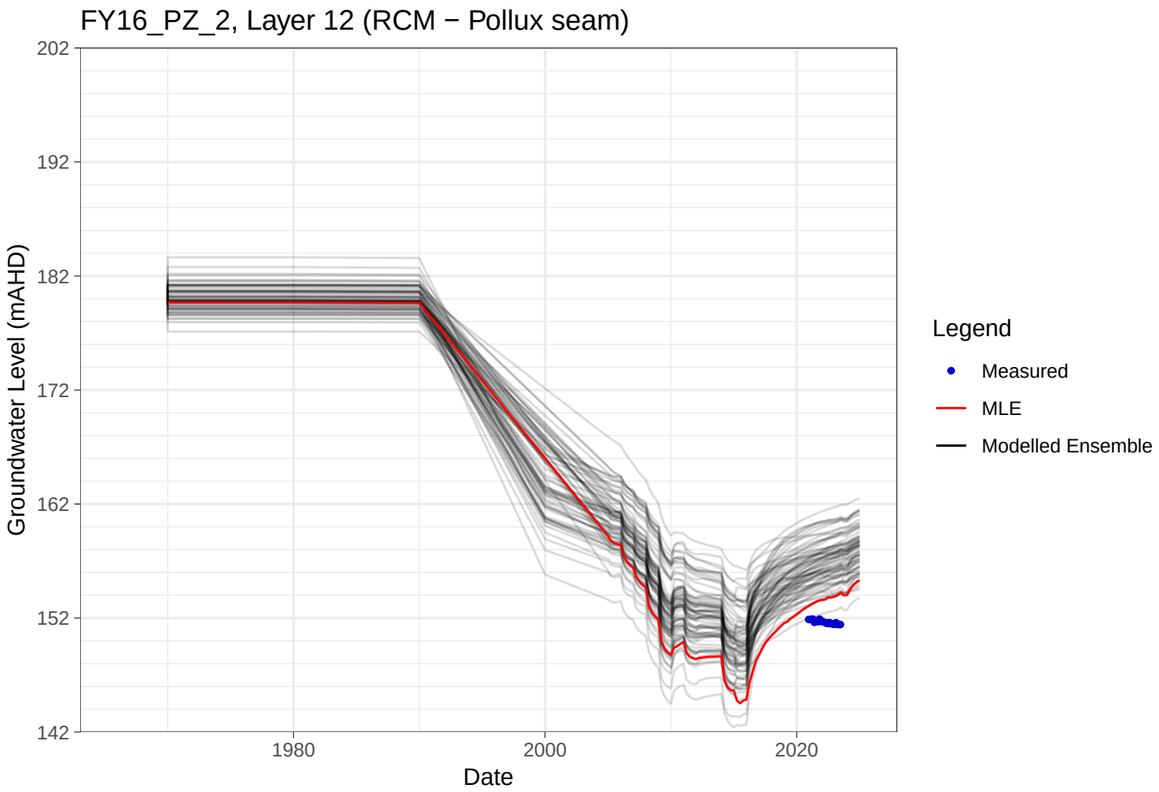

BWM_MB130_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
282
277
272
267
262
257
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

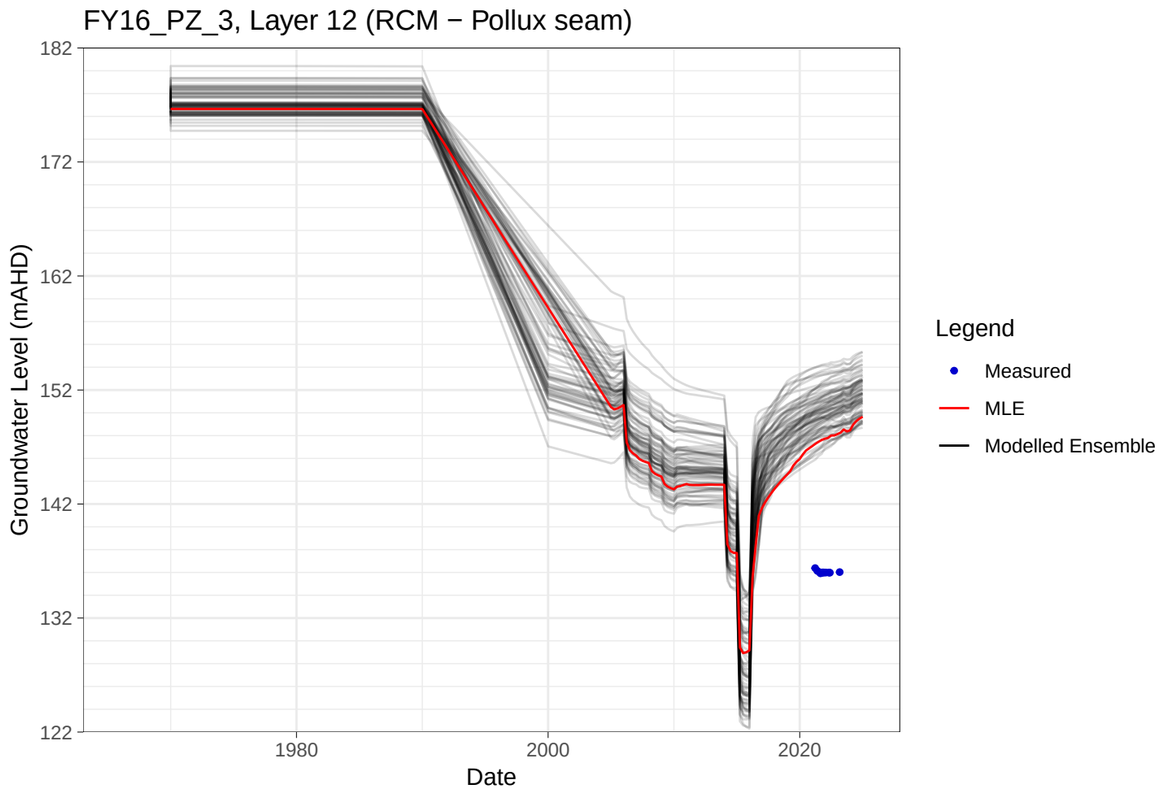

BWM_MB15_02, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
329
309
289
269
249
229
209
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

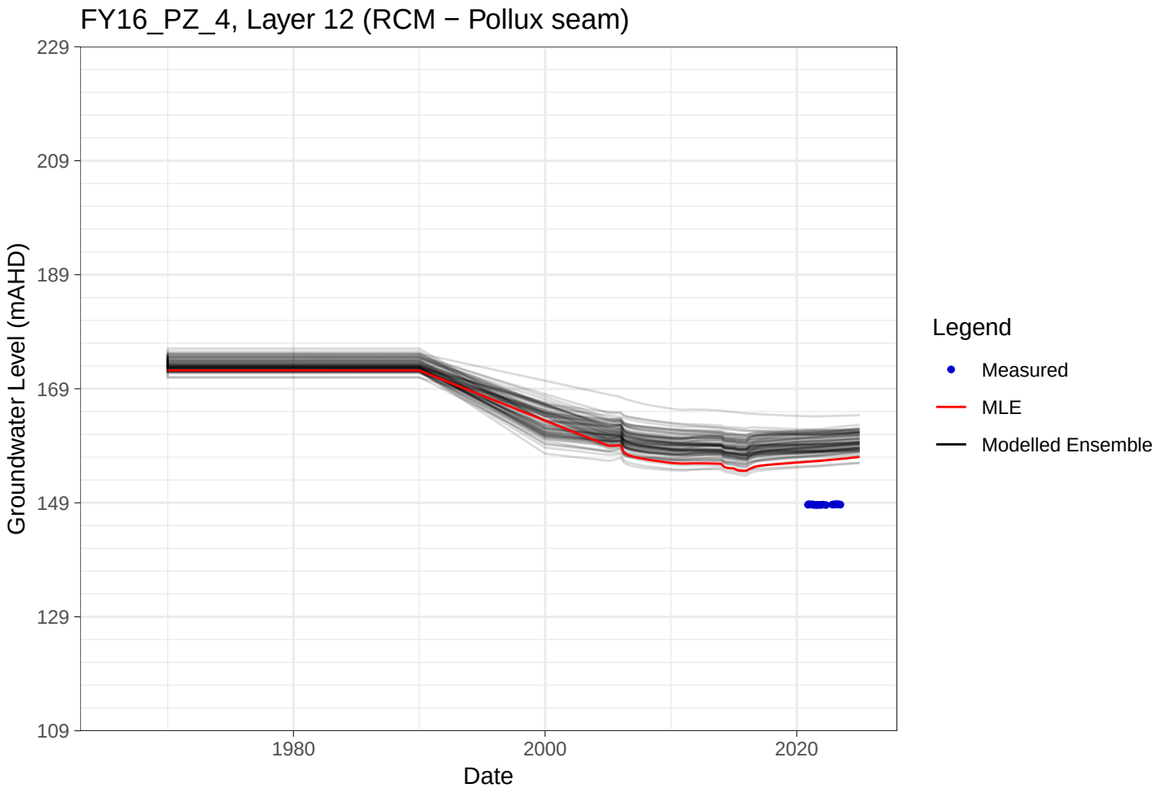

BWM_MB16_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
290
270
250
230
210
190
170
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

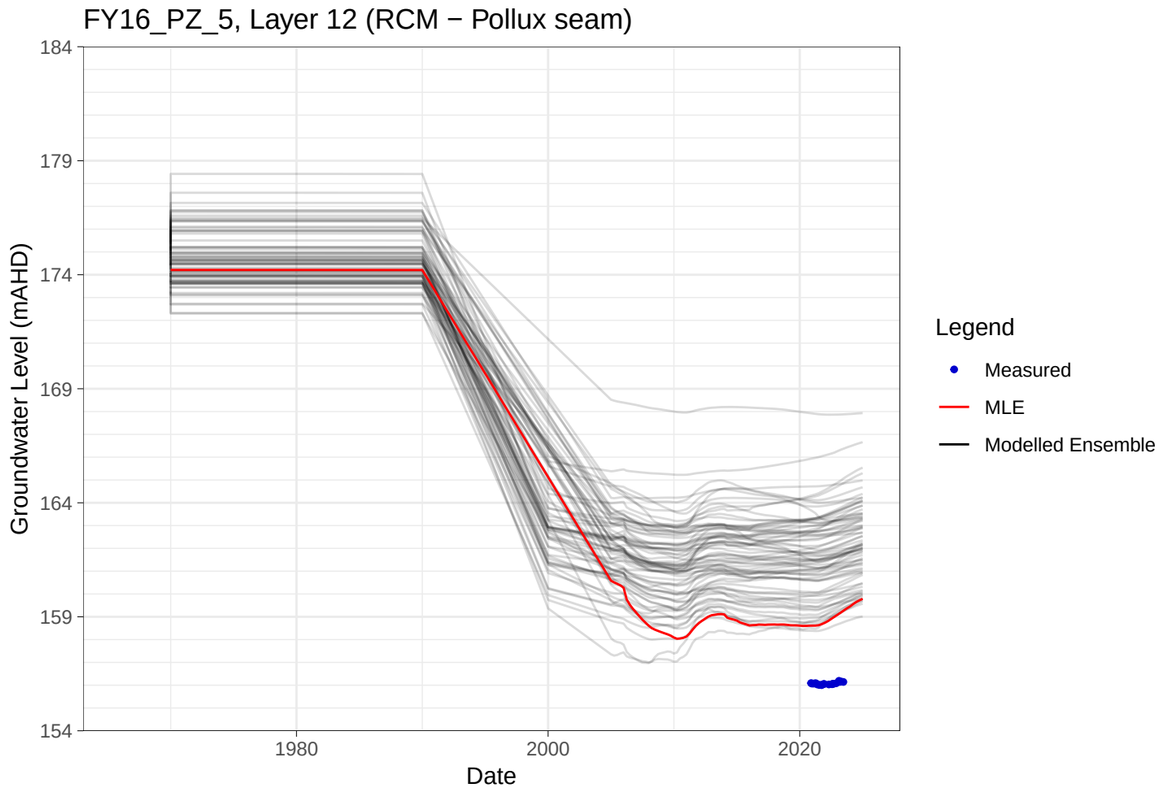

BWM_MB21_03, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
365
325
285
245
205
165
125
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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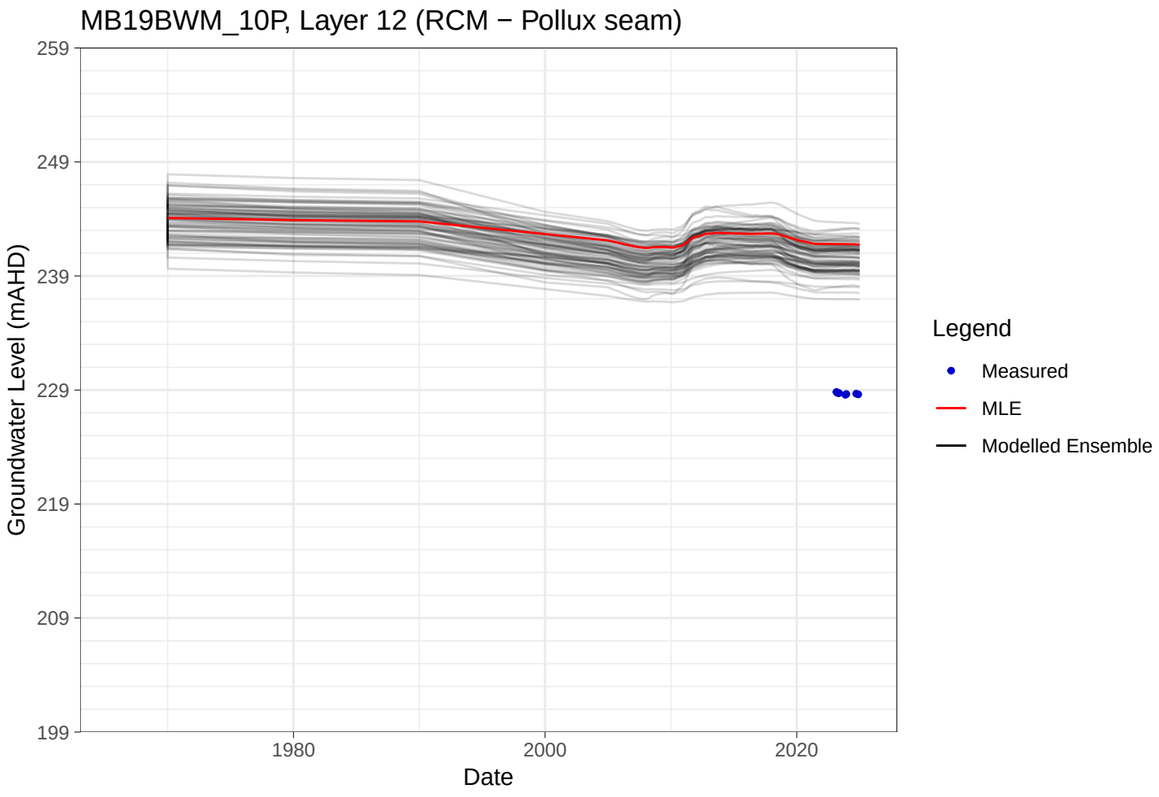

FY16_PZ_2, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
202
192
182
172
162
152
142
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

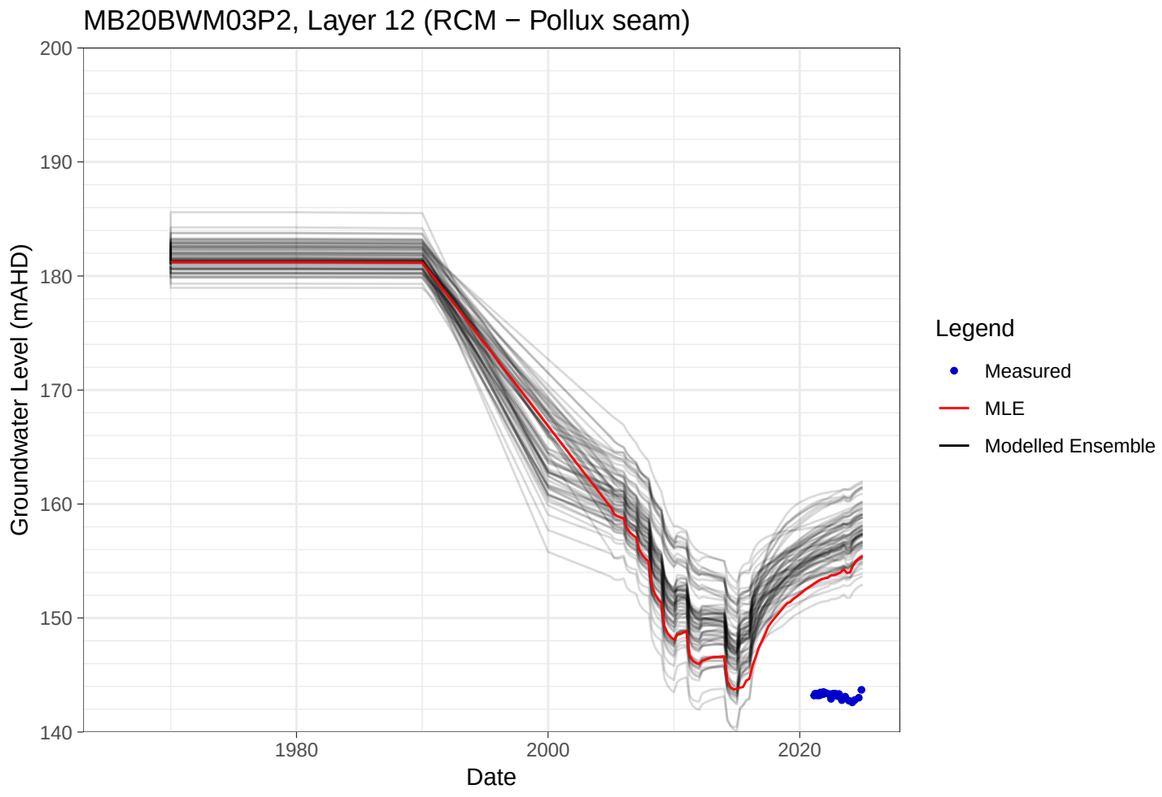

FY16_PZ_3, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
182
172
162
152
142
132
122
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

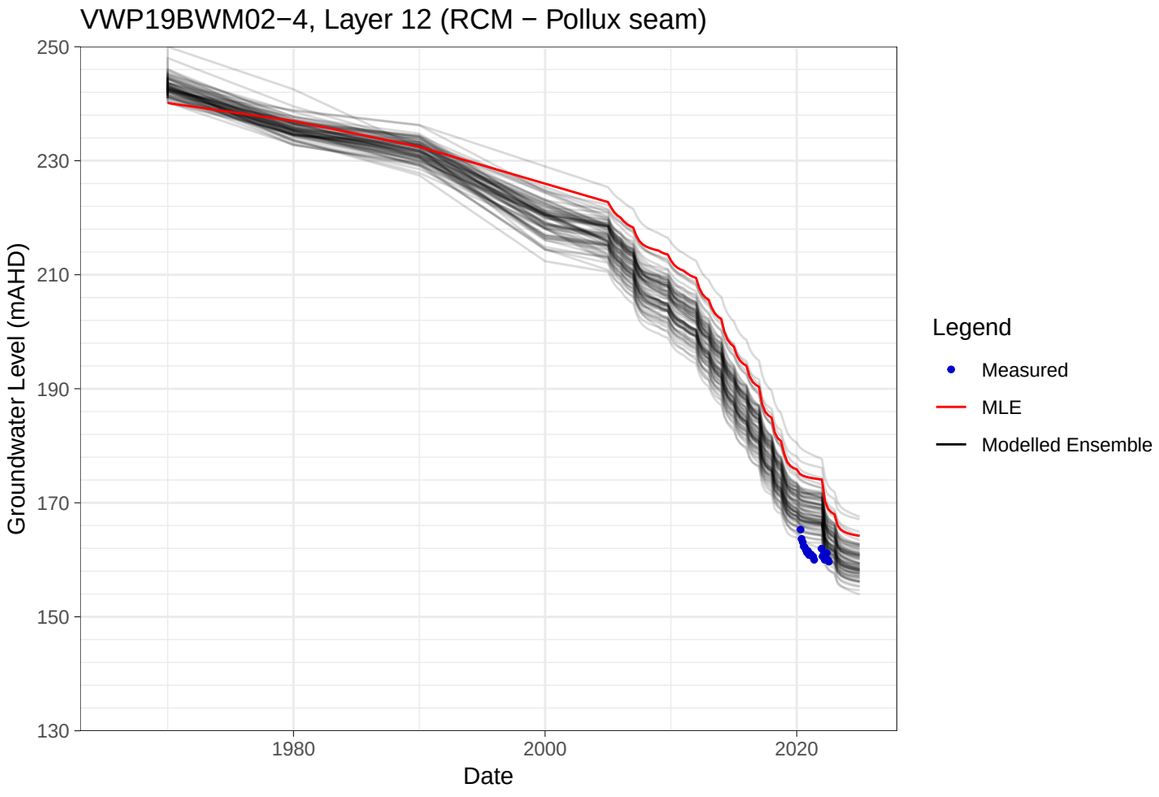

FY16_PZ_4, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
229
209
189
169
149
129
109
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

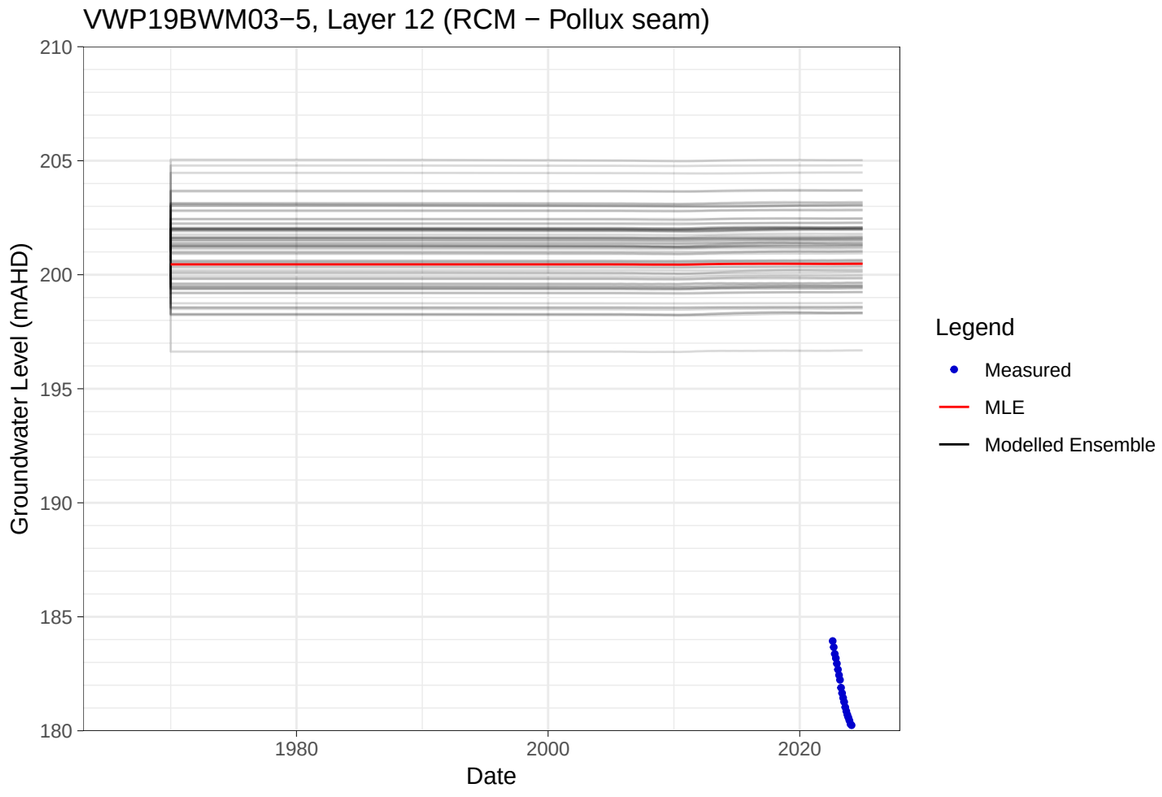

FY16_PZ_5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
184
179
174
169
164
159
154
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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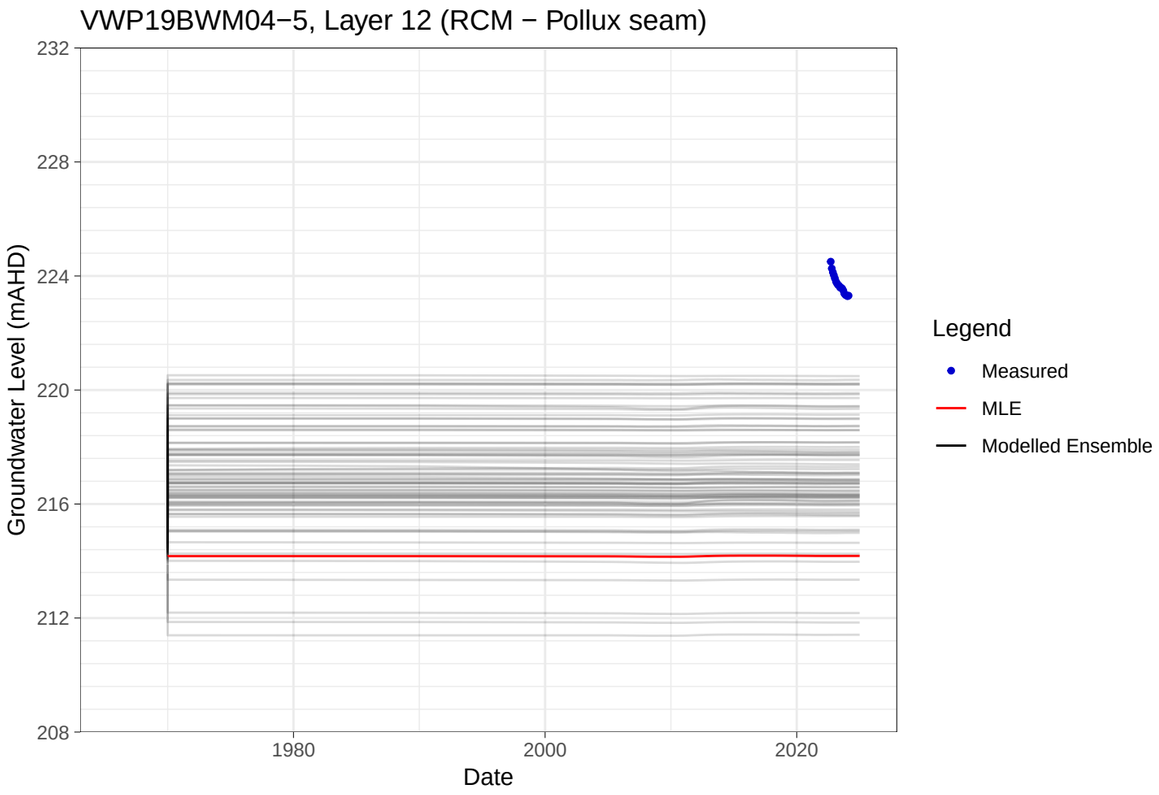

MB19BWM_10P, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
259
249
239
229
219
209
199
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

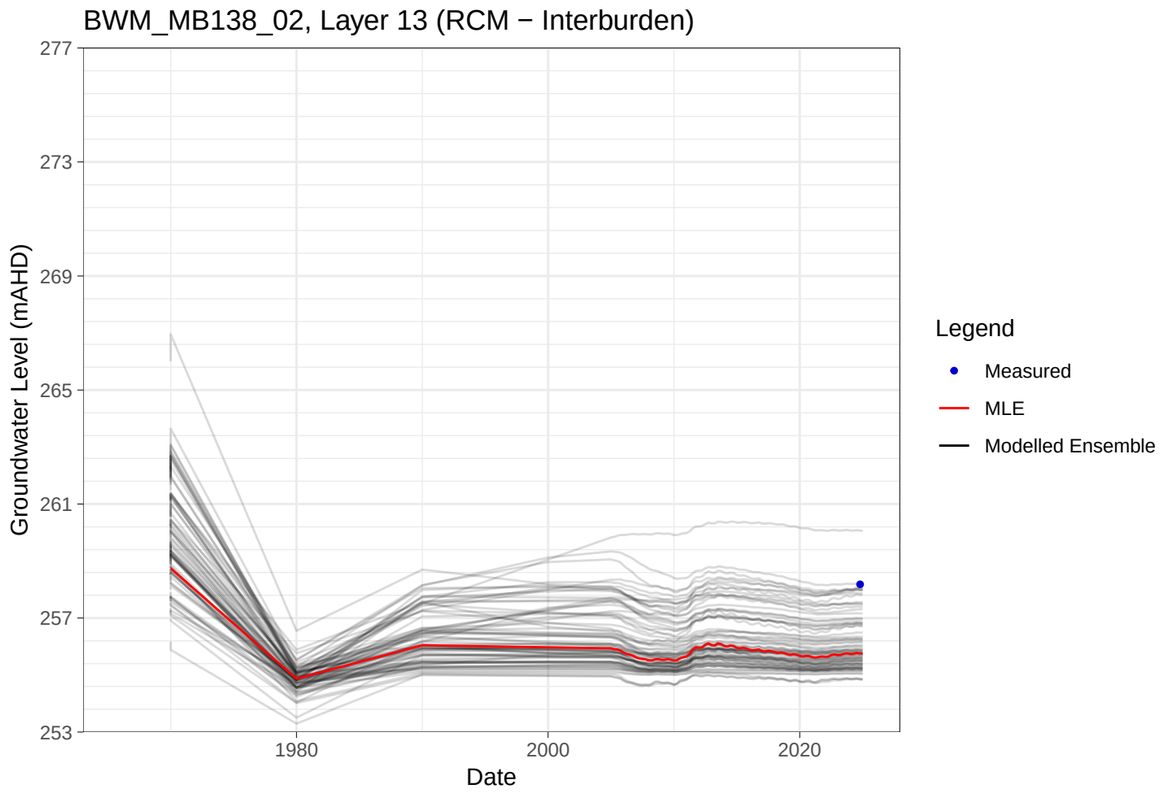

MB20BWM03P2, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
200
190
180
170
160
150
140
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

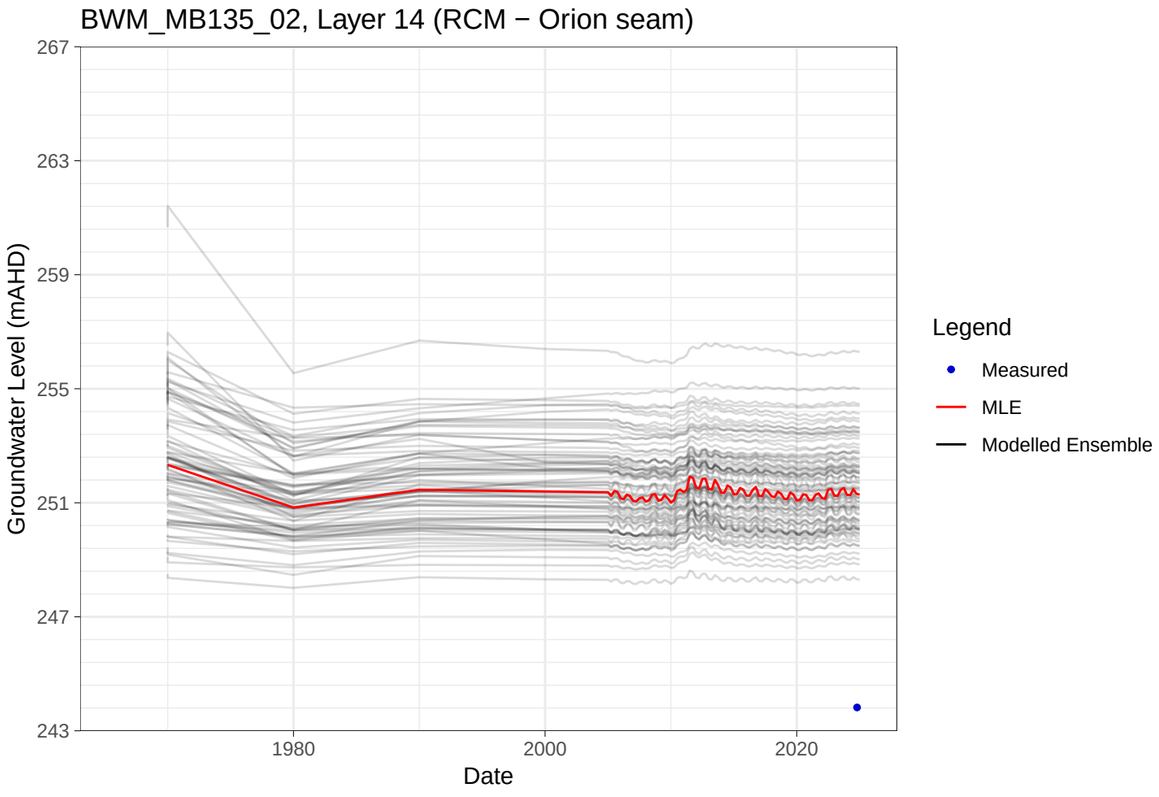

VWP19BWM02−4, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
250
230
210
190
170
150
130
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

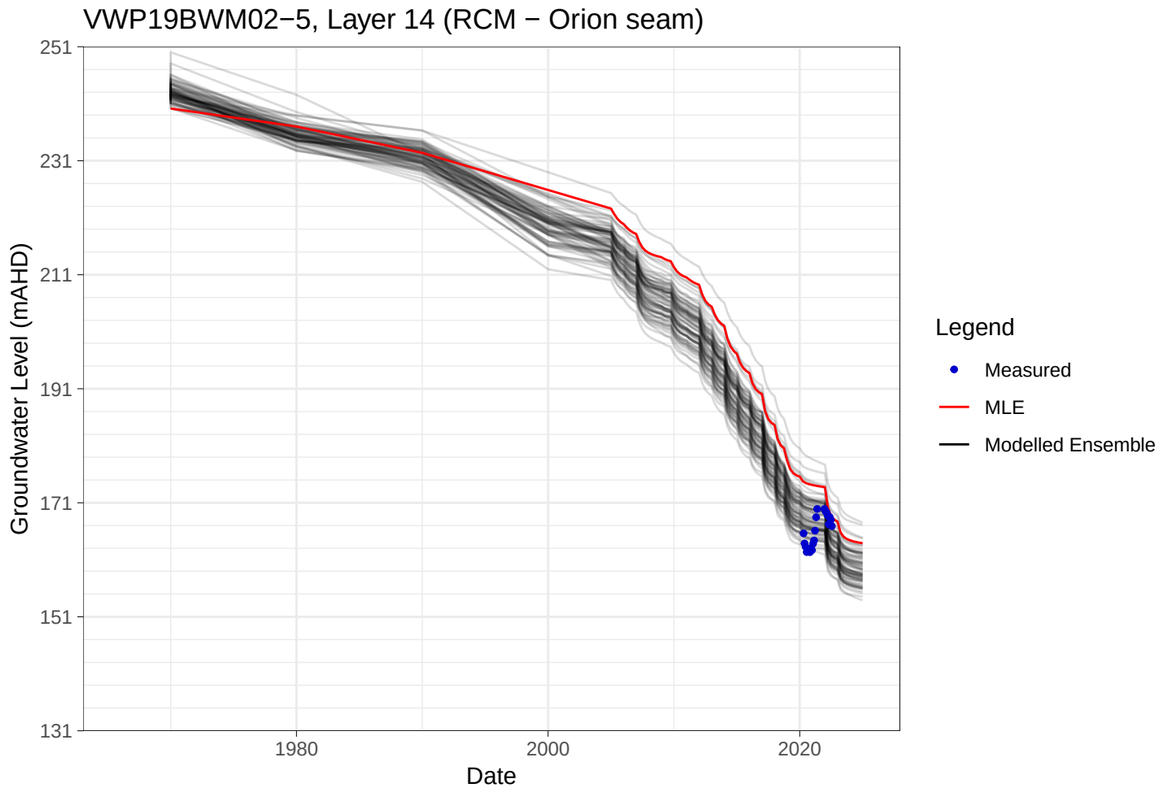

VWP19BWM03−5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
210
205
200
195
190
185
180
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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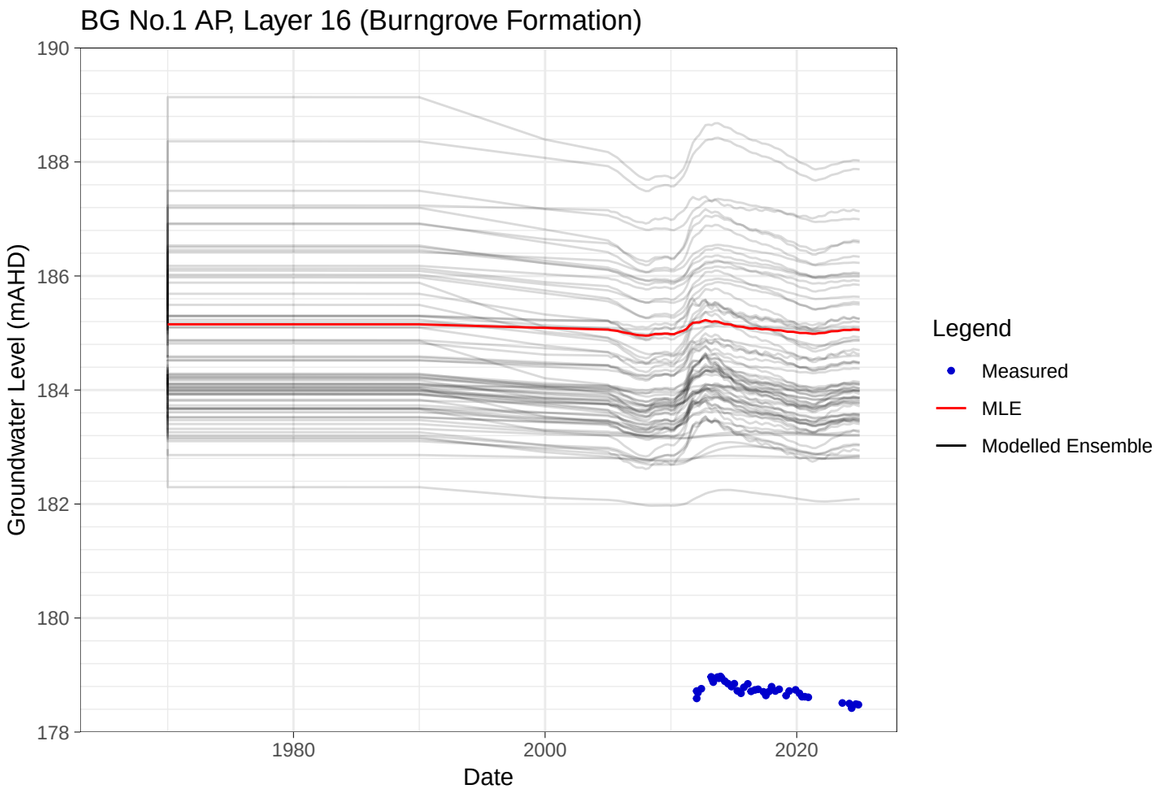

VWP19BWM04−5, Layer 12 (RCM − Pollux seam)
Groundwater Level (mAHD)
232
228
224
220
216
212
208
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

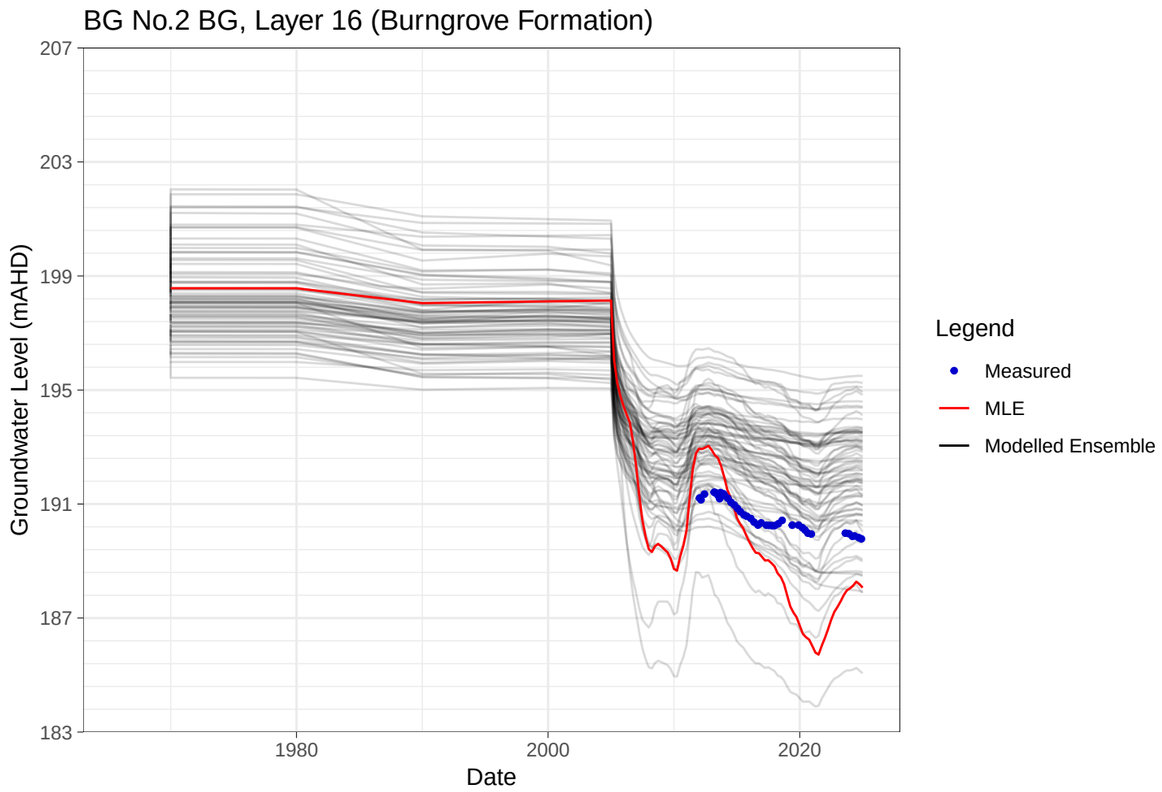

BWM_MB138_02, Layer 13 (RCM − Interburden)
Groundwater Level (mAHD)
277
273
269
265
261
257
253
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

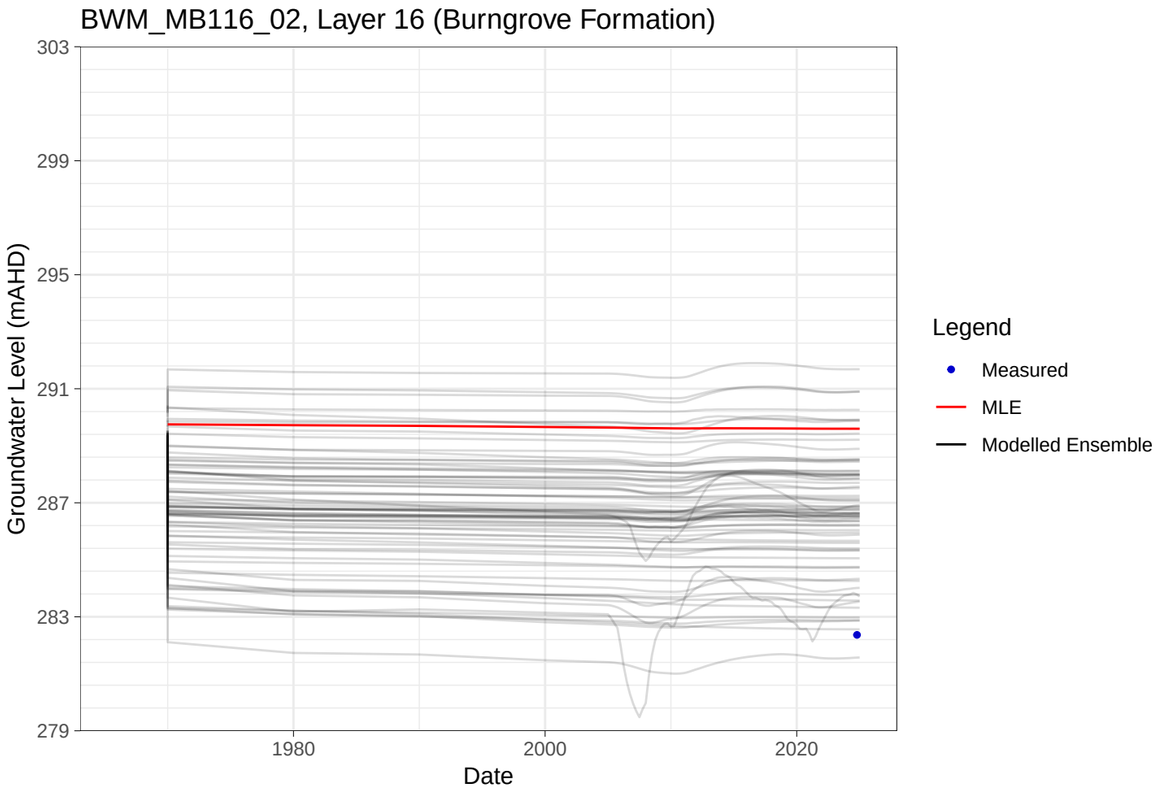

BWM_MB135_02, Layer 14 (RCM − Orion seam)
Groundwater Level (mAHD)
267
263
259
255
251
247
243
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

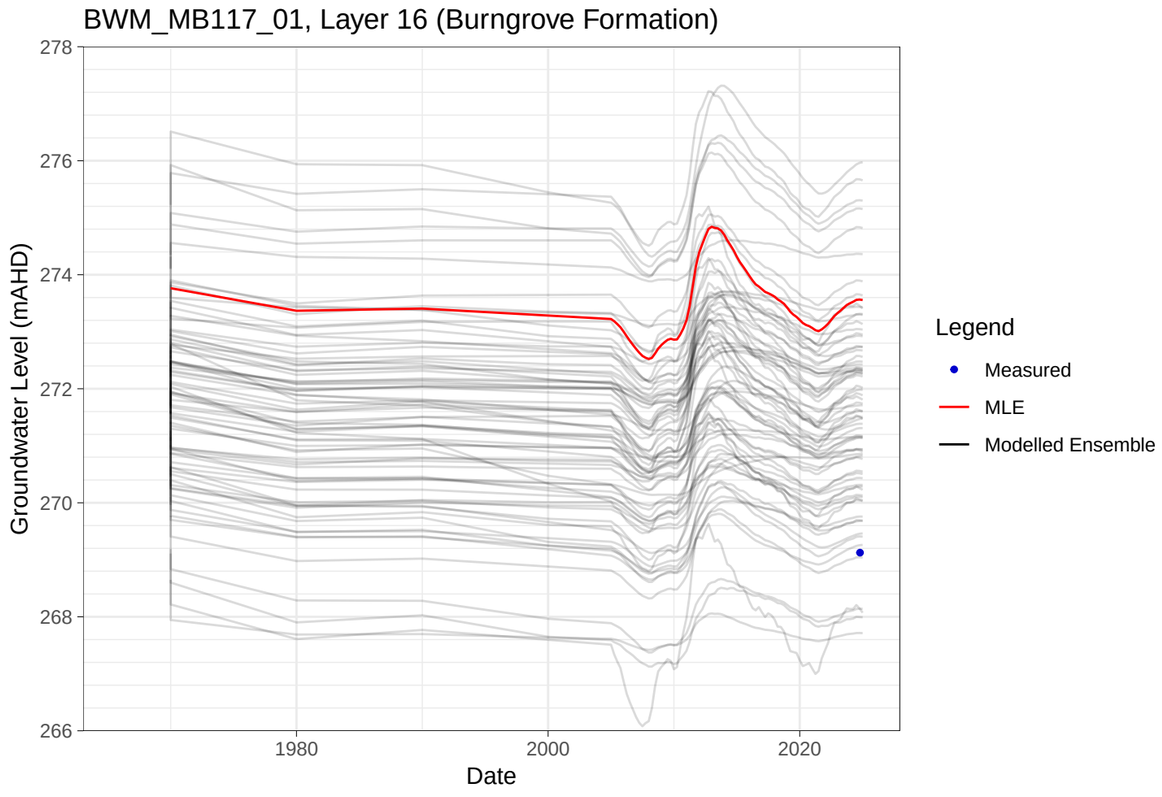

VWP19BWM02−5, Layer 14 (RCM − Orion seam)
Groundwater Level (mAHD)
251
231
211
191
171
151
131
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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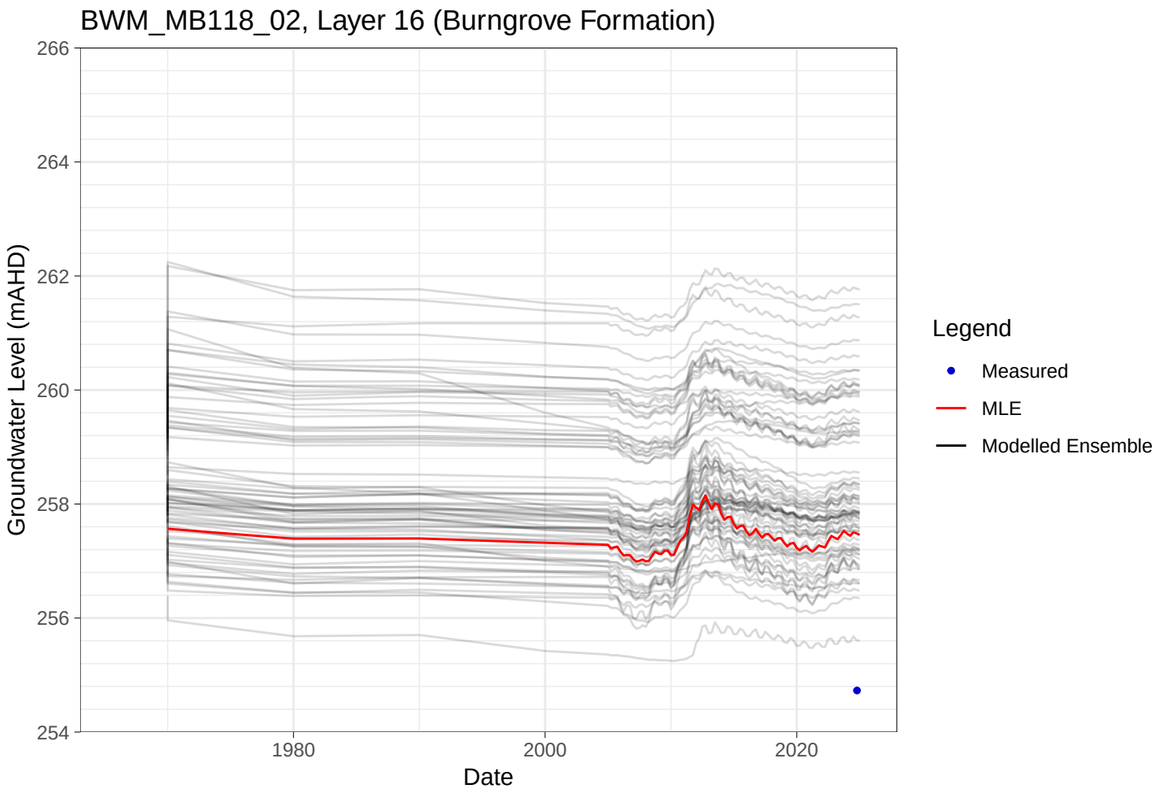

BG No.1 AP, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
190
188
186
184
182
180
178
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

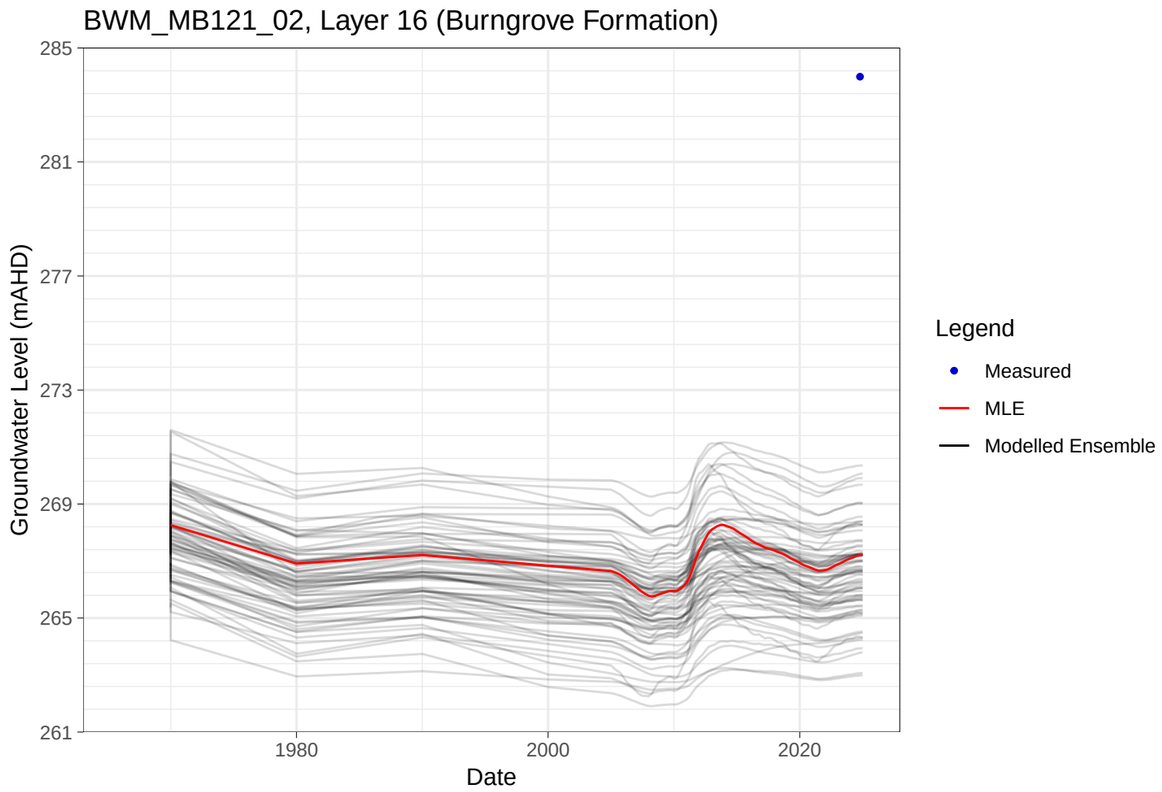

BG No.2 BG, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
207
203
199
195
191
187
183
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

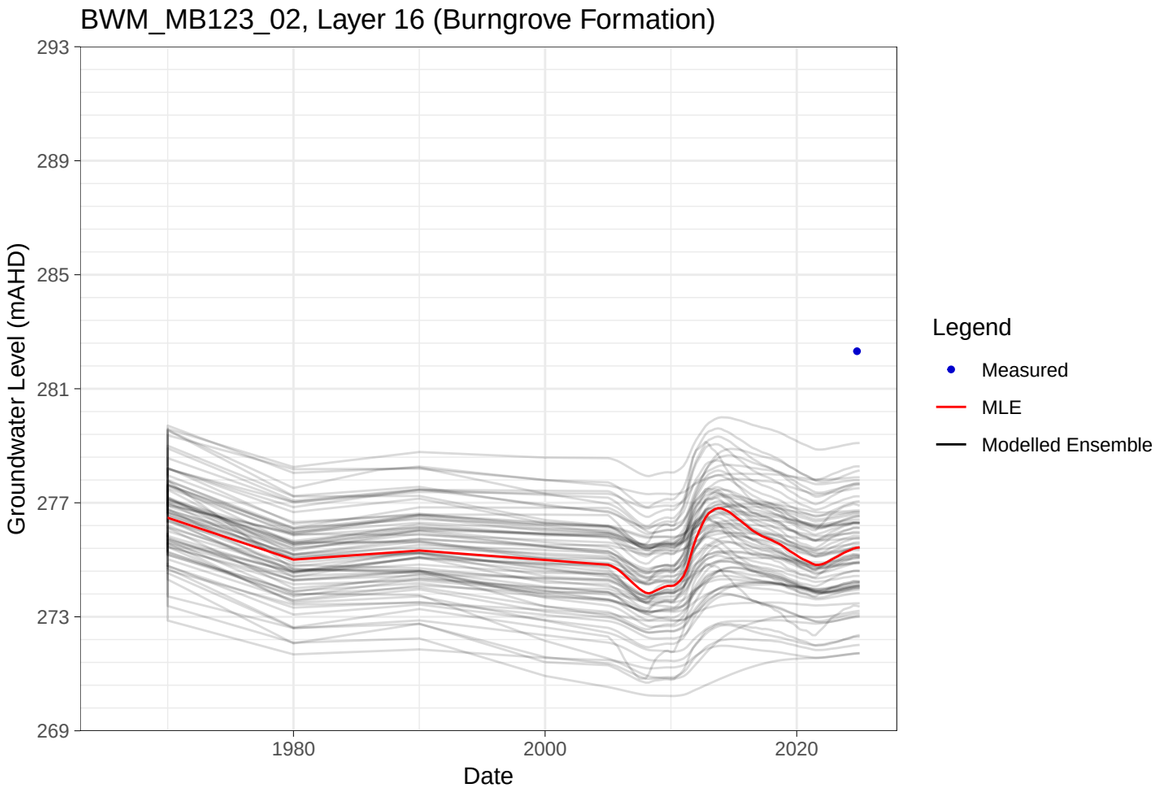

BWM_MB116_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
303
299
295
291
287
283
279
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

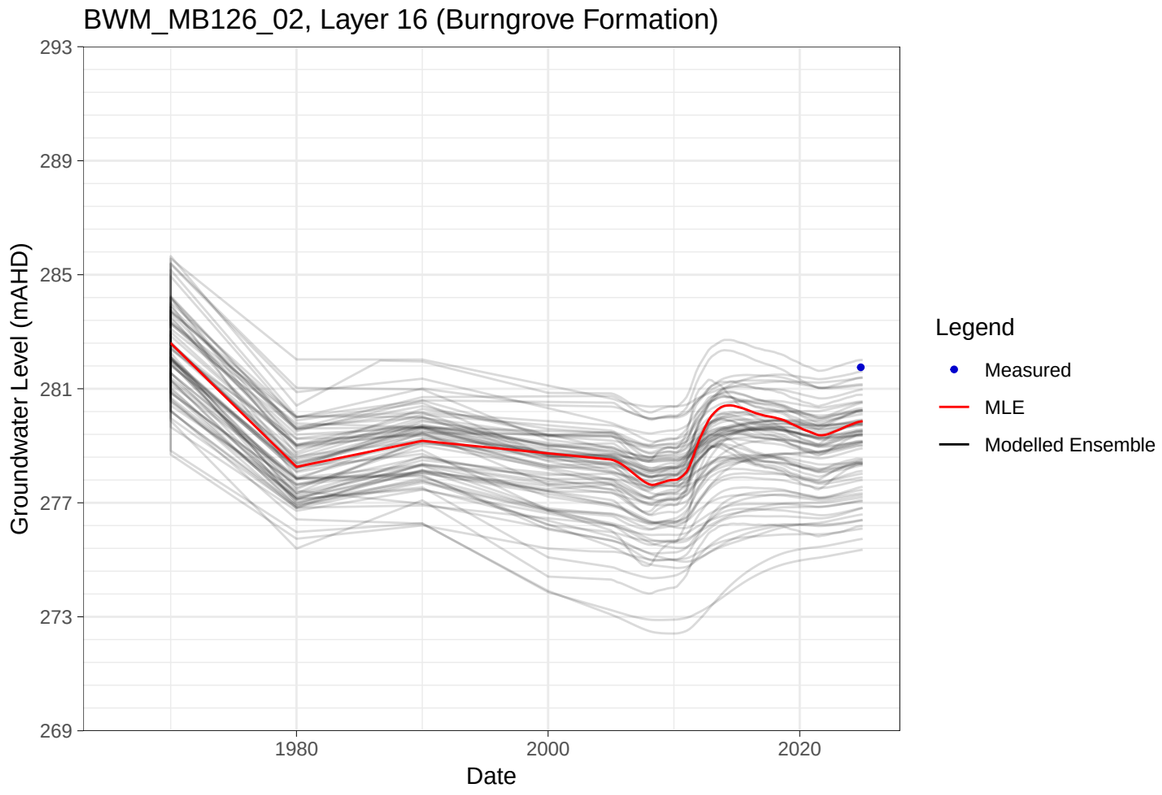

BWM_MB117_01, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
278
276
274
272
270
268
266
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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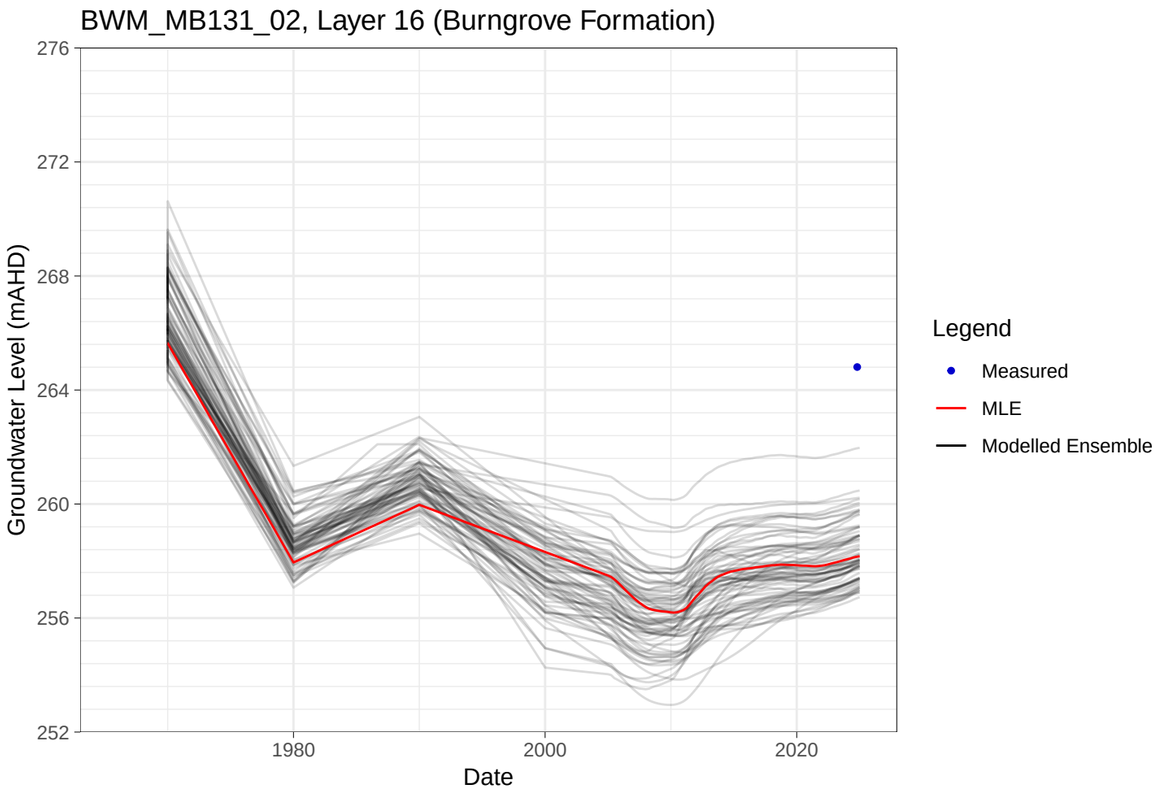

BWM_MB118_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
266
264
262
260
258
256
254
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

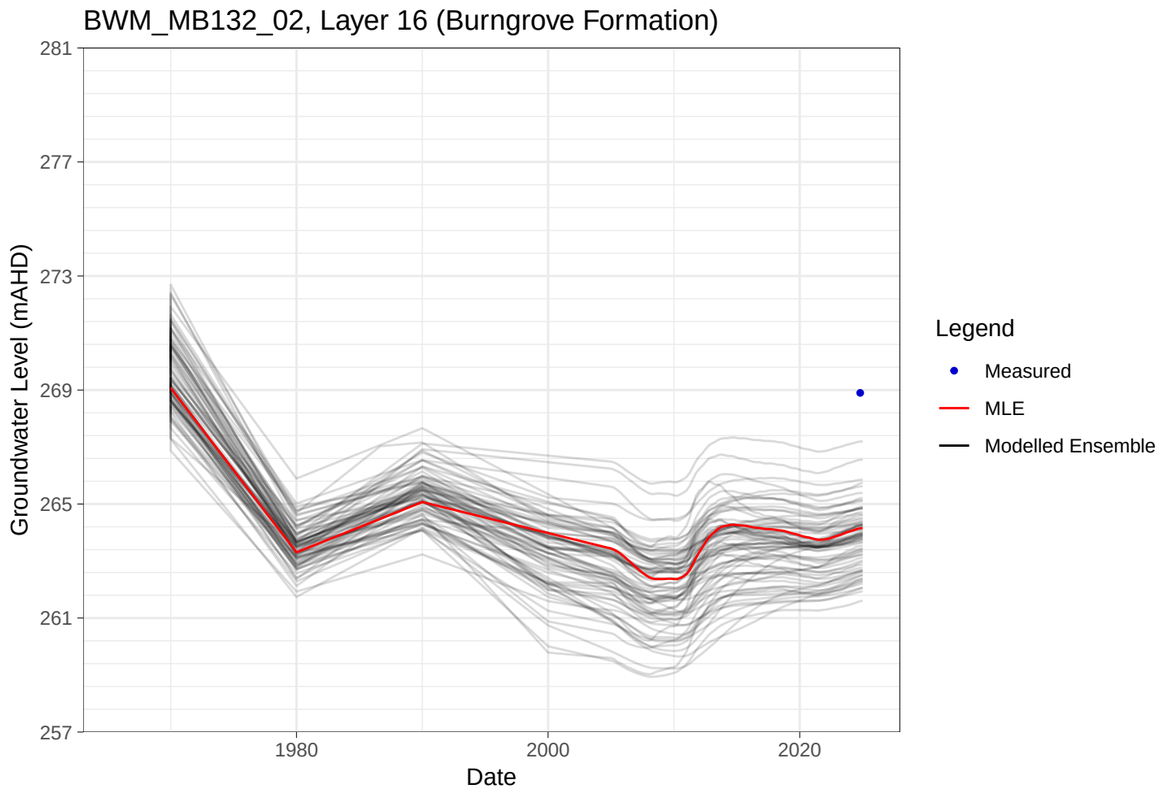

BWM_MB121_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
285
281
277
273
269
265
261
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

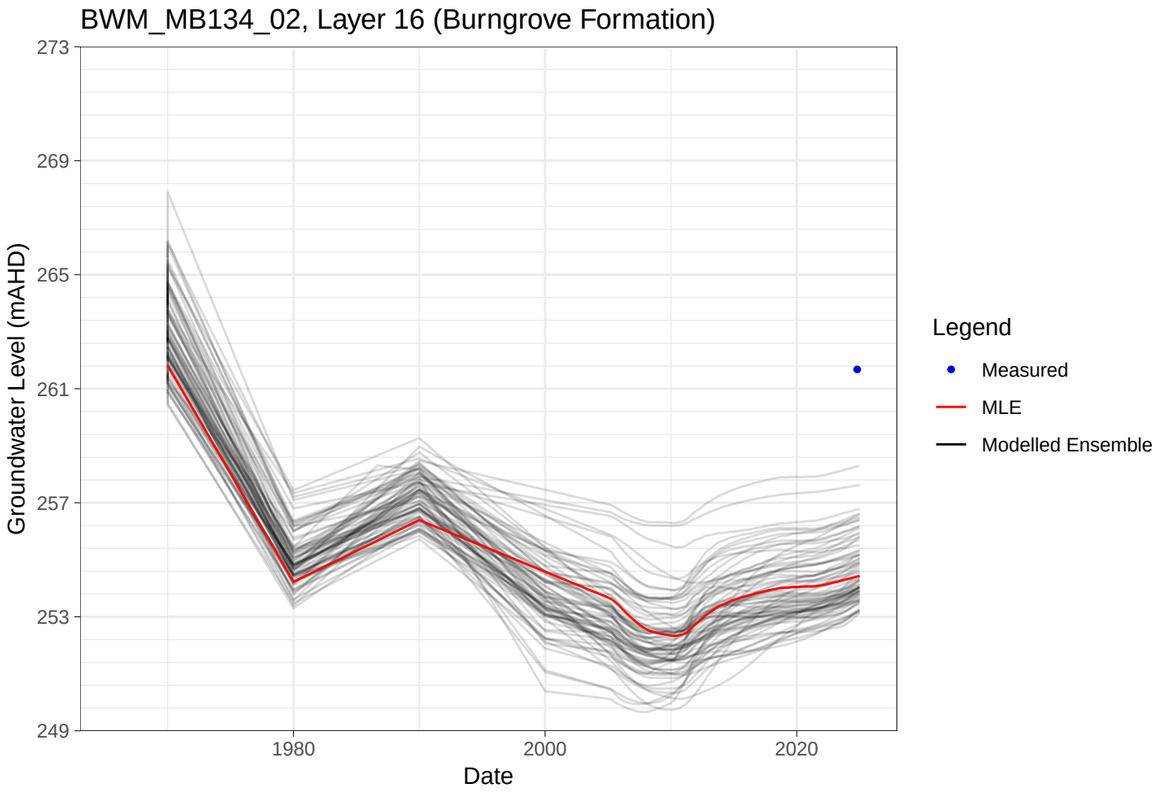

BWM_MB123_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
293
289
285
281
277
273
269
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

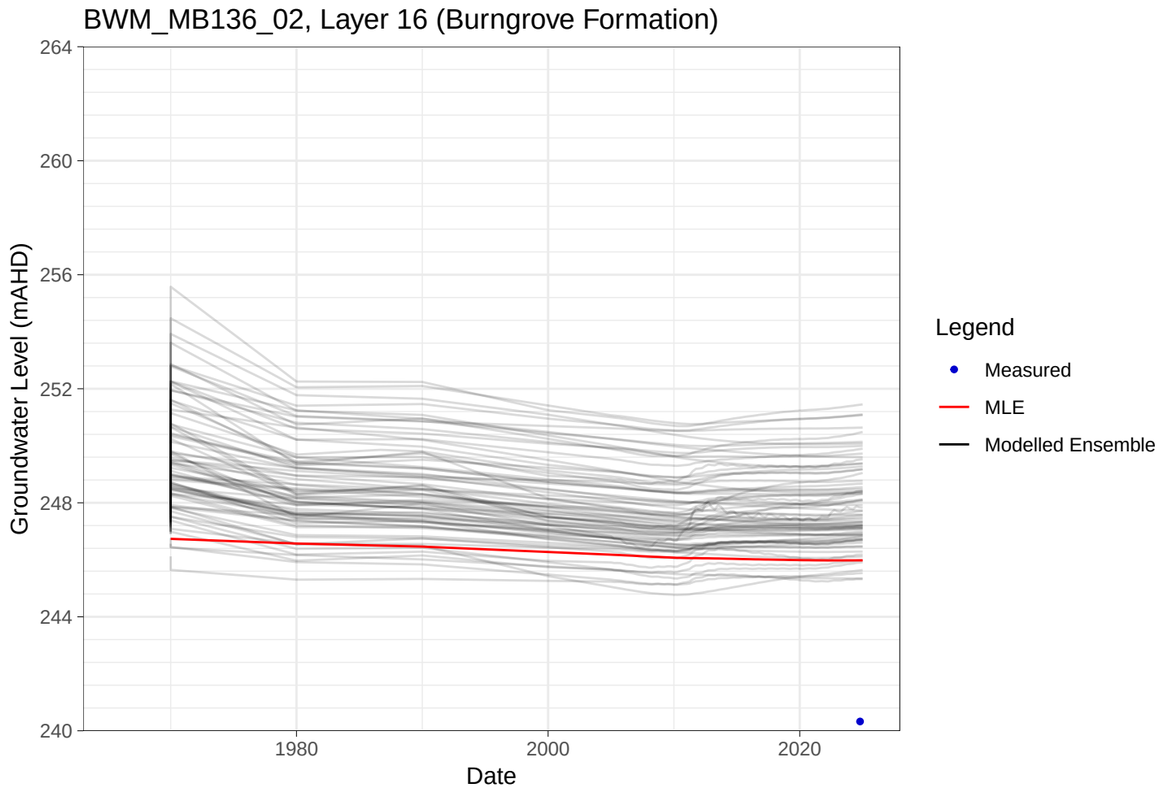

BWM_MB126_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
293
289
285
281
277
273
269
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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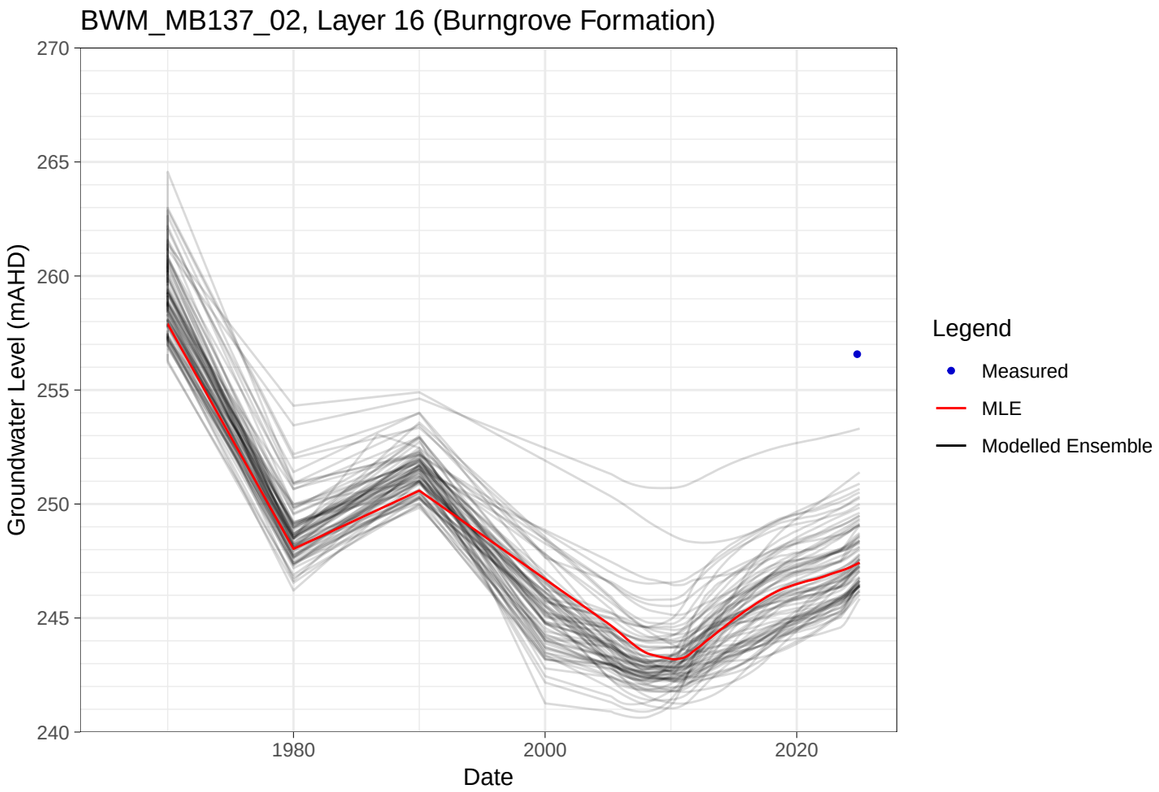

BWM_MB131_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
276
272
268
264
260
256
252
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

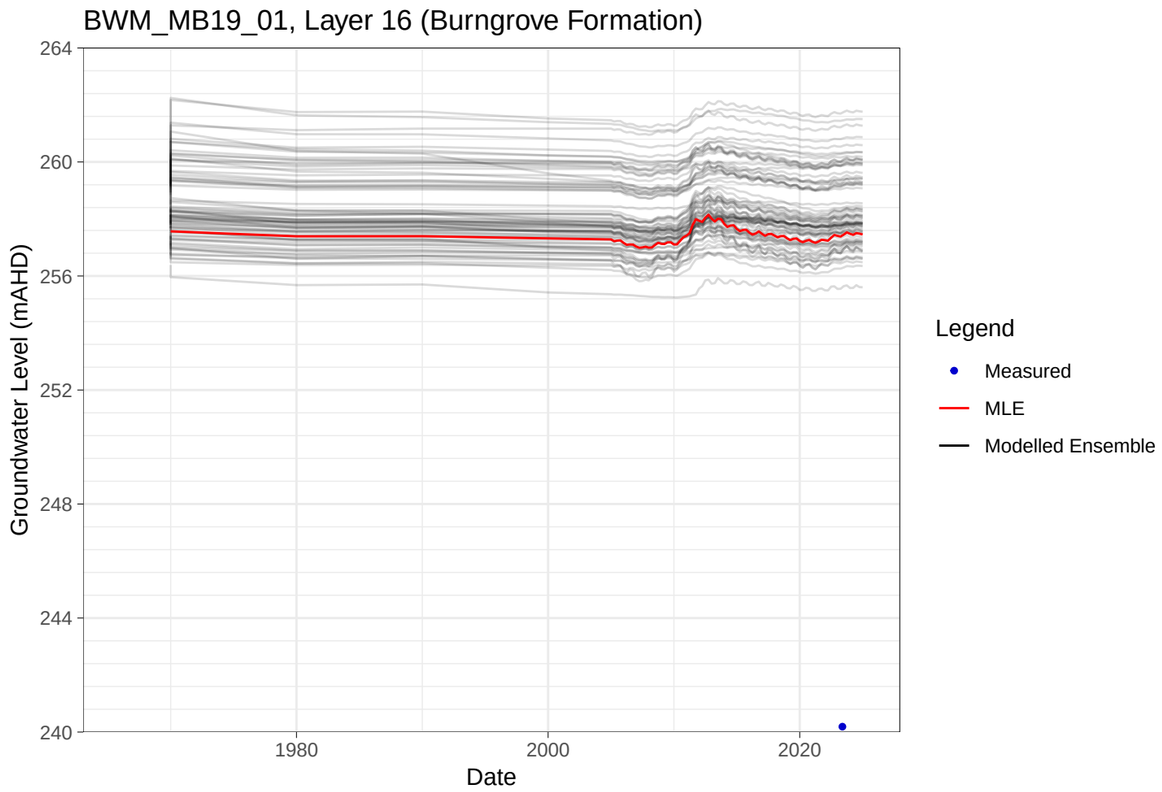

BWM_MB132_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
281
277
273
269
265
261
257
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

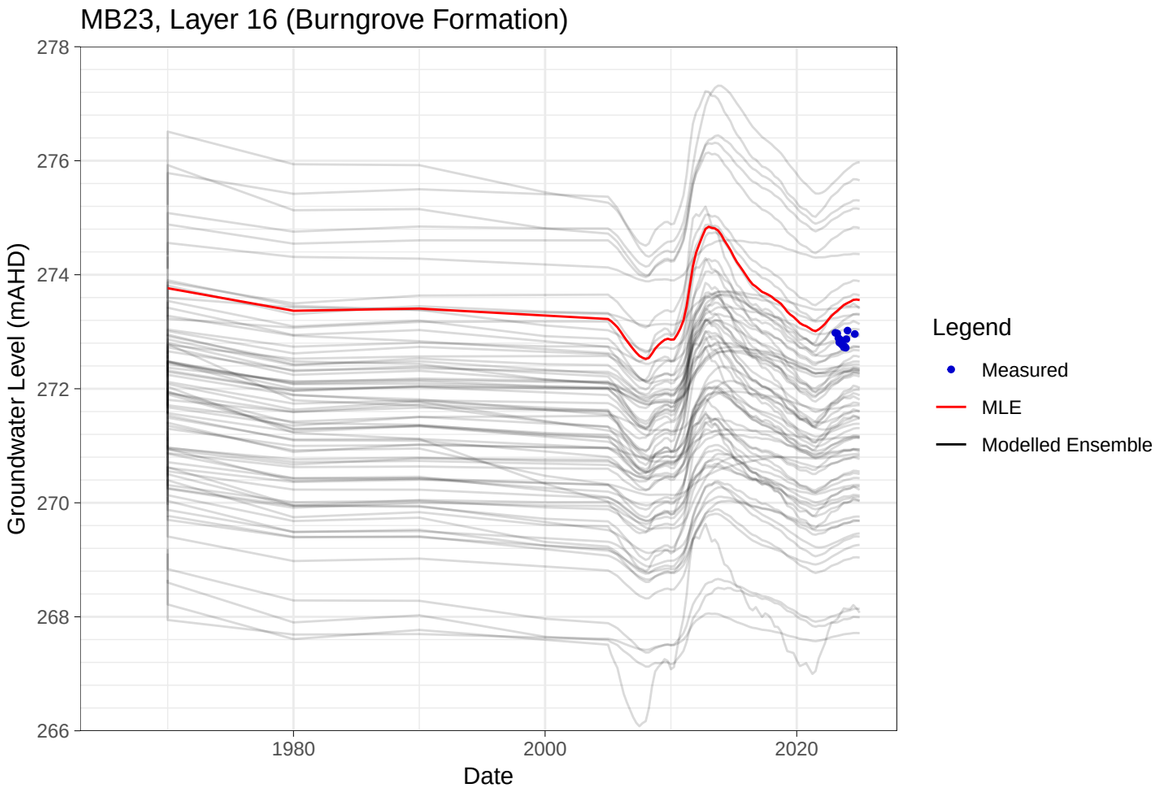

BWM_MB134_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
273
269
265
261
257
253
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

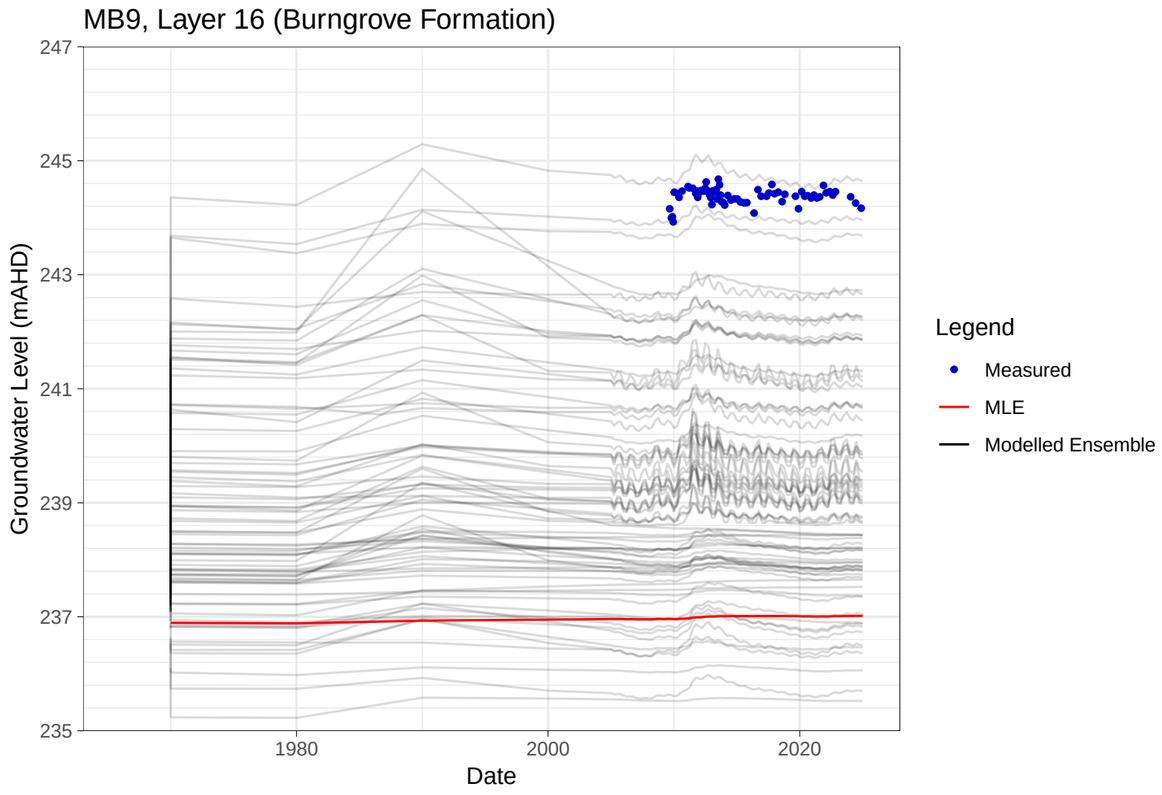

BWM_MB136_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
264
260
256
252
248
244
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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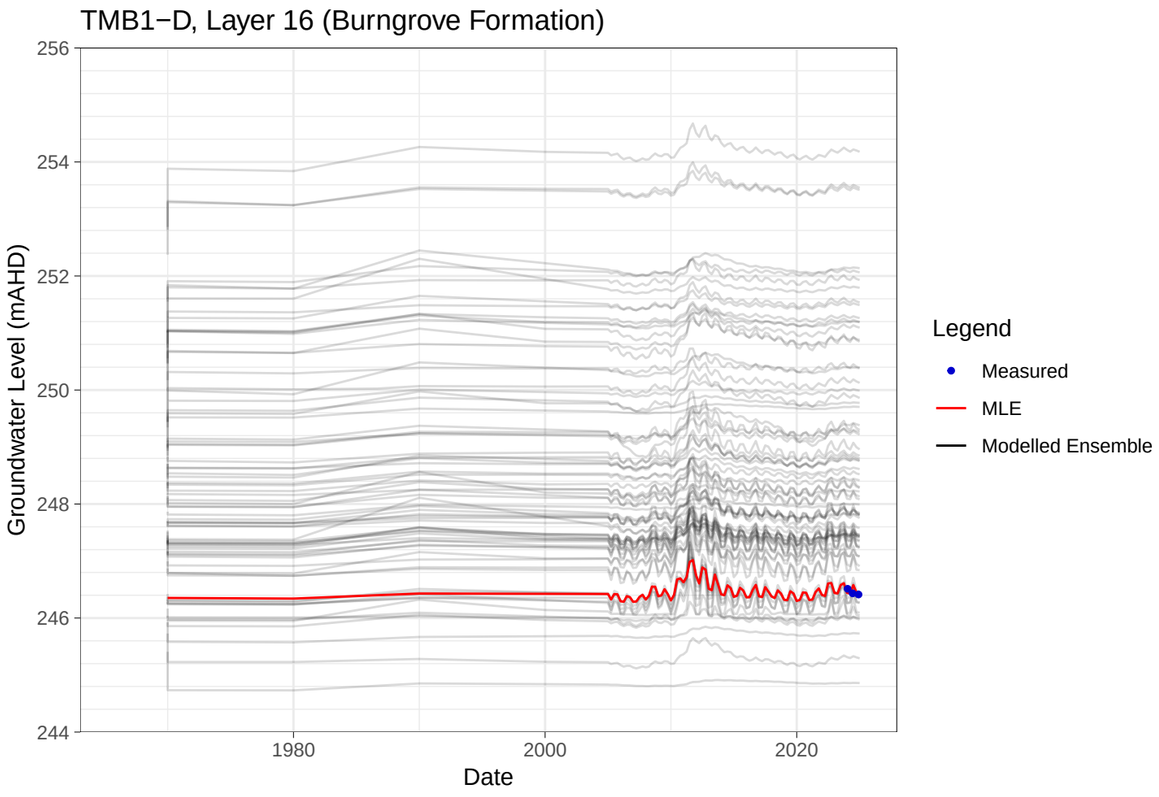

BWM_MB137_02, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
270
265
260
255
250
245
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

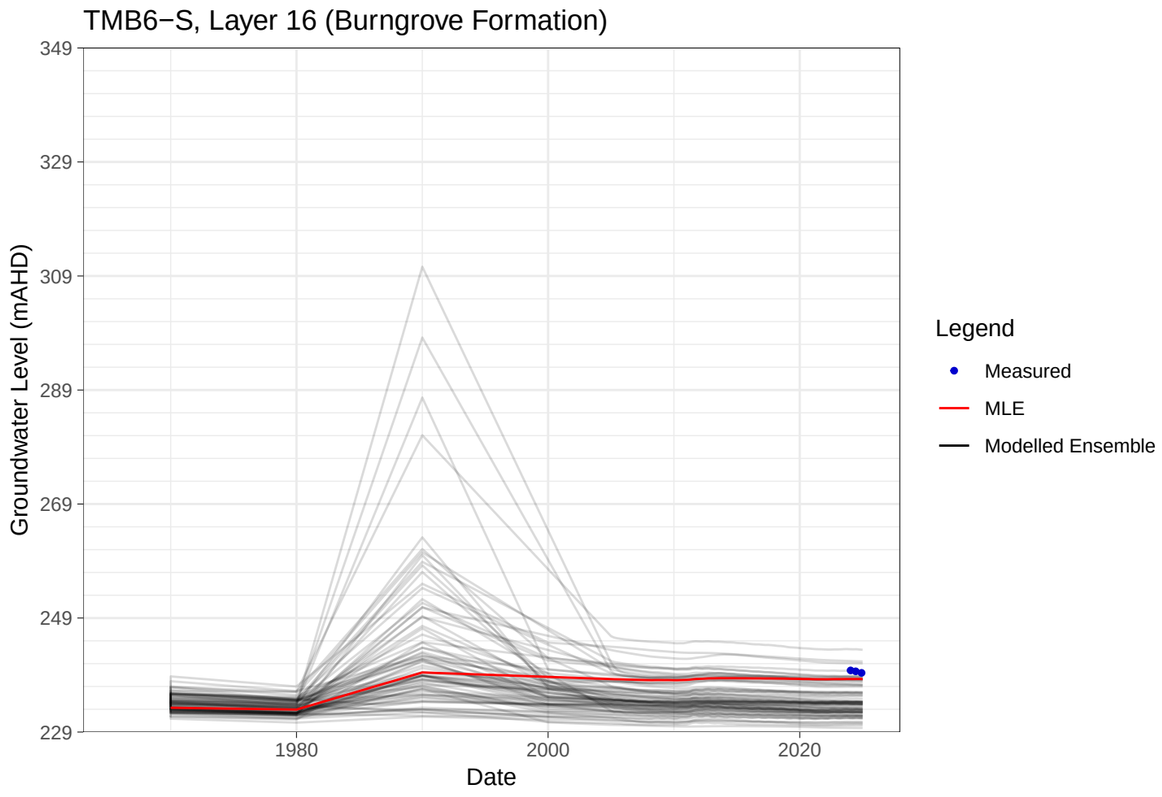

BWM_MB19_01, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
264
260
256
252
248
244
240
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

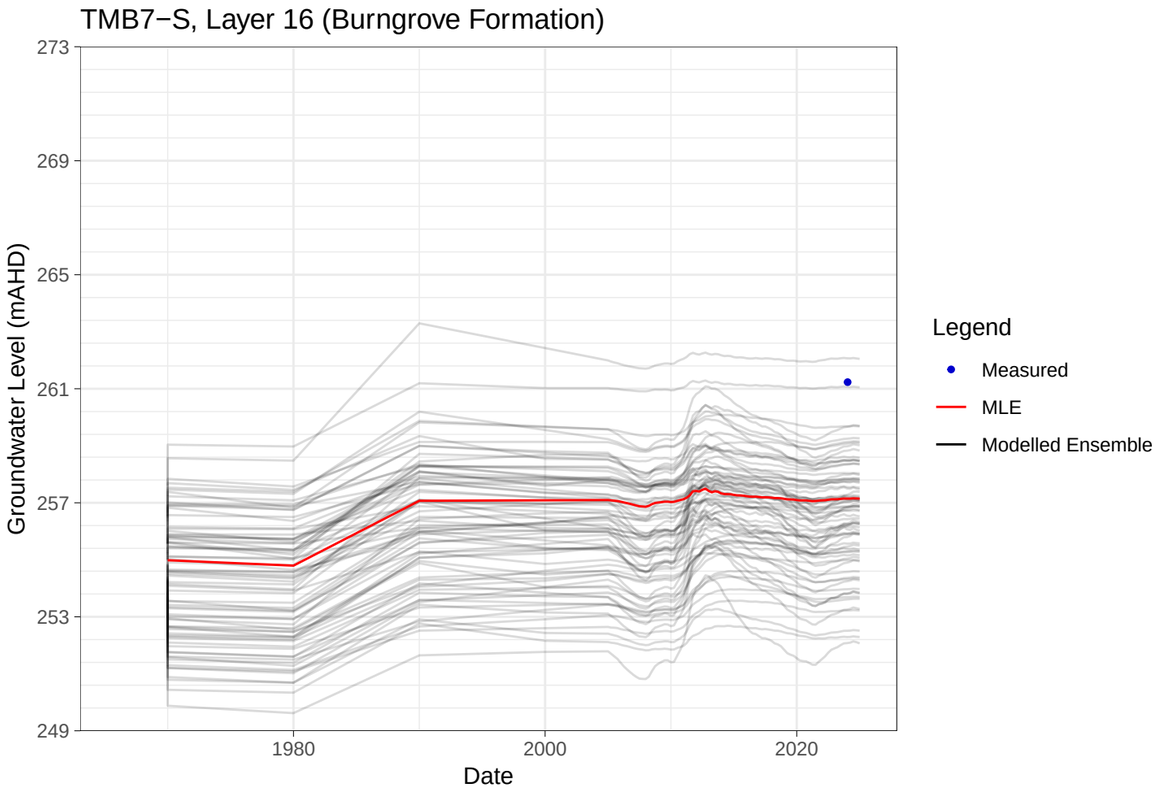

MB23, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
278
276
274
272
270
268
266
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

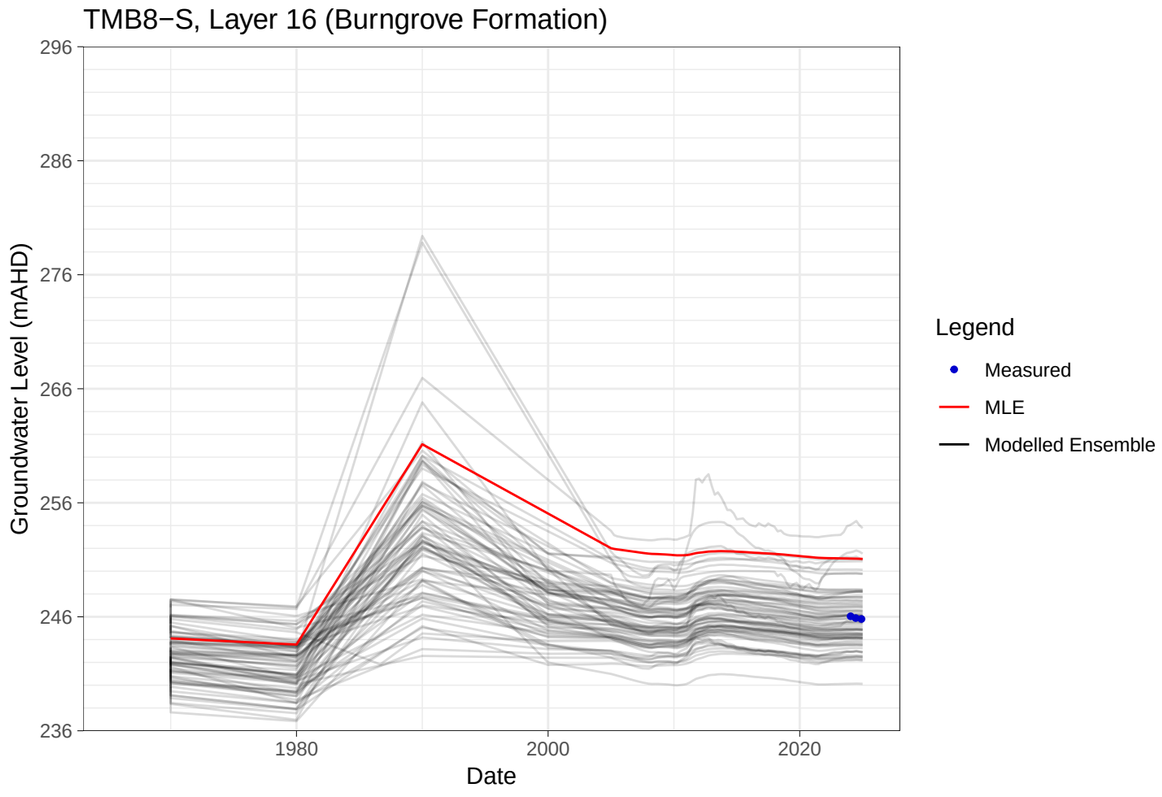

MB9, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
247
245
243
241
239
237
235
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

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TMB1−D, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
256
254
252
250
248
246
244
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB6−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
349
329
309
289
269
249
229
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB7−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
273
269
265
261
257
253
249
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble


TMB8−S, Layer 16 (Burngrove Formation)
Groundwater Level (mAHD)
296
286
276
266
256
246
236
1980
2000
2020
Date
Legend
Measured
MLE
Modelled Ensemble

Appendix C Predictive Period Timing

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

9 April 2026

Interval	Stress Period	Date (from)	Date (to)	Blackwater North (OC)	Blackwater South (OC)	Cook Colliery (UG)
Annually	86	01-01-2025	31-12-2025	x	x	x
Annually	87	01-01-2026	31-12-2026	x	x	x
Annually	88	01-01-2027	31-12-2027	x	x	x
Annually	89	01-01-2028	31-12-2028	x	x	x
Annually	90	01-01-2029	31-12-2029	x	x	x
Annually	91	01-01-2030	31-12-2030	x	x	x
Annually	92	01-01-2031	31-12-2031	x	x	x
Annually	93	01-01-2032	31-12-2032	x	x	x
Annually	94	01-01-2033	31-12-2033	x	x	x
Annually	95	01-01-2034	31-12-2034	x	x	x
Annually	96	01-01-2035	31-12-2035	x	x	x
Annually	97	01-01-2036	31-12-2036	x	x	x
Annually	98	01-01-2037	31-12-2037	x	x	x
Annually	99	01-01-2038	31-12-2038	x	x	x
Annually	100	01-01-2039	31-12-2039	x	x	x
Annually	101	01-01-2040	31-12-2040	x	x	x
Annually	102	01-01-2041	31-12-2041	x	x	x
Annually	103	01-01-2042	31-12-2042	x	x	x
Annually	104	01-01-2043	31-12-2043	x	x	x
Annually	105	01-01-2044	31-12-2044	x	x	x
Annually	106	01-01-2045	31-12-2045	x	x	x
Annually	107	01-01-2046	31-12-2046	x	x	x
Annually	108	01-01-2047	31-12-2047	x	x	x
Annually	109	01-01-2048	31-12-2048	x	x	x
Annually	110	01-01-2049	31-12-2049	x	x	x
Annually	111	01-01-2050	31-12-2050	x	x	x
Annually	112	01-01-2051	31-12-2051	x	x	x
Annually	113	01-01-2052	31-12-2052	x	x	x
Annually	114	01-01-2053	31-12-2053	x	x	x
Annually	115	01-01-2054	31-12-2054	x	x	x
Annually	116	01-01-2055	31-12-2055	x	x	x
Annually	117	01-01-2056	31-12-2056		x	x
Annually	118	01-01-2057	31-12-2057		x	x
Annually	119	01-01-2058	31-12-2058		x	x
Annually	120	01-01-2059	31-12-2059		x	x
Annually	121	01-01-2060	31-12-2060		x	x

Interval	Stress Period	Date (from)	Date (to)	Blackwater North (OC)	Blackwater South (OC)	Cook Colliery (UG)
Annually	122	01-01-2061	31-12-2061		x	x
Annually	123	01-01-2062	31-12-2062		x	x
Annually	124	01-01-2063	31-12-2063		x	x
Annually	125	01-01-2064	31-12-2064		x	x
Annually	126	01-01-2065	31-12-2065		x	x
Annually	127	01-01-2066	31-12-2066		x	x
Annually	128	01-01-2067	31-12-2067		x	x
Annually	129	01-01-2068	31-12-2068		x	x
Annually	130	01-01-2069	31-12-2069		x	x
Annually	131	01-01-2070	31-12-2070		x	x
Annually	132	01-01-2071	31-12-2071		x	x
Annually	133	01-01-2072	31-12-2072		x	x
Annually	134	01-01-2073	31-12-2073		x	x
Annually	135	01-01-2074	31-12-2074		x	x
Annually	136	01-01-2075	31-12-2075		x	x
Annually	137	01-01-2076	31-12-2076		x	x
Annually	138	01-01-2077	31-12-2077		x	x
Annually	139	01-01-2078	31-12-2078		x	
Annually	140	01-01-2079	31-12-2079		x	
Annually	141	01-01-2080	31-12-2080		x	
Annually	142	01-01-2081	31-12-2081		x	
Annually	143	01-01-2082	31-12-2082		x	
Annually	144	01-01-2083	31-12-2083		x	
Annually	145	01-01-2084	31-12-2084		x	
Annually	146	01-01-2085	31-12-2085		x	
Annually	147	01-01-2086	31-12-2086		x	
Annually	148	01-01-2087	31-12-2087		x	
Annually	149	01-01-2088	31-12-2088		x	
Annually	150	01-01-2089	31-12-2089		x	
Annually	151	01-01-2090	31-12-2090		x	
Annually	152	01-01-2091	31-12-2091		x	
Annually	153	01-01-2092	31-12-2092		x	
Annually	154	01-01-2093	31-12-2093		x	

Appendix D Sensitivity Analysis Plots

Blackwater North Extension Project

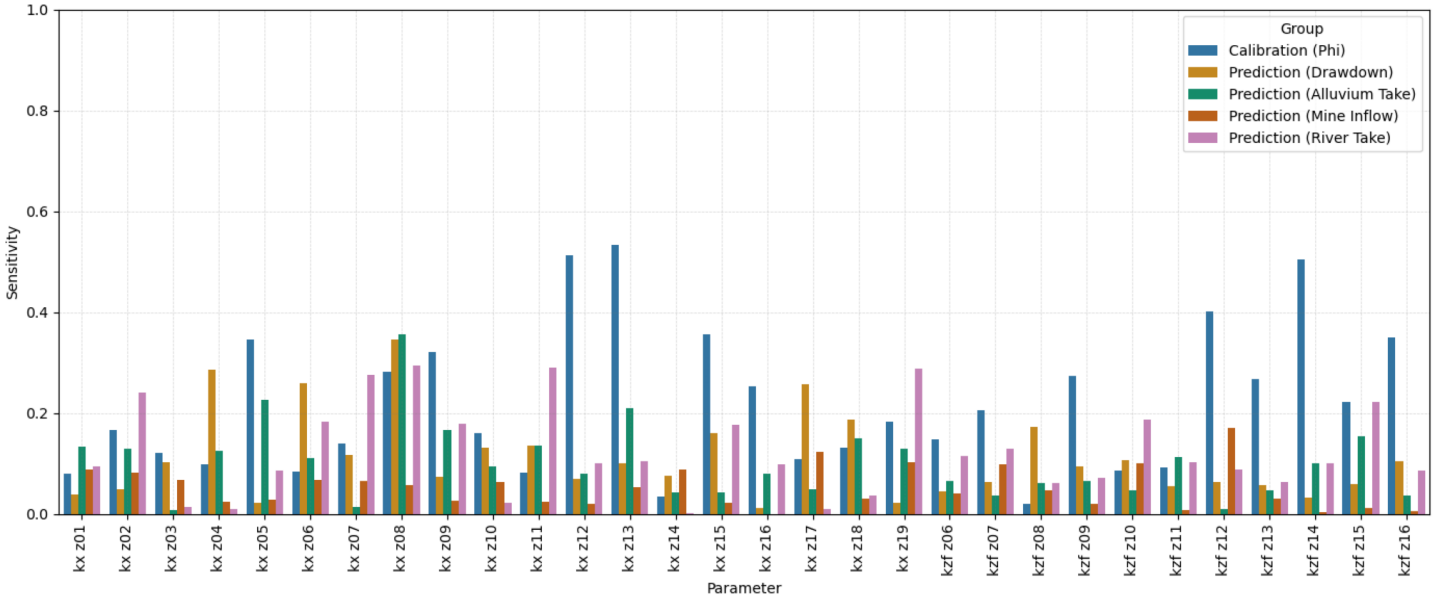
Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

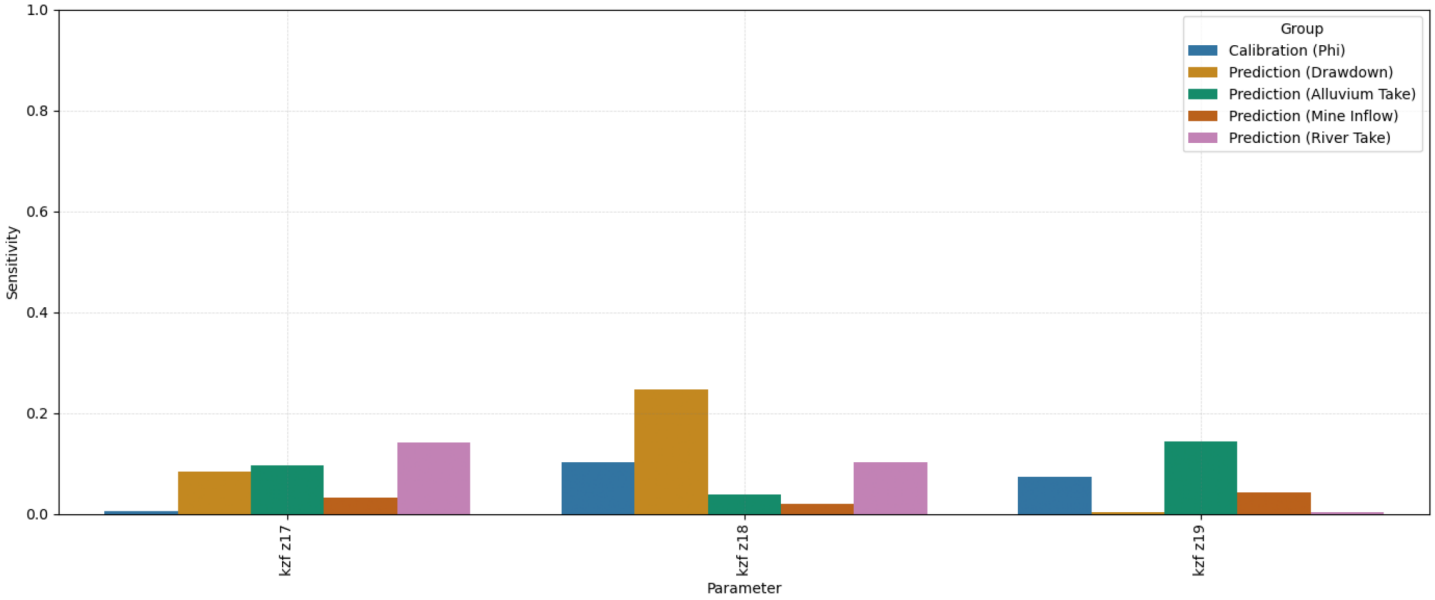
SLR Project No.: 640.031809.00001

9 April 2026

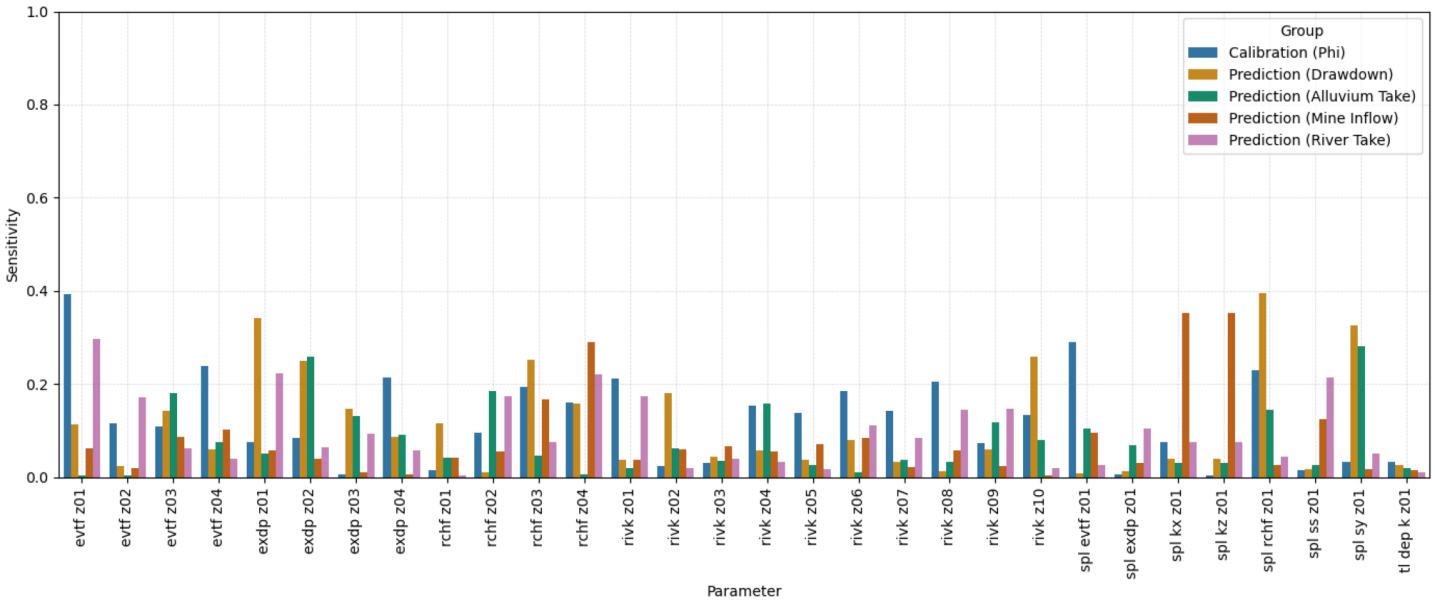
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



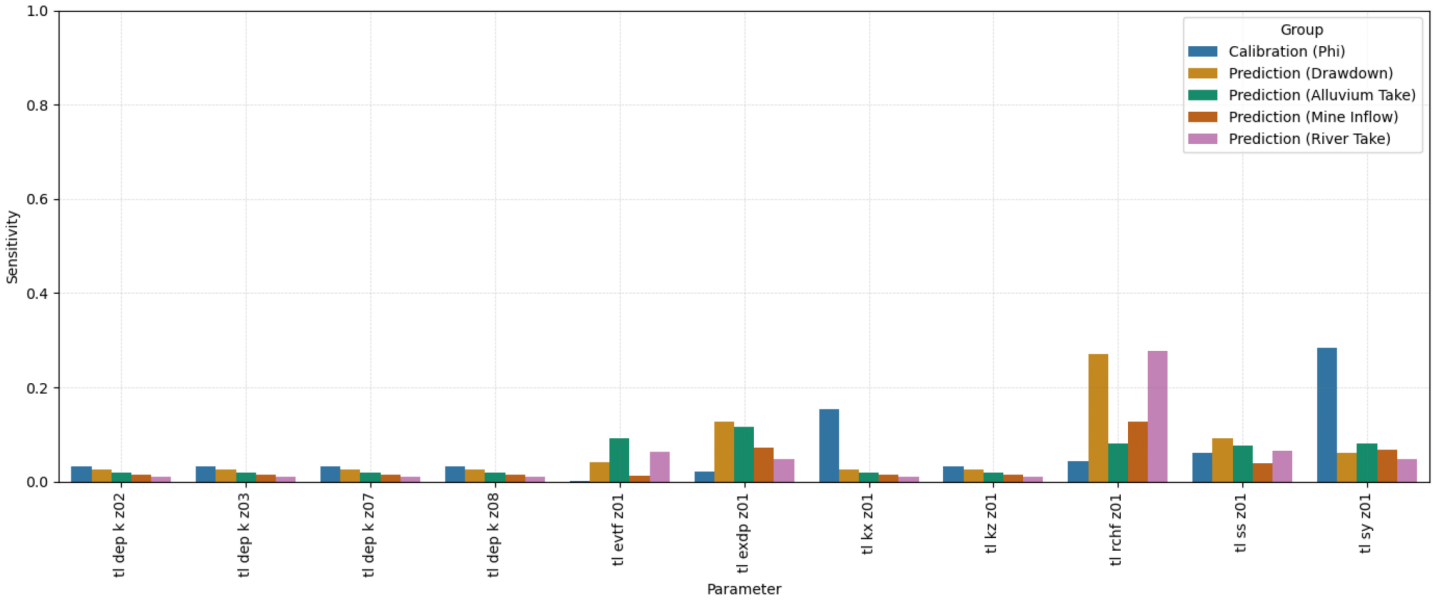
Linear Regression Sensitivity Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



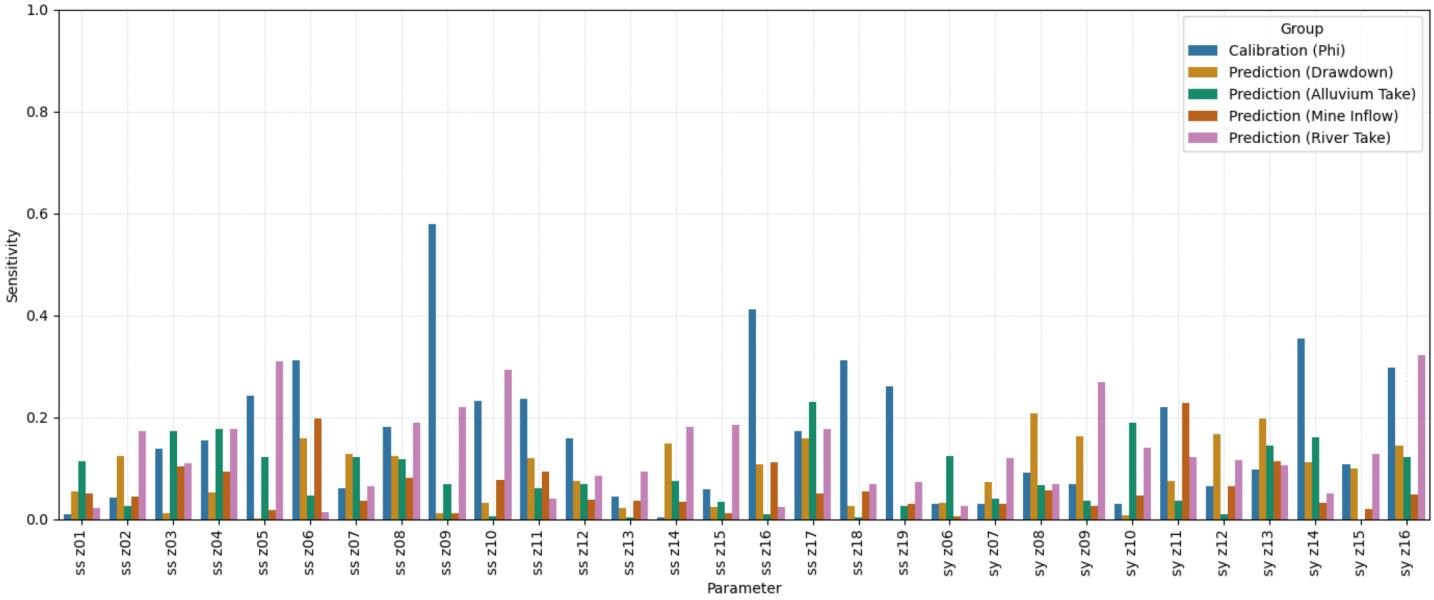
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



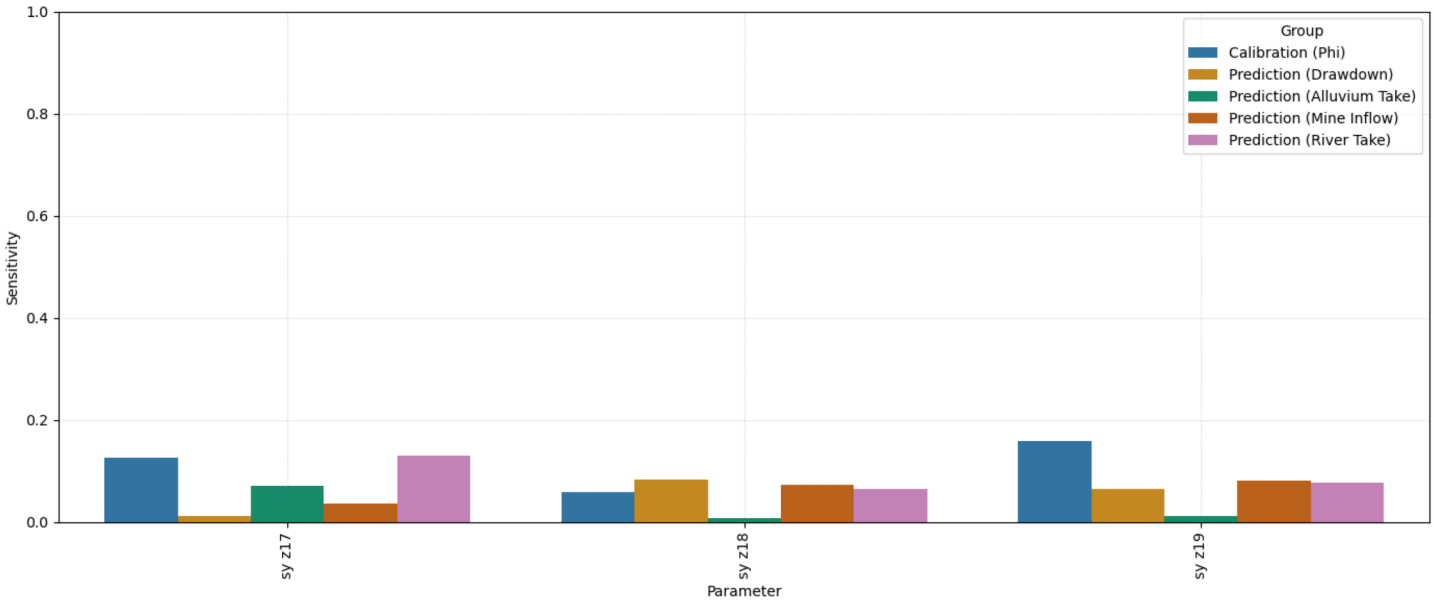
Linear Regression Sensitivity Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



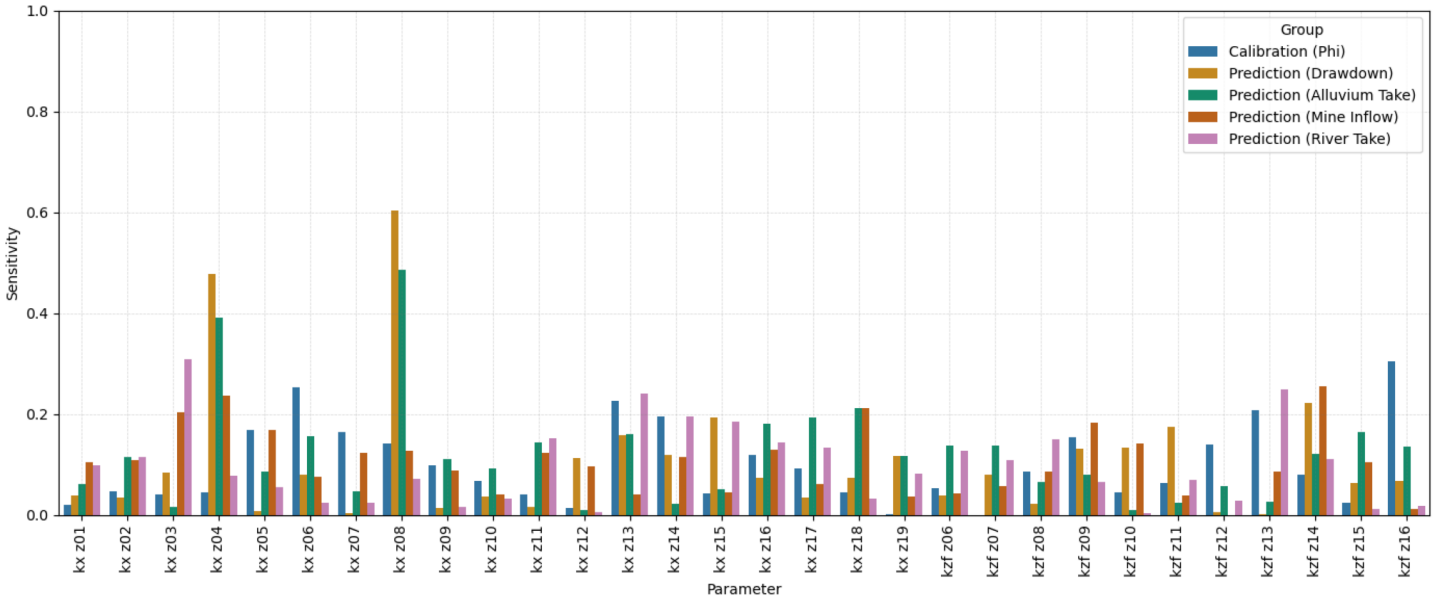
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure1



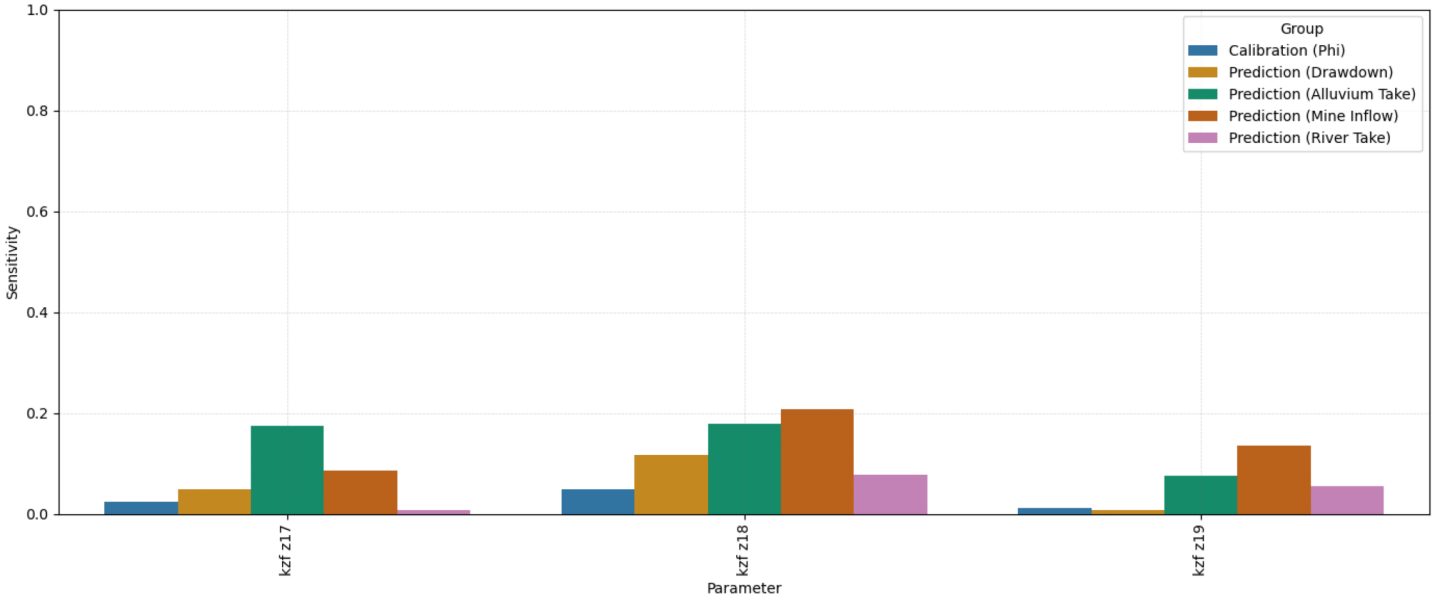
Linear Regression Sensitivity Coefficient (Absolute Value)_Storage Parameters_Figure2



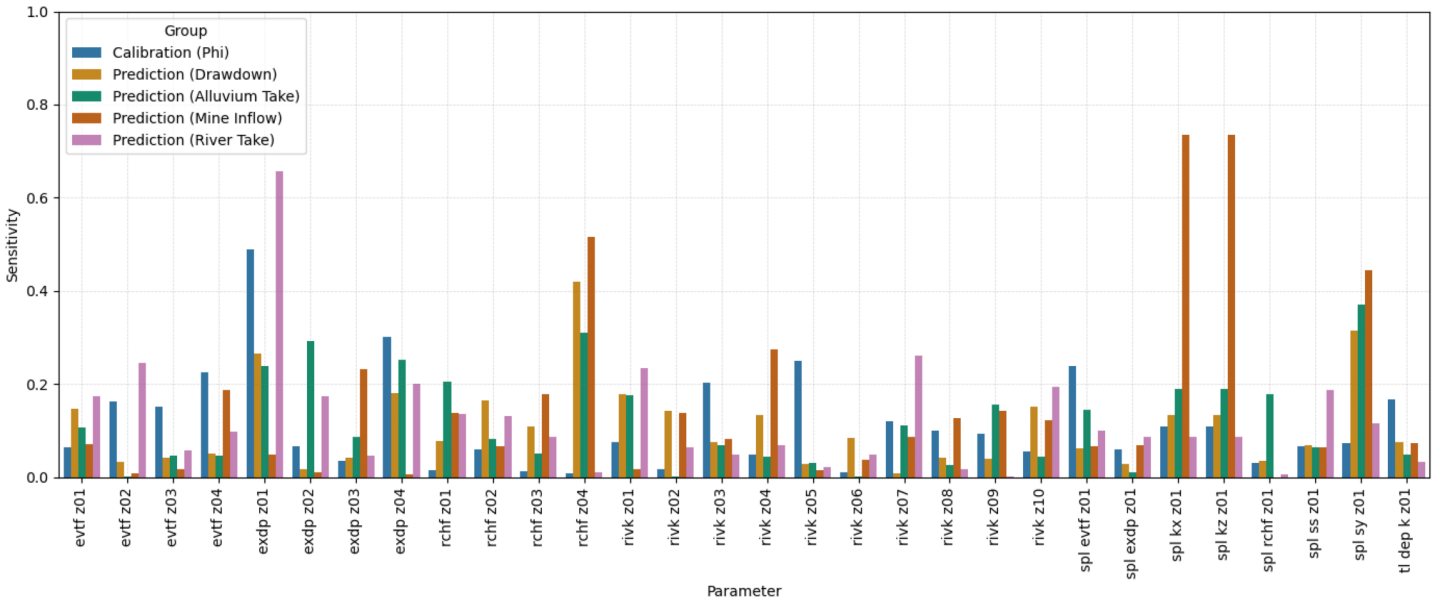
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure1



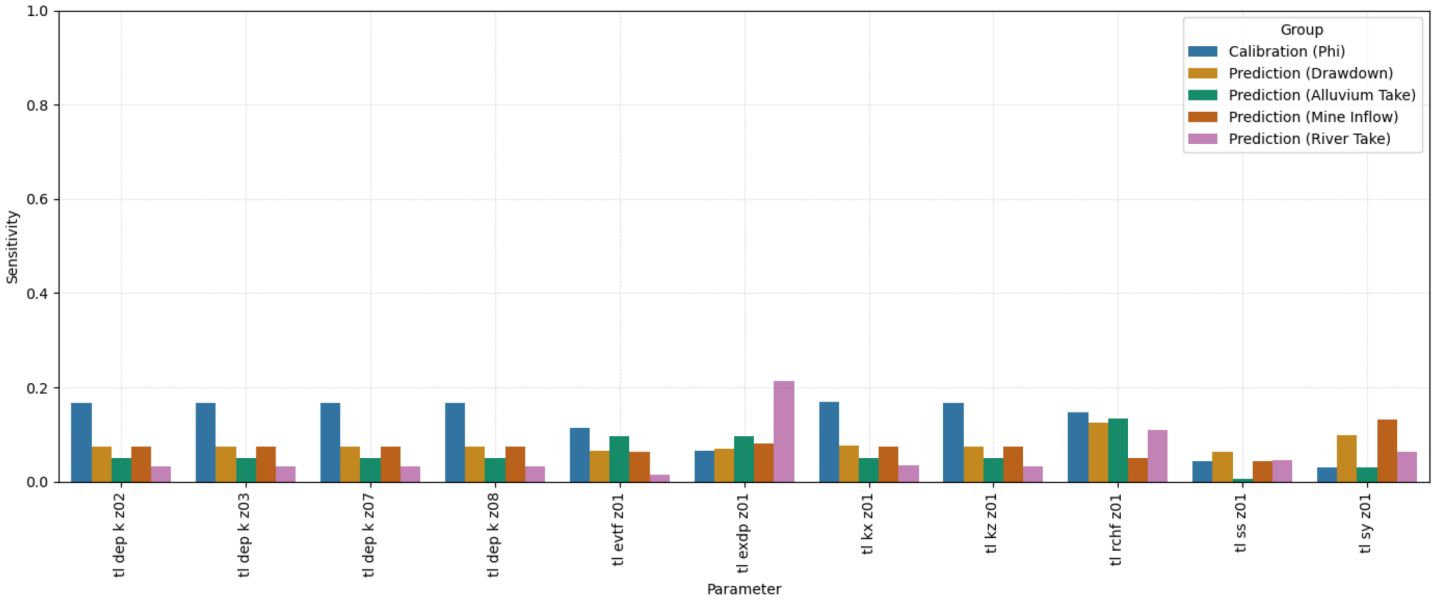
Spearman Rank Correlation Coefficient (Absolute Value)_Hydraulic Conductivity_Figure2



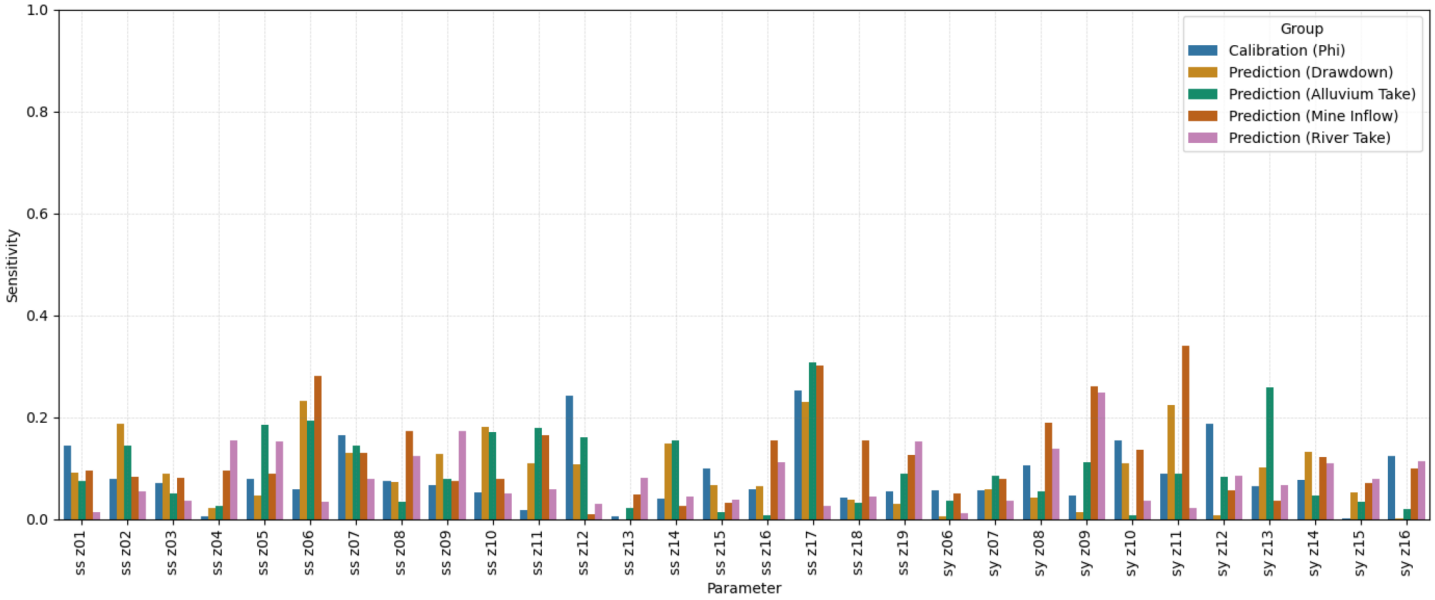
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure1



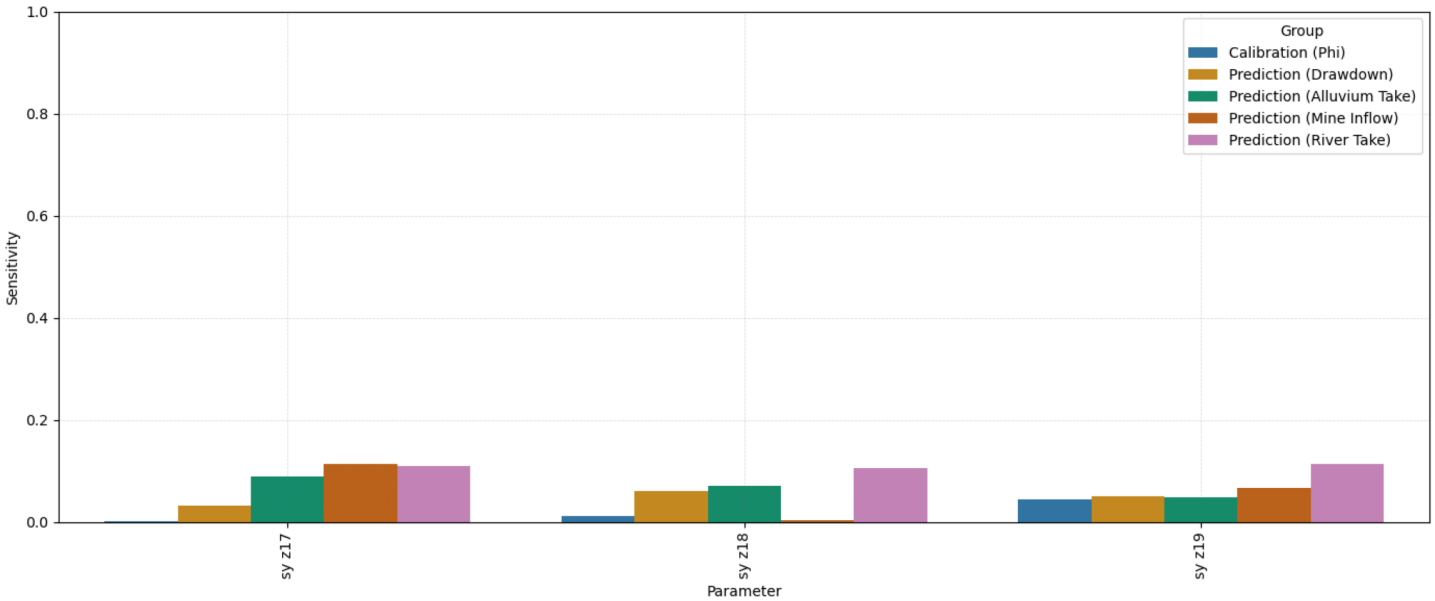
Spearman Rank Correlation Coefficient (Absolute Value)_Boundary Conditions and Spoil_Figure2



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure1



Spearman Rank Correlation Coefficient (Absolute Value)_Storage Parameters_Figure2



Appendix E Parameter Distribution Plots for Sampled Prior and Calibrated Ensemble

Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

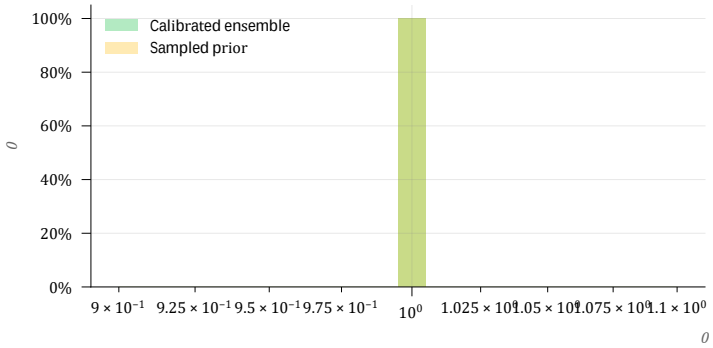
9 April 2026


evtf_z01
evtf_z02
evtf_z03
evtf_z04
exdp_z01
exdp_z02
exdp_z03
exdp_z04
kx_z01
kx_z02
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Sampled prior
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Parameters

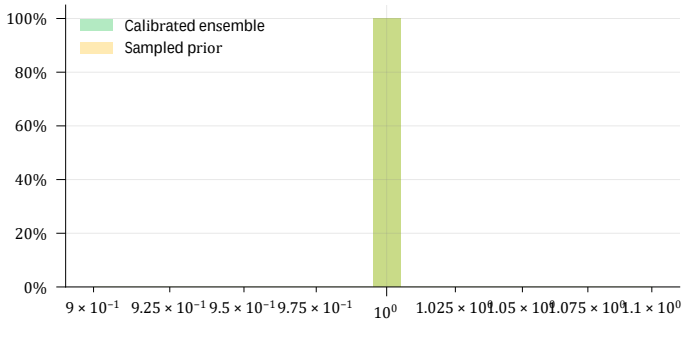

kx_z03
kx_z04
kx_z05
kx_z06
kx_z07
kx_z08
kx_z09
kx_z10
kx_z11
kx_z12
Calibrated ensemble
Sampled prior
0
Parameters


kx_z13
kx_z14
kx_z15
kx_z16
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Calibrated ensemble
Sampled prior
Parameters

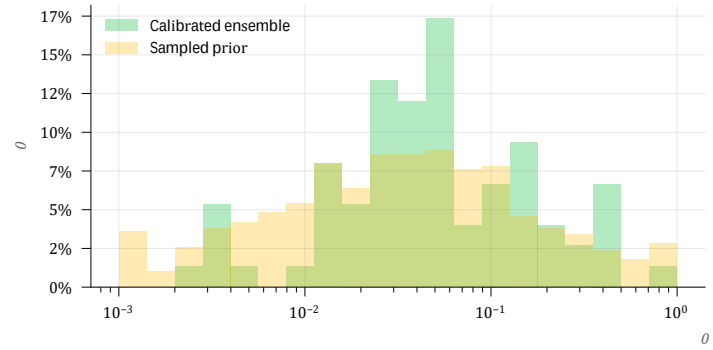
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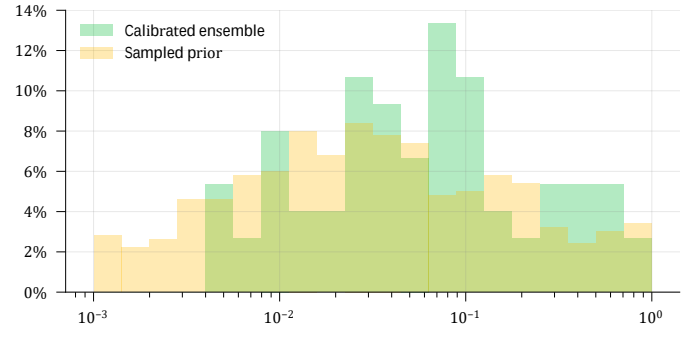
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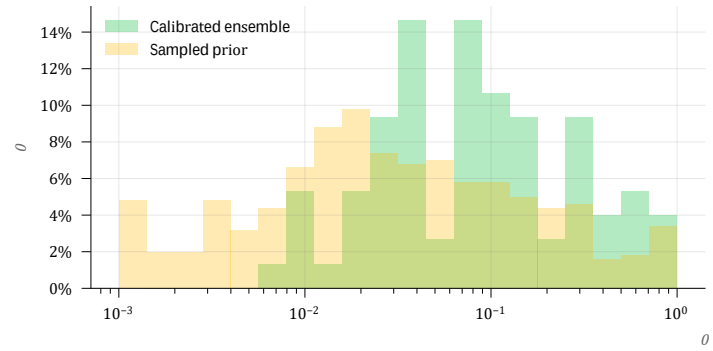
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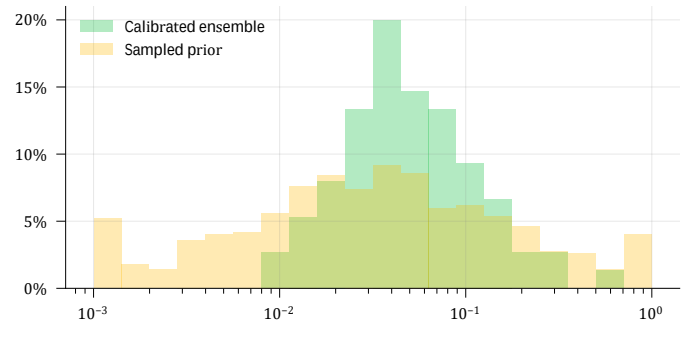
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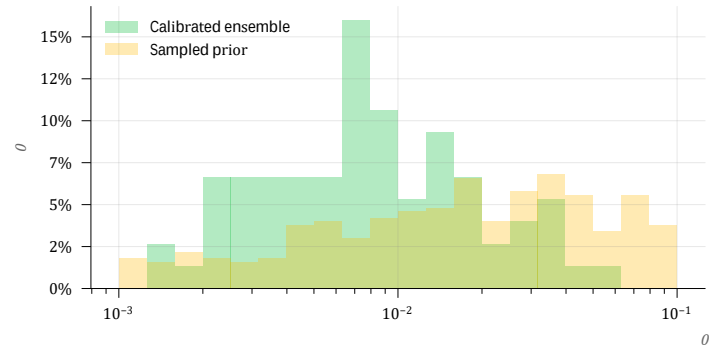
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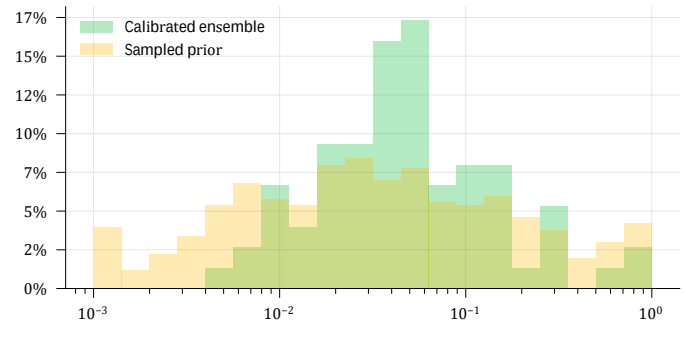
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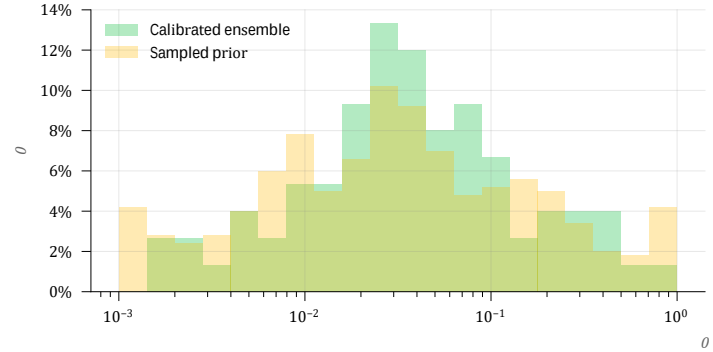
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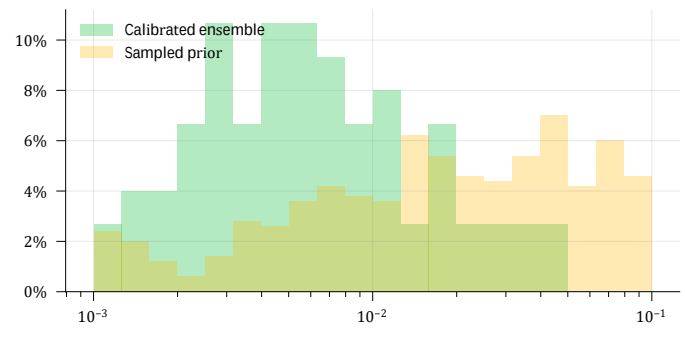
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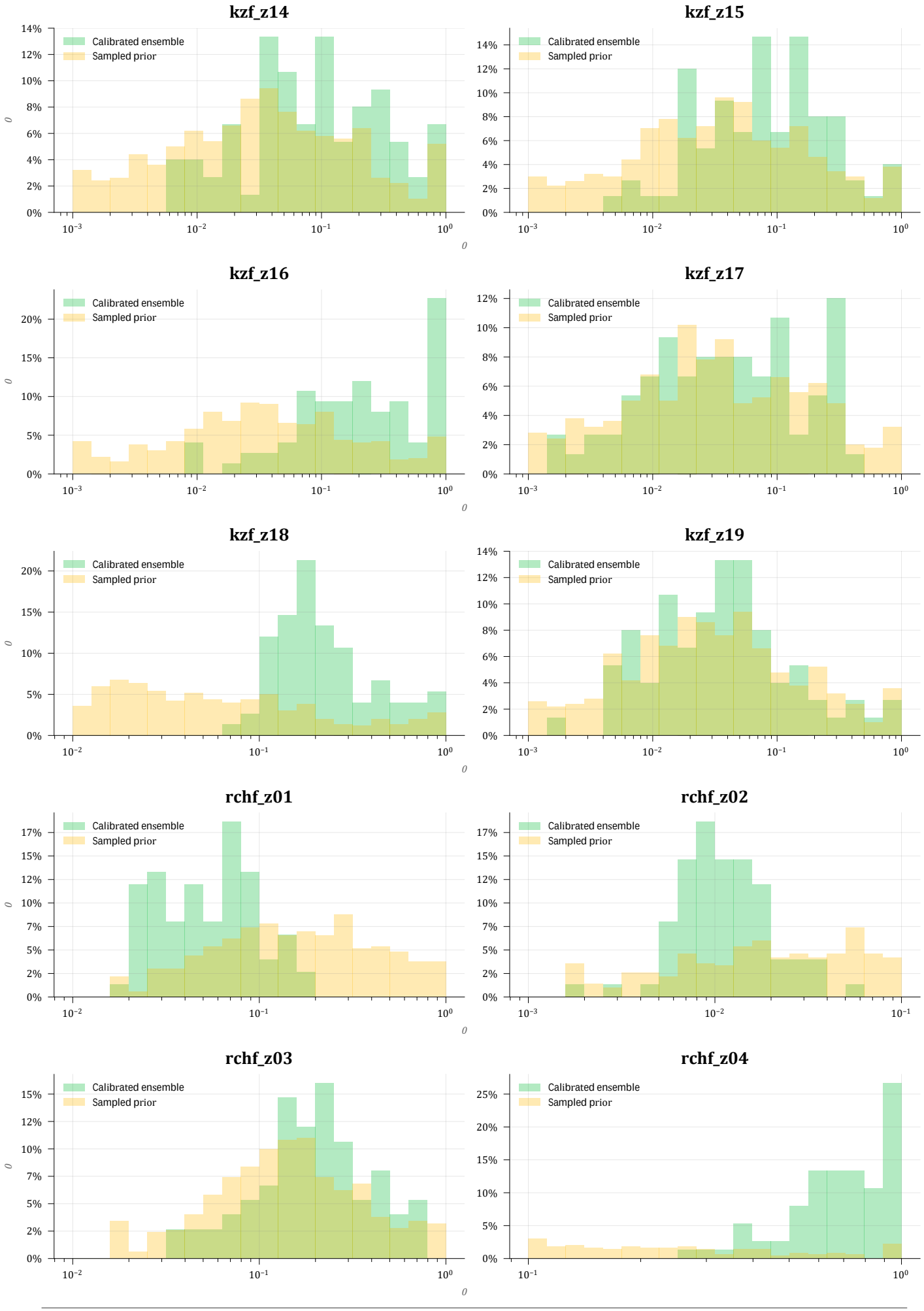


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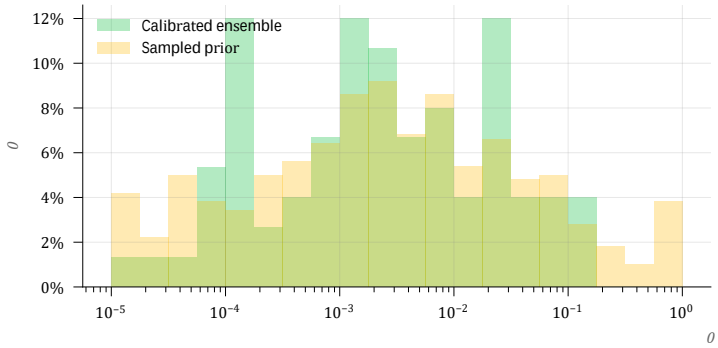


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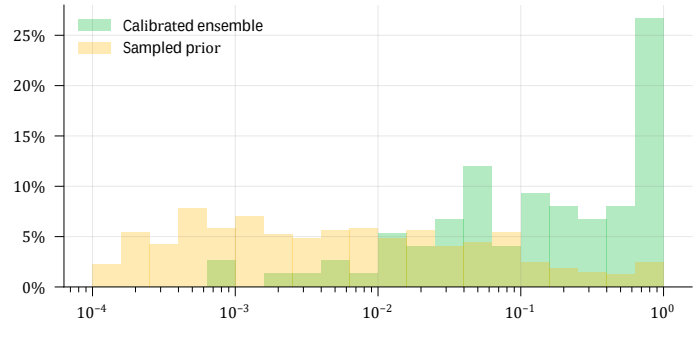



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rchf_z04
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Sampled prior
Parameters

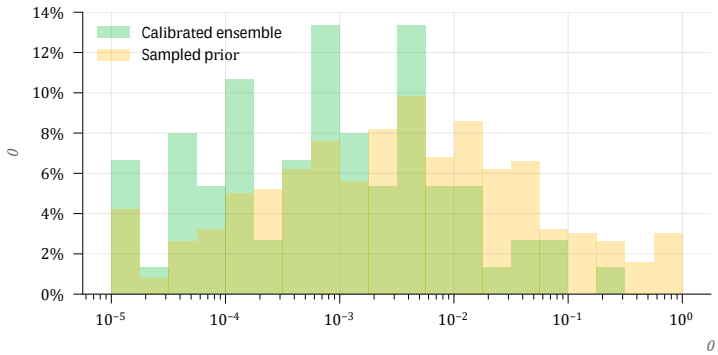
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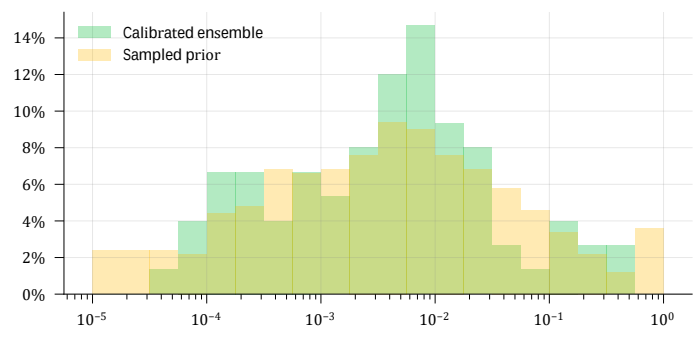
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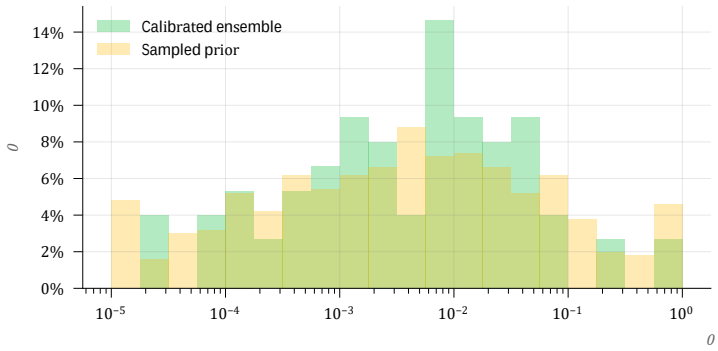
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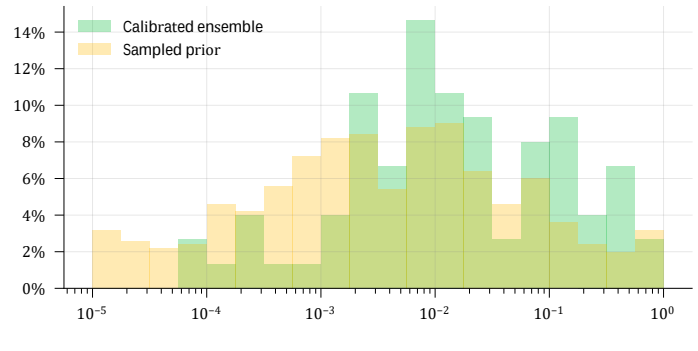
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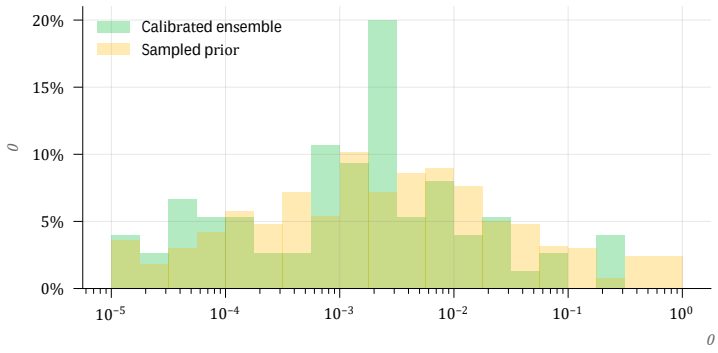
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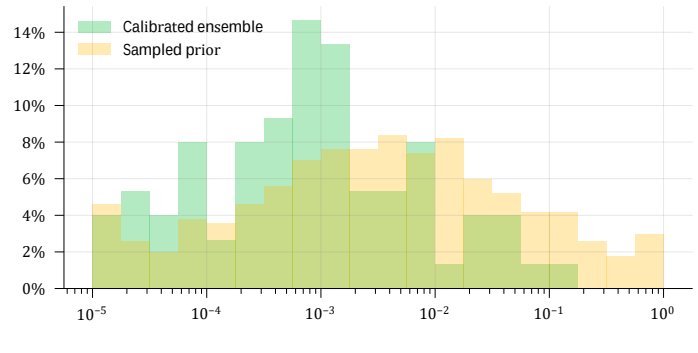
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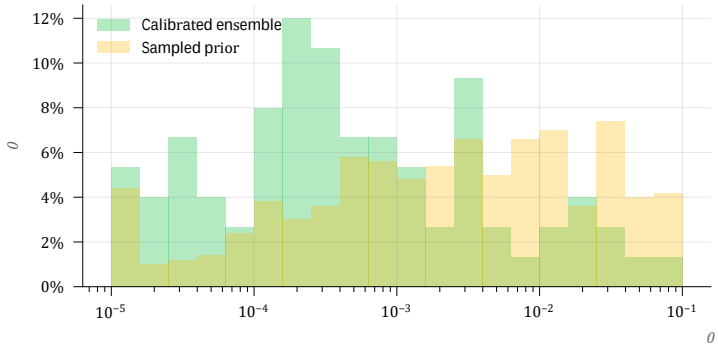
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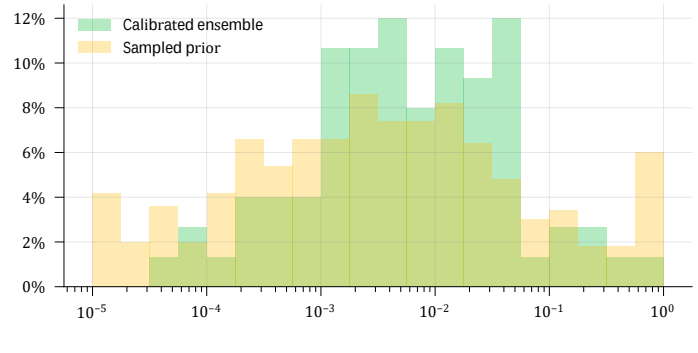
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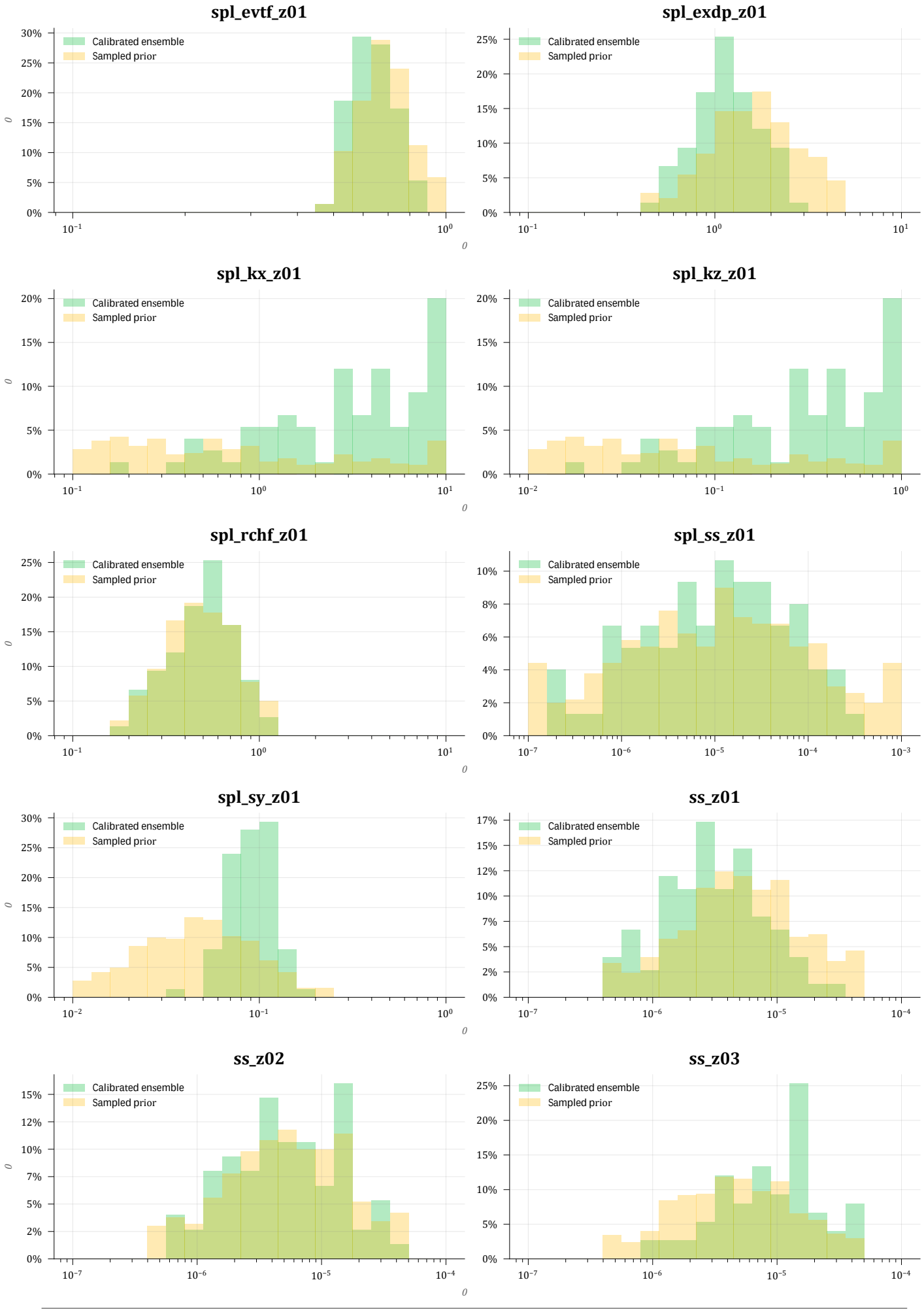


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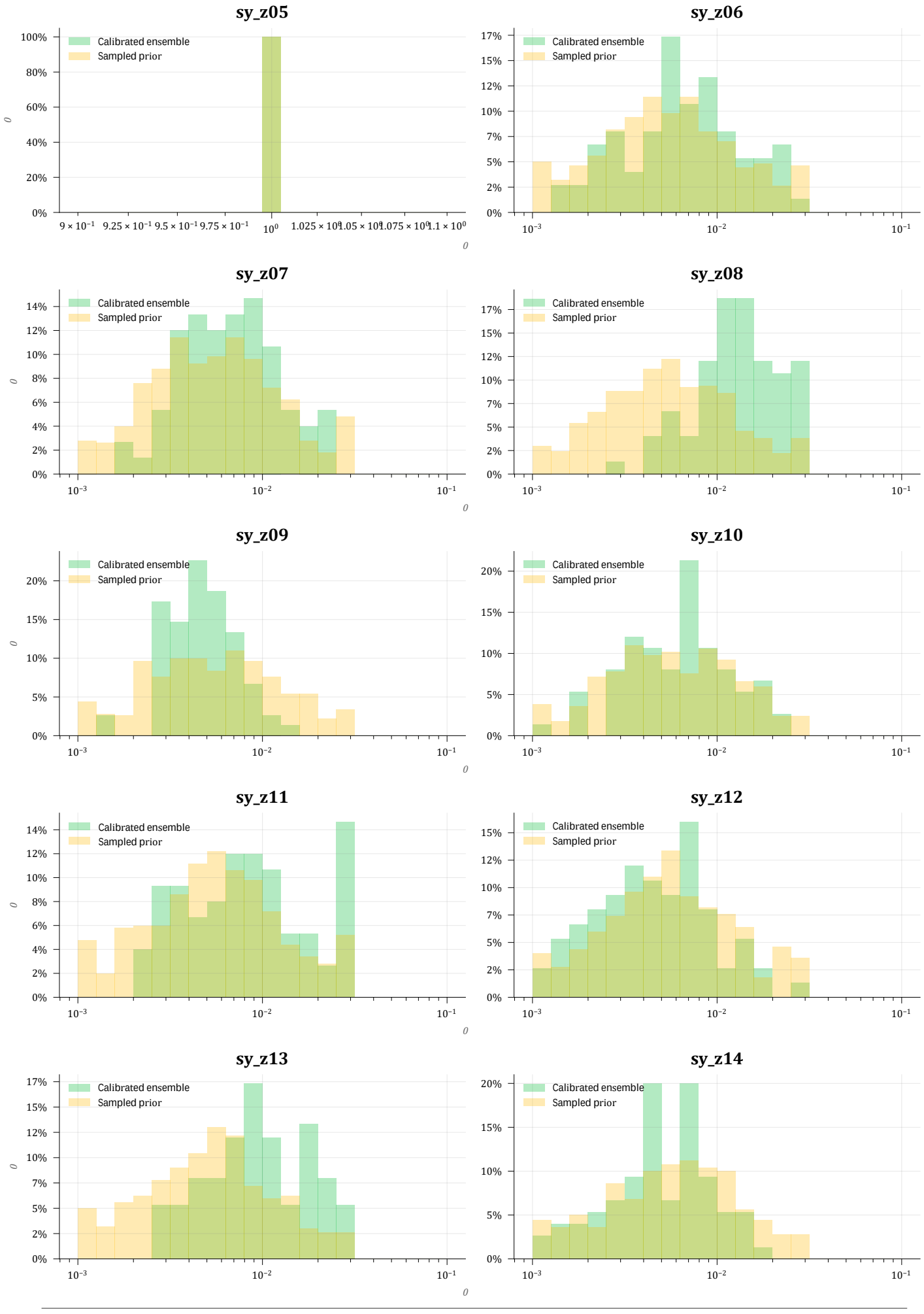
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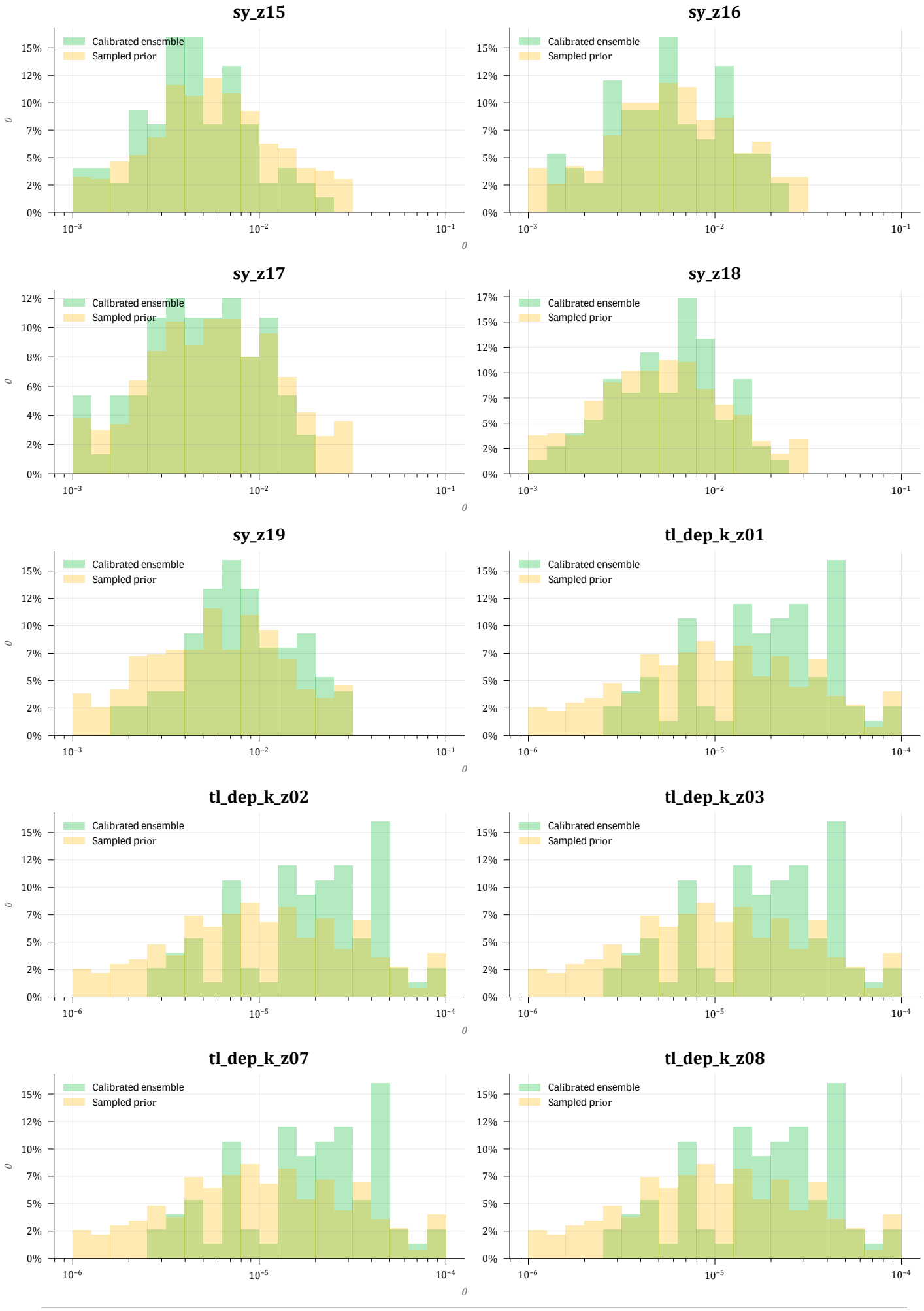


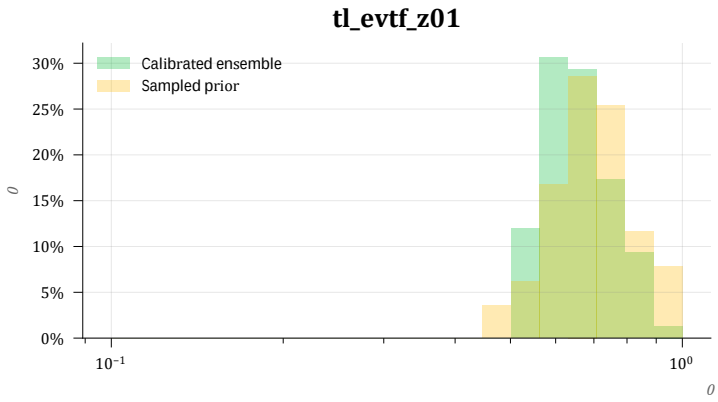

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ss_z02
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Sampled prior
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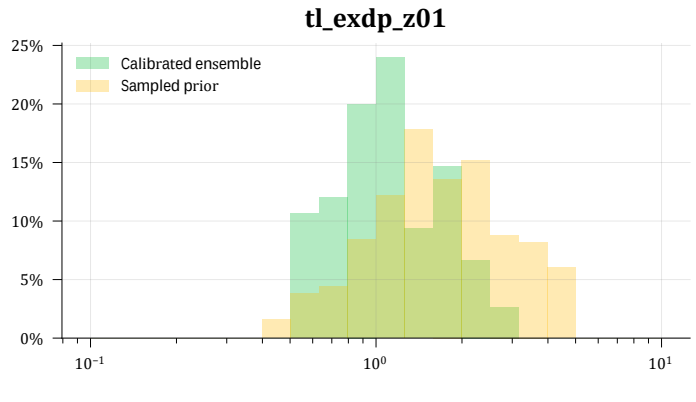

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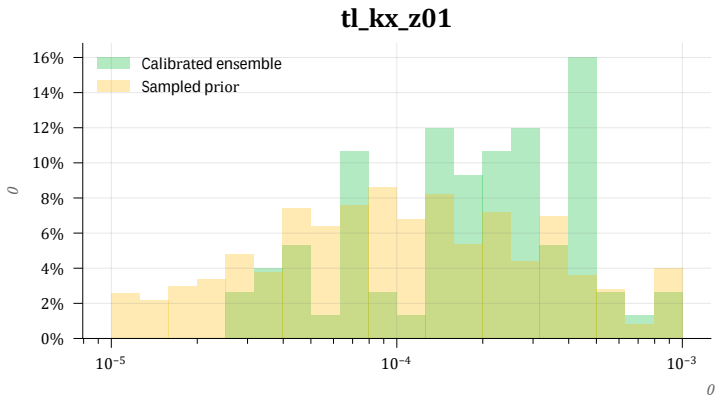

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ss_z19
sy_z01
sy_z02
sy_z03
sy_z04
Calibrated ensemble
Sampled prior
Parameters

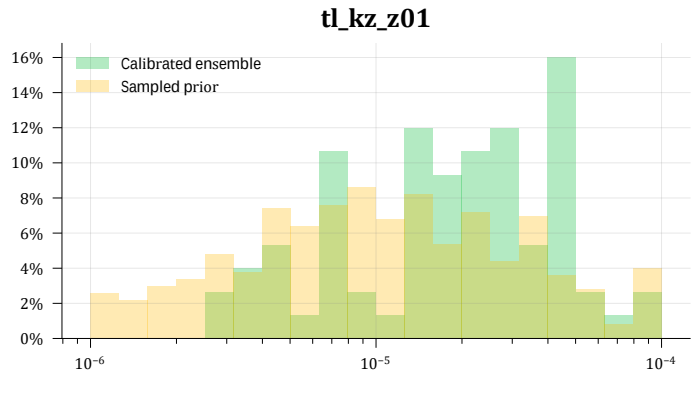

sy_z05
sy_z06
sy_z07
sy_z08
sy_z09
sy_z10
sy_z11
sy_z12
sy_z13
sy_z14
Calibrated ensemble
Sampled prior
Parameters

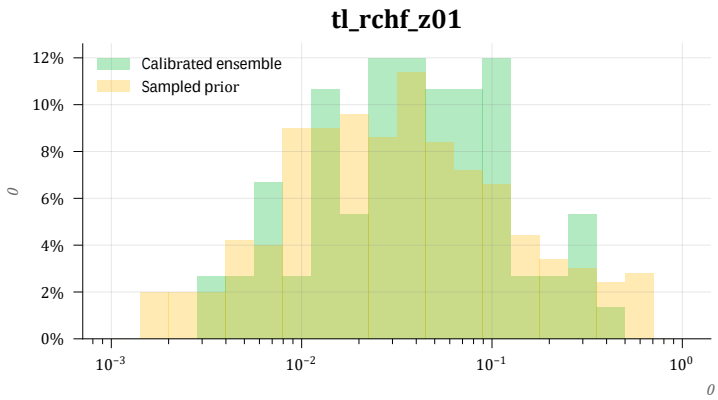

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sy_z16
sy_z17
sy_z18
sy_z19
tl_dep_k_z01
tl_dep_k_z02
tl_dep_k_z03
tl_dep_k_z07
tl_dep_k_z08
Calibrated ensemble
Sampled prior
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Parameters

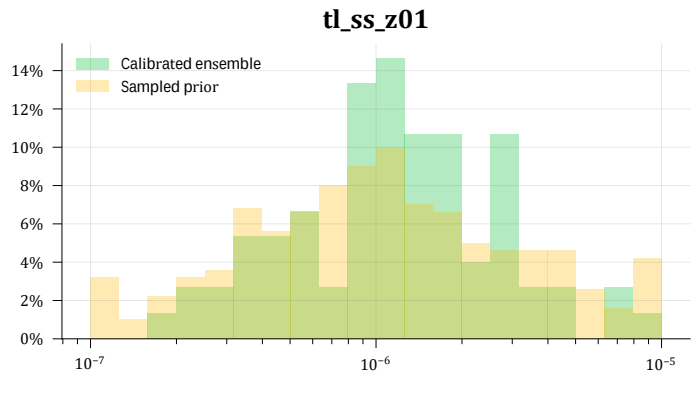

tl_evtf_z01
Calibrated ensemble
Sampled prior
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25%
20%
15%
10%
5%
0%
0
10^{-1}
10^{0}
0

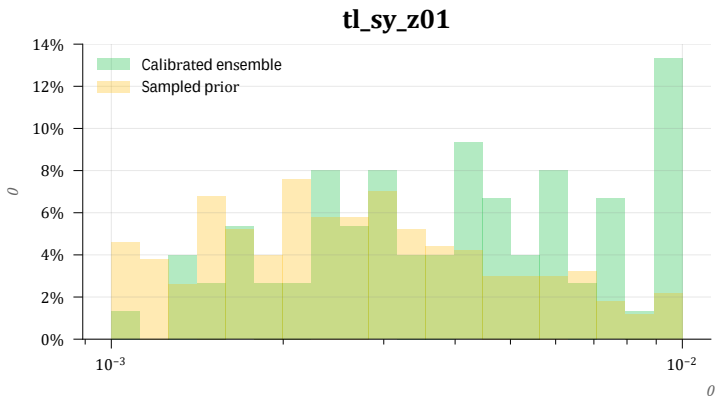

tl_exdp_z01
Calibrated ensemble
Sampled prior
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20%
15%
10%
5%
0%
10^{-1}
10^{0}
10^{1}


tl_kx_z01
Calibrated ensemble
Sampled prior
16%
14%
12%
10%
8%
6%
4%
2%
0%
0
10^{-5}
10^{-4}
10^{-3}
0


tl_kz_z01
Calibrated ensemble
Sampled prior
16%
14%
12%
10%
8%
6%
4%
2%
0%
10^{-6}
10^{-5}
10^{-4}


tl_rchf_z01
Calibrated ensemble
Sampled prior
12%
10%
8%
6%
4%
2%
0%
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
0


tl_ss_z01
Calibrated ensemble
Sampled prior
14%
12%
10%
8%
6%
4%
2%
0%
10^{-7}
10^{-6}
10^{-5}


tl_sy_z01
Calibrated ensemble
Sampled prior
14%
12%
10%
8%
6%
4%
2%
0%
0
10^{-3}
10^{-2}
0

Appendix F Uncertainty in 1 m Drawdown Contours

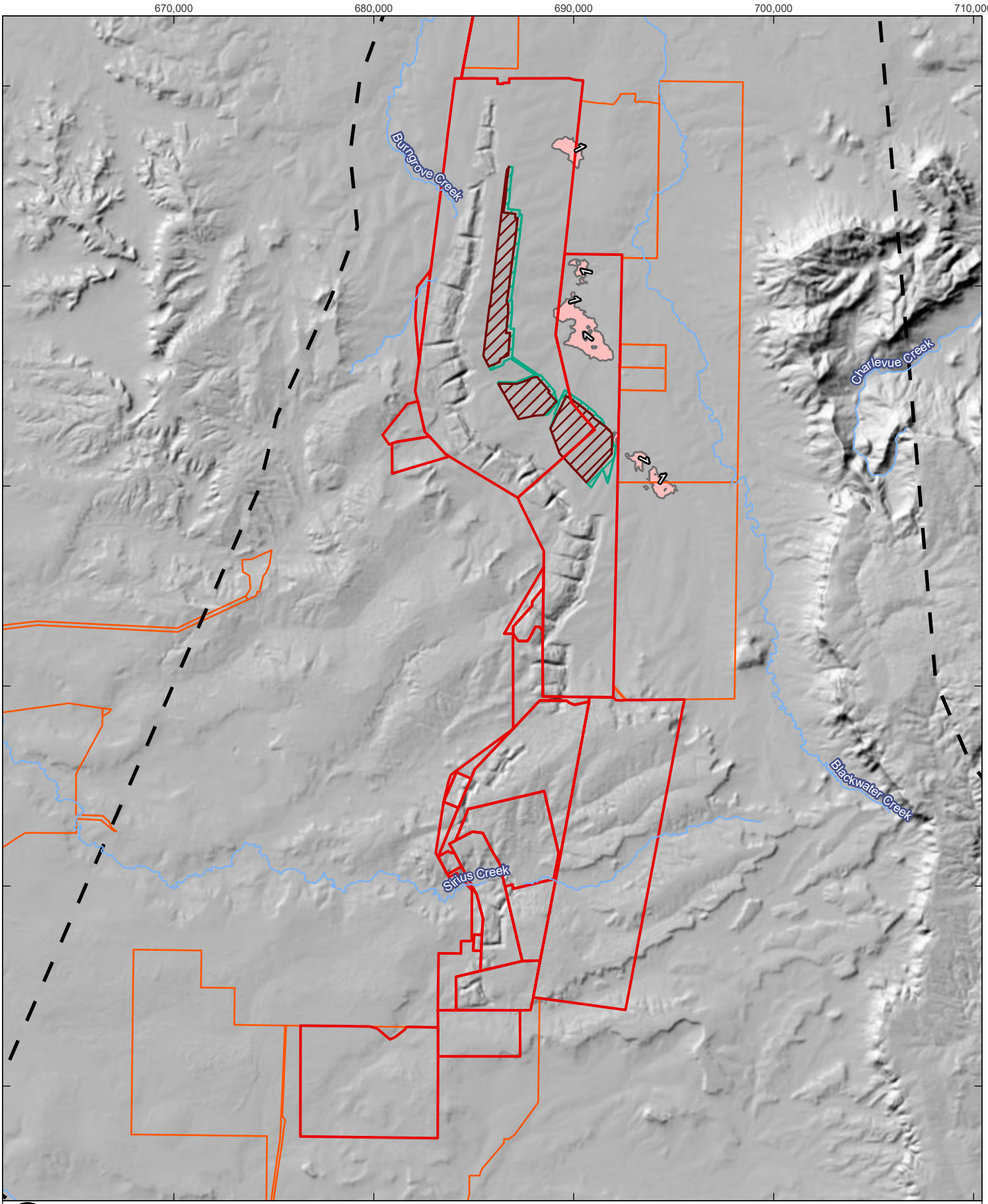
Blackwater North Extension Project

Groundwater Modelling Technical Report

Whitehaven Blackwater Pty Ltd

SLR Project No.: 640.031809.00001

9 April 2026



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

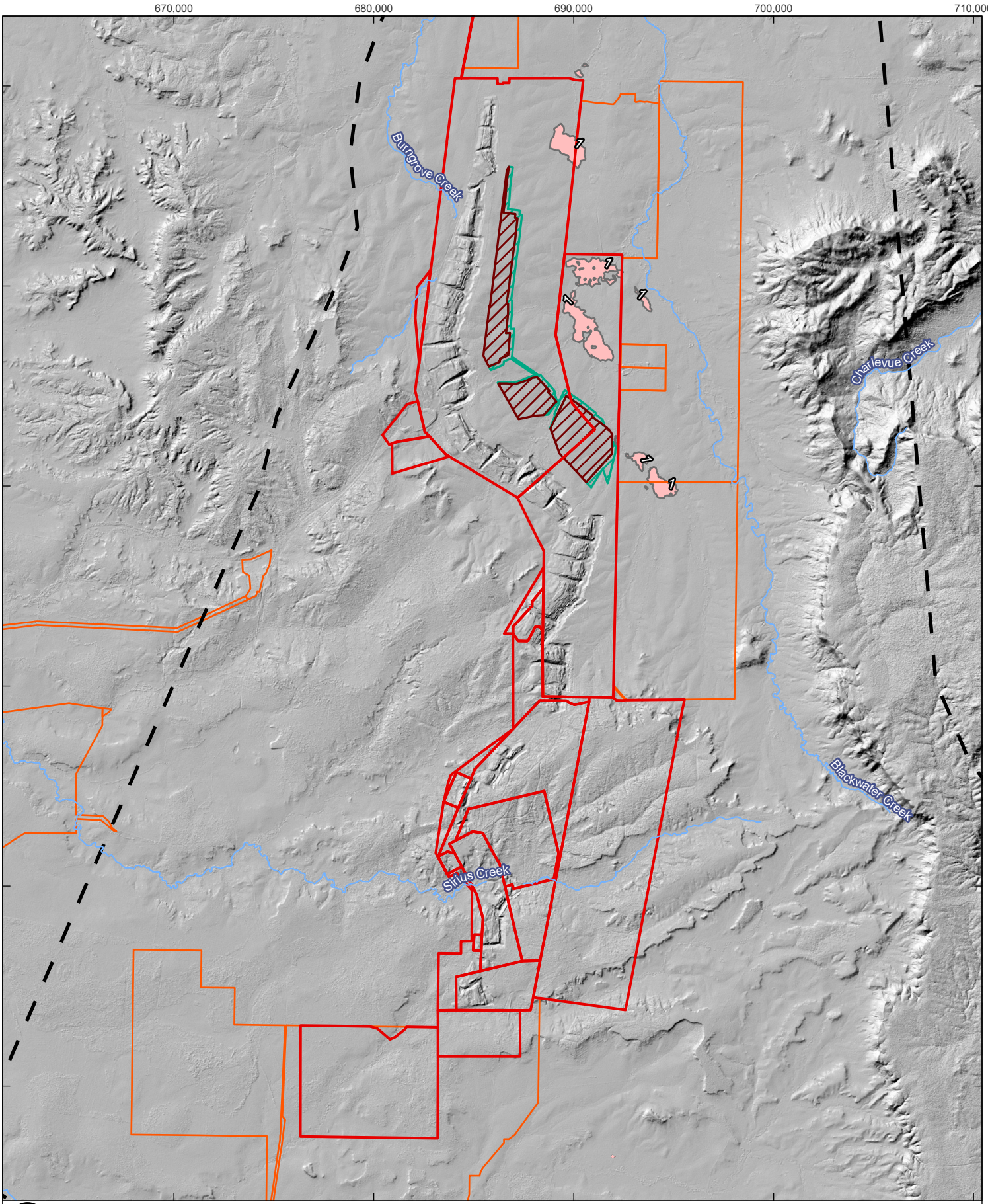
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/TERTIARY (END OF MINING) (LAYER 1)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-1

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E01_Uncertainty in Predicted 1m Incremental DD in Alluvium and Tertiary (EoM) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

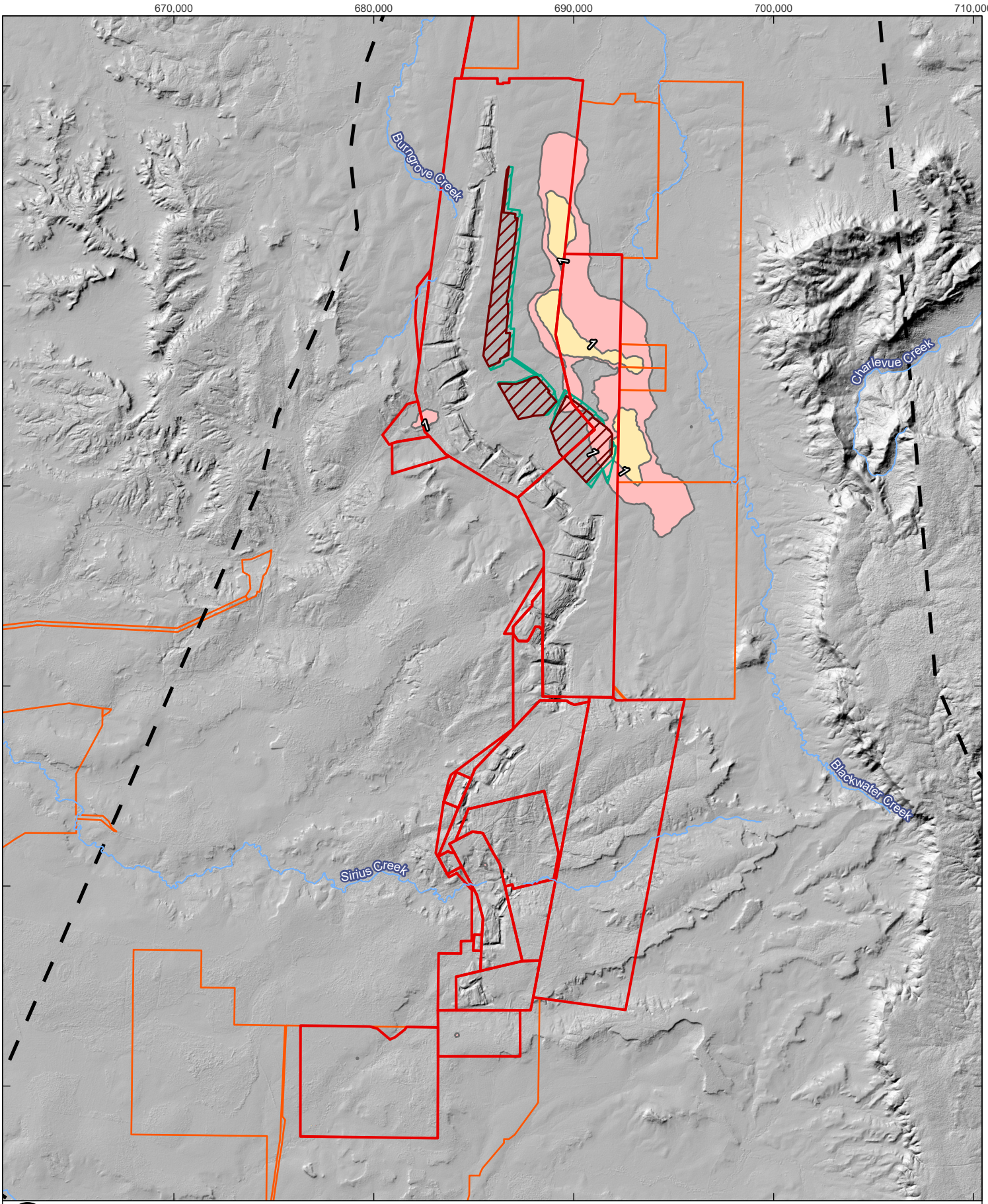
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/TERTIARY (END OF RECOVERY) (LAYER 1)

SLR

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APPENDIX F-2

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E02_Uncertainty in Predicted 1m Incremental DD in Alluvium and Tertiary (EoR) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

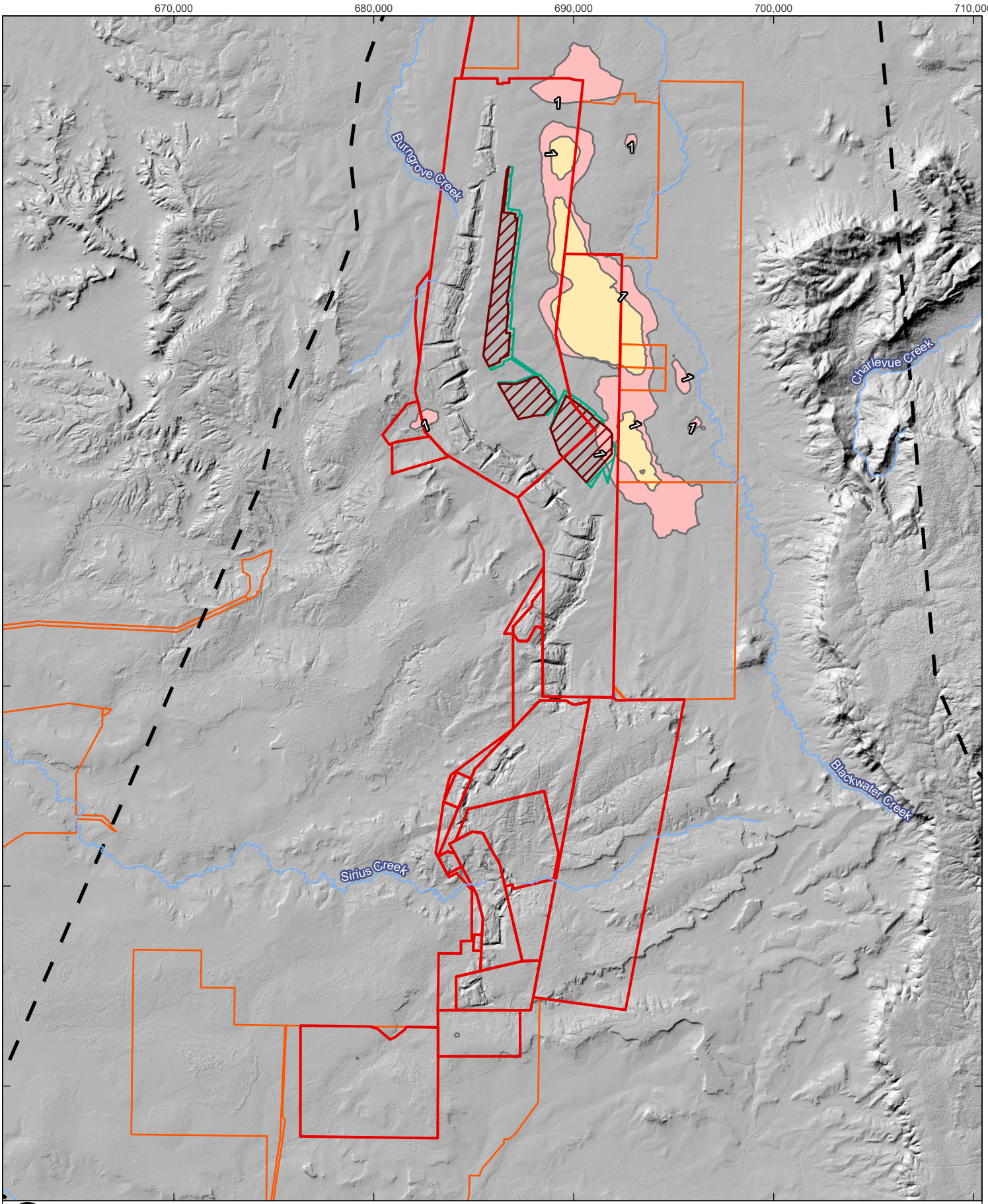
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/WEATHERED (END OF MINING) (LAYER 2)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-3

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E03_Uncertainty in Predicted 1m Incremental DD in Alluvium and Weathered (EoM) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

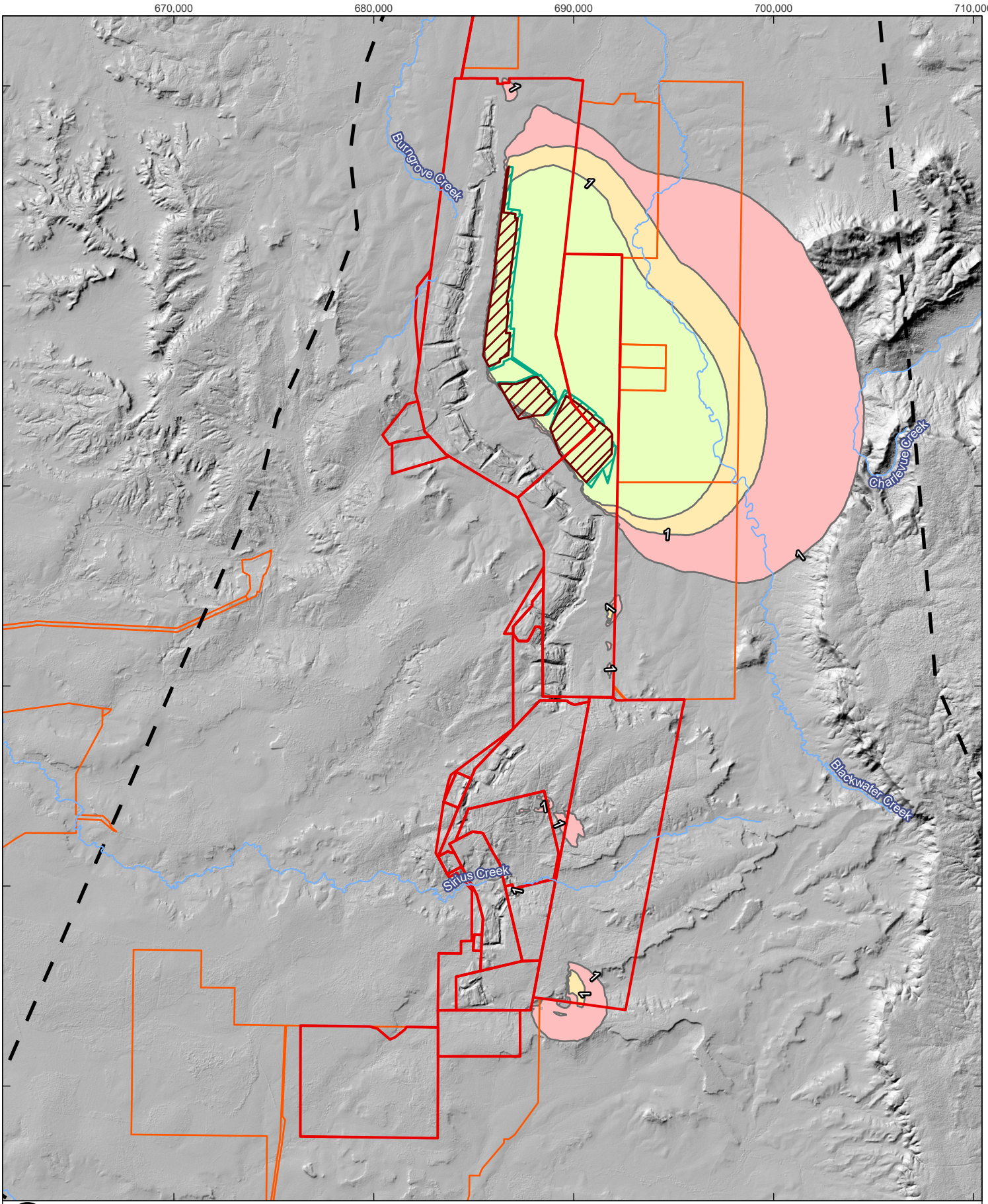
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ALLUVIUM/WEATHERED (END OF RECOVERY) (LAYER 2)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-4

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E04_Uncertainty in Predicted 1m Incremental DD in Alluvium and Weathered (EoR) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

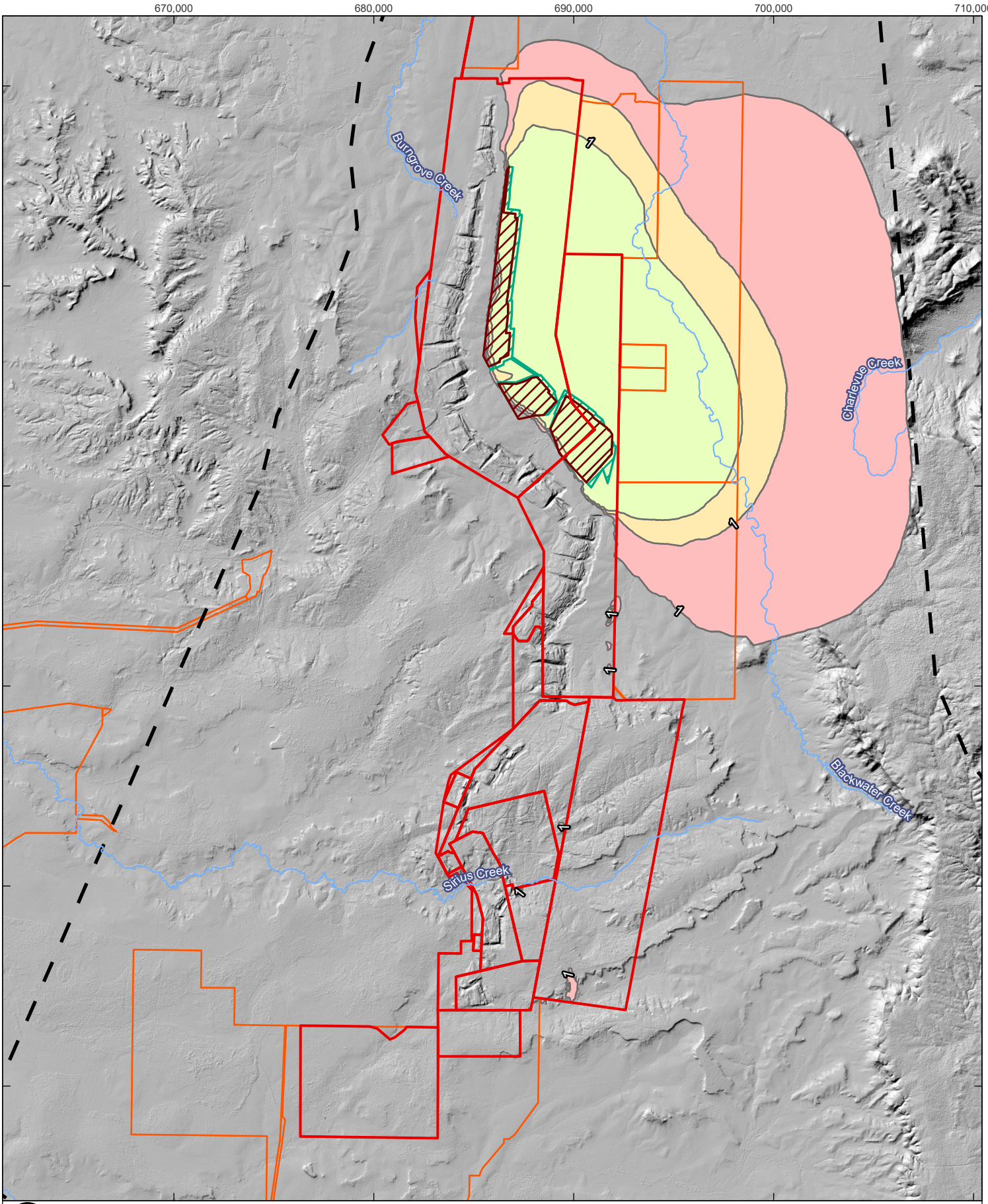
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ARIES SEAM (END OF MINING) (LAYER 8)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-5

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E05_Uncertainty in Predicted 1m Incremental DD in Aries Seam (EoM) L8



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

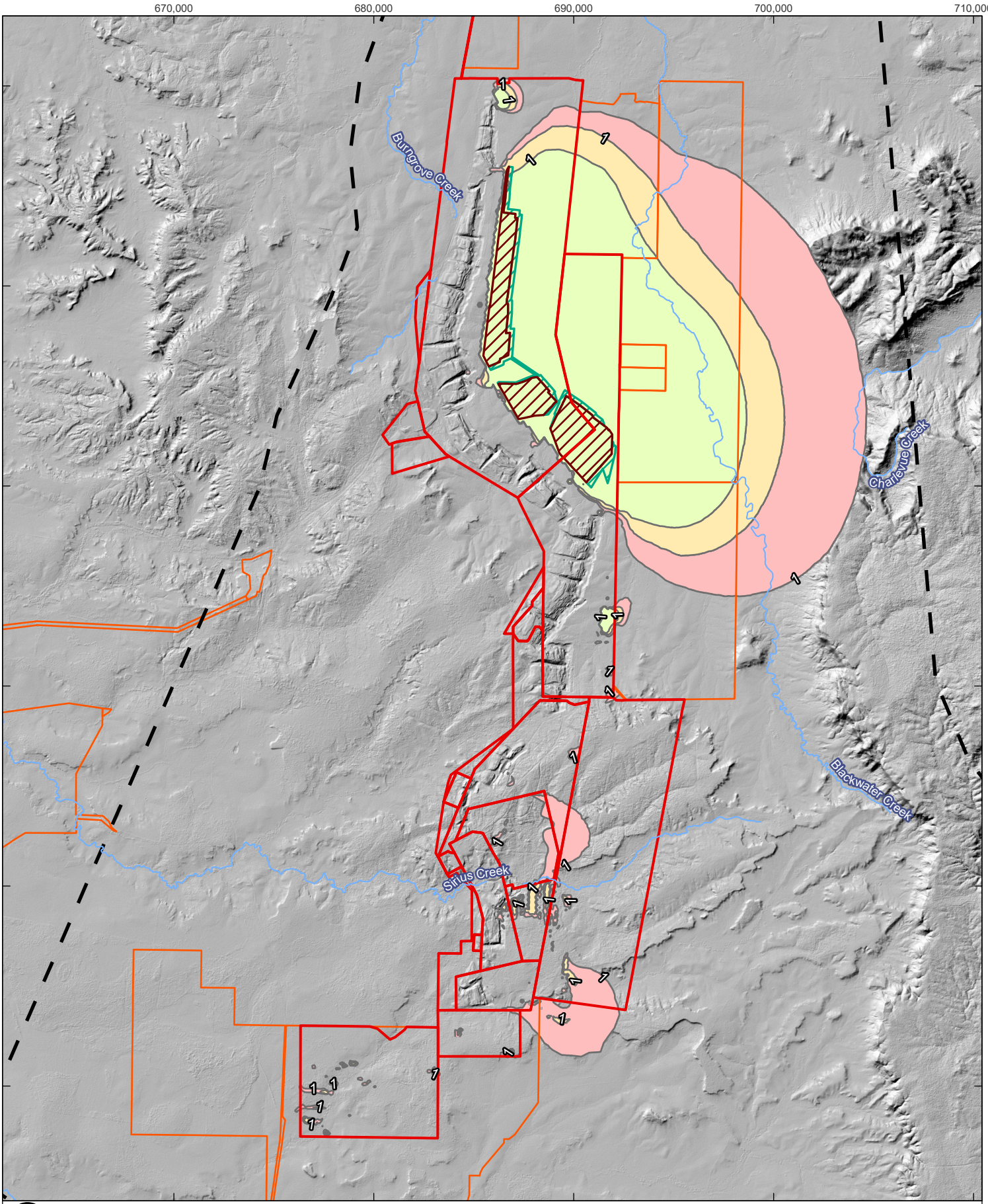
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN ARIES SEAM (END OF RECOVERY) (LAYER 8)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-6

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E06_Uncertainty in Predicted 1m Incremental DD in Aries Seam (EoR) L8



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

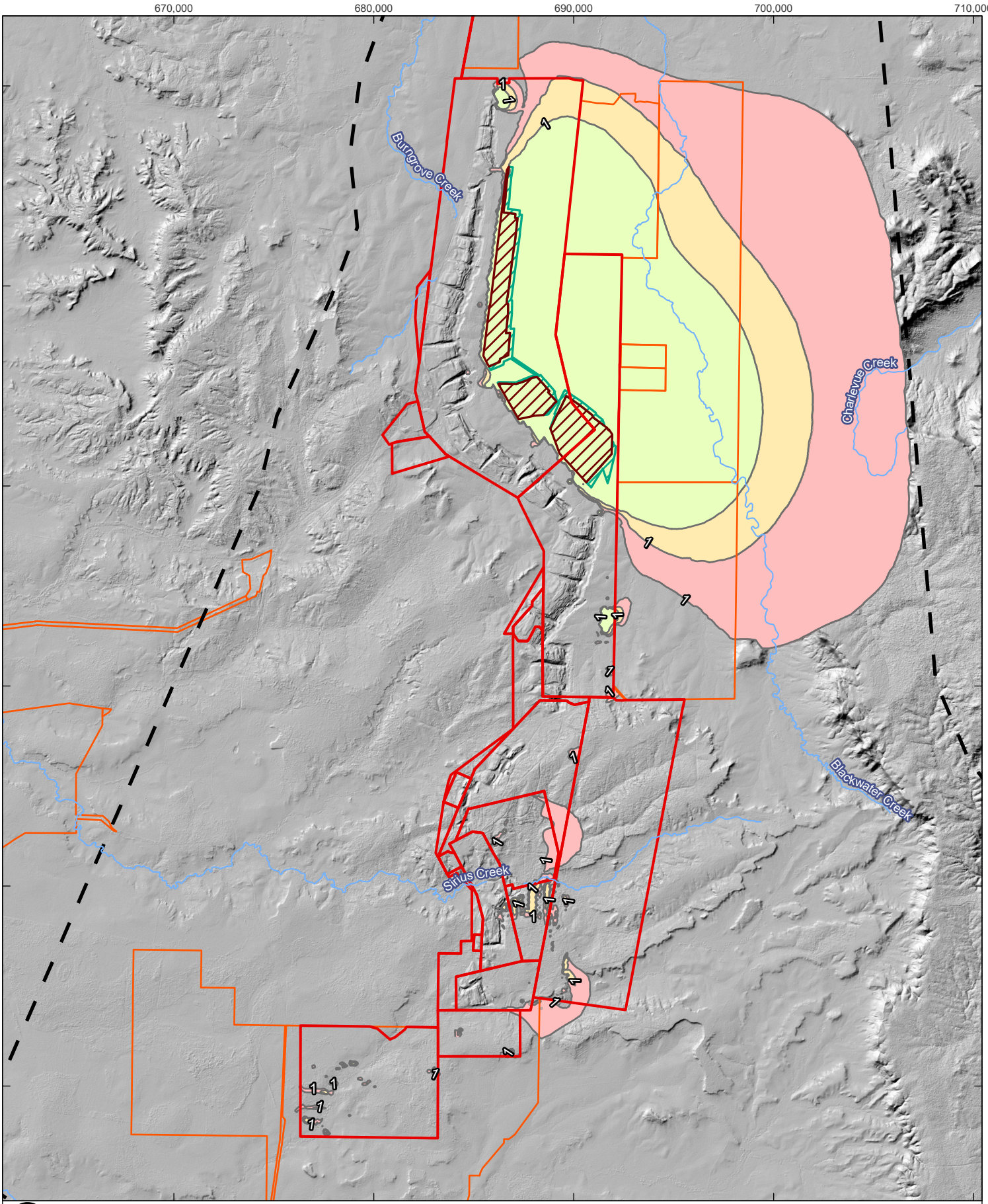
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN POLLUX SEAM (END OF MINING) (LAYER 12)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-7

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E07_Uncertainty in Predicted 1m Incremental DD in Pollux Seam (EoM) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

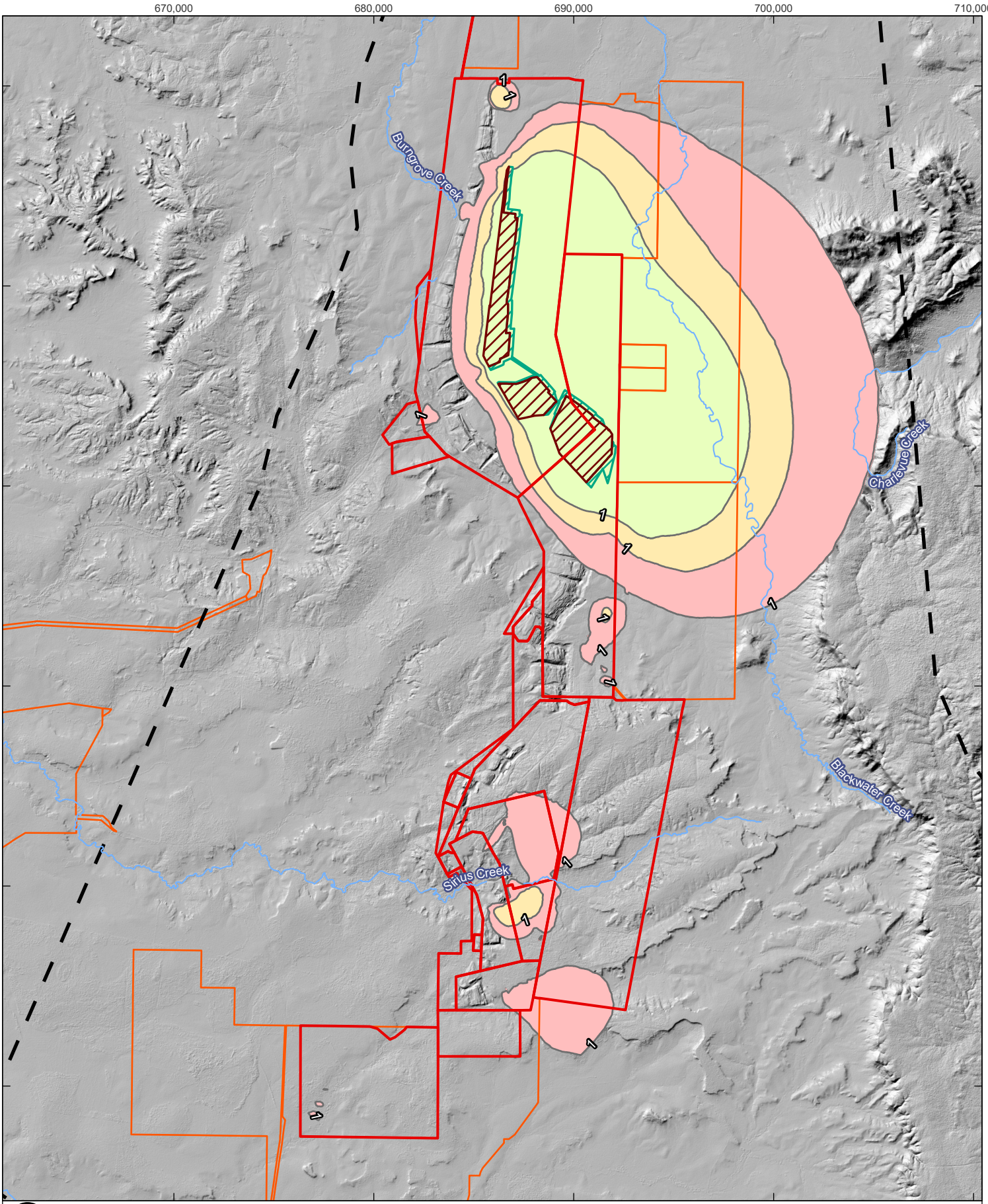
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN POLLUX SEAM (END OF RECOVERY) (LAYER 12)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-8

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E08_Uncertainty in Predicted 1m Incremental DD in Pollux Seam (EoR) L12



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

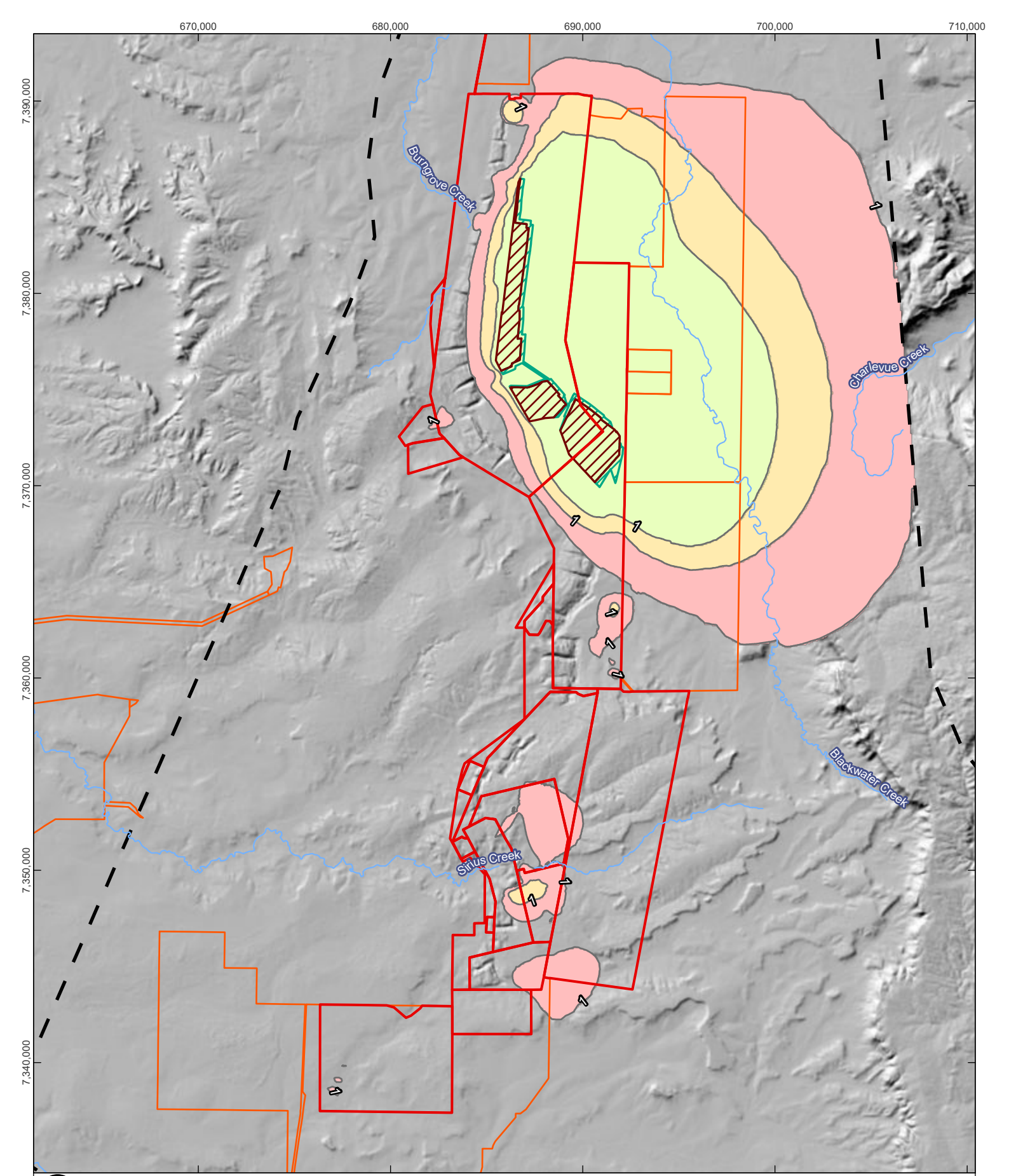
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN BURNGROVE FORMATION (END OF MINING) (LAYER 16)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-9

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E09_Uncertainty in Predicted 1m Incremental DD in Burngrove Formation (EoM) L16



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

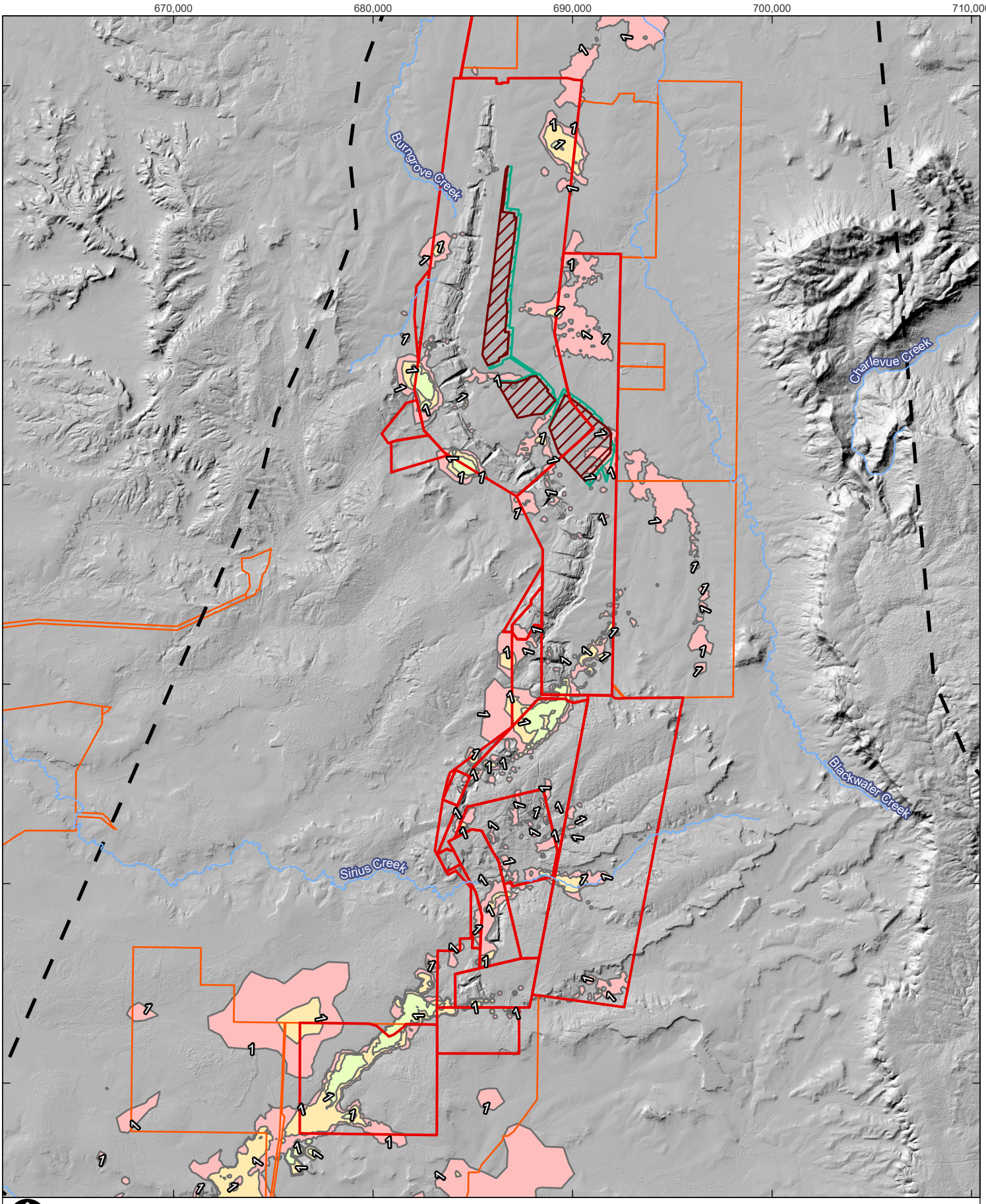
UNCERTAINTY IN PREDICTED 1M INCREMENTAL DRAWDOWN IN BURNGROVE FORMATION (END OF RECOVERY) (LAYER 16)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-10

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E10_Uncertainty in Predicted 1m Incremental DD in Burngrove Formation (EoR) L16



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

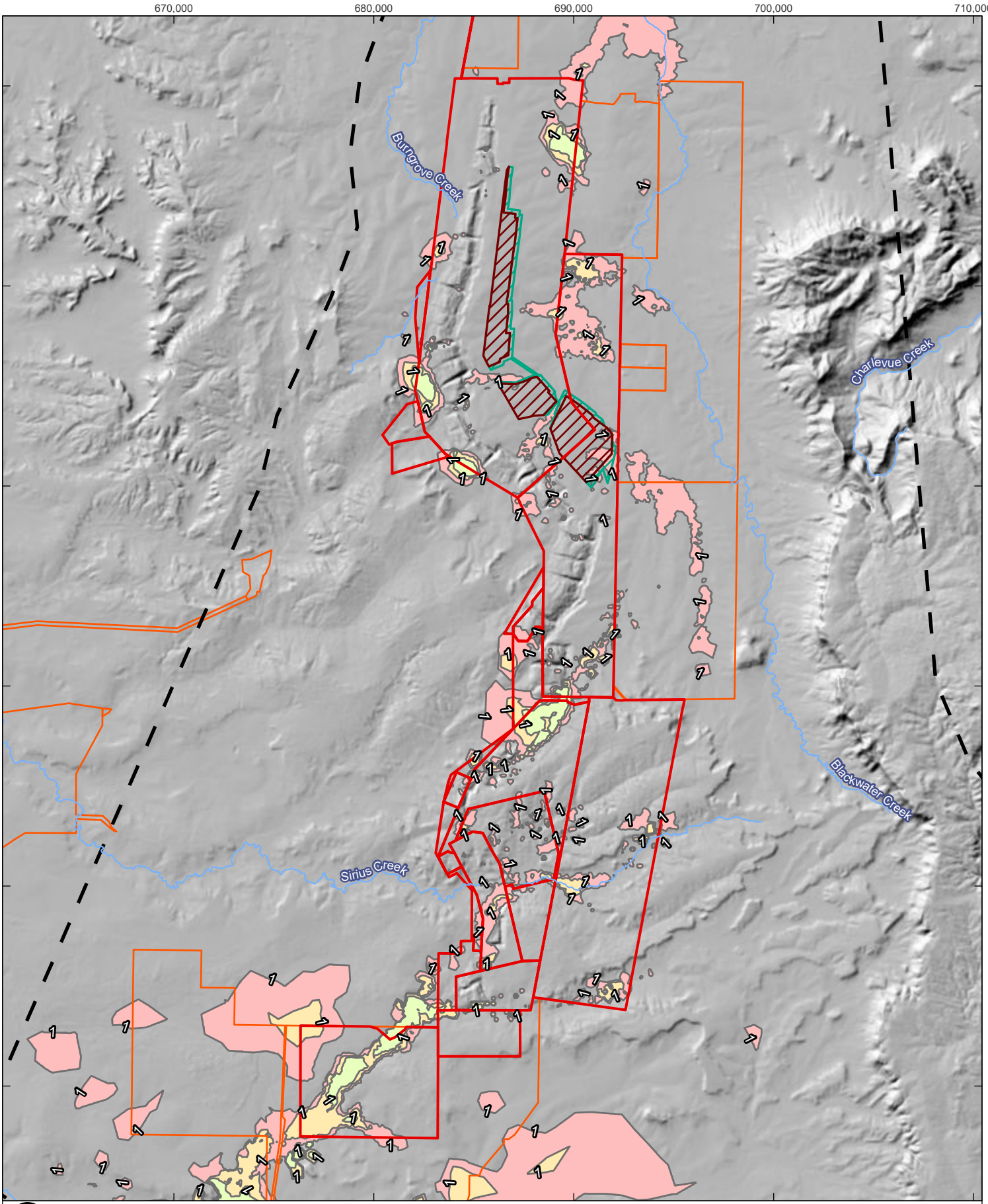
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/TERTIARY (END OF MINING) (LAYER 1)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-11

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E11_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Tertiary (EoM) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

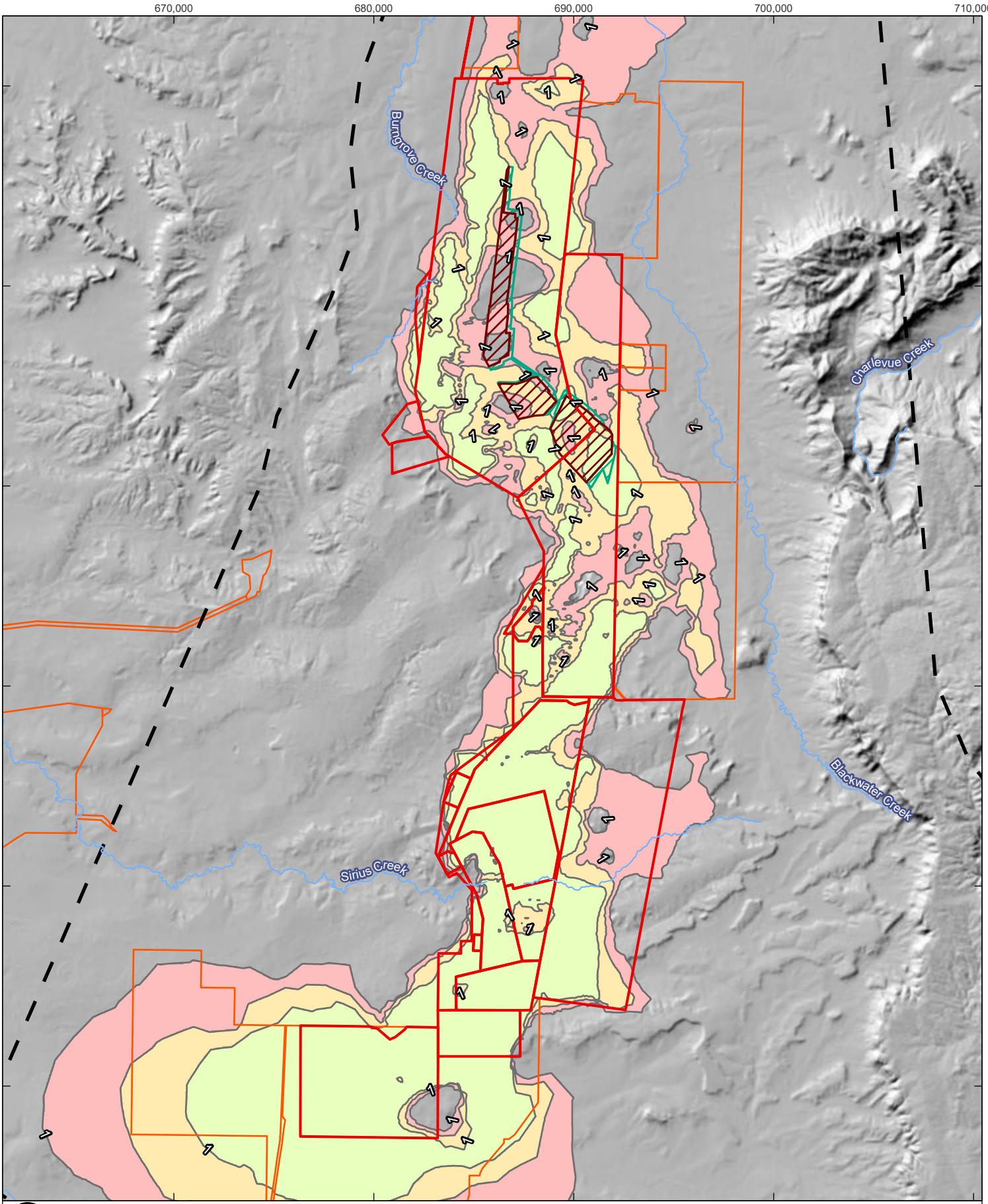
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/TERTIARY (END OF RECOVERY) (LAYER 1)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-12

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E12_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Tertiary (EoR) L1



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

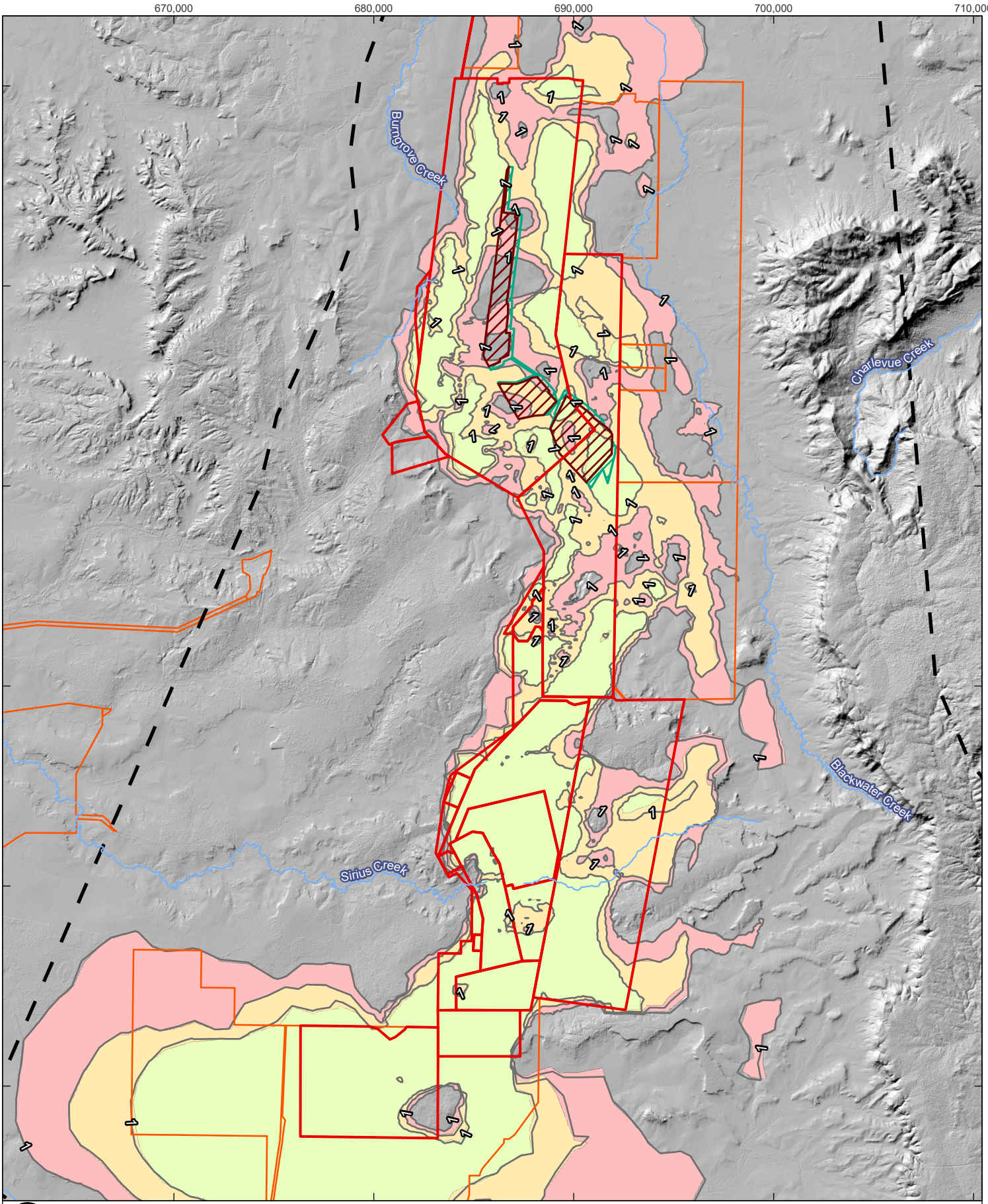
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/WEATHERED (END OF MINING) (LAYER 2)

SLR

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

APPENDIX F-13

Path: H:\Projects-SLR\640-MEL\640-MEL\640.031809.00001 BWM North EIS - Groundwater As\06 SLR Data\01 GIS\640_031809_BWN_EIS.aprx\640031809_MOD_APP_E13_Uncertainty in Predicted 1m Cumulative DD in Alluvium and Weathered (EoM) L2



0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

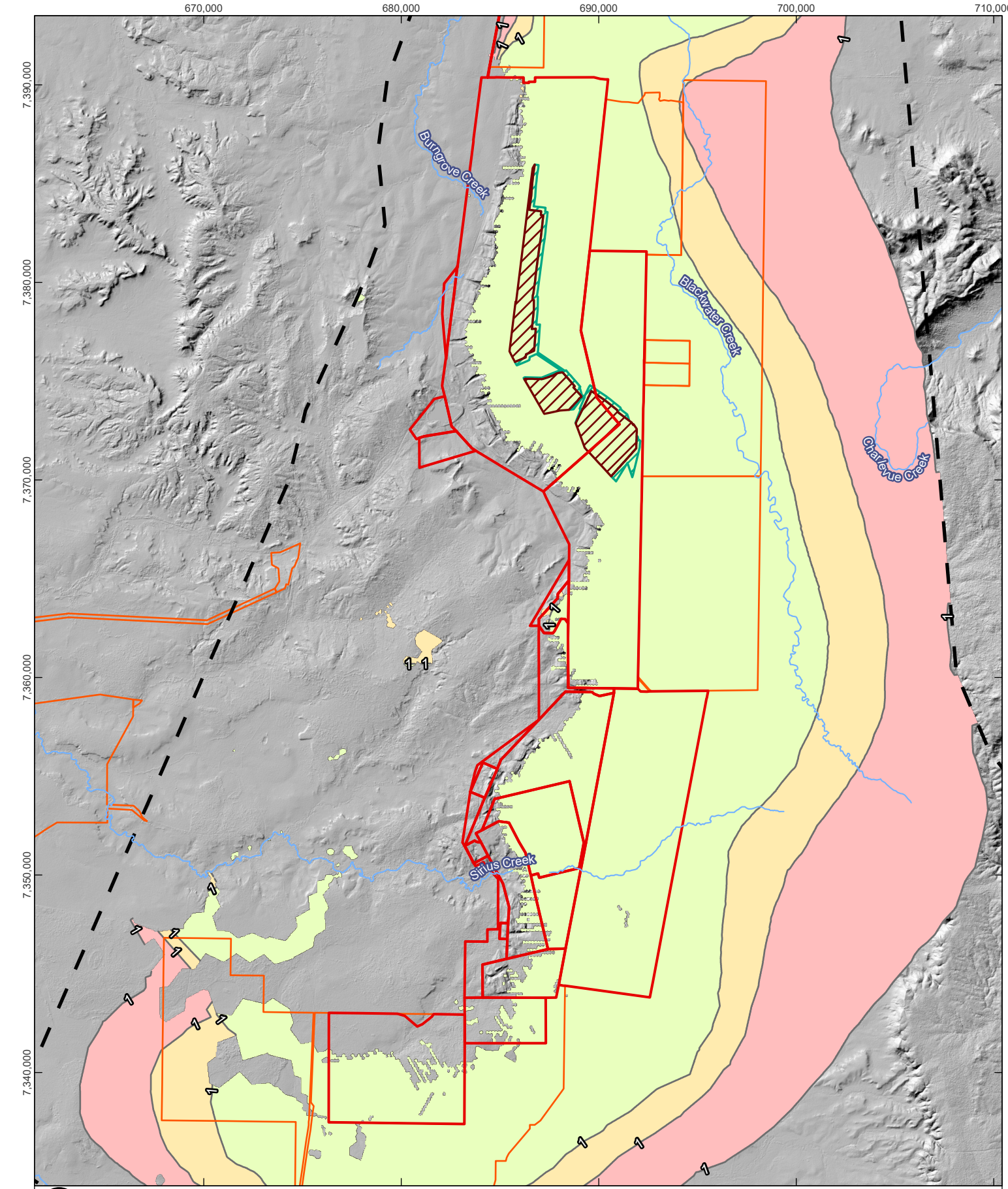
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ALLUVIUM/WEATHERED (END OF RECOVERY) (LAYER 2)

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APPENDIX F-14

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

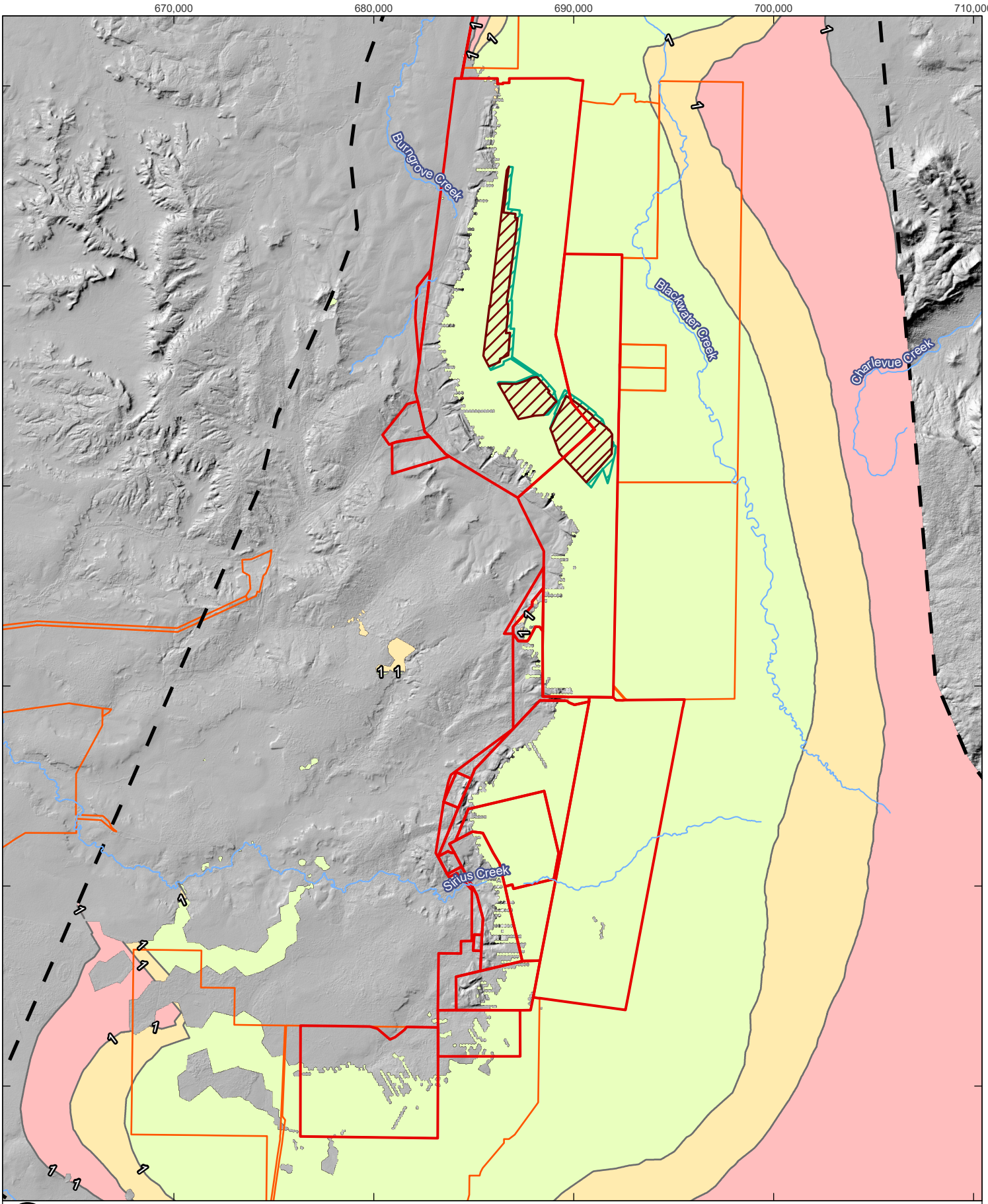
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ARIES SEAM (END OF MINING) (LAYER 8)

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APPENDIX F-15

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

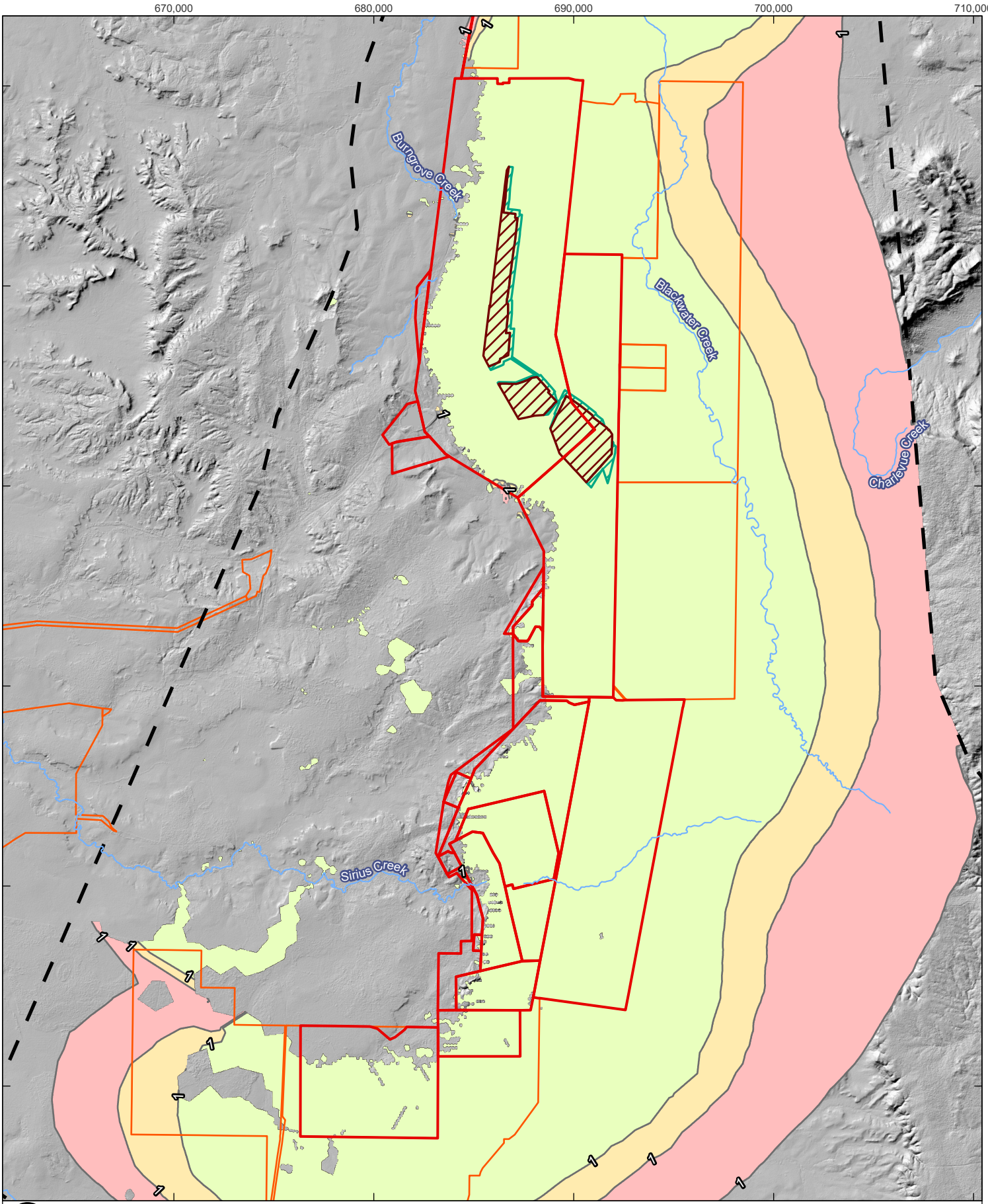
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN ARIES SEAM (END OF RECOVERY) (LAYER 8)

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

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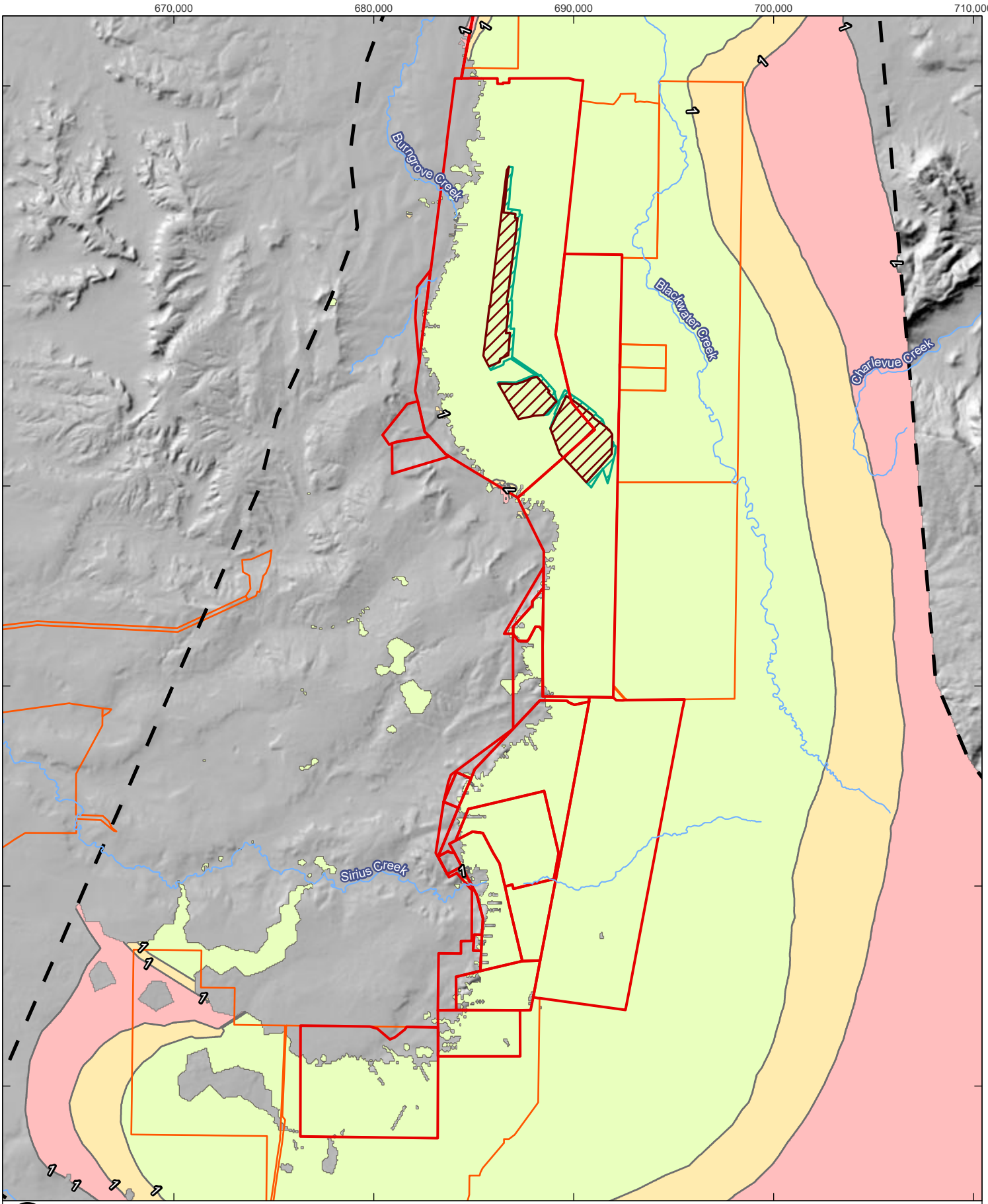
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN POLLUX SEAM (END OF MINING) (LAYER 12)

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

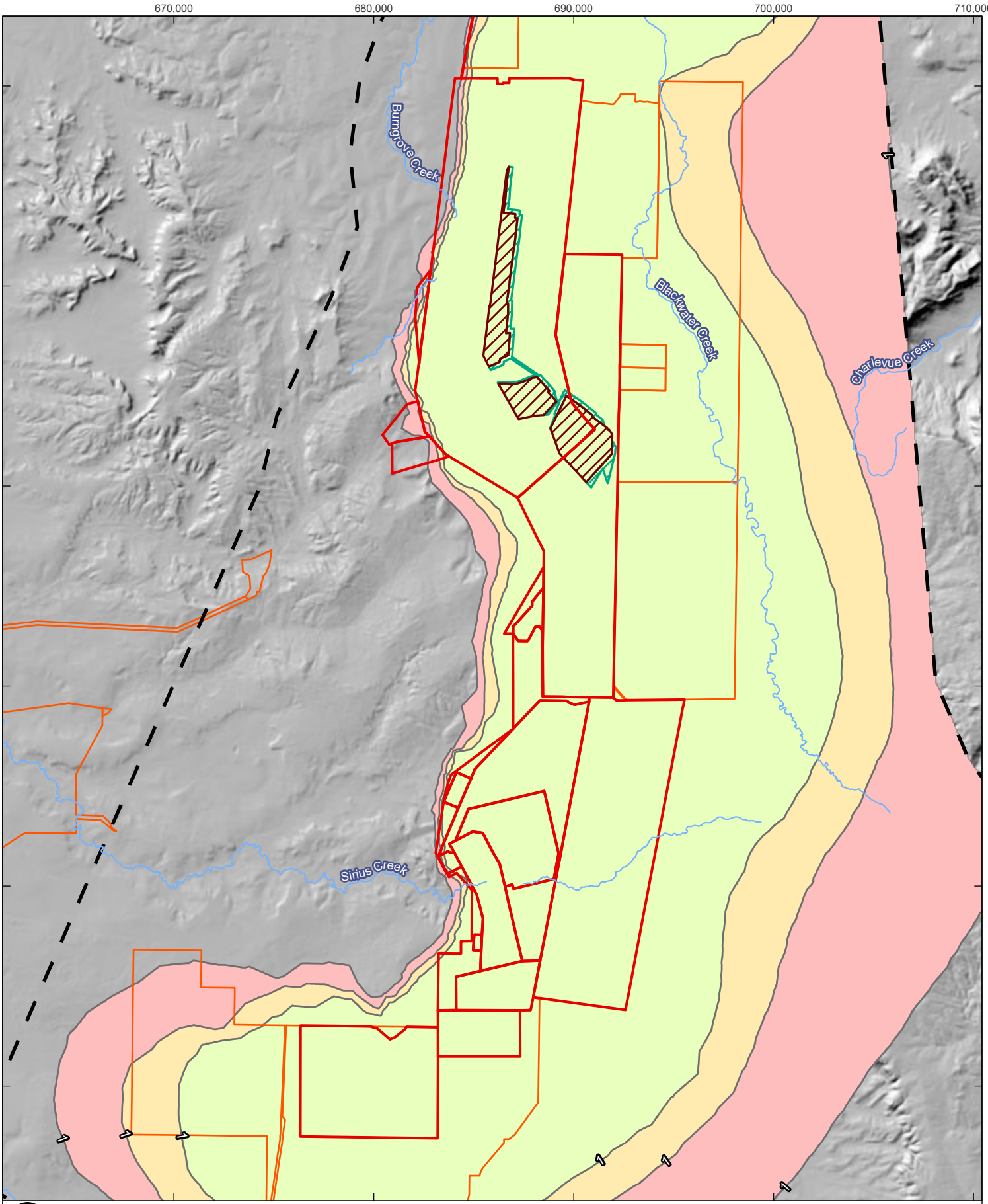
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN POLLUX SEAM (END OF RECOVERY) (LAYER 12)

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	08-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

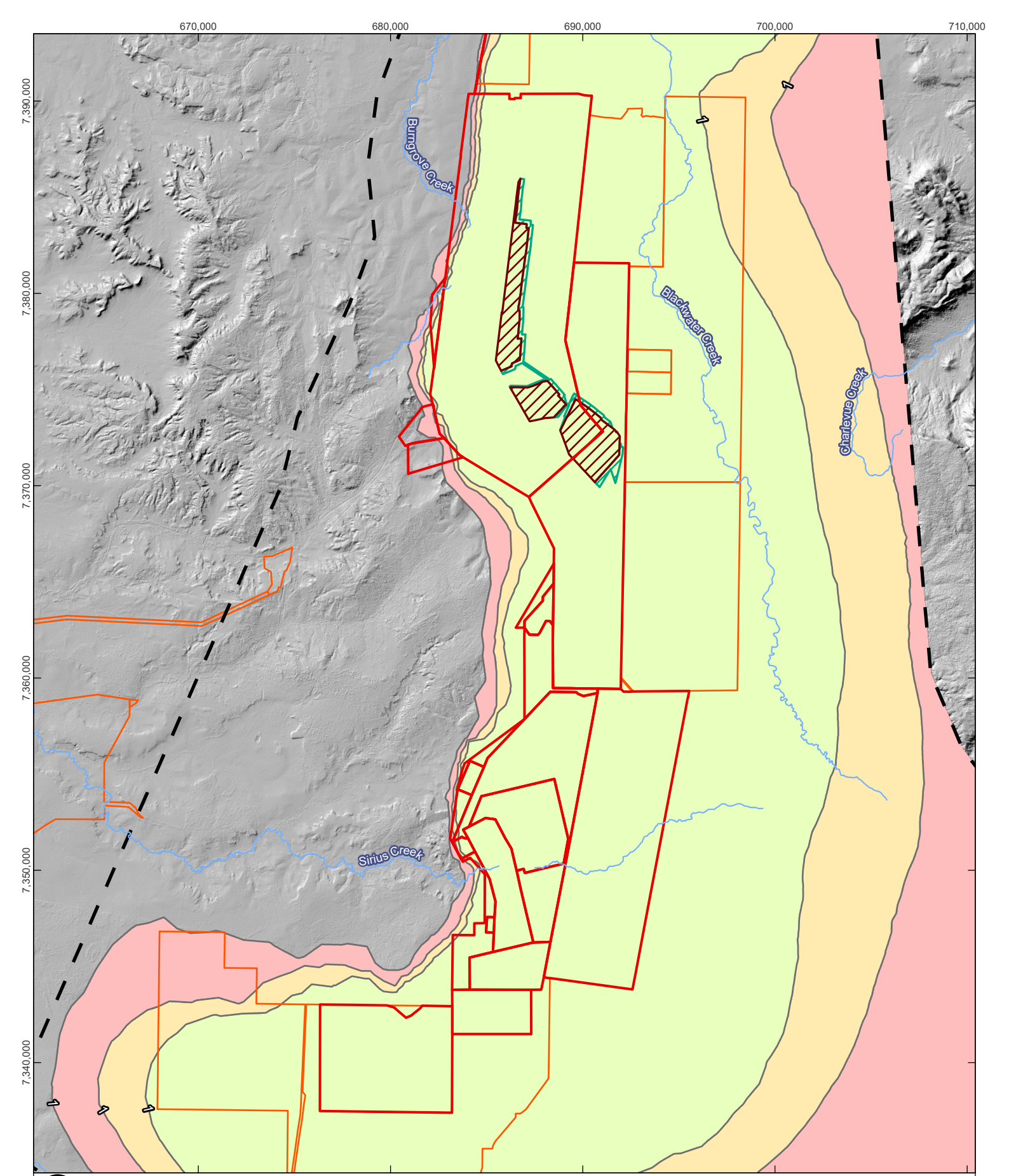
UNCERTAINTY IN PREDICTED 1M CUMULATIVE DRAWDOWN IN BURNGROVE FORMATION (END OF MINING) (LAYER 16)

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0 2.5 5 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:250,000 at A4
Project Number:	640.031809.00001
Date Drawn:	10-Apr-2026
Drawn by:	RB

LEGEND

- Watercourse
- BWM Mining Lease
- Mining Lease
- Model Boundary
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Maximum Drawdown (m)

- 5th Percentile
- 50th Percentile
- 95th Percentile

BLACKWATER NORTH EXTENSION PROJECT GROUNDWATER MODELLING TECHNICAL REPORT

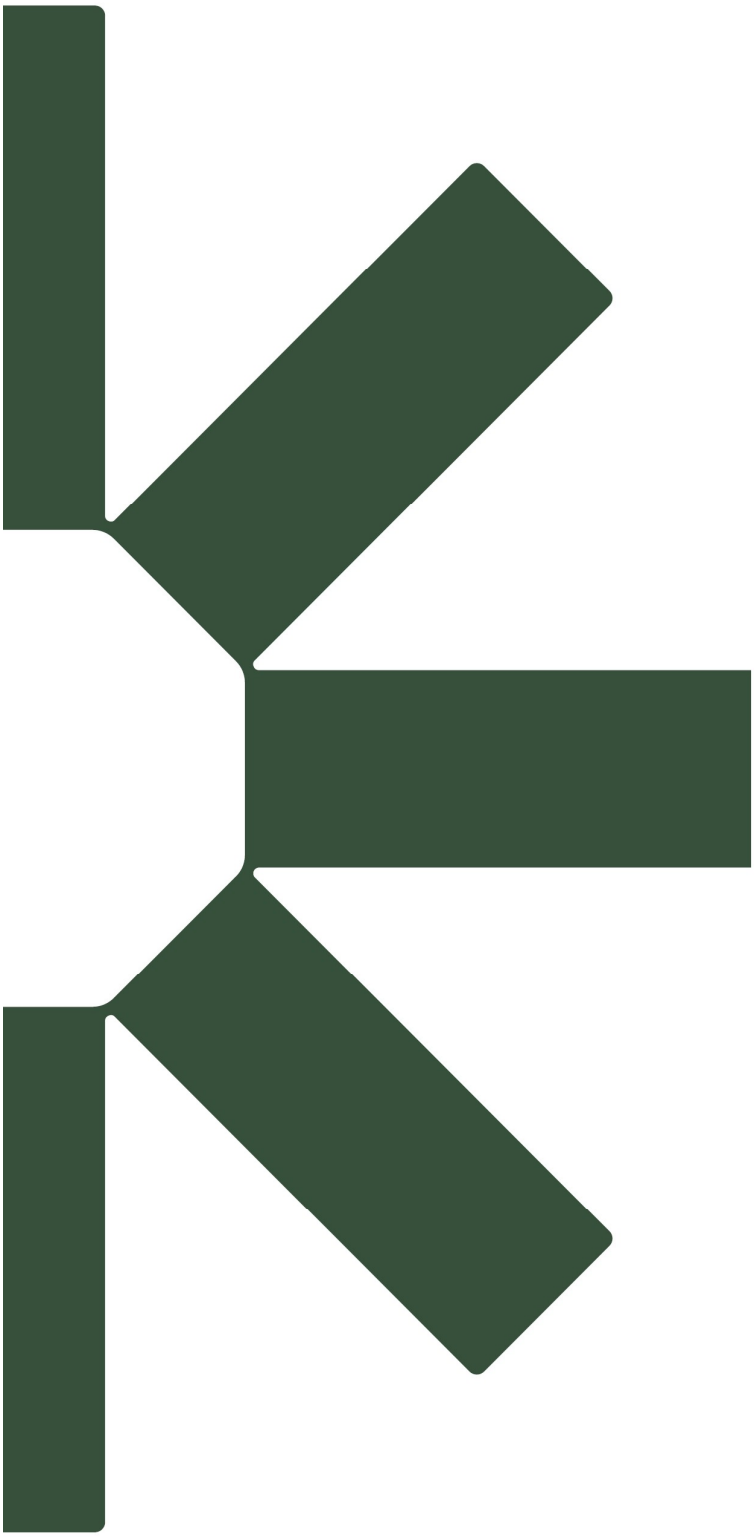
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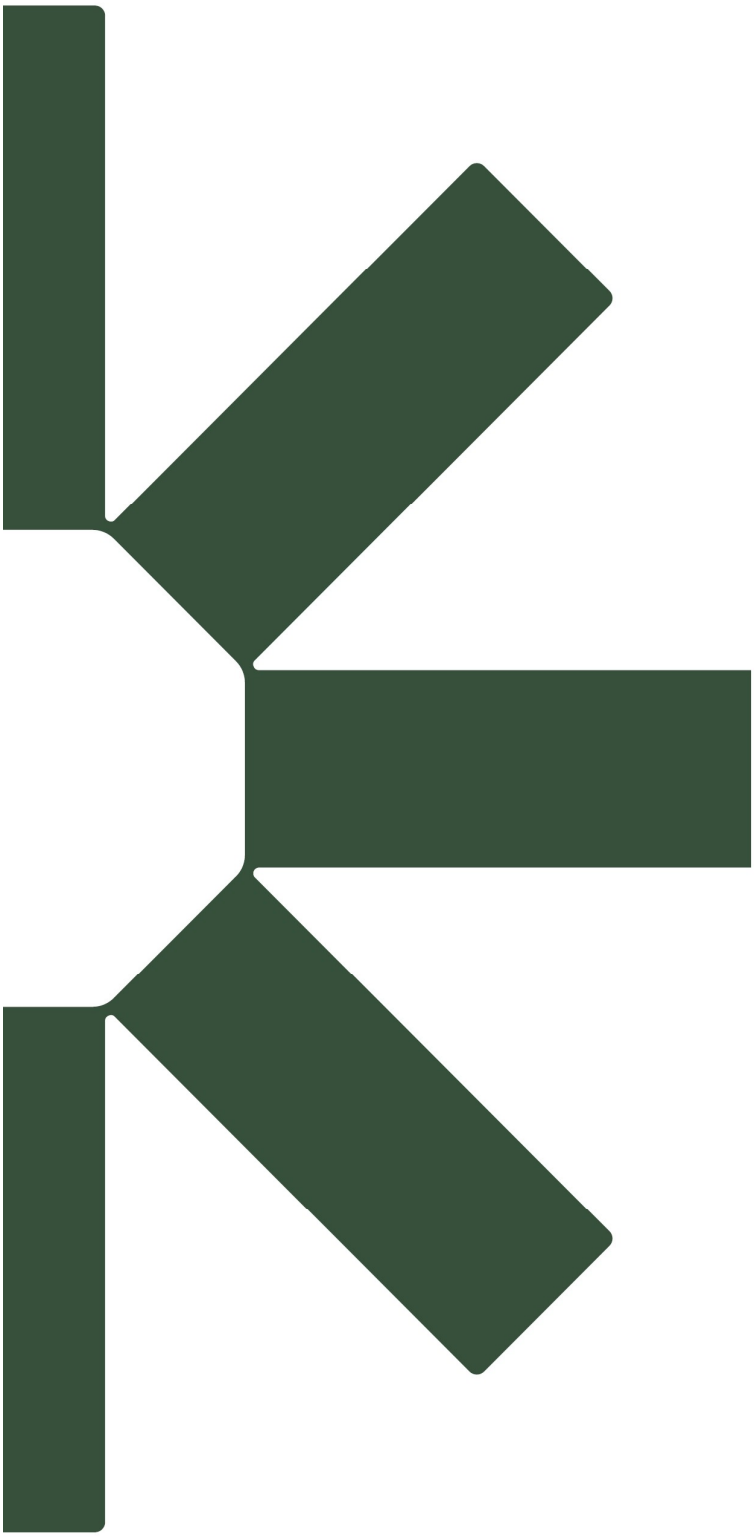
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Making Sustainability Happen



Making Sustainability Happen

Whitehaven

Blackwater North Extension Project

Appendix D
Terrestrial Ecological Assessment



Blackwater North Extension Project - Terrestrial Ecological Assessment

9 April 2026

Whitehaven Blackwater Pty Ltd
Level 31, 12 Creek Street, Brisbane, QLD, 4000



Document Management

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Definitions

Term	Definition
Broad vegetation group	A pragmatic, higher level grouping of regional ecosystems and vegetation communities that provide an overview of the vegetation across Queensland (Neldner et al., 2025). They describe major ecological patterns and relationships across Queensland, independent of bioregions and land zones, and facilitate comparisons with vegetation in other States and internationally.
Disturbance Footprint	The approximately 2,316.58 ha (rounded to 2,317 ha) area in which Whitehaven plans to develop infrastructure and conduct mining operation for the Project.
Environmentally sensitive area	Environmentally sensitive areas as described in the Queensland *Environmental Protection Regulation 2019*.
Groundwater dependent ecosystem	Ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis for maintenance of the ecosystem (Richardson et al., 2011).
High-value regrowth	Vegetation communities that conform with the definition under the VM Act and referenced by Neldner et al. (2025). Specifically, this comprises native vegetation regrowth that is greater than 15 years old and meets the minimum cover requirements specified by Neldner et al. (2025).
Non-remnant vegetation	All vegetation that is not mapped as remnant vegetation. May include regrowth, heavily thinned or logged and significantly disturbed vegetation that fails to meet the structural and/or floristic characteristics of remnant vegetation. It also includes urban and cropping land (Neldner et al., 2025).
Regional ecosystem	A vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil (Neldner et al., 2025). Regional ecosystems are described in the Regional Ecosystem Description Database, produced by the Queensland Herbarium.
Remnant vegetation	A regional ecosystem that has not undergone recent clearing. It is defined under the Queensland *Vegetation Management Act 1999* as: forming the predominant canopy of the vegetation— (i) covering more than 50% of the undisturbed predominant canopy; and (ii) averaging more than 70% of the vegetation's undisturbed height; and (iii) composed of species characteristic of the vegetation's undisturbed predominant canopy.
The Project	The extension to current mining activities associated with Environmental Authority (EA) EPML00717813, i.e. the Blackwater Mine North Extension Project.
Threatened Ecological Community	An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. Its structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability. Threatened ecological communities are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Term	Definition
Threatened species	A threatened species is any plant or animal species that is at risk of extinction. Species listed as extinct (EX), extinct in the wild (XW), critically endangered (CE), endangered (E), vulnerable (V) or conservation dependent (CD) under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* or extinct (EX), extinct in the wild (XW), critically endangered (CE), endangered (E), vulnerable (V) under the Queensland *Nature Conservation Act 1992*.
Study Area	An area located in Mining leases (ML) 1759 and ML 1762 covering approximately 6,907.49 ha in which E2M have undertaken the terrestrial ecological assessment.
Vegetation community	An area of vegetation which is relatively uniform with respect to structure and floristic composition (Neldner et al., 2025).
Wet season survey	The wet season ecological assessment conducted in March 2025 by E2M targeting ecological matters suitable for wet season conditions.

Abbreviations

Abbreviation	Description
ALA	Atlas of Living Australia
AU	Assessment unit
Biosecurity Act	Queensland *Biosecurity Act 2014*
BoM	Bureau of Meteorology
Bonn	Convention on the Conservation of Migratory Species of Wild Animals/Bonn Convention
Brigalow TEC	Brigalow (*Acacia harpophylla* dominant and co-dominant) Threatened Ecological Community
BVGs	Broad Vegetation Groups
BWM	Blackwater Mine
CAMBA	China-Australia Migratory Bird Agreement
CHPP	Coal handling and preparation plant
DAF	Department of Agriculture and Fisheries
DAWE	Former Commonwealth Department of Agriculture, Water and the Environment (now DCCEEW)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEE	Former Commonwealth Department of the Environment and Energy (now DCCEEW)
DEHP	Former Queensland Department of Environment and Heritage Protection (now DETSI)
DES	Former Queensland Department of Science (now DETSI)
DETSI	Queensland Department of Environment, Tourism and Science and Innovation
DEWHA	Former Commonwealth Department of the Environment, Water, Heritage and the Arts (now DCCEEW)
DotE	Former Commonwealth Department of the Environment (now DCCEEW)
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development
DSEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DCCEEW)
E2M	E2M Pty Ltd
EA	Environmental Authority
EMM	EMM Pty Ltd
EO Act	Queensland *Environmental Offsets Act 2014*
EO Policy	The Environmental Offsets Policy 2022 Version 1.12
EO Regulation	Queensland *Environmental Offsets Regulation 2014*

Abbreviation	Description
EP Act	Queensland *Environment Protection Act* 1994
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EP Regulation	Queensland *Environmental Protection Regulation 2019*
ESA	Environmentally Sensitive Areas
GBRMP	Great Barrier Reef Marine Park
GMMP	Groundwater Monitoring and Management Program
GDE	Groundwater dependent ecosystem
HEC	High Ecological Significance
HEV	High Ecological Value
IBRA	Interim Biogeographic Regionalisation of Australia
IUCN	Internation Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
KoRV	Koala retrovirus
LGA	Local Government Area
LIKT	Locally important Koala tree
MHQA	Modified Habitat Quality Guide
ML	Mining lease
MNES	Matters of National Environmental Significance
MNES SIA Guidelines	*EPBC Act Matters of National Environmental Significance: Significant Impact Guidelines 1.1*
MSES SRI Guideline	*Queensland Environmental Offsets Policy – Significant Residual Impact Guideline*
MSES	Matters of State Environmental Significance
NC Act	Queensland *Nature Conservation Act 1992*
NRM	Natural Resource Management
OAG	Offset assessment guide
PEM	Prescribed Environmental Matter
PMST	Protected Matters Search Tool
Poplar box TEC	Poplar box Grassy Woodland on Alluvial Plains Threatened Ecological Community
RE	Regional ecosystem
REDD	Regional Ecosystem Description Database
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROM	Run-of-mine

Abbreviation	Description
SA	Surface Area
SAT	Koala spot assessment technique
SEVT TEC	Semi Evergreen Vine Thicket Threatened Ecological Community of the Brigalow Belt (North and South) and Nandewar Bioregions
SO	Stream Order
SPRAT	Species Profile and Threats Database
SRI Guideline	*Queensland Environmental Offsets Policy: Significant Impact Guideline*
TCP	Thermal coal plant
TEC	Threatened ecological community
TSSC	Threatened Species Scientific Committee
VM Act	Queensland *Vegetation Management Act 1999*
Whitehaven	Whitehaven Coal Ltd
Whitehaven Blackwater	Whitehaven Blackwater Pty Ltd
WoNS	Weeds of National significance

Executive Summary

E2M Pty Ltd (E2M) was engaged by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater) to conduct a desktop assessment and field surveys to validate and characterise ecological values of interest to the proposed extension of the existing Blackwater Mine (BWM) south-west of the town of Blackwater, hereby referred to as the Project. The purpose of the assessment was to identify and evaluate terrestrial Matters of National Environmental Significance (MNES), Matters of State Environmental Significance (MSES) and Environmentally Sensitive Areas (ESAs) that have potential to be impacted by the Project. This report summarises the desktop and subsequent field assessments undertaken by E2M within the Study Area as well as the results from previous field surveys conducted by EMM Pty Ltd (EMM).

The Study Area is located on approximately 6,907.49 hectares (ha) of predominately gently undulating to flat landscape. It has a long history of cattle grazing and the environment has been subject to past clearance and modification. The majority of the Study Area consists of improved/disturbed pasture dominated by non-native grasses and *Acacia harpophylla* (Brigalow) regrowth shrublands. These areas have been subject to livestock impacts, pasture improvement and weed encroachment.

The initial EMM surveys occurred between 2018 and 2020 and identified a number of MNES and MSES for consideration to the Project. Further surveys conducted by E2M occurred throughout 2025 included a wet season survey (flora and fauna) in March, late wet season surveys (habitat quality) in April and May and a dry season survey (flora and fauna) in September and October. Initial desktop findings and previous field results from EMM surveys revealed a number of environmental matters known, likely or possibly occurring within the Study Area, including both threatened and/or migratory species and ecological communities listed under State and Commonwealth legislation. Further, E2M field surveys re-confirmed the presence of *Solanum elachophyllum*, Brigalow Threatened Ecological Community (TEC), Fork-tailed swift and regional ecosystems (RE) listed as endangered and vulnerable under the Queensland (QLD) *Nature Conservation Act 1992* (NC Act).

Terrestrial ecological matters known to occur in the Study Area include:

- Eight MNES, including:
  - One TEC, namely Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC) listed as endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
  - Five threatened fauna species listed under the EPBC Act:
    - Australian painted snipe (*Rostratula australis*) listed as endangered under the EPBC Act;
    - Koala (*Phascolarctos cinereus*) listed as endangered under the EPBC Act;
    - Latham's snipe (*Gallinago hardwickii*) listed as vulnerable under the EPBC Act;
    - Ornamental snake (*Denisonia maculata*) listed as vulnerable under the EPBC Act; and
    - Squatter pigeon (southern) (*Geophaps scripta scripta*) listed as vulnerable under the EPBC Act.
  - Migratory fauna species listed under the EPBC Act:
    - Fork-tailed swift (*Apus pacificus)*; and
    - Latham's snipe (*Gallinago hardwickii*).
- 16 MSES, including:
  - Regulated Vegetation including:
    - RE 11.3.1 listed as endangered under the *Vegetation Management Act 1999* (VM Act) and the Biodiversity Status.

- RE 11.4.9 listed as endangered under the VM Act and the Biodiversity Status.
- RE 11.9.5 listed as endangered under the VM Act and the Biodiversity Status.
- RE 11.3.2 listed as of concern under the VM Act.
- RE 11.3.3 listed as of concern under the VM Act.
- REs within a defined distance of a watercourse, including:
  - RE 11.3.1;
  - RE 11.3.2;
  - RE 11.3.3;
  - RE 11.3.6; and
  - RE 11.3.27.

- Protected wildlife habitat as defined in the QLD *Environmental Offsets Regulation 2014* (EO Regulation) for:
  - One threatened flora species, *Solanum elachophyllum* listed as endangered under the NC Act; and
  - Five threatened fauna species listed under the NC Act (as per EPBC threatened fauna listed species above).
- MSES Connectivity Areas comprising remnant vegetation, including State-significant and/or regionally important corridors linking areas of fauna habitat.
- ESAs, including three endangered REs classified as Category B ESAs.

Terrestrial ecological matters considered likely or possibly occurring within the Study Area include:

- MNES including:
  - Glossy ibis (*Plegadis falcinellus*); and
  - White-throated needletail (*Hirundapus caudacutus*).
- MNES and MSES including:
- South-eastern Glossy black-cockatoo (*Calyptorhynchus lathami lathami*);
- Painted honeyeater (*Grantiella picta*); and
  - Sharp-tailed sandpiper (*Calidris acuminata*).
- MSES including:
  - Short-beaked echidna (*Tachyglossus aculeatus*).

The majority (97.65 percent; 2,262.07 ha) of the Disturbance Footprint (2,316.58 ha rounded to 2,317 ha) has been historically cleared and is characterised as non-remnant. The Project would require the progressive removal of 3.93 ha of remnant vegetation and 39.78 ha of high value regrowth vegetation.

While the Project would avoid, mitigate, and manage environmental impacts associated with construction and operation, residual impacts on conservation significant matters will still occur. Assessment of residual impacts against relevant guidelines determine the Project is likely to result in a significant impact on:

- One MNES: Brigalow TEC.
- Two MSES:
  - Regulated vegetation, comprising endangered RE 11.3.1; and
  - Protected wildlife habitat for *Solanum elachophyllum*.

Habitat quality scoring has been undertaken for those MNES and MSES matters that are likely to be significantly impacted by the Project in line with the State and Commonwealth guidelines. Residual impacts on these matters would be offset in accordance the *EPBC Act Environmental Offsets Policy* and *Queensland Environmental Offsets Policy*.

1 Introduction

1.1 Purpose

This terrestrial ecological assessment was prepared by E2M Pty Ltd (E2M) for the Blackwater North Extension Project (the Project) as part of a major Environmental Authority (EA) amendment application and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral.

1.2 Project background

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (Figure 1).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, EA EPML00717813, granted under the QLD *Environmental Protection Act 1994* (EP Act).

The BWM is a joint venture between Whitehaven (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven Coal Ltd (Whitehaven), is the operator of BWM.

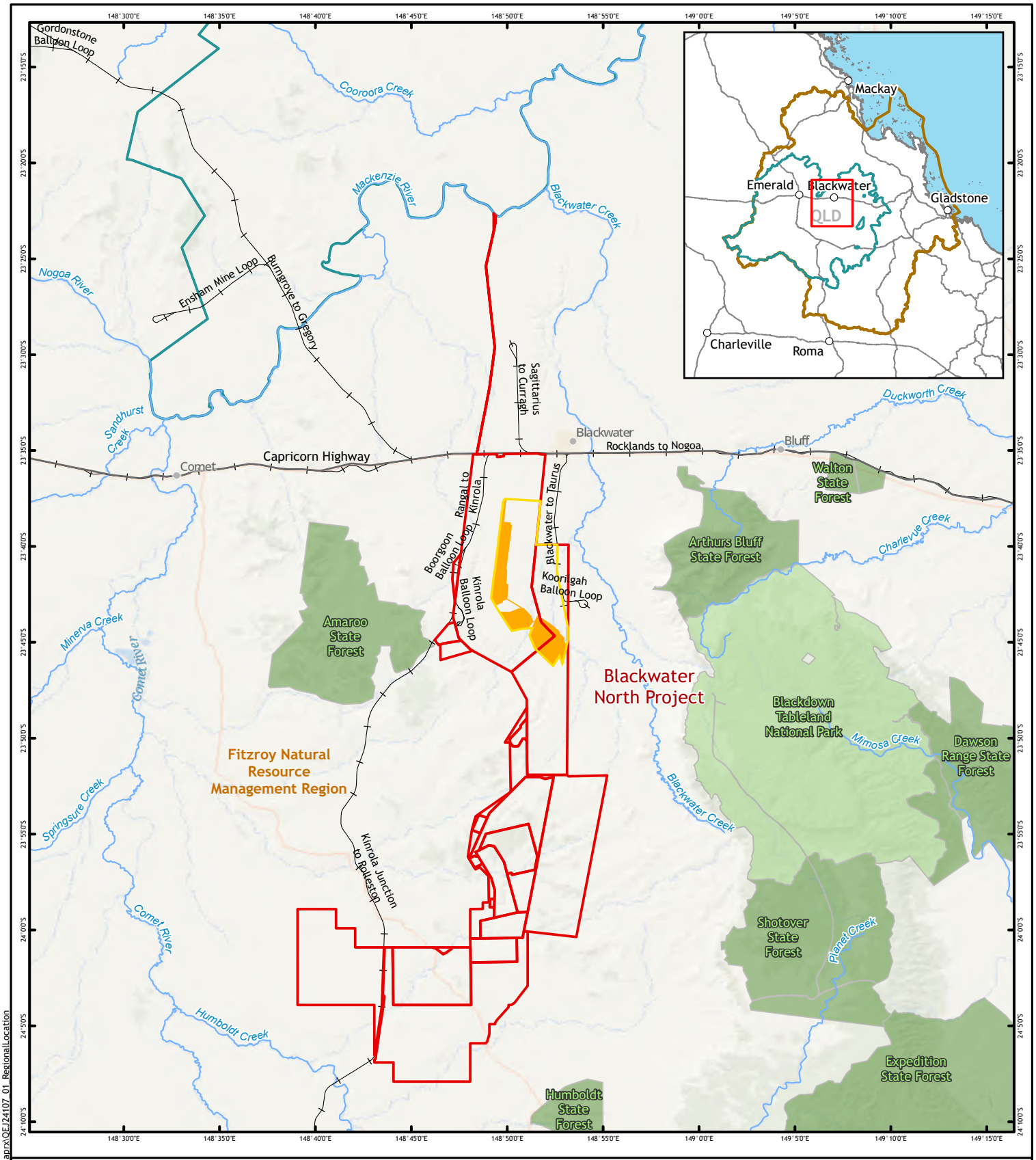
The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. overburden) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

Whitehaven Blackwater proposes to develop the Project, which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759 (Figure 1 and Figure 2). The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles,
- train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;

- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.



Legend

- Railway
- Road
- Watercourse
- Study Area
- Blackwater Mining Lease
- Disturbance Footprint
- NRM Region
- Isaac Regional Council
- **Protected Area**
- National Park
- State Forest

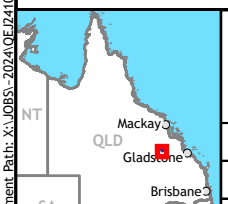
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0 5 10 15 20 25

Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
Cadastre: © DNRMMRRD 2025
Ordered Drainage: © DNRMMRRD 2025
Mining Lease: © DNRMMRRD 2025

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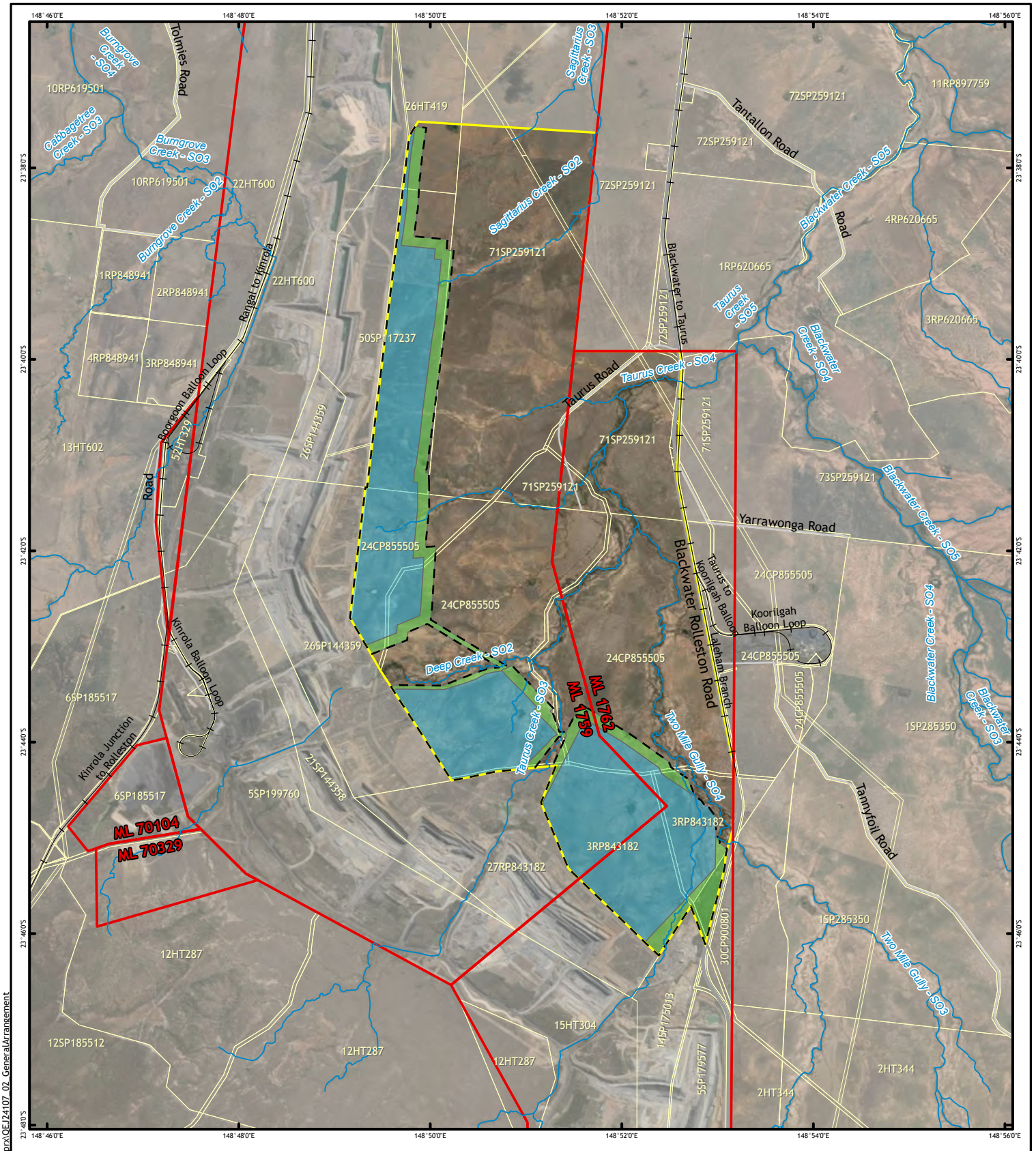
FIGURE 1: REGIONAL LOCATION

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Cadastre

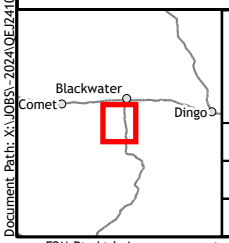
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Coordinate System: GDA2020



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1	Issued for Use	PR	CO	02/04/2026

FIGURE 2: PROPOSED GENERAL ARRANGEMENT

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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1.3 Scope of the assessment

The Study Area covers 6,907.49 hectares (ha) and is located within ML 1759 (SA10) and ML 1762 (SA 7). The Study Area (Figure 2) has been designed to encompass the disturbance footprint extending from the existing mine to the Blackwater - Rolleston Rail corridor. The Project's Disturbance Footprint covers a 2,316.41 ha subset of the Project's ML 1759 and ML 1762.

This report documents the terrestrial ecological values in the vicinity of the Project and provides an assessment of the potential impacts of the Project on terrestrial ecology. Specifically, it provides:

- a desktop review of relevant background information and available environmental databases;
- flora surveys to verify the extent, composition, condition and conservation values of:
  - Regional Ecosystems (REs) in accordance with Neldner *et al*. (2025);
  - potential Threatened Ecological Communities (TECs) protected under the EPBC Act; and
  - Environmentally Sensitive Areas (ESAs) identified under the EP Act.
- fauna surveys to identify fauna species assemblages and habitat types (including threatened species);
- targeted surveys for conservation significant flora and fauna species identified under the EPBC Act and QLD *Nature Conservation Act 1992* (NC Act);
- habitat quality assessments in accordance with the *Guide to determining terrestrial habitat quality (version 1.2)* (Department of Environment and Heritage Protection [DEHP], 2017) for environmental offsets;
- occurrence of Weeds of National Significance (WoNS) (Australian Weeds Committee, 2012) and restricted biosecurity matter under the Queensland *Biosecurity Act 2014* (Biosecurity Act);
- an assessment of the potential indirect, direct and cumulative impacts of the Project on terrestrial ecology (including threatened species and communities); and
- a description of recommended avoidance and mitigation measures and management plans to minimise impacts to terrestrial ecology.

2 Existing environment

2.1 Study Area overview

The Study Area is located approximately 4.5 km southeast of the town of Blackwater and extends south for approximately 17.5 km, covering approximately 6,907.49 ha. The Study Area is bounded by the approved mining areas at BWM to the west, and Ardurad Road and Blackwater Rolleston Road to the east. The Study Area comprises of mix of non-remnant pasture primarily used for cattle grazing, with occasional patches of remnant and regrowth vegetation primarily associated with drainage lines and watercourses.

2.2 Regional context

The Project is located within the Central Highlands Local Government Area (LGA). This LGA comprises an area of approximately 59,834 square kilometres (km^2). It also occurs within the Brigalow Belt bioregion, which encompasses approximately 216,000 km^2 of central Queensland, extending from Townsville in the north to Narrabri in New South Wales in the south (Sattler & Williams, 1999). Brigalow forests and woodlands growing on clay soils are one of the major vegetation types that characterise the region (Sattler & Williams, 1999). While historically brigalow vegetation covered up to six million ha of the bioregion in Queensland, extensive broad scale clearing, predominantly for agriculture, has greatly reduced the extent of this community throughout the bioregion (Sattler & Williams, 1999). In addition to remnant brigalow vegetation, other ecosystems that typify the bioregion include eucalypt forest and woodlands, grasslands, dry rainforest, cypress pine woodland and riparian communities (Sattler & Williams, 1999).

The Interim Biogeographic Regionalisation of Australia (IBRA) divides the Brigalow Belt bioregion into the Brigalow Belt North and Brigalow Belt South (Sattler & Williams, 1999). The geology of the Brigalow Belt North bioregion, in which the Project is located, is characterised by Permian volcanics and Permian-Triassic sediments, Carboniferous and Devonian sediments and volcanics and Cambrian/Ordovician rocks (and associated Tertiary deposits) (Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development [DNRMMRRD], 2025a).

The Study Area lies within the Isaac – Comet Downs biogeographic subregion of the Brigalow Belt bioregion. While areas within and directly surrounding the Study Area are predominately cleared for agricultural use, large areas of remnant vegetation still occur in the nearby surrounding landscape as part of Amaroo State Forest 4.5 km to the west, Arthurs Bluff State Forest 8.5 km to the east and Blackdown Tableland National Park 11.5 km to the southeast.

2.3 Climate

The Study Area is characterised by a sub-tropical, semi-arid climate with high rainfall variability (Bureau of Meteorology [BoM], 2025). The average annual rainfall for the Blackwater area is approximately 546 millimetres (mm) and is predominantly seasonal, characterised by wet summers and dry winters (Figure 3)[1]. The average monthly temperatures range between a maximum of 34.8 degrees Celsius (°C) and a minimum of 9.5 °C recorded during December and July respectively (Figure 4)[1].

[1] Meteorological data was collected from Queensland Government weather data for the central coordinates of the project (-23.58,148.89) (BoM, 2025).

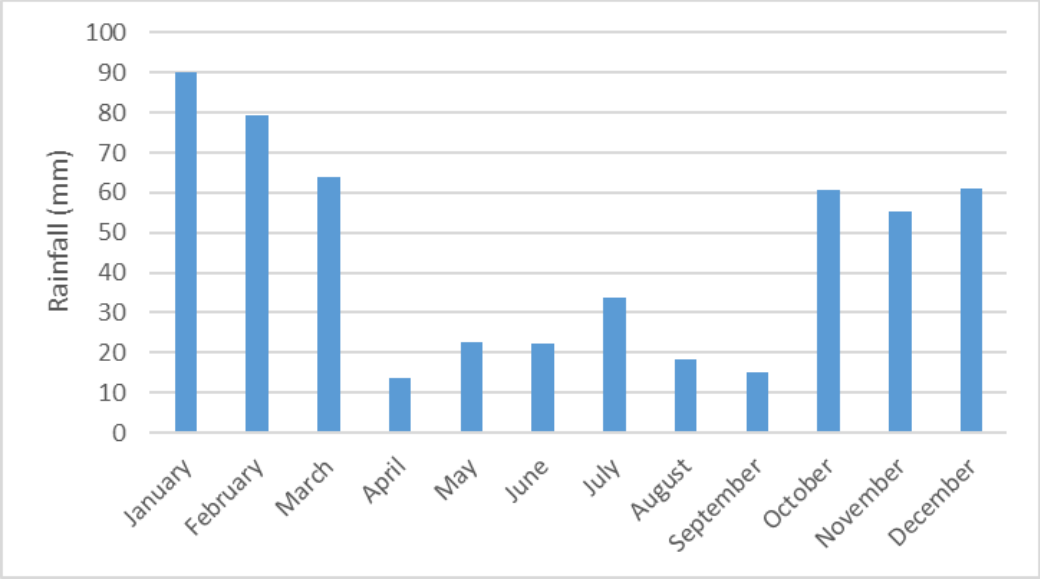


Figure 3: Average monthly rainfall and variability for the Blackwater area between 2014 and 2024 (BoM, 2025)

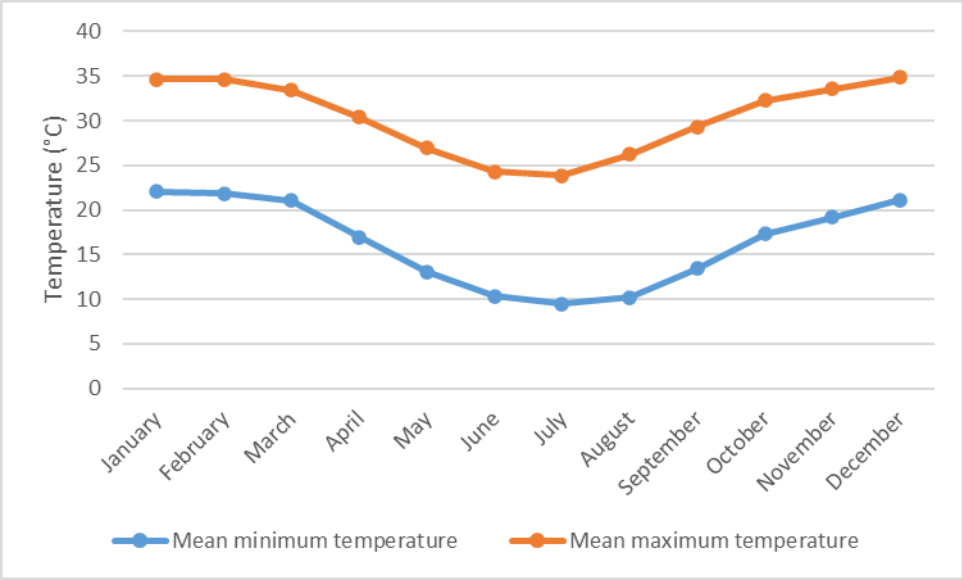


Figure 4: Average monthly temperatures for the area between 2014 and 2024 (BoM, 2025)

2.4 Topography

The Study Area has gently undulating topography, and ranges from approximately 200 m above Australian Height Datum through the centre of the Study Area to 230 metres (m) in the southern and western extents of the Study Area (Queensland Government, 2026).

2.5 Hydrology

The Study Area is intersected by several moderate watercourses, including:

- Taurus Creek in the east (stream order [SO] 4);
- Two Mile Gully in the southeast (SO 4);
- Deep Creek in the southwest (SO 2); and
- Sagittarius Creek in the north (SO 2).

Permanent water sources, such as dams, troughs and bores, are scattered throughout the Study Area.

2.6 Geology

The Geological Survey of Queensland (2024) Detailed Surface Geology Mapping and GeoScience Australia (2023) 1:100,000 geology mapping identified four geological units mapped within the Study Area (Table 1). Based on these mapped geological units, five potential land zones, as described by Wilson & Taylor (2012), may be present including:

- Land Zone 3;
- Land Zone 4;
- Land zone 5;
- Land zone 9; and
- Land Zone 10.

Table 1: Geology and land zones within the Study Area

Geological Unit	Description	Land Zone
Pwj	Late Permian - Calcareous sandstone, calcareous shale, mudstone, coal, concretionary limestone.	9 /10
Rr	Early Triassic / Middle Triassic - Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate.	9 /10
TQa	Late Tertiary / Quaternary – Locally red-brown mottled, poorly consolidated sand, silty clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected).	4 / 5
Qa	Quaternary – Quaternary alluvium containing clay, silt, sand and gravel.	3

2.7 Land use

The traditional industries of the Central Highlands region have been primarily beef and mutton, agriculture, timber, and substantial mining development (Bourne et al., 1993). Agriculture is a further emerging industry with agricultural technologies being a particular focus (Central Highlands Development Corporation, 2023). Mining is still the dominant industry in the region, with more residents working in mining than in any other industry. The regional economy is underpinned by a substantial coal deposit that facilitates more than a quarter of Queensland's total coal production (Central Highlands Development Corporation, 2023). The primary land use within the Study Area consists predominately of cattle grazing.

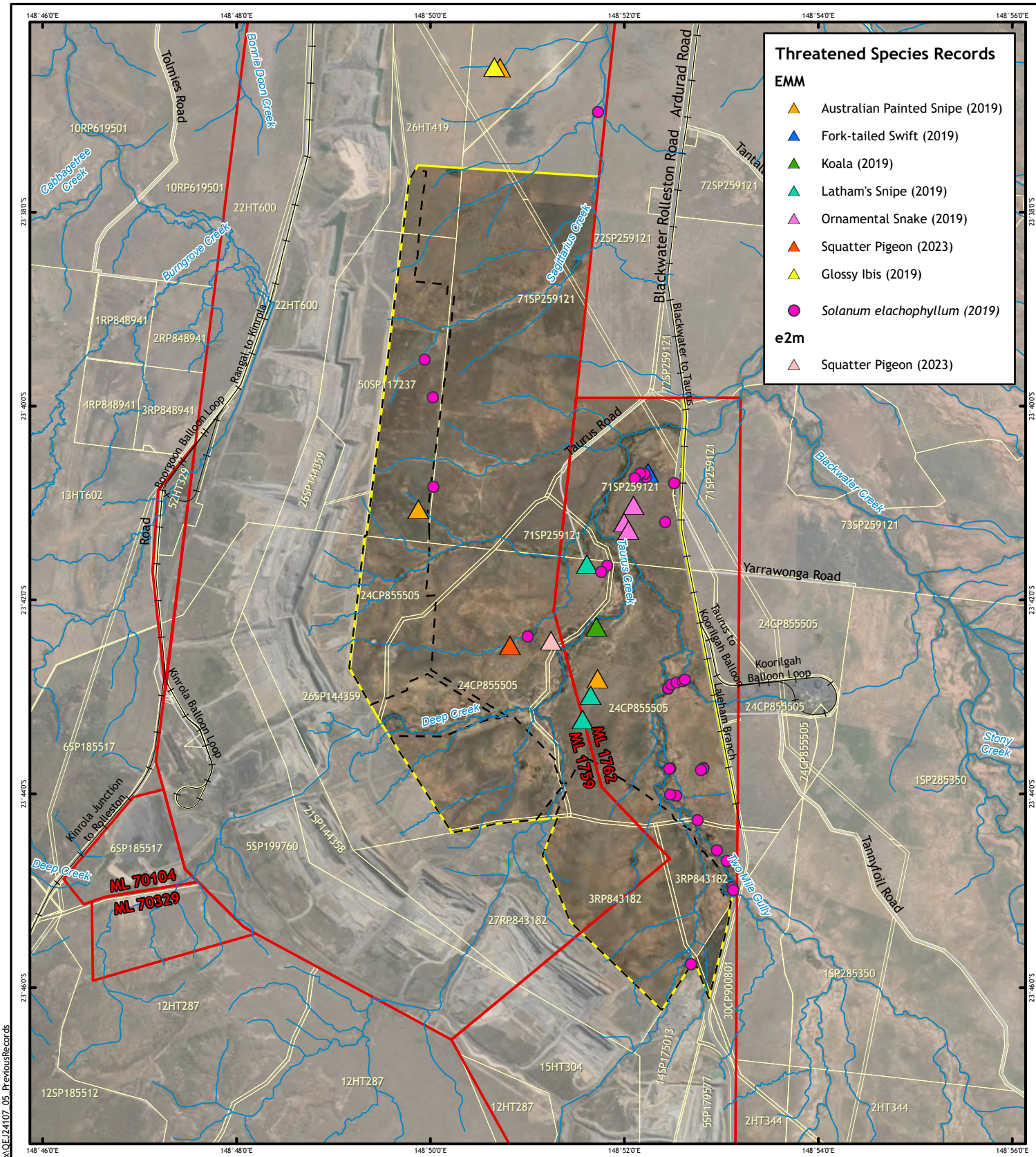
2.8 Previous surveys

Seasonal ecological surveys were commissioned by BM Alliance Coal Operations Pty Ltd and conducted by EMM Pty Ltd (EMM) (EMM, 2023a, 2023b) between 2018 and 2020, for the purpose of preparing a *Terrestrial Ecology Matters of State Environmental Significance Assessment* report (EMM, 2023b) and *Terrestrial Ecology Matters of National Environmental Significance Assessment* report (EMM, 2023a). Additionally, e2m and EMM also conducted supplementary surveys in 2023, as part of the previous assessment.Previous locations of conservation significant flora and fauna species records are depicted in Figure 5.

2.8.1 Flora surveys

Flora surveys were undertaken by EMM over three seasons at several locations across the Study Area. Summer season surveys were undertaken over five days in December 2018. The surveys focused on RE and TEC assessments whilst including threatened flora surveys and habitat assessments. Rainfall for this period were 59 mm in November, and 89 mm in October, with a mean temperature range of 21.7 °C – 34.8 °C. Autumn (post-wet) season flora surveys were undertaken in April 2019 with 62 mm of rain recorded in January, 14.6 mm in February and 179.6 mm in March. Temperatures during this survey period ranged between 14.8 °C and 30.3 °C. Spring (pre-wet) season surveys were conducted in September and October 2019, as well as early summer between 3 – 8 December 2018. 89.6mm of rain was recorded in October 2018, 59.0 mm in November 2018, and 56.6 mm in December 2018. Very little rainfall was recorded up to spring of 2019 with 1.4 mm of rain in August 2019, 0.0 mm in September 2019 and 8.2 mm in October 2019. Temperatures ranged between 24.4°C and 40.7°C during the December surveys (EMM, 2023a).

One TEC listed under the EPBC Act was recorded, namely the Brigalow (*Acacia harpophylla* [*A. harpophylla*] dominant and co-dominant) TEC, listed as Endangered. No Matters of National Environmental Significance (MNES) threatened flora species were identified as occurring within the Study Area or considered likely to occur, although one Matter of State Environmental Significance (MSES) listed threatened flora species, *Solanum elachophyllum*, was identified within the Study Area. The species was detected at 27 separate locations across the Study Area, most frequently on clay or loamy soils in fragmented non-remnant vegetation associated with *A. harpophylla, Lysiphyllum hookeri* and/or *Archidendropsis basaltica* (and mostly outside the proposed Disturbance Footprint – Figure 5). No other MSES flora species were considered likely to occur within the Study Area.



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

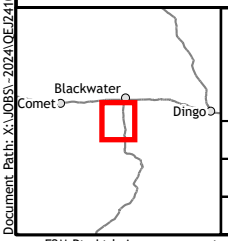
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0 2.5 5

Kilometres

Coordinate System: GDA2020



Notes:
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FIGURE 5: PREVIOUS THREATENED AND MIGRATORY SPECIES RECORDS WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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2.8.2 Fauna surveys

Fauna surveys were undertaken by four EMM field ecologists during the Autumn season (March 2019 and April 2019) and Spring (September 2019 and October 2019). The Autumn (post-wet) surveys were completed over a period of 12 days, undertaken on 18 – 24th March 2019 (diurnal surveys) and 11 – 15th April 2019 (nocturnal surveys and diurnal surveys). The Spring (pre-wet) surveys were completed over a 13-day period, from 29th September – 4th October 2019 (diurnal surveys) and 15th October – 21st October 2019 (nocturnal surveys). Supplementary Ornamental Snake and Australian painted snipe surveys were undertaken in areas of gilgai over three nights in March 2020 (EMM, 2023a).

EMM (EMM, 2023a, 2023b) confirmed the presence of five threatened EPBC Act listed species, including:

- Australian painted snipe (*Rostratula australis*) was observed on three occasions within or in proximity to the Study Area, once within cleared gilgai habitat and another two within dams observed in gilgai areas. While dams may provide more permanent foraging opportunities and ephemeral wetland habitat provide periodical foraging opportunities, no suitable breeding habitat identified within the Study Area.
- The Squatter pigeon (southern) (G*eophaps scripta scripta*) was recorded in the Study Area on two occasions during supplementary ecology surveys (undertaken by e2m and EMM) commissioned in June-August 2023, in the vicinity of two dams around Taurus Road (2 km outside the proposed Disturbance Footprint - Figure 5). Despite not being observed in over 600 hours of earlier baseline surveys, the species was found in a fragmented, degraded habitat dominated by Buffel grass, which is not ideal for the species.
- The Ornamental snake (*Denisonia maculata*) was recorded in gilgai areas between Taurus Creek and the Blackwater-Rolleston Road (4 km outside the proposed Disturbance Footprint – Figure 5). The species was found near each other over three nights of searching in March 2020, but the species appears to be scarce in the Study Area. Habitat degradation, including heavy disturbances and isolation of gilgai areas, likely reduces the species' presence.
- Koala (*Phascolarctos cinereus*) was recorded through indirect signs on three occasions. Koala scratches were recorded on *Eucalyptus tereticornis* on two occasions along Taurus Creek. Additionally, Koala scat was recorded along a tributary of Taurus Creek in the central portion of the Study Area. The Koala's status in the Study Area is likely limited to transient individuals, and the Study Area does not appear to support a permanent population.
- Latham's snipe (*Gallinago hardwickii*) was recorded at three locations across the Study Area in ephemeral gilgai habitat, which the species is likely to utilise periodically for foraging.

In addition to the Latham's snipe, EMM (EMM, 2023a) confirmed the presence of two additional migratory EPBC Act listed species:

- Glossy ibis (*Plegadis falcinellus*) was recorded once during autumn surveys on a dam in the north of the Study Area.
- Fork-tailed swift (*Apus pacificus*) was recorded on a single occasion with six individuals observed flying above the Study Area.

2.8.3 Fauna habitat surveys

EMM conducted habitat assessments across 165 sites during the survey period, where they analysed sites to determine suitable habitat presence for threatened species. This included 41 general habitat assessments during the Autumn flora survey period, and 11 during the Spring flora survey period. An additional 83 supplementary assessments were completed in June 2023, and a further in September 2023

(EMM, 2023a, 2023b). EMM's habitat assessments involved identification of the following micro-habitat attributes:

- presence of fallen logs, leaf litter, rocks;
- vegetation groundcover;
- presence of cracking soils;
- presence of rocky overhangs, caves, decorticating bark;
- foraging resources such as native grasses, preferred food trees for Koalas etc;
- available water sources;
- animal breeding places (hollow-bearing trees, dens, nests);
- presence and abundance of weeds; and
- signs of pest animals.

3 Methods

The terrestrial ecological values of the Study Area were evaluated through desktop and field assessments that were conducted in accordance with the relevant Commonwealth and State Government survey guidelines. The following sections detail the methods employed to conduct both the desktop and the field assessments as well as the survey effort undertaken.

3.1 Desktop assessment

A desktop assessment was undertaken to identify potential MNES within the Study Area prior to field surveys and to inform the likelihood of occurrence assessment (Appendix A). The assessment included a review of the following:

- Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) EPBC Act Protected Matters Search Tool (PMST) (DCCEEW, 2025a);
- Queensland Department of the Environment, Tourism, Science and Innovation (DETSI) WildNet Database (DETSI, 2025a);
- DETSI Protected Plants Flora Survey Trigger Map (DETSI, 2025b);
- DNRMMRRD- Regulated Vegetation Management Map and Vegetation Management Supporting Map, including essential habitat, watercourse and wetland mapping (DNRMMRRD, 2025a);
- DETSI remnant REs and pre-clear mapping (Version 13) and associated Regional Ecosystem Description Database (REDD) (Version 13) (Queensland Herbarium, 2023) definitions;
- Atlas of Living Australia (ALA) species search (ALA, 2025);
- GeoScience Australia 1:100,000 drainage network of Queensland (Geoscience Australia, 2023);
- DNRMMRRD, Detailed Surface Geology Map (DNRMMRRD, 2025b);
- Bureau of Meteorology (BoM) Groundwater Dependent Ecosystem (GDE) Atlas search (BoM, 2026);
- Latest available aerial photography;
- A review of historical aerial photography to determine high value regrowth vegetation (DNRMMRRD, 2025c); and
- Previous ecological assessments (including associated field data) undertaken within the Study Area, including:
  - *Blackwater Terrestrial Ecology Survey Report: Flora and fauna seasonal surveys* (EMM, 2020);
  - *Blackwater Mine—North Extension Project: Terrestrial Ecology Matters of National Environmental Significance Assessment* (EMM, 2023a); and
  - *Blackwater Mine—North Extension Project: Terrestrial Matters of State Environmental Significance Assessment* (EMM, 2023b).

Where desktop sources required a search extent, a 20 km buffer to the approximate centre of the Study Area (-23.6759, 148.8496) was applied. Results of the desktop assessments are provided in Appendix A.

3.2 Field assessment

Field surveys were conducted to identify and characterise the presence, extent and condition of terrestrial ecological values within the Study Area. The methods and timing of surveys followed applicable Commonwealth and State Government survey guidelines, conservation advice, and recovery plans:

- Survey guidelines for Australia's threatened birds (Department of the Environment, Water, Heritage and the Arts [DEWHA], 2010a);

- Survey guidelines for Australia's threatened bats (DEWHA, 2010b);
- Survey guidelines for Australia's threatened reptiles (Department of Sustainability, Environment, Water, Population and Communities [DSEWPaC], 2011a);
- Survey guidelines for Ornamental snake, released in November 2025 following the completion of field surveys (DCCEEW, 2025b);
- Survey guidelines for Australia's threatened mammals (DSEWPaC, 2011b);
- Terrestrial vertebrate fauna survey guidelines for Queensland (Eyre et al., 2022);
- Flora Survey Guidelines – Protected Plants (DETSI, 2025c); and
- Conservation Advice and Recovery Plans for listed threatened species under the EPBC Act, where relevant.

3.2.1 Survey team, timing and conditions

A summary of the survey team and timing for the four ecological surveys is provided in Table 2, with additional information on the survey conditions provided in the following sections.

Table 2: Survey team and timing

Survey Event	Survey Dates	Field Team
Wet Season (flora and fauna survey)	10/03/25 – 19/03/25	• Eamon Amsters (BSc): Professional Ecologist – 5 years' experience • Jeff Heatlie (BSc): Professional Ecologist – 5 years' experience • Tess Ramm (BSc): Professional Ecologist – 2 years' experience • Elizabeth Smith (BSc): Professional Ecologist – 2 years' experience
Late Wet Season (habitat quality survey)	14/04/25 – 17/04/25	• Chays Ogston (BSc -Hons): Principal Ecologist – 12 years' experience • Kaylee Pitt (BSc): Graduate Ecologist – 1.5 years' experience
	19/05/25 – 23/05/25	• Eamon Amsters (BSc): Professional Ecologist – 5 years' experience • Tess Ramm (BSc): Professional Ecologist – 2 years' experience
Dry Season (fauna survey)	23/09/25 – 26/09/25	• Chays Ogston (BSc -Hons): Principal Ecologist – 12 years' experience • Tess Ramm (BSc): Professional Ecologist – 2 years' experience
	29/09/25 – 03/10/25	• Matt Keir (BSc -Hons): Senior Ecologist – 4.5 years' experience • Ash Megginson (BSc): Graduate Ecologist – 0.5 years' experience

3.2.1.1 Wet season (flora and fauna survey) survey conditions

The wet season flora and fauna survey was timed to comply with optimal survey timing for the Brigalow Belt bioregion as detailed in the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022). This guideline recommends an autumn (March to mid-May) survey to capture conditions and characteristics of a late wet season period. Conditions during the survey (10 to 19 March 2025) were consistent with historical average temperatures and rainfall at Blackwater (Section 2.3). The Blackwater region had received 52.8 mm from the beginning of March to the end of the survey period (Queensland Government, 2025). Temperatures during the survey period ranged from an average minimum temperature of 21.2 °C to an average maximum temperature of 30.5 °C (Table 3) (Queensland Government, 2025).

3.2.1.2 Late wet season (habitat quality surveys) survey conditions

Late wet season surveys (habitat quality surveys) were conducted during suitable flowering and seeding conditions for perennial and annual flora species. Conditions during the surveys (13-17 April and 19-23 May 2025) were characteristic of a typical late wet season, where the dry season approaches, and these temperature and rainfall begin to fall. Although rainfall was higher than expected this late in the season (by about 50mm) (Queensland Government, 2025), temperatures were consistent with historical averages in April and May at Blackwater (Section 2.3).

3.2.1.3 Dry season (fauna survey) survey conditions

Dry season fauna surveys were conducted during optimal survey periods for targeted fauna species. Conditions during the surveys (23 – 26 September and 30 September – 3 October 2025) were characteristic of dry season conditions, where conditions were warm and dry. Maximum and minimum temperatures were typical of the historical averages. Although rainfall was higher than expected this late in the season (by about 50mm) (Queensland Government, 2025), temperatures were consistent with historical averages in April and May at Blackwater (Section 2.3).

Table 3: Summary of field survey timing and conditions

Survey Event	Dates (inclusive)	Total Days / Nights	Climate Conditions			
			Min. Temp. (°C)	Max. Temp (°C)	Rainfall (mm) (prior[1])	Rainfall (mm) (during)
Wet Season (flora and fauna)	10-19 March 2025	5 days 6 nights	19.8	31.7	14.8	67.6
Late Wet Season (habitat quality)	13-17 April 2025	4 days	14.8	29.5	111.6	0
	19-23 May 2025	5 days	23.7	28.0	19.6	0
Dry Season (flora and fauna)	23-26 September 2025	4 days 1 night	8.6	30.7	0	13.0
	30 September – 3 October 2025	4 days 3 nights	14.2	38.3	13.0	0

[1] Rainfall totals include the 30 days prior to the survey period (BoM, 2025).

3.2.2 Flora surveys

Flora survey methods undertaken across the Study Area are detailed in the following sections, with location of flora survey techniques depicted in Figure 6.

3.2.2.1 Regional ecosystems

Ground-truthing and validating vegetation community mapping within the Study Area was conducted in accordance with the *Methodology for surveying and mapping of regional ecosystems and vegetation communities in Queensland* (Neldner et al., 2025). A total of nine tertiary and 136 quaternary vegetation assessments were undertaken across the Study Area (Figure 6). Parameters recorded as part of tertiary surveys included:

- flora species composition;
- relative abundance;
- vegetation structure (height, cover and density of each stratum);
- soil and substrate characteristics (e.g. litter, rock, bare ground); and
- disturbance factors (e.g. evidence of fire, grazing, weed invasion or other environmental pressures).

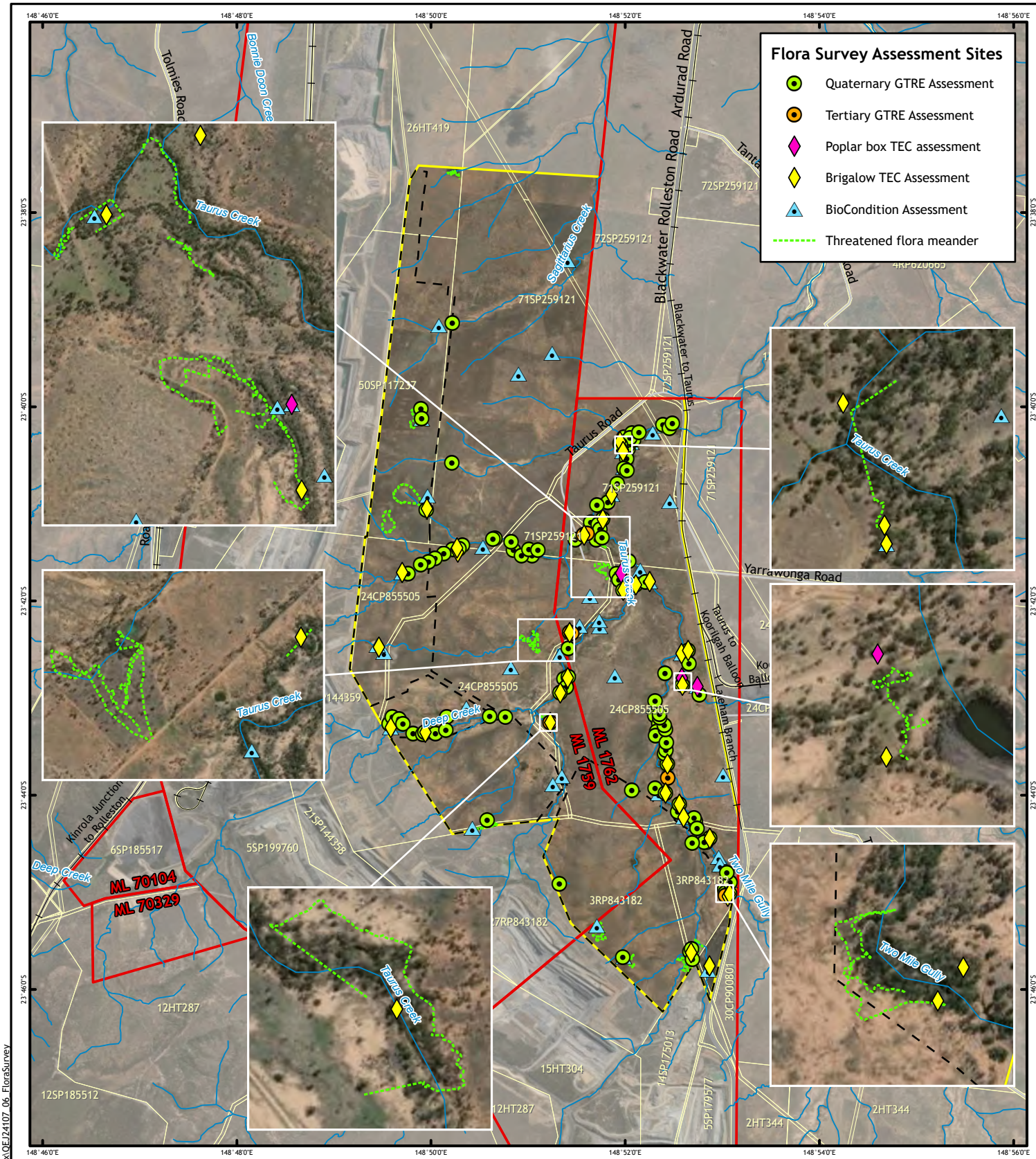
Quaternary surveys are a rapid assessment used to verify RE based on the structure, composition and condition of the ecologically dominant layer. Parameters recorded include:

- species present;
- remnant vegetation cover;
- RE map unit;
- structural code;
- ecologically dominant layer species;
- ecologically dominant layer height (in m);
- ecologically dominant layer cover (in %); and
- land zone.

Vegetation was categorised into three classes based on RE description, vegetation structure and condition. These categories included:

- **Remnant vegetation** - communities that conform with the definition under the Queensland *Vegetation Management Act 1999* (VM Act) and referenced by Neldner et al. (2025). Specifically, this comprises vegetation, part of which forms the predominant canopy of the vegetation:
  - covering more than 50% of the undisturbed predominant canopy;
  - averaging more than 70% of the vegetation's undisturbed height; and
  - composed of species characteristic of the vegetation's undisturbed predominant canopy.
- **High value regrowth** – vegetation communities that conform with the definition under the VM Act and referenced by Neldner et al. (2025). Specifically, this comprises native vegetation regrowth that is greater than 15 years old and meets the minimum cover requirements specified by Neldner et al. (2025).

- **Non-remnant** – all areas that are not mapped as remnant vegetation or high value regrowth. This includes vegetation communities that have been historically cleared/disturbed or heavily modified and areas that have a significant woody component but fails to meet the structural and/or floristic characteristics and/or time since clearing requirements of remnant vegetation or high value regrowth (Neldner et al., 2025). This vegetation category also includes areas of young woody regrowth vegetation, whereby vegetation has been historically cleared within the last 15 years or has been maintained as such from continual land management.



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

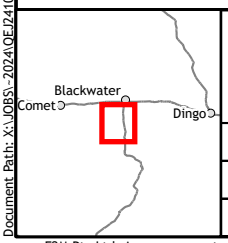
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Scale 1:100,000 (A4)

0 2.5 5

Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
Cadastre: © DNRMMRRD 2025
Ordered Drainage: © DNRMMRRD 2025
Mining Lease: © DNRMMRRD 2025

Rev	Description	Drawn	Approved	Date
1	Issued for Use	PR	CO	02/04/2026

FIGURE 6: FLORA SURVEY SITES

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

Document Path: X:\JOBS\-2024\QEJ24107\GIS\PRO\QEJ24107_EA.aprx\QEJ24107_06_FloraSurvey

E2M Pty Ltd gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability for any loss, damage or costs (including consequential damage) relating to any use of the data in this map.

3.2.2.2 Threatened ecological communities

Where a RE analogous with a TEC was identified, a TEC assessment was undertaken to determine whether the key diagnostic characteristics and condition thresholds for TECs listed under the EPBC Act were met. The assessment criteria, including specific condition thresholds and diagnostic characteristics, were drawn from the 'Approved Listing Advice' documents for each TEC identified during the desktop review. The following sections outline the field assessments undertaken to assess condition thresholds for TECs with analogous REs identified within the Study Area. While additional TECs were identified as potentially occurring within the Study Area during desktop assessment, no analogous REs were confirmed within the Study Area during surveys (refer to Section 4.1.1).

3.2.2.2.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC assessment

To determine whether a vegetation community meets the condition requirements of the Brigalow TEC (Department of the Environment [DotE], 2013a), vegetation communities containing Brigalow were assessed against the minimum thresholds for patch size and weed encroachment. Each vegetation community was also assessed on whether Brigalow (*Acacia harpophylla*) was the dominant or co-dominant species within the tree layer.

Brigalow TEC is limited to patches that meet the following key diagnostic characteristics and condition thresholds (DotE, 2013a):

Key diagnostic characteristics

A patch must include the following key diagnostic characteristics to be considered the Brigalow ecological community:

> *1) The presence of Acacia harpophylla as one of the most abundant tree species in the patch. A. harpophylla is either dominant in the tree layer, or co-dominant with other species (notably Casuarina cristata (Belah), other species of Acacia, or species of Eucalyptus).*
>
> *AND*
>
> *2a) In Queensland (Qld) - the patch is in one of the following Qld bioregions (including outliers) and it meets the description of one of 16 Qld REs determined at the time of the national listing of the Brigalow ecological community under the EPBC Act. The 16 REs are, as described by the* Queensland Herbarium (2013)*:*
>
> *In the Qld Brigalow Belt Bioregion – REs 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21;*
>
> *OR*
>
> *2c) The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs or New South Wales (NSW) vegetation communities (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.*

Condition thresholds

A patch must meet the following condition thresholds to be considered the Brigalow ecological community:

> *3) The patch is 0.5 ha or more in size;*
>
> *AND*

4) Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

Regarding Point 4, Brigalow TEC assessments involved a combination of desktop and field-based assessments to determine if vegetation within the Study Area met the condition thresholds for the Brigalow TEC specified in the Approved Conservation Advice (DotE, 2013a). Field surveys included targeted assessment of patch size (≥0.5ha), canopy cover and height, canopy composition (dominance or co-dominance of *A. harpophylla*) and non-native cover across all vegetation strata. Specific assessment methodologies for condition thresholds are specified in Table 4.

In total 24 Brigalow TEC assessments were undertaken across the Study Area (Figure 6).

Table 4: Brigalow TEC assessment methodology

Criteria/Threshold	TEC Assessment Methodology
Key diagnostic criteria	
Acacia harpophylla is either dominant in the tree layer, or co-dominant with other species.	Assessed in accordance with Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (Neldner et al., 2025).
The patch is analogous with one of the prescribed 16 REs within the appropriate bioregion, including Queensland Brigalow Belt Bioregion, Southeast Queensland Bioregion or Queensland Mulga Lands Bioregion. OR The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Queensland REs (i.e. has not been cleared for 15yrs.	• Analogous REs: Ground-truthed REs compared against 16 prescribed REs. • Species composition and structural elements: Structural condition (e.g. cover and height) assessed prescribed RE descriptions, and age of regrowth assessed against historical aerial imagery.
Condition thresholds	
The patch is 0.5 ha or more in size. AND Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha, that is representative of the patch.	• Patch size: assessed spatially, inclusive of where patches extend outside of the Study Area. • Exotic cover: % cover of exotic perennial plants was assessed within each stratum across a 50x100 m plot. Specifically, the total % cover of exotic perennial across all strata was compared against the total vegetation cover across all strata.

3.2.2.2.2 Poplar box grassy woodland on alluvial plains TEC assessment

The Poplar box TEC is associated with REs 11.3.2, 11.3.17, 11.4.7 and 11.4.12 within the Brigalow Belt and Darling Riverine Plains bioregions (Department of the Environment and Energy (DEE), 2019a). These REs form the primary vegetation communities considered representative of the TEC, subject to meeting specific condition thresholds. Poplar box TEC is limited to patches that meet the following key diagnostic characteristics and condition thresholds (DEE, 2019a):

Key diagnostic characteristics

- Location and physical environment:
  - Occurs in the Brigalow Belt North, Brigalow Belt South, Southeast Queensland, Cobar Peneplains, Darling Riverine Plains, New South Wales Southwestern Slopes, Riverina and Murray Darling Depression IBRA bioregions.

- Associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols. This includes areas that may not be part of currently defined floodplains.

- Structure:
  - A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale.
  - A tree canopy must be present that shows these features:
    - Canopy tree species capable of reaching 10 m or more in height;
      - *Eucalyptus populnea* (Poplar box) must be present in the canopy and is the dominant tree species; and
    - Where hybrids of Poplar box with other *Eucalyptus* spp. are present, they should be counted as part of the *Eucalyptus populnea* component of the tree canopy when assessing the previous criterion.
  - Mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less. A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick (in response to canopy development, soil moisture, disturbance and/or management history).
  - A ground layer (<1 m) mostly dominated across a patch by native grasses, other herbs and occasionally chenopods (during extended dry periods), ranging from sparse to thick (in response to canopy development, soil moisture, disturbance and/or management history).
  - A list of diagnostic native plant species and some of the key native fauna that make up the ecological community is provided in Appendix A of the Approved Conservation Advice (DEE, 2019a); although particular species may be abundant or rare, or not necessarily present, at every location.

Condition thresholds

The ecological community that is protected under national environment law comprises patches that meet the key diagnostic characteristics (above) and at least the minimum condition thresholds (Moderate and High condition categories A, B, or C) set out in Table 5.

Poplar box TEC assessments involved a desktop review and targeted field assessment to determine whether vegetation within the Study Area met the criteria for the Poplar box TEC. Assessments focused on confirming the presence and dominance of Eucalyptus populnea in the canopy, patch size (≥2 ha), and evaluating the condition thresholds including native species richness, ground cover composition, and weed invasion. Field surveys included floristic plots, canopy cover estimates, and identification of key indicator species. Areas of regrowth and disturbance were also assessed to determine if they met the EPBC-defined condition classes (e.g. high or low condition thresholds). Specific assessment methodologies for condition thresholds are specified in Table 5. In total three Poplar box TEC assessments were undertaken across the Study Area (Figure 6).

Table 5: Poplar box TEC condition thresholds

Category and Rationale	Native Cover and Diversity Thresholds	Minimum Patch Size Thresholds*	TEC Assessment Methodology
Class A Highest Quality			
Category A1. Little to no perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% AND ≥ 90% of perennial vegetation cover in the ground layer** is native AND ≥ 30 native plant species per patch in the ground layer	≥ 1 ha	• Patch size: assessed spatially, inclusive of where patches extend outside of the Study Area. • Crown cover: assessed as per *BioCondition Assessment Manual (V2.2)* tree canopy cover method. Specifically, utilising canopy intercept over a 100 m transect. • Perennial vegetation cover: assessed as per *BioCondition Assessment Manual (V2.2)* native perennial grass cover method. Specifically, average of five 1 x 1 m quadrats assessed at 10m intervals on alternating sides of a 50m transect. • Native plant species richness: random meander throughout patch to quantify number of native ground layer species.
Category A2. A large patch with low perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% AND ≥70% of perennial vegetation cover in the ground layer** is native AND ≥ 30 native plant spp. per patch in the ground layer	≥ 5 ha	
Class B Good Quality			
Category B. A large patch with good quality native understorey or with mature trees	The crown cover of canopy trees in the patch is ≥10% AND ≥ 50% of perennial vegetation cover in ground layer** is native AND EITHER ≥ 20 perennial native plant species per patch in the ground layer OR ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows)	≥ 5 ha	• Patch size: As above. • Crown cover: As above. • Perennial vegetation cover: As above. • Native plant species richness: As above. • Mature trees / hollows: assessed as per *BioCondition Assessment Manual (V2.2)* large tree method. Specifically, number of trees ≥ 30cm dbh and/or containing hollows was quantified across a 100 x 50m (0.5 ha) plot and multiplied to 1ha.

Category and Rationale	Native Cover and Diversity Thresholds	Minimum Patch Size Thresholds*	TEC Assessment Methodology
Class C Moderate Quality			
Category C A large patch with low native cover but retains good native understorey diversity and habitat features of mature trees	The crown cover of canopy trees in the patch is ≥10% AND If < 50% of perennial vegetation cover in ground layer** is native, then the patch must have: ≥ 20 native plant spp. per patch in the ground layer AND ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows) AND smaller trees+, saplings or seedlings suggestive of periodic recruitment	≥ 5 ha	• Patch size: As above. • Crown cover: As above. • Perennial vegetation cover: As above. • Native plant species richness: As above. • Mature trees / hollows: As above. • Smaller trees (recruitment): assessed as per *BioCondition Assessment Manual (V2.2)* recruitment method. Specifically, presence of *Eucalyptus populnea* saplings <5cm dbh was assessed across a 100 x 50m (0.5 ha) plot.

* **Minimum patch size thresholds** apply to patches of various shapes but, a minimum patch width threshold applies to linear remnants, such as along roadsides or former travelling stock routes. These are explained in the next section on 'Defining a patch'.

** **Perennial native vegetation cover in the ground layer** (i.e. below the tree canopy) includes vascular plant species of the ground layer with a life-cycle of more than two growing seasons. The ground layer includes grasses and herbs (i.e. forbs) and some low shrubs (woody plants ≤ 1 m high). Measurement of perennial ground layer vegetation cover excludes annuals, cryptogams (i.e. mosses, lichens and related flora), leaf litter or exposed soil.

*** **dbh** (diameter at breast height) refers to the tree diameter measured at 1.3 m above the ground.

+ **Trees -** Refers to *Eucalyptus populnea* (Poplar box) and/or hybrids of Poplar box with other Eucalyptus species (for instance Coolabah).

3.2.2.3 Threatened flora

Based on desktop assessment outputs (ALA, PMST, WildNet) (ALA, 2025; DCCEEW, 2025a; DETSI, 2025a) and RE mapping, threatened flora species were identified as possibly occurring within the Study Area and were specifically targeted during field surveys (Table 6). The random meander technique (refer to (Cropper, 1993)) was used to survey the potentially occurring threatened flora throughout the Study Area (Figure 6). The random meander technique involves traversing potential habitat within the Study Area and searching for flora species that may not have been located using more structured search methods. This technique is particularly suitable for locating species that typically occur at very low densities or that may be distributed in isolated clumps. Targeted surveys for threatened species using the Cropper (1993) random survey technique were undertaken for possibly occurring species identified from the desktop assessment where potential habitat was identified within the Study Area.

Though a count of individuals is usually an appropriate survey metric, in the case of two of the threatened target *Solanum* species, it was not suitable due to the nature with which these plants grow. *Solanum elachophyllum* and *S. dissectum* have been shown to form underground suckers that connect stems together, thereby making it difficult to determine the number of individuals within a given area (Fensham et al., 2019). For these species a stem count method was utilised, consistent with the approach taken by Fensham et al. (2019).

Across the Study Area 32 random meanders covering approximately 20.54 km were conducted targeting threatened plants. Additionally, six plots were undertaken to estimate population of recorded threatened flora within the Study Area.

Table 6: Flora species targeted during meander flora surveys

Species	NC Status	EPBC Status
Bertya opponens	Least concern	Vulnerable
Solanum adenophorum	Endangered	Not listed
Solanum dissectum	Endangered	Endangered
Solanum elachophyllum	Endangered	Not listed

3.2.2.4 Pest flora

The presence of pest flora species were recorded within the Study Area as part of tertiary and quaternary assessments, BioCondition surveys and while undertaking foot traverses. Pest flora species recorded include those listed under the Biosecurity Act (Department of Agriculture and Fisheries (DAF), 2023) as restricted or prohibited invasive plants, triggering General Biosecurity Obligation for landholders and proponents to manage and prevent their spread. In addition, other species not listed under the Biosecurity Act, but in which may negatively affect native plant communities were recorded. This includes species listed as WoNS (Centre for Invasive Species Solutions, 2025) requiring priority management due to their invasive nature and ecological impacts.

3.2.2.5 Opportunistic observations

Flora species observed that were not recorded via other survey methods, were also collected as opportunistic observations. This included those species observed while driving or walking between survey sites.

3.2.3 Fauna surveys

Fauna surveys involved a combination of targeted surveys and habitat suitability assessments (Figure 7) to determine likely presence/absence of target species. Fauna survey techniques undertaken during field surveys are detailed in the following sections and based on the following guidelines:

- Survey guidelines for Australia's threatened birds (DEWHA, 2010a);
- Survey guidelines for Australia's threatened bats (DEWHA, 2010b);
- Survey guidelines for Australia's threatened reptiles (DSEWPaC, 2011a);
- Survey guidelines for Australia's threatened mammals (DSEWPaC, 2011b);
- Terrestrial vertebrate fauna survey guidelines for Queensland (Eyre et al., 2022); and
- Conservation Advice and Recovery Plants for listed threatened species under the EPBC Act, where relevant.

3.2.3.1 Habitat suitability assessments

Habitat suitability assessments were undertaken throughout the Study Area to identify the presence of habitat features that may support target fauna. Specifically, the following features were assessed:

- the presence and condition of watercourses, wetlands, or artificial waterbodies (e.g., dams), including relative permanency of water;
- abundance of Locally Important Koala Tree (LIKTs) species and ancillary shelter species as identified by Youngentob et al. (2021);
- presence and abundance of feed tree species (e.g. known feed tree species for Greater glider);
- presence and abundance of native grasses and forbs;
- abundance of hollow bearing trees and logs;
- abundance of coarse woody debris and leaf litter;
- soil crack abundance and depth; and
- evidence of existing threats, including:

- presence and abundance of feral species (i.e. wild dogs, feral cats, European foxes etc.);
- woody weed encroachment;
- presence and abundance of barbed wire fencing;
- presence and abundance of cattle;
- extent and severity of habitat fragmentation; and
- bushfire risk (i.e. high fuel loads, fire-prone species).

Habitat suitability assessments were completed at 48 sites across the Study Area (Figure 7). The outcomes of these habitat assessments were used to map species habitat and direct targeted fauna survey effort for threatened fauna. Habitat quality surveys are described in Section 3.2.5.

3.2.3.2 Motion detection cameras

A combination of baited and non-baited camera traps were deployed to assist with the detection of target fauna (e.g. Squatter pigeon (southern) and Australian painted snipe) and pest fauna species that may pose a threat to native species (e.g. wild dogs, feral cats and foxes). Camera traps were deployed at six locations for a minimum of five nights within the Study Area during the wet season survey, totalling 32 nights, and at four locations for a minimum of ten consecutive nights during the dry season survey (Figure 7). As described in Section 2.8, the Squatter pigeon (southern) and Australian painted snipe are known to be present.

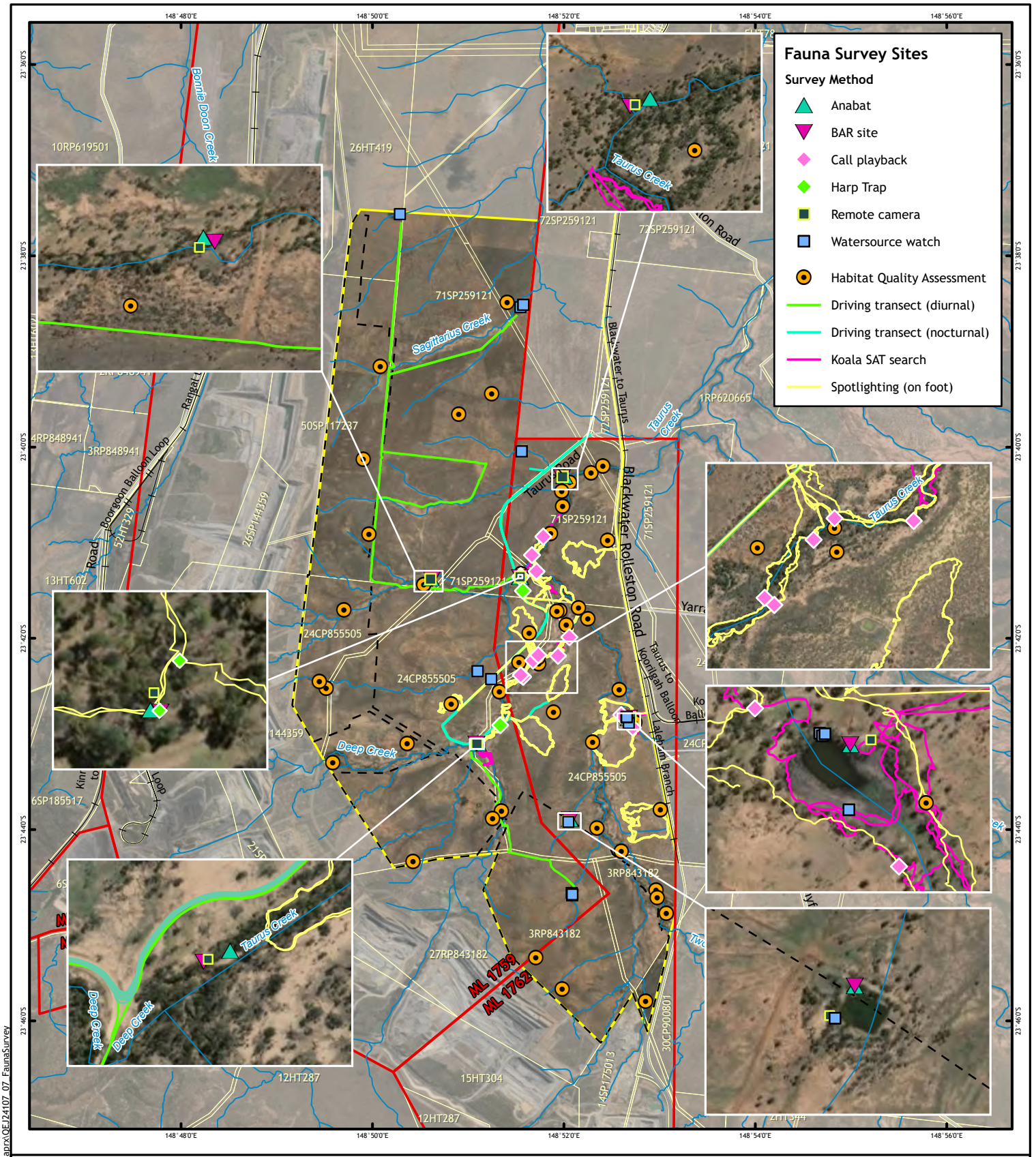
3.2.3.3 Harp trapping

Harp trapping was undertaken during the late wet season to target Corben's long-eared bat (*Nyctophilus corbeni*) in accordance with the *Survey guidelines for Australia's threatened bats* (DEWHA, 2010b). Harp traps were set at locations considered likely to be used by the species (e.g. flyways and water sources) and all bat species caught were identified and recorded. Traps were set at four locations over a minimum of four consecutive nights, totalling 16 trap nights during the wet season survey at four locations. Survey locations are depicted in Figure 7.

3.2.3.4 Ultrasonic recorders

Ultrasonic recorders (Anabats) were deployed within the Study Area, to detect potential presence of threatened microbats. Similarly to harp traps, Anabats were deployed in areas likely to contain microbats (e.g. flyways and water sources). Devices were set at six locations over a minimum of five consecutive nights, totalling 32 trap nights during the wet season survey (Sites BAT fl 1, BAT fl 2, E2M022, E2M023, E2M024 and E2M025), and three locations over a minimum of ten consecutive nights (Sites E2M09, E2M010 and E2M012), totalling 30 trap nights during the dry season survey at the locations depicted in Figure 7.

Anabat detector data was first analysed by E2M (Eamon Amsters) with any possible detections of potentially occurring target fauna (i.e. *Nyctophilus corbeni* and *Chalinolobus dwyeri*) vetted by Greg Ford (Balance! Environmental).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

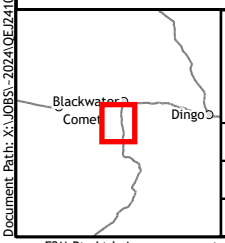
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Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
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Rev	Description	Drawn	Approved	Date
1	Issued for Use	PR	CO	02/04/2026

FIGURE 7: FAUNA SURVEY SITES

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

Document Path: X:\JOBS\-2024\QEJ24107\GIS\PRO\QEJ24107_EA.aprx\QEJ24107_07_FaunaSurvey

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3.2.3.5 Nocturnal spotlighting

Nocturnal spotlighting surveys targeting Ornamental snake, Greater glider (southern) and Koala were undertaken within suitable habitat by two ecologists equipped with a handheld torch/spotlight and head torches. Nocturnal spotlighting surveys were conducted for a minimum of 3 hours per night, traversing areas of suitable habitat on foot. Call playback targeting the key threatened species was undertaken during these surveys. Spotlighting surveys were undertaken across four nights during the wet season survey and four nights during the dry season survey, totalling 17 person hours. Location of spotlighting transects are depicted in Figure 7 .

3.2.3.6 Diurnal water source watches

Water source watches including flushing surveys were conducted at suitable water sources across the Study Area. Surveys involved either stationary visual assessments or flushing surveys for a minimum of 30 minutes either early morning or late afternoon. Water source watches were undertaken during the wet season totalling 16 person hours (across nine sites) and 22.25 person hours during the dry season (across seven sites), totalling 38.25 person hours of water source watches. Location of water source watches are depicted in Figure 7.

3.2.3.7 Koala spot assessment technique and scratch surveys

The Koala spot assessment technique (SAT) (Phillips & Callaghan, 2011) involves systematically search for Koala scats under trees of preferred Koala food species and an appropriate size (at least 10 centimetres (cm) diameter at breast height) in a given area. More specifically, scats are searched for within a 1 m radius of the base of a central tree and its nearest 29 neighbouring trees. SAT surveys were combined with bark scratch surveys and were undertaken at 14 locations, ten during the wet season and four during the dry season (Figure 7). The bark scratch surveys involved inspecting the lower trunks (0-2 m height) of preferred and secondary food trees for evidence of claw marks consistent with Koala use. Trees were examined for vertical scratches with fresh or weathered characteristics. These surveys were conducted within potential Koala habitat and areas of preferred Eucalypt species.

3.2.4 Threatened species habitat mapping

Habitat for each relevant threatened species was mapped based on using a combination of desktop analysis and field validation. The initial desktop assessment utilised species distribution data from the EPBC PMST, Queensland Wildlife Online, RE mapping, topography, and known habitat preferences as outlined in the species profiles and conservation advice (EPBC Listing Advice, Recovery Plans, Species Profile and Threats Database (SPRAT) profiles).

Potential habitat was then refined during field surveys by ground-truthing vegetation communities, verifying the presence of key habitat features, and assessing condition and connectivity. Species-specific criteria such as presence of suitable food sources, breeding habitat, and microclimate were considered for each species. Only those areas meeting the known ecological requirements of each species were mapped as potential suitable habitat. Areas that were too degraded, fragmented, or lacked essential habitat components were excluded.

The results and mapped habitat extents for each relevant threatened species are summarised in Section 4.2.3. Species-specific mapping rationale, likelihood of occurrence, and supporting field observations are also discussed.

3.2.5 Habitat quality surveys

Habitat quality was calculated differently for MNES and MSES matters. Specifically, MSES habitat quality was undertaken in accordance with the *Guide to determining terrestrial habitat quality: Methods for assessing habitat quality (version 1.3)* (Department of Environment and Science [DES], 2020), while MNES and dual-listed (both MNES and MSES) Prescribed Environmental Matters (PEMs) were assessed in accordance with the Commonwealth Government *Modified Habitat Quality Assessment (MHQA)* method, which uses methods detailed within the *Guide to determining terrestrial habitat quality* (Version 1.2) (DEHP, 2017) (habitat quality guide). The MHQA method assesses key requirements in accordance with the EPBC *Act Environmental Offsets Policy 2022* (EO Policy). The MHQA method involves the collection of data relating to three key attributes, namely:

- Site condition;
- Site context; and
- Specie stocking rate.

In determining habitat quality scores, habitat areas were first delineated into Assessment Units (AUs). An AU refers to an area or a group of areas within the matter area (i.e. the Offset Area or Impact Area) that is homogenous in vegetation community classification (i.e. RE) and broad condition state (i.e. remnant, regrowth, non-remnant). Each AU reflects a particular community with similar structure, function and quality of habitat. Sampling sites were then selected for each AU and relevant attribute data was collected at each sampling site.

A Trimble TDC600 Global Positioning System device was used to record the location of mid-point (50 m mark) of each assessment site. Further detail regarding data collected for each of the three attributes is provided in the following sections.

Detailed description of habitat quality scoring methodology is presented in Section 3.3.

3.2.6 Survey effort

The following section summarises the ecological survey effort that has occurred within the Study Area during the E2M 2025 surveys (refer to Table 7). The timing and survey effort undertaken during these surveys was designed with reference to the:

- Nature of the target species (e.g. home range size, population density);
- Conditions within the Study Area (e.g. habitat availability); and
- Recommended survey effort guidelines prescribed by the relevant Commonwealth and/or Queensland government guidelines.

Survey effort completed as part of E2M 2025 surveys and previous surveys undertaken by EMM in 2019-2020, were assessed against relevant Commonwealth and State survey guidelines (refer to Table 8).

Table 7: E2M 2025 Survey effort summary

Survey Technique	Effort Unit	Survey Effort		
		Wet Season / Late Wet Season	Dry Season	Total
Flora				
Tertiary assessment	Number of sites	9	-	9
Quaternary assessment	Number of sites	136	6	142
TEC assessment	Number of sites	27	2	29
Threatened flora meander searches	Number of meanders / km	18 / 9.49 km	14 / 11.05 km	32 / 20.54 km
Fauna				
Ultrasonic recorders	Recorder nights	32	30	62
Harp traps	Trap nights	16	-	16
Bioacoustics recorders	Recorder days/nights	32	40	72
Motion cameras	Recorder days/nights	32	40	72
Water source watches	Person hours	16	22.25	38.25
Diurnal SAT searches	Person hours	8	8.5	16.5
Diurnal driving transects	Person hours	12	6	18
Nocturnal spotlighting	Person hours	32	17	49

Table 8: Survey effort against survey guidelines

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
Threatened flora – excluding species considered unlikely to occur based on desktop assessment					
Bertya opponens	No specific survey guidelines are prescribed.	No specific survey guidelines are prescribed for *Bertya opponens*.	During suitable conditions, two timed meanders were undertaken within high-risk area on flora survey trigger map as per Flora Survey Guidelines methodology, covering an approximate area of 58 ha. Broader EVNT flora species surveys were undertaken outside high-risk areas while completing other flora surveys across the Study Area.	A total of 32 threatened flora meander searches totalling 20.54 km were undertaken during wet season (March-May) and dry season (September) field surveys targeting threatened flora. During this time *Solanum elachophyllum* were found to be readily identifiable from vegetative matter (i.e. not requiring flowers or fruit). Opportunistic searches were undertaken while traversing the Study Area.	Survey effort includes: • 34 combined threatened flora meander searches (EMM - 58 ha, E2M - 20.54 km); and • opportunistic searches while traversing the Study Area. No specific survey guidelines are prescribed for threatened flora in the Study Area. The Disturbance Footprint has been extensively searched during the field surveys completed to date and known habitat quantified.
Solanum adenophorum	The species has been recorded flowering in October and fruiting in May, September and October (Bean, 2004).	No specific survey guidelines are prescribed for this *Solanum* species.			
Solanum dissectum	The species has been reported as flowering between July and November and fruiting between March and July (DotE, 2015a).	No specific survey guidelines are prescribed for this *Solanum* species.			

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
Solanum elachophyllum	February to September (DES, 2023).	No specific survey guidelines are prescribed for this *Solanum* species.			
Fauna – excluding species considered unlikely to occur based on desktop assessment					
Reptiles					
Ornamental snake (*Denisonia maculata)*	Late-September to late-March (DSEWPC, 2011b)	The *Draft Referral Guidelines for Nationally Listed Brigalow Belt Reptiles* (DSEWPC, 2011b) recommend 1.5 hours of spotlighting per hectare of suitable Ornamental snake habitat, which equates to 744 hours of spotlighting effort. The guideline document also recommends the use of funnel traps across a period of four	**Wet season:** • 16.5 person hours of active diurnal searches of gilgai and trap sites • pitfall and funnel trapping comprising four trap nights at four sites, totalling 64 pitfall trap nights and 96 funnel trap nights; and • 24 person hours over four consecutive nights and 60 hours over three consecutive nights of	**Wet season:** • 8 person hours of active diurnal searches in suitable habitat; and • 32 person hours of nocturnal spotlighting searches across six nights. **Dry season:** • 8.5 person hours of active diurnal searches in suitable habitat; and • 17 person hours of nocturnal spotlighting searches across four nights. **TOTAL:**	Survey effort includes: • 37 person hours of active diurnal searches in suitable habitat • 128 pitfall trapping nights • 196 funnel trapping nights; and • 182.5 person hours of nocturnal spotlighting searches across 22 nights. The funnel trapping survey effort meets the survey guideline requirements. Spotlighting at the density required to cover all potential Ornamental snake habitat within the

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
		days (DSEWPC, 2011b). Survey guidelines for Ornamental snake, released in November 2025 recommends 240 minutes of spotlight searches per 5 ha of suitable habitat(DCCEEW, 2025m). This amounts to 398 hours of spotlighting effort.	nocturnal spotlighting searches. **Dry season:** • four person hours of diurnal active searches at trap sites for 30 minutes • four trap nights at four trap sites, totalling 64 pitfall trap nights and 100 funnel trap nights; and • 49.5 person hours of nocturnal spotlighting across five consecutive nights. **TOTAL:** • 20.5 person hours active diurnal searches of gilgai and trap site quadrants	• 16.5 person hours of diurnal active searches in suitable habitat; and • 49 person hours of nocturnal spotlighting searches across ten nights.	Study Area at the recommended survey effort would be prohibitive. Although the total spotlighting effort undertaken was 182.5 person-hours, which is below the levels recommended in both the 2011 (744 hrs) and 2025 (398 hrs) survey guidelines, the effort conducted by EMM and E2M across the Study Area is considered sufficient. The level of survey effort resulted in the detection of Ornamental snake within the Study Area.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• 128 pitfall trap nights • 196 funnel trap nights; and • 133.5 person hours over four of spotlighting.		
Birds					
Australian painted snipe (*Rostratula australis*)	No optimal survey period specified	Targeted stationary observations at suitable wetlands for ten hours over five days are recommended (DEWHA, 2010b).	**Wet season:** • 18.5 person hours of diurnal bird surveys (including water source watches) • 79 person hours of nocturnal spotlighting; and • 10 motion detection camera trap nights. **Dry season:** • 10 person hours of diurnal bird surveys (including	**Wet season:** • 16 person hours of diurnal bird surveys (including water source watches) • 32 person hours of nocturnal spotlighting across six nights; and • 32 motion detection camera trap nights. **Dry season:** • 22.25 person hours of diurnal bird surveys (including water source watches);	Survey effort includes: • 66.75 person hours of diurnal bird surveys (including water source watches) • 175.5 person hours of spotlighting; and • 93 motion detection camera trap nights. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			water source watches) • 47.5 person hours of nocturnal spotlighting across 5 nights; and • 11 motion detection camera trap nights. **TOTAL:** • 28.5 person hours of diurnal bird surveys • 126.5 person hours of spotlighting; and • 21 motion detection camera trap nights.	• 17 person hours of nocturnal spotlighting across four nights; and • 40 motion detection camera trap nights. **TOTAL:** • 38.25 person hours of diurnal bird surveys (including water source watches) • 49 person hours of nocturnal spotlighting across ten nights; and • 72 motion detection camera trap nights.	
Latham's snipe (*Gallinago hardwickii*)	October to February (DCCEEW, 2025e)	No specific survey guidelines are prescribed for the species.	No targeted surveys undertaken. However, other habitat preferences similar to Australian painted snipe which	**Wet season:** • 16 person hours of diurnal bird surveys (including water source watches)	Survey effort includes: • 66.75 person hours of diurnal bird surveys (including water source watches)

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			was targeted during surveys (as below). **Wet season:** • 18.5 person hours of diurnal bird surveys (including water source watches) • 79 person hours of nocturnal spotlighting; and • 10 motion detection camera trap nights. **Dry season:** • 10 person hours of diurnal bird surveys (including water source watches) • 47.5 person hours of nocturnal spotlighting across 5 nights; and	• 32 person hours of nocturnal spotlighting across six nights; and • 32 motion detection camera trap nights. **Dry season:** • 22.25 person hours of diurnal bird surveys (including water source watches) • 17 person hours of nocturnal spotlighting across four nights; and • 40 motion detection camera trap nights. **TOTAL:** • 38.25 person hours of diurnal bird surveys (including water source watches) • 49 person hours of nocturnal spotlighting across ten nights; and	• 175.5 person hours of spotlighting; and • 93 motion detection camera trap nights. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• 11 motion detection camera trap nights. **TOTAL:** • 28.5 person hours of diurnal bird surveys • 126.5 person hours of spotlighting; and • 21 motion detection camera trap nights.	• 72 motion detection camera trap nights.	
Squatter pigeon (southern subspecies) (*Geophaps scripta scripta*)	May to October (DCCEEW, 2023g)	The *Survey Guidelines for Australia's Threatened Birds* (DEWHA, 2010b) recommends 15 hours of survey effort for the species over three days for areas less than 50 ha. Additional recommended survey methods include slow	**Wet season:** • 370 person hours of dedicated bird surveys (on foot or driving) over 19 days, • 42 motion detection camera trap nights; and • approximately 125 person hours spent opportunistically	**Wet season:** • 16 person hours of diurnal bird surveys (incl. water source watches), • 32 bioacoustic recorder deployment days, • 32 motion detection camera trap nights; and	Survey effort includes: • 551.25 person hours of diurnal bird surveys (incl. walking transects, driving transects and water source watches) • 144 motion detection camera trap nights • 70 bioacoustic recorder deployment days; and

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
		drive transects and diurnal stationary observations at water sources (DCCEEW, 2023g)	across the Study Area. **Dry season:** • 125 person hours of dedicated bird surveys (on foot or driving) over seven days, • 30 camera trap nights; and • approximately 370 person hours spent opportunistically across the Study Area. **TOTAL:** • 495 person hours of dedicated bird surveys (on foot or driving) over 26 days • 72 camera trap nights • Approximately 495 person hours spent	• 12 person hours of diurnal driving transects; and • approximately 252 person hours spent opportunistically searching across the Study Area. **Dry season:** • 22.25 person hours of diurnal bird surveys (incl. water source watches) • 38 bioacoustic recorder deployment days, • 40 motion detection camera trap nights, • 6 person hours of diurnal driving transects; and • approximately 72 person hours spent opportunistically searching across the Study Area.	• 819 person hours of opportunistically across 61 days. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			opportunistically searching across the Study Area over 42 days in total.	**TOTAL:** • 38.25 person hours of diurnal bird surveys (incl. water source watches), • 70 bioacoustic recorder deployment days, • 72 motion detection camera trap nights, • 18 person hours of diurnal driving transects; and • approximately 324 person hours spent opportunistically searching across the Study Area over 19 days.	
White-throated needletail (*Hirundapus caudacutus*)	October to April (TSSC, 2019)	No specific survey guidelines are prescribed for this species; however, general diurnal bird survey methods are appropriate	**Wet Season** • 26.6 person hours of diurnal bird surveys (transect surveys and water source watches); and	**Wet season:** • 16 person hours of diurnal bird surveys (incl. water source watches); and • approximately 252 person hours spent	Survey effort includes: • 91.35 person hours of diurnal bird surveys (transect surveys and water source watches); and

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
		(DEWHA, 2010b; Eyre et al., 2018).	• approximately 125 person hours spent opportunistically across the Study Area. **Dry season** • 26.5 person hours of diurnal bird surveys (transect surveys and water source watches); and • Approximately 370 person hours spent opportunistically across the Study Area. **TOTAL** • 53.1 person hours of diurnal bird surveys; and • approximately 495 person hours spent opportunistically searching across	opportunistically searching across the Study Area. **Dry season:** • 22.25 person hours of diurnal bird surveys (incl. water source watches); and • Approximately 72 person hours spent opportunistically searches across the Study Area. **TOTAL:** • water source watches totalling 38.25 person hours; and • approximately 324 person hours spent opportunistically searching across the Study Area over 19 days	• 819 person hours of opportunistically across 61 days. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			the Study Area over 42 days in total.		
Sharp-tailed sandpiper (*Calidris acuminata*)	August to April (DCCEEW, 2025c)	No specific survey guidelines for species. Guidelines listed in Australia painted snipe used as a surrogate.	No targeted surveys undertaken. However, other habitat preferences similar to Australian painted snipe which was targeted during surveys (as below). **Wet season:** • 18.5 person hours of diurnal bird surveys (including water source watches); and • 10 motion detection camera trap nights. **Dry season:** • 10 person hours of diurnal bird surveys (including water source watches); and	**Wet season:** • 16 person hours of diurnal bird surveys (including water source watches); and • 32 motion detection camera trap nights. **Dry season:** • 22.25 person hours of diurnal bird surveys (including water source watches); and • 40 motion detection camera trap nights. **TOTAL:** • 38.25 person hours of diurnal bird surveys; and • 72 motion detection camera trap nights.	Survey effort includes: • 66.75 person hours of diurnal bird surveys (including water source watches) • 93 motion detection camera trap nights.; and • Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• 11 motion detection camera trap nights. **TOTAL:** • 28.5 person hours of diurnal bird surveys; and • 21 motion detection camera trap nights.		
South-eastern Glossy black-cockatoo (*Calyptorhynchus lathami lathami*)	No optimal survey timing	Diurnal bird surveys for 5 hours over 1 day per 50 ha of project area. A search for foraging and nesting signs for 20 hours over 4 days per 50 ha of project area (Hourigan, 2012b).	**Wet Season** • 26.6 person hours of diurnal bird surveys (transect surveys and water source watches); and • approximately 125 person hours spent opportunistically across the Study Area. **Dry season** • 26.5 person hours of diurnal bird	**Wet season:** • 16 person hours of diurnal bird surveys (incl. water source watches) • 32 bioacoustic recorder deployment days; and • approximately 252 person hours spent opportunistically searching across the Study Area. **Dry season:** • 22.25 person hours of diurnal bird surveys	Survey effort includes: • 91.35 person hours of diurnal bird surveys (transect surveys and water source watches) • 70 bioacoustic recorder deployment days; and • 819 person hours of opportunistically across 61 days. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			surveys (transect surveys and water source watches); and • Approximately 370 person hours spent opportunistically across the Study Area. **TOTAL** • 53.1 person hours of diurnal bird surveys; and • approximately 495 person hours spent opportunistically searching across the Study Area over 42 days in total.	(incl. water source watches) • 38 bioacoustic recorder deployment days; and • Approximately 72 person hours spent opportunistically searches across the Study Area. **TOTAL:** • 38.25 person hours of diurnal bird surveys (incl. water source watches) • 70 bioacoustic recorder deployment days; and • approximately 324 person hours spent opportunistically searching across the Study Area over 19 days	
Painted honeyeater (*Grantiella picta*)	Early spring to late summer	Per 50 ha of suitable habitat, 4 hours of area	**Wet Season**	**Wet season:**	Survey effort includes:

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
	(Rowland, 2012)	searches are recommended for a minimum of 4 days (Rowland, 2012).	• 26.6 person hours of diurnal bird surveys (transect surveys and water source watches); and • approximately 125 person hours spent opportunistically across the Study Area. **Dry season** • 26.5 person hours of diurnal bird surveys (transect surveys and water source watches); and • Approximately 370 person hours spent opportunistically across the Study Area. **TOTAL**	• 16 person hours of diurnal bird surveys (incl. water source watches) • 32 bioacoustic recorder deployment days; and • approximately 252 person hours spent opportunistically searching across the Study Area. **Dry season:** • 22.25 person hours of diurnal bird surveys (incl. water source watches) • 38 bioacoustic recorder deployment days; and • Approximately 72 person hours spent opportunistically searches across the Study Area. **TOTAL:**	• 91.35 person hours of diurnal bird surveys (transect surveys and water source watches) • 70 bioacoustic recorder deployment days; and • 819 person hours of opportunistically across 61 days. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• 53.1 person hours of diurnal bird surveys; and • approximately 495 person hours spent opportunistically searching across the Study Area over 42 days in total.	• 38.25 person hours of diurnal bird surveys (incl. water source watches) • 70 bioacoustic recorder deployment days; and • approximately 324 person hours spent opportunistically searching across the Study Area over 19 days	
Fork-tailed swift (*Apus pacificus*)	September to April (DCCEEW, 2025b)	No formal survey guidelines are prescribed for this species; however, general guidance is provided in the *Draft referral guideline for 14 birds listed migratory under the EPBC Act* (DotE, 2015c) which states that observations should be made	**Wet Season** • 26.6 person hours of diurnal bird surveys (transect surveys and water source watches); and • approximately 125 person hours spent opportunistically across the Study Area. **Dry season**	**Wet season:** • 16 person hours of diurnal bird surveys (incl. water source watches); and • approximately 252 person hours spent opportunistically searching across the Study Area. **Dry season:** • 22.25 person hours of diurnal bird surveys	Survey effort includes: • 91.35 person hours of diurnal bird surveys (transect surveys and water source watches); and • 819 person hours of opportunistically across 61 days. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
		from elevated viewpoints, in the late afternoon, near tall trees.	• 26.5 person hours of diurnal bird surveys (transect surveys and water source watches); and • Approximately 370 person hours spent opportunistically across the Study Area. **TOTAL** • 53.1 person hours of diurnal bird surveys; and • approximately 495 person hours spent opportunistically searching across the Study Area over 42 days in total.	(incl. water source watches); and • Approximately 72 person hours spent opportunistically searches across the Study Area. **TOTAL:** • 38.25 person hours of diurnal bird surveys (incl. water source watches); and • approximately 324 person hours spent opportunistically searching across the Study Area over 19 days	
Glossy ibis (*Plegadis falcinellus*)	March to August (DCCEEW, 2025l)	No formal survey guidelines are prescribed for this species.	No targeted surveys undertaken. However, other habitat preferences	**Wet season:** • 16 person hours of diurnal bird surveys	Survey effort includes: • 66.75 person hours of diurnal bird surveys

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			similar to Australian painted snipe which was targeted during surveys (as below). **Wet season:** • 18.5 person hours of diurnal bird surveys (including water source watches); and • 10 motion detection camera trap nights. **Dry season:** • 10 person hours of diurnal bird surveys (including water source watches); and • 11 motion detection camera trap nights. **TOTAL:** • 28.5 person hours of diurnal bird surveys; and	(including water source watches); and • 32 motion detection camera trap nights. **Dry season:** • 22.25 person hours of diurnal bird surveys (including water source watches); and • 40 motion detection camera trap nights. **TOTAL:** • 38.25 person hours of diurnal bird surveys; and • 72 motion detection camera trap nights.	(including water source watches); and • 93 motion detection camera trap nights. Survey effort meets the survey guideline requirements.

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• 21 motion detection camera trap nights.		
Mammals					
Koala (*Phascolarctos cinereus*)	No optimal survey period specified	Survey effort is not prescribed but established survey methods include: • Nocturnal spotlighting; and • Spot Assessment Technique surveys (Eyre et al., 2018; Phillips & Callaghan, 2011).	**Wet season:** • 4 SAT surveys totalling 3.65 km of diurnal transects • 1.5 km spotlighting transects; and • additional nocturnal spotlighting around two trap sites. **Dry season:** • 2 SAT surveys totalling 4.2 km of diurnal transects • 7 km of nocturnal spotlighting transects	**Wet season:** • diurnal SAT searches totalling eight person hours • 32 person hours of nocturnal spotlighting across six nights; and • six bioacoustics recorders over five-six nights totalling 32 trap nights. **Dry season:** • 8.5 person hours of SAT searches, • 17 person hours of nocturnal spotlighting; and • 10 bioacoustics recorders totalling 38 trap nights.	No specific survey guidelines are available for the species; however, general arboreal mammal surveys methods and SAT searches have been applied. Extensive field surveys have been completed to date, including: • 6 SAT surveys totalling 7.85 km of diurnal transects (EMM) • 16.5 person hours of SAT searches (E2M) • 8.5 km of nocturnal spotlighting transects (EMM) • 49 person hours of nocturnal spotlighting (E2M)

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			• additional nocturnal spotlighting around two trap sites; and • call playback. **TOTAL:** • 6 SAT surveys totalling 7.85 km of diurnal transects, • 8.5 km spotlighting transects; and • call playback.	**TOTAL:** • 16.5 person hours of SAT searches, • 49 person hours of nocturnal spotlighting; and • 16 bioacoustics recorders totalling 70 trap nights.	• 16 bioacoustics recorders totalling 70 trap nights; and • additional nocturnal spotlighting around two trap sites (EMM).
Short-beaked echidna (*Tachyglossus aculeatus*)	No optimal survey period specified	No specific survey guidelines are prescribed for the species.	No targeted surveys undertaken. However, other general mammal surveys undertaken, including: **Wet season:** • 16.5 person hours of active diurnal searches • 24 person hours of nocturnal	**Wet season:** • 8 person hours of active diurnal searches • 32 person hours of nocturnal spotlighting searches • 32 motion detection camera trap nights; and	Extensive survey effort has been completed across the Study Area, including: • 36.5 person hours of active diurnal searches have been completed • 49 person hours of nocturnal spotlighting (E2M)

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			spotlighting searches • 42 motion detection camera trap nights; and • approximately 125 person hours spent opportunistically across the Study Area **Dry season:** • 4 person hours of active diurnal searches • 49.5 person hours of nocturnal spotlighting searches • 30 camera trap nights; and • approximately 370 person hours spent opportunistically across the Study Area.	• approximately 252 person hours spent opportunistically **Dry season:** • 8.5 person hours of active diurnal searches in suitable habitat • 17 person hours of nocturnal spotlighting searches across four nights • 40 motion detection camera trap nights; and • approximately 72 person hours spent opportunistically **TOTAL:** • 16.5 person hours of diurnal active searches in suitable habitat • 49 person hours of nocturnal	• 144 camera traps nights; and • approximately 819 person hours spent opportunistically • .

Survey Requirement	Optimal Survey Timing	Survey Effort Consideration	Survey Effort Undertaken to Date		Status in Meeting Survey Guideline Requirements
			EMM 2019-2020	E2M 2025	
			Total: • 20.5 person hours of active diurnal searches • 133.5 person hours of nocturnal spotlighting searches • 72 camera trap nights; and • approximately 495 person hours spent opportunistically across the Study Area.	spotlighting searches across ten nights • 72 motion detection camera trap nights; and • approximately 324 person hours spent opportunistically.	

3.3 Habitat quality scoring

The Offset assessment guide (OAG) (DCCEEW, 2023f) and *How to use the Offsets Assessment Guide* (DCCEEW, 2023d) provides guidance on the assessment offset requirements and suitability. This framework provides key concepts and guiding principles, however, there is no stipulated Commonwealth method for assessing habitat quality outlined within the offset framework. The DCCEEW *Modified Habitat Quality Assessment* is an unpublished method that provides guidance on habitat quality determination for MNES and is based on the *Guide to determining terrestrial habitat quality (version 1.2)* (Department of Environment and Heritage Protection, 2017).

The habitat quality score is assessed using three indicators; site condition, site context, and species stocking rate, with the default ratios being 30%, 30% and 40%, respectively (Department of Environment and Heritage Protection, 2017). These default ratios were utilised for all assessed MNES.

3.3.1 Site condition

Site condition data was collected within 100 m x 50 m areas (including various sub-plots) for each AU, weighted in accordance with the terrestrial habitat quality guide and compared to BioCondition benchmark values for the relevant RE benchmark (Queensland Herbarium, 2025a). Quality and availability of food, foraging habitat and shelter were also incorporated into the assessment of site condition.

A summary of site condition data collected (i.e. habitat quality sites), plot area and associated maximum scores, based on the default weightings, is summarised in Table 9. These default ratios were utilised for all assessed MNES.

Table 9: Site-based attributes assessment criteria

Attribute	Description	Assessment plot	Maximum score
Large trees	Number of large trees per hectare, as determined by existing BioCondition benchmarks for the associated RE.	100 m x 50 m	15
Tree canopy height	Median canopy height in metres of the ecologically dominant layer.	100 m x 50 m	5
Recruitment (%)	The proportion of overstorey species present at a site that are regenerating (<5 cm diameter at breast height [DBH]).	100 m x 50 m	5
Tree canopy cover (%)	Vertical projection of the tree canopy crown cover along a transect.	100 m transect	5
Shrub layer cover (%)	Vertical projection of the shrub layer cover of native shrubs.	100 m transect	5[†]
Coarse woody debris	The length of fallen woody logs and other coarse woody debris (>10 cm diameter and >0.5 m in length) per ha.	50 m x 20 m	5
Native plant species richness	Native plant species richness, comprising all life forms (i.e. trees, shrubs, grasses and forbs/other).	100 m x 50 m (trees) 50 m x 10 m (shrubs, grasses, forbs/other)	5 each (20 total)

Attribute	Description	Assessment plot	Maximum score
Non-native plant cover (%)	Percentage cover of non-native/weed plant species.	50 m x 10 m	10
Native perennial grass cover (%)	Average percentage cover of native perennial grass species.	Five 1 m x 1 m	5
Organic litter cover	The average percentage cover of organic material such as fallen leaves, twigs, and branches <10 cm diameter.	Five 1 m x 1 m	5
		BioCondition values (sub-total)	**80**
Quality and availability of food and foraging habitat	Consider these parameters relative to the essential habitat requirements for the species. These attributes should realistically reflect how much of a sustainable population of a species could be supported. This component was determined using the criteria detailed within DES *Guide to determining terrestrial habitat quality (version 1.2)* (Department of Environment and Heritage Protection, 2017).	100 m x 50 m	10
Quality and availability of shelter habitat	An assessment of a species' shelter requirements must take into account the relative abundance and condition of habitat features that could be used within a site. The site's shelter habitat is necessarily species specific and includes microhabitat requirements (e.g. hollows, logs, cracking clays, large trees, leaf litter, caves etc.). This component was determined using the criteria detailed within DES *Guide to determining terrestrial habitat quality (version 1.2)* (Department of Environment and Heritage Protection, 2017).	100 m x 50 m	10
		Total (maximum score)	**100**

† Denotes site-based attributes which does not apply for some REs where no shrub layer was identified by the associated benchmarks.

3.3.2 Site context

Landscape context assessments provide a quantitative assessment of the landscape values of the Impact or Offset Areas and are used to determine the site context component of the habitat quality score for the proposed action (Table 10). When calculating context, a 20 km buffer was utilised for each of the MNES species.

The site context component of the habitat quality score is weighted based on the species-specific habitat quality Indicator ratios provided in Table 10.

Table 10: Site context criteria and scoring

Criterion	Description	Maximum score
Size of patch	Size of the patch containing the habitat quality site and any directly connecting suitable habitat.	10
Connectedness	The proportion of the polygon boundary containing the habitat quality site which is connected to suitable habitat.	5
Context	The percentage of habitat within a suitable buffer around the site (species dependent).	5
Ecological corridors	The proximity of the site to the Department of Environment, Science and Innovation (DESI) mapped state, bioregional, regional or sub-regional corridors.	6
Role of the site location to species overall population in the State	The role of the site in relation to the overall population of the species in Queensland. This takes into account the species' use of the site, such as whether it is used for feeding and/or nesting and the effect that damage to or removal of the site would have to the likelihood of the species' overall population survival.	5
Threats to Species	Each individual threat was scored in accordance with Guide to determining terrestrial habitat quality *version* 1.2, where threats are categorised as: - Low level of threat = 1 - Moderate level of threat = 7 - High level of threat = 15 Each threat was then weighted based on relevant risk ratings and summed to provide an overall threat score out of 15.	15
Species mobility capacity	Consideration of the presence and severity of factors that would contribute to a reduction in the mobility of the species (e.g. barriers to movement). This component was determined using the criteria detailed within DES *Guide to determining terrestrial habitat quality (version 1.2)* (Department of Environment and Heritage Protection, 2017).	10
Total (max. score)		**56**

3.3.3 Species stocking rate

Species stocking rate is determined based on the outcomes of surveys using best-practice methods aimed at maximising detectability of the target species. This includes undertaking surveys during appropriate timing and applying suitable search effort, preferentially over numerous monitoring periods. Attributes for species stocking rate and their respective scoring are summarised in Table 11.

For species with sufficient population data, approximate density ranges can be calculated based on local survey records/sightings; or if comprehensive targeted surveys have been done within the impact and offset sites, ranges may be devised based on the survey results. For cryptic species and data-deficient species, calculating density may not be possible, meaning an increase in stocking rate is not feasible.

Table 11: Species stocking rate scoring

Attribute	Description	Maximum score
Presence detected on or adjacent to the site	Scored based on the target species being recorded within or adjacent (neighbouring property) to the site. The associated score is based on the following categories: • Yes – on site = 10 • Yes – adjacent to site = 5; and • No = 0.	10
Species usage on the site	Scored based on the target species habitat utilisation type within the site. The associated score is based on the following categories: • Dispersal = 5 • Foraging = 10; and • Breeding = 15.	15
Approximate density (per ha)	Estimated density of the target species based on local survey records and available literature. Due to the limited available data for the Impact Area and surrounding landscape, the approximate densities for each species were categorised into four broad categories: • Absent = 0 • Low = 10 • Moderate = 20; and • High = 30. The density of each species was then scored based on survey effort, detectability and number of detections.	30
Role/importance of species population on site*	Score is based on the supplementary scoring matrix (refer to Table 12*). Overall score is determined based on the following categories: • 0 = 0 • 5 to 15 = 5 • 20 to 35 = 10; and • 40 to 45 = 15.	15
	Total (maximum score)	**70**

* Attribute calculated based on supplementary scoring matrix provided in Table 12.

Table 12: Supplementary scoring matrix for role of importance of species population

Attribute	Categories	Maximum score
Key source population for breeding	• Yes/Possibly = 10; and • No = 0.	10
Key source population for dispersal	• Yes/Possibly = 5; and • No = 0.	5
Necessary for maintaining genetic diversity	• Yes/Possibly = 15; and • No = 0.	15
Near the limit of the species range	• Yes = 15; and • No = 0.	15

3.4 Likelihood of occurrence

A likelihood of occurrence assessment evaluates the qualitative probability that a flora or fauna species, can physically occupy the Study Area during all or part (e.g. breeding season, migration) of its life cycle. The assessment evaluates:

- species-specific ecological and physiological requirements
- recorded species observations including during field surveys and existing records
- the resources and constraints present in the Study Area informed by the desktop assessment; and
- the resources and constraints present in the Study Area informed by the field surveys.

During the desktop assessment, the outcome of the likelihood of occurrence assessment is used to guide the field design and planning phase. Threatened species that are known, likely or possibly occurring in the Study Area were targeted during the field surveys (i.e. target species). Following the field surveys, the likelihood of occurrence assessment was re-evaluated using the field data to modulate the target species list prior to further assessment.

The likelihood of occurrence assessment criteria are detailed in Table 13 and the complete likelihood of occurrence assessment is included in Appendix B.

Table 13: Likelihood of threatened and migratory species to occur in the Study Area

Assessment Outcome	Criteria
Known to occur	The species or population has been observed within the Study Area.
Likely to occur	Suitable habitat for a species or population occurs within the Study Area and nearby records are present.
Possibly occurring	Suitable habitat for a species or population occurs within the Study Area but it is degraded or of limited extent, the species has never been recorded in the local area and/or habitat only supports a portion of the species' life cycle.
Unlikely to occur	A low to very low probability that a species or population uses/occurs within the Study Area due to the lack of potential habitat or the Study Area is outside the species known range.

4 Results

4.1 Flora

A desktop assessment was undertaken to determine the potential presence of flora species within the disturbance footprint and the overall Study Area. Record searches included ALA, Wildlife Online, and PMST. A likelihood of occurrence assessment was then undertaken to determine the likelihood of the species presence. Previous records produced by EMM surveys were included within this assessment.

The desktop assessment identified 22 threatened flora species potentially occurring within the 20 km buffer of the Study Area based on data from the ALA, PMST and WildNet records (ALA, 2025; DCCEEW, 2025i; DETSI, 2025c). The assessment concluded the only threatened flora species with historical records occurring within the disturbance footprint was the *Solanum elachophyllum*, with four historical records occurring within the Study Area (ALA, 2025). An additional 13 historical records occurred within the 20 km buffer area (PMST, Wildnet) (DCCEEW, 2025i; DETSI, 2025c). Further, a substantial population totalling more than 1,200 individuals of *S. elachophyllum* had also been recorded by EMM (EMM, 2020b) within the Study Area.

E2M recorded 112 species of flora through systematic and opportunistic surveying effort. This included:

- 88 native species; and
- 24 introduced species.

A detailed list of species recorded is provided in Appendix C.

4.1.1 Ground-truthed vegetation communities

A total of seven REs were ground-truthed across the Study Area, including 203.11 ha of remnant vegetation and 83.77 ha of high value regrowth vegetation. A further 6,597.09 ha of the Study Area was mapped as non-remnant, consisting of cleared pasture, young regrowth and scattered mature trees. These non-remnant areas had been subject to modification, historical clearing processes and introduction of exotic species. The remaining 23.52 ha within the Study Area consisted of farm dams and wetlands.

State mapped REs within the Study Area include only small patches of heterogenous remnant and regrowth RE 11.3.2, 11.3.25 and 11.3.1 along the central portion of Taurus Creek (DNRMMRRD, 2025d). Ground-truthed vegetation suggests that vegetation composition throughout the Study Area is more complex and contains an additional six REs. Additionally, RE 11.3.25 was not ground-truthed during field surveys. Heterogenous polygons originally mapped by EMM (EMM, 2020b) were delineated into homogenous polygons by using quaternary and tertiary ground truthed RE surveys (Neldner et al., 2025).

Vegetation in the Disturbance Footprint mainly comprise of non-remnant areas. Small areas of remnant RE 11.3.6 and 11.3.1 and high value regrowth RE 11.3.1 and 11.9.5 are located in the central and southern extents of the Disturbance Footprint. Large well-connected areas of remnant *Eucalyptus* sp. woodland (RE 11.3.2, 11.3.3 and 11.3.27) and remnant brigalow woodland (RE 11.3.1) are predominately confined to Taurus Creek and Two Mile Gully and are outside of the Disturbance Footprint, as depicted in Figure 8.

The ground-truthed extent of vegetation communities within the Study Area and Disturbance Footprint are summarised within Table 14 and depicted within Figure 8, with further detailed descriptions provided in Appendix F.

Table 14: Ground-truthed regional ecosystems within the Study Area and Disturbance Footprint

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.3.1	E	E	25a	**Description** Remnant and high value regrowth areas consisted of open forest to woodland dominated by *Acacia harpophylla* on Cainozoic alluvial clays forming plains and low undulating plains, with associated *Eucalyptus coolabah* and *Lysiphyllum carronii*. The sub-canopy consists primarily of *L. carronii* and *Terminalia oblongata*, with scattered occurrences of *A. excelsa*, *Erythroxylum australe* and *Brachychiton rupestris*. The shrub layer contained juvenile sub-canopy species as well as *Citrus glauca* and *Notelaea macrocarpa*. The ground layer was generally dense (50-90% cover) consisting of a mixture of native and exotic grasses and forbs, including *Dichanthium sericeum, Aristida calycina, Cenchrus ciliaris*, Megathyrsus maximus*, Atriplex muelleri* and *Enchylaena tomentosa*. Some remnant areas have been subject to historical disturbance (i.e. clearing/thinning) which has altered the species composition of these areas. However, they still meet the height and cover requirements of the associated remnant RE, though provide fauna habitat resources more closely aligned with areas of high-value regrowth (refer to Section 4.2.2). **Distribution** Areas of this RE are confined to the central and southern portions of the Study Area, restricted to Taurus Creek, Two Mile Gully, Deep Creek and associated tributaries.	Remnant	99.73	1.21
					High value regrowth	40.99	18.35

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.3.2	OC	OC	17a	**Description** Remnant areas consisted of *Eucalyptus populnea* dominated low open woodland on alluvial plains. The subcanopy layer consisted of *Acacia salicina*, and *Terminalia oblongata*. The shrub layer included *Lysiphyllum hookeri, Cassia brewsteri, Capparis lasiantha, Carissa ovata, Acacia excelsa, Citrus glauca, Owenia acidula,* and *Acacia saligna.* The ground layer was generally very dense (86-95% cover) consisting of a mixture of native and exotic grasses and forbs, including *Dichanthium sericeum, Chloris divaricata, Bothriochloa ewartiana, Bothriochloa pertusa*, Enneapogon polyphyllus, Enteropogon ramosus, Aristida ramosa, Themeda triandra, Cenchrus ciliaris*, Megathyrsus maximus*, Urochloa mosambicensis*, Parthenium hysterophorus*, Bryophyllum delagoense*, Harrisia cactus*, Opuntia tomentosa** and *Opuntia stricta**. **Distribution** Areas of this RE are confined to the southeastern portion of the Study Area, restricted to Taurus Creek, Two Mile Gully, Deep Creek and associated tributaries.	Remnant	11.07	0.0

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.3.3	OC	OC	16c	**Description** Remnant areas consisted of *Eucalyptus* coolabah open forest woodland on alluvial plains. The subcanopy layer consisted of *Lysiphyllum carronii, Alstonia constricta, Eucalyptus melanophloia, Brachychiton rupestris,* and *Erythroxylum australe*. The shrub layer included *Acacia harpophylla, Lysiphyllum carronii, Atalaya hemiglauca (Whitewood) and Erythroxylum australe*. The ground layer was generally dense (66-70%) and was dominated by mostly introduced species with occasional native species, including *Dichanthium sericeum, Megathyrsus maximus*, Bothriochloa pertusa*, Cenchrus ciliaris*, Cyperus sp., Malvastrum americanum*, Vittadinia triloba, Amyema preissii, Cryptostegia grandiflora*, Parthenium hysterophorus** and *Bryophyllum delagoense**. **Distribution** Areas of this RE are confined to the eastern portion of the Study Area, restricted to the upper streams of Taurus Creek.	Remnant	38.28	0.0

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.3.6	LC	OC	17b	**Description** Remnant areas consisted of *Eucalyptus melanophloia* dominant woodland on an alluvial plain. Subcanopy species consisted of *Lysiphyllum hookeri, Terminalia oblongata, Acacia harpophylla* and *Alectryon diversifolius*. Shrub species consisted of *Lysiphyllum hookeri, Terminalia oblongata, Carissa ovata, A. harpophylla, Alstonia constricta, Atalaya hemiglauca* and *A. salicina*. The ground layer was generally dense (56-90%) and consisted of a mixture of native and introduced species such as *Bothriochloa bladhii*, Chloris sp., Sporobolus caroli, Dichanthium sericeum, Chrysopogon fallax, Enteropogon acicularis, Cynodon dactylon*, Aristida calycina, Megathyrsus maximus*, Urochloa mosambicensis*, Cenchrus ciliaris** and *Enchylaena tomentosa*. Some remnant areas have been subject to historical disturbance (i.e. clearing/thinning) which has altered the species composition of these areas. However, they still meet the height and cover requirements of the associated remnant RE, though provide fauna habitat resources more closely aligned with areas of high-value regrowth (refer to Section 4.2.2). **Distribution** Areas of this RE are confined to the central and southern portions of the Study Area, restricted to Taurus Creek, Two Mile Gully, Deep Creek and associated tributaries.	Remnant	45.32	2.72

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.3.27	LC	OC	34d	**Description** Remnant areas of this RE consisted of *Eucalyptus camaldulensis* open forest fringing watercourses. The subcanopy consisted of *Acacia harpophylla, Eremophila mitchellii* (False sandalwood), *Atalaya hemiglauca, Grevillea parvifolia, Lysiphyllum carronii, Owenia acidula* and *Terminalia oblongata*. Groundcover species consisted of a mixture of native and introduced species such as *Bothriochloa ewartiana, Enchylaena tomentosa, Megathyrsus maximus*, Cenchrus ciliaris** and varied throughout the assessment units in density (6-75%). **Distribution** Remnant areas of this RE are confined to the eastern portion of the Study Area, restricted to Taurus Creek and Two Mile Gully.	Remnant	8.71	0.0

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.4.9	E	E	25a	**Description** High value regrowth areas of this RE consisted of *Acacia harpophylla* open low woodland. The subcanopy layer consisted of *A. salicina, Atalaya hemiglauca* and *Lysiphyllum hookeri*. The shrub layer included *Carissa ovata, Lysiphyllum carronii, Acacia harpophylla, Citrus glauca, Terminalia oblongata* and *A. salicina*. The ground layer was generally dense (76-80%) and was dominated by mostly introduced species with occasional native species, including *Cenchrus ciliaris*, Megathyrsus maximus*, Harrisia martini*, Aristida ramosa, Sporobolus caroli, Panicum decompositum, S. actinocladus, Trianthema triquetra, Salsola australis, Enchylaena tomentosa, Solanum elachophyllum, Enneapogon sp.* and *Sida sp.* **Distribution** High value regrowth areas of this RE are confined to the southeastern portions of the Study Area.	High value regrowth	32.16	17.66

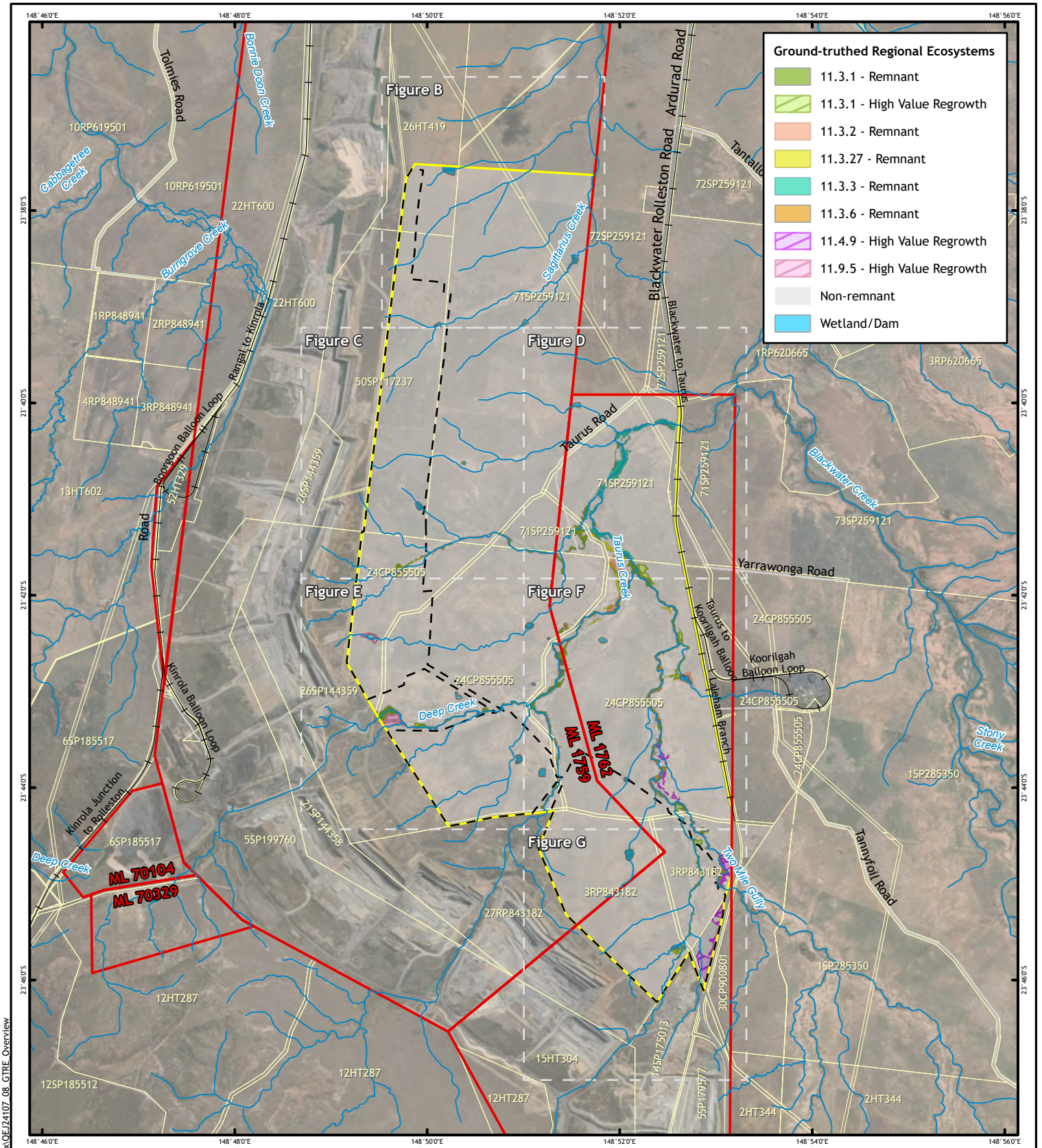
RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
11.9.5	E	E	25a	**Description** High value regrowth areas consisted of *Acacia harpophylla* open woodland on gently undulating plains. The subcanopy layer included *Lysiphyllum carronii, Atalaya hemiglauca and Terminalia oblongata. Erythroxylum australe, Citrus glauca, Eremophila mitchellii, Santalum lanceolatum, Grewia latifolia, Alstonia constricta, Jasminum didymum subsp. lineare, and Capparis* spp. comprised the majority of the shrub layer. The ground layer was generally very sparse (95%) and comprised both native and introduced species. Species included *Dactyloctenium radulans, Enneapogon sp., Sporobolus actinocladus, S. caroli, Enteropogon ramosus, Chloris divaricata, Aristida latifolia, A. ramosa, Malvastrum americanum*, Harrisia martinii*, Opuntia tomentosa*, Cenchrus ciliaris*, Bothriochloa pertusa** and *Portulaca oleracea**. **Distribution** Patches of high value regrowth RE 11.9.5 are scattered throughout the Study Area.	High value regrowth	10.62	3.77

RE	VM Act status[1]	Biodiversity status[1]	Broad vegetation group	RE Description	Condition type	Extent within the Study Area (ha)	Extent within the Disturbance Footprint (ha)
Non-remnant	N/A	N/A	N/A	**Description** Non-remnant areas in the Study Area comprised a mixture of cleared areas with improved pasture species, scattered young regrowth and mature trees. Isolated mature trees consisted of *Acacia harpophylla*, *Eucalyptus populnea* and *Lysiphyllum carronii*. Improved pasture species included the following *Cenchrus ciliaris*, Bothriochloa pertusa*, Urochloa mosambicensis*, Megathyrsus maximus*, Chloris gayana**. **Distribution** Non-remnant areas with improved pasture species and young woody regrowth are present throughout the Study Area and dominates most of the landscape outside of remnant and high value regrowth woodlands and open forests which are restricted to watercourses.	Non-remnant	6,597.09^	2,262.07^

[1] LC = Least concern, NC = No concern at present, Of concern = OC, Endangered = E

* - denotes non-native species

^ - excludes wetland and dam areas



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre
- Figure Extent

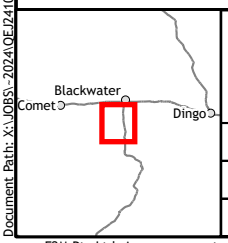
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Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
Cadastre: © DNRMMRRD 2025
Ordered Drainage: © DNRMMRRD 2025
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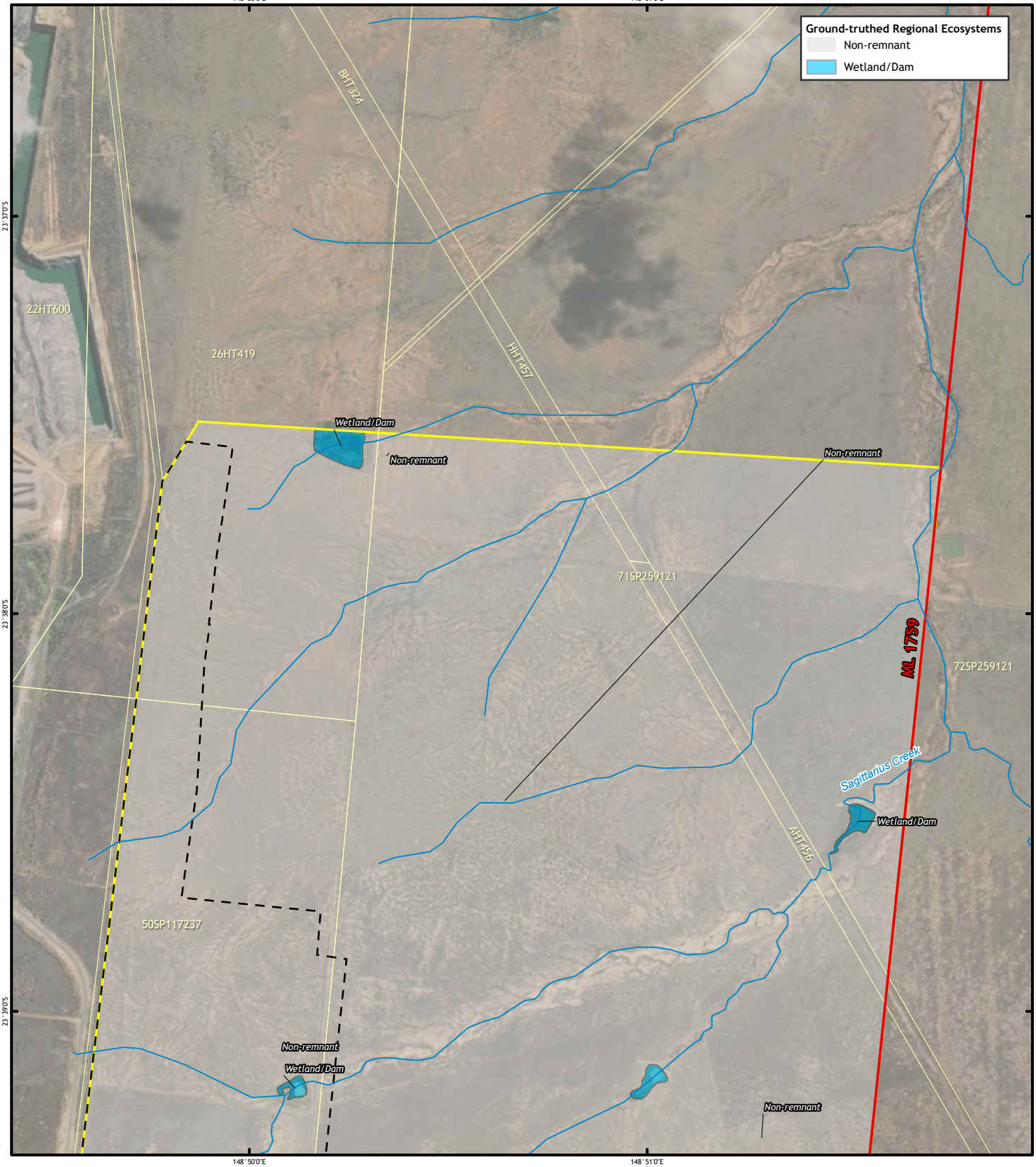
FIGURE 8A: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA - OVERVIEW

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 7	QEJ24107	1

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

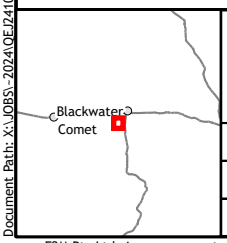
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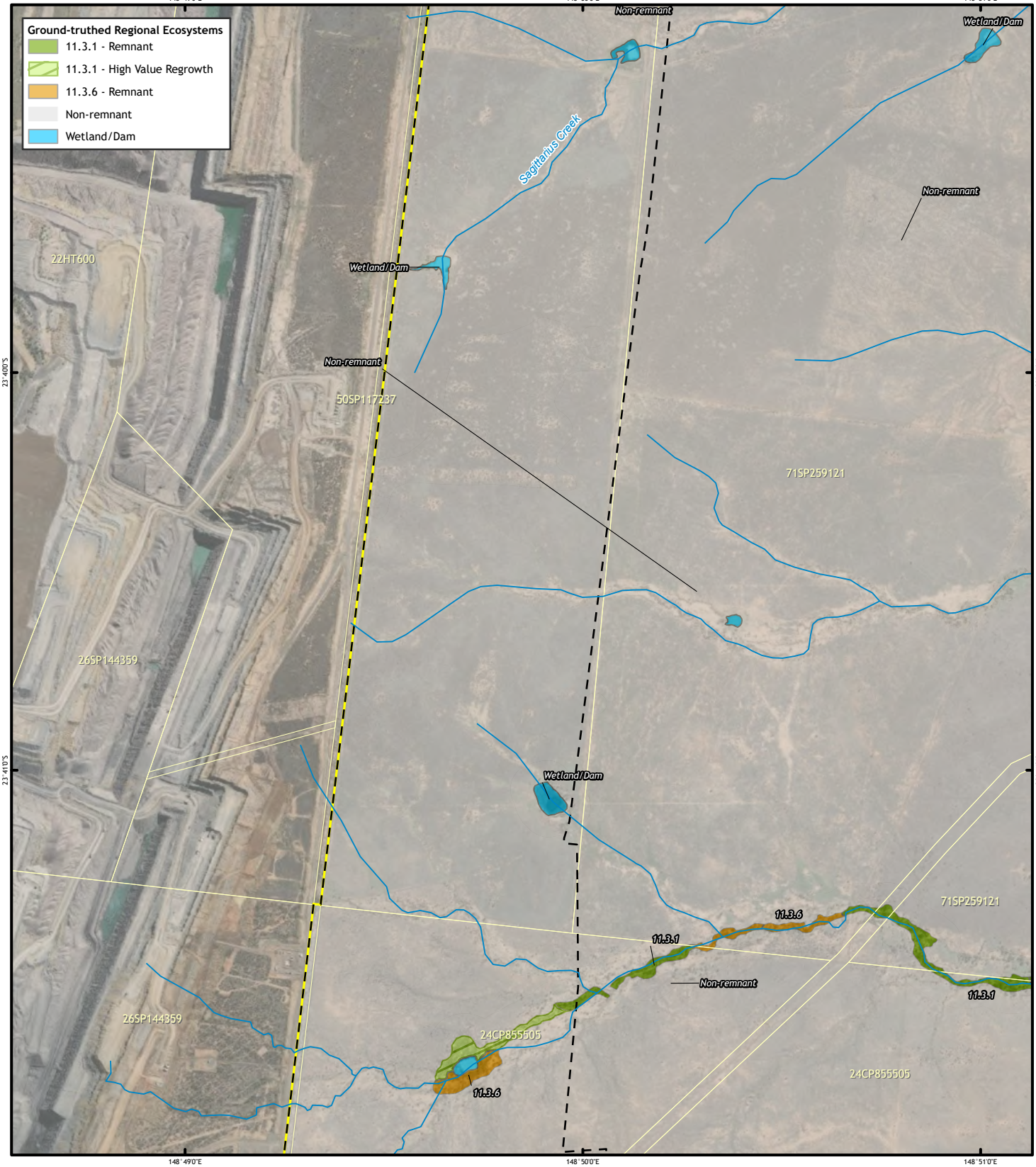
FIGURE 8B: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
2 of 7	QEJ24107	1

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

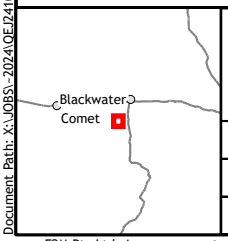
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
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Ordered Drainage: © DNRMMRRD 2025
Mining Lease: © DNRMMRRD 2025

Rev	Description	Drawn	Approved	Date
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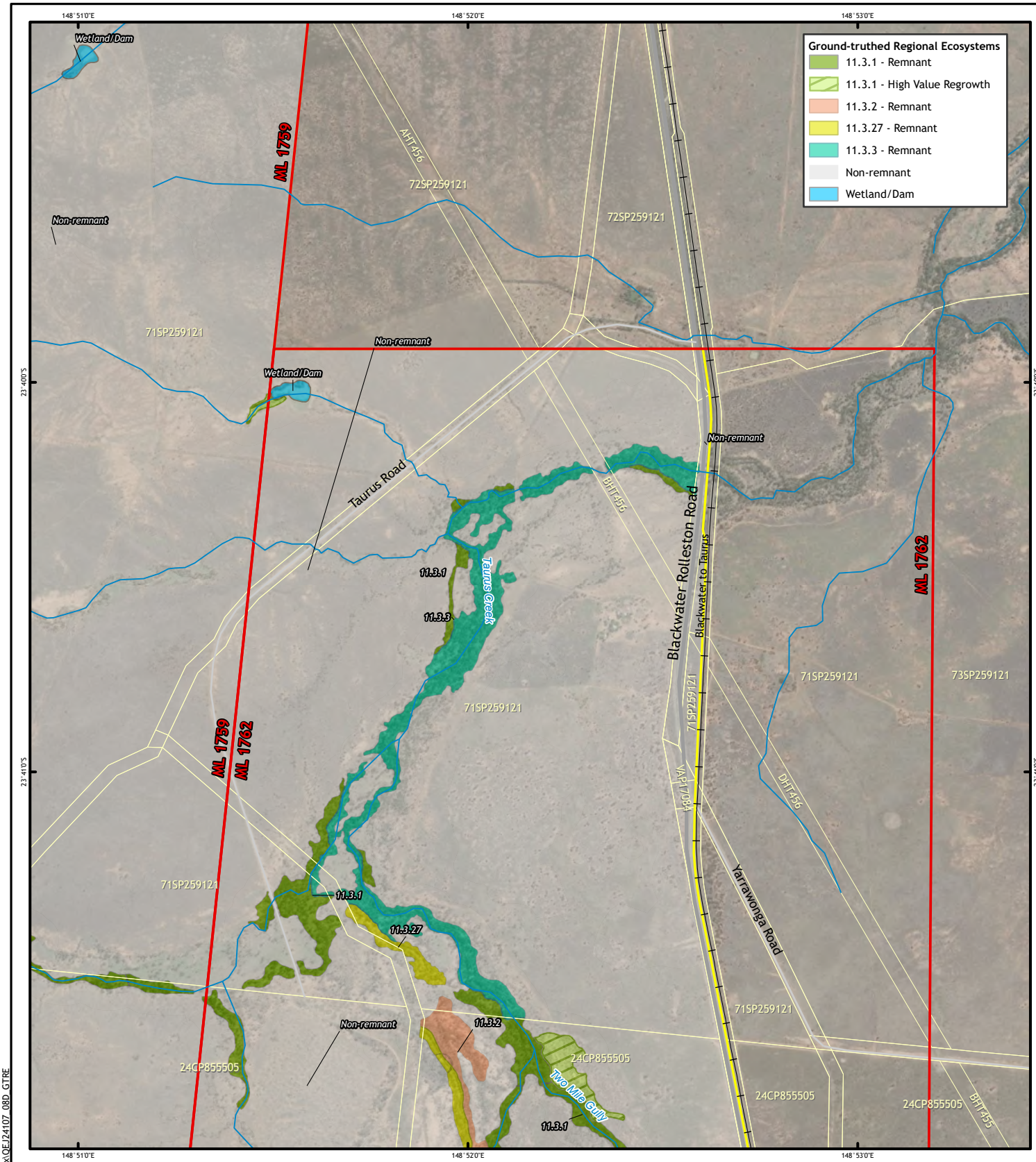
FIGURE 8C: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
3 of 7	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Blackwater Mining Lease
- Cadastre

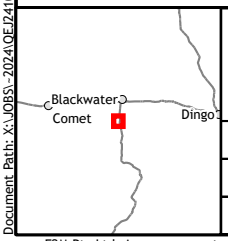
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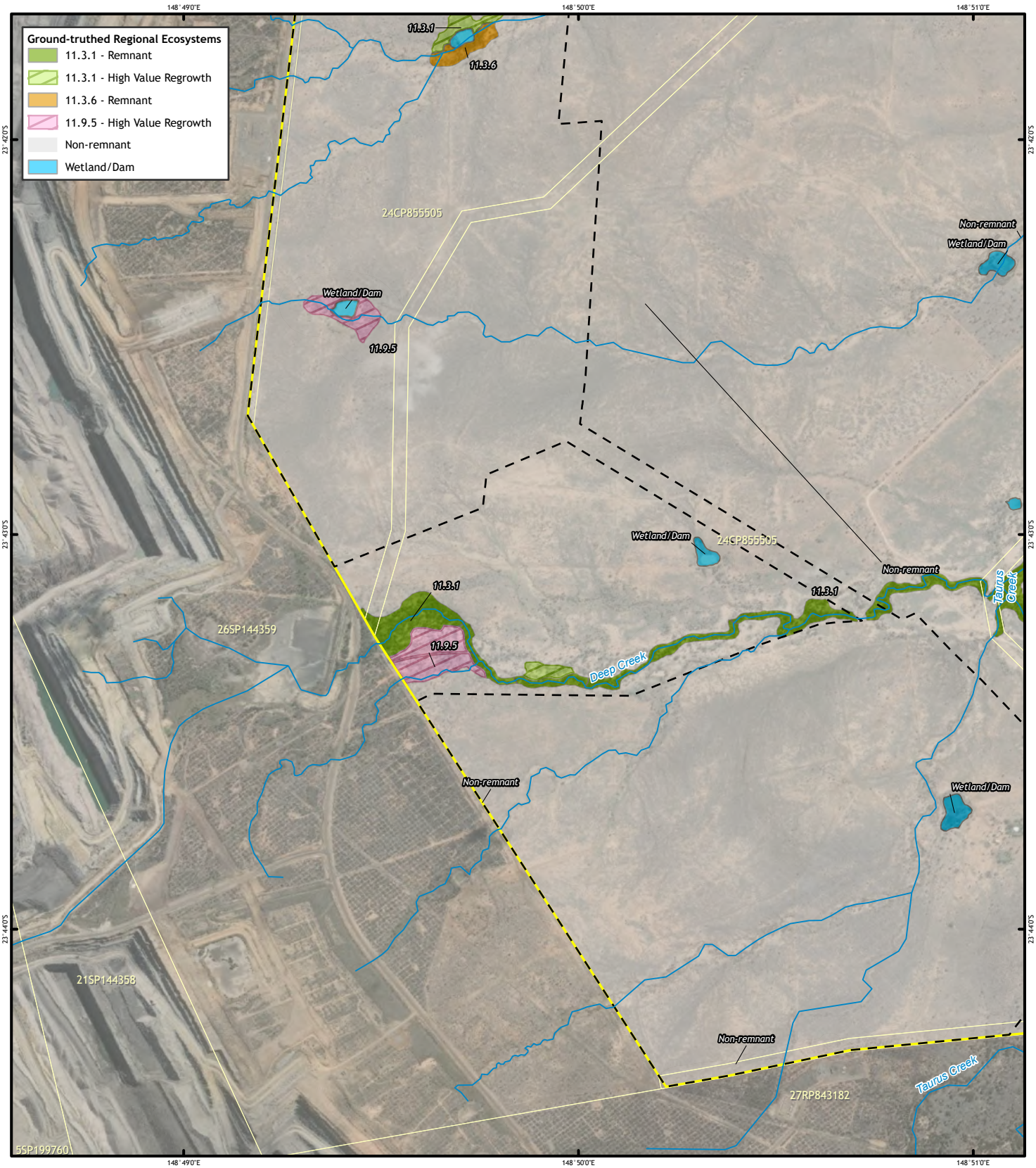
FIGURE 8D: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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- Cadastre

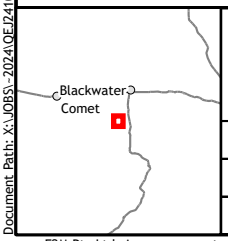
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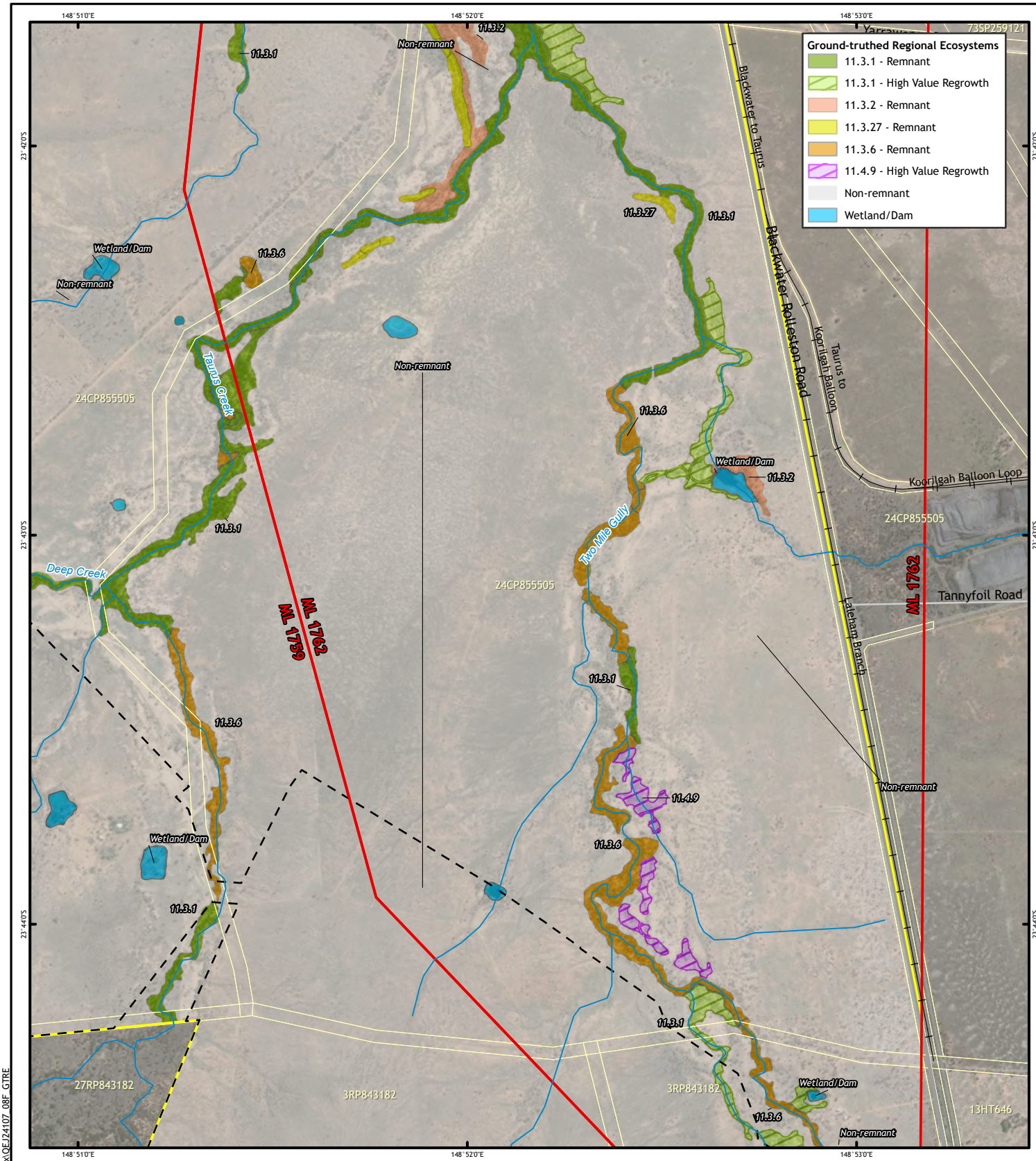
FIGURE 8E: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
5 of 7	QEJ24107	1

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- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

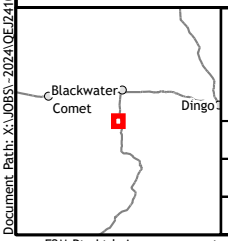
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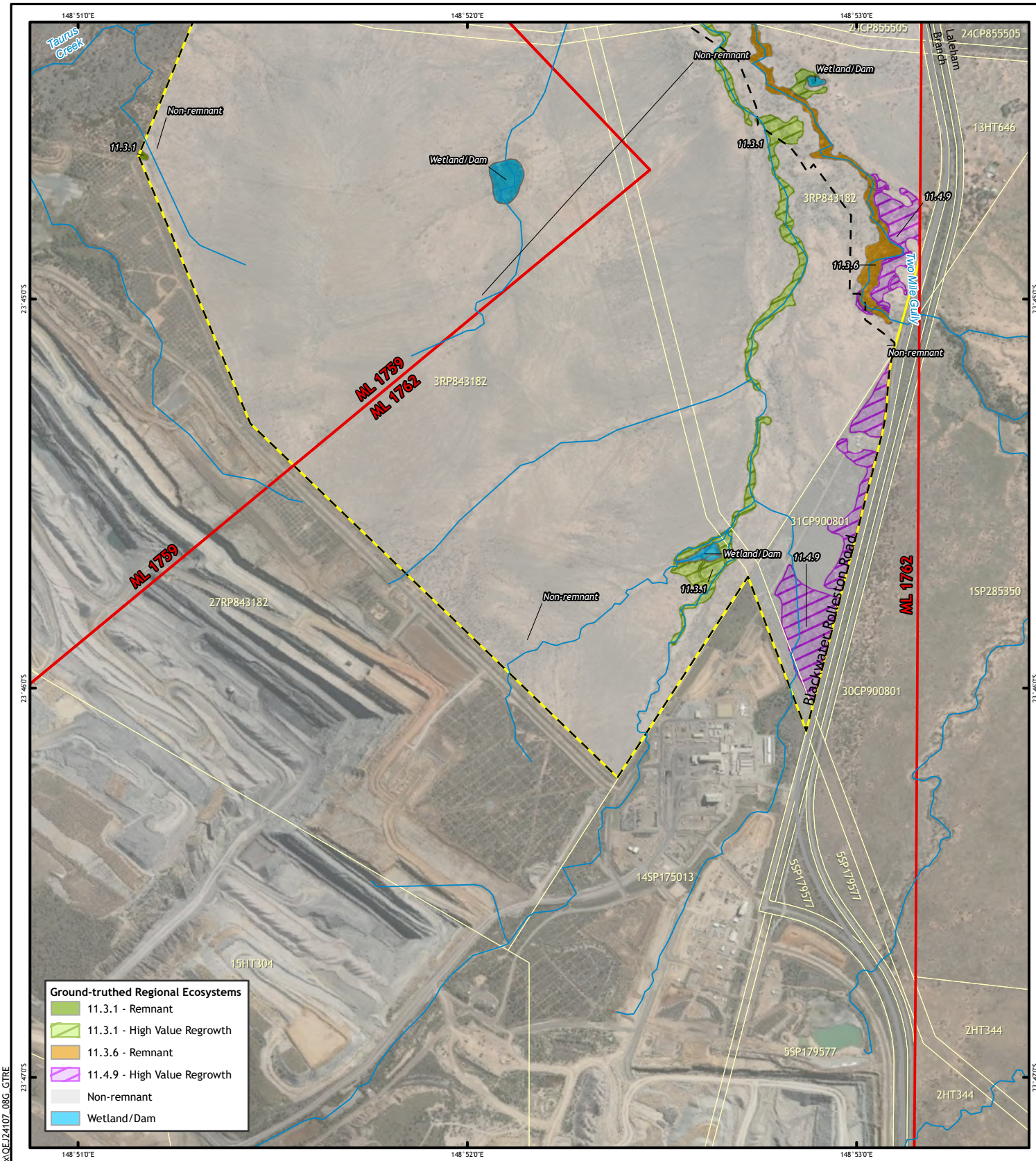
FIGURE 8F: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
6 of 7	QEJ24107	1

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- Secondary Road
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

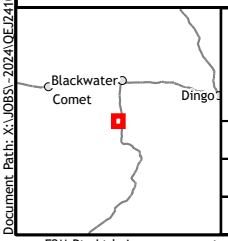
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FIGURE 8G: GROUND-TRUTHED VEGETATION COMMUNITIES WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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4.1.2 Threatened Ecological Communities

A desktop assessment was undertaken to identify the potential presence of TECs listed under the EPBC Act within the Study Area. This included a review of PMST, existing RE mapping, and soil/land information to determine where known TEC-aligned REs may occur.

The desktop assessment identified six TECs that were potentially occurring within the Study Area (Appendix A). This included:

- Brigalow (*Acacia harpohylla* dominant and co-dominant) (Brigalow TEC)
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (Coolibah TEC)
- Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Natural grasslands TEC)
- Poplar box grassy woodland on alluvial plains (Poplar box TEC)
- Semi Evergreen Vine Thicket Threatened Ecological Community of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC); and
- Weeping Myall Woodlands.

Mapped occurrences of analogous REs within the Study Area were further assessed during field surveys to determine whether they met the key criteria and condition thresholds in the listing advice. Field verification confirmed the presence of the Brigalow TEC within the Study Area, in association with both remnant and high value regrowth vegetation. The TEC was recorded within areas mapped as RE 11.3.1, 11.4.9 and 11.9.5 where *Acacia harpophylla* was dominant or co-dominant. This is consistent with the ecological character of Brigalow communities described within the EPBC Act conservation advice (DotE, 2013a). Table 15 provides a summary of the TECs potentially occurring within the Study Area and their field-verified presence outcomes.

Table 15: Summary of potentially occurring TECs occurring in the Study Area

TEC	EPBC Act status	Presence within the Study Area
Brigalow (*Acacia harpohylla* dominant and co-dominant) (Brigalow TEC)	Endangered	**Confirmed present** A total of 148.88 ha of Brigalow TEC was mapped within the Study Area in association with remnant and high value regrowth areas of RE 11.3.1 and high value regrowth RE 11.4.9 and 11.9.5 where *Acacia harpophylla* was dominant or codominant (DotE, 2013a) (Section 4.1.2.1). Brigalow TEC mapped in the Disturbance Footprint totalled 40.29 ha.
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions (Coolibah TEC)	Endangered	**Not present** Mapped areas of RE 11.3.3, which is analogous with the TEC, were identified within the Study Area, however, the Study Area is located outside of the Brigalow Belt southern bioregion in which this TEC is located (DSEWPaC, 2011a).
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin (Natural grasslands TEC)	Endangered	**Not present** No REs analogous with TEC were identified within the Study Area.

TEC	EPBC Act status	Presence within the Study Area
Poplar box grassy woodland on alluvial plains (Poplar box TEC)	Endangered	**Not present** Mapped areas of RE 11.3.2, which is analogous with the TEC, were identified within the Study Area, however, these patches did not meet the minimum condition thresholds (Section 4.1.2.2).
Semi Evergreen Vine Thicket Threatened Ecological Community of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT TEC)	Endangered	**Not present** No REs analogous with TEC were identified within the Study Area.
Weeping myall woodlands	Endangered	**Not present** While RE 11.3.2 was observed within the Study Area, the eponymous weeping myall (*Acacia pendula*) was not recorded (DEWHA, 2009).

4.1.2.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC

The Brigalow TEC is listed as Endangered under the EPBC Act. The Brigalow TEC includes 16 REs within Queensland (DCCEEW, 2025j) and typically occurs on fertile soils associated with land zones 4 and 9. The TEC is characterised by the dominance or co-dominance of *A. harpophylla* (brigalow) in the canopy, often in association with species such as *Casuarina cristata*, *Eremophila mitchellii*, or *Geijera parviflora* (Wilga). The community can exist as open woodland to closed forest and may occur as remnant or regrowth vegetation. To be considered a TEC under the EPBC Act, a patch must meet minimum threshold conditions pertaining to patch size and weed encroachment as detailed in Section 3.2.2.2.1.

The initial desktop assessment determined that the Study Area includes REs 11.3.1, 11.4.9 and 11.9.5. The field assessment verified a total of 148.88 ha of Brigalow TEC identified within the Study Area, associated with high value regrowth and remnant areas of RE 11.3.1, 11.4.9 and 11.9.5 where *A. harpophylla* was dominant or codominant (Plate 1).

An additional 18 patches, totalling 93.33 ha, analogous to these REs were not considered to meet the requirements of Brigalow TEC due to small patch size (less than 0.5 ha), the ecologically dominant layer not being dominant or codominant by *A. harpophylla,* exotic perennial plants have more than 50% cover or vegetation that has been comprehensively cleared (not just thinned) within the last 15 years.

Brigalow TEC mapped in the Disturbance Footprint totalled 40.29 ha. Areas analogous with these three REs which were considered the TEC all exceeded the 0.5 ha patch size and total vegetation cover consisted of less than 50% perennial exotics. While some patches contained high exotic cover within the ground layer, including *Cenchrus ciliaris* (Buffel grass) and *Harrisia martinii* (Harrisia cactus), non-native encroachment was limited within the other structural layers of the community, keeping the overall perennial exotic cover below 50%. Brigalow TEC habitat within the Study Area is illustrated in Figure 9.

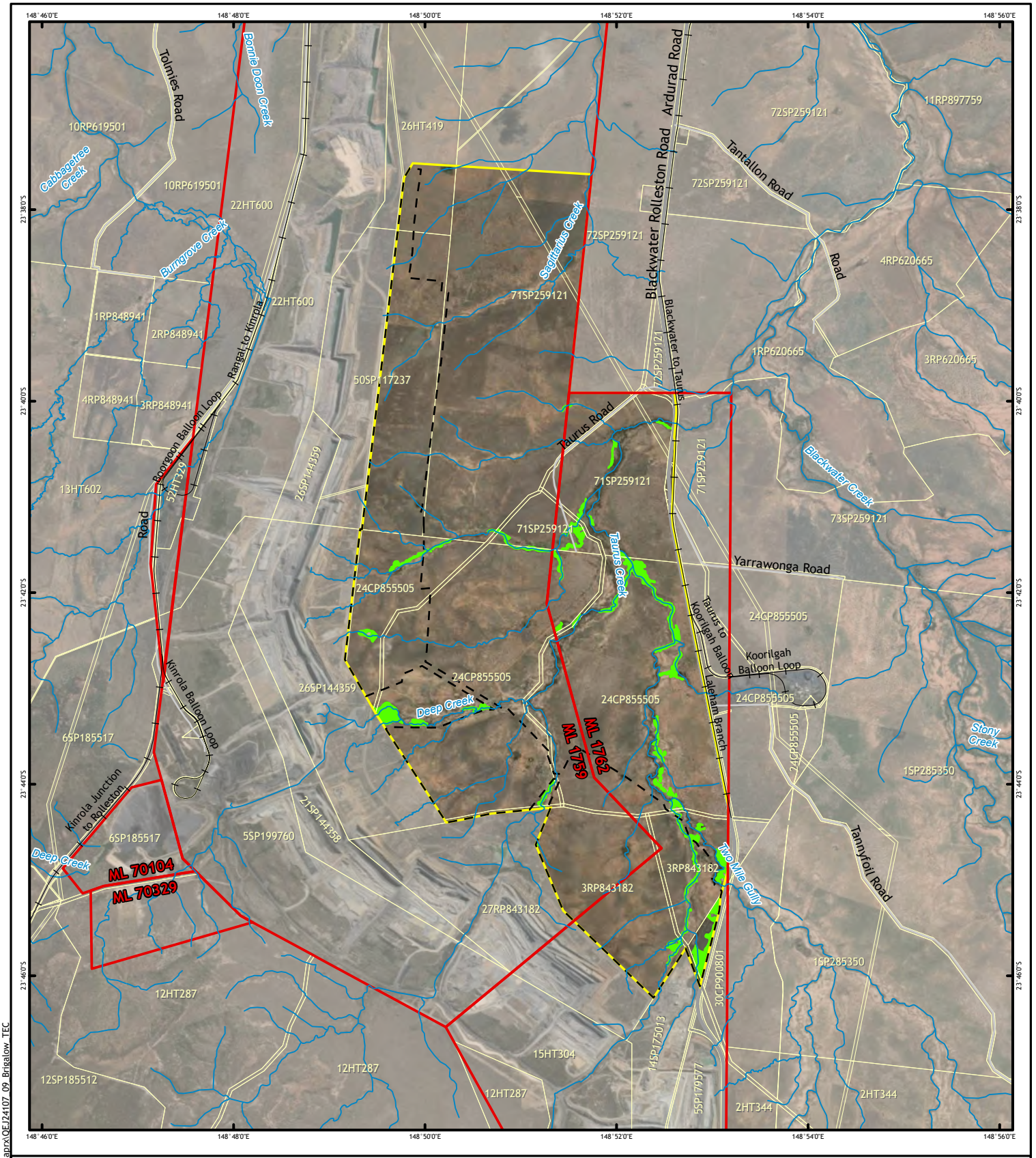


Plate 1: Remnant Brigalow TEC within the Study Area



Plate 2: Young regrowth areas not consistent with Brigalow TEC within the Study Area

Young regrowth (i.e. non-remnant areas) (Plate 2) associated with REs 11.3.1, 11.4.9 and 11.9.5 were dominated by *A. harpophylla* and commonly associated with *Lysiphyllum carronii* (Ebony tree) and *Atalaya hemiglauca* (Whitewood) with a median height of 3 m. However, these areas were deemed to not meet the structural elements broadly typical of the associated REs with clearing occurring within the last 15 years.



Legend

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- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Brigalow TEC
- Blackwater Mining Lease
- Cadastre

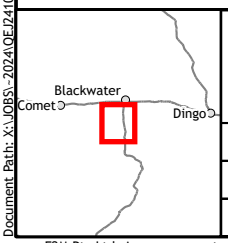
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Kilometres

Coordinate System: GDA2020



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FIGURE 9: BRIGALOW THREATENED ECOLOGICAL COMMUNITY HABITAT WITHIN THE STUDY AREA

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Whitehaven Coal

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4.1.2.2 Poplar box grassy woodland on alluvial plains TEC

The Poplar box grassy woodland on alluvial plans is listed as a TEC under the EPBC Act and is primarily associated with *Eucalyptus populnea* (Poplar box) as the dominant or co-dominant species. The Poplar box TEC typically occurs on alluvial plains and fine-textured soils across Queensland and northern New South Wales.

The Poplar box TEC includes five REs within Queensland (DCCEEW, 2025j), with 11.3.2 the only analogous RE identified within the Study Area. To qualify as the Poplar box TEC, the remnant or high value regrowth vegetation community must meet minimum threshold conditions pertaining to patch size, crown cover, species composition, diversity, and weed encroachment as detailed in Section 3.2.2.2.2.

Two patches of RE 11.3.2 were assessed within the Study Area to determine whether they met the Poplar box TEC key diagnostic and condition thresholds requirements. While both patches met the key diagnostic requirements of the TEC, neither patch met the moderate or high condition thresholds to be considered the TEC. Both patches were less than 5 ha in size meaning they would need to meet the Class A1 condition to be considered the Poplar box TEC. However, assessment of perennial vegetation cover in the ground layer identified both patches contained over 50% non-native cover, dominated by Buffel grass (Plate 3), far in exceedance of the 10% requirement to be considered Class A1.



Plate 3: Non-native grasses dominating remnant area of RE 11.3.2

4.1.3 Threatened flora

The desktop assessment identified 22 threatened flora species potentially occurring within the 20 km buffer of the Study Area based on data from the ALA, PMST and WildNet records (ALA, 2025; DCCEEW, 2025i; DETSI, 2025c). The assessment concluded that only three species were considered known, likely or possible occurrences within the Study Area, including:

- *Bertya opponens* - Study Area is unlikely to contain suitable habitat but species has been previously recorded within close proximity to the Study Area
- *Solanum dissectum* - Study Area contains suitable habitat and the species has previously been recorded in close proximity to the Study Area; and
- *Solanum elachophyllum* - the species was previously recorded within the Study Area during EMM surveys including identification of approximately 1,200 stems[2].

[2] Fensham *et al*. (2019) found that *S. elachophyllum* have lateral underground stems that generate clonal shoots from rhizomes. As such, population estimates were calculated for stems instead of individuals.

Extensive field surveys targeting potential habitat for these three threatened flora species, re-confirmed presence of *S. elachophyllum* but failed to identify the presence of either *Bertya opponens* or *Solanum dissectum*. Therefore, given the neither species has been detected during extensive flora surveys and the lack of suitable habitat, specifically for *Bertya opponens*, neither species is considered likely to occur within the Study Area. Description of *S. elachophyllum* habitat and records within the Study Area is provided in the following section with likelihood of occurrence assessment for all other threatened flora species provided in Appendix B.

4.1.3.1 Solanum elachophyllum

Solanum elachophyllum, is listed as Endangered under the NC Act (not listed under the EPBC Act), and is found primarily on fertile cracking-clay soils in open forest of *E. thozetiana* (Lapunyah) *A. harpophylla*, with understorey of *Geijera parviflora*, *Casuarina cristata*, *Macropteranthes leichhardtii* (Bonewood), *E. cambageana*, or woodland of *E. crebra* and *E. tenuipes* (Bean, 2004). This species grows in vegetation communities in which fire is normally absent (Bean, 2004). The species is a shrub growing 0.1 m to 0.4 m height, on fertile cracking soils between Middlemount and Theodore.

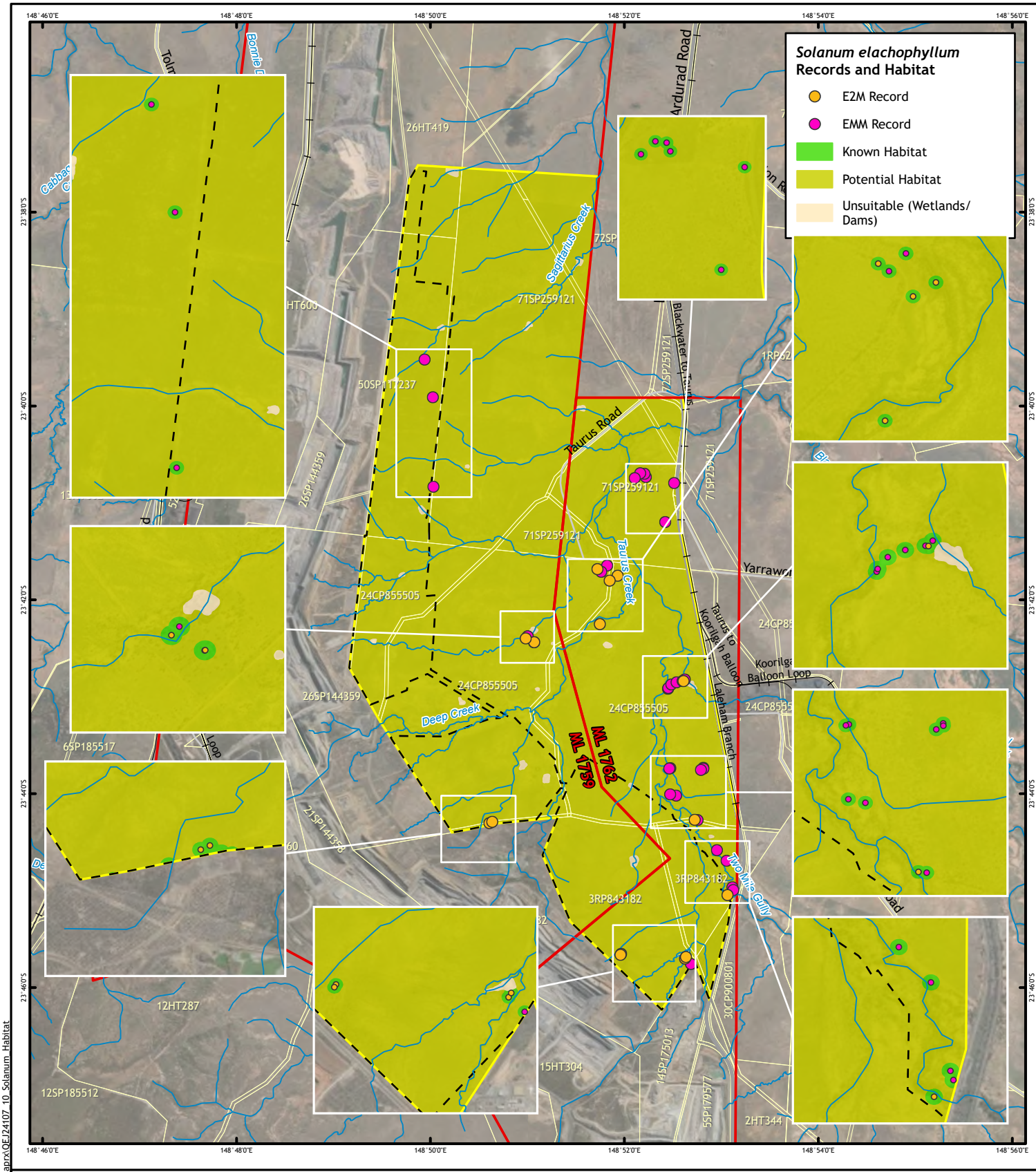
The species was primarily recorded on cracking clay soils in vegetation communities containing or previously dominated by *A. harpophylla*. Suitable habitat for *S. elachophyllum* within the Study Area, comprises:

- **Known habitat:** consists of suitable habitat within 50 m of known records of the species including REs 11.3.1, 11.3.2, 11.3.27, 11.3.6, 11.4.9, 11.9.5 and non-remnant vegetation.
- **Potential habitat:** consists of suitable habitat outside areas of known habitat including the REs listed above with the addition of RE 11.3.3.

Specifically, suitable habitat for *S. elachophyllum*, within the Study Area consists of remnant, high value regrowth and non-remnant vegetation associated with REs 11.3.1, 11.3.6, 11.4.9 and 11.9.5. In total 6,883.97 ha of habitat was identified within the Study Area, including 30.32 ha of known habitat and 6,853.65 ha of potential habitat. Approximately 2,305.60 ha of habitat was identified in the Disturbance Footprint, including 6.00 ha of known habitat and 2,299.78 ha of potential habitat. Threatened flora meanders conducted by both EMM and e2m within the Disturbance Footprint identified approximately 123 stems (Figure 10). S. *elachophyllum* observed within the Study Area is presented in Plate 4.



Plate 4: *Solanum elachophyllum* observed within the Study Area



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

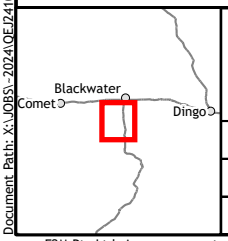
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FIGURE 10: *SOLANUM ELACHOPHYLLUM* HABITAT AND RECORDS WITHIN THE STUDY AREA

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Whitehaven Coal

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4.1.4 Pest flora

Eight weed species listed as Weeds of National Significance (WoNS) or restricted matter under the Biosecurity Act 2014 (Biosecurity Act) were recorded within the Study Area (Table 16). This correlates with EMM's findings (EMM, 2020b) where they observed pest flora to be widespread across the Study Area and included all species observed by E2M. *Opuntia* spp. (Prickly pears) were commonly observed within Brigalow communities, *Bryophyllum delagoense* (Mother of Millions) and *Parthenium hysterophorus* (Parthenium) amongst floodplains, and *Harrisia martinii* (Harrisia cactus) often in areas of regrowth vegetation and pasture (Plate 5). EMM observed *Cryptostegia grandiflora* (Rubber Vine) mostly within sections of stream banks, encroaching trees and forming thickets (EMM, 2020b), whilst during E2M surveys the species was commonly observed throughout Taurus Creek (Plate 6). Both EMM and E2M observed *Parkinsonia aculeata* (Parkinsonia weed) at some dam and wetland sites, although it was noted that it was relatively rare across the full Study Area (EMM, 2020b).



Plate 5 A dense patch of pest flora species *Bryophyllum delagoense* (Mother of millions), *Harrisia martinii* (Harrisia cactus), and *Parthenium hysterophorus*



Plate 6: Rubber vine *Cryptostegia grandiflora* encroachment

The extent categories used to describe flora species presence in Table 16, such as common, scattered and high density, reflect varying patterns of presence across the landscape. Scattered indicates irregular and isolated occurrences; common suggests regular but moderate presence; and high density refers to areas where the species occurs in large numbers or concentrations.

Table 16: Pest flora within the Study Area

Scientific name	Common name	WoNS	Biosecurity Act status	Extent within Study Area
Bryophyllum delagoense	Mother of millions	-	Category 3	Common throughout Study Area
Cryptostegia grandiflora	Rubber vine	WoNS	Category 3	Common throughout Taurus Creek
Harrisia martinii	Harrisia cactus	-	Category 3	Common throughout Study Area

Scientific name	Common name	WoNS	Biosecurity Act status	Extent within Study Area
Opuntia streptacantha	White-spined pear	WoNS	Category 3	Scattered throughout Study Area
Opuntia stricta	Common prickly pear	WoNS	Category 3	Scattered throughout Study Area
Opuntia tomentosa	Velvet tree pear	WoNS	Category 3	Scattered throughout Study Area
Parkinsonia aculeata	Parkinsonia	WoNS	Category 3	Scattered throughout Study Area
Parthenium hysterophorus	Parthenium	WoNS	Category 3	High density throughout the Study Area

4.1.5 Groundwater Dependent Ecosystems

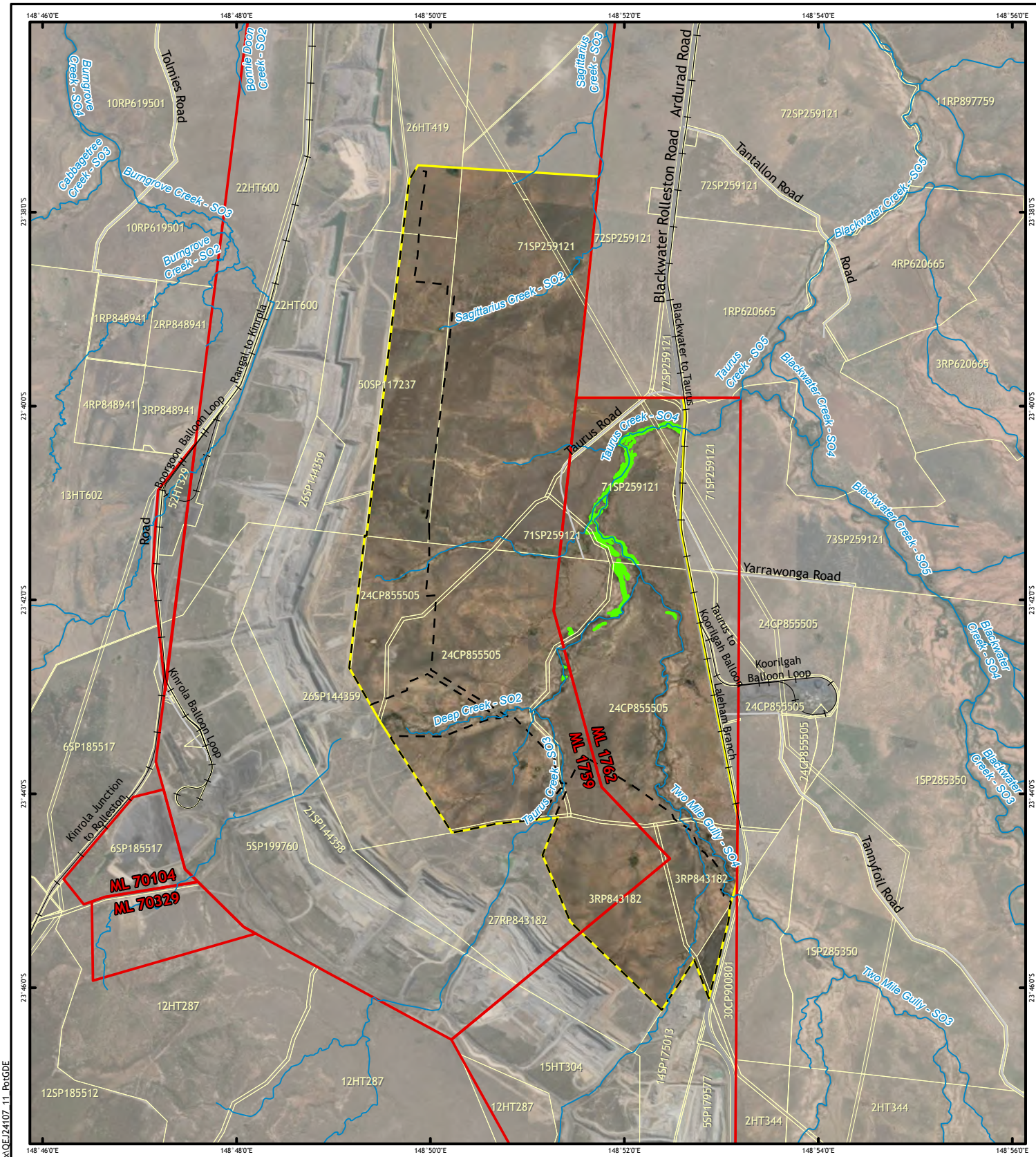
Groundwater Dependent Ecosystems (GDEs) are identified as 'water resources' under the Commonwealth *Water Act 2007* and require assessment under the EPBC Act in relation to coal seam gas and large coal mining developments. GDEs are ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis for maintenance of the ecosystem (Richardson et al., 2011). GDEs are classified by Doody et al. (2019) into three broad types, including:

- aquifer/cave ecosystems, occupied by stygofauna (subterranean GDEs);
- ecosystems dependant on the surface availability (discharge) of groundwater, which are characterised by permanent provision of surface water (aquatic GDEs); and
- ecosystems dependent on access to subsurface groundwater, which includes many riparian communities (terrestrial GDEs).

Assessment of subterranean and aquatic GDEs are not included within this report, and so only terrestrial GDEs will be discussed further. Desktop assessments identified a potential terrestrial GDEs in the central extent of the Study Area around Taurus Creek (BoM, 2026). A field assessment of potential GDEs determined that upstream and downstream extents of terrestrial GDEs within the Study Area have not been delineated, but likely correspond with RE 11.3.2, 11.3.25, 11.3.27, 11.3.3 and 11.3.6 on Taurus Creek (DPM, 2026).

Based on the species composition of these communities, areas of these REs potentially access groundwater during dry periods, given the presence of *E. coolabah and E. populnea*, which can be facultative groundwater dependent species (Eamus et al., 2006; Kath et al., 2014; Roberts & Marston, 2000).Remnant vegetation on Two Mile Gully and further upstream on Taurus Creek is unlikely to constitute terrestrial GDEs as they generally contained species that do not represent ground-water dependent vegetation such as *Acacia harpophylla* and *Terminalia oblongata*. These species typically have a horizontal root system and are considered unlikely to be dependent on access to groundwater for long-term survival (DES, 2017).

Areas of terrestrial GDEs identified in the Study Area are depicted in Figure 11 (DPM, 2026).



Legend

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- Property Access
- Watercourse
- Potential GDE
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
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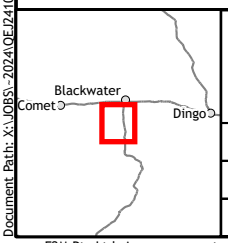
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Scale 1:100,000 (A4)

0 2.5 5

Kilometres

Coordinate System: GDA2020



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FIGURE 11: POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS

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Whitehaven Coal

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4.2 Fauna

Fauna surveys were undertaken within the Study Area in accordance with the relevant guidelines outlined in Section 3.2.3.

4.2.1 Fauna diversity

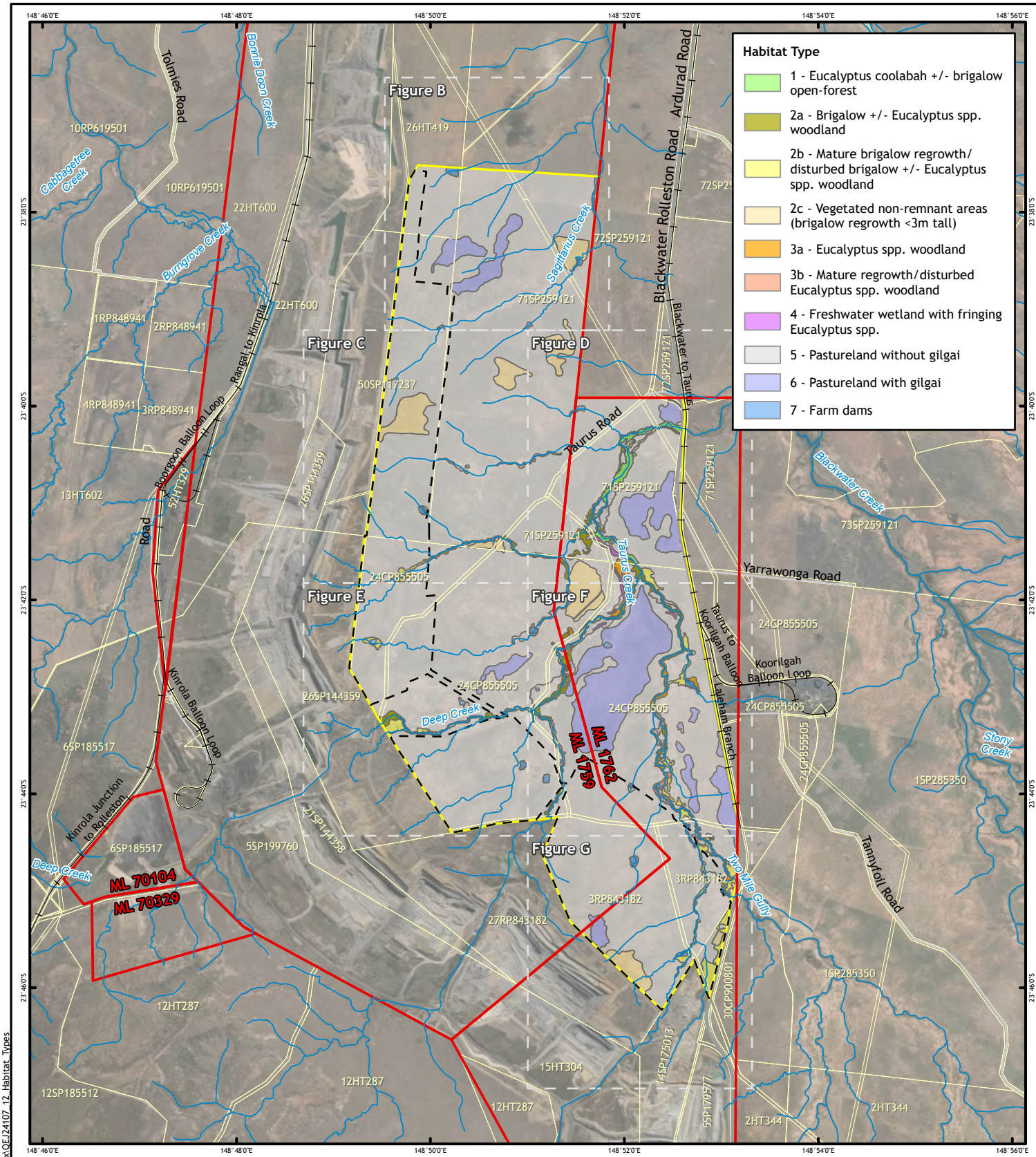
During the field surveys, E2M recorded 81 species of terrestrial fauna within the Study Area, including 74 native species and seven pest/introduced species. Birds accounted for 81.48% of the recorded fauna species, whilst mammals, reptiles and amphibians composed 8.64%, 2.47% and 7.41% of records, respectively. Refer to Appendix C for a full fauna species list.

4.2.2 Fauna habitat types

The Study Area can be delineated into ten broad habitat types based largely on vegetation type and structure (Table 17). The description of each fauna habitat type is presented from Section 4.2.2.1 to 4.2.2.10. Fauna habitat types within the Study Area are illustrated in Figure 12.

Table 17: Broad fauna habitat and their associated REs

Broad fauna habitat type	Broad fauna habitat type description	Associated RE	Location
Habitat 1	*Eucalyptus coolabah* +/ - brigalow open-forest	Remnant 11.3.3	Outside Disturbance Footprint
Habitat 2a	Brigalow +/- *Eucalyptus spp.* woodland	Remnant 11.3.1, 11.4.9, 11.9.5	Inside Disturbance Footprint
Habitat 2b	Mature brigalow regrowth / disturbed brigalow +/- *Eucalyptus* spp. woodland	High value regrowth/disturbed remnant 11.3.1, 11.4.9, 11.9.5	Inside Disturbance Footprint
Habitat 2c	Vegetated non-remnant areas (brigalow regrowth <3m tall)	Vegetated non-remnant areas associated with REs 11.3.1, 11.4.9, 11.9.5	Inside Disturbance Footprint
Habitat 3a	*Eucalyptus spp.* woodland	Remnant 11.3.2, 11.3.6	Inside Disturbance Footprint
Habitat 3b	High value regrowth / disturbed Eucalyptus spp. woodland	High value regrowth/disturbed remnant areas 11.3.2, 11.3.6	Inside Disturbance Footprint
Habitat 4	Freshwater wetland with fringing *Eucalyptus* spp.	Remnant 11.3.27	Outside Disturbance Footprint
Habitat 5	Pastureland without gilgai	N/A	Inside Disturbance Footprint
Habitat 6	Pastureland with gilgai	N/A	Inside Disturbance Footprint
Habitat 7	Dams	N/A	Inside Disturbance Footprint



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre
- Figure Extent

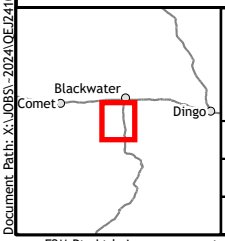
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Scale 1:100,000 (A4)

0 2.5 5

Kilometres

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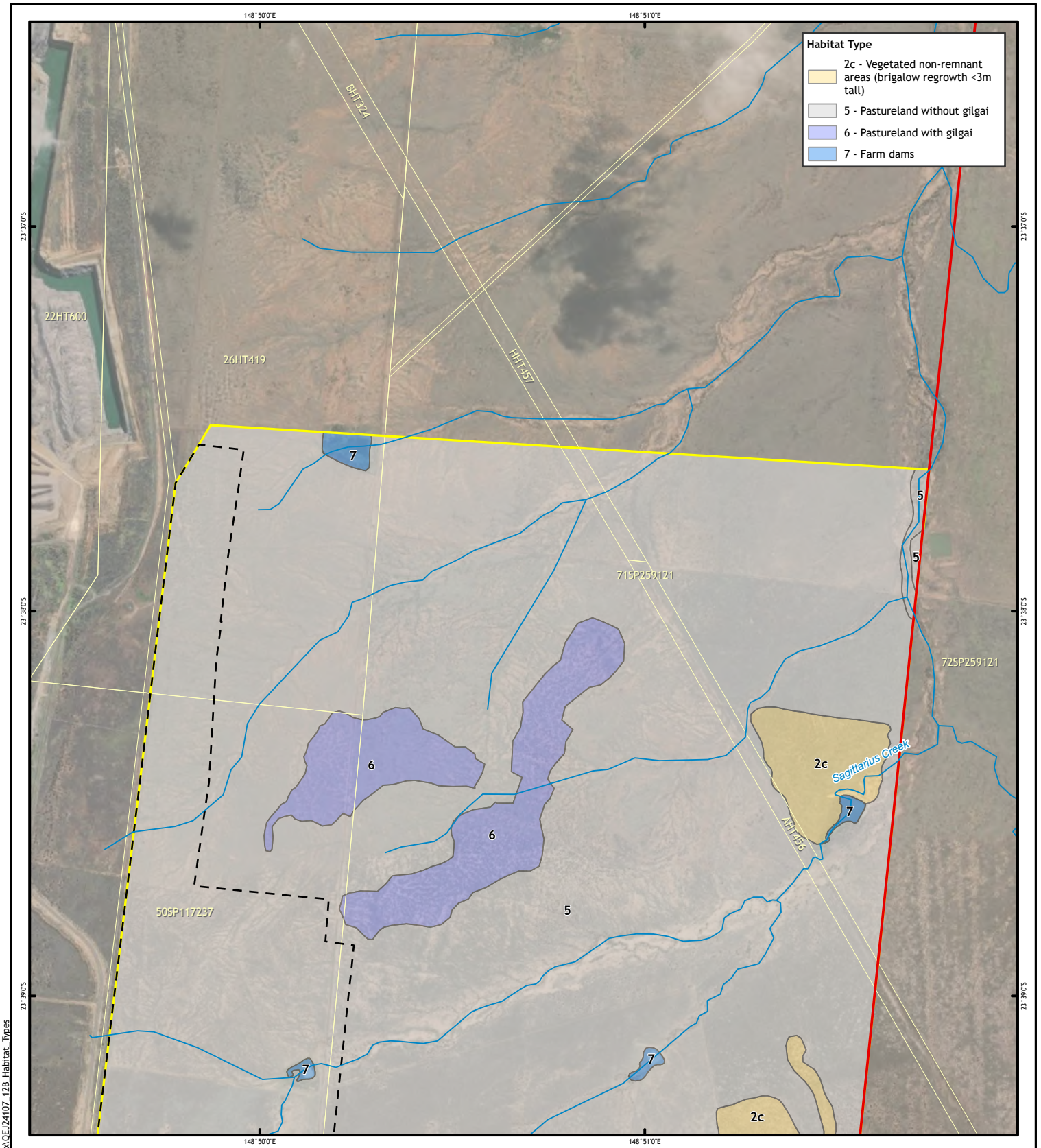
FIGURE 12A: FAUNA HABITAT TYPES IN THE STUDY AREA - OVERVIEW

Blackwater North Ecological Assessment
Whitehaven Coal

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

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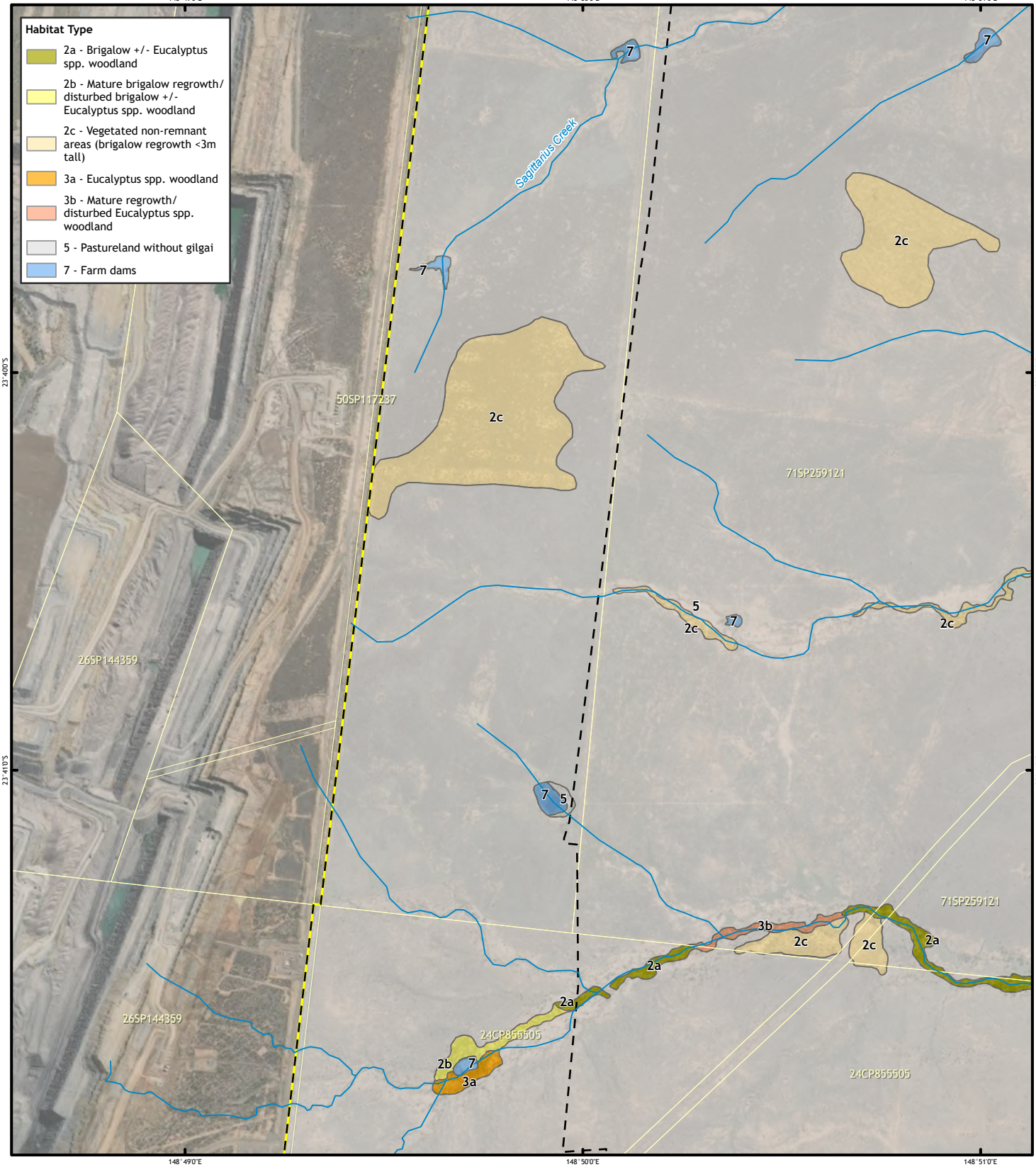
FIGURE 12B: FAUNA HABITAT TYPES IN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

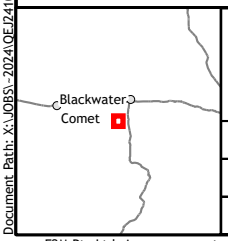
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



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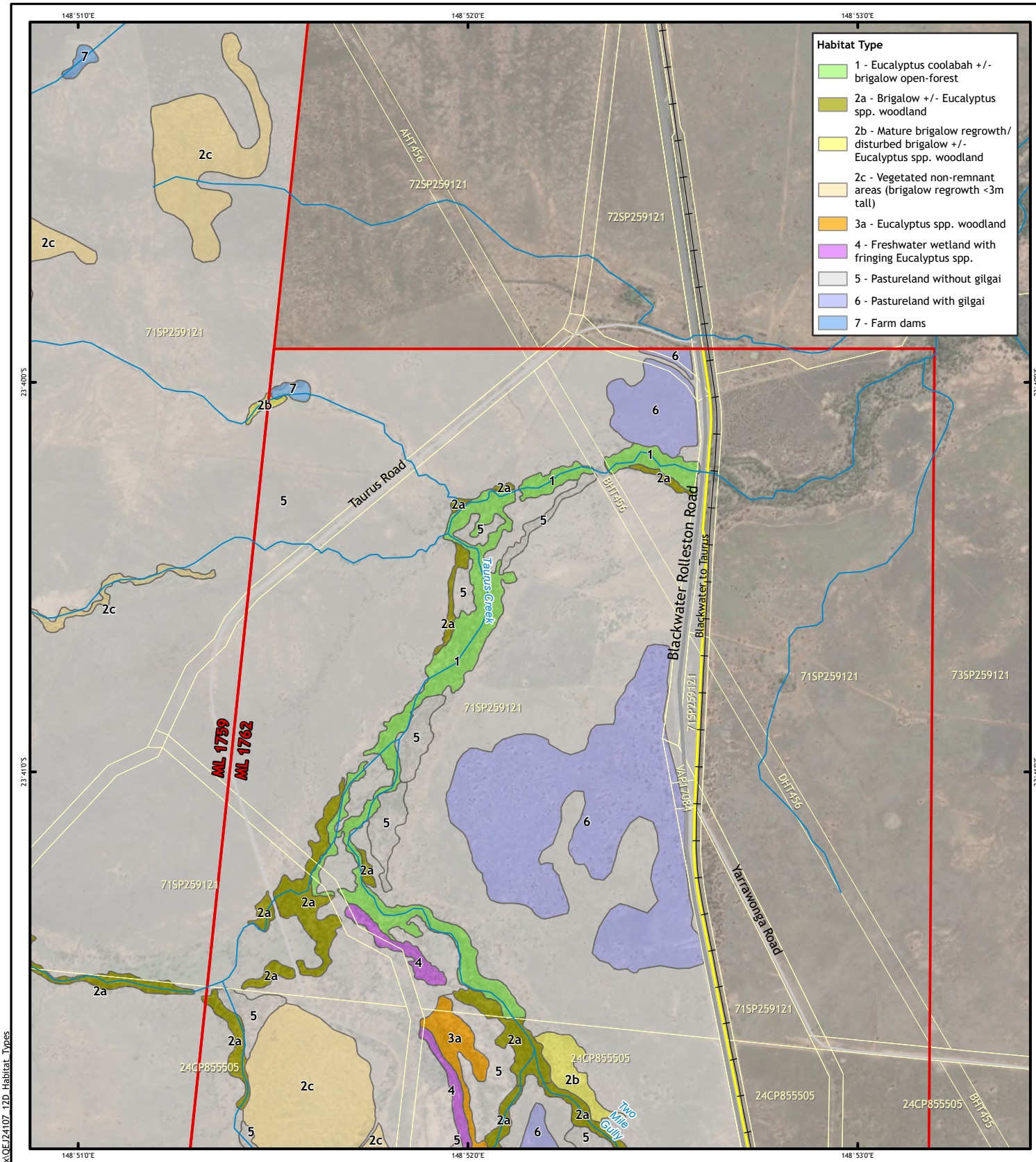
FIGURE 12C: FAUNA HABITAT TYPES IN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Blackwater Mining Lease
- Cadastre

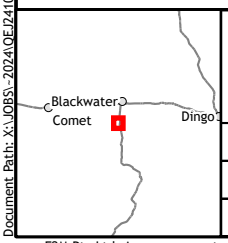
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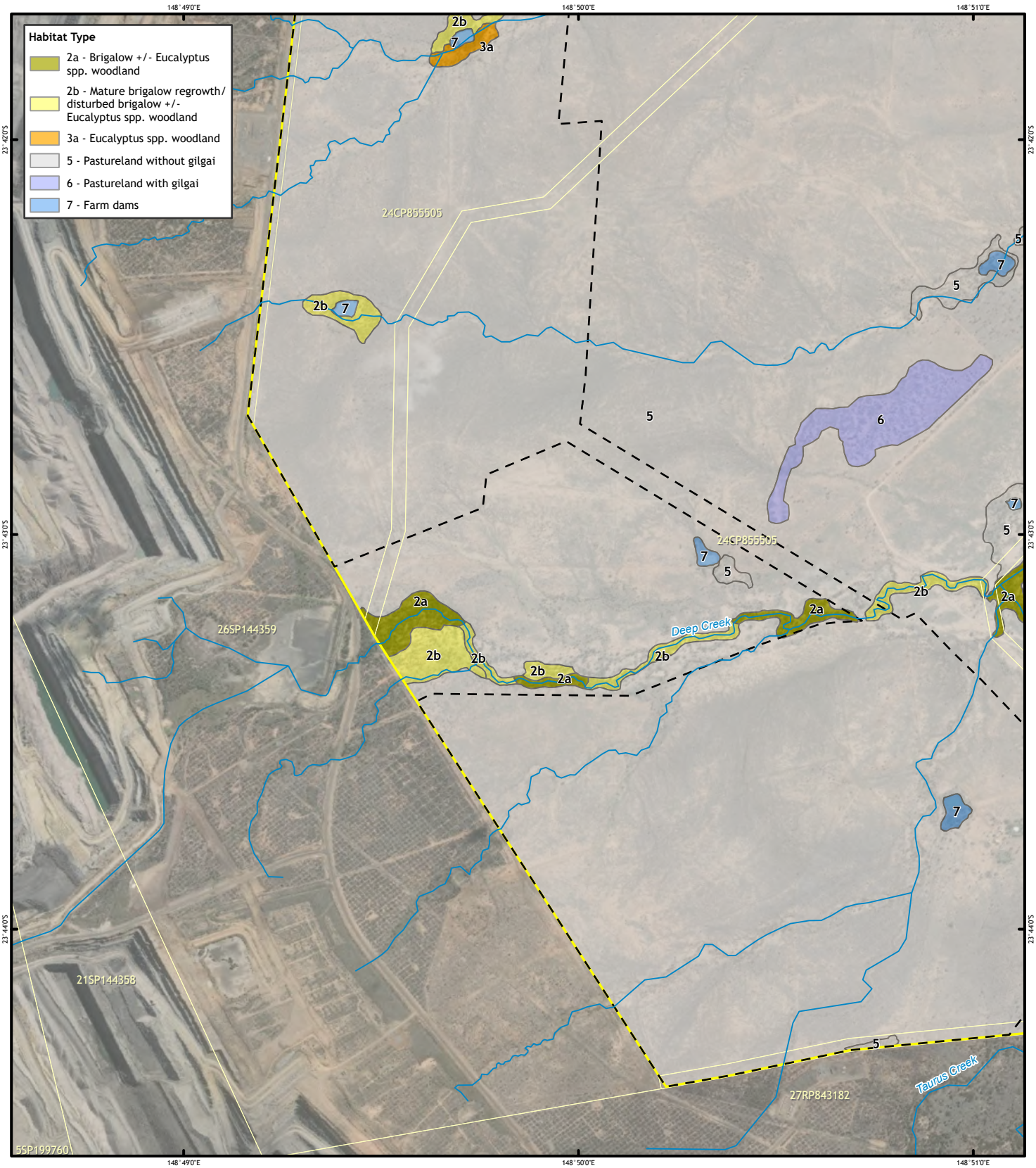
FIGURE 12D: FAUNA HABITAT TYPES IN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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4 of 7	QEJ24107	1

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- Study Area
- Disturbance Footprint
- Cadastre

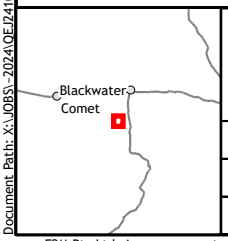
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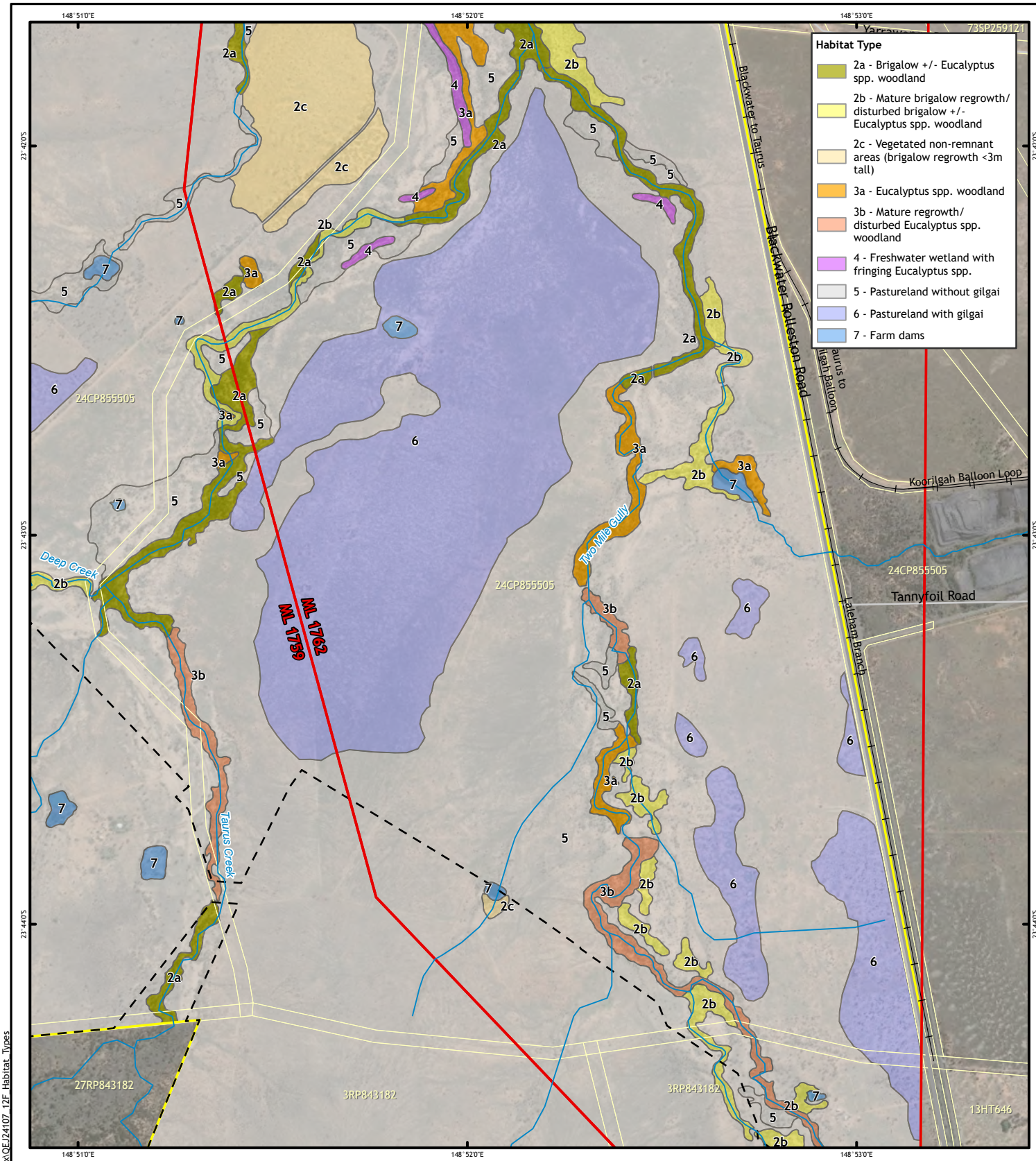
FIGURE 12E: FAUNA HABITAT TYPES IN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

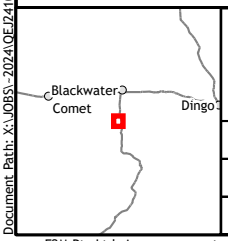
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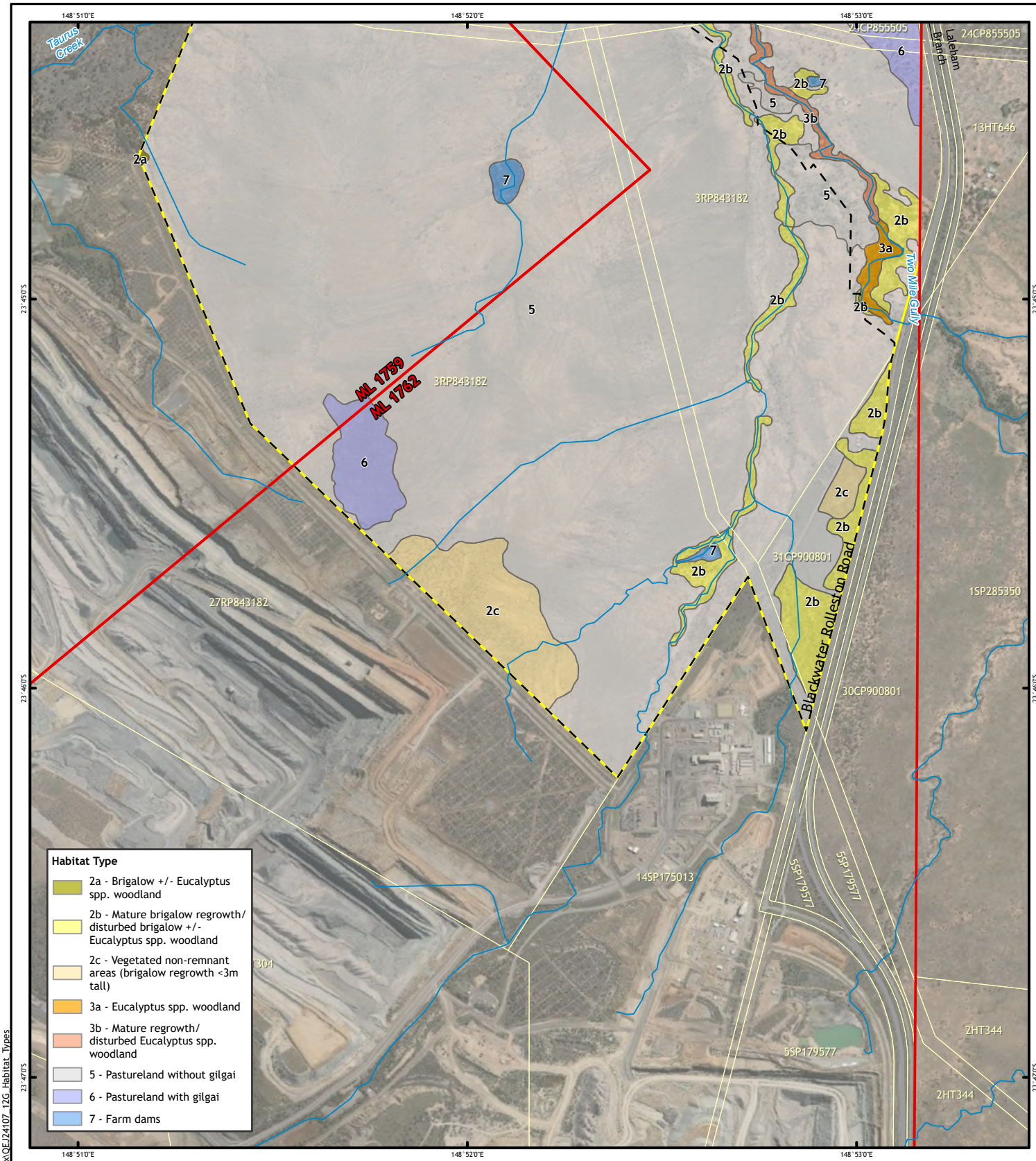
FIGURE 12F: FAUNA HABITAT TYPES IN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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6 of 7	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

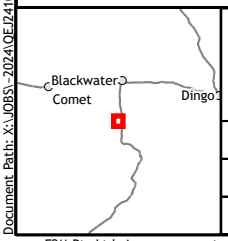
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FIGURE 12G: FAUNA HABITAT TYPES IN THE STUDY AREA

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Whitehaven Coal

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4.2.2.1 Habitat 1: *Eucalyptus coolabah* +/- brigalow open-forest

This habitat type occurs outside of the Disturbance Footprint. The habitat is characterised by an open forest dominated by *Eucalyptus coolabah*, with *Acacia harpophylla* forming a prominent sub-canopy. The canopy structure provides nesting and roosting opportunities for arboreal mammals and birds, though lacks high abundances to support hollow dependent fauna (e.g. Greater gliders). A dense shrub layer, primarily comprising *Lysiphyllum carronii* and *Erythroxylum australe,* offers additional shelter and nesting sites for ground-dwelling birds and small mammals.

The ground layer, composed of native grasses and forbs, supports seed-eating birds, small mammals and invertebrates. An abundance of fallen logs and leaf litter is present, providing shelter and foraging substrate for reptiles, amphibians and invertebrates, and nesting materials for small mammals and birds. There is evidence of canopy species recruitment, indicating habitat resilience and long-term suitability for fauna dependent on mature vegetation. Despite this, a high presence of non-native species, such as *Megathyrsus maximus* and *Parthenium hysterophorus*, suggests reduced habitat quality.

This habitat type is equivalent to RE 11.3.3 (*Eucalyptus coolabah* woodland on alluvial plains), and representative photographs of this habitat type is provided in Plate 7.



Plate 7: Habitat 1: *Eucalyptus coolabah* +/- brigalow open-forest

4.2.2.2 Habitat 2a: Brigalow +/- *Eucalyptus* spp. woodland

This habitat occurs within the Disturbance Footprint and is generally comprised of an open forest dominated by *A. harpophylla* and scattered trees of *Eucalyptus coolabah, Brachychiton rupestris,* and *L. carronii*. The shrub layer provides shelter, nesting sites, and foraging opportunities for small mammals, birds and reptiles, with species such as *L. carronii* and *Erythroxylum australe* known to support insect life and offer structural diversity. Grass species diversity is low across the sites for this habitat, with species such as *Dichanthium sericeum* and *Sporobolus* spp. common, although some sites completely lack the presence of native grass species. This low diversity may limit habitat quality across some areas.

The habitat is heavily invaded by non-native species such as *Parthenium hysterophorus* and *Bryophyllum delagoense*, which may suppress native flora and alter fauna dynamics. Coarse woody debris was observed in great accumulations across all sites and is likely to enhance shelter and foraging availability for fauna species.

REs within the Study Area associated with this habitat type include 11.3.1, 11.4.9, and 11.9.5 and is depicted in Plate 8.



Plate 8: Habitat 2a: Brigalow +/- *Eucalyptus* spp. woodland

4.2.2.3 Habitat 2b: Mature brigalow regrowth/disturbed brigalow +/- *Eucalyptus* spp. woodland

This habitat occurs within the Disturbance Footprint. It is a mix of structurally open forests and shrubland with a moderate canopy layer dominated by *A. harpophylla*. The canopy cover ranges from moderate to high, while shrub layers are consistently sparse. Tree diversity is high with species such as *Eucalyptus coolabah*, *Terminalia oblongata*, and *Geijera parviflora*. Native ground cover is low or absent on some sites, with exotic species such as *Megathyrsus maximus, Cenchrus ciliaris* and *Parthenium sp*. dominating the ground layer, which significantly reduces the suitability for ground-dwelling and herbivorous fauna.

Sites within this habitat that are located on watercourses generally appear to offer higher ecological value compared to those on alluvial plains or with exotic understoreys. These watercourse-associated sites are likely to support a more diverse tree community, maintain better canopy structure and exhibit lower exotic species cover and a slightly higher native ground layer diversity. While they still are impacted by degradation, their structural complexity and species richness make them more suitable for a broader range of native fauna, particularly arboreal and shrub-dwelling species. This suggests that riparian or watercourse-associated vegetation may serve as important ecological refuges in otherwise modified landscapes.

REs within the Study Area associated with this habitat type include high value regrowth/disturbed remnant 11.3.1, 11.4.9, and 11.9.5 and is depicted in Plate 9.



Plate 9: Habitat 2b: Mature brigalow regrowth/disturbed brigalow +/- *Eucalyptus* spp. woodland

4.2.2.4 Habitat 2c: Vegetated non-remnant areas (brigalow regrowth <3m tall)

This habitat occurs within the Disturbance Footprint. The habitat represents non-remnant regrowth of *A. harpophylla* (<3m tall), forming sparse low woodlands. Canopy structure is underdeveloped, reflecting early successional growth following historical clearing. *A. harpophylla* is consistently dominant, though associated species such as *T. oblongata*, *L. carronii* and *A. hemiglauca* may be present in low numbers. Emergent and subcanopy layers are largely absent and tree diversity is low to moderate.

Shrub layers are sparse and composed of regenerating woody species such as *Carissa ovata*, *Capparis lasiantha*, and *Dodonaea* spp., while ground cover is a mix of native and introduced grasses including *Aristida ramosa*, *Panicum decompositum*, and *Cenchrus ciliaris*, with exotic species cover often exceeding 50%. Forbs are present but include many disturbance-tolerant and non-native taxa such as *Parthenium hysterophorus*, *Melinis repens*, and *Salsola australis*. Litter cover is patchy, with some areas showing high bare ground percentages.

This early regrowth habitat is structurally simple, with limited vertical complexity, moderate canopy cover (~20-30%), and often a high dominance of pasture species. As a result, it provides low habitat suitability for arboreal or ground-dwelling fauna, although it may support some shrub and disturbance-adapted species.

REs within the Study Area associated with this habitat type include non-remnant brigalow regrowth (<3 m tall) associated with previously cleared REs 11.3.1, 11.4.9, 11.9.5 and is depicted in Plate 10.



Plate 10: Habitat 2c: Vegetated non-remnant areas (brigalow regrowth <3m tall)

4.2.2.5 Habitat 3a: *Eucalyptus* spp. woodland

This habitat occurs within the Disturbance Footprint and is an open woodland dominated by species such as *Eucalyptus populnea, Eucalyptus melanophloia*, *Eucalyptus camaldulensis, T. oblongata* and *A. harpophylla*. The canopy cover ranges from sparse to moderately dense and is rich in diversity in some sites (up to 8 tree species). Sites with mixed species composition and higher canopy cover is likely to prove more ecological niches and support higher biodiversity, particularly arboreal fauna, though lack of hollows reduces suitability. The shrub layer is generally sparse across most sites and includes species such as *Lysiphyllum hookeri*, *Carissa ovata*, and *Citrus glauca*. The ground layer is highly variable and often degraded. Native grasses such as *Dichanthium sericeum, Enteropogon ramosus,* and *Sporobolus caroli* were present in some site although exotic species such as *Cenchrus ciliaris*, *Megathyrsus maximus* and *Urochloa mosambicensis* dominated in most.

Sites with high exotic cover (up to 70%) and low native grass diversity offer poor habitat for groundforaging fauna and herbivores. Coarse woody debris is moderate to high across most sites and are likely to support a richer and more diverse fauna community, particularly those depended on ground-level habitat features such as reptiles, amphibians and small mammals.

REs within the Study Area associated with this habitat type include Remnant 11.3.2, 11.3.6 and is depicted in Plate 11.



Plate 11: Habitat 3a: *Eucalyptus* spp. woodland

4.2.2.6 Habitat 3b: High value regrowth/disturbed *Eucalyptus* spp. woodland

The habitat type occurs within the Disturbance Footprint. It is characterised as a disturbed open forest and woodland habitat, primarily dominated by *Eucalyptus populnea*, *Eucalyptus melanophloia* and associated species such as *T. oblongata*, *Lysiphyllum hookeri*, and *A. harpophylla*. The canopy is variable in density, ranging from sparse to moderately closed. The presence of mature Eucalypt species provides vertical structure and potential nesting and foraging opportunities for arboreal fauna, though generally lacks hollows.

The shrub layer is patchy and inconsistent, with one site supporting a well-developed shrub layer whilst others are nearly devoid of mid-strata vegetation. This likely affects habitat suitability for small mammals, reptiles and birds that rely on shrub cover for shelter and movement. The ground layer is mostly degraded with a high exotic species cover (50-70%) including species such as *Cenchrus ciliaris*, *Megathyrsus maximus*, *Parthenium* spp. and *Opuntia* spp. Native grass and forb diversity is limited. Coarse woody debris is moderate to high, offering important microhabitats for invertebrates, reptiles and small mammals.

REs within the Study Area associated with this habitat type include high value regrowth/disturbed remnant areas 11.3.2 and 11.3.6 and is depicted in Plate 12.



Plate 12: Habitat 3b: High value regrowth/disturbed *Eucalyptus* spp. woodland

4.2.2.7 Habitat 4: Freshwater wetland with fringing *Eucalyptus* spp.

The habitat type occurs outside the Disturbance Footprint. The habitat is characterised as a riparian open forest dominated by *Eucalyptus camaldulensis* (River red gum), occurring adjacent to a backwater wetland. It features diverse tree assemblage and moderate to high canopy, providing strong vertical structure and habitat for arboreal fauna such as birds and possums. The shrub layer is sparse (2.4%) with species such as *L. carronii* and *Acacia saligna*. This limited mid-stratum vegetation is likely to reduce shelter and foraging opportunities for small mammals and birds.

Amongst the ground layer, native grass is limited with only *Bothriochloa ewartiana* recorded and forbs demonstrate low diversity with just three species recorded. Exotic cover is high (70%) and is dominated by *Megathyrsus maximus* and *Cenchrus ciliaris*, likely suppressing native regeneration and reducing habitat quality. There is moderate coarse woody debris presence, contributing to ground-level habitat complexity and supporting reptiles, invertebrates and decomposers.

Presence of permanent to semi-permanent water in these areas likely provide foraging opportunities for wetlands bird species.

REs within this Study Area associated with this habitat type include Remnant 11.3.27 and is depicted in Plate 13.



Plate 13: Habitat 4: Freshwater wetland with fringing *Eucalyptus* spp.

4.2.2.8 Habitat 5: Pastureland without gilgai

This habitat, located within the Disturbance Footprint, comprises cleared paddocks with scattered regrowth and improved pasture species. The overstorey is very sparse and contains only scattered individuals such as *A. harpophylla*, *L. carronii*, and *Acacia saligna*, with emergent heights reaching up to 12 m in some areas. Canopy and subcanopy cover are minimal (0-2.2%), offering limited vertical structure and habitat for arboreal fauna.

The shrub layer is variable with some sites supporting a moderate diversity of species including *Carrisa ovata, Capparis lasiantha, Dodonaea sp.*, and *Grewia latifolia*, though overall shrub cover remains low. This patchiness likely limits shelter and foraging opportunities for small mammals and understorey birds. The ground layer is dominated by exotic pasture grasses and forbs, with non-native cover ranging from 65% to 90%. Invasive species such as *Cenchrus ciliaris, Bothriochloa pertusa, Megathyrsus maximus*, and *Stylosanthes scabra* are widespread and likely suppress native regeneration. Native grasses such as *Themeda triandra, Aristida ramosa*, and *Sporobolus actinocladus* are present but patchy. Forb diversity is moderate, with a mix of native and exotic species including *Enchylaena tomentosa*, *Trianthema triquetra* and *Portulaca oleracea*.

Ground condition is variable, with litter cover ranging from 5% to 90% and bare ground from 0% to 25%, indicating inconsistent surface stability and microhabitat availability. Coarse woody debris is largely absent, further reducing structural complexity at ground level. This habitat type is depicted in Plate 14.



Plate 14: Habitat 5: Pastureland without gilgai

4.2.2.9 Habitat 6: Pastureland with gilgai

This habitat, located within the Disturbance Footprint, comprises cleared paddocks with scattered regrowth and improved pasture species on Cainozoic clay plains with gilgai microrelief. This habitat is characterised as a disturbed open woodland on improved pasture, dominated by *A. harpophylla*, *L. carronii*, and associated species such as *Apophyllum anomalum* and *A. hemiglauca*. Vertical structure is limited, with emergent heights ranging from 1.8 to 5 m and very sparse canopy development. Canopy and subcanopy are generally low, offering limited arboreal habitat value.

The shrub layer is patchy and species-rich in some areas, with taxa such *as Dodonaea sp., Capparis lasiantha* and *Sesbania cannabina*, but overall shrub cover remains minimal. This likely reduces shelter and foraging opportunities for small mammals and understorey birds. The ground layer is dominated by exotic grasses, with non-native cover averaging 80-90%. Invasive species such as *Cenchrus ciliaris, Bothriochloa pertusa*, and *Chloris gayana* are prevalent, likely suppressing native regeneration. Native grasses are present but limited, including *Eragrostis parviflora* and *Dichanthium sericeum*. Forb diversity is moderate, with a mix of native and exotic species.

Coarse woody debris is present in some areas, contributing to microhabitat complexity for reptiles, invertebrates and decomposers. However, high bare ground and litter variability across the sites suggest inconsistent ground-level habitat quality. Importantly, the presence of gilgai microtopography and cracking clays soils enhances habit heterogeneity by creating small seasonal refuge and breeding sites for amphibians, invertebrates and reptiles, while ephemeral water presence provides seasonal foraging opportunities for birds including herons and snipes. This habitat type is depicted in Plate 15.



Plate 15: Habitat 6: Pastureland with gilgai

4.2.2.10 Habitat 7: Dams

This habitat is located within the Disturbance Footprint and includes artificial waterbodies constructed primarily for agricultural purposes, such as livestock watering or irrigation. They can provide important aquatic and semi-aquatic habitat on otherwise dry landscapes. This habitat often supports a range of fauna, such as providing breeding habitat for amphibians, providing drinking, foraging and nesting opportunities for terrestrial and waterbirds, providing a water source for mammals, basking, shelter and foraging habitat for reptiles, and supporting a wide range of aquatic and semi-aquatic invertebrates.

Vegetation surrounding dams typically include emergent aquatic plants, sedges and grasses with occasional regrowth of native shrubs. However, the surrounding ground layer is often dominated by exotic pasture species and may show signs of trampling or erosion due to livestock access.

Water quality and ecological value vary widely depending on management practices, including well-maintained dams with fenced margins and native vegetation buffers and other degraded or heavily grazed dams may offer limited ecological function. This habitat type is depicted in Plate 16.



Plate 16: Habitat 7: Dams

4.2.3 Threatened fauna

The desktop assessment identified 39 fauna species listed under both the EPBC Act and NC Act as potentially occurring within the Study Area, including 36 EPBC Act listed species, and 37 NC Act listed species. Prior to field surveys, an assessment of the likelihood of occurrence for threatened fauna species was conducted based on species habitat suitability, species distribution ranges and historical occurrence records. Desktop assessments results identified 12 species as known, likely or possibly occurring within the Study Area, including:

- Known to occur (previously recorded within the Study Area during EMM surveys (EMM, 2023a, 2023b)):
  - **Koala**: indirect evidence (Koala scratches) was recorded along Taurus Creek (2.11 km northeast of the Disturbance Footprint)
  - **Australian painted snipe**: observed on three occasions within the Study Area
  - **Squatter pigeon (southern)**: recorded on two occasions in the vicinity of dams near Taurus Road
  - **Ornamental snake**: recorded in gilgai areas between Taurus Creek and the Blackwater-Rolleston Road
  - **Latham's snipe**: was recorded at three locations across the Study Area in ephemeral gilgai habitat
- Likely to occur:
  - **White-throated needletail:** the species occurs widely across Queensland and forages aerially above all most habitat types including cleared pasture. The species has been recorded on multiple occasions within the desktop search extent and foraging habitat occurs above the entire Study Area.
  - **Short-beaked echidna:** the species occurs in a wide range of habitats across Australia including grasslands and open-woodlands which occur throughout the Study Area. The species has also been recorded multiple occasions within desktop search extent.
- Possibly occurring:
  - **Corben's long-eared bat:** the Study Area occurs at the edge of the species potential distribution and may contain suitable habitat
  - **Greater glider (southern and central):** the species has been previously recorded within the desktop search extent and suitable habitat may occur within the Study Area
  - **South-eastern Glossy black-cockatoo:** numerous records occur within the desktop search extent, and the Study Area may contain suitable habitat
  - **Painted honeyeater:** numerous records occur within the desktop search extent, and the Study Area may contain suitable habitat
  - **Sharp-tailed sandpiper:** the species has been previously recorded within the desktop search extent and suitable habitat may occur within the Study Area

These species formed the basis of targeted surveys and habitat assessments undertaken by E2M with the aim of refining species likelihood of occurrence based on field verified results.

While no additional threatened fauna species were identified during field surveys, potential suitable habitat was confirmed for both likely occurring threatened species, whilst the five possibly occurring species were downgraded to unlikely to occur based on the species not being detected during targeted surveys and the lack of suitable habitat within the Study Area. Full likelihood of occurrence results for all species identified during the desktop assessment are provided in (Appendix B).

The characteristics of habitat mapped for known or likely to occur species are summarised in Table 18 and described in further detail in Sections 4.2.1 to 4.2.3.7.

Table 18: Summary of threatened fauna habitat within the Study Area and Disturbance Footprint

Species	Habitat summary	Habitat with Study Area (ha)	Habitat within Disturbance Footprint (ha)
Reptiles			
Ornamental snake (*Denisonia maculata*)	Breeding and foraging - remnant, high value regrowth and non-remnant areas with suitable gilgai microrelief and soil cracks	497.52	0.0
Birds			
Australian painted snipe *(Rostratula australis)*	Intermittent foraging – consisting of all remnant, high value regrowth or non-remnant areas with gilgai microrelief	593.55	14.45
	Permanent foraging - consisting of dams/wetlands with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges)	16.45	6.41
Latham's snipe *(Gallinago hardwickii)*	Intermittent foraging – consisting of all remnant, high value regrowth or non-remnant areas with gilgai microrelief	593.55	14.45
	Permanent foraging - consisting of dams/wetlands with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges)	16.45	6.41
Squatter pigeon (southern) *(Geophaps scripta scripta)*	Breeding and foraging – remnant, high value regrowth and young regrowth communities on well-draining soils (i.e. land zones 3, 5, 7 and 9) within 1 km of a semi-permanent or permanent waterbody	239.01	26.05
	Foraging - remnant, high value regrowth and young regrowth communities on well-draining soils (i.e. land zones 3, 5, 7 and 9) between 1 km to 3 km of a seasonal or permanent waterbody	30.46	6.41
	Dispersal – all other remnant, high value regrowth and young regrowth communities which links areas of suitable breeding and foraging habitat, as well as non-remnant areas less than 100 m wide which join breeding and foraging habitat	990.75	262.34
White-throated needletail *(Hirundapus caudacutus)*	Aerial foraging – all remnant, high value regrowth, young regrowth and non-remnant habitat	6,907.49	2,316.58

Species	Habitat summary	Habitat with Study Area (ha)	Habitat within Disturbance Footprint (ha)
Mammals			
Koala (*Phascolarctos cinereus*)	Breeding and foraging – all remnant and high value regrowth vegetation dominated or co-dominated LIKTs, including RE 11.3.2, 11.3.3, 11.3.6 and 11.3.27.	103.38	2.72
	Dispersal – all remnant and high value regrowth areas associated with REs dominated or co-dominated by containing ancillary species (i.e. REs 11.3.1, 11.4.9 and 11.9.5) OR non-remnant areas with scattered LIKTs which provide connectivity between areas of breeding and foraging habitat.	209.24	48.29
Short-beaked echidna (*Tachyglossus aculeatus*)	Breeding and foraging: All remnant, high value regrowth and young regrowth communities.	501.13	122.11

4.2.3.1 Ornamental snake (*Denisonia maculata*)

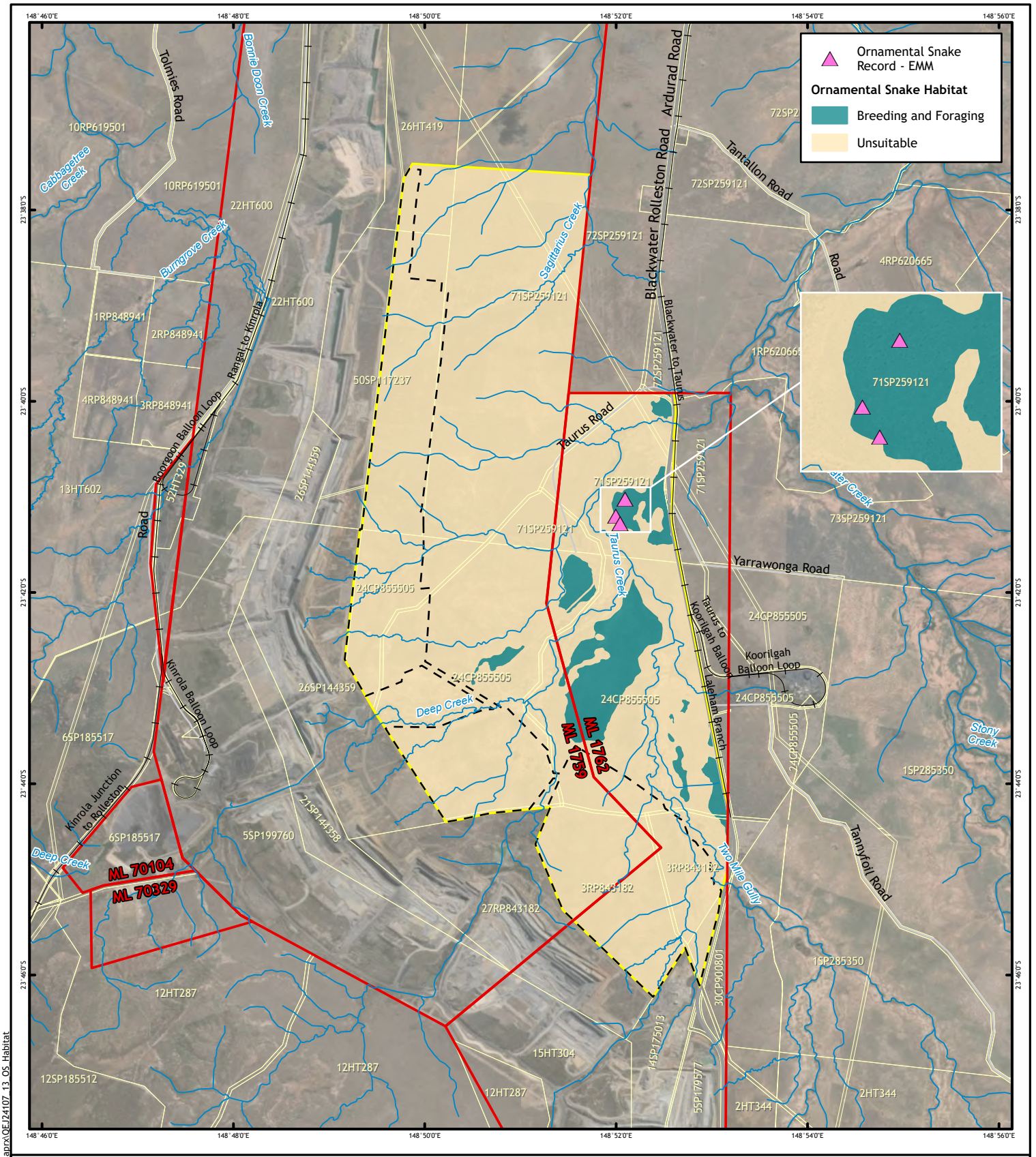
Ornamental snake is listed as vulnerable under the EPBC Act and NC Act, and is a habitat specialist, closely dependent on gilgai for foraging and refuge (Brigalow Belt Reptiles Workshop, 2010). When flooded, gilgai provide habitat for prey species such as Green tree frogs (*Litoria caerulea)*, Striped burrowing frogs (*Cyclorana alboguttata)*, Salmon-striped frogs (*Limnodynastes salmini*) and Broad-palmed frog (*Litoria latopalmata*) (Veary, 2011). As the water ebbs and the gilgai dries, deep cracks within the clay soil provide shelter for Ornamental snake. Gilgai are associated with Brigalow (*A. harpophylla*), Gidgee (*A. cambagei*), Blackwood (*A. argyrodendron*) and/or Coolabah (*Eucalyptus coolabah*) dominant vegetation communities (DCCEEW, 2025d).

While not recorded during E2M surveys, Ornamental snake was recorded during previous field surveys within the Study Area (see Section 2.8). The species was recorded on three separate occasions, in close proximity to each other, within non-remnant gilgai habitat (Figure 13). Given the highly disturbed and degraded nature of the Study Area, suitable habitat for Ornamental snake was categorised based primarily on the availability of suitable gilgai microrelief with deep cracking clay soils. Specifically, Ornamental snake habitat with the Study Area was categorised into the following:

- **497.52 ha of breeding and foraging habitat:** remnant, high value regrowth and non-remnant areas with suitable gilgai microrelief and soil cracks (Plate 17).

Note: Some areas containing gilgai microrelief were excluded as suitable habitat for Ornamental snake based on them being shallow and lacking sufficient soil cracks and microhabitat (i.e. woody debris) to support the species (Plate 18). Brigalow TEC within the Disturbance Footprint is not considered as Ornamental snake habitat due to the absence of these key microhabitat features.

A total of 497.52 ha of breeding and foraging habitat was identified in the Study Area. No areas of Ornamental snake habitat were identified in the Disturbance Footprint (Figure 13).



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- Railway
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- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

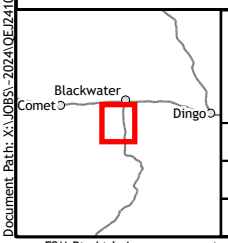
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FIGURE 13: ORNAMENTAL SNAKE HABITAT AND RECORDS WITHIN THE STUDY AREA

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Plate 17: Well developed gilgai within suitable Ornamental snake habitat



Plate 18: Shallow gilgai with limited soil cracks

4.2.3.2 Australian painted snipe (*Rostratula australis*)

Australian painted snipe is listed as endangered under the EPBC Act and NC Act, and generally forages in a variety of shallow wetlands yet breeding habitat requires specific microhabitat features such as exposed mud, dense low vegetation cover, on or near a small islands within a shallow, freshwater wetland (Rogers, et al., 2005). Breeding habitat for the species is very specific and includes shallow wetlands with areas of bare wet mud with canopy cover nearby. Nests are almost always recorded on or near small islands in freshwater wetlands, which provide a combination of water, exposed mud, dense low cover and sometimes dense canopy cover (Rogers et al., 2005).

While not recorded during E2M surveys, Australian painted snipe has been detected at two separate locations across the Study Area during previous ecological surveys, once within permanent foraging habitat and once within the intermittent foraging habitat (see Section 2.8) (Figure 14). The species was observed within dams and non-remnant gilgai habitat, which provide suitable foraging opportunities. No suitable breeding habitat was identified within the Study Area. Specifically, within the Study Area, suitable habitat for Australian painted snipe comprises:

- **610.00 ha of foraging habitat, including (Figure 14):**
  - 593.55 ha within which there is intermittent foraging habitat in the form of gilgai microrelief with remnant, high value regrowth or non-remnant areas (Plate 19); and
  - 16.45 ha of permanent foraging habitat in the form of farm dams [man-made] with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges) (Plate 20).

'Gilgai' are characterised by repeating mounds and depressions formed on shrink–swell cracking clay soils. Seasonal ponding occurs in depressions over only a small subset of the total intermittent foraging habitat mapped and the location of gilgal depressions change over time. For this reason, gilgai depressions associated with this soil type can provide intermittent foraging habitat for the Australian painted snipe.

DPM (2026) describe that the lacustrine wetlands (hydrologically modified or artificial) within the Study Area are either farm dams with constructed earthen walls on the downstream side or are constructed mine water dams. Some dams identified within the Study Area were not considered suitable habitat as they contained unvegetated steep bank margins. As this species requires dense low vegetation for cover (Department of the Environment and Energy, 2019), these areas were excluded from habitat. Additionally, some gilgai microrelief lacked suitable native aquatic vegetation, were extremely shallow and lacked the capability to hold water for prolonged periods (Rogers et al., 2005).

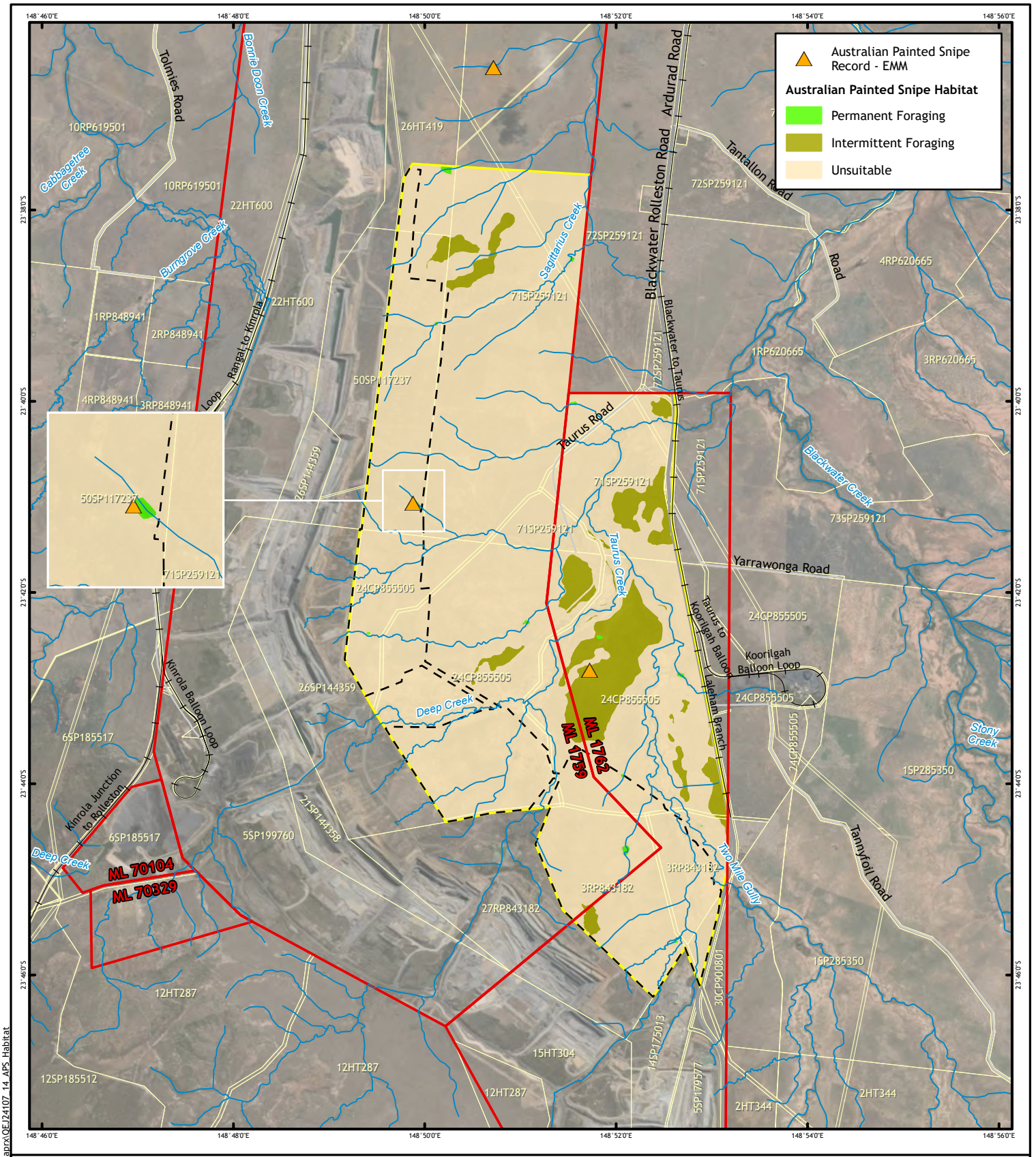
A total of 610.00 ha of foraging habitat for Australian painted snipe was identified in the Study Area, of which only 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat (i.e. man-made farm dams) occurs within the Disturbance Footprint (Figure 14). As described above, not all of the intermittent foraging habitat contains gilgai depressions suitable for the species.



Plate 19: Well developed gilgai within suitable Australian painted snipe foraging habitat



Plate 20: Dam providing suitable foraging habitat



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- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

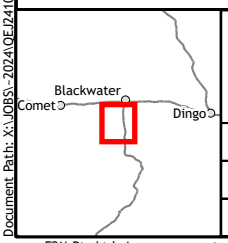
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FIGURE 14: AUSTRALIAN PAINTED SNIPE HABITAT AND RECORDS WITHIN THE STUDY AREA

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4.2.3.3 Latham's snipe (*Gallinago hardwickii*)

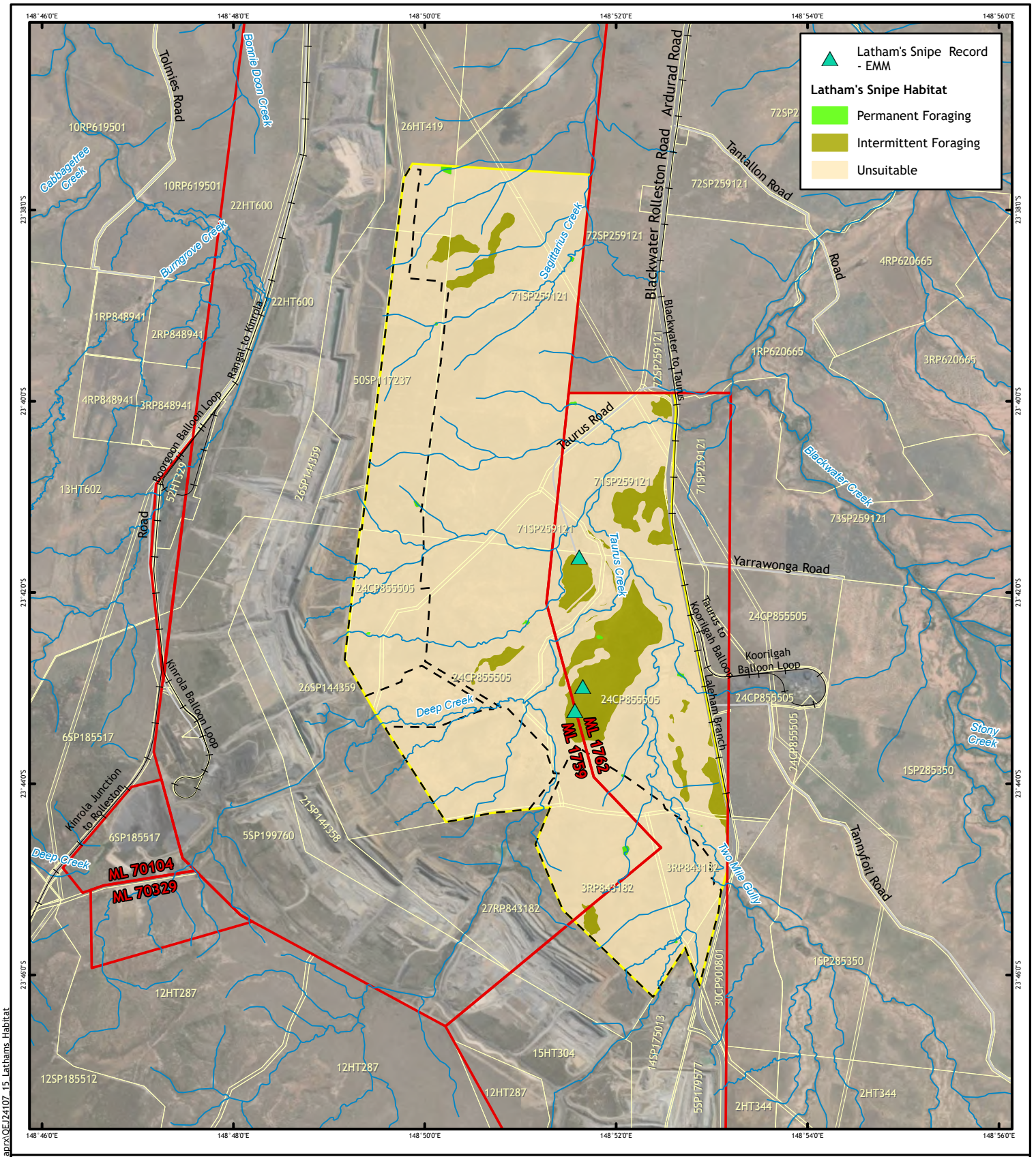
The Latham's snipe is listed as vulnerable under the EPBC Act and NC Act, and typically occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level (DCCEEW, 2025e). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (DCCEEW, 2025e). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (DCCEEW, 2025e). Various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (DCCEEW, 2025e).

While not recorded during E2M surveys, Latham's snipe was recorded during previous field surveys within the Study Area (see Section 2.8). The species was recorded on three separate occasions within non-remnant gilgai habitat, which provide suitable foraging opportunities (Figure 15). Specifically, within the Study Area, suitable habitat for Latham's snipe comprises:

- **610.00 ha of foraging habitat, including:**
  - 593.55 ha of intermittent foraging habitat in the form of all remnant, high value regrowth or non-remnant areas with gilgai microrelief (Plate 19); and
  - 16.45 ha of permanent foraging habitat in the form of dams/wetlands with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges) (Plate 20).

Note: Some dams/wetlands and areas of gilgai microrelief identified within the Study Area were not considered suitable habitat based on dams having unvegetated steep banks or gilgai areas being extremely shallow and lacking aquatic vegetation.

A total of 610.00 ha of foraging habitat for Latham's snipe was identified in the Study Area, including 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat within the Disturbance Footprint (Figure 15).



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- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

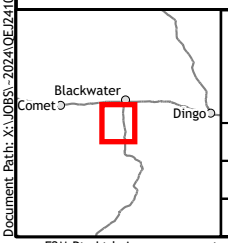
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FIGURE 15: LATHAM'S SNIPE HABITAT AND RECORDS WITHIN THE STUDY AREA

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4.2.3.4 Squatter pigeon (southern subspecies) (*Geophaps scripta scripta*)

Squatter pigeon (southern) is listed as vulnerable under the EPBC Act and NC Act, and is a ground dwelling species whose habitat occurs in tropical, open, dry sclerophyll woodlands and savannahs of north-east Australia (DCCEEW, 2025g). The species is generally found in areas mostly dominated in the overstorey by *Eucalyptus, Acacia* and *Callitris* species, in remnant, regrowth or partly modified vegetated communities and within 3 km of water bodies or water courses (DCCEEW, 2025g). Water bodies suitable for the species include permanent or seasonal rivers, creeks, lakes, ponds and waterholes (TSSC, 2015). The species drinks daily and prefers to drink where there is gently sloping, bare ground on which to approach and stand at the water's edge. A small patch (less than a square metre) of bare ground at the water's edge is what the bird requires (DCCEEW, 2025g).

While not recorded during E2M surveys in 2025, Squatter pigeon (southern) was recorded during previous field surveys within the Study Area (see Section 2.8). The species was recorded on two separate occasions, in close proximity to each other, within the vicinity of two dams. Within the Study Area, Squatter pigeon (southern) habitat was generally in poor condition due to exotic pasture species dominating the ground-layer (Plate 21), resulting in high ground-layer cover and low native foraging species diversity. Suitable habitat within the Study Area consisted off:

- **239.01 ha of breeding and foraging habitat:** remnant, high value regrowth and vegetated non-remnant communities on well-draining soils (i.e. land zones 3, 5, 7 and 9) within 1 km of a semi-permanent or permanent waterbody (i.e. dams, wetlands (RE 11.3.27) and SO 4 or greater watercourses) (Plate 22).
- **30.46 ha foraging habitat:** remnant, high value regrowth and vegetated non-remnant communities on well-draining soils (i.e. land zones 3, 5, 7 and 9) between 1 km to 3 km of a semi-permanent or permanent waterbody (i.e. dams, wetlands (RE 11.3.27) and SO 4 or greater watercourses).
- **990.75 ha of dispersal habitat:** all other remnant, high value regrowth and vegetated non-remnant communities which links areas of suitable breeding and foraging habitat, as well as non-remnant areas less than 100 m wide which join breeding and foraging habitat.

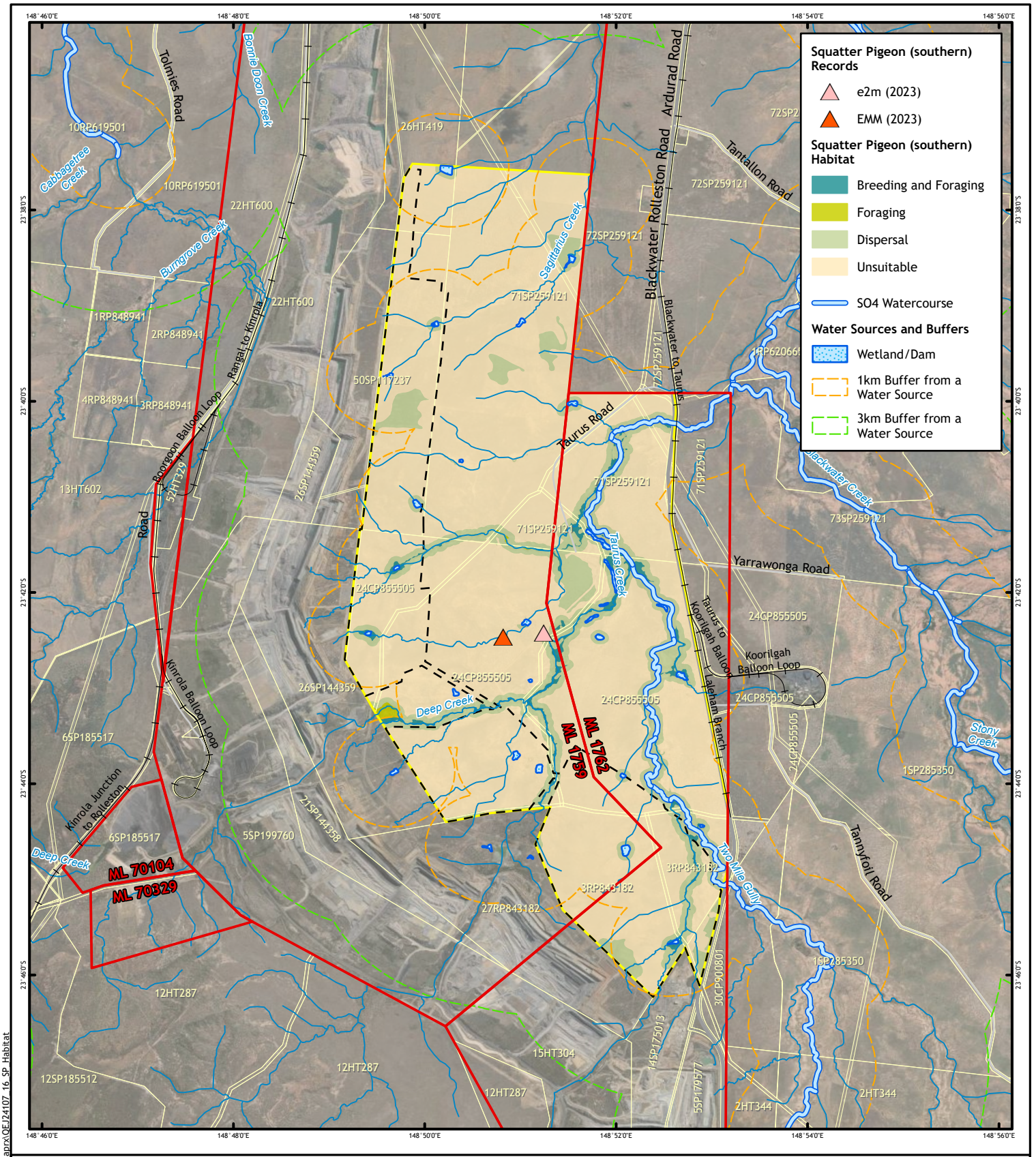
A total of 239.01 ha breeding and foraging, 30.46 ha of foraging, and 990.75 ha of dispersal habitat was identified in the Study Area. Additionally potential habitat within the Disturbance Footprint for Squatter pigeon (southern) includes 26.05 ha of breeding and foraging, 6.41 ha of foraging, and 262.34 ha of dispersal habitat (Figure 16).



Plate 21: Remnant eucalypt woodland with high cover of exotic pasture species



Plate 22: Semi-permanent water available within RE 11.3.27



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

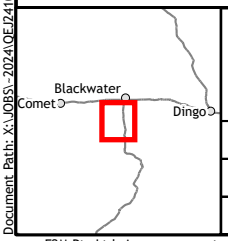
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Kilometres

Coordinate System: GDA2020



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FIGURE 16: SQUATTER PIGEON (SOUTHERN) HABITAT AND RECORDS WITHIN THE STUDY AREA

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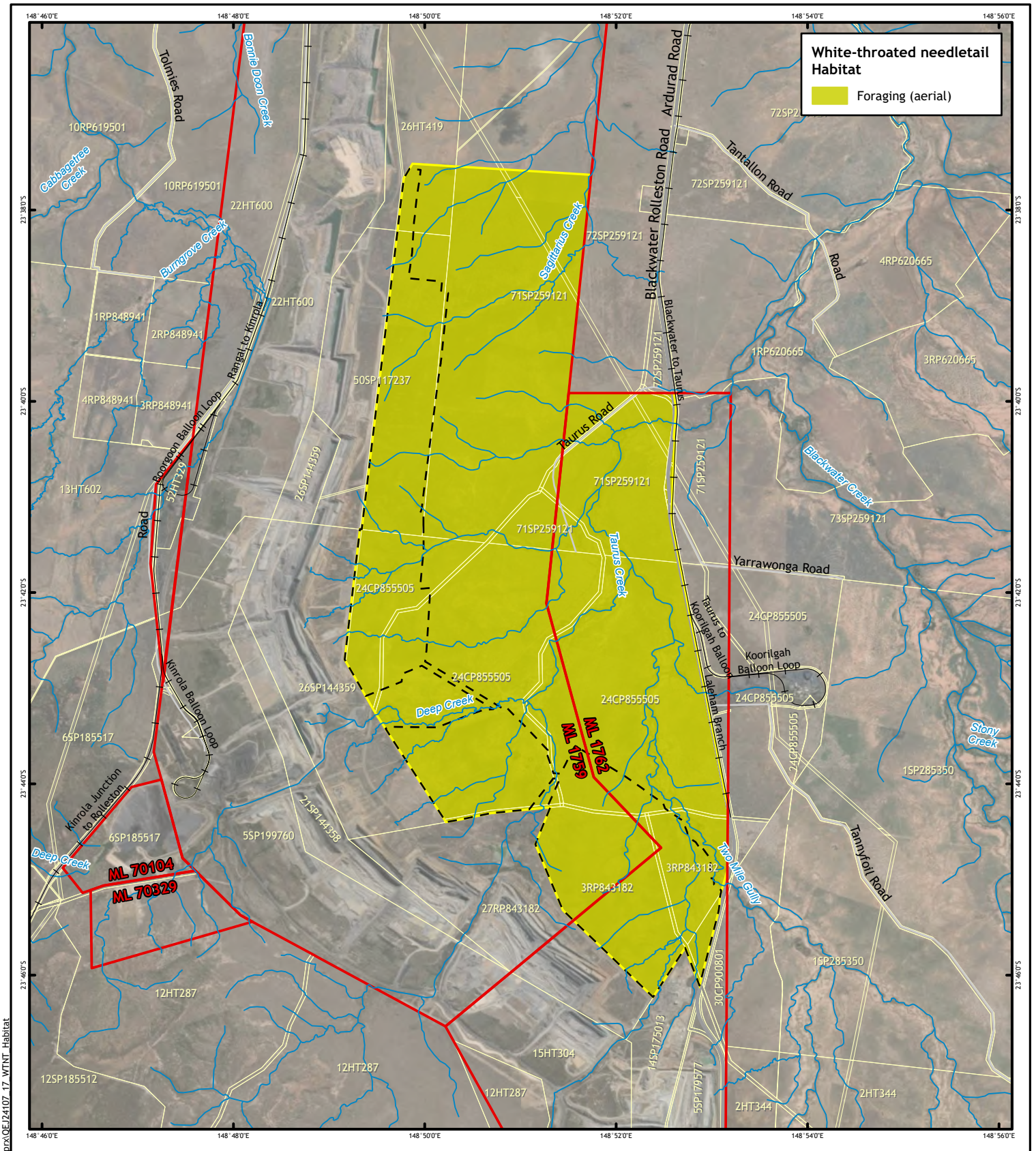
4.2.3.5 White-throated needletail (*Hirundapus caudacutus*)

The White-throated needletail listed as vulnerable under the EPBC Act and NC Act, as is widespread across eastern and south-eastern Australia (DCCEEW, 2025j). In Queensland it occurs in all coastal regions including inland to the western slopes of the Great Dividing Range and occasionally onto the adjacent inland plains (DCCEEW, 2025j). In Australia, the species is primarily aerial, from heights of 1 m up to 1000 m above the ground. They are known to roost in tall trees bordering clearings, both natural and man-made. While they do occur over most habitat types, they are predominately recorded above wooded areas (DCCEEW, 2025j). The species does not breed in Australia, with their local habitat restricted to foraging during their non-breeding season (DCCEEW, 2025j).

White-throated needletail has not been recorded during any surveys; however, the species is considered likely to occur based on habitat availability and previous records within the vicinity of the Study Area (see Section 2.8). Given the species does not breed in Australia, is highly nomadic and is primarily aerial, suitable habitat within the Study Area, includes:

- **6,907.49 ha of foraging habitat**: aerially above the entirety of the Study Area.

A total of 6,907.49 ha of potential foraging habitat was identified in the Study Area and 2,316.58 ha of foraging habitat within the Disturbance Footprint for the White-throated needletail (Figure 17).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

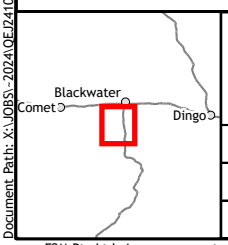
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Scale 1:100,000 (A4)

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Kilometres

Coordinate System: GDA2020



Notes:
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FIGURE 17: WHITE-THROATED NEEDLETAIL HABITAT AND RECORDS WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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4.2.3.6 Koala (*Phascolarctos cinereus*)

The Koala is listed as endangered under the EPBC Act and NC Act, and are widespread across Queensland, however they generally occur in patchy and often low-density populations in different bioregions (DAWE, 2022). At a local scale, Koala habitat is defined by several factors including the availability and nutritional quality of food trees, presence of suitable resting trees and microclimates, age structure of vegetation, history and impediments to dispersal. These differ regionally because they are strongly influenced by local climatic conditions and landform attributes (DAWE, 2022d).

A variety of food tree species are utilised by Koalas, from genera including *Eucalyptus*, *Corymbia* and *Lophostemon*. In a particular region or site, only a few species may constitute preferred feed trees. Non-food trees are also an important resource for Koalas and may be used for thermoregulation, shelter, and predator avoidance. Non-food trees include species from genera such as *Acacia*, *Callitris* and *Melaleuca* (DAWE, 2022d). Stream fringing eucalypts (*Eucalyptus camaldulensis* and *Eucalyptus tereticornis*) have the highest leaf moisture content, and as Koalas largely rely on diet to meet their water intake requirements, the presence of eucalypts with a high leaf moisture content is likely to positively influence habitat suitability, particularly during times of drought (Wu et al., 2012). Koala are known to utilise all types of eucalypt woodland across its range where Locally Important Koala Trees (LIKTs) are abundant (Youngentob et al., 2021).

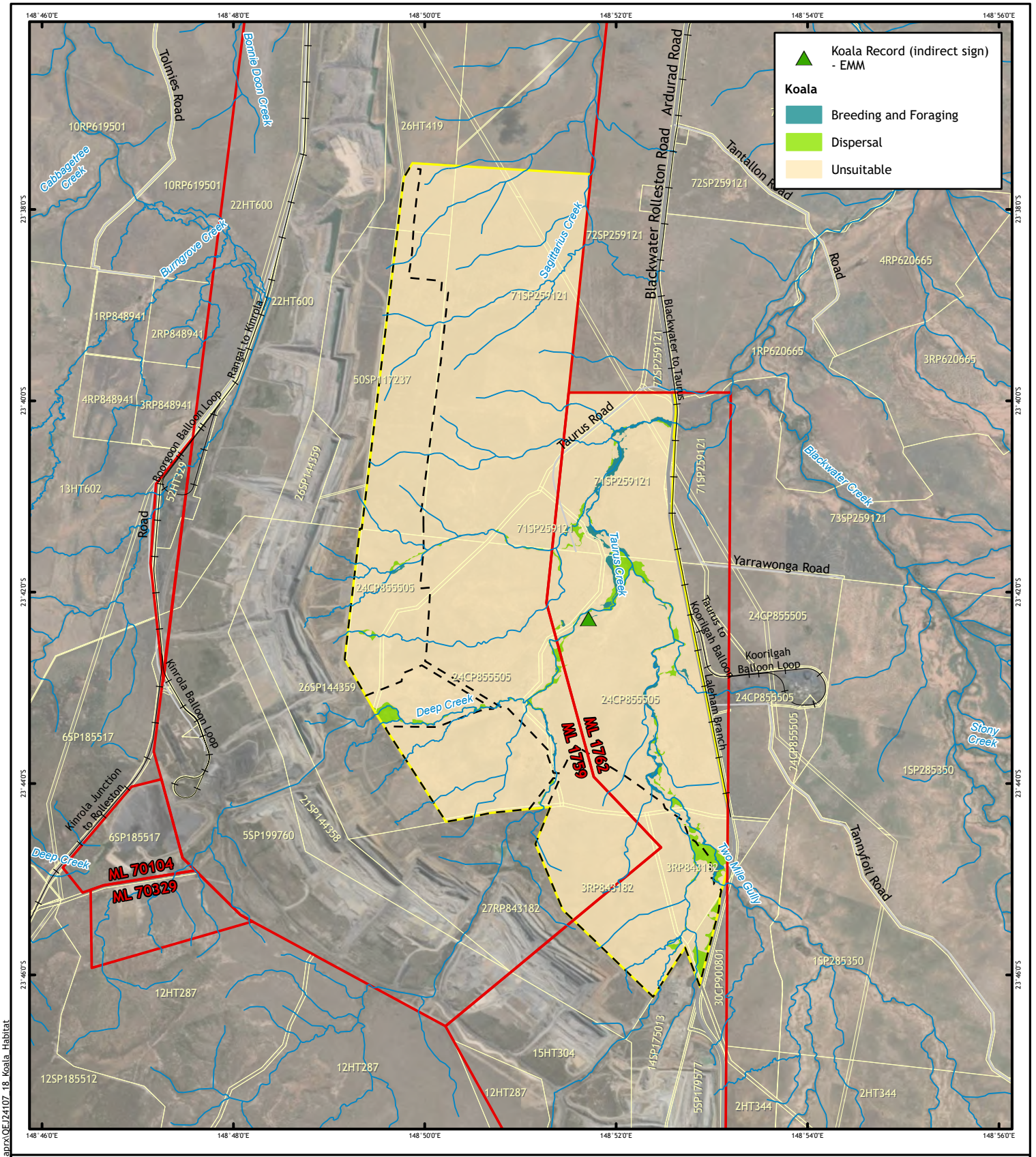
Previous ecological assessments undertaken by EMM recorded evidence of Koala activity (i.e. tree scratch marks and scat) within the Study Area (EMM, 2020), suggesting historical use of the site by the species. To verify current presence, ground-truthing was undertaken during this assessment that included systematic searches across both remnant and non-remnant vegetation for Koala scats, scratch marks, vocalisations, and visual sightings during diurnal fauna surveys. However, no evidence of Koala activity was recorded during these assessments.

Suitable habitat for Koala within the Study Area is highly degraded due to historical land clearing, with the majority of potential habitat now limited to retained mature vegetation associated with watercourses and drainage lines. Non-remnant areas where scattered LIKTs or ancillary species are still retained and provided connectivity between areas of suitable mature vegetation were also assessed as providing habitat for Koala. Within the Study Area, suitable habitat was categorised into two types based on the presence and abundance of LIKTs and ancillary species, including:

- **103.38 ha of breeding and foraging habitat:** consisting of remnant and high value regrowth areas associated with REs dominated or co-dominated by LIKTs, including REs 11.3.2, 11.3.3, 11.3.6 and 11.3.27.
- **209.24 ha of dispersal habitat:** consisting of remnant and high value regrowth areas associated with REs dominated or co-dominated by containing ancillary species (i.e. REs 11.3.1, 11.4.9 and 11.9.5) or non-remnant areas with scattered LIKTs which provide connectivity between areas of breeding and foraging habitat.

Note: Small areas of potential suitable habitat which are fragmented from other areas of suitable habitat were not considered suitable habitat due to their inaccessibility and unlikely utilisation by the species.

A total of 103.38 ha of breeding and foraging habitat and 209.24 ha of dispersal habitat was identified in the Study Area. Additionally, 2.72 ha of breeding and foraging habitat and 48.29 of dispersal habitat was identified within the Disturbance Footprint for the Koala (Figure 18).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

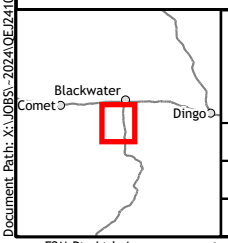
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Kilometres

Coordinate System: GDA2020



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FIGURE 18: KOALA HABITAT AND RECORDS WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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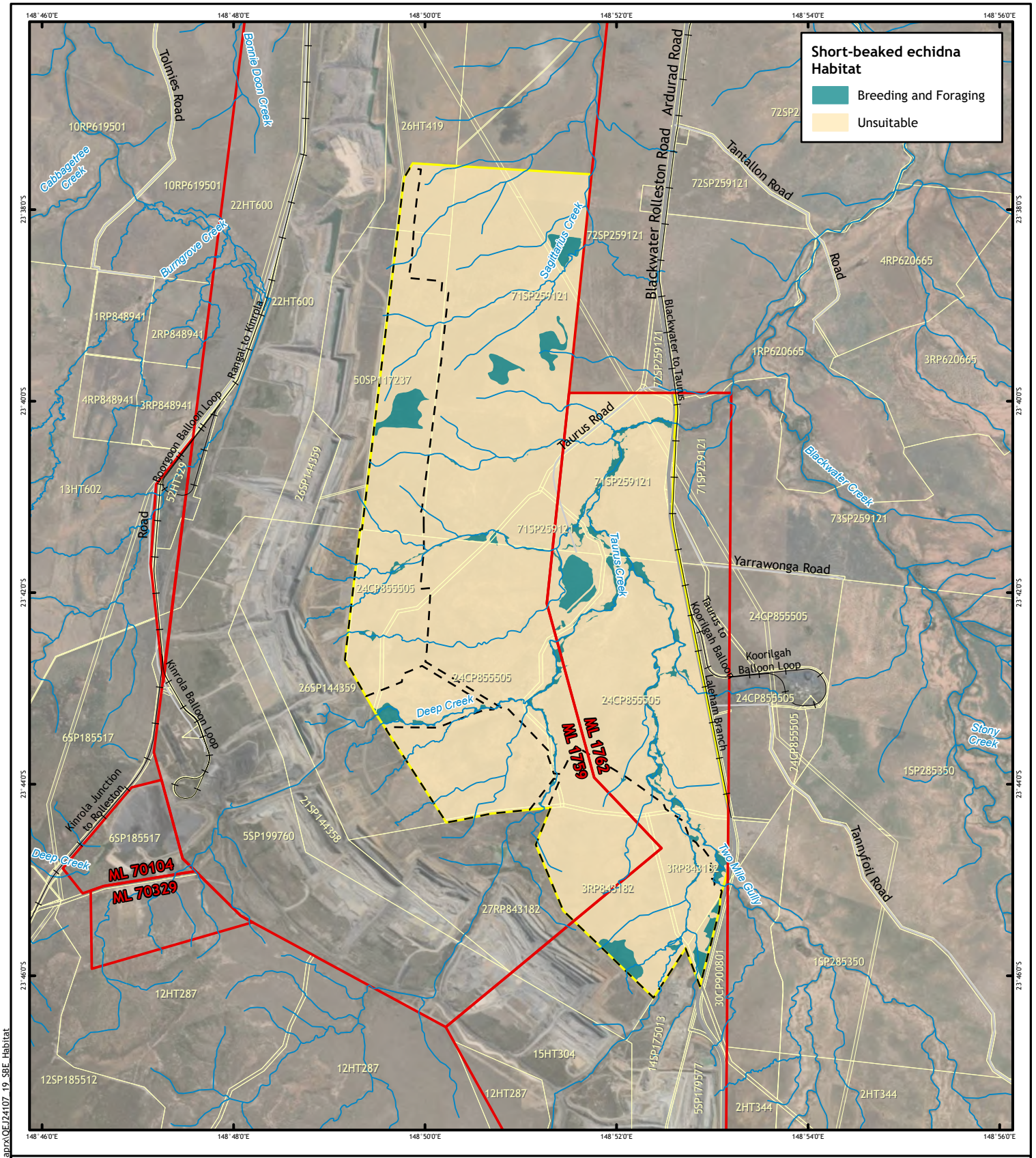
4.2.3.7 Short-beaked echidna (*Tachyglossus aculeatus*)

Short-beaked echidna is listed as special least concern under the NC Act. This species occurs throughout Australia in a wide variety of habitats including mountains, tropics, open woodlands, grasslands, arid zones and coastal environments; wherever there is a supply of ants and termites, upon which it feeds. They prefer to inhabit areas with vegetation that provides cover such as gaps under rocks, hollow logs, hollows at the base of trees, piles of leaves or bunched grasses (Nicol et al., 2011). The species also enters a period of torpor or deep hibernation during autumn and winter, during which time it also requires these forms of cover (ALA, 2025).

Short-beaked echidna has not been recorded during any surveys within the Study Area with degraded nature of the Study Area limiting availability of suitable shelter microhabitat (e.g. hollow logs and termite mounds). However, given the species is widespread and utilises a range of habitats, suitable habitat within the Study Area, includes:

- **501.13 ha of breeding and foraging habitat:** all remnant, high value regrowth and vegetated non-remnant communities within the Study Area.

A total of 501.13 ha of potential breeding and foraging habitat was identified in the Study Area and 122.11 ha of breeding and foraging habitat within the Disturbance Footprint for the Short-beaked echidna (Figure 19).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

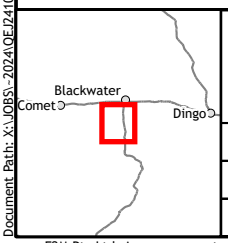
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Kilometres

Coordinate System: GDA2020



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1	Issued for Use	PR	CO	02/04/2026

FIGURE 19: SHORT-BEAKED ECHIDNA HABITAT WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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4.2.4 Migratory fauna

The desktop assessment identified twelve migratory fauna species listed under both the EPBC Act and as potentially occurring within the Study Area. Prior to field surveys, an assessment of the likelihood of occurrence for migratory fauna species was conducted based on species habitat suitability, species distribution ranges and historical occurrence records. Desktop assessments results identified five species as known, likely or possibly occurring within the Study Area, including:

- Known to occur (previously recorded within the Study Area during EMM surveys (EMM, 2023a, 2023b)):
  - **Fork-tailed swift:** was recorded at one location in the Study Area in the vicinity of Taurus Creek
  - **Latham's snipe**: was recorded at three locations across the Study Area in ephemeral gilgai habitat.
- Likely to occur:
  - **White-throated needletail:** the species occurs widely across QLD and forages aerially above all most habitat types including cleared pasture. The species has been recorded on multiple occasions within the desktop search extent and foraging habitat occurs above the entire Study Area.
  - **Glossy ibis:** was recorded at one location in the northern extent of the Study Area in ephemeral gilgai habitat.
- Possibly occurring:
  - **Sharp-tailed sandpiper:** the species has been previously recorded within the desktop search extent and suitable habitat may occur within the Study Area.

These species formed the basis of targeted surveys and habitat assessments undertaken by E2M with the aim of refining species likelihood of occurrence based on field verified results.

One migratory species was identified during E2M surveys within the Study Area:

- Fork-tailed swift (*Apus pacificus*) – Migratory under the EPBC Act.

Following an evaluation against the likelihood of occurrence assessment criteria and the results of the field surveys, two species are considered likely to occur:

- White-throated needletail (*Hirundapus caudacutus*) - vulnerable and migratory under the EPBC Act; and
- Glossy ibis (*Plegadis falcinellus*) – migratory under the EPBC Act.

Suitable habitat was confirmed for two known occurring and two likely occurring migratory species, whilst one possibly occurring species, namely Sharp-tailed sandpiper, was downgraded to unlikely to occur based on the species not being detected during targeted surveys and the Study Area only containing marginal habitat. Full likelihood of occurrence results for all species identified during the desktop assessment are provided in Appendix B.

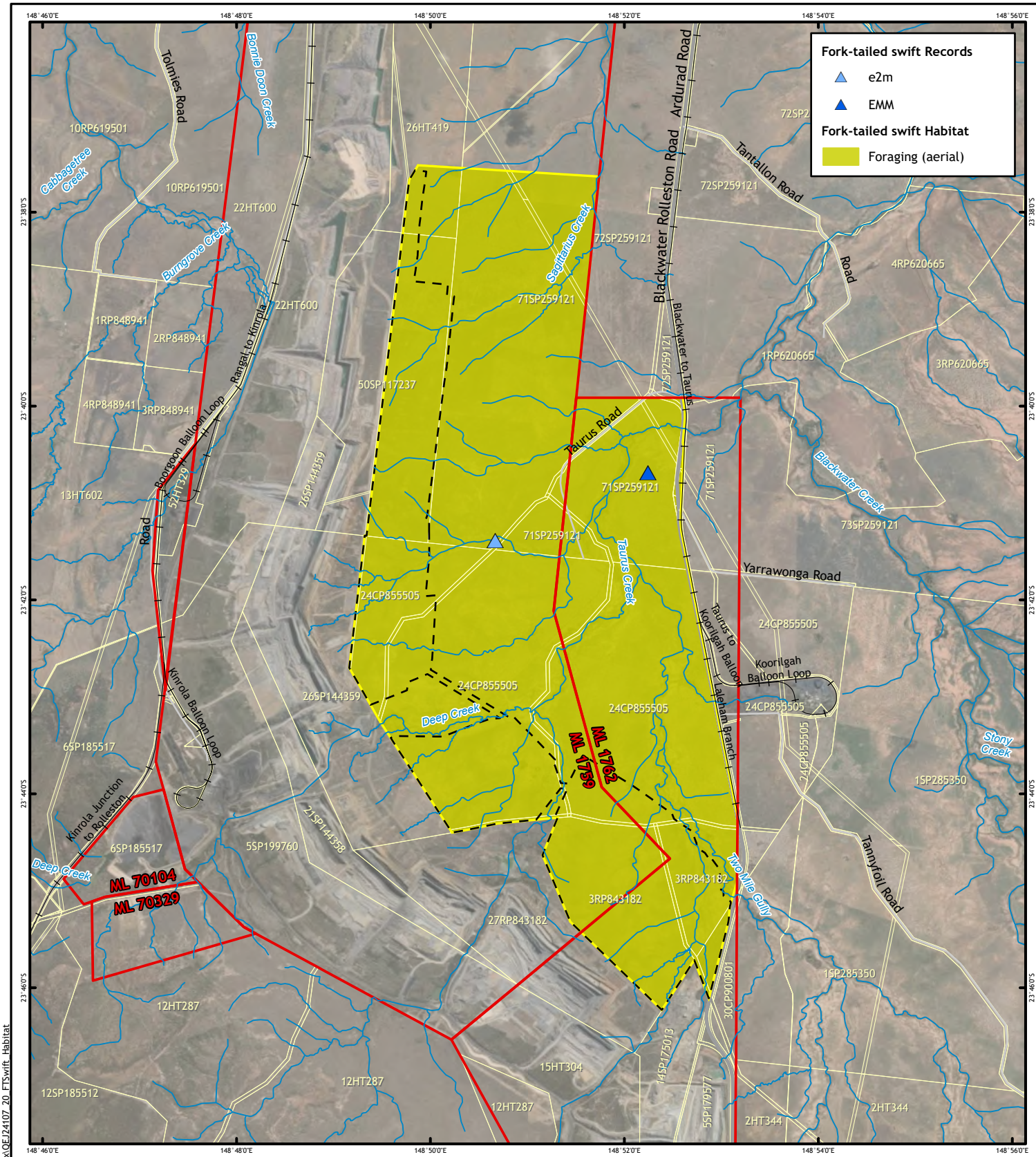
4.2.4.1 Fork-tailed swift

Fork-tailed swift is a non-breeding visitor leaving its breeding grounds in Siberia from August to September and arrives in Australia around October. Although the species mostly occurs over dry open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, it also is found in treeless grassland, open farmland and coastal sand-dunes (DCCEEW, 2025a).

This species has been observed on a single occasion during surveys above the Study Area, during the 2025 wet season survey. Given the species may occur above any habitats across the Study Area, suitable habitat includes:

- **6,907.49 ha of foraging habitat:** aerially above the entirety of the Study Area.

A total of 6,907.49 ha of foraging habitat was identified in the Study Area and 2,316.58 ha of foraging habitat within the Disturbance Footprint for the Fork-tailed swift (Figure 20).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

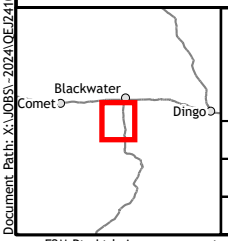
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Scale 1:100,000 (A4)

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Kilometres

Coordinate System: GDA2020



Notes:
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FIGURE 20: FORK-TAILED SWIFT HABITAT AND RECORDS WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

Document Path: X:\JOBS\-2024\QEJ24107\GIS\PRO\QEJ24107\QEJ24107_EA.aprx\QEJ24107_20_FTSwift_Habitat

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4.2.4.2 Glossy ibis (*Plegadis falcinellus*)

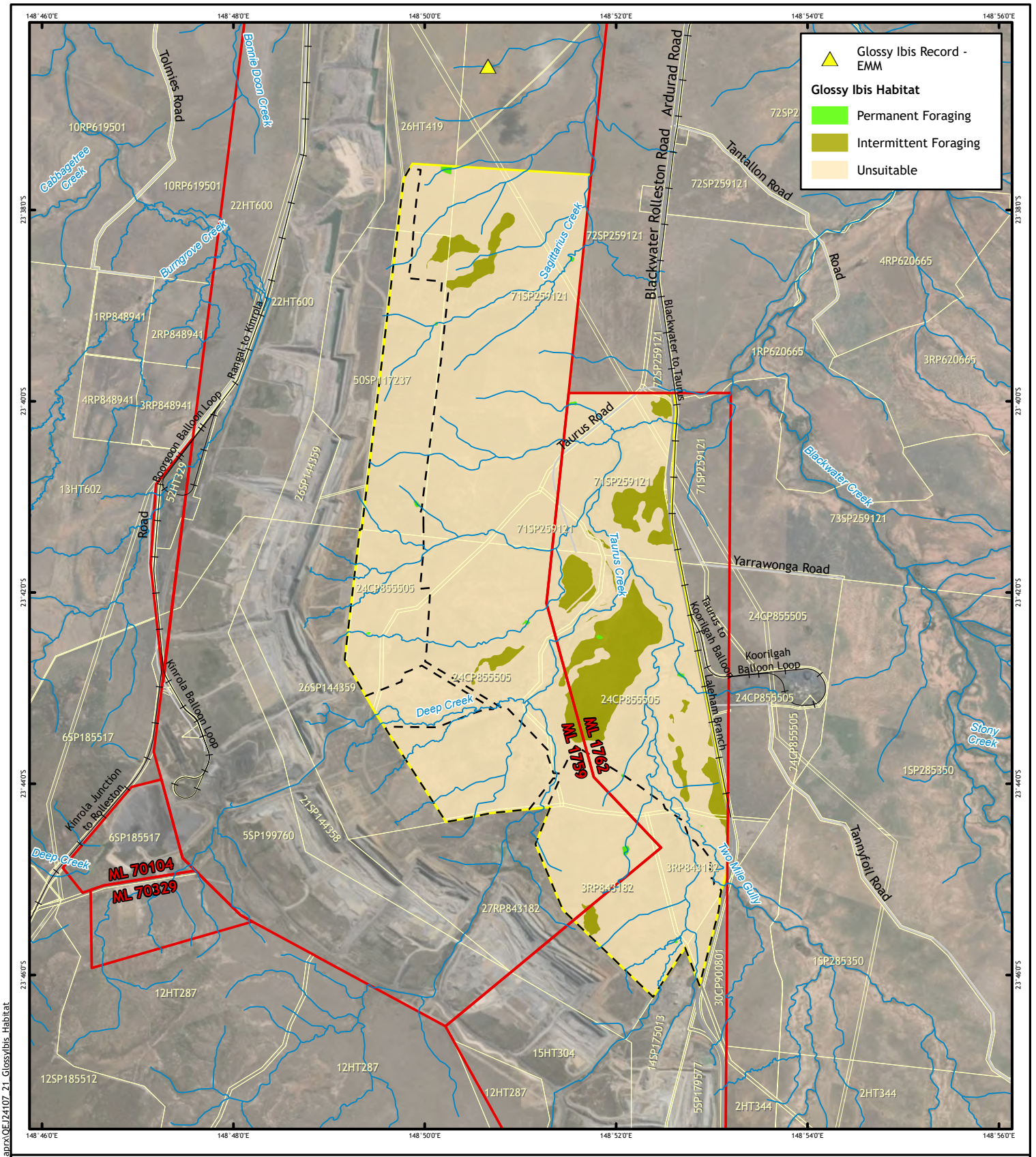
Glossy ibis generally occurs singly, in pairs or small flocks foraging in freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (DCCEEW, 2025l). Glossy ibis has been recorded breeding at a limited number of locations within its Australian distribution, with core breeding areas occurring within the Murray-Darling Basin region of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland (DCCEEW, 2025l). Within Australia, Glossy ibis move north in Autumn, then south to the main breeding areas in Spring and Summer (DCCEEW, 2025l).

While not recorded during E2M surveys, Glossy ibis has been detected on a single location during previous EMM ecological surveys (Section 2.8), approximately 2 km north of the current Study Area. The species was observed within a dam, which provides suitable foraging opportunities. Given the species breeds primarily within distinct locations within Australia, no suitable breeding habitat was mapped within the Study Area. Specifically, within the Study Area, suitable habitat for Glossy ibis comprises:

- 593.55 ha of potential intermittent foraging habitat in the form of all remnant, high value regrowth or non-remnant areas with gilgai microrelief (Plate 19); and
- 16.45 ha of permanent foraging habitat in the form of dams/wetlands with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges) (Plate 20).

Note: Some dams/wetlands and areas of gilgai microrelief identified within the Study Area were not considered suitable habitat based on dams having unvegetated steep banks or gilgai areas being extremely shallow and lacking aquatic vegetation.

A total of 610.00 ha of foraging habitat for Glossy ibis was identified in the Study Area, including 14.45 ha of potential intermittent foraging habitat and 6.41 ha of permanent foraging habitat within the Disturbance Footprint (Figure 21).



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

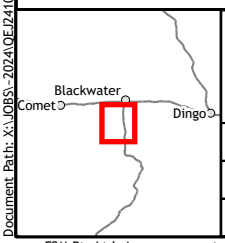
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Kilometres

Coordinate System: GDA2020



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FIGURE 21: GLOSSY IBIS HABITAT WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

Document Path: X:\JOBS\-2024\QEJ24107\GIS\PRO\QEJ24107_EA.aprx\QEJ24107_21 Glossyibis Habitat

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4.2.4.3 Latham's snipe (*Gallinago hardwickii)*

Refer to Section 4.2.3.3.

4.2.4.4 White-throated needletail (*Hirundapus caudacutus*)

Refer to Section 4.2.3.5.

4.2.5 Pest fauna

Pest fauna species have varying adverse impacts on the environment ranging from competition for resources to predation on native species. Eight pest fauna species were recorded within the Study Area during the field assessments (Table 19). The extent categories used to describe fauna species presence, such as common, scattered and high density, reflect varying patterns of presence across the landscape. Scattered indicates irregular and isolated occurrences; common suggests regular but moderate presence; and high density refers to areas where the species occurs in large numbers or concentrations.

Table 19: Pest fauna within the Study Area

Scientific name	Common name	Biosecurity Act status	Extent within Study Area
Acridotheres tristis	Common myna	-	Common throughout Study Area
Canis lupus dingo	Dingo	Category 3, 4, 5 and 6	Scattered throughout Study Area
Canis lupus familiaris	Wild dog	Category 3, 4 and 6	Scattered throughout Study Area
Felis catus	Feral cat	Category 3, 4 and 6	Scattered throughout Study Area
Lepus europaeus	European hare	-	Scattered throughout Study Area
Oryctolagus cuniculus	European rabbit	Category 3, 4, 5 and 6	Scattered throughout Study Area
Rhinella marina	Cane toad	-	High density throughout the Study Area
Sus scrofa	Feral pig	Category 3, 4 and 6	Scattered throughout Study Area

Feral cats are efficient predators and are likely to prey upon snakes, birds and amphibians (Doherty et al., 2017), including the target MNES (namely Ornamental snake). Herbivorous pest species including Rabbit, Hare and Feral pig compete with native wildlife for resources, degrade the land (Plate 23) and damage vegetation (DSEWPaC, 2011c). Cane toads were observed in high abundance throughout the Study Area (Plate 24) including within the gilgai and cracking clay soil habitats where they co-exist with Ornamental snake. As a specialist predator of amphibians, the Ornamental snake is likely to predate small Cane toads, potentially resulting in the snake's mortality (Veary, 2011).



Plate 23: Feral pig (*Sus scrofa*) wallow



Plate 24: Cane toad (*Rhinella marina*) identified on remote camera

Wild dog and Dingo tracks were observed scattered throughout the Study Area (Plate 25). Wild dogs (*Canis lupus familiaris*) have been identified as one of the most significant threats to Koala populations (Beyer et al., 2018; DAWE, 2022b). Recent research highlights that although threats such as vehicle collisions and disease remain substantial, predation by wild dogs can be the leading cause of mortality in some Koala populations (Beyer et al., 2018). In addition to ecological impacts, wild dogs and Dingos also pose biosecurity risks through disease transmission and can threaten human safety and livestock (Queensland Government, 2024).



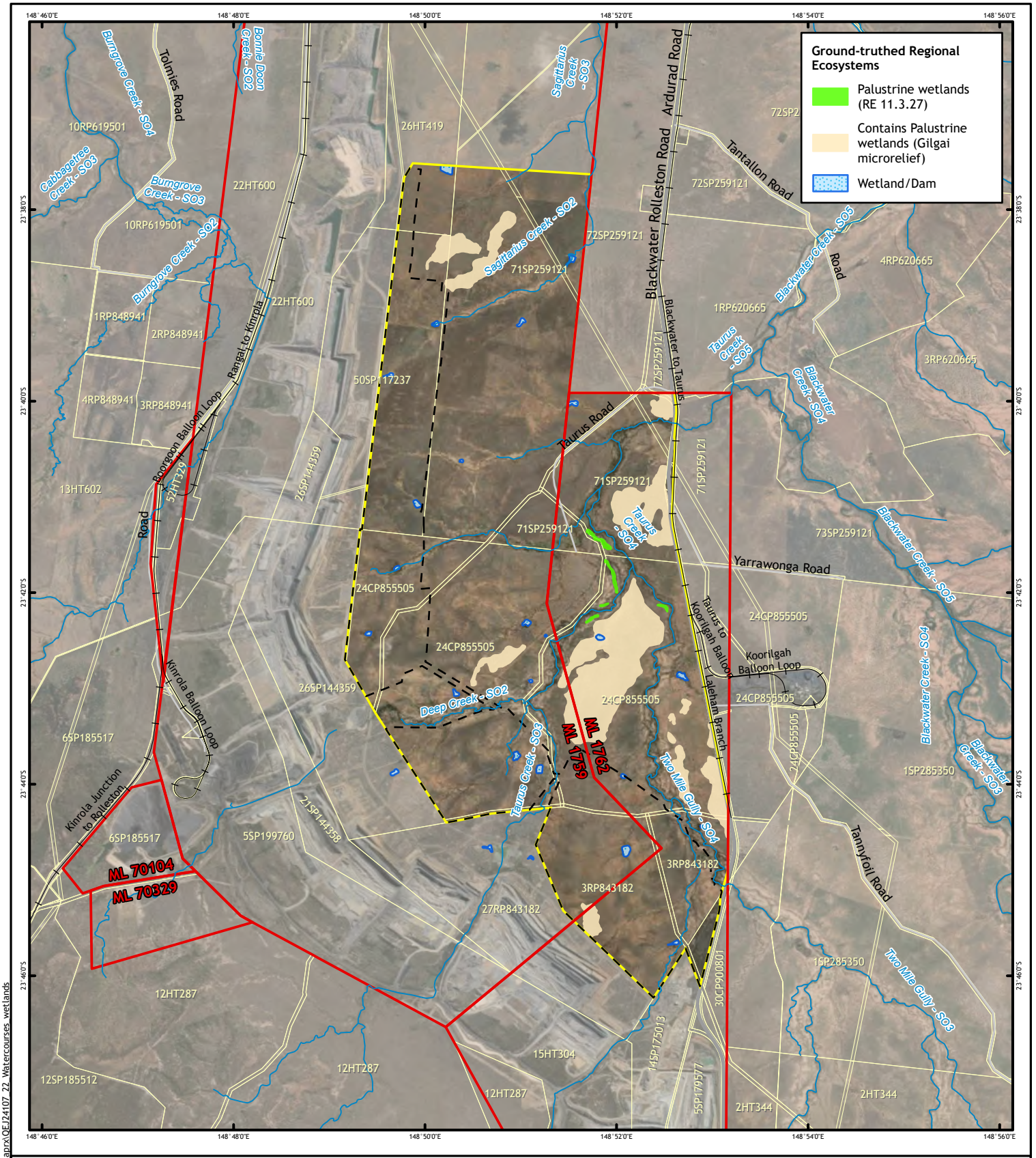
Plate 25: Wild dog (*Canis lupus familiaris*) tracks

4.3 Ecological function

4.3.1 Watercourses and wetlands

Several unnamed tributaries traverse the Study Area (Figure 22), predominantly in the SO of 1 to 3. These minor watercourses are predominantly ephemeral, remaining dry for most of the year and lack substantial riparian vegetation. These tributaries then contribute to watercourses of higher SOs, including Sagittarius Creek (SO 2) to the north, Taurus Creek (SO 4) to the east and Two Mile Gully (SO 4) to the south. Although these larger watercourses are also ephemeral, some fragmented riparian vegetation is present along their margins. However, the lack of vegetation across the remainder of the Study Area is attributed to the historic broadscale clearing and cattle grazing. Watercourses within the Study Area have also been impacted by weed invasion, pest fauna species presence (i.e. feral pig uprooting), and altered hydrology resulting from existing mining activity.

No wetlands of high ecological significance (HES) or high ecological value (HEV) under the EP Act, or wetlands under the VM Act occur within the Study Area.



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

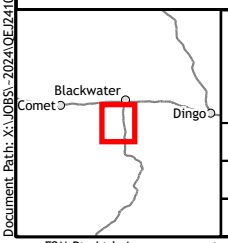
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0 2.5 5

Kilometres

Coordinate System: GDA2020



Notes:
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FIGURE 22: WATERCOURSES AND WETLANDS WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

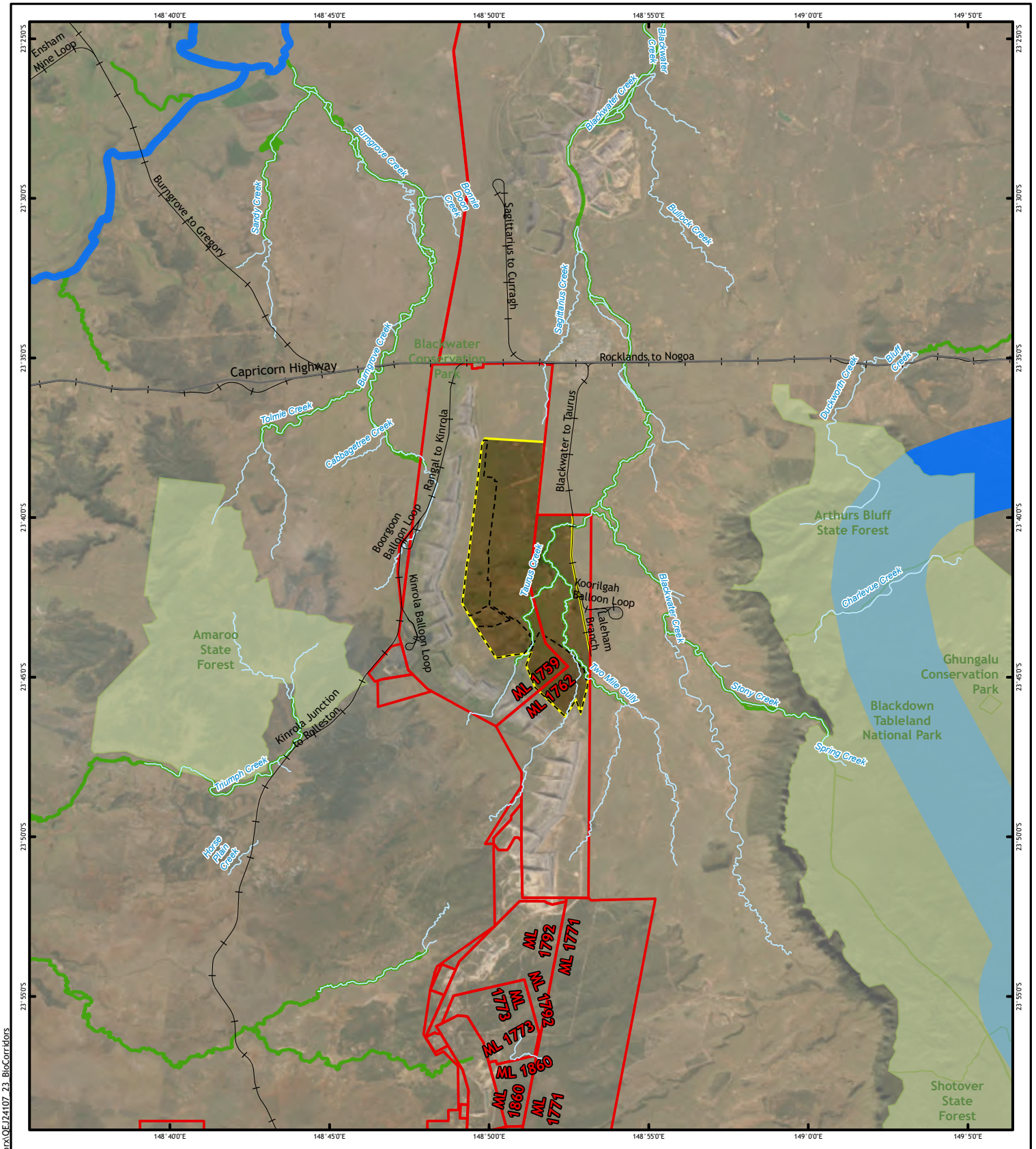
Map Number	Job Number	Rev
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4.3.2 Corridors and connectivity

Taurus Creek and Two Mile Gully in the eastern part of the Study Area are mapped as a regional riparian biodiversity corridors (DETSI, 2024) (Figure 23). However, due to the historic and extensive cattle grazing activities not only within the Study Area, but surrounding, the landscape is highly fragmented and disconnected. This is particularly evident regarding the largely disturbed, non-remnant vegetation within the Study Area that restricts dispersal opportunities between the remnant, intact Blackdown Tableland National Park, situated less than 10 km to the east (Figure 23). As vegetation is primarily restricted to riparian zones within the Study Area, opportunities for fauna dispersal are expected to be highly limited and restricted to species with large dispersal abilities.



Legend

- Railway
- Watercourse
- Road
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Protected Area

Statewide Corridors v1.6 - significance

- Regional
- State

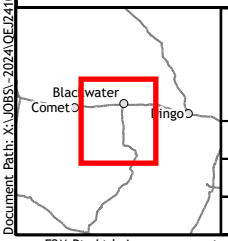
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Kilometres

Coordinate System: GDA2020



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FIGURE 23: STATE AND REGIONAL BIODIVERSITY CORRIDORS

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 1	QEJ24107	1

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4.4 Habitat quality assessments

A total of 13 AUs were identified within the Study Area. A total of 53 habitat quality assessment sites were undertaken to meet the survey requirements of the Commonwealth Government *Modified Habitat Quality Assessment* method (Table 20).

Data from these sites was used to determine the habitat quality and offset requirements for MNES and MSES that are likely significantly impacted by the Project (refer to Section 8.1 and Section 8.2).

Table 20: Survey effort per assessment unit for habitat quality assessment sites

BVGs	RE	Condition	AU	Extent within the Study Area (ha)	No. of survey sites	Assessment against the habitat quality guideline requirements[1]
25a	11.3.1, 11.4.9, 11.9.5	Non-remnant	1a	62.07	8	Survey guideline sampling units achieved
		Vegetated non-remnant (regrowth <3m tall)	1b	214.22	4	Survey guideline sampling units achieved
		High value regrowth	1c	83.77	8	Survey guideline sampling units achieved
		Remnant	1d	99.73	7	Survey guideline sampling units achieved
17a	11.3.2	Non-remnant	2a	25.74	2	Survey guideline sampling units achieved
		Remnant	2b	11.07	2	Survey guideline sampling units achieved
16c	11.3.3	Remnant	3	38.28	2	Survey guideline sampling units achieved
17b	11.3.6	Disturbed remnant	4b	26.71	3	Survey guideline sampling units achieved
		Remnant	4c	18.61	2	Survey guideline sampling units achieved
34a	11.3.27	Remnant	5	8.71	2	Survey guideline sampling units achieved
17b	11.9.2	Non-remnant	6	1.34	1	Survey guideline sampling units achieved as there is only enough area to allow for one sampling unit
-	-	Non-remnant (cleared) with gilgai	7a	534.65	5	Survey guideline sampling units achieved
-	-	Non-remnant (cleared) without gilgai	7b	5,759.07	7	Survey guideline sampling units achieved

5 Environmentally sensitive areas

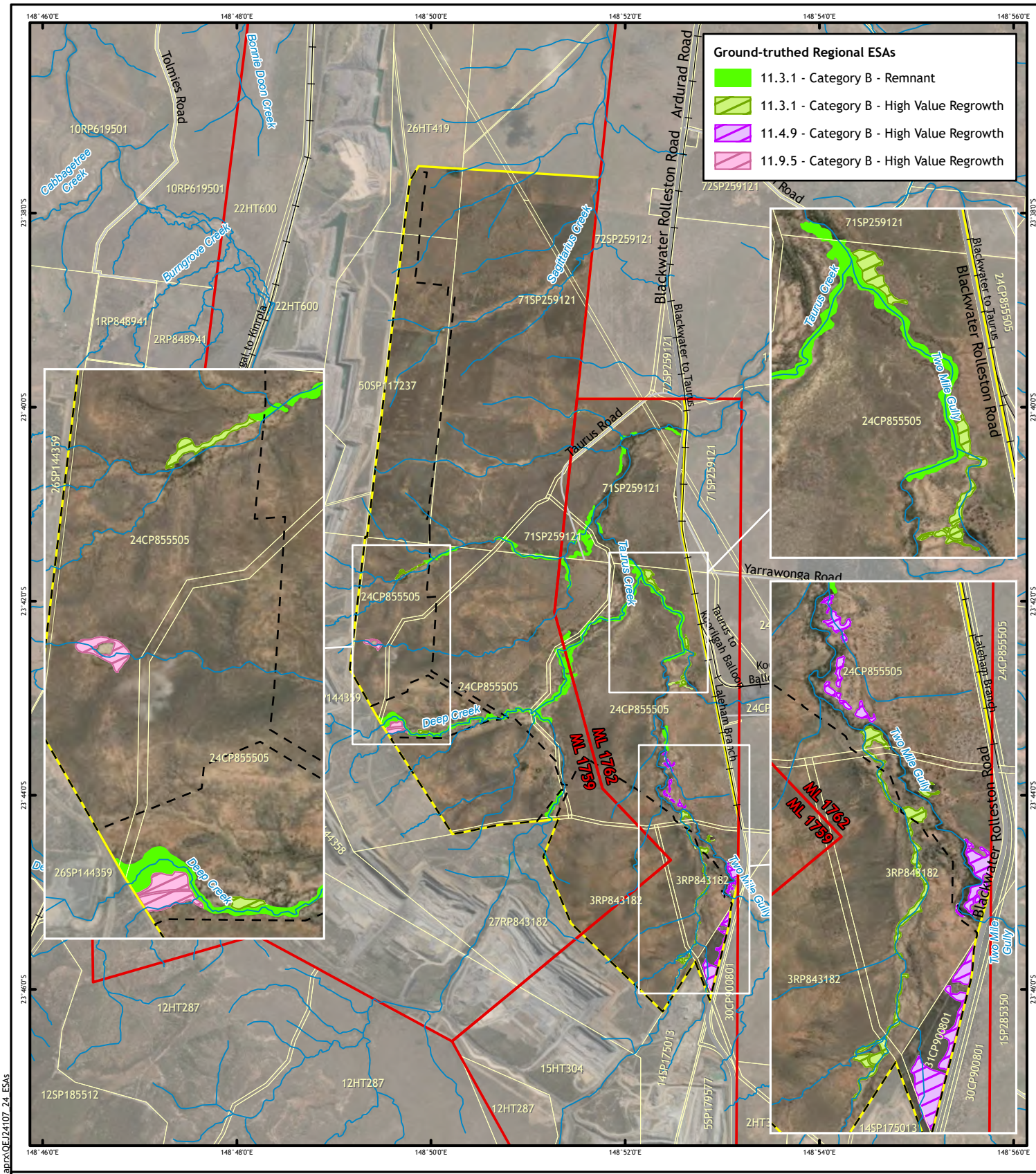
ESAs are defined by the Queensland *Environmental Protection Regulation 2019* (EP Regulation). ESAs include national parks, state forests, world heritage areas, Ramsar wetlands and nationally important wetlands. In addition, they feature areas of elevated natural and cultural value such as habitat for conservation significant flora and fauna and places of Aboriginal and European cultural heritage.

No Category A ESAs were identified within or in proximity to the Study Area.

Category B ESAs were identified within the Study Area during the desktop assessment and were associated with VM Act mapped REs listed as endangered under the biodiversity status framework. This included endangered remnant and high-value regrowth RE 11.3.1. Field assessment confirmed the presence of RE 11.3.1 within the Study Area along with an additional two endangered REs (RE 11.4.9 and RE 11.9.5). These are listed in Table 21 below and depicted in Figure 24.

Table 21: Ground-truthed Category B ESAs within the Study Area

RE	Short description	Condition type	Extent within Study Area (ha)	Extent within Disturbance Footprint (ha)
11.3.1	*Acacia harpophylla* open woodland on alluvial plains	Remnant	99.73	1.21
		High value regrowth	40.99	18.35
11.4.9	*Acacia harpophylla* shrubby open forest to woodland; *Terminalia oblongata* on Cainozoic clay plains	High value regrowth	32.16	17.66
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on fine-grained sedimentary rocks	High value regrowth	10.62	3.77



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

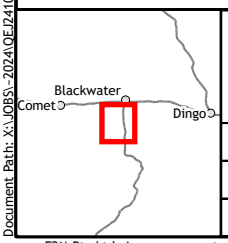
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Scale 1:100,000 (A4)

0 2.5 5

Kilometres

Coordinate System: GDA2020



Notes:
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FIGURE 24: ENVIRONMENTALLY SENSITIVE AREAS (ESAs)

Blackwater North Ecological Assessment
Whitehaven Coal

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1 of 1	QEJ24107	1

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6 MNES and MSES summary

6.1 Summary of MNES

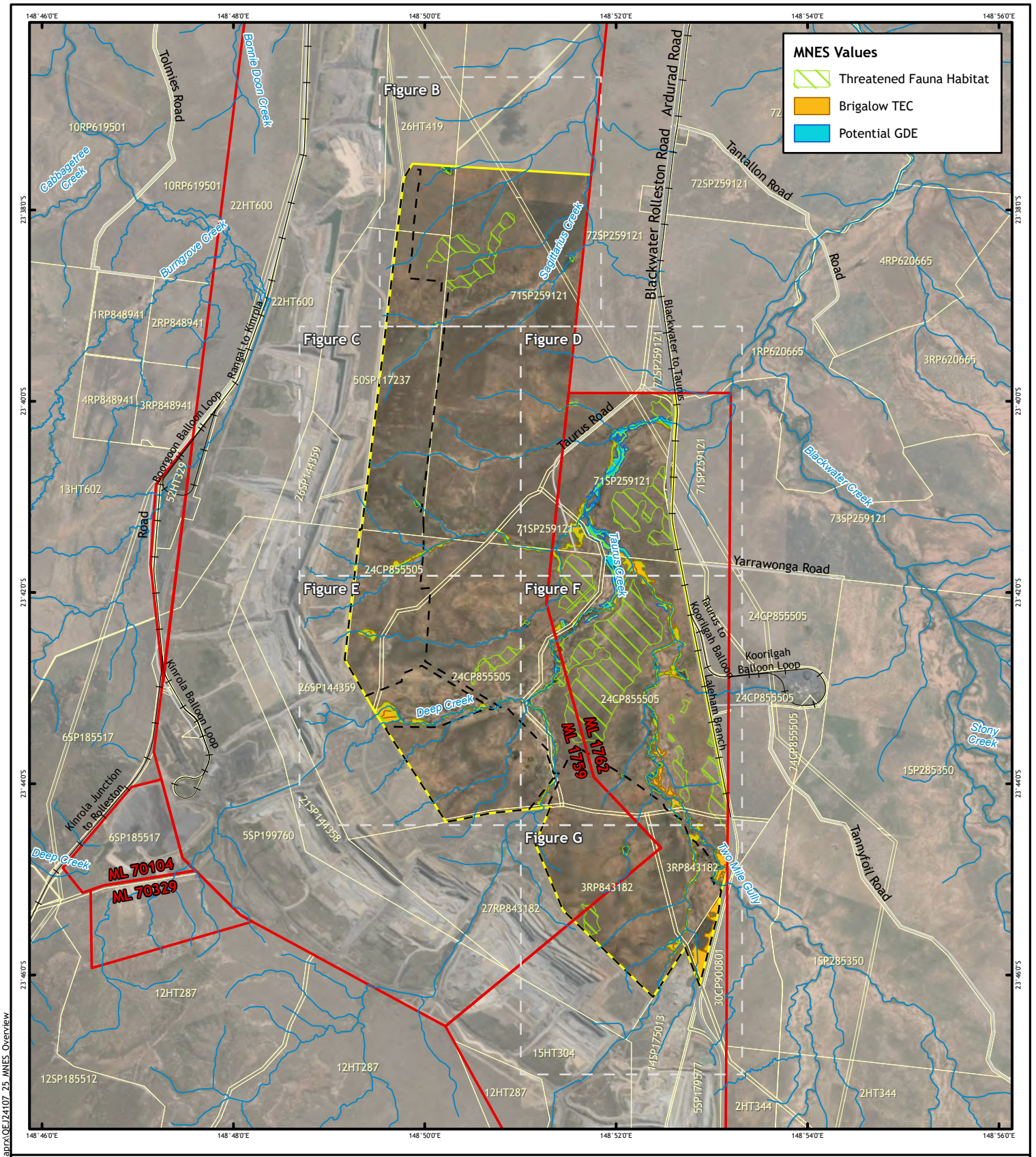
A summary of the MNES as defined in the EPBC Act EO Policy (DSEWPC, 2012) that were identified as known or likely to occur within the Study Area and Disturbance Footprint is provided in Table 22 and depicted in Figure 25.

Table 22: MNES identified within the Study Area

MNES	NC Act status[1]	EPBC Act status[1]	Area within Study Area (ha)[2]	Area within Disturbance Footprint (ha)[2]	Likelihood of occurrence within the Disturbance Footprint	Relevant section
Threatened ecological communities						
Brigalow (*Acacia harpophylla* dominant and co-dominant)	-	E	148.88	40.29	Known to occur	Section 4.1.2.1
Threatened fauna species						
Ornamental snake	V	V	Breeding and foraging t: 497.52	Breeding and foraging: 0	Unlikely to occur	Section 4.2.3.1
Australian painted snipe	E	E	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Known to occur	Section 4.2.3.2
Latham's snipe	V	V, M	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Likely to occur	Section 4.2.3.3
Squatter pigeon (southern subspecies)	V	V	Breeding and foraging: 239.01 Foraging: 30.46 Dispersal: 990.75	Breeding and foraging: 26.05 Foraging: 6.41 Dispersal: 262.34	Likely to occur	Section 4.2.3.4
White-throated needletail	V	V, M	Foraging (aerial): 6,907.49	Foraging (aerial): 2,316.58	Likely to occur as a flyover	Section 4.2.3.5

MNES	NC Act status[1]	EPBC Act status[1]	Area within Study Area (ha)[2]	Area within Disturbance Footprint (ha)[2]	Likelihood of occurrence within the Disturbance Footprint	Relevant section
Koala	E	E	Breeding and foraging: 103.38 Dispersal: 209.24	Breeding and foraging: 2.72 Dispersal: 48.29	Likely to occur	Section 4.2.3.6
Migratory (only) species						
Fork-tailed swift	SLC	M	Foraging (aerial): 6,907.49	Foraging (aerial): 2,316.58	Likely to occur as a flyover	Section 4.2.4.1
Glossy ibis	LC	M	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Likely to occur	Section 4.2.4.2

[1] E = Endangered, V = Vulnerable, M = Migratory, SLC = Special Least Concern, LC = Least Concern
[2] Breeding = Breeding and foraging habitat, Foraging = Foraging habitat, Dispersal = Dispersal habitat



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre
- Figure Extent

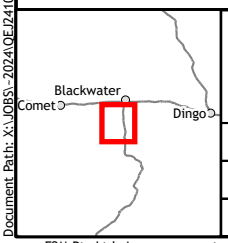
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0 2.5 5

Kilometres

Coordinate System: GDA2020



Notes:
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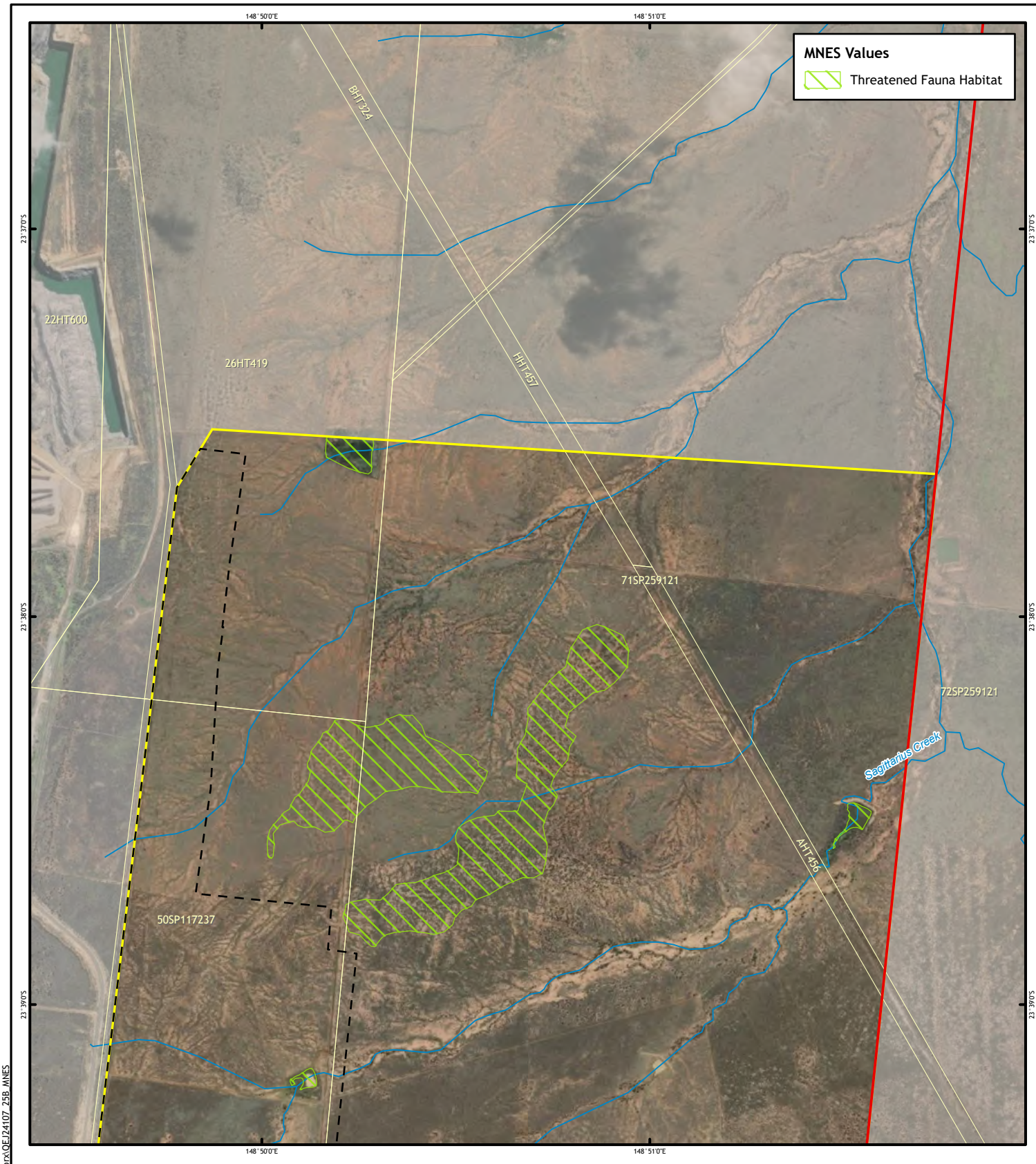
FIGURE 25A: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA - OVERVIEW

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 7	QEJ24107	1

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

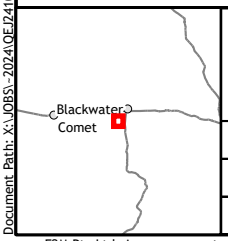
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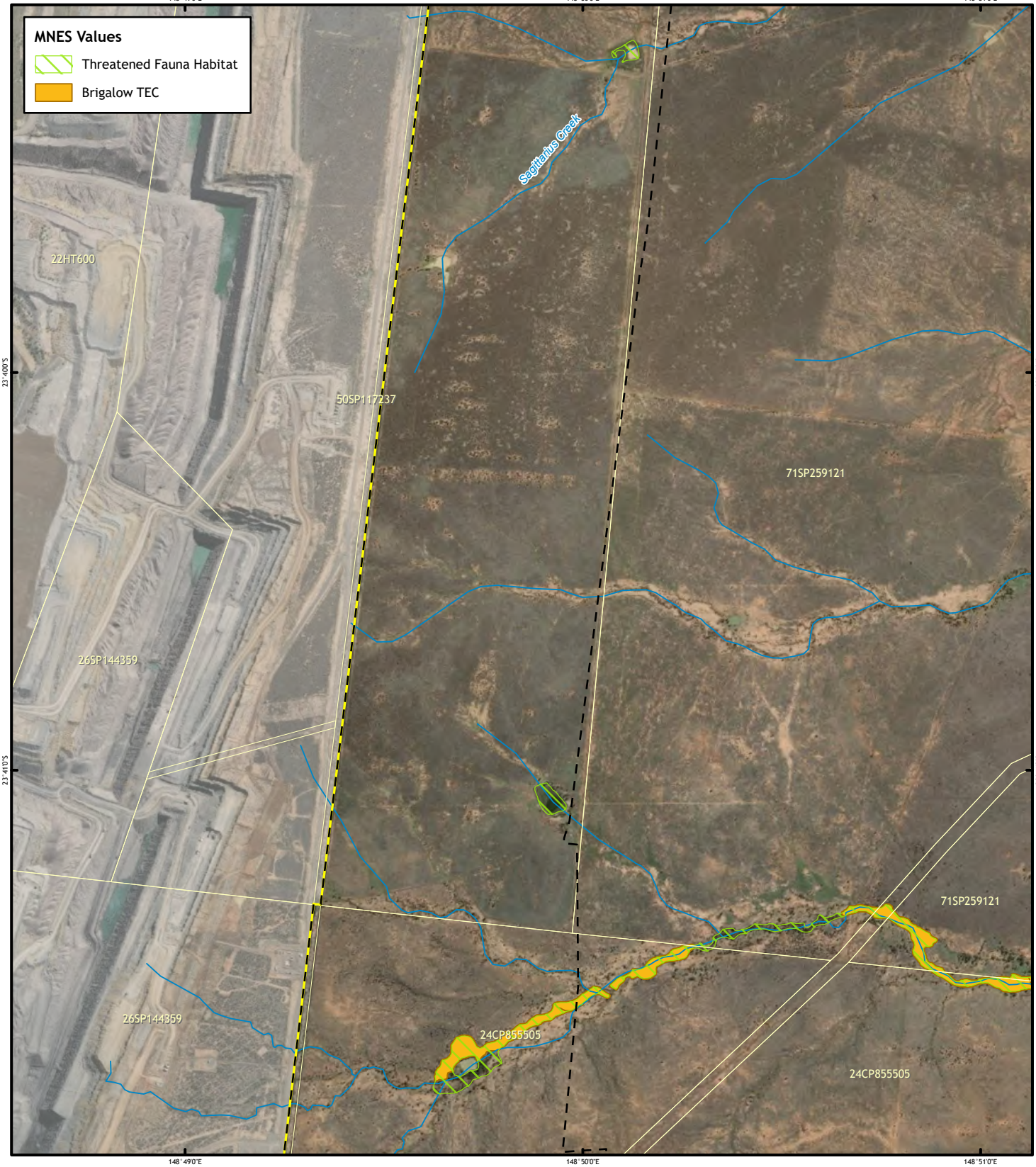
FIGURE 25B: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

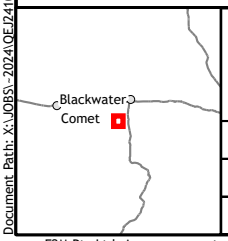
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Kilometres

Coordinate System: GDA2020



Notes:
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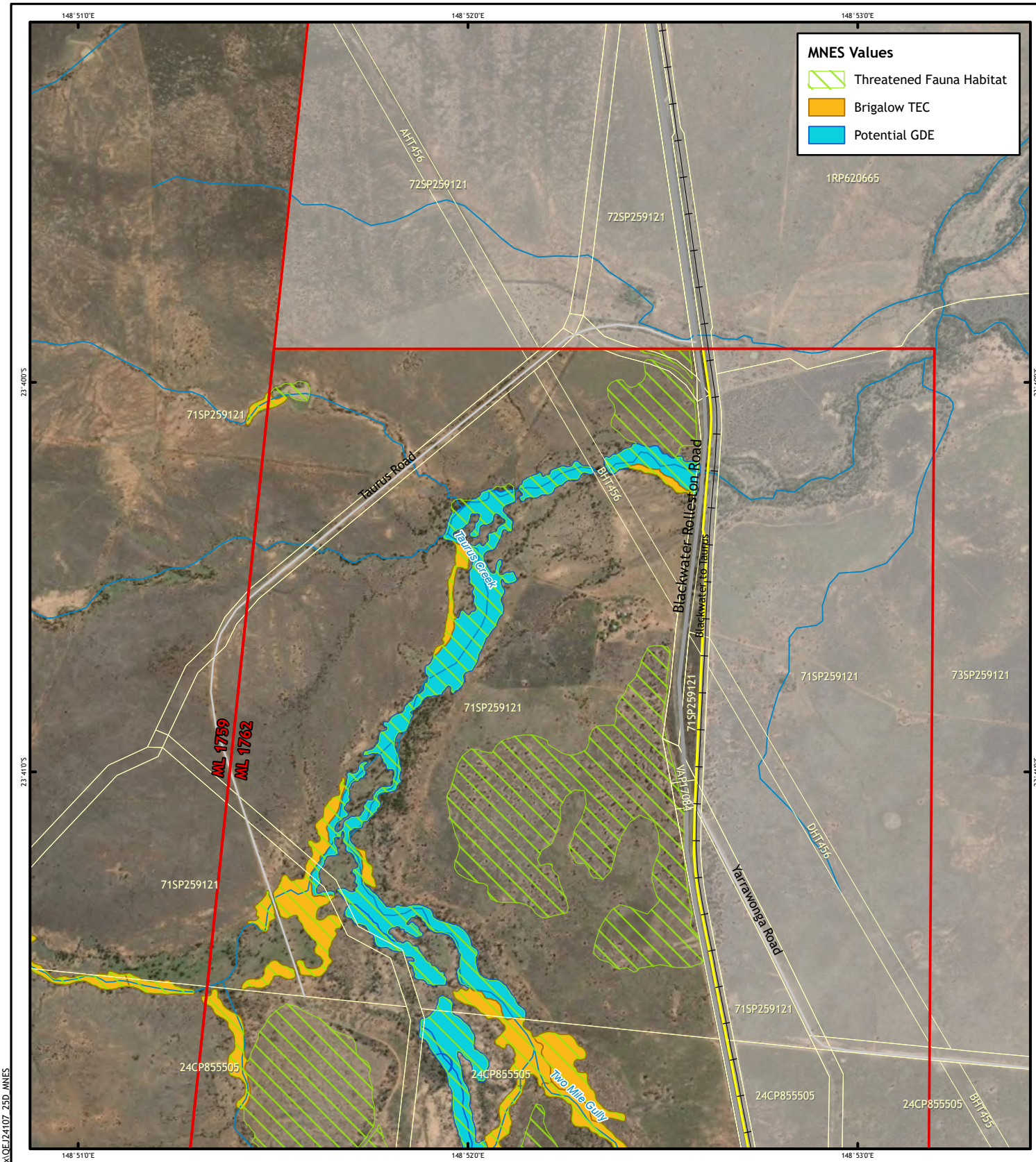
FIGURE 25C: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Blackwater Mining Lease
- Cadastre

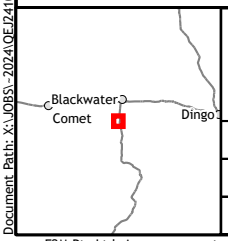
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Scale 1:25,000 (A4)

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Kilometres

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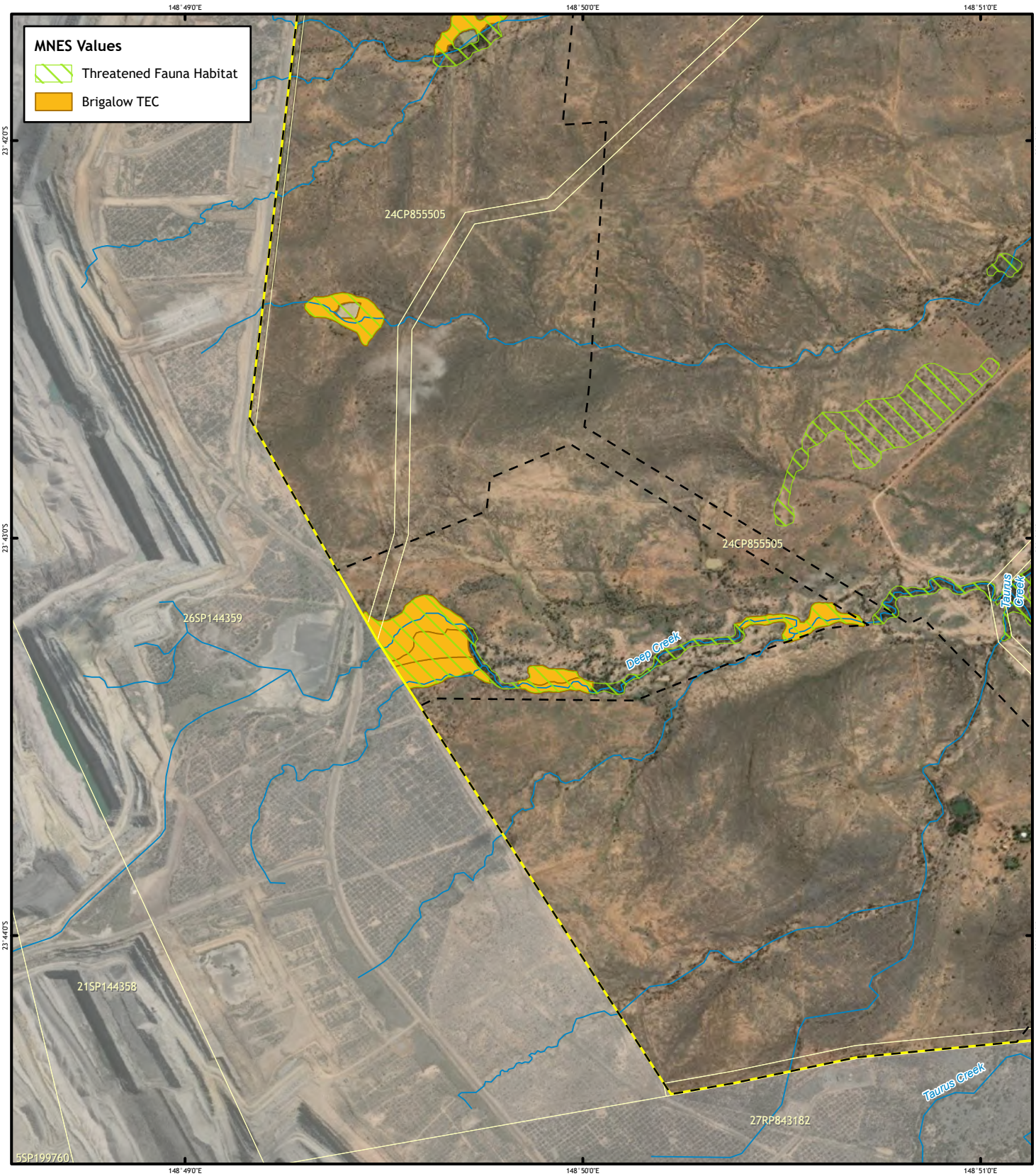
FIGURE 25D: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

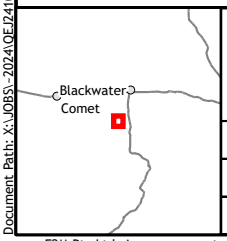
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Kilometres

Coordinate System: GDA2020



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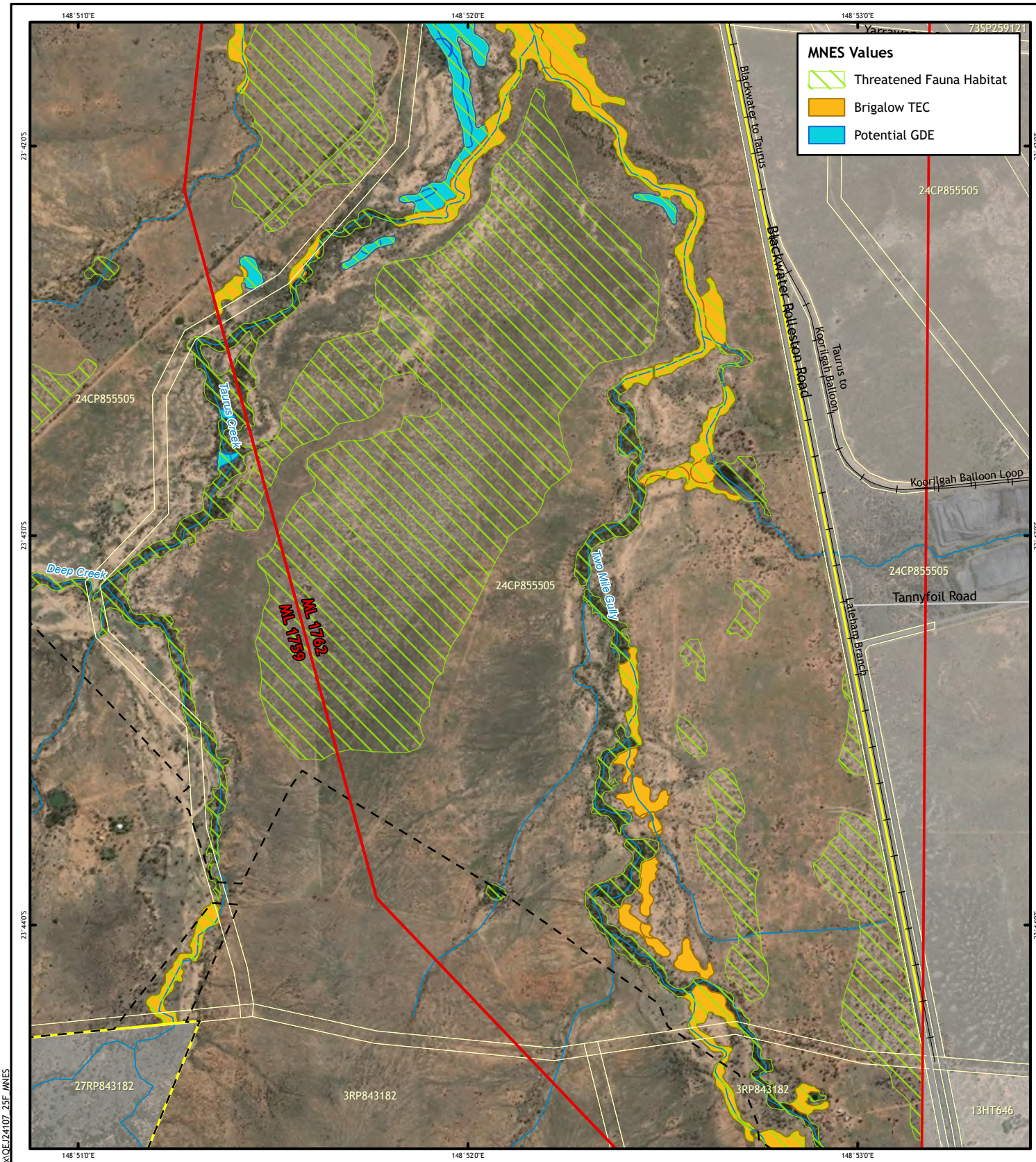
FIGURE 25E: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

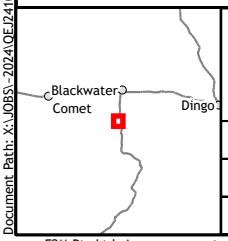
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



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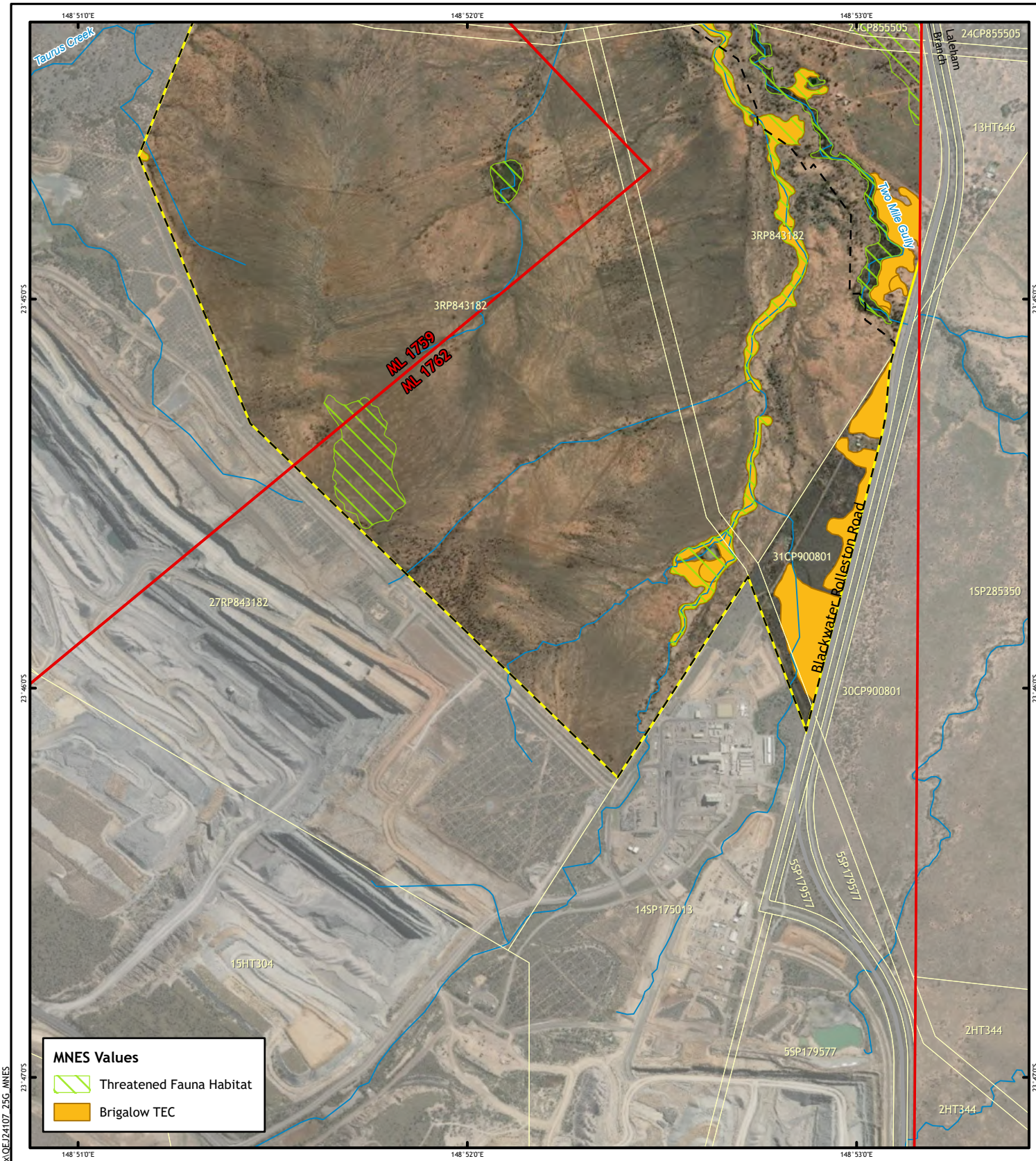
FIGURE 25F: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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Legend

- Railway
- Secondary Road
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

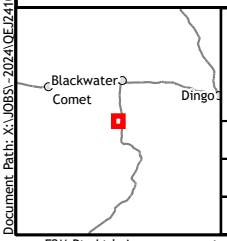
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



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FIGURE 25G: FIELD VERIFIED MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
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6.2 Summary of MSES

The following MSES as defined in the Queensland *Environmental Offsets Regulation 2014* (EO Regulation) were identified within the Study Area:

- regulated vegetation
- connectivity areas; and
- protected wildlife habitat.

A summary of the MSES within the Study Area is provided in Table 23 and Table 24.

Table 23: MSES ground-truthed regulated vegetation

MSES	VM Act status	Broad vegetation group	Structure category	Area within Study Area (ha)	Area within Disturbance Footprint (ha)
Endangered and of concern REs					
11.3.1	Endangered	25a	Mid-dense	99.73	1.21
11.3.2	Of concern	17a	Sparse	11.07	0.0
REs within the defined distance of a Vegetation Management watercourse					
11.3.1	Endangered	25a	Mid-dense	10.99	0.06
11.3.2	Of concern	17a	Sparse	0.02	0.0
11.3.3	Of concern	16c	Sparse	4.21	0.0
11.3.6	Least concern	17b	Sparse	7.40	0.18
11.3.27	Least concern	34d	Sparse	0.0	0.0

Table 24: MSES protected wildlife habitat within the Study Area

Species	EPBC Act Status	NC Act status	Area within Study Area (ha)	Area within Disturbance Footprint (ha)	Relevant section
Flora					
Solanum elachophyllum	Least concern	Endangered	Known: 30.32 Potential: 6,853.65	Known: 6.00 Potential: 2,299.78	Section 4.1.3.1
Fauna					
Ornamental snake (*Denisonia maculata*)	Vulnerable	Vulnerable	Breeding and foraging: 497.52	Breeding and foraging: 0.0	Section 4.2.3.1
Australian painted snipe (*Rostratula australis*)	Endangered	Endangered	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Section 4.2.3.2
Latham's snipe *(Gallinago hardwickii)*	Vulnerable	Vulnerable	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Section 4.2.3.3
Squatter pigeon (southern) (*Geophaps scripta scripta)*	Vulnerable	Vulnerable	Breeding and foraging: 239.01 Foraging: 30.46 Dispersal: 990.75	Breeding and foraging: 26.05 Foraging: 6.41 Dispersal: 262.34	Section 4.2.3.4
White-throated needletail *(Hirundapus caudacutus)*	Vulnerable	Vulnerable	Foraging (aerial): 6,907.49	Foraging (aerial): 2,316.58	Section 4.2.3.5
Koala (*Phascolarctos cinereus*)	Endangered	Endangered	Breeding and foraging: 103.38 Dispersal: 209.24	Breeding and foraging: 2.72 Dispersal: 48.29	Section 4.2.3.6
Short-beaked echidna (*Tachyglossus aculeatus*)	Least concern	Special least concern	Breeding and foraging: 501.13	Breeding and foraging: 122.11	Section 4.2.3.7

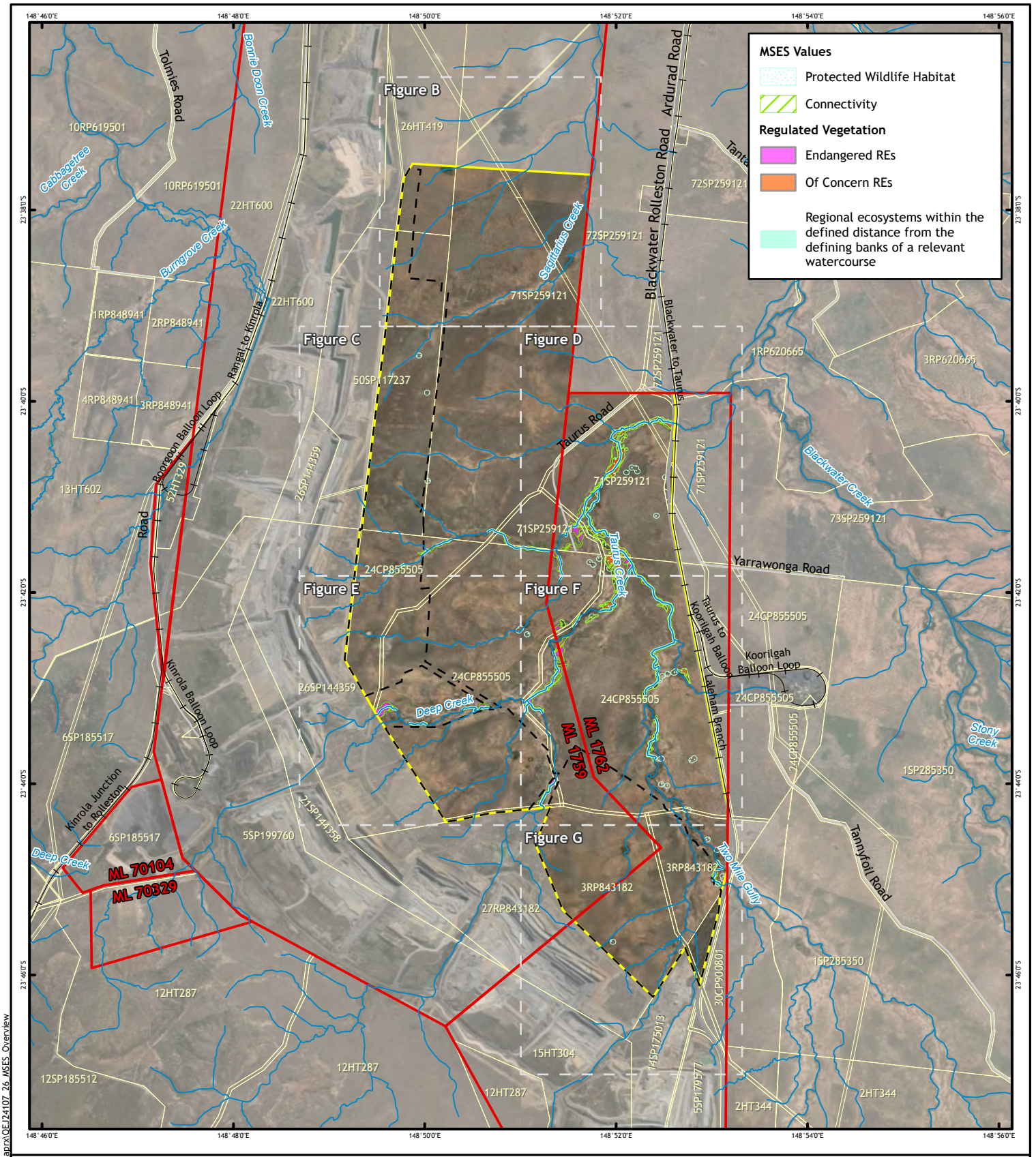
6.2.1 Regulated vegetation

MSES regulated vegetation under the EO Regulation includes prescribed REs containing remnant vegetation. MSES regulated vegetation within the Study Area was assessed using a combination of Queensland Government supplied mapping and RE ground-truthing. The specific methods to map regulated vegetation within the Study Area include:

- REs listed as endangered or of concern under the VM Act, using E2M ground-truthed remnant REs.
- REs located within the defined distance from the defining banks of Vegetation Management watercourse were mapped by buffering DNRMMRR mapped VM Act watercourses and drainage features by a defined distance[3] to estimate the defining banks (DNRMMRRD, 2025d). The size of the buffer was determined by the SO; a 2.5m buffer was applied to SO 1 and 2, a 5 m buffer was applied to SO 3 and 4, and SO 5 or greater were buffered by 10 m. E2M ground-truthed remnant REs within these defined distances and were included as MSES regulated vegetation.

Essential habitat for Ornamental snake (*Denisonia maculata*) occurs within the Study Area however it has not been included as it is assessed and offset as Protected Wildlife habitat for resource projects (Department of the Environment, Tourism, Science (DETSI), 2025). MSES regulated vegetation within the Study Area is depicted in Figure 26.

[3] *defined distance*, for a RE, means a distance identified in the EO Policy as the relevant distance from the defining banks of a relevant watercourse or relevant drainage feature.



Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Disturbance Footprint
- Blackwater Mining Lease
- Cadastre

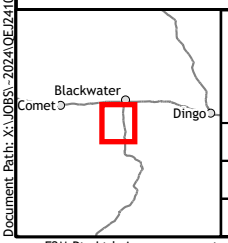
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Scale 1:100,000 (A4)

0 2.5 5

Kilometres

Coordinate System: GDA2020



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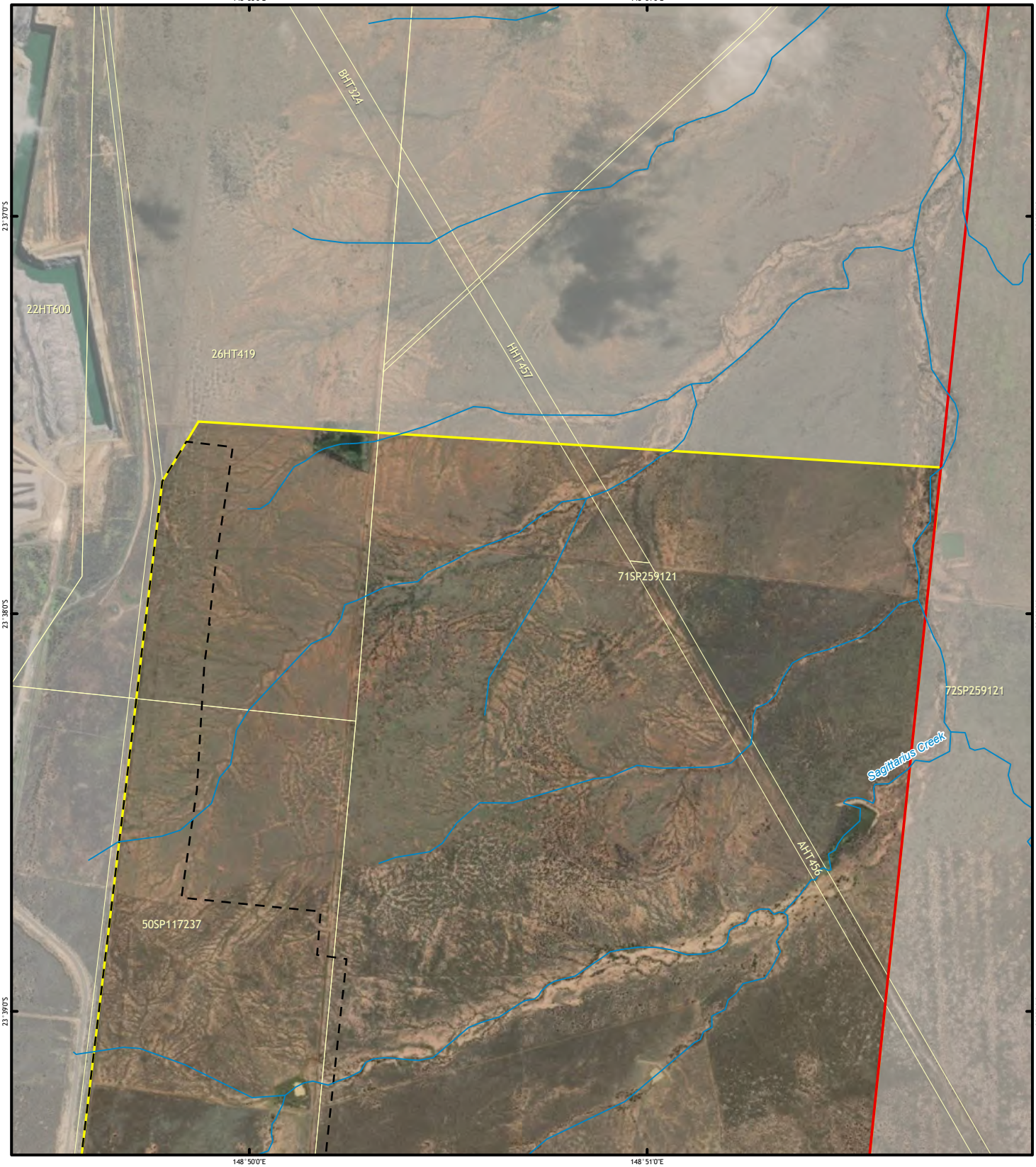
FIGURE 26A: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA - OVERVIEW

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
1 of 7	QEJ24107	1

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Legend

- Watercourse
- Study Area
- Blackwater Mining Lease
- Disturbance Footprint
- Cadastre

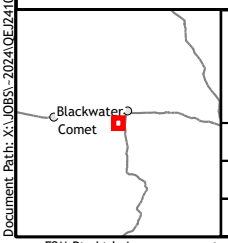
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



Notes:
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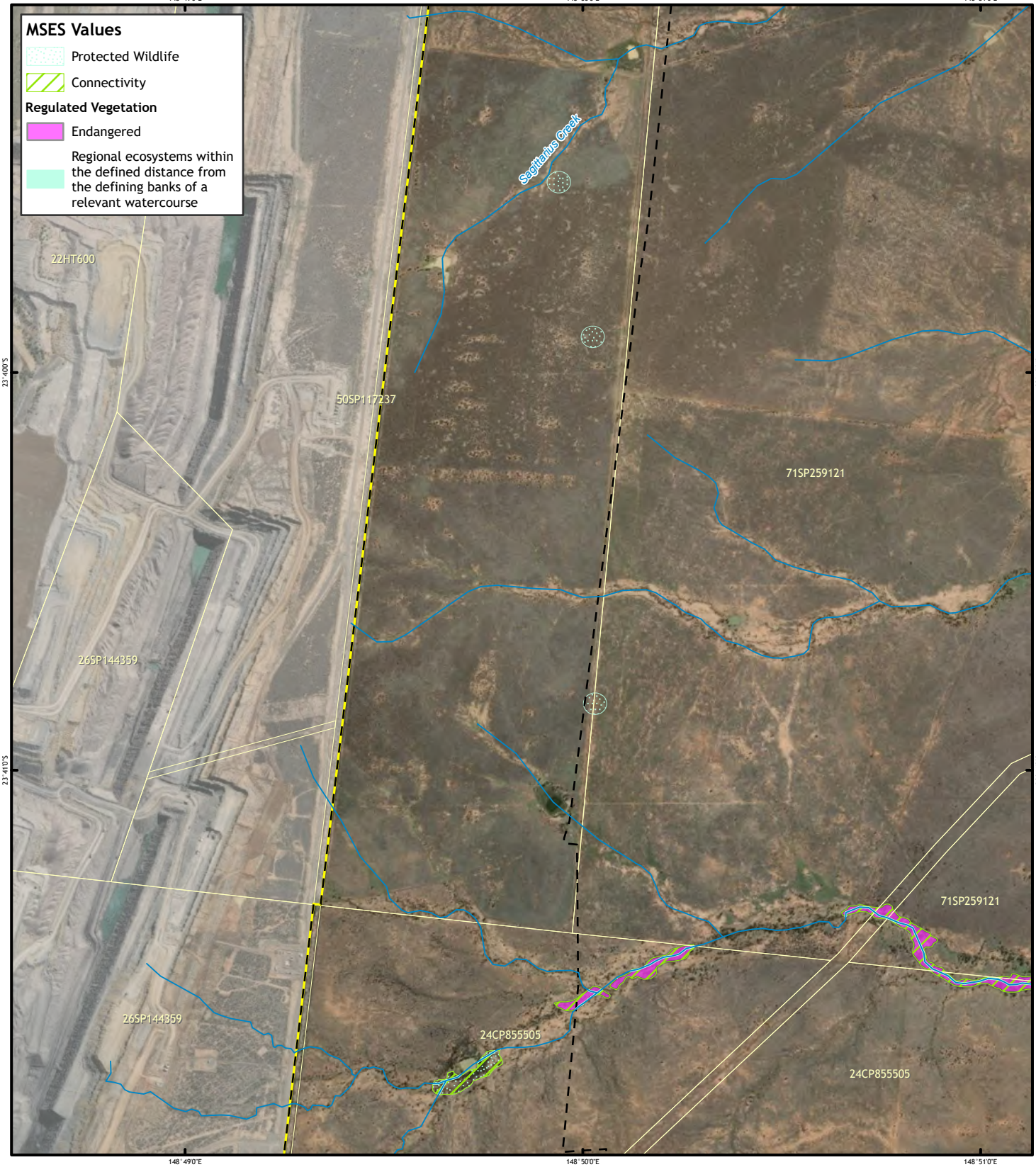
FIGURE 26B: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
2 of 7	QEJ24107	1

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

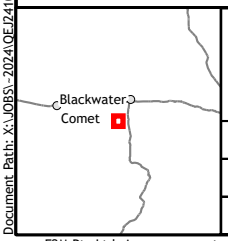
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Kilometres

Coordinate System: GDA2020



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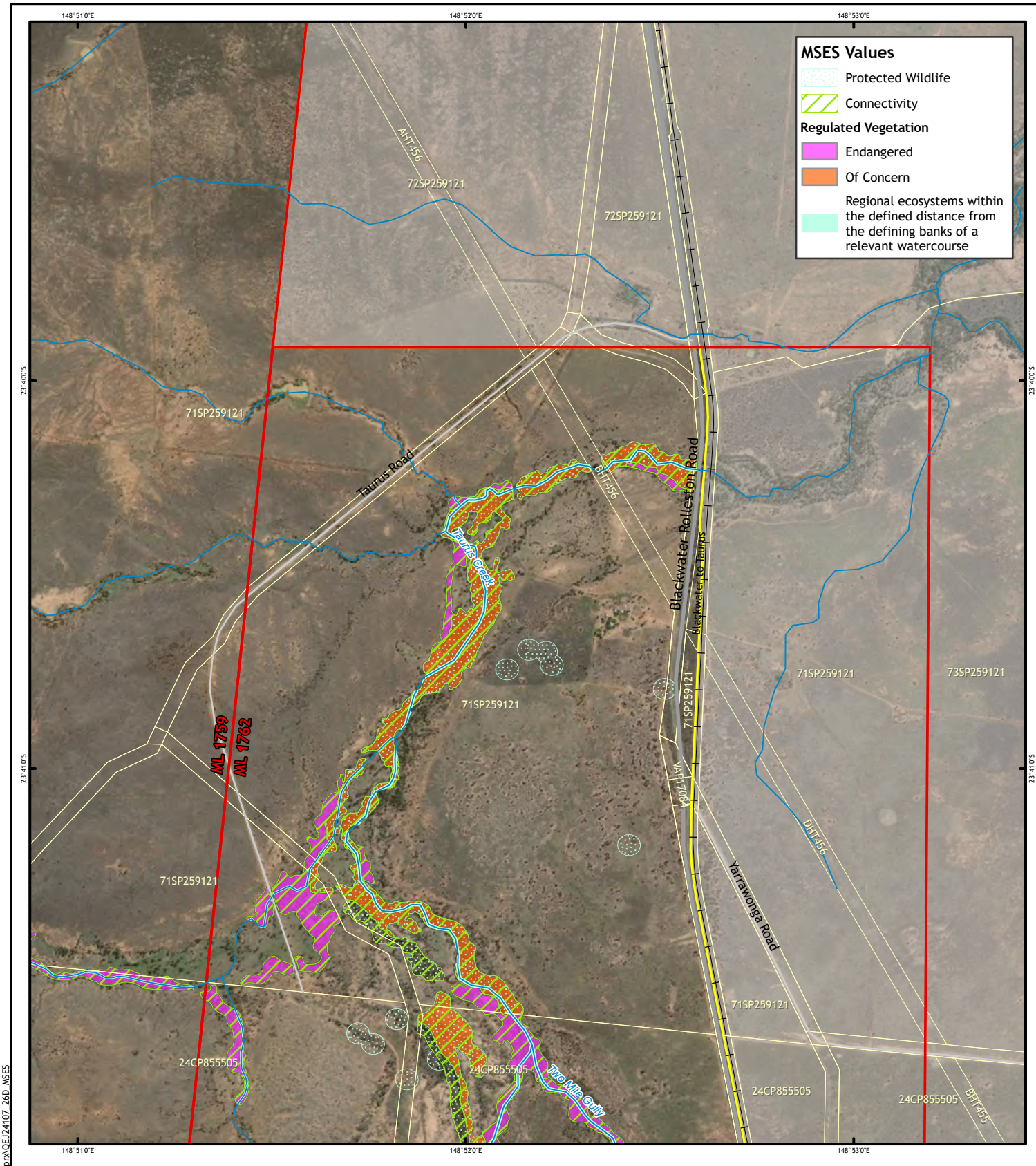
FIGURE 26C: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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3 of 7	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Blackwater Mining Lease
- Cadastre

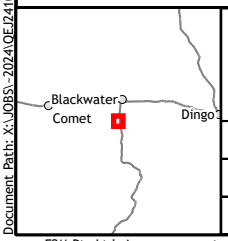
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Kilometres

Coordinate System: GDA2020



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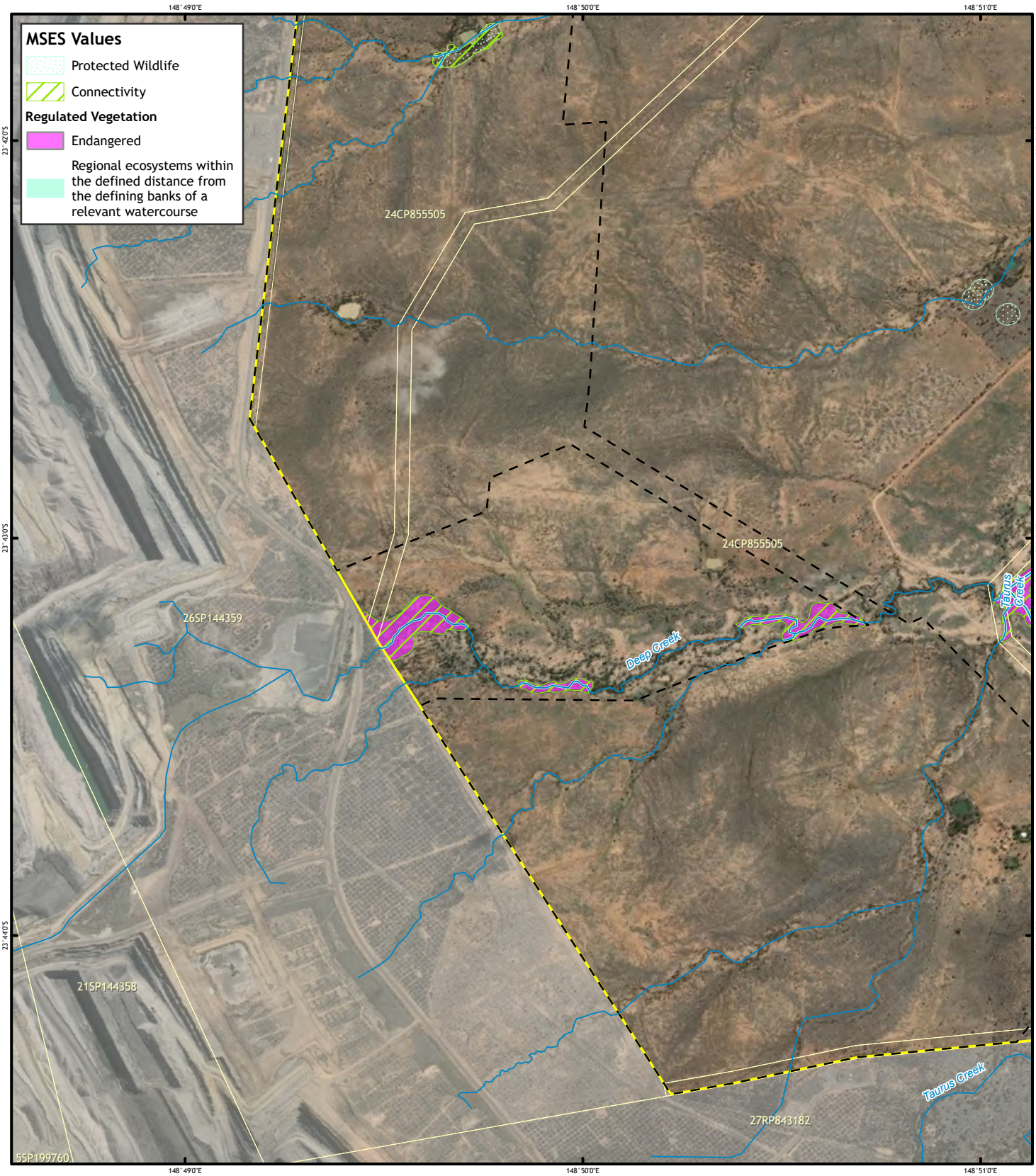
FIGURE 26D: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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Legend

- Watercourse
- Study Area
- Disturbance Footprint
- Cadastre

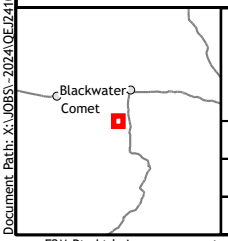
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



Notes:
Topographic: © ESRI 2025
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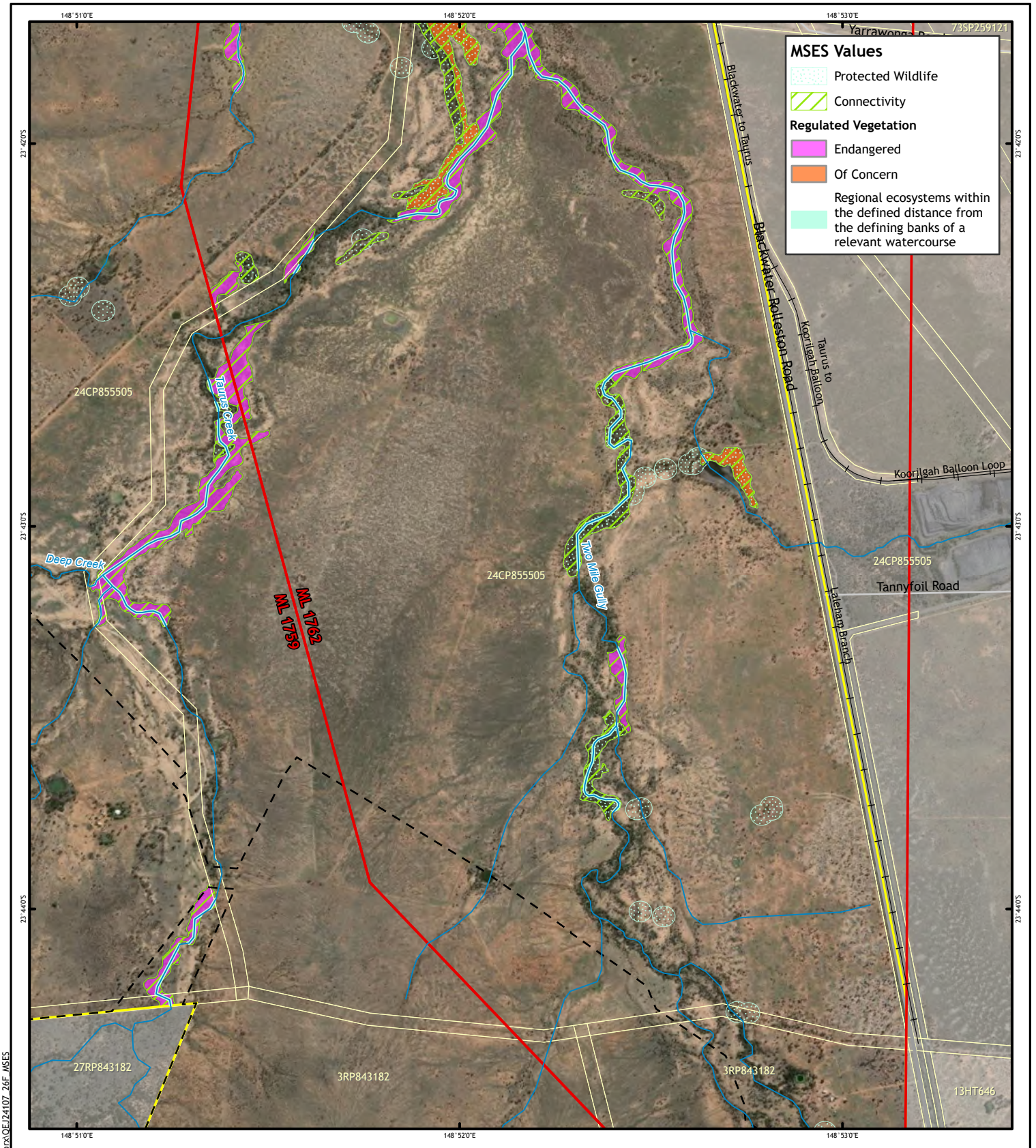
FIGURE 26E: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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5 of 7	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Property Access
- Watercourse
- Study Area
- Blackwater Mining Lease
- Disturbance Footprint
- Cadastre

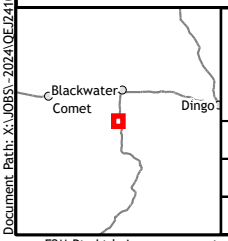
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Scale 1:25,000 (A4)

0 1

Kilometres

Coordinate System: GDA2020



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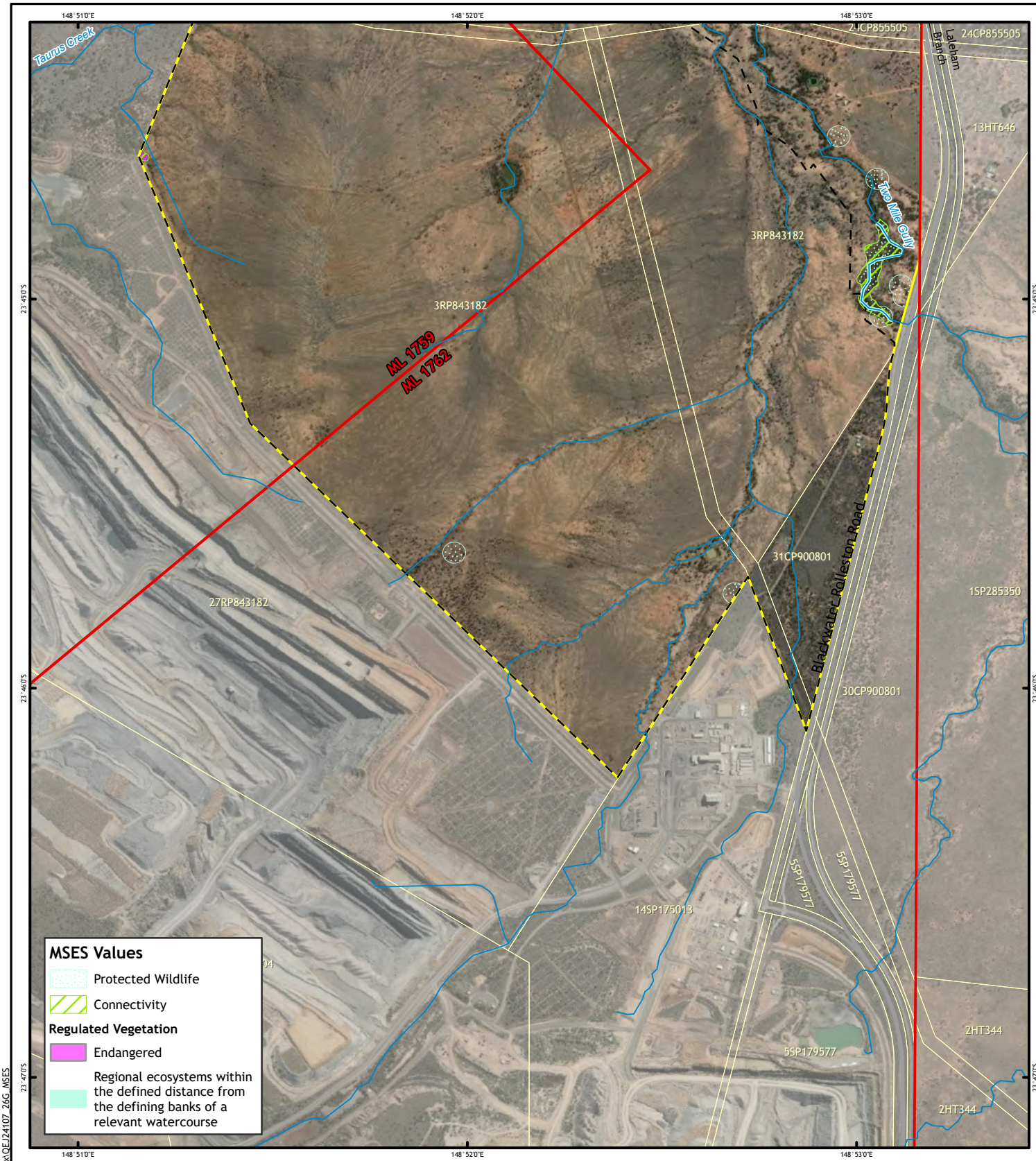
FIGURE 26F: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

Map Number	Job Number	Rev
6 of 7	QEJ24107	1

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Legend

- Railway
- Secondary Road
- Watercourse
- Study Area
- Blackwater Mining Lease
- Disturbance Footprint
- Cadastre

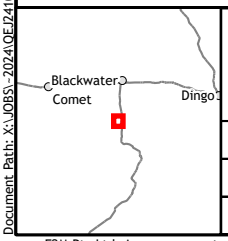
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Scale 1:25,000 (A4)

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Kilometres

Coordinate System: GDA2020



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FIGURE 26G: FIELD VERIFIED MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE WITHIN THE STUDY AREA

Blackwater North Ecological Assessment
Whitehaven Coal

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6.2.2 Connectivity areas

Connectivity areas are defined under the EO Regulation as prescribed REs that contain remnant vegetation and an area of land that is required for ecosystem functioning. Therefore, all ground-truthed remnant vegetation within the Study Area and Disturbance Footprint is considered to potentially contain connectivity values. The Study Area contains approximately 203.11 ha of remnant vegetation/connectivity areas and the Disturbance Footprint contains 3.93 ha of remnant vegetation/connectivity areas.

6.2.3 Protected wildlife habitat

Protected wildlife habitat is defined in the EO Regulation as:

- an area that contains flora that are listed as critically endangered, endangered or vulnerable; and
- an area that contains fauna that are listed as critically endangered, endangered, vulnerable or special least concern (non-migratory).

The EO Policy: *Significant Residual Impact Guideline* (DEHP, 2014) (SRI Guideline) defines habitat as '*the area occupied, or periodically or occasionally occupied, by any species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles*'.

The MSES protected wildlife habitat summarised in Section 6.2 comprises those species that were identified as known or likely to occur within the Study Area.

7 Impacts and mitigation

7.1 Native vegetation clearing

7.1.1 Impact

The overall extent of surface disturbance associated with the Project is approximately 2,316.58 ha. The majority of this disturbance (97.65%, 2,262.07 ha) comprises non-remnant areas that have historically been cleared for livestock grazing and agriculture. The remnant and high value regrowth vegetation that would require removal for the Project totals 43.71 ha and is detailed in Table 25.

Table 25: Summary of direct impact to ground-truthed vegetation communities

RE	VM Act class	Area within Study Area (ha)	Area within Disturbance Footprint (ha) Ground-truthed Regional Ecosystem (GTRE)	RE mapped area within Isaac Comet Downs	Percent of disturbance within Isaac Comet Downs (%)
Remnant					
11.3.1	Endangered	99.73	1.21	21,832.42	0.0055
11.3.2	Of concern	11.07	0.0	34,854.35	0.0
11.3.3	Of concern	38.28	0.0	41,098.88	0.0
11.3.6	Least concern	45.32	2.72	1,315.35	0.21
11.3.27	Least concern	8.71	0.0	1,142.78	0.0
Sub-total		203.11	3.93	100,243.78	0.0039
High Value Regrowth					
11.3.1	Endangered	40.99	18.35	3,917.28	0.47
11.4.9	Endangered	32.16	17.66	3,826.97	0.46
11.9.5	Endangered	10.62	3.77	754.60	0.49
Sub-total		83.77	39.78	8,498.85	0.46

Clearance of remnant vegetation within the Disturbance Footprint is unavoidable due to the fixed location of the mining pits and the requirement to position supporting infrastructure around these operational areas. As a result, the project will necessitate the removal of approximately 3.93 ha of remnant vegetation for mining activities and associated infrastructure. The layout has been refined where possible to minimise impacts; however, complete avoidance is not feasible given operational, safety and engineering constraints.

The final landform concept incorporates a multifunctional landscape that will support a mix of pastoral, agricultural, ecological, and hydrological land uses. Key landform elements include areas rehabilitated for cattle grazing and suitable for dryland cropping as well as woodland habitat to provide ecological connectivity. The land will also provide dedicated water storage features to support agricultural use and ecological function, and a stabilised watercourses that maintain natural drainage patterns.

Vegetation clearing for the Project would result in disturbance of habitat for threatened flora species and TECs. Within the Disturbance Footprint, 40.29 ha of Brigalow TEC habitat, and 6.00 ha of known and 2,299.78 ha of potential *Solanum elachophyllum* habitat, will be affected. These impacts are unavoidable due to the reasons discussed above. Table 26 summarises these impacts and significant impact assessments are detailed in Appendix D.1 and E.3.

Table 26: Threatened flora and TECs impacted by the Project

Species	EPBC Act status	NC Act status	Area within Study Area (ha)	Area within Disturbance Footprint (ha)	Percentage impacted (%)
Threatened ecological communities					
Brigalow TEC	Endangered	-	148.88	40.29	27.06
Threatened flora					
Solanum elachophyllum	-	Endangered	Known: 30.32 Potential: 6,853.65	Known: 6.00 Potential: 2,299.78	Known: 19.80 Potential: 33.56

7.1.2 Avoidance Measures

Field surveys were undertaken early in the design process such that ecological constraints could be considered as part of design and direct impacts to native vegetation could be minimised. The Disturbance Footprint has been designed to avoid impacting areas of vegetation where possible, including avoiding Taurus Creek and the ecological values along its riparian corridor.

7.1.3 Mitigation

While the Project would result in unavoidable impacts on native vegetation, a range of vegetation clearing measures would be implemented during both the construction and operation phases of the Project. These include the following:

- Vegetation clearing extents would be kept to the minimum area necessary for construction to minimise the removal of S. *elachophyllum* habitat and Brigalow TEC.
- Areas that must not be cleared or damaged outside of the Disturbance Area would be clearly identified on construction plans. Where necessary, signage, flagging and/or barricade fencing will be used to demarcate areas not to be cleared and this information clearly communicated to all necessary construction personnel.
- Implementation of weed hygiene protocols (e.g. wash-down, weed hygiene certification) for all vehicles, equipment and materials to be used in areas of native vegetation. This will help reduce the indirect impacts on the remaining Brigalow TEC in the Study Area by minimising further increases in weed density.

- Development of a Rehabilitation Management Plan, including a specification that rehabilitation commence as soon as practicable for all areas containing temporary infrastructure and cleared areas which are no longer required.
- Re-spread cleared vegetation and vegetation mulch on rehabilitated land to suppress weeds and assist in regrowth of S. *elachophyllum* and Brigalow community species.

7.2 Fauna habitat removal

7.2.1 Impact

7.2.1.1 Habitat removal

Habitat for eight conservation significant fauna species will be disturbed due to clearing within the Disturbance Footprint, including disturbance or removal of animal breeding places as well as foraging and dispersal habitat. This is summarised in Table 27. The Project's Disturbance Footprint encompasses areas of remnant Brigalow and Eucalypt woodland, as well as both mature and young Brigalow regrowth, which serve as habitats for a range of species. It will also impact extensive sections of non-remnant vegetation (with and without gilgai), however, the gilgai present within the Disturbance Footprint does not provide suitable habitat for the Ornamental snake. In addition, several wetlands and dams are present within the Disturbance Footprint which support various bird species.

Clearance of fauna habitat within the Disturbance Footprint is unavoidable due to the fixed location of the mining pits and the requirement to position supporting infrastructure around these operational areas. The layout has been refined where possible to minimise impacts; however, complete avoidance is not feasible given operational, safety and engineering constraints.

Table 27: Threatened and migratory fauna habitat impacted by the Project

Species	EPBC Act status	NC Act status	Area within Study Area (ha)	Area within Disturbance Footprint (ha)	Percentage impacted (%)
Australian painted snipe (*Rostratula australis)*	Endangered	Endangered	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Permanent Foraging: 38.97 Intermittent Foraging: 2.43
Koala (*Phascolarctos cinereus*)	Endangered	Endangered	Breeding and foraging: 103.38 Dispersal: 209.24	Breeding and foraging: 2.72 Dispersal: 48.29	Breeding and foraging: 2.63 Dispersal: 23.08
Latham's snipe *(Gallinago hardwickii)*	Vulnerable, migratory	Vulnerable	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Permanent Foraging: 38.97 Intermittent Foraging: 2.43
Ornamental snake (*Denisonia maculata*)	Vulnerable	Vulnerable	Breeding and foraging: 497.52	Breeding and foraging: 0	Breeding and foraging: 0

Species	EPBC Act status	NC Act status	Area within Study Area (ha)	Area within Disturbance Footprint (ha)	Percentage impacted (%)
Squatter pigeon (southern subspecies) (*Geophaps scripta scripta)*	Vulnerable	Vulnerable	Breeding and foraging: 239.01 Foraging: 30.46 Dispersal: 990.75	Breeding and foraging: 26.05 Foraging: 6.41 Dispersal: 262.34	Breeding and foraging: 10.90 Foraging: 21.04 Dispersal: 26.48
White-throated needletail *(Hirundapus caudacutus)*	Vulnerable, migratory	Vulnerable	Foraging (aerial): 6,907.48	Foraging (aerial): 2,316.58	Foraging (aerial): 33.54
Short-beaked echidna (*Tachyglossus aculeatus*)	-	Special least concern	Breeding and foraging: 501.13	Breeding and foraging: 122.11	Breeding and foraging: 24.37
Glossy ibis (*Plegadis falcinellus*)	Migratory	-	Permanent Foraging: 16.45 Intermittent Foraging: 593.55	Permanent Foraging: 6.41 Intermittent Foraging: 14.45	Permanent Foraging: 38.97 Intermittent Foraging: 2.43
Fork-tailed swift (*Apus pacificus*)	Migratory	-	Foraging (aerial): 6,907.48	Foraging (aerial): 2,316.58	Foraging (aerial): 33.54

7.2.1.2 Habitat degradation and edge effects

In general, construction activities and vegetation removal have the potential to indirectly degrade adjacent fauna habitat through edge effects. These occur where newly created habitat boundaries are subject to altered microclimate, vegetation structure and resource availability, leading to changes in habitat quality (Laurance & Yensen, 1991). For fauna, edge effects can increase exposure to weeds, noise, light, dust, as well as reduced foraging resources and shifts in species assemblages (Laurance & Yensen, 1991). Prolonged exposure to edge effects can degrade or reduce the quality of habitat, potentially impacting the abundance, richness and diversity of fauna species.

Habitat surrounding the Disturbance Footprint is largely fragmented from agricultural development and the existing mine area. Edge effects are not likely to be present in non-remnant or regrowth areas as the land is already disturbed with reduced foraging resources and altered vegetation structures. Edge effects are likely to be present within remnant vegetation as these communities have not previously been disturbed. However, remnant areas along Taurus creek adjacent to the Disturbance Footprint are very narrow and impact to this vegetation is not likely to cause a significant increase in edge effects within the greater landscape.

7.2.1.3 Habitat connectivity and fragmentation

Habitat connectivity within the Study Area (i.e. physical linkages between remnant and regrowth areas) is limited, attributed largely to the disturbance and fragmentation associated with historical and ongoing agricultural development and land use practices. Landscape connectivity values have largely been avoided for the Project with clearing of 3.93 ha of remnant connectivity areas being removed within the

Disturbance Footprint (Section 6.2.2). In particular, the remnant riparian vegetation associated with Taurus Creek and Two Mile Gully have largely been avoided.

Clearance of connectivity areas within the Disturbance Footprint is unavoidable due to the fixed location of the mining pits and the requirement to position supporting infrastructure around these operational areas. The layout has been refined where possible to minimise impacts; however, complete avoidance is not feasible given operational, safety and engineering constraints.

7.2.1.4 Fauna mortality and injury

Construction and operation activities associated with the Project have the potential to result in fauna injury or mortality. Vehicles and machinery operating within the Disturbance Footprint may inadvertently strike fauna residing in these areas, leading to direct harm. Similarly, fauna that are unable to disperse away from areas under active clearing are also particularly susceptible to injury or mortality, which may include threated species present in the area, such as Koala, Ornamental snake and Short-beaked echidna. Other potential causes of injury or mortality include animals becoming trapped in excavations/trenches. Additionally, following the completion of construction works, fauna that remain within the Study Area may face an elevated risk of being struck by vehicles or machinery operating adjacent to the Disturbance Footprint.

Impact avoidance measures currently being practiced to avoid fauna mortality during disturbance include (Whitehaven, 2020):

- Consideration of restrictions in relation to the presence of critical habitat for listed threatened species or ecological communities, triggering the referral process as per EPBC Act.
- Presence of a fauna spotter/catcher during clearing of vegetation or fauna habitat.

7.2.2 Avoidance Measures

Field surveys were undertaken early in the design process such that ecological constraints could be considered as part of design and the direct impact to native vegetation could be minimised. The disturbance footprint for the Project has been defined to avoid impacting areas of fauna habitat where possible.

7.2.3 Mitigation

In order to mitigate unavoidable impacts on fauna habitat values associated with the Project, a range of vegetation clearing measures will be implemented over the course of the Project. Measures associated with the spread of environmental weeds, noise, light and dust are discussed in Sections 7.3.2. Mitigation measures include the following:

- Vegetation clearing would be carried out sequentially over the life of the Project to allow fauna species the opportunity to disperse away from clearing areas.
- Directional clearing towards habitat to be retained to prevent fauna from becoming trapped in the clearing front.
- Identified fauna would be left in place with dispersal routes and connecting trees available until the individual has moved on without interference.
- Pre-clearance fauna surveys would be undertaken by suitably experienced and qualified persons to identify individual fauna at direct risk from clearing activities and provide advice to avoid/minimise the impacts.

- A suitably experienced and qualified fauna spotter/catcher would be present during the clearing of any habitat features (e.g trees, woody debris, logs and rocks) that may serve as habitat or refugia for animals, particularly in remnant and regrowth habitat areas.
- Prior to removal, all hollow-bearing trees would be thoroughly checked for large hollow-dwelling fauna prior to felling. If presence is identified, it is recommended that the tree be left overnight to allow for self-dispersal.
- Management of fauna identified during clearing would include relocating individuals to adjacent habitat or treating injuries.
- Select habitat features (e.g. hollow bearing trees, woody debris, logs and rocks) would be salvaged for re-use in rehabilitation areas.

The existing Blackwater Mine Land and Biodiversity Management Plan (Whitehaven Coal Pty Ltd, 2020) will be updated to include both the mitigation measures above as well as species-specific management measures for relevant MNES and MSES species, including:

- Australian painted snipe
- Koala
- Latham's snipe
- Squatter pigeon (southern)
- White-throated needletail; and
- Short-beaked echidna.

7.3 Introduction and spread of weeds and pests

7.3.1 Impacts

Introduced flora species disrupt ecosystems by outcompeting and replacing native species, resulting in altered ecosystem diversity and function. Proliferation and spread of environmental weeds and pests may occur with vegetation clearing, soil disturbance and increased movement of heavy machinery and vehicles. Seven weed species listed as WoNS and/or restricted matters under the Biosecurity Act were recorded within the Study Area as scattered individuals and groups:

- *Bryophyllum delagoense;*
- *Cryptostegia grandiflora;*
- *Harrisia martinii;*
- *Opuntia streptacantha;*
- *Opuntia stricta;*
- *Opuntia tomentosa;*
- *Parkinsonia aculeata;* and
- *Parthenium hysterophorus*.

Weed seeds can be transported in contaminated landfill, and as seed and material on machinery, vehicles or personnel. Construction activities have the potential to spread or introduce weeds throughout adjacent areas, resulting in a degradation of vegetation/habitat quality and native species assemblages.

The Project may also result in an increase in the presence and abundance of feral animals due to increased permanency of water sources (e.g. dams and troughs). These pests can result in adverse impacts to native fauna through increased habitat degradation, predation pressure and competition for resources. Environmental pests recorded in the Study Area during the field survey are:

- Cane toad (*Rhinella marina*);
- Wild dog (*Canis lupus familiaris*);
- Feral cat (*Felis catus*);
- Common myna (*Acridotheres tristis*);
- Rabbit (*Oryctolagus cuniculus*); and
- Feral pig (*Sus scrofa*).

7.3.2 Mitigation

Management and control of environmental weeds and pests will be required during the construction and operational phases of the Project. Associated management measures will include:

- Prior to vegetation clearing activities, a pre-clearance survey would be undertaken to identify and map infestations of WoNS and biosecurity matters to minimise spread during clearing works and the operational phase.
- Monitor and respond early with regular inspections, mapping, and rapid treatment of new outbreaks
- Treat established weeds using appropriate manual, mechanical, chemical, or biological methods
- Implementation of weed hygiene protocols (e.g. wash-down, weed hygiene certification) for all vehicles, equipment and materials to be used in areas of native vegetation.
- Weeds or soil removed as a result of construction activities would be removed from the area to minimise potential spread and proliferation of weed species.
- Continuation of waste management measures described in the Blackwater Mine Waste Management Plan (Whitehaven Coal, 2021). Waste management measures would be identified and enacted to minimise occurrences of pest fauna. Food scraps, which attract pest fauna, would be disposed of in designated bins. The contents of the bins would be transferred to the industrial bins which are then emptied by the designated contractor directly to the designated landfill onsite.
- Control feral animals through monitored programs (trapping and 1080 baiting) when thresholds are me
- Educate and report via toolbox talks, training, record-keeping, and landholder notification

An existing Weed and Feral Animal Management Plan (Whitehaven Coal, 2022a) has been developed to monitor the distribution and density of listed invasive flora and fauna. This plan oversees the implementation of the mitigation methods described above, ensuring that all recommended actions are carried out effectively.

7.4 Modification of hydrology

7.4.1 Impacts

7.4.1.1 Surface water quality

Changes in the surface water quality and quantity may impact terrestrial ecosystems downstream of disturbance associated with the Project. Sedimentation and chemicals can enter downstream environments resulting from overland flow patterns (Evans, 2000). Based on the water level data collected to date, groundwater interaction with ephemeral creeks is considered to be unlikely (SLR, 2026).

7.4.1.2 Groundwater drawdown

Changes to groundwater quality and quantity can have an indirect impact on ecosystems surrounding the Study Area, including ecosystems that are dependant or partially dependent on groundwater (terrestrial GDEs). The process of mining reduces water levels in the surrounding groundwater units. The extent of the zone affected is dependent on the properties of the aquifers/aquitards and is referred to as the zone of drawdown. The potential impacts to groundwater have been assessed in accordance with the Blackwater Mine - North Extension Project Groundwater Impact Assessment (SLR, 2026). Groundwater will not leave the mine lease permanently and the final voids anticipated to act as a groundwater sink, capturing water associated with in-pit rejects (SLR, 2026).

7.4.2 Mitigation

Mitigation measures to minimise potential impacts to hydrology associated with the Project include:

- A Groundwater Monitoring and Management Program (GMMP) exists for the BWM (WSP, 2024). The purpose of the GMMP is to monitor the scale and distribution of shifts to groundwater resources due to existing operations at BWM and to provide early detection of any unforeseen impacts to groundwater levels or groundwater quality.
- Groundwater inflows to the open cut pits during mining operations would be pumped out (along with any surface water) via in-pit sumps if the groundwater doesn't passively evaporate on the pit face or from the pit floor (SLR, 2026). The groundwater inflows would be collected and contained within the mine water management system (SLR, 2026).
- Erosion and sediment control monitoring would be implemented to reduce the amount of sediment laden run-off entering downstream waterways. The following general principles should apply to the erosion and sediment controls:
  - minimise the surface disturbance areas
  - where possible, apply local temporary erosion control measures
  - intercept run-off from undisturbed areas and divert around surface disturbance areas, through the use of up-catchment diversions; and
  - where temporary measures are likely to be ineffective, direct surface water run-off from surface disturbance areas to sediment dams prior to release from the Project area.
- Active haul roads are to be regularly watered (or applied with dust suppressants) to minimise dust generation potential.

- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with Australian Standard (AS)1940:2004, and where practical, will be located away from any waterbodies.
- Oil spill recovery equipment will be available when working adjacent to drainage channels with the ability to discharge off site. Spill kits will be located with construction crews conducting activities with the potential for significant spills.
- As soon as practical, disturbed areas will be rehabilitated to reduce the amount of exposed soils.

7.5 Proliferation of noise, light and dust

7.5.1 Impacts

Construction and operation activities can disrupt local fauna roosting, breeding and foraging activities as a result of increased exposure to artificial lighting, noise and vibration. Artificial lighting poses risks to fauna, as increased light allows predators to locate prey more easily. In particular, threatened fauna within the Study Area may be at increased risk of predation, such as Ornamental Snake, Australian painted snipe, Latham's snipe, Squatter pigeon and Short-beaked echidna. As the Project brings operational areas closer to the more heavily vegetated sections of Taurus Creek, these impacts may affect the fauna species that inhabit and utilise this watercourse.

7.5.2 Mitigation

To minimise potential impacts associated with proliferation of dust the following management measures would be implemented:

- Dust suppression activities are to be carried out where required and managed in accordance with the limits and risk levels identified within the Blackwater *Air Emissions Management Plan*. The Project would continue to implement the measures described in the Blackwater Air Emissions Management Plan (Whitehaven Coal, 2022b), including:
  - Availability of water trucks to provide dust suppression on haul and light vehicle roads
  - Water sprays on stacker/reclaimer unites; and
  - Train loadout to incorporate veneering.
- Topsoil stockpiles are to be kept to a maximum height of 3 m and side slopes profiled to 3H:1V to decrease wind impact.
- Active mining areas and haul roads are to be maintained in good condition to minimise emissions.
- Blasting operations are to be monitored in relation to wind speed and direction to ensure that emissions do not adversely impact on sensitive receivers.
- Completed mining areas and any other cleared areas would be rehabilitated as soon as possible after use.
- Other controls listed in the Blackwater Air Emissions Management Plan include (Whitehaven Coal, 2022b):
  - minimising the area of disturbance;
  - progressive backfilling of overburden and rejects to in pit spoil dumps;
  - ongoing implementation of the WHC-QLD-PRO Permit to Disturb; and
  - avoid burning cleared vegetation.

To minimise potential impacts associated with proliferation of noise and light the following management measures would be implemented:

- Where artificial lighting is required, directional lighting would be implemented in a way to:
  - focus on disturbance/work areas
  - minimise/avoid lighting of remnant vegetation; and
  - implemented in accordance with AS including consideration of *National Light Pollution Guidelines for Wildlife* (DCCEEW, 2023).
- Regular maintenance of machinery and plant would be undertaken to minimise unnecessary noise.
- The Blackwater Air Emissions Management Plan states the following measures should be implemented during operational activities (Whitehaven Coal, 2022b):
  - upgrading silencing of mobile equipment
  - limiting speed of heavy vehicle traffic on haul roads
  - implement maintenance and operation procedures to minimise nuisance noise emissions from equipment
  - only carry out blasting during daylight hours
  - restricting blasts to favourable weather conditions; and
  - alteration of number of blast holes; stemming depth, spacing etc. of blasts.

7.6 Bushfire event

7.6.1 Impacts

Accidental ignitions in the Project area may be caused by machinery, an accident or collision, scheduled burns getting out of control, hot works, spontaneous combustion of coal or from the incorrect disposal of flammable items. These ignitions have the potential to cause uncontrollable fires that can have pronounced impacts on vegetation and habitat within and adjacent to the Project area.

The majority of vegetation surrounding the Disturbance Footprint are Brigalow dominated vegetation types, which typically do not carry fire, except where invaded by exotic species, such as Buffel grass (Butler & Fairfax, 2008).

7.6.2 Mitigation

To minimise potential impacts from a bushfire event, the following management measures would be implemented:

- Implement a Bushfire Management Plan, which includes strategies for fuel load management. The Bushfire Management Plan should include an assessment of appropriate fire strategies to maintain the ecological values of surrounding vegetation communities, some of which are sensitive to uncontrolled burns (i.e. brigalow communities).
- Any chemicals used in the Project area would be handled and disposed of in accordance with the relevant Safety Data Sheet.
- Access tracks would be constructed and maintained for ready use by Queensland Fire and Rescue Service in emergency situations. These tracks could also be used as fire breaks if appropriately maintained. The designation of fire breaks is to be specified within the Bushfire Management Plan.
- An Emergency Response Procedure would be prepared in consultation with emergency services and implemented.

7.7 Cumulative impacts

Land use in the Isaac - Comet Downs sub-bioregion consists primarily of mining, cattle grazing and grain production. The Project area comprises of patches of remnant and regrowth vegetation and agricultural land, primarily used for cattle grazing.

The Project's impact on the environment is additive to that from past and present grazing, agriculture and mining activities within the Northern Bowen Basin and Isaac - Comet Downs sub-bioregions. As such, this section focusses on evaluating the Project's impact inclusive of other local and regional disturbances, which allows a broad-scale assessment on impacts to MNES habitat.

The Isaac – Comet Downs subregion includes extensive agricultural practices and large-scale regional development comprising several existing and approved EPBC Act Referrals. Referrals within 30 km of the Project are detailed in Table 28.

Table 28: Approved EPBC Act Referrals within 30 km of the Project

EPBC Act referral title	Referral number	Distance to Blackwater North	Date of Referral	Approval status
Bowen Gas Project	2012/6377	Incorporates the northern extent of the Study Area	09/05/2012	Active Project, with condition variation being considered
Blackwater to Rolleston 132 kV transmission line	2002/880	Immediately west of the Study Area	25/11/2002	Active Project
Development and operation of a new multi-seam underground coal mine with associated on-site infrastructure	2011/5811	Immediately east of the Study Area	16/01/2011	Active Project
Blackwater to Emerald Dual Circuit 132kV Powerline, QLD	2012/6480	0.37 km	23/07/2012	Active Project
Curragh Extension Project, Blackwater, QLD	2015/7508	0.5 km	02/07/2015	Active Project
Rail track to link the proposed MIM Rolleston coal mine to existing rail network	2002/637	3.26 km	08/04/2002	Active Project
Curragh West Project	2011/6187	5.93 km	08/11/2011	Active Project
Blackwater creek diversion and coal mine	2007/3925	8.79 km	17/12/2007	Active Project
Curragh North Coal Mine	2003/1096	12.62 km	12/06/2003	Active Project
Springsure Creek 132kV powerline and switchyards	2012/6385	14.97 km	15/05/2012	Active Project
Development and operation of the Star Coal Project Bulk Sample Project	2023/09502	15.03 km	23/03/2023	Active Project
Santos GLNG Gas Field Development Project, QLD	2012/6615	19.70 km	07/11/2012	Active Project
Bluff open cut coal mine project, central Queensland	2013/7064	20.16 km	24/11/2013	Active Project

EPBC Act referral title	Referral number	Distance to Blackwater North	Date of Referral	Approval status
Blackwater System Rail Expansion	2011/6209	21.07 km	29/11/2011	Active Project
Expansion of Ensham Mine	2004/1822	24.91 km	13/10/2004	Approval decision made
Jellinbah Coal Mine-Central North Extension, QLD	2018/8139	25.25 km	02/01/2018	Approval decision made
Coal Seam Gas Field Development for Natural Gas Liquefaction Park, Curtis Island	2008/4059	26.34 km	27/02/2008	Approval decision made
Blackwater Mine South Coking Coal Project	2022/09279	26.68 km	09/06/2022	Under Assessment

The Project would result in the removal of 43.71 ha of remnant and high value regrowth vegetation.

The potential cumulative impacts on threatened species arising from the Project are minimal because of the localised nature of the Project compared to the wider distribution of the species and associated habitats and communities in the surrounding landscapes and subregions, together with the highly disturbed existing character of the habitats within the Disturbance Footprint. A total of 3.93 ha of remnant vegetation will be removed within the Disturbance Footprint, comprising 0.17% of the total disturbance.

The cumulative impact on the MNES and MSES identified within the Study Area was estimated by comparing the Project's direct impact to the area of habitat present within the Central Highlands. The available habitat for each MNES was calculated across the Isaac – Comet Downs subregion using similar habitat definitions applied on the Study Area with the exception of field-based criteria (such as species diversity, ground cover, etc) (Table 29). Species profiles and listing advice were used to identify REs and Broad Vegetation Groups (BVGs) within the subregion that provide suitable habitat for each MNES. Threatened matters habitat listed in Table 29 generally cover the entire Isaac - Comet Downs sub-bioregion, extending from Nebo in the north, to Rolleston in the south (Atlas of Living Australia (ALA), 2025; DCCEEW, 2025k).

For threatened fauna species, it was conservatively assumed that all remnant REs contains the necessary microhabitat for each species. Therefore, for species and communities that occur in regrowth areas, which are detailed in the broad habitat descriptions in the table below, this assessment is an under-estimate of available habitat in the region.

Table 29: MNES and MSES regional habitat associations

MNES and MSES	Qualifying RE/BVG[1]	Broad habitat description
Threatened ecological communities		
Brigalow TEC	11.3.1, 11.4.8, 11.4.9, 11.5.16, 11.9.1, 11.9.5	Remnant and regrowth *Acacia harpophylla* dominated woodlands and open forests
Conservation significant species		
Solanum elachophyllum	11.3.1, 11.3.6, 11.4.9 and 11.5.16	Remnant and regrowth *Eucalyptus thozetiana*, *Acacia harpophylla* open forests or *E. crebra and E. tenuipes* woodland.
Ornamental snake *Denisonia maculata*	11.4.3, 11.4.6, 11.4.8, 11.4.9, 11.3.3 and 11.5.16	Remnant and regrowth *Acacia harpophylla* and/or *Casuarina cristata* dominated vegetation where gilgai occur
Australian painted snipe *Rostratula australis*	11.2.4, 11.2.5, 11.3.2, 11.3.12, 11.3.15, 11.3.22, 11.3.23, 11.3.24, 11.3.27, 11.3.37, 11.3.40, 11.4.3, 11.4.8, 11.4.9, 11.5.16, 11.5.17 and 11.10.14	Remnant and regrowth REs providing palustrine or lacustrine wetland habitat in the brigalow belt bioregion
Latham's snipe *Gallinago hardwickii*	11.2.4, 11.2.5, 11.3.2, 11.3.12, 11.3.15, 11.3.22, 11.3.23, 11.3.24, 11.3.27, 11.3.37, 11.3.40, 11.4.3, 11.4.8, 11.4.9, 11.5.16, 11.5.17 and 11.10.14	Remnant and regrowth REs providing palustrine or lacustrine wetland habitat in the brigalow belt bioregion
Squatter pigeon (southern) *Geophaps scripta scripta*	11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.7, 11.3.11, 11.3.17, 11.3.18, 11.3.19, 11.3.21, 11.3.25, 11.3.26, 11.3.27, 11.3.37, 11.3.39, 11.5.1, 11.5.10, 11.5.12, 11.5.16, 11.5.17, 11.5.2, 11.5.20, 11.5.2a, 11.5.3, 11.5.3b, 11.5.5c, 11.5.8c, 11.5.9, 11.5.9a, 11.5.9b, 11.5.9c, 11.7.1, 11.7.2, 11.7.3 and 11.7.4	Remnant and regrowth eucalypt woodland
White-throated needletail *Hirundapus caudacutus*	-	All remnant and regrowth woodland where the species forages in airspace above
Koala *Phascolarctos cinereus*	8a, 9e, 10a, 11a, 12a, 13c, 13d, 16a, 16c, 17a, 17b, 18b, 19d and 34d	Remnant and regrowth eucalypt dominated woodland
Fork-tailed swift *Apus pacificus*	-	All remnant and regrowth woodland where the species forages in airspace above

MNES and MSES	Qualifying RE/BVG[1]	Broad habitat description
Glossy Ibis *Plegadis falcinellus*	11.2.4, 11.2.5, 11.3.2, 11.3.12, 11.3.15, 11.3.22, 11.3.23, 11.3.24, 11.3.27, 11.3.37, 11.3.40, 11.4.3, 11.4.8, 11.4.9, 11.5.16, 11.5.17 and 11.10.14	Remnant and regrowth REs providing palustrine or lacustrine wetland habitat in the brigalow belt bioregion
Short-beaked echidna *Tachyglossus aculeata*	-	All remnant and regrowth vegetation

[1] BVGs used as surrogate habitat values, when applicable

Based on the analysis of Project-related disturbance, approved disturbance from nearby major resource projects (Table 30) and the available habitat/area in the region, the Project is predicted to have minor increase on cumulative impacts on threatened matters.

Table 30: Proportion of regional habitat to be affected by cumulative impacts

Species	Estimate of remnant habitat available within 30km of the Project (ha)[1]	Total habitat impacted within EPBC Projects in Table 28 (ha)	Total habitat removed for the Project (ha)	Project percentage affected (%)	Cumulative impacts percentage affected (%)[2]
TECs					
Brigalow TEC	6,339	1,480.01	40.29	0.64	19.44
Conservation significant species					
Solanum elachophyllum	6,520	2,328.19	6.00 (known habitat)	0.06	26.38
Ornamental snake *Denisonia maculata*	4,550	1,580.61	0.0	0.0	25.78
Australian painted snipe *Rostratula australis*	6,969	267.9	20.86	0.28	3.99
Latham's snipe *Gallinago hardwickii*	6,969	0	20.86	0.30	0.3
Squatter pigeon (southern) *Geophaps scripta scripta*	69,942	7,584	32.46 (breeding and foraging)	0.05	9.82
White-throated needletail *Hirundapus caudacutus*	130,359	0	2,316.58	1.77	1.77
Koala *Phascolarctos cinereus*	81,344	13,333	2.72 (breeding and foraging)	0.003	14.09

Species	Estimate of remnant habitat available within 30km of the Project (ha)[1]	Total habitat impacted within EPBC Projects in Table 28 (ha)	Total habitat removed for the Project (ha)	Project percentage affected (%)	Cumulative impacts percentage affected (%)[2]
Fork-tailed swift *Apus pacificus*	130,359	0	2,316.58	1.77	1.77
Glossy Ibis *Plegadis falcinellus*	6,969	168	20.86	0.29	2.65
Short beaked echidna *Tachyglossus aculeatus*	125,589	0	122.11	0.1	0.1

[1] Habitat for threatened matters are an estimate only. On ground surveys would be required to verify the extent of available habitat.

[2] Cumulative impact percentages are calculated by adding the estimate of remnant habitat within 30 km, with total habitat impacted by EPBC projects, and dividing by the total of cumulative impacts and Project impacts.

8 Significant impact assessments

8.1 MNES significant impact assessment

The field surveys identified that the Study Area contains one TEC and affords habitat for six threatened fauna and two migratory species listed under the EPBC Act. The Australian Government has produced the EPBC Act *Matters of Environmental Significance: Significant Impact Guidelines 1.1* (DotE, 2013b) (MNES SIA Guidelines) to assist in determining if significant impacts associated with a Project require referral to the DCCEEW and associated offsetting. Self-assessments against the MNES SIA Guidelines are provided in Appendix D. An assessment against the MNES SIA Guidelines determined that the Project is likely to result in a significant impact on one MNES. A significant impact was considered likely to occur on Brigalow TEC.

The remaining eight MNES considered known or likely to occur within the Study Area were considered unlikely to be significantly impacted by the Project, as below:

- Australian painted snipe (*Rostratula australis*);
- Latham's snipe (*Gallinago hardwickii*);
- Koala (*Phascolarctos cinereus*);
- Ornamental snake (*Denisonia maculata*);
- Squatter Pigeon (southern) (*Geophaps scripta scripta*);
- White-throated needletail (*Hirundapus caudacutus*);
- Fork-tailed swift (*Apus pacificus*); and
- Glossy ibis (*Plegadis falcinellus*).

8.2 MSES significant residual impact assessment

Field surveys identified that the Study Area contains three MSES (i.e. Regulated vegetation, protected wildlife habitat and connectivity areas) identified under the Queensland *Environmental Offsets Act 2014* (EO Act). The Queensland Government has produced the *Queensland Environmental Offsets Policy - Significant Residual Impact Guideline* (DEHP, 2014) (MSES SRI Guideline) to assist in determining if significant residual impacts associated with a Project would require offsetting. Self-assessments against the MSES SRI Guideline are provided in Appendix E. An assessment against the MSES SRI Guideline determined that the Project is likely to result in a significant residual impact on:

- Regulated vegetation, comprising:
    - Endangered prescribed REs (RE 11.3.1)
- Protected wildlife habitat, comprising:
    - *Solanum elachophyllum*

The remaining MSES identified within the Study Area were considered unlikely to result a significant residual impact from the Project. It was determined that a significant residual impact was unlikely for:

- Regulated vegetation, comprising:
    - Of Concern prescribed RE 11.3.2

- Of Concern prescribed RE 11.3.3
- Prescribed REs within the defined distance of the defining banks of a relevant watercourse or drainage feature:
  - RE 11.3.1;
  - RE 11.3.2;
  - RE 11.3.3;
  - RE 11.3.6; and
  - RE 11.3.27.

- Protected wildlife habitat, comprising:
  - Australian painted snipe (*Rostratula australis*)
  - Koala *(Phascolarctos cinereus*)
  - Latham's snipe (*Gallinago hardwickii*)
  - Ornamental snake (*Denisonia maculata*)
  - Squatter pigeon (southern) (*Geophaps scripta scripta*)
  - White-throated needletail (*Hirundapus caudacutus*); and
  - Short-beaked echidna (*Tachyglossus aculeatus*).
- Connectivity areas

9 Biodiversity offsets

An environmental offset is required to address the significant residual impacts on MNES and MSES that are likely as a result of the Project. The offset requirements are considerate of the residual impact to each MNES and MSES, as well as their habitat quality.

The overall environmental offset requirements include the total disturbance area for each matter and the habitat quality scores for these matters in the impact area (Table 31).

A number of offsetable matters relevant to the Project are protected under both Commonwealth and State legislation. As per Section 15 of the EO Act, an administering agency may impose an offset condition on an authority only if:

- the same, or substantially the same, impact has not been assessed under a relevant Commonwealth Act; and
- the same, or substantially the same, prescribed environmental matters has not been assessed under a relevant Commonwealth Act.

As such, MSES that are also a MNES are unlikely to require any additional offsets under the EO Act for impacts on MSES, if the Commonwealth Government has assessed impacts for the same values under the EPBC Act. These matters have been included in the MNES offset requirements only, to avoid duplication of offsets at the State level.

Habitat quality scores derived for MNES and MSES likely to be significantly impacted by the Project (refer to Section 8) using the Commonwealth Government *Modified Habitat Quality Assessment* method, as detailed in Section 3.2.5.

Table 31: Summary of habitat quality for MNES and MSES likely to have a significant residual impact

Environmental matter	Assessment unit (AU)	AU description	Disturbance Footprint area (ha)	Weighted habitat quality score	Overall habitat quality score (/10)
Matters of National Environmental Significance					
Threatened Ecological Communities					
Brigalow TEC	1c	High value regrowth RE 11.3.1, 11.4.9 and 11.9.5	39.60	4.08	4.17
	1d	Remnant RE 11.3.1, 11.4.9 and 11.9.5	0.69	0.08	
Matters of State Environmental Significance					
Protected wildlife habitat					
Solanum elachophyllum	1b	Young regrowth RE 11.3.1, 11.4.9 and 11.9.5	0.88	0.52	3.18

Environmental matter	Assessment unit (AU)	AU description	Disturbance Footprint area (ha)	Weighted habitat quality score	Overall habitat quality score (/10)
	1c	High value regrowth RE 11.3.1, 11.4.9 and 11.9.5	0.98	0.71	
	7b	Non-remnant	4.14	1.95	
Regulated vegetation					
Endangered RE 11.3.1	1d	Remnant RE 11.3.1	1.21	4.40	4.40

10 Conclusion

Whitehaven Blackwater is proposing to expand the current BWM, to extent the current open cut mining development at the BWM to within SA 7 on ML 1762 and SA 10 on ML 1759. This report presents the terrestrial ecological assessment conducted to support a submission for a major EA amendment.

The Disturbance Footprint covers approximately 2,316.58 ha (rounded to 2,317 ha). The majority (97.65%, 2,262.07 ha) comprises non-remnant areas that have historically been cleared, primarily for agricultural use. This includes non-remnant areas with gilgai's. A further 39.78 ha (1.72%) comprises vegetation ground-truthed as high value regrowth. The remaining disturbance comprises 10.80 ha (0.47%) wetlands and dams and 3.93 ha (0.17%) remnant vegetation.

While the Project would avoid, mitigate, and manage environmental impacts associated with construction and operation, residual impacts on conservation significant matters will still occur. Assessment of residual impacts against relevant guidelines determine the Project is likely to result in a significant impact on:

- One MNES: Brigalow TEC
- Two MSES, including:
  - Regulated vegetation, comprising endangered RE 11.3.1; and
  - Protected wildlife habitat for *Solanum elachophyllum*.

Habitat quality scoring has been undertaken for those MNES and MSES matters that are likely to significantly impacted by the Project in line with the State and Commonwealth guidelines. Residual impacts on these matters would be offset in accordance the EPBC Act Environmental Offsets Policy and Queensland Environmental Offsets Policy.

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Appendix A Desktop search results

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 17-Feb-2025

Summary

Details

- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat

Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	41
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	3
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	24
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area	In feature area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area	In buffer area only
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area	In buffer area only
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
MAMMAL			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area	In buffer area only
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area	In feature area
Onychogalea fraenata Bridled Nail-tail Wallaby, Bridled Nailtail Wallaby [239]	Endangered	Species or species habitat may occur within area	In buffer area only
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
Aristida annua [17906]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Bertya opponens [13792]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Daviesia discolor [3567]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat may occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Homoranthus decumbens a shrub [55186]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Logania diffusa [24159]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Macrozamia platyrhachis cycad [3412]	Endangered	Species or species habitat known to occur within area	In buffer area only
Polianthion minutiflorum [82772]	Vulnerable	Species or species habitat known to occur within area	In feature area
Solanum dissectum [75720]	Endangered	Species or species habitat known to occur within area	In buffer area only
REPTILE			
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area	In feature area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat known to occur within area	In feature area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Endangered	Species or species habitat known to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Pandion haliaetus			
Osprey [952]		Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - BLACKWATER TRAINING DEPOT [30270]	QLD	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Anseranas semipalmata](#) Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
[Chalcites osculans as Chrysococcyx osculans](#) Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Blackdown Tableland	National Park	QLD	In buffer area only
Blackwater	Conservation Park	QLD	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Kenmare	Nature Refuge	QLD	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Blackwater Mine ? North Extension Project	2023/09723		Assessment	In feature area
Comet Ridge Coal Mine, Comet, QLD	2015/7507		Post-Approval	In buffer area only
Development and operation of the Star Coal Project Bulk Sample Project	2023/09502		Completed	In buffer area only
rail track to link the proposed MIM Rolleston coal mine to existing rail network	2002/637		Post-Approval	In buffer area only
Walton Coal Project, Bowen Basin, Qld	2017/8077		Post-Approval	In buffer area only
Controlled action				
Blackwater creek diversion and coal mine	2007/3925	Controlled Action	Post-Approval	In buffer area only
Blackwater to Gladstone Gas Pipeline Project	2011/6034	Controlled Action	Completed	In buffer area only
Bluff open cut coal mine project, central Queensland	2013/7064	Controlled Action	Post-Approval	In buffer area only
Bowen Gas Project	2012/6377	Controlled Action	Post-Approval	In feature area
Construct and operate a coal gasification plant and carbon dioxide capture and storage	2006/3040	Controlled Action	Completed	In feature area
Curragh Extension Project, Blackwater, QLD	2015/7508	Controlled Action	Post-Approval	In feature area
Curragh North Coal Mine	2003/1096	Controlled Action	Post-Approval	In buffer area only
Norwich Park & Blackwater CSG Fields & supporting infrastructure Bowen Basin	2011/6032	Controlled Action	Completed	In feature area
Norwich Park to Blackwater Gas Pipeline	2011/6031	Controlled Action	Completed	In buffer area only
Santos GLNG Gas Field Development Project, QLD	2012/6615	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Washpool Coal Mine Project	2009/5240	Controlled Action	Completed	In buffer area only
ZeroGen Integrated Gasification Combined Cycle Power Plant and CO2 Capture, Transport and Storage	2009/5195	Controlled Action	Completed	In feature area
Not controlled action				
Blackwater to Emerald Dual Circuit 132kV Powerline, QLD	2012/6480	Not Controlled Action	Completed	In feature area
Development and operation of a new multi-seam underground coal mine with associated on-site infrastr	2011/5811	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Springsure Creek 132kV powerline and switchyards	2012/6385	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Blackwater to Rolleston 132 kV transmission line	2002/880	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Curragh West Project	2011/6187	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Proposal for open cut coal mining operation, central QLD	2013/6946	Referral Decision	Completed	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Queensland status: All
Records: All
Date: Since 1980
Latitude: -23.6759
Longitude: 148.8496
Distance: 20
Email: kaylee.pitt@e2m.com.au
Date submitted: Tuesday 18 Feb 2025 09:52:01
Date extracted: Tuesday 18 Feb 2025 10:00:03

The number of records retrieved = 867

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Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			9
animals	amphibians	Hylidae	*Cyclorana alboguttata*	greenstripe frog		C		4
animals	amphibians	Hylidae	*Cyclorana cultripes*	grassland collared frog		C		3/3
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		2
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		4
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		1
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		2
animals	amphibians	Hylidae	*Litoria latopalmata*	broad palmed rocketfrog		C		7
animals	amphibians	Hylidae	*Litoria peronii*	emerald spotted treefrog		C		1
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		2
animals	amphibians	Hylidae	*Litoria wilcoxii*	eastern stony creek frog		C		1
animals	amphibians	Limnodynastidae	*Limnodynastes salmini*	salmon striped frog		C		3
animals	amphibians	Limnodynastidae	*Limnodynastes tasmaniensis*	spotted grassfrog		C		2
animals	amphibians	Limnodynastidae	*Limnodynastes terraereginae*	scarlet sided pobblebonk		C		1
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		1
animals	amphibians	Myobatrachidae	*Crinia signifera*	clicking froglet		C		1
animals	amphibians	Myobatrachidae	*Pseudophryne major*	great brown broodfrog		C		1
animals	amphibians	Myobatrachidae	*Uperoleia laevigata*	eastern gungan		C		1
animals	amphibians	Myobatrachidae	*Uperoleia rugosa*	chubby gungan		C		3
animals	birds	Acanthizidae	*Acanthiza apicalis*	inland thornbill		C		5
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		3
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		3
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		8
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		15
animals	birds	Acanthizidae	*Pyrrholaemus sagittatus*	speckled warbler		C		4
animals	birds	Acanthizidae	*Sericornis frontalis*	white-browed scrubwren		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		8
animals	birds	Accipitridae	*Accipiter cirrocephalus*	collared sparrowhawk		C		1
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		3
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		3
animals	birds	Accipitridae	*Aviceda subcristata*	Pacific baza		C		1
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		1
animals	birds	Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle		C		1
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		5
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		2
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		5
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		3
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		8
animals	birds	Alaudidae	*Mirafra javanica*	Horsfield's bushlark		C		4
animals	birds	Alcedinidae	*Dacelo leachii*	blue-winged kookaburra		C		10
animals	birds	Alcedinidae	*Dacelo novaeguineae*	laughing kookaburra		C		23
animals	birds	Alcedinidae	*Todiramphus macleayii*	forest kingfisher		C		6
animals	birds	Alcedinidae	*Todiramphus sanctus*	sacred kingfisher		C		3
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		4
animals	birds	Anatidae	*Aythya australis*	hardhead		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		1
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		1
animals	birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		1
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		2
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		2
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		3
animals	birds	Ardeidae	*Ixobrychus flavicollis*	black bittern		C		1
animals	birds	Artamidae	*Artamus cinereus inkermani*	black-faced woodswallow (east-central Queensland)		C		1
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		3
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		1
animals	birds	Artamidae	*Artamus superciliosus*	white-browed woodswallow		C		2
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		12
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		12
animals	birds	Artamidae	*Gymnorhina tibicen*	Australian magpie		C		17
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		19/3
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		2
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		24
animals	birds	Cacatuidae	*Cacatua sanguinea*	little corella		C		3
animals	birds	Cacatuidae	*Calyptorhynchus banksii banksii*	red-tailed black-cockatoo (Cape York & Eastern Aust)		C		1
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		6
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		2
animals	birds	Campephagidae	*Coracina maxima*	ground cuckoo-shrike		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		14
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		2
animals	birds	Campephagidae	*Edolisoma tenuirostre*	common cicadabird		C		6
animals	birds	Campephagidae	*Lalage tricolor*	white-winged triller		C		9
animals	birds	Casuariidae	*Dromaius novaehollandiae*	emu		C		3
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		1
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		3
animals	birds	Charadriidae	*Vanellus miles novaehollandiae*	masked lapwing (southern subspecies)		C		1
animals	birds	Cinclosomatidae	*Cinclosoma punctatum*	spotted quail-thrush		C		2
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		2
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		1
animals	birds	Climacteridae	*Cormobates leucophaea metastasis*	white-throated treecreeper (southern)		C		3
animals	birds	Columbidae	*Geopelia cuneata*	diamond dove		C		1
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		6
animals	birds	Columbidae	*Geopelia placida*	peaceful dove		C		10
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		6
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		1
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		17
animals	birds	Corcoracidae	*Corcorax melanorhamphos*	white-winged chough		C		8

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		13
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		8
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		30
animals	birds	Corvidae	*Corvus sp.*			C		2
animals	birds	Cuculidae	*Cacomantis flabelliformis*	fan-tailed cuckoo		C		1
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		7
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		4
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		5
animals	birds	Cuculidae	*Chalcites lucidus*	shining bronze-cuckoo		C		3
animals	birds	Cuculidae	*Chalcites minutillus barnardi*	Eastern little bronze-cuckoo		C		4
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		1
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		7
animals	birds	Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird		C		13
animals	birds	Dicruridae	*Dicrurus bracteatus*	spangled drongo		C		1
animals	birds	Dicruridae	*Dicrurus bracteatus bracteatus*	spangled drongo (eastern Australia)		C		2
animals	birds	Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin		C		2
animals	birds	Estrildidae	*Neochmia modesta*	plum-headed finch		C		1
animals	birds	Estrildidae	*Neochmia temporalis*	red-browed finch		C		1
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		12
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		2
animals	birds	Eurostopodidae	*Eurostopodus argus*	spotted nightjar		C		1
animals	birds	Eurostopodidae	*Eurostopodus mystacalis*	white-throated nightjar		C		2
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		4
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		5
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		4
animals	birds	Falconidae	*Falco peregrinus macropus*	Australian peregrine falcon		C		3
animals	birds	Falconidae	*Falco subniger*	black falcon		C		1
animals	birds	Gruidae	*Antigone rubicunda*	brolga		C		1
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		7
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		4
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		1
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		1
animals	birds	Laridae	*Hydroprogne caspia*	Caspian tern		SL		1
animals	birds	Locustellidae	*Cincloramphus cruralis*	brown songlark		C		2
animals	birds	Locustellidae	*Cincloramphus mathewsi*	rufous songlark		C		3
animals	birds	Locustellidae	*Cincloramphus timoriensis*	tawny grassbird		C		1
animals	birds	Maluridae	*Malurus assimilis*	purple-backed fairy-wren		C		4
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		1
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		11
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		2
animals	birds	Meliphagidae	*Caligavis chrysops*	yellow-faced honeyeater		C		2
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		17
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		10
animals	birds	Meliphagidae	*Grantiella picta*	painted honeyeater		V	V	2
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		11
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		19
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		4
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		9
animals	birds	Meliphagidae	*Melithreptus brevirostris*	brown-headed honeyeater		C		4
animals	birds	Meliphagidae	*Melithreptus gularis gularis*	black-chinned honeyeater (eastern)		C		1
animals	birds	Meliphagidae	*Melithreptus lunatus*	white-naped honeyeater		C		1
animals	birds	Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater		C		1
animals	birds	Meliphagidae	*Nesoptilotis leucotis*	white-eared honeyeater		C		2
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		8
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		21
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		9
animals	birds	Meliphagidae	*Ptilotula fusca*	fuscous honeyeater		C		1
animals	birds	Meliphagidae	*Ptilotula penicillata*	white-plumed honeyeater		C		1
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		6
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		11
animals	birds	Monarchidae	*Monarcha melanopsis*	black-faced monarch		C		2
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		1
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		17
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		3
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		1
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		6
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		2
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		3
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		12
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		9
animals	birds	Pandionidae	*Pandion haliaetus cristatus*	eastern osprey		SL		1
animals	birds	Pardalotidae	*Pardalotus punctatus*	spotted pardalote		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		18
animals	birds	Passeridae	*Passer domesticus*	house sparrow	Y			3
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		1
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		3
animals	birds	Petroicidae	*Petroica goodenovii*	red-capped robin		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant		C		1
animals	birds	Phasianidae	*Synoicus ypsilophorus*	brown quail		C		5
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		7
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		8
animals	birds	Pomatostomidae	*Pomatostomus temporalis temporalis*	grey-crowned babbler (eastern)		C		4
animals	birds	Psittaculidae	*Alisterus scapularis*	Australian king-parrot		C		1
animals	birds	Psittaculidae	*Aprosmictus erythropterus*	red-winged parrot		C		14
animals	birds	Psittaculidae	*Melopsittacus undulatus*	budgerigar		C		2
animals	birds	Psittaculidae	*Parvipsitta pusilla*	little lorikeet		C		2
animals	birds	Psittaculidae	*Platycercus adscitus*	pale-headed rosella		C		16

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Psittaculidae	*Platycercus adscitus palliceps*	pale-headed rosella (southern form)		C		4
animals	birds	Psittaculidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		7
animals	birds	Psittaculidae	*Trichoglossus moluccanus*	rainbow lorikeet		C		19
animals	birds	Ptilonorhynchidae	*Chlamydera maculata*	spotted bowerbird		C		1
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		1
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		2
animals	birds	Rallidae	*Porphyrio melanotus*	purple swamphen		C		1
animals	birds	Rallidae	*Tribonyx ventralis*	black-tailed native-hen		C		1
animals	birds	Recurvirostridae	*Himantopus leucocephalus*	pied stilt		C		1
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		4
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		7
animals	birds	Rhipiduridae	*Rhipidura leucophrys leucophrys*	willie wagtail (southern)		C		4
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		5
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		1
animals	birds	Threskiornithidae	*Plegadis falcinellus*	glossy ibis		SL		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		1
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Turnicidae	*Turnix varius*	painted button-quail		C		1
animals	birds	Tytonidae	*Tyto javanica*	eastern barn owl		C		2
animals	birds	Zosteropidae	*Zosterops lateralis*	silvereye		C		4
animals	birds	Zosteropidae	*Zosterops lateralis cornwalli*	silvereye (eastern)		C		1
animals	mammals	Bovidae	*Bos taurus*	European cattle	Y			3
animals	mammals	Canidae	*Canis familiaris*	dog	Y			6
animals	mammals	Canidae	*Canis familiaris (dingo)*	dingo				1
animals	mammals	Dasyuridae	*Antechinus flavipes flavipes*	yellow-footed antechinus (south-east Queensland)		C		2
animals	mammals	Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		C		3
animals	mammals	Equidae	*Equus caballus*	horse	Y			1
animals	mammals	Felidae	*Felis catus*	cat	Y			4
animals	mammals	Leporidae	*Lepus europaeus*	European brown hare	Y			4
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			5
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		9
animals	mammals	Macropodidae	*Notamacropus parryi*	whiptail wallaby		C		2
animals	mammals	Macropodidae	*Osphranter robustus*	common wallaroo		C		4
animals	mammals	Macropodidae	*Petrogale herberti*	Herbert's rock-wallaby		C		3/3
animals	mammals	Macropodidae	*Petrogale inornata*	unadorned rock-wallaby		C		4
animals	mammals	Macropodidae	*Wallabia bicolor*	swamp wallaby		C		2
animals	mammals	Miniopteridae	*Miniopterus orianae oceanensis*	eastern bent-wing bat		C		2
animals	mammals	Molossidae	*Mormopterus petersi*	inland free-tailed bat		C		1
animals	mammals	Muridae	*Hydromys chrysogaster*	water rat		C		1
animals	mammals	Muridae	*Melomys cervinipes*	fawn-footed melomys		C		3
animals	mammals	Muridae	*Mus musculus*	house mouse	Y			2
animals	mammals	Muridae	*Pseudomys patrius*	eastern pebble-mound mouse		C		2
animals	mammals	Muridae	*Pseudomys sp.*			C		1/1
animals	mammals	Petauridae	*Petaurus australis australis*	yellow-bellied glider (southern subspecies)		V	V	1

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animals	mammals	Petauridae	*Petaurus norfolcensis*	squirrel glider		C		1
animals	mammals	Petauridae	*Petaurus notatus*	Krefft's glider		C		2
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		1
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		4
animals	mammals	Pseudocheiridae	*Petauroides volans volans*	southern greater glider		E	E	2
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		1
animals	mammals	Suidae	*Sus scrofa*	pig	Y			1
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		SL		9
animals	mammals	Vespertilionidae	*Chalinolobus dwyeri*	large-eared pied bat		E	E	1
animals	mammals	Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		C		3
animals	mammals	Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat		C		4
animals	mammals	Vespertilionidae	*Chalinolobus picatus*	little pied bat		C		3
animals	mammals	Vespertilionidae	*Nyctophilus geoffroyi*	lesser long-eared bat		C		1
animals	mammals	Vespertilionidae	*Nyctophilus gouldi*	Gould's long-eared bat		C		4
animals	mammals	Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat		C		1
animals	mammals	Vespertilionidae	*Scotorepens greyii*	little broad-nosed bat		C		5
animals	mammals	Vespertilionidae	*Vespadelus pumilus*	eastern forest bat		C		1
animals	mammals	Vespertilionidae	*Vespadelus sp.*			C		1
animals	ray-finned fishes	Ambassidae	*Ambassis agassizii*	Agassiz's glassfish				5
animals	ray-finned fishes	Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead				1
animals	ray-finned fishes	Clupeidae	*Nematalosa erebi*	bony bream				2
animals	ray-finned fishes	Eleotridae	*Hypseleotris klunzingeri*	western carp gudgeon				2
animals	ray-finned fishes	Eleotridae	*Hypseleotris sp.*					4
animals	ray-finned fishes	Eleotridae	*Mogurnda adspersa*	southern purplespotted gudgeon				5
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida splendida*	eastern rainbowfish				5
animals	ray-finned fishes	Plotosidae	*Neosilurus hyrtlii*	Hyrtl's catfish				4
animals	ray-finned fishes	Poeciliidae	*Gambusia holbrooki*	mosquitofish	Y			2
animals	ray-finned fishes	Terapontidae	*Leiopotherapon unicolor*	spangled perch				5
animals	reptiles	Agamidae	*Diporiphora nobbi*	nobbi		C		5
animals	reptiles	Agamidae	*Pogona barbata*	bearded dragon		C		1
animals	reptiles	Boidae	*Antaresia maculosa*	spotted python		C		1
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		1
animals	reptiles	Boidae	*Morelia spilota*	carpet python		C		1
animals	reptiles	Carphodactylidae	*Nephrurus asper*	spiny knob-tailed gecko		C		3
animals	reptiles	Carphodactylidae	*Saltuarius salebrosus*	rough-throated leaf-tailed gecko		C		1
animals	reptiles	Carphodactylidae	*Underwoodisaurus milii*	thick-tailed gecko		C		1
animals	reptiles	Chelidae	*Emydura macquarii krefftii*	Krefft's river turtle		C		2
animals	reptiles	Chelidae	*Wollumbinia latisternum*	saw-shelled turtle		C		1
animals	reptiles	Colubridae	*Boiga irregularis*	brown tree snake		C		1
animals	reptiles	Colubridae	*Dendrelaphis punctulatus*	green tree snake		C		1
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		2
animals	reptiles	Diplodactylidae	*Diplodactylus platyurus*	eastern fat-tailed gecko		C		4/1
animals	reptiles	Diplodactylidae	*Diplodactylus vittatus*	wood gecko		C		2
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		2/1
animals	reptiles	Diplodactylidae	*Oedura monilis sensu lato*	ocellated velvet gecko		C		6/1
animals	reptiles	Elapidae	*Furina diadema*	red-naped snake		C		1

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animals	reptiles	Elapidae	*Furina ornata*	orange-naped snake		C		1
animals	reptiles	Elapidae	*Suta suta*	myall snake		C		1
animals	reptiles	Elapidae	*Vermicella annulata*	bandy-bandy		C		1
animals	reptiles	Gekkonidae	*Gehyra catenata*	chain-backed dtella		C		5
animals	reptiles	Gekkonidae	*Gehyra dubia*	dubious dtella		C		11/1
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		21/1
animals	reptiles	Pygopodidae	*Lialis burtonis*	Burton's legless lizard		C		1
animals	reptiles	Pygopodidae	*Paradelma orientalis*	brigalow scaly-foot		C		1
animals	reptiles	Scincidae	*Carlia pectoralis*	open-litter rainbow skink		C		6
animals	reptiles	Scincidae	*Carlia pectoralis sensu lato*			C		15
animals	reptiles	Scincidae	*Carlia schmeltzii*	robust rainbow-skink		C		7/2
animals	reptiles	Scincidae	*Concinnia sokosoma*	stout bar-sided skink		C		1
animals	reptiles	Scincidae	*Concinnia tenuis*	bar-sided skink		C		3/1
animals	reptiles	Scincidae	*Cryptoblepharus pulcher pulcher*	elegant snake-eyed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus sp.*			C		1
animals	reptiles	Scincidae	*Cryptoblepharus virgatus sensu lato*			C		8
animals	reptiles	Scincidae	*Ctenotus ingrami*	unspotted yellow-sided ctenotus		C		1
animals	reptiles	Scincidae	*Ctenotus taeniolatus*	copper-tailed skink		C		18/1
animals	reptiles	Scincidae	*Eulamprus sp.*			C		2/1
animals	reptiles	Scincidae	*Lampropholis delicata*	dark-flecked garden sunskink		C		1/1
animals	reptiles	Scincidae	*Lerista fragilis*	eastern mulch slider		C		3
animals	reptiles	Scincidae	*Lygisaurus foliorum*	tree-base litter-skink		C		3
animals	reptiles	Scincidae	*Menetia greyii*	common dwarf skink		C		1
animals	reptiles	Scincidae	*Morethia boulengeri*	south-eastern morethia skink		C		1
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		8/2
animals	reptiles	Typhlopidae	*Anilios nigrescens*	blackish blind snake		C		1/1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		1
plants	land plants	Acanthaceae	*Brunoniella australis*	blue trumpet		C		3
plants	land plants	Acanthaceae	*Dipteracanthus australasicus*			C		1
plants	land plants	Acanthaceae	*Dipteracanthus australasicus subsp. corynothecus*			C		3/1
plants	land plants	Acanthaceae	*Pseuderanthemum variabile*	pastel flower		C		3/1
plants	land plants	Acanthaceae	*Rostellularia adscendens*			C		6/1
plants	land plants	Acanthaceae	*Rostellularia adscendens var. adscendens*			C		1
plants	land plants	Acanthaceae	*Ruellia simplex*		Y			1/1
plants	land plants	Agavaceae	*Agave americana var. americana*		Y			1
plants	land plants	Aizoaceae	*Trianthema portulacastrum*	black pigweed	Y			6
plants	land plants	Aizoaceae	*Trianthema triquetrum*	red spinach		C		3
plants	land plants	Aizoaceae	*Zaleya galericulata subsp. galericulata*			C		1
plants	land plants	Alismataceae	*Caldesia oligococca*			SL		1
plants	land plants	Amaranthaceae	*Achyranthes aspera*			C		4/1
plants	land plants	Amaranthaceae	*Alternanthera denticulata*	lesser joyweed		C		6
plants	land plants	Amaranthaceae	*Alternanthera nana*	hairy joyweed		C		4
plants	land plants	Amaranthaceae	*Alternanthera nodiflora*	joyweed		C		1
plants	land plants	Amaranthaceae	*Amaranthus viridis*	green amaranth	Y			1
plants	land plants	Amaranthaceae	*Gomphrena celosioides*	gomphrena weed	Y			3
plants	land plants	Amaranthaceae	*Nyssanthes erecta*			C		2/2

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plants	land plants	Amaranthaceae	*Ptilotus*					1
plants	land plants	Amaranthaceae	*Ptilotus semilanatus*			C		1/1
plants	land plants	Amaryllidaceae	*Crinum*					1
plants	land plants	Amaryllidaceae	*Crinum flaccidum*	Murray lily		SL		3
plants	land plants	Anacardiaceae	*Schinus terebinthifolius*		Y			1/1
plants	land plants	Annonaceae	*Melodorum leichhardtii*			C		1/1
plants	land plants	Apiaceae	*Centella asiatica*			C		1/1
plants	land plants	Apiaceae	*Platysace ericoides*	heath platysace		C		1/1
plants	land plants	Apocynaceae	*Alstonia constricta*	bitterbark		C		7
plants	land plants	Apocynaceae	*Asclepias curassavica*	red-head cottonbush	Y			2/1
plants	land plants	Apocynaceae	*Carissa ovata*	currantbush		C		21/1
plants	land plants	Apocynaceae	*Cerbera dumicola*			NT		2/2
plants	land plants	Apocynaceae	*Cryptostegia grandiflora*	rubber vine	Y			1
plants	land plants	Apocynaceae	*Cynanchum viminale*			C		1
plants	land plants	Apocynaceae	*Cynanchum viminale subsp. brunonianum*			C		1/1
plants	land plants	Apocynaceae	*Hoya australis subsp. australis*			C		3/3
plants	land plants	Apocynaceae	*Leichhardtia microlepis*			C		1/1
plants	land plants	Apocynaceae	*Leichhardtia viridiflora subsp. viridiflora*			C		3/1
plants	land plants	Apocynaceae	*Parsonsia eucalyptophylla*	gargaloo		C		1
plants	land plants	Apocynaceae	*Parsonsia lanceolata*	northern silkpod		C		1
plants	land plants	Aristolochiaceae	*Aristolochia meridionalis subsp. centralis*			C		2/2
plants	land plants	Asteraceae	*Acmella grandiflora var. brachyglossa*			C		1
plants	land plants	Asteraceae	*Bidens bipinnata*	bipinnate beggar's ticks	Y			2
plants	land plants	Asteraceae	*Bidens pilosa*		Y			1
plants	land plants	Asteraceae	*Brachyscome*					1
plants	land plants	Asteraceae	*Brachyscome dalbyensis*			C		1
plants	land plants	Asteraceae	*Calotis cuneata*			C		1
plants	land plants	Asteraceae	*Calotis dentex*	white burr daisy		C		3/3
plants	land plants	Asteraceae	*Calyptocarpus vialis*	creeping cinderella weed	Y			1
plants	land plants	Asteraceae	*Centipeda minima*			C		1
plants	land plants	Asteraceae	*Centipeda minima subsp. minima*			C		3/2
plants	land plants	Asteraceae	*Cyanthillium cinereum*			C		3/3
plants	land plants	Asteraceae	*Euchiton sphaericus*			C		1
plants	land plants	Asteraceae	*Flaveria trinervia*		Y			1
plants	land plants	Asteraceae	*Gynura drymophila var. drymophila*			C		1/1
plants	land plants	Asteraceae	*Lactuca serriola forma serriola*		Y			1/1
plants	land plants	Asteraceae	*Minuria integerrima*	smooth minuria		C		2/1
plants	land plants	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			9
plants	land plants	Asteraceae	*Pluchea xanthina*			C		1/1
plants	land plants	Asteraceae	*Pterocaulon serrulatum var. serrulatum*			C		1/1
plants	land plants	Asteraceae	*Senecio*					1
plants	land plants	Asteraceae	*Sonchus asper*	rough sowthistle	Y			1
plants	land plants	Asteraceae	*Sphaeromorphaea australis*			C		1/1
plants	land plants	Asteraceae	*Sphaeromorphaea subintegra*			C		1
plants	land plants	Asteraceae	*Tagetes minuta*	stinking roger	Y			1/1
plants	land plants	Asteraceae	*Verbesina encelioides var. encelioides*		Y			1/1

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plants	land plants	Asteraceae	*Vittadinia pustulata*			C		1
plants	land plants	Asteraceae	*Vittadinia sulcata*	native daisy		C		1
plants	land plants	Asteraceae	*Xanthium occidentale*		Y			5/2
plants	land plants	Bignoniaceae	*Pandorea pandorana*	wonga vine		C		1/1
plants	land plants	Boraginaceae	*Ehretia membranifolia*	weeping koda		C		5
plants	land plants	Boraginaceae	*Heliotropium indicum*		Y			1
plants	land plants	Byttneriaceae	*Hannafordia shanesii*			C		1/1
plants	land plants	Byttneriaceae	*Melochia pyramidata*		Y			1
plants	land plants	Byttneriaceae	*Seringia collina*			C		1/1
plants	land plants	Byttneriaceae	*Seringia corollata*			C		1/1
plants	land plants	Byttneriaceae	*Seringia hookeriana*			C		1/1
plants	land plants	Byttneriaceae	*Waltheria indica*			C		2
plants	land plants	Cactaceae	*Harrisia*					1
plants	land plants	Cactaceae	*Harrisia martinii*		Y			10
plants	land plants	Cactaceae	*Opuntia*					1
plants	land plants	Cactaceae	*Opuntia stricta*		Y			2
plants	land plants	Cactaceae	*Opuntia tomentosa*	velvety tree pear	Y			9
plants	land plants	Campanulaceae	*Lobelia concolor*			SL		1
plants	land plants	Campanulaceae	*Wahlenbergia gracilis*	sprawling bluebell		SL		2
plants	land plants	Capparaceae	*Capparis anomala*			C		5
plants	land plants	Capparaceae	*Capparis canescens*			C		1/1
plants	land plants	Capparaceae	*Capparis lasiantha*	nipan		C		7/1
plants	land plants	Capparaceae	*Capparis loranthifolia*			C		7
plants	land plants	Capparaceae	*Capparis loranthifolia var. bancroftii*			C		1/1
plants	land plants	Capparaceae	*Capparis loranthifolia var. loranthifolia*			C		2/2
plants	land plants	Capparaceae	*Capparis mitchellii*			C		4
plants	land plants	Caryophyllaceae	*Cerastium glomeratum*	mouse ear chickweed	Y			1
plants	land plants	Casuarinaceae	*Allocasuarina torulosa*			C		1/1
plants	land plants	Casuarinaceae	*Casuarina cristata*	belah		C		2/1
plants	land plants	Celastraceae	*Denhamia cunninghamii*			C		2/1
plants	land plants	Celastraceae	*Denhamia disperma*			C		2
plants	land plants	Celastraceae	*Denhamia oleaster*			C		4
plants	land plants	Celastraceae	*Elaeodendron australe*			C		4
plants	land plants	Celastraceae	*Elaeodendron australe var. integrifolium*			C		1/1
plants	land plants	Chenopodiaceae	*Atriplex elachophylla*			C		1
plants	land plants	Chenopodiaceae	*Atriplex muelleri*	lagoon saltbush		C		4
plants	land plants	Chenopodiaceae	*Atriplex semibaccata*	creeping saltbush		C		3
plants	land plants	Chenopodiaceae	*Chenopodium desertorum subsp. anidiophyllum*			C		1
plants	land plants	Chenopodiaceae	*Dysphania carinata*			C		2/1
plants	land plants	Chenopodiaceae	*Dysphania glomulifera subsp. glomulifera*			C		2/2
plants	land plants	Chenopodiaceae	*Einadia nutans*			C		4
plants	land plants	Chenopodiaceae	*Einadia nutans subsp. linifolia*			C		1/1
plants	land plants	Chenopodiaceae	*Einadia polygonoides*	knotweed goosefoot		C		4
plants	land plants	Chenopodiaceae	*Enchylaena tomentosa*			C		9
plants	land plants	Chenopodiaceae	*Maireana microphylla*			C		1
plants	land plants	Chenopodiaceae	*Rhagodia spinescens*	thorny saltbush		C		1

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plants	land plants	Chenopodiaceae	*Salsola australis*			C		11
plants	land plants	Chenopodiaceae	*Sclerolaena anisacanthoides*	yellow burr		C		1
plants	land plants	Chenopodiaceae	*Sclerolaena bicornis var. horrida*			C		3
plants	land plants	Chenopodiaceae	*Sclerolaena muricata*			C		1
plants	land plants	Cleomaceae	*Arivela viscosa*			C		1
plants	land plants	Combretaceae	*Terminalia oblongata*			C		11
plants	land plants	Combretaceae	*Terminalia oblongata subsp. oblongata*			C		11
plants	land plants	Commelinaceae	*Commelina ensifolia*	scurvy grass		C		1
plants	land plants	Convolvulaceae	*Convolvulus arvensis*		Y			1
plants	land plants	Convolvulaceae	*Evolvulus alsinoides*			C		5
plants	land plants	Convolvulaceae	*Ipomoea calobra*			C		1/1
plants	land plants	Convolvulaceae	*Ipomoea plebeia*	bellvine		C		5
plants	land plants	Convolvulaceae	*Polymeria pusilla*			C		3
plants	land plants	Crassulaceae	*Bryophyllum delagoense*		Y			8/1
plants	land plants	Crassulaceae	*Bryophyllum x houghtonii*		Y			1/1
plants	land plants	Crassulaceae	*Crassula tetramera*			C		1/1
plants	land plants	Cyperaceae	*Caustis sp. (Robinson Gorge P.I.Forster+ PIF11256)*			C		1/1
plants	land plants	Cyperaceae	*Cyperus betchei*			C		6
plants	land plants	Cyperaceae	*Cyperus concinnus*			C		2
plants	land plants	Cyperaceae	*Cyperus difformis*	rice sedge		C		1
plants	land plants	Cyperaceae	*Cyperus exaltatus*	tall flatsedge		C		1
plants	land plants	Cyperaceae	*Cyperus fulvus*			C		2/1
plants	land plants	Cyperaceae	*Cyperus gracilis*			C		3
plants	land plants	Cyperaceae	*Cyperus gymnocaulos*	spiny flatsedge		C		1
plants	land plants	Cyperaceae	*Cyperus haspan*			C		1
plants	land plants	Cyperaceae	*Cyperus involucratus*		Y			1/1
plants	land plants	Cyperaceae	*Cyperus iria*			C		4
plants	land plants	Cyperaceae	*Cyperus isabellinus*			C		1/1
plants	land plants	Cyperaceae	*Cyperus rigidellus*			C		1
plants	land plants	Cyperaceae	*Eleocharis plana*	ribbed spikerush		C		1
plants	land plants	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		2/2
plants	land plants	Cyperaceae	*Schoenus kennyi*			C		4/4
plants	land plants	Cyperaceae	*Scleria sphacelata*			C		1/1
plants	land plants	Dilleniaceae	*Hibbertia ferox*			C		2/2
plants	land plants	Ebenaceae	*Diospyros humilis*	small-leaved ebony		C		9/1
plants	land plants	Elatinaceae	*Elatine gratioloides*	waterwort		C		1
plants	land plants	Ericaceae	*Melichrus sp. (Isla Gorge P.Sharpe+ 601)*			C		1/1
plants	land plants	Ericaceae	*Styphelia mitchellii*			C		1/1
plants	land plants	Erythroxylaceae	*Erythroxylum australe*	cocaine tree		C		7/2
plants	land plants	Euphorbiaceae	*Acalypha capillipes*	small-leaved acalypha		C		6
plants	land plants	Euphorbiaceae	*Acalypha eremorum*	soft acalypha		C		5/2
plants	land plants	Euphorbiaceae	*Bertya opponens*			C	V	1/1
plants	land plants	Euphorbiaceae	*Croton insularis*	Queensland cascarilla		C		3/2
plants	land plants	Euphorbiaceae	*Croton phebalioides*	narrow-leaved croton		C		6/2
plants	land plants	Euphorbiaceae	*Euphorbia*					3
plants	land plants	Euphorbiaceae	*Euphorbia drummondii*			C		1

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plants	land plants	Euphorbiaceae	*Euphorbia hyssopifolia*		Y			1/1
plants	land plants	Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*			C		2/1
plants	land plants	Euphorbiaceae	*Euphorbia tannensis subsp. tannensis*			C		1
plants	land plants	Euphorbiaceae	*Ricinocarpos linearifolius*			C		2/2
plants	land plants	Goodeniaceae	*Brunonia australis*	blue pincushion		SL		1
plants	land plants	Goodeniaceae	*Dampiera adpressa*			C		2/2
plants	land plants	Goodeniaceae	*Goodenia glabra*			C		1/1
plants	land plants	Goodeniaceae	*Goodenia grandiflora*			C		3/3
plants	land plants	Goodeniaceae	*Goodenia rotundifolia*			C		1/1
plants	land plants	Gyrostemonaceae	*Codonocarpus attenuatus*			C		1
plants	land plants	Gyrostemonaceae	*Codonocarpus cotinifolius*			C		1
plants	land plants	Haloragaceae	*Gonocarpus elatus*			C		1/1
plants	land plants	Haloragaceae	*Haloragis stricta*			C		1
plants	land plants	Hemerocallidaceae	*Dianella longifolia*			C		1
plants	land plants	Hemerocallidaceae	*Geitonoplesium cymosum*	scrambling lily		C		1
plants	land plants	Hemerocallidaceae	*Tricoryne muricata*			C		1/1
plants	land plants	Hydrocharitaceae	*Ottelia ovalifolia*	swamp lily		SL		1
plants	land plants	Juncaceae	*Juncus*					1
plants	land plants	Juncaceae	*Juncus aridicola*	tussock rush		C		2
plants	land plants	Lamiaceae	*Basilicum polystachyon*			C		1
plants	land plants	Lamiaceae	*Chloanthes parviflora*			C		1/1
plants	land plants	Lamiaceae	*Clerodendrum floribundum*			C		2
plants	land plants	Lamiaceae	*Coleus australis*			C		1
plants	land plants	Lamiaceae	*Coleus blakei*			NT		3/3
plants	land plants	Lamiaceae	*Ocimum*					1
plants	land plants	Lamiaceae	*Ocimum tenuiflorum*			C		4
plants	land plants	Lamiaceae	*Prostanthera collina*			C		2/2
plants	land plants	Lamiaceae	*Prostanthera cryptandroides subsp. euphrasioides*			C		2/2
plants	land plants	Lamiaceae	*Prostanthera parvifolia*			C		2/2
plants	land plants	Lamiaceae	*Prostanthera suborbicularis*			C		1/1
plants	land plants	Lamiaceae	*Teucrium puberulum*			C		1/1
plants	land plants	Lauraceae	*Cassytha pubescens*	downy devil's twine		C		1
plants	land plants	Laxmanniaceae	*Eustrephus latifolius*	wombat berry		C		3
plants	land plants	Laxmanniaceae	*Lomandra confertifolia subsp. pallida*			C		1/1
plants	land plants	Laxmanniaceae	*Lomandra longifolia*			C		5
plants	land plants	Laxmanniaceae	*Lomandra multiflora subsp. multiflora*			C		1/1
plants	land plants	Leguminosae	*Acacia burrowii*			C		1/1
plants	land plants	Leguminosae	*Acacia caroleae*			C		1
plants	land plants	Leguminosae	*Acacia catenulata*	bendee		C		7
plants	land plants	Leguminosae	*Acacia cretata*			C		5/3
plants	land plants	Leguminosae	*Acacia cretata x Acacia fodinalis*			C		2/2
plants	land plants	Leguminosae	*Acacia everistii*			C		1/1
plants	land plants	Leguminosae	*Acacia excelsa*			C		6
plants	land plants	Leguminosae	*Acacia gittinsii*			C		1/1
plants	land plants	Leguminosae	*Acacia harpophylla*	brigalow		C		21
plants	land plants	Leguminosae	*Acacia juncifolia*			C		1/1

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plants	land plants	Leguminosae	*Acacia leichhardtii*			C		1/1
plants	land plants	Leguminosae	*Acacia leptostachya*	Townsville wattle		C		1/1
plants	land plants	Leguminosae	*Acacia macradenia*	zig-zag wattle		C		1/1
plants	land plants	Leguminosae	*Acacia melanoxylon*	blackwood		C		1
plants	land plants	Leguminosae	*Acacia neriifolia*	pechey wattle		C		1/1
plants	land plants	Leguminosae	*Acacia oswaldii*	miljee		C		3
plants	land plants	Leguminosae	*Acacia pendula*	myall		C		1
plants	land plants	Leguminosae	*Acacia rhodoxylon*	ringy rosewood		C		1
plants	land plants	Leguminosae	*Acacia salicina*	doolan		C		11
plants	land plants	Leguminosae	*Acacia shirleyi*	lancewood		C		3
plants	land plants	Leguminosae	*Acacia sp. (Comet L.Pedley 4091)*			C		1/1
plants	land plants	Leguminosae	*Acacia storyi*			NT		1/1
plants	land plants	Leguminosae	*Acacia triptera*			C		1/1
plants	land plants	Leguminosae	*Acacia venulosa*	veined wattle		C		1/1
plants	land plants	Leguminosae	*Aeschynomene indica*	budda pea		C		2
plants	land plants	Leguminosae	*Albizia lebbeck*	Indian siris		C		1
plants	land plants	Leguminosae	*Bossiaea carinalis*			C		1/1
plants	land plants	Leguminosae	*Canavalia papuana*	wild jack bean		C		2/1
plants	land plants	Leguminosae	*Cassia brewsteri*			C		11/3
plants	land plants	Leguminosae	*Cassia queenslandica*			C		2
plants	land plants	Leguminosae	*Clitoria ternatea*	butterfly pea	Y			1
plants	land plants	Leguminosae	*Crotalaria dissitiflora subsp. dissitiflora*			C		1
plants	land plants	Leguminosae	*Crotalaria incana subsp. incana*		Y			2/1
plants	land plants	Leguminosae	*Cullen tenax*	emu-foot		C		1
plants	land plants	Leguminosae	*Delonix regia*	poinciana	Y			1/1
plants	land plants	Leguminosae	*Desmodium campylocaulon*			C		1
plants	land plants	Leguminosae	*Dillwynia phylicoides*			C		1/1
plants	land plants	Leguminosae	*Glycine clandestina var. clandestina*			C		1
plants	land plants	Leguminosae	*Glycine clandestina var. sericea*			C		1/1
plants	land plants	Leguminosae	*Glycine falcata*			C		1
plants	land plants	Leguminosae	*Glycine tabacina*	glycine pea		C		1
plants	land plants	Leguminosae	*Glycine tomentella*	woolly glycine		C		5/2
plants	land plants	Leguminosae	*Hardenbergia perbrevidens*			C		1/1
plants	land plants	Leguminosae	*Heliodendron basalticum*			C		4
plants	land plants	Leguminosae	*Hovea linearis x Hovea planifolia*			C		1/1
plants	land plants	Leguminosae	*Hovea longipes*	brush hovea		C		2/1
plants	land plants	Leguminosae	*Hovea tholiformis*			C		1/1
plants	land plants	Leguminosae	*Indigofera australis*			C		2
plants	land plants	Leguminosae	*Indigofera brevidens*			C		3/2
plants	land plants	Leguminosae	*Indigofera colutea*	sticky indigo		C		1/1
plants	land plants	Leguminosae	*Indigofera linifolia*			C		2
plants	land plants	Leguminosae	*Indigofera pratensis*			C		1
plants	land plants	Leguminosae	*Kennedia sp. (Blackdown Tableland R.J.Henderson+ H747)*			C		1/1
plants	land plants	Leguminosae	*Leucaena leucocephala*		Y			1
plants	land plants	Leguminosae	*Leucaena leucocephala subsp. glabrata*		Y			1/1

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plants	land plants	Leguminosae	*Leucaena leucocephala subsp. leucocephala*		Y			1/1
plants	land plants	Leguminosae	*Lotus australis*	Australian trefoil		C		1
plants	land plants	Leguminosae	*Lysiphyllum*					1
plants	land plants	Leguminosae	*Lysiphyllum carronii*	ebony tree		C		12/1
plants	land plants	Leguminosae	*Lysiphyllum hookeri*	Queensland ebony		C		14/3
plants	land plants	Leguminosae	*Macroptilium atropurpureum*	siratro	Y			1
plants	land plants	Leguminosae	*Mirbelia pungens*			C		1/1
plants	land plants	Leguminosae	*Mirbelia speciosa subsp. ringrosei*			C		1/1
plants	land plants	Leguminosae	*Neptunia gracilis*			C		1
plants	land plants	Leguminosae	*Neptunia gracilis forma gracilis*			C		2
plants	land plants	Leguminosae	*Parkinsonia aculeata*	parkinsonia	Y			9/5
plants	land plants	Leguminosae	*Petalostylis labicheoides*			C		1/1
plants	land plants	Leguminosae	*Pultenaea cunninghamii*	prickly pea		C		2/2
plants	land plants	Leguminosae	*Pultenaea petiolaris*			C		1/1
plants	land plants	Leguminosae	*Rhynchosia minima var. minima*			C		1
plants	land plants	Leguminosae	*Senna aciphylla*	Australian senna		C		1/1
plants	land plants	Leguminosae	*Senna artemisioides subsp. coriacea*			C		1
plants	land plants	Leguminosae	*Senna barclayana*			C		1/1
plants	land plants	Leguminosae	*Senna circinnata*			C		1
plants	land plants	Leguminosae	*Senna occidentalis*	coffee senna	Y			1/1
plants	land plants	Leguminosae	*Sesbania cannabina*			C		1
plants	land plants	Leguminosae	*Sesbania cannabina var. cannabina*			C		1
plants	land plants	Leguminosae	*Stylosanthes scabra*		Y			4
plants	land plants	Leguminosae	*Tephrosia brachyodon*			C		1
plants	land plants	Leguminosae	*Tephrosia filipes subsp. filipes*			C		1/1
plants	land plants	Leguminosae	*Vachellia farnesiana*		Y			2
plants	land plants	Leguminosae	*Zornia muriculata subsp. angustata*			C		1/1
plants	land plants	Loganiaceae	*Mitrasacme paludosa*			C		1/1
plants	land plants	Loranthaceae	*Amyema quandang var. bancroftii*	broad-leaved grey mistletoe		C		2
plants	land plants	Loranthaceae	*Amyema quandang var. quandang*			C		1
plants	land plants	Loranthaceae	*Lysiana filifolia*			C		1/1
plants	land plants	Loranthaceae	*Lysiana subfalcata*			C		5
plants	land plants	Lythraceae	*Lythrum paradoxum*			C		1
plants	land plants	Lythraceae	*Rotala*			C		1
plants	land plants	Macarthuriaceae	*Macarthuria ephedroides*			C		1/1
plants	land plants	Malvaceae	*Abutilon auritum*	Chinese lantern		C		1
plants	land plants	Malvaceae	*Abutilon fraseri*	dwarf lantern flower		C		1
plants	land plants	Malvaceae	*Abutilon fraseri subsp. fraseri*			C		1
plants	land plants	Malvaceae	*Abutilon malvifolium*	bastard marshmallow		C		2
plants	land plants	Malvaceae	*Abutilon nobile*			C		1/1
plants	land plants	Malvaceae	*Abutilon otocarpum*			C		1
plants	land plants	Malvaceae	*Abutilon oxycarpum*			C		1
plants	land plants	Malvaceae	*Abutilon oxycarpum var. oxycarpum*			C		1
plants	land plants	Malvaceae	*Abutilon oxycarpum var. subsagittatum*			C		2
plants	land plants	Malvaceae	*Gossypium australe*			C		2/1
plants	land plants	Malvaceae	*Hibiscus*					3

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plants	land plants	Malvaceae	*Hibiscus brachysiphonius*			C		2/1
plants	land plants	Malvaceae	*Hibiscus divaricatus*			C		1/1
plants	land plants	Malvaceae	*Hibiscus heterophyllus*			C		1
plants	land plants	Malvaceae	*Hibiscus krichauffianus*			C		1/1
plants	land plants	Malvaceae	*Hibiscus sp. (Emerald S.L.Everist 2124)*			C		1/1
plants	land plants	Malvaceae	*Hibiscus sturtii*			C		3/1
plants	land plants	Malvaceae	*Hibiscus sturtii var. sturtii*			C		3/1
plants	land plants	Malvaceae	*Malvastrum americanum*		Y			6
plants	land plants	Malvaceae	*Malvastrum americanum var. americanum*		Y			1
plants	land plants	Malvaceae	*Sida aprica var. aprica*			C		2/2
plants	land plants	Malvaceae	*Sida atherophora*			C		1/1
plants	land plants	Malvaceae	*Sida cordifolia*		Y			2/1
plants	land plants	Malvaceae	*Sida corrugata*			C		2
plants	land plants	Malvaceae	*Sida corrugata var. angustifolia*			C		1
plants	land plants	Malvaceae	*Sida cunninghamii*			C		1
plants	land plants	Malvaceae	*Sida fibulifera*			C		1
plants	land plants	Malvaceae	*Sida rhombifolia*		Y			4
plants	land plants	Malvaceae	*Sida rohlenae*			C		2
plants	land plants	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		1
plants	land plants	Malvaceae	*Sida sp. (Musselbrook M.B.Thomas+ MRS437)*			C		1
plants	land plants	Malvaceae	*Sida trichopoda*			C		9/1
plants	land plants	Marsileaceae	*Marsilea costulifera*	narrow-leaved nardoo		C		2
plants	land plants	Marsileaceae	*Marsilea drummondii*	common nardoo		C		1
plants	land plants	Marsileaceae	*Marsilea hirsuta*	hairy nardoo		C		2
plants	land plants	Meliaceae	*Owenia acidula*	emu apple		C		7/1
plants	land plants	Molluginaceae	*Glinus lotoides*	hairy carpet weed		C		1/1
plants	land plants	Moraceae	*Ficus opposita*			C		3
plants	land plants	Myrtaceae	*Angophora floribunda*	rough-barked apple		C		1
plants	land plants	Myrtaceae	*Blakella dallachiana*			C		6/1
plants	land plants	Myrtaceae	*Blakella leichhardtii*			C		1/1
plants	land plants	Myrtaceae	*Blakella tessellaris*			C		5
plants	land plants	Myrtaceae	*Corymbia aureola*			C		1/1
plants	land plants	Myrtaceae	*Corymbia citriodora subsp. citriodora*			C		4
plants	land plants	Myrtaceae	*Corymbia citriodora subsp. variegata*			C		1
plants	land plants	Myrtaceae	*Corymbia clarksoniana*			C		1
plants	land plants	Myrtaceae	*Corymbia hendersonii*			C		1/1
plants	land plants	Myrtaceae	*Corymbia intermedia*	pink bloodwood		C		1
plants	land plants	Myrtaceae	*Corymbia trachyphloia subsp. trachyphloia*			C		2/1
plants	land plants	Myrtaceae	*Eucalyptus acmenoides*			C		2/2
plants	land plants	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		1
plants	land plants	Myrtaceae	*Eucalyptus cambageana*	Dawson gum		C		8/1
plants	land plants	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		10
plants	land plants	Myrtaceae	*Eucalyptus crebra*	narrow-leaved red ironbark		C		9/2
plants	land plants	Myrtaceae	*Eucalyptus decorticans*			C		1/1
plants	land plants	Myrtaceae	*Eucalyptus exserta*	Queensland peppermint		C		3/2
plants	land plants	Myrtaceae	*Eucalyptus melanophloia*			C		11

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plants	land plants	Myrtaceae	*Eucalyptus orgadophila*	mountain coolibah		C		1
plants	land plants	Myrtaceae	*Eucalyptus populnea*	poplar box		C		10
plants	land plants	Myrtaceae	*Eucalyptus tenuipes*	narrow-leaved white mahogany		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus tereticornis*			C		5
plants	land plants	Myrtaceae	*Eucalyptus tereticornis subsp. tereticornis*			C		2
plants	land plants	Myrtaceae	*Eucalyptus tholiformis*			C		1/1
plants	land plants	Myrtaceae	*Eucalyptus thozetiana*			C		7
plants	land plants	Myrtaceae	*Lophostemon suaveolens*	swamp box		C		1/1
plants	land plants	Myrtaceae	*Lysicarpus angustifolius*	budgeroo		C		1/1
plants	land plants	Myrtaceae	*Melaleuca bracteata*			C		3
plants	land plants	Myrtaceae	*Melaleuca decora*			C		1/1
plants	land plants	Myrtaceae	*Melaleuca lazaridis*			C		1/1
plants	land plants	Myrtaceae	*Melaleuca linariifolia*	snow-in summer		C		1/1
plants	land plants	Myrtaceae	*Melaleuca nodosa*			C		1/1
plants	land plants	Myrtaceae	*Melaleuca tamariscina*			C		3/3
plants	land plants	Myrtaceae	*Melaleuca trichostachya*			C		1/1
plants	land plants	Myrtaceae	*Micromyrtus capricornia*			C		5/5
plants	land plants	Myrtaceae	*Ochrosperma adpressum*			C		1/1
plants	land plants	Myrtaceae	*Triplarina paludosa*			C		1/1
plants	land plants	Nyctaginaceae	*Boerhavia burbidgeana*			C		1/1
plants	land plants	Nyctaginaceae	*Boerhavia dominii*			C		7
plants	land plants	Nyctaginaceae	*Boerhavia pubescens*			C		1
plants	land plants	Nyctaginaceae	*Boerhavia sp. (St George A.Hill AQ399299)*			C		1/1
plants	land plants	Olacaceae	*Ximenia americana*			C		1/1
plants	land plants	Oleaceae	*Jasminum didymum*			C		1
plants	land plants	Oleaceae	*Jasminum didymum subsp. lineare*			C		9
plants	land plants	Oleaceae	*Jasminum didymum subsp. racemosum*			C		2
plants	land plants	Oleaceae	*Jasminum simplicifolium subsp. australiense*			C		1/1
plants	land plants	Oleaceae	*Notelaea microcarpa*			C		3/1
plants	land plants	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		2
plants	land plants	Onagraceae	*Ludwigia peploides subsp. montevidensis*			C		1
plants	land plants	Orchidaceae	*Corunastylis valida*			V		1/1
plants	land plants	Orchidaceae	*Cymbidium canaliculatum*			SL		4
plants	land plants	Oxalidaceae	*Oxalis*					1
plants	land plants	Oxalidaceae	*Oxalis corniculata*		Y			1
plants	land plants	Oxalidaceae	*Oxalis radicosa*			C		1/1
plants	land plants	Papaveraceae	*Argemone ochroleuca subsp. ochroleuca*	Mexican poppy	Y			1
plants	land plants	Passifloraceae	*Passiflora aurantia var. aurantia*			C		2/2
plants	land plants	Phyllanthaceae	*Breynia oblongifolia*			C		1/1
plants	land plants	Phyllanthaceae	*Flueggea*					1
plants	land plants	Phyllanthaceae	*Phyllanthus*					1/1
plants	land plants	Phyllanthaceae	*Phyllanthus maderaspatensis*			C		4
plants	land plants	Phyllanthaceae	*Phyllanthus maderaspatensis var. maderaspatensis*			C		1
plants	land plants	Phyllanthaceae	*Phyllanthus mitchellii*			C		1/1
plants	land plants	Phyllanthaceae	*Phyllanthus virgatus*			C		1
plants	land plants	Phyllanthaceae	*Synostemon spinosus*			C		2/2

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plants	land plants	Picrodendraceae	*Petalostigma pachyphyllum*			C		1/1
plants	land plants	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		4/1
plants	land plants	Pittosporaceae	*Pittosporum angustifolium*			C		2
plants	land plants	Pittosporaceae	*Pittosporum spinescens*			C		4/1
plants	land plants	Pittosporaceae	*Rhytidosporum diosmoides*			C		1/1
plants	land plants	Plantaginaceae	*Plantago cunninghamii*	sago weed		C		1
plants	land plants	Plantaginaceae	*Scoparia dulcis*	scoparia	Y			1
plants	land plants	Plumbaginaceae	*Plumbago zeylanica*	native plumbago		C		2
plants	land plants	Poaceae	*Alloteropsis cimicina*			C		1/1
plants	land plants	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		1
plants	land plants	Poaceae	*Ancistrachne uncinulata*	hooky grass		C		4/3
plants	land plants	Poaceae	*Aristida caput-medusae*			C		6/2
plants	land plants	Poaceae	*Aristida holathera*			C		1
plants	land plants	Poaceae	*Aristida holathera var. holathera*			C		1
plants	land plants	Poaceae	*Aristida jerichoensis var. subspinulifera*			C		5
plants	land plants	Poaceae	*Aristida leptopoda*	white speargrass		C		1
plants	land plants	Poaceae	*Aristida lignosa*			C		1/1
plants	land plants	Poaceae	*Aristida polyclados*			C		3
plants	land plants	Poaceae	*Aristida queenslandica var. dissimilis*			C		2/2
plants	land plants	Poaceae	*Aristida ramosa*	purple wiregrass		C		1
plants	land plants	Poaceae	*Aristida vagans*			C		2
plants	land plants	Poaceae	*Arundinella nepalensis*	reedgrass		C		1/1
plants	land plants	Poaceae	*Astrebla lappacea*	curly mitchell grass		C		1
plants	land plants	Poaceae	*Astrebla squarrosa*	bull mitchell grass		C		3
plants	land plants	Poaceae	*Bothriochloa bladhii subsp. bladhii*			C		2
plants	land plants	Poaceae	*Bothriochloa decipiens var. decipiens*			C		1
plants	land plants	Poaceae	*Bothriochloa ewartiana*	desert bluegrass		C		6
plants	land plants	Poaceae	*Bothriochloa pertusa*		Y			3
plants	land plants	Poaceae	*Brachyachne convergens*	common native couch		C		5
plants	land plants	Poaceae	*Calyptochloa sphaerocarpa*			C		4/4
plants	land plants	Poaceae	*Cenchrus*					1
plants	land plants	Poaceae	*Cenchrus ciliaris*		Y			17
plants	land plants	Poaceae	*Chloris gayana*	rhodes grass	Y			1
plants	land plants	Poaceae	*Chloris inflata*	purpletop chloris	Y			3
plants	land plants	Poaceae	*Chloris ventricosa*	tall chloris		C		2
plants	land plants	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			1
plants	land plants	Poaceae	*Chrysopogon fallax*			C		1
plants	land plants	Poaceae	*Cleistochloa subjuncea*			C		1/1
plants	land plants	Poaceae	*Cymbopogon refractus*	barbed-wire grass		C		1
plants	land plants	Poaceae	*Cynodon dactylon*		Y			3
plants	land plants	Poaceae	*Cynodon dactylon var. dactylon*		Y			1
plants	land plants	Poaceae	*Dactyloctenium radulans*	button grass		C		8
plants	land plants	Poaceae	*Dichanthium sericeum subsp. sericeum*			C		1
plants	land plants	Poaceae	*Digitaria bicornis*			C		1
plants	land plants	Poaceae	*Digitaria brownii*			C		2
plants	land plants	Poaceae	*Digitaria diffusa*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	*Dinebra decipiens var. asthenes*			C		1
plants	land plants	Poaceae	*Dinebra decipiens var. decipiens*			C		4/1
plants	land plants	Poaceae	*Diplachne fusca var. fusca*			C		2/1
plants	land plants	Poaceae	*Echinochloa colona*	awnless barnyard grass	Y			4
plants	land plants	Poaceae	*Echinochloa esculenta*	Japanese millet	Y			1
plants	land plants	Poaceae	*Enneapogon gracilis*	slender nineawn		C		5
plants	land plants	Poaceae	*Enneapogon nigricans*	niggerheads		C		2
plants	land plants	Poaceae	*Enteropogon acicularis*	curly windmill grass		C		5
plants	land plants	Poaceae	*Enteropogon ramosus*			C		1
plants	land plants	Poaceae	*Enteropogon unispiceus*			C		9/1
plants	land plants	Poaceae	*Eragrostis elongata*			C		1
plants	land plants	Poaceae	*Eragrostis lacunaria*	purple lovegrass		C		2
plants	land plants	Poaceae	*Eragrostis leptostachya*			C		1
plants	land plants	Poaceae	*Eragrostis megalosperma*			C		1
plants	land plants	Poaceae	*Eragrostis minor*	smaller stinkgrass	Y			2
plants	land plants	Poaceae	*Eriachne*					1
plants	land plants	Poaceae	*Eriochloa crebra*	spring grass		C		6
plants	land plants	Poaceae	*Heteropogon contortus*	black speargrass		C		1
plants	land plants	Poaceae	*Hyparrhenia rufa subsp. rufa*		Y			2/2
plants	land plants	Poaceae	*Iseilema vaginiflorum*	red flinders grass		C		2
plants	land plants	Poaceae	*Leptochloa digitata*			C		4
plants	land plants	Poaceae	*Megathyrsus maximus*		Y			1
plants	land plants	Poaceae	*Megathyrsus maximus var. pubiglumis*		Y			8
plants	land plants	Poaceae	*Melinis repens*	red natal grass	Y			2
plants	land plants	Poaceae	*Panicum decompositum*			C		1
plants	land plants	Poaceae	*Panicum decompositum var. tenuius*			C		2
plants	land plants	Poaceae	*Panicum effusum*			C		1/1
plants	land plants	Poaceae	*Paspalidium albovillosum*			C		1/1
plants	land plants	Poaceae	*Paspalidium caespitosum*	brigalow grass		C		8
plants	land plants	Poaceae	*Paspalidium constrictum*			C		1
plants	land plants	Poaceae	*Paspalidium distans*	shotgrass		C		1
plants	land plants	Poaceae	*Paspalidium jubiflorum*	warrego grass		C		1
plants	land plants	Poaceae	*Paspalum distichum*	water couch	Y			2
plants	land plants	Poaceae	*Paspalum longifolium*			C		1
plants	land plants	Poaceae	*Setaria paspalidioides*			C		1/1
plants	land plants	Poaceae	*Setaria surgens*			C		1/1
plants	land plants	Poaceae	*Sorghum x almum*		Y			1/1
plants	land plants	Poaceae	*Sporobolus actinocladus*	katoora grass		C		1
plants	land plants	Poaceae	*Sporobolus caroli*	fairy grass		C		8
plants	land plants	Poaceae	*Sporobolus creber*			C		1/1
plants	land plants	Poaceae	*Sporobolus elongatus*			C		2
plants	land plants	Poaceae	*Sporobolus laxus*			C		1
plants	land plants	Poaceae	*Themeda triandra*	kangaroo grass		C		2
plants	land plants	Poaceae	*Thyridolepis xerophila*			C		1/1
plants	land plants	Poaceae	*Tragus australianus*	small burr grass		C		5
plants	land plants	Poaceae	*Triodia mitchellii*	buck spinifex		C		4/3

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			5
plants	land plants	Polygalaceae	*Polygala rhinanthoides*			C		1/1
plants	land plants	Polygonaceae	*Duma florulenta*			C		2
plants	land plants	Polygonaceae	*Emex*			C		1
plants	land plants	Polygonaceae	*Persicaria attenuata*			C		1
plants	land plants	Polygonaceae	*Persicaria orientalis*	princes feathers		C		1
plants	land plants	Polygonaceae	*Polygonum plebeium*	small knotweed		C		1/1
plants	land plants	Pontederiaceae	*Pontederia cyanea*			C		2
plants	land plants	Portulacaceae	*Calandrinia pickeringii*			C		2/1
plants	land plants	Portulacaceae	*Portulaca bicolor*			C		1/1
plants	land plants	Portulacaceae	*Portulaca filifolia*			C		4
plants	land plants	Portulacaceae	*Portulaca oleracea*	pigweed	Y			7
plants	land plants	Portulacaceae	*Portulaca pilosa*		Y			3
plants	land plants	Potamogetonaceae	*Potamogeton tricarinatus*	floating pondweed		SL		1
plants	land plants	Proteaceae	*Grevillea longistyla*			C		3/3
plants	land plants	Proteaceae	*Grevillea sessilis*			C		1/1
plants	land plants	Proteaceae	*Hakea*					2/2
plants	land plants	Proteaceae	*Hakea lorea*			C		1
plants	land plants	Proteaceae	*Hakea lorea subsp. lorea*			C		2/1
plants	land plants	Proteaceae	*Persoonia subtilis*			C		1/1
plants	land plants	Proteaceae	*Xylomelum cunninghamianum*			C		1
plants	land plants	Pteridaceae	*Cheilanthes sieberi subsp. sieberi*			C		2
plants	land plants	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		4
plants	land plants	Rhamnaceae	*Polianthion minutiflorum*			V	V	2/2
plants	land plants	Rhamnaceae	*Ventilago viminalis*	supplejack		C		7/1
plants	land plants	Rubiaceae	*Coelospermum reticulatum*			C		1/1
plants	land plants	Rubiaceae	*Everistia vacciniifolia var. vacciniifolia*			C		2/2
plants	land plants	Rubiaceae	*Larsenaikia ochreata*			C		2/2
plants	land plants	Rubiaceae	*Opercularia diphylla*			C		1/1
plants	land plants	Rubiaceae	*Psydrax johnsonii*			C		1/1
plants	land plants	Rubiaceae	*Psydrax odorata*			C		1
plants	land plants	Rubiaceae	*Psydrax odorata forma buxifolia*			C		2
plants	land plants	Rubiaceae	*Psydrax odorata subsp. australiana*			C		1/1
plants	land plants	Rubiaceae	*Psydrax oleifolia*			C		2
plants	land plants	Rutaceae	*Acronychia pauciflora*	soft acronychia		C		1/1
plants	land plants	Rutaceae	*Boronia odorata*			C		1/1
plants	land plants	Rutaceae	*Boronia splendida*			C		1/1
plants	land plants	Rutaceae	*Citrus glauca*			C		4
plants	land plants	Rutaceae	*Cyanothamnus occidentalis*			C		3/3
plants	land plants	Rutaceae	*Flindersia dissosperma*			C		3/1
plants	land plants	Rutaceae	*Geijera parviflora*	wilga		C		9/2
plants	land plants	Rutaceae	*Phebalium glandulosum subsp. glandulosum*			C		1/1
plants	land plants	Rutaceae	*Phebalium nottii*	pink phebalium		C		3/3
plants	land plants	Rutaceae	*Philotheca difformis subsp. difformis*			C		3/3
plants	land plants	Santalaceae	*Santalum lanceolatum*			SL		3
plants	land plants	Santalaceae	*Viscum articulatum*	flat mistletoe		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Sapindaceae	*Alectryon connatus*	grey birds-eye		C		2/1
plants	land plants	Sapindaceae	*Alectryon diversifolius*	scrub boonaree		C		14/2
plants	land plants	Sapindaceae	*Alectryon oleifolius subsp. elongatus*			C		4
plants	land plants	Sapindaceae	*Atalaya hemiglauca*			C		10
plants	land plants	Sapindaceae	*Dodonaea*					2/2
plants	land plants	Sapindaceae	*Dodonaea filifolia*			C		1/1
plants	land plants	Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			C		1/1
plants	land plants	Sapindaceae	*Dodonaea vestita*			C		1/1
plants	land plants	Sapindaceae	*Dodonaea viscosa subsp. viscosa*			C		1
plants	land plants	Scrophulariaceae	*Eremophila latrobei*			C		2/1
plants	land plants	Scrophulariaceae	*Eremophila latrobei subsp. glabra*			C		4/4
plants	land plants	Scrophulariaceae	*Eremophila latrobei subsp. latrobei*			C		1/1
plants	land plants	Scrophulariaceae	*Eremophila longifolia*	berrigan		C		2/1
plants	land plants	Scrophulariaceae	*Eremophila maculata*			C		1
plants	land plants	Scrophulariaceae	*Eremophila maculata subsp. maculata*			C		1/1
plants	land plants	Scrophulariaceae	*Eremophila mitchellii*			C		12/1
plants	land plants	Scrophulariaceae	*Myoporum acuminatum*	coastal boobialla		C		3
plants	land plants	Solanaceae	*Physalis lanceifolia*		Y			1
plants	land plants	Solanaceae	*Solanum*					1
plants	land plants	Solanaceae	*Solanum adenophorum*			E		1
plants	land plants	Solanaceae	*Solanum cocosoides*			C		5/5
plants	land plants	Solanaceae	*Solanum elachophyllum*			E		5/4
plants	land plants	Solanaceae	*Solanum ellipticum*	potato bush		C		5/2
plants	land plants	Solanaceae	*Solanum esuriale*	quena		C		4/1
plants	land plants	Solanaceae	*Solanum ferocissimum*			C		3/2
plants	land plants	Solanaceae	*Solanum mitchellianum*			C		2/2
plants	land plants	Solanaceae	*Solanum pusillum*			C		2/2
plants	land plants	Solanaceae	*Solanum semiarmatum*	prickly nightshade		C		1
plants	land plants	Sparrmanniaceae	*Corchorus tomentellus*			C		1/1
plants	land plants	Sparrmanniaceae	*Corchorus trilocularis*			C		1
plants	land plants	Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C		2/1
plants	land plants	Sparrmanniaceae	*Grewia scabrella*			C		7/3
plants	land plants	Sterculiaceae	*Brachychiton australis*	broad-leaved bottle tree		SL		1
plants	land plants	Sterculiaceae	*Brachychiton populneus subsp. trilobus*			SL		1/1
plants	land plants	Sterculiaceae	*Brachychiton rupestris*			SL		14/1
plants	land plants	Stylidiaceae	*Stylidium eglandulosum*			SL		1/1
plants	land plants	Typhaceae	*Typha orientalis*	broad-leaved cumbungi		C		1
plants	land plants	Verbenaceae	*Lippia alba var. alba*		Y			5/5
plants	land plants	Vitaceae	*Clematicissus opaca*			C		5/1
plants	land plants	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			SL		1
plants	land plants	Zamiaceae	*Macrozamia platyrhachis*			E	E	6/6
plants	land plants	Zygophyllaceae	*Tribulus eichlerianus*	bull head		C		3
plants	uncertain	Indet.	*Indet.*			C		5

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.



Vegetation management report

For Lot: 71 Plan: SP259121
12/05/2025

nrmmrrd.qld.gov.au

Queensland Government

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of the Environment, Tourism, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 71 Plan: SP259121 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
A	HT301	Easement	496,250
A	HT456	Easement	301,400
H	HT457	Easement	148,900
F	HT381	Easement	279,000
G	HT412	Easement	104,300
71	SP259121	Freehold	37,045,930
D	HT456	Easement	149,400
C	HT456	Easement	3,103
B	HT456	Easement	89,150

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 71 Plan: SP259121 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 71 Plan: SP259121, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Central Highlands Regional	Fitzroy	Brigalow Belt	Isaac - Comet Downs

2. Vegetation management framework (administered by the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2023, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 71 Plan: SP259121

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category B	26.96
Category R	0.69
Category X	3,662.30

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

The following Property Map of Assessable Vegetation (PMAVs) may be present on this property.
Reference number:

2007/000524

2008/008489

2009/006406

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
11.3.1	Endangered	B	1.35	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Mid-dense
11.3.1	Endangered	R	0.02	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Mid-dense
11.3.2	Of concern	B	13.48	Eucalyptus populnea woodland on alluvial plains	Sparse
11.3.2	Of concern	R	less than 0.01	Eucalyptus populnea woodland on alluvial plains	Sparse
11.3.25	Least concern	B	12.13	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.3.25	Least concern	R	less than 0.01	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.4.9	Endangered	R	0.66	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Sparse
non-rem	None	X	3,662.30	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
483	Denisonia maculata	ornamental snake	V	Riparian woodland/open forest and shrub/woodland including Brigalow Acacia harpophylla; into drier habitats in summer.	100-450m.	Cracking clay with gilgai/soil crack microrelief and sandy loam substrates.	Near freshwater waterholes/creeks and low lying poorly drained areas that are frequently inundated by freshwater.

Label	Regional Ecosystem (mandatory unless otherwise specified)
483	10.3.2, 10.3.3, 10.3.4, 10.3.7, 10.3.13, 10.3.14, 10.3.15, 10.3.16, 10.3.27, 10.3.30, 10.3.31, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5, 10.4.6, 10.4.7, 10.4.8, 10.5.5, 10.9.1. 10.9.6. 10.9.7, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.9, 11.3.10, 11.3.12, 11.3.15, 11.3.21, 11.3.23, 11.3.24, 11.3.25, 11.3.27, 11.3.28, 11.3.31, 11.3.34, 11.3.37, 11.3.38, 11.3.40, 11.4.2, 11.4.3, 11.4.4, 11.4.6, 11.4.7, 11.4.8, 11.4.9, 11.4.11, 11.5.2, 11.5.3, 11.5.16, 11.8.11, 11.9.1, 11.9.2, 11.9.3, 11.9.5, 11.9.7, 11.9.11, 11.9.12, 11.9.14, 11.11.15, 11.12.6

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

No Class A

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 71 Plan: SP259121.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.qld.gov.au/environment/land/management/vegetation/maps/map-request

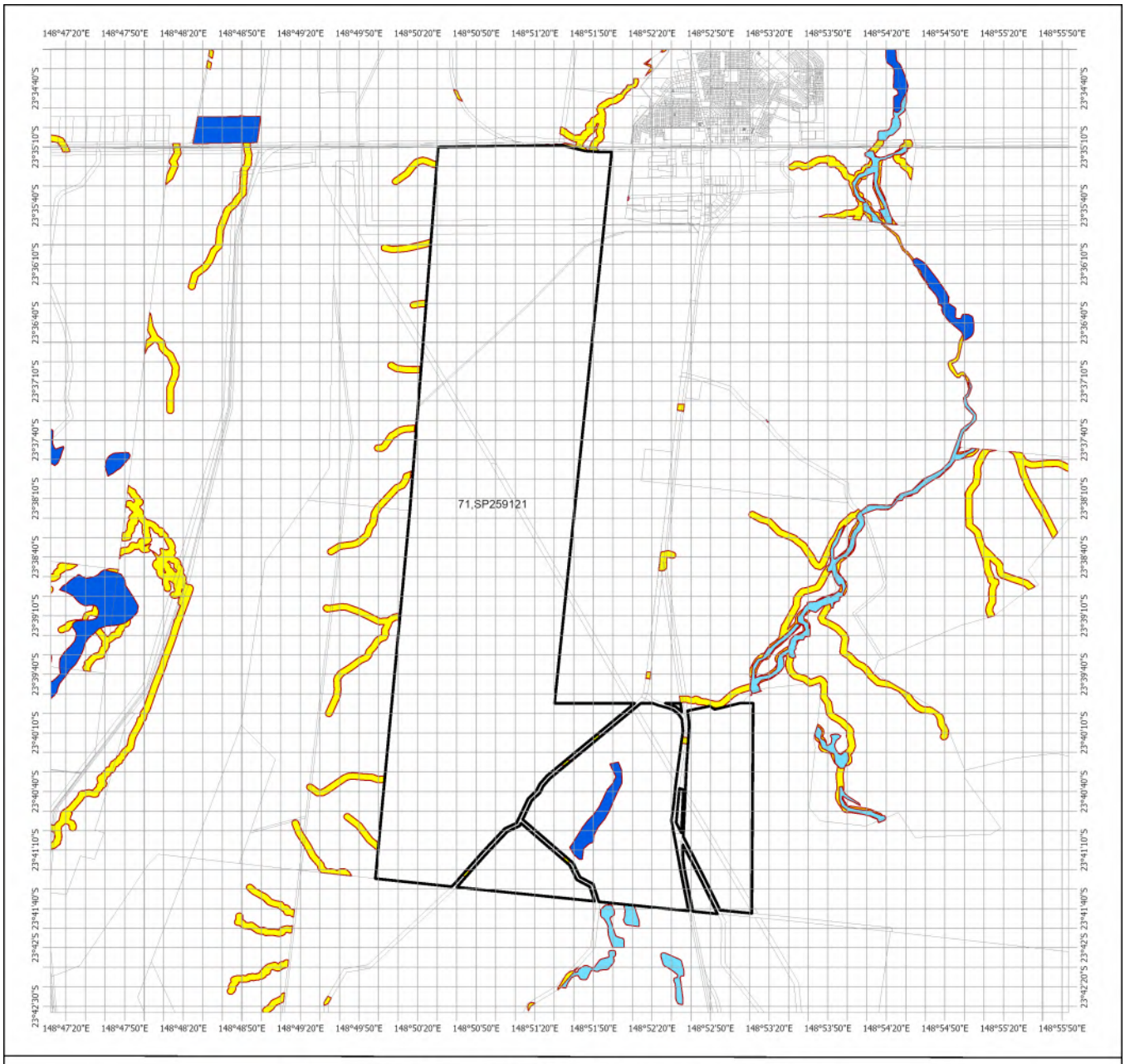
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

Queensland Government

Category A area (Vegetation offsets/compliance notices/VDecs)
Category B area (Remnant vegetation)
Category C area (High-value regrowth vegetation)
Category R area (Reef regrowth watercourse vegetation)
Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
Water
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 870 1,740 2,610 3,480 4,350 m

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

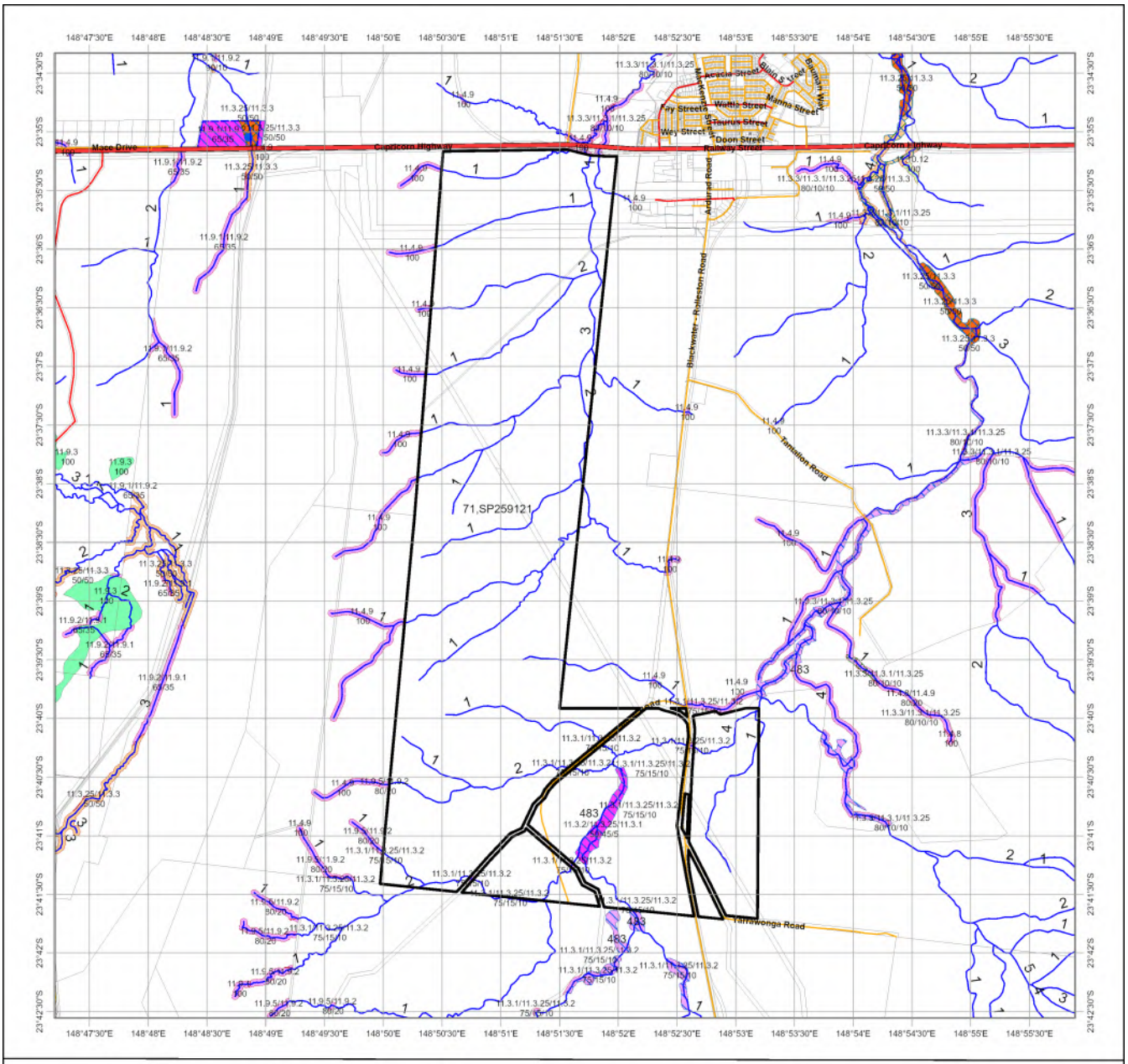
Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

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4.2 Vegetation management supporting map



Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

Queensland Government

LOCALITY DIAGRAM



N

0 625 1,250 1,875 2,500 3,125 m

This product is displayed in: GDA2020

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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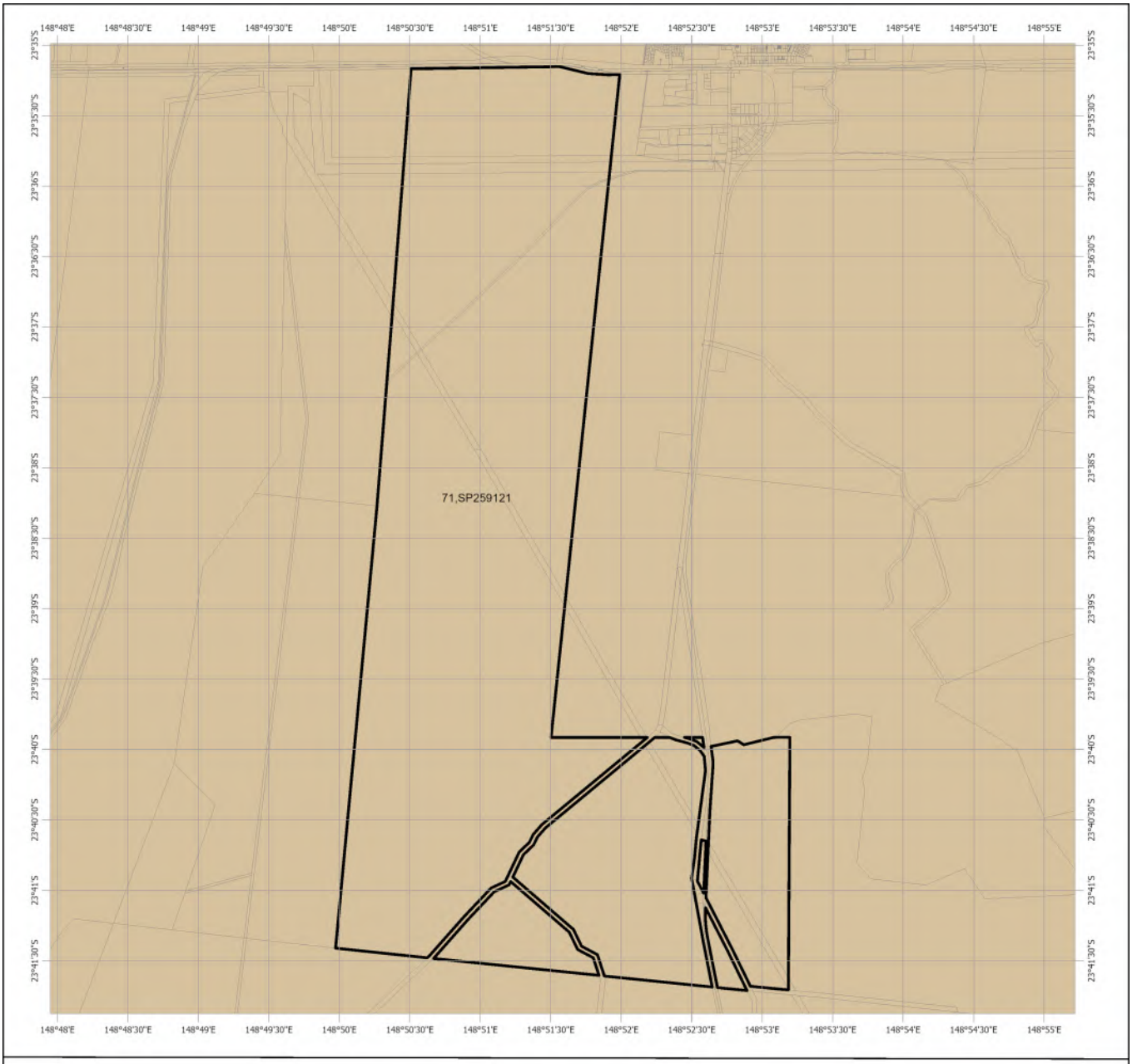
Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

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4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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N

0 730 1,460 2,190 2,920 3,650 m

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4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

- Towns
- Rivers and creeks
- Freeways / motorways; Highways
- Secondary roads; Streets

Agricultural land class A or B

- A
- B
- Not class A or B
- Selected Lot and Plan

LOCALITY DIAGRAM



N

0 730 1460 2190 2920 3650 m

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5. Protected plants framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of Endangered, Vulnerable, Near-Threatened (EVNT) plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of the Environment, Tourism, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DETSI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

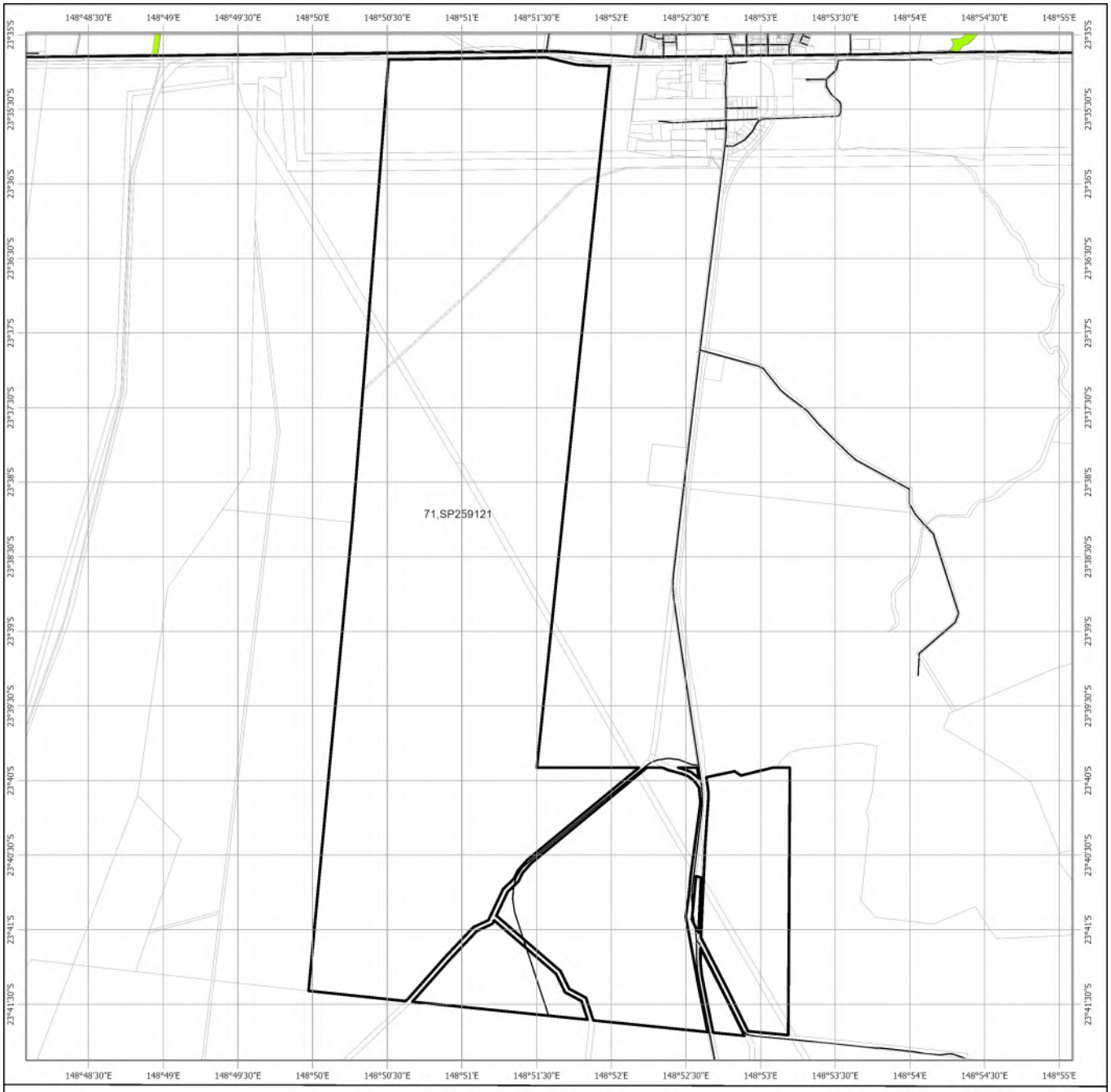
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of the Environment, Tourism, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of the Environment, Tourism, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 480 960 1,440 1,920 2,400 m

This product is displayed in:
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This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of the Environment, Tourism, Science and Innovation at palm@des.qld.gov.au

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6. Koala protection framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DETSI

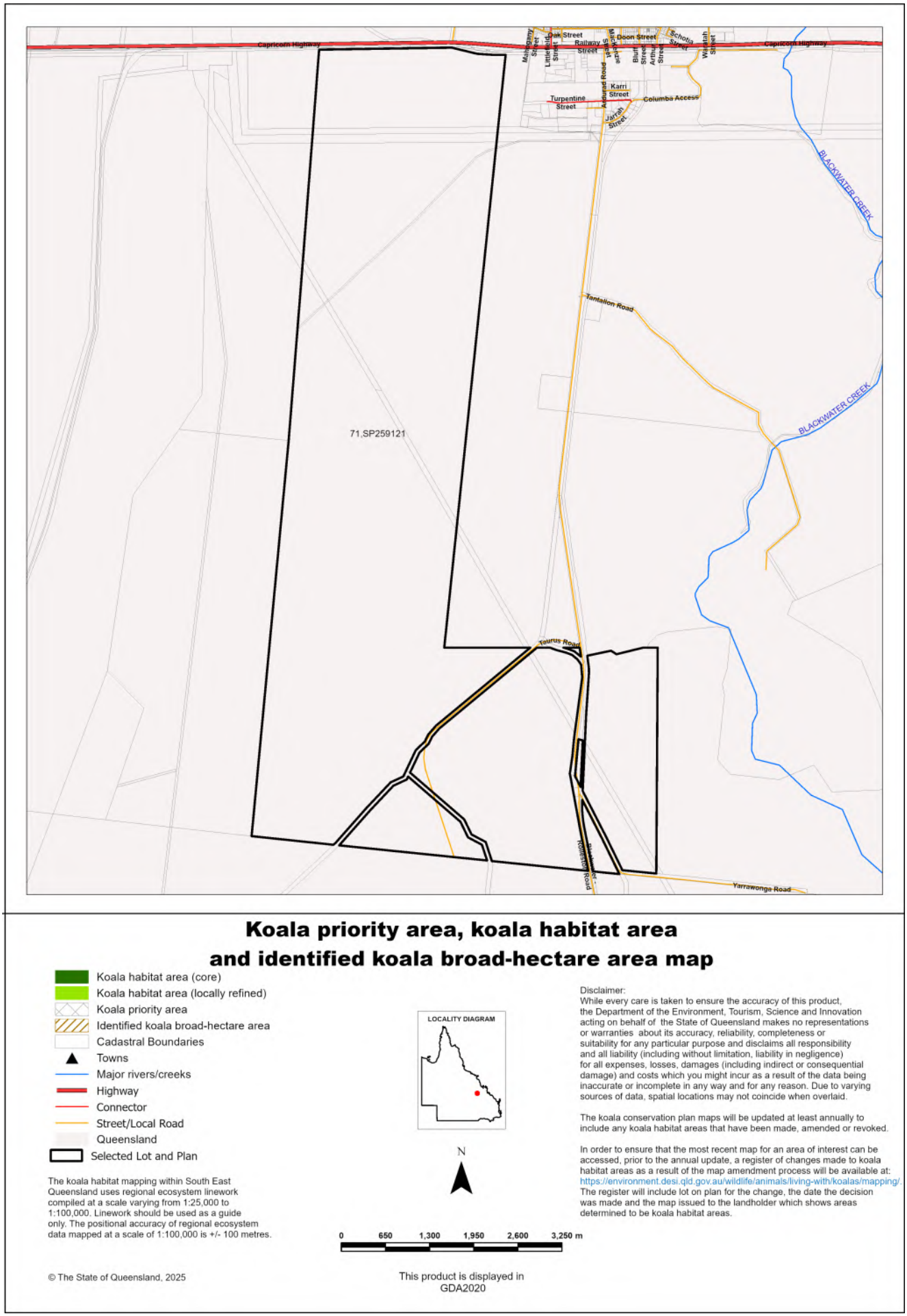
For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@detsi.qld.gov.au
Visit https://environment.desi.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 71 Plan: SP259121

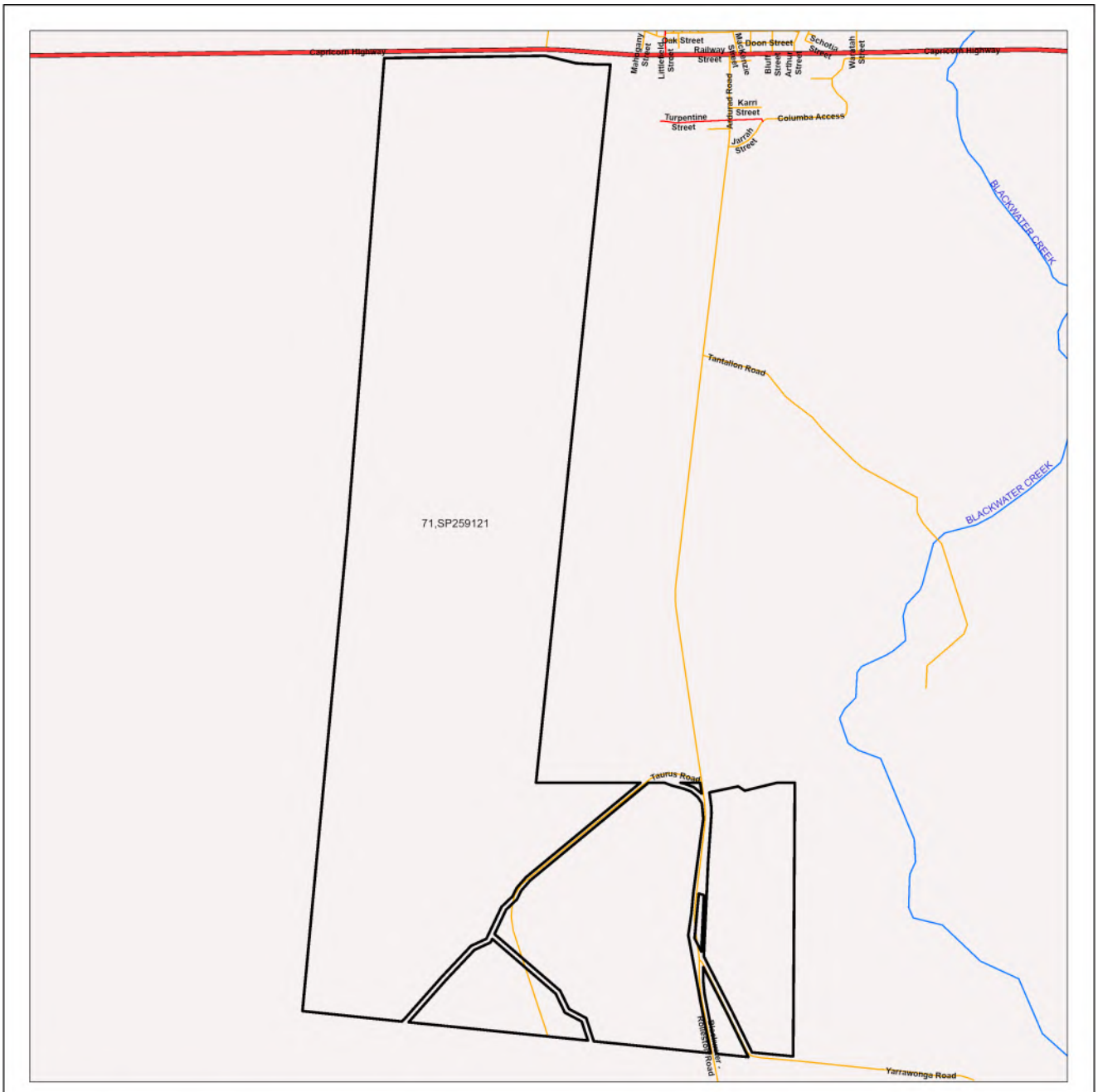
7.1 Koala districts

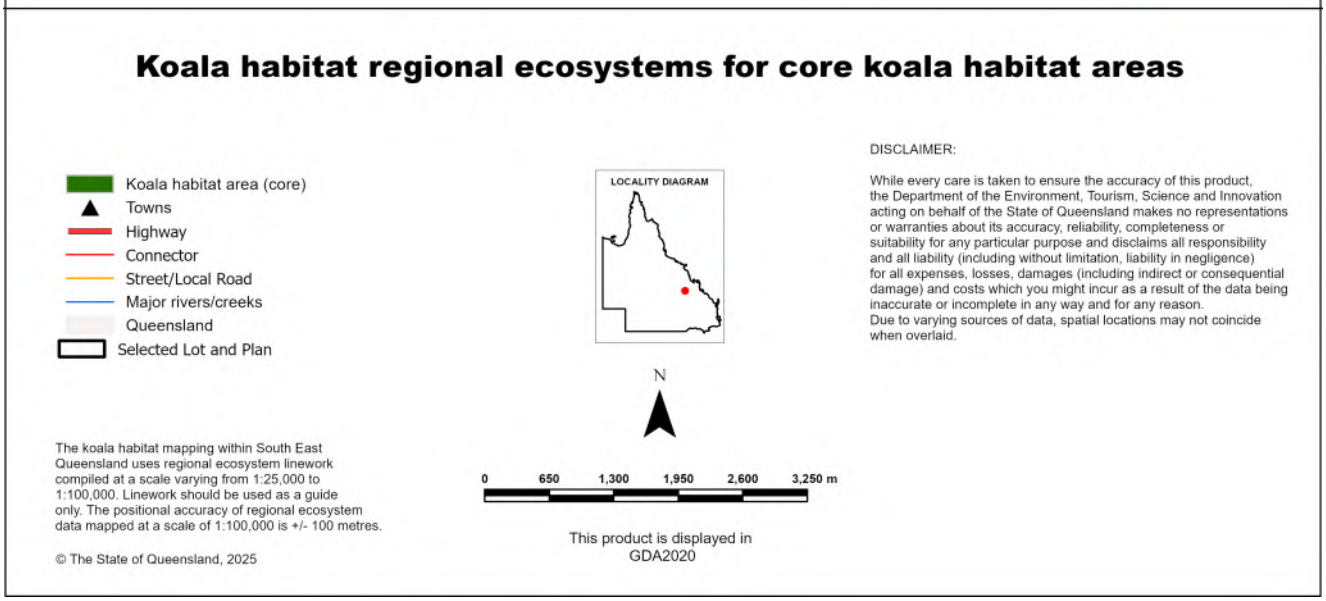
Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



7.3 Koala habitat regional ecosystems for core koala habitat areas





8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
Interference with overland flow	*Water Act 2000*	Department of Local Government, Water and Volunteers	Ph: 13 QGOV (13 74 68) www.dlgwv.qld.gov.au
Earthworks, significant disturbance	*Soil Conservation Act 1986*	Queensland Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development	Ph: 13 QGOV (13 74 68) www.nrmmrrd.qld.gov.au
Fire Permits	*Fire and Emergency Services Act 1990*	Queensland Fire Department	Ph: 13 QGOV (13 74 68) www.fire.qld.gov.au
Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Queensland Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism	Ph: 13 QGOV (13 74 68) www.tatsipca.qld.gov.au
Mining and environmentally relevant activities Infrastructure development (coastal) Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) www.detsi.qld.gov.au
Protected plants and protected areas	*Nature Conservation Act 1992* *Planning Act 2016*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 1300 130 372 (option 4) palm@detsi.qld.gov.au www.detsi.qld.gov.au
Koala mapping and regulations	*Nature Conservation Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) Koala.assessment@detsi.qld.gov.au
Interference with fish passage in a watercourse, mangroves Forestry activities	*Fisheries Act 1994* *Forestry Act 1959*	Queensland Department of Primary Industries	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Climate Change, Energy, the Environment and Water (Australian Government)	Ph: 1800 803 772 www.dcceew.gov.au
Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Queensland Department of State Development, Infrastructure and Planning	Ph: 13 QGOV (13 74 68) www.planning.qld.gov.au
Coordinated projects	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Office of the Coordinator-General	Ph: 13 QGOV (13 74 68) www.statedevelopment.qld.gov.au/coordinator-general
Wet Tropics World Heritage Area	*Wet Tropics World Heritage Protection and Management Act 1993*	Queensland Wet Tropics Management Authority	Ph: (07) 4241 0500 www.wettropics.gov.au
Requirements on State controlled road	*Transport Infrastructure Act 1994*	Queensland Department of Transport and Main Roads	Ph: 13 QGOV (13 74 68) https://www.tmr.qld.gov.au
Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Your relevant local government office	Local Government Contact Directory



Vegetation management report

For Lot: 50 Plan: SP117237
11/04/2025

nrmmrrd.qld.gov.au

Queensland Government

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of the Environment, Tourism, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 50 Plan: SP117237 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
50	SP117237	Freehold	11,100,000
E	HT444	Easement	109,800
B	HT443	Easement	174,000
C	RP619638	Easement	0

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 50 Plan: SP117237 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 50 Plan: SP117237, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Central Highlands Regional	Fitzroy	Brigalow Belt	Isaac - Comet Downs

2. Vegetation management framework (administered by the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2023, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 50 Plan: SP117237

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category R	72.13
Category X	1,046.64

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

The following Property Map of Assessable Vegetation (PMAVs) may be present on this property.
Reference number:
2008/008489

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
11.3.1	Endangered	R	0.60	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Mid-dense
11.3.2	Of concern	R	0.08	Eucalyptus populnea woodland on alluvial plains	Sparse
11.3.25	Least concern	R	0.12	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.4.9	Endangered	R	53.12	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Sparse
11.9.2	Least concern	R	3.64	Eucalyptus melanophloia +/- E. orgadophila woodland to open woodland on fine-grained sedimentary rocks	Sparse
11.9.5	Endangered	R	14.57	Acacia harpophylla and/or Casuarina cristata open forest to woodland on fine-grained sedimentary rocks	Mid-dense
non-rem	None	X	1,046.64	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur

up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C
No records

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

No Class A

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 50 Plan: SP117237.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.qld.gov.au/environment/land/management/vegetation/maps/map-request

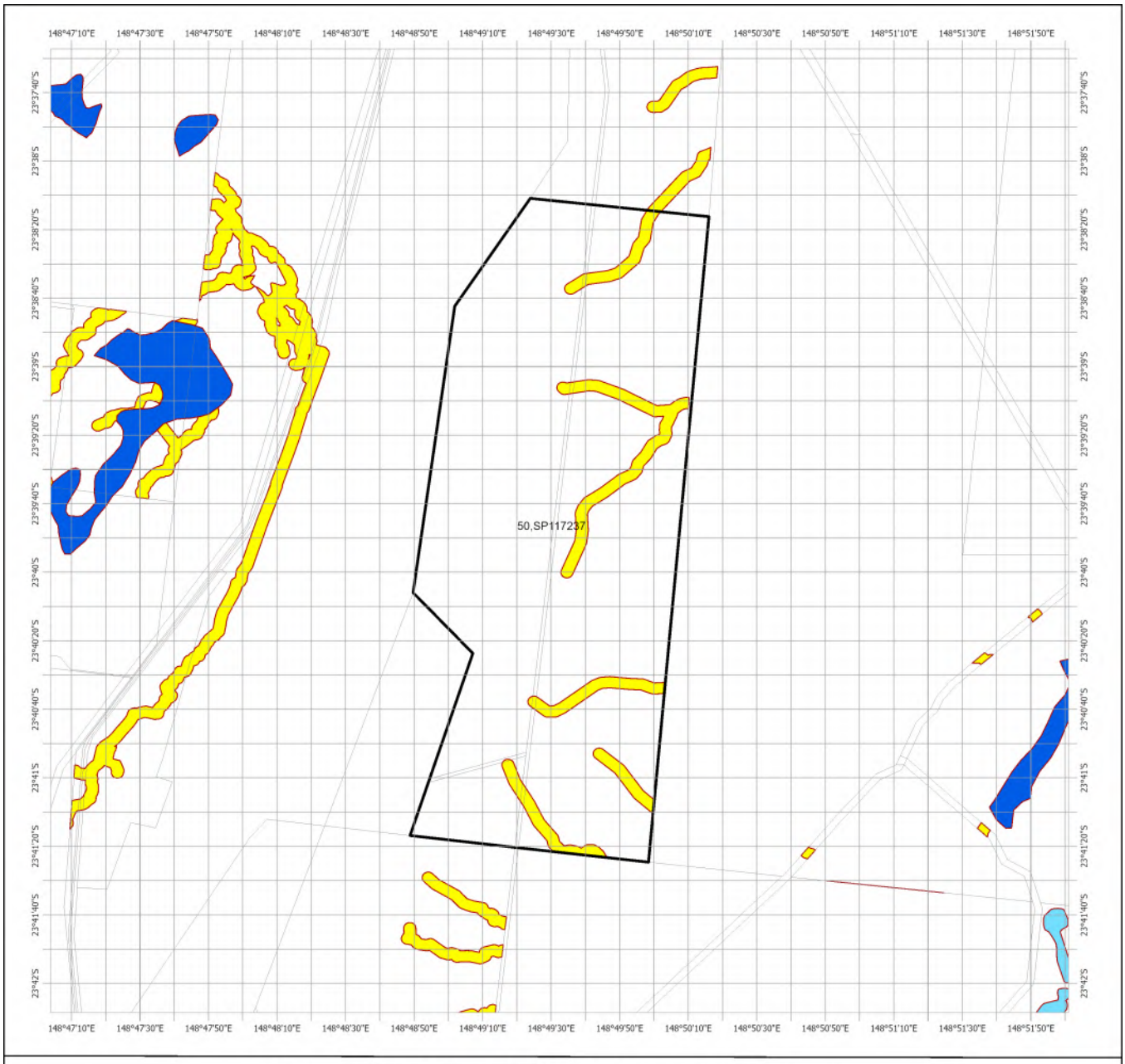
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

Queensland Government

Category A area (Vegetation offsets/compliance notices/VDecs)
Category B area (Remnant vegetation)
Category C area (High-value regrowth vegetation)
Category R area (Reef regrowth watercourse vegetation)
Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
Water
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 500 1,000 1,500 2,000 2,500 m

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

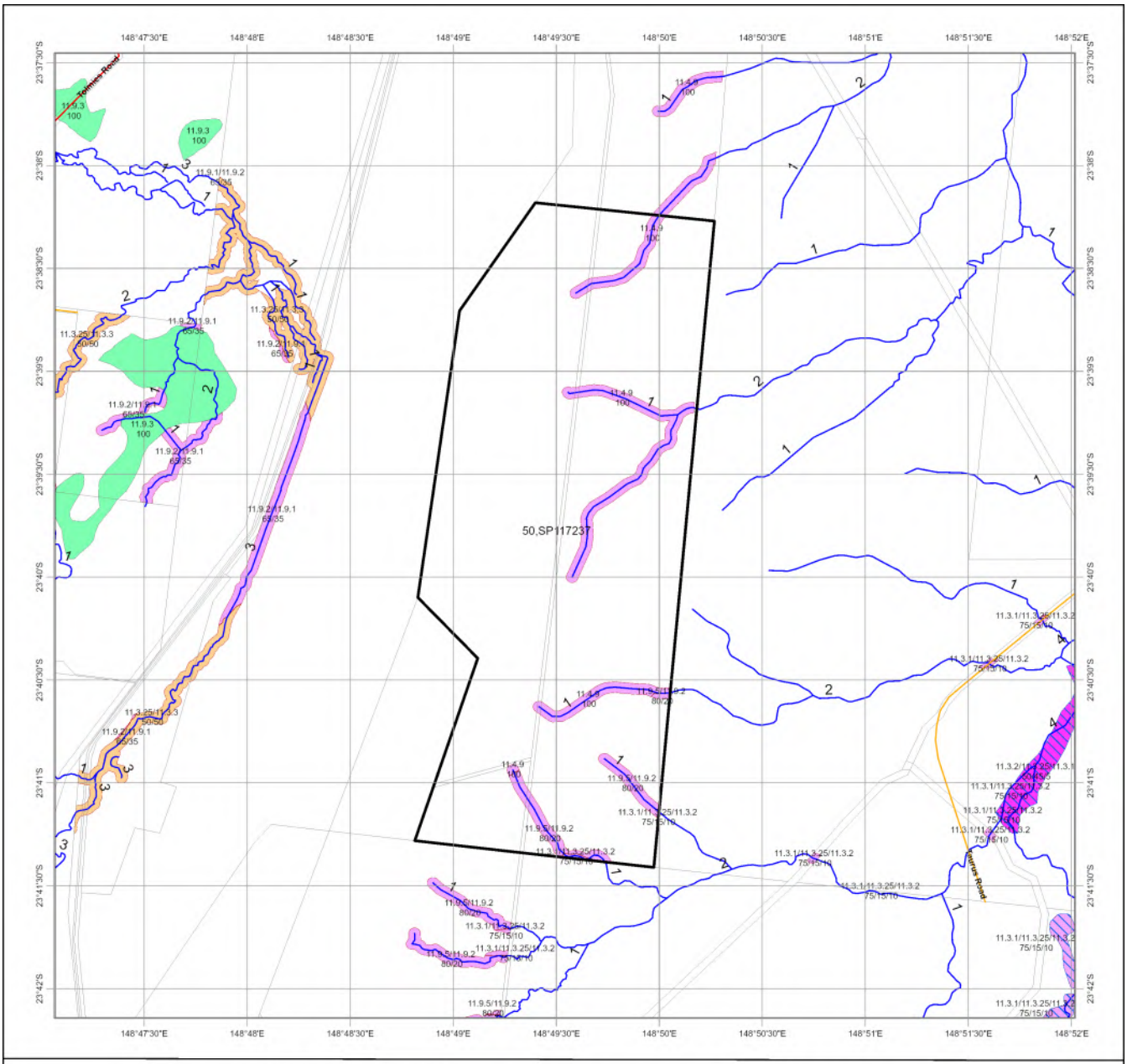
Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

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4.2 Vegetation management supporting map



Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

Queensland Government

LOCALITY DIAGRAM



N

0 350 700 1,050 1,400 1,750 m

This product is displayed in: GDA2020

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

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4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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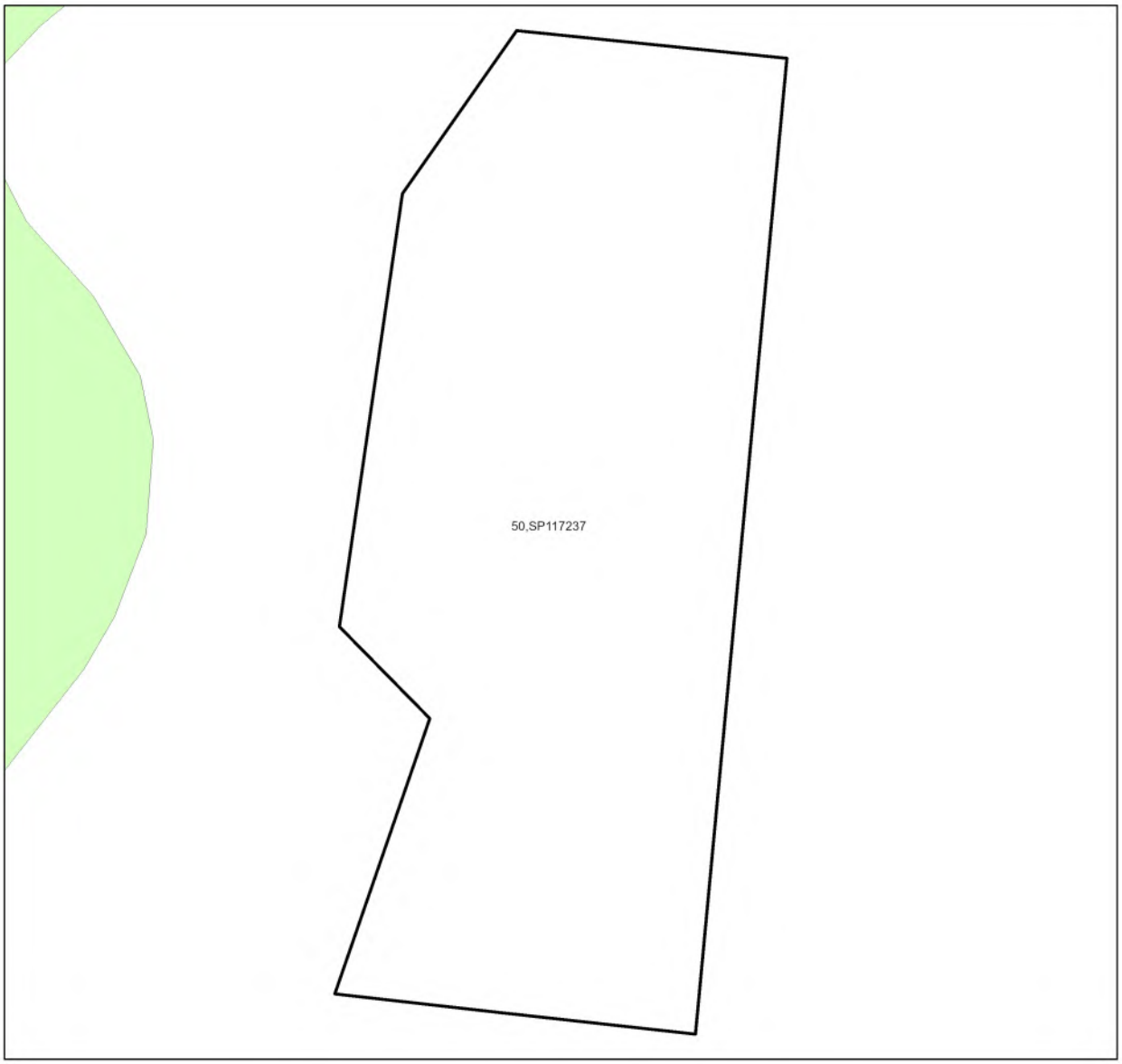
N

0 360 720 1,080 1,440 1,800 m

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4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

Towns
Rivers and creeks
Freeways / motorways; Highways
Secondary roads; Streets
Agricultural land class A or B
A
B
Not class A or B
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 360 720 1080 1440 1800 m

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5. Protected plants framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of Endangered, Vulnerable, Near-Threatened (EVNT) plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of the Environment, Tourism, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DETSI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

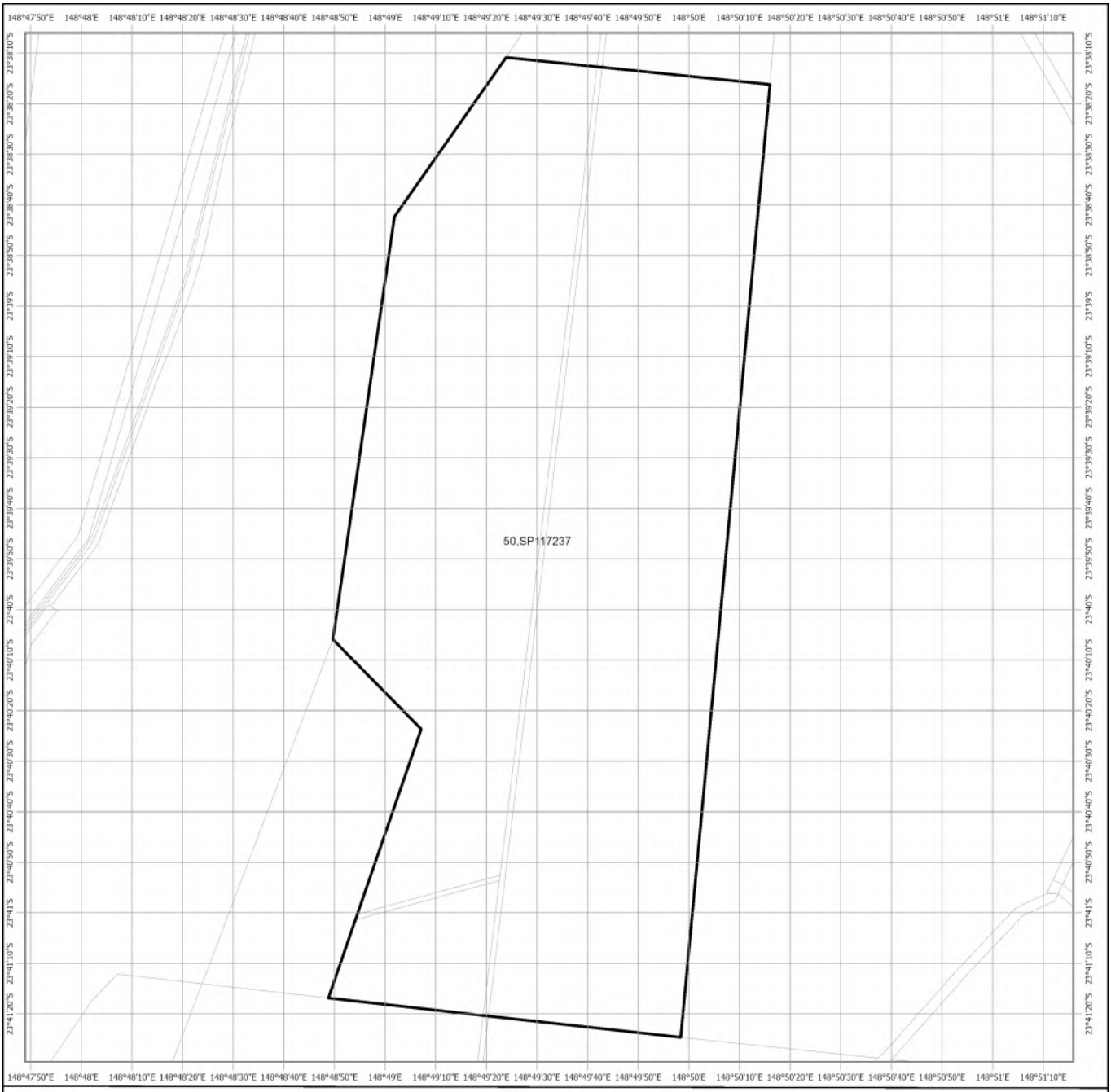
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of the Environment, Tourism, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of the Environment, Tourism, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 240 480 720 960 1,200 m

This product is displayed in:
GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of the Environment, Tourism, Science and Innovation at palm@des.qld.gov.au

Disclaimer: While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.

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6. Koala protection framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DETSI

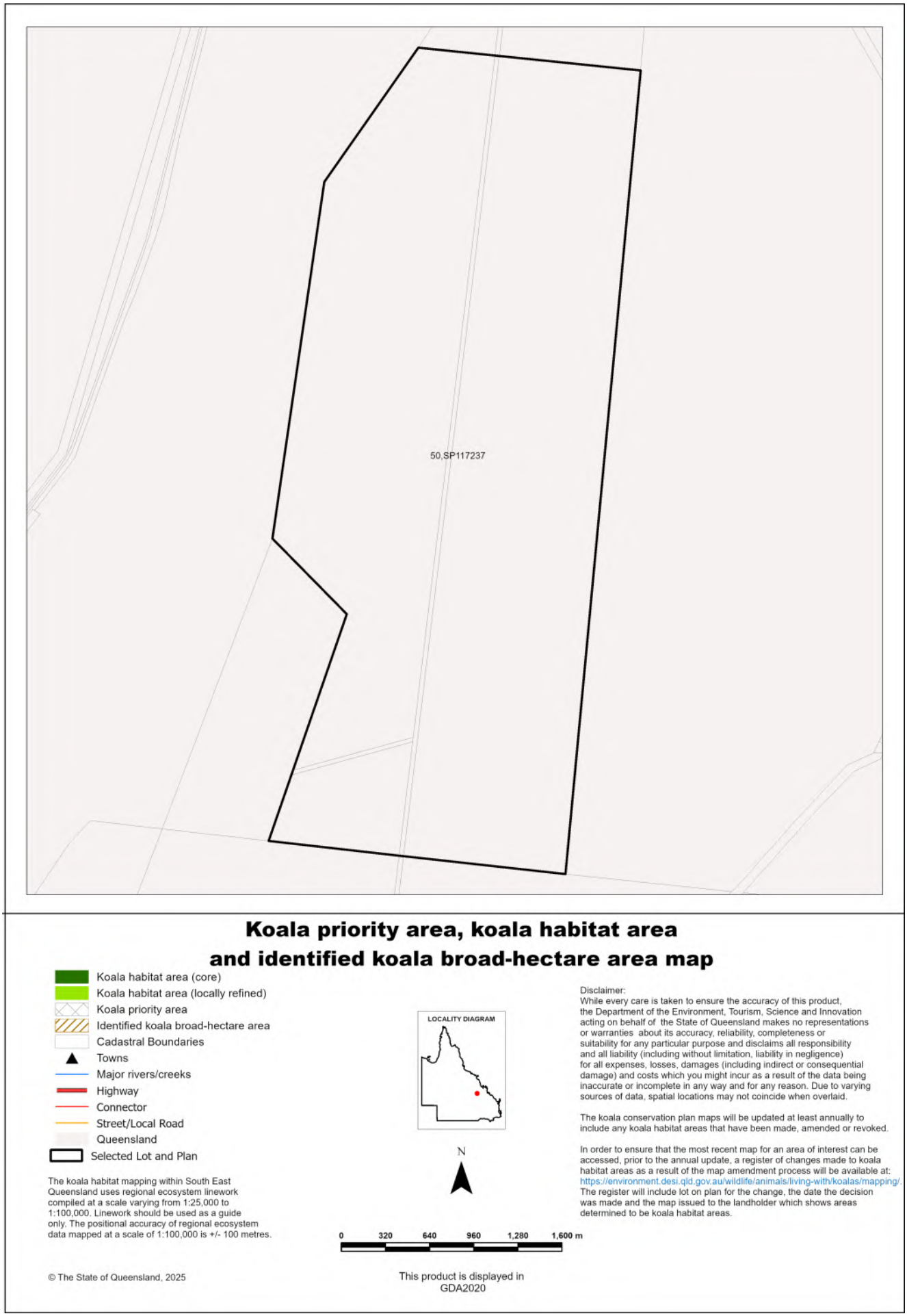
For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@detsi.qld.gov.au
Visit https://environment.desi.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 50 Plan: SP117237

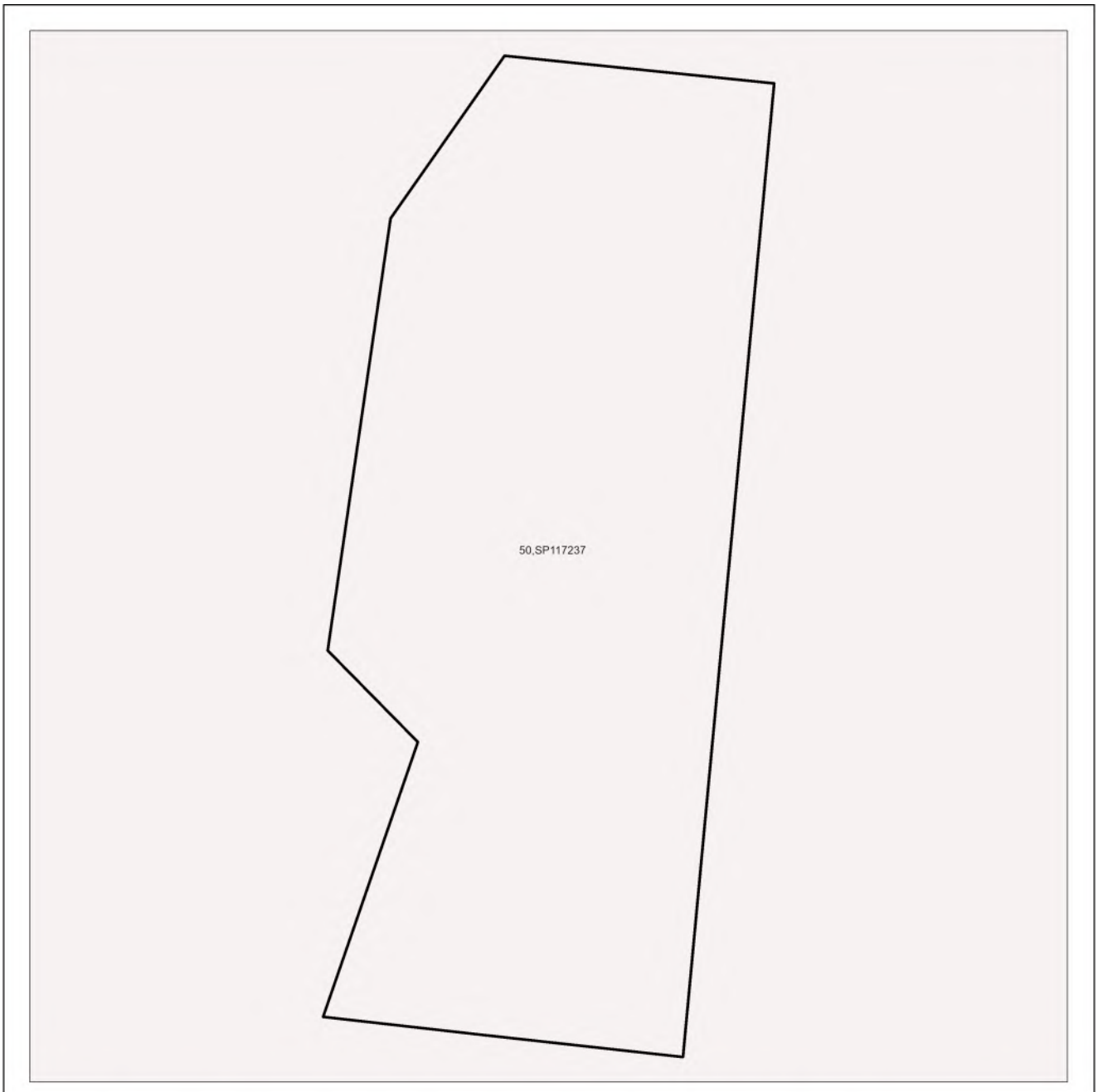
7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



7.3 Koala habitat regional ecosystems for core koala habitat areas



8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
Interference with overland flow	*Water Act 2000*	Department of Local Government, Water and Volunteers	Ph: 13 QGOV (13 74 68) www.dlgwv.qld.gov.au
Earthworks, significant disturbance	*Soil Conservation Act 1986*	Queensland Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development	Ph: 13 QGOV (13 74 68) www.nrmmrrd.qld.gov.au
Fire Permits	*Fire and Emergency Services Act 1990*	Queensland Fire Department	Ph: 13 QGOV (13 74 68) www.fire.qld.gov.au
Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Queensland Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism	Ph: 13 QGOV (13 74 68) www.tatsipca.qld.gov.au
Mining and environmentally relevant activities Infrastructure development (coastal) Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) www.detsi.qld.gov.au
Protected plants and protected areas	*Nature Conservation Act 1992* *Planning Act 2016*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 1300 130 372 (option 4) palm@detsi.qld.gov.au www.detsi.qld.gov.au
Koala mapping and regulations	*Nature Conservation Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) Koala.assessment@detsi.qld.gov.au
Interference with fish passage in a watercourse, mangroves Forestry activities	*Fisheries Act 1994* *Forestry Act 1959*	Queensland Department of Primary Industries	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Climate Change, Energy, the Environment and Water (Australian Government)	Ph: 1800 803 772 www.dcceew.gov.au
Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Queensland Department of State Development, Infrastructure and Planning	Ph: 13 QGOV (13 74 68) www.planning.qld.gov.au
Coordinated projects	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Office of the Coordinator-General	Ph: 13 QGOV (13 74 68) www.statedevelopment.qld.gov.au/coordinator-general
Wet Tropics World Heritage Area	*Wet Tropics World Heritage Protection and Management Act 1993*	Queensland Wet Tropics Management Authority	Ph: (07) 4241 0500 www.wettropics.gov.au
Requirements on State controlled road	*Transport Infrastructure Act 1994*	Queensland Department of Transport and Main Roads	Ph: 13 QGOV (13 74 68) https://www.tmr.qld.gov.au
Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Your relevant local government office	Local Government Contact Directory



Vegetation management report

For Lot: 24 Plan: CP855505
11/04/2025

nrmmrrd.qld.gov.au

Queensland Government

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of the Environment, Tourism, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 24 Plan: CP855505 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
24	CP855505	Lands Lease	38,266,670
B	HT455	Easement	146,600
H	HT609	Easement	122
D	HT455	Easement	82,810
G	HT605	Easement	7,395
C	HT455	Easement	46,280
J	CP855505	Easement	76,560

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 24 Plan: CP855505 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 24 Plan: CP855505, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Central Highlands Regional	Fitzroy	Brigalow Belt	Isaac - Comet Downs

2. Vegetation management framework (administered by the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2023, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 24 Plan: CP855505

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category C	44.93
Category R	less than 0.01
Category X	3,778.52

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

The following Property Map of Assessable Vegetation (PMAVs) may be present on this property.
Reference number:

2009/006406

2017/004269

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
11.3.1	Endangered	C	33.70	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Mid-dense
11.3.1	Endangered	R	less than 0.01	Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains	Mid-dense
11.3.2	Of concern	C	4.49	Eucalyptus populnea woodland on alluvial plains	Sparse
11.3.2	Of concern	R	less than 0.01	Eucalyptus populnea woodland on alluvial plains	Sparse
11.3.25	Least concern	C	6.74	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.3.25	Least concern	R	less than 0.01	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.4.9	Endangered	R	less than 0.01	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Sparse
11.9.2	Least concern	R	less than 0.01	Eucalyptus melanophloia +/- E. orgadophila woodland to open woodland on fine-grained sedimentary rocks	Sparse
11.9.5	Endangered	R	less than 0.01	Acacia harpophylla and/or Casuarina cristata open forest to woodland on fine-grained sedimentary rocks	Mid-dense
non-rem	None	X	3,778.52	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
483	Denisonia maculata	ornamental snake	V	Riparian woodland/open forest and shrub/woodland including Brigalow Acacia harpophylla; into drier habitats in summer.	100-450m.	Cracking clay with gilgai/soil crack microrelief and sandy loam substrates.	Near freshwater waterholes/creeks and low lying poorly drained areas that are frequently inundated by freshwater.

Label	Regional Ecosystem (mandatory unless otherwise specified)
483	10.3.2, 10.3.3, 10.3.4, 10.3.7, 10.3.13, 10.3.14, 10.3.15, 10.3.16, 10.3.27, 10.3.30, 10.3.31, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5, 10.4.6, 10.4.7, 10.4.8, 10.5.5, 10.9.1. 10.9.6. 10.9.7, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.9, 11.3.10, 11.3.12, 11.3.15, 11.3.21, 11.3.23, 11.3.24, 11.3.25, 11.3.27, 11.3.28, 11.3.31, 11.3.34, 11.3.37, 11.3.38, 11.3.40, 11.4.2, 11.4.3, 11.4.4, 11.4.6, 11.4.7, 11.4.8, 11.4.9, 11.4.11, 11.5.2, 11.5.3, 11.5.16, 11.8.11, 11.9.1, 11.9.2, 11.9.3, 11.9.5, 11.9.7, 11.9.11, 11.9.12, 11.9.14, 11.11.15, 11.12.6

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

No Class A

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 24 Plan: CP855505.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.qld.gov.au/environment/land/management/vegetation/maps/map-request

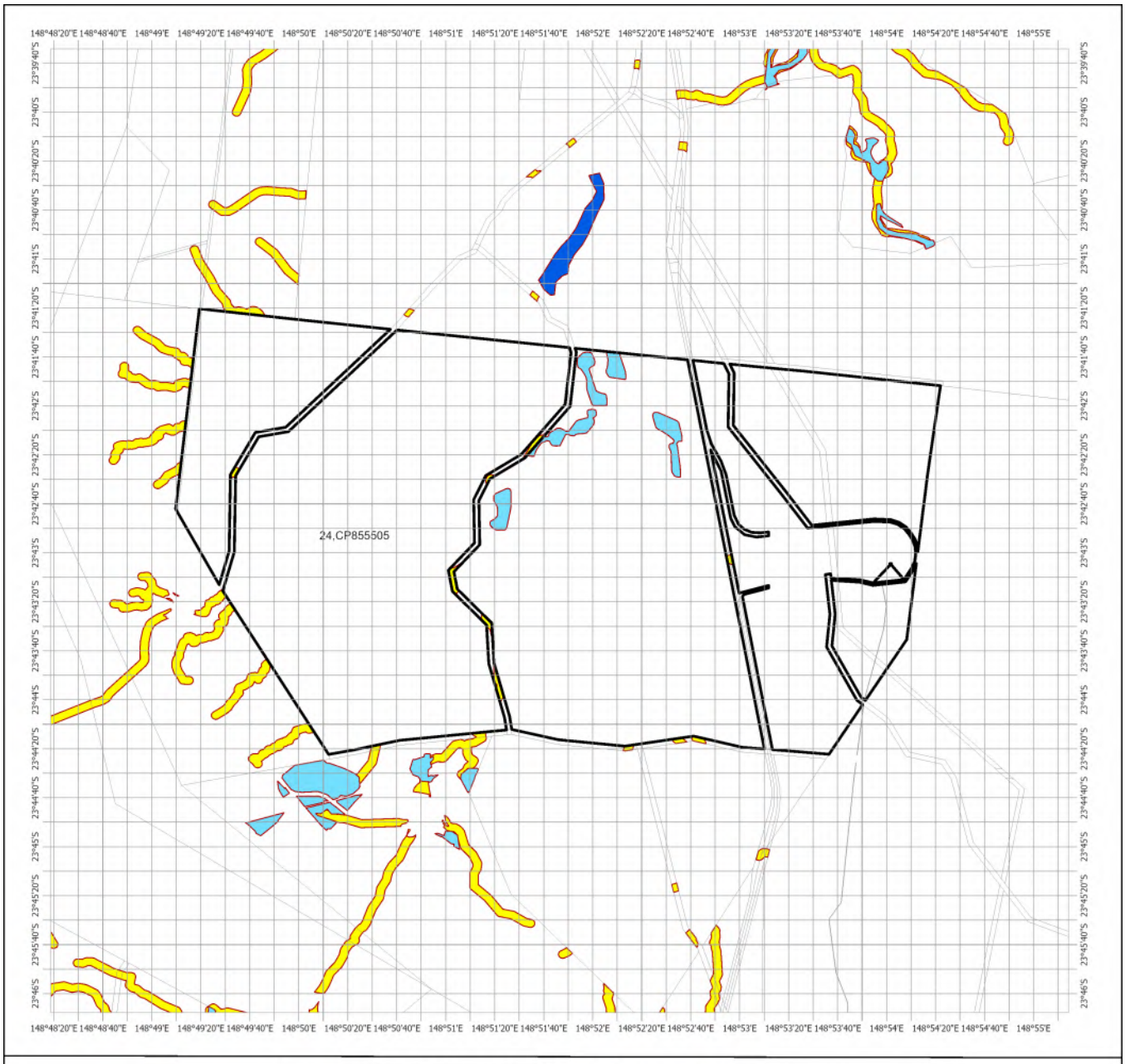
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

Queensland Government

Category A area (Vegetation offsets/compliance notices/VDecs)
Category B area (Remnant vegetation)
Category C area (High-value regrowth vegetation)
Category R area (Reef regrowth watercourse vegetation)
Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
Water
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM

N

0 690 1,380 2,070 2,760 3,450 m

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

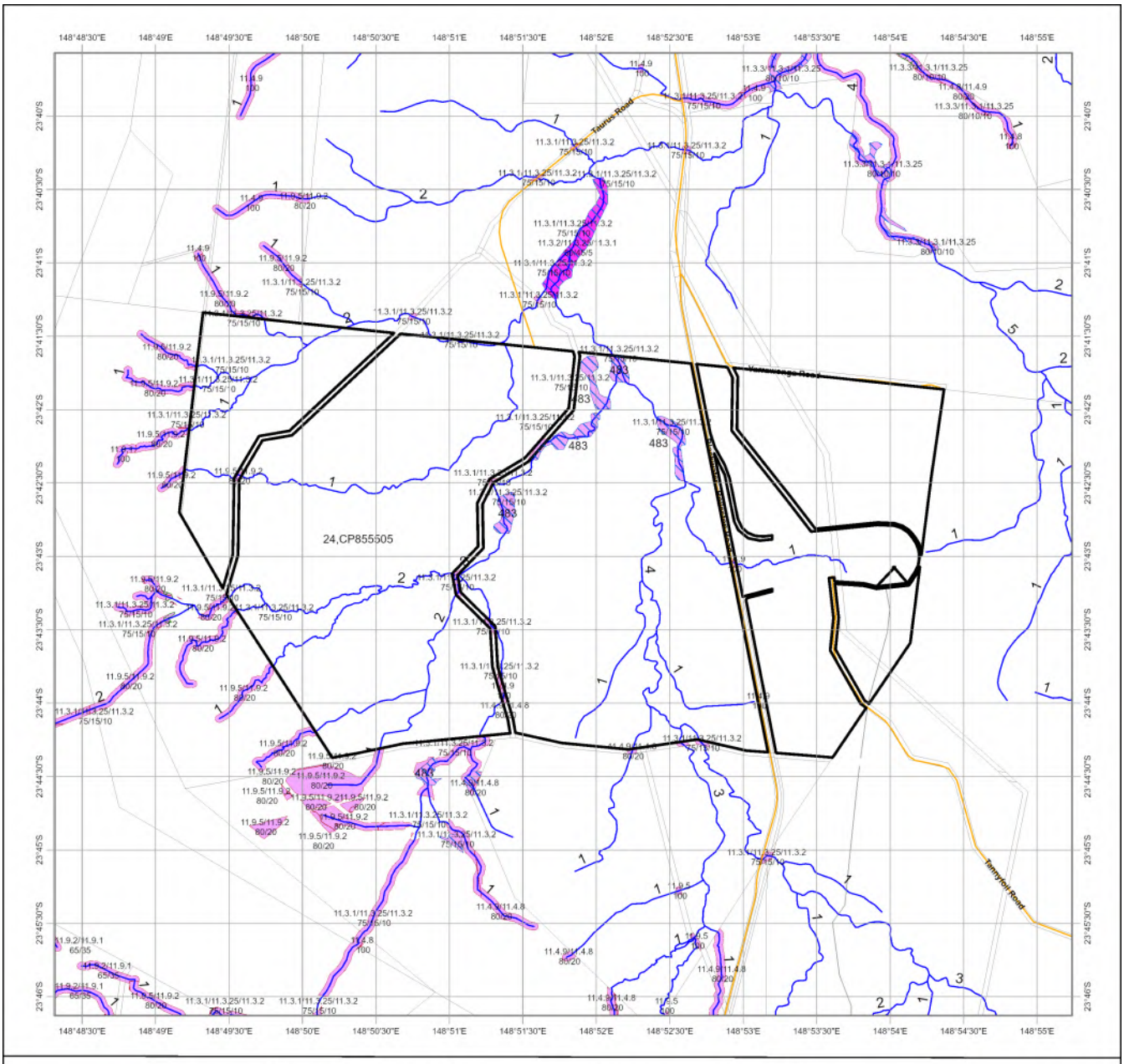
Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

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4.2 Vegetation management supporting map



Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

Queensland Government

LOCALITY DIAGRAM



N

0 500 1,000 1,500 2,000 2,500 m

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Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

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4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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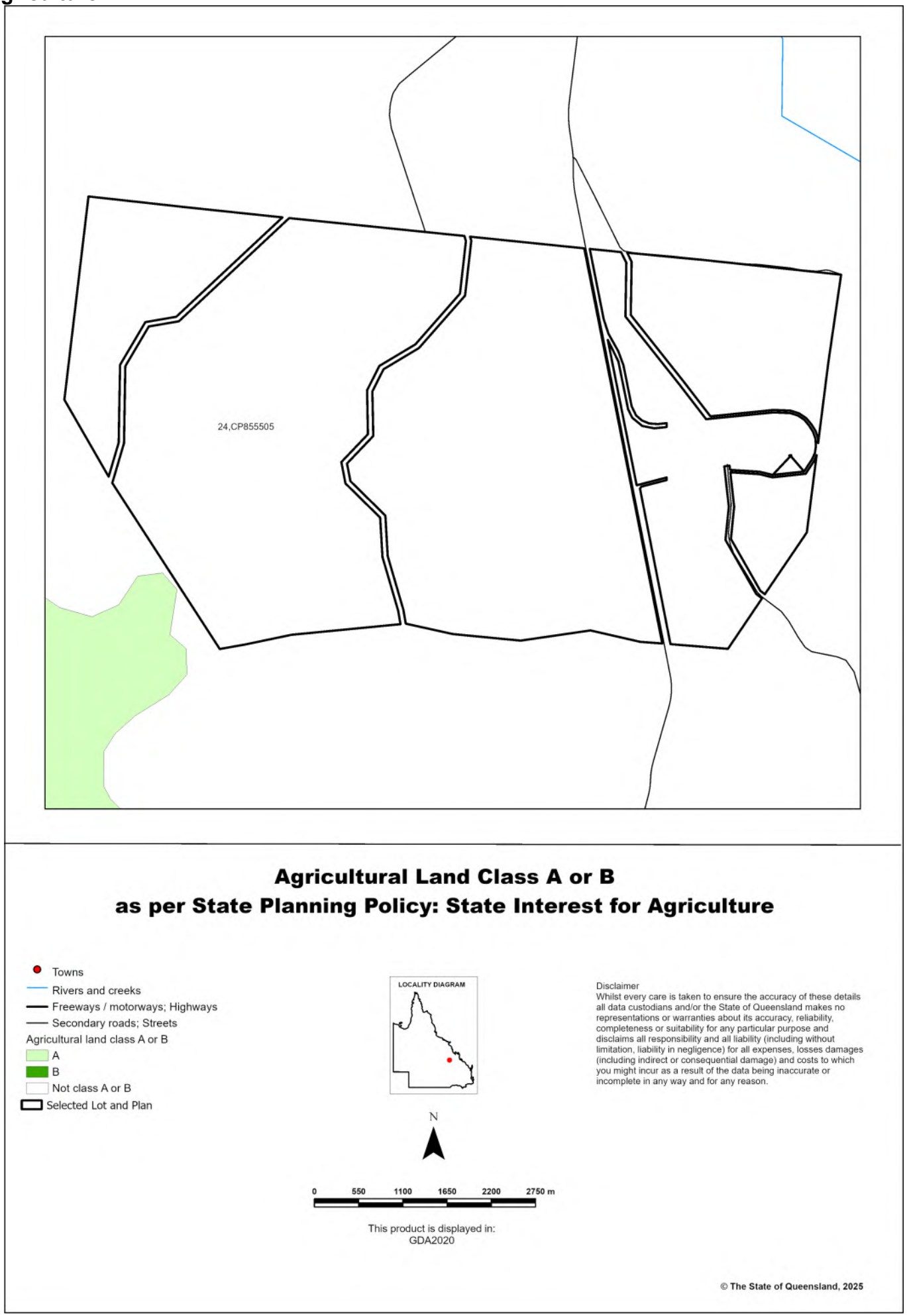
N

0 550 1,100 1,650 2,200 2,750 m

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4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



5. Protected plants framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of Endangered, Vulnerable, Near-Threatened (EVNT) plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of the Environment, Tourism, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DETSI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

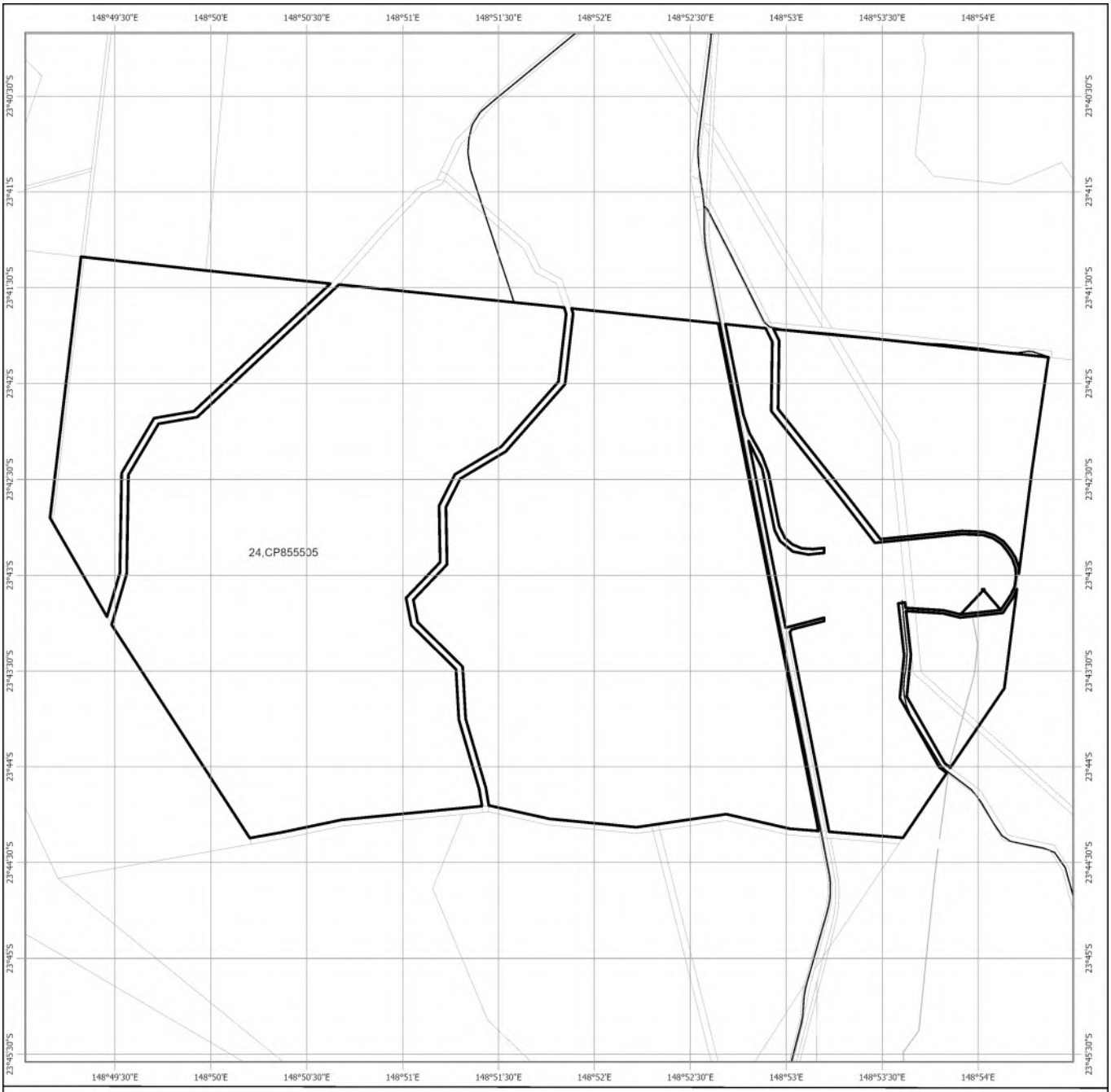
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of the Environment, Tourism, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of the Environment, Tourism, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 375 750 1,125 1,500 1,875 m

This product is displayed in:
GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of the Environment, Tourism, Science and Innovation at palm@des.qld.gov.au

Disclaimer: While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.

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6. Koala protection framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DETSI

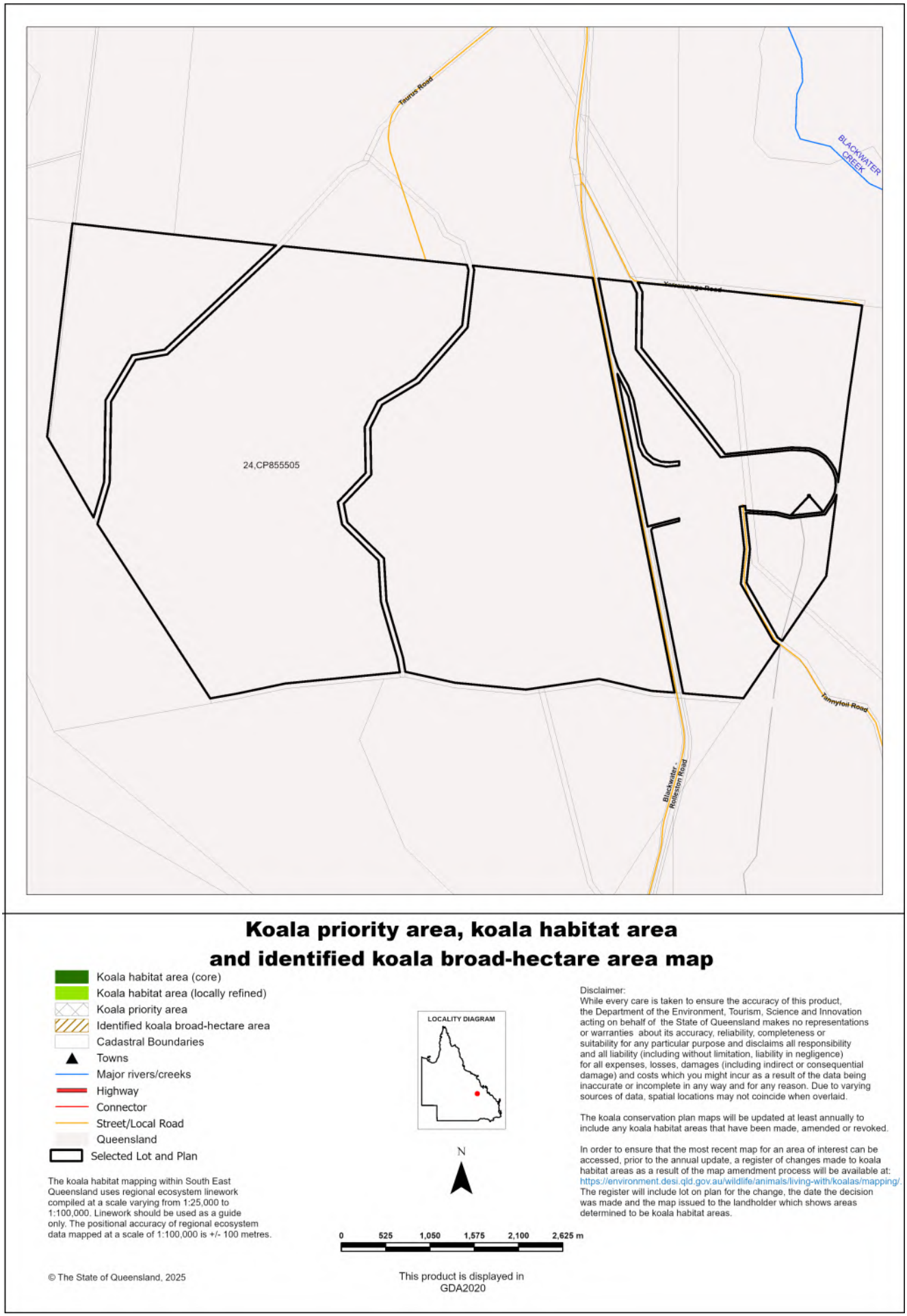
For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@detsi.qld.gov.au
Visit https://environment.desi.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 24 Plan: CP855505

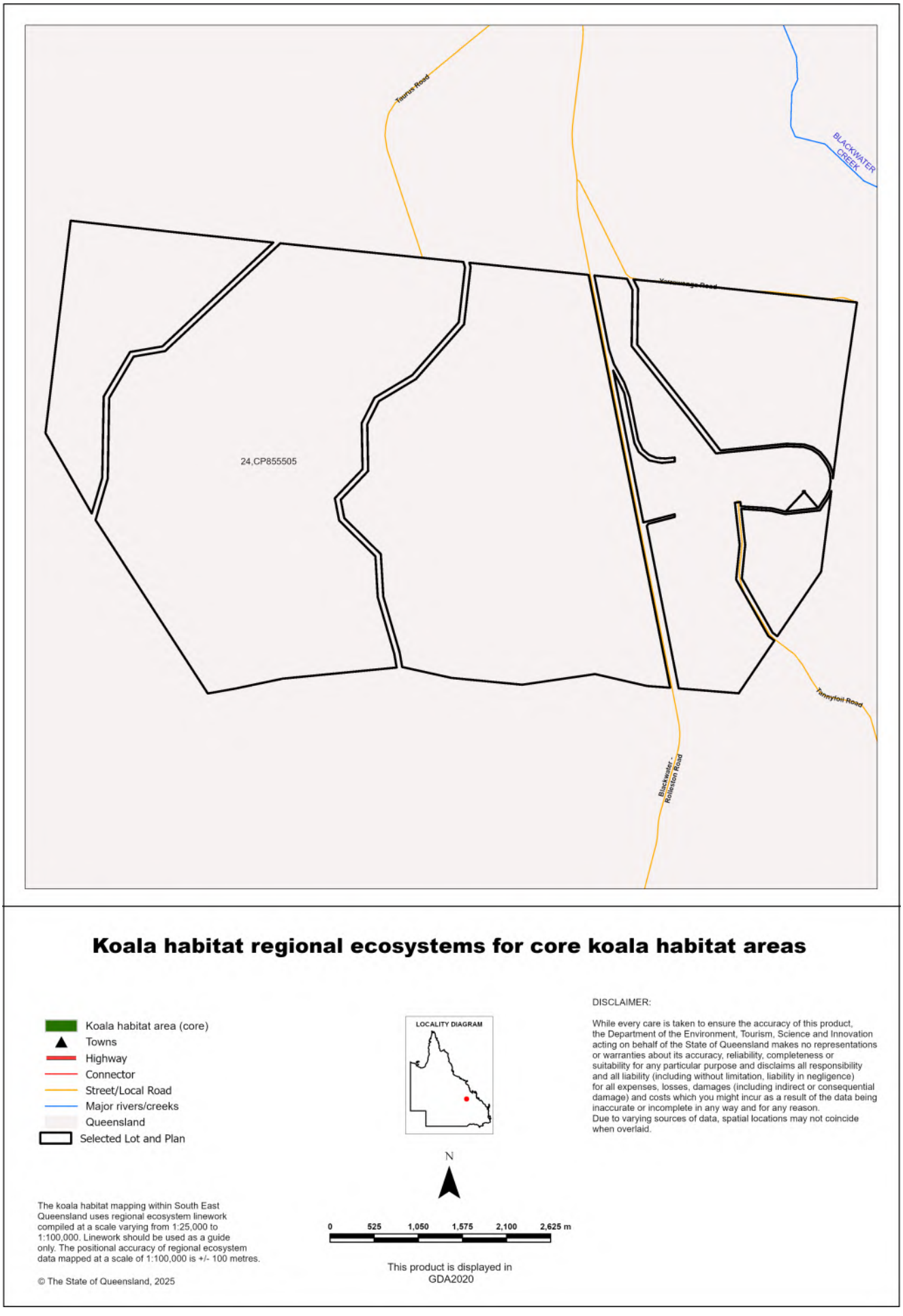
7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



7.3 Koala habitat regional ecosystems for core koala habitat areas



8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
Interference with overland flow	*Water Act 2000*	Department of Local Government, Water and Volunteers	Ph: 13 QGOV (13 74 68) www.dlgwv.qld.gov.au
Earthworks, significant disturbance	*Soil Conservation Act 1986*	Queensland Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development	Ph: 13 QGOV (13 74 68) www.nrmmrrd.qld.gov.au
Fire Permits	*Fire and Emergency Services Act 1990*	Queensland Fire Department	Ph: 13 QGOV (13 74 68) www.fire.qld.gov.au
Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Queensland Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism	Ph: 13 QGOV (13 74 68) www.tatsipca.qld.gov.au
Mining and environmentally relevant activities Infrastructure development (coastal) Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) www.detsi.qld.gov.au
Protected plants and protected areas	*Nature Conservation Act 1992* *Planning Act 2016*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 1300 130 372 (option 4) palm@detsi.qld.gov.au www.detsi.qld.gov.au
Koala mapping and regulations	*Nature Conservation Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) Koala.assessment@detsi.qld.gov.au
Interference with fish passage in a watercourse, mangroves Forestry activities	*Fisheries Act 1994* *Forestry Act 1959*	Queensland Department of Primary Industries	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Climate Change, Energy, the Environment and Water (Australian Government)	Ph: 1800 803 772 www.dcceew.gov.au
Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Queensland Department of State Development, Infrastructure and Planning	Ph: 13 QGOV (13 74 68) www.planning.qld.gov.au
Coordinated projects	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Office of the Coordinator-General	Ph: 13 QGOV (13 74 68) www.statedevelopment.qld.gov.au/coordinator-general
Wet Tropics World Heritage Area	*Wet Tropics World Heritage Protection and Management Act 1993*	Queensland Wet Tropics Management Authority	Ph: (07) 4241 0500 www.wettropics.gov.au
Requirements on State controlled road	*Transport Infrastructure Act 1994*	Queensland Department of Transport and Main Roads	Ph: 13 QGOV (13 74 68) https://www.tmr.qld.gov.au
Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Your relevant local government office	Local Government Contact Directory



Vegetation management report

For Lot: 3 Plan: RP843182
11/04/2025

nrmmrrd.qld.gov.au

Queensland Government

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of the Environment, Tourism, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of the Environment, Tourism, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 3 Plan: RP843182 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
3	RP843182	Freehold	7,996,000

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 3 Plan: RP843182 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 3 Plan: RP843182, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Central Highlands Regional	Fitzroy	Brigalow Belt	Isaac - Comet Downs

2. Vegetation management framework (administered by the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2023, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 3 Plan: RP843182

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category R	less than 0.01
Category X	798.86

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

The following Property Map of Assessable Vegetation (PMAVs) may be present on this property.
Reference number:
2009/006406

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
11.4.8	Endangered	R	less than 0.01	Eucalyptus cambageana woodland to open forest with Acacia harpophylla or A. argyrodendron on Cainozoic clay plains	Sparse
11.4.9	Endangered	R	less than 0.01	Acacia harpophylla shrubby woodland with Terminalia oblongata on Cainozoic clay plains	Sparse
11.9.5	Endangered	R	less than 0.01	Acacia harpophylla and/or Casuarina cristata open forest to woodland on fine-grained sedimentary rocks	Mid-dense
non-rem	None	X	798.86	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C

No records

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

No Class A

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 3 Plan: RP843182.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.qld.gov.au/environment/land/management/vegetation/maps/map-request

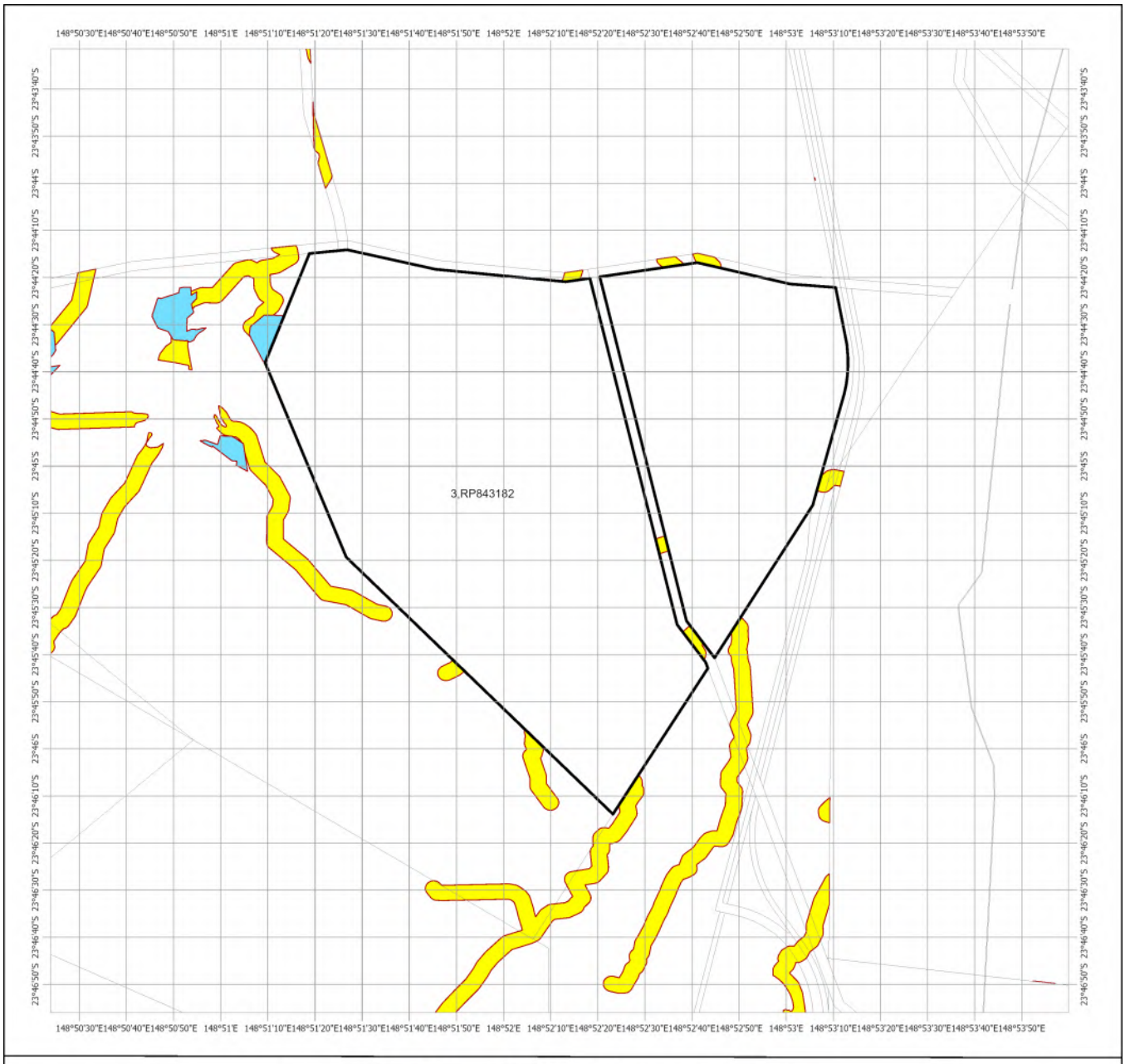
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

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LOCALITY DIAGRAM



- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries
- Selected Lot and Plan

N

0 360 720 1,080 1,440 1,800 m

This product is displayed in: GDA2020

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

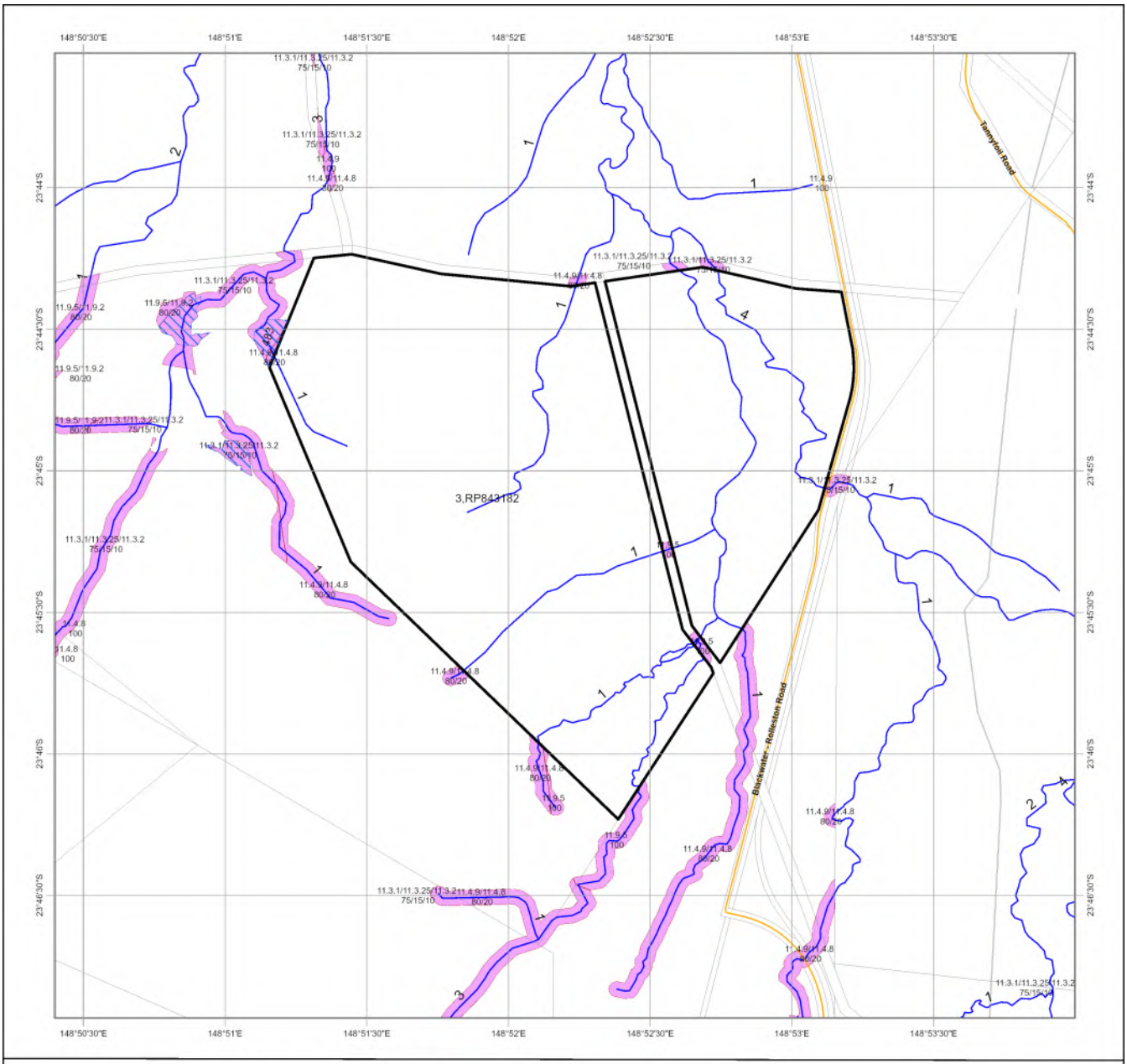
Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

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4.2 Vegetation management supporting map



Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

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LOCALITY DIAGRAM



N

0 260 520 780 1,040 1,300 m

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Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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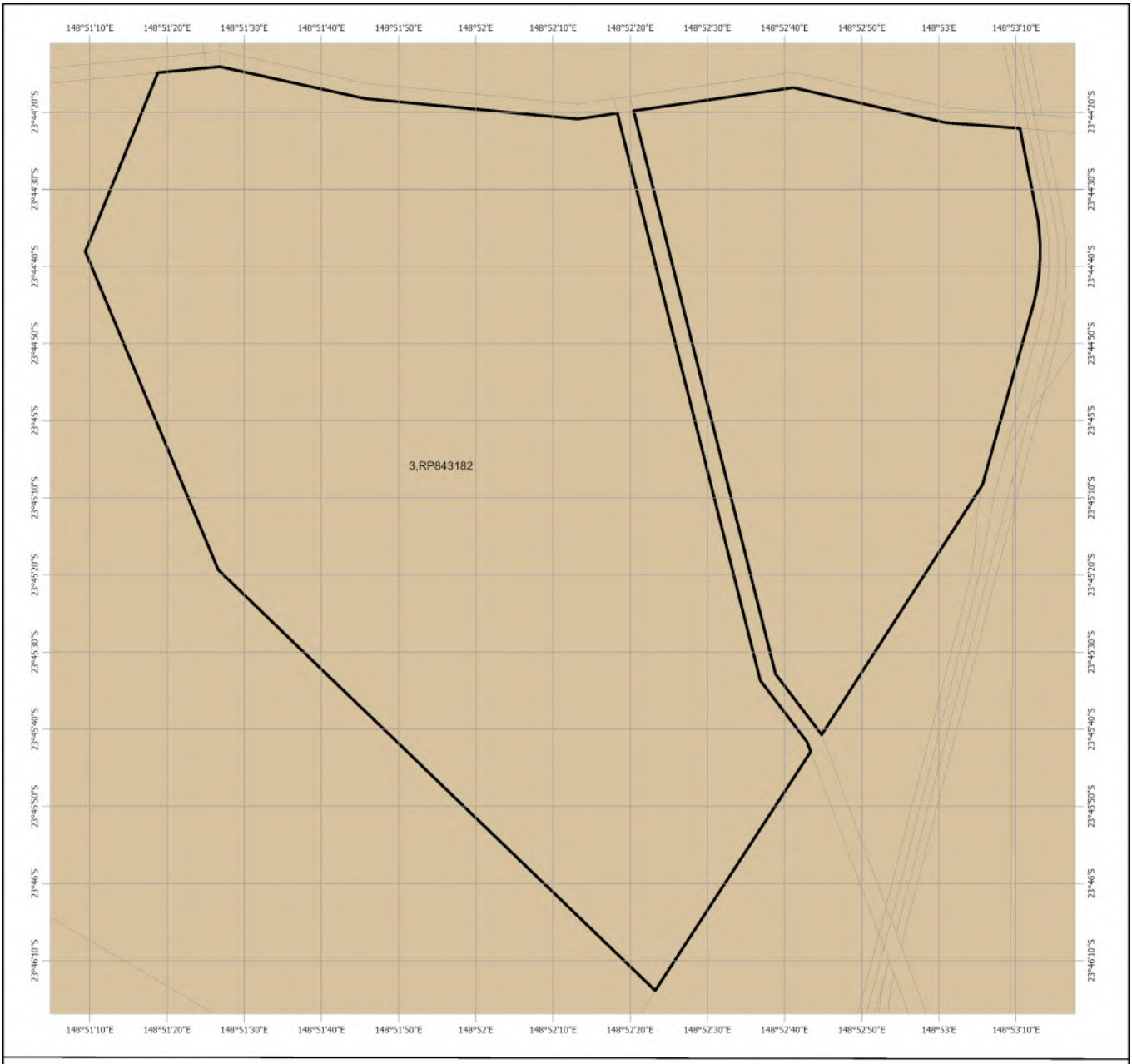
Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrmmrrd.qld.gov.au or contact the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.spatial.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

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4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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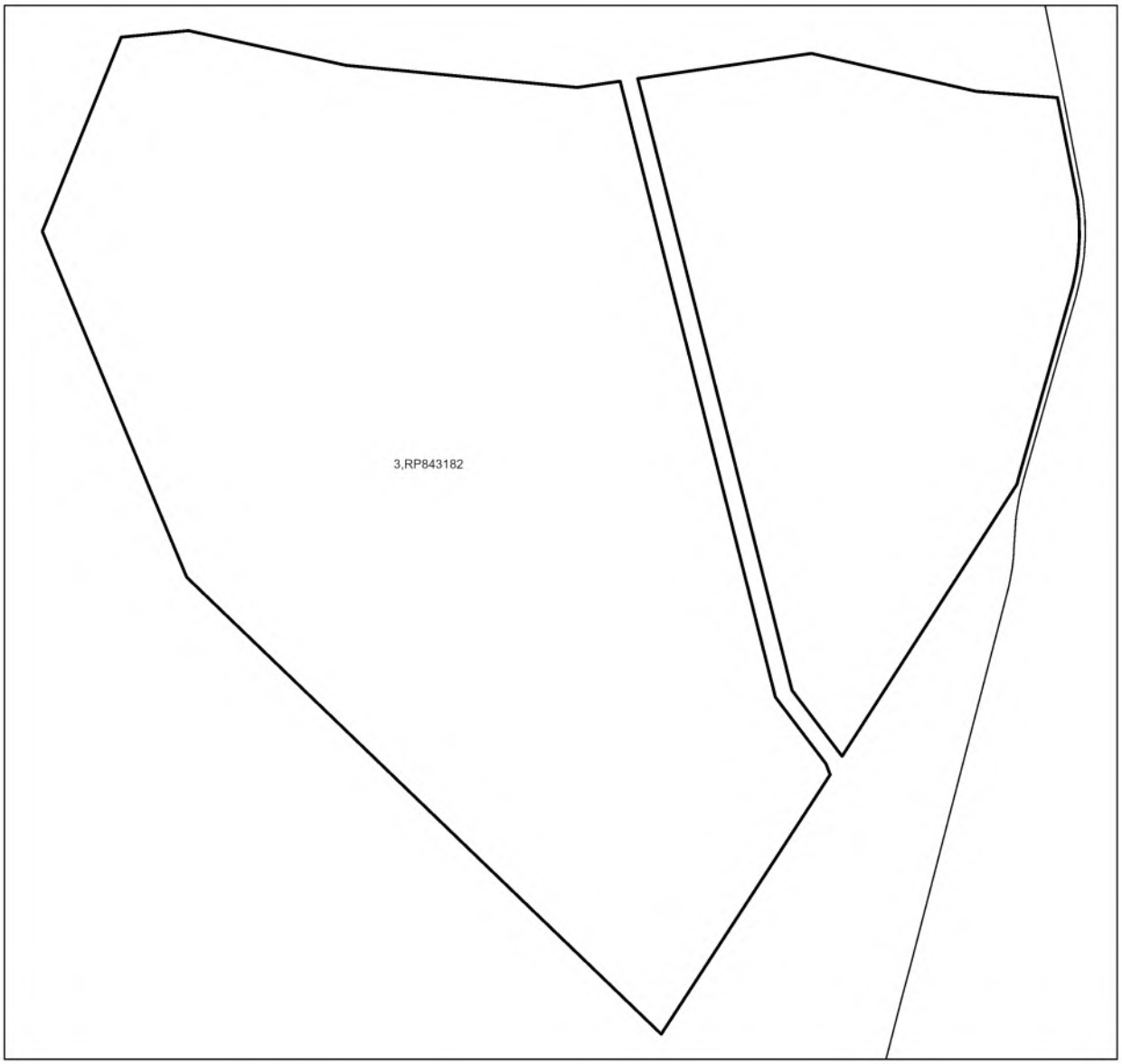
N

0 220 440 660 880 1,100 m

This product is displayed in:
GDA2020

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4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

- Towns
- Rivers and creeks
- Freeways / motorways; Highways
- Secondary roads; Streets

Agricultural land class A or B

- A
- B
- Not class A or B
- Selected Lot and Plan

LOCALITY DIAGRAM



N

0 225 450 675 900 1125 m

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5. Protected plants framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of Endangered, Vulnerable, Near-Threatened (EVNT) plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of the Environment, Tourism, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DETSI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

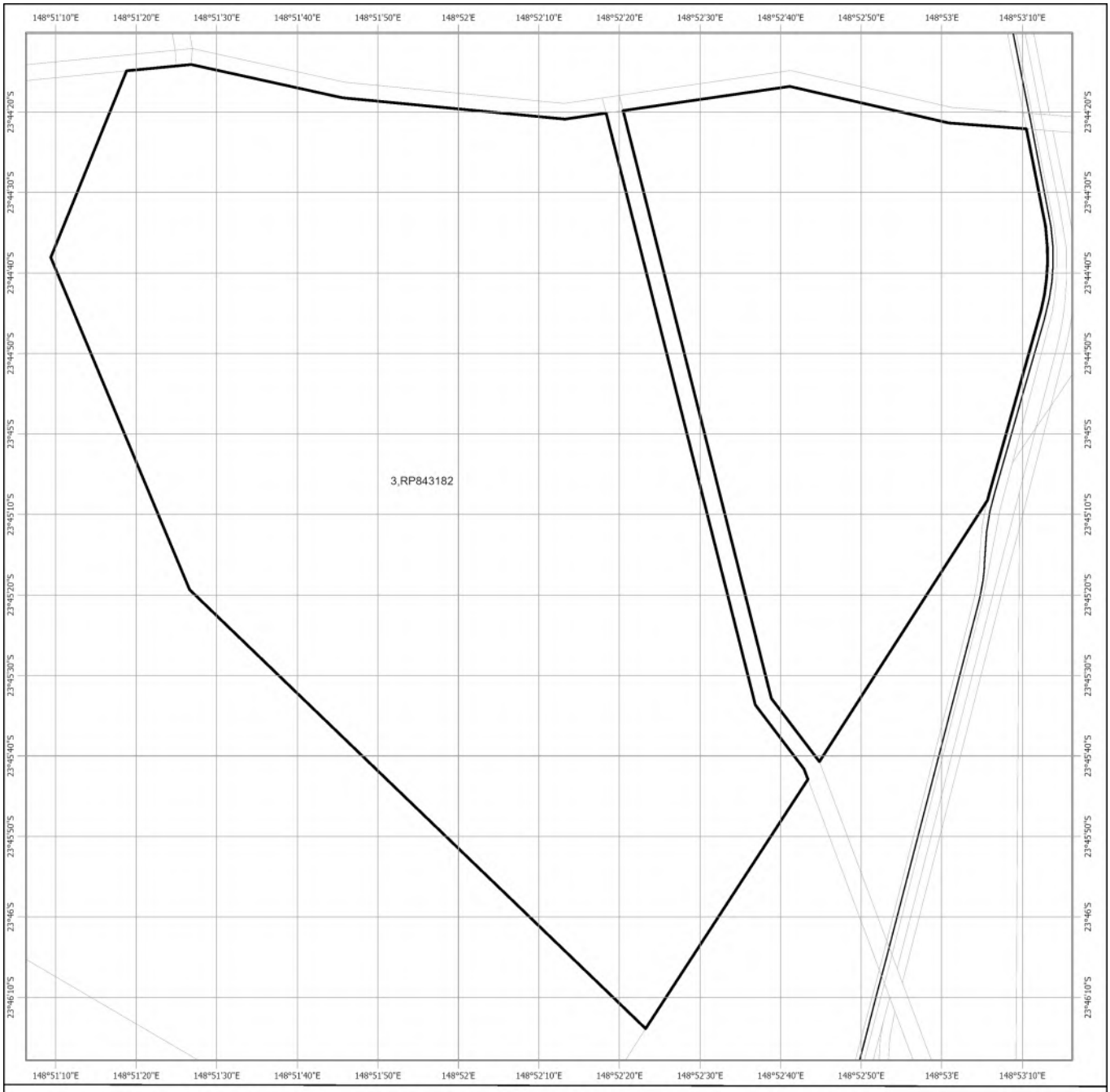
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of the Environment, Tourism, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of the Environment, Tourism, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 150 300 450 600 750 m

This product is displayed in:
GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of the Environment, Tourism, Science and Innovation at palm@des.qld.gov.au

Disclaimer: While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.

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6. Koala protection framework (administered by the Department of the Environment, Tourism, Science and Innovation (DETSI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DETSI

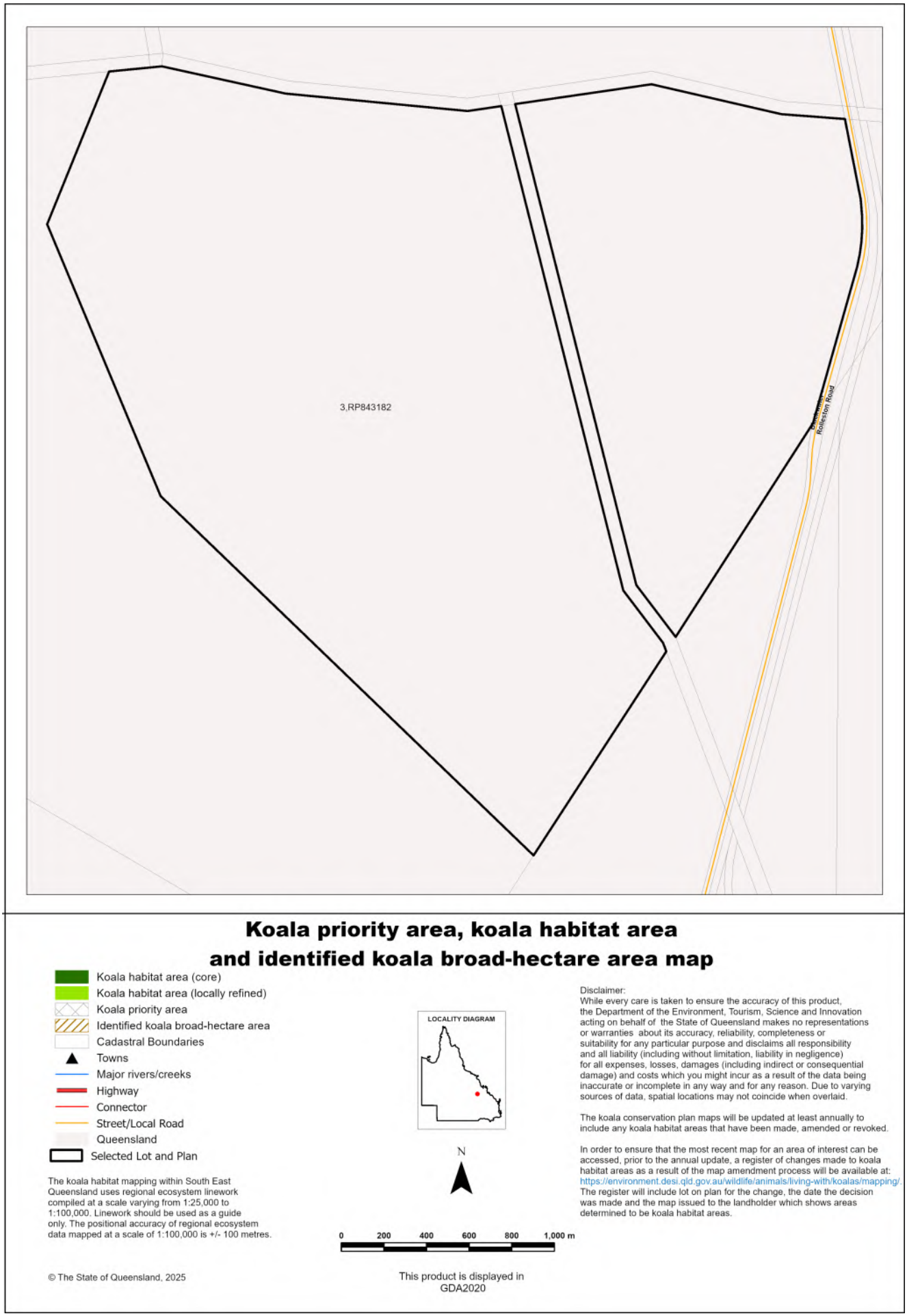
For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@detsi.qld.gov.au
Visit https://environment.desi.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 3 Plan: RP843182

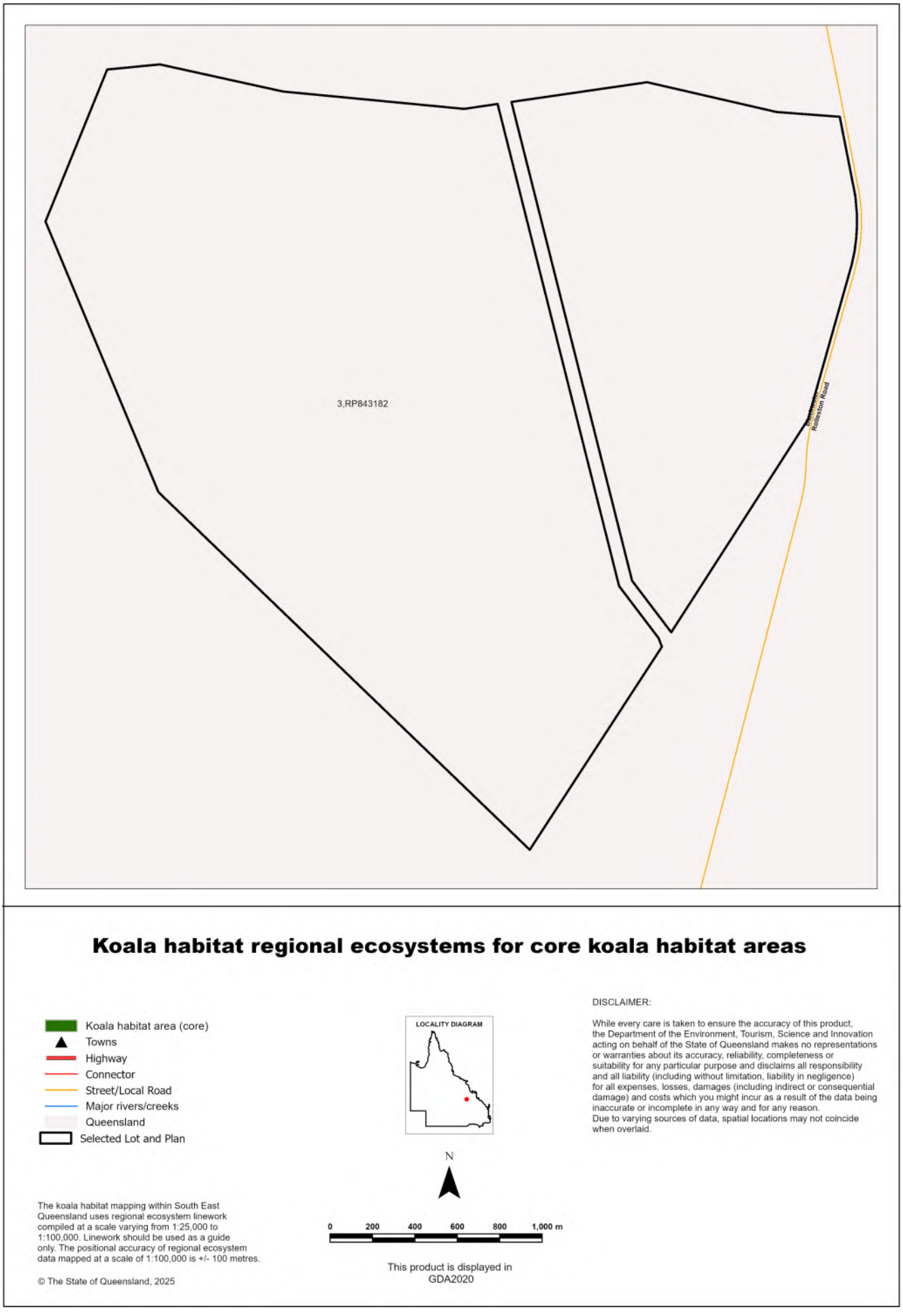
7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



7.3 Koala habitat regional ecosystems for core koala habitat areas



8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
Interference with overland flow	*Water Act 2000*	Department of Local Government, Water and Volunteers	Ph: 13 QGOV (13 74 68) www.dlgwv.qld.gov.au
Earthworks, significant disturbance	*Soil Conservation Act 1986*	Queensland Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development	Ph: 13 QGOV (13 74 68) www.nrmmrrd.qld.gov.au
Fire Permits	*Fire and Emergency Services Act 1990*	Queensland Fire Department	Ph: 13 QGOV (13 74 68) www.fire.qld.gov.au
Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Queensland Department of Women, Aboriginal and Torres Strait Islander Partnerships and Multiculturalism	Ph: 13 QGOV (13 74 68) www.tatsipca.qld.gov.au
Mining and environmentally relevant activities Infrastructure development (coastal) Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) www.detsi.qld.gov.au
Protected plants and protected areas	*Nature Conservation Act 1992* *Planning Act 2016*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 1300 130 372 (option 4) palm@detsi.qld.gov.au www.detsi.qld.gov.au
Koala mapping and regulations	*Nature Conservation Act 1992*	Queensland Department of the Environment, Tourism, Science and Innovation	Ph: 13 QGOV (13 74 68) Koala.assessment@detsi.qld.gov.au
Interference with fish passage in a watercourse, mangroves Forestry activities	*Fisheries Act 1994* *Forestry Act 1959*	Queensland Department of Primary Industries	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Climate Change, Energy, the Environment and Water (Australian Government)	Ph: 1800 803 772 www.dcceew.gov.au
Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Queensland Department of State Development, Infrastructure and Planning	Ph: 13 QGOV (13 74 68) www.planning.qld.gov.au
Coordinated projects	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Office of the Coordinator-General	Ph: 13 QGOV (13 74 68) www.statedevelopment.qld.gov.au/coordinator-general
Wet Tropics World Heritage Area	*Wet Tropics World Heritage Protection and Management Act 1993*	Queensland Wet Tropics Management Authority	Ph: (07) 4241 0500 www.wettropics.gov.au
Requirements on State controlled road	*Transport Infrastructure Act 1994*	Queensland Department of Transport and Main Roads	Ph: 13 QGOV (13 74 68) https://www.tmr.qld.gov.au
Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Your relevant local government office	Local Government Contact Directory

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

Custom input

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

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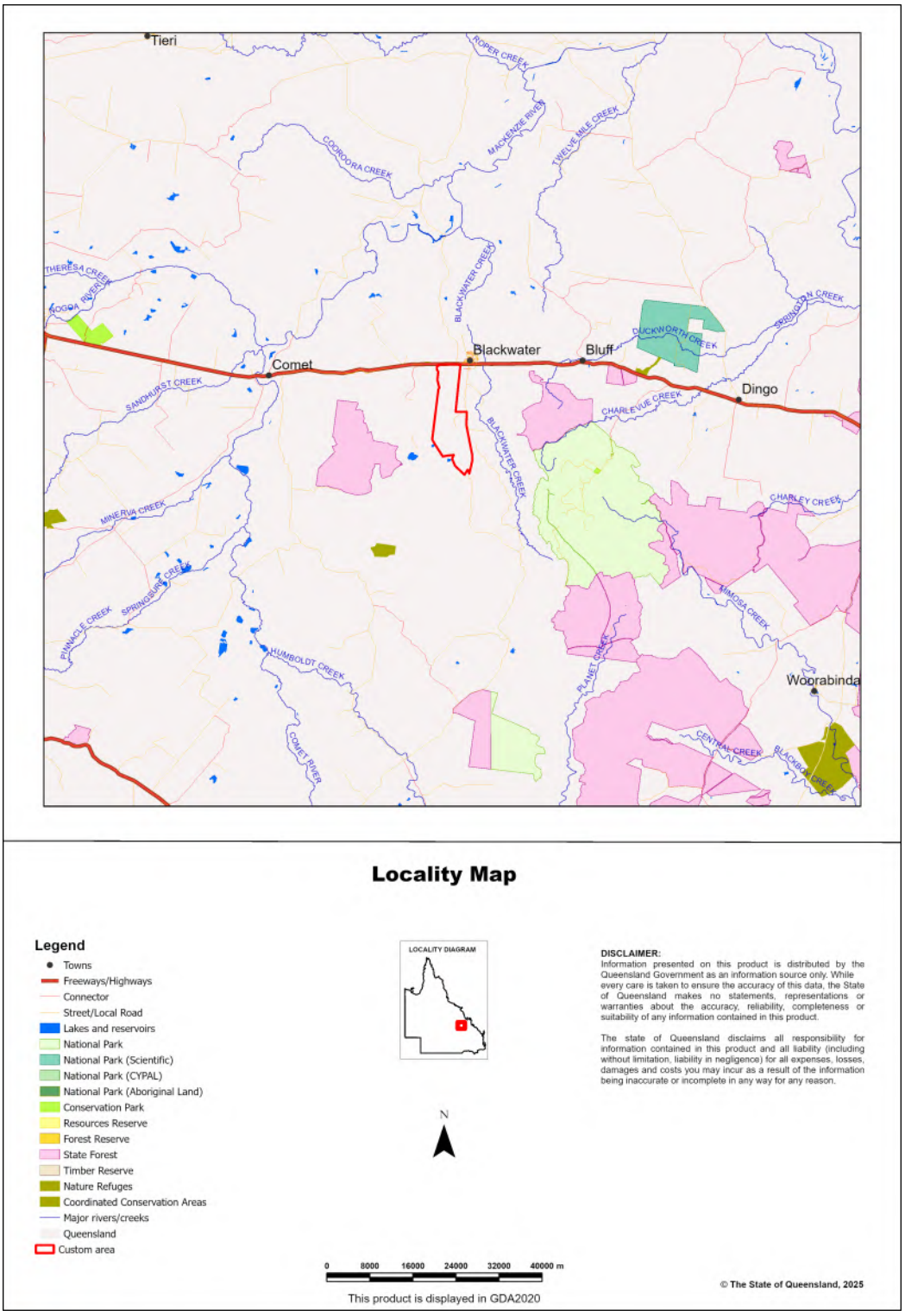
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: Custom input, with area 8521.7 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Central Highlands Regional	Fitzroy	Brigalow Belt	Isaac - Comet Downs



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	0.0%
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	73.38 ha	0.9%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	26.96 ha	0.3%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	44.98 ha	0.5%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	127.32 ha	1.5%
8d Regulated Vegetation - Essential habitat	71.94 ha	0.8%
8e Regulated Vegetation - intersecting a watercourse	112.9 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	Core
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	E	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	None
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
11.3.1/11.3.25/11.3.2	E-dom	rem_end
11.3.2/11.3.25/11.3.1	E-subdom	rem_end

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Regional ecosystem	Vegetation management polygon	Vegetation management status
11.3.1/11.3.25/11.3.2	E-dom	hvr_end
11.4.9/11.4.8	E-dom	hvr_end

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Regulated vegetation map category	Map number
R	8650

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

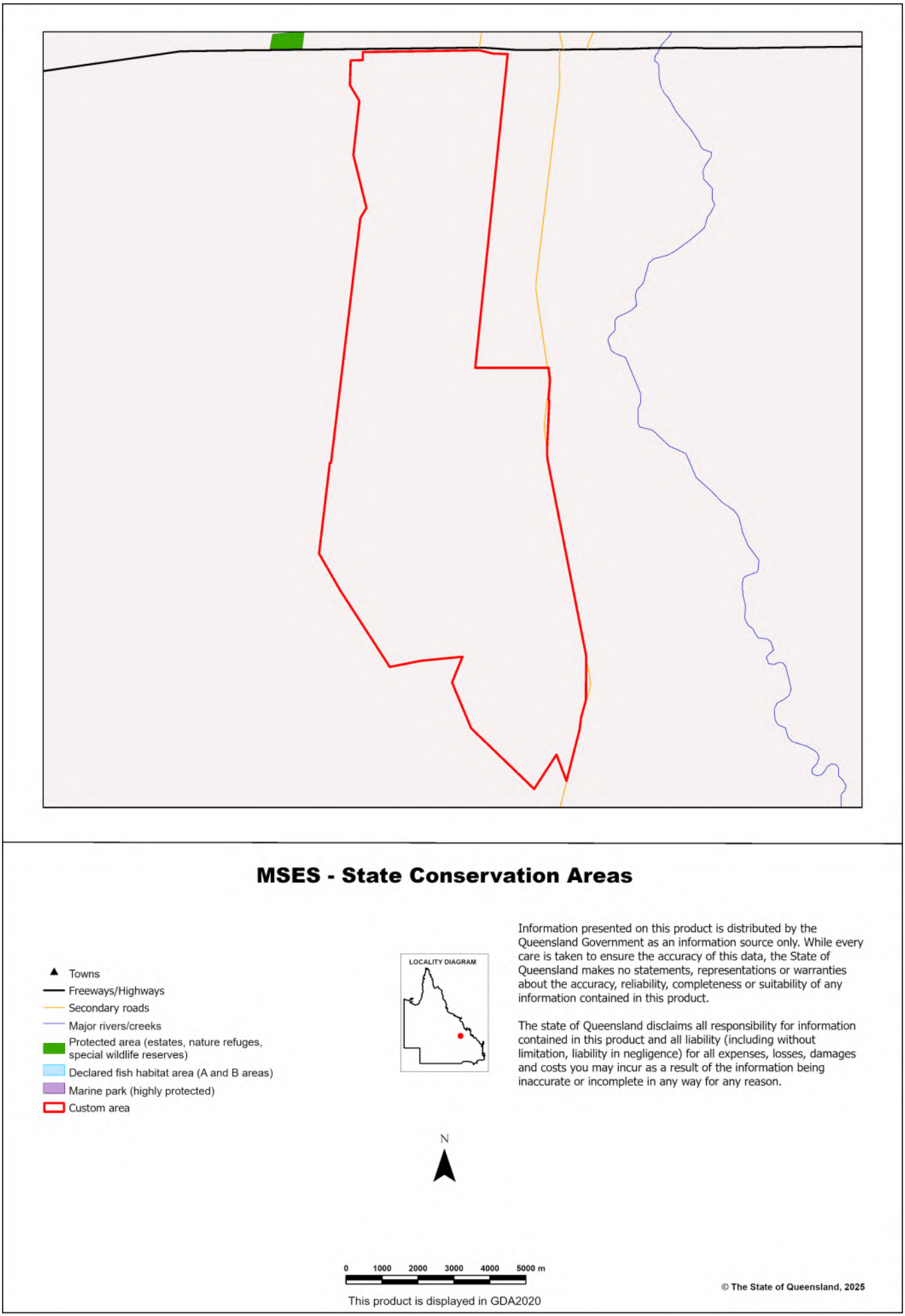
(No results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

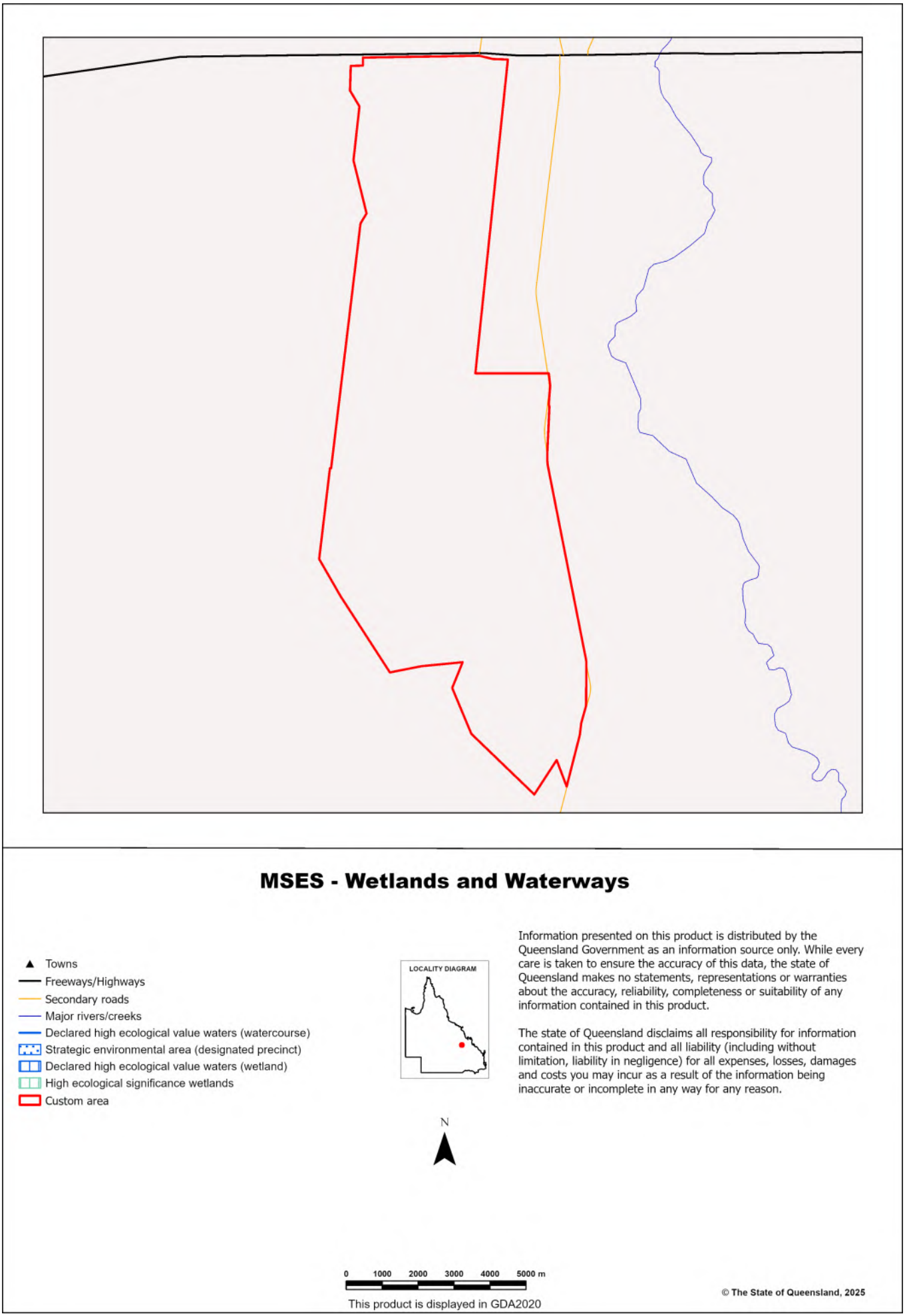
(No results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

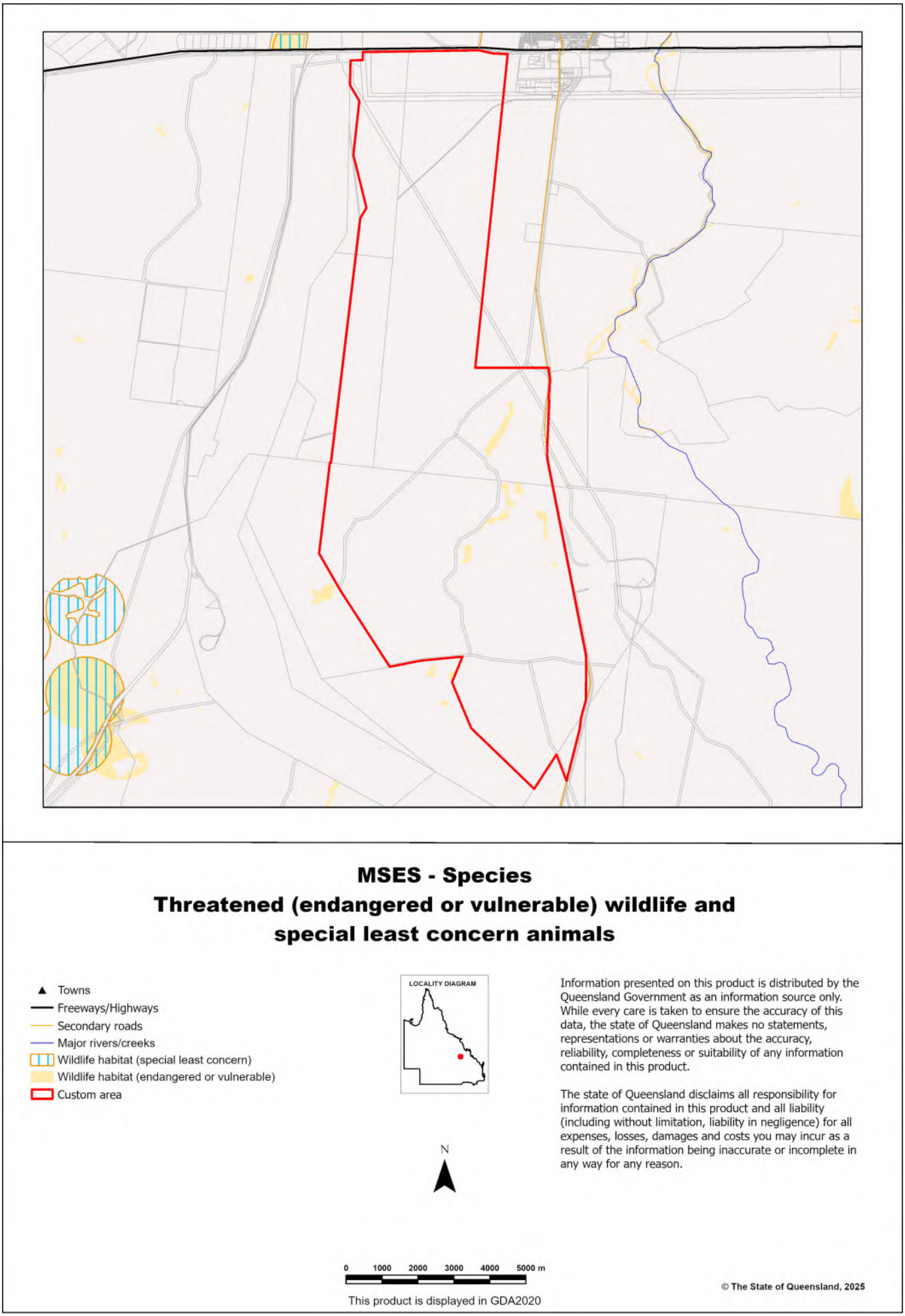
Map 1 - MSES - State Conservation Areas



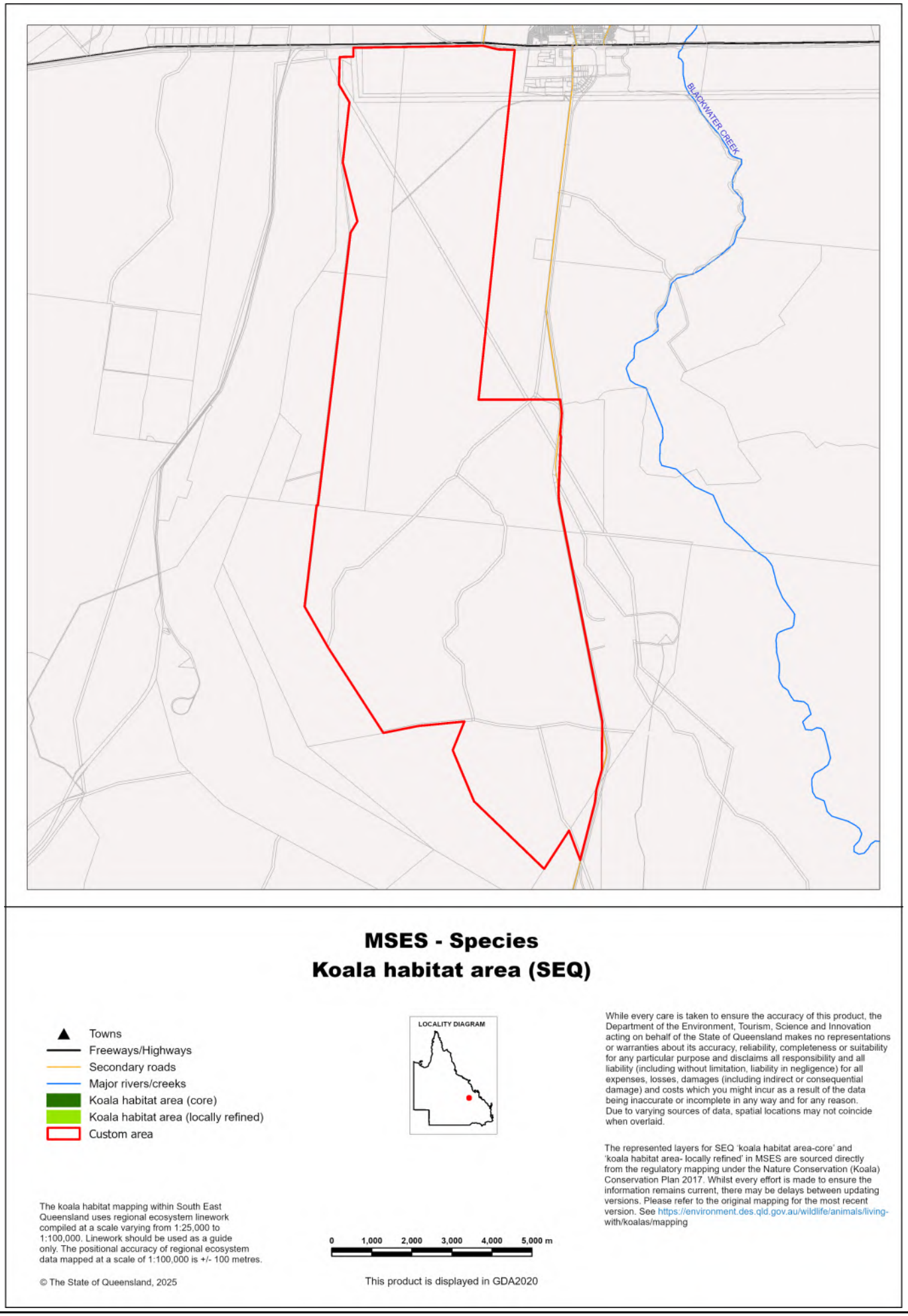
Map 2 - MSES - Wetlands and Waterways



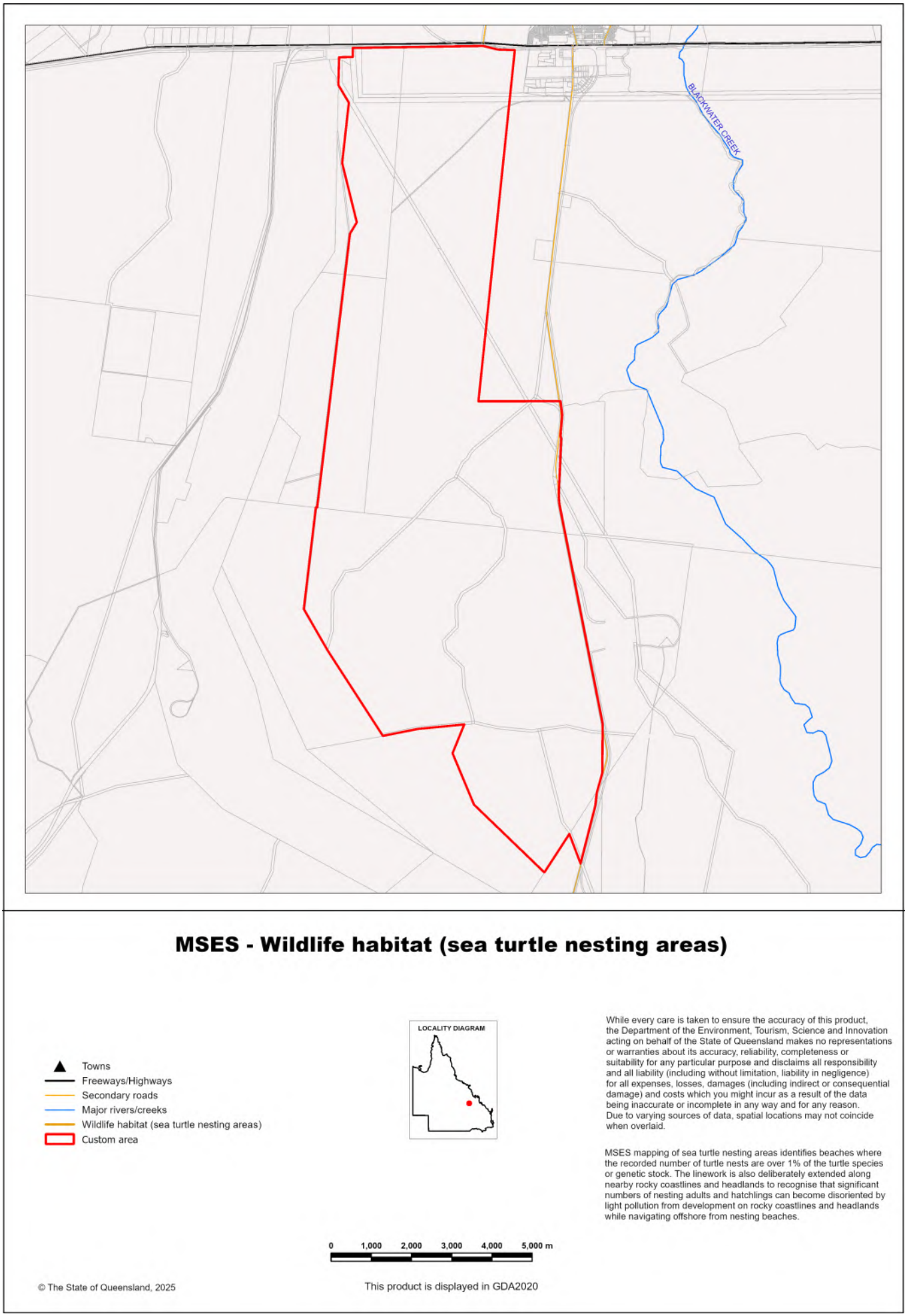
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



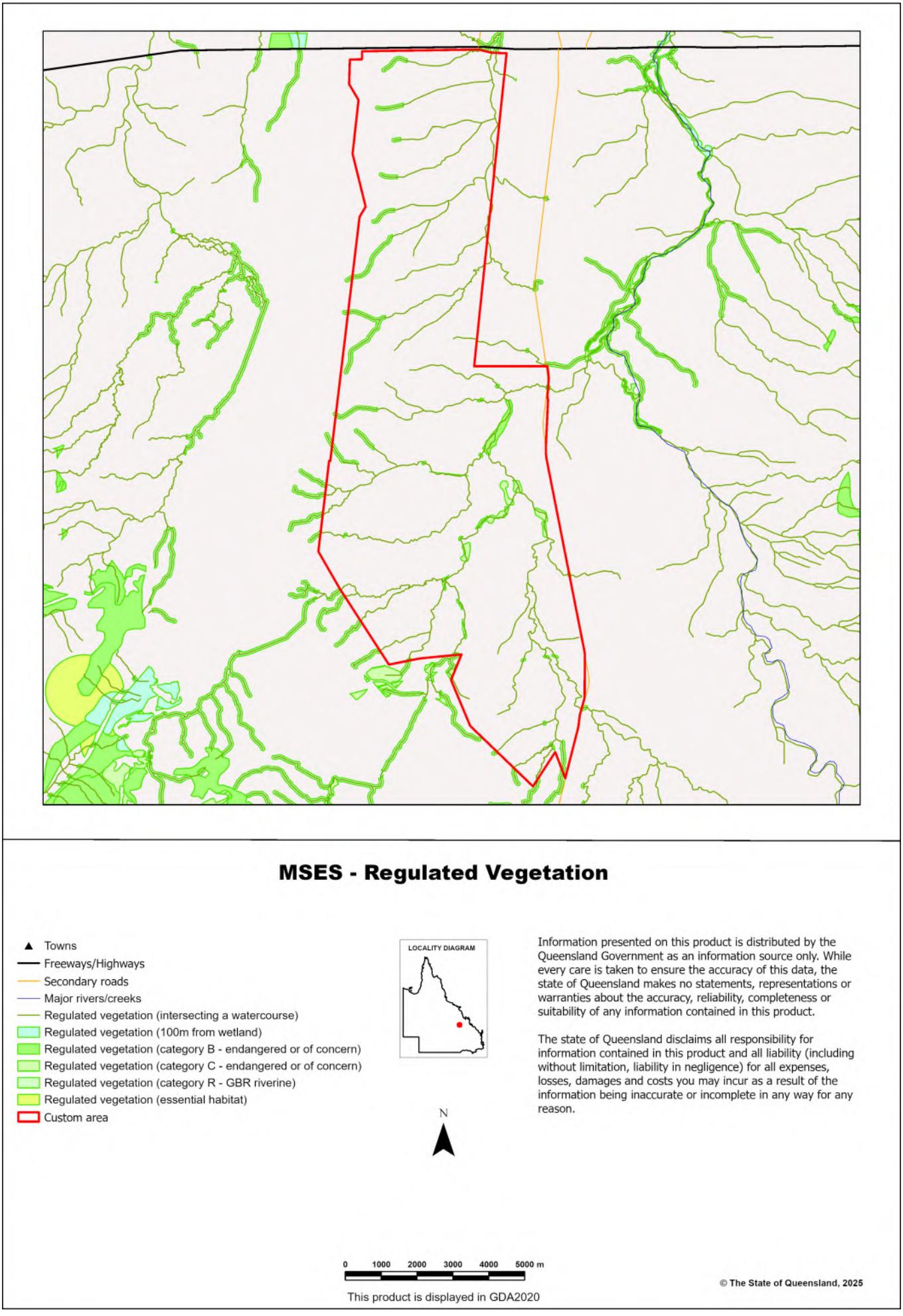
Map 3b - MSES - Species - Koala habitat area (SEQ)



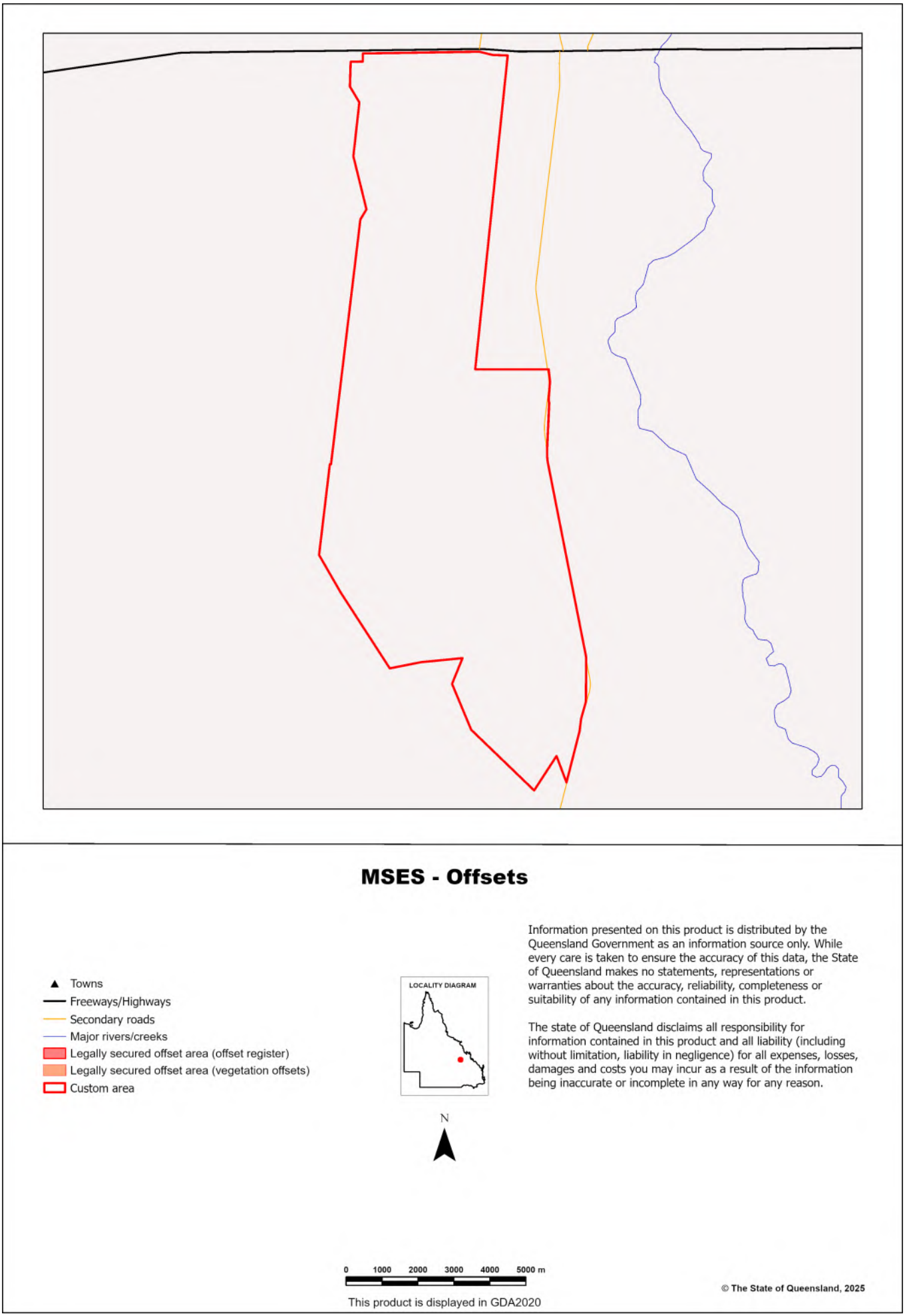
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

MSES mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

MSES mapping does not determine whether state or local development assessment is required. For state assessment triggers refer to the Development Assessment Mapping System (DAMS). For local assessment triggers, refer to the relevant local planning scheme.

The Queensland Government's "Method for mapping - matters of state environmental significance can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

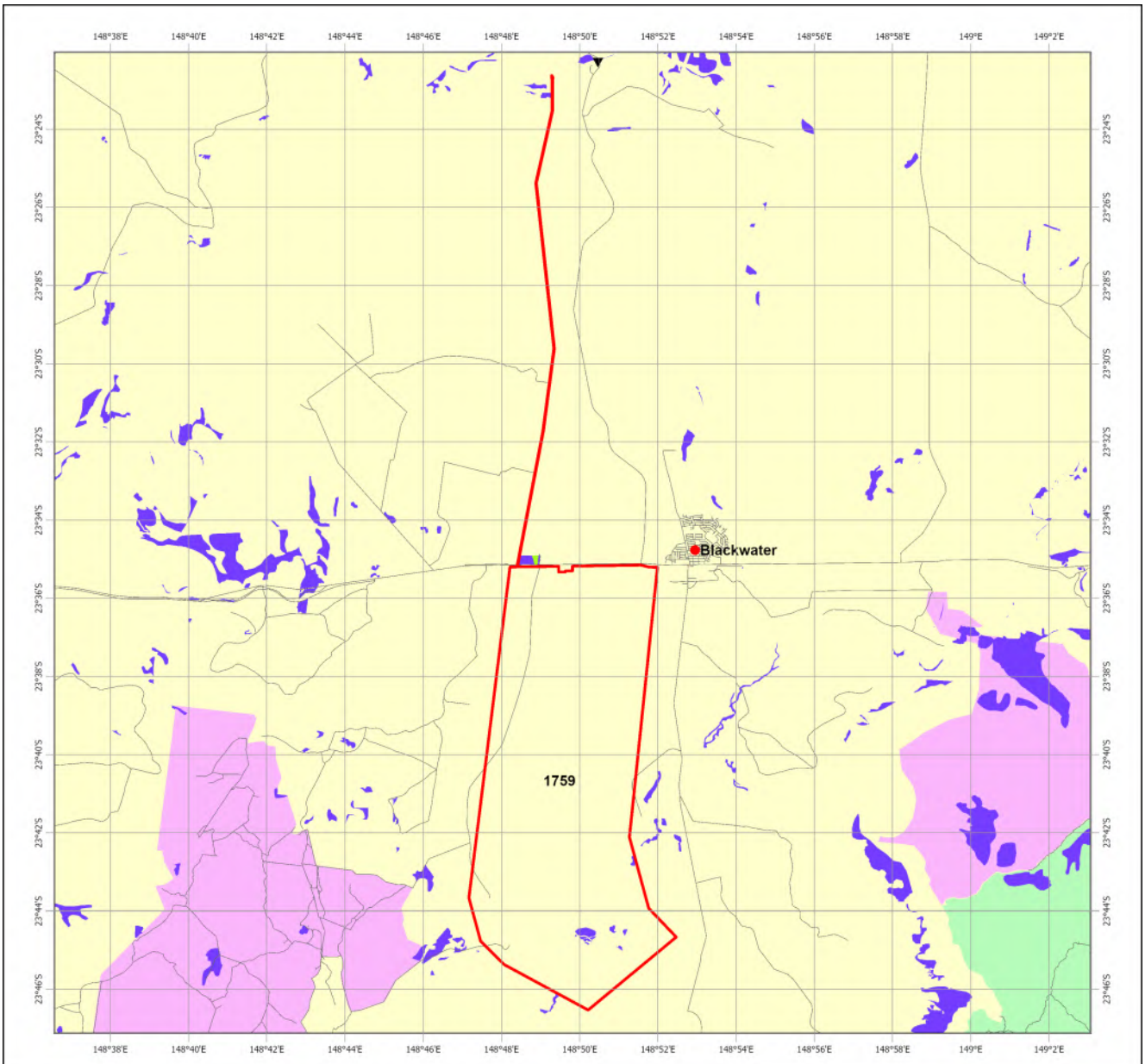
MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DETSI
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DETSI	- Department of the Environment, Tourism, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA2020	- Geocentric Datum of Australia 2020
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

Centred on tenure: ML: 1759

Map requested: 11/04/2025 16:31:34



ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

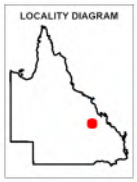
CATEGORY A
- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Region
- Marine Parks other than General Use Zones

CATEGORY B
- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants
- Selected Mining Lease (ML)

CATEGORY C
- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS
- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



N

0 2,500 5,000 7,500 10,000 12,500 m

This product is displayed in GDA2020

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NOTE TO USER: Themes presented in this map are indicative only. Field survey may be required to verify the 'true' spatial extent and value. Not all environmentally sensitive areas are presented in this map. A user should refer to the particular circumstances relevant to their situation to assess the 'completeness' of themes provided.

The user should note that some boundaries and indicated values are ambient and may change over time (e.g. regional ecosystem boundaries and conservation status, watercourse mapping etc.).

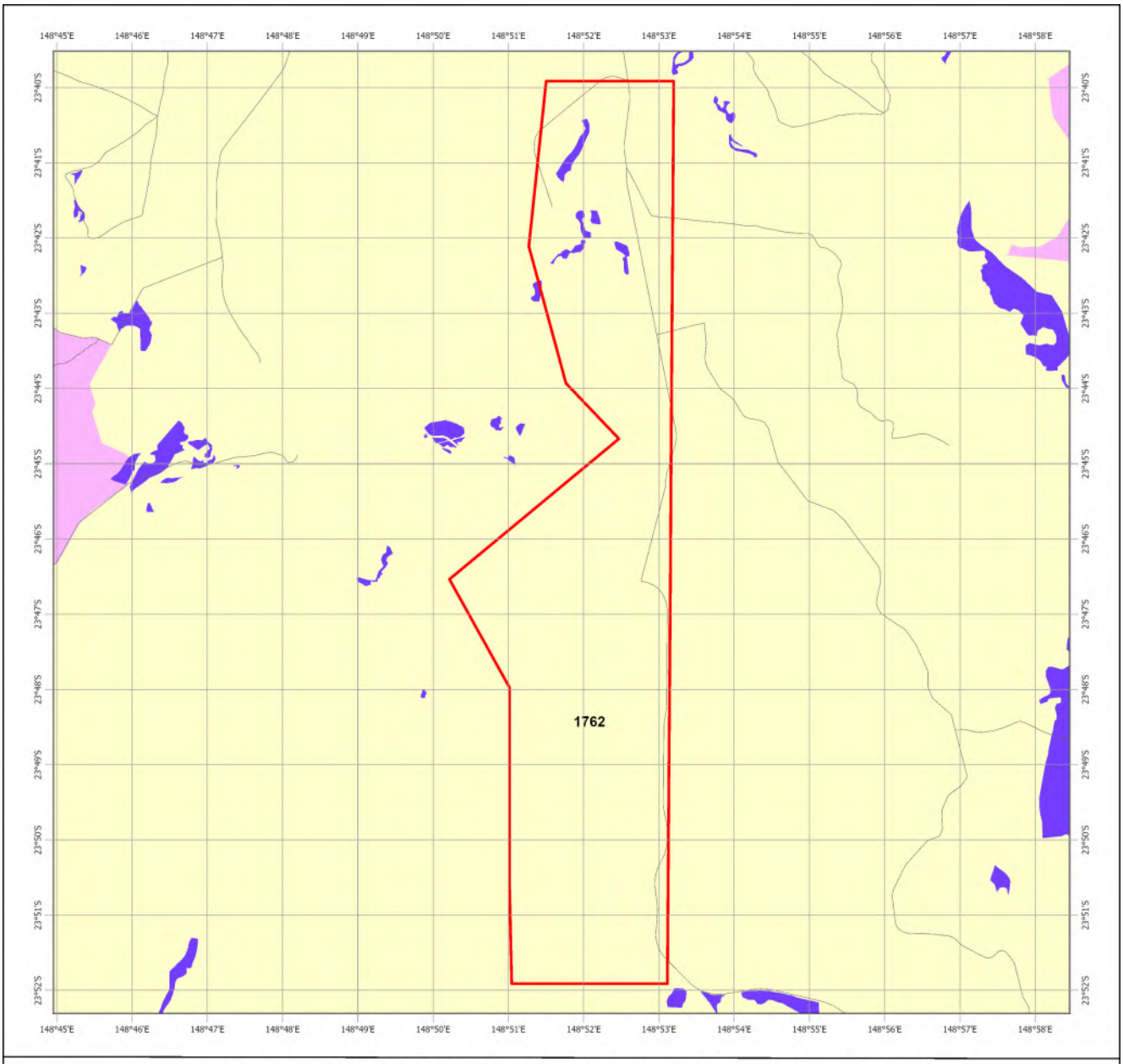
The user should be aware that due to multiple overlapping themes/ layers present, some themes/layers may be obscured by others. Ordering in the Legend does not accurately reflect the order by which themes/layers are displayed.

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Centred on tenure: ML: 1762

Map requested: 11/04/2025 16:32:13



ENVIRONMENTALLY SENSITIVE AREAS - Mining Activities

CATEGORY A

- National Parks
- Conservation Parks
- Forest Reserves
- Special Wildlife Reserve
- Wet Tropics World Heritage Area
- Great Barrier Reef Region
- Marine Parks other than General Use Zones

CATEGORY B

- Queensland Heritage Register Places
- Ramsar Sites
- Cultural Heritage Registered Areas and DLA's other than Stanbroke
- Special Forestry Areas
- Seaward Side of Highest Astronomical Tide
- Fish Habitat Areas
- Coordinated Conservation Areas
- Endangered Regional Ecosystems - regrowth and remnant (Biodiversity Status)
- General Use Zones of Marine Parks
- Marine Plants
- Selected Mining Lease (ML)

CATEGORY C

- Nature Refuges
- Resources Reserve
- State Forests
- Timber Reserves
- River Improvement Areas
- Stanbroke DLA
- Coastal Management District
- Dams and Weirs

OTHERS

- Towns
- Roads
- Repealed Wild River Nominated Waterways
- Repealed Wild River Preservation Areas
- Repealed Wild River High Preservation Areas
- Mahogany Glider Habitat
- Directory of Important Wetlands
- Queensland

LOCALITY DIAGRAM



N

0 1,000 2,000 3,000 4,000 5,000 m

This product is displayed in GDA2020

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NOTE TO USER: Themes presented in this map are indicative only. Field survey may be required to verify the 'true' spatial extent and value. Not all environmentally sensitive areas are presented in this map. A user should refer to the particular circumstances relevant to their situation to assess the 'completeness' of themes provided.

The user should note that some boundaries and indicated values are ambient and may change over time (e.g. regional ecosystem boundaries and conservation status, watercourse mapping etc.).

The user should be aware that due to multiple overlapping themes/ layers present, some themes/layers may be obscured by others. Ordering in the Legend does not accurately reflect the order by which themes/layers are displayed.

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Appendix B Likelihood of occurrence

B.1 Threatened ecological communities (TECs)

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
Brigalow (*Acacia harpophylla* dominant and co-dominant)	E	Brigalow (*Acacia harpophylla* dominant and co-dominant) (Brigalow TEC) is a woodland ecological community characterised by the presence of *Acacia harpophylla* as one of the most abundant tree species (Butler, 2007). *Acacia harpophylla* is either a dominant in the tree layer, or co-dominant with other species – notably *Casuarina cristata* (belah), other species of *Acacia*, or species of *Eucalyptus*. The community is usually characterised by an open forest or woodland structure with a mixture of eucalypts, acacia and casuarina species in the canopy and occurs with a considerable range of vegetation structure and suite of species on acidic and salty clay soils (DotE, 2013a). The Brigalow TEC occurs over a substantial geographic area in semi-arid eastern Australia. Brigalow woodlands are found mostly west of the Great Dividing Range, stretching in a broad swathe east of Blackall, Charleville and Cunnamulla, north almost to Townsville in Qld, south to Narrabri in NSW, and west to Bourke on the Darling River and Blackall in central western Qld. In Qld it is found in the Brigalow Belt North, Brigalow Belt South, Mulga Lands, Darling Riverine Plains and Southeast Queensland IBRA bioregions (DotE, 2013a). Brigalow TEC coincides with 16 Qld REs under the EPBC Act (Queensland Herbarium, 2025b): In the Qld Brigalow Belt Bioregion – REs 11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14 and 11.12.21; In the Qld Southeast Queensland Bioregion – REs 12.8.23, 12.9-10.6 and 12.12.26; and, In the Qld Mulga Lands Bioregion – RE 6.4.2.	**Confirmed present** A total of 148.88 ha of Brigalow TEC was mapped within the Study Area in association with remnant and high value regrowth areas of RE 11.3.1 and 11.9.5 and remnant RE 11.4.9.
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	E	The Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Blet South Bioregions TEC are characterised by the dominance of *Eucalyptus coolabah* subsp. *coolabah* (Coolibah, Coolabah) and/or *Eucalyptus largiflorens* (Black Box) in the canopy of a eucalypt woodland structure where the understorey tends to be grassy (DSEWPC, 2011).	**Not present** Mapped areas of RE 11.3.3, which is analogous with the TEC, were identified within the Study Area, however the Study Area is located outside of the Brigalow Belt southern bioregion in which this TEC is located (DSEWPaC, 2011a).

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
		The TEC is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees (DSEWPC, 2011). The landscape is flat to low relief where small changes in slope and height can influence the species composition. Found in a climatic zone with summer dominant rainfall of an average of approximately 250-700 mm/year. Average minimum monthly temperatures range from -2°C to 5°C and average maximum monthly temperatures range from 23°C to 35°C (DSEWPC, 2011). Vegetation structure may vary from tall woodland in riparian zones to very open woodland with a sparse id layer of shrubs and saplings and a grassy ground layer, typically forming mosaics with grasslands, shrublands and wetlands. *Eucalyptus coolabah subsp. coolabah* (Coolibah) must be present in the tree canopy and is typically a dominant. The relative dominance of Coolibah and Black Box varies across the range of the ecological community and in response to landscape position. Black Box may be a dominant tree species on parts of the central and northern riverine plains of NSW and on slightly more elevated parts of the floodplain. Black Box is less common in the north-eastern part of the ecological community's range (DSEWPC, 2011). or subdominant tree species. Where Coolibah is not the dominant tree species present on its own, then Coolibah together with *E. largiflorens* (Black Box) make up the dominant tree species in the canopy (TSSC, 2011). It is a floodplain ecological community within the upper reaches of the Murray-Darling Basin and southern part of the Fitzroy River system, limited to the Darling Riverine Plains and Brigalow Belt South bioregions in northern NSW and southern QLD. The northern limit is the northern boundary of the Brigalow Belt South bioregion in QLD. In QLD it is likely to occur in the following Catchment Management Authorities/Natural Resource Management Regions: Border Rivers Maranoa-Balonne, Condamine, Desert Channels, Fitzroy and South-West Queensland (DSEWPC, 2011). The Coolibah – Black Box Woodlands TEC coincides with 5 Qld REs: 11.3.3, 11.3.15, 11.3.16, 11.3.28 and 11.3.37 (TSSC, 2011).	
Natural Grasslands of the Queensland	E	The Natural grasslands of the Queensland central highlands and northern Fitzroy Basin TEC occurs in a subtropical, subhumid climatic	**Not present**

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
Central Highlands and northern Fitzroy Basin		zone with a marked wet summer and moderately dry winter. Mean annual rainfall over most of the ecological community ranges from 500-700 mm. Usually, this TEC occurs on flat ground or gently undulating rises on soils that have formed either in situ on the fresh basalt, or on fine-grained sedimentary rocks, or where the material has been transported to form extensive alluvial plains along ancient and flood-prone watercourses. Soils include cracking clays, often deep and dark in colour though may be shallower on ridges or sloping land. The cracking or self-mulching nature means that they expand when wet and contract when dry (TSSC, 2009b). The ecological community is endemic to Queensland. It broadly occurs where the Fitzroy River Basin and the Brigalow Belt North coincide. It extends from Collinsville in the north to Carnarvon National Park in the south. It is bounded to the south by the Expedition, Carnarvon, Great Dividing, Drummond and Narrien ranges; and to the north by the Clark, Denham, Connors and Broadsound ranges (TSSC, 2009b). Trees are mostly excluded from the area possibly due to the cracking that might tear tap roots and inhibit deep penetration during most rainfall events. The TEC is typically composed of a mixture of forbs (i.e. herbs that are broad-leaved and not grass-like) and native grasses. The perennial native grasses are the primary indicators, based on their prominence and utility as indicators. They are mostly dominated by Dichanthium spp. (Bluegrasses), with tropical Aristida spp. (Three-awned grasses) and Panicum spp. (Panic grasses) also a major component (TSSC, 2009b). Temperate grasses, such as Austrostipa spp. (Spear grasses) and Austrodanthonia spp. (Wallaby grasses), are lacking and are more a feature of grasslands further south (Fensham, 2003). Drier sites of the TEC may include a higher proportion of Astrebla spp. (Mitchell grasses). Whilst shrub cover is typically a minor component of the grassland, in some areas the cover of shrubs, such as Acacia salicina (Sally Wattle) and Acacia farnesiana (Mimosa), can be more extensive QLD REs include: 11.3.21, 11.4.4, 11.4.11, 11.8.11, 11.9.3, 11.9.12, and 11.11.17 (TSSC, 2009b).	No vegetation communities with potential to contain this TEC were found to occur within the Study Area (TSSC, 2009b).

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
Poplar Box Grassy Woodland on Alluvial Plains	E	The Poplar Box Grassy Woodland on Alluvial Plains TEC is typically a grassy woodland with a canopy dominated by *Eucalyptus populnea* and understorey mostly of grasses and other herbs. The TEC may include a low density of shrubs, however patches of the ecological community generally lack a substantial mid layer (tall shrub). Vegetative ground cover can be very sparse during dry periods but become mid-dense after rain particularly if fire has been absent for a long time. It occurs on paleo and recent depositional soils in flat terrain and occasionally along watercourses in undulating country. It is mainly associated with active and depositional plains and flats including back plains, higher terraces, levees along rivers particularly in QLD. It is sometimes found in close proximity to ephemeral watercourses and depressions. The soils in these watercourses are considered alluvial and the regularity of flow after heavy rain curtails shrub growth. These soils typically occur as clay, clay-loam, loam or sandy-loam (DEE, 2019). Of note, *Eucalyptus populnea* is commonly known as either Poplar Box or bimble box, depending on the region and subspecies that were formerly recognised (DEE, 2019). The TEC is located west of the Great Dividing Range, typically at less than 300 m ASL and between latitudes 20°S to 34°S. The ecological community is scattered across a broad distribution in eastern Australia, intergrading with but ranging further west and north than other grassy woodlands that extend through NSW and southern Qld, including: south of Charters Towers in Qld, north of Leeton in NSW, west of Ipswich in Qld and Armidale in NSW and east of Longreach in Queensland and Hillston in NSW. As the TEC has a wide distribution, the mean annual rainfall can range from about 400 mm up to 800 mm per year in agro-climates within QLD that range from semi-arid to limited moisture (DEE, 2019). REs considered analogous to this TEC include; 11.3.2, 11.3.17, 11.4.7, 11.4.12, and 12.3.10 (DEE, 2019).	**Not present** Mapped areas of RE 11.3.2, which is analogous with the TEC, were identified within the Study Area, however these patches did not meet the minimum condition thresholds.
Semi-evergreen vine thickets of the Brigalow Belt (North and South)	E	Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC is a community of extremely dry seasonal subtropical rainforest. The TEC occurs just north-west of Townsville in Queensland to central northern NSW, mostly within the	**Not present** Remnant REs containing vine thickets listed as potentially analogous with this TEC were not

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
and Nandewar Bioregions		Brigalow Belt North and South bioregions. Post-clearing distribution of the TEC means that remnant patches are scattered on rocky outcrops in the Broken River subregion of the Einasleigh Uplands, through the northern and central parts of the Brigalow Belt to its south-eastern parts between Jandowae and Killarney on the Queensland/New South Wales border. In QLD, the TEC is generally characterised by the prominence of trees with microphyll sized leaves (2.5–7.5 cm long) and the frequent presence of swollen-stemmed *Brachychiton* spp. (bottle trees) as emergents from the vegetation. The thickets typically have an uneven canopy 4–9 m high with mixed evergreen, semievergreen and deciduous emergent tree species 9–18 m high and vines, twining or scrambling plants prominent. Fluctuations in the composition and diversity of species can be based on the amount of rainfall received, with floristic composition differing as follows (DCCEEW, 2023a): • Brigalow Belt North: trees typically include Brachychiton australis (Broad-leaved Bottle Tree), Drypetes deplanchei (Yellow Tulip), Diospyros humilis (Small-leaved Ebony), Gyrocarpus americanus (Helicopter Tree), Geijera salicifolia (Brush Wilga), Planchonella cotinifolia (Yellow Lemon) and Strychnos psilosperma (Strychnine), with the vines Cissus reniformis and Jasminum didymum. Common emergent trees range from fully deciduous (e.g. Broad-leaved Bottle Tree, Helicopter Tree) to semi-evergreen (e.g. Euroschinus falcata (Ribbonwood), Pleiogynium timorense (Burdekin Plum)). • Brigalow Belt South: vine thickets in Qld commonly, but not invariably, have a shrub understorey, with common species including Acalypha eremorum (Soft Acalypha), Alectryon diversifolius (Scrub Boonaree), Everistia vacciniifolia, Carissa spinarum (Currantbush), Croton phebalioides, Exocarpos latifolius, Geijera parviflora (Wilga), Pittosporum spinescens (Wallaby Apple) and Triflorensia ixoroides. Common vines/lianes include Clematicissus opaca, Cissus oblonga, Trophis scandens, Jasminum spp., Marsdenia spp., Cynanchum viminale subsp. brunonianum, Secamone elliptica, Parsonsia lanceolata and Tylophora spp.	identified within the Study Area (DCCEEW, 2023a).

Community name	EPBC Act status	Habitat preference and distribution	Likelihood of occurrence
		In Queensland, the ecological community is most common on undulating plains on fine grained sedimentary rocks (frequently shale) and on basalt hills and plains, though also occurring less frequently on coastal dunes, Quaternary alluvium, Tertiary clay plains, old loamy and sandy plains, or hills and lowlands on metamorphic rocks (DCCEEW, 2023a). QLD REs include: 11.2.3, 11.3.11, 11.4.1, 11.5.15, 11.8.3, 11.8.6, 11.8.13, 11.9.4, 11.9.8 and 11.11.18 (DCCEEW, 2023a).	
Weeping Myall Woodlands	E	Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which Weeping Myall (*Acacia pendula*) trees are the sole or dominant overstorey species. Other vegetation may occur in the community but not as dominant species (TSSC, 2009a). It occurs on the inland alluvial plains west of the Great Dividing Range in QLD and NSW, and an outlying patch in VIC. In QLD it occurs in the Darling Riverine Plains, Brigalow Belt South, Brigalow Belt North and Nandewar IBRA Bioregions. It generally occurs as part of a mosaic of sparse to open woodlands and treeless shrublands and grasslands. It generally occurs on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. These areas are not associated with active drainage channels and are rarely if ever flooded. It occurs on black, brown, red-brown or grey clay or clay loam soils (TSSC, 2009a). It varies in structure throughout its range forming an open woodland in higher rainfall areas, becoming sparse/scattered stands of woodland occurring in discrete bands fringing better-watered country with decreasing rainfall. Can also occur as relatively narrow strips on the margins of floodplain woodland or on minor depressions or run-on areas adjacent to sandhills (TSSC, 2009a). In QLD it is restricted to small patches within REs 11.3.2 and 11.3.28 (TSSC, 2009a).	**Not present** While RE 11.3.2 was observed within the Study Area, the eponymous weeping myall (*Acacia pendula*) was not recorded (DEWHA, 2009).

B.2 Flora

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Acacia storyi	-	V	This species typically grows on sandstone plateaux with sandy, shallow skeletal soils over sandstone. The vegetation in these areas includes open forests or tall open forests, with associated species such *as Eucalyptus tereticornis*, *E. hendersonii*, *E. cloeziana*, *E.melanoleuca*, *E. propinqua*, and *Aristida spp*. Most populations of the species are found on Blackdown Tableland, with three additional populations located outside the park in Rockland Spring and upper Davy Creek, near the footslopes of Experiditon Range (DETSI, 2025a).	No habitat occurring within the Study Area.	18 occurrence records (ALA, Wildnet) within the desktop search extent. All records are restricted to Blackdown Tablelands.	**Unlikely to occur** The species has not been recorded in the Study Area and nearby records are limited to Blackdown Tablelands.
Aristida annua **Annual wiregrass**	V	V	This species is known to occur in eucalypt woodlands with *Eucalyptus orgadophila* on black clay, basalt, and sandy, red loamy soils (DCCEEW, 2025j). This species is restricted to central QLD in the Emerald and Springsure districts. The northern distribution of the species occurs on the eastern slopes of Lord's Table Mountain, north of Yungaba. Other locations include Gindie Downs via Springsure; 50km south of Comet Downs; 8-	No habitat occurring within the Study Area.	No occurrence records within the desktop search extent. The nearest record occurs 27km southwest of the Study Area.	**Unlikely to occur** The Study Area does not comprise suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			30km south of Springsure (DCCEEW, 2025a).			
Arthraxon hispidus **Hairy-joint grass**	V	V	This species is found within or on the edges of rainforest and in wet eucalypt forest, near creeks and swamps, woodlands, around freshwater springs on coastal foreshore dunes, shaded gullies, creek banks and on alluvium in creek beds in open forest and also with bog mosses in mound springs (DCCEEW, 2025j). This species has scattered locations throughout QLD and on the northern tablelands and north coast of NSW, and overseas from tropical Africa to Asia. This species occurs as far south as Kempsey, and west to Glen Innes, NSW; in QLD it occurs north to Port Douglas, and west to disjunct occurrences around mound springs in Carnarvon National Park (NP); however, most occurrences are from Noosa southwards (DCCEEW, 2025j).	No habitat occurring within the Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution.
Baeckea trapeza	-	V	This species is endemic to the Blackdown Tableland, west of Rockhampton in central Queensland, where it grows at altitudes of 700-800 meters. It thrives on sandy soils in open Eucalyptus forests, often in association with species such as Leptospermum polygalifolium,	No habitat occurring within study the area. This species is endemic to Blackdown Tableland National Park.	4 occurrence records (ALA) within the desktop search extent. The nearest occurrence occurs approximately 17km from the Study Area.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Triplarina paludosa, Casuarina torulosa, and Melastoma affine (DETSI, 2025b).			
Bertya opponens	V	LC	This species occurs in a variety of vegetation communities including mixed shrubland, lancewood woodland, mallee woodland, eucalypt/acacia open forest with shrubby understorey, eucalypt/callitris open woodland and semi-evergreen vine-thicket. It grows in soils which are generally shallow sandy loams or red earths associated mostly with sandstone, but also with rhyolite, shale, and metasediments. Associated species include: woodland with *Eucalyptus citriodora* and *Alyxia spicata*; *Corymbia leichhardtii* woodland with some *Acacia harpophylla* on sandstone; sheltered sandstone gully with *Acacia shirleyi*, *Corymbia citriodora*, *C. trachyphloia*, *Gahnia aspera*; woodland of *E. cloeziana* with *E. suffulgens* and *Callitris endlicheri*; *E. crebra* /*C. trachyphloia* tall woodland; and in open woodland of *E. exserta*, *E. panda*, *C. trachyphloia* on lateritic sandstone (DCCEEW, 2025j; DETSI, 2025c). This species occurs in QLD and NSW in the Cobar	Suitable habitat present.	6 occurrence records (ALA, Wildnet) within the desktop search extent. The species has been observed in previous surveys in high densities (>6,500) along periphery of disturbed areas in association with Lancewood dominated communities of RE 11.7.2 south of the Study Area.	**Unlikely to occur** This species has been observed south of the Study Area in land zone 7. However, no suitable habitat was observed in the Study Area.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Peneplain, Brigalow Belt South, Brigalow Belt North, Southeastern QLD, NSW North Coast and New England Tablelands IBRA regions. In QLD, it is widely distributed within an area bounded by Emerald in the north and Charleville in the west, with an outlier near Charters Tower. In NSW, the species has been recorded at the following sites: north-east of Cobar; in the Jacks Creek State Forest area of the Pilliga Scrub; Gibraltar Range National Park east of Glen Innes; and Kangaroo River State Forest north-west of Coffs Harbour (TSSC, 2016).			
Bertya pedicellata	-	NT	This species has been recorded on rocky hillsides in eucalypt forest or woodland, Acacia woodland or shrubland and open heathland or vine thicket communities. The soil it grows in soils include skeletal to shallow sandy, sandy clay or clay loams overlaying rhyolite, trachyte, or sandstone substrates. Associated species include *Corymbia trachyphloia, Dodonaea filifolia, Acacia catenulata, A. curvinervia, A. shirleyi, A. rhodoxylon, A. sparsiflora, E. crebra, Acacia harpophylla* and *E. decorticans* (Department of Environment, Tourism, Science and Innovation (DETSI), 2025b).	No habitat occurring within the Study Area.	3 occurrence records (ALA) within the desktop search extent. The nearest record is approximately 12km East of the Study Area in Arthurs Bluff State Forest.	**Unlikely to occur** The species has been previously recorded within the desktop search extent, however the Study Area does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			This species is confined to central and south-east QLD, from near Aramac eastwards to Rockhampton and south to near Biggenden with an isolated record from the Warwick district. The species has been recorded in Peak Range National Park and Allies Creek State Forest (Department of Environment, Tourism, Science and Innovation (DETSI), 2025b).			
Cadellia pentastylis **Ooline**	V	V	This species grows in dry rainforest, semi-evergreen vine thickets and sclerophyll ecological communities, often locally dominant or as an emergent, on undulating terrain of various geology, including sandstone, conglomerate, and claystone. Soils generally have low to medium nutrient content and are normally associated with upper and mid-slopes in the landscape. The altitude is generally 300-460m above sea-level. The species forms a closed or open canopy, as a dominant or commonly with *Eucalyptus albens* and *Callitris glaucophylla*, with an open understorey and leaf litter dominating the forest floor. There is some uniformity in the understorey, with Native Olive (*Notelaea microcarpa*), Pinkwood (*Beyeria viscosa*), Bitterbark (*Alstonia constricta*), Wilga	No habitat occurring within the Study Area.	3 occurrence records (ALA) within the desktop search extent. The nearest record is 11km south of the Study Area.	**Unlikely to occur** The species has been previously recorded within the desktop search extent, however the Study Area does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			(*Geijera parviflora*), Berry Saltbush (*Einadia hastate*), *Stipa* spp. and *Aristida* spp., abundant at many locations (DCCEEW, 2025j). This species occurs on the western edge of the NSW north-west slopes, from Mt Black Jack near Gunnedah to west of Tenterfield, and extends into QLD to Carnarvon Range and Callide Valley, south-west of Rockhampton (DCCEEW, 2025j).			
Cerbera dumicola	-	NT	*Cerbera dumicola* occurs across a range of habitats in central and southern QLD. Associated vegetation and species include: sandstone hills in open *E. umbra* subsp. *carnea*; on plateaus, in woodland of *Acacia shirleyi* with *Corymbia dolichocarpa*; acidic soils in mine rehabilitation area; woodland of *A. catenulata* and *A. shirleyi* with *E. thozetiana* on a slope of sand/clay soil; semi-deciduous notophyll-microphyll vine forest of *Brachychiton australis*, *Gyrocarpus americanus*, *Flindersia australis*, *Pleiogynium timorense*, *Drypetes deplanchei* and *Sterculia quadrifida* on rhyolite hillslopes; open-woodland of *E. melanophloia* with occasional *Acacia shirleyi*, *E. populnea* and *E. brownii*; semi-evergreen vine thicket with	No suitable land zone 7 habitat is present within the Study Area.	9 occurrence records (ALA, Wildnet) within the desktop search extent. Historical surveys by EMM identified a population within remnant RE 11.7.2 in ML1792 south of the Study Area.	**Unlikely to occur** This species has been observed south of the Study Area in land zone 7. However, no suitable habitat was observed in the Study Area.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Corymbia citriodora and *Corymbia aureola* emergents; woodland of *A. rhodoxylon* on brown, sandy loam; and in *Corymbia tessellaris - Acacia aneura* open woodland (DETSI, 2025d) . Cerbera dumicola is known from central coastal and subcoastal QLD, with a few populations located in central QLD. The most northern populations are located 23km southwest of Charters Towers and the most southern population occurs at Baralaba (DETSI, 2025d).			
Coleus blakei	-	NT	This species typically grows in moist, well-drained soils, thriving in tropical and subtropical climates and preferring partial shade (Suva et al., 2015).	No habitat occurring within the Study Area. A population is present within Blackdown Tableland National Park.	10 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record occurs 15km from the Study Area.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Commersonia pearnii	-	CR	This species inhabits open forest and woodland alongside a range of canopy species. It grows on sandstone escarpments and tablelands with shallow, medium- to coarse-grained soils. It is only known from the Blackdown Tableland in central Queensland (DETSI, 2025e).	No habitat occurring within the Study Area. The species is restricted to Blackdown Tableland National Park.	1 occurrence record (ALA) within the desktop search extent within Blackdown Tableland National Park.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Corunastylis valida	-	V	This species grows in sandy soil in rocky places on the Blackdown Tableland (ALA, 2025)	No habitat occurring within the Study Area.	1 occurrence record (Wildnet) within the desktop search extent within Blackdown Tableland National Park.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Daviesia discolor	V	V	This species occurs on the Blackdown Tableland on sandy soil derived from sandstone and on lateritic clay, at altitudes of 60-900m, in open eucalypt forest dominated by species such as *Eucalyptus sphaerocarpa* and *Eucalyptus nigra*. In the Mount Walsh area, this species grows in very tall open forests of *Corymbia trachyphloia* and *Eucalyptus acmenoides* on hillcrests and slopes at 500-580m altitude on well-drained, shallow sandy loam to sandy clays. The population in Carnarvon National Park occurs on brown sandy loam of creek banks, in mixed shrubland with scattered Triodia sp. hummocks and Angophora sp. trees (DEWHA, 2008d). This is known from three widely disjunct localities in QLD, near Blackwater on the Blackdown Tableland, in the Mount Walsh area near Biggenden and north of Mount Playfair within Carnarvon National Park (DEWHA, 2008d).	No habitat occurring within the Study Area. A local population occurs within Blackdown Tableland National Park.	3 occurrence records (ALA) within the desktop search extent, the nearest occurrence approximately 12km East of the Study Area within Arthurs Bluff State Forest.	**Unlikely to occur** The species has been previously recorded within the desktop search extent, however the Study Area does not comprise suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Dichanthium queenslandicum **King Blue-grass**	E	V	This species occurs on black cracking clay in tussock grasslands in association with other species of blue grasses (*Dichanthium spp.* & *Bothriochloa spp.*). It is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains. Other species include *Aristida leptopoda, Bothriochloa erianthoides, Moorochloa eruciformis, Corchorus trilocularis, Cyperus bifax, Dichanthium sericeum, Digitaria brownii, D. divaricatissima, Eulalia fulva, Ipomoea lonchophylla, Iseilema vaginiflorum, Panicum decompositum, P. queenslandicum, Paspalidium globoideum, Parthenium hysterophorus* and *Thellungia advena*. Communities include *Acacia salicina* thickets in grassland and eucalypt woodlands (i.e. *Corymbia dallachiana, C. erythrophloia, E. orgadophila*) (TSSC, 2013). This species occurs from near Dalby north to about 90km north of Hughenden and west as far as Clermont. The main concentration of populations in central QLD in the Emerald region. It is found in Gemini Peaks NP north east of Clermont and	No habitat occurring within the Study Area.	No occurrence records within the desktop search extent. The nearest record occurs 28km Southwest of the Study Area.	**Unlikely to occur** The species has not been recorded within the desktop search extent and the the Study Area does not comprise suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Alpinia NP near Rolleston (TSSC, 2013).			
Dichanthium setosum **Bluegrass**	V	LC	This species is associated with heavy basaltic black soils and red-brown loams with clay subsoil. Associated species: White Box (*Eucalyptus albens*), Silver-leaved Ironbark (*E. melanophloia*), Yellow Box (*E. melliodora*), Manna Gum (*E. viminalis*), Amulla (*Myoporum debile*), Purple Wire-grass (*Aristida ramosa*), Kangaroo Grass (*Themeda triandra*), Fine-leaved Tussock-grass (*Poa sieberiana*), Red-leg Grass (*Bothriochloa ambigua*), Pitted Blue-grass (*B. decipiens*), *Macrozamia stenomera*, Small Woolly Burr-medic (*Medicago minima*), Scaly Buttons (*Leptorhynchos squamatus*), *Lomandra aff. longifolia*, Australian Bugle (*Ajuga australis*), Bogan-flea (*Calotis hispidula)* and *Austrodanthonia spp., Dichopogon spp., Brachyscome spp., Vittadinia spp., Wahlenbergia spp.* and *Psoralea spp.* This species is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, and highly disturbed pasture. It is often collected from	No habitat occurring within the Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not comprise suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched (DCCEEW, 2025j). It occurs chiefly on the northern tablelands in the Saumarez area, west of Armidale, and 18–30km east of Guyra. It is more rarely found on the north-western slopes, central western slopes and north-western plains of NSW, extending west to Narrabri. In QLD it has been reported from the Leichhardt, Morton, North Kennedy and Port Curtis regions (TSSC, 2012).			
Eucalyptus raveretiana **Black ironbox**	V	-	This species grows along watercourses and occasionally on river flats or open woodland. Soil varies from sand through to heavy clay. Altitudinal range is 0–300m and the climate of the area is sub-tropical with an annual rainfall of 650–1100m. The species is said to be highly salt tolerant. It does not occur in pure stands, but is co-dominant with species such as Broad-leaved Teatree (*Melaleuca leucadendra*), *M. fluviatilis*, Forest Red Gum (*Eucalyptus tereticornis*), Carbeen (*Corymbia tessellaris*) (Regional Ecosystem 11.3.25a) and occasionally in semi evergreen vine thicket (e.g.	No habitat occurring within the Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not comprise suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Broad-leaved Bottle Tree (*Brachychiton australis*), Narrow-leaved Bottle Tree (*Brachychiton rupestris*), Scrub Wilga (*Geijera salicifolia*) and *Lysiphyllum* spp.) (Regional Ecosystem 11.3.11). Other species it grows in association with include River Red Gum (*E. camaldulensis*), Moreton Bay Ash (*Corymbia tessellaris*), River Oak (*Casuarina cuninghamiana*) and Weeping Paperbark (*Melaleuca fluviatilis*) and other Regional Ecosystems that include 9.3.1 and 8.3.3 (DCCEEW, 2025j). This species occurs between Rockhampton and Ayr in QLD (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2008a).			
Homoranthus decumbens	E	V	This species occurs on flat country on deep sandy soils with lateritic pebbles, in heath and shrubby woodland. It has been recorded growing with *Goodenia racemosa*, *Petrophile sp.*, *Xanthorrhoea spp.* and Dwarf Banksia (*Banksia oblongifolia*) (DCCEEW, 2025j). This species occurs in QLD where it is restricted to Barakula State Forest near Chinchilla (DCCEEW, 2025j).	No habitat occurring within the Study Area. This species is restricted to Barakula State Forest.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Logania diffusa	V	V	*Logania diffusa* occurs on the top of the plateau escarpment in heathland dominated by *Banksia oblongifolia* and *Leptospermum spp*. and in open forest with Eucalyptus spp. and Forest Sheoak (*Allocasuarina torulosa*) in shallow, sandy, often stony soil overlying sandstone (DEWHA, 2008e). *Logania diffusa* is known from the Blackdown Tableland, central-eastern Queensland (DEWHA, 2008e).	No habitat occurring within the Study Area.	4 occurrence records (ALA) within the desktop search extent. The nearest record occurs approximately 12km East of the Study Area within Arthurs Bluff State Forest.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Macrozamia platyrhachis	E	E	*Macrozamia platyrhachis* occurs in eucalypt woodland or open forest at altitudes between 300-780m above sea level. The mid- and under-stories of the vegetation may be quite dense, but this is variable depending on fire history. The species grows on deep sandy soils, derived from sandstone (DESI, 2024). *M. platyrhachis* has a restricted distribution in the Blackdown Tableland - Planet Downs area of the Dawson Range in central Queensland. There are also historical records from the Ceres Holding southeast of Springsure (1973) and from Spring Creek (1972), but these populations have not yet been relocated (DETSI, 2025f).	No habitat occurring within the Study Area. The species is restricted to Blackdown Tableland.	20 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record occurs approximately 12km from the Study Area in Blackdown Tableland National Park.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Polianthion minutiflorum	V	V	It grows in forest and woodland on sandstone slopes and gullies with skeletal soil, or deeper soils adjacent to deeply weathered laterite (DCCEEW, 2025b). Trymalium minutiflorum is known from five areas in east Queensland, from Redcliffe Vale, about 110 km west of Mackay, south to Kingaroy, covering approximately 800km (DCCEEW, 2025b).	No habitat occurring within the Study Area.	3 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record occurs approximately 12km West of the Study Area within Amaroo State Forest.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Solanum adenophorum	-	E	*Solanum adenophorum* occurs mostly in brigalow woodland and on very gently inclined slopes. It also occurs in gidgee (*Acacia cambagei*) scrub on deep cracking clay soils (Bean, 2004). The species is distributed within the Dingo-Nebo-Clermont region in central-eastern Queensland (Bean, 2004).	No habitat occurring within the Study Area.	1 occurrence record (Wildnet) within the desktop search extent, occurring approximately 18km North of the Study Area near Curragh Mine.	**Unlikely to occur** The Study Area is outside of the species known distribution.
Solanum dissectum	E	E	*Solanum dissectum* has a restricted distribution in central Queensland. The species occurs in open forest and woodland of brigalow (*Acacia harpophylla*) or *Eucalyptus thozetiana* on solodic clay soils (Department of the Environment, Tourism, Science and Innovation (DETSI), 2025d).	Suitable Brigalow dominated communities occur within the Study Area.	4 occurrence records (ALA) within the desktop search extent, the nearest records approximately 20km South of the Study Area.	**Unlikely to occur** This species is identifiable year-round, and as it has not been recorded during multiple targeted surveys, it is unlikely to occur in the Study Area.
Solanum elachophyllum	-	E	*Solanum elachophyllum* grows on fertile cracking-clay soils in open forest of Eucalyptus thozetiana,	Suitable habitat present.	13 historical occurrence records (ALA, Wildnet)	**Known to occur**

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Acacia harpophylla, with understorey of Geijera parviflora, Casuarina cristata, Macropteranthes leichhardtii, Eucalyptus cambageana, or woodland of E. crebra and E. tenuipes (Bean, 2004; Queensland Herbarium, 2012).		within the desktop search extent. A substantial population (>1200) was recorded by EMM at 27 locations associated with RE's 11.3.1/11.3.6 and non-remnant vegetation. The species was also observed in high densities by E2M during 2025 surveys.	The species has been observed within the Study Area at multiple locations.

[1] CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern

[2] Habitat types including microhabitat features where relevant and distribution of the species from reputable online sources and databases

[3] Presence, extent, condition and proximity/connectivity to other habitat and type of habitat whether breeding, feeding, shelter, dispersal, and temporary use.

[4] Nearest and notable records of the species from relevant databases

[5] Most suitable and relevant survey timing and required effort to detect the species (time of year, rainfall events, temperature etc.)

[6] Assessment result of likelihood of species occurring

B.3 Fauna

Amphibians

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area or surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
tusked frog *Adelotus brevis*	-	V	Inhabits wet eucalypt forest, rainforest, and sometimes dry eucalypt forest, where it can be found near suitable breeding habitat such as ponds and slow-moving sections of streams. It has also been recorded from dams and garden ponds in urban and peri-urban areas. It has a disjunct distribution, occurring in the Clarke Range (mideast QLD); then from Shoalwater Bay (mid-east QLD) south to near Moss Vale (mid-east NSW). In QLD, inland populations are also present at Blackdown Tableland and Carnarvon Gorge and in Barakula State Forest (Rowland, 2013).	The Study Area is unlikely to support preferred habitats for this species.	There are 15 occurrence records (ALA) within the desktop search extent. The nearest record is 15km to the East of the Study Area.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

[1] EX = Extinct, PE = Extinct in the wild, CE = Critically Endangered, CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern.

[2] Habitat types including microhabitat features where relevant and distribution of the species from reputable online sources and databases.

[3] Presence, extent, condition and proximity/connectivity to other habitat and type of habitat whether breeding, feeding, shelter, dispersal, and temporary use.

[4] Nearest and notable records of the species from relevant databases.

[5] Most suitable and relevant survey timing and required effort to detect the species (time of year, rainfall events, temperature etc.).

[6] Assessment result of likelihood of species occurring.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Common sandpiper *Actitis hypoleucos*	Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	SLC	The species has been recorded from a wide range of wetland habitats, of varying levels of salinity. The species typically forages in shallow water and on bare soft mud at the edges of wetlands (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2025a). The common sandpiper is found along all coastlines of Australia, including several areas inland, but is concentrated to northern and western Australia. In Queensland, areas of national importance occur in southeastern Gulf of Carpentaria and the Cairns foreshore. The south-eastern Gulf of Carpentaria is also a site of international importance (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2025a).	The Study Area is unlikely to support preferred habitats for this species. Potential distribution for this species occurs 70km towards the East of the Study Area.	The species has not been recorded within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution.
Fork-tailed swift *Apus pacificus*	Migratory (CAMBA, JAMBA, ROKAMBA)	SLC	The species is predominantly aerial and occurs over inland areas and occasionally above the foothills in coastal areas with dry and open habitat. The species can also occur over low scrub, heathland, saltmarsh and riparian woodlands and are associated with low pressure systems that favour the occurrence of insect prey (DCCEEW, 2026). The fork-tailed swift is a non-breeding visitor to all states and territories of Australia which consists of its core range. In Qld, scattered records occur in the Gulf Country, and a few records on Cape York Peninsula. There are many records east of the Great Divide, from near Cooktown and south to Townsville. They are also widespread but scattered in coastal areas from 20° S, south to Brisbane and in much of the south south-eastern region. They are more widespread west of the Great	Suitable habitat is present within the Study Area.	16 occurrence records (ALA) within desktop search extent. 4 of these records occur within 5km of the Study Area in the town of Blackwater, with the nearest	**Known to occur** There is suitable habitat within the Study Area and the species has been observed within the Study Area on multiple occasions.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Divide and are commonly found west of the line joining Chinchilla and Hughenden. They are found to the west between Richmond and Winton, Longreach, Gowan Range, Maraila National Park and Dirranbandi. They are rarely found further west to Windorah and Thargomindah (DCCEEW, 2026).		record 1.3km to the East of the Study Area.	
Sharp-tailed sandpiper *Calidris acuminata*	V, Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	SL	The species typically inhabits muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh, or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. The species may use flooded paddocks, sedgelands and other ephemeral wetlands, but vacate these habitats during dry conditions. Marine habitats for the species include intertidal mudflats in sheltered bays, inlets, estuaries, or seashores, and swamps and creeks lined with mangroves. They sometimes occur on rocky shores and rarely on exposed reefs (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2024). In Queensland, they are recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions (Higgins & Davies, 1996). There are 39 international important sites across Australia, four of which are in Queensland comprising south-east Gulf of Carpentaria, Lake Machattie, Lake Yamma Yamma, and Lake Numalla (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2024).	Limited suitable habitat present.	1 occurrence record (ALA) desktop search extent, 12 km north of the Study Area.	**Possibly occurring** Due to its migratory nature, the presence of potentially suitable habitat within the Study Area and an occurrence record to the North of the Study Area, the species is considered possibly occurring.
Curlew sandpiper *Calidris ferruginea*	CE, Marine, Migratory (Bonn, CAMBA,	CR	This species usually forages and roosts in intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms	No suitable habitat present.	The species has not been recorded within the desktop	**Unlikely to occur** The Study Area is outside of the species known

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
	JAMBA, ROKAMBA)		(Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2023b). Curlew sandpipers commonly occur around the Australian coastline. Queensland records indicate that this species is more widespread in coastal areas south of Cairns, however scattered records occur in the Gulf of Carpentaria. There are sparsely scattered records inland (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2023b).		search extent.	distribution. There is potential for the species to occur during migration, but this is unlikely.
Pectoral sandpiper *Calidris melanotos*	Marine, Migratory (Bonn, JAMBA, ROKAMBA)	SL	Typical habitat for the species comprises shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally further inland. Also recorded in swamp overgrown with lignum (Department of Climate Change, Energy, the Enviornment and Water (DCCEEW), 2026). In Queensland, most records for the species occur around Cairns. There are scattered records elsewhere, mainly from east of the Great Divide between Townsville and Yeppoon. Records also exist in the south-east of the state as well as a few inland records at Mount Isa, Longreach and Oakey (Department of Climate Change, Energy, the Enviornment and Water (DCCEEW), 2026).	No suitable habitat present.	The species has not been recorded within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
South-eastern Glossy black-cockatoo *Calyptorhynchus lathami lathami*	-	V	This species feed exclusively on the cones and seed of *Allocasuarina* and *Casuarina spp.* and is dependent on these spp. (Chapman, 2007), with feed tree species use varying across the species' range (Higgins, 1999). In south-east QLD and north-east NSW, the species shows a strong preference for *A. littoralis* and *A. torulosa* trees (Higgins, 1999). There are also records of the species feeding on *A. inophloia*, *C. equisetifolia* and, to a lesser extent, *C. cunninghamiana* and *C. glauca*	Limited habitat is present within the Study Area. Suitable habitat is present in	64 occurrence records (ALA) within the desktop search extent, with the nearest record 3.7km	**Possibly occurring** Due to the large number of occurrences within proximity to the Study

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			(Glossy Black Conservancy, 2021). In the Brigalow Belt bioregion, *Casuarina cristata* and *Allocasuarina luehmannii* are also used as feed trees (Hourigan, 2012a). As a hollow nester, they require large old trees (living or dead), usually eucalypts, for breeding (S. T. Garnett et al., 1999). Nests are typically located in proximity to a water source (within 1.5 km of a permanent water source) usually in eucalypt, particularly *Eucalyptus crebra*, but at least once recorded in Kurrajong *Brachychiton populneus* where hollows are usually 10-20 m above ground in vertical or near vertical branches, stems, and spouts or in trunk cavities (BirdLife Australia, 2023; S. T. Garnett et al., 1999). It prefers woodland areas dominated by Allocasuarina, or open sclerophyll forests and woodlands with a middle stratum of Allocasuarina beneath Eucalyptus, Corymbia or Angophora (BirdLife Australia, 2023). It has also been observed in mixed Allocasaurina, Casuarina, Callitris and brigalow woodland assemblages (BirdLife Australia, 2023). Occasionally in *Allocasuarina* in grasslands, towns and on golf-courses, and possibly among mangroves and cereal crops (BirdLife Australia, 2023). Often in coastal or subcoastal areas, including foreshores and offshore islands but also occur farther inland in foothills, mountain ranges and plains, especially in *Allocasuarina* associations fringing watercourses or on stony ridges (BirdLife Australia, 2023). Also known to utilise appropriate remnant woodlands and Allocasuarina and Casuarina feed trees in urban areas (BirdLife Australia, 2023; Hourigan, 2012b). South-eastern Glossy black-cockatoo occurs in the north and central east coast of QLD. This subspecies ranges from the Dawson-Mackenzie-Isaac Rivers basin, north to the Connors-Clarke Ranges, south to Dawes and Many Peaks Ranges, and inland to the Expedition, Peak and Denham Ranges, including the Blackdown Tableland (Hourigan, 2012b). The species	Blackdown Tableland National Park, Southeast of the buffer zone of the Study Area.	to the Southeast in Blackdown Tableland National Park. Evidence of feeding (orts) has been identified during previous surveys.	Area and observations of potential feeding (orts) within the Study Area (EMM), it is possible this species will occur, however there is limited foraging opportunities (i.e. *Allocasuarina* or *Casuarina* spp.) present within the Study Area.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			movement patterns, and home ranges have not been well identified in literature.			
Oriental cuckoo *Cuculus optatus*	Marine, Migratory (CAMBA, JAMBA, ROKAMBA)	SL	Inhabits monsoon forest, rainforest edges, isolated trees in paddocks, river flats, roadsides, mangroves, islands (Pizzey & Knight, 2007). Also occurs in woodlands and open forest associated with riparian areas. The species frequents sheltered gullies, and slopes with a dense understorey of shrubs and ferns within wet sclerophyll forests (DotE, 2015c). Core non-breeding range in Queensland includes Northern QLD and the Gulf of capenteria and extends along eastern QLD (DotE, 2015c). The species is a regular nonbreeding migrant to coastal northern and eastern Australia. The species occurs in the Gulf of Carpentaria and Cape York Peninsular to the QLD-NSW border, including inland areas of eastern Queensland (Pizzey & Knight, 2007).	No suitable habitat within the Study Area.	1 occurrence record (eBird) from 2019 within the desktop search extent.	**Unlikely to occur** The species has only been detected on a single occasion within the desktop search extent and the Study Area contains limited marginal habitat for the species.
Red goshawk *Erythrotriorchis radiatus*	E	E	The species occurs over wooded and forested lands of tropical and warm-temperate Australia, coastal and sub-coastal (BirdLife Australia, 2023). It prefers tall open forest, woodland and rainforest edges with a mosaic of vegetation types, large population of birds (largely prey species) and permanent water; riverine vegetation much used (BirdLife Australia, 2023). Forests of intermediate density are favoured, as are ecotones between habitats of differing densities: e.g. between rainforest and eucalypt forest, between gallery forest and woodland, or on edges of woodland and forest where they meet grassland, cleared land, roads or watercourses (BirdLife Australia, 2023). Avoid very dense and very open habitats, although sometimes seen over open agricultural land or grassland. Rarely enter dense forest (rainforest, tall wet forest), except as drought refuge; but may occur on edges and in clearings, penetrate along roads or watercourses, or hunt over canopy (BirdLife Australia, 2023). Immature birds reported	No suitable habitat within the Study Area.	1 occurrence record (ALA) within the desktop search extent. Historical records occur within Blacktown Tableland National Park, approximately 20 km Northeast of the Study Area.	**Unlikely to occur** The species has only been detected on a single occasion within the desktop search extent and the Study Area contains limited marginal habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			from mangroves, open river floodplains, low open woodland, agricultural land and pasture, but such habitats not used regularly (BirdLife Australia, 2023). Few detailed descriptions of structure and floristics of habitats. In eastern Australia rainforest, tall open forest, open forest in rugged terrain; mixed eucalypt woodland with scrubby understorey (Blue Gum *E. saligna*, Lemon-scented Gum *E. citriodora*); valley with subtropical rainforest, open forest of Spotted Gum *E. maculata*and ironbarks, forest of Hoop Pine *Araucaria cunninghamii* and vines, regrowth of eucalypt and *Acacia*, and farmland; mixed eucalypt woodland with thickets of *Melaleuca*; low *Melaleuca* lining watercourse through *Banksia* heath on dunes; tall forest of *E. pilularis* and *Melaleuca* fringing river; gallery forest of *Casuarina* along river, through partly cleared eucalypt open forest; *Melaleuca* swamp forest (BirdLife Australia, 2023). In NT: coastal and subcoastal tall open forests and woodlands, and savannas traversed by forested or wooded rivers; gallery forest along watercourses, eucalypt woodland and open forest to 15–40 m (BirdLife Australia, 2023). Nesting occurs in tall trees within one kilometre of permanent water, generally in open, biologically rich forest or woodlands (DCCEEW, 2025). The range of the red goshawk has significantly retracted in recent years towards northern Australia and is now considered locally extinct in southern Queensland and NSW (DCCEEW, 2025). Although the movement patterns are poorly known, they are generally considered sedentary with some dispersive individuals and no evidence for migration (BirdLife Australia, 2024a; DCCEEW, 2025). One radio-telemetry study has been conducted on a pair of Red Goshawks in northern Australia which resulted in an estimated home range for the breeding female of 120 km^2, and 200 km^2 for the male with some			

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			indications that it might have been larger (DCCEEW, 2025). Five historic records of pairs of Red Goshawks in southeastern Queensland suggested home range may vary from 50–220 km^2 based on the available habitat surrounding the areas where the pairs were located (DCCEEW, 2025). It appears the species is no longer present or is present at critically low levels in Eastern Australian Temperate Forests and Brigalow Tropical Savannah ecoregions in coastal and sub-coastal eastern Australia. It is thought the species is no longer present in the Rockhampton and Eungella regions (MacColl et al., 2023). Recent records in Queensland suggest that the species is existing in National Parks or State forests with a stronghold in north-east Queensland and eastern Cape York Peninsula (DERM, 2012; MacColl et al., 2023).			
Grey falcon *Falco hypoleucos*	V	V	The grey falcon occurs over open country and wooded lands of tropical and temperate Australia (BirdLife Australia, 2023; TSSC, 2020). It mainly occurs on sandy and stony plains of inland drainage systems, lightly timbered with acacia scrublands and intersected by eucalypt-lined, wooded, watercourses (BirdLife Australia, 2023). They hunt far into open areas, over spinifex (*Triodia*), tussock grassland (*Astrebla*), and low shrubland (e.g. bluebush), as well as near and over swamps, bores and waterholes, where surface water attracts prey, similarly occurring in tussock grasslands and open woodlands during winter (BirdLife Australia, 2023; TSSC, 2020). Occasionally they are found near the coast in open woodlands (e.g. mallee), lightly timbered plains and grasslands of lowlands and foothills, as well as occasionally entering country towns (BirdLife Australia, 2023). Nesting occurs on usually slender, sloping, or vertical fork in top part of tallest tree in area, usually near water or dry	No suitable habitat present.	No occurrence records within the desktop search extent. The nearest record occurs 35km to the Northwest of the Study Area.	**Unlikely to occur** The species has not been previously recorded within the desktop search extent and the Study Area contains limited marginal habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			watercourses. Height of nests: from 6 m to over 25 m (BirdLife Australia, 2023). The grey falcon is poorly understood and is considered to be Australia's rarest falcon and the rarest Falco species in the world (Schoenjahn, 2013). It occurs in arid and semi-arid Australia, with a stronghold in arid and semi-arid zones with a mean annual rainfall <500 mm but seldom in waterless desert, with the exception of drought conditions following wet years where the species may become marginally more widespread (BirdLife Australia, 2023; TSSC, 2020). This includes the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia (TSSC, 2020). It is a highly mobile species travelling hundreds of kilometres dispersing during periods of drought to coastal areas, with wintering occurring within northern Australia (mostly immature birds) (NSW Scientific Committee, 2009). It is a resident or nomadic visitor to inland parts of all mainland states, recorded from most of Australia except Cape York Peninsula and areas east of the Great Dividing Range in QLD and NSW (S. Garnett et al., 2021; TSSC, 2020). Their home range size is not specified however they are likely to be larger than 100 km^2 (NSW Scientific Committee, 2009).			
Latham's snipe, Japanese snipe *Gallinago hardwicki*i	V, Marine, Migratory (Bonn, JAMBA, ROKAMBA)	V	In Australia the species typically occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters, but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains. However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (DCCEEW), 2025).	Suitable habitat is present.	EMM has recorded the species during autumn surveys in area of Gilgai on ML1762 and recorded twice during March 2020 surveys.	**Known to occur** There is suitable habitat within the Study Area and the species has been observed within the Study Area (EMM).

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Known from all east coast areas. Extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales. Occasionally recorded in south-western Queensland (DCCEEW, 2025j).			
Squatter pigeon (southern) *Geophaps scripta scripta*	V	V	This species' habitat occurs in tropical, open, dry sclerophyll woodlands and savannahs of north-east Australia (DCCEEW, 2025j; TSSC, 2015). The species is generally found in areas mostly dominated in the overstorey by *Eucalyptus*, *Acacia* and *Callitris* species, in remnant, regrowth or partly modified vegetated communities and within 3km of water bodies or water courses (DCCEEW, 2025j). Water bodies suitable for the species include permanent or seasonal rivers, creeks, lakes, ponds and waterholes (BirdLife Australia, 2023; TSSC, 2015). The species drinks daily and prefers to drink where there is gently sloping, bare ground on which to approach and stand at the water's edge. A small patch (less than a square metre) of bare ground at the water's edge is what the bird requires (DCCEEW, 2025j). Squatter Pigeon (southern) foraging and breeding habitat is known to occur on well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills (LZ 5) and and lateritic (duplex) soils on low 'jump-ups' and escarpments (LZ 7). mainly forages on seeds which have fallen to the ground from low vegetation, such as grasses, herbs and shrubs (Chrome 1976b; Chrome and Shields 1992). The patchy, ground layer of vegetation rarely exceeds 33% of the ground area The species is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions). It is common in grazing country north of the Tropic of Capricorn. The squatter pigeon (southern) occurs on the inland slopes of the Great Dividing Range. Its current	Suitable habitat present.	6 occurrence records (ALA, Wildnet) desktop search extent. The nearest occurrence record (2023) occurs approximately 1.5km East of the Study Area.	**Known to occur** Suitable habitat to support the species is present within the Study Area, and the species has been recorded in the Study Area (EMM).

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			distribution extends from the Burdekin-Lynd Divide in central Queensland, west to Longreach and Charleville, east to the coast between Port Curtis and Proserpine, and south to NSW north of 29°S (Cooper et al., 2015). There is a broad zone of hybridisation with the northern subspecies along the Burdekin-Lynd Divide (S. T. Garnett & Crowley, 2000; Higgins & Davies, 1996). It is known to occur within the following natural resource management regions: Desert Channels, Burdekin, Mackay Whitsunday, Fitzroy, Burnett Mary, South East Queensland, Condamine, Border Rivers and Maranoa-Balonne, and South West Queensland (DCCEEW, 2025j). The species is considered sedentary or locally nomadic (Squatter Pigeon Workshop, 2011). They are likely to be sedentary where both food and water resources are reliable however, when these resources become unavailable, they may disperse along vegetated corridors to areas where there is access to permanent water (Squatter Pigeon Workshop, 2011).			
Painted honeyeater *Grantiella picta*	V	V	Painted honeyeater habitat mostly comprises a strong association with mistletoes, occurring in eucalypt forests, woodlands, riparian woodlands of *Eucalyptus largiflorens* and *E. camaldulensis*, box-ironbark-yellow gum woodlands, acacia dominated woodlands, paperbarks, *Casuarina* spp., *Callitris* spp. and trees on farmland or in gardens (BirdLife Australia, 2023; DoE, 2015a). The species prefer woodlands that with a higher number of mature trees which generally contain more mistletoes, and are more common in wider areas of woodland than in narrower strips (DCCEEW, 2025j). Mainly in box-ironbark woodlands and forests on inland foothills of Great Divide, dominated by species such as Red Ironbark, Mugga, Yellow Box, Broad-leaved Peppermint *E. dives* or Red Stringybark *E. macrorhyncha* with Drooping *Amyema pendulum* and Box *A.*	The Study Area consists of sub-optimal habitat for mistletoe.	4 occurrence records (ALA, Wildnet) within desktop search extent.	**Possibly occurring** The species has been previously recorded within the desktop search extent, however habitat within the Study Area is marginal and limited due to a low abundance of mistletoe.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			miquelii Mistletoes; also in box-casuarina woodlands, especially those dominated by Yellow Gum with Buloke, and Belah (BirdLife Australia, 2023). Also common in riparian forests of River Sheoak with Needle-leaf Mistletoe *Amyema cambagei* (BirdLife Australia, 2023). Often found on plains with scattered eucalypts, and remnant trees on farmland, sometimes in stands of acacia, such as Myall, Prickly Wattle *A. victoriae*, Mulga, Brigalow and Silver Wattle with mistletoes, including Grey *Amyema quandang* and Wire-Leaf *A. preissii* Mistletoes (BirdLife Australia, 2023). Also occurs in woodlands dominated by native pine *Callitris*; or River Red Gum and Black Box, with Box and Drooping Mistletoes (BirdLife Australia, 2023). Sometimes observed in urban parks and gardens, especially those with large eucalypts (BirdLife Australia, 2023). Widespread and sparsely distributed from southeastern Australia to northwestern Queensland and eastern Northern Territory (S. T. Garnett & Crowley, 2000). The greatest concentrations and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland (DCCEEW, 2025j). Painted honeyeater follows a seasonal north-south movement dictated by mistletoe fruiting (DoE, 2015a). After breeding, the species then moves to semi-arid areas such as central and western Queensland (DAWE, 2021). Given this, the species is considered to be highly dispersive and nomadic, and thus can occur across a wide variety of land tenures (DAWE, 2021).			
White-throated needletail	V, Marine, Migratory (CAMBA,	V	The species is almost exclusively aerial in Australia. It breeds in Siberia from April to August and in the non-breeding season, can occur over most habitat types. The species is most often	Suitable habitat present.	10 occurrence records (ALA) within	**Likely to occur** Suitable habitat to support the

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Hirundapus caudacutus	JAMBA, ROKAMBA)		recorded above wooded areas including open forest, closed forest and rainforest. In coastal areas, they are sometimes seen flying over sandy beaches or mudflats, and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes. The species is commonly observed high on storm fronts feeding exclusively on insects. It has been recorded from ground level up to 1000m. The species has been recorded roosting in hollows in Australia. Roosting habitat has been recorded as hollow-bearing trees on cliffs, ridges, edges of clearing areas and emergents (DCCEEW, 2025j). The species Core nonbreeding range is widespread in eastern and south-eastern Australia, recorded in all coastal regions of Queensland and NSW. Their range extends to the western slopes of the Great Dividing Range and are occasionally seen over the adjacent inland plains (TSSC, 2019).		desktop search extent.	species is present within the Study Area, and the species has been previously recorded within the desktop search extent.
Caspian tern *Hydroprogne caspia*	Marine, Migratory (JAMBA)	SL	Mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs. Breeding sites include low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks (DCCEEW, 2025j). Widespread in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. Recorded in the western districts, especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mt Isa and Cloncurry, there are also scattered records for central Queensland (Higgins & Davies, 1996). Breeding occurs on the	No suitable habitat present.	1 occurrence record (Wildnet) within the desktop search extent, occurring approximately 23 km North of the Study Area.	**Unlikely to occur** The species has only been detected on a single occasion within the desktop search extent and the Study Area contains limited marginal habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Wellesley Islands, south-east Gulf of Carpentaria; islands off the far north coast, from Bird Island, south to Three Isles; and from islands around Shoalwater Bay, including Pelican Rock, south to Fairfax Island. Inland breeding records occur at Lake Bindegolly and Lake Moondarra (Chatto, 2001; Higgins & Davies, 1996).			
Yellow wagtail *Motacilla flava*	Marine, Migratory (CAMBA, JAMBA, ROKAMBA)	SL	The species typically inhabits short grass and bare ground; swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns (Pizzey & Knight, 2007). The species is regularly recorded as a regular summer migrant to coastal northern Australia, or as a vagrant to southern states (DotE, 2015; Pizzey & Knight, 2007).	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Star finch (eastern and southern) *Neochmia ruficauda ruficauda*	E	E	The star finch mainly inhabit grassy open (savanna) woodland, tall, rank grassland, rushes with woodland, mixed-forest woodland, and riparian woodland, damp grassland, and sedgeland all intrinsically associated with permanent surface water and regularly (seasonally) inundated areas (BirdLife Australia, 2023; DEWHA, 2010; DEWHA, 2008b). Grassy woodlands are typically interspersed with shrubs or small trees which has previously been eucalypt woodland with vine forest that had been cleared (Holmes, 1998). It often occurs among rank grass, reeds, rushes, or canegrass (BirdLife Australia, 2023). Frequently associated woodland tree species include *Eucalyptus coolabah, E. tereticornis, E. tessellaris, Melaleuca leucadendra, E. camaldulensis* and *Casuarina cunninghamiana* (Holmes, 1998). Woodland tree species may also be dominated by *Pandanus*, paperbarks, such as Weeping paperbarks, eucalypts including Coolibah, Forest Red Gum, River Red Gum Moreton Bay Ash,	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The species has only been detected on a single occasion within the desktop search extent and the Study Area contains limited marginal habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			casuarinas such as River Sheoak or combinations of these (BirdLife Australia, 2023). This species avoids expansive open lands without trees or shrubs (Holmes, 1998). In Lakefield NP, QLD, they disperse to nearby saltmarsh during wet season and return to grasslands at the end of the wet season to breed (BirdLife Australia, 2023). Sometimes occurring in farmland, such as irrigated pasture or rice fields, or cane fields, around stockyards and sewage ponds (BirdLife Australia, 2023). On Cape York, the species is known from the following vegetation types: • woodlands and open woodlands dominated by *Eucalyptus chlorophylla*, *E. microtheca* and *E. acroleuca* • woodlands and open woodlands dominated by *E. clarksoniana*, *E. novoguinensis* or *E. polycarpa* • low open woodlands and low woodlands dominated by broad-leaved paperbarks *Melaleuca viridiflora* on depositional plains • tussock grasslands on marine and alluvial plains or on longitudinal drainage depressions • woodlands and herblands on beach ridges and at the littoral margins; and • sedgelands, lakes and lagoons (Holmes, 1998). Most records from Cape York Peninsula come from grasslands or open woodlands, and in the east, near Princess Charlotte Bay, the dominant grasses are *Sporobolus virginicus, Dichanthium sp.*, *Panicum maximum, Xerochloa imberbis* and *Oryza*			

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			australiensis, with the sedge *Fimbristylis littoralis* (Holmes, 1998). The distribution of star finch is poorly known but it is thought to only occur in central Queensland from Bowen in the north, to Winton in the west and Wowan in the south (DCCEEW, 2025j). It is possible that the distribution extends farther north to Mount Surprise and the Cloncurry-Mount Isa region, but records from these locations could relate to the subspecies *N. r. subclarescens* (DCCEEW, 2025j). Recent studies estimate the total population at 50 individuals or as being possibly extinct (DEWHA, 2008b). Species movements are poorly known though generally considered sedentary or resident with some localised movements (BirdLife Australia, 2023; Holmes, 1998). During a banding study of star finches in Western Australia, it was found that the average distance star finches moved within the one Study Area was 4.05 km. Average movements between separate Study Areas was 10.2 km and of the banded birds, only 6% were making these larger movements (Lewis, & Leyrer, Jutta, 2015).			
Osprey, Eastern Osprey *Pandion haliaetus/ Pandion cristatus*	Marine, Migratory (Bonn)	SL	The species inhabits littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. The species has been recorded within a variety of wetland habitats including swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (DCCEEW, 2025j). The species occurs along the coast around the entirety of Australia, with the breeding range extending from the south-west coast of Western Australia, up and around through Queensland and south to Lake Macquarie in NSW. They	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The species has not been previously recorded within the desktop search extent and the Study Area contains limited marginal habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			occasionally travel inland along major rivers, particularly in northern Australia. They can occur in central Australia between May and December during years of average or above-average rainfall, when fish are abundant in inland waterways (DCCEEW, 2025j).			
Glossy ibis *Plegadis falcinellus*	Marine, Migratory (Bonn)	SL	The species typically inhabits freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons. Sometimes recorded in wooded swamps, artificial wetlands (such as irrigated fields), and in mangroves for breeding. Feeds in very shallow water (DCCEEW, 2025). The species is found in most states of Australia and throughout Queensland. Commonly in largest numbers in drying Top End grass/sedge swamps and Channel Country grass/forb meadows. The glossy ibis breeds at only a limited number of locations within Australia, including the Channel Country of Queensland/South Australia (wetlands of the Bulloo, Diamantina and Georgina River systems, occasionally also Cooper Creek) (DCCEEW, 2025).	Suitable habitat present.	2 occurrence records (ALA, Wildnet) within desktop search extent, the nearest record 1.5km Northeast of the Study Area.	**Likely to occur** The species has been observed within the previous surveys (EMM), approximately 2 km north of the current Study Area in habitat consistent with that present within the Study Area.
Black-throated finch (southern subspecies) *Poephila cincta cincta*	E	E	Occurs mainly in dry, open, grassy woodlands and forests, typically dominated by *Eucalyptus, Corymbia* and *Melaleuca,* and occasionally in tussock grasslands of the tropics and subtropics with seeding grasses and free water (BirdLife Australia, 2023; DCCEEW, 2025j). They mainly inhabit dry, open to very open (savanna) eucalypt woodlands, often along or near watercourses, or in the vicinity of water but also woodlands dominated by paperbarks or acacias (BirdLife Australia, 2023; DCCEEW, 2025j). Almost all recent records of the finch from south of the tropics have been in riparian habitat (Black-throated Finch Recovery Team, 2007). Some of	No suitable habitat present.	No occurrence records within desktop search extent.	**Unlikely to occur** There are no occurrence records for this species and there is no suitable habitat present within the Study Area.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			the more common species of eucalypts in woodlands and forests frequented by the subspecies include *Eucalyptus platyphylla, Corymbia clarksoniana, Melaleuca viridiflora, E. melanophloia, E. brownii, E. similis, E. crebra, E. tereticornis* and *E. camaldulensis.* (DAWE, 2023). Areas with a high diversity of grass species, particularly native grass species are likely to be favoured by the species as they are a specialist granivore requiring year-round access to grass seed (DAWE, 2023). On Atherton Tableland, ne. Qld, recorded in grassy grevillea–paperbark woodland dominated by Fern-leaved Grevillea *Grevillea pteridifolia*, Bushman's Clothes Pegs *G. glauca*, Yellow-barked Paperbark *Melaleuca nervosa*and *M. stenostachya*, with ground-cover of grasses *Setaria*, *Rhynchelytrum*, *Schizarchyrium*, *Panicum* and *Aristida*, and with several dams and an irrigation channel nearby; and also recorded in open mixed forests of eucalypts, casuarinas, *Tristania* and acacias, with *Callistemon* along streams (BirdLife Australia, 2023). In se. Qld, formerly recorded in dry open forest on ridges, grassy hillsides and 'mountain flats'; and, round Inverell, northern NSW, in riparian vegetation of thickets of Yellow Tea-tree *Leptospermum flavescens* and *Melaleuca*, and dense River Sheoaks surrounded by grassy open woodland (BirdLife Australia, 2023). Also, often on grassy plains; and on C. York Pen. and near coast, on grassy flats with *Pandanus*. Recorded in cultivation surrounded by woodland, and grazed paddocks. Said usually to avoid settled areas (Immelmann), though recorded on mown lawn near Ashford, NSW, once recorded in suburban garden in Townsville and formerly said to have been found in towns and cities in se. Qld (BirdLife Australia, 2023). This subspecies historically contacted the northern subspecies near Mareeba where the current distribution of the black-throated finch (southern) has now largely contracted and is			

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			only locally common in Queensland at sites near Townsville and Charters Towers, with small flocks scattered throughout the Brigalow Belt North and Desert Uplands bioregions (Black-throated Finch Recovery Team, 2007). Very few records occur south of Rockhampton after the 1970s and no populations are known to occur on conservation reserves (DCCEEW, 2025j). There are no modern records (since 2000) in the northern Bowen Basin (DAWE, 2023). Although movements are poorly known they are probably sedentary or resident around Charters Towers, Innisfail, Townsville and Rockhampton in QLD (BirdLife Australia, 2023). Some movement may be triggered by drought: gather in large mobile flocks around waterholes during drought (BirdLife Australia, 2023).			
Australian painted snipe *Rostratula australis*	E, Marine	E	This species inhabits shallow terrestrial freshwater (occasionally brackish) wetlands (ephemeral and permanent) (BirdLife Australia, 2023; DCCEEW, 2025j). This primarily includes temporary and permanent lakes, swamps, claypans, inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (BirdLife Australia, 2023; DCCEEW, 2025j). Vegetation in these habitat areas typically include emergent tussocks of grass, sedges, rushes, reeds or samphire, often with lignum *Muehleneckia* sp. (lignum), cane grass or tea-tree *Melaleuca*; sometimes tree-lined, with some scattered fallen or washed-up timber (BirdLife Australia, 2023; DCCEEW, 2025j). The structure of vegetation is important for the species, with patchy to continuous low vegetation in and/or surrounding the wetland being essential (Rogers et al., 2003). Extensive reed-beds (or similar) are avoided (Rogers et al., 2003). Breeding occurs in shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby, typically from or near small islands in freshwater wetlands (BirdLife Australia, 2023;	Suitable habitat is present. Constructed dams and flooded Gilgai known to provide suitable habitat for the species.	This species has been recorded on 3 occasions by EMM ecologists (2020) within the Study Area on lease ML1762 during both dry and wet conditions.	**Known to occur** Suitable habitat to support the species is present within the Study Area, and the species has been recorded in the Study Area (EMM).

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			DCCEEW, 2025j). Use modified habitats, such as low-lying woodlands converted to grazing pasture, sewage farms, dams, bores and irrigation schemes (BirdLife Australia, 2023). This species occurs in all states of Australia but is most common in eastern Australia being well-known from the Murray-Darling basin (BirdLife Australia, 2023; DCCEEW, 2025j). Other sightings include the Channel Country and the Fitzroy basin, and recently from the floodwater plains of coastal central and north Qld (DCCEEW, 2025j). The migratory patterns of the Australian painted snipe is poorly known, however, they are possibly dispersive or migratory due to evidence of irregular and infrequent occurrence and breeding at various locations (DCCEEW, 2025j). Dispersive moments have been attributed to local conditions as the species seeks flooded and wetland areas to avoid areas affected by drought (DCCEEW, 2025j). There have been claims of regular seasonal influxes, for example species numbers increasing in spring-summer or summer in Cunnamulla and Minden in Queensland (DCCEEW, 2025j). Suspected to be regular migrants to coastal floodwater plains, in autumn and winter (DCCEEW, 2025j).			
Diamond firetail *Stagonopleura guttata*	V	V	Habitat critical to the survival of the diamond firetail includes areas of eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats including farmlands and grasslands scattered with trees; habitat with low tree density, few large logs, and little litter cover but high grass cover for foraging, roosting and breeding; and drooping she-oak (*Allocasuarina verticillata*) within the Mt Lofty Ranges (DCCEEW, 2023h). Often inhabit open woodlands and forests, usually dominated by eucalypts such as red gums (particularly River Red Gum and Blakely's Red Gum) and other gums (e.g. Yellow Gum, Spotted Gum, Manna Gum), stringybarks (especially Broad-leaved Stringybark), ironbarks and box	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** There are no occurrence records of this species within the desktop search extent and the Study Area is outside of the species

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			eucalypts (especially Yellow, Grey and White Box) and other species such as Moreton Bay Ash, and typically with open or sparse (though occasionally dense) understorey of shrubs, small trees or regrowth, and grass ground-cover (e.g. of Kangaroo Grass *Themeda australis*. and including mallee woodlands (BirdLife Australia, 2023). Sometimes also in woodlands dominated by casuarinas, such as Buloke or Belah, and cypress-pines *Callitris*, such as White Cypress-pine *Callitris columellaris*, sometimes in mixed associations with eucalypts (BirdLife Australia, 2023). The species is found on the south-east mainland of Australia from south-east Queensland to Eyre Peninsula, South Australia and 300km inland from coastal areas. In Qld, their range previously extended to north Queensland, however it has greatly retracted and they now only occur in the very south of the state (DCCEEW, 2023h). Movements are apparently mainly resident or sedentary throughout its range, but short-distance migrant in parts of western Victorian (<200km), and seasonal occurrence or movements reported elsewhere in Victoria and SA (BirdLife Australia, 2023). Described as resident or present throughout year in many areas throughout range: e.g. Rockhampton, QLD; various sites and regions in NSW; round Caniambo, northern Victoria; and in Scott CP on Fleurieu Peninsula, SA (BirdLife Australia, 2023). At Boree, NSW, vacated garden in winter, and suggested to have moved into nearby bushland (BirdLife Australia, 2023).			current known distribution.
Black-breasted button-quail *(Turnix melanogaster)*	V	V	Black-breasted button-quail in SE QLD are restricted to rainforests and forests with a thick leaf litter between 3-10cm deep, a largely closed canopy with >70-80% canopy cover, and that receive 800-1200 mm annual average rainfall (BirdLife Australia, 2023; Mathieson & Smith, 2009). They prefer drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll forest and	No suitable habitat present within Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			araucarian notophyll vine forest. The species also is found in softwood scrubs, vine scrub regrowth, mature hoop pine plantations, especially where there is lantana, dry sclerophyll forest adjacent to rainforest and Acacia and Austromyrtus scrubs on sandy coastal soils (TSSC, 2015b). The shrub layers vary from dense to absent and often comprises many fruit-producing plants and a sparse ground cover (BirdLife Australia, 2023). Favoured vegetation is described as Bottletree scrub: dry rainforest of Brigalow Acacia harpophylla, Belah Casuarina cristata and Bottletree Brachychiton rupestris, with or without emergent Hoop Pine Araucaria cunninghamii, with shrub understorey and thick litter (BirdLife Australia, 2023). Other records in se. Qld from semi-evergreen vine thicket with emergent Coowarra Box Eucalyptus cambageana and Australian Teak Flindersia australis; semi-evergreen vine thicket with undergrowth of shrubs and Prickly Pear Opuntia; open sclerophyll forest dominated by Spotted Gum Eucalyptus maculata, with ground cover comprising clumps of Wallaby Grass Danthonia and deep litter; forest or rainforest with an understorey of introduced lantana; lantana thickets; and occasionally plantations of Hoop Pine or introduced Pinus (BirdLife Australia, 2023). On Fraser Island, in Brush Box Tristania conferta, Pink Bloodwood Eucalyptus intermedia and Forest Red Gum E. tereticornis forest, with an understorey of Black She-oak Allocasuarina littoralis, acacia, lantana and berry-bearing shrubs (BirdLife Australia, 2023). Occasionally occur in grain stubble, well distant from forest, e.g. Moore area, Brisbane R (BirdLife Australia, 2023). Nests are often found in areas with the following understorey plants: Pteridium esculentum, Doodia aspera and Lantana camara (TSSC, 2015b). This species is endemic to eastern Australia and is restricted to coastal and near-coastal regions of south-eastern QLD and north-eastern NSW (DCCEEW, 2025j). The main populations occur within south-east QLD (DCCEEW, 2025j). It has been			does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			recorded from the Byfield region in the north to at least the Border Ranges rainforests, generally east of the Great Dividing Range, although some observations have been made on its western slopes, up to 300 km inland at locations such as Palm Grove National Park and Barakula State Forest in QLD (DCCEEW, 2025j). A lack of knowledge of the species' dispersal capability and propensity makes it difficult to determine whether isolated groups represent single interbreeding populations (DCCEEW, 2025j). However, given the species' specialised habitat requirements and the lack of records from intervening cleared land and other habitats, it may be surmised that little interchange occurs between widely fragmented populations (DCCEEW, 2025j). It is generally considered to be a sedentary species, although it can appear intermittently or as a transient in other areas and has an estimated home-ranges ranged from 1.9 ha to 6.2 ha (BirdLife Australia, 2023; DCCEEW, 2025j).			

[1] CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern.

[2] Habitat types including microhabitat features where relevant and distribution of the species from reputable online sources and databases.

[3] Presence, extent, condition and proximity/connectivity to other habitat and type of habitat whether breeding, feeding, shelter, dispersal, and temporary use.

[4] Nearest and notable records of the species from relevant databases.

[5] Most suitable and relevant survey timing and required effort to detect the species (time of year, rainfall events, temperature etc.).

[6] Assessment result of likelihood of species occurring.

Mammals

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Silver-headed antechinus *Antechinus argentus*	E	E	At Kroombit Tops National Park, the silver-headed antechinus occurs on an undulating sandstone plateau bounded on the eastern side by an escarpment with cliffs, at an elevation of 850-900 m asl. The habitat comprises of *Eucalyptus montivaga* (a blackbutt) with subdominant *Corymbia trachyphloia* (brown bloodwood) shrubby tall open forest. At Blackdown Tableland National Park and Bulburin National Park, the silver-headed antechinus occurs in similar wet, high altitude open forest habitat (DCCEEW, 2025j; TSSC, 2018). The silver-headed antechinus is known from three isolated subpopulations located in central eastern Queensland - the plateau at the eastern escarpment of Kroombit Tops National Park, located 70 km south-west of Gladstone; Blackdown Tableland National Park, located 220 km west of Gladstone (Mason et al., 2016); and Bulburin National Park, located 80 km south-east of Gladstone (TSSC, 2018).	No suitable habitat present within Study Area.	2 occurrence records (ALA) within the desktop search extent. The nearest record occurs approximately 23km from the Study Area in Blackdown Tableland National Park.	**Unlikely to occur** The Study Area is outside of the known distribution and does not contain suitable habitat.
Large-eared pied bat	E	E	Sandstone cliffs and fertile woodland valley habitat within	No suitable habitat present within Study	2 occurrence records (ALA, Wildnet) within	**Unlikely to occur**

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Chalinolobus dwyeri			proximity of each other is habitat of importance to the large-eared pied bat. Records from southeast Queensland suggest that rainforest and moist eucalypt forest habitats on other geological substrates (rhyolite, trachyte and basalt) at high elevation are of similar importance to the species (DCCEEW, 2025j). Records in Queensland are known from sandstone escarpments in the Carnarvon and Expedition Ranges, Blackdown Tablelands and Cania Gorge. It is likely that these areas support a high proportion of Queensland populations. Additional records exist in the Scenic Rim near the NSW/Queensland border (DCCEEW, 2025j).	Area. The Study Area occurs 10km west of the species distribution extent in Arthurs Bluff State Forest.	the desktop search extent, the nearest record approximately 12km East in Blackdown Tableland National Park.	The Study Area is outside of the species known distribution.
Northern quoll *Dasyurus hallucatus*	E	LC	The species inhabits a diverse range of habitats including eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. The species is also known to occupy non-rocky lowland habitats such as beach scrub communities in central Queensland. Their habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Rocky habitats are	No suitable habitat present within Study Area.	No occurrence records within this desktop search extent.	**Unlikely to occur** The Study Area does not comprise of suitable habitat for the species and there are no historical occurrence records within the desktop search extent.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			usually of high relief, often rugged and dissected but can also include tor fields or caves in low lying areas. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes. Dens are made in rock crevices, tree holes or occasionally termite mounds (DCCEEW, 2025j). The northern quoll occurs in five regional populations across northern Australia, including Queensland, the Northern Territory, Western Australia and offshore islands. In Queensland, they are known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton; as far north as Weipa; and as far west in central Queensland to the vicinity of Carnarvon Range National Park (McGoldrick, 2013; Woinarski et al., 2008). There are occasionally records as far south as Maleny on the Sunshine Coast hinterland. Recent records in central Queensland are from around Proserpine, Midge Point, Eungella and Cape Upstart. In northern Queensland recent records exist from Mareeba, Mount			

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Carbine, Tolga, Weipa and around Cooktown (DCCEEW, 2025j).			
Ghost Bat *Macroderma gigas*	V	E	The species occurs across a range of habitats, from arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines. Roost sites used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°–28°C and a moderate to high relative humidity of 50–100 percent. The average foraging distance is approximately 2 km from the daytime roost (TSSC, 2016a). The species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley (including several islands), northern Northern Territory (including Groote Eylandt), the Gulf of Carpentaria, coastal and near coastal eastern Queensland from Cape York to near Rockhampton, and western Queensland (including Riversleigh and Cammoweal districts (TSSC, 2016a).	No suitable habitat present within Study Area.	No occurrence records within desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
South-eastern long-eared bat	V	V	This species inhabits inland woodland vegetation types, including woodlands of *Allocasuarina luehmannii*, *Acacia*	No suitable habitat present within Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Nyctophilus corbeni			*harpophylla*, *Casuarina cristata*, *Angophora costata*, *Eucalyptus camaldulensis*, *E. largiflorens* and various types of tree mallee, however, the most common is box, ironbark and cypress pine vegetation (TSSC, 2016). The species is most abundant in more extensive stands of vegetation and habitats with a distinct tree canopy and dense, cluttered understorey (TSSC, 2016). It also appears to prefer old-growth forest where it roosts in dead trees or dead spouts of live trees (TSSC, 2016). The species has also been found to nest in exfoliating bark (DEWHA, 2010). It generally forages in concentrated tree patches within the landscape (TSSC, 2016). The species is found in southern central Queensland, central western New South Wales, north-western Victoria and eastern South Australia, where it is patchily distributed, with most of its range in the Murray Darling Basin. Most records are from inland of the Great Dividing Range. The species is uncommon within this distribution and is rarely recorded, except in some areas including the Nandewar and Brigalow Belt South bioregions in			distribution range and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			New South Wales and Queensland (TSSC, 2015).			
Bridled nail-tail wallaby *Onychogalea fraenata*	E	E	The preferred habitat of bridled nail tail wallabies is the narrow band of transitional vegetation that separates dense *Acacia* scrub from open grassy eucalypt woodland. Within Taunton National Park, bridled nail tail wallabies are found in open grassy eucalypt woodland dominated by *Eucalyptus populnea* (poplar box), dense acacia forest dominated by *Acacia harpophylla* (brigalow) and transitional vegetation intermediate between the woodland and forest areas of very dense *brigalow regrowth ylla* (brigalow) scrub, preferring areas with the most fertile soil. During the day, the species prefers habitat that consists of young Acacia harpophylla regrowth or contains fallen logs, for shelter. They generally choose shelter sites with the densest cover of foliage and stems at the species height (25-50 cm), and this type of shelter is concentrated at the edges of wooded areas such as Acacia harpophylla regrowth (DCCEEW, 2025j; TSSC, 2016c). The historical distribution of the bridled nail tail wallaby extended across inland eastern Australia, from north-central Victoria to	No suitable habitat present within the Study Area. Taunton National Park (30km to the East of the Study Area) contains a dense brigalow *Acacia harpophylla* forest and grassy eucalypt woodland habitat (Department of Environment and Resource Management, 2011), and supports a population of the species.	No occurrence records within desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution range and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			near Ravenswood in Queensland. The bridled nail tail wallaby is now restricted to Taunton National Park, central Queensland (area of occupancy: 4 km2), Avocet Nature Refuge, central Queensland (area of occupancy: 2 km2) and Scotia Sanctuary, New South Wales (area of occupancy: 80 km2) (DCCEEW, 2025j; TSSC, 2016c).			
Greater glider (southern and central) *Petauroides volans/ Petauroides volans volans*	E	E	This species is largely restricted to eucalypt forests and woodlands of eastern Australia, typically found in highest abundance in taller, montane, moist eucalypt forest on fertile soils, with relatively old trees and abundant hollows. Six species were identified as dominant or co-dominant species to the majority of greater glider habitat: *Corymbia citriodora, Eucalyptus moluccana, E. tereticornis, E. crebra, C. intermedia and E. portuensis*. Size of trees is also important for Greater Gliders, with trees >30cm DBH preferentially selected for foraging and >50cm DBH for denning as they are more likely to contain suitable hollows for sheltering. Greater glider shelters in tree hollows, with a preference for large hollows in large old trees that are both dead and alive.	No suitable habitat present within Study Area.	4 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record (1994) occurs approximately 7km North of the Study Area. More recent observations (2022-2025) occur approximately 20km from the Study Area in Blackdown Tableland National Park.	**Unlikely to occur** The Study Area does not comprise of suitable habitat for the species.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			In SE QLD, the species shows a strong preference for three den-tree species; broad-leaved white mahogany, red ironbark, and forest red gum. The species requires at least two-four live den trees for every 2 ha of suitable forest habitat. The species also prefers a cool microclimate and favours protected gullies, sheltered high elevation areas, coastal lowland areas and southern slopes (DAWE, 2022a). The species occurs in eastern Australia, where it has a broad distribution from around Proserpine in Qld, south through NSW and the ACT, to Wombat State Forest in central Victoria. It occurs across an elevational range of 0–1200 m above sea level (DAWE, 2022a).			
Yellow-bellied glider *Petaurus australis australis*	V	V	This species occurs in eucalypt-dominated woodlands and forests, including both wet and dry sclerophyll forests. The subspecies shows a preference for large patches of mature old growth forest that provide old, large (usually more than one meter in diameter) hollow bearing trees that can be utilised as den sites for breeding and sheltering during	Lack of suitable habitat present within Study Area.	8 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record occurs approximately 7km West of the Study Area. Multiple occurrence records recorded within Blackdown Tableland National Park.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			the day (DAWE, 2022). There is also a clear preference for forests with a high proportion of winter-flowering and smooth-barked eucalypts. They are found at altitudes ranging from sea level to 1400 m above sea level (DAWE, 2022). The species utilised for sap feeding include; *Angophora leiocarpa, Corymbia citriodora, C. intermedia, Eucalyptus biturbinata*, E. longirostrata, *E. major, E. melliodora, E. mollucana, E. tereticornis, E. racemosa, E. resinifera, E. laevopinea* and *E. sphaerocarpa* (Eyre & Goldingay, 2005). They have a widespread but patchy distribution from southeast Queensland (Qld) to far southeast SA near the SA-Vic border. Most of the Qld distribution is coastal, extending southward along the eastern seaboard from north of Mackay and continuing through the NSW-Qld border. However, isolated subpopulations are found inland in the Blackdown and Canarvon Ranges of central Qld (DAWE, 2022).			
Koala *Phascolarctos cinereus*	E	E	In Queensland, koalas inhabit moist coastal forests, southern and central western subhumid woodlands, and several eucalypt	Small patches of suitable habitat are present.	5 occurrence records (ALA) within the desktop search extent. Several old scratches	**Known to occur** The species has been indirectly observed in the Study Area during previous

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			woodlands adjacent to waterbodies in semi-arid western parts of the state. Surveys in north-western Qld found koalas were patchily distributed and associated with creek-lines and areas of higher tree species richness, with higher abundance correlating with leaf-moisture content. Koalas are reported to utilise more than 400 different tree species for their food and habitat requirements, with tree species varying by habitat type and location across their range. Primary food species differ across habitats and may be as few as two at a particular location (DAWE, 2022b). Koalas feed on approximately 120 species of *Eucalyptus, Corymbia and Angophora*. The listed population of the koala has a wide but patchy distribution that spans the coastal and inland areas of QLD north to the Herberton area and westwards into hotter and dryer semi-arid climates of central QLD, NSW and the ACT. Koalas are widespread across QLD, occurring in patchy and often low-density populations across the different bioregions. They occur as far north as the Einasleigh Uplands and Wet		have been identified on Blue Gums along Taurus Creek on ML1762 by EMM ecologists.	surveys (EMM) with suitable habitat present within the Study Area.

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
			Tropics bioregions, and to the south and west in the Desert Uplands, Central Mackay Coast, Mitchell Grass Downs, Mulga Lands, Brigalow Belt North, Brigalow Belt South, and South Eastern QLD bioregions, where they are most frequently sighted (DAWE, 2022b).			
Short-beaked echidna *Tachyglossus aculeatus*	-	SL	The species occurs throughout Australia in a wide variety of habitats including mountains, tropics, open woodlands, grasslands, arid zones and coastal environments; wherever there is a supply of ants and termites, upon which it feeds. They prefer to inhabit areas with vegetation that provides cover such as gaps under rocks, hollow logs, hollows at the base of trees, piles of leaves or bunched grasses (S. C. Nicol et al., 2011). The species also enters a period of torpor or deep hibernation during autumn and winter, during which time it also requires these forms of cover (ALA, 2025). The short-beaked echidna is found throughout Australia including Tasmania (Van Dyck & Strahan, 2008).	Suitable habitat is present, particularly within Amaroo State Forest.	17 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest occurrence is approximately 1km Northwest of the Study Area, with multiple occurrences within Amaroo State Forest.	**Likely to occur** Suitable habitat to support the species is present within the Study Area, and the species has been previously recorded within the desktop search extent.

[1] CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern

Species name	EPBC Act Status[1]	NC Act Status[1]	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]

[2] Habitat types including microhabitat features where relevant and distribution of the species from reputable online sources and databases

[3] Presence, extent, condition and proximity/connectivity to other habitat and type of habitat whether breeding, feeding, shelter, dispersal, and temporary use.

[4] Nearest and notable records of the species from relevant databases

[5] Most suitable and relevant survey timing and required effort to detect the species (time of year, rainfall events, temperature etc.)

[6] Assessment result of likelihood of species occurring

Reptiles

Species name	EPBC Act Status1	NC Act Status[1] e	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Collared delma *Delma torquata*	V	V	The collared delma typically inhabits eucalypt-dominated woodlands and open forests where it is associated with suitable microhabitat features including exposed rocky outcrops, rocks, logs, bark and other coarse woody debris and mats of leaf litter (typically 30–100 mm thick). The ground cover is predominantly native grasses, such as *Themeda triandra*, *Cymbopogon refractus*, *Aristida* sp. and *Lomandra* sp. It occurs in QLD Land Zones 3 (alluvium river and creek flats), 9 (undulating country on fine-grained sedimentary rocks) and 10 (sandstone ranges), and has been recorded in REs 11.3.2, 11.9.10 ,11.10.1 and 11.10.4 Recorded from several soil types throughout SEQ. Essential (DCCEEW, 2025j; DSEWPC, 2011b). The species is endemic to QLD and has been recorded in southwest and central QLD, however most records are from southeast Queensland such as the western suburbs of Brisbane and inland to the Bunya Mountains. Recorded at the following sites: Bunya Mountains, Blackdown Tablelands National Park, Expedition National Park, Western Creek near Millmerran, Toowoomba Range, and large concentration of records from the western suburbs of Brisbane (DCCEEW, 2025j; Department of the Environment, Water, Heritage and the Arts (DEWHA), 2008c).	Limited suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and there is limited suitable habitat present within the Study Area.

Ornamental snake *Denisonia maculata*	V	V	Ornamental snake prefer moist areas in woodlands and open forests, particularly in depressions located in QLD Regional Ecosystem (RE) Land Zone 4 and in Gilgai mounds occurring in areas of deep cracking alluvial soils with high clay content (DCCEEW, 2025j).The species habitat is generally found in *Acacia harpophylla*, *A. cambagei*, *A. argyrodendron* or *Eucalyptus coolabah* dominated communities including primarily REs 11.4.3, 11.4.6, 11.4.8 and 11.4.9 (DCCEEW, 2025j). Habitat is also found in grasslands that contain Gilgai (DCCEEW, 2025j). Ornamental snake shelter under logs, leaf litter, bark, rocks and coarse woody debris on the ground, and during dry periods they will seek refuge within clay cracks in Gilgai (Brigalow Belt Reptiles Workshop, 2010). Habitat characteristics that are shared across locations in which ornamental snake have been recorded include; • located in the lowest part of the catchment • have a diversity of Gilgai size and depth • contain soils of high clay content and deep cracking characteristics • the presence of ground timber is usually common (especially piles) • burrowing frogs are abundant; and, • habitat patches are greater than 10 ha and are within, or connected, to larger areas of remnant vegetation (DCCEEW, 2025j). The ornamental snake is only known from the Brigalow Belt North, and parts of the Brigalow Belt South Bioregions. The stronghold of this species is within the Fitzroy and Dawson River catchments, particularly in the area surrounding Moranbah (DCCEEW, 2025j).	Areas of high-quality Gilgai habitat is present. Despite this, the Gilgai is observed to be at risk of degradation by cattle and non-native grass and weed species.	3 occurrence records (ALA, Wildnet) within the desktop search extent. The nearest record is approximately 10km South of the Study Area.	**Known to occur** This species has been recorded within the Study Area during previous surveys (EMM) with areas of gilgai microrelief providing habitat for the species.

Species name	EPBC Act Status1	NC Act Status[1] e	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Yakka skink *Egernia rugosa*	V	V	The species is known to occur in open dry sclerophyll forest, woodland and scrub, including on Land Zones 3, 4, 5, 7, 9 and 10. Common woodland and open forest types include *Acacia harpophylla*, *A. aneura*, *A. catenulata*, *A. shirleyi*, *Casuarina cristata*, *Eucalyptus populnea*, *Eucalyptus* spp. and *Callitris glaucophylla*. This species will often take refuge among dense ground vegetation, large hollow logs, cavities in soil-bound root systems of fallen trees and beneath rocks. The species also utilises coarse woody debris and rabbit warrens (DCCEEW, 2025j).It is commonly found in cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows. The species often takes refuge in large hollow logs and has been known to excavate deep burrow systems, sometimes under dense ground vegetation. In cleared habitat, this species can persist where there are shelter sites such as raked log piles, deep gullies, tunnel erosion/sinkholes and rabbit warrens. This species is not generally found in trees or rocky habitats (DoE, 2025). Yakka skink is endemic to Queensland where its distribution is patchy. Isolated populations occur throughout subhumid areas in the interior of Queensland from St George in the south, to Coen and Cape York in the north. In the southern half of the Brigalow Belt it occurs near Rockhampton, south to St George and west to Chesterton Range National Park (DotE, 2014).	No suitable habitat present within Study Area.	No occurrence records within the desktop search extent.	**Unlikely to occur** The species has not been previously recorded within the desktop search extent and the Study Area does not contain suitable habitat for the species due to it being highly degraded and containing limited suitable microhabitat features.

Species name	EPBC Act Status1	NC Act Status[1] e	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Dunmall's snake *Furina dunmalli*	V	V	The species inhabits a range of habitats including forests and woodlands on black alluvial cracking clay and clay loams dominated by *Acacia harpophylla*, other wattles (*A. burowii, A. deanii, A. leiocalyx*), *Callitris* spp. or *Allocasuarina luehmannii*; and *Corymbia citriodora*, *Eucalyptus crebra*, *E. melanophloia*, *Callitris glaucophylla* and *A. luehmannii* open forest and woodland associations on sandstone derived soils (DCCEEW, 2025j). The species has been found sheltering under fallen timber and ground litter and may use cracks in alluvial clay soils. Records indicate the species prefers habitats between 200 to 500 m above sea level (DSEWPC, 2011). Dunmall's snake is found from near the Queensland border throughout the Brigalow Belt South and Nandewar bioregions, and as far south as Ashford in NSW. In QLD, it occurs primarily in the Brigalow Belt region in the south-eastern interior. The snake is very rare or secretive with limited records existing. It has been recorded at Archokoora, Oakey, Miles, Glenmorgan, Wallaville, Gladstone, Lake Broadwater, Mount Archer, Tarong Power Station, Exhibition Range National Park, roadside reserves between Inglewood and Texas, Rosedale, Yeppoon and Lake Broadwater Conservation Park (DCCEEW, 2025j).	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.

Species name	EPBC Act Status1	NC Act Status[1] e	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]
Grey snake *Hemiaspis damelii*	E	E	The grey snake favours woodlands (typically *Acacia harpophylla* and *Casuarina cristata*), usually on heavier, cracking clay soils, particularly in association with water bodies or in areas with small gullies and ditches (gilgai). It shelters under rocks, logs, other debris in soil cracks and abandoned burrows (DCCEEW, 2025b). The grey snake distribution extends from central inland NSW, north to several isolated populations near Rockhampton in QLD. Within QLD, records are known from near Goondiwindi and the adjacent Darling-Riverine Plain, from the Darling Downs and from the Lockyer Valley. The species core area is in the Brigalow Belt south of the Great Dividing Range, between Dalby and Glenmorgan. A single reliable record (captured, no specimen collected) is known from Currawinya National Park in western QLD (DCCEEW, 2025b).	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the species known distribution and does not contain suitable habitat.
Fitzroy River turtle *Rheodytes leukops*	V	E	Fitzroy River turtle occurs in flowing rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with Ribbonweed (*Vallisneria* sp.) beds. Common riparian vegetation includes Blue Gums (*Eucalyptus tereticornis*), River Oaks (*Casuarina cunninghamiana*), Weeping Bottlebrushes (*Callistemon viminalis*) and paperbarks (*Melaleuca linariifolia*) (DCCEEW, 2025j; DEWHA, 2008). The species is restricted to the Fitzroy River and its tributaries. Known sites include Boolburra, Gainsford, Glenroy Crossing, Theodore, Baralba, the Mackenzie River, the Connors River, Duaringa, Marlborough Ck, and Gogango (DCCEEW, 2025j; DEWHA, 2008).	No suitable habitat present.	No occurrence records within the desktop search extent.	**Unlikely to occur** The Study Area is outside of the known distribution and does not contain suitable habitat.

Species name	EPBC Act Status1	NC Act Status[1] e	Habitat and Distribution[2]	Suitable habitat present within Study Area and surrounds[3]	Occurrence records[4]	Likelihood of occurrence[6]

[1] CR = Critically Endangered, E = Endangered, V = Vulnerable, NT = Near Threatened, SLC = Special Least Concern

[2] Habitat types including microhabitat features where relevant and distribution of the species from reputable online sources and databases

[3] Presence, extent, condition and proximity/connectivity to other habitat and type of habitat whether breeding, feeding, shelter, dispersal, and temporary use.

[4] Nearest and notable records of the species from relevant databases

[5] Most suitable and relevant survey timing and required effort to detect the species (time of year, rainfall events, temperature etc.)

[6] Assessment result of likelihood of species occurring

Appendix C Flora and fauna species list

Table A - 1: Flora species identified during field surveys

Species name	Common name	Status		Exotic status[2]
		EPBC Act	NC Act[1]	
Abutilon sp.	-	-	C	-
Acacia excelsa	-	-	C	-
Acacia harpophylla	Brigalow	-	C	-
Acacia salicina	Doolan	-	C	-
Acacia sp.	-	-	C	-
Acalypha eremorum	Soft acalypha	-	C	-
Alectryon diversifolius	Scrub boonaree	-	C	-
Alstonia constricta	Bitterbark	-	C	-
Amyema quandang	-	-	C	-
Amyema salignum	-	-	C	-
Aristida calycina	-	-	C	-
Aristida latifolia	Feathertop wiregrass	-	C	-
Aristida ramosa	Purple wiregrass	-	C	-
Aristida sp.	-	-	C	-
Atalaya hemiglauca	-	-	C	-
Atriplex muelleri	Lagoon saltbush	-	C	-
Bothriochloa bladhii	-	-	C	-
Bothriochloa ewartiana	Desert bluegrass	-	C	-
*Bothriochloa pertusa**	-	-	-	-
Brachychiton rupestris	-	-	SL	-
Brachyscome sp.	-	-	C	-
*Bryophyllum daigremontianum**	-	-	-	-
*Bryophyllum delagoense**	-	-	-	RI Cat 3
*Bryophyllum pinnatum**	-	-	-	-
Capparis lasiantha	Nipan	-	C	-
Carissa ovata	Currantbush	-	C	-
Cassia brewsteri	-	-	C	-

Casuarina cristata	Belah	-	C	-
*Cenchrus ciliaris**	Buffel grass	-	-	-
Chloris divaricata	-	-	C	-
Chloris ventricosa	Tall chloris	-	C	-
Chrysopogon fallax	-	-	C	-
Citrus glauca	-	-	C	-
Clematicissus opaca	-	-	C	-
Commaleana sp.	-	-	C	-
Blakella dallachiana	-	-	C	-
Blakella tessellaris	Moreton Bay ash	-	C	-
Crotolaria sp.	-	-	C	-
*Cryptostegia grandiflora**	-	-	-	WoNS, RI Cat 3
*Cynodon dactylon**	-	-	-	-
Cyperus sp.	-	-	C	-
Dactyloctenium radulans	Button grass	-	C	-
Dichanthium sericeum	-	-	C	-
*Echinochloa colona**	-	-	-	-
Enchylaena tomentosa	-	-	C	-
Enneapogon polyphyllus	Leafy nineawn	-	C	-
Enteropogon acicularis	Curly windmill grass	-	C	-
Enteropogon ramosus	-	-	C	-
Eragrostis parviflora	Weeping lovegrass	-	C	-
*Eragrostis trichophora**	-	-	-	-
Eremophila mitchellii	-	-	C	-
Eriachne sp.	-	-	C	-
Eriochloa pseudoacrotricha	-	-	C	-
Erythroxylum australe	Cocaine tree	-	C	-
Eucalyptus camaldulensis	-	-	C	-

Eucalyptus coolabah	Coolabah	-	C	-
Eucalyptus crebra	Narrow-leaved ironbark	-	C	-
Eucalyptus melanophloia	-	-	C	-
Eucalyptus populnea	Poplar box	-	C	-
Eucalyptus tereticornis	-	-	C	-
Evolulus sp.	-	-	C	-
Fimbristylis dichotoma	Common fringe-rush	-	C	-
Flindersia dissosperma	-	-	C	-
Geijera parviflora	-	-	C	-
*Gomphocarpus physocarpus**	-	-	-	-
Grevillea parvifolia	Wilga	-	C	-
Grevillea striata	Beefwood	-	C	-
Grewia sp.	-	-	C	-
Harrisia cactus	-	-	C	-
*Harrisia martinii**	-	-	-	RI Cat 3
Heteropogon contortus	Black speargrass	-	C	-
Juncus sp.	-	-	C	-
Lysiana subfalcata	-	-	C	-
Lysiphyllum carronii	Ebony tree	-	C	-
Lysiphyllum cunninghamii	-	-	C	-
Lysiphyllum hookeri	Queensland ebony	-	C	-
Maireana microphylla	-	-	C	-
*Malvastrum americanum**	-	-	-	-
*Megathyrsus maximus**	-	-	-	-
Melaleuca bracteata	-	-	C	-
Melhania oblongifolia	-	-	C	-
*Melinis repens**	-	-	-	-

Notelaea microcarpa	-	-	C	-
Nyssanthes diffusa	Barbed-wire weed	-	C	-
*Opuntia streptacantha**	-	-	-	WoNS, RI Cat 3
*Opuntia stricta**	-	-	-	WoNS, RI Cat 3
*Opuntia tomentosa**	-	-	-	WoNS, RI Cat 3
Owenia acidula	Emu apple	-	C	-
Panicum decompositum	-	-	C	-
Panicum effusum	-	-	C	-
*Parkinsonia aculeata**	-	-	-	WoNS, RI Cat 3
Parkinsonia sp.	-	-	C	-
*Parthenium hysterophorus**	-	-	-	WoNS, RI Cat 3
*Portulaca oleracea**	-	-	-	-
Portulaca sp.	-	-	C	-
Salsola australis	-	-	C	-
Santalum lanceolatum	-	-	SL	-
Scleroleana muricata	-	-	C	-
Sesbania cannabina	-	-	C	-
Sida fibulifera	-	-	C	-
*Sida filiformis**	-	-	-	-
Sida hackettiana	-	-	C	-
Solanum elachophyllum	-	-	E	-
Sporobolus actinocladus	Katoora grass	-	C	-
Sporobolus caroli	Fairy grass	-	C	-
Sporobolus creber	-	-	C	-
*Stylosanthes scabra**	-	-	-	-
*Synedrella nodiflora**	-	-	C	-
Terminalia oblongata	-	-	C	-
Themeda triandra	Kangaroo grass	-	C	-

*Urochloa mosambicensis**	-	-	-	-
*Vachellia farnesiana**	-	-	-	-

Notes:

* Species is introduced to Queensland

1 Species is listed as E = endangered, SL = special least concern, C = least concern under the Queensland Nature Conservation Act 1999

3 GBO = general biosecurity obligation, RI Cat2 to 5 = Restricted invasive species category under the Queensland Biosecurity Act 2014

Table A - 2: Fauna species identified during field surveys

Common name	Species name	Status		Exotic status[3]
		EPBC Act[1]	NC Act[2]	
Apostlebird	*Struthidea cinerea*	-	C	-
Australasian darter	*Anhinga novaehollandiae*	-	C	-
Australasian grebe	*Tachybaptus novaehollandiae*	-	C	-
Australasian pipit	*Anthus novaeseelandiae*	Ma	C	-
Australian bustard	*Ardeotis australis*	-	C	-
Australian magpie	*Cracticus tibicen*	-	C	-
Australian owlet-nightjar	*Aegotheles cristatus*	-	C	-
Australian reed-warbler	*Acrocephalus australis*	Ma	C	-
Bar-shouldered dove	*Geopelia humeralis*	-	C	-
Black kite	*Milvus migrans*	-	C	-
Black-faced cuckoo-shrike	*Coracina novaehollandiae*	Ma	C	-
Black-faced woodswallow	*Artamus cinereus*	-	C	-
Black-shouldered kite	*Elanus axillaris*	-	C	-
Blue-faced honeyeater	*Entomyzon cyanotis*	-	C	-
Broad palmed rocketfrog	*Litoria latopalmata*	-	C	-
Brown falcon	*Falco berigora*	-	C	-
Brown honeyeater	*Lichmera indistincta*	-	C	-
Brown quail	*Coturnix ypsilophora*	-	C	-
Bush stone-curlew	*Burhinus grallarius*	-	C	-
Cane toad*	*Rhinella marina**	-	-	GBO
Common brushtail possum	*Trichosurus vulpecula*	-	C	-
Common green treefrog	*Litoria caerulea*	-	C	-

Common myna*	*Acridotheres tristis**	-	-	GBO
Crested pigeon	*Ocyphaps lophotes*	-	C	-
Dingo*	*Canis lupus dingo**	-	-	Cat 3,4,5 & 6
Dog*	*Canis lupus familiaris**	-	-	Cat 3,4 & 6
Double-barred finch	*Taeniopygia bichenovii*	-	C	-
Dusky moorhen	*Gallinula tenebrosa*	-	C	-
Eastern great egret	*Ardea alba modesta*	-	C	-
Eastern grey kangaroo	*Macropus giganteus*	-	C	-
European hare*	*Lepus europaeus**	-	-	GBO
European rabbit*	*Oryctolagus cuniculus**	-	-	Cat 3,4,5 & 6
Feral cat*	*Felis catus**	-	-	Cat 3,4 & 6
Forest kingfisher	*Todiramphus macleayii*	Ma	C	-
Fork-tailed swift	*Apus pacificus*	Ma, Mi	C	-
Freshwater snake	*Tropidonophis mairii*	-	SL	-
Galah	*Eolophus roseicapilla*	-	C	-
Golden-headed cisticola	*Cisticola exilis*	-	C	-
Grey butcherbird	*Cracticus torquatus*	-	C	-
Grey fantail	*Rhipidura albiscapa*	-	C	-
Grey shrike-thrush	*Colluricincla harmonica*	-	C	-
Grey-crowned babbler	*Pomatostomus temporalis*	-	C	-
Hardhead	*Aythya australis*	-	C	-
Horsfield's bronze-cuckoo	*Chalcites basalis*	Ma	C	-
Jacky winter	*Microeca fascinans*	-	C	-
Little friarbird	*Philemon citreogularis*	-	C	-
Little pied cormorant	*Microcarbo melanoleucos*	-	C	-
Little red flying-fox	*Pteropus scapulatus*	-	C	-
Magpie-lark	*Grallina cyanoleuca*	Ma	C	-
Masked lapwing	*Vanellus miles*	-	C	-

Masked woodswallow	*Artamus personatus*	-	C	-
Mistletoebird	*Dicaeum hirundinaceum*	-	C	-
Myall snake	*Suta suta*	-	C	-
Noisy friarbird	*Philemon corniculatus*	-	C	-
Noisy miner	*Manorina melanocephala*	-	C	-
Ornate burrowing frog	*Platyplectrum ornatum*	-	C	-
Pacific black duck	*Anas superciliosa*	-	C	-
Pale-headed rosella	*Platycercus adscitus*	-	C	-
Pied butcherbird	*Cracticus nigrogularis*	-	C	-
Pig*	*Sus scrofa**	-	-	Cat 3,4 & 6
Plum-headed finch	*Neochmia modesta*	-	C	-
Red-backed fairy-wren	*Malurus melanocephalus*	-	C	-
Red-winged parrot	*Aprosmictus erythropterus*	-	C	-
Rufous whistler	*Pachycephala rufiventris*	-	C	-
Salmon-striped frog	*Limnodynastes salmini*	-	C	-
Singing honeyeater	*Gavicalis virescens*	-	C	-
Spangled drongo	*Dicrurus bracteatus*	Ma	C	-
Spotted bowerbird	*Ptilonorhynchus maculatus*	-	C	-
Striped burrowing frog	*Cyclorana alboguttata*	-	C	-
Striped honeyeater	*Plectorhyncha lanceolata*	-	C	-
Sulphur-crested cockatoo	*Cacatua galerita*	-	C	-
Superb fairy-wren	*Malurus cyaneus*	-	C	-
Torresian crow	*Corvus orru*	-	C	-
Tree martin	*Petrochelidon nigricans*	Ma	C	-

Wedge-tailed eagle	*Aquila audax*	-	C	-
Whistling kite	*Haliastur sphenurus*	Ma	C	-
White-bellied cuckoo-shrike	*Coracina papuensis*	Ma	C	-
White-breasted woodswallow	*Artamus leucorynchus*	-	C	-
White-faced heron	*Egretta novaehollandiae*	-	C	-
White-necked heron	*Ardea pacifica*	-	C	-
Willie wagtail	*Rhipidura leucophrys*	-	C	-
Zebra finch	*Taeniopygia guttata*	-	C	-

Notes:
* Species is introduced to Queensland
1 Species listed as Ma = marine, M = migratory under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999
2 Species is listed as SL = special least concern, C = least concern under the Queensland Nature Conservation Act 1999
3 GBO = general biosecurity obligation, RI Cat2 to 6 = Restricted invasive species category under the Queensland Biosecurity Act 2014

Appendix D MNES Significant Residual Impact Assessments

Definitions

Key terms are used within the significant impact assessment criteria and must be addressed as part of the assessment. These include:

- important populations
- habitat critical to the survival of the species or ecological community; and
- important habitat and significant proportion of a population for migratory species.

Important populations

The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (MNES SIA guidelines) (DotE, 2013) define important populations for vulnerable species listed under the EPBC Act as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species' range.

Habitat critical to the survival of the species or ecological community

The MNES SIA guidelines (DotE, 2013) define habitat critical to the survival of a species or ecological community as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development; or
- for the reintroduction of populations or recovery of the species or ecological community.

Species specific referral guidelines, recovery plans and conservation advice may further define habitat critical to the survival of a species or community.

Important habitat for migratory species

The MNES SIA guidelines (DotE, 2013) define an area of 'important habitat' for a migratory species as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat that is of critical importance to the species at particular life-cycle stages
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

Ecologically significant proportions of a population of a migratory species

Additionally, the *Referral guidelines for the 14 migratory species under the EPBC Act* (Migratory Bird Guidelines) identify ecologically significant proportion of the population of a migratory species (Department of the Environment (DotE), 2015c). Where this is not available for the species the Internation Union for Conservation of Nature (IUCN) estimated, total population was extrapolated to estimate internationally and nationally ecologically significant proportions of a population (IUCN, 2025). The ecologically significant proportion of the population of migratory species applicable to the Project are detailed in Table A - 3.

Table A - 3: Ecologically significant proportions of a migratory species population

Species	Ecologically significant proportion of a population (individuals)[1]	
	Internationally	Nationally
White-throated needletail (*Hirundapus caudacutus*)	100	10
Fork-tailed swift (*Apus pacificus*)	1,000	100
Latham's snipe (*Gallinago hardwickii*)	300[2]	18[2]
Glossy ibis (*Plegadis falcinellus*)	1,190-8,600[3]	119-860[3]

[1] For species that aggregate in flocks, 1% of the population is considered internationally important, 0.1% as nationally important (Department of the Environment (DotE), 2015c).
[2] The migratory species not listed in the Migratory Bird Guidelines, internationally and nationally ecologically significant proportions of a population are described in conservation advice for the species (DCCEEW, 2024).
[3] The migratory species not listed in the Migratory Bird Guidelines, as such ecologically significant proportions of a population have been extrapolated based on IUCN population estimates (IUCN, 2025).

D.1 Brigalow TEC

The Brigalow (Acacia *harpophylla* dominant and co-dominant) Threatened Ecological Community (Brigalow TEC) is listed as endangered under the EPBC Act.

Habitat preferences and distribution

The Brigalow TEC occurs in semi-arid eastern New South Wales and Queensland, predominantly west of the Great Dividing Range (DotE, 2013a). For additional information on the Brigalow TEC habitat preferences and distribution, refer to Section 4.1.2.1.

Presence in the Disturbance Footprint

A total of 40.29 ha of Brigalow TEC was recorded within the Disturbance Footprint during field surveys. These areas are associated with high value regrowth and remnant sections of Regional Ecosystems (REs) 11.3.1, 11.4.9, and 11.9.5, where *Acacia harpophylla* was identified as a dominant or co-dominant species and met the TEC condition thresholds. Further details regarding the presence of Brigalow TEC can be found in Section 4.1.2.1.

Habitat critical to the survival of the species

Habitat considered critical to the survival of the Brigalow TEC is any vegetation meeting the criteria listed in the conservation advice (DotE, 2013a). Therefore, all areas of Brigalow TEC present in the Disturbance Footprint are considered habitat critical to the survival of the community.

Threatening processes

Key threats to the Brigalow TEC have been identified as those that may lead to further reduction in extent or cause a decline in condition (DotE, 2013a). These are listed and discussed below in order of significance:

- clearing for resource extraction and illegal logging
- the introduction of invasive pasture species such as Rhode's grass (*Chloris gayana*), Buffel grass (*Cenchrus ciliaris)* and Green panic (*Megathyrsus maximus)*, which increases biomass and fuel load and subsequently increase fire risk
- the infestation of introduced weeds can alter the structure of the community
- feral animals, particularly feral pigs which degrade habitat by disturbing soil and destroying young and small plants; and
- cattle grazing which can impact the ground layer through disturbing leaf litter, interfering with recruitment, altering the composition of the ground and shrub layer and compacting soil.

Recovery actions

Priority recovery and threat abatement actions listed in the approved conservation advice for the Brigalow TEC (DotE, 2013a) include, but are not limited to:

- protecting and conserving remnant and regrowth areas of the Brigalow TEC
- managing areas of the Brigalow TEC to reduce threats, including through fire management and targeted weed and feral animal control
- encouraging landholders to balance primary production and the conservation of native flora and fauna within and close to the Brigalow TEC

- undertaking regeneration of high-value regrowth sites and revegetation of degraded sites
- devising and implementing water management, sediment erosion and pollution control and monitoring plans; and
- consulting with land managers, local and state authorities and Indigenous groups to develop environmentally sustainable management guidelines and education programs (DotE, 2013a).

Significant impact assessment

Approximately 40.29 hectares (ha) of Brigalow TEC is located within the Disturbance Footprint and will be cleared for the Project (Figure 9). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 4.

Table A - 4: Significant impact assessment for the Brigalow TEC

MNES Significant Impact Guideline criteria for TEC	Response
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	
reduce the extent of an ecological community	A total seven patches of Brigalow TEC, totalling 40.29 ha, will be directly removed for surface infrastructure and mining operations for the Project. As such the Project would reduce the extent of the ecological community.
fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	A total of 40.29 ha of Brigalow TEC will be removed as a result of surface infrastructure and mining operations for the Project. The Project will fragment or increase fragmentation of the ecological community in the Disturbance Footprint, as it partially impacts five patches of TEC. These patches are primarily located along Two Mile Gully, Deep Creek and associated tributaries.
adversely affect habitat critical to the survival of an ecological community	Surface disturbance associated with the Project would result in the direct removal of 40.29 ha, which is identified as habitat critical to the survival of Brigalow TEC as outlined above. As such, the Project would adversely affect habitat critical to the survival of the TEC.
modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	Alterations to surface water drainage patterns, as well as physical changes to soil and nutrient profiles has the potential to impact downstream TEC patches outside of the Disturbance Footprint (Palamara et al., 2006; Lechner et al., 2016). Mitigation measures described in Section 7.4.2 which includes erosion and sediment control and annual monitoring of these measures will negate these potential impacts for the Brigalow TEC. As such, there is no real chance or possibility that the Project would modify abiotic factors necessary for the ecological community's survival outside of the Disturbance Footprint.

MNES Significant Impact Guideline criteria for TEC	Response
cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	Indirect impacts (e.g. edge effects and weed invasion) which can alter species composition or loss of functionality in the Threatened Ecological Community (TEC), can be reasonably managed and avoided as per mitigation and management measures discussed in Section 7.1.3. Dust and weed management measures identified in Section 7.5.2 and 7.3.2 will be essential to ensure that degradation of adjacent retained patches of Brigalow TEC does not occur as a result of the Project. Additionally, prescribed burning is not expected to occur as part of the Project and can be reasonably managed with mitigation actions described in Section 7.6.2, including Bushfire Management Plans, appropriate chemical storage, designated access tracks and fire breaks and emergency response procedures. Additionally, there is no scope for flora harvesting associated with this Project. As such, there is a very low chance or possibility that the Project would cause a substantial change in the species composition of an occurrence of an ecological community.
cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community	The presence of weeds, particularly species most threatening to Brigalow TEC such as Rhode's grass (*Chloris gayana*), Buffel grass (*Cenchrus ciliaris)* and Green panic (*Megathyrsus maximus)* (DoE, 2013a), are already present within the landscape and abundant in some locations as described in Section 4.1.4. These species increase may increase fire frequency and severity within Brigalow TEC (DoE, 2013a). The implementation of mitigation measures presented in Section 7.3.2 are expected to reasonably manage the introduction and proliferation of weeds and pests within the Study Area, reducing the risk of changes to species composition or loss of functionality in the TEC as a result of the Project. Storage and management of equipment and chemicals on site will be contained and involve relatively small quantities in any given location. Furthermore, the risk of spills, leaks or other accidental mobilisation of hazardous materials will be avoided and managed in accordance with management plans identified in Section 7.4.2. Therefore, there is a very low possibility that the Project would cause a substantial reduction in the quality or integrity of an occurrence of this TEC within the remainder of the Study Area by assisting weed invasion or mobilisation of hazardous materials.
interfere with the recovery of an ecological community	There is no Recovery Plan for the Brigalow TEC, however, the approved conservation advice is recommended as an effective guide to support the recovery of this TEC. Land clearance is listed as a key threatening process under the EPBC Act and is relevant to this TEC. As such, due to the removal of 40.29 ha of Brigalow TEC, the Project has a real chance or possibility to interfere with the recovery of the ecological community.
Conclusion	*The Project would have a significant residual impact to the Brigalow TEC due to the area of clearing proposed, which is habitat critical to the survival of the TEC and the potential for this impact to interfere with the recovery of the TEC.*

D.2 Australian painted snipe *(Rostratula australis)*

The Australian painted snipe is listed as endangered under the EPBC Act.

Habitat preferences and distribution

This species generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DCCEEW, 2025j). This species occurs in all states of Australia but is most common in eastern Australia and is well-known from the Murray-Darling basin (DCCEEW, 2025j).

For additional information on the Australian painted snipe habitat preferences and distribution, refer to Section 4.2.3.3.

Presence in the Disturbance Footprint

DPM (2026) describe that the lacustrine wetlands (hydrologically modified or artificial) within the Study Area are either farm dams with constructed earthen walls on the downstream side or are constructed mine water dams. Some dams identified within the Study Area were not considered suitable habitat as they contained unvegetated steep bank margins. As this species requires dense low vegetation for cover (Department of the Environment and Energy, 2019), these areas were excluded from habitat. Additionally, some gilgai microrelief lacked suitable native aquatic vegetation, were extremely shallow and lacked the capability to hold water for prolonged periods (Rogers et al., 2005).

A total of 610.00 ha of foraging habitat for Australian painted snipe was identified in the Study Area, of which only 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat (farm dams [man-made]) occurs within the Disturbance Footprint. No suitable breeding habitat was identified within the Disturbance Footprint.

For additional information on Australian painted snipe habitat in the Study Area, refer to Section 4.2.3.2.

Habitat critical to the survival of the species

Habitat critical to the survival of the Australian painted snipe is recognised in the National Recovery Plan for the species but is not clearly defined. The National Recovery Plan describes habitats that provide suitable combinations of plants, animals, water depth, geology, landforms and climate that is relevant to the geographical unit (DCCEEW, 2022). It also refers to habitats that may be a natural wetland where the species is likely or known to occur or an area that may be periodically occupied by the Australian painted snipe when wetland conditions are favourable (DCCEEW, 2022). The listing advice for the species also refers to preservation of wetland habitat suitable for breeding as ‘critical to the species’ survival (TSSC, 2013). Habitat critical to the survival of the species is defined within the MNES SIA guidelines as habitat that contains features that are crucial for the species’ persistence in an area, including for activities such as foraging, breeding, roosting or dispersal (DotE, 2013)..

The species was observed within dams and non-remnant gilgai habitat, which provide suitable foraging opportunities. No suitable breeding habitat was identified within the Study Area.

Given the degraded nature of non-remnant gilgai habitat within the Study Area and the extensive occurrence of similar intermittent foraging habitat throughout the region, these areas are not considered habitat critical to the survival of the species. Furthermore, given the permanent foraging habitat present within the Study Area largely consists of constructed farm dams and similar farm dams are abundant throughout the landscape, these areas are not considered crucial for the species’ persistence in an area and therefore not considered habitat critical to the survival of the species.

Threatening processes

The main identified threat to the Australian painted snipe is the loss and degradation of wetlands, through drainage and the diversion of water for agriculture and reservoirs. Loss of breeding habitat is noted for the Murray-Darling Basin through hydrological changes. These changes have occurred in parallel with an extended period of drought in Australia which has intensified the impacts of wetland degradation and water diversion in the Murray-Darling Basin (Lane & Rogers, 2000) (Rogers et al., 2005).

Other more broadly described threats to the Australian painted snipe include (Department of Sustainability, Environment, Water, 2013):

- grazing and the associated trampling of wetland vegetation and nests
- nutrient enrichment
- reduced rainfall and runoff in the Murray Darling basin associated with climate change
- predation by feral animals (e.g. nest predation by foxes or cats)
- coastal port and infrastructure development
- shale oil mining near autumn-winter sites; and
- the replacement of native wetland vegetation by invasive weeds.

Recovery actions

The *National Recovery Plan for the Australian Painted Snipe* describes a key objective as sustaining a positive population trend in the number of mature individuals (DCCEEW, 2022). The strategies to achieve this objective are listed below:

- manage and protect known Australian painted snipe habitat at the landscape scale
- develop and apply techniques to measure changes in population trajectory in order to measure the success of recovery actions
- reduce, or eliminate threats at breeding and non-breeding habitats
- undertake research to improve knowledge of the habitat requirements, biology and behaviour of Australian painted snipe
- engage community stakeholders to improve awareness of the conservation of Australian painted snipe; and
- coordinate, review and report on recovery progress.

Significant impact assessment

Approximately 20.86 ha of Australian painted snipe foraging habitat is located within the Disturbance Footprint, including 6.41 ha of permanent foraging habitat in the form of dams and 14.45 ha of intermittent foraging habitat (Figure 14). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 5.

Table A - 5: Significant impact assessment for the Australian painted snipe

MNES Significant Impact Guideline criteria for Endangered Species	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of a population	The Australian painted snipe population is small, likely to be continuous, dispersive or migratory (DCCEWW, 2022) and unlikely to comprise local sub-populations. The Project would result in the removal of 20.86 ha of foraging habitat for Australian painted snipe, with no suitable breeding habitat present within the Disturbance Footprint (refer to Section 4.2.3.2). The foraging habitat present consists of 6.41 ha of permanent foraging opportunities in the form of farm dams and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland. Areas of similar foraging habitat are abundant throughout the wider Study Area, including 10.03 ha of farm dams or wetlands, 520.20 ha of non-remnant gilgai and 8.71 ha of remnant RE 11.3.27 providing wetland habitat. Therefore, given the Project would not result in the removal of breeding habitat and impact a small proportion (3.42%) of available foraging habitat within the Study Area, there is a very low chance or possibility that the Project would lead to a long-term decrease in the size of a population.
reduce the area of occupancy of the species	The area of occupancy for the Australian painted snipe is estimated to be 2,000 square kilometres (km^2), with low reliability (S. T. Garnett et al., 2011). Given, the species is widespread and dispersive, and the Project would result in the removal of a small portion (20.86 ha/3.42%) of similar foraging habitat within the Study Area, there is a very low possibility that the Project would likely reduce the area if occupancy of the species.
fragment an existing population into two or more populations	The Australian painted snipe is a mobile avian species, and the Project would not create barriers to movement. The species will be able to persist within the landscape. Therefore, there is no chance or possibility that the Project would fragment and existing population.
adversely affect habitat critical to the survival of a species	The species was observed within dams and non-remnant gilgai habitat within the Study Area, which provide suitable foraging opportunities. No suitable breeding habitat was identified within the Study Area. Given the degraded nature of non-remnant gilgai habitat within the Study Area and the extensive occurrence of similar intermittent foraging habitat throughout the region, these areas are not considered habitat critical to the survival of the species. Furthermore, given the permanent foraging habitat present within the Disturbance Footprint consists solely of constructed farm dams and similar farm dams are abundant throughout the landscape, these areas are not considered crucial for the species' persistence in an area and therefore not considered habitat critical to the survival of the species.

MNES Significant Impact Guideline criteria for Endangered Species	Response
disrupt the breeding cycle of a population	Foraging habitat in the form of ephemeral gilgais and dams are proposed to be impacted for the Project. However, this habitat is not expected to support breeding resources for the species as described in Section 4.2.3.2. Nonetheless, the Land and Biodiversity Management Plan ((Whitehaven Coal Pty Ltd, 2020)) will be updated to manage potential impacts to Australian painted snipe (refer to 7.2.2). Therefore, there is no real chance or possibility that the Project would disrupt the breeding cycle of a population of Australian painted snipe.
modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The removal of 6.41 ha of permanent foraging habitat and 14.45 ha of intermittent foraging habitat for this species is unlikely to decrease the availability of habitat to the extent the species is likely to decline due to the extent of similar habitat retained within the broader Study Area (refer to Section 4.2.3.2) and the highly mobile nature of the species, which minimises the risk of isolation of habitat. Similarly, potential indirect impacts such as changes to the hydrology, invasion by exotic weeds and disturbance and predation by pest animals will be managed (as described in Section 7.4.1 and Section 7.3.1 respectively) to the extent they are unlikely to decrease the availability or quality of habitat remaining in the Study Area. Therefore, there is a very low chance or possibility that the Project would modify, destroy, remove or decrease the availability of habitat to the extent that the species is likely to decline.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Study Area is already impacted by grazing, clearing and mining activities and invasive species are established in the area. Threats to the species as a result of this existing disturbance includes proliferation of weed species, degradation of already modified seasonal and ephemeral wetland habitat by feral pigs and predation by feral cats. Management and control of weed and pest species, as described in Section 7.3, will include standard industry accepted measures to minimise the spread of weeds and pest animals (e.g. feral pigs, that have the potential to degrade the ground layer and foraging resources for the Australian painted snipe, and feral cats which prey on the species). Therefore, there is no real chance or possibility that the Project would contribute substantially to an invasive species becoming established in Australian painted snipe habitat.
introduce disease that may cause the species to decline	There are no diseases listed as threats to the Australian painted snipe. Therefore, the Project is not expected to result in the introduction of a disease that would cause the species to decline.

MNES Significant Impact Guideline criteria for Endangered Species	Response
interfere with the recovery of the species	The strategies identified to achieve the recovery plan objectives include the management and protection of known habitat at a landscape level, reduce or eliminate threats at breeding and non-breeding habitat as well as research activities relating to population trajectories, habitat requirements and the engagement of stakeholders (DCCEWW, 2022). While the removal of 6.41 ha of permanent foraging habitat and 14.45 ha of intermittent foraging habitat is not conducive with reducing threats to the species, given the availability of similar habitat within the Study Area and broader region, the extent of proposed clearing is not considered of a scale which is likely to interfere with the recovery of the species.
Outcome	*While The Project would result in the removal of 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat for Australian painted snipe. Given the extent of similar habitat available throughout the Study Area and wider region, these impacts are not considered important, notable, or of consequence, having regard to its context and intensity.*

D.3 Koala (*Phascolarctos cinereus*)

The Koala is listed as endangered under the EPBC Act.

Habitat preferences and distribution

Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genera *Eucalyptus*, *Corymbia* and *Angophora* (Martin & Handasyde, 1999). Within central Queensland, Koalas have been studied at Tambo (Mitchell Grass Downs bioregion), Springsure and Blair Athol (both in Brigalow Belt North bioregion). Koalas in this region typically occur in low densities and have large home ranges (Ellis et al., 2002).

For additional information on Koala habitat and preferences, refer to Section 4.2.3.6.

Presence in the Disturbance Footprint

Previous ecological assessments undertaken by EMM Pty Ltd (EMM) recorded evidence of Koala activity (i.e. tree scratch marks) within the Study Area (EMM, 2020). Based on desktop and field investigations, the Disturbance Footprint contains 50.01 ha of habitat for the species. This includes:

- 2.72 ha of breeding and foraging habitat; and
- 48.29 ha of dispersal habitat.

For additional information on Koala presence in the Study Area, refer to Section 4.2.3.6.

Habitat critical to the survival of the species

Habitat critical to the survival of the species is the area that the species relies on to halt decline and promote the recovery of the species. The approved conservation advice for the species describes key questions for evaluating habitat critical to the survival of the Koala as:

- whether the habitat is used during periods of stress (examples flood, drought or fire)
- whether the habitat is used to meet essential life cycle requirements (e.g. foraging, breeding, social behaviour, dispersal)
- the extent to which the habitat is used by important populations
- whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development
- whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements
- whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation; and
- any other way in which habitat may be critical to the survival of the listed threatened species (DAWE, 2022c).

Vegetation is highly fragmented, and there are no large, intact eucalypt woodlands present. While some riparian corridors may support limited breeding and foraging activity, these areas are sparse and degraded. The habitat is not likely used by important Koala populations, nor is it essential for maintaining genetic diversity or ensuring the species' long-term survival. Although the riparian corridors may facilitate movement between sites, their fragmentation significantly reduces their effectiveness.

Based on these factors, there is no habitat critical to the survival of the species present within the Disturbance Footprint.

Threatening processes

The main identified threats to the species are (DAWE, 2022):

- climate change driven processes and threats:
  - loss of climatically suitable habitat
  - increased intensity/frequency of drought, heatwaves and bushfire
  - declining nutritional value of foliage
- human related activities:
  - clearing and degradation of Koala habitat
  - encounter mortality with vehicles and dogs; and
- disease and health:
  - Koala retrovirus (KoRV) and chlamydia (*Chlamydia percorum*).

Drought and extreme heat are also known to cause significant mortality, and post-drought recovery may be substantially impaired by the range of other threatening factors (DAWE, 2022).

Recovery actions

The objectives for the recovery of the species listed in the National Recovery Plan for the Koala (DAWE, 2022) are as follows:

- the area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased

- the area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased
- metapopulation processes are maintained or improved; and
- partners, communities and individuals have a greater role and capability in Koala monitoring, conservation and management.

Significant impact assessment

Approximately 2.72 ha of Koala breeding and foraging habitat, and 48.29 ha of dispersal habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 18). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 6.

Table A - 6: Significant impact assessment for Koala

MNES Significant Impact Guideline criteria for Endangered Species	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of a local population	The Project would remove a total of 50.01 ha of habitat for the species. This will comprise of 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, with majority of habitat highly degraded as a result of historical clearing (refer to Section 4.1.1). Given the paucity of records within the Study Area and the degraded nature of the habitat, no resident populations are expected to occur within the Study Area, with any individuals likely to occur transiently when moving between areas of higher quality habitat. Additionally, habitat present within the Disturbance Footprint does not provided connectivity between areas of higher quality habitat, with the primary movement corridor along Taurus Creek and Two Mile Gully being retained. Therefore, given the Study Area is unlikely to contain a resident population of Koalas and the Project would result in the removal of 88.47 ha of highly degraded habitat which is unlikely to be utilised by the species, there is a very low chance or possibility that the Project would cause a long term decrease in the size of a local population.
reduce the area of occupancy of the species	In 2023, the area of occupancy for the species was calculated as 19,428 km^2 with a contracting trend (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2023e). While the Project would result in the removal of 50.01 ha of habitat, including 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, these areas are highly degraded and do not provide connectivity between areas of higher quality habitat. As such these areas are considered unlikely to be occupied by Koalas. Therefore, given habitat within the Disturbance Footprint is unlikely to be occupied by Koalas and the primary movement corridor within the Study Area (i.e. Taurus Creek and Two Mile Gully) is being retained, there is a very low chance or possibility that the Project would reduce the area of occupancy of the species.

MNES Significant Impact Guideline criteria for Endangered Species	Response
fragment an existing population into two or more populations	Koalas are known to traverse up to 1-3 km on ground and will often travel through cleared or treeless areas (DAWE, 2022). While the Project would result in the removal of 50.01 ha of habitat, including 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, these areas are highly degraded and do not provide connectivity between areas of higher quality habitat. Therefore, given the Project would not impact habitat providing connectivity for Koalas and the primary movement corridor within the Study Area (i.e. Taurus Creek and Two Mile Gully) is being retained, there is a very low chance or possibility that the Project would fragment an existing population.
adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Koala does not occur within the Disturbance Footprint, as outlined in the section above. As a result, there is no real chance or possibility that the Project would have an adverse effect on habitat that is considered critical to the survival of the species.
cause disruption to the breeding cycle of a population	Koalas do not have specific breeding habitat requirements. Males are most active during the breeding season and can cover areas of several kilometres (km) with limited vegetation (DAWE, 2022c). Clearing for the Project would not fragment habitat to the extent that dispersing males looking for mates would be unable to do so. Additionally, it is considered unlikely that habitat within the Disturbance Footprint would be occupied by the species. Nonetheless, vegetation clearing during construction activities, has the potential to disrupt breeding individuals, therefore, Koala specific management measures will be put in place as part of the updated Blackwater Mine Land and Biodiversity Management Plan (Whitehaven Coal Pty Ltd, 2020) to ensure this threat is mitigated (Section 7.2.2). Important measures will include but not be limited to; pre-clearance surveys to detect the presence of Koalas, directional clearing towards habitat to be retained, leaving identified Koalas in place with dispersal routes and connecting trees available until the individual has moved on without interference. As a result, there is a very low chance or possibility that the Project would disrupt the breeding cycle of a population.
modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	While the Project would result in the removal of 50.01 ha of habitat, including 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, these areas are highly degraded, do not provide connectivity between areas of higher quality habitat and don't provide refuge habitat. Additionally, the implementation of mitigation measures presented in Sections 7.2.2, 7.3.2 and 7.5.2 will reduce indirect impacts to Koala as a result of the Project including construction disturbance, and weed and pest incursion. Therefore, based on the proposed minimal direct impacts Koala habitat and negligible indirect impacts, there is a very low chance or possibility that the project is likely to modify, destroy, remove, isolate or decrease the availability of quality of habitat of habitat to the extent that the species is likely to decline.

MNES Significant Impact Guideline criteria for Endangered Species	Response
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The primary invasive species, which poses a threat to Koala are dogs (DAWE, 2022). Dogs were recorded in the Study Area during the field survey, though given the already highly disturbed nature of the Study Area and the Project implementing specific environmental management plans including a Pest and Weed Management Plan to mitigate the threat of dogs (see Section 7.3.2), it is unlikely that the Project would proliferate the occurrence of dogs within the area. Therefore, there is no real chance or possibility that the Project would result in invasive species that are harmful to Koala becoming established in Koala habitat.
introduce disease that may cause the population to decline	Diseases such as Chlamydia (*Chlamydia pecorum*) and Koala retrovirus (KoRV) have been identified in the populations within the region (DAWE, 2022). The prevalence of disease (chlamydiosis) has been found to increase following extreme stress from hot weather, drought, habitat loss and fragmentation (Lunney et al., 2012; McCallum et al., 2017). Symptoms of individuals carrying Chlamydia can become overt when subjected to additional stress. Such stress may be caused by habitat clearing associated with the Project. However, Koala specific management measures will be put in place as part of the updated Blackwater Mine Land and Biodiversity Management Plan (Whitehaven Coal Pty Ltd, 2020) to ensure this threat is mitigated (Section 7.1.2). Important measures will include but not be limited to; pre-clearance surveys to detect the presence of Koalas, directional clearing towards habitat to be retained, leaving identified Koalas in place with dispersal routes and connecting trees available until the individual has moved on without interference. Implementation of these measures will ensure there is no real chance or possibility that the Project would introduce diseases or exacerbate existing diseases that may cause the species to decline.
interfere with the recovery of the species	The National Recovery Plan identifies recovery objectives and threats to be managed for the recovery of the species (DAWE, 2022). The key threats to the species listed in the recovery plan that are relevant to the Project include habitat loss, fragmentation and degradation. In relation to these threats: • the Disturbance Footprint will involve clearing of habitat, although these areas are considered unlikely to be occupied by individuals, will not impact refuge habitat and will not fragment remaining habitat to the extent the species cannot continue to disperse through the landscape; and • suitable habitat will remain in the Study Area and will continue to be available to support the long-term persistence of the species. As the species is expected to persist in the Study Area, there is a very low chance or possibility that the Project would interfere with the recovery of the species.

MNES Significant Impact Guideline criteria for Endangered Species	Response
Outcome	*Given the limited extent of proposed clearing, the species being considered unlikely to occupy habitat within the Disturbance Footprint, the absence of habitat critical to the Koala's survival, and the Project not fragmenting or isolating populations, there is a very low chance or possibility that the Project would result in a significant impact on the Koala.*

D.4 Latham's snipe (*Gallinago hardwickii*)

The Latham's snipe is listed as vulnerable and migratory (Bonn, JAMBA, ROCKAMBA) under the EPBC Act.

Habitat preferences and distribution

This species typically occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (DCCEEW, 2025j). The species is known from all east coast areas and extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to the west of the Great Dividing Range in New South Wales (DCCEEW, 2025j).

For additional information on Latham's snipe habitat preferences and distribution, refer to Section 4.2.3.3.

Presence in the Disturbance Footprint

No individuals of Latham's snipe were observed within the Disturbance Footprint during field surveys. Suitable foraging habitat within the Disturbance Footprint comprises dams and non-remnant gilgai habitat. This includes 14.45 ha of intermittent foraging habitat in the form of all remnant, high value regrowth or non-remnant areas with gilgai microrelief, and 6.41 ha of permanent foraging habitat in the form of dams/wetlands with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges). No suitable breeding habitat was identified within the Disturbance Footprint.

For additional information on Latham's snipe presence in the Study Area, refer to Section 4.2.3.3.

Important populations

The entire population of Latham's snipe is thought to migrate to Australia during the northern hemisphere's winter (i.e. December to February) (DCCEEW, 2025j). While the Species Profile and Threats Database (SPRAT) profile and Conservation Advice for Latham's snipe (DCCEEW, 2025j) do not detail information about important populations of this species, the Conservation Advice refers to 'important sites or habitat' as those areas regularly supporting internationally significant numbers of the species, which is 300 individuals.

Nationally important habitat is described as areas previously been identified as internationally important or areas that support at least 18 individuals (DCCEEW, 2024). Based on outcomes of the seasonal surveys, the Study Area does not support an important population of Latham's snipe as evidence of large numbers of the species would have been identified.

Habitat critical to the survival of the species

The Conservation Advice for Latham's snipe states habitat critical to the survival of the species as areas that are necessary for:

- foraging, breeding (outside Australia), roosting or dispersal activities
- long term maintenance of the species
- maintaining genetic diversity and long-term evolutionary development; or
- assisting in the reintroduction of populations or recovery of the species (DCCEEW, 2024).

Based on the definitions above, habitat within the Disturbance Footprint has potential to be considered habitat critical to the survival of the species. However, given the degraded nature of non-remnant gilgai

habitat within the Disturbance Footprint and the extensive occurrence of similar intermittent foraging habitat throughout the region, these areas have not been considered habitat critical to the survival of the species.

Threatening processes

Threats to the Latham's snipe, as identified on the SPRAT profile include loss of habitat, which includes drainage and modification of wetlands, excess mortality from hunting. However, bans on shooting have been implemented throughout Australia (DCCEEW, 2025j).

Threats identified in the Latham's snipe Conservation Advice (DCCEEW, 2024) include habitat loss caused by residential and commercial development, habitat degradation by high-intensity grazing, increased frequency or severity of drought and fires, cat and fox predation, broad-leaved tea-tree invasion of grasslands, and hunting.

Recovery actions

Latham's snipe does not have an adopted or made Recovery Plan. Conservation and recovery actions, listed in the Conservation Advice outlines actions to address and manage the following key threats:

- habitat loss
- habitat degradation caused by high-intensity grazing
- climate change and severe weather impacts; and
- hunting (DCCEEW, 2024).

Significant impact assessment

Approximately 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 15). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 7.

Table A - 7: Significant impact assessment for the Latham's snipe

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population	As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat has no chance or possibility of leading to a long-tern decrease in the size of an important population.
reduce the area of occupancy of an important population	The Area of Occupancy for Latham's Snipe has been estimated as 3,430,000 km^2 (DCCEEW, 2024). As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of 6.41 ha of permanent foraging opportunities in the form of dams and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland has a no chance or possibility of reducing the area of occupancy of an important population.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
fragment an existing important population into two or more populations	As described in the sections above, the Study Area does not support an important population of the species. Latham's snipe are a highly mobile species, able to travel long distances and the Project would not cause a barrier to movement for this species. Furthermore, the species will be able to persist in remaining habitats in the Study Area and broader landscape. Therefore, there is a no chance or possibility that Project would result in the fragmentation of an important population, nor an existing population of Latham's snipe.
adversely affect habitat critical to the survival of a species	The Project will not remove habitat considered critical to the survival of the species, as no individuals were recorded in the Disturbance Footprint, and habitat within the Disturbance Footprint is degraded and is unlikely to support important populations.
cause disruption to the breeding cycle of an important population	As described above, the Study Area does not support an important population. Further, Latham's snipe does not breed within Australia. Therefore, there is no chance or possibility that the Project would result in a disruption to the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The removal of 6.41 ha of permanent foraging opportunities in the form of dams and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland. for this species is unlikely to decrease the availability of habitat to the extent the species is likely to decline due to the extent of similar habitat retained within the broader Study Area (refer to Section 4.2.3.3) and the highly mobile nature of the species, which minimises the risk of isolation of habitat. Similarly, potential indirect impacts such as changes to the hydrology, invasion by exotic weeds and disturbance and predation by pest animals will be managed (as described in Section 7.4.1 and Section 7.3.1 respectively) to the extent they are unlikely to decrease the availability or quality of habitat remaining in the Study Area. Therefore, there is no real chance or possibility the Project would modify, destroy, remove, isolate or decrease the availability of habitat available that would result in the decline of the Latham's snipe.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Study Area is already impacted by grazing, clearing and mining activities and invasive species are established in the area. Threats to the species as a result of this existing disturbance includes proliferation of weed species and the degradation of habitat by feral pigs and predation by feral cats. Management and control of weed and pest species, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and pest animals (e.g. feral pigs, that have the potential to degrade the ground layer and foraging resources for the Latham's snipe, and feral cats which prey on the species). Therefore, there is no real chance or possibility that the Project would contribute substantially to an invasive species becoming established in Latham's snipe habitat.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
introduce disease that may cause the population to decline	The Approved conservation advice for Latham's snipe does not identify any diseases that are likely to impact the species (DCCEEW, 2024). The Project is not expected to result in the introduction of a disease that would impact Latham's snipe.
interfere substantially with the recovery of the species	While the removal of 14.45 ha of intermittent foraging habitat and 6.41 ha of permanent foraging habitat is inconsistent with the objective of reducing habitat loss, given the availability of similar habitat within the Study Area and broader region, the extent of proposed clearing is not considered of a scale which is likely to interfere with the recovery of the species.
Outcome	*While The Project would result in the removal of 20.86 ha of foraging habitat for the Latham's snipe, given the extent of similar habitat available throughout the Study Area and wider region, these impacts are not considered important, notable, or of consequence, having regard to its context and intensity.*

D.5 Ornamental snake (*Denisonia maculata*)

The Ornamental snake is listed as vulnerable under the EPBC Act.

Habitat preferences and distribution

This species prefer moist areas in woodlands and open forests, particularly in depressions located in Queensland RE Land Zone 4 and in gilgai mounds occurring in areas of deep cracking alluvial soils with high clay content (DCCEEW, 2011). Ornamental snake shelter under logs, leaf litter, bark, rocks and coarse woody debris on the ground, and during dry periods they will seek refuge within clay cracks in gilgai (Brigalow Belt Reptiles Workshop, 2010).

For additional information on the Ornamental snake habitat preferences and distribution, refer to Section 4.2.3.1

Presence in the Disturbance Footprint

Ornamental snake was not recorded within the Disturbance Footprint. Based on field investigations, the Disturbance Footprint does not contain breeding and foraging habitat for the species, as it lacks suitable microhabitat features such as soil cracks.

For additional information on the Ornamental snake habitat, refer to Section 4.2.3.1.

Important populations

Important habitat for the Ornamental snake has been defined by the DCCEEW as of gilgai depressions and mounds, as well as habitat connectivity between gilgais and other suitable habitat (DCCEEW, 2023c).

The DCCEEW considers that an occurrence of important habitat for the Ornamental snake is a surrogate for an 'important population' of the species (DCCEEW, 2025j). A total of 497.52 ha of gilgai habitat in the Study Area meets the definition of important habitat and therefore is considered to support an important population of the species.

Important habitat

Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles (DCCEEW, 2023c) specifies that for Brigalow Belt reptiles, important habitat is considered a surrogate for an important population. Additionally, any suitable habitat where the species presence has been confirmed, is near the limit of the known range, or is a large patch of contiguous suitable habitat, is considered to be important habitat. This species has not been identified in the disturbance footprint during field surveys. Additionally, no habitat for this species has been identified in the disturbance footprint, therefore, there is no important habitat within the disturbance footprint.

Habitat critical to the survival of the species

Given the highly disturbed and degraded nature of the Disturbance Footprint, and the absence of suitable habitat for the species, there is no habitat critical to the survival of the species is located within the Disturbance Footprint.

Threatening processes

The Ornamental snake has undergone a decline in abundance in the past few decades. There are a variety of factors that are possibly contributing to this decline, including:

- habitat loss through clearing (roads, ploughing, railways, mining-related activities, pipeline constructions)
- habitat fragmentation
- habitat degradation by overgrazing by stock, especially cattle, or grazing of gilgais during the wet season leads to soil compaction and compromising of soil structure
- alteration of landscape hydrology in and around gilgai environments
- alteration of water quality through chemical and sediment pollution of wet areas
- contact with the cane toad
- predation by feral species; and
- invasive weeds (Brigalow Belt Reptiles Workshop, 2010); Cogger et al. 1993).

Recovery actions

The Ornamental snake does not have a contemporary recovery plan. Research priorities and conservation actions are described in the species conservation advice and include the following matters:

- refine understanding of population metrics, habitat needs, and threat impacts
- develop and apply monitoring in key habitats and priority areas
- track existing populations to identify emerging threats
- evaluate recovery progress and adapt management strategies as needed
- identify and prioritise key populations for conservation
- explore legal protection options for private and crown lands, including reserve inclusion
- reduce land-use pressures at known sites
- control invasive species, particularly pigs, at critical locations
- establish and implement cane toad management practices; and
- promote awareness of the Ornamental snake within the Brigalow Belt Bioregion (DEWHA, 2014).

Significant impact assessment

No habitat for the Ornamental snake is located within the Disturbance Footprint (Figure 13). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 8.

Table A - 8: Significant impact assessment for the Ornamental snake

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population	No Ornamental snake habitat was identified within the Disturbance Footprint. Additionally, indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project would not lead to a long-term decrease in the size of an important population.
reduce the area of occupancy of an important population	The current area of occupancy for this species is 21,315 km^2 (ALA, 2025). Whilst the Study Area is considered likely to contain an important population, no Ornamental snake habitat was identified within the Disturbance Footprint. Additionally, indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project would not reduce the area of occupancy of an important population.
fragment an existing important population into two or more populations	Whilst the Study Area is considered likely to contain an important population, no Ornamental snake habitat was identified within the Disturbance Footprint. As such, there is no chance or possibility the Project would fragment an existing important population into two or more populations.
adversely affect habitat critical to the survival of a species	The habitat in the Study Area and Disturbance Footprint is unlikely to be habitat critical to the survival of the species as due to the degraded and highly disturbed nature of the habitat.
cause disruption to the breeding cycle of an important population	Whilst the Study Area is considered likely to contain an important population, no Ornamental snake habitat was identified within the Disturbance Footprint. Additionally, indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project would not cause disruption to the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No Ornamental snake habitat was identified within the Disturbance Footprint and indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project would not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Threats to the species include habitat degradation by feral herbivores such as rabbits and feral pigs, contact with cane toads, proliferation of weed species and predation by feral carnivores, such as foxes and feral cats. The Study Area is already impacted by grazing, clearing and mining extraction activities and invasive species are already established in the landscape, including those listed as potential threats above. Management and control of weed and pest species, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and proliferation of pest animals that have the potential to impact the Ornamental snake. Therefore, the Project would not result in an invasive species becoming established in the Ornamental snake habitat remaining in the Study Area.
introduce disease that may cause the population to decline	No introduced diseases are known to significantly impact this species. As such, there is no real chance of possibility that the Project would introduce a disease that may cause the population to decline.
interfere with the recovery of the species	No Ornamental snake habitat was identified within the Disturbance Footprint, and indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project would not interfere with the recovery of the species.
Outcome	*The Project is unlikely to have a significant impact on the Ornamental snake, as no habitat will be directly removed and potential indirect impacts on retained habitat is considered negligible based on implementation of proposed mitigation measures.*

D.6 Squatter pigeon (southern) (*Geophaps scripta scripta*)

The Squatter pigeon (southern) is listed as vulnerable under the EPBC Act.

Habitat preferences and distribution

The subspecies occurs on the inland slopes of the Great Dividing Range from the Burdekin-Lynd Divide in central Queensland, west to Longreach and Charleville and south to Moree in New South Wales (TSSC, 2015). The Squatter pigeon (southern) inhabits eucalypt woodland communities with a grassy understorey in proximity to permanent water sources, such as rivers, creeks and dams (TSSC, 2015a).

For additional information on the Squatter pigeon (southern) habitat preferences and distribution, refer to Section 4.2.3.4.

Presence in the Disturbance Footprint

This species has not been recorded in the Disturbance Footprint during field surveys. Habitat within the Disturbance Footprint includes 26.05 ha of breeding and foraging, 6.41 ha of foraging, and 262.34 ha of dispersal habitat.

For additional information on the Squatter pigeon (southern) habitat preferences and distribution, refer to Section 4.2.3.4.

Important populations

As this species currently has no adopted recovery plan, important populations of Squatter pigeon (southern) have been defined as per those listed in the SPRAT database (DCCEEW, 2025f):

- populations occurring in the Condamine River catchment and darling downs of southern Queensland
- the populations known to occur in the Warwick-Inglewood-Texas region of southern Queensland; and
- any populations potentially occurring in northern New South Wales.

Based on these criteria, any Squatter pigeon (southern) within the Study Area is unlikely to be part of an important population. Furthermore, in consideration of the MNES SIA Guidelines, the local population is unlikely to be a key source population for breeding or dispersal, or maintaining genetic diversity due to its relatively common occurrence in the local region and the Study Area is not at the limit of the species distribution.

Habitat critical to the survival of the species

Habitat critical to the survival of the species is not defined for the species in the approved conservation advice or listing advice. As such the MNES SIA guidelines (DotE, 2013) for habitat critical to the survival of a species is applied and includes as areas for activities such as foraging, breeding, roosting, or dispersal. Habitat within the Study Area does not provide particularly unique or rare resources that are important for the long-term maintenance of the species, maintaining genetic diversity, or provide area to support reintroductions of the species. Given the degraded nature of habitat within the Disturbance Footprint and no records of Squatter pigeon (southern) have been recorded in the Disturbance Footprint, it is unlikely to be considered habitat critical to the survival of the species.

Threatening processes

Current threats to the Squatter pigeon (southern) include (DCCEEW, 2025f):

- ongoing vegetation clearance and fragmentation

- overgrazing of habitat by livestock and feral herbivores such as rabbits, cows and sheep
- introduction and degradation of habitats by invasive weeds, such as Buffel grass
- inappropriate fire regimes
- thickening of understorey vegetation
- predation by feral cats and foxes and avian predators; and
- trampling of nests by domestic stock.

Recovery actions

Conservation and management actions specified by the Approved Conservation Advice (TSSC, 2015a) for the species are as follows:

- identify sub-populations of high conservation priority, especially in the southern part of the Squatter pigeon (southern) range
- protect and rehabilitate areas of vegetation that support important sub-populations
- protect sub-populations of the listed subspecies through the development of covenants, conservation agreements or inclusion in reserve tenure
- develop and implement a stock management plan for key sites
- develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the Squatter pigeon (southern); and
- raise awareness of the Squatter pigeon (southern) within the local community, particularly among land managers.

Significant impact assessment

Approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat for the Squatter pigeon (southern) is located within the Disturbance Footprint and will be cleared for the Project (Figure 16). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 9.

Table A - 9: Significant impact assessments for Squatter pigeon (southern)

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population	As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat, has no chance or possibility of leading to a long-term decrease in the size of an important population.
reduce the area of occupancy of an important population	The area of occupancy for the species has been calculated to be 2,888 km^2 (Queensland Resources Council, 2015). As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat, has no chance or possibility of reducing the area of occupancy of an important population.
The action is likely to fragment an existing important population into two or more populations	As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat, has no chance or possibility of fragmenting and important population.
adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the species for the squatter pigeon (southern) is not present within the Disturbance Footprint. As such, the Project will not adversely affect habitat critical to the survival of the species.
cause disruption to the breeding cycle of an important population	As described in the section above, the Study Area does not support an important population of the species. Therefore, the Project would not disrupt the breeding cycle of an important population. Nonetheless, the Blackwater Land and Biodiversity Management plan will be updated for the Project as discussed in Section 7.2.2 and will include industry standard and acceptable measures to avoid and minimise impacts to animal breeding places and unnecessary stress on native fauna.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project proposes the removal of approximately 32.46 ha of combined potential breeding and foraging habitat for the species. Although this represents a relatively large area, no individuals were recorded in the Disturbance Footprint, which suggests limited use of the habitat by the species. In addition, the substantial extent of similar habitat retained within both the Study Area and the broader region, along with the minimal potential for indirect impacts on retained habitat, indicates that the Project has a very low chance or possibility to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Threats to the species include overgrazing by feral herbivores such as rabbits, proliferation of weed species and predation by feral carnivores such as Foxes and feral cats. The Disturbance Footprint is already impacted by grazing, clearing and mining activities and invasive species are established in the area including feral cats. Implementation of a Weed and Pest Management Plan, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and proliferation of pest animals that have the potential to degrade the ground layer and foraging resources for the Squatter pigeon (southern). Therefore, there is a very low chance or possibility the Project would contribute to a harmful invasive species becoming established in Squatter pigeon (southern) habitat within the Study Area.
introduce disease that may cause the population to decline	Disease has not been identified as a threat to the Squatter pigeon (southern). Therefore, the Project is not expected to result in the introduction of a disease that may cause population decline.
interfere with the recovery of the species	Recovery actions primarily address impacts to important sub-populations of the Squatter pigeon (southern), of which none occur in the Study Area. Given the low abundance of individuals recorded in the Study Area and availability of similar habitat elsewhere in the region, there is a very low chance or probability that the Project would interfere with the recovery of the Squatter pigeon (southern).
Outcome	*The Project is unlikely to have a significant impact on the Squatter Pigeon (southern subspecies), as the Study Area does not support an important population or habitat critical to the survival of the species. Additionally, the Project has a very low possibility to remove or isolate the availability of habitat to the extent that the species is likely to decline.*

D.7 White-throated needletail (*Hirundapus caudacutus*)

The White-throated needletail is listed as vulnerable and migratory (CAMBA, JAMBA, ROCKAMBA) under the EPBC Act.

Habitat preferences and distribution

The White-throated needletail is a non-breeding visitor to Australia where it is widespread across eastern and south-eastern Queensland (TSSC, 2019). It is most often recorded above wooded areas such as open forest and rainforest (TSSC, 2019).

For additional information on White-throated needletail habitat preferences and distribution, refer to Section 4.2.3.5.

Presence in the Disturbance Footprint

White-throated needletail has not been recorded during any surveys; however, the species is considered likely to occur based on habitat availability and previous records within the vicinity of the Study Area. Suitable foraging habitat for the species was identified as the airspace above the entirety of the Study Area.

For additional information on White-throated needletail presence in the Study Area, refer to Section 4.2.3.5.

Important populations

An important population has not been specifically defined for the White-throated needletail and in consideration of the MNES SIA definition for 'important population', the Study Area is unlikely to support such a population as outlined below:

- a key source population either for breeding or dispersal – the species is a non-breeding migrant to Australia and the Study Area does not support a population of this species as it is likely to only overfly the Study Area
- populations that are necessary for maintaining genetic diversity –the Study Area is unlikely to support a nationally or internationally significant proportion of a population; and
- populations that are near the limit of the species range – the Study Area is not at the limit of this species migratory range in Australia.

The Migratory Bird Guidelines (DotE, 2015c) addresses referral considerations for the White-throated needletail. The relationship between important habitat and important populations is discussed, whereby avoiding impacts to important habitat for the species and implementing mitigation measures will help reduce the risk of a significant impact on the population. For the White-throated needletail, important habitat is described as large tracts of native vegetation, particularly forest, and the species appears to have traditional roost sites (DotE, 2015c). The Study Area does not contain large tracts of forested habitat; instead, remnant vegetation is highly fragmented and patchily distributed. However, approximately 8.5 km east of the Study Area lie the Blackdown Tablelands, which support extensive and intact forested ecosystems that may offer more suitable habitat for the species.

The Migratory Bird Guidelines (DotE, 2015c) also provide advice about 'ecologically significant proportions' of populations. For the white throated needletail, an ecologically significant proportion of the national population is 10 birds (0.1% of the population) and for the international population is 100 birds (i.e. 1% of the population) (DotE, 2015c) . The Study Area is unlikely to support an ecologically significant proportion of the population.

Habitat critical to the survival of the species

Habitat critical to the survival of the species has not been defined for the White-throated needletail (DCCEEW, 2025e; TSSC, 2019). Areas deemed as habitat critical to the survival of the species may be considered traditional roost sites where the species has been known to frequent, which are not evident within the Study Area. All areas that provide foraging habitat in the airspace above the Study Area are not considered habitat critical to the survival of the species due to the availability of similar habitat throughout the region. Therefore, the Study Area is not considered to contain habitat critical to the survival of the species.

Threatening processes

Due to the widespread distribution and aerial nature of the White-throated needletail, no significant threats have been identified for the species in Australia (DCCEEW, 2025e; TSSC, 2019). Some potential threats have been suggested to include collision with wind turbines, overhead wires, windows and lighthouses, and degradation of forest and woodland area resulting in the loss of roosting sites and reduction in availability of prey (TSSC, 2019).

Recovery actions

No specific recovery actions have been identified for the White-throated needletail, however primary conservation actions relevant to the species within Australia include:

- identify requirements of important habitat in Australia
- support initiatives to improve habitat management at key sites in Australia
- stakeholder engagement to promote conservation and the exchange of information
- enhance existing monitoring programs particularly to improve coverage in under surveyed parts of Australia; and
- information and research priorities including improved knowledge on threatened processes and understanding of life history, population size, distribution and ecological requirements in Australia (TSSC, 2019).

Significant impact assessment

Approximately 2,316.58 ha of aerial foraging habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 17). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 10.

Table A - 10: Significant impact assessment for the White-throated needletail

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important local population	As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of approximately 2,316.58 ha of aerial foraging habitat, has no chance or possibility of leading to a long-term decrease in the size of an important population.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
reduce the area of occupancy of an important population	As described in the section above, the Study Area does not support an important population of the species. Therefore, the removal of approximately 2,316.58ha of aerial foraging habitat, has no chance or possibility of reducing the area of occupancy of an important population.
fragment an existing important population into two or more populations	As described in the section above, the Study Area does not support an important population of the species. Additionally, the species is highly mobile, almost exclusively aerial species. Therefore, the removal of approximately 2,316.58 ha of aerial foraging habitat, has no chance or possibility of fragment an existing important population.
adversely affect habitat critical to the survival of a species	As described in the section above, given this is a non-breeding visitor to Australia, is an almost exclusively aerial species within Australia and the Disturbance Footprint and surrounding Study Area is unlikely to provide preferred roosting habitat for this species, the Study Area is not considered likely to contain habitat critical to the survival of the species. As such, there is no chance the Project would adversely affect habitat critical to the survival of a species.
cause disruption to the breeding cycle of an important population	The White-throated needletail does not breed within Australia. Therefore, the Project would not result in disruption to the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Clearing and disturbance of vegetation communities, over which this species is likely to forage and disperse, is proposed as part of the Project. However, this species is highly mobile, and almost exclusively aerial, occurring over a variety of habitats throughout Australia. As such, there is a very low chance that the Project would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The conservation advice does not identify any invasive species that are considered likely to impact the species. Additionally, the Project is not expected to result in the introduction of an invasive species that would be harmful to White-throated needletails becoming established within the Study Area.
introduce disease that may cause the population to decline	The conservation advice does not identify any diseases that are likely to impact the species. Therefore, the Project is not expected to result in the introduction of a disease that may cause population decline.
interfere substantially with the recovery of the species	The species is unlikely to directly use vegetation communities in the Disturbance Footprint and surrounding Study Area therefore it is not considered to provide habitat critical for the survival of the species or support an important population, therefore there is a very low chance or possibility that the Project would interfere substantially with the recovery of the species.

MNES Significant Impact Guideline Criteria for Vulnerable Species	Response
Outcome	*Given the Study Area is unlikely to contain an important population or habitat critical to the survival of the species, and impacts will be limited to aerial foraging habitat which is widely available throughout the region, the Project is considered unlikely to result in a significant impact to this species.*

D.8 Migratory species

Fork-tailed swift (*Apus pacificus*)

The Fork-tailed swift is listed as migratory (CAMBA, JAMBA, ROCKAMBA) under the EPBC Act.

Habitat preferences and distribution

The Fork-tailed swift is almost exclusively aerial in Australia, where it occurs primarily over inland areas of dry or open habitat comprising riparian woodlands, tea-tree swamps, low scrub, heath or saltmarsh (DCCEEW, 2025j). The Fork-tailed swift is a non-breeding visitor to all states and territories of Australia (DCCEEW, 2025e; DotE, 2015). The Fork-tailed swift generally arrive to Australia in October and leave to return to their breeding grounds in Siberia during the second half of April (DCCEEW, 2025e; DotE, 2015).

For additional information on the Fork-tailed swift habitat preferences and distribution, refer to Section 4.2.4.1.

Presence in the Disturbance Footprint

This species has been observed on a single occasion during surveys above the Study Area, during the 2025 wet season survey. Suitable foraging habitat for the species was identified in the airspace above the entirety of the Study Area. Based on desktop and field investigations to date, the Study Area contains 6,907.49 ha of suitable aerial foraging habitat for the Fork-tailed swift as illustrated in Figure 20.

For additional information on the Fork-tailed swift presence in the Study Area, refer to Section 4.2.4.1.

Important habitat

The Fork-tailed swift is a non-breeding visitor to Australia. The species is found across a range of habitats from open plains to wooded areas and it is exclusively aerial (Department of the Environment (DotE), 2015c). Important habitat is defined in the Migratory Bird Guideline as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat that is of critical importance to the species at particular life-cycle stages
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

The Study Area is unlikely to provide important habitat for this species due to the fragmented and patchy landscape in which the Study Area is located. The species is exclusively aerial and known roosts have not been identified in the local areas. Therefore, the Study Area is considered unlikely to provide resources for this species other than as overfly habitat.

Ecologically significant proportion of the population

The Migratory Bird Guidelines define the ecologically significant proportion of the national population (0.1%) as 100 birds and for the international population (1%) 1,000 birds (Department of the Environment (DotE), 2015c).The Study Area is unlikely to support an ecologically significant proportion of the population as this would have been evident in literature or as a result of seasonal surveys.

Threatening processes

The Fork-tailed swift faces no significant threats within Australia. While potential risks such as habitat loss and predation by feral animals exist, the species' extensive range means that any localised impacts are considered negligible and unlikely to affect the overall population (BirdLife International, 2009).

Recovery actions

No specific recovery actions have been identified for the Fork-tailed swift.

Significant impact assessment

Approximately 2,316.58 ha of foraging habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 20). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 11.

Table A - 11: Significant impact assessment for the Fork-tailed swift

MNES Significant Impact Guideline Criteria for Migratory Species	Response
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	As described in the section above, the Study Area does not support an important habitat for the species. Therefore, the removal of approximately 2,316.58 ha of aerial foraging habitat, has no chance or possibility of leading to a long-term decrease in the size of an important population.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	As described in the section above, the Study Area does not support an important habitat for the species. Additionally, the Project is not expected to result in the introduction of an invasive species that would be harmful to Fork-tailed swifts becoming established within the Study Area.
result seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	As described in the section above, the Study Area is unlikely to contain an ecologically significant proportion. Nonetheless, should an ecologically significant proportion of a population overfly the Study Area as part of migratory movements, there is a very low chance or possibility that the Projects activities would seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of the species.
Outcome	*The Project is unlikely to result in a significant impact to this species, as the Study Area is unlikely to contain important habitat or an ecological significant proportion of the population.*

Glossy ibis (*Plegadis falcinellus*)

The Glossy ibis is listed as migratory (Bonn) under the EPBC Act.

Habitat preferences and distribution

Glossy ibis typically inhabits freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (DCCEEW, 2025j). The Glossy ibis is found throughout Queensland and breeds at only a limited number of locations within Australia including the Channel Country of Queensland/South Australia (i.e. wetlands of the Bulloo, Diamantina and Georgina River systems, occasionally also Cooper Creek) (DCCEEW, 2025j).

For additional information on Glossy ibis habitat preferences and distribution, refer to Section 4.2.4.2.

Presence in the Disturbance Footprint

While not recorded during E2M Pty Ltd (E2M) surveys, Glossy ibis has been detected on a single location during previous EMM ecological surveys, approximately 2 km north of the current Study Area. No suitable breeding habitat was mapped within the Study Area. 610 ha of suitable foraging habitat was mapped in the Study Area consisting of dams with shallow sloping margins and dense fringing vegetation (e.g. reeds and sedges), and all remnant, high value regrowth or non-remnant areas with gilgai microrelief.

For additional information on Glossy ibis habitat preferences and distribution, refer to Section 4.2.4.2.

Important habitat

Important habitat for the Glossy ibis is not defined on the species profile (DotE, 2025l). Therefore, it is considered that all known and potential breeding areas comprise important habitat for the species.

Breeding habitat in Australia is limited to five known locations, including the Murray-Darling Basin and Channel Country of Queensland/South Australia for Queensland. In addition, the species has also been recorded is small, isolated breeding colonies throughout eastern Australia (DotE, 2025l).

Breeding habitat types in Australia includes wooded and shrubby swamps in the semi-arid and arid regions of the Northern Territory and Queensland. This includes Cooba (*Acacia stenophylla*), *Eucalyptus*/lignum swamps (*Muehlenbeckia florulenta*) of the Murray-Darling Basin and in *Melaleuca*/reed swamps at near-coastal breeding colonies in the south (DotE, 2025l).

Therefore, given the Study Area is not located within any of these areas and does not contain suitable breeding habitat, it is considered unlikely that habitat within Study Area constitutes important habitat for Glossy ibis.

Ecologically significant proportion of the population

The total population of Glossy ibis globally is estimated to be between 119,000 and 860,000 individuals (IUCN, 2025). Nationally important ecologically significant proportions of a population for the species are estimated to be between 119 and 860 individuals. Therefore, considering the widespread distribution and the detection of only a single individual approximately 2 km north of the Study Area, it is unlikely that any individuals present would constitute an ecologically significant portion of the population.

Threatening processes

Threats to the Glossy ibis populations in Australia, as identified in the SPRAT Profile (DotE, 2025l) include:

- wetland habitat degradation due to agricultural expansion and urban development

- hydrological alterations from irrigation and damming, disrupting natural water regimes
- water pollution from nutrient-rich runoff and urban waste, reducing prey availability
- anthropogenic disturbance from recreational activities, especially during breeding periods
- climate variability and change, affecting rainfall patterns and wetland persistence; and
- invasive species impacts, including predation and competition for nesting sites.

Recovery actions

No specific recovery actions have been identified for the Glossy ibis.

Significant impact assessment

Approximately 20.86 ha of foraging habitat for the Glossy ibis is located within the Disturbance Footprint and will be cleared for the Project (Figure 21). A significant impact assessment has been completed against the MNES SIA Guidelines (DotE, 2013b) in Table A - 12.

Table A - 12: Significant impact assessment for the Glossy ibis

MNES Significant Impact Guideline Criteria for Migratory Species	Response
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	As described in the section above, the Study Area does not support an important habitat for the species. Therefore, the removal of approximately 20.86 ha of foraging habitat, has no chance or possibility of leading to a long-term decrease in the size of an important population.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	As described in the section above, the Study Area does not support an important habitat for the species. Additionally, the Disturbance Footprint is already impacted by grazing, clearing and mining activities and invasive species are established in the area including exotic grasses, pigs, cats and dogs. Management and control of weed and pest species, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and proliferation of pest animals. Therefore, there is no real chance or possibility that the Project would substantially modify, destroy or isolate an area of important habitat for the species.
result seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	As described in the section above, the Study Area is unlikely to contain an ecologically significant proportion. Nonetheless, should an ecologically significant proportion of a population utilise the Study Area, given the abundance of similar foraging habitat throughout the region, there is a very low chance or possibility the removal of 20.86 ha of foraging habitat would seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population

MNES Significant Impact Guideline Criteria for Migratory Species	Response
Outcome	*The Project is unlikely to result in a significant impact to this species, as the Study Area is unlikely to contain important habitat or an ecological significant proportion of the population.*

Appendix E MSES Significant Residual Impact Assessments

E.1 Regulated vegetation

Matters of State Environmental Significance (MSES) regulated vegetation within the Study Area was assessed using ground-truthed RE mapping. MSES Regulated Vegetation occurring within the Study Area has been assessed against the Queensland Environmental Offsets Policy – Significant Residual Impact Guideline (MSES SRI Guideline) (DSDIP, 2014) in Table A - 13. This assessment shows that an SRI is likely to occur to endangered RE 11.3.1.

Table A - 13: Regulated vegetation significant residual impact assessment

RE	VM Act status	Structure Category	Assessment criteria	Assessment	Significant residual impact likely?
Endangered and Of Concern REs					
11.3.1	Endangered	Mid-dense	Clearing of an area greater than 0.5 ha where in a mid-dense (structural category) RE.	Clearing of 1.21 ha of remnant RE 11.3.1 will be undertaken within the Disturbance Footprint.	Yes, clearing is greater than the clearing threshold of 0.5 ha.
11.3.2	Of Concern	Sparse	Clearing of an area greater than 2 ha where in a sparse (structural category) RE.	No clearing of remnant RE 11.3.2 will be undertaken within the Disturbance Footprint.	No, the clearing threshold is not exceeded.
11.3.3	Of Concern	Sparse	Clearing of an area greater than 2 ha where in a sparse (structural category) RE.	No clearing of remnant RE 11.3.3 will be undertaken within the Disturbance Footprint.	No, the clearing threshold is not exceeded.
REs within the defined distance of the defining banks of a relevant watercourse or drainage feature					
11.3.1	NA	Mid-dense	• Clearing of an area greater than 0.5 ha where in a mid-dense (structural category) RE; and • Clearing within 5 metres (m) of the defining bank.	Clearing of 0.06 ha of remnant RE 11.3.1 within a defined distance to a watercourse will be undertaken within the Disturbance Footprint including disturbance within 5 m of the defining bank.	No, the clearing threshold is not exceeded.

RE	VM Act status	Structure Category	Assessment criteria	Assessment	Significant residual impact likely?
11.3.2	NA	Sparse	• Clearing of an area greater than 2 ha where in a sparse (structural category) RE; and • Clearing within 5 m of the defining bank.	No clearing of remnant RE 11.3.2 will be undertaken within the Disturbance Footprint.	No, the clearing threshold is not exceeded.
11.3.3	NA	Sparse	• Clearing of an area greater than 2 ha where in a sparse (structural category) RE; and • Clearing within 5 m of the defining bank.	No clearing of remnant RE 11.3.3 will be undertaken within the Disturbance Footprint.	No, the clearing threshold is not exceeded.
11.3.6	NA	Sparse	• Clearing of an area greater than 2 ha where in a sparse (structural category) RE; and • Clearing within 5 m of the defining bank.	Clearing of 0.18 ha of remnant RE 11.3.6 within a defined distance to a watercourse will be undertaken within the Disturbance Footprint. This includes areas being cleared within 5 m of defining banks.	No, the clearing threshold is not exceeded.
11.3.27	NA	Sparse	• Clearing of an area greater than 2 ha where in a sparse (structural category) RE; and • Clearing within 5 m of the defining bank.	No clearing of remnant 11.3.27 will be undertaken within the Disturbance Footprint.	No, the clearing threshold is not exceeded.

E.2 Connectivity

The Landscape Fragmentation Connectivity tool performs a desktop assessment of development impacts on connectivity areas containing remnant vegetation. The tool is a test for significant residual impacts on connectivity, a Prescribed Environmental Matter (PEM) under the Environmental Offsets Framework. It is also effective as a mechanism for quantifying the fragmentation of remnant REs at the bioregion scale.

The Landscape Fragmentation Connectivity tool results for the Project are summarised in Table A - 14 below and used the Queensland Herbarium certified mapping for the Study Area. The outcome of this tool determined that no significant impact would occur for connectivity areas. Particularly, as the change of core remnant areas post impact are low (0.0%).

Table A - 14: Landscape fragmentation and connectivity significant residual impact assessment

Output	Value
Significance test one	
Regional total area	202,133.05 ha
Regional extent of core remnant	56,862.04 ha
Area of core at the local scale (pre impact)	232.49 ha
Area of core at the local scale (post impact)	232.48 ha
Percent change of core at the local scale (post impact)	0.0%
Significance test two	
The number of core remnant areas occurring on the site	0
The number of core remnant areas occurring on the site post impact	0
Result	*This analysis has determined no significant impact on connectivity areas.*

E.3 Protected Wildlife Habitat - *Solanum elachophyllum*

Solanum elachophyllum, is listed as Endangered under the Nature Conservation Act 1992 (NC Act).

Habitat preferences and distribution

S. elachophyllum is found primarily on fertile cracking-clay soils in open forest of *Eucalyptus thozetiana*, *Acacia harpophylla*, with understorey of *Geijera parviflora*, *Casuarina cristata*, *Macropteranthes leichhardtii*, *E. cambageana*, or woodland of *E. crebra* and *E. tenuipes* (Bean, 2004). This species grows in vegetation communities in which fire is normally absent (Bean, 2004) on fertile cracking soils between Middlemount and Theodore.

For additional information on *S. elachophyllum* habitat preferences and distribution, refer to Section 4.1.3.1.

Presence in the Disturbance Footprint

S. elachophyllum, has been identified numerous locations within the Disturbance Footprint, during E2M field surveys and additional locations during EMM surveys. Suitable habitat for *Solanum elachophyllum* within the Disturbance Footprint, comprises known habitat which consists of 6.00 ha of suitable habitat within 50 m of known records of the species and 2,299.78 ha of potential habitat which consists of potential suitable habitat outside areas of known habitat.

Populations within the Disturbance Footprint surveyed by E2M and EMM consisted of approximately 369 individuals across 10 discrete locations. These individuals were located in non-remnant areas and high value regrowth RE 11.3.1, 11.4.9 and 11.9.5.

For additional information on *S. elachophyllum* habitat preferences and distribution, refer to Section 4.1.3.1.

Threatening processes

The primary threats to *S. elachophyllum* include habitat loss through vegetation clearing and reduced habitat availability, particularly due to the spread of invasive species such as introduced pasture grasses (Bean, 2004). Additional risks arise from the destruction of individuals and populations on private freehold land, where small vegetation patches may be cleared without detection under the Vegetation Management Act 1999. The species is also vulnerable to stochastic events (such as changes in drainage, drought, fire, and wildlife predation) which can significantly reduce or eliminate populations. This vulnerability is heightened by the fragmented nature of remaining vegetation, with populations at the Brigalow Research Station notably impacted by heavy wallaby grazing (Bean, 2004). Furthermore, small population sizes across all known sites raise concerns about genetic inbreeding depression.

Recovery actions

There are no recovery actions for *S. elachophyllum*. However, monitoring is recommended to improve species management and knowledge (DERM, 2011). Further field studies are required to locate any additional populations and to precisely determine the number of populations, geographical range, area of occupancy and number of individuals.

Significant impact assessment

Approximately 6.00 ha of known habitat and 2,299.78 ha of potential habitat for *S. elachophyllum* is located within the Disturbance Footprint and will be cleared for the Project (Figure 10). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 15.

Table A - 15: Significant residual impact assessment for the *Solanum elachophyllum*

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	A total 6.00 ha of known *S. elachophyllum* habitat, including the removal of approximately 123 stems, will be removed as part of the Project. This removal of known individuals is likely to lead to a long-term decrease in the size of the local population.
reduce the extent of occurrence of the species	The extent of occurrence for this species is 53,798 km^2 (ALA, 2025). The proposed disturbance is located in Blackwater, which lies centrally within the known distribution of the species. Therefore, given the Projects central position within the species known distribution and the number of records within the Study Area and surrounding region, the Project is unlikely to result in a reduction of the species' extent of occurrence.
fragment an existing population	The Project would require the removal of approximately 6.00 ha of known *S. elachophyllum* habitat, including the removal of approximately 123 stems, as well as an additional 2,299.78 ha of potential habitat. However, while entire patches of individuals will be removed as part of the Project, given the Study Area is already highly fragmented and individuals occur as small, isolated patches, it is unlikely that the Project would fragment an existing population.
result in genetically distinct populations forming as a result of habitat isolation	As the landscape within the Study Area is already highly fragmented and existing records of the species occur in small, isolated patches, it is unlikely that the Project would result in genetically distinct populations forming as a result of habitat isolation.
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	As discussed above, one of the greatest threats to the species is reduced habitat availability, due to the spread of invasive species such as introduced pasture grasses (Bean, 2004). Pasture grasses such as Buffel grass are already prevalent within the species habitat and widespread throughout the broader landscape. Nonetheless, implementation of a Weed and Pest Management Plan, as described in Section 7.3.2, will include standard industry accepted measures to minimise the introduction and spread of weeds. As such, it is unlikely that the Project would result in the establishment or proliferation of invasive species which are harmful to the species.
introduce disease that may cause the population to decline	There are no diseases listed as threats to *S. elachophyllum*. Therefore, the Project is not expected to result in the introduction of a disease that would cause the species to decline.

Significant impact criteria	Response
interfere with the recovery of the species	The Project would require the removal of approximately 6.00 ha of known *S. elachophyllum* habitat, including the removal of approximately 123 stems, as well as an additional 2,299.78 ha of potential habitat. While this result in a reduction in the local population, given the extent of similar habitat and known record within and surrounding the Study Area, it is considered unlikely that the Project would substantially interfere with the recovery of the species.
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The potential habitat mapped within the Disturbance Footprint is unlikely to be an ecologically significant location as more extensive, better-connected, and higher-quality habitat is available elsewhere within the Study Area and boarder landscape. As such, the Project is unlikely to cause disruption to an ecological significant location for the species.
Outcome	*The Project is likely to lead to a long-term decrease in the size of a local population. Therefore, it is likely the Project would have a significant residual impact on S. elachophyllum.*

E.4 Protected Wildlife Habitat - Australian painted snipe (*Rostratula australis*)

The Australian painted snipe is listed as endangered under and the NC Act.

Habitat preference and distribution

Refer to Appendix D.2.

Presence within the Disturbance Footprint

Refer to Appendix D.2.

Threatening processes

Refer to Appendix D.2.

Recovery actions

Refer to Appendix D.2.

Significant impact assessment

Approximately 20.86 ha of foraging habitat for Australian painted snipe is located within the Disturbance Footprint and will be cleared for the Project (Figure 14). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 16.

Table A - 16: Significant residual impact assessment for the Australian painted snipe

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	The Australian painted snipe population is small, likely to be continuous, dispersive or migratory (DCCEWW, 2022) and unlikely to comprise local sub-populations. The Project would result in the removal of 20.86 ha of foraging habitat for Australian painted snipe, with no suitable breeding habitat present within the Disturbance Footprint (refer to Section 4.2.3.2). The foraging habitat present consists of 6.41 ha of permanent foraging opportunities in the form of dams and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland. Areas of similar foraging habitat are abundant throughout the wider Study Area, including 10.03 ha of dams or wetlands, 520.20 ha of non-remnant gilgai and 8.71 ha of remnant RE 11.3.27 providing wetland habitat. Therefore, given the Project would not result in the removal of breeding habitat, impact a small proportion (3.42%) of available foraging habitat within the Study Area, it is unlikely the Project would lead to a long-term decrease in the size of a local population.

Significant impact criteria	Response
reduce the extent of occurrence of the species	The extent of occurrence for the species is estimated at 7,100,000 km^2 (S. T. Garnett et al., 2011). Given, the species is widespread and dispersive, and the Project would result in the removal of a small portion (20.86 ha / 3.42%) of similar foraging habitat within the Study Area, it is considered unlikely the Project would reduce the extent of occurrence of the species.
fragment an existing population	This is a highly mobile species for which the Project is unlikely to create barriers to movement, and the species will be able to persist within the landscape. Therefore, the Project is not expected to fragment an existing population.
result in genetically distinct populations forming as a result of habitat isolation	Given that the Project is unlikely to fragment an existing population, it is also unlikely to lead to the formation of genetically distinct populations through habitat isolation. Furthermore, the habitat affected by the Project is already extremely fragmented, reducing the potential for additional genetic divergence.
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	The Study Area is already impacted by grazing, clearing and mining activities and invasive species are established in the area. Threats to the species as a result of this existing disturbance includes proliferation of weed species, degradation of already modified seasonal and ephemeral wetland habitat by feral pigs and predation by feral cats. Management and control of weed and pest species, as described in 0, will include standard industry accepted measures to minimise the spread of weeds and pest animals (e.g. feral pigs, that have the potential to degrade the ground layer and foraging resources for the Australian painted snipe, and feral cats which prey on the species). Therefore, the Project is unlikely to contribute substantially to an invasive species becoming established in Australian painted snipe habitat.
introduce disease that may cause the population to decline	There are no diseases listed as threats to the Australian painted snipe. Therefore, the Project is not expected to result in the introduction of a disease that would cause the species to decline.
interfere with the recovery of the species	The strategies identified to achieve the recovery plan objectives include the management and protection of known habitat at a landscape level, reduce or eliminate threats at breeding and non-breeding habitat as well as research activities relating to population trajectories, habitat requirements and the engagement of stakeholders (DCCEWW, 2022). While the removal of 20.86 ha of foraging habitat goes against the reducing threats to the species, given the availability of similar habitat within the Study Area and broader region, the extent of proposed clearing is not considered of a scale which is likely to interfere with the recovery of the species.

Significant impact criteria	Response
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The Project would result in the removal of 20.86 ha of foraging habitat for Australian painted snipe, with no suitable breeding habitat present within the Disturbance Footprint (refer to Section 4.2.3.2). The foraging habitat present consists of 6.41 ha of permanent foraging opportunities in the form of dams and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland. Therefore, given the Disturbance Footprint does not contain suitable breeding habitat for the species and similar foraging habitat is abundant throughout the Study Area and broader region, habitat within the Disturbance Footprint is unlikely to constitute ecologically significant location.
Outcome	*While The Project would result in the removal of 20.86 ha of foraging habitat for Australian painted snipe, given these areas are not considered ecological significant locations based on extensive similar habitat being available within the broader region, the Project is unlikely to have a significant impact on the species.*

E.5 Protected Wildlife Habitat - Koala (*Phascolarctos cinereus*)

The Koala is listed as endangered under the NC Act.

Habitat preference and distribution

Refer to Appendix D.3.

Presence within the Disturbance Footprint

Refer to Appendix D.3.

Threatening processes

Refer to Appendix D.3.

Recovery actions

Refer to Appendix D.3.

Significant impact assessment

Approximately 2.72 ha of Koala breeding and foraging habitat, and 48.29 ha of dispersal habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 18). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 17.

Table A - 17: Significant residual impact assessment for the Koala

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	The Project would remove a total of 50.01 ha of habitat for the species. This will comprise of 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, with majority of habitat highly degraded as a result of historical clearing (refer to Section 4.1.1). Given the paucity of records within the Study Area and the degraded nature of the habitat, no resident populations are expected to occur within the Study Area, with any individuals likely to occur transiently when moving between areas of higher quality habitat. Additionally, habitat present within the Disturbance Footprint does not provided connectivity between areas of higher quality habitat, with the primary movement corridor along Taurus Creek and Two Mile Gully being retained. Therefore, given the Study Area is unlikely to contain a resident population of Koalas and the Project would result in the removal of 50.01 ha of highly degraded habitat which is unlikely to be utilised by the species, it is unlikely the Project would lead to a long-term decrease in the size of a local population.

Significant impact criteria	Response
reduce the extent of occurrence of the species	The extent of occurrence was calculated as 1,665,850 km (DAWE, 2022). While the Project would result in the removal of 50.01 ha of habitat, including 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, these areas are highly degraded and do not provide connectivity between areas of higher quality habitat. As such these areas are considered unlikely to be occupied by Koalas. Therefore, given habitat within the Disturbance Footprint is unlikely to be occupied by Koalas and the primary movement corridor within the Study Area (i.e. Taurus Creek and Two Mile Gully) is being retained, it is unlikely the Project would reduce the extent of occurrence of this species.
fragment an existing population	Koalas are known to traverse up to 1-3 km on ground and will often travel through cleared or treeless areas (DAWE, 2022). While the Project would result in the removal of 50.01 ha of habitat, including 2.72 ha of breeding and foraging habitat and 48.29 ha of dispersal habitat, these areas are highly degraded and do not provide connectivity between areas of higher quality habitat. Therefore, given the Project would not impact habitat providing connectivity for Koalas and the primary movement corridor within the Study Area (i.e. Taurus Creek and Two Mile Gully) is being retained, it is unlikely the Project would fragment an existing population.
result in genetically distinct populations forming as a result of habitat isolation	Given that the Project is unlikely to fragment an existing population, it is also unlikely to lead to the formation of genetically distinct populations through habitat isolation. Furthermore, the habitat affected by the Project is already extremely fragmented and provides limited connectivity, reducing the potential for additional genetic divergence.
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	The primary invasive species, which poses a threat to Koala are dogs (DAWE, 2022). Dogs were recorded in the Study Area during the field survey, though given the already highly disturbed nature of the Study Area and the Project implementing specific environmental management plans including a Pest and Weed Management Plan to mitigate the threat of dogs (see Section 7.3.2), it is unlikely that the Project would proliferate the occurrence of dogs within the area.

Significant impact criteria	Response
introduce disease that may cause the population to decline	Diseases such as Chlamydia (*Chlamydia pecorum*) and Koala retrovirus (KoRV) have been identified in the populations within the region. The prevalence of disease (chlamydiosis) has been found to increase following extreme stress from hot weather, drought, habitat loss and fragmentation (Lunney et al., 2012; McCallum et al., 2017). Symptoms of individuals carrying Chlamydia can become overt when subjected to additional stress. Such stress may be caused by habitat clearing associated with the Project. However, Koala specific management measures will be put in place as part of the updated Blackwater Mine Land and Management Plan (Whitehaven Coal Pty Ltd, 2020) to ensure this threat is mitigated (Section 7.1.2). Important measures will include but not be limited to; pre-clearance surveys to detect the presence of Koalas, directional clearing towards habitat to be retained, leaving identified Koalas in place with dispersal routes and connecting trees available until the individual has moved on without interference. Implementation of these measures will ensure the Project is unlikely to introduce diseases or exacerbate existing diseases that may cause the species to decline.
interfere with the recovery of the species	The National Recovery Plan identifies recovery objectives and threats to be managed for the recovery of the species (DAWE, 2022). The key threats to the species listed in the recovery plan that are relevant to the Project include habitat loss, fragmentation and degradation. In relation to these threats: • the Disturbance Footprint will involve clearing of habitat, although these areas are considered unlikely to be occupied by individuals, will not impact refuge habitat and will not fragment remaining habitat to the extent the species cannot continue to disperse through the landscape; and • suitable habitat will remain in the Study Area and will continue to be available to support the long-term persistence of the species. As the species is expected to persist in the Study Area, the Project is unlikely to interfere with the recovery of the species.
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The suitable habitat within the Disturbance Footprint is not considered to constitute an ecological significant location, given: • the area is unlikely to occupy the habitat • is highly degraded; and • does not provide connectivity between larger areas of higher quality habitat. Additionally, potential indirect impacts on retained habitat are considered to be negligible based on the implementation of mitigation measures detailed in Section 7. As such, the Project is considered unlikely to cause disruption to ecological significant locations of the species.

Significant impact criteria	Response
Outcome	*Given the limited extent of proposed clearing, the species being considered unlikely to occupy habitat within the Disturbance Footprint, the absence of ecological significant locations and the Project not fragmenting or isolating populations, it is unlikely the Project would result in a significant residual impact on the Koala.*

E.6 Protected Wildlife Habitat - Latham's snipe (*Gallinago hardwickii*)

The Latham's snipe is listed as vulnerable under the NC Act.

Habitat preference and distribution

Refer to Appendix D.4.

Presence within the Disturbance Footprint

Refer to Appendix D.4.

Threatening processes

Refer to Appendix D.4.

Recovery actions

Refer to Appendix D.4.

Significant impact assessment

Approximately 20.86 ha of foraging habitat for the Latham's snipe is located within the Disturbance Footprint and will be cleared for the Project (Figure 15). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 18.

Table A - 18: Significant residual impact assessment for the Latham's snipe

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	

Significant impact criteria	Response
lead to a long-term decrease in the size of a local population	The Study Area is unlikely to support a local population of the species, and the entire population of Latham's snipe migrate to Australia during the northern hemisphere boreal winter where it returns to breed, and therefore local populations do not occur in the Study Area. The foraging habitat present consists of 6.41 ha of permanent foraging opportunities in the form of dams/wetlands and 14.45 ha of ephemeral/intermittent foraging opportunities in the form of cleared gilgai pastureland. Areas of similar foraging habitat are abundant throughout the wider Study Area, including 10.03 ha of dams or wetlands, 520.20 ha of non-remnant gilgai and 8.71 ha of remnant RE 11.3.27 providing wetland habitat. Therefore, given the Project would impact a small proportion (3.42%) of available foraging habitat within the Study Area, it is unlikely the Project would lead to a long-term decrease in the size of a local population.
reduce the extent of occurrence of the species	The Extent of occurrence for Latham's Snipe has been estimated at 13,000 km^2 (DCCEEW, 2024). Approximately 20.86 ha of foraging habitat to be removed within the Disturbance Footprint. Given, the species is widespread and dispersive, and the Project would result in the removal of a small portion (20.86 ha / 3.42%) of similar foraging habitat within the Study Area, there is a very low possibility that the Project would likely reduce the extent of occurrence of the species.
fragment an existing population	Latham's Snipe are a highly mobile species, able to travel long distances and the Project would not cause a barrier to movement for this species. Furthermore, the species will be able to persist in remaining habitat which offers greater quality and quantity in the Study Area and broader landscape. Therefore, the Project is not expected to result in the fragmentation of an existing population of Latham's Snipe.
result in genetically distinct populations forming as a result of habitat isolation	The Project would impact 20.86 ha of foraging habitat for this species. However, the relatively small area of impact to foraging habitat is already well isolated and, as such is unlikely to result in genetically distinct populations. In addition, Latham's snipe do not breed in Australia and the removal of 20.86 ha of foraging habitat outside of the breeding habitat for the species is unlikely to cause the creation of genetically distinct populations. Similarly, potential indirect impacts such as changes to the hydrology, invasion by exotic weeds and disturbance and predation by pest animals will be managed (as described in Section 7.4.1 and Section 7.3.1 respectively) to the extent they are unlikely to decrease the availability or quality of habitat remaining in the Study Area.

Significant impact criteria	Response
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	The Study Area is already impacted by grazing, clearing and mining activities and invasive species are established in the area. Threats to the species as a result of this existing disturbance includes proliferation of weed species, degradation of wetland habitat by feral pigs and predation by feral cats. Management and control of weed and pest species, as described in 0, will include standard industry accepted measures to minimise the spread of weeds and pest animals that have the potential to degrade the ground layer and foraging resources for the Latham's snipe and prey on the species. Therefore, the Project is unlikely to contribute substantially to an invasive species becoming established in Latham's snipe habitat.
introduce disease that may cause the population to decline	The Approved conservation advice for Latham's snipe does not identify any diseases that are likely to impact the species (DCCEEW, 2024). The Project is not expected to result in the introduction of a disease that would impact Latham's snipe.
interfere with the recovery of the species	The removal of 20.86 ha of foraging habitat is not expected to interfere with the recovery of the species. In addition, large areas of non-remnant gilgai habitat that provide high-quality foraging opportunities will remain within the Study Area, continuing to support habitat availability for the species. Therefore, it is unlikely the Project would interfere with the recovery of the species.
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The Project proposes the removal of approximately 20.86 ha of anthropogenic wetlands and dams, along with non-remnant gilgai habitat that may offer ephemeral habitat following rainfall events. While foraging habitat does exist within the Disturbance Footprint, it is relatively isolated from larger, higher-quality habitat areas elsewhere in the Study Area. As a result, these foraging areas are unlikely to be ecologically significant locations.
Outcome	*While The Project would result in the removal of 20.86 ha of foraging habitat for the Latham's snipe, given the extent of similar habitat available throughout the Study Area and wider region, these impacts are not considered important, notable, or of consequence, having regard to its context and intensity.*

E.7 Protected Wildlife Habitat - Ornamental snake (*Denisonia maculata*)

The Ornamental snake is listed as vulnerable under the NC Act.

Habitat preference and distribution

Refer to Appendix D.5.

Presence within the Disturbance Footprint

Refer to Appendix D.5.

Threatening processes

Refer to Appendix D.5.

Recovery actions

Refer to Appendix D.5.

Significant impact assessment

No habitat for the Ornamental snake is located within the Disturbance Footprint (Figure 13). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 19.

Table A - 19: Significant residual impact assessment for the Ornamental snake

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	No Ornamental snake habitat was identified within the Disturbance Footprint. The Project would therefore not result in the direct loss of suitable habitat and is unlikely to lead to a long-term decline in the size of an important population. The gilgai habitat remaining in the Study Area that is likely to support an important population will not be directly impacted by the Project
reduce the extent of occurrence of the species	The extent of occurrence for this species is 376,319 km^2 (ALA, 2025). As no Ornamental snake habitat was identified within the Disturbance Footprint, the Project would not reduce the extent of occurrence for the species. Additionally, indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, there is a very low chance or possibility that the Project would reduce the extent of occurrence of the species.
fragment an existing population	As no Ornamental snake habitat was identified within the Disturbance Footprint, the Project is unlikely to fragment an existing population. The gilgai habitat remaining in the Study Area that is likely to support an important population will not be directly impacted by the Project.

Significant impact criteria	Response
result in genetically distinct populations forming as a result of habitat isolation	As no suitable habitat for the species has been identified within the Disturbance Footprint, there is no chance or possibility the Project would result in genetically distinct populations forming as a result of habitat isolation.
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	Threats to the species include overgrazing and degradation by feral herbivores such as rabbits and feral pigs, proliferation of weed species and predation by feral carnivores, such as foxes and feral cats. The Study Area is already impacted by grazing, clearing and mining extraction activities and invasive species are already established in the landscape, including those listed as potential threats above. Management and control of weed and pest species, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and proliferation of pest animals that have the potential to degrade the ground layer. Therefore, the Project is unlikely to contribute to an invasive species becoming established in the Ornamental snake habitat remaining in the Study Area.
introduce disease that may cause the population to decline	No introduced diseases are known to significantly impact this species. It is unlikely the Project would introduce such as disease in this region.
interfere with the recovery of the species	No Ornamental snake habitat was identified within the Disturbance Footprint, and indirect impacts on retained habitat are considered negligible based on the implementation of mitigation measures detailed in Section 7. As such, there is a very low chance or possibility that the Project would interfere with the recovery of the species.
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	As no Ornamental snake habitat was identified within the Disturbance Footprint, the Project is unlikely to cause disruption to ecologically significant locations. The gilgai habitat remaining in the Study Area that is likely to support an important population will not be directly impacted by the Project.
Outcome	*The Project is unlikely to have a significant residual impact on the Ornamental snake, as there is no habitat within the Disturbance Footprint.*

E.8 Protected Wildlife Habitat - Squatter pigeon (southern) (*Geophaps scripta scripta*)

The Squatter pigeon (southern) is listed as vulnerable under the NC Act.

Habitat preference and distribution

Refer to Appendix D.6.

Presence within the Disturbance Footprint

Refer to Appendix D.6.

Threatening processes

Refer to Appendix D.6.

Recovery actions

Refer to Appendix D.6.

Significant impact assessment

Approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat for the Squatter pigeon (southern) is located within the Disturbance Footprint (totalling 294.80 ha) and will be cleared for the Project (Figure 16). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 20.

Table A - 20: Significant residual impact assessment for the Squatter pigeon (southern)

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	The Project proposes the removal of approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat. However, this impact is unlikely to lead to a long-term decrease in the size of a local population, as any individuals present are expected to be in very low numbers. Additionally, suitable breeding and foraging habitat remains available elsewhere within the Study Area.
reduce the extent of occurrence of the species	The extent of occurrence for the species has been calculated at 1,684,230 km^2 (Queensland Resources Council, 2015). The species will persist in the Study Area and broader region despite the removal of approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat. Therefore, the Project has a low chance or possibility to reduce the extent of occurrence of the species.

Significant impact criteria	Response
fragment an existing population	The proposed removal will affect approximately 26.05 ha of breeding and foraging habitat, 6.41 ha of foraging-only habitat, and 262.34 ha of dispersal habitat within the Disturbance Footprint. However, this impact has a low chance or possibility to fragment an existing population, as any individuals present are expected to be in very low numbers. Additionally, suitable breeding and foraging habitat remains available elsewhere within the Study Area.
result in genetically distinct populations forming as a result of habitat isolation	The presence of individuals within the Disturbance Footprint is anticipated to be minimal, if any. Furthermore, the habitat across the Study Area is well connected, and any impacts within the Disturbance Footprint are unlikely to result in the formation of genetically distinct populations due to habitat isolation.
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	Threats to the species include overgrazing by feral herbivores such as rabbits, proliferation of weed species and predation by feral carnivores such as foxes and feral cats. The Disturbance Footprint is already impacted by grazing, clearing and mining activities and invasive species are established in the area including feral cats. Implementation of a Weed and Pest Management Plan, as described in Section 7.3.2, will include standard industry accepted measures to minimise the spread of weeds and proliferation of pest animals that have the potential to degrade the ground layer and foraging resources for the Squatter pigeon (southern). Therefore, the Project has a low chance or possibility of contributing to an invasive species becoming established in Squatter pigeon (southern) habitat.
introduce disease that may cause the population to decline	Disease has not been identified as a threat to the Squatter pigeon (southern). Therefore, the Project would not introduce disease that may cause the species to decline.
interfere with the recovery of the species	Recovery actions primarily address impacts to important sub-populations of the Squatter pigeon (southern), of which none occur in the Study Area. Given the low abundance of individuals recorded in the Study Area and availability of habitat elsewhere in the region and mitigation proposed, it is unlikely the Project would interfere with the recovery of the Squatter pigeon (southern).
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The Project proposed the removal of 26.05 ha of breeding and foraging habitat along with 6.41 ha of foraging-only habitat for the species. Although, habitat within the Study Area does not provide particularly unique or rare resources that are important for the long-term maintenance of the species, maintaining genetic diversity, or provide area to support reintroductions of the species.
Outcome	*The Project is unlikely to have a significant impact on the Squatter pigeon (southern) as habitat within the Disturbance Footprint is degraded and unlikely to contain important habitat for the species.*

E.9 Protected Wildlife Habitat - White-throated needletail (*Hirundapus caudacutus*)

The White-throated needletail is listed as vulnerable under the NC Act.

Habitat preference and distribution

Refer to Appendix D.7.

Presence within the Disturbance Footprint

Refer to Appendix D.7.

Threatening processes

Refer to Appendix D.7.

Recovery actions

Refer to Appendix D.7.

Significant impact assessment

Approximately 2,316.58 ha of foraging habitat is located within the Disturbance Footprint and will be cleared for the Project (Figure 17). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 21.

Table A - 21: Significant residual impact assessment for the White-throated needletail

Significant impact criteria	Response
An action is likely to have a significant impact on endangered and vulnerable wildlife if the impact on the habitat is likely to:	
lead to a long-term decrease in the size of a local population	Given the species' migratory and highly mobile nature, the Study Area is unlikely to support a local population. Therefore, removal of approximately 2,316.58 ha of aerial foraging habitat has a low chance or possibility of leading to a long-term decrease in the size of a local population.
reduce the extent of occurrence of the species	The Disturbance Footprint and surrounding Study Area is unlikely to support a local population of White-throated needletail. Despite the removal of approximately 2,316.58 ha of aerial foraging habitat for the Project, the species is likely to continue to overfly the Study Area and landscapes within the broader region. Therefore, the action has no chance or possibility of reducing the extent of occurrence of the species.
fragment an existing population	The Disturbance Footprint and surrounding Study Area is unlikely to support a local population of White-throated needletails. This is a highly mobile, almost exclusively aerial species. Therefore, the clearing of vegetation within the Disturbance Footprint is unlikely to fragment an existing population.
result in genetically distinct populations forming as a result of habitat isolation	The removal of approximately 2,316.58 ha of aerial foraging habitat has no chance or possibility of resulting in habitat isolation that will lead to the formation of genetically distinct populations given that the species is highly mobile and almost exclusively aerial.

Significant impact criteria	Response
result in invasive species that are harmful to an endangered, vulnerable or near-threatened species becoming established in the endangered, vulnerable or near-threatened species' habitat	The *Conservation Advice Hirundapus caudacutus White-throated Needletail* (TSSC, 2019) does not identify any invasive species that are considered likely to impact the species. The Project is not expected to result in the introduction of an invasive species that would be harmful to White-throated needletails becoming established within overfly habitat for this species.
introduce disease that may cause the population to decline	The *Conservation Advice Hirundapus caudacutus White-throated Needletail* (TSSC, 2019) does not identify any diseases that are likely to impact the species. The Project is not expected to result in the introduction of a disease that would impact White-throated needletails.
interfere with the recovery of the species	The species is unlikely to directly use vegetation communities in the Disturbance Footprint and surrounding Study Area therefore it is not considered to provide ecologically significant habitat for the species or support a local population, therefore the action is unlikely to interfere substantially with the recovery of the species.
cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Given this is a non-breeding visitor to Australia, an almost exclusively aerial species and the Disturbance Footprint and surrounding Study Area is unlikely to provide preferred roosting habitat for this species, the Project has no chance or possibility of causing disruption to ecologically significant locations of the species.
Outcome	*Given the species is almost exclusively aerial, the Project is unlikely to cause disruption to ecologically significant locations, fragment an existing population or lead to a long-term decrease in the size of a location population. The Project is therefore considered unlikely to result in a significant residual impact to this species.*

E.10 Protected Wildlife Habitat - Short-beaked echidna (*Tachyglossus aculeatus*)

Short-beaked echidna is listed as Special Least Concern under the NC Act.

Habitat preferences and distribution

The Short-beaked echidna is widespread and occurs throughout Australia in a broad variety of habitats where there is a supply of ants and termites upon which it feeds (Van Dyck & Strahan, 2008). The species also utilises microhabitat features such as thick bushes, hollow logs and debris piles for shelter (Van Dyck & Strahan, 2008) (refer to Section 4.2.3.7).

Presence in the Disturbance Footprint

Short-beaked echidna has not been recorded during any surveys within the Disturbance Footprint. However, given the species is widespread and utilises and range of habitats, suitable habitat within the Disturbance Footprint, includes 122.11 ha of breeding and foraging habitat consisting of remnant, high value regrowth and young regrowth communities.

For additional information on Short-beaked echidna habitat preferences and distribution, refer to Section 4.2.3.7.

Threatening processes

Across most of its range, the Short-beaked echidna is considered to have few major threats (Aplin, 2015). At an individual scale they are susceptible to predation by feral cats and pigs as well as being hit by motor vehicles (S. Nicol, 2015). Land clearing for agriculture and livestock may reduce habitat quality and microhabitat availability for the species (Eldridge et al., 2016).

Recovery actions

There are no recovery actions for the short beaked echidna as the species has a wide distribution, is a habitat generalist and there are limited key threats to the species.

Significant impact assessment

Approximately 122.11 ha of breeding and foraging habitat for the Short-beaked echidna is located within the Disturbance Footprint and will be cleared for the Project (Figure 19). A significant residual impact assessment has been completed against the MSES SRI Guidelines (DSDIP, 2014) and is provided in Table A - 22.

Table A - 22: Significant residual impact assessment for the Short-beaked echidna

Significant impact criteria	Response
An action is likely to have a significant impact on a special least concern (non-migratory) animal wildlife habitat if it is likely that it will result in:	
a long-term decrease in the size of a local population	Up to 122.11 ha of breeding and foraging is proposed to be cleared within the Disturbance Footprint. This is unlikely to lead to a long-term decrease in the size of the local Short-beaked echidna population, given: • measures to mitigate mortality or injury of animals during clearing and construction works (as detailed in Section 7.1.2 of this report) • the presence and extent of similarly suitable habitat adjacent to and connected with the Disturbance Footprint • the species' mobility and continued ability to access foraging and shelter resources within the Study Area and surrounds, and • potential utilisation of cleared and disturbed areas for foraging following rehabilitation or revegetation works.
a reduced extent of occurrence of the species	The Project is unlikely to reduce the species' extent of occurrence, given: • the extent of similarly suitable habitat adjoining and connected with the Disturbance Footprint and within the broader surrounding landscape; and • the species' mobility and continued ability to access breeding, foraging and shelter resources within the Study Area and surrounds.
fragmentation of an existing population	The Project is unlikely to fragment an existing population, as any individuals present are expected to be in very low numbers and the species is known to move across cleared areas.
genetically distinct populations forming as a result of habitat isolation	The Project is likely to remove a total of 122.11 ha of breeding and foraging habitat. This disturbance will not create dispersal barriers that would result in genetically distinct populations forming as the species is the known to move across cleared areas and any individuals present are expected to be in very low numbers.
disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	The Study Area is unlikely to support ecologically significant locations for this species given the similar nature of vegetation and habitat across the landscape in this region. Nonetheless, the Blackwater Mine Land and Biodiversity Management Plan will be updated as discussed in Section 7, and which will include industry standards to avoid and minimise impacts to animal breeding places and unnecessary stress on native fauna.
Outcome	*The Project is unlikely to result in a significant impact on Short-beaked echidna as the species is likely to occupy the surrounding landscape and the Project is unlikely to fragment or isolate populations of the species.*

Appendix F Vegetation community descriptions

RE 11.3.1 - Remnant

Habitat quality sites:
7



Landform: alluvial plains and channels

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Acacia harpophylla* woodland on alluvial plains. The subcanopy contained *Terminalia oblongata, Acacia excelsa* and *Lysiphyllum hookeri*. The shrub layer included *Lysiphyllum carronii, Atalaya hemiglauca, Terminalia oblongata, Erythroxylum australe,* and *Citrus glauca.*

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 7-16 m	**Median Height:** 10 m	**Estimated Cover Density:** 3-46%

Species: *Acacia harpophylla* (d), *Eucalyptus coolabah* (a), *Lysiphyllum carronii* (a), *Brachychiton rupestris* (a), *Atalaya hemiglauca* (a), *Acacia excelsa* (a), *Erythroxylum australe* (a)

T2

Height interval: 3-6 m	**Median Height:** 4.5 m	**Estimated Cover Density:** 3-48%

Species: *Lysiphyllum carronii, Terminalia oblongata, Acacia excelsa, Erythroxylum australe, Brachychiton rupestris, Lysiphyllum hookeri, Grevillea parviflora*

S1

Height interval: 0.5-8 m	**Median Height:** 3 m	**Estimated Cover Density:** 1-7%

Species: *Lysiphyllum carronii, Atalaya hemiglauca, Citrus glauca, Erythroxylum australe, Terminalia oblongata, Alstonia constricta, Lysiphyllum hookeri, Notelaea microcarpa, Owenia acidula,* and *Grevillea parviflora*

Groundcover

Estimated Cover Density: 12-80%

Species: *Dichanthium sericeum, Aristida calycina, Sporobolus caroli, S. actinocladus, Cynodon dactylon*, Enteropogon ramosus, Chloris divaricata, Heteropogon contortus, Salsola australis, Atriplex muelleri, Enchylaena tomentosa, Nyssanthes diffusa, Capparis lasiantha, Cenchrus ciliaris*, Bothriochloa pertusa*, Urochloa mosambicensis*, Megathyrsus maximus*, Opuntia tomentosa*, Malvastrum americanum*, Harrisia cactus*, Eragrostis trichophora*, Parthenium sp.*, Cryptostegia grandiflora**

RE 11.3.1 – High value regrowth

Habitat quality sites:
3



Landform: alluvial plains

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Acacia harpophylla* low open woodland on alluvial plain. The subcanopy contained *Lysiphyllum carronii, Terminalia oblongata, A. excelsa, Erythroxylum australe, Brachychiton rupestris, L. hookeri* and *Grevillea parviflora*. The shrub layer included *Terminalia oblongata, L. carronii, Atalya hemiglauca, L. hookeri, and A. harpophylla.*

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 7- 8 m	**Median Height:** 7.5 m	**Estimated Cover Density:** 17-58%

Species: *Acacia harpophylla*

T2

Height interval: 3-6 m	**Median Height:** 4.5 m	**Estimated Cover Density:** 7-12%

Species: *Lysiphyllum carronii, Terminalia oblongata, Acacia excelsa, Erythroxylum australe, Brachychiton rupestris, Lysiphyllum hookeri, Grevillea parviflora*

S1

Height interval:1-2 m	**Median Height:** 1.5 m	**Estimated Cover Density:** 1-12%

Species: *Terminalia oblongata, Lysiphyllum carronii, Atalaya hemiglauca, L. hookeri, Acacia harpophylla, Capparis sp.*

Groundcover

Estimated Cover Density: 15-51%

Species: *Sporobolus caroli, S. actinocladus, Dichanthium sericeum, Eragrostis trichophora*, Cynodon dactylon*, Cenchrus ciliaris*, Megathyrsus maximus*, Cyperus sp., Salsola australis, Sclerolaena sp., Atriplex muelleri, Portulaca sp., Parthenium hysterophorus*, Bryophyllum delagoense*, Harrisia sp.**

RE 11.3.2 - Remnant

Habitat quality sites:
2



Landform: alluvial plain

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Eucalyptus populnea* dominated open woodland on alluvial plain. The subcanopy contained *A. saligna, Terminalia oblongata, Owenia acidula* and *Eremophila mitchellii*. The shrub layer included *Lysiphyllum hookeri, Cassia brewsteri, Capparis lasiantha, Carissa ovata, A. excelsa, Citrus glauca, Owenia acidula,* and *A. saligna.*

Structural formation: Open woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Of concern

T1

Height interval: 10-16m	**Median Height:** 15m	**Estimated Cover Density:** 8-44%

Species: *Eucalyptus coolabah (d), E. camaldulensis (d), Lysiphyllum carronii (d), E. populnea (d), Acacia harpophylla (a)*

T2

Height interval: 4 – 7m	**Median Height:** 6m	**Estimated Cover Density:** 12%

Species: *Acacia saligna, Terminalia oblongata, Owenia acidula, Eremophila mitchellii*

S1

Height interval: 2 – 4 m	**Median Height:** 3 m	**Estimated Cover Density:** 0-4%

Species: *Lysiphyllum carronii, Acacia salicina, A. harpophylla, Grewia sp., Atalaya hemiglauca, Citrus glauca, Lysiphyllum hookeri, Owenia acidula, Cassia brewsteri, Capparis lasiantha, Carrisa ovata, Acacia excelsa, Eucalyptus populnea*

Groundcover

Estimated Cover Density: 86 -95%

Species: *Dichanthium sericeum, Chloris divaricata, Eriachne sp., Bothriochloa ewartiana, Bothriochloa pertusa*, Enneapogon polyphyllus, Enteropogon ramosus, Aristida ramosa, Themeda triandra, Eragrostis trichophora*, Stylosanthes scabra*, Abutilon sp., Sida hackettiana, Salsola australis, Melhania oblongifolia, Enchylaena tomentosa, Evolvulus sp., Sclerolaena sp., Cyperus sp., Sida filicaulis, Cenchrus ciliaris*, Megathyrsus maximus*, Urochloa mosambicensis*, Parthenium hysterophorus*, Bryophyllum delagoense*, Harrisia martinii*, Opuntia tomentosa*, Opuntia stricta**

RE 11.3.3 - Remnant

Habitat quality sites:
2



Landform: alluvial channels

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Eucalyptus coolabah* open forest woodland on alluvial plains. The subcanopy contained *Lysiphyllum carronii, Alstonia constricta, E. melanophloia, Brachychiton rupestris,* and *Erythroxylum australe*. The shrub layer included *Acacia harpophylla, Lysiphyllum carronii, Atalaya hemiglauca* and *Erythroxylum australe*.

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Of concern

T1

Height interval: 18m	**Median Height:** 18 m	**Estimated Cover Density:** 37-87%

Species: *Eucalyptus coolabah (d), Acacia harpophylla (a), Lysiphyllum sp. (a) and Terminalia oblongata (a).*

T2

Height interval: 8m	**Median Height:** 8 m	**Estimated Cover Density:** 12–34%

Species: *Lysiphyllum carronii, Alstonia constricta, Eucalyptus melanophloia, Brachychiton rupestris,* and *Erythroxylum australe*

S1

Height interval:1-3 m	**Median Height:** 2 m	**Estimated Cover Density:** 2–8%

Species: *Acacia harpophylla, Lysiphyllum carronii, Atalaya hemiglauca, Erythroxylum australe*

Groundcover

Estimated Cover Density: 50-52%

Species: *Dichanthium sericeum, Megathyrsus maximus*, Bothriochloa pertusa*, Cenchrus ciliaris*, Cyperus sp., Malvastrum americanum*, Vittadinia sp., Amyema preissii, Cryptostegia grandiflora*, Parthenium hysterophorus*, Bryophyllum delagoense**

RE 11.3.6 - Remnant

Habitat quality sites:
2



Landform: alluvial plains **and channels**

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Eucalyptus melanophloia* woodland on alluvial plan. The subcanopy included *Lysiphyllum hookeri, Terminalia oblongata, Acacia harpophylla, Alectryon diversifolius*. The shrub layer included *L. hookeri, Alstonia constricta, A. harpophylla, Terminalia oblongata, Carissa ovata, Atalaya hemiglauca,* and *A. salicina*.

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 7-16 m	**Median Height:** 10 m	**Estimated Cover Density:** 12-16%

Species: *Eucalyptus melanophloia* (d), *Acacia harpophylla* (a), *Lysiphyllum carronii* (a), *Acacia excelsa* (a), *Erythroxylum australe* (a)

T2

Height interval: 6-8m	**Median Height:** 7 m	**Estimated Cover Density:** 33-35%

Species: *Lysiphyllum hookeri, Terminalia oblongata, Acacia harpophylla, Alectryon diversifolius, Atalaya hemiglauca*

S1

Height interval: 0.5-2 m	**Median Height:** 1.5 m	**Estimated Cover Density:** 1-30%

Species: *Lysiphyllum hookeri, Terminalia oblongata, Carissa ovata, Acacia harpophylla, Alstonia constricta, Atalaya hemiglauca, Acacia Salicina*

Groundcover

Estimated Cover Density: 40%

Species: *Bothriochloa bladhii, Chloris sp., Sporobolus caroli, Dichanthium sericeum, Chrysopogon fallax, Enteropogon acicularis, Cynodon dactylon*, Aristida calycina, Megathyrsus maximus*, Urochloa mosambicensis*, Cenchrus ciliaris*, Enchylaena tomentosa, Sclerolaena sp., Salsola australis, Capparis lasiantha, Brachyscome sp., Abutilon sp., Cyperus sp., Evolvulus sp., Sida hackettiana, Parthenium sp.*, Harrisia martinii*, Opuntia tomentosa*, Bryophyllum delagoense*, Cryptostegia grandiflora**

RE 11.3.6 - Disturbed Remnant

Habitat quality sites:
3



Landform: alluvial plains **and channels**

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: Disturbed *Eucalyptus melanophloia* open forest with understorey of *Lysiphyllum hookeri* and *Terminalia oblongata* along watercourse.

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 7-16 m	**Median Height:** 10 m	**Estimated Cover Density:** 16-60%

Species: *Eucalyptus melanophloia* (d), Eucalyptus camaldulensis (sd), *Lysiphyllum hookeri* (sd), *Acacia harpophylla (a),*

T2

Height interval: 4.5-12m	**Median Height:** 8 m	**Estimated Cover Density:** 23-46%

Species: *Acacia harpophylla, Terminalia oblongata, Lysiphyllum hookeri, Alectryon diversifolius, Grevillia parviflora*

S1

Height interval: 0.5-4 m	**Median Height:** 2.5 m	**Estimated Cover Density:** 1-30%

Species: *Lysiphyllum hookeri, Alstonia constricta, Acacia harpophylla, Carissa ovata*

Groundcover

Estimated Cover Density: 56-95%

Species: *Bothriochloa bladhii, Chloris sp., Sporobolus caroli, Salsola australis, Enchylaena tomentosa, Sclerolaena sp., Megathyrsus maximus*, Urochloa mosambicensis*, Cenchrus ciliaris*, Parthenium sp., Harrisia martini*, Bryophyllum delagoense**

RE 11.3.27 - Remnant

Habitat quality sites:
2



Landform: swamp

Geology/Soils: Quaternary – Quaternary alluvium containing clay, silt, sand and gravel

Land zone: 3

Description: *Eucalyptus camaldulensis* woodland fringing watercourse. The subcanopy included *Eremophila mitchellii, Atalaya hemiglauca, Grevillea parvifolia, Lysiphyllum carronii, Owenia acidula, Terminalia oblongata, Acacia salicina.* The shrub layer included *Lysiphyllum carronii, Acacia harpophylla, Acacia saligna, Citrus glauca, Carissa ovata and Capparis lasiantha.*

Structural formation: Woodland

Ecologically Dominant Layer (EDL): T1

Comment: -

VM Act status/BD: Endangered/ Endangered

T1

Height interval: 15.2-16.5 m | **Median Height:** 15.9 m | **Estimated Cover Density:** 7-26%

Species: *Eucalyptus camaldulensis (d), Acacia harpophylla (a), Eucalyptus populnea (a)*

T2

Height interval: 7 m | **Median Height:** 7 m | **Estimated Cover Density:** 10%

Species: *Eremophila mitchellii, Atalaya hemiglauca, Grevillea parvifolia, Lysiphyllum carronii, Owenia acidula, Terminalia oblongata, Acacia salicina,*

S1

Height interval:1-3 m | **Median Height:** 2 m | **Estimated Cover Density:** 3-4%

Species: *Lysiphyllum carronii, Acacia harpophylla, Acacia saligna, Citrus glauca, Carissa ovata, Capparis lasiantha*

Groundcover

Estimated Cover Density: 26-34%

Species: *Bothriochloa ewartiana, Enchylaena tomentosa, Megathyrsus maximus*, Cenchrus ciliaris*, Chloris ventricosa, Aristida ramosa, Urochloa mosambicensis*, Harrisia martinii*, Malvastrum americanum**

RE 11.4.9 – High value regrowth

Habitat quality sites:
2



Landform: gently undulating clay plains

Geology/Soils: Late Tertiary / Quaternary – Locally red-brown mottled, poorly consolidated sand, silty clay, minor gravel; high-level alluvial deposits (generally related to present stream valleys but commonly dissected

Land zone: 4

Description: *Acacia harpophylla* low open forest. The shrub layer included *Carissa ovata, Lysiphyllum carronii, Acacia harpophylla, Citrus glauca, Terminalia oblongata,* and *Acacia salicina*

Structural formation: Low open forest	**Ecologically Dominant Layer (EDL):** T1
Comment: No T2 layer present.	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 6-8 m	**Median Height:** 5 m	**Estimated Cover Density:** 26%

Species: *Clematicissus opaca, Atalaya hemiglauca, Owenia acidula, Geijera parviflora, Santalum lanceolatum, Acacia harpophylla (d), Lysiphyllum hookeri (sd), Eucalyptus populnea (scattered), Lysiphyllum carronii, Apophyllum anomalum, Cassia brewsteri, Eremophila mitchellii, Terminalia oblongata, Acacia salicina, Lysiana subfalcata,* and *Amyema quandang.*

T2

Height interval: NA	**Median Height:** 0 m	**Estimated Cover Density:** NA

Species: NA

S1

Height interval:1-2 m	**Median Height:** 1.5 m	**Estimated Cover Density:** 4%

Species: *Carissa ovata, Lysiphyllum carronii, Acacia harpophylla, Citrus glauca, Terminalia oblongata,* and *Acacia salicina.*

Groundcover

Estimated Cover Density: 66%

Species: *Aristida ramosa, Sporobolus caroli, Panicum decompositum, Eriachne mucronata, Eriochloa sp., Sida fibulifera, Cheilanthes sieberi, Oxalis sp., Salsola australis, Enchylaena tomentosa, Trianthema triquetra, Euphorbia sp., Indigofera sp., Cenchrus ciliaris*, Harrisia martinii*, Opuntia stricta*, Abutilon sp., Chloris gayana*, Melinis repens*, Megathyrsus maximus*,* and *Bothriochloa pertusa*.*

RE 11.9.5 – High value regrowth

Habitat quality sites:
4



Landform: gently undulating plains

Geology/Soils: Early Triassic / Middle Triassic - Lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanilithic pebble conglomerate.

Land zone: 9

Description: *Acacia harpophylla* open woodland. The shrub layer included *Lysiphyllum carronii*, *Atalaya hemiglauca, Terminalia oblongata, Erythroxylum australe*, and *Citrus glauca.*

Structural formation: Woodland	**Ecologically Dominant Layer (EDL):** T1
Comment: -	**VM Act status/BD:** Endangered/ Endangered

T1

Height interval: 6-8.5 m	**Median Height:** 7.8 m	**Estimated Cover Density:** 12-31%

Species: *Acacia harpophylla (d), Flindersia dissosperma (sd), Terminalia oblongata, Santalum lanceolatum, Eremophila mitchellii, Eucalyptus populnea, Brachychiton rupestris*

T2

Height interval: 3-5 m	**Median Height:** 4 m	**Estimated Cover Density:** 8-24%

Species: *Acacia harpophylla, Lysiphyllum carronii, Terminalia oblongata, Owenia acidula, Acacia salicina, Amyema quandang,* and *Atalaya hemiglauca.*

S1

Height interval: 1-2 m	**Median Height:** 1.5 m	**Estimated Cover Density:** 0-16%

Species: *Acacia harpophylla, Terminalia oblongata, Acacia salicina, Atalaya hemiglauca, Carissa ovata, Eremophila mitchellii, Santalum lanceolatum, Grewia latifolia, Alstonia constricta, Jasminum didymum subsp. lineare, Capparis loranthifolia. Cynanchum viminale, Lysiphyllum carronii, Capparis lasiantha, Capparis mitchellii*

Groundcover

Estimated Cover Density: 5-13%

Species: *Achyranthes aspera, Trianthema triquetra, Cenchrus ciliaris*, Enchylaena tomentosa, Enteropogon acicularis, Enteropogon ramosus, Chloris divaricata, Panicum decompositum, Aristida latifolia, Aristida ramosa, Dipteracanthus australis, Sporobolus caroli, Sporobolus actinocladus, Harrisia martini*, Dactyloctenium radulans*, Hypochaeris sp., Phyllanthus sp., Sida sp., Dianella sp., Enneapogon sp.*

Whitehaven

Blackwater North Extension Project

Appendix E
Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment



DPM ENVIROSCIENCES



Blackwater North Project – Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment

April 2026

Blackwater North Extension Project – Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment

10 April 2026

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DISTRIBUTION

Blackwater North Extension Project – Aquatic Ecology and Groundwater-Dependent Ecosystems Assessment

10 April 2026

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EXECUTIVE SUMMARY

Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater) owns and operates the Blackwater Mine (BWM), situated approximately 20 kilometres (km) south of Blackwater, Queensland. The BWM has been operating since 1967 and currently operates under Environmental Authority EPML00717813, with existing run-of-mine coal production at approximately 19 million tonnes per annum.

Whitehaven Blackwater is planning an expansion of its current mining footprint to the east of the existing operation. DPM Envirosciences Pty Ltd (DPM Envirosciences) was commissioned by Whitehaven Blackwater to undertake seasonal aquatic ecology and groundwater-dependent ecosystem (GDE) surveys and assessments across the proposed mine expansion areas defined as the Blackwater North Extension Project (the Project).

The scope of this assessment was to describe the aquatic values of the Blackwater North Extension Project area (the Study Area), identify any conservation significant species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act), identify the potential for GDEs to occur, identify and describe any aquatic Matters of State or National Environmental Significance, assess impacts of the Project on aquatic and GDE values and propose impact avoidance and mitigation measures to protect these values.

The findings discussed in this report are based on a desktop assessment and seasonal field surveys by DPM Envirosciences in June-July 2025 and October 2025. Earlier aquatic ecology surveys of the Study Area were undertaken by DPM Envirosciences on behalf of EMM Consulting Pty Ltd (EMM) in December 2019 and May 2020. The findings of these earlier surveys form part of the desktop assessment and provide contextual baseline information alongside the 2025 field surveys.

Aquatic ecology surveys were undertaken in accordance with the Australian River Assessment System (AusRivAS) protocols for Queensland streams. Aquatic GDEs were assessed by desktop assessment, field assessment for visual indicators, and comparison of surface water and groundwater samples for major cations and anions consistent with the Australian *Environmental water tracers in environmental impacts assessments for coal seam gas and large coal mining developments – factsheet*. Subterranean GDEs were assessed by desktop assessment and seasonal pilot survey in accordance with the Queensland *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (Department of Science, Information Technology and Innovation 2015). Terrestrial GDEs were assessed by desktop assessment and field measurement of pre-dawn LWP in accordance with the *Australian groundwater-dependent ecosystems toolbox part 2: assessment tools* (Richardson et al. 2011). The assessment of aquatic, subterranean and terrestrial GDEs of the Study Area follows the logical framework identified in the *Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems* (Doody, Hancock and Pritchard 2019).

The waterways of the Study Area range from small first order tributaries to the larger fourth order Two Mile Gully and Taurus Creek. Other named waterways of the Study Area include Sagittarius and Deep Creeks. Mapped wetlands in the Study Area are comprised of artificial or modified lacustrine wetlands and include farm dams and two mine water dams (Deep Creek Dam and Taurus Dam). Several smaller, unmapped lacustrine wetland waterbodies (farm dams and a riverine flood channel wetland) also occur. The waterways of the Study Area are ephemeral and are expected to experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is lower. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to vary seasonally.

Aquatic habitat assessment was undertaken at 13 sites in June-July 2025. The same 13 sites and an additional three aquatic habitat assessment sites were assessed in October 2025. The additional sites were positioned to address amendments to the layout of the Study Area and proposed waterway crossings. The 16 sites comprised 12 sites on riverine system drainage lines, two farm dam sites and two mine water dams. Detailed survey was undertaken at a subset of these sites and included backpack electrofishing, netting for fish/turtles and aquatic macroinvertebrate sampling. No flow was encountered during both survey periods due to prevailing dry conditions in the months leading up to sampling, therefore detailed survey was limited to isolated riverine pools and the dams. However, these conditions provided an opportunity to identify dry season refuge pools that may be important for 'seeding' waterways with fish, turtles, macrocrustaceans and other obligate aquatic invertebrates in times of flow. The dry conditions also presented an opportunity to inform the likelihood of occurrence of surface expression and terrestrial GDEs.

Fish, macroinvertebrates and turtles were surveyed at most wetted sites. Nine Least Concern native fish species, one pest fish species, two Least Concern native turtle species, and a diversity of aquatic macroinvertebrates were detected. Aquatic macroinvertebrate indices, including taxa richness Plecoptera, Ephemeroptera and Trichoptera richness, Stream Invertebrate Grade Number – Average Level Version 2, tolerant taxa and AusRivAS OE50 scores, were variable but likely reflected seasonality more than catchment impacts.

Seasonal flora surveys across the Study Area detected 22 species of aquatic or semi-aquatic flora species, comprising 20 Least Concern native species and two introduced species of little ecological significance.

Overall aquatic value scored at each of the 16 survey sites ranged from Low to Moderate. Sites on Taurus Creek and Two Mile Gully were rated Moderate, due to their importance as regional conduits for fish passage (mapped High or Major risk waterways for fish passage in State mapping). Riverine sites with a stream order 1-2 were rated as having Low aquatic value, except where the Aquatic Conservation Assessment mapping identified the waterway as being of Medium conservation significance – in which case they were rated Moderate aquatic value. The lacustrine wetlands (farm and mine water dams) were rated Low-Moderate or Moderate. Although these lacustrine wetlands are modified or artificial, the semi-permanence of water offers dry season refuge for Least Concern fish and turtle species.

No conservation significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded in the Study Area. Due to habitat requirements and distributional range, it is unlikely that any conservation-significant aquatic flora or fauna species occur within the waterways or wetlands of the Study Area as either resident or transient occurrences.

There are no wetlands of International Importance or National Importance identified within the Study Area.

Matters of State Environment Significance (MSES) relevant to this aquatic ecology assessment comprise waterways providing for fish passage, which is an MSES only if waterway barrier works are proposed that would limit the passage of fish along the waterway. While the upper extent of several low order (stream order 1 and 2) waterways would be removed for mining, these waterways do not connect to important fish habitat upstream because upstream reaches are within existing active mining areas. As such, their removal would not fragment fish habitat in these waterways as they do not connect to fish habitat further upstream.

Waterway crossings would be positioned on Deep and Taurus creeks. Fish passage would be maintained between existing upstream and downstream habitats because these waterway crossings would be designed and constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Primary Industries [DPI] 2025b).

Terrestrial GDEs occur within the Study Area in part of the riparian corridor of Taurus Creek. There is no evidence of surface expression or subterranean GDEs within the Study Area, both of which are unlikely to occur. The presence of stygofauna in an aquifer would indicate a subterranean GDE; however, no stygofauna were detected from five bores and five micropiezometers sampled as part of a pilot survey in both July and October 2025, and there is no evidence of stygofauna having previously been detected from within 5 km of the Study Area.

Groundwater is expected to occur in the shallow alluvium of Taurus Creek as ephemeral, discontinuous perched aquifers in sandier material; with clayey material forming aquitards. The alluvial sediments are expected to be of limited extent and thickness but are likely to be episodically recharged by rainfall run-off when Taurus Creek hosts water, resulting in the presence of perched aquifers associated with the alluvium. Given Taurus Creek is subject to continuous natural wetting and drying cycles, the riparian vegetation likely accesses available moisture in the soil/sediment following rainfall, runoff and flow, and accesses available shallow groundwater in the alluvial aquifer for short periods in drier times. The terrestrial GDEs associated with this aquifer would likely be opportunistic, utilising small inputs of groundwater in the alluvial aquifer on occasion, but likely persisting without this input.

The alluvial aquifer of Taurus Creek is recharged by surface flows within Taurus Creek. The Surface Water Assessment for the Project (WRM Water and Environment Pty Ltd 2026) indicates that, notwithstanding the 8.9 percent (%) reduction in the contributing Taurus Creek catchment area during mining, the Project is not expected to materially alter the overall magnitude, duration or frequency characteristics of flows within Taurus Creek. Accordingly, recharge processes to the alluvial aquifer are anticipated to be maintained. On this basis, potential impacts to terrestrial GDEs associated with perched alluvial aquifers are expected to be low.

With effective implementation of mitigation and management measures presented in this report, the Project is unlikely to result in significant impacts on aquatic ecosystem values, including aquatic Matters of National Environmental Significance or MSES.

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Acronyms

Acronym	Description
ACA	Aquatic Conservation Assessment (associated with AquaBAMM)
ALA	Atlas of Living Australia
AquaBAMM	Aquatic Biodiversity Assessment Mapping Methodology
AusRivAS	Australian River Assessment System
BoM	The Bureau of Meteorology
CE	Critically Endangered (threatened fauna species conservation status)
cm	centimetre
DCCEEW	The Commonwealth Department of Climate Change, Environment, Energy and Water
DEHP	The former Queensland Department of Environment and Heritage Protection
DERM	The former Queensland Department of Environment and Resource Management
DES	The former Queensland Department of Environment and Science
DETSI	The Queensland Department of the Environment, Tourism, Science and Innovation
DLGWV	The Queensland Department of Local Government, Water and Volunteers
DNRM	The former Queensland Department of Natural Resources and Mines
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development
DO	Dissolved Oxygen
DPI	Department of Primary Industries
DSITI	The former Queensland Department of Science, Information Technology and Innovation
E	Endangered (threatened species conservation status)
EA	Environmental Authority
EC	Electrical Conductivity
EO Regulation	Queensland Environmental Offsets Regulation 2014
EPP 2019	*Environmental Protection (Wetland and Water Biodiversity) Policy 2019*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDA	Geocentric Datum of Australia
GDE	Groundwater-Dependent Ecosystem
GES	General Ecological Significance (relating to wetlands identified under the EPP 2019)
HES	High Ecological Significance (relating to wetlands identified under the EPP 2019)
HEV	High Ecological Value (relating to waters identified under the EPP 2019)
IESC	Independent Expert Scientific Committee
km^2	Square kilometres
LC	Least Concern species conservation status under the NC Act
LEV	Low Ecological Value

LWP	Pre-dawn leaf water potential
m	metres
mAHD	Metres above (or below) the Australian Height Datum
mbgl	Metres Below Ground Level
MDB	Murray-Darling Basin
MNES	Matters of National Environmental Significance
MQWEV	Map of Queensland Wetland Environmental Values
MSES	Matters of State Environmental Significance
NC Act	Queensland *Nature Conservation Act 1992*
NT	Near Threatened (species conservation status)
NTU	Nephelometric Turbidity Units
PET	Plecoptera, Ephemeroptera and Trichoptera macroinvertebrate richness
RE	Regional Ecosystem
SEA	Sensitive Environmental Area
SIGNAL2	Stream Invertebrate Grade Number – Average Level Version 2
SLC	Special Least Concern species conservation status under the NC Act
SWP	Soil water potential
V	Vulnerable (threatened species conservation status)
WoNS	Weeds of National Significance
WQO	Water Quality Objective

Definitions

Term	Description
Aquatic fauna	An aquatic animal is either a vertebrate or invertebrate that lives in water for most or all of its life. It does not include amphibians or waterbirds (which are considered terrestrial fauna).
Aquatic flora	Plants that have adapted to living in aquatic environments (saltwater or freshwater). These plants require special adaptations for living submerged in water, or at the water's surface.
Biosecurity matter	A living thing, other than a human or part of a human; or a pathogenic agent that can cause disease in a living thing, other than a human, or a pathogenic agent that can cause disease in a human, by the transmission of a pathogenic agent from an animal to a human; or a disease; or a contaminant.
Conservation-significant species	Threatened species listed as Critically Endangered, Endangered, or Vulnerable under the EPBC Act, or as Endangered, Vulnerable, or Near Threatened under the NC Act.
Ephemeral waterways	Waterways that flow for short periods of time following rain events.
Focus Area	An area extending 5 kilometres beyond the Study Area, used for consideration of potential groundwater-dependent ecosystems in the broader area.
Groundwater-Dependent Ecosystem	Groundwater-Dependent Ecosystems (or GDEs) are ecosystems that rely upon groundwater for their continued existence. They may be 100% dependent on groundwater, such as aquifer GDEs, or may access groundwater intermittently to supplement their water requirements, such as riparian tree species in arid and semi-arid areas.
Intermittent waterways	Waterways with seasonal flow during certain times of the year when smaller upstream waters are flowing and/or when groundwater provides enough water for stream flow.
Lacustrine wetland	Large, open, water-dominated systems (for example, lakes) typically larger than 8 hectares. This definition also applies to modified systems (for example, dams), which are similar to lacustrine systems (for example, deep, standing or slow-moving waters) (DERM 2011).
Restricted matter	Listed in Schedule 2 of the Queensland *Biosecurity Act 2014* and refers to biosecurity matter that are currently found in Queensland and that are known to have a significant impact on human health, social amenity, the economy or the environment.
Search Area	The areas/extents of the desktop searches identified in Section 3.5.
Study Area	The polygon provided by Whitehaven and their consultant Resource Strategies.
Stygofauna	Stygofauna are aquatic fauna that live part or all their lives in groundwater systems such as aquifers or underground caves. Stygofauna are found in aquifers and caves, inhabiting the water filled pore spaces, voids, cracks and fissures.
Stygoxenes	Fauna that are not obligate inhabitants of groundwater system (i.e. are not stygofauna).
Waterway	Waterways include riverine systems, watercourses, waterways or drainage lines identified in Queensland Wetlands Map 2009, *Fisheries Act 1994*, Queensland Waterways for Waterway Barrier Works map or Watercourse identification map (*Water Act 2000*).
Waterway barrier works	Defined in Schedule 2 of the *Environmental Offsets Regulation 2014*, and means a dam, weir or other barrier across a waterway.
Wetland	Wetlands include marine, estuarine, riverine, lacustrine and palustrine waterbodies and wetland Regional Ecosystems in Queensland identified in the Queensland Wetlands Mapping, Wetlands of International Importance (EPBC Act), Wetlands of National Importance (EPBC Act), or in the Queensland Wetland Environmental Values map.

1 INTRODUCTION

1.1 Background

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (Figure 1).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the *Environmental Protection Act 1994*.

The BWM is a joint venture between Whitehaven Coal Limited (Whitehaven) (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven, is the operator of BWM.

The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML 1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles;
- train load-out, water management, tailings management and other supporting infrastructure;
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

1.2 Purpose

The purpose of this Aquatic Ecology and Groundwater-dependent Ecosystem (GDE) Assessment is to describe the aquatic ecology and GDE values of the Study Area (Figure 2) as relevant to current Commonwealth and State legislation, and to assess the impact of the Project on these values.

This report includes a baseline assessment of aquatic ecology and GDE values of the Study Area based on desktop assessments of available information, a post-wet season survey conducted June-July 2025, and a follow-up pre-wet season survey conducted in October 2025. Earlier aquatic ecology surveys of the Study Area were undertaken by DPM Enviросciences on behalf of EMM Consulting Pty Ltd (EMM) in December 2019 and May 2020. The findings of these earlier surveys form part of the desktop assessment and provide contextual baseline information alongside the 2025 field surveys. In addition to baseline assessment, this report assesses the impact of the Project on these values and proposes measures to avoid, minimise and mitigate these impacts.

1.3 Scope of work

The scope of work for this Aquatic Ecology and GDE Assessment included the following tasks:

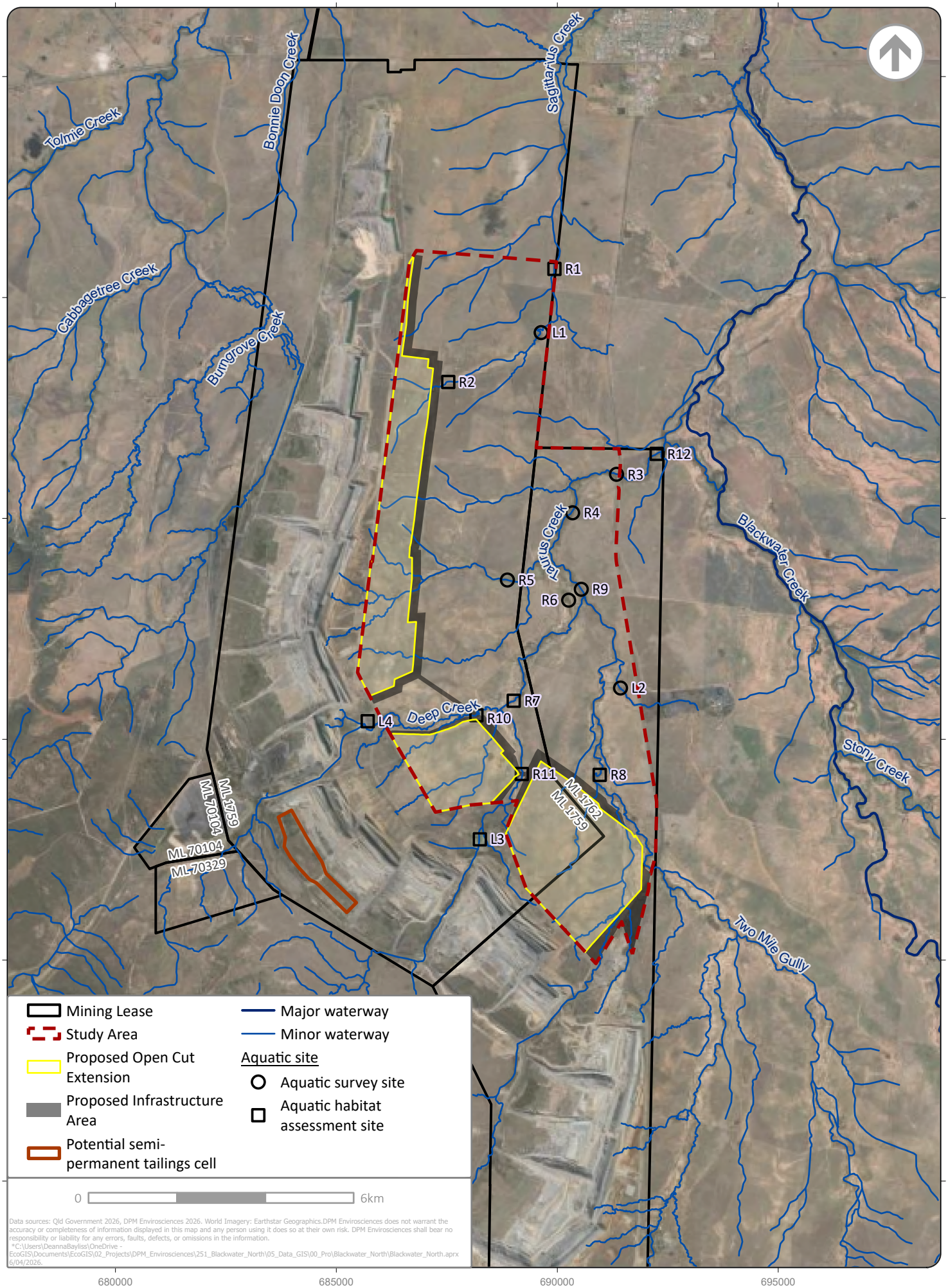
- Conduct a desktop review of available literature and previous studies in the vicinity of the Study Area and conduct database searches for conservation-significant aquatic species.
- Undertake aquatic ecology surveys throughout the Study Area using appropriate methodology to:
  - describe aquatic habitats and their value and importance, including features such as substrate, stream type, water quality, and surrounding land uses;
  - describe aquatic flora and fauna (including mammals, fish, reptiles and aquatic invertebrates) present, or likely to be present at any time of the year;
  - identify and describe any conservation-significant aquatic species, and any introduced aquatic species, that are present or likely to be present in the Study Area, and identify their habitat resources;
  - consider relevant State and Commonwealth guidelines associated with conservation-significant aquatic species likely to occur in the Study Area;
  - identify and describe wetlands present, and their value and importance; and
  - identify and describe GDEs.
- Prepare a comprehensive Aquatic Ecology and GDE Assessment that presents the methods and results of the desktop and field studies, assesses the potential impacts of the Project on aquatic and GDE values, and proposes methods to avoid and mitigate impacts on these values.



REGIONAL CONTEXT

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 1



BLACKWATER NORTH STUDY AREA

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 2

2 EXISTING ENVIRONMENT

2.1 Climate and weather

The Study Area falls within the Central Highlands Region of Queensland. The region's climate is sub-tropical, sub-humid, with nearly half its annual rainfall (535 millimetres [mm] per annum) occurring in summer (The Bureau of Meteorology [BoM] 2025).

In the months preceding the June-July 2025 survey, Blackwater Airport weather station 35134 recorded 85.8 mm of rainfall in March, 79.8 mm in April, and 47.0 mm in May 2025 (BoM 2025), representing above-average rainfall in each month. Dry conditions then prevailed in June, with only 1.4 mm rainfall in the 20 days preceding sampling (BoM 2025).

In the three months preceding the October 2025 survey, Blackwater Airport weather station 35134 recorded 42.4 mm of rainfall in July, 17.2 mm in August and 13.0 mm in September (BoM 2025). Dry conditions then prevailed in October leading into the pre-wet survey.

Mean minimum and maximum temperatures for June 2025 at Blackwater Airport were 8.8°C and 23.3°C, respectively, both slightly below average (BoM 2025). Mean minimum and maximum temperatures for October 2025 at Blackwater Airport were 18.6°C and 35.4°C, respectively; both slightly higher than average (BoM 2025).

2.2 Topography and drainage

The topography of the Study Area is gently undulating and low-lying (less than 300 metres Australian Height Datum [mAHD]). Elevation ranges from about 240 mAHD near tributaries of Two Mile Gully to about 170 mAHD in the downstream-most reach of Sagittarius Creek (Queensland Globe 2025). The Study Area is located within the Mackenzie River Sub-basin of the broader Fitzroy Basin. Two Mile Gully and Deep Creek flow into Taurus Creek within the Study Area, which then flows into Blackwater Creek downstream of the Study Area. Blackwater Creek flows in a general northern direction passing to the east of Blackwater township (Figure 2). Sagittarius Creek flows north and passes to the west of Blackwater township, meeting Blackwater Creek to the north of Blackwater township, then into the Mackenzie River. The Mackenzie River converges with the Dawson River to form the Fitzroy River which flows initially north and then east towards the east coast of Queensland and discharges into the Coral Sea south-east of Rockhampton near Port Alma.

Upstream of the Study Area, a third order tributary of Two Mile Gully has historically been diverted to a third order tributary of Taurus Creek, creating fourth and subsequent fifth order reaches of Taurus Creek within the Study Area (actual stream order, based on Strahler 1952) (Figure 3, Section 3.6.1). The Department of the Environment, Tourism, Science and Innovation (DETSI) Queensland Wetlands Mapping (DETSI 2025e, Section 4.1) and the Department of Primary Industries (DPI) Queensland Waterway Barrier Works mapping (DPI 2025a, Section 4.1.3) present the original flow path and therefore third and fourth order reaches of Taurus Creek within the Study Area. Further references to stream order in this document refer to the actual (on ground) stream order based on Strahler 1952, unless specifically referring to State mapping.

At a regional scale, the Mackenzie River Sub-basin is approximately 13,059 square kilometres (km²) and the broader Fitzroy Basin is approximately 142,483 km² (DETSI 2025a).

The *Environmental Protection (Water) Policy 2009: Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (former Department of Environment and Heritage Protection [DEHP] 2011) and accompanying maps identify environmental values (EVs) for the Study Area. The relevant EVs for the Mackenzie southern tributaries are:

- aquatic ecosystems;

- farm supply/use;
- stock water;
- human consumption;
- primary, secondary and visual recreation;
- drinking water;
- industrial use; and
- cultural and spiritual values.

Whitehaven Blackwater is authorised to release mine-affected water directly to Deep Creek, Taurus Creek and a tributary of Two Mile Gully in accordance with EA EPML00717813 (DETSI 2025a).

2.3 Land Zones

The Study Area contains two Land Zones (Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development [DNRMMRRD] 2025a), comprising:

- Land Zone 3 – Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits, currently under freshwater influence, inland lakes and associated wave-built lunettes. Excludes colluvial deposits such as talus slopes and pediments. Includes a diverse range of soils, predominantly Vertosols and Sodosols; also, with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols; and Organosols in high rainfall areas.
- Land Zone 4 – Tertiary-early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems. Excludes clay plains formed in-situ on bedrock. Mainly Vertosols with gilgai microrelief but includes thin sandy or loamy surfaced Sodosols and Chromosols with the same paleo-clay subsoil deposits.

2.4 Land use

The Study Area is located in the Bowen Basin, where coal mining is prevalent. Land within the Study Area is used predominately for cattle grazing, with areas on the western periphery overlapping with existing coal mining operations at BWM. The land has been largely cleared through past agricultural practices and ongoing disturbance. Relatively small and narrow tracts of remnant vegetation remain (or have re-established) along some of the waterways.

3 METHODS

3.1 Taxonomic nomenclature

Scientific names of fauna used in this report follow those in the WildNet database (DETSI 2025c). Scientific names of flora used in this report follow the Census of the Queensland Flora (Laidlaw 2022).

3.2 Determination of significance level

Conservation-significant species are those taxa listed in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or Queensland *Nature Conservation Act 1992* (NC Act) as Critically Endangered (CE or CR), Endangered (E), Vulnerable (V), Near Threatened (NT) or conservation dependent (i.e. the focus of a specific conservation program and would become V or E without intervention).

All other native species are Special Least Concern (SLC) or Least Concern (LC) under the NC Act.

3.3 Conservation-significant species likelihood of occurrence

Conservation-significant species identified from the desktop assessment were assigned a likelihood of occurrence based on the criteria identified in Table 1. Targeted searches were undertaken in the field for species identified as either being likely to occur or having potential to occur within the Study Area, based on desktop sources. The assessment was applied again after the surveys to determine the likelihood of occurrence once site-based information became available.

Table 1 Criteria adopted for the likelihood of conservation-significant species, identified from the desktop assessment, occurring within the Study Area

Likelihood of occurrence	Description
Known	The species was positively identified and recorded in the Study Area during the field assessment; previous records of occurrence within the Study Area.
Likely	The species was not recorded during the field survey or previously; however, there are known records within 10 km of the Study Area and suitable habitat exists within the Study Area.
Potential	The species was not recorded during the field survey or previously; however, there are known records within 50 km of the Study Area and suitable habitat exists within the Study Area.
Unlikely	Habitat in the Study Area might be suitable; however, the species was not recorded during the field survey, and no known records of the species exist within 50km of the Study Area.

3.4 Groundwater-dependent ecosystem assessment framework

The assessment of aquatic, subterranean and terrestrial GDEs of the Study Area follows the logical framework identified in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019). The steps of the framework include:

1. defining the project impact area (which includes the footprint of surface infrastructure and the extent of groundwater depressurisation);
2. undertaking a desktop study to identify potential GDEs and potential risks to GDEs in the project impact area (which includes the footprint of surface infrastructure and the extent of groundwater depressurisation);
3. assessing the level of groundwater dependence for each GDE and the potential pathways of cause and effect of activities;
4. identifying the baseline ecological condition and value of each GDE;
5. assessing the likelihood, frequency and magnitude of potential impacts on GDEs and determining the risks related to the activity; and
6. prioritising options to avoid or mitigate impacts on GDEs and establishing a monitoring plan to test the effectiveness of mitigation strategies.

This impact assessment presents and discusses the existing Queensland GDE and Potential GDE Aquifer Mapping (DETSI 2025d) with reference to site observations made during post wet and pre-wet surveys (Section 4.8). In addition to the above, this impact assessment considers a remote sensing-derived GDE mapping dataset (2rog Consulting Pty Ltd [2rog Consulting] 2021) developed for several tenements throughout the Bowen Basin, including BWM, applying the remote sensing method recommended by the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC 2018). The impact assessment also considers a terrestrial GDE desktop assessment for BWM prepared by RDM Hydro Pty Ltd (RDM Hydro), 3D Environmental and Groundwater Enterprises (2023). These datasets have been used to assess the potential for terrestrial GDEs to occur in the Study Area. Field verification of potential GDEs in July and October 2025 approximated the extent of terrestrial GDEs within the Study Area (Section 4.8).

3.4.1 Groundwater-dependent ecosystem risk assessment

A GDE risk assessment process was undertaken following the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019) (Section 4.8). This included:

- Identifying GDE types and subtypes and their inferred dependency on groundwater;
- determining the ecological value of the aquifer and its associated GDEs;
- determining the impact of an activity to the aquifer and/or associated GDEs;
- determining the magnitude of potential risk from the project; and
- developing management action strategies through a risk matrix approach.

3.4.2 Ecological value of groundwater-dependent ecosystems

Ecological value ratings were assigned to relevant (terrestrial) GDEs following the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov, Kuginis and Williams 2012) (Table 2), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019).

Table 2 Criteria adopted for assigning GDE ecological values ratings, adapted from the New South Wales Risk assessment guidelines for GDEs (Serov, Kuginis and Williams 2012)

Ecological value	Criteria
Category 1 – High Ecological Value (HEV) – Sensitive environmental areas	▪ GDE communities (including stygofauna) where only slight changes in key groundwater attributes below or above a threshold would result in their loss; i.e. entirely dependent ecosystems. ▪ GDEs or aquifers that are partly or wholly located within a State or Federal Reserve System; e.g. National Park / Reserve, or a high conservation area. ▪ Any GDE or aquifer that is relatively unaltered and in good condition. ▪ Any natural GDE that is habitat for any endemic, relictual, rare or endangered biota (fauna or flora), populations or communities as listed under State or Commonwealth legislation or identified as above by an acknowledged expert taxonomist/ecologist.
Category 2 – Moderate Ecological Value (MEV) – Sensitive environmental area	▪ GDE communities where moderate change in groundwater discharge or water tables is required to cause change in their distribution, composition and/or health (the value is based on the potential vulnerability/sensitivity to change). ▪ Any natural GDE system that is habitat for any vulnerable or threatened biota (fauna or flora), populations or communities as listed under State or Commonwealth legislation. ▪ Any GDE or aquifer that provides ecological services to other ecosystems such as rivers, wetlands and estuaries. ▪ GDE communities that exhibit either a threshold or proportional response to changes in groundwater attributes. Moderate systems can include highly dependent systems which can exhibit a threshold response. ▪ Any GDE or aquifer that is regarded as in moderate to good condition from its natural state but not covered by state or federal legislation. ▪ Ecosystems where groundwater appears only to play a minor role in the water balance of such ecosystems such as at the end of a dry season or during extreme drought.
Category 3 – Low Ecological Value (LEV)	▪ Any aquifer or GDE type that is highly modified from that of its natural state (that don't otherwise contain High or Moderate value attributes). ▪ Would likely involve a high cost to rehabilitate, if even possible, and there are other similar GDE types in moderate to good condition; i.e. have little need of rehabilitation, existing within the catchment/aquifer.

3.4.3 Potential impacts to an aquifer and/or associated groundwater-dependent ecosystem

Potential impacts to aquifers and/or associated GDEs within the Study Area were considered following the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019) (Section 3.8).

3.4.4 Magnitude of risk

The magnitude of risk from Project activities on aquifers and/or associated GDEs of the Study Area has been determined following the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems* (Doody, Hancock and Pritchard 2019) (Table 3).

Table 3 Determining the magnitude of potential risk to aquifers and GDEs (Serov, Kuginis and Williams 2012)

Risk factors	High	Moderate	Low	Insufficient data or unknown
Water quantity asset				
What will be the risk of a change in groundwater levels/pressure on GDEs?	Reduction in groundwater level(s) or piezometric pressure beyond seasonal variation, resulting in permanent loss or alteration of defined habitat type.	Reduction in groundwater level(s) or piezometric pressure beyond seasonal variation, resulting in temporary loss or alteration of defined habitat type.	No change to aquifer water levels or pressure.	-
What will be the risk of a change in the timing or magnitude of groundwater level fluctuations on GDEs?	Fluctuation in groundwater level(s) or piezometric pressure beyond established seasonal variation, resulting in permanent loss or alteration of defined habitat type.	Fluctuation in groundwater level(s) or piezometric pressure beyond seasonal variation, resulting in temporary loss or alteration of defined habitat type.	No change in timing of water level fluctuations.	-
What will be the risk of changing base flow conditions on GDEs?	Permanent reversal of base flow conditions.	Temporary reversal of base flow conditions exceeding seasonal variation.	No change in direction of flow.	-
Water quality asset				
What is the risk of changing the chemical conditions of the aquifer?	Permanent change; e.g. in pH, dissolved oxygen (DO), nutrients, temperature and/or turbidity.	Temporary change; e.g. in pH, DO, nutrients, temperature and/or turbidity.	Negligible change (<5%).	-
What is the risk on the aquifer by a change in the salt/freshwater interface?	Permanent change in location or gradient of salt/freshwater interface.	Temporary change in location or gradient of salt/freshwater interface.	No change or not applicable.	-

Risk factors	High	Moderate	Low	Insufficient data or unknown
What is the likelihood of a change in beneficial use of the aquifer?	Reduction in water quality beyond designated beneficial use category (for identified trigger parameters).	Reduction in water quality within designated beneficial use category (for identified trigger parameters).	Negligible change for identified triggers (<5%).	-
Aquifer integrity asset				
What is the risk of damage to the geologic structure?	Permanent destruction of the aquifer matrix. Major cracking/fracturing of the bedrock/stream bed leading to complete dewatering of the GDE.	Temporary adjustment to the aquifer matrix. Major cracking/fracturing of the bedrock/stream bed leading to complete dewatering of the GDE.	No change.	-
Biological integrity				
What is the risk of alterations to the number of native species (i.e. richness) within the groundwater-dependent communities (fauna and flora)?	>10% reduction in number of species.	10 to 5% reduction in number of species.	No reduction in number of species.	-
What is the risk of alterations to the species composition (i.e. diversity) of the groundwater-dependent communities (fauna and flora)?	>10% change in species composition.	10 to 5% change in species composition.	No change in species composition.	-
What is the risk of increasing the presence of exotic flora or fauna?	Large populations of one or more species.	Species in small numbers.	None exist.	-
What is the risk of removing or altering a GDE subtype habitat?	>20% removal or alteration of habitat area.	10 to 20% removal or alteration of habitat.	No removal or alteration of habitat.	-

Exception rule: if the number of unknown exceed 50% of questions, the risk is considered to be high until proven otherwise.

3.4.5 Risk matrix and determination of management actions

A risk matrix was applied consistent with the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019) (Table 4) to outline the most appropriate management response to potential impacts on EVs (Section 5.6.2).

Table 4 GDE risk matrix (Serov, Kuginis and Williams 2012)

Category 1 HEV Sensitive Environmental Area (SEA)	**A**	**B**	**C**
Category 2 MEV SEA	**D**	**E**	**F**
Category 3 LEV	**G**	**H**	**I**
	Category 1 **Low Risk**	**Category 2** **Moderate Risk**	**Category 3** **High Risk**

3.5 Desktop assessment

3.5.1 Surface aquatic ecosystems, including surface expression groundwater-dependent ecosystems

Desktop searches were undertaken prior to field survey in June 2025. This included a review of available aerial imagery and the following:

- The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) EPBC Act Protected Matters Search Tool, to identify potential aquatic Matters of National Environmental Significance (MNES) within approximately 10 km of the Study Area (Appendix A) (DCCEEW 2025a).
- DETSI Wetland*Info* Wetland Summary Information (including species listings) for the Mackenzie River drainage sub-basin and the broader Fitzroy Basin, incorporating data from the DETSI WildNet database, Queensland Museum and Queensland Herbarium (DESTI 2025b, c).
- Mapping of Matters of State Environmental Significance (MSES) (the former Department of Environment and Science [DES] 2023), to identify aquatic matters of state interest under the *State Planning Policy 2017* and *Environmental Offsets Regulation 2014* (EO Regulation).
- DETSI WildNet database, to identify aquatic species records within approximately 10 km and 50 km of the Study Area (DETSI 2025c).
- Atlas of Living Australia (ALA) (2025), to interrogate existing species records.
- Queensland Waterways for Waterway Barrier Works mapping (Queensland Department of Primary Industries [DPI] 2025a).
- Queensland Watercourse Identification Series (Queensland Department of Local Government, Water and Volunteers [DLGWV] 2025a).
- Queensland GDE and Potential GDE Aquifer Mapping (DETSI 2025d).
- DETSI Queensland Wetland Data Series Version 7 – Queensland Wetlands Mapping (DETSI 2025e), to determine the classification, extent and significance of lacustrine, palustrine and riverine systems within the Study Area and surrounds.
- Queensland Map of Great Barrier Reef Wetland Protection Areas (DETSI 2025f).
- Queensland Map of Queensland Wetland Environmental Values (DETSI 2025g).
- Queensland Aquatic Conservation Assessment (ACA) mapping (DETSI 2025h).
- Published ecological information on conservation-significant and SLC aquatic flora and fauna species.
- Previous studies relating to aquatic ecology in the Project Area, including:
  - Blackwater Mine – North Extension Project, Aquatic Ecology Baseline Assessment (prepared by DPM Enviros ciences for EMM 2023);
- Relevant survey guidelines, including the Australian River Assessment System (AusRivAS) protocols for Queensland streams (the former Queensland Department of Natural Resources and Mines [DNRM] 2001).

3.5.2 Subterranean groundwater-dependent ecosystems

DPM Enviros applied the Queensland *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (the former Queensland Department of Science, Information Technology and Innovation [DSITI] 2015). This included a desktop review to assess the likely presence and composition of subterranean aquatic faunal communities within 5 km of the Study Area. The desktop review involved:

- assessing the suitability of local habitat for subterranean aquatic fauna based on local geological and hydrological conditions; and
- determining the presence and composition of subterranean aquatic fauna in the Focus Area based on any available previous studies or relevant databases, including:
  - *BMA Blackwater Mine: Stygofauna Pilot Survey* (Freshwater Ecology Pty Ltd [Freshwater Ecology] 2021); and
  - the Queensland subterranean aquatic fauna database (Queensland Herbarium 2025), for a search area extending 50 km from the Study Area.

The desktop review results are provided in Section 4.8.1. Freshwater Ecology (2021) sampled 10 bores for stygofauna in November 2020 and May 2021. However, five of these bores are screened too deep (>168 metres below ground level [mbgl]) for subterranean fauna to have access to the borehole and two of the five shallower bores were dry at the time of each seasonal sampling event. Consequently, only three of the 10 bores sampled for stygofauna met the criteria for sampling as per the DSITI (2015) guideline.

DPM Enviros conducted a seasonal stygofauna pilot survey of 10 suitable bores in accordance with the DSITI (2015) guideline, described further in Section 3.7.

3.5.3 Terrestrial groundwater-dependent ecosystems

Desktop searches included a review of the following:

- potential terrestrial GDE mapping in the Queensland GDE and Potential GDE Aquifer Mapping (DETSI 2025d); and
- previous studies relating to the Study Area, including:
  - Remote Sensing of Terrestrial GDEs (2rog Consulting 2021); and
  - BHP Groundwater Dependent Ecosystem Desktop Assessment – Blackwater Mine (RDM Hydro, 3D Environmental and Groundwater Enterprises 2023).

3.6 Survey of surface aquatic ecosystems, including aquatic (surface expression) groundwater-dependent ecosystems

3.6.1 Survey timing, site selection and effort

A post-wet season survey was undertaken across the Study Area by DPM Enviros within the period 18 June to 2 July 2025, aligning with the AusRivAS late wet or post-wet sampling season (May to July). A follow-up dry season survey was undertaken within the period 20 to 25 October 2025, aligning with the AusRivAS early wet or pre-wet sampling season (October to December).

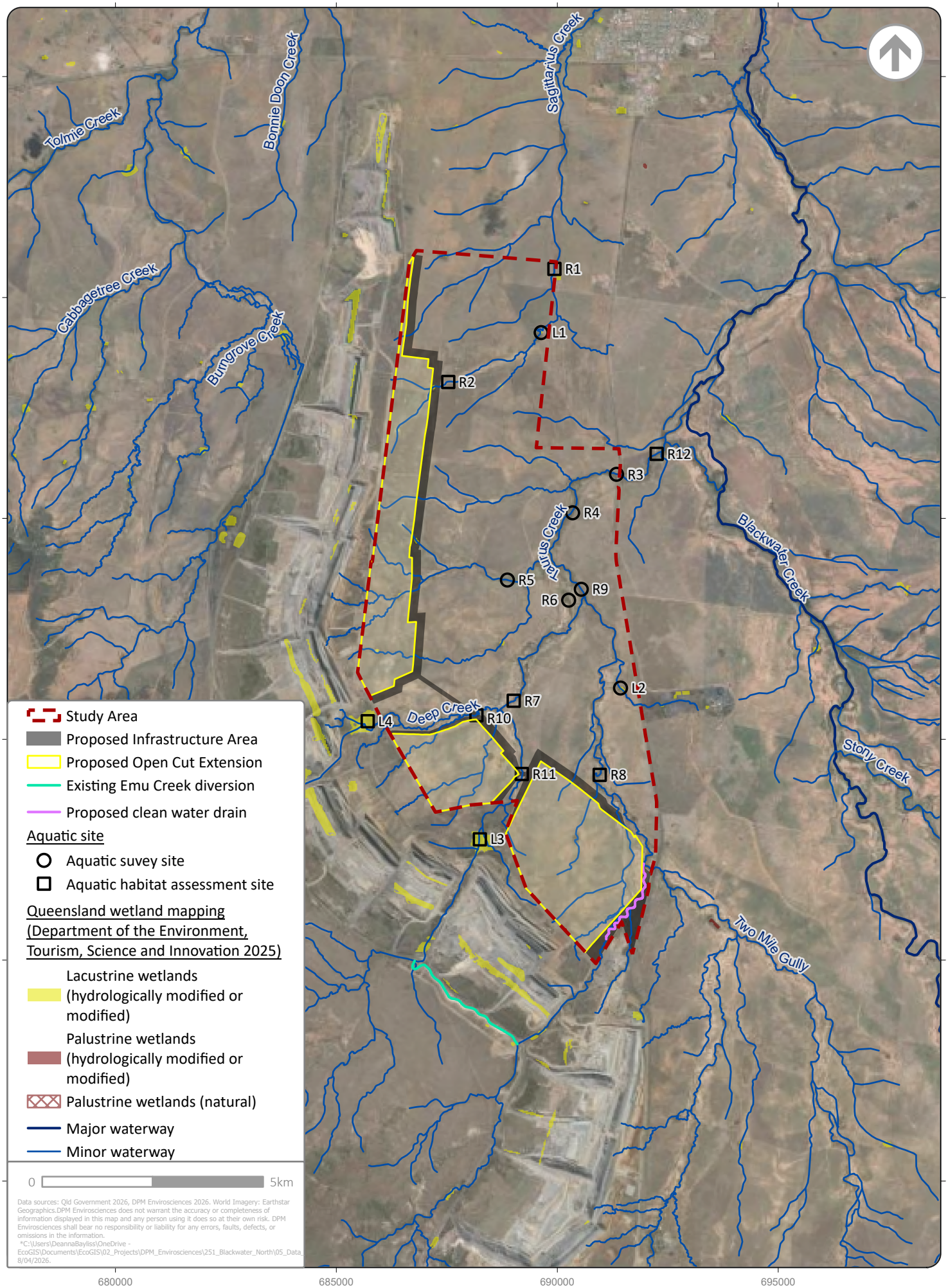
Desktop results were used to identify representative stream reaches and wetland waterbodies for field assessment. Aquatic habitat assessment was undertaken at sites representative of the waterways and wetlands of the Study Area. This comprised 13 sites in June-July 2025 (nine riverine and four wetland sites) (Table 5). The same 13 sites and an additional three riverine aquatic habitat assessment sites were assessed in October 2025, to address amendments to the layout of the Study Area and proposed waterway crossings. Aquatic habitat assessment sites comprised (Figure 3):

1. 12 riverine system drainage lines based on the Strahler (1952) stream order system:
    - three sites (R2, R5 and R10) on second order waterways, including Sagittarius Creek;
    - one site (R1) on third order Sagittarius Creek;
    - four sites (R6, R7, R8 and R11) on fourth order waterways, including Taurus Creek and Two Mile Gully; and
    - four sites (R3, R4, R9 and R12) on the fifth order Taurus Creek (note: appears as fourth order in various State mapping datasets but is verified as a fifth order creek due to the existing Emu Creek Diversion into Taurus Creek.
2. four lacustrine wetland sites (hydrologically modified or artificial):
    - two farm sites on unnamed tributaries (L1 and L2); and
    - two mine water dams on Deep and Taurus creeks (L4 and L3, respectively).

No flow was encountered during the June-July 2025 survey due to prevailing dry conditions in the month leading up to sampling. However, above-average rainfall in March, April and May 2025 resulted in isolated pools and dams sufficient for detailed survey at seven sites in the post-wet (June-July) 2025 survey (Table 5). Detailed survey (including habitat assessment, fish/turtle and macroinvertebrate sampling) was undertaken at five riverine drainage line sites (R3, R4, R5, R6 and R9) and two farm dam sites (L1 and L2). Habitat assessment was undertaken at all 13 sites in June 2025 (Appendix B). Dry conditions provided an opportunity to identify dry season refuge pools important for ‘seeding’ waterways with fish, turtles, macrocrustaceans and other obligate aquatic invertebrates in later times of flow. The dry conditions also presented an opportunity to inform the likelihood of occurrence of surface expression GDEs.

Similarly, lack of rainfall in early October 2025 resulted in dry conditions in the pre-wet survey. Consequently, detailed survey was undertaken at two of the 12 riverine drainage line sites (R3 and R6) and the same two farm dam sites (L1 and L2) in October 2025. All other riverine drainage line sites were dry at the time of assessment. Habitat assessment was undertaken at all 16 sites in October 2025 (Appendix B).

The sampling sites and survey effort are identified in Table 5.



WATERWAYS & WETLANDS OF THE STUDY AREA

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 3

DPM ENVIROSCIENCES

Table 5 Aquatic survey effort across the Study Area

Site description	Site ID	Date	Stream order (actual, Strahler 1952)	Latitude (Geocentric Datum of Australia [GDA] '20)	Longitude (GDA'20)	Fish survey effort			Turtle effort		Macroinverts.		Physico-chemical water quality	Water sample retained for ion analysis	Habitat assess./aquatic plant survey/photos
						Backpack Electrofishing	Fyke nets	Box traps	Fyke nets	Cathedral traps	Bed habitat	Edge habitat			
Riverine drainage system sites															
Sagittarius Creek	R1	17/06/25	3	-23.6287	148.8619	-	-	-	-	-	-	-	-	-	✓
		20/10/25				-	-	-	-	-	-	-	-	-	✓
Sagittarius Creek	R2	17/06/25	2	-23.6521	148.8387	-	-	-	-	-	-	-	-	-	✓
		20/10/25				-	-	-	-	-	-	-	-	-	✓
Taurus Creek	R3	20/06/25	5	-23.6705	148.8762	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
		22/10/25				✓	-	-	-	-	✓	✓	✓	✓	✓
Taurus Creek	R4	20/06/25	5	-23.6785	148.8666	✓	-	-	-	-	✓	✓	✓	✓	✓
		21/10/25				-	-	-	-	-	-	-	-	-	✓
Taurus Creek tributary	R5	18/06/25	2	-23.6924	148.8523	✓	-	-	-	-	✓	✓	✓	✓	✓
		21/10/25				-	-	-	-	-	-	-	-	-	✓
Taurus Creek flood channel	R6	1/07/25	4	-23.6963	148.8660	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
		21/10/25				✓	-	-	-	-	✓	✓	✓	✓	✓
Taurus Creek	R7	1/07/25	4	-23.7170	148.8541	-	-	-	-	-	-	-	-	-	✓
		22/10/25				-	-	-	-	-	-	-	-	-	✓
Two Mile Gully	R8	1/07/25	4	-23.7319	148.8734	-	-	-	-	-	-	-	-	-	✓
		22/10/25				-	-	-	-	-	-	-	-	-	✓
Taurus Creek	R9	18/06/25	5	-23.6941	148.8688	✓	-	✓	-	-	✓	✓	✓	✓	✓
		21/10/25				-	-	-	-	-	-	-	-	-	✓
Deep Creek	R10	21/10/25	2	-23.7201	148.8459	-	-	-	-	-	-	-	-	-	✓
Taurus Creek	R11	21/10/25	4	-23.7320	148.8561	-	-	-	-	-	-	-	-	-	✓
Taurus Creek	R12	23/10/25	5	-23.6662	148.8851	-	-	-	-	-	-	-	-	-	✓

Site description	Site ID	Date	Stream order (actual, Strahler 1952)	Latitude (Geocentric Datum of Australia [GDA] '20)	Longitude (GDA'20)	Fish survey effort			Turtle effort		Macroinverts.		Physico-chemical water quality	Water sample retained for ion analysis	Habitat assess./aquatic plant survey/photos
						Backpack Electrofishing	Fyke nets	Box traps	Fyke nets	Cathedral traps	Bed habitat	Edge habitat			
Lacustrine waterbody sites															
Farm dam	L1	17/06/25	1	-23.6417	148.8591	✓	✓	✓	✓	-	✓		✓	✓	✓
		20/10/25				✓	✓	✓	✓	-	✓		✓	✓	✓
Farm dam	L2	17/06/25	1	-23.7141	148.8778	✓	✓	✓	✓	-	✓		✓	✓	✓
		22/10/25				✓	✓	✓	✓	-	✓		✓	✓	✓
Taurus Dam (mine water)	L3	3/07/25	3	-23.7454	148.8470	-	-	-	-	-	-		✓	✓	✓
		20/10/25				-	-	-	-	-	-		✓	✓	✓
Deep Creek Dam (mine water)	L4	3/07/25	2	-23.7216	148.8217	-	-	-	-	-	-		✓	✓	✓
		20/10/25				-	-	-	-	-	-		✓	✓	✓

3.6.2 Aquatic habitats

Aquatic habitats were described in accordance with AusRivAS protocols for Queensland streams (DNRM 2001). This established a general description of the environment of each site and its immediate surrounds. The classifications are based on flow level, depth, velocity, width, canopy cover, substrate types, habitat attributes, local catchment erosion, sediment deposits, water colour, algae, water odour, substrate odour, presence of large woody debris, riparian zone width and cover, and general signs of disturbance.

Variable flows, caused by natural events such as rainfall, runoff and drought/flood cycles influence the aquatic ecosystems of an area. This should be taken into consideration for future studies which may utilise results contained in this report.

Habitat assessment scores (out of 135) were made for each site based on the 9 AusRivAS categories (Table 6). Aquatic habitat at each site was classified as Poor, Fair, Good or Excellent based on the overall score.

A detailed description of the aquatic habitat encountered at each site is included in the site profiles in Appendix B.

Table 6 Aquatic habitat assessment variables and categories

Habitat variable	Poor	Fair	Good	Excellent
Bottom substrate/available cover	0 – 5	6 – 10	11 – 15	16 – 20
Embeddedness	0 – 5	6 – 10	11 – 15	16 – 20
Velocity/depth category	0 – 5	6 – 10	11 – 15	16 – 20
Channel alteration	0 – 3	4 – 7	8 – 11	12 – 15
Bottom scouring and deposition	0 – 3	4 – 7	8 – 11	12 – 15
Pool/riffle, run/bend ratio	0 – 3	4 – 7	8 – 11	12 – 15
Bank stability	0 – 2	3 – 5	6 – 8	9 – 10
Bank vegetative stability	0 – 2	3 – 5	6 – 8	9 – 10
Streamside cover	0 – 2	3 – 5	6 – 8	9 – 10
Total	**0 – 38**	**39 – 74**	**75 – 110**	**111 – 135**

3.6.3 Surface water quality

In-situ physico-chemical water quality was assessed as a component of the AusRivAS aquatic habitat assessments, to inform initial equipment settings for backpack electrofishing, and to assist in the interpretation of collected macroinvertebrate data. The ionic composition of surface water was sampled and assessed to assist in characterising surface waters of the Study Area, including their likely interaction with groundwater.

In-situ measurements

In-situ physico-chemical water quality parameters were measured at each wetted survey site using a YSI Professional Plus multi-parameter water quality meter and Hach Turbidimeter 2100Q, each calibrated prior to and following sampling. Water quality parameters measured included:

- temperature (°C);
- pH;
- electrical conductivity (EC; micro siemens per centimetre [µS/cm]);
- turbidity (Nephelometric Turbidity Units [NTU]); and
- DO (milligrams per litre [mg/L] and % saturation).

For the purposes of this assessment, salinity descriptors were based on the following EC ranges (the former Department of Agriculture, Fisheries and Forestry 2012):

- fresh – <800 µS/cm;
- marginal – 800 to 1,600 µS/cm;
- brackish – 1,600 to 4,800 µS/cm;
- slightly saline – 4,800 to 10,000 µS/cm;
- moderately saline – 10,000 to 20,000 µS/cm; and
- saline – >20,000 µS/cm.

Ions

Water samples were obtained from each wetted site in accordance with the *Monitoring and Sampling Manual* (DES 2018). Samples were chilled and delivered to ALS Environmental (a National Association of Testing Authorities [NATA] accredited laboratory) and were analysed for the following major ions to assist in characterising surface waters of the Study Area:

- major anions (Cl, SO_4 and alkalinity); and
- major cations (Ca, Mg, Na and K).

Groundwater samples were also obtained from subterranean GDE sampling sites (Section 3.7.2) for analysis and comparison of major anions and cations consistent with the IESC *Fact Sheet: Environmental water tracers in environmental impact assessments for coal seam gas and large coal mining development* (Office of Water Science 2020).

Data analysis

Physico-chemical water quality measurements were compared against Water Quality Objectives (WQOs) nominated in *Environmental Protection (Water) Policy 2009: Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (DEHP 2011). This includes WQOs for moderately disturbed aquatic ecosystems (applied to riverine sites) and WQOs for lakes/reservoirs (applied to wetland waterbody sites).

3.6.4 Fish

Fish were surveyed at seven wetted sites using a combination of backpack electrofishing, dip-netting, and overnight deployment of baited box traps and fyke nets (Section 3.6.1) where sufficient depth was encountered (Table 5).

Fish survey effort included:

- backpack electrofishing using a Smith-Root LR-24 electrofisher for up to 1200 seconds power-on time (100 hertz frequency; 20% duty cycle; 200-400 volts, to suit conductivity);
- dip-netting in combination with backpack electrofishing, using an Environet® manoeuvred through the water column;
- fyke netting – with two fyke nets, dual wing, 4 metres (m) wing lengths, 0.6 m drop, 3 mm mesh, baited with apple, banana, beef, spinach and rinsed sardines – deployed overnight to capture active fish (and both carnivorous and omnivorous turtles); and
- box traps – with five traps, 22 centimetres (cm) x 22 cm x 40 cm, 2 mm mesh, 50 mm opening, baited with dry cat food.

Fish survey was restricted to backpack electrofishing and dip-netting at some sites, due to insufficient depth for deployment of fyke nets or box traps (Table 5). However, these sites were thoroughly fished using backpack electrofishing techniques.

Captured fish were identified, with native species released at the point of capture.

3.6.5 Turtles

The Survey Guidelines for Australia's Threatened Reptiles (Department of Sustainability, Environment, Water, Population and Community [DSEWPC] 2011) suggest that the Fitzroy River turtle (*Rheodytes leukops*) can be readily observed in riffle zones by diving with a face mask and snorkel, or collected by seine netting, and also that the partly carnivorous diet of this species indicates it might be attracted to meat baits in traps. Survey guidelines for the white-throated snapping turtle (*Elseya albagula*) are not identified in the DSEWPC (2011) survey guidelines due to the subsequent listing of this species as Critically Endangered (from Least Concern) in November 2014. However, DPM Enviros has successfully captured this species using baited fyke nets and cathedral traps on other projects in the Mackenzie River Sub-basin.

The Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Department of Science, Technology, Innovation and the Arts 2014) suggest that freshwater turtle surveys should employ one or more of the following techniques:

- visual survey;
- snorkelling;
- spotlighting;
- trapping; and
- seine netting.

Freshwater turtles were surveyed at sites R3, R6, L1 and L2 (Section 3.6.1) by overnight deployment of baited fyke nets, as well as observations of the bank and water surface for sunning and breaching turtles. Suitable habitat for the deployment of cathedral traps (i.e. trees or snags overhanging deep pools) was not encountered.

Snorkelling surveys are not permitted by Whitehaven Coal Limited safety policy.

3.6.6 Mammals

Habitat suitability for platypus (*Ornithorhynchus anatinus*) was assessed at each site. This included targeted searches for burrows along banks.

3.6.7 Freshwater macroinvertebrates

Freshwater macroinvertebrate samples were collected from suitable habitats in June 2025 (sites R3, R4, R5, R6, L1 and L2) and October 2025 (sites R3, R6, L1 and L2) to gain an improved understanding of the health, trophic interactions and values of representative aquatic sites. Samples were collected by AusRivAS accredited ecologists following AusRivAS protocols for Queensland streams (DNRM 2001; DES 2018). AusRivAS protocols specify a standardised, qualitative, rapid bioassessment method that aims to consistently sample a wide diversity of macroinvertebrates within a defined timeframe.

The bed and edge habitats were sampled separately at each riverine site in accordance with AusRivAS protocols. At wetland waterbody sites (farm dams), a composite sample was collected incorporating all habitat conditions available (i.e. woody debris, macrophytes, bed and edge, deep and shallow areas).

A standard sized dip net with 250 micrometre (µm) mesh was used to sample macroinvertebrates. Following collection, the samples were transferred to plastic sorting trays, where the contents were sorted and live-picked for 30 minutes. Picked specimens were placed into specimen jars with 70% ethanol.

Samples were identified by an AusRivAS accredited ecologist to AusRivAS taxonomic level in the laboratory under stereomicroscope. AusRivAS taxonomic identification is primarily to Family level, with the exception of lower Phyla such as Porifera, Nematoda and Nemertea, Oligochaetes (freshwater worms), Acarina (mites), and microcrustacea such as Ostracoda, Copepoda and Cladocera. Chironomids (midges) are identified to sub-family taxonomic level.

Data analysis

The macroinvertebrate data was used to calculate a number of community descriptors as described in the following sections.

Taxonomic richness

Taxonomic richness was calculated from the number of taxa present in each sample, with richness typically increasing with ecological condition.

Plecoptera, Ephemeroptera and Trichoptera

The Plecoptera, Ephemeroptera and Trichoptera (PET) richness was calculated from the number of taxa belonging to the three PET orders. These orders are widely accepted as being most sensitive to environmental change, such as habitat degradation and pollution (DEHP 2009). A low PET richness score, due to the absence of these pollution-sensitive taxa, suggests that a site may be impacted by degradation or pollution. Conversely, a high PET richness suggests a system free from degradation or pollution.

Stream Invertebrate Grade Number – Average Level Version 2

Stream Invertebrate Grade Number – Average Level Version 2 (SIGNAL2) indices were calculated, with each taxon allocated a score from 1 to 10 based on Chessman (2003). Taxa with low scores are most tolerant of a range of environmental conditions, and those with high scores are more sensitive to pollution. The presence/absence data of each taxon were used to calculate the SIGNAL2 average for the site, in accordance with the protocols described by Chessman (2003).

Pollution-tolerant taxa

The percentage of pollution-tolerant taxa was calculated based on the SIGNAL2 indices. Tolerant taxa are classified as those with a SIGNAL2 score of 3 or less (Marshall et al. 2001). Macroinvertebrate families in this group are expected to tolerate changes to their environment, including habitat degradation and some pollution. An absence of more sensitive taxa suggests environmental conditions may be too harsh for sensitive taxa (those with SIGNAL2 scores above 3) to tolerate.

Australian River Assessment System OE50

The macroinvertebrate and predictor variables (habitat) data were analysed using the AusRivAS macroinvertebrate predictive modelling program, version 3.2.2 (eWater Ltd 2017). The predictive models are typically based on semi-permanent to permanent reference streams. Although the models provide another useful macroinvertebrate community descriptor, the results are applied to ephemeral waterways with caution.

AusRivAS OE50 values were derived from the AusRivAS model, comparing the observed taxonomic assemblages to those expected (i.e. O/E) (with a >50% chance of occurring at a test site) under 'reference' (least disturbed) conditions in the broader catchment. OE50 taxa are attributed to bands representing different levels of biological condition. The band width is based on the distribution of OE50 taxa values for the reference sites in each model. The AusRivAS bands and descriptions are identified in Table 7.

Table 7 AusRivAS bands and descriptions (based on Coysh et al. 2000)

Band	Description	OE50 taxa	O/E taxa interpretation
X	More biologically diverse than reference	OE50 greater than 90th percentile of reference sites used to create the model.	More families found than expected. Potential biodiversity "hot spot" or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream.
A	Similar to reference	OE50 within ranged of central 80% of reference sites used to create the model.	Expected number of families within the range found at 80% of the reference sites.
B	Significantly impaired	OE50 below 10th percentile of reference sites used to create the model. Same width as Band A.	Fewer families than expected. Potential impact either on water and/or habitat quality resulting in a loss of families.
C	Severely impaired	OE50 below Band B. Same width as band A.	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	Extremely impaired	OE50 below Band C down to zero.	Few of the expected families and only the hardy, pollution tolerant families remain.

The AusRivAS models utilised, based on location, season and habitats sampled, are identified in Table 8 (post-wet) and Table 9 (pre-wet), along with the different input variables applied to each season.

Table 8 AusRivAS post-wet habitat predictor model variables for Queensland Regional Coastal draining sites, and the values applied

Code	Description	Riverine site and input value				
		R3	R4	R5	R6	R9
Edge habitat						
ALTITUDE	Height above sea level (mAHD)	182	185	192	190	190
BEDSLOPE	Slope of bed (m/m)	0.002	0.002	0.004	0.002	0.002
LONGITUDE	Decimal degrees to 4 decimal places	148.8762	148.8666	148.8523	148.8660	148.8688
MDMR	Mean dry season monthly rainfall (mm)	21	21	21	21	21
RAINRANGE	Annual range in mean monthly rainfall	74	74	74	74	74
RAWD	Ratio of mean wet season to mean dry season rainfall	3.25	3.25	3.25	3.25	3.25
WETPERCENT	Percentage rainfall in wet season	76	76	76	76	76
Pool/bed habitat						
COBBLE	Percent cobble (64-256 mm diameter sediments) in habitat	0	0	0	0	0
DFS	Distance from source (km)	41	39	6	20	36
MDMR	Mean dry season monthly rainfall (mm)	21	21	21	21	21
MINTEMP	Mean daily minimum temperature (°C)	16.3	16.3	16.3	16.3	16.3
RAINFALL	Mean annual rainfall (mm)	535	535	535	535	535

Notes:

Rainfall and temperature data derived from the BoM station 35134 – Blackwater Airport (2013-2025).

°C = degrees Celsius.

Table 9 AusRivAS pre-wet habitat predictor model variables for Queensland Regional Coastal draining sites, and the values applied

Code	Description	Riverine site and input value	
		R3	R6
Edge habitat			
ALTITUDE	Height above sea level (mAHD)	182	190
LONGITUDE	Decimal degrees to 4 decimal places	148.8762	148.8660
MDMR	Mean dry season monthly rainfall (mm)	21	21
MINTEMP	Mean daily minimum temperature (°C)	16.3	16.3
RAWD	Ratio of mean wet season to mean dry season rainfall	3.25	3.25
WETR	Range in wet season monthly rainfall means (mm)	40.7	40.7
Pool/bed habitat			
COBBLE	Percent cobble (64-256 mm diameter sediments) in habitat	0	0
MDMR	Mean dry season monthly rainfall (mm)	21	21
PROCESSZONE	Process zone category (2 = erosional; 1 = transport; 0 = depositional)	1	1
RAINRANGE	Annual range in mean monthly rainfall	74	74
RAINGETEMP	Mean daily temperature range (°C)	14.1	14.1

Notes:
Rainfall and temperature data derived from the BoM station 35134 – Blackwater Airport (2013-2025).
°C = degrees Celsius.

3.6.8 Aquatic flora

Aquatic plants were surveyed at each site. All aquatic plants were identified to species using available literature and taxonomic keys where needed. The abundance of each species was estimated using the AusRivAS (DNRM 2001) categories: extensive (>75% cover), moderate (50-75%), some (10-50%) or little (1-10%).

3.6.9 Overall aquatic values

An aquatic values rating of Low, Moderate or High was assigned to each site based on the summation of all available information from the desktop and field assessments (Table 10). When assessing each site, the most conservative criteria was applied. The criteria in Table 10 are listed from most to least important.

Table 10 Adopted criteria for assigning aquatic values ratings

Aquatic values/sensitivity	Key aquatic values/criteria
High	A site can have one or more of the following to be considered 'High': ▪ Permanent riverine waterbody or natural wetland. ▪ Wetland of High Ecological Significance. ▪ Conservation-significant species habitat present. ▪ Known presence of platypus breeding place. ▪ Near natural / excellent in-stream habitat. ▪ Mapped as High or Very High conservation significance in ACA mapping. ▪ Excellent habitat assessment score (111 – 135).
Moderate	A site can have one or more of the following to be considered 'Moderate': ▪ Ephemeral or semi-permanent waterbody. ▪ Wetland of General Ecological Significance. ▪ Platypus foraging habitat present. ▪ Some good quality in-stream habitat. ▪ Mapped as Major or High risk of impact from fish barriers. ▪ Mapped as Medium conservation significance in ACA mapping. ▪ Good habitat assessment score (75 – 110). ▪ Dry season riverine refuge for common (Least Concern) species.
Low	A site can have one or more of the following to be considered 'Low': ▪ Ephemeral waterbody. ▪ No conservation-significant species or platypus habitat. ▪ In-stream habitat highly modified/disturbed. ▪ Mapped as Low or Very Low conservation significance in ACA mapping. ▪ Poor to Fair habitat assessment score (0 – 74).

3.7 Field-verification of subterranean groundwater-dependent ecosystems

3.7.1 Stygofauna sampling effort

A seasonal pilot survey was undertaken to sample the local presence of subterranean aquatic fauna in consideration of the *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (DSITI 2015). Field sampling protocols were consistent with the *Monitoring and Sampling Manual* (DES 2018).

Consideration of existing groundwater bores for sampling

A review of the DLGWV (2025b) groundwater database identified 49 registered bores within 5 km of the Study Area. Bore reports were reviewed to assess the suitability of bores for sampling and their likelihood of containing stygofauna.

The *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* (DSITI 2015) requires that bores sampled for stygofauna be at least 6-months old, have groundwater present, and are constructed such that subterranean fauna would have access to the borehole. The *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019) identifies characteristics of bores most likely to yield stygofauna, including screen aperture (slot widths) of at least 1 mm wide in the screened interval to allow entry of larger taxa such as amphipods.

Stygofauna in Queensland have been encountered at depths of up to 60 mbgl, at conductivities above 50,000 µS/cm and in both acidic and alkaline environments (Schultz et al. 2013 and Glanville et al. 2016, cited in DES 2018). 4T Consultants Pty Ltd (4T 2012) prepared a desktop assessment of at least 13 stygofauna studies in Queensland and established water quality conditions in which stygofauna were likely to be found. In fractured rock, stygofauna were more likely where the aquifer was <50 mbgl, pH 6.5-8.5 and EC <5,000 µS/cm (4T 2012). In alluvium, stygofauna were more likely where the aquifer was <20 mbgl, pH 6.5-8.5 and EC <2,000 µS/cm (4T 2012).

Bores within the Focus Area with these characteristics, or similar, were targeted for field sampling in July and October 2025. Of the 49 bores within the Focus Area (Appendix C), 10 were considered suitable to target for stygofauna. Of these 10 target bores, only five contained water at the time of sampling (Section 4.8.1). Five micropiezometer sampling sites were established in the sandy/gravelly alluvium of Blackwater Creek (Section 3.7.2) to fulfill the DSITI (2015) guideline requirement for 10 locations sampled (twice/seasonally) in a pilot survey.

3.7.2 Field sampling

Stygofauna sampling from bores

Three sizes of phreatobiological nets were carried in the field for stygofauna sampling, with diameters of 40 mm, 90 mm and 130 mm. Nets are constructed of 50 µm monomesh and are weighted at the bottom. The net tapers to a removable collection chamber at the base, allowing ease of collection for replicate samples following each haul.

Nets were lowered to the bottom of the bore, bounced five to 10 times to dislodge resting animals, then retrieved. The collection chamber was rinsed into a 50 µm mesh sieve at the top of each haul. The 20 litres (L) of purged water was also run through the 50 µm mesh sieve. Once 6 hauls were completed, the entire sieve contents were transferred to a labelled sample jar and preserved in ethanol.

Nets were washed thoroughly three times in deionised water between sampling locations.

Stygofauna sampling from micropiezometers

Samples were collected from the hyporheic zones at the edge of standing pools using a hand-operated bilge-pump to extract water from micropiezometers (13 mm internal diameter, 2 mm openings; of similar construction to Hancock and Boulton 2005) hammered into the sediments with a metal driving rod to a total depth of 1 mbgl and with a screened interval of 0.3-1.0 mbgl (Plate 1). A sample of 10 L was extracted from micropiezometers MP1 to MP5 (Figure 23) and run through a 50 µm monomesh filter. The filtered contents were transferred to a labelled sample jar and preserved in ethanol.



Plate 1 Micropiezometers (small, temporary polyvinyl chloride wells) utilised for stygofauna sampling from the stream bed

Physico-chemical water quality

A water sample was retained from each bore and micropiezometer after the stygofauna sampling. EC and pH were measured from this sample on site using a YSI Professional Plus multi-parameter water quality meter, calibrated prior to and following sampling.

Ions

A separate water sample was retained from each bore immediately after obtaining the water sample for physico-chemical water quality. Samples for major cations were field-filtered and collected in bottles pre-treated with nitric acid. Samples for major anions were placed in bottles without preservative. Samples were chilled and delivered to ALS Environmental (a NATA accredited laboratory) and were analysed for the following major ions to assist in characterising surface water/groundwater interactions of the Project site:

- major anions (Cl, SO_4, F and HCO_3); and
- major cations (Ca, Mg, Na and K).

3.7.3 Sample processing

Field samples were sorted in the laboratory under stereomicroscope. Each sample container was drained of ethanol and washed into a channelled counting tray to create a thin layer of sediment spread across the bottom of the tray. Aquatic animals were picked under stereomicroscope. Potential significant stygofauna would have been sent to Dr Peter Hancock, a stygofauna specialist, for identification to genus/morphospecies taxonomic level; however, no potential stygofauna were detected.

3.7.4 Personnel

Field sampling was led by David Moore, an aquatic ecologist with over 20 years of experience on both surface water and groundwater projects across Australia, including stygofauna sampling. Laboratory processing was undertaken by Chris Pietsch, an aquatic ecologist with 20 years of experience in aquatic assessments across Australia, including processing of aquatic invertebrate samples.

3.8 Field-verification of terrestrial groundwater-dependent ecosystems

3.8.1 Approach

State-mapped terrestrial GDEs were field verified on 19-20 June 2025 using measurements of pre-dawn leaf water potential (LWP) and soil water potential (SWP). Dry conditions in the lead-up to and throughout the fieldwork (only 1.4 mm in 20 days preceding sampling [BoM 2025]) made for suitable conditions to differentiate between trees utilising soil moisture in the upper soil profile versus those trees accessing deeper sources of moisture/groundwater. Follow-up sampling was conducted on 25 October 2025 at the same locations. Additional locations upstream and downstream of the initial survey location were scheduled for October 2025 to further inform the delineation of GDEs along Taurus Creek. However, trees within the original sites were not accessing groundwater in October 2025 and therefore no delineation was undertaken.

LWP is a measure of the resistance of the pathway to water movement and is a function of the soil water availability, evaporative demand and the conductivity of the soil-to-leaf pathway (Richardson et al. 2011). There is generally little to no transpiration of water during the night from most types of plants and so the movement of water through the stem approaches static conditions overnight. For this reason, pre-dawn LWP is generally in equilibrium with the matric potential of the soil (the tension with which water is held to soil particles) at the main depth at which the plant takes up water.

Pre-dawn LWP measurements were used to compare trees against the expected LWP range for known terrestrial GDEs subject to fresh to slightly saline salinity regimes as is expected in the shallow alluvial aquifers of the Study Area. The expected pre-dawn LWP range was drawn from a range of published and unpublished sources including DPM Enviroscienses (2022), 3D Environmental (2020), Jones et al (2019), Holland et al (2006) and Mensforth et al (1994). Expected pre-dawn LWP for trees in equilibrium with:

- a fresh to marginal saturated source of moisture (EC <1,500 µS/cm) = >-0.2 megapascals (MPa);
- a slightly saline saturated source of moisture (EC >1,500 to 10,000 µS/cm) = <-0.2 to >-0.55 MPa; and
- a moderately saline to saline saturated source of moisture (EC >10,000 to 25,000 µS/cm) = <-0.55 to >-1.4 MPa.

Trees that demonstrated pre-dawn LWP values that were more negative than the expected range for the local groundwater salinity regime (i.e. <-0.55 MPa) were assumed not to be groundwater dependent.

For trees where pre-dawn LWP was within the expected range of values for GDEs accessing fresh to slightly saline saturated sources of moisture (i.e. pre-dawn LWP ≥-0.55 MPa), comparison with SWP values from the soil profile (at 1 and 2 m depths) was undertaken to determine whether moisture for transpiration was likely being supplied from the upper soil profile or whether deeper sources of moisture/groundwater can be inferred.

Field survey results were analysed spatially to distinguish between canopy trees that were likely accessing groundwater at the time of assessment and those which were not.

3.8.2 Pre-dawn leaf water potential

Measurements of pre-dawn LWP were obtained within 2-hours of dawn using a pressure chamber (Model 1505D, scale range of 0.0 to 10.0 MPa, PMS Instrument Company, Oregon, USA) filled with nitrogen gas. Measurements were taken from excised shoots, each with 3-10 leaves, sampled from the lower foliage (mean height of 4.7 m from ground level, range 1 to 8 m) of each sample tree (Plate 2). Twelve trees were sampled on 20 June 2025, comprising six trees at each of two sites. Coolibah (*Eucalyptus coolabah*) was the dominant canopy species at each site, with only rare occurrence of other species. Consequently, only coolibah trees were sampled. The same 12 coolibah trees were sampled on 25 October 2025, plus three silver-leaved ironbark (*E. melanophloia*) and two poplar box (*E. populnea*) individuals.

Nitrogen gas was used to apply pressure to each leaf/shoot sample in the pressure chamber. Most of the shoot is placed inside the chamber, but the cut end of the stem (the petiole) is exposed outside the chamber. The amount of pressure it takes to cause water to appear at the cut surface of the petiole indicates how much tension the leaf is experiencing on its water supply. A high value of required pressure means a high value of tension and a high degree of water stress.



Pre-dawn collection of leaves using a pole saw



Pre-dawn measurement of leaf water potential

Plate 2 Measuring pre-dawn leaf water potential

3.8.3 Soil water potential

Soil samples were collected in June and October 2025 from two depths (1 and 2 m below surface) from two locations at each of the two sites using a battery-powered drill, auger bit and soil probe. Samples were not required from 2 m at two locations in June 2025 due to saturated soils at 1 m negating the need for deeper samples. Samples were placed in a 50 millilitre jar, sealed, then analysed later that day using a WP4C chilled mirror hygrometer (Plate 3).



Collection of soil from 1 m and 2 m depths with a drill and probe combination



Analysis of samples with a chilled mirror hygrometer

Plate 3 Measuring soil water potential

4 RESULTS – AQUATIC ECOLOGY CHARACTERISTICS OF THE STUDY AREA

4.1 Waterways

The Queensland Wetlands Mapping (DETSI 2025e) identifies riverine systems, watercourses, waterways or drainage lines (herein referred to collectively as waterways) for the Study Area.

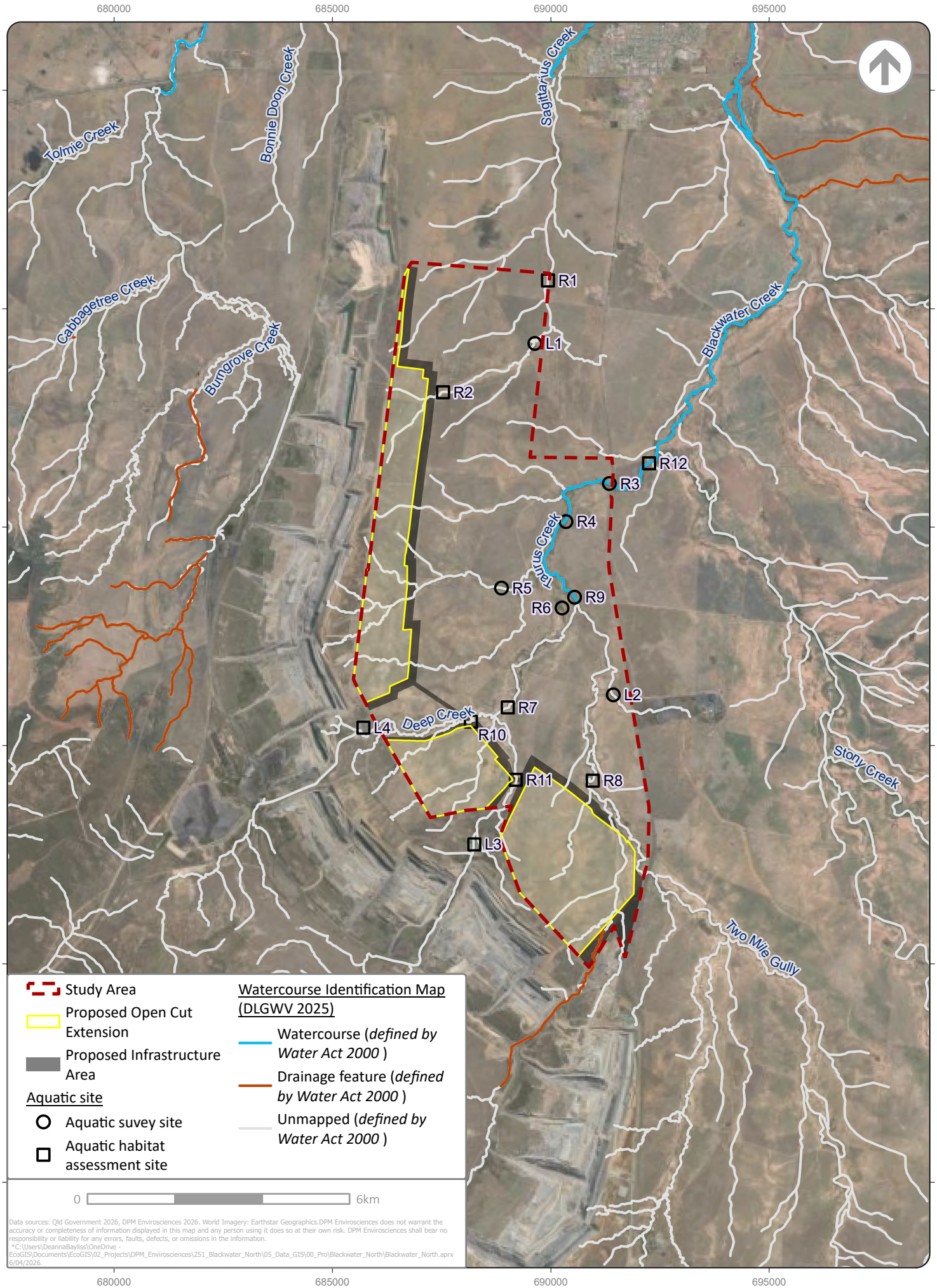
The waterways of the Study Area comprise mainly first and second order waterways (based on Strahler 1952). The third order waterways comprise Sagittarius and Taurus Creeks and an unnamed tributary of Two Mile Gully. The fourth order waterways comprise Taurus Creek and Two Mile Gully. Taurus Creek also includes a fifth order reach within the Study Area (Figure 3).

The waterways of the Study Area are ephemeral, experiencing flow for relatively short duration following rainfall and runoff in the catchment, likely ceasing to flow within days to weeks, and supporting aquatic life whose life cycles are adapted to these conditions. Flow within the larger fifth order Blackwater Creek, approximately 1.8 km downstream of the Study Area, is likely ephemeral to intermittent, with seasonal flow during certain times of the year when smaller upstream waterways are flowing and/or when groundwater contributions provide enough water for stream flow following recharge of the alluvial aquifer.

4.1.1 Watercourses

State-mapped watercourses

The DLGWV (2025a) watercourse identification map (Figure 4) identifies Taurus Creek, downstream of its confluence with Two Mile Gully, as a waterway that exhibits the characteristics of a watercourse as defined by the *Water Act 2000*. All other waterways of the Study Area were yet to be mapped by DLGWV (2025a) at the time of this assessment.



WATERCOURSE IDENTIFICATION MAP

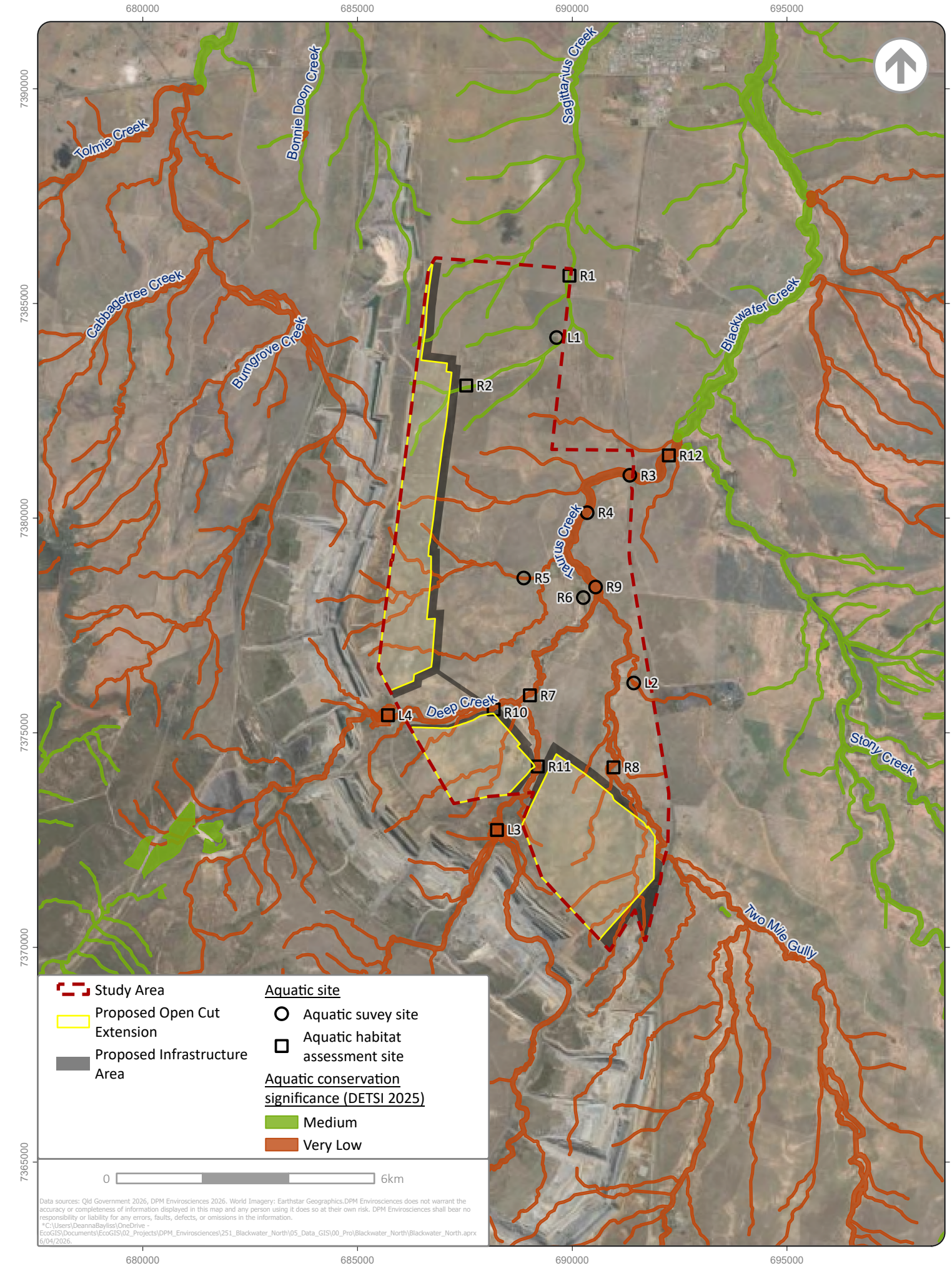
Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 4

4.1.2 Conservation values

The Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM) (Clayton et al. 2006), was developed to assess conservation values of wetlands and waterways in Queensland. It is a comprehensive method that uses available data (including data from expert opinion) to identify relative non-social, non-economic conservation/ecological values within a specified area. The criteria in AquaBAMM are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. The ACA for the riverine (Inglis and Howell 2009) and non-riverine (Rollason and Howell 2012) wetlands of the Great Barrier Reef (produced by the former Queensland Department of Environment and Resource Management) is a product of applying this method. The associated ACA mapping (DETSI 2025h) identifies (Figure 5):

- Sagittarius Creek and its tributaries as being of Medium conservation significance;
- Taurus Creek and its tributaries as being of Very Low conservation significance; and
- Lacustrine waterbodies (farm and mine water dams), where mapped, as being of very low conservation significance.



AQUATIC CONSERVATION ASSESSMENT

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

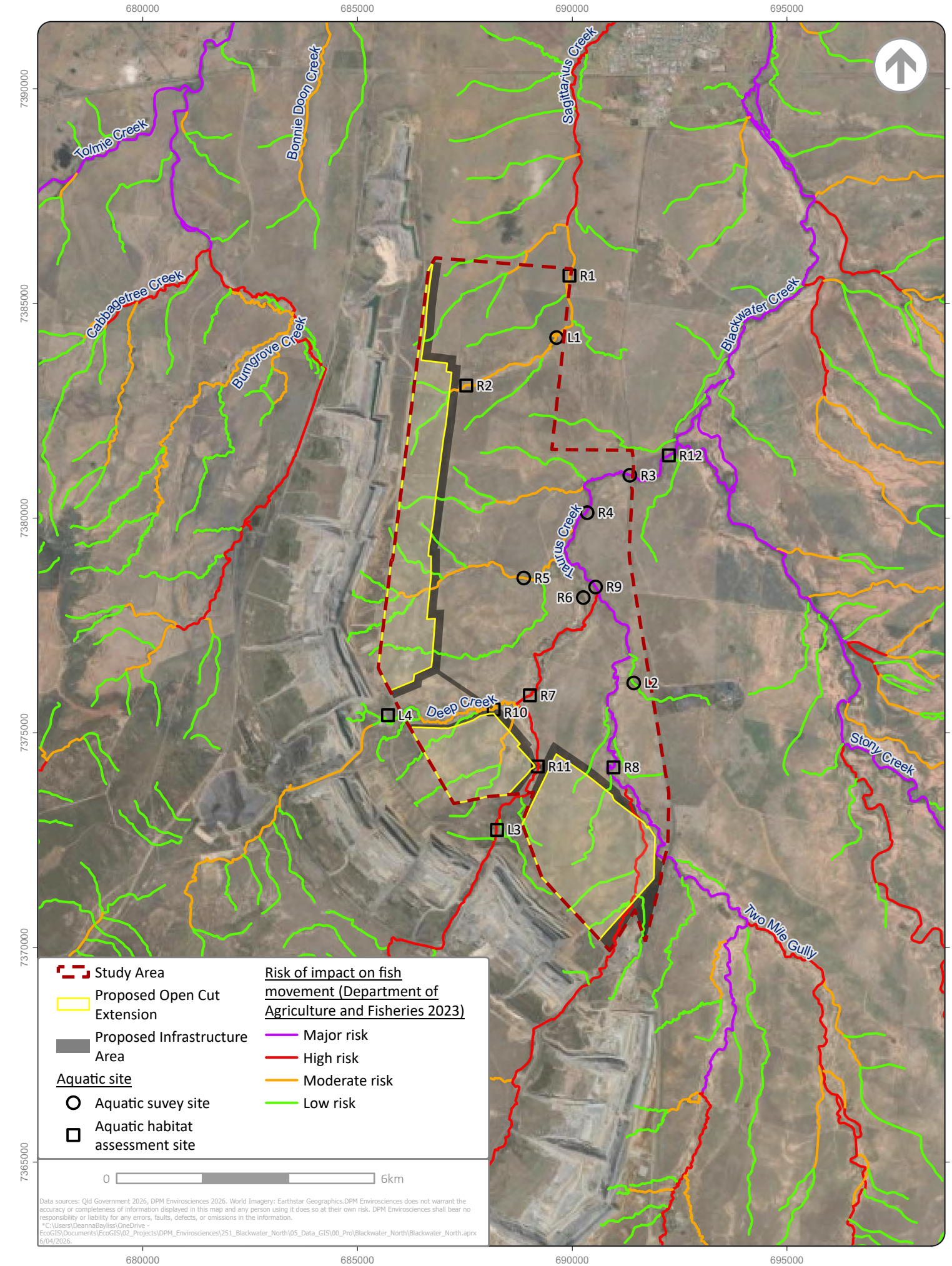
FIGURE 5

4.1.3 Waterways for fish passage

While it is understood that a waterways barrier works permit is not required where the works occur in a ML authorised under an EA, fish passage is a MSES and so is addressed here.

Waterways, as defined by the *Fisheries Act 1994*, include rivers, creeks, streams, watercourses or inlets of the sea. The DPI (2025a) Queensland Waterways for Waterway Barrier Works mapping (Figure 6) indicates the level of 'risk' associated with undertaking waterway barrier works within Queensland waterways. Waterways with higher stream orders, steeper slopes, higher flow rates, greater numbers of fish present and fish with stronger swimming abilities are allocated a higher level of risk (Department of Agriculture and Fisheries 2023).

In consideration of these factors, Two Mile Gully and the downstream reach of Taurus Creek are State-mapped as being at Major risk of adverse impact from waterway barrier works on fish movement (DPI 2025a). Waterways State-mapped as being at High risk of adverse impact from waterway barrier works on fish movement (DPI 2025a) include the upstream reach of Taurus Creek and an unnamed tributary of Two Mile Gully. Other mapped waterways within the Study Area are indicated as being at Low to Moderate risk of adverse impact from waterway barrier works on fish movement (DPI 2025a) (Figure 6).



WATERWAYS FOR WATERWAY BARRIER WORKS MAPPING

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 6

4.2 Aquatic habitat

The waterways of the Study Area are ephemeral and experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is generally lower. During these times, aquatic fauna concentrates in senescing pools and may perish. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to vary seasonally.

Aquatic habitat was assessed at 12 riverine sites (sites R1 to R12) on representative waterways of the Study Area (Figure 3). No flow was encountered at the time of assessment in June-July 2025, but isolated pools were encountered at sites R3, R4, R5, R6 and R9. In October 2025, isolated pools of much less extent were encountered only at sites R3 and R6.

There are 12 State-mapped (DETSI 2025e) lacustrine wetlands (hydrologically modified or artificial) within the Study Area, all of which are either farm dams with constructed earthen walls on the downstream side or are constructed mine water dams. Numerous smaller farm dams occur throughout the Study Area but are too small to form part of the Queensland Wetland Mapping (DETSI 2025e). The lacustrine wetland waterbodies of the Study Area provide semi-permanent aquatic habitat, although are likely only connective with downstream habitats when flow is encountered following sufficient rainfall and runoff in the catchment that results in filling and spill from these dams. Aquatic habitat was assessed at four of the State-mapped lacustrine wetlands, comprising two representative farm dams (sites L1 and L2) and the two mine water dams (sites L3 and L4) within the Study Area. Site L3 comprises a mine water dam on Taurus Creek referred to as Taurus Dam or Release Point (RP) 2 in EA EPML00717813 (DETSI 2025a). Site L4 comprises a mine water dam on Deep Creek referred to as Deep Creek Dam or RP3 in EA EPML00717813.

4.2.1 Physico-chemical water quality

Post-wet (June-July) 2025

Surface water temperatures at the time of assessment in June-July 2025 ranged from 11.5°C to 17.2°C (Table 11). Water temperatures are influenced by time of day, shading and depth. The slightly higher temperature of 17.2°C at site L2 likely reflects temperature absorption from black sediments containing coal fines washed down from the Cook CHPP, observed in June 2025 (Appendix B) and also in 2019-2020 (EMM 2023).

pH levels ranged from 6.2 (slightly acid) to 8.9 (strongly alkaline), falling within the WQO guideline range of 6.5-8.5 at the riverine sites, falling below the WQO range at farm dam site L1, and exceeding the WQO range at mine water dam sites L3 and L4 (Table 11).

The riverine and farm dam sites exhibited ‘fresh’ (<800 µS/cm) water (Table 11). Marginal water was detected at mine water dam L4 (965 µS/cm) and slightly saline water was detected at mine water dam L3 (5,124 µS/cm). EC levels exceeded the relevant WQO guideline (<310 µS/cm for riverine sites and <250 µS/cm for lakes/reservoirs) at sites R5 (378 µS/cm), L2 (628 µS/cm), L3 and L4. The EC levels at sites L3 and L4 (RP2 and RP3 in EA EPML00717813, respectively) were below the release limit (for context only) of 10,000 µS/cm (being slightly to moderately saline water) identified in EA EPML00717813 (DETSI 2025a).

Surface water DO levels were variable across the Study Area (Appendix B), reflecting several factors including time of day, temperature, organic load, biological activity, flow (or lack thereof) and rate of transfer from the atmosphere. DO measurements ranged from 45.8% (low saturation) at riverine site R9 to 98.4% (saturated) at riverine site R5 (Table 11).

Turbidity levels ranged from 9.6 NTU (high clarity) at farm dam site L1 (fenced to exclude cattle) to 394 NTU (poor clarity; opaque) at riverine site R4 on Taurus Creek. The higher turbidity levels at some sites reflect a high washload (silts and clays held in suspension) likely associated with cattle and other animals accessing these drying pools, as well as bioturbation from aquatic fauna within these pools.

Pre-wet (October) 2025

Surface water temperatures at the time of assessment in October 2025 ranged from 21.3°C to 33.1°C (Table 12). Water temperatures are influenced by time of day, shading and depth.

pH levels ranged from 7.5 (mildly alkaline) to 9.7 (very strongly alkaline), falling within the WQO guideline range of 6.5-8.5 at riverine site R3, exceeding this range at site R6, and exceeding the WQO guideline range of 6.5-8.0 at each lacustrine site (Table 12). The elevated pH levels are associated with high DO levels.

Low DO levels at site R3 reflects a combination of factors including time of day (early morning), lack of flow, and oxygen consumption by aerobic bacteria associated with the breakdown of organic matter in senescing pools. Supersaturated DO levels at sites R6, L1 and L3 reflect the time of day and photosynthetic release of oxygen from the extensive algae and macrophyte cover at these sites. The consumption of carbon dioxide during photosynthesis reduces the formation of carbonic acid and decreases the concentration of hydrogen ions, increasing the pH of the water. Both DO and pH levels are expected to fluctuate vastly over a 24-hour period, especially as isolated waterbodies senesce, nutrients concentrate, temperatures increase, and both algae levels and macrophyte cover proliferate.

The riverine and farm dam sites exhibited ‘fresh’ (<800 µS/cm) water (Table 12). Marginal water was again detected at mine water dam L4 (1,403 µS/cm) and slightly saline water was again detected at mine water dam L3 (4,951 µS/cm). EC levels exceeded the relevant WQO guideline (<310 µS/cm for riverine sites and <250 µS/cm for lakes/reservoirs) at sites R3 (633 µS/cm), R6 (471 µS/cm), L2 (786 µS/cm), L3 and L4. The EC levels at sites L3 and L4 (RP2 and RP3 in EA EPML00717813, respectively) were below the release limit (for context only) of 10,000 µS/cm (being slightly to moderately saline water) identified in EA EPML00717813 (DETSI 2025a).

Turbidity levels ranged from 13.2 NTU (high clarity) at farm dam site L1 (fenced to exclude cattle) to 220 NTU (poor clarity; opaque) at riverine site R3 on Taurus Creek.

Table 11 Surface water quality measurements, post-wet (June-July) 2025

Parameter	Units	WQO (DEHP 2011)	Riverine sites									Lacustrine sites			
			R1	R2	R3	R4	R5	R6	R7	R8	R9	L1	L2	L3	L4
Date	DD/MM/2025	-	18/06	17/06	20/06	20/06	18/06	18/06	1/07	1/07	18/06	17/06	30/06	3/07	3/07
Time	HH:MM	-	12:10	16:30	11:00	07:34	10:21	12:37	12:00	14:28	08:12	13:51	15:57	9:13	7:47
Flow	NA	-	Dry	Dry	Nil	Nil	Nil	Nil	Dry	Dry	Nil	Nil	Nil	Nil	Nil
Physico-chemical water quality															
Temperature	°C	-	-	-	13.0	11.7	13.4	13.8	-	-	11.5	14.1	17.2	13.9	14.5
pH	pH units	6.5-8.5[R], 6.5-8.0[L]	-	-	7.0	7.1	7.6	6.8	-	-	6.6	**6.2**	7.6	**8.4**	**8.9**
EC	µS/cm (@25C°)	<310[R, B], <250[L, B]	-	-	286	187	**378**	234	-	-	159	196	**628**	**5124**	**965**
DO	% saturation	85-110[R], 90-110[L]	-	-	**77.0**	**64.4**	98.4	**81.3**	-	-	**45.8**	**88.5**	**83.7**	**76.6**	94.8
	mg/L	-	-	-	8.10	6.98	10.27	8.35	-	-	5.00	9.10	7.92	7.78	9.63
Turbidity	NTU	50[R], 1-20[L]	-	-	37	**394**	**153**	**217**	-	-	**289**	9.6	11.2	**38**	16.5
Alkalinity (as $CaCO_3$)	mg/L	-	-	-	110	78	171	92	-	-	78	93	121	630	161
Major cations															
Calcium (Ca^{2+})	mg/L	-	-	-	23	15	37	19	-	-	15	16	32	31	35
Magnesium (Mg^{2+})	mg/L	-	-	-	8	5	8	6	-	-	4	6	13	40	14
Sodium (Na^{+})	mg/L	-	-	-	23	16	39	22	-	-	12	19	48	1000	140
Potassium (K^{+})	mg/L	-	-	-	7	6	4	6	-	-	54	5	9	10	6
Major anions															
Chloride (Cl^{-})	mg/L	-	-	-	24	10	18	15	-	-	7	8	40	1160	161
Sulphate (SO_4^{2-})	mg/L	<10[R]	-	-	5	7	4	8	-	-	2	<1	**99**	**537**	**110**
Bicarbonate (HCO_3^{-})	mg/L	-	-	-	110	78	171	92	-	-	78	93	121	578	149

Notes: [R] WQO applies to riverine sites. [B] WQO for no flow or baseflow conditions (differs for high flow conditions). [L] WQO applies to freshwater lakes / reservoirs.* DO levels for fresh waters only apply to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50% saturation (DEHP 2011).

Table 12 Surface water quality measurements, pre-wet (October) 2025

Parameter	Units	WQO (DEHP 2011)	Riverine sites												Lacustrine sites			
			R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	L1	L2	L3	L4
Date	DD/MM/2025	-	20/10	20/10	22/10	21/10	21/10	21/10	22/10	22/10	21/10	21/10	21/10	23/10	20/10	22/10	20/10	20/10
Time	HH:MM	-	14:00	11:00	07:15	09:30	10:15	11:40	09:30	12:00	10:40	14:30	15:15	13:30	15:07	12:46	10:04	09:21
Flow	NA	-	Dry	Dry	Nil	Dry	Dry	Nil	Dry	Dry	Dry	Dry	Dry	Dry	Nil	Nil	Nil	Nil
Physico-chemical water quality																		
Temperature	°C	-	-	-	21.3	-	-	33.1	-	-	-	-	-	-	28.6	29.1	29.4	25.2
pH	pH units	6.5-8.5[R], 6.5-8.0[L]	-	-	7.5	-	-	**9.3**	-	-	-	-	-	-	**9.7**	**8.2**	**9.1**	**8.5**
EC	µS/cm (@25C°)	<310[R, B], <250[L, B]	-	-	**633**	-	-	**471**	-	-	-	-	-	-	210	**786**	**4951**	**1403**
DO	% saturation	85-110[R], 90-110[L]	-	-	**20.5**	-	-	**184.0**	-	-	-	-	-	-	**170.5**	91.6	**136.7**	**83.8**
	mg/L	-	-	-	1.82	-	-	13.17	-	-	-	-	-	-	13.15	7.02	10.29	6.88
Turbidity	NTU	50[R], 1-20[L]	-	-	**220**	-	-	**152**	-	-	-	-	-	-	13.2	19.2	**85.3**	**42.7**
Alkalinity (as $CaCO_3$)	mg/L	-	-	-	164	-	-	155	-	-	-	-	-	-	69	145	502	198
Major cations																		
Calcium (Ca^{2+})	mg/L	-	-	-	40	-	-	17	-	-	-	-	-	-	8	31	25	38
Magnesium (Mg^{2+})	mg/L	-	-	-	17	-	-	11	-	-	-	-	-	-	4	23	39	21
Sodium (Na^{+})	mg/L	-	-	-	58	-	-	54	-	-	-	-	-	-	26	96	939	228
Potassium (K^{+})	mg/L	-	-	-	14	-	-	9	-	-	-	-	-	-	4	10	11	7
Major anions																		
Chloride (Cl^{-})	mg/L	-	-	-	87	-	-	48	-	-	-	-	-	-	12	68	948	232
Sulphate (SO_4^{2-})	mg/L	<10[R]	-	-	2	-	-	4	-	-	-	-	-	-	<1	111	352	152
Bicarbonate (HCO_3^{-})	mg/L	-	-	-	164	-	-	147	-	-	-	-	-	-	54	145	488	198

Notes: [R] WQO applies to riverine sites. [B] WQO for no flow or baseflow conditions (differs for high flow conditions). [L] WQO applies to freshwater lakes / reservoirs.* DO levels for fresh waters only apply to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50% saturation (DEHP 2011).

4.2.2 Ionic composition of surface waters

The concentration and proportion of ions in surface waters depends on the location of the waterway (geology, land use, and topography), climate and the proportionate contributions of groundwater flow, interflow and overland flow (Boulton and Brock 2001). These proportionate contributions will vary depending on seasonal and climatic patterns and so the source of ions will also vary. During periods of low to no rainfall or runoff, groundwater contributions can become more evident. During periods of high rainfall and runoff, catchment and atmospheric sources typically dominate.

The concentrations of major anions and cations in surface water (and groundwater) samples collected from the Study Area (and broader GDE Focus Area) are provided in Appendix D. The relative proportions of these major cations and anions are presented in Piper plots for the post-wet sampling in June-July 2025 (Figure 7 and the pre-wet sampling in October 2025 (Figure 8). The Piper plots indicate that most surface waters of the Study Area are mixed bicarbonate waters. These waters are typical of many inland rivers, or the upland reaches of coastal draining rivers, where weak carbonic acid (formed from atmospheric carbon dioxide dissolved in water as well as from rainwater infiltrating carbon dioxide-rich soil) reacts with the sodium, magnesium and calcium in soil, rock or other deposits to form mixed bicarbonate waters.

The surface waters collected from the mine water dams (sites L3 and L4) (and the five sampled bores) were sodium chloride dominated. Chlorides are typically dissolved from rocks and soils derived from evaporites, minerals or igneous rock, although are also concentrated in animal excretions. Mine water runoff containing chlorides from coal and other Permian rock is the likely source of sodium chloride in these mine water dams.

The sodium chloride dominated waters from the mine water dams exhibited a moderate to high concentration (based on the logarithmic scale of Gibbs [1970]) of total dissolved salts (approximately 647 to 3,433 mg/L, inferred from EC levels of 965 to 5,124 µS/cm) (Figure 9 and Figure 10). These waters have incurred a higher contact time with Permian rock of the catchment than the fresh, mixed bicarbonate-dominated waters of the broader Study Area.

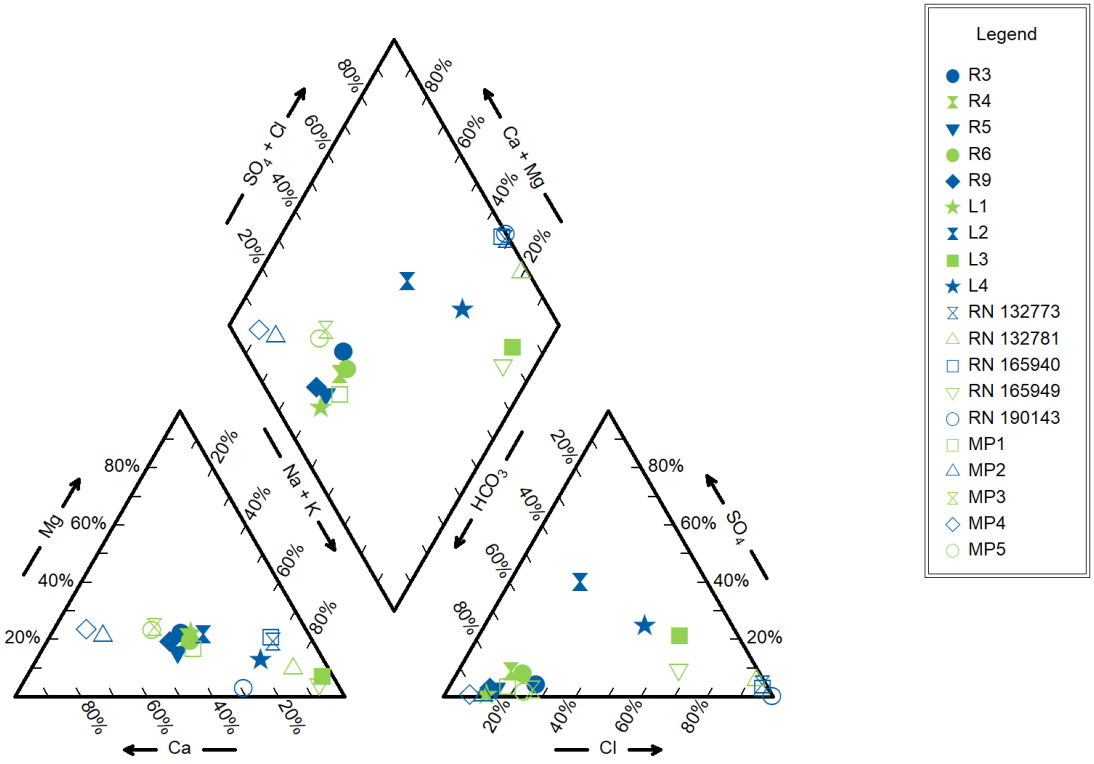


Figure 7 Piper plot showing relative abundance of major cations and anions from surface water and groundwater samples, post-wet (June-July) 2025

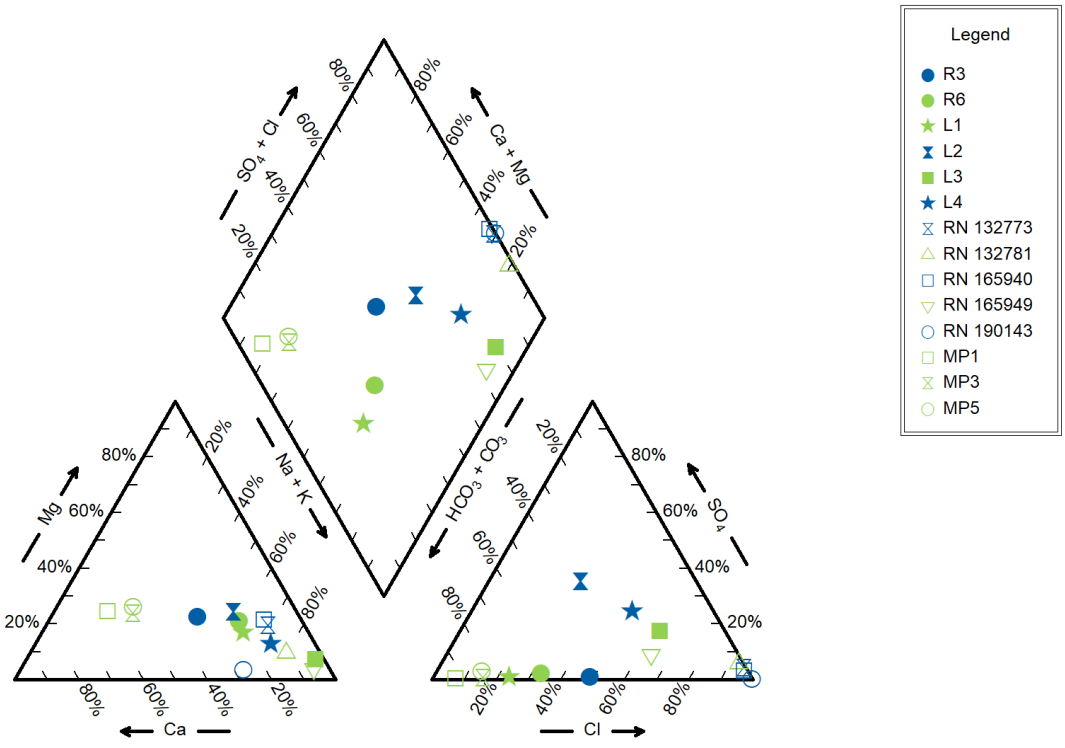


Figure 8 Piper plot showing relative abundance of major cations and anions from surface water and groundwater samples, pre-wet (October) 2025

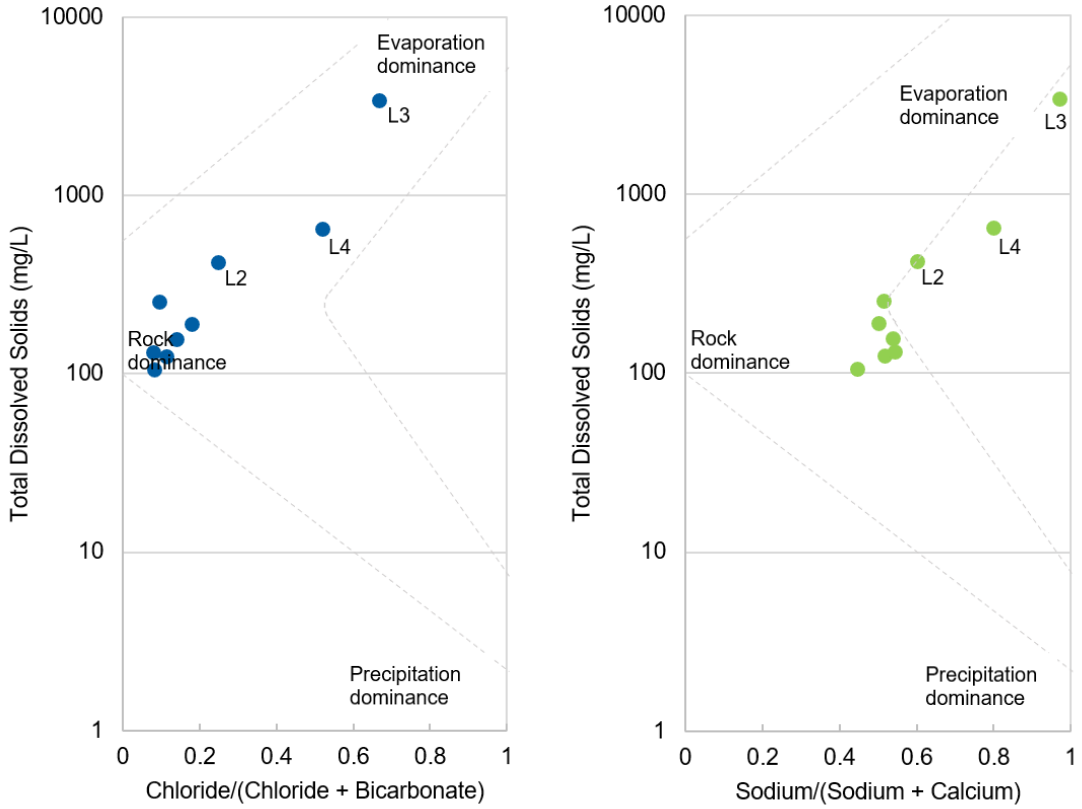


Figure 9 Gibbs (1970) diagrams and ionic balance of surface water samples, post-wet (June-July) 2025

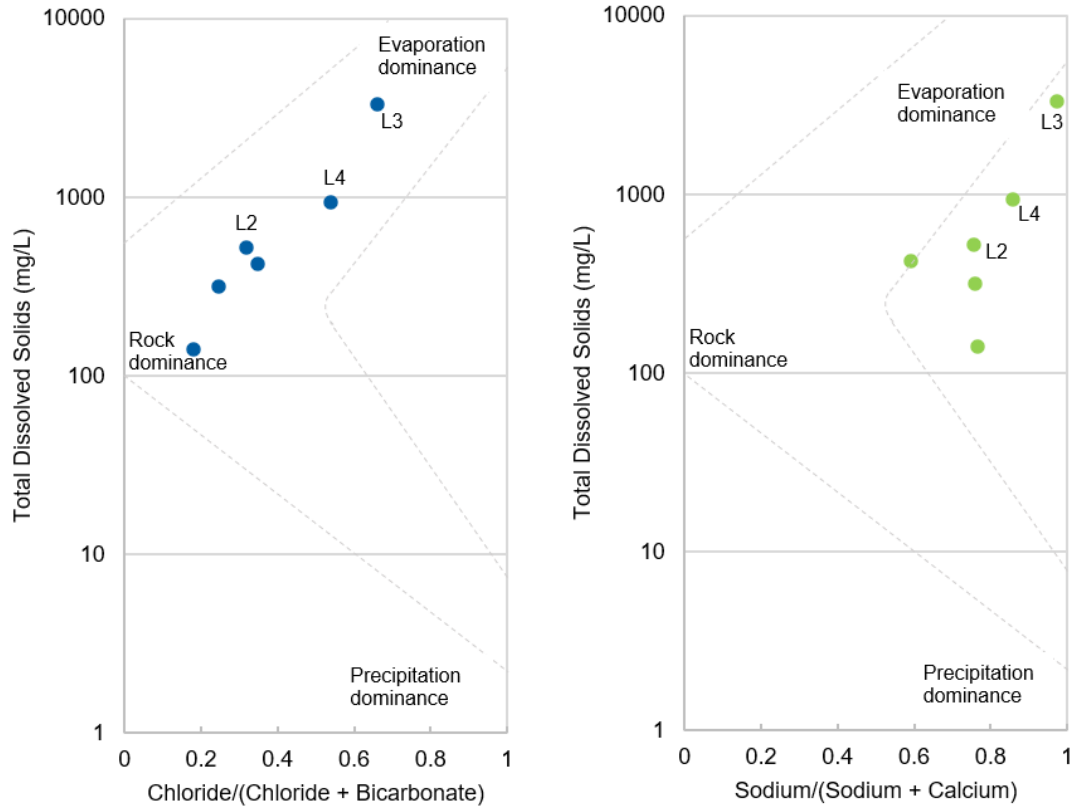


Figure 10 Gibbs (1970) diagrams and ionic balance of surface water samples, pre-wet (October) 2025

4.2.3 Instream habitat

Post-wet (June-July) 2025

Instream (aquatic) habitat assessment scores were Fair at each riverine survey site in the post-wet survey (Table 13). Bottom substrate / available cover and embeddedness was rated Poor at most sites, owing to the dominance of fine sediments (silt/clay and sand) and general lack of the larger pebble, cobble and boulder substrates. However, each site exhibited at least some detritus, sticks, branches and/or logs, providing some instream habitat and refugia for aquatic fauna. The velocity/depth category rated Poor to Fair at each riverine site, due to lack of flow. Sites rated Poor for velocity/depth had only shallow (<0.5 m) isolated pools. Those rated Fair had both shallow and deep (>0.5 m) isolated pools.

Table 13 Aquatic habitat assessment scores for riverine survey sites across the Study Area, post-wet (June-July) 2025

Habitat variable	R1	R2	R3	R4	R5	R6	R7	R8	R9
Bottom substrate/available cover	P (2)	P (2)	F (6)	P (3)	P (2)	P (2)	P (2)	P (2)	F (6)
Embeddedness	P (2)	P (2)	P (3)	P (2)	P (2)	P (2)	P (2)	P (2)	P (3)
Velocity/depth category	P (0)	P (0)	F (6)	F (6)	P (2)	F (6)	P (0)	P (0)	P (2)
Channel alteration	G (8)	F (6)	F (5)	G (8)	G (8)	E (12)	F (5)	F (5)	F (5)
Bottom scouring and deposition	G (8)	G (8)	F (5)	F (5)	G (8)	G (8)	F (5)	F (5)	F (4)
Pool/riffle, run/bend ratio	F (5)	F (4)	F (6)	F (4)	F (5)	F (4)	F (6)	F (5)	F (7)
Bank stability	G (6)	G (7)	G (8)	G (7)	G (8)	G (8)	F (4)	F (5)	F (4)
Bank vegetative stability	E (9)	G (8)	G (7)	F (3)	E (9)	G (8)	G (8)	G (7)	G (7)
Streamside cover	E (9)	E (9)	E (9)	E (10)	E (9)	E (9)	E (9)	G (8)	E (10)
Total (out of 135)	**49**	**46**	**55**	**48**	**53**	**59**	**41**	**39**	**48**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**

Pre-wet (October) 2025

Instream (aquatic) habitat assessment scores were Fair at each riverine survey site in the pre-wet survey, including the additional sites R10, R11 and R12 (Table 14). Bottom substrate/available cover and embeddedness was rated Poor at most sites. The velocity/depth category rated Poor at each riverine site, due to either dry conditions or only shallow (<0.5 m deep) isolated pools encountered.

Table 14 Aquatic habitat assessment scores for riverine survey sites across the Study Area, pre-wet (October) 2025

Habitat variable	R1	R2	R3	R4	R5	R6	R7	R8	R9	R1	R1	R1
Bottom substrate/available cover	P (2)	P (2)	P (3)	P (3)	P (2)	P (2)	P (2)	P (2)	P (3)	F	P	P (2)
Embeddedness	P (2)	P (2)	P (3)	P (2)	P (2)	P (2)	P (2)	P (2)	P (3)	P	P	P (2)
Velocity/depth category	P (0)	P (0)	P (3)	P (0)	P (0)	P (2)	P (0)	P (0)	P (2)	P	P	P (0)
Channel alteration	G (8)	F (6)	F (5)	G (8)	G (8)	E (12)	F (5)	F (5)	F (5)	F	F	G (8)
Bottom scouring and deposition	G (8)	G (8)	F (5)	F (5)	G (8)	G (8)	F (5)	F (5)	F (4)	F	F	F (4)
Pool/riffle, run/bend ratio	F (5)	F (4)	F (6)	F (4)	F (5)	F (4)	F (6)	F (5)	F (7)	F	F	F (5)
Bank stability	G (6)	G (7)	G (8)	G (7)	G (8)	G (8)	F (4)	F (5)	F (4)	P	P	G (6)
Bank vegetative stability	G (7)	G (6)	G (7)	F (3)	E (9)	F (5)	G (6)	G (7)	G (7)	G (7)	G (8)	F (5)
Streamside cover	E (9)	E (9)	E (9)	E (10)	E (9)	E (9)	E (9)	G (8)	E (10)	E	E	E (9)
Total (out of 135)	**47**	**44**	**56**	**42**	**51**	**52**	**39**	**39**	**45**	**47**	**39**	**41**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**

4.2.4 Bank stability/erosion

Bank vegetative stability ranged from Fair to Excellent at the riverine survey sites. Most sites rated Good, indicating that at least 50% of the stream banks were covered by vegetation at the time of assessment. Site R4 rated Fair, due to recent bank scouring removing much of the groundcover. This scoring is expected to improve throughout the dry season as groundcover re-establishes.

Bank stability ranged from Fair to Good across the riverine survey sites. Sites rated Good were moderately stable, with only infrequent, small areas of erosion mostly healed over. Sites rated Fair were moderately unstable, with moderate frequency and size of erosional areas, and present a higher erosion potential during extreme/high flows (Table 13 and Table 14).

4.2.5 Adjacent land use

Land use across the Study Area is dominated by cattle grazing of varying intensity. The Study Area has been largely cleared through past agricultural practices and ongoing disturbance. Relatively small and narrow tracts of remnant vegetation remain (or have re-established) along some of the waterways. Riparian zone widths ranged from approximately 2 m (on the periphery of constructed dams) to 25 m (site R4 on Taurus Creek) (Appendix B). Tree canopy species commonly encountered in riparian zones across the Study Area included yellowwood (*Terminalia oblongata*), brigalow (*Acacia harpophylla*), coolabah (*Eucalyptus coolabah*), forest red gum (*E. tereticornis*), silver-leaved ironbark (*E. melanophloia*), poplar box (*E. populnea*), white bauhinia (*Lysiphyllum hookeri*), red bauhinia (*Lysiphyllum carronii*) and sally wattle (*Acacia salicina*). The shrub layer and groundcover were variable across the Study Area (Appendix B).

4.2.6 Aquatic values

Aquatic values for each site are presented in the site profiles in Appendix B. Ratings for aquatic values were determined for each site based on the criteria in Section 3.6.9 and are presented in Table 15. The sites on Taurus Creek and Two Mile Gully were rated as having Moderate aquatic value due to their importance as regional conduits for fish passage (State-mapped High or Major risk waterways for fish passage, Section 4.1.3). Riverine sites with a stream order 1-2 were rated as having Low aquatic value, except where the ACA mapping identified the waterway as being of Medium conservation significance – in which case it was rated as having Moderate aquatic value.

The lacustrine wetlands (hydrologically modified or artificial) were rated as having Low-Moderate or Moderate aquatic value. Although these lacustrine wetlands are modified or artificial (dammed), the semi-permanence of water offers dry season refuge for Least Concern fish and turtle species.

Table 15 Aquatic values ratings for the Study Area

Site	Waterway	Stream order	Key aquatic values/criteria	Aquatic values rating
R1	Sagittarius Creek	3	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Low risk). ▪ Mapped Medium conservation significance in ACA.	Moderate
R2	Sagittarius Creek	2	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ Mapped Medium conservation significance in ACA.	Moderate

Site	Waterway	Stream order	Key aquatic values/criteria	Aquatic values rating
R3	Taurus Creek	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (mapped Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R4	Taurus Creek	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (mapped Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R5	Unnamed tributary of Taurus Creek	2	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ Mapped Very Low conservation significance in ACA.	Low
R6	Taurus Creek flood channel wetland	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Flood channel wetland on the floodplain of a regional conduit for fish passage (mapped High risk). ▪ Flood channel wetland on floodplain of waterways mapped Very Low conservation significance in ACA.	Moderate
R7	Taurus Creek	3	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (State-mapped High risk, verified Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R8	Two Mile Gully	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (mapped Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R9	Taurus Creek	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (mapped Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R10	Deep Creek	2	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ Mapped Very Low conservation significance in ACA.	Low

Site	Waterway	Stream order	Key aquatic values/criteria	Aquatic values rating
R11	Taurus Creek	4	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (State-mapped High risk, verified Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
R12	Taurus Creek	5	▪ Ephemeral waterway. ▪ Fair habitat bioassessment score. ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Regional conduit for fish passage (mapped Major risk). ▪ Mapped Very Low conservation significance in ACA.	Moderate
L1	Lacustrine wetland waterbody (farm dam)	1	▪ Semi-permanent waterbody. ▪ Modified wetland (constructed dam). ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ Provides dry season refuge for Least Concern aquatic fauna. ▪ On waterway of Medium conservation significance in ACA.	Moderate
L2	Lacustrine wetland waterbody (farm dam)	1	▪ Semi-permanent waterbody. ▪ Modified wetland (constructed dam). ▪ No conservation-significant or SLC aquatic species detected, nor likely. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ Provides dry season refuge for Least Concern aquatic fauna. ▪ Mapped Very Low conservation significance in ACA.	Low-Moderate
L3	Lacustrine wetland waterbody (Taurus Dam – mine water dam)	3	▪ Semi-permanent waterbody. ▪ Modified wetland (constructed dam). ▪ conservation-significant or SLC aquatic species unlikely to occur. ▪ Regional conduit for fish passage (mapped High risk). ▪ May offer dry season refuge for Least Concern aquatic fauna. ▪ Mapped Very Low conservation significance in ACA.	Moderate
L4	Lacustrine wetland waterbody (Deep Creek Dam – mine water dam)	2	▪ Semi-permanent waterbody. ▪ Modified wetland (constructed dam). ▪ conservation-significant or SLC aquatic species unlikely to occur. ▪ Local conduit for fish passage (mapped Moderate risk). ▪ May offer dry season refuge for Least Concern aquatic fauna. ▪ Mapped Very Low conservation significance in ACA.	Low-Moderate

4.3 Wetlands

4.3.1 Wetlands of International importance

There are no wetlands of International Importance (i.e. Ramsar wetlands) identified within the Study Area or broader desktop search area in the EPBC Act Protected Matters Report (DCCEEW 2025a). Wetlands of International Importance nearest to the Study Area include those of the Shoalwater and Corio Bays Area, approximately 200 km to the north-east (DCCEEW 2025b).

4.3.2 Wetlands of National importance

No nationally important wetlands occur in the Mackenzie River Sub-basin (DCCEEW 2025b).

4.3.3 Queensland referrable wetlands

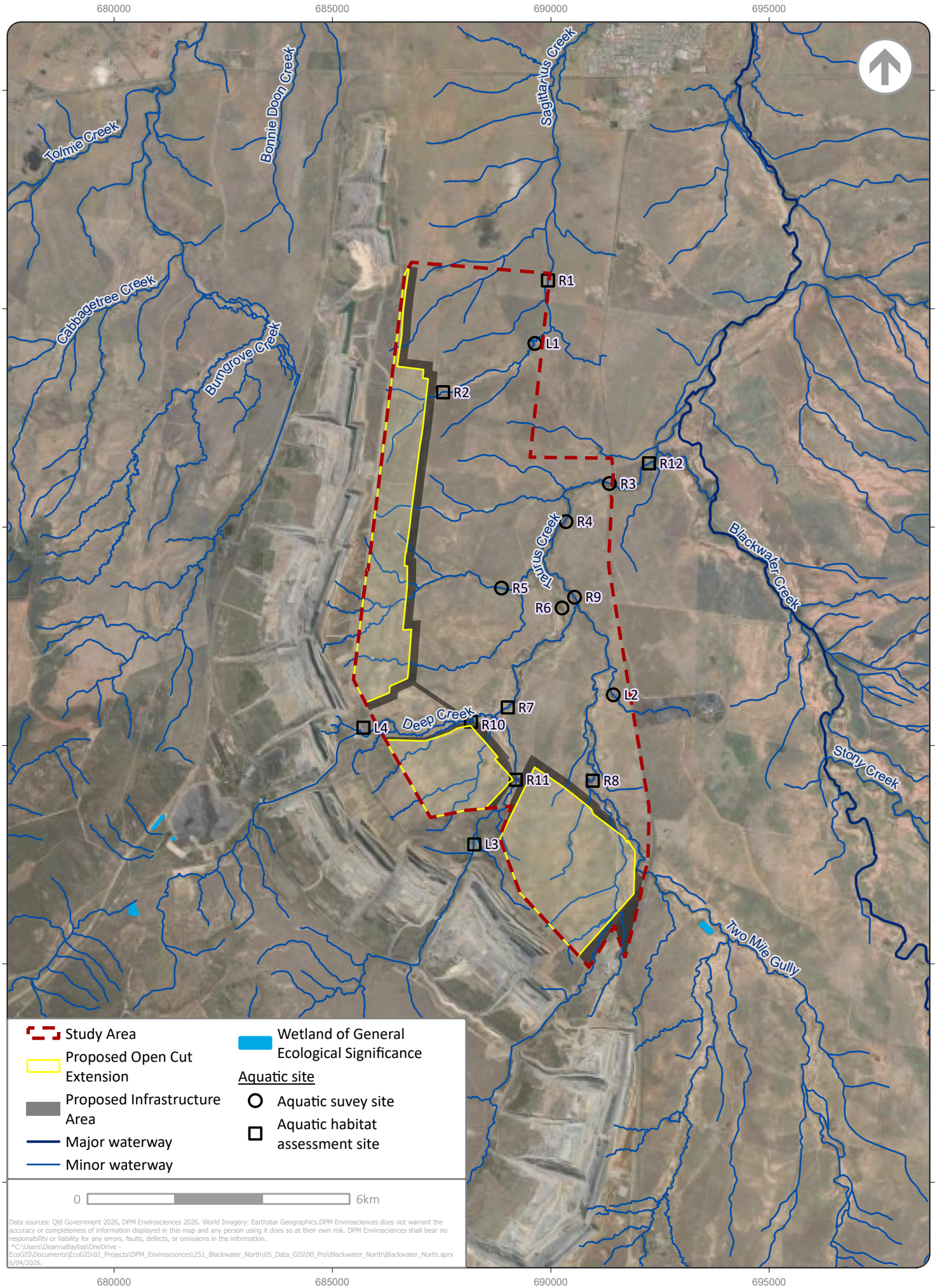
The Map of Great Barrier Reef Wetland Protection Areas (WPAs) (DETSI 2025f) shows the location of WPAs, comprising wetlands of High Ecological Significance (HES wetlands) and their 500 m policy trigger area buffers. These wetlands have been assessed as containing high ecological values by a bioregional ACA, the AquaBAMM (Rollason and Howell 2012). No HES wetlands are mapped as occurring in the Study Area or immediate surrounds.

4.3.4 Queensland Wetland Environmental Values

The Map of Queensland Wetland Environmental Values (MQWEV; DETSI 2025g) identifies the location and ecological significance of wetlands using the EVs for wetlands in section 7 of the *Environmental Protection (Wetland and Water Biodiversity) Policy 2019* (EPP 2019). Wetlands appearing on the MQWEV are considered either HES or General Ecological Significance (GES) for the purposes of allocating EVs. The MQWEV also shows HEV waters management intent under Schedule 2 of the EPP 2019.

No State-mapped HES or GES wetlands are mapped as occurring in the Study Area. One GES wetland is mapped nearby, upstream of the Study Area on Two Mile Gully (Figure 11).

No HEV waters are identified in the MQWEV for the Study Area or immediate surrounds.



QUEENSLAND WETLAND ENVIRONMENTAL VALUES

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 11

4.4 Aquatic flora

A total of 22 species of aquatic or semi-aquatic plants were recorded from the Study Area during the post-wet (June-July) 2025 survey (Table 16). One additional species (*Myriophyllum verrocosum*) was recorded during the pre-wet (October) 2025 survey (Table 17). All native aquatic flora species detected are considered Least Concern under the NC Act. Introduced species are discussed in Section 4.7.1.

Most aquatic flora species encountered are semi-aquatic species including grasses, sedges and rushes. The greatest diversity of aquatic flora was recorded from lacustrine wetland site L2, with 12 species detected in the post-wet 2025 survey.

The lack of both diversity and abundance of aquatic plants at most riverine sites reflects the harsh physical conditions, impacts from cattle grazing and trampling, or a combination of these factors.

Table 16 Aquatic flora recorded from the Study Area, post-wet (June-July) 2025

Scientific name	Common name	Riverine sites									Lacustrine			
		R1	R2	R3	R4	R5	R6	R7	R8	R9	L1	L2	L3	L4
Azolla pinnata	Ferny azolla											L		
Cyperus betchei	-			L		L	L							
Cyperus bifax	Western nutgrass			L	L				L	L				
Cyperus difformis	Rice sedge					L						L		
Cyperus exaltatus	Tall flatsedge										L			
Cyperus pygmaeus	Dwarf sedge						L				L			
*Echinochloa colona**	Awnless barnyard grass*			L		L						L	L	L
*Eclipta prostrata**	White eclipta*			L	L		L				L	L		
Juncus usitatus	Common rush											L		
Lemna aequinoctialis	Common duckweed											L		
Leptochloa digitata	Umbrella canegrass			L									L	L
Ludwigia octovalvis	Willow primrose					L	L							
Ludwigia peploides	Water primrose			L								S		
Najas tenuifolia	Waternymph											L		
Nitella sp.	Branched algae													L
Nymphoides indica	Water snowflake											S		
Persicaria attenuata	-			L			L				M		L	L
Persicaria lapathifolia	Pale knotweed												L	L
Polygonum minuta	Small knotweed													L
Potamogeton crispus	Curly pondweed											L		
Schoenoplectus validus	River clubrush											L	L	
Typha domingensis	Narrow-leaved cumbungi					L					E	S	L	
Species richness		**0**	**0**	**7**	**2**	**5**	**5**	**0**	**1**	**1**	**5**	**12**	**6**	**6**

Notes: * denotes introduced species; L = 1-10% (little); S = 10-50% (some); M = 50-75% (moderate); E = >75% (extensive), as per AusRivAS categories (DNRM 2001).

Table 17 Aquatic flora recorded from the Study Area, pre-wet (October) 2025

Scientific name	Common name	Riverine sites												Lacustrine			
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	L1	L2	L3	L4
Azolla pinnata	Ferny azolla														L		
Cyperus betchei	-			L		L	L										
Cyperus bifax	Western nutgrass			S	L				L	L	L		L				
Cyperus difformis	Rice sedge					L											
Cyperus exaltatus	Tall flatsedge													L	L		
Cyperus pygmaeus	Dwarf sedge						L							L			
*Echinochloa colona**	Awnless barnyard grass*			L		L										L	L
*Eclipta prostrata**	White eclipta*			L	L		L							L	L		
Juncus usitatus	Common rush														L		
Lemna aequinoctialis	Common duckweed														L		
Leptochloa digitata	Umbrella canegrass			L									L			L	L
Ludwigia octovalvis	Willow primrose					L	L										
Ludwigia peploides	Water primrose			L											L		
Myriophyllum verrucosum	Red water-milfoil																L
Najas tenuifolia	Waternymph														L		
Nitella sp.	Branched algae																
Nymphoides indica	Water snowflake														L		
Persicaria attenuata	-			L			L							M		L	L
Persicaria lapathifolia	Pale knotweed															L	L
Polygonum minuta	Small knotweed																L
Potamogeton crispus	Curly pondweed													L	M		
Schoenoplectus validus	River clubrush														L	L	
Typha domingensis	Narrow-leaved cumbungi					L								E	S	L	
Species richness		**0**	**0**	**7**	**2**	**5**	**5**	**0**	**1**	**1**	**1**	**0**	**2**	**6**	**11**	**6**	**6**

Notes: * denotes introduced species; L = 1-10% (little); S = 10-50% (some); M = 50-75% (moderate); E = >75% (extensive), as per AusRivAS categories (DNRM 2001).

4.5 Aquatic fauna

4.5.1 Fish

Nine Least Concern native species and one pest fish species were recorded from the Study Area in each of the post-wet (June-July) and pre-wet (October) 2025 surveys (Table 18 and Table 19). These species are commonly recorded from both high and low order drainage lines throughout the Mackenzie River Sub-basin.

Most fishes captured appeared healthy, with little sign of stress or disease. Some of the bony bream (*Nematalosa erebi*) and spangled perch (*Leiopotherapon unicolor*) collected from site R3 on Taurus Creek in June-July 2025 showed signs of likely epizootic ulcerative syndrome (Plate 4), being an endemic fungal disease that often appears in host species (including bony bream, catfish, rainbowfish and other freshwater and estuarine species) after acid water runoff following heavy rains (Queensland Government 2022).

All native fishes were released at the point of capture. Pest fish were humanely euthanised in accordance with DPM Enviroscences' Animal Ethics Committee approval and General Fisheries Permit.

The species composition is typical of ephemeral waterways and farm dams of Central Queensland.

Table 18 Fishes recorded from the Study Area, post-wet (June-July) 2025

Scientific name	Common name	Riverine sites					Dam site	
		R3	R4	R5	R6	R9	L1	L2
Ambassis agassizii	Agassiz's glassfish	54	27	12	5		55	17
Anguilla reinhardtii	Longfin eel						1	2
*Gambusia holbrooki**	Mosquitofish*						120	
Hypseleotris bucephala	Boofhead carp gudgeon	12	39		8	1	16	45
Leiopotherapon unicolor	Spangled perch	18	21	9	11		6	4
Melanotaenia splendida splendida	Eastern rainbowfish	55	5			1		48
Mogurnda adspersa	Purple-spotted gudgeon	6	8				6	2
Nematalosa erebi	Bony bream	5						
Neosilurus hyrtlii	Hyrtl's catfish	2						
Porochilus rendahli	Rendahl's tandan						6	
Number of individuals		**152**	**100**	**21**	**24**	**2**	**210**	**118**
Species richness		**7**	**5**	**2**	**3**	**2**	**7**	**6**

Notes: * denotes introduced species.

Table 19 Fishes recorded from the Study Area, pre-wet (October) 2025

Scientific name	Common name	Riverine sites		Dam site	
		R3	R6	L1	L2
Ambassis agassizii	Agassiz's glassfish	1	4	42	55
Anguilla reinhardtii	Longfin eel				1
*Gambusia holbrooki**	Mosquitofish*			103	
Hypseleotris bucephala	Boofhead carp gudgeon	41	19	24	38
Leiopotherapon unicolor	Spangled perch	17	38	8	14
Melanotaenia splendida splendida	Eastern rainbowfish	41		12	22
Mogurnda adspersa	Purple-spotted gudgeon	8		12	7
Nematalosa erebi	Bony bream	1	5		
Neosilurus hyrtlii	Hyrtl's catfish		2		
Porochilus rendahli	Rendahl's tandan			1	1
Number of individuals		**109**	**68**	**202**	**138**
Species richness		**6**	**5**	**7**	**7**

Notes: * denotes introduced species.



Agassiz's glassfish (*Ambassis agassizii*)



Longfin eel (*Anguilla reinhardtii*)



Mosquitofish (*Gambusia holbrooki*)*



Boofhead carp gudgeon (*Hypseleotris bucephala*)



Spangled perch (*Leiopotherapon unicolor*)



Eastern rainbowfish (*Melanotaenia splendida splendida*)



Purple-spotted gudgeon (*Mogurnda adspersa*)



Bony bream (*Nematalosa erebi*), with ulcerative lesions



Hyrtl's catfish (*Neosilurus hyrtlii*)



Rendahl's tandan (*Porochilus rendahli*)

Plate 4 Fish captured from the Study Area

4.5.2 Turtles

The Least Concern Krefft's river turtle (*Emydura macquarii krefftii*) was recorded at site L2 in June-July (seven adult males and three adult females) and in October 2025 (one adult male, one adult female and three juveniles), and at site L1 (two adult males) in October 2025. The Least Concern eastern snake-necked turtle (*Chelodina longicollis*) was recorded at site L2 (one juvenile) in October 2025. In an earlier study in December 2019 (EMM 2023) an adult eastern snake--necked turtle was also recorded at site L1. No conservation-significant turtles or their habitat were detected within the Study Area (Section 4.6.3).

4.5.3 Platypus

The platypus is listed as Special Least Concern under the NC Act. The Wetland*Info* database (DETS1 2025b) identifies the platypus as having previously been recorded from the Mackenzie River Sub-basin. The nearest record of platypus is from the Dawson Range Stage Forest, approximately 35 km east-southeast of the Study Area (ALA 2025).

The seasonal nature of waterways of the Study Area is not conducive to sustaining a population of platypus. Similarly, the lacustrine wetlands (i.e. farm and mine water dams) within the Study Area are unlikely to sustain a population of platypus as, despite relative permanence of wetted habitat, these wetlands lack the banks and habitat features required for platypus burrow construction.

No platypus burrows were encountered during the surveys, despite targeted searches at each site. It is considered unlikely that platypus occupies the waterways and bodies of the Study Area.

4.5.4 Aquatic invertebrates

Aquatic macroinvertebrates and stream health

A total of 50 taxa from 1,941 aquatic macroinvertebrates were collected from waterways and wetlands of the Study Area in June 2025. A total of 44 taxa from 986 aquatic macroinvertebrates were collected in October 2025. The raw data is presented in Appendix E. Sampling effort for the riverine sites was limited by the availability of wetted habitat. The post-wet (June) 2025 aquatic macroinvertebrate sampling consisted of five riverine bed habitat samples, five riverine edge habitat samples and two lacustrine wetland samples. Drier conditions were encountered in the pre-wet (October) 2025 sampling, with two riverine bed habitat samples, two riverine edge habitat samples and two lacustrine wetland samples obtained.

Taxonomic composition

The most taxa-rich order of aquatic macroinvertebrates collected from the Study Area in June 2025 was Diptera (true flies), with nine families identified. Hemiptera (true bugs) and Coleoptera (beetles) were also well represented, each with eight families identified. Hemiptera was the most taxa-rich order collected in October 2025, with 12 families identified. Other taxa included Ephemeroptera (mayflies), Trichoptera (caddis flies), Zygoptera (damselflies), Epiprocta (dragonflies), Acarina (mites), Decapoda (yabbies, river prawns and glass shrimp), Gastropoda (snails), Lepidoptera (aquatic caterpillars), Hirudinea (leeches), Nematoda (round worms), Platyhelminths (flat worms), Annelida (segmented worms), Cladocera (water fleas), Copepoda (copepods) and Ostracoda (seed shrimp).

Aquatic macroinvertebrate taxa richness ranged from 13 to 22 in samples collected from riverine bed habitats, from 11 to 31 in samples collected from riverine edge habitats, and from 20 to 34 in composite samples from lacustrine wetlands (farm dams) (Figure 12 and Figure 13). Data is presented alongside the DEHP (2011) WQOs for the Mackenzie River Sub-basin. The WQOs apply to riverine systems only. No taxa richness guidelines are available for lacustrine wetlands.

Taxa richness was variable; largely influenced by the extent of wetted habitat available in the drying pools sampled, and the extent of livestock access (Appendix B). The taxa richness of the five riverine bed habitat samples collected in June 2025 and the two bed habitat samples collected in October 2025 fell within or favourably above the DEHP (2011) 20:80 percentile range. The taxa richness of the riverine edge habitat sample collected from site R3 in June 2025 and the two edge habitat samples collected in October 2025 fell within the DEHP (2011) 20:80 percentile guideline range. Taxa richness was below this range in the edge habitat samples collected from sites R4, R5, R6 and R9 in June 2025 (Figure 12 and Figure 13). Taxa richness was greater in the edge habitats than in the bed habitats of most riverine sites, owing to the greater habitat complexity and food sources available.

Plecoptera, Ephemeroptera and Trichoptera taxa

Two PET taxa were recorded from the Study Area, including one Ephemeroptera (mayfly) family (Baetidae) and one Trichoptera (caddis fly) family (Leptoceridae). No Plecoptera (stonefly) families were recorded, nor were they expected due to lack of rocky substrates and riffle habitat.

PET taxa richness ranged from 0-2 taxa in the riverine bed samples, from 0-2 taxa in the riverine edge samples, and with 2 PET taxa in each of the lacustrine wetland samples (Figure 14 and Figure 15). Data is presented alongside the DEHP (2011) WQOs for the Mackenzie River Sub-basin. The WQOs apply to riverine systems only. As such, no guidelines are presented for the lacustrine wetland sites.

PET taxa in the bed and edge habitat samples collected from site R3 in June 2025 met the DEHP (2011) 20:80 percentile guideline range, indicating an expected number of pollutant sensitive taxa. PET richness was below the guideline range in all other riverine bed and edge habitat samples collected. However, this lower PET taxa richness most likely reflects seasonality and the ephemeral flow nature of these waterways, rather than pollution or other anthropogenic impacts.

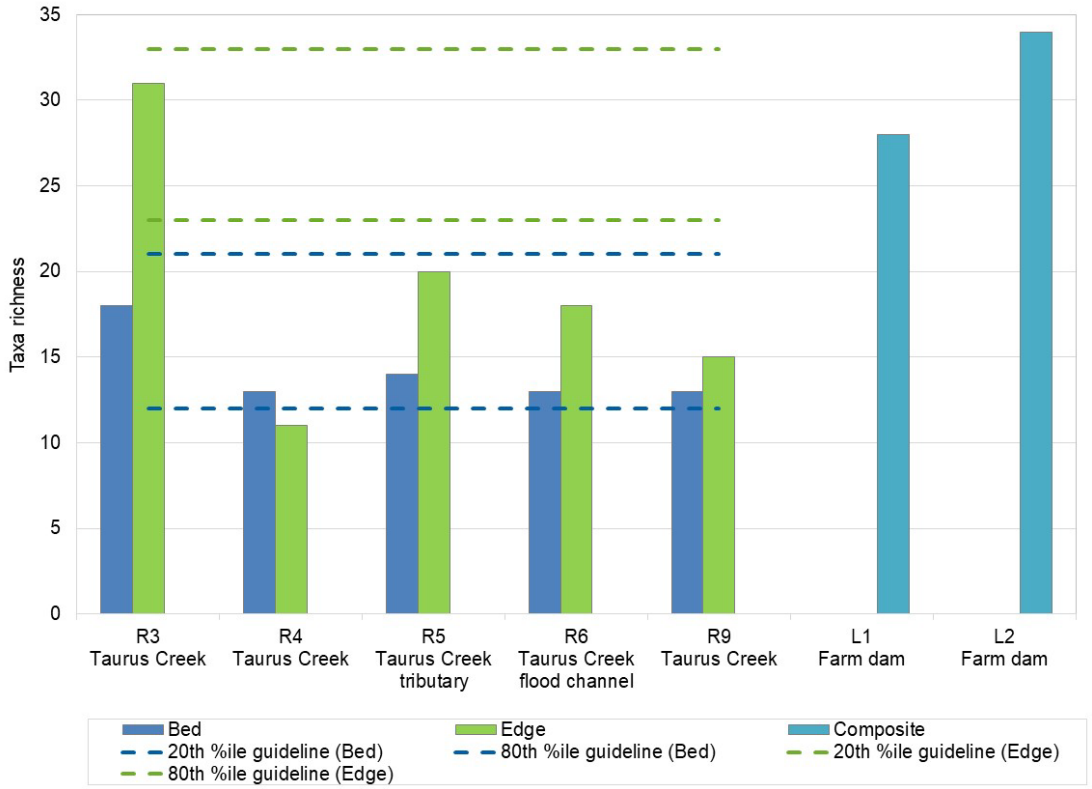


Figure 12 Taxa richness of aquatic macroinvertebrate samples collected from the Study Area, post-wet (June) 2025

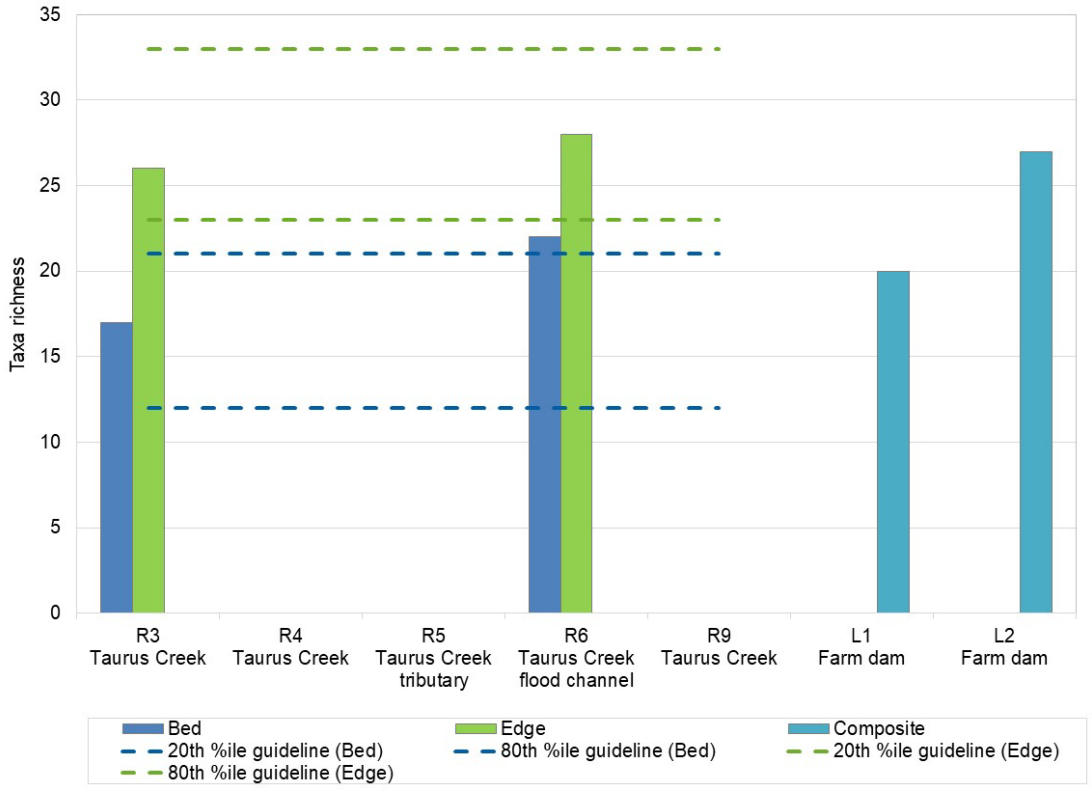


Figure 13 Taxa richness of aquatic macroinvertebrate samples collected from the Study Area, pre-wet (October) 2025

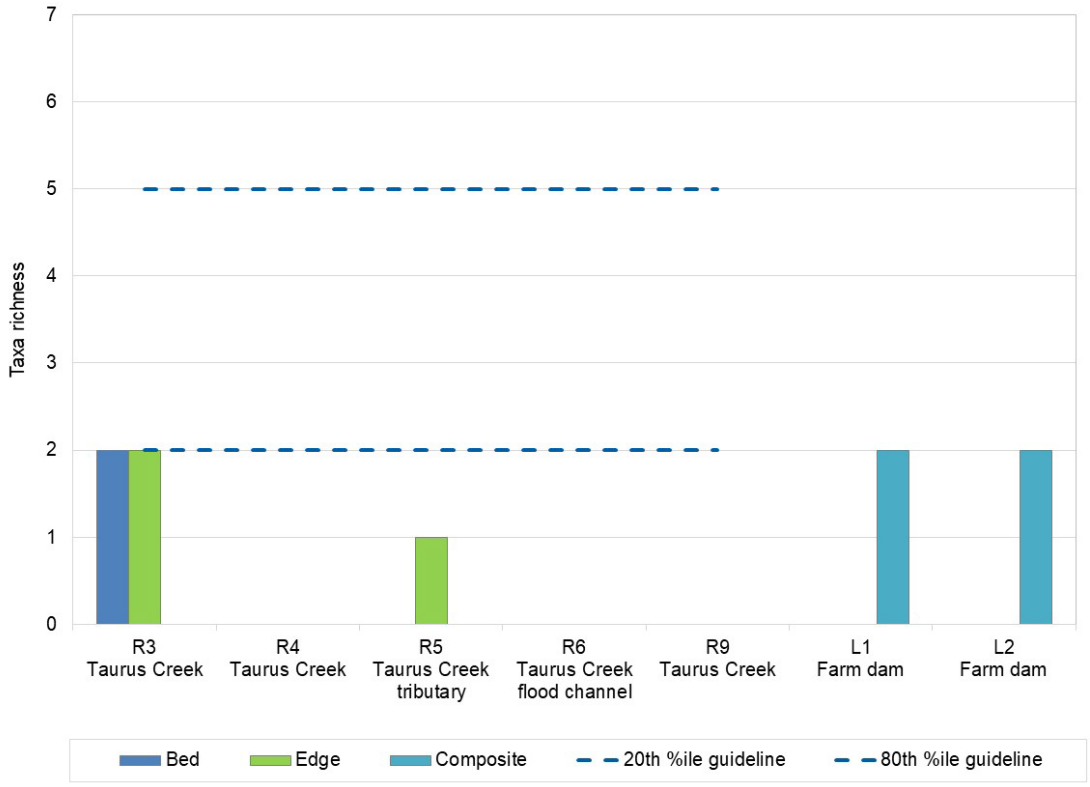


Figure 14 PET taxa richness for aquatic macroinvertebrate samples collected from the Study Area, post-wet (June) 2025

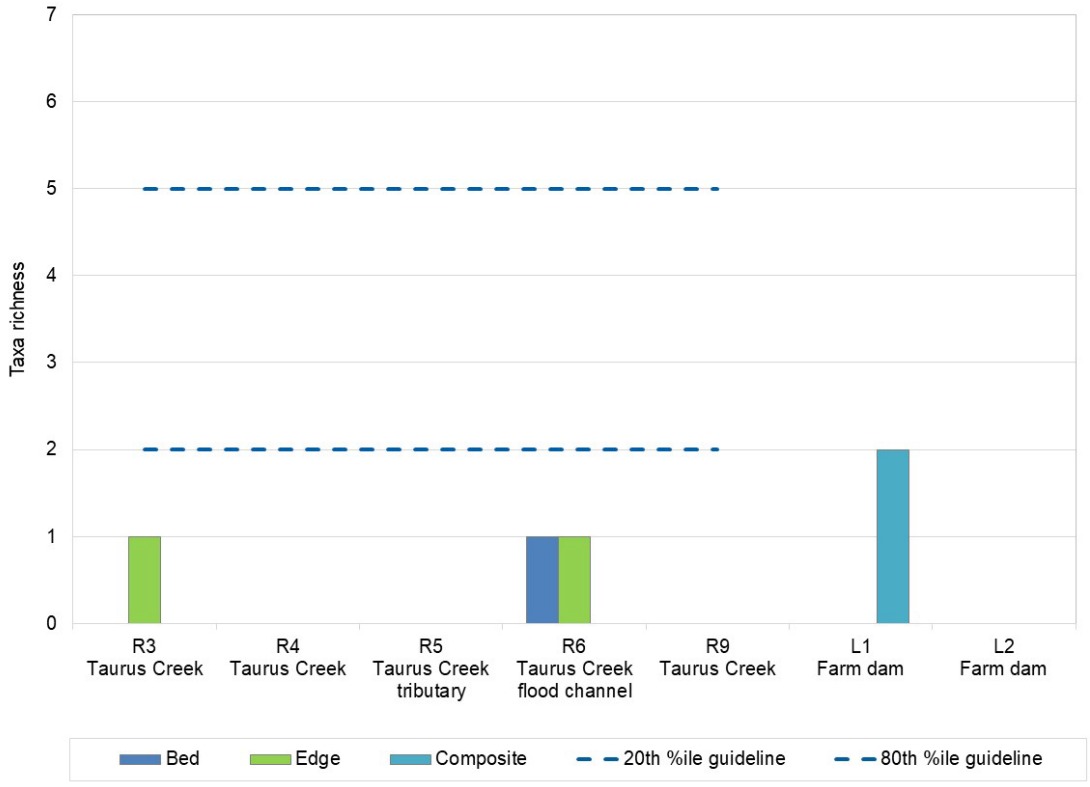


Figure 15 PET taxa richness for aquatic macroinvertebrate samples collected from the Study Area, pre-wet (October) 2025

Pollution-tolerant taxa

The percentage of pollution-tolerant taxa (SIGNAL2 score of 1-3) ranged from 40 to 82% in the riverine bed samples, from 40 to 65% in the riverine edge samples, and from 47 to 63% in the lacustrine wetland samples (Figure 16 and Figure 17). Data is presented alongside the DEHP (2011) WQOs for the Mackenzie River Sub-basin. The WQOs apply to riverine systems only. As such, no guidelines are presented for the lacustrine wetland sites.

The percentage of pollution-tolerant taxa exceeded the DEHP (2011) 20:80 percentile guideline range in most riverine samples (Figure 16 and Figure 17), indicating unfavourable physical conditions and/or reduced habitat quality, and likely reflecting the ephemeral flow regime.

Stream Invertebrate Grade Number – Average Level Version 2 scores

Average SIGNAL2 scores ranged from 2.36 to 3.70 for samples collected from riverine bed habitat, from 3.00 to 3.60 for samples collected from riverine edge habitat, and from 3.06 to 3.47 for samples collected from lacustrine wetland sites (Figure 18 and Figure 19). SIGNAL2 results are presented alongside the DEHP (2011) WQOs for the Mackenzie River Sub-basin. The WQOs apply to riverine systems only. As such, no guidelines are presented for the lacustrine wetland sites.

The SIGNAL2 scores for most bed and edge samples fell below the DEHP (2011) 20:80 percentile guideline range, reflecting a lower composition of pollution sensitive taxa (and a higher composition of pollutant tolerant taxa) than what is expected for the broader Mackenzie River Sub-basin. This likely indicates unfavourable physical conditions and/or reduced habitat quality associated with high ephemerality.

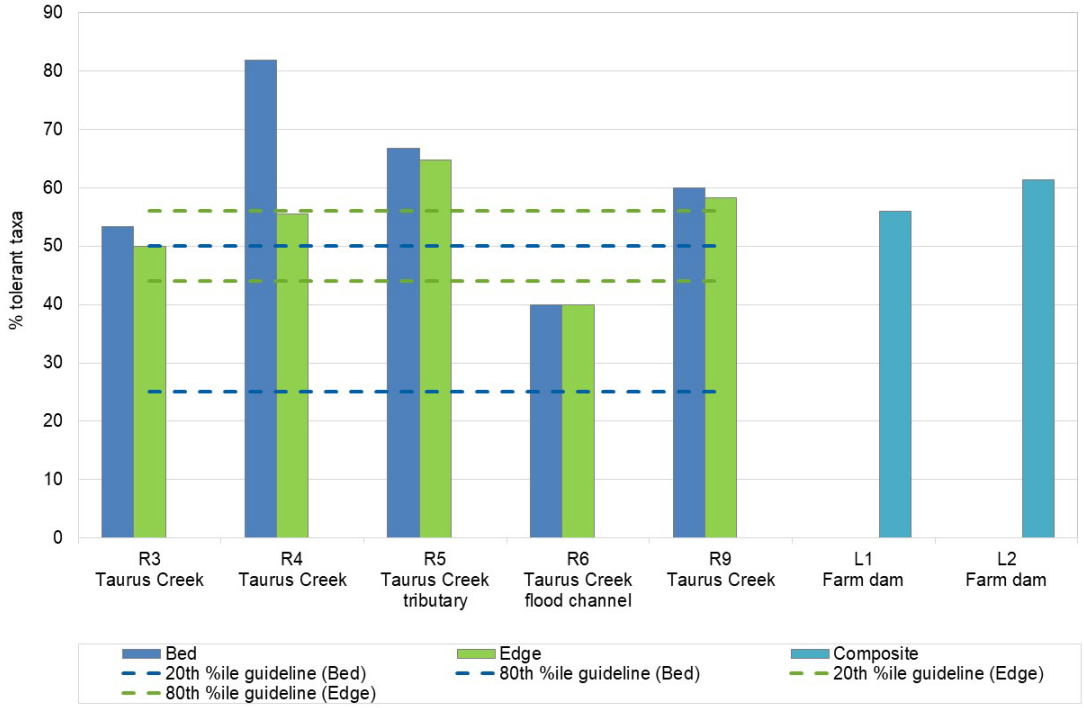


Figure 16 Percentage of pollution-tolerant taxa in aquatic macroinvertebrate samples collected from the Study Area, post-wet (June) 2025

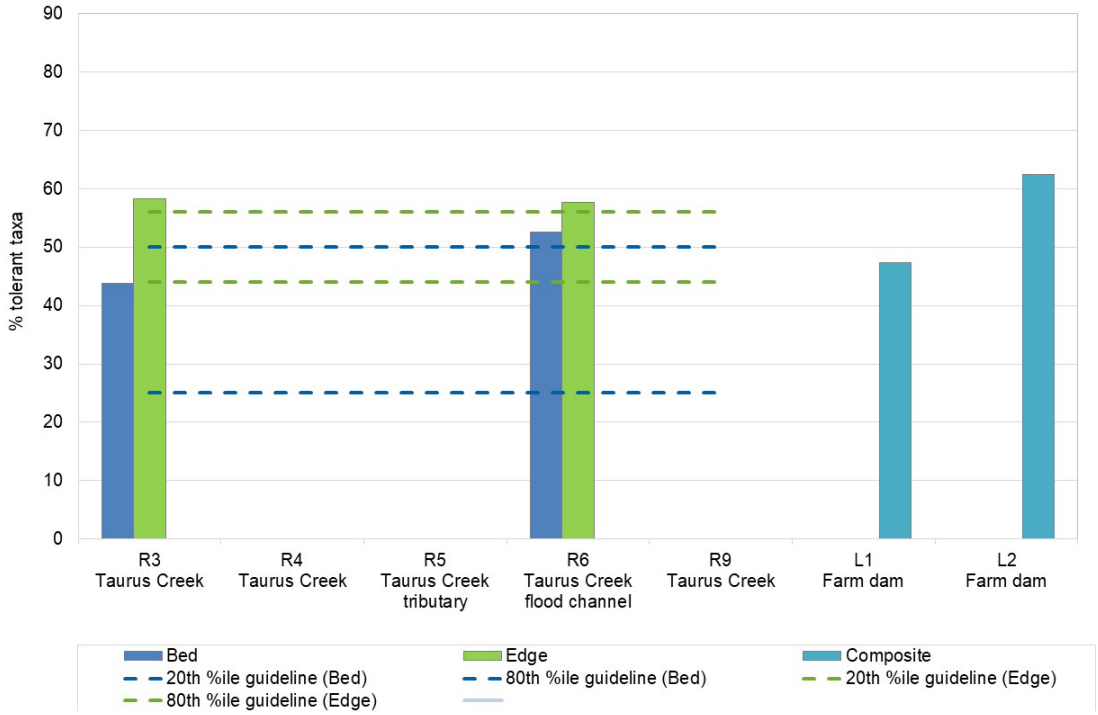


Figure 17 Percentage of pollution-tolerant taxa in aquatic macroinvertebrate samples collected from the Study Area, pre-wet (October) 2025

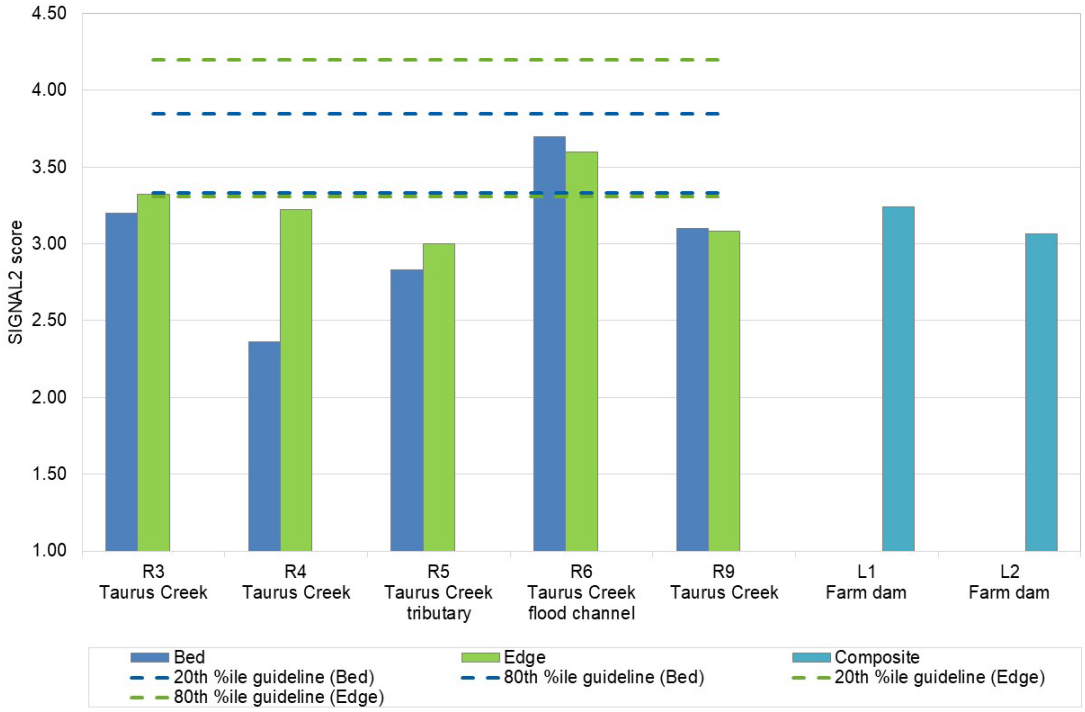


Figure 18 SIGNAL2 scores for aquatic macroinvertebrate samples collected from the Study Area, post-wet (June) 2025

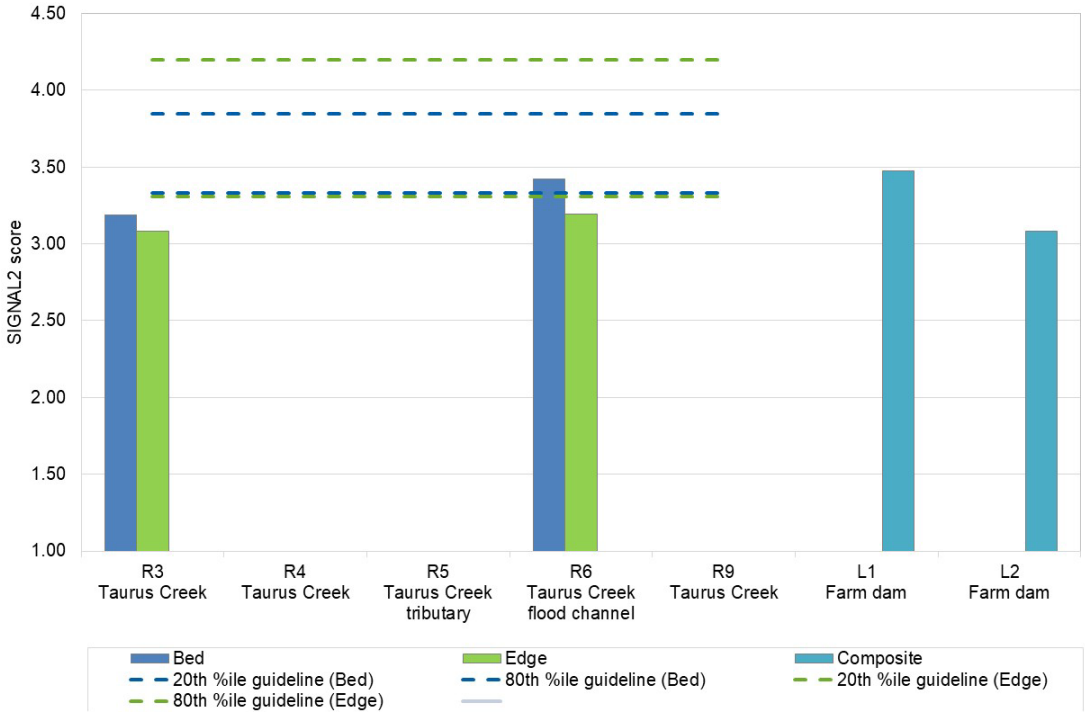


Figure 19 SIGNAL2 scores for aquatic macroinvertebrate samples collected from the Study Area, pre-wet (October) 2025

Australian River Assessment System OE50

Aquatic macroinvertebrate data from the post-wet (June) and pre-wet (October) 2025 sampling rounds was modelled using the AusRivAS Queensland regional coastal models for the seasons and habitats sampled. All riverine sites were within the experience of the models.

AusRivAS observed to expected (OE50) taxa scores indicate that the bed habitat samples were in reference condition (Band A; natural or near natural) at Taurus Creek site R3 in both June (Figure 20) and October 2025 (Figure 21), and at Taurus Creek flood channel site R6 in October 2025. Bed habitat samples were significantly impaired (Band B) in samples collected from Taurus Creek tributary site R5 and site R6 in June 2025. The bed habitat sample was severely impaired (Band C) at Taurus Creek sites R4 and R9 in June 2025, reflecting limited habitat in the senescing pools sampled. Sites R4 and R9 had dried completely by October 2025.

The AusRivAS OE50 taxa scores indicate that the edge habitat samples were in reference condition (Band A; natural or near natural) at Taurus Creek site R3 in June and October 2025, at Taurus Creek tributary site R5 in June 2025 (Figure 20), and at Taurus Creek flood channel site R6 in October 2025 (Figure 21). Edge habitat samples were significantly impaired (Band B) at sites R6 and Taurus Creek site R9 in June 2025. The edge habitat sample was severely impaired (Band C) at Taurus Creek site R4 in June 2025, reflecting limited edge habitat in the senescing pools sampled.

The prevalence of wetted habitat is a key driver in macroinvertebrate community structure and ecosystem functioning, and caution is applied to the use of AusRivAS ratings in ephemeral systems. The lower (Band B and C) OE50 taxa scores for most sites/samples are more likely a reflection of natural seasonality than catchment impacts.

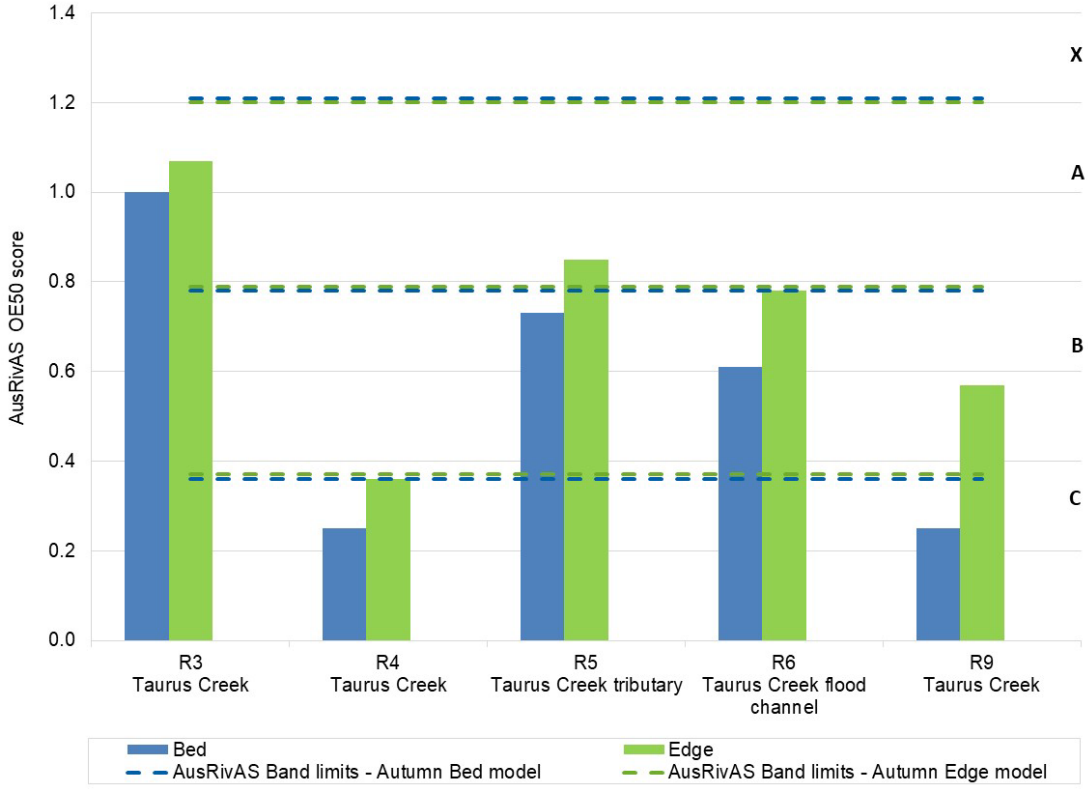


Figure 20 OE50 scores for riverine macroinvertebrate samples collected from the Study Area, post-wet (June) 2025

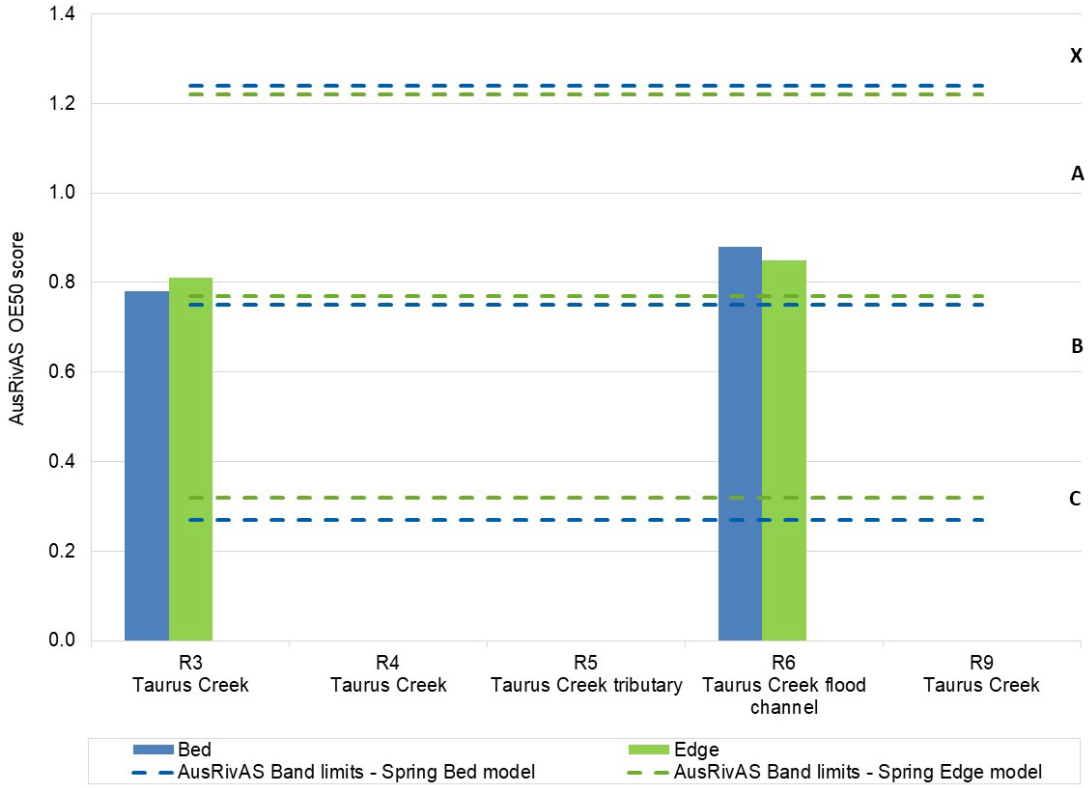


Figure 21 OE50 scores for riverine macroinvertebrate samples collected from the Study Area, pre-wet (October) 2025

4.6 Conservation-significant species

4.6.1 Aquatic flora

No conservation-significant aquatic flora species were recorded during the surveys. The Wetland*Info* database identifies 306 wetland indicator flora species/subspecies previously recorded from the broader Fitzroy Basin (DETSI 2025b). Of these, five are listed as conservation-significant (Table 20):

- salt pipewort/button grass (*Eriocaulon carsonii*) – Endangered (NC Act);
- salt pipewort/button grass (*Eriocaulon carsonii* subsp. *orientale*) – Endangered (EPBC Act and NC Act);
- *Maundia triglochinoides* – Vulnerable (NC Act);
- lesser swamp orchid (*Phaius australis*) – Endangered (EPBC Act and NC Act); and
- swamp fern (*Thelypteris confluens*) – Vulnerable (NC Act).

None of these species were recorded during the survey and are unlikely to occur within the Study Area (Table 20).

4.6.2 Fish

No conservation-significant fish species were recorded during the surveys. The Wetland*Info* database identifies 53 native fish species previously recorded from the Fitzroy Basin (DETSI 2025b). Of these, two are conservation-significant:

- silver perch (*Bidyanus bidyanus*) – Endangered (EPBC Act and NC Act); and
- Murray cod (*Maccullochella peelii*) – Vulnerable (EPBC Act).

It is unlikely that these conservation-significant species occur within waterways or wetlands of the Study Area as either resident or transient occurrences, as suitable habitat is not present, and the Study Area is outside the natural range of these species (Table 21).

4.6.3 Turtles

No conservation-significant turtle species were recorded during the surveys. The Wetland*Info* database identifies seven freshwater turtle species previously recorded from the Fitzroy Basin (DETSI 2025b). Of these, two are conservation-significant:

- white-throated snapping turtle (*Elseya albagula*) – Critically Endangered (EPBC Act and NC Act); and
- Fitzroy River turtle (*Rheodytes leukops*) – Vulnerable (EPBC Act and NC Act).

The white-throated snapping turtle and Fitzroy River turtle are also identified in the EPBC Act Protected Matters Report as ‘may’ occur and ‘likely’ to occur within the Search Area, respectively (DCCEEW 2025a, Appendix A).

It is unlikely that conservation-significant turtle species occur within the Study Area as either resident or transient occurrences, as suitable habitat was not detected during the field survey (Table 22).

4.6.4 Platypus

The Special Least Concern (NC Act) platypus (*Ornithorhynchus anatinus*) was not recorded during field surveys.

The ephemeral nature of the waterways of the Study Area are not conducive to sustaining a population of platypus. Similarly, the lacustrine waterbodies (i.e. farm and mine water dams) of the Study Area are unlikely to sustain a population of platypus as, despite relative permanence of wetted habitat, these waterbodies lack the bank structure required for platypus burrow construction.

4.6.5 Aquatic invertebrates

No conservation-significant aquatic invertebrates are identified in the EPBC Act Protected Matters Report (DCCEEW 2025a, Appendix A), nor in the Wetland*Info* database for the Fitzroy Basin (DETSI 2025b).

Table 20 Conservation-significant aquatic flora species recorded from the desktop Search Area

Scientific name	Common name	Status[1]		Preferred habitat	Likelihood of occurrence within the Project Area based on desktop	Likelihood of occurrence within the Project Area post field surveys	Data Source[2]			
		EPBC Act	NC Act				DCCEEW 2025a	DESTI 2025b (F-Basin)	DESTI 2025c (10km)	DESTI 2025c (50km)
Eriocaulon carsonii (including subsp. *orientale*)	salt pipewort/button grass	E	E	Restricted to saturated soil adjacent to flowing mound springs (Sainty and Jacobs 2003).	**Unlikely**. Mound springs not known to occur within the Study Area. Preferred habitat is unlikely to occur within the Study Area. There are no records within 50 km of the Study Area (DETSI 2025c).	**Unlikely**. Species or species habitat not detected during the field survey.		✓		
Maundia triglochinoides	-		V	Grows in coastal freshwater swamps and streams (Sainty and Jacobs 2003), in waters up to 0.5 m deep, or shallow waters that may dry up seasonally.	**Unlikely**. Preferred habitat unlikely to occur within the Study Area. There are no records within 50 km of the Study Area (DETSI 2025c).	**Unlikely**. Species or species habitat not detected during field surveys.				
Phaius australis	lesser swamp-orchid	E	E	Occurs near the coast. Grows in sandy areas where soils are almost always damp, but not flooded for lengthy periods; occurring in southern Queensland and northern New South Wales (DETSI 2025i).	**Unlikely**. Preferred habitat not known to occur within the Study Area. There are no records within 50 km of the Study Area (DETSI 2025c).	**Unlikely**. Species or species habitat not detected during the field survey.		✓		
Thelypteris confluens	swamp fern		V	Found in permanently swampy areas and mound springs (DETSI 2025i). Occurs in the Queensland pastoral districts on Leichhardt, Moreton and Wide Bay (DETSI 2025i).	**Unlikely**. Preferred habitat not known to occur within the Study Area. There are no records within 50 km of the Study Area (DESTI 2025c).	**Unlikely**. Species or species habitat not detected during the field survey.		✓		

Notes: [1] Status under the Commonwealth EPBC Act and/or Queensland NC Act as E = Endangered or V = Vulnerable.

[2] Data sources: Commonwealth EPBC Act Protected Matters Report – Study Area plus 10 km buffer – created 11 June 2025 (DCCEEW 2025a); Queensland WildNet database – Study Area plus approximate 10 km and 50 km buffers – created 11 June 2025 (DETSI 2025c); and Queensland WetlandInfo – Fitzroy Basin – Wetland Summary Information (DETSI 2025b).

Table 21 Conservation-significant fish species recorded from the desktop Search Area

Scientific name	Common name	Status[1]		Preferred habitat	Likelihood of occurrence within the Project Area based on desktop	Likelihood of occurrence within the Project Area post field surveys	Data Source[2]			
		EPBC Act	NC Act				DCCEEW 2025a	DESTI 2025b (F-Basin)	DETSI 2025c (10km)	DETSI 2025c (50km)
Bidyanus bidyanus	Silver perch	E	E	Faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin (MDB) (Clunie and Koehn 2001, cited in DotE 2013).	**Unlikely**. Distributional range is naturally in the MDB, although translocated to coastal streams in south-east Queensland (and other states). Preferred habitat not detected within the Study Area. No records within 50 km of the Study Area (DETSI 2025c).	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓		
Maccullochella peelii	Murray cod	V	LC	Deep water with in-stream habitat such as boulders, logs, and overhanging vegetation (Allen et al. 2002). From fast-moving clear upland streams to slow-flowing turbid lowland waters. Most individuals stay within a 10 km reach of the river (Pusey et al. 2004; Allen et al. 2002).	**Unlikely**. Distributional range is naturally in the MDB, although translocated to coastal streams in south-east Queensland (and other states). Preferred habitat not detected within the Study Area. No records within 50 km of the Study Area (DETSI 2025c).	**Unlikely**. Species or species habitat not detected during field surveys.	✓			✓

Notes: [1] Status under the Commonwealth EPBC Act and/or Queensland NC Act as E = Endangered or V = Vulnerable.

[2] Data sources: Commonwealth EPBC Act Protected Matters Report – Study Area plus 10 km buffer – created 11 June 2025 (DCCEEW 2025a); Queensland WildNet database – Study Area plus approximate 10 km and 50 km buffers – created 11 June 2025 (DETSI 2025c); and Queensland WetlandInfo – Fitzroy Basin – Wetland Summary Information (DETSI 2025b).

Table 22 Conservation-significant turtle species recorded from the desktop Search Area

Scientific name	Common name	Status[1]		Preferred habitat	Likelihood of occurrence within the Project Area based on desktop	Likelihood of occurrence within the Project Area post field surveys	Data Source[2]			
		EPBC Act	NC Act				DCCEEW 2025a	DESTI 2025b (F-Basin)	DETSI 2025c (10km)	DETSI 2025c (50km)
Rheodytes leukops	Fitzroy River turtle	V	V	Fast-flowing water of the Fitzroy River and its tributaries (Cogger 2014). Rivers with large, deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* sp.) (DCCEEW 2025c).	**Unlikely**. Preferred habitat 'likely' to occur within the desktop Search Area (DCCEEW 2025a), but unlikely to occur within the Study Area. Recorded from within 50 km of the Study Area (DETSI 2025c), from the Mackenzie River (ALA 2025).	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓		
Elseya albagula	White-throated snapping turtle (also known as the southern snapping turtle)	CE	CR	Permanent flowing water habitats where there are suitable shelters and refuges (DETSI 2025i); clear, flowing, well-oxygenated waters (Todd et al. 2013) of the Fitzroy, Mary and Burnett catchments.	**Unlikely**. Preferred habitat 'may' occur within the desktop Search Area (DCCEEW 2025a), but unlikely to occur within the Study Area. Recorded from within 50 km of the Study Area, from the Comet and Mackenzie rivers (ALA 2025).	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓		

Notes: [1] Status under the Commonwealth EPBC Act and/or Queensland NC Act as E = Endangered or V = Vulnerable or CE = Critically Endangered.

[2] Data sources: Commonwealth EPBC Act Protected Matters Report – Study Area plus 10 km buffer – created 11 June 2025 (DCCEEW 2025a); Queensland WildNet database – Study Area plus approximate 10 km and 50 km buffers – created 11 June 2025 (DETSI 2025c); and Queensland WetlandInfo – Fitzroy Basin – Wetland Summary Information (DETSI 2025b).

4.7 Introduced species

4.7.1 Introduced aquatic flora

There are 22 introduced wetland indicator plant species known from the Fitzroy Basin (DETSI 2025b). Only two of these species were recorded in the Study Area during the seasonal surveys: awnless barnyard grass (*Echinochloa colona*) and white eclipta (*Eclipta prostrata*). Neither are of ecological significance.

Those invasive species considered to pose a particular threat to aquatic biodiversity, and that could potentially occur within the Study Area, are identified as either Weeds of National Significance (WoNS) (Weeds Australia 2025) or Restricted matter category 3 under the Queensland *Biosecurity Act 2014* (Table 23). None were detected in the Study Area.

Table 23 Introduced wetland indicator plants recorded from the desktop Search Area

Scientific name	Common name	National status^	Biosecurity Act status*
Arundo donax	-		
Cyperus esculentus	Yellow nutgrass		
Cyperus involucratus	-		
Cyperus papyrus	Papyrus		
Diplachne fusca var. *uninervia*	-		
Echinochloa colona	**Awnless barnyard grass**		
Echinochloa crus-galli	Barnyard grass		
Eclipta prostrata	**White eclipta**		
Eichhornia crassipes	Water hyacinth	WoNS	Restricted 3
Eleocharis minuta	-		
Hymenachne amplexicaulis 'Olive'	Olive hymenachne	WoNS	Restricted 3
Juncus bufonius	Toad rush		
Nymphaea caerulea	Cape waterlily		
Paspalum distichum	Water couch		
Paspalum vaginatum	Saltwater couch		
Pistia stratiotes	Water lettuce		Restricted 3
Polypogon monspeliensis	Annual beardgrass		
Rorippa nasturtium-aquaticum	Watercress		
Salix babylonica	Weeping willow		
Salvinia molesta	Salvinia	WoNS	Restricted 3
Sparganium erectum subsp. *stoloniferum*	Erect bur-reed		
Urochloa mutica	Para grass		

Notes: ^ Species listed as WoNS; * species listed under the Queensland *Biosecurity Act 2014*; * **Bold text** indicates species detected during field surveys.

4.7.2 Pest fish species

Six introduced fish species have been recorded from the Fitzroy Basin: mosquitofish (*Gambusia holbrooki*), guppy (*Poecilia reticulata*), goldfish (*Carassius auratus*), European carp (*Cyprinus carpio*), tilapia (*Oreochromus mossambicus*) and platy (*Xiphophorus maculatus*) (DETSI 2025b).

Mosquitofish was confirmed from site L1 in June and October 2025 (Section 4.5.1). The mosquitofish is a noxious species listed as restricted categories 3, 5, 6 and 7 in the *Biosecurity Act 2014*. This species was introduced into Australia from North America in 1929 as a biological control for mosquitos; however, this was unsuccessful and the species is now regarded as one of the greatest threats to Australia's native biodiversity (Business Queensland 2020). The mosquitofish has many traits that make them a good invader such as high reproductive potential, flexible diet, broad environmental tolerances and low vulnerability to predation, and they have the potential to rapidly outnumber native fish and dominate aquatic communities (Business Queensland 2020).

4.7.3 Introduced aquatic reptiles

No introduced aquatic reptile species were recorded during the surveys, and none were identified from the desktop assessments as having potential to occur in the Study Area.

4.8 Groundwater-dependent ecosystems

GDEs are ecosystems that rely upon groundwater for their continued existence. They may be 100% dependent on groundwater, such as aquifer GDEs, or may access groundwater intermittently to supplement their water requirements, such as riparian tree species in arid and semi-arid areas (IESC 2018). GDEs can be classified into three broad types:

- aquifer or cave ecosystems (subterranean GDEs);
- ecosystems dependent on the surface expression of groundwater (surface expression GDEs, including river baseflow systems, springs and swamps); and
- ecosystems dependent on the subsurface presence of groundwater (terrestrial GDEs, including some riparian vegetation communities).

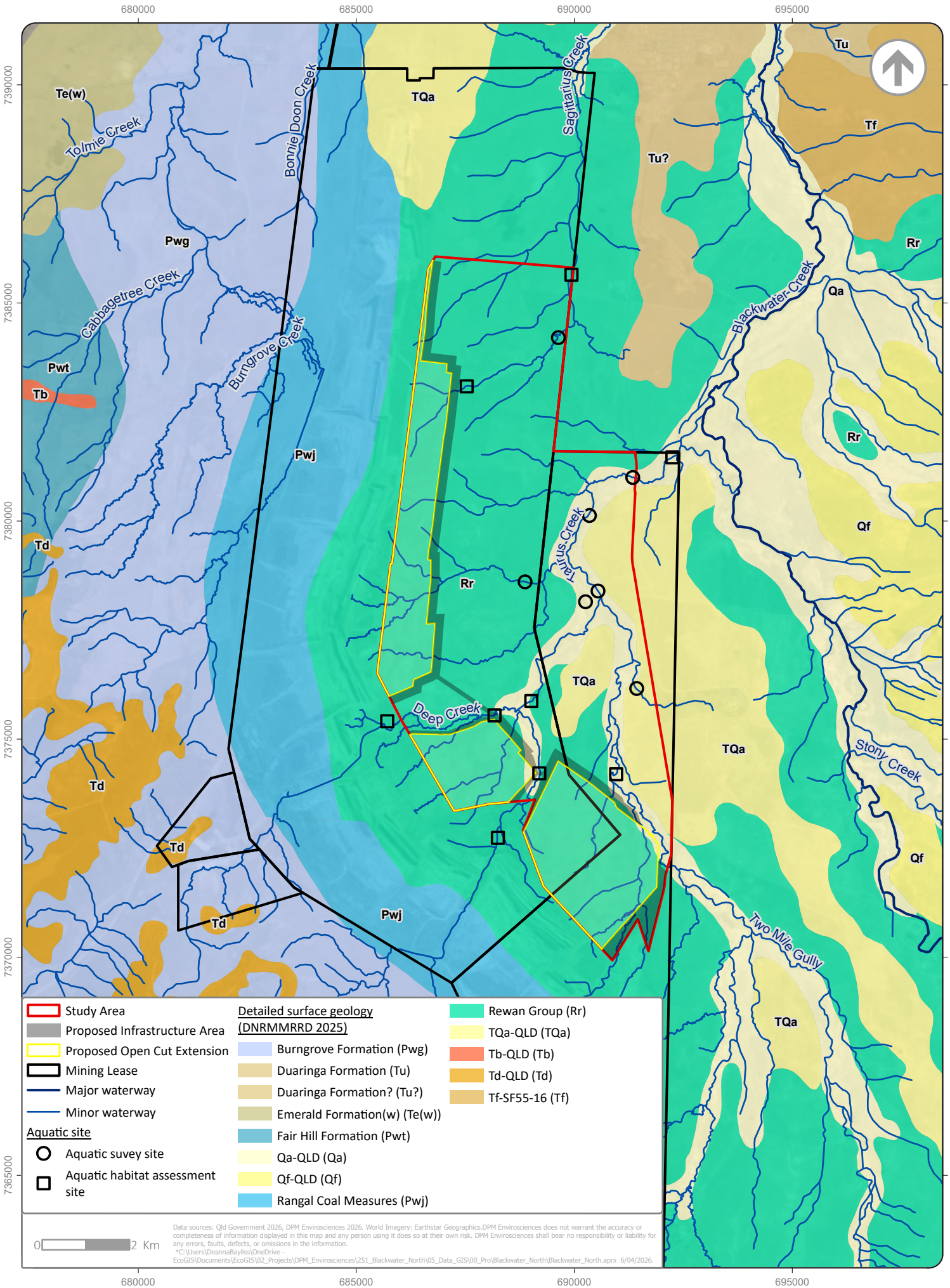
4.8.1 Subterranean groundwater-dependent ecosystems

Stygofauna desktop assessment results

Aquifers of the Study Area

The surface geology of the Study Area (Figure 22) is dominated by lithology belonging to the Rewan Group, which includes lithic sandstone, pebbly lithic sandstone, mudstone and minor volcanilithic pebble conglomerate at the base (DNRMMRRD 2025b). Late Tertiary to Quaternary alluvium, which includes high-level alluvial deposits of poorly consolidated sand, silt, clay and minor gravel, occurs on the broad valleys and floodplains of Taurus Creek and Two Mile Gully, extending east towards Blackwater Creek. The late Tertiary to Quaternary alluvium is intersected by more recent Quaternary alluvium, which includes unconsolidated clay, silt, sand and gravel, on the floodplain and channels of Two Mile Gully and Deep and Taurus creeks (Figure 22). More specifically, these potential GDE aquifers (Figure 23) are identified as ‘Quaternary alluvial aquifers with fluctuating, intermittent groundwater connectivity regime and unknown pH’ based on expert opinion (DETSI 2025d). These Quaternary alluvial aquifers align broadly with the Quaternary and late Tertiary to Quaternary alluvium identified in the surface geology mapping (DNRMMRRD 2025b) and correspond with the Land Zone mapping (Land Zone 3 [Section 2.3]; DNRMMRRD 2025b).

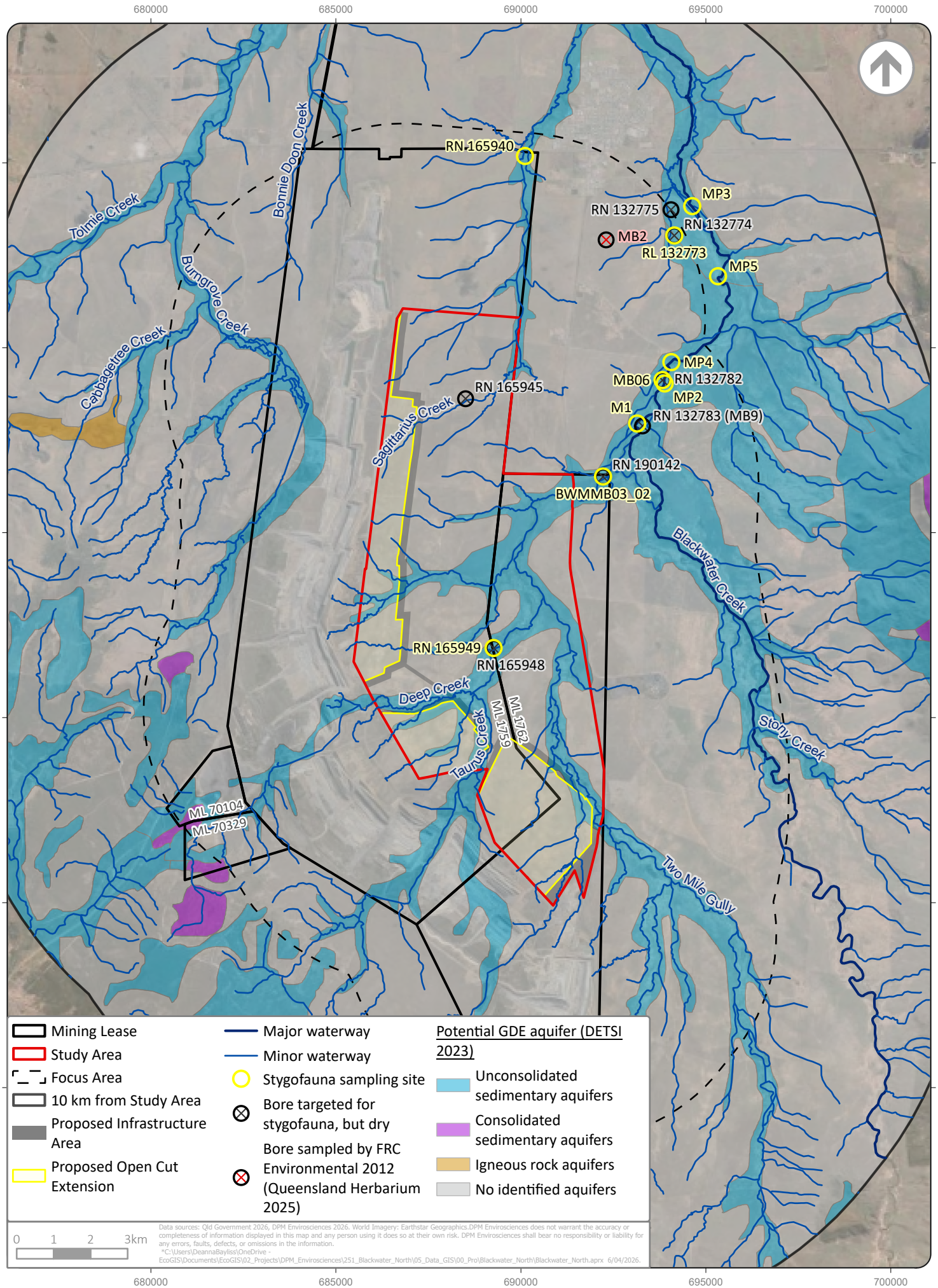
The alluvial aquifers of the Study Area are intercepted by a number of existing monitoring bores (Appendix C) with similar characteristics (lithology, aquifer depth, EC, pH etc.) to other bores in Queensland (4T 2012, DPM Enviroscences 2022 and Queensland Herbarium 2025) in which stygofauna have been previously detected.



SURFACE GEOLOGY OF THE STUDY AREA

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 22



GROUNDWATER-DEPENDENT ECOSYSTEM AQUIFERS

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

DPM ENVIROSCIENCES

FIGURE 23

Stygofauna Potential Presence

The Queensland subterranean aquatic fauna database (Queensland Herbarium 2025) identifies several bores that have been sampled for stygofauna within a 50 km radius of the Study Area. Subterranean fauna (recognised as potential stygofauna at the time) were detected in two of these bores (Table 24) in 2012 by FRC Environmental as part of an assessment of the 'Minyango Project' (Queensland Herbarium 2025), comprising specimens from the:

- insect order Coleoptera (beetles), family Hydraenidae (one individual from bore MB2);
- annelid class Oligochaeta (segmented worms), family Naididae (one individual from bore MB2); and
- crustacean sub-class Copepoda, order Cyclopoida (two individuals from bore MB9).

Since 2012, there is a better understanding of taxa likely to be stygofauna and the previous specimens are considered unlikely to be stygofauna.

Bores MB2 and MB9, sampled by FRC Environmental in 2012, are located within 5 km of the Study Area. DPM Enviros attempted to sample bore MB9 (RN 132783) in July and October 2025, but it was dry at the time of sampling as shown in Table 24 and Figure 23. Bore MB2 (RN 132777) was not targeted by DPM Enviros as it is screened too deep (220--226 mbgl) to be suitable for stygofauna. Various species of hydraenid beetles live in riparian, littoral and aquatic habitats, but are not known to include stygofauna which potentially explains the individual recorded by FRC Environmental from bore MB2.

Oligochaete worms of the family Naididae (detritus worms) are key components of the benthic communities of many freshwater ecosystems. Naidids were once considered members of a community that occurs within the shallow to deep sand and gravel beds associated with areas of groundwater discharge (Gilbert et al. 1994), representing a common group of worms existing in all Australian States and Territories. However, subsequent studies now consider the broader Oligochaeta class as part of the soil fauna (Halse and Pearson 2014). The hydraenid and naidid specimens recorded from bore MB2 may be stygoxenes (i.e. not obligate inhabitants of groundwater systems) but are unlikely to be stygofauna.

Copepods in the taxonomic order Cyclopoida are normally associated with fine to coarse sandy substrates of still water environments of rivers, wetlands, the hyporheic zone and shallow groundwaters. The cyclopoid collected by FRC Environmental from bore MB9 in 2012 represents a likely stygoxene rather than stygofauna (see discussion in the 'Stygofauna sampling results' below).

Freshwater Ecology targeted 10 bores within and surrounding the Study Area in November 2020 and May 2021 (Freshwater Ecology 2021). Five of these bores are screened too deep (>168 mbgl) for stygofauna to have access to the borehole, and two of the five shallower bores were dry at the time of each seasonal sampling event. Consequently, only three of the 10 bores targeted for stygofauna met the criteria for sampling as per the DSITI (2015) guideline. No stygofauna was detected by Freshwater Ecology (2021).

Stygofauna sampling results

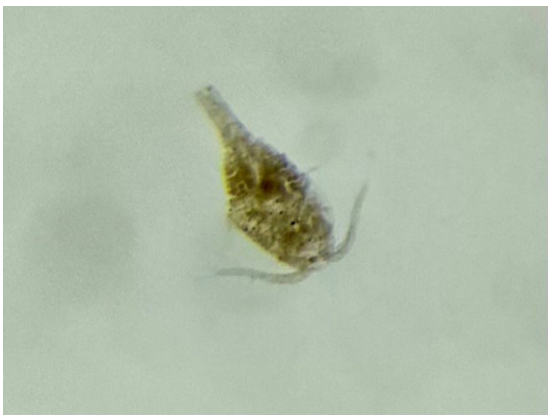
July 2025 sampling

Five wet groundwater bores and five wet micropiezometers were sampled for stygofauna in July 2025, as shown in Table 24 and Figure 23. Standing water levels ranged from 0.3 mbgl in each of the micropiezometers within the bed of Blackwater Creek to 14.55 mbgl at bore RN 132781 (MB6) on the floodplain of Blackwater Creek (Table 24). pH levels ranged from 6.2 (slightly acid) at bore RN 165940 on the floodplain of Sagittarius Creek to 8.3 (moderately alkaline) at micropiezometer site MP1 within Blackwater Creek. Specific conductivity levels ranged from 271 µS/cm (fresh) at site MP1 to 48,984 µS/cm (saline) at bore RN 132773 on the floodplain of Blackwater Creek.

A single cyclopoid copepod was identified in the sample collected from micropiezometer site MP4 on Blackwater Creek (Plate 5). Stygofauna specialist Dr Peter Hancock advised (pers. comm. 29/07/2025) that further taxonomy is unlikely to determine whether the cyclopoid is stygofauna or not. As the sampling was only shallow and close to the creek, it is more likely a surface/hyporheic benthic copepod (a stygoxene) taking refuge in shallow alluvium, but which may still rely on shallow groundwater during dry times. Copepod stygofauna are more commonly represented by harpacticoid copepods in alluvium, rather than cyclopoid copepods, as the large swimming antennae of cyclopoid copepods are not well suited to tightly packed aquifers (pers. comm. Dr Peter Hancock 29/07/2025). The cyclopoid copepod detected is considered to be a stygoxene. No stygofauna were detected.



Site MP4 on Blackwater Creek



Cyclopoid copepod specimen from site MP4

Plate 5 Micropiezometer site MP4 and cyclopoid specimen from Blackwater Creek, July 2025

October 2025

The same 10 locations sampled in July 2025 were targeted for follow-up seasonal sampling in October 2025 (Table 24). Standing water levels ranged from 0.1 mbgl at micropiezometer site MP3 in the bed of Taurus Creek to 14.50 mbgl at bore RN 132781 (MB6) on the floodplain of Blackwater Creek (Table 24). pH levels ranged from 6.4 (slightly acid) to 7.4 (neutral). Specific conductivity levels ranged from 420 µS/cm (fresh) at site MP5 to 48,563 µS/cm (saline) at bore RN 132773 on the floodplain of Blackwater Creek.

No stygofauna were detected.

Table 24 Characteristics of groundwater monitoring bores and micropiezometers targeted for stygofauna, July and October 2025

Bore ID^	Lithology at screened interval	Bore depth (mBGL)	Screen (mBGL)	SWL (mBGL)	Date sampled	pH	EC (µS/cm)	Ion sample	Stygo. sampling	Notes
RN 132773 (MB13A)	Siltstone	15.69	12.3-15.3	11.64	2/07/2025	6.5	48984	✓	✓	Six hauls off bottom, then purged/filtered 20 L (each time).
				11.65	25/10/2025	6.5	48563	✓	✓	
RN 132774 (MB13B)	Alluvial sand	9.15	6-9	-	2/07/2025	-	-	-	-	Dry at the time of sampling.
				-	25/10/2025	-	-	-	-	
RN 132775 (MB12)	Alluvial sand	9.98	6.5-9.5	-	2/07/2025	-	-	-	-	Dry at the time of sampling.
				-	25/10/2025	-	-	-	-	
RN 132781 (MB6)	Siltstone	41.23	32-41	14.55	2/07/2025	7.3	21370	✓	✓	Six hauls off bottom, then purged/filtered 20 L (each time).
				14.50	25/10/2025	6.8	22355	✓	✓	
RN 132782 (MB10)	Alluvial sand	8.45	6-9	-	2/07/2025	-	-	-	-	Dry at the time of sampling.
				-	25/10/2025	-	-	-	-	
RN 132783 (MB9^)	Alluvial sand	11.84	9-12	-	2/07/2025	-	-	-	-	Dry at the time of sampling.
				-	25/10/2025	-	-	-	-	
RN 165940 (MB19BWM02A)	Alluvial clay/sand	15.30	12-15	6.25	1/07/2025	6.2	37384	✓	✓	Six hauls off bottom, then purged/filtered 20 L (each time).
				6.36	20/10/2025	6.4	37326	✓	✓	
RN 165945 (MB19BWM05A)	Claystone	15.06	9-15	-	1/07/2025	-	-	-	-	Dry at the time of sampling.
				-	20/10/2025	-	-	-	-	
RN 165948 (MB19BWM07A)	Alluvial sand and gravel	7.06	4-7	-	1/07/2025	-	-	-	-	Dry at the time of sampling.
				-	22/10/2025	-	-	-	-	
RN 165949 (MB19BWM25P)	Sandstone	20.20	17-20	11.00	1/07/2025	7.3	5420	✓	✓	Six hauls off bottom, then purged/filtered 20 L (each time).
				11.20	22/10/2025	7.4	4601	✓	✓	
RN 190142 (BWMMB03_01)	Alluvial sand and gravel	11.13	8-11	-	2/07/2025	-	-	-	-	Dry at the time of sampling.
				-	23/10/2025	-	-	-	-	
RN 190143 (BWMMB03_02)	Sandstone	40.99	35-41	12.09	3/07/2025	6.6	36033	✓	✓	Six hauls, then purged/filtered 20 L (each time).
				12.12	23/10/2025	7.0	36159	✓	✓	
MP1	Alluvial sand and gravel	1.0	0.3-1.0	0.3	2/07/2025	8.3	271	✓	✓	10 L purged/filtered with micropiezometer.
		1.2	0.5-1.2	0.6	25/10/2025	7.4	743	✓	✓	

Bore ID^	Lithology at screened interval	Bore depth (mBGL)	Screen (mBGL)	SWL (mBGL)	Date sampled	pH	EC (µS/cm)	Ion sample	Stygo. sampling	Notes
MP2	Alluvial sand and gravel	1.0	0.3-1.0	0.3	2/07/2025	7.5	589	✓	✓	10 L purged/filtered with micropiezometer.
		-	-	-	25/10/2025	-	-	-	-	Dry. Excavated sand to dry clay layer beside lowest point in bed.
MP3	Alluvial sand and gravel	1.0	0.3-1.0	0.3	3/07/2025	7.4	341	✓	✓	10 L purged/filtered with micropiezometer (each time).
		0.5	0-0.5	0.1	25/10/2025	7.0	466	✓	✓	
MP4	Alluvial sand and gravel	1.0	0.3-1.0	0.3	3/07/2025	7.0	1112	✓	✓	10 L purged/filtered with micropiezometer.
		-	-	-	25/10/2025	-	-	-	-	Dry, Dard dry clay at 0.2 m below bed level of dried pool.
MP5	Alluvial sand and gravel	1.0	0.3-1.0	0.3	3/07/2025	7.6	315	✓	✓	10 L purged/filtered with micropiezometer (each time).
		1.2	0.5-1.2	0.9	25/10/2025	7.3	420	✓	✓	

Notes:

^ Indicates bores in which subterranean fauna was detected by FRC Environmental in 2012 (Queensland Herbarium 2025); and

* EC = Electrical Conductivity, standardised to 25˚C (i.e. Specific Conductivity).

4.8.2 Surface expression groundwater-dependent ecosystems

Desktop mapping of potential surface expression GDEs throughout Queensland (DETSI 2025d) shows no ‘known’ or ‘derived’ surface expression GDEs within the Study Area. ‘Derived’ surface expression GDE lines and areas of ‘moderate confidence’ are identified in the DETSI (2025d) mapping downstream of the Study Area to the north-east on Blackwater Creek (Figure 24). The lines represent ‘channels on alluvia overlying sandstone ranges with fresh, intermittent flow’, and the areas represent ‘riverine waterbodies on alluvia overlying sandstone ranges with fresh, intermittent flow’; each forming part of ‘Quaternary alluvial aquifers overlying sandstone ranges with fresh, intermittent groundwater connectivity regime’ (DETSI 2025d).

Micropiezometer site MP3 (Figure 23 in Section 4.8.1) was positioned in fresh (341 to 466 µS/cm) saturated alluvium beside an isolated pool on Blackwater Creek (downstream of the Study Area) that forms part of the State-mapped derived surface expression lines.

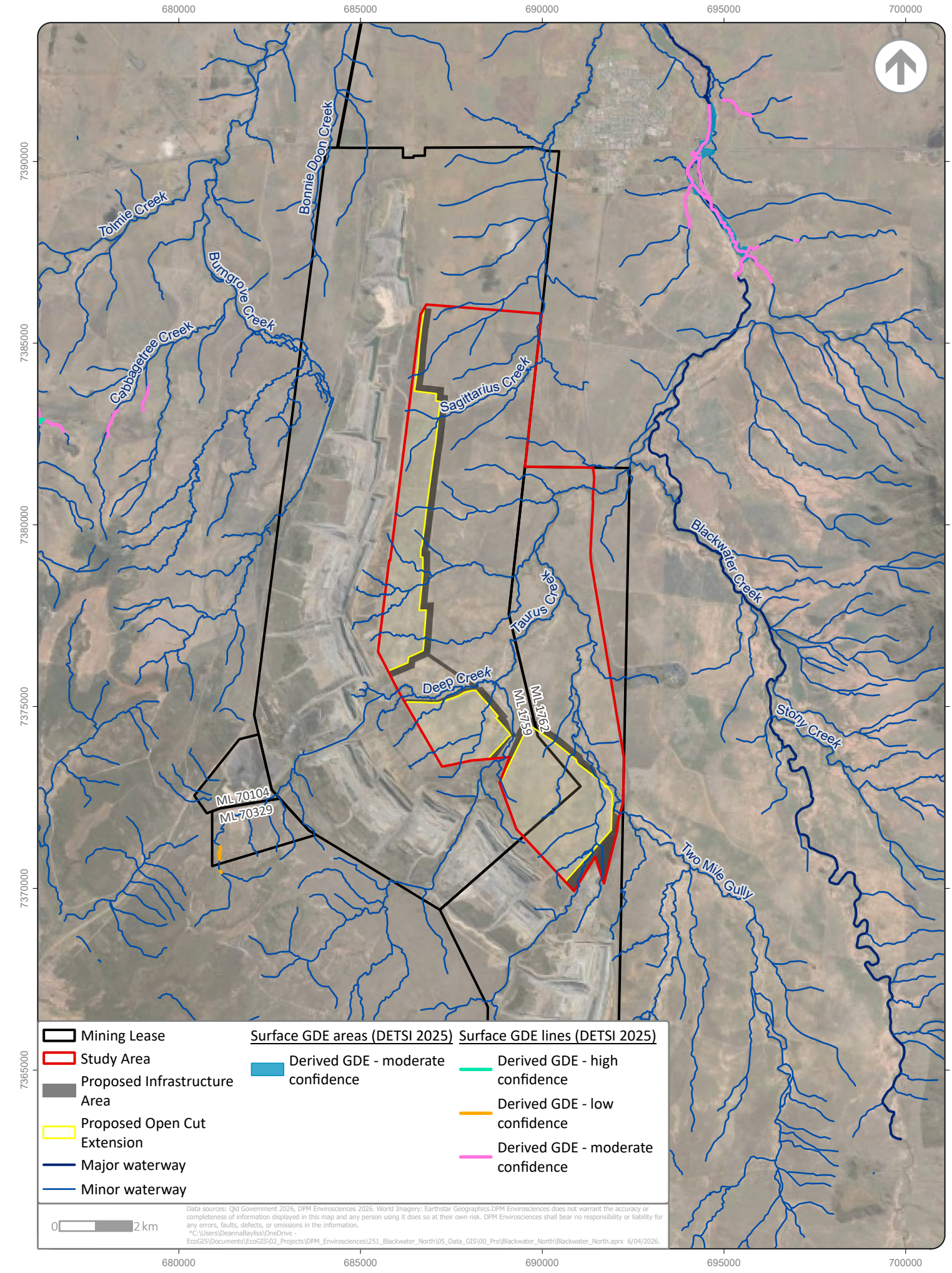
Water samples collected from site MP3 in July and October 2025 were both fresh and bicarbonate dominated, consistent with most surface waters of the Study Area (Figure 7 in Section 4.2.2). The alluvial aquifer of Blackwater Creek is expected to be recharged by rainfall and surface water infiltration in the catchment and channel. Saturated alluvia above the less permeable sandstone base may express water into Blackwater Creek, extending the duration of ephemeral/intermittent flow and isolated pools in Blackwater Creek for longer than waterways that lack alluvia overlying a sandstone base. Consequently, the State-mapped ‘derived’ surface expression GDEs of ‘moderate confidence’ on Blackwater Creek are indeed likely to be surface expression GDEs (Plate 6).

Field observations of waterways and wetlands within the Study Area (i.e. excluding Blackwater Creek) found no obvious evidence of groundwater expressions, salt seeps or other on-ground indicators of surface expression GDEs.



July 2025 October 2025

Plate 6 State-mapped ‘moderate confidence’ ‘surface expression groundwater-dependent ecosystem line’ at site MP3



SURFACE EXPRESSION GROUNDWATER-DEPENDENT ECOSYSTEMS

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

DPM ENVIROSCIENCES

FIGURE 24

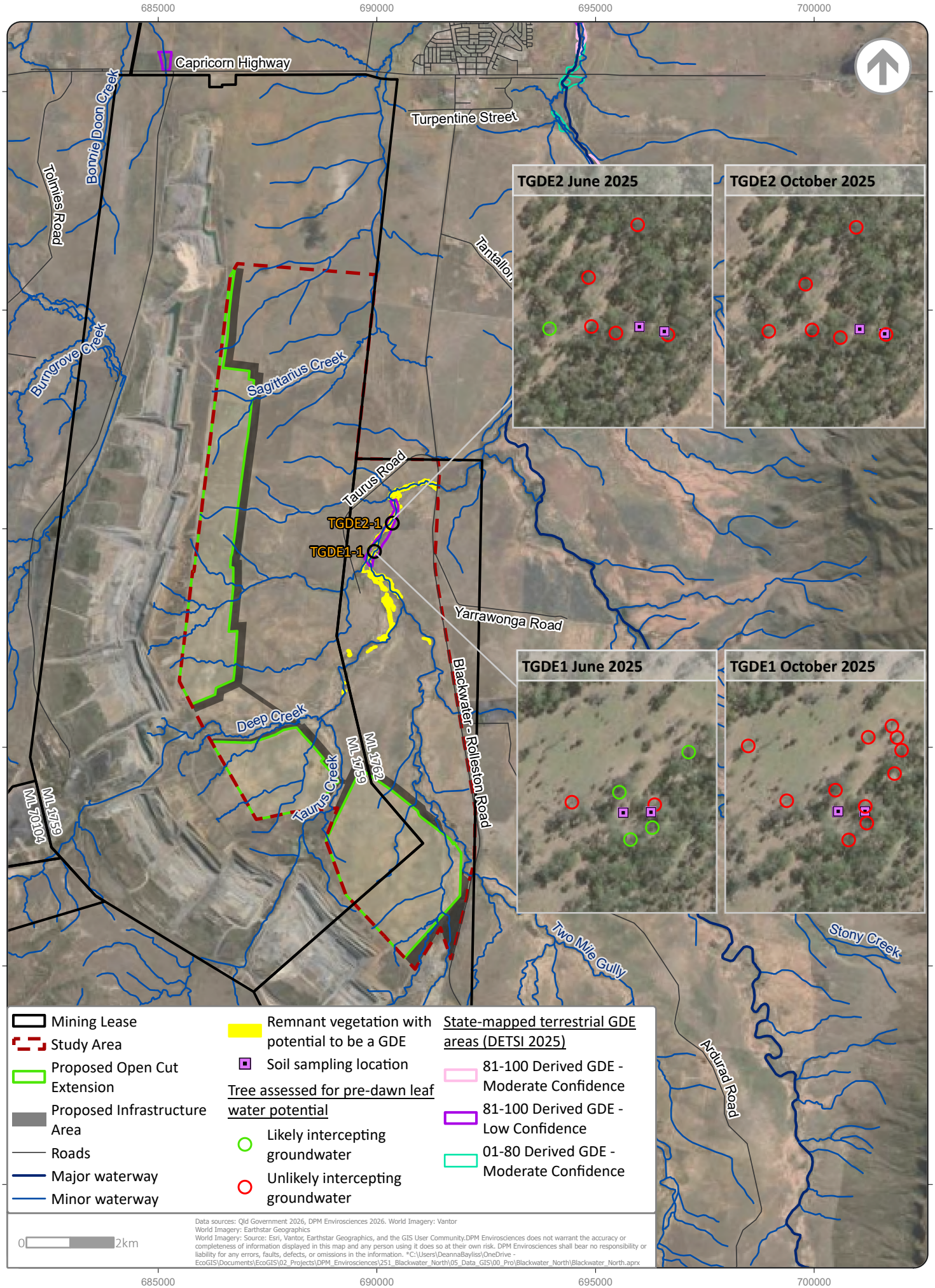
4.8.3 Terrestrial groundwater-dependent ecosystems

State-mapped terrestrial groundwater-dependent ecosystems

Desktop mapping of potential GDEs throughout Queensland (DETSI 2025d) shows no 'known' terrestrial GDEs within the Study Area. However, a single polygon of 'derived' terrestrial GDE of 'low confidence' is identified in the State mapping (DETSI 2025d), based on expert knowledge of the landscape and available spatial datasets (but without field verification) (Figure 25). Specifically, it is identified as a treed Regional Ecosystem (RE) on alluvia, with fluctuating, intermittent flow, that may be dependent on the sub-surface presence of groundwater (DETSI 2025d).

Remote sensing of terrestrial groundwater-dependent ecosystems

2rog Consulting (2021) developed a remote sensing dataset of potential terrestrial GDEs for several tenements throughout the Bowen Basin, applying the remote sensing method recommended by the IESC (Doody, Hancock and Pritchard 2019). This dataset identifies areas that are relatively wetter and greener than surrounding areas, though does not identify regions of confirmed terrestrial GDE. 2rog Consulting mapped potential terrestrial GDEs within a 50 km buffer of the assessed tenements, including BWM. No remotely sensed potential terrestrial GDEs were identified by 2rog Consulting in the BWM Study Area.



TERRESTRIAL GROUNDWATER-DEPENDENT ECOSYSTEMS

Blackwater North Extension Project- Aquatic Ecology and GDE Assessment

DPM ENVIROSCIENCES

FIGURE 25

Conceptual understanding

RDM Hydro, 3D Environmental and Groundwater Enterprises (2023) undertook a desktop assessment to identify the distribution of potential terrestrial GDEs within the Study Area. This included a hydrogeological review of shallow groundwater to better understand the groundwater regime with consideration of terrestrial GDEs. RDM Hydro et al. (2023) determined that the shallow water table is a subdued reflection of topography and is generally in excess of 25 mbgl, except in the vicinity of drainage lines and topographic lows where the water table is likely shallower.

RDM Hydro, 3D Environmental and Groundwater Enterprises (2023) presented conceptual ecohydrological models which are likely to be found across the broader BWM tenements and the wider Bowen Basin based on the findings of the desktop study and previous field assessments of other GDE studies in the Bowen Basin. The conceptual ecohydrological models include perched aquifers in alluvium and systems exhibiting interactions with Tertiary and Permo-Triassic sediments (coal seams and alluvium). For the Quaternary Alluvium formations, which includes Taurus Creek, groundwater occurs as ephemeral, discontinuous perched aquifers in sandier material, with clayey material forming aquitards (RDM Hydro, 3D Environmental and Groundwater Enterprises 2023). The alluvial sediments are of limited extent and thickness but are likely to be episodically recharged by rainfall run-off when the watercourse hosts water, resulting in the presence of perched aquifers associated with the alluvium (Figure 26).

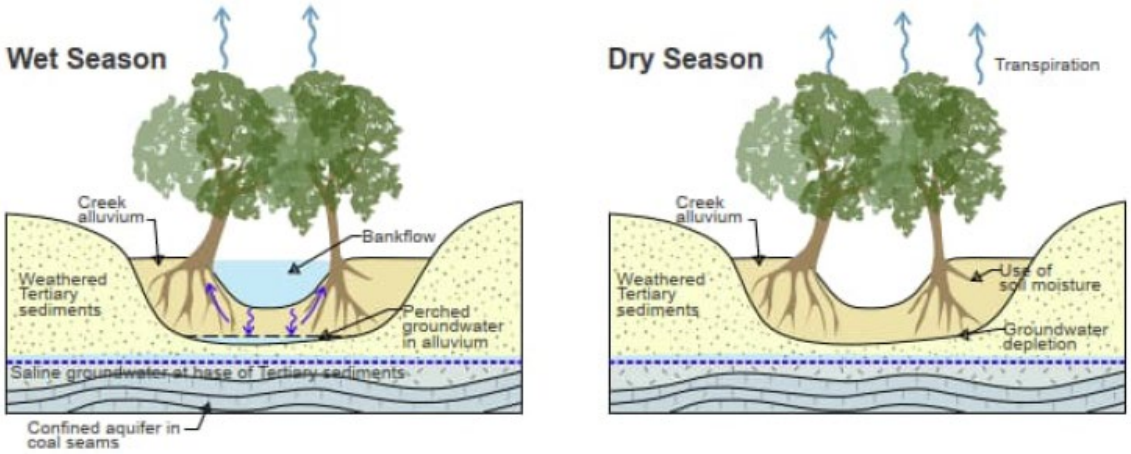


Figure 26 Perched aquifer in creek alluvium, showing seasonal depletion (RDM Hydro, 3D Environmental and Groundwater Enterprises 2023)

The potential terrestrial GDEs of Taurus Creek are dominated by coolibah (*Eucalyptus coolabah*), aligning with RE 11.3.3 on the channel and 11.3.1 further out on the floodplain where brigalow (*Acacia harpophylla*) tends to dominate. RDM Hydro, 3D Environmental and Groundwater Enterprises (2023) identify that the coolibah is likely to utilise groundwater only when groundwater is <5 mbgl and moisture availability in the vadose zone is extremely limited. Brigalow (*Acacia harpophylla*) is also prevalent within the State-mapped terrestrial GDE polygon, particularly on the floodplain away from the channel. However, brigalow is not considered to represent groundwater-dependent vegetation.

Field verification of terrestrial GDEs

Two sites/areas (TGDE-1 and TGDE-2) were field verified for groundwater-dependent trees within the single State-mapped polygon of potential terrestrial GDE (DETSI 2025d) adjoining Taurus Creek in the Study Area (Figure 25). These sites were assessed in June 2025, then again in October 2025. The raw data relating to pre-dawn LWP and SWP measurements is provided as Appendix F and is graphed in Figure 27. Pre-dawn LWP measurements ≥ - 0.55 MPa indicate trees that are likely accessing a saturated source of water (ranging from fresh to slightly saline) in either the soil profile or water table (Section 3.8.1; Figure 27).

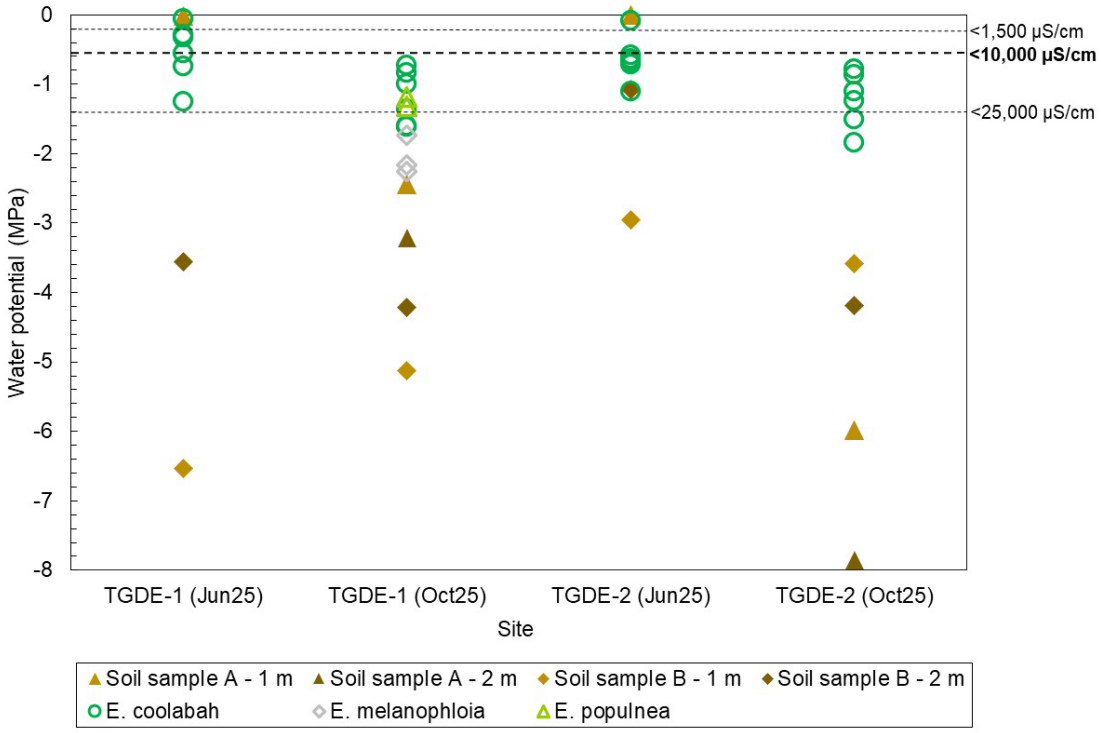


Figure 27 Pre-dawn leaf water potential (LWP) and soil water potential (SWP) measurements at target sites

Note: dashed lines indicate expected LWP value for trees in equilibrium with saturated moisture sources expected at 1,500 µS/cm, 10,000 µS/cm and 25,000 µS/cm.

Five of the 12 trees assessed at sites TGDE-1 and TGDE-2 were likely intercepting either soil water or groundwater at the time of assessment 20 June 2025. This comprised coolibah (*Eucalyptus coolabah*) in the channel, on the stream bank, and on the adjoining floodplain. Saturated sediments were encountered in the upper 1 m of bed sediments. Soil/sediments were much drier in the upper 2 m of the soil/sediment profile on the adjoining floodplain. It is likely that those well-hydrated trees (pre-dawn LWP ≥ -0.55 MPa) sampled on the bed and bank of Taurus Creek were intercepting soil/sediment water in the upper profile. However, some of the well-hydrated trees on the floodplain, which were up to 30 m from the channel, were likely intercepting deeper water in the perched alluvial aquifer at the time of assessment 20 June 2025.

The same 12 coolibah trees were assessed in October 2025. In addition, three silver-leaved ironbark (*E. melanophloia*) and two poplar box (*E. populnea*) individuals (rare occurrence of each in the vegetation community) were also assessed at site TGDE1 in October 2025 (Figure 25). Pre-dawn LWP measurements indicated that these 17 trees were unlikely accessing groundwater at the time of assessment, as indicated by measurements < -0.55 MPa. Sampling of nearby bore RN165949 (approximately 3 km upstream) indicated only brackish conditions (4,601 µS/cm, within the range of fresh to slightly saline [<800 to 10,000 µS/cm]) supporting the notion that trees were unlikely to be accessing any groundwater, as opposed to trees accessing moderately saline to saline groundwater (Section 3.8.1).

Given Taurus Creek is subject to continuous natural wetting and drying cycles, the riparian vegetation would access available moisture in the soil/sediment following rainfall, runoff and flow, and likely accesses shallow groundwater in the alluvial aquifer in drier times. This terrestrial GDE would likely be opportunistic, utilising small inputs of groundwater on occasion, but likely persisting without this input.

The upstream and downstream extents of terrestrial GDEs within the Study Area have not been delineated, but likely correspond with REs 11.3.2, 11.3.25, 11.3.27, 11.3.3 and 11.3.6 on Taurus Creek field verified by E2M Pty Ltd (E2M) (2026) (Figure 25). Remnant vegetation on Two Mile Gully and further upstream on Taurus Creek is unlikely to constitute terrestrial GDEs due to less extensive alluvial deposits and where site observations by DPM Enviroscences (aquatic sites R7, R8 and R11) found the riparian vegetation to be dominated by regrowth yellowwood (*Terminalia oblongata*) and brigalow (*Acacia harpophylla*), neither of which are considered to represent groundwater-dependent vegetation

Ecological value of terrestrial GDEs of the Study Area

The terrestrial GDEs of the Study Area would likely exist without groundwater input but are known to utilise groundwater on occasion (episodic or opportunistic GDEs, not obligate GDEs). Notwithstanding, these vegetation communities form potential habitat for the Endangered (EBPC Act and NC Act) folivorous species koala (*Phascolarctos cinereus*) and likely provide higher leaf moisture levels and nutritional value than surrounding vegetation not able to access groundwater in drier times.

Accordingly, the terrestrial GDEs of the Study Area would be attributed a HEV (Category 1 sensitive environmental area) in accordance with the *Risk Assessment Guidelines for GDEs* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019).

4.9 Matters of National Environmental Significance

World and National Heritage properties

No World Heritage Properties or National Heritage Places are identified for the Search Area in the EPBC Act Protected Matters Report (DCCEEW 2025a; Appendix A).

Wetlands of International Importance

No wetlands of International Importance are identified within the Search Area in the EPBC Act Protected Matters Report (DCCEEW 2025a). Wetlands of International Importance nearest to the Study Area include those of the Shoalwater and Corio Bays Area, approximately 200 km to the north-east. These wetlands are well removed from the Study Area and are hydraulically connected only by the Coral Sea.

Threatened Ecological Communities

No EPBC Act listed TECs, relevant to aquatic ecology, are identified from the Search Area (DCCEEW 2025a). No aquatic TECs are expected to occur within the Study Area.

Threatened Species

No MNES aquatic flora or fauna species were detected during field surveys, nor were any detected during previous surveys of the Study Area (EMM 2023).

Aquatic fauna species that are MNES which are considered to have potential to occur in the broader desktop Search Area include the Critically Endangered white-throated snapping turtle (*Elseya albagula*) and the Vulnerable Fitzroy River turtle (*Rheodytes leukops*), each listed under the EPBC Act. However, due to habitat requirements, it is unlikely these species occur within waterways or wetlands of the Study Area as either resident or transient occurrences. Habitat for these species was not encountered within the Study Area (Section 4.6.3).

No MNES aquatic flora species are likely to occur within the Study Area (Section 4.6.1).

Migratory Species

No aquatic migratory species (i.e. migratory species that live in water for most or all their lives) are identified from the Search Area.

Commonwealth Marine Areas

The Study Area is located approximately 200 km west of any marine area and is separated hydraulically by at least two sub-catchments (Dawson River and the Fitzroy River) with varying land use and water quality.

Nuclear actions (including uranium mines)

The Action does not involve any nuclear actions.

Water resource

A water resource, in relation to coal seam gas development and large coal mining development, is an MNES. This report documents the aquatic ecology of water resources.

4.10 Matters of State Environmental Significance

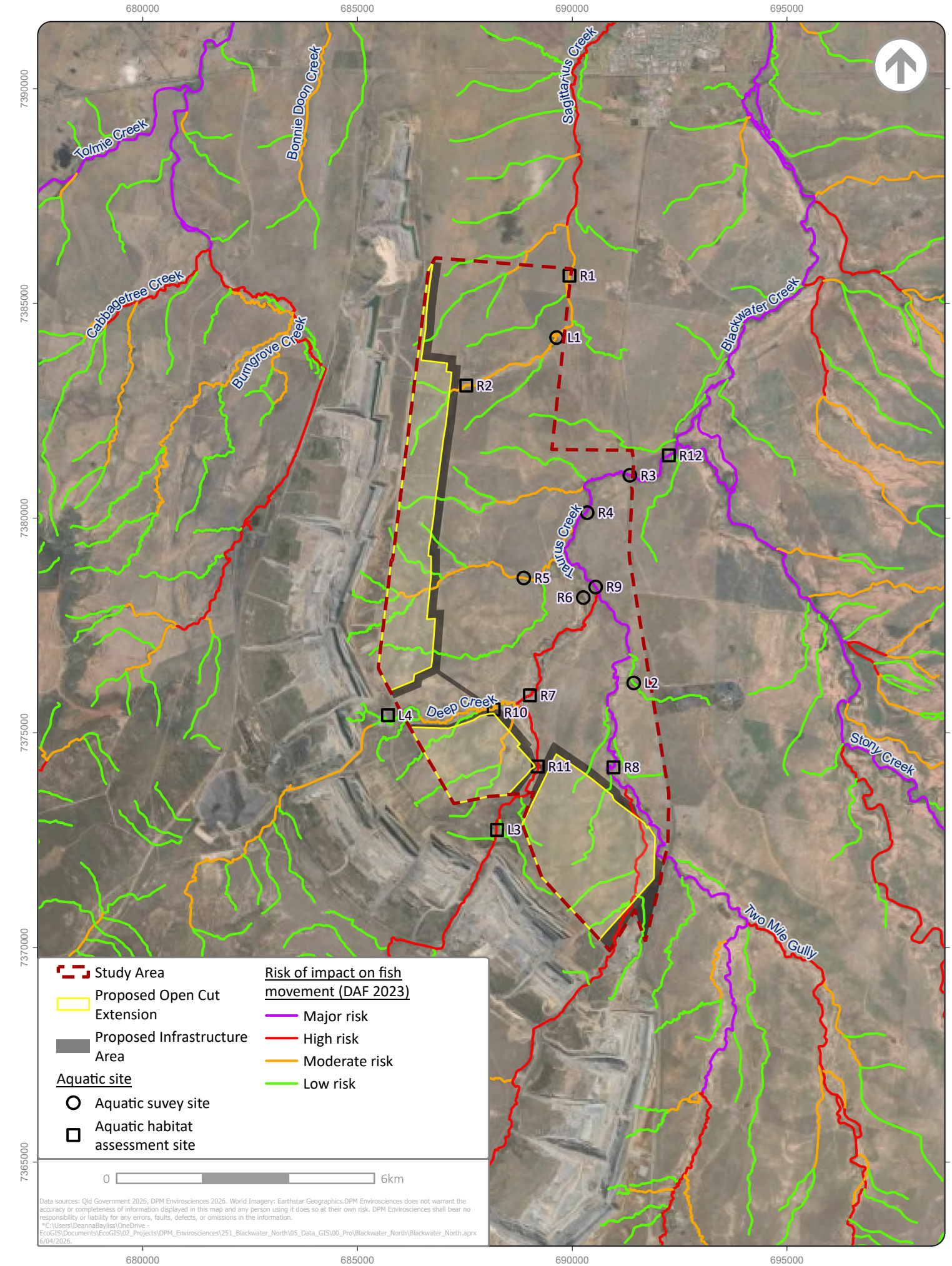
The environmental offsets framework in Queensland includes the *Environmental Offsets Act 2014*, the EO Regulation and the Queensland Environmental Offsets Policy. MSES are defined in the EO Regulation and are a component of the biodiversity state interest identified in the Queensland State Planning Policy.

MSES were identified during the desktop review as occurring within the Study Area (Table 25). Potential MSES of relevance to aquatic ecology include 'waterways providing for fish passage'. A 'waterway providing for fish passage' is only an MSES if waterway barrier work is proposed that would limit the passage of fish along a waterway.

Figure 28 presents the potential aquatic MSES mapping for the Study Area.

Table 25 Matters of State Environmental Significance located within the Study Area

Prescribed Environmental Matter	Within the Study Area	Detail
Regulated vegetation	-	Refer to terrestrial ecology assessment.
Connectivity areas	-	Refer to terrestrial ecology assessment.
Wetlands and watercourses	No	The Study Area does not contain any HES wetlands or High Ecological Value waters or watercourses (Figure 11).
Designated precinct in a strategic environmental area	No	The Study Area is not a designated precinct in a strategic environmental area.
Protected Wildlife Habitat	-	Refer to terrestrial ecology assessment. No Conservation-significant aquatic species observed or assessed as likely to occur.
Protected Areas	No	No Protected Areas occur within or adjoining the Study Area.
Fish Habitat Areas and Highly Protected Zones of State Marine Parks	No	The Study Area is not located in a State Marine Park.
Waterway providing for fish passage	Yes	Waterways within the Study Area provide for fish passage (Figure 28).
Marine Plants	No	The Study Area is not located in a marine environment.
Legally Secured Offset Area	-	Refer to terrestrial ecology assessment.



AQUATIC MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE MAPPING

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 28

5 POTENTIAL IMPACTS

5.1 Aquatic habitat modification and loss

The Project would remove or otherwise modify aquatic habitats in the Project Area, comprising ephemeral waterways and semi-permanent farm dams. These habitats are unlikely to support aquatic species of conservation significance listed under the NC Act or EPBC Act, given the lack of suitable habitat features (Section 4.6).

No 'watercourses', as defined by the *Water Act 2000,* would be directly impacted by the Project. Several first and second order waterways (based on Strahler 1952) would be removed (Section 4.1.3), comprising an aggregate 23.6 km of first order waterways and 5.2 km of second order waterways. Waterway crossings (either bridge, culvert or ford) are proposed on a retained second order reach of Deep Creek and a fourth order reach of Taurus Creek. Aquatic habitat would be modified at each of these locations to enable the construction of properly formed waterway crossings.

All aquatic flora and fauna species detected during the surveys are Least Concern under the NC Act. No aquatic fauna species listed under the EPBC Act or NC Act were detected. The extent of aquatic habitat, and consequently the extent of Least Concern aquatic flora and fauna species within the Project Area, would be reduced because of the Project. The species detected within the Study Area are common and have a broad distribution in the region and so the removal of these habitat areas from the Project area would not have a significant impact on these species as a whole.

5.2 Fish passage

'Waterway barrier works' are defined in the *Fisheries Act 1994* to mean a dam, weir or other barrier across a waterway if the barrier limits fish access and movement along a waterway. While it is understood that a waterways barrier works permit is not required where the works occur in a ML authorised under an EA, fish passage is an MSES and still needs to be considered. A 'waterway providing for fish passage' is an MSES (if located outside of Urban Areas – as per Schedule 2, Section 10 of the EO Regulation) only if a waterway barrier work is proposed that would limit the passage of fish.

The DPI (2025b) *Accepted development requirements for operational work that is constructing or raising waterway barrier works* states the requirements that must be complied with and provides guidance for conducting operational work that involves constructing or raising waterway barrier works. If the proposed waterway crossing does not meet the DPI (2025b) accepted development requirements, it would need to achieve the assessable development requirements (performance outcomes and/or acceptable outcomes) identified in the Department of State Development, Infrastructure and Planning (2025) *State Code 18: Constructing or raising waterways barrier works in fish habitats*, or be otherwise approved by DPI.

At the location of the proposed crossing (site R11), Taurus Creek is mapped by DPI (2025a) as being at High risk of adverse impact from waterway barrier works on fish movement Figure 6). Deep Creek (site R10) and other unnamed tributaries are State-mapped (DPI 2025a) as being at Moderate and Low risk of adverse impact from waterway barrier works on fish movement (Figure 6, Section 4.1.3).

Waterway removal

A number of first and second order (based on Strahler 1952) waterways within the Project area, being waterways State mapped as being at Low or Moderate risk of adverse impact from waterway barrier works on fish movement (Figure 6), would be completely removed or otherwise significantly altered by the Project. This comprises an aggregate 22.3 km of first order / Low risk waterways and 2.8 km of second order / Moderate risk waterways. An approximate 3.9 km third order / State mapped High risk waterway would also be removed and replaced with a constructed diversion channel (see 'Waterway diversion' below). While the Project would remove these waterways and wetlands (small farm dams) that provide fish habitat within the Proposed Project Area and Infrastructure Area, it would not fragment fish habitat as these waterways do not connect to fish habitat further upstream.

Waterway diversion

Approximately 3.9 km of an unnamed tributary of Two Mile Gully would be replaced by an approximate 2.4 km constructed clean water drain within the Project area (Figure 3, Section 3.6.1). This unnamed tributary of Two Mile Gully is State mapped (DPI 2025a) as being at High risk (third order) of adverse impact from waterway barrier works on fish movement (Figure 6), although would be considered only Moderate risk (second order) if considering the Emu Creek diversion already in place upstream.

The proposed clean water drain is a trapezoidal channel with base width of 5 m, a maximum top width of 65 m, 1V:5H (vertical rise to horizontal run) internal batter slopes and a longitudinal slope of 0.7% (WRM 2026). In comparison, the existing tributary (to be diverted) has a base width between <2 m and up to 5 m, with bank slopes of between 1V:5H to 1V:10H, and a longitudinal slope of 0.35% to 0.61% (WRM 2026). In summary, the proposed clean water drain is slightly steeper than the steepest section of the existing tributary being diverted. The channel shape of the proposed clean water drain generally would not replicate the existing tributary, due to the constraints of the site (WRM 2026). Fish passage is not a key consideration for the proposed clean water drain, as it does not connect to fish habitat upstream of the Project area. Notwithstanding, the clean water drain would incorporate a number of deeper pools to provide refuge to fish attempting to inhabit or pass through it.

Flood levees, constrained flow and increased flow velocities

Flood levees, built to contain 1 in 1,000-year flood events, would be positioned between Taurus Creek and the proposed pits and between Deep Creek and the proposed pits (WRM Water and Environment Pty Ltd [WRM] 2026). These levees would constrain flood flows within Taurus and Deep creeks during mining operations, increasing flood flow velocities to varying degrees.

The floodplains of Deep and Taurus creeks would likely be constrained adjoining the proposed open cut pits. However, the flood levees would be sloped and constructed with a rough earthen surface. Accordingly, these reaches are expected to still provide areas of low to no flow on the outer extremities to allow for fish passage and resting opportunities under all low, moderate and high flow conditions.

Waterway crossings

Waterway crossings would be constructed on a Moderate risk reach of Deep Creek (site R10 in Figure 6) and on a High risk reach of Taurus Creek (site R11 in Figure 6). These crossing locations are indicative and may be changed during the design process. Other Low and Moderate risk waterways (Figure 6) may also require either temporary or semi-permanent crossings as part of the Project, such as for development of the Proposed Infrastructure Area ahead of development of the proposed pits (Figure 6).

Of the stream crossing options available, bridges – especially those without instream support sections – would have the least impact on fish passage. It is anticipated that a culvert or ford crossing would be installed at the crossing of Deep Creek and any other waterways field verified as being at Low or Moderate risk of impact to fish passage that may require temporary or semi-permanent crossings as part of the Project (Figure 6).

Poorly designed waterway crossings can create a barrier to fish passage, restricting and/or isolating fish communities and preventing access to fish habitats otherwise available to them. Poorly designed structures can kill or injure fish moving over or around them or can cause fish to become stranded and subjected to poor water quality, lack of food, increased predation, crowding or other conditions that can impact their health, wellbeing and productivity.

Queensland policy and guidance material for waterway barrier works centres largely around the Queensland *Planning Act 2016*, which does not strictly apply to development authorised under the *Mineral Resources Act 1989*. Notwithstanding, the policies and guidance material help to achieve proper consideration of on-lease ecological values.

The Project would require crossings of waterways. However, the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage given waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b).

The detailed design and construction of each waterway crossing will involve an assessment against DPI (2025b), which is beyond the scope of this aquatic ecology and GDE assessment.

5.3 Release of mine-affected water

The Project includes the controlled release of mine affected water in accordance with the conditions of EA EPML00717813 (as amended).

5.3.1 Existing Environmental Authority release conditions

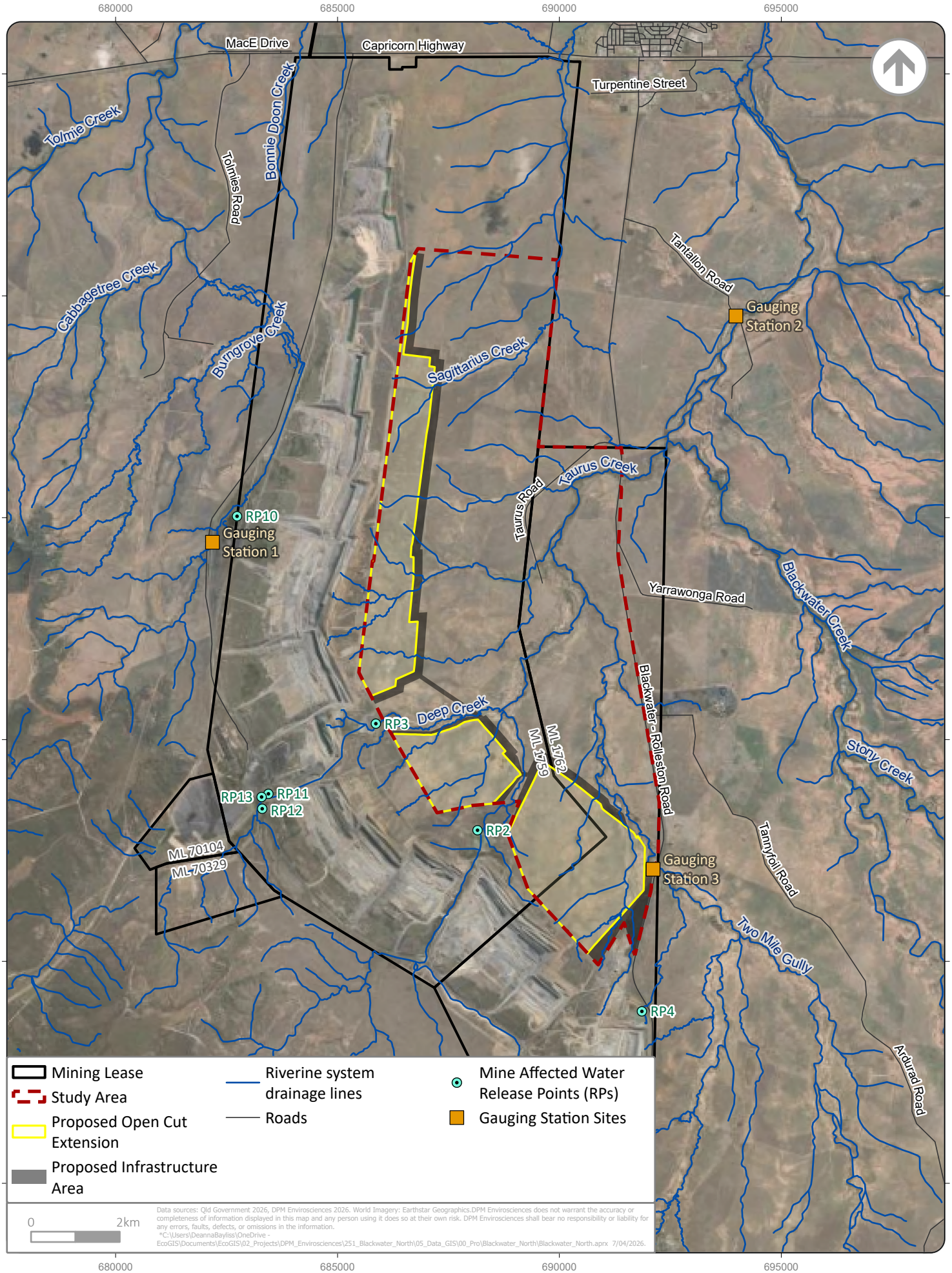
The existing EA includes 11 RPs; three of which are relevant to the Study Area: RP2 (Taurus Dam), RP3 (Deep Creek Dam) and RP4 (Tannyfoil Dam) (Figure 29). These dams are able to release both actively via a gate valve and passively via the spillway.

The existing EA permits the release of mine-affected water with an EC of up to 10,000 µS/cm (being slightly to moderately saline water) from RP3 and RP2 into the second order Deep Creek and fourth order Taurus Creek, respectively, when flows of ≥ 1 cubic metres per second (m^3/s) are encountered 18 km downstream at Gauging Station 2 on the fifth order Blackwater Creek (Figure 29). The existing EA allows for mine-affected water releases to commence when flows at this downstream gauging station exceed ≥ 1 m^3/s. Releases may then continue for up to 28 days, even when flows then fall below the 1 m^3/s, providing that the 80th percentile of EC levels at this downstream gauging station remain below 2,000 µS/cm throughout the release. The existing EA permits the same releases from RP4 into a first order tributary of Two Mile Gully when flows encountered approximately 5 km downstream at Gauging Station 3, on the fourth order Two Mile Gully, exceed ≥ 1 m^3/s.

The existing EA conditions allow for mine-affected water releases into Deep and Taurus creeks when the downstream, and much larger, Blackwater Creek is flowing, but when Deep and Taurus creeks are not necessarily flowing themselves. Such releases have the potential to impact the health and integrity of Deep and Taurus creeks and their ecosystem components, including aquatic ecosystems as well as terrestrial GDEs. The existing EA conditions allow Deep and Taurus creeks (from RP2 and RP3) to be used as conduits for slightly to moderately saline mine--affected water of up to 10,000 µS/cm until these flows reach Blackwater Creek approximately 14 km downstream. The existing EA conditions also allow the tributary of Two Mile Gully between RP4 and Two Mile Gully to be used as a conduit for this mine-affected water.

5.3.2 Changes to Environmental Authority release conditions

It is understood that releases of mine-affected water from Taurus and Deep Creek dams are proposed to continue consistent with the existing EA conditions (EA EPML00717813; DETSI 2025a).The Water Balance Assessment Report (HydroBalance 2026) indicates that the Project would result in relatively small increases to annual release volumes, including an 11-20% increase during median climatic conditions, up to a 7% increase during wet climatic conditions (tenth percentile) and a 2-4% increase during very wet (fifth percentile) climatic conditions (HydroBalance 2026). Release water quality is not expected to change as a result of the Project (HydroBalance 2026). Despite the relatively small increase to annual release volumes, the approved controlled release strategy is sufficient for maintaining excess mine-affected water volumes at BWM (HydroBalance 2026). There are no proposed changes to the currently approved controlled release strategy as a result of the Project (HydroBalance 2026). Accordingly, the release of mine-affected water from the Project is not anticipated to affect the receiving environment beyond existing impacts/conditions already approved under the existing EA for BWM.



EXISTING EA EPML00717813 MINE-AFFECTED WATER RELEASE POINTS AND GAUGING STATIONS

Blackwater North Extension Project - Aquatic Ecology and GDE Assessment

FIGURE 29

5.4 Changes in surface water

Surface water flows and quality are relevant to the health and productivity of aquatic ecosystems. The following sections discuss surface water and potential impacts of the Project on surface water from an ecological perspective. This section draws on the key conclusions from the *Surface Water Assessment* (WRM 2026) for the Project.

5.4.1 Surface water flow

Development of the open cut pits would remove several first and second order (based on Strahler 1952) waterways that are tributaries of Taurus Creek, and the upper reaches of three first order tributaries of Sagittarius Creek.

The Project would result in an approximate 8.9% reduction of the Taurus Creek catchment and a 7.9% reduction of the Sagittarius catchment, associated with capture of upstream catchment areas within the open cut pits (WRM 2026). While the reduction in Taurus Creek catchment area is slightly greater, the reduction in the Sagittarius Creek catchment is also material and therefore potential flow impacts to Sagittarius Creek are not necessarily negligible and require consideration in the context of overall hydrological behaviours.

A flow duration curve prepared for Taurus Creek, at the Taurus Creek downstream gauge near the downstream extent of the Study Area, shows that Taurus Creek is ephemeral, with flows >1 megalitre per day occurring less than 10% of the time (WRM 2026). The flow duration curve for both existing and Project conditions indicate only minor changes in the magnitude and frequency of flows under most flow conditions (WRM 2026). Whilst the Project may change the magnitude of peak flows marginally, the duration of flows in the Taurus Creek main channel would not be materially changed (WRM 2026).

A diversion of an unnamed tributary of Two Mile Gully is proposed within the Project area and is referred to as the proposed clean water drain. This flow would be diverted along the south-eastern margin of the Stewarton Pit to accommodate Project mining activities. Hydraulic modelling indicates the proposed clean water drain would safely convey flows up to and including the 0.1% AEP event, while maintaining an ephemeral, event-driven flow regime consistent with baseline conditions. Predicted changes to flow velocities and stream power would remain well within accepted stability thresholds (WRM 2026).

Further details regarding potential impacts to flows are outlined in the *Surface Water Assessment* (WRM 2026). Overall, notwithstanding the reduction in contributing catchment area, the Project is not expected to fundamentally alter the flow regime characteristics of the remaining waterways within the Project area and broader Study Area. Consequently, adverse impacts to aquatic ecology arising from changes in flow as a result of the Project are expected to be low.

5.4.2 Flood regimes

Protecting the open cut pits from flood ingress from Taurus and Deep creeks will require the construction of flood protection levees. Hydrologic and hydraulic modelling has been undertaken for a range of Annual Exceedance Probability (AEP) events under baseline (existing conditions), during mining and post-mining scenarios (WRM 2026). The events modelled for each scenario are summarised in Table 26.

Table 26 Flood Events Modelled for Baseline, During Mining and Post-Mining Scenarios (WRM 2026)

Mine Stage	Modelling Undertaken					
	50% AEP	5% AEP	2% AEP	1% AEP	0.1% AEP	PMF
Baseline (existing conditions)	✓	✓	✓	✓	✓ [a]	x
During Mining	✓	✓	✓	✓	✓	x
Post-Mining	x	x	x	✓	✓	✓

The modelling scope varies between scenarios to reflect the phase-specific flood, operational requirements and the progressive landform development.

The hydraulic modelling assessed potential changes in flood extent, depth, velocity and afflux associated with the construction of levees and post-mining landforms. The results (WRM 2026) indicate that:

- Predicted increases in peak flood levels are generally minor and contained on-lease for all events up to the 0.1% AEP.
- Increases in peak flood levels are generally less than 0.1 m and peak velocities are generally less than 0.5 m/s across the floodplains within the Project area.
- Increases in peak flood levels greater than 0.1 m and peak velocities greater than 0.5 m/s are generally localised to areas adjacent to the proposed levees, and along the Taurus Creek temporary diversion.
- Predicted velocities and stream power along the proposed clean water drain is predicted to be higher than the existing tributary (under existing conditions); however, would remain within accepted thresholds.

Potential impacts to aquatic flora and fauna are likely to be restricted to changes in flood levels during rare significant flood events (i.e. when the flood protection levees/landforms influence stream levels). Further details regarding potential impacts to flood regimes are outlined in the *Surface Water Assessment* (WRM 2026). Given changes in flood regimes are restricted to localised changes in flood levels during floods, adverse impacts on aquatic ecology are expected to be insignificant.

5.4.3 Surface water quality

Erosion and sedimentation within the Project Area can lead to locally increased dissolved and suspended solids, turbidity, nutrients and contaminants, and reduced DO levels in surface waters. Leaks or spills of hydrocarbon-based fluids from construction equipment and spread of coal dust can also affect surface water quality.

High levels of turbidity can reduce light penetration, photosynthesis and growth of aquatic macrophytes and algae, affecting aquatic ecosystem food chains. Reduced light penetration can also reduce the photosynthetic release of oxygen by these plants and algae, reducing productivity and the extent of habitable conditions available to aquatic fauna. Changes in water quality can also affect the behaviour of aquatic biota (including avoidance response, and reduced foraging) and physiology (including gill damage to fish or reduced efficacy of cloacal respiration in turtles) associated with increased suspended sediment concentrations and deposition. Increased salinity and contaminants such as metals and hydrocarbons can affect the health, reproduction and persistence of aquatic flora and fauna. Increased nutrients can lead to increased or excessive aquatic plant and algal growth, leading to extremes in diurnal DO levels, and in some cases eutrophication and fish kills. These changes in water quality can lead to changes in aquatic and riparian ecological health and community assemblages. The severity of these changes are influenced by the type, concentration and volume of suspended sediments, nutrients, salts and contaminants, along with environmental factors such as dilution and existing exposure levels.

In the absence of suitable controls, potential impacts to surface water quality as a result of the Project would include:

- Ground disturbance associated with vegetation clearing and earthworks may expose dispersive subsoils, increase erosion potential, or impact stream bank stability, which may impact surface water quality (particularly turbidity and suspended sediments).
- Surface water runoff from mine-affected areas may mobilise contaminants into downstream waterways.
- Dust and other airborne particulate matter may enter waterways and increase turbidity, sedimentation, nutrients and contaminants in downstream or other nearby waterways.
- Leaks or spills of hydrocarbon-based fluids from vehicles and equipment used during the Project may spill and enter waterways, impacting water quality.
- Uncontrolled releases of mine-affected water may adversely impact on receiving water quality.
- Continued releases of mine-affected water from Taurus and Deep Creek dams (Section 5.3) in accordance with existing EA conditions (EA EPML00717813; DETSI 2025a), which allows for the release of mine-affected water of up to 10,000 µS/cm (being slightly to moderately saline water), may adversely impact on receiving water quality in Deep Creek and the upper reach of Taurus Creek (until it is diluted in the lower reach of Taurus Creek).

Notwithstanding the above, impacts of the Project on existing water quality are expected to be minimal given the Project is a continuation of existing mining at BWM, with the Project largely utilising existing infrastructure and operating under existing EA conditions. By implementing the mitigation and management measures identified in Sections 6.2 and 6.3, the risk of adverse impacts to the water quality of waterways downstream of the Project is minimal.

5.5 Proliferation of aquatic pests

Aquatic pests, such as invasive pest fishes, can cause a variety of issues within the aquatic environment, such as competing with native fish for food and habitat, preying on native species, habitat disturbance and introduction of disease. Typically, established introduced species have a wide range of environmental tolerances, habitat requirements and food requirements. In addition, they tend to have high reproductive rates and be early maturing, allowing populations to become readily established. These attributes often allow introduced fishes to be more adaptable to changes in the environment, whether natural or manmade, than some native fish species.

The Project is unlikely to result in the addition of new aquatic flora or fauna pest species, nor the growth and spread of aquatic pest species. The Project does not involve the diversion of waterways into adjacent catchments (i.e. beyond the Blackwater Creek catchment) and will not create additional habitat for invasive species. Weed prevention, monitoring and control will continue to be undertaken across the broader BWM to mitigate the number and abundance of weeds. Weed hygiene protocols will continue to be implemented using the dedicated vehicle and machinery cleaning bay located at the Mine Infrastructure Area. Given the controls in place, risks are expected to be low.

5.6 Changes to groundwater-dependent ecosystems

No obligate GDEs are present. Baseline studies confirmed the occurrence of opportunistic facultative terrestrial GDEs within the Study Area (Section 4.8.3). No surface expression or subterranean GDEs were detected within the Study Area, nor are they likely to occur. If present (and undetected), it is likely that any surface expression GDEs would be opportunistic, utilising small inputs of groundwater on occasion, but persisting without this input. Most of the aquatic

biota of the Study Area is adapted to living in ephemeral waterways, reducing the potential risk of impacts to surface expression GDEs should they occur.

The following sections focus on potential impacts of the Project on facultative terrestrial GDEs known to occur within the Project area.

5.6.1 Impact mechanisms

No direct impacts to field-verified facultative GDEs are proposed. Indirect impacts of mining activities are typically associated with reduced surface water recharge, increased groundwater drawdown, and changes in groundwater quality.

Surface water recharge

Groundwater is expected to occur in the shallow alluvium of Taurus Creek as ephemeral, discontinuous perched aquifers in sandier material; with clayey material forming aquitards. The alluvial sediments are expected to be of limited extent and thickness but are episodically recharged by rainfall run-off when Taurus Creek hosts water, resulting in the presence of perched aquifers associated with the alluvium. Pre-dawn LWP measurements in the post-wet season (June 2025) demonstrated that some trees within the Taurus Creek riparian and floodplain corridor were accessing groundwater, likely from a perched alluvial aquifer. Pre-dawn LWP measurements of these same trees (and additional trees) in the pre-wet season (October 2025) demonstrated that none of these trees were accessing groundwater, as the perched alluvial aquifer had likely dried and the deeper tertiary aquifer was likely too deep for these trees to access.

The discontinuous perched aquifers that support opportunistic terrestrial GDEs of the Study Area are recharged by surface flows in Taurus Creek. WRM (2026) has determined that the impact of the Project on the magnitude of flows in Taurus Creek is insignificant and that the duration of flows in the Taurus Creek main channel would not be materially changed (WRM 2026). Consequently, the terrestrial GDEs of the Study Area are unlikely to be affected by the Project.

Groundwater drawdown

Dewatering and depressurisation would result in groundwater drawdown in the regional groundwater table, especially to aquifers near proposed open cut pits.

Dewatering unconfined aquifers can lower the water table to a depth that is inaccessible to tree roots. Terrestrial vegetation that once accessed shallow groundwater in drier times when soil water was not available can begin to show signs of impairment if groundwater levels fall too low. The response of vegetation to this water stress may result in dieback almost immediately or may take years to become obvious (Doody, Hancock and Pritchard 2019).

Changes to subsurface flow paths (by pumping water from mine pits or when groundwater drains through the walls and floors of mine pits) can alter the direction and velocity of groundwater flow, resulting in water moving away from a GDE and towards the extraction point.

Groundwater drawdown in the tertiary and deeper aquifers of the Study Area is unlikely to be of consequence to the terrestrial GDEs of the Study Area, as field surveys have demonstrated that these trees are unlikely to be accessing these regional groundwater aquifers (Section 4.8.3). Consequently, terrestrial GDEs of the Study Area are unlikely to be impacted by groundwater drawdown resulting from the Project.

Change in groundwater water quality

Reduced groundwater volumes and flows in the deeper aquifers can lead to reduced groundwater quality. This can be due to evaporative concentration of salts in mine voids, induced flow of groundwater of reduced quality towards depressurised zones, infiltration of water containing elevated concentrations of dissolved solids, sulphate and metals from waste rock emplacements and mine water storages, or from unintended leaks or spills. However, the discontinuous perched aquifers that support opportunistic terrestrial GDEs of the Study Area are recharged by surface flows in Taurus Creek. The Project is not expected to alter the duration of flows in Taurus Creek, and modelling indicates that changes to flow magnitude would be minor and not ecologically significant.

The facultative terrestrial GDEs of the Study Area are unlikely to be affected by changes in groundwater quality in the deeper aquifers, as field surveys have demonstrated that these trees are unlikely to be accessing these deeper aquifers (Section 4.8.3). Groundwater quality in the shallow perched alluvial aquifers is likely to continue to mirror surface water quality (Section 4.2.2). WRM (2026) identify that release water quality is not expected to change as a result of the Project and determined that impacts on surface water quality in Taurus Creek would be mitigated by adhering to the approved controlled release strategy. The approved controlled release strategy is sufficient for maintaining excess mine-affected water volumes at BWM. There are no proposed changes to the currently approved controlled release strategy as a result of the Project. (WRM 2026). Consequently, groundwater quality in the shallow perched alluvial aquifers is unlikely to be impacted by the Project.

5.6.2 Terrestrial groundwater-dependent ecosystem – Taurus Creek riparian vegetation

Ecological value

The facultative terrestrial GDE comprising riparian (including floodplain) vegetation of Taurus Creek would likely exist without groundwater input but is known to utilise groundwater on occasion (episodic or opportunistic GDEs, not obligate GDEs). Notwithstanding, these vegetation communities form potential habitat for the Endangered (EBPC Act and NC Act) folivorous koala (*Phascolarctos cinereus*) (E2M 2026) and likely provide higher nutrient and leaf moisture levels than surrounding vegetation not able to access groundwater in drier times. Consequently, this terrestrial GDE is attributed a HEV (Category 1 sensitive environmental area) in accordance with the criteria adopted for this assessment (Section 3.4.2).

Impacts

No direct impacts (i.e. clearing) of terrestrial GDEs is proposed. The Project is unlikely to impact the perched alluvial aquifers of Taurus Creek (Section 5.6.1). Consequently, indirect impacts on terrestrial GDEs associated with this aquifer are unlikely. Impacts to the terrestrial GDE comprising riparian/floodplain vegetation of Taurus Creek have been assessed against the impact criteria identified in the *Risk Assessment Guidelines for GDEs* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019). Impacts to the integrity of this terrestrial GDE are considered unlikely based on the majority rule as per Serov, Kuginis and Williams (2012) (Table 27).

Magnitude of risk

The magnitude of risk is determined to be Low when assessed against the criteria identified in the *Risk Assessment Guidelines for GDEs* (Serov, Kuginis and Williams 2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019) (Table 28).

Table 27 Potential impacts of the Project on the perched alluvial aquifers and associated terrestrial GDEs of Taurus Creek (as per Serov, Kuginis and Williams 2012)

Impacts	Likely	Unlikely	Insufficient data
Water quantity impacts			
Will there be an alteration to the water table levels (rising or dropping water tables)?		✓	
Will there be any alteration to the aquifer flow paths?		✓	
Will there be any alteration of aquifer discharge volume to off-site GDEs?		✓	
Will there be an alteration of the frequency/timing of water table level fluctuations?		✓	
Will there be an alteration of surface river base flow?		✓	
Will there be a reduction in artesian/spring water pressure?		✓	
Water quality impacts			
Will there be an alteration to the natural groundwater chemistry and/or chemical gradients?		✓	
Will acid sulphate soils be exposed, resulting in the acidification of groundwater source and acid runoff?		✓	
Will there be an alteration in nutrient loads?		✓	
Will there be an alteration in sediment loads?		✓	
Will there be an alteration in groundwater salinity levels?		✓	
Will there be an alteration in groundwater temperatures?		✓	
Will there be any bioaccumulation of heavy metals?		✓	
Soil and geo-morphological impacts			
Will there be any substrate alteration or compaction; e.g. aquifer, river gravel bed compaction by heavy machinery or over extraction of water?		✓	
Will there be any cracking or fracturing of the bedrock?		✓	
Biological impacts			
Will there be an alteration to the number of native species (i.e. richness) within the groundwater-dependent communities (fauna and flora)?		✓	
Will there be an alteration to the species composition (i.e. diversity) of the groundwater-dependent communities (fauna and flora)?		✓	
Will exotic flora or fauna be introduced?		✓	
Will there be any removal or alteration of a GDE type/subtype habitat?		✓	
Totals	**0**	**19**	**0**
Impact is unlikely (based on the majority rule as per Serov, Kunis and Williams, 2012)			

Table 28 Magnitude of risk of the Project impacting the perched alluvial aquifers and associated terrestrial GDEs of Taurus Creek (as per Serov, Kuginis and Williams 2012)

Risk factors	High	Mod.	Low	ID*	Justification for risk rating
Water quantity asset					
What will be the risk of a change in groundwater levels/pressure on GDEs?			✓		No change to aquifer water levels or pressure.
What will be the risk of a change in the timing or magnitude of groundwater level fluctuations on GDEs?			✓		No change in timing of water level fluctuations.
What will be the risk of changing base flow conditions on GDEs?			✓		No change in direction of flow.
Water quality asset					
What is the risk of changing the chemical conditions of the aquifer?			✓		Negligible change (<5%).
What is the risk on the aquifer by a change in the salt/freshwater interface?			✓		Not applicable.
What is the likelihood of a change in beneficial use of the aquifer?			✓		Negligible change (<5%).
Aquifer integrity asset					
What is the risk of damage to the geologic structure?			✓		No change.
Biological integrity asset					
What is the risk of alterations to the number of native species (i.e. richness) within the groundwater--dependent communities (fauna and flora)?			✓		No reduction in number of species.
What is the risk of alterations to the species composition (i.e. diversity) of the groundwater--dependent communities (fauna and flora)?			✓		No change in species composition.
What is the risk of increasing the presence of exotic flora or fauna?		✓			Little to none.
What is the risk of removing or altering a GDE subtype habitat?			✓		No removal or alteration of habitat.
Total number of attributes	0	1	10	0	
Overall risk	**Low (based on the majority rule as per Serov, Kunis and Williams, 2012)**				

Notes: *ID = Insufficient Data

Application of risk matrix to determine management actions

Terrestrial GDEs comprising riparian (and floodplain) vegetation of Taurus Creek are of HEV but subject to a Low magnitude of risk from Project activities in accordance with Serov, Kuginis and Williams (2012), as referred to in the *Information Guidelines Explanatory Note: Assessing GDEs* (Doody, Hancock and Pritchard 2019). The risk matrix (Table 4, Section 3.4.5) therefore places this terrestrial GDE in the 'A' box, with the relevant management actions identified as (Serov, Kuginis and Williams 2012):

- short-term – protection measures for the aquifer and GDEs, and baseline risk monitoring;
- mid-term – continue protection measures for aquifers and GDEs, and periodic monitoring and assessment; and
- long-term – adaptive management, and continued monitoring.

Considering that impacts to this terrestrial GDE are unlikely, key measures would instead comprise the avoidance of both direct and indirect impacts on terrestrial GDEs.

5.7 Final landform

Final landform modelling for the Project indicates that the final landform would be stable and flood flows will be free draining (WRM 2026). At the conclusion of mining, final voids would remain. Three of these final voids are predicted to become long-term sinks and the remaining two are predicted to be flow through systems reporting to those long-term sinks (SLR 2026). These voids are not predicted to overflow into the environment (WRM 2026). Results of the flood modelling indicate that the proposed final landform design prevents flood ingress to the final void for events up to the 0.1% AEP event. Overall, the final landform is expected to be safe, stable, and with no adverse impacts to surrounding surface water quality or flood behaviour.

5.8 Evaluation of impacts on Matters of National Environmental Significance

The EPBC Act lists 'a water resource, in relation to coal seam gas development and large coal mining development' as an MNES. An assessment of the impacts on water resources is outside the scope of this assessment.

5.9 Evaluation of impacts on Matters of State Environmental Significance

No HES wetlands or HEV waterways are present within or in the vicinity of the Study Area. No aquatic MSES flora or fauna species have been recorded from the Study Area, nor are they likely to occur within or in the vicinity of the Study Area given the lack of suitable habitat. Waterways Providing for Fish Passage is the only MSES relevant to aquatic ecology that is known to occur in the Study Area or surrounds that may be subject to impacts from the Project.

The *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (DEHP 2014) is used to determine if a prescribed activity would have a significant residual impact on MSES. A significant residual impact is defined as an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

a) remains, or will or is likely to remain (whether temporarily or permanently), despite on-site avoidance and mitigation measures for the prescribed activity; and

b) is, or will or is likely to be significant.

Potential impacts on the MSES Waterways Providing for Fish Passage are discussed below.

5.9.1 Waterways providing for fish passage

Most waterways that would be removed for mining within the Project footprint are mapped as having Low and Moderate risk of impact to fish passage in the Waterway Barrier Works mapping layer (Figure 6, Section 4.1.3). While the Project would remove waterways and wetlands (small farm dams) that provide fish habitat within the Proposed Project Area and Infrastructure Area, it would not fragment fish habitat as these waterways do not connect to fish habitat further upstream.

Approximately 3.9 km of an unnamed tributary of Two Mile Gully would be replaced by an approximate 2.4 km clean water drain within the Project area (Figure 3, Section 3.6.1). This tributary of Two Mile Gully is State mapped (DPI 2025a) as being at High risk (third order) of adverse impact from waterway barrier works on fish movement (Figure 6), although would be considered only Moderate risk (second order) if considering the Emu Creek diversion already in place upstream. Fish passage is not a key consideration for the proposed clean water drain, as it does not connect to fish habitat upstream of the Project area. Notwithstanding, the channel of the proposed clean water drain would incorporate a number of deeper pools to provide refuge to fish attempting to inhabit or pass through it.

At least two semi-permanent waterway crossings for vehicles would be constructed, including a crossing of the State-mapped Moderate risk Deep Creek and a crossing of the State-mapped High risk Taurus Creek. Culvert or ford crossings would be installed at the other crossings of waterways field verified as being at Low or Moderate risk of impact to fish passage.

Fish passage would be considered and maintained at each of these crossings. As described in Section 5.2, waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b).

Fish passage requirements associated with the waterway barrier works (a dam, weir or other barrier across a waterway) are considered in relation to impacts on MSES. An assessment of the potential impacts on this MSES, in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (DEHP 2014) is provided in Table 29. The assessment concludes that the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage on the basis that waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b). Accordingly, offsets are not triggered for this matter.

Table 29 Waterways Providing for Fish Passage Significant Residual Impact Assessment

Criteria	Assessment/Consideration
An action is likely to have a significant impact on a waterway providing fish passage if there is a real possibility that the action will:	
Result in the mortality or injury of fish	The Project is unlikely to result in barriers that cause the mortality or injury of native fish because: ▪ waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b), so as not to create a barrier to fish movement; ▪ the proposed clean water drain would incorporate a number of deeper pools to provide habitat and refuge for fish inhabiting or attempting to pass through it; ▪ native fish encountered in waterbodies (dams) that are dewatered would be relocated in accordance with a General Fisheries Permit or equivalent; and ▪ the reaches of Deep and Taurus creeks constrained by the proposed open cut pits and their flood levees would still provide areas of low to no flow on the outer extremities to allow for fish passage under all flow conditions (Section 5.2).
Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish.	The Project is unlikely to result in conditions that would substantially increase risks to the health, wellbeing and productivity of fish seeking passage because: ▪ waterway crossings would be constructed so as not to create a barrier to fish movement; ▪ the Project is unlikely to lead to substantial changes in water quality parameters beyond existing conditions; and waterways constrained by proposed flood levees are still expected to provide areas of low to no flow on the outer extremities to allow for passage of all fish species under all flow conditions (Section 5.4.2).
Reduce the extent, frequency or duration of fish passage previously found at a site.	The Project would directly remove or otherwise alter the extent of an aggregate 22.3 km of Low risk waterways, 2.8 km of Moderate risk waterways and 3.9 km of High risk waterway (Figure 6). The frequency and duration of fish passage would decrease downstream of these removed waterways, owing to the reduced catchment area. These waterways are of relatively low ecological value (Section 4.2.6). These waterways are highly ephemeral; therefore, fish habitat and passage are restricted to periods during and immediately following rainfall. These waterways do not connect to important fish habitat upstream, given upstream reaches are within existing active mining areas. As such, the Project would remove these waterways providing fish habitat within the Project and Infrastructure areas, but would not fragment fish habitat in these waterways as they do not connect to fish habitat further upstream.

Criteria	Assessment/Consideration
	The Project involves the construction of two internal road crossings across Deep and Taurus creeks adjacent to the Deep Creek open pit. Deep and Taurus creeks are indicated as Moderate and High risk waterways in the DPI (2025a) Queensland Waterways for Waterway Barrier Works mapping in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b). The two proposed road crossings would be designed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b) to facilitate fish passage along Deep and Taurus creeks. The Project is not expected to reduce the frequency or duration of fish passage within Two Mile Gully (WRM 2026).
Substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish.	The waterways of the Project area are not known to constitute any rare, unique or particularly important habitats or features essential for the breeding and/or survival of the native fish species known to utilise this area. Waterways verified as low stream order (1 or 2) would be removed or otherwise impacted by mining activities (Section 5.2; Figure 6). These waterways are highly ephemeral and are not considered to constitute, nor provide a conduit to, fish habitat areas essential for the breeding and/or survival of native fish. Waterway crossings would be positioned on Deep and Taurus creeks. Fish passage would be maintained between existing upstream and downstream habitats because these waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b).
Result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows.	Surface water hydrology would be altered by the Project as a result of removing waterways, capturing water in pits or dams, water loss due to use for Project operation or pond evaporation. However, the volume, depth, timing, duration and frequency of flows would continue to reflect the ephemeral and variable flow nature of the waterways of the Project area. The Project is considered unlikely to result in a substantial and measurable change in the existing hydrological regime of the waterways draining the Project area. The seasonality of fish movements is unlikely to be affected.
Lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues to movement in local fish species.	The Project is unlikely to lead to substantial changes in water quality parameters beyond existing conditions. Any water releases required by the Project would be managed in accordance with the EA Conditions (as amended). The risk of deteriorating water quality would be mitigated by monitoring and maintaining receiving environment and release water quality and quantity in accordance with the EA Conditions (as amended).

The assessment concludes that significant residual impacts on this MSES are unlikely. Accordingly, offsets are not triggered for this matter.

6 AVOIDANCE AND MITIGATION MEASURES

Consistent with DETSI's management hierarchy, the mitigation strategy for the Project has focused on a hierarchy of:

1. avoidance;
2. minimisation;
3. mitigation; then
4. offset residual impacts.

The avoidance or minimisation of adverse impacts is most relevant to the design phase of the Project, where information collected through desktop analysis and field surveys can be incorporated into the planning and preliminary engineering work (Section 6.1). The mitigation of impacts and the implementation of monitoring and management plans are most relevant to the construction and operational phases of the Project. Table 30 provides a summary of the mitigation measures for the Project, with a brief description of potential impacts and measures that can be implemented during the construction and operational phases of the Project.

The requirement for environmental offsets has not been triggered by aquatic MNES or MSES.

6.1 Measures to avoid and minimise impacts

The following measures would be implemented to avoid and/or minimise impacts on aquatic ecology and GDEs:

- Where possible, waterways have been avoided in the mine design. The larger waterways in the Study Area, comprising of Deep Creek, Taurus Creek and Two Mile Gully do not require diversion.
- The construction of waterway crossings would be scheduled to coincide with periods of no to low flow, where possible.
- Direct impacts (such as clearing for drilling or access tracks) would avoid terrestrial GDEs along Taurus Creek.

6.2 Impact mitigation

Mitigation measures proposed to be implemented for the Project are detailed in Table 30.

Table 30 Mitigation measures

Potential impact	Mitigation measures

1. Aquatic habitat clearing	▪ Clearing of native vegetation undertaken progressively over the life of the mine and only in areas required for mining activities within the following year. This would have the effect of minimising the area of exposed land and associated sedimentation risk.
	▪ Update and implement the existing Environmental Management Plan (or equivalent) for the Blackwater Mine to include vegetation management measures relevant to Blackwater North, including:
	  ▪ demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing; and
	  ▪ clearing of native vegetation to be undertaken progressively.
	▪ Update the BWM Erosion and Sediment Control Plan (Section 6.3) to include reference to the Project.
	▪ Update and implement the existing Environmental Management Plan (or equivalent) for the Blackwater Mine to include fauna species management measures relevant to Blackwater North, including:
	  ▪ use of suitable fauna spotter-catchers for relocation of animals, including any native fish or turtles during dewatering of any waterways (pools) and farm dams;
	  ▪ salvage of microhabitat features (e.g. logs and boulders) from waterway crossing construction footprints and reinstatement immediately downstream.
	▪ Progressive and timely re-instatement and rehabilitation of the disturbed landform consistent with the rehabilitation criteria in EA EPML00717813 (as amended).

2. Increased numbers of pests	▪ Identify and treat aquatic weed infestations that may arise within the Study Area. ▪ Implement strategies for preventing the spread of aquatic weeds and pest fish, including machinery (e.g. excavator) wash-down on arrival, and before entering, the Study Area.
3. Creating a barrier to fish passage	▪ Design and construct waterway crossings consistent with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b). ▪ Incorporate a number of deeper pools into the channel of the proposed clean water drain design to provide habitat and refuge for fish inhabiting or attempting to pass through it. ▪ Where possible, construct waterway crossings in the drier months of the year when surface water flows (and aquatic fauna) are less likely to be encountered.
4. Alteration to surface water quality and/or quantity	▪ Where possible, construct waterway crossings in the drier months of the year when surface water flow (and associated risk of impacting water quality) is less likely to be encountered. ▪ Clearing of native vegetation would be undertaken progressively over the life of the mine and only in areas required for mining activities within the following year. This would have the effect of minimising the area of exposed land and associated sedimentation risk. ▪ Refuel and maintain machinery in designated locations away from waterways. Use machinery that is regularly serviced in accordance with the manufacturer's recommendations. Familiarise operators with the spill response procedure for the BWM. ▪ Update the BWM Erosion and Sediment Control Plan (Section 6.3) to include reference to the Project. ▪ Update the BWM Water Management Plan (Section 6.3). ▪ Continued monitoring of surface water quality for receiving water in accordance with the EA. ▪ Update and implement the Fitzroy Regional Receiving Environment Monitoring Program for the BWM, to incorporate the Project.

6.3 Management plans

The existing management plans which would be updated to include the mitigation measures identified in Table 30 above for are:

- BWM Erosion and Sediment Control Plan (Whitehaven Blackwater 2022);
- BWM Land and Biodiversity Management Plan (Whitehaven Blackwater 2020); and
- BWM Water Management Plan (Whitehaven Blackwater 2023).

7 CONCLUSION

The waterways of the Study Area are predominantly first and second order tributaries, with some reaching up to fourth order, including Two Mile Gully and Taurus Creek. Two Mile Gully flows into Taurus Creek, which then flows north into the fifth order Blackwater Creek downstream of the Study Area. Mapped wetlands are comprised of lacustrine wetland waterbodies and include farm dams and two mine water dams (Deep Creek Dam and Taurus Dam). Several smaller, unmapped lacustrine wetland waterbodies (farm dams and a riverine flood channel wetland) also occur.

The waterways of the Study Area are ephemeral and are expected to experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are highly variable, with most channels expected to dry during winter to early spring when rainfall and runoff is historically low. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to vary seasonally.

No conservation-significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded from the Study Area. Due to habitat requirements and distributional range, it is unlikely that any conservation-significant aquatic flora or fauna species occur within the waterways or wetlands of the Study Area as either resident or transient occurrences.

There are no wetlands of International Importance or National Importance identified within the Study Area.

MSES relevant to this aquatic ecology assessment comprise waterways providing for fish passage, which is an MSES only if waterway barrier works are proposed that would limit the passage of fish along the waterway. While the upper extent of several low order (stream order 1 and 2) waterways would be removed for mining, these waterways do not connect to important fish habitat upstream, given upstream reaches are within existing active mining areas. Therefore, their removal would not fragment fish habitat in these waterways as they do not connect to fish habitat further upstream.

Waterway crossings would be positioned on retained waterways Deep Creek and Taurus Creek. Fish passage would be maintained between existing upstream and downstream habitats because these waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DPI 2025b).

No stygofauna have been identified from the stygofauna pilot survey and there is no evidence of stygofauna having previously been detected within the Focus Area.

Given Taurus Creek is subject to continuous natural wetting and drying cycles, the riparian vegetation (dominated by coolibah [*Eucalyptus coolabah*]) likely accesses available moisture in the soil/sediment following rainfall, runoff and flow, and accesses available shallow groundwater in the alluvial aquifer for short periods in drier times. The facultative terrestrial GDEs associated with this aquifer would likely be opportunistic, utilising small inputs of groundwater in the alluvial aquifer on occasion, but likely persisting without this input.

The alluvial aquifer of Taurus Creek is recharged by surface flows within Taurus Creek. The *Surface Water Assessment* for the Project (WRM 2026) indicates that, notwithstanding the 8.9% reduction in the contributing Taurus Creek catchment area during mining, the Project is not expected to materially alter the overall magnitude, duration or frequency characteristics of flows within Taurus Creek. Accordingly, recharge processes to the alluvial aquifer are anticipated to be maintained. On this basis, potential impacts to terrestrial GDEs associated with perched alluvial aquifers are expected to be low.

With effective implementation of mitigation and management measures presented in Section 6 of this report, the Project is unlikely to result in significant impacts on aquatic ecosystem values, including aquatic MNES or MSES.

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Appendix A: EPBC Act Protected Matters Report

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 11-Jun-2025

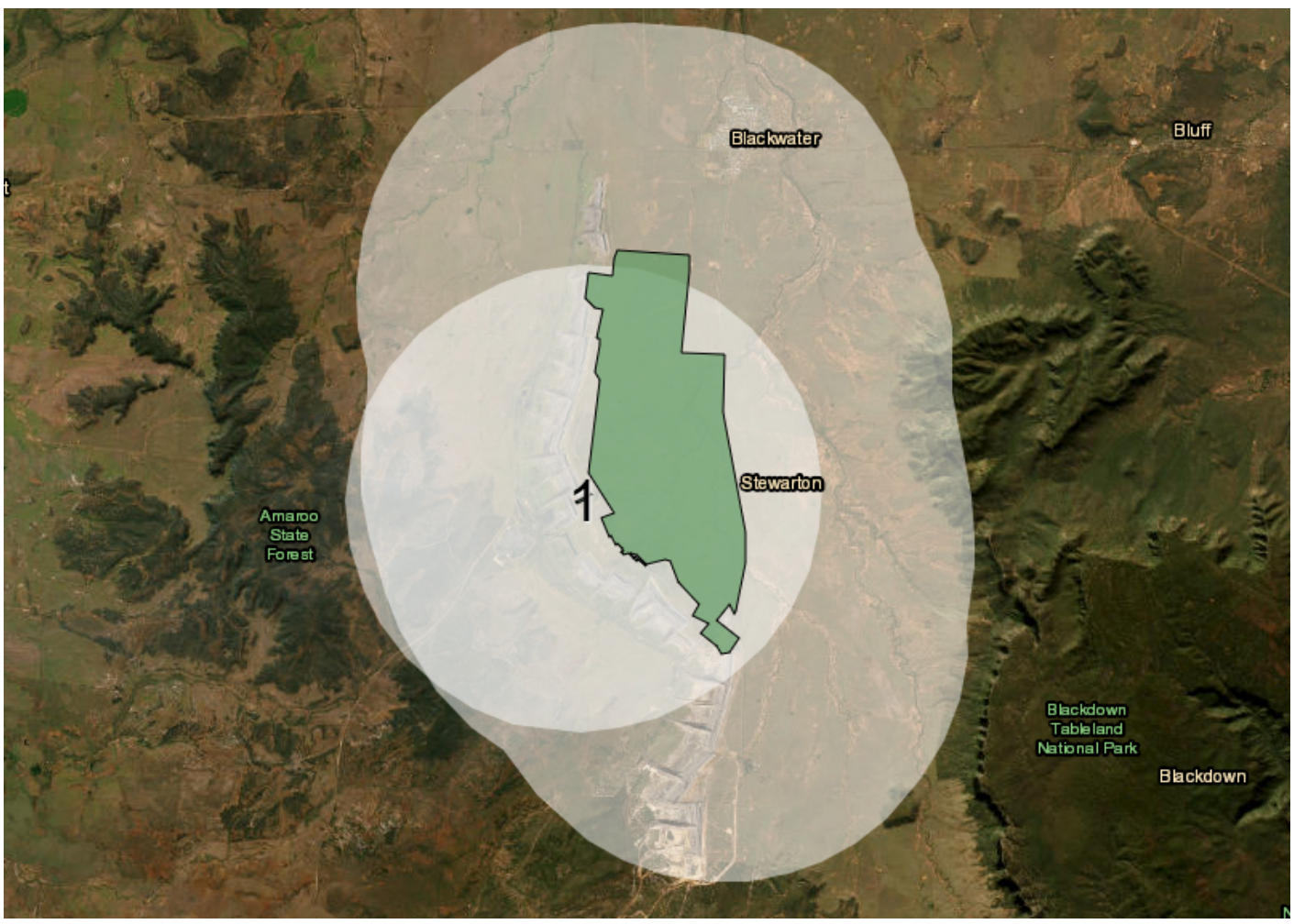
[Summary](#)

[Details](#)

- [Matters of NES](#)
- [Other Matters Protected by the EPBC Act](#)
- [Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	36
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	2
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	12
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area	In feature area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area	In buffer area only
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
MAMMAL			
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area	In buffer area only
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
[Nyctophilus corbeni](#) Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area	In feature area
[Petauroides volans](#) Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
[Petaurus australis australis](#) Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			
[Arthraxon hispidus](#) Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Bertya opponens](#) [13792]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Cadellia pentastylis](#) Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Daviesia discolor](#) [3567]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Dichanthium queenslandicum](#) King Blue-grass [5481]	Endangered	Species or species habitat may occur within area	In feature area
[Dichanthium setosum](#) bluegrass [14159]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Eucalyptus raveretiana Black Ironbox [16344]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Homoranthus decumbens a shrub [55186]	Endangered	Species or species habitat may occur within area	In buffer area only
Macrozamia platyrhachis cycad [3412]	Endangered	Species or species habitat may occur within area	In buffer area only
Polianthion minutiflorum [82772]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Solanum dissectum [75720]	Endangered	Species or species habitat may occur within area	In buffer area only
REPTILE			
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat known to occur within area	In feature area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat may occur within area	In feature area
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Endangered	Species or species habitat likely to occur within area	In feature area
Listed Migratory Species			[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus			
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - BLACKWATER TRAINING DEPOT [30270]	QLD	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Anseranas semipalmata			
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area overfly marine area	In buffer area only
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Blackdown Tableland	National Park	QLD	In buffer area only
Blackwater	Conservation Park	QLD	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Blackwater Mine ? North Extension Project	2023/09723		Assessment	In feature area
rail track to link the proposed MIM Rolleston coal mine to existing rail network	2002/637		Post-Approval	In buffer area only
Controlled action				
Bowen Gas Project	2012/6377	Controlled Action	Post-Approval	In feature area
Construct and operate a coal gasification plant and carbon dioxide capture and storage	2006/3040	Controlled Action	Completed	In buffer area only
Curragh Extension Project, Blackwater, QLD	2015/7508	Controlled Action	Post-Approval	In buffer area only
Norwich Park & Blackwater CSG Fields & supporting infrastructure Bowen Basin	2011/6032	Controlled Action	Completed	In feature area
ZeroGen Integrated Gasification Combined Cycle Power Plant and CO2 Capture, Transport and Storage	2009/5195	Controlled Action	Completed	In feature area
Not controlled action				
Blackwater to Emerald Dual Circuit 132kV Powerline, QLD	2012/6480	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Development and operation of a new multi-seam underground coal mine with associated on-site infrastr	2011/5811	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Blackwater to Rolleston 132 kV transmission line	2002/880	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Curragh West Project	2011/6187	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix B: Aquatic Survey Site Profiles

AQUATIC HABITAT ASSESSMENT

Site code: R1	**Location:** Sagittarius Creek
Date: 17/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6287; 148.8619 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1.8 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: moderate grazing, past vegetation clearing	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 70% silt/clay (<0.05 mm), 27% sand (0.05-2 mm), 3% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 70% silt/clay (<0.05 mm), 27% sand (0.05-2 mm), 3% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (S)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 7 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (D)	
Sub-canopy species: *Lysiphyllum carronii* (F), *Terminalia oblongata* subsp. *oblongata* (F), *Acacia harpophylla* (O)	
Shrub species: *Acacia harpophylla* (O), *Acalypha eremorum* (O), *Atalaya hemiglauca* (O), *Geijera parviflora* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (O), *Sida* sp. (O), *Enchylaena tomentosa* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	6 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	9 (Excellent)
Overall score	49 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R1	**Location:** Sagittarius Creek
Date: 20/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6287; 148.8619 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1.8 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (S), sticks (S), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: moderate grazing, past vegetation clearing	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 70% silt/clay (<0.05 mm), 27% sand (0.05-2 mm), 3% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 70% silt/clay (<0.05 mm), 27% sand (0.05-2 mm), 3% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 7 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (D)	
Sub-canopy species: *Lysiphyllum carronii* (F), *Terminalia oblongata* subsp. *oblongata* (F), *Acacia harpophylla* (O)	
Shrub species: *Acacia harpophylla* (O), *Acalypha eremorum* (O), *Atalaya hemiglauca* (O), *Geijera parviflora* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (O), *Sida* sp. (O), *Enchylaena tomentosa* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	6 (Good)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	47 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R2	**Location:** Sagittarius Creek
Date: 17/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6521; 148.8387 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 15 m
Maximum depth: 0 m	**Bankfull height:** 1.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 33% sand (0.05-2 mm), 3% gravel (2-4 mm), 2% pebble (4-64 mm), 1% cobble (64-256 mm), 1% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 3% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 30%
Canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (D), *Lysiphyllum carronii* (O)	
Sub-canopy species: *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Lysiphyllum carronii* (O)	
Shrub species: *Acacia harpophylla* (O), *Carissa ovata* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Archidendropsis basaltica* (O), *Atalaya hemiglauca* (O)	
Ground species: *Cenchrus ciliaris** (D), *Enchylaena tomentosa* (O), *Bothriochloa bladhii* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	6 (Fair)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (Excellent)
Overall score	46 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R2	**Location:** Sagittarius Creek
Date: 20/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6521; 148.8387 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 15 m
Maximum depth: 0 m	**Bankfull height:** 1.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (S), sticks (S), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 33% sand (0.05-2 mm), 3% gravel (2-4 mm), 2% pebble (4-64 mm), 1% cobble (64-256 mm), 1% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 3% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:**M
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 30%
Canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (D), *Lysiphyllum carronii* (O)	
Sub-canopy species: *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Lysiphyllum carronii* (O)	
Shrub species: *Acacia harpophylla* (O), *Carissa ovata* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Archidendropsis basaltica* (O), *Atalaya hemiglauca* (O)	
Ground species: *Cenchrus ciliaris** (D), *Enchylaena tomentosa* (O), *Bothriochloa bladhii* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	6 (Fair)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	6 (Good)
9. Streamside cover	9 (Excellent)
Overall score	44 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R3	**Location:** Taurus Creek
Date: 20/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6705; 148.8762 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Water quality	
Time (EST): 11:00	**Water temperature:** 13.0˚C
Sp. Conductivity: 286 µS/cm	**pH:** 7.0
Dissolved oxygen: 77.0%	**Dissolved oxygen:** 8.10 mg/L
Turbidity: 36.9 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 90%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: L	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 6 m	**Bankfull width:** 25 m
Maximum depth: 1 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (S), branches (S), logs (L), periphyton (S), moss (N), filamentous algae (L), macrophytes (L), bank overhang (N), trailing bank vegetation (L), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): past vegetation clearing, light grazing	
Adjacent landuse (left bank): past vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 40% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 40% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately stable
Bed stability: mod. deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.3/11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 18 m	**EDL cover:** 30%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (F)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (D), *Lysiphyllum hookeri* (F)	
Shrub species: *A. harpophylla* (O), *T. oblongata* (O), *Cryptostegia grandiflora** (O), *Atalaya hemiglauca* (O)	
Ground species: *Megathyrsus maximus** (D), *Bothriochloa bladhii* (A), *Parthenium hysterophorus** (O), *Cyperus bifax* (O), *Sida* sp. (O), *Calyptocarpus vialis** (F)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (S), *C. betchei* (L), *Persicaria attenuata* (L), *Ludwigia peploides* (L), *Eclipta prostrata** (L), *Echinochloa colona** (L), *Leptochloa digitata* (L)	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat (insufficient permanence); no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: yes
Aquatic vertebrates encountered: *Ambassis agassizii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*, *Nematalosa erebi*, *Neosilurus hyrtlii*

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	6 (Fair)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	55 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R3	**Location:** Taurus Creek
Date: 22/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6705; 148.8762 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Water quality	
Time (EST): 07:15	**Water temperature:** 21.3˚C
Sp. Conductivity: 633 µS/cm	**pH:** 7.5
Dissolved oxygen: 20.5%	**Dissolved oxygen:** 1.82 mg/L
Turbidity: 220 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 90%	**Water colour:** turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** L
Emergent macrophytes: L	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 2 m	**Bankfull width:** 25 m
Maximum depth: 0.2 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 30% sandy pool, 0% rocky pool, 70% dry	
Variety of habitat: shallow (<0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (M), sticks (S), branches (S), logs (L), periphyton (S), moss (N), filamentous algae (L), macrophytes (L), bank overhang (N), trailing bank vegetation (L), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): past vegetation clearing, light grazing	
Adjacent landuse (left bank): past vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 40% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 40% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately stable
Bed stability: mod. deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (E)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: L	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.3/11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 18 m	**EDL cover:** 30%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (F)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (D), *Lysiphyllum hookeri* (F)	
Shrub species: *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Cryptostegia grandiflora** (O), *Atalaya hemiglauca* (O)	
Ground species: *Megathyrsus maximus** (D), *Bothriochloa bladhii* (A), *Cenchrus ciliaris** (O), *Parthenium hysterophorus** (O), *Cyperus bifax* (O), *Sida* sp. (O), *Calyptocarpus vialis** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (S), *C. betchei* (L), *Persicaria attenuata* (L), *Ludwigia peploides* (L), *Eclipta prostrata** (L), *Echinochloa colona** (L), *Leptochloa digitata* (L)	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: yes	
Habitat for platypus: unlikely habitat (insufficient permanence); no burrows detected	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: yes	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: yes	
Aquatic vertebrates encountered: *Ambassis agassizii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*, *Nematalosa erebi*	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	10 (Fair)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	3 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	56 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).
Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R4	**Location:** Taurus Creek
Date: 20/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6785; 148.8666 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Water quality	
Time (EST): 7:34	**Water temperature:** 11.7˚C
Sp. Conductivity: 187 µS/cm	**pH:** 7.1
Dissolved oxygen: 64.4%	**Dissolved oxygen:** 6.98 mg/L
Turbidity: 394 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 100%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 2.5 m	**Bankfull width:** 20 m
Maximum depth: 0.8 m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 80% sandy pool, 0% rocky pool, 20% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (S), branches (S), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (L), trailing bank vegetation (L), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): past vegetation clearing, light grazing	
Adjacent landuse (left bank): past vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately unstable
Bed stability: mod. deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (S), cattle pugging (L)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 25 m	**Width of riparian zone on right bank:** 25 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** M
Composition and health	
State-mapped RE: 11.3.2/11.3.25/11.3.1 (50/45/5)	**Verified RE:** 11.3.3
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 18 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (O)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (A), *Acacia salicina* (O), *Brachychiton rupestris* (R), *Cryptostegia grandiflora** (O), *Lysiphyllum hookeri* (F)	
Shrub species: *Acalypha eremorum* (F), *Cryptocarya* sp. (O), *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Cryptostegia grandiflora** (O), *Atalaya hemiglauca* (O)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (F), *Calyptocarpus vialis** (O), *Bryophyllum delagoense** (O), *Bothriochloa bladhii* (O), *Parthenium hysterophorus** (O), *Alternanthera* sp. (O), *Cyperus bifax* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *C. bifax* (L), *Eclipta prostrata** (L)	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: yes	
Habitat for platypus: unlikely habitat,no burrows detected	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: yes	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: *Ambassis agassizii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	3 (Fair)
9. Streamside cover	10 (Excellent)
Overall score	48 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R4	**Location:** Taurus Creek
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6785; 148.8666 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (S), branches (S), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): past vegetation clearing, light grazing	
Adjacent landuse (left bank): past vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately unstable
Bed stability: mod. deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (S), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

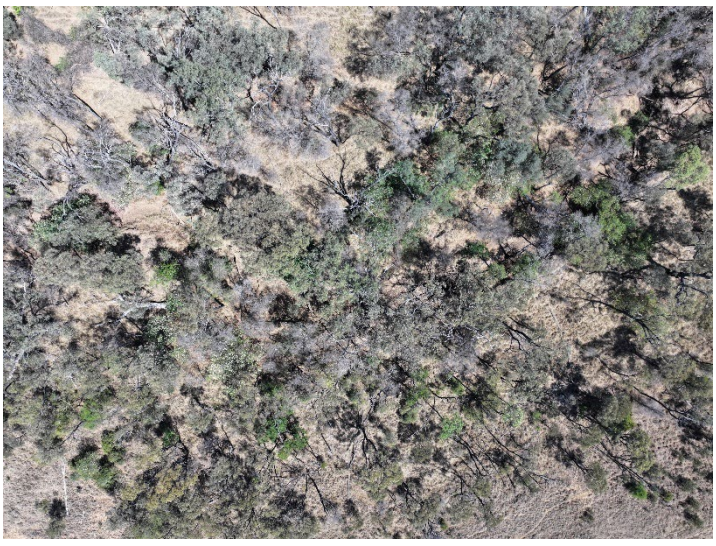
Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 25 m	**Width of riparian zone on right bank:** 25 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** M
Composition and health	
State-mapped RE: 11.3.2/11.3.25/11.3.1 (50/45/5)	**Verified RE:** 11.3.3
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 18 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (O)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (A), *Acacia salicina* (O), *Brachychiton rupestris* (R), *Cryptostegia grandiflora** (O), *Lysiphyllum hookeri* (F)	
Shrub species: *Acalypha eremorum* (F), *Cryptocarya* sp. (O), *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Cryptostegia grandiflora** (O), *Atalaya hemiglauca* (O)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (F), *Calyptocarpus vialis** (O), *Bryophyllum delagoense** (O), *Bothriochloa bladhii* (O), *Parthenium hysterophorus** (O), *Alternanthera* sp. (O), *Argemone mexicana** (O), *Xanthium occidentale** (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: *Cyperus bifax* (L), *Eclipta prostrata** (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat,no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	3 (Fair)
9. Streamside cover	10 (Excellent)
Overall score	42 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).
Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R5	**Location:** tributary of Taurus Creek
Date: 18/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6924; 148.8523 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Water quality	
Time (EST): 10:21	**Water temperature:** 13.4˚C
Sp. Conductivity: 378 µS/cm	**pH:** 7.6
Dissolved oxygen: 98.4%	**Dissolved oxygen:** 10.27 mg/L
Turbidity: 153 NTU	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: 50%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 10% sandy pool, 0% rocky pool, 90% dry	
Variety of habitat: macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (N), logs (N), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): vegetation clearing, light grazing	
Adjacent landuse (left bank): vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 65% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 65% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clayey loam	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 10 m	**EDL cover:** 30%
Canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (D), *Acacia salicina* (F)	
Sub-canopy species: *Acacia salicina* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acacia harpophylla* (O), *Eremophila mitchellii* (R)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acalypha eremorum* (R)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (O), *Megathyrsus maximus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus betchei* (L), *Ludwigia octovalvis* (L), *Cyperus difformis* (L), *Echinochloa colona** (L), *Typha domingensis* (L)	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: *Ambassis agassizii*, *Leiopotherapon unicolor*

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	2 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	9 (Excellent)
Overall score	53 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R5	**Location:** tributary of Taurus Creek
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6924; 148.8523 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (N), logs (N), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): vegetation clearing, light grazing	
Adjacent landuse (left bank): vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 65% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 65% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clayey loam	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 10 m	**EDL cover:** 30%
Canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (D), *Acacia salicina* (F)	
Sub-canopy species: *Acacia salicina* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acacia harpophylla* (O), *Eremophila mitchellii* (R)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acalypha eremorum* (R)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus betchei* (L), *Ludwigia octovalvis* (L), *Cyperus difformis* (L), *Echinochloa colona** (L), *Typha domingensis* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: yes	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	9 (Excellent)
Overall score	51 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R6	**Location:** Taurus Creek flood channel wetland
Date: 18/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6963; 148.8660 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DLGWV 2025): not applicable	
Likely a watercourse: not applicable	
State-mapped waterway providing for fish passage (DAF 2020): not applicable	
Water quality	
Time (EST): 12:37	**Water temperature:** 13.8˚C
Sp. Conductivity: 234 µS/cm	**pH:** 6.8
Dissolved oxygen: 81.3%	**Dissolved oxygen:** 8.35 mg/L
Turbidity: 217 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 20%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 10 m	**Bankfull width:** 22 m
Maximum depth: 0.7 m	**Bankfull height:** 2 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (L), periphyton (L), moss (N), filamentous algae (N), macrophytes (L), bank overhang (L), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): moderate grazing, past clearing	
Adjacent landuse (left bank): moderate grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (E)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 15 m	**Width of riparian zone on right bank:** 15 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** M
Trees >10m: L	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.25/11.3.2
Vegetation status: remnant	**Dominant stratum:** tree
Health: average	**Dieback:** 11-25%
EDL height: 15 m	**EDL cover:** 40%
Canopy species: *Eucalyptus tereticornis* (D), *Eucalyptus populnea* (D), *Acacia salicina* (R)	
Sub-canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Lysiphyllum hookeri* (D), *Acacia harpophylla* (O), *Eremophila mitchellii* (O), *Cassia brewsteri* (O), *Acacia salicina* (O)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia salicina* (O), *Carissa ovata* (O)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (D), *Sida* sp. (O), *Basilicum polystachyon* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus betchei* (L), *Ludwigia octovalvis* (L), *Eclipta prostrata** (L), *Cyperus pygmaeus* (L), *Persicaria attenuata* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: yes	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: yes	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: yes	
Aquatic vertebrates encountered: *Ambassis agassizii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (Excellent)
Overall score	59 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R6	**Location:** Taurus Creek flood channel wetland
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6963; 148.8660 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DLGWV 2025): not applicable	
Likely a watercourse: not applicable	
State-mapped waterway providing for fish passage (DAF 2020): not applicable	
Water quality	
Time (EST): 11:40	**Water temperature:** 33.1˚C
Sp. Conductivity: 471 µS/cm	**pH:** 9.3
Dissolved oxygen: 184.0%	**Dissolved oxygen:** 13.17 mg/L
Turbidity: 152 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: E	**Algae in water column:** E
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 5 m	**Bankfull width:** 22 m
Maximum depth: 0.2 m	**Bankfull height:** 2 m
Habitat types: 0% riffle, 0% run, 15% sandy pool, 0% rocky pool, 85% dry	
Variety of habitat: shallow (<0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (L), moss (N), filamentous algae (E), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): moderate grazing, past clearing	
Adjacent landuse (left bank): moderate grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (E)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 15 m	**Width of riparian zone on right bank:** 15 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** M
Trees >10m: L	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.25/11.3.2
Vegetation status: remnant	**Dominant stratum:** tree
Health: average	**Dieback:** 11-25%
EDL height: 15 m	**EDL cover:** 40%
Canopy species: *Eucalyptus tereticornis* (D), *Eucalyptus populnea* (D), *Acacia salicina* (R)	
Sub-canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Lysiphyllum hookeri* (D), *Acacia harpophylla* (O), *Eremophila mitchellii* (O), *Cassia brewsteri* (O), *Acacia salicina* (O)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia salicina* (O), *Carissa ovata* (O)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (D), *Sida* sp. (O), *Basilicum polystachyon* (O), *Glinus lotoides* (O), *Centipeda minima* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus betchei* (L), *Ludwigia octovalvis* (L), *Eclipta prostrata** (L), *Cyperus pygmaeus* (L), *Persicaria attenuata* (L)	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: yes	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: yes	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: yes	
Aquatic vertebrates encountered: *Ambassis agassizii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Nematalosa erebi*, *Neosilurus hyrtlii*	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	2 (Poor)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	5 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	52 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R7	**Location:** Taurus Creek
Date: 01/07/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.7170; 148.8541 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, High risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 25 m
Maximum depth: 0 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 7% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 2% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 7% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 2% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (M)	



Upstream



Left bank



Downstream



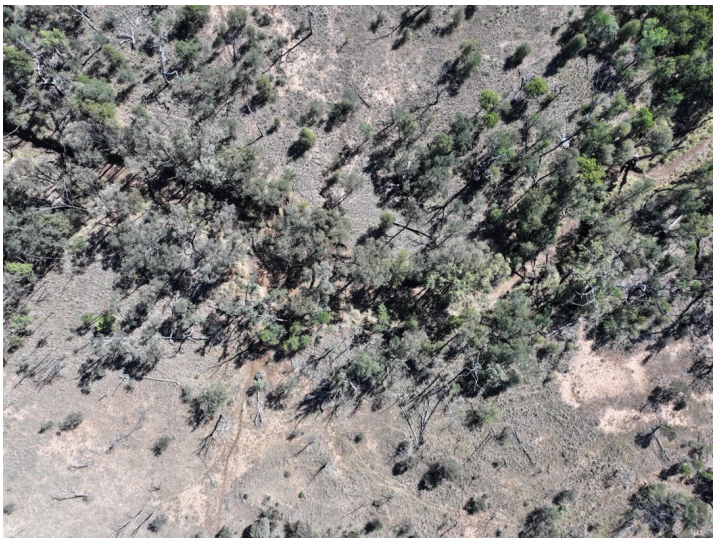
Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 15 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1/11.4.9
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 30%
Canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O), *Eucalyptus tereticornis* (O), *Blakella tessellaris* (O)	
Sub-canopy species: *Lysiphyllum hookeri* (D), *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Eremophila mitchellii* (O)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Carissa ovata* (O), *Harrisia martinii** (O)	
Ground species: *Cenchrus ciliaris** (D), *Megathyrsus maximus** (D), *Chloris* sp. (O), *Parthenium hysterophorus** (O), *Sida* sp. (O), *Bothriochloa bladhii* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	4 (Fair)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (Excellent)
Overall score	41 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R7	**Location:** Taurus Creek
Date: 22/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7170; 148.8541 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, High risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 25 m
Maximum depth: 0 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): moderate grazing, past vegetation clearing	
Adjacent landuse (left bank): moderate grazing, past vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 7% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 2% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 7% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 2% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (S)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 15 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1/11.4.9
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 30%
Canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O), *Eucalyptus tereticornis* (O), *Blakella tessellaris* (O)	
Sub-canopy species: *Lysiphyllum hookeri* (D), *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Eremophila mitchellii* (O)	
Shrub species: *Lysiphyllum hookeri* (O), *Acacia harpophylla* (O), *Carissa ovata* (O), *Harrisia martinii** (O)	
Ground species: *Cenchrus ciliaris** (D), *Megathyrsus maximus** (F), *Chloris* sp. (O), *Parthenium hysterophorus** (O), *Sida* sp. (O), *Bothriochloa bladhii* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: none observed	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	4 (Fair)
8. Bank vegetative stability	6 (Good)
9. Streamside cover	9 (Excellent)
Overall score	39 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R8	**Location:** Two Mile Gully
Date: 01/07/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.7319; 148.8734 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 2.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: macrophytes, large woody debris	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (S), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): vegetation clearing, light grazing	
Adjacent landuse (left bank): vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (L)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: M	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10%
EDL height: 8 m	**EDL cover:** 30%
Canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (F), *Eucalyptus tereticornis* (R), *Blakella tessellaris* (R)	
Sub-canopy species: *Cryptostegia grandiflora** (D), *Lysiphyllum hookeri* (O), *Acacia salicina* (O)	
Shrub species: *Cryptostegia grandiflora** (D), *Terminalia oblongata* subsp. *oblongata* (O), *Acalypha eremorum* (F)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (D), *Bothriochloa bladhii* (F), *Cyperus bifax* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	8 (Good)
Overall score	39 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R8	**Location:** Two Mile Gully
Date: 22/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7319; 148.8734 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 2.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: macrophytes, large woody debris	
Habitat attributes: detritus (M), sticks (L), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (S), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): vegetation clearing, light grazing	
Adjacent landuse (left bank): vegetation clearing, light grazing	
Bed, edge and bank characteristics	
Bed substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (L)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: M	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10%
EDL height: 8 m	**EDL cover:** 30%
Canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (F), *Eucalyptus tereticornis* (R), *Blakella tessellaris* (R)	
Sub-canopy species: *Cryptostegia grandiflora** (D), *Lysiphyllum hookeri* (O), *Acacia salicina* (O)	
Shrub species: *Cryptostegia grandiflora** (D), *Terminalia oblongata* subsp. *oblongata* (O), *Acalypha eremorum* (F)	
Ground species: *Megathyrsus maximus** (D), *Cenchrus ciliaris** (D), *Bothriochloa bladhii* (F), *Cyperus bifax* (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (L)	

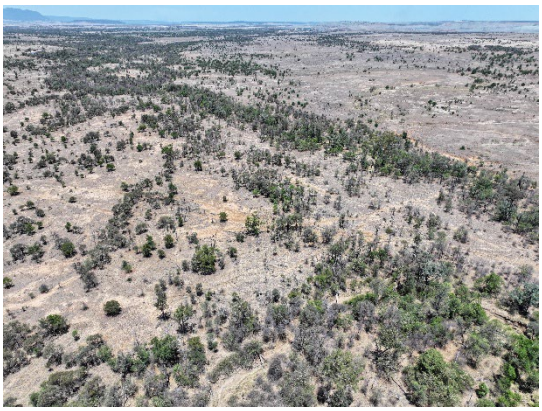
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	8 (Good)
Overall score	39 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: R9	**Location:** Taurus Creek
Date: 18/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6941; 148.8688 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Water quality	
Time (EST): 08:12	**Water temperature:** 11.5˚C
Sp. Conductivity: 159 µS/cm	**pH:** 6.6
Dissolved oxygen: 45.8%	**Dissolved oxygen:** 5.00 mg/L
Turbidity: 289 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 100%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 3 m	**Bankfull width:** 17 m
Maximum depth: 0.4 m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 20% sandy pool, 0% rocky pool, 80% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (S), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): light grazing, past clearing	
Adjacent landuse (left bank): light grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 71% silt/clay (<0.05 mm), 25% sand (0.05-2 mm), 3% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 71% silt/clay (<0.05 mm), 25% sand (0.05-2 mm), 3% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clayey loam	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.3/11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 15 m	**EDL cover:** 40%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (F), *Eucalyptus populnea* (O)	
Sub-canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (D), *Lysiphyllum hookeri* (A), *Brachychiton* sp. (R)	
Shrub species: *Acacia salicina* (O), *Acalypha eremorum* (O), *Acacia harpophylla* (O)	
Ground species: *Megathyrsus maximus** (D), *Bothriochloa bladhii* (F), *Lobelia concolor* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (L)	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat,no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: *Hypseleotris bucephala*, *Melanotaenia splendida splendida*

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	8 (Fair)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	2 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	4 (Fair)
6. Pool/riffle, run/bend ratio	7 (Fair)
7. Bank stability	4 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	10 (Excellent)
Overall score	50 (Fair)
Overall aquatic value: Moderate	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R9	**Location:** Taurus Creek
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6941; 148.8688 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 17 m
Maximum depth: 0 m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris, macrophytes	
Habitat attributes: detritus (M), sticks (L), branches (S), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): light grazing, past clearing	
Adjacent landuse (left bank): light grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 71% silt/clay (<0.05 mm), 25% sand (0.05-2 mm), 3% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 71% silt/clay (<0.05 mm), 25% sand (0.05-2 mm), 3% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clayey loam	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.3/11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10%
EDL height: 15 m	**EDL cover:** 40%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (F), *Eucalyptus populnea* (O)	
Sub-canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (D), *Lysiphyllum hookeri* (A), *Brachychiton rupestris* (R)	
Shrub species: *Acacia salicina* (O), *Acalypha eremorum* (O), *Acacia harpophylla* (O)	
Ground species: *Megathyrsus maximus** (D), *Bothriochloa bladhii* (F), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (L)	
Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered: none observed	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	4 (Fair)
6. Pool/riffle, run/bend ratio	7 (Fair)
7. Bank stability	4 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	10 (Excellent)
Overall score	42 (Fair)
Overall aquatic value: Moderate	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R10	**Location:** Deep Creek – proposed crossing location
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7201; 148.8459 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 25 m
Maximum depth: 0 m	**Bankfull height:** 3.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, light grazing, coal mining	
Adjacent landuse (right bank): light grazing, past clearing	
Adjacent landuse (left bank): light grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 10% silt/clay (<0.05 mm), 55% sand (0.05-2 mm), 10% gravel (2-4 mm), 1% pebble (4-64 mm), 2% cobble (64-256 mm), 2% boulder (>256 mm), 10% bedrock	
Edge substrates: 10% silt/clay (<0.05 mm), 55% sand (0.05-2 mm), 10% gravel (2-4 mm), 1% pebble (4-64 mm), 2% cobble (64-256 mm), 2% boulder (>256 mm), 10% bedrock	
Bank soils: sandy clay	**Bank stability:** unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (L), bank slumping (S), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** regrowth 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 9 m	**EDL cover:** 15%
Canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Sub-canopy species: *Lysiphyllum hookeri* (D), *Acacia salicina* (O),	
Shrub species: *Lysiphyllum hookeri* (O), *A. salicina* (O), *A. harpophylla* (O)	
Ground species: *Cenchrus ciliaris** (D), *Bothriochloa bladhii* (O), *Chloris* sp. (O), *Sida* sp. (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Cyperus bifax* (L)	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat, no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	6 (Fair)
2. Embeddedness	4 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	7 (Fair)
5. Bottom scouring and deposition	7 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	2 (Poor)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	47 (Fair)
Overall aquatic value: Low	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R11	**Location:** Taurus Creek – proposed crossing location
Date: 21/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7320; 148.8561 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, High risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (S), sticks (L), branches (L), logs (L), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, light grazing, coal mining	
Adjacent landuse (right bank): light grazing, past clearing	
Adjacent landuse (left bank): light grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 15% silt/clay (<0.05 mm), 68% sand (0.05-2 mm), 10% gravel (2-4 mm), 1% pebble (4-64 mm), 1% cobble (64-256 mm), 2% boulder (>256 mm), 3% bedrock	
Edge substrates: 15% silt/clay (<0.05 mm), 68% sand (0.05-2 mm), 10% gravel (2-4 mm), 1% pebble (4-64 mm), 1% cobble (64-256 mm), 2% boulder (>256 mm), 3% bedrock	
Bank soils: clayey sand	**Bank stability:** unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (L), rill (L), tunnel (N), sheet (L), bank slumping (L), cattle pugging (L)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** regrowth 11.3.1
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 7 m	**EDL cover:** 25%
Canopy species: *Terminalia oblongata* subsp. *oblongata* (D), *Acacia harpophylla* (O), *Eucalyptus tereticornis* (R), *Blakella tessellaris* (R)	
Sub-canopy species: *Lysiphyllum hookeri* (D), *Acacia salicina* (O), *Brachychiton* sp. (R)	
Shrub species: *Carissa ovata* (O), *Acacia salicina* (O), *Lysiphyllum hookeri* (O), *Harrisia martinii** (O), *Terminalia oblongata* subsp. *oblongata* (O)	
Ground species: *Cenchrus ciliaris** (D), *Megathyrsus maximus** (O), *Sida* sp. (O), *Parthenium hysterophorus** (O), *Cynodon dactylon* (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: none observed

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat, no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	2 (Poor)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (Excellent)
Overall score	39 (Fair)
Overall aquatic value: Moderate	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: R12	**Location:** Taurus Creek
Date: 23/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6662; 148.8851 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DLGWV 2025): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, Major risk of impact	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 25 m
Maximum depth: 0 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (S), logs (S), periphyton (N), moss (N), filamentous algae (N), macrophytes (L), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: past vegetation clearing, moderate grazing, coal mining	
Adjacent landuse (right bank): moderate grazing, past clearing	
Adjacent landuse (left bank): moderate grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 20% silt/clay (<0.05 mm), 80% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 20% silt/clay (<0.05 mm), 80% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clayey loam	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (L), bank slumping (L), cattle pugging (E)	



Upstream



Left bank



Downstream



Right bank

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: L	**Trees <10 m:** S
Trees >10m: M	**Exotic riparian species: L**
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.3/11.3.1
Vegetation status: remnant	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10%
EDL height: 20 m	**EDL cover:** 55%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (F)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O), *Lysiphyllum hookeri* (O), *Lysiphyllum carronii* (O)	
Shrub species: *Terminalia oblongata* subsp. *oblongata* (O), *Acacia harpophylla* (O), *Harrisia martinii** (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F), *Enchylaena tomentosa* (O), *Atriplex* sp. (O), *Sida* sp. (O), *Argemone mexicana** (O),	
Macrophytes	
Submerged macrophytes: none observed	
Floating macrophytes: none observed	
Emergent macrophytes: *Leptochloa digitata* (L), *Cyperus bifax* (L)	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat, no burrows detected
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	8 (Good)
5. Bottom scouring and deposition	4 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	6 (Good)
8. Bank vegetative stability	5 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	41 (Fair)
Overall aquatic value: Moderate	

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: L1	**Location:** Farm dam on Sagittarius Creek
Date: 17/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.6417; 148.8591 (GDA 2020)
Water level: moderate (= watermark)	**Likely flow nature:** semi-permanent waterbody on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Water quality	
Time (EST): 13:51	**Water temperature:** 14.1˚C
Sp. Conductivity: 196 µS/cm	**pH:** 6.2
Dissolved oxygen: 88.5%	**Dissolved oxygen:** 9.10 mg/L
Turbidity: 9.6 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 100%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** N
Emergent macrophytes: M	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 70 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 3+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, macrophytes	
Habitat attributes: detritus (S), sticks (N), branches (N), logs (N), periphyton (S), moss (N), filamentous algae (S), macrophytes (E), bank overhang (N), trailing bank vegetation (E), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing	
Adjacent landuse (right bank): moderate grazing, vegetation clearing	
Adjacent landuse (left bank): moderate grazing, vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 3 m	**Width of riparian zone on right bank:** 3 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: average	**Dieback:** 1-10%
EDL height: 2.5 m	**EDL cover:** 90%
Canopy species: *Acacia salicina* (R), *Terminalia oblongata* subsp. *oblongata* (R), *Acacia harpophylla* (R)	
Shrub species: *Acacia salicina* (R), *Acacia harpophylla* (R), *Lysiphyllum carronii* (R)	
Ground species: *Typha domingensis* (D), *Persicaria attenuata* (A), *Cyperus exaltatus* (O), *Cenchrus ciliaris** (O), *Basilicum polystachyon* (O), *Bothriochloa bladhii* (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: *Typha domingensis* (E), *Persicaria attenuata* (M), *Cyperus exaltatus* (L), *Eclipta prostrata** (L), *Cyperus pygmaeus* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: yes
Aquatic vertebrates encountered: *Ambassis agassizii*, *Anguilla reinhardtii*, *Gambusia holbrooki**, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Mogurnda adspersa*, *Porochilus rendahli*
Overall aquatic value: Moderate

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: L1	**Location:** Farm dam on Sagittarius Creek
Date: 20/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.6417; 148.8591 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** semi-permanent waterbody on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Moderate risk of impact	
Water quality	
Time (EST): 15:07	**Water temperature:** 28.6˚C
Sp. Conductivity: 210 µS/cm	**pH:** 9.7
Dissolved oxygen: 170.5%	**Dissolved oxygen:** 13.15 mg/L
Turbidity: 13.2 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** L
Emergent macrophytes: M	**Submerged macrophytes:** E
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 50 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 3+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, macrophytes	
Habitat attributes: detritus (S), sticks (N), branches (N), logs (N), periphyton (S), moss (N), filamentous algae (S), macrophytes (E), bank overhang (N), trailing bank vegetation (E), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: vegetation clearing, moderate grazing	
Adjacent landuse (right bank): moderate grazing, vegetation clearing	
Adjacent landuse (left bank): moderate grazing, vegetation clearing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (L), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 3 m	**Width of riparian zone on right bank:** 3 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: average	**Dieback:** 1-10%
EDL height: 2.5 m	**EDL cover:** 90%
Canopy species: *Acacia salicina* (R), *Terminalia oblongata* subsp. *oblongata* (R), *Acacia harpophylla* (R)	
Shrub species: *Acacia salicina* (R), *Acacia harpophylla* (R), *Lysiphyllum carronii* (R)	
Ground species: *Typha domingensis* (D), *Persicaria attenuata* (A), *Cyperus exaltatus* (O), *Cenchrus ciliaris** (O), *Bothriochloa bladhii* (O), *Chloris* sp. (O)	

Macrophytes
Submerged macrophytes: *Potamogeton crispus* (E)
Floating macrophytes: none observed
Emergent macrophytes: *Typha domingensis* (E), *Persicaria attenuata* (M), *Cyperus exaltatus* (L), *Eclipta prostrata** (L), *Cyperus pygmaeus* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: yes
Aquatic vertebrates encountered: *Ambassis agassizii*, *Gambusia holbrooki**, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*, *Porochilus rendahli*, *Emydura macquarii krefftii*
Overall aquatic value: Moderate

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: L2	**Location:** Farm dam on unnamed tributary of Two Mile Gully
Date: 30/06/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.7141; 148.8778 (GDA 2020)
Water level: moderate (= watermark)	**Likely flow nature:** semi-permanent waterbody on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Low risk of impact	
Water quality	
Time (EST): 15:57	**Water temperature:** 17.2˚C
Sp. Conductivity: 628 µS/cm	**pH:** 7.6
Dissolved oxygen: 83.7%	**Dissolved oxygen:** 7.92 mg/L
Turbidity: 11.2 NTU	**Ion sample collected:** yes
Notes: Impacted by coal fines in runoff from Cook CHPP upstream	
Observations within 2 m of sampling point	
Shading: 90%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: E	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 80 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 3.5+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (L), moss (N), filamentous algae (L), macrophytes (S), bank overhang (N), trailing bank vegetation (S), blanketing silt (E), substrate anoxia (L)	
Upstream landuse: past vegetation clearing, moderate grazing, Cook CHPP	
Adjacent landuse (right bank): moderate grazing, past clearing	
Adjacent landuse (left bank): moderate grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt or sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N),	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream

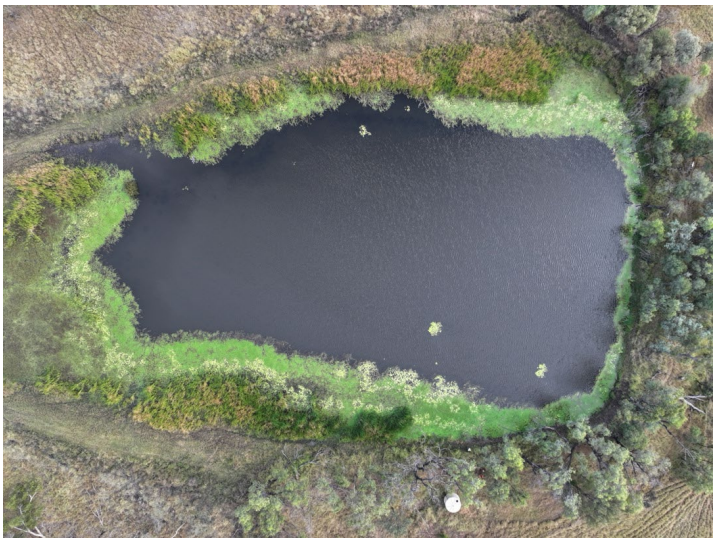


Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** wetland
Health: average	**Dieback:** 1-10%
EDL height: 2 m	**EDL cover:** 20%
Canopy species: *Acacia salicina* (D), *Eucalyptus populnea* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acacia harpophylla* (O)	
Shrub species: *Acacia salicina* (O), *Opuntia tomentosa** (O), *Typha domingensis* (D), *Santalum* sp. (O), *Geijera parviflora* (O), *Eremophila mitchellii* (O)	
Ground species: *Cenchrus ciliaris** (D), *Typha domingensis* (D), *Ludwigia peploides* subsp. *montevidensis* (A), *Megathyrsus maximus** (A), *Parthenium hysterophorus** (O), *Cynodon dactylon** (O)	

Macrophytes
Submerged macrophytes: *Najas tenuifolia* (L), *Potamogeton crispus* (L)
Floating macrophytes: *Lemna aequinoctialis* (L), *Azolla pinnata* (L)
Emergent macrophytes: *Typha domingensis* (S), *Ludwigia peploides* subsp. *montevidensis* (S), *Nymphoides indica* (S), *Cyperus* sp. (L), *Echinochloa colona** (L), *Eclipta prostrata** (L), *Juncus usitatus* (L), *Cyperus difformis* (L), *Schoenoplectus validus* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: yes
Aquatic vertebrates encountered: *Ambassis agassizii*, *Anguilla reinhardtii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*, *Emydura macquarii krefftii*
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT

Site code: L2	**Location:** Farm dam on unnamed tributary of Two Mile Gully
Date: 22/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7141; 148.8778 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Low risk of impact	
Water quality	
Time (EST): 12:46	**Water temperature:** 29.1˚C
Sp. Conductivity: 786 µS/cm	**pH:** 8.2
Dissolved oxygen: 91.6%	**Dissolved oxygen:** 7.02 mg/L
Turbidity: 19.2 NTU	**Ion sample collected:** yes
Notes: Impacted by coal fines in runoff from Cook CHPP upstream	
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** M
Floating macrophytes: S	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 65 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 3.5+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (L), moss (N), filamentous algae (L), macrophytes (S), bank overhang (N), trailing bank vegetation (S), blanketing silt (E), substrate anoxia (L)	
Upstream landuse: past vegetation clearing, moderate grazing, Cook CHPP	
Adjacent landuse (right bank): moderate grazing, past clearing	
Adjacent landuse (left bank): moderate grazing, past clearing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt or sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (S)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: L	**Trees <10 m:** S
Trees >10m: L	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** wetland
Health: average	**Dieback:** 1-10%
EDL height: 2 m	**EDL cover:** 20%
Canopy species: *Acacia salicina* (D), *Eucalyptus populnea* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Acacia harpophylla* (O)	
Shrub species: *Acacia salicina* (O), *Opuntia tomentosa** (O), *Typha domingensis* (D), *Santalum* sp. (O), *Geijera parviflora* (O), *Eremophila mitchellii* (O)	
Ground species: *Cenchrus ciliaris** (D), *Typha domingensis* (F), *Megathyrsus maximus** (F), *Cynodon dactylon** (F), *Ludwigia peploides* subsp. *montevidensis* (O), *Parthenium hysterophorus** (O)	

Macrophytes
Submerged macrophytes: *Potamogeton crispus* (M), *Najas tenuifolia* (L)
Floating macrophytes: *Lemna aequinoctialis* (L), *Azolla pinnata* (S)
Emergent macrophytes: *Typha domingensis* (S), *Ludwigia peploides* subsp. *montevidensis* (L), *Nymphoides indica* (L), *Cyperus exaltatus* (L), *Eclipta prostrata** (L), *Juncus usitatus* (L), *Schoenoplectus validus* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: yes
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: yes
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: yes
Aquatic vertebrates encountered: *Ambassis agassizii*, *Anguilla reinhardtii*, *Hypseleotris bucephala*, *Leiopotherapon unicolor*, *Melanotaenia splendida splendida*, *Mogurnda adspersa*, *Porochilus rendahli*, *Emydura macquarii krefftii*
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: L3	**Location:** Taurus Dam
Date: 3/07/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.7454; 148.8470 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** mine water dam on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, High risk of impact	
Water quality	
Time (EST): 9:13	**Water temperature:** 13.9˚C
Sp. Conductivity: 5124 µS/cm	**pH:** 8.4
Dissolved oxygen: 76.6%	**Dissolved oxygen:** 7.78 mg/L
Turbidity: 37.6 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** L
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 400 m	**Bankfull width:** 600 m
Maximum depth: 2+ m	**Bankfull height:** 4+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (S), moss (N), filamentous algae (L), macrophytes (L), bank overhang (N), trailing bank vegetation (S), blanketing silt (S), substrate anoxia (S)	
Upstream landuse: coal mining	
Adjacent landuse (right bank): coal mining	
Adjacent landuse (left bank): coal mining	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: severe deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (E), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 5 m	**Width of riparian zone on right bank:** 5 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: poor	**Dieback:** 1-10%
EDL height: 1 m	**EDL cover:** 30%
Canopy species: *Acacia salicina* (F), *Acacia* sp. (O), *Lysiphyllum hookeri* (R)	
Shrub species: *Acacia salicina* (F), *Acacia harpophylla* (O), *Typha domingensis* (F), *Sesbania cannabina* (O)	
Ground species: *Cynodon dactylon** (D), *Parthenium hysterophorus** (O), *Chloris* sp. (O), *Eriochloa pseudoacrotricha* (O), *Panicum* sp. (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: *Typha domingensis* (L), *Schoenoplectus vallidus* (L), *Persicaria attenuata* (L), *Leptochloa digitata* (L), *Persicaria lapathifolia* (L), *Echinochloa colona** (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed
Notes: Partly de-silted within last year. Mine water being pumped into it at the time of assessment.
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: L3	**Location:** Taurus Dam
Date: 20/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7454; 148.8470 (GDA 2020)
Water level: no flow – isolated (higher than last time)	**Likely flow nature:** mine water dam on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, High risk of impact	
Water quality	
Time (EST): 10:04	**Water temperature:** 29.4˚C
Sp. Conductivity: 4951 µS/cm	**pH:** 9.1
Dissolved oxygen: 29.4%	**Dissolved oxygen:** 10.29 mg/L
Turbidity: 85.3 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: anoxia	**Water surface:** normal
Algae on substrate: E	**Algae in water column:** M
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 420 m	**Bankfull width:** 600 m
Maximum depth: 2+ m	**Bankfull height:** 4+ m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, large woody debris, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (S), moss (N), filamentous algae (M), macrophytes (L), bank overhang (N), trailing bank vegetation (S), blanketing silt (S), substrate anoxia (S)	
Upstream landuse: coal mining	
Adjacent landuse (right bank): coal mining	
Adjacent landuse (left bank): coal mining	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: severe deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (E), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 5 m	**Width of riparian zone on right bank:** 5 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: poor	**Dieback:** 1-10%
EDL height: 1 m	**EDL cover:** 30%
Canopy species: *Acacia salicina* (F), *Acacia* sp. (O), *Lysiphyllum hookeri* (R)	
Shrub species: *Acacia salicina* (F), *Acacia harpophylla* (O), *Typha domingensis* (F), *Sesbania cannabina* (O)	
Ground species: *Cynodon dactylon** (D), *Parthenium hysterophorus** (O), *Chloris* sp. (O), *Eriochloa pseudoacrotricha* (O), *Panicum* sp. (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: *Typha domingensis* (L), *Schoenoplectus vallidus* (L), *Persicaria attenuata* (L), *Leptochloa digitata* (L), *Persicaria lapathifolia* (L), *Echinochloa colona** (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: L4	**Location:** Deep Creek Dam
Date: 3/07/2025	**Season:** late wet
Assessor: DM	**Coordinates:** -23.7216; 148.8217 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** mine water dam on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Low risk of impact	
Water quality	
Time (EST): 7:47	**Water temperature:** 14.5˚C
Sp. Conductivity: 965 µS/cm	**pH:** 8.9
Dissolved oxygen: 94.8%	**Dissolved oxygen:** 9.63 mg/L
Turbidity: 16.5 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 300 m	**Bankfull width:** 400 m
Maximum depth: 1 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) and deep pool, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (N), logs (N), periphyton (L), moss (N), filamentous algae (L), macrophytes (L), bank overhang (N), trailing bank vegetation (M), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: coal mining	
Adjacent landuse (right bank): coal mining	
Adjacent landuse (left bank): coal mining	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: severe deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (M), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

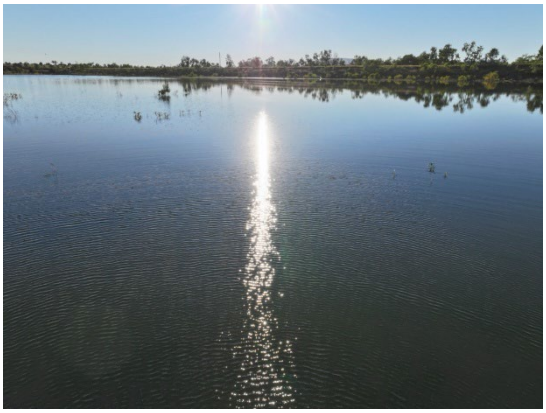
Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 2 m	**Width of riparian zone on right bank:** 2 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: poor	**Dieback:** 1-10%
EDL height: 1 m	**EDL cover:** 15%
Canopy species: *Acacia harpophylla* (O)	
Shrub species: *Acacia harpophylla* (O), *Sesbania cannabina* (F), *Acacia salicina* (O), *Cryptostegia grandiflora** (R), *Sclerolaena* sp. (O), *Vachellia farnesiana** (R), *Tamarix aphylla** (R)	
Ground species: *Cynodon dactylon** (D), *Parthenium hysterophorus** (O), *Sporobolus* sp. (O), *Melinis repens** (O), *Enchylaena tomentosa* (O), *Trianthema portulacastrum** (O)	

Macrophytes
Submerged macrophytes: *Nitella* sp. (L)
Floating macrophytes: none observed
Emergent macrophytes: *Leptochloa digitata* (L), *Persicaria attenuata* (L), *Echinochloa colona** (L), *Persicaria lapathifolia* (L), *Polygonum minuta* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed
Notes: De-silted in late 2024
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

AQUATIC HABITAT ASSESSMENT	
Site code: L4	**Location:** Deep Creek Dam
Date: 20/10/2025	**Season:** dry
Assessor: DM	**Coordinates:** -23.7216; 148.8217 (GDA 2020)
Water level: no flow – isolated (lower than last time)	**Likely flow nature:** mine water dam on ephemeral waterway
State-mapped watercourse (DLGWV 2025): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, Low risk of impact	
Water quality	
Time (EST): 9:21	**Water temperature:** 25.2˚C
Sp. Conductivity: 1403 µS/cm	**pH:** 8.5
Dissolved oxygen: 83.8%	**Dissolved oxygen:** 6.88 mg/L
Turbidity: 42.7 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 200 m	**Bankfull width:** 400 m
Maximum depth: 0.5 m	**Bankfull height:** 3 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) and deep pool, macrophytes	
Habitat attributes: detritus (S), sticks (L), branches (N), logs (N), periphyton (L), moss (N), filamentous algae (L), macrophytes (L), bank overhang (N), trailing bank vegetation (L), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: coal mining	
Adjacent landuse (right bank): coal mining	
Adjacent landuse (left bank): coal mining	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: severe deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (M), sand (N)
Local catchment erosion: gully (N), rill (N), tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).



Upstream



Left bank



Downstream



Right bank

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** S
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** S
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** wetland
Health: poor	**Dieback:** 1-10%
EDL height: 0.3 m	**EDL cover:** 15%
Canopy species: *Acacia harpophylla* (O)	
Shrub species: *Acacia harpophylla* (O), *Sesbania cannabina* (F), *Acacia salicina* (O), *Cryptostegia grandiflora** (R), *Sclerolaena* sp. (O), *Vachellia farnesiana** (R), *Tamarix aphylla** (R)	
Ground species: *Cynodon dactylon var. dactylon** (D), *Parthenium hysterophorus** (O), *Sporobolus* sp. (O), *Melinis repens** (O), *Enchylaena tomentosa* (O)	

Macrophytes
Submerged macrophytes: none observed
Floating macrophytes: none observed
Emergent macrophytes: *Leptochloa digitata* (L), *Persicaria attenuata* (L), *Echinochloa colona** (L), *Persicaria lapathifolia* (L), *Polygonum minuta* (L), *Myriophyllum verrucosum* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered: none observed
Notes: De-silted in late 2024
Overall aquatic value: Low

A



B



C



A: Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)
B: Aerial photograph from 100 m above ground, looking upstream
C: Aerial photograph from 100 m above ground, looking downstream

Notes: Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Appendix C: Bores Considered for Stygofauna Sampling

Registered bore	Other name	Drilled date	Depth (mbgl)	Screened interval (m)	Screen aperture (mm)	Lithology	Logged SWL (mbgl)	Mean pH	Mean EC (µS/cm)	Data points (n)	WHC notes	Suitable?	Can it be accessed?	DPM would like to seek access	DPM notes
RN 190142	BWMMB03_01	27/09/2020	12	8-11	1	Sand and gravel	Unknown	Unknown	Unknown	0		Potential	Yes	Yes	
RN 190143	BWMMB03_02	27/09/2020	41	35-41	1	Sandstone	12.5	7.7	34100	1		x	Yes	x	
RN 158688	MB16	28/08/2012	59.2	50.2-59.2	1	Siltstone	33.0	Unknown	6500	1	Would require a land access agreement	Potential	Possibly	x	Outside of State-mapped aquifer
RN 158687	MB17	28/08/2012	50	38.2-47.2	1	Sandstone	22	Unknown	30000	1	Would require a land access agreement	x	Possibly	x	
RN 132783	MB9	29/11/2011	13	9-12	1	Sand	Unknown	Unknown	Unknown	0	Would require a land access agreement	Potential	Possibly	Yes	
RN 132781	MB6	29/11/2011	41	32-41	1	Siltstone	8.35	Unknown	20000	1	Would require a land access agreement	x	Possibly	x	
RN 132782	MB10	29/11/2011	10	6-9	1	Sand	Unknown	Unknown	Unknown	0	Would require a land access agreement	Potential	Possibly	Yes	
RN 158306	MB8	30/05/2012	438	NA	NA	Coal	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 132780	MB11	29/11/2011	53	44-53	1	Siltstone	Unknown	Unknown	26000	1	Would require a land access agreement	x	Possibly	x	
RN 158305	MB7	9/04/2012	434	NA	NA	Coal	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 158304	MB3R	14/03/2012	65	59-65	1	Sandstone/siltstone	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 132785	MB3	29/11/2011	65	59-65	1	Siltstone	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 132784	MB5	29/11/2011	47	42-45	1	Siltstone	Unknown	Unknown	17500	1	Would require a land access agreement	x	Possibly	x	
RN 158024	MB15	14/12/2011	23	20-23	1	Siltstone	Unknown	Unknown	22000	1	Would require a land access agreement	x	Possibly	x	
RN 132778	MB14A	23/11/2011	35	32-35	1	Siltstone	Unknown	Unknown	12700	1	Would require a land access agreement	x	Possibly	x	
RN 132779	MB14B	23/11/2011	23	20-23	1	Sandstone	Unknown	Unknown	26200	1	Would require a land access agreement	x	Possibly	x	
RN 132776	MB4	29/11/2011	33	27-33	1	Siltstone	Unknown	Unknown	16900	1	Would require a land access agreement	x	Possibly	x	
RN 132777	MB2	27/11/2011	226	220-226	2	Coal	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 158263	MB1	30/11/2011	269	NA	NA	Coal	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 132775	MB12	29/11/2011	9.5	6.5-9.5	1	Sand	Unknown	Unknown	Unknown	0	Would require a land access agreement	Potential	Possibly	Yes	
RN 132773	MB13A	26/11/2011	16	12.3-15.3	1	Siltstone	Unknown	Unknown	Unknown	0	Would require a land access agreement	Potential	Possibly	Yes	
RN 132774	MB13B	29/11/2011	9	6.0-9.0	1	Sand	Unknown	Unknown	Unknown	0	Would require a land access agreement	Potential	Possibly	Yes	
RN 190464	-	10/11/2020	30	21.0-30.0	0.4	Siltstone	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 190459	-	6/11/2020	51	42.0-51.0	0.4	Siltstone	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 165940	MB19BWM02A	13/11/2019	15	12.0-15.0	1	Clay/sand	7.61	Unknown	Brackish	1		Potential	Yes	Yes	
RN 165971	MB19BWM01P	13/11/2019	171	168-171	1	Coal	13.6	8.2	27350	1		x	Yes	x	
RN 165972	MB19BWM04R	15/11/2019	80	71-80	1	Sandstone/siltstone	36.7	Unknown	Salty	1		x	Yes	x	
RN 165945	MB19BWM05A	9/11/2019	15	9-15	1	Claystone	Unknown	Unknown	Unknown	0		Potential	Yes	Yes	Within ML
RN 165941	MB19BWM03P	8/11/2019	234	221-230	1	Siltstone/coal	200	Unknown	Brackish	1		x	Yes	x	
RN 165947	MB19BWM06P	7/11/2019	186	180-186	1	Siltstone/coal	25.8	Unknown	20410	1	Would require a land access agreement	x	Possibly	x	
RN 165973	MB19BWM27P	18/12/2019	189	180-189	4	Coal	25	Unknown	Salty	1		x	Yes	x	
RN 165951	MB19BWM26P	7/12/2019	191	Unknown	Unknown	Siltstone/coal	11.5	Unknown	Salty	1		x	Yes	x	
RN 165950	PB19BWM01P	3/12/2019	198	Unknown	Unknown	Siltstone/coal	30	Unknown	Salty	1		x	Yes	x	
RN 165949	MB19BWM25P	30/11/2019	20	17-20	1	Sandstone	13.8	8.7	4441	1		✓	Yes	Yes	Within ML
RN 165948	MB19BWM07A	29/11/2019	7	4-7	4	Sand and gravel	4	8.7	4400	1		✓	Yes	Yes	Within ML
RN 190679	-	14/09/2021	25	Unknown	1	-	-	Unknown	Unknown	0		x	Yes	x	
RN 165946	MB19BWM09A	4/12/2019	15	Grouted	Unknown	-	-	Unknown	Unknown	0		x	Yes	x	
RN 165936	MB19BWM08P	19/10/2019	190	184-190	1	Sandstone/coal	21.5	8.0	5507	1		x	Yes	x	
RN 209136	C1424W	23/11/2023	176	NA	NA	Coal	Unknown	Unknown	Unknown	0	Would require a land access agreement	x	Possibly	x	
RN 47668	-	1/01/1978	19.2	15.2-19.2	open	Mudstone/shale/silt	Unknown	Unknown	Unknown	0	Abandoned and destroyed	x	No	x	
RN 208478	C1419W	21/07/2024	10	12-15; 17-23	1	Sandstone/siltstone	10	Unknown	Unknown	1	Would require a land access agreement	Potential	Possibly	x	Outside of State-mapped aquifer
RN 205177	C1423W	22/07/2023	27	18-27	1	Sandstone	17	Unknown	Unknown	1	Would require a land access agreement	Potential	Possibly	x	Outside of State-mapped aquifer

Registered bore	Other name	Drilled date	Depth (mbgl)	Screened interval (m)	Screen aperture (mm)	Lithology	Logged SWL (mbgl)	Mean pH	Mean EC (µS/cm)	Data points (n)	WHC notes	Suitable?	Can it be accessed?	DPM would like to seek access	DPM notes
RN 208477	C1420W	21/07/2024	30	18-27	1	Sandstone/siltstone	7	Unknown	Unknown	1	Would require a land access agreement	**Potential**	**Possibly**	**x**	Outside of State-mapped aquifer
RN 208476	C1421W	21/07/2024	23.5	17.5-23.5	1	Sandstone/siltstone	16	Unknown	Unknown	1	Would require a land access agreement	**Potential**	**Possibly**	**x**	Outside of State-mapped aquifer
RN 23022	HPP GEMINI 3	28/08/1980	444	Unknown	Unknown	-	-	Unknown	Unknown	0	Would require a land access agreement	**x**	**Possibly**	**x**	
RN 205176	C1422W	22/07/2023	30	21-30	1	Sandstone	-	Unknown	Unknown	0	Dry during drilling	**x**	**No**	**x**	
RN 23021	HPP GEMINI 2	17/08/1980	443	Unknown	Unknown	-	-	Unknown	Unknown	0	Would require a land access agreement	**x**	**Possibly**	**x**	
RN 23020	HPP GEMINI 4	3/08/1980	465	Unknown	Unknown	-	-	Unknown	Unknown	0	Would require a land access agreement	**x**	**Possibly**	**x**	
RN 23023	HPP GEMINI 1	8/09/1980	609	Unknown	Unknown	-	-	Unknown	Unknown	0	Would require a land access agreement	**x**	**Possibly**	**x**	

Selection criteria:

1. Not a dry bore
2. At least 6 months old
3. Screened interval no deeper than 60 mbgl, and ideally shallower than 50 mbgl (stygofauna rarely found deeper than this due to lack of dissolved organic carbon)
4. Screen aperture 1 mm or greater (exceptions can be made, but non-detection is inconclusive)
5. EC ideally <5,000 uS/cm, although exceptions can be made
6. pH ideally 6.5-8.5, although not as important
7. not purged in the last 1-3 months

Colour coding:

Green cells = likely suitable
Orange cells = marginal, or unknown and potentially suitable
Red cells = not suitable

Appendix D: Water Sampling Analytical Results

CERTIFICATE OF ANALYSIS

Work Order	: **EB2523359**	Page	: 1 of 6
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 07-Jul-2025 14:30
Order number	: ----	Date Analysis Commenced	: 07-Jul-2025
C-O-C number	: ----	Issue Date	: 14-Jul-2025 14:48
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 19		
No. of samples analysed	: 19		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	L1	R5	R6	R9	R3
				Sampling date / time	17-Jun-2025 00:00	18-Jun-2025 00:00	18-Jun-2025 00:00	19-Jun-2025 00:00	20-Jun-2025 00:00
Compound	CAS Number	LOR	Unit		EB2523359-001	EB2523359-002	EB2523359-003	EB2523359-004	EB2523359-005
					Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**93**	**171**	**92**	**78**	**110**
Total Alkalinity as CaCO3	----	1	mg/L		**93**	**171**	**92**	**78**	**110**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<1	**4**	**8**	**2**	**5**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**8**	**18**	**15**	**7**	**24**
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**16**	**37**	**19**	**15**	**23**
Magnesium	7439-95-4	1	mg/L		**6**	**8**	**6**	**4**	**8**
Sodium	7440-23-5	1	mg/L		**19**	**39**	**22**	**12**	**23**
Potassium	7440-09-7	1	mg/L		**5**	**4**	**6**	**5**	**7**
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**2.08**	**4.01**	**2.43**	**1.80**	**2.98**
ø Total Cations	----	0.01	meq/L		**2.25**	**4.30**	**2.55**	**1.73**	**2.98**
ø Ionic Balance	----	0.01	%		**----**	**3.56**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	R4	L2	RN165940	RN165949	MB06
			Sampling date / time	20-Jun-2025 00:00	30-Jun-2025 00:00	01-Jul-2025 00:00	01-Jul-2025 00:00	02-Jul-2025 00:00
Compound	CAS Number	LOR	Unit	EB2523359-006	EB2523359-007	EB2523359-008	EB2523359-009	EB2523359-010
				Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	78	121	438	788	280
Total Alkalinity as CaCO3	----	1	mg/L	78	121	438	788	280
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	7	99	502	240	604
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	10	40	13100	1290	7230
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	15	32	995	59	454
Magnesium	7439-95-4	1	mg/L	5	13	1040	26	248
Sodium	7440-23-5	1	mg/L	16	48	6420	1100	3870
Potassium	7440-09-7	1	mg/L	6	9	9	4	15
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	1.99	5.61	389	57.1	222
ø Total Cations	----	0.01	meq/L	2.01	4.98	415	53.0	212
ø Ionic Balance	----	0.01	%	----	5.88	3.23	3.72	2.38

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MP1	MP2	RN132773	L3	L4
				Sampling date / time	02-Jul-2025 00:00	02-Jul-2025 00:00	02-Jul-2025 00:00	03-Jul-2025 00:00	03-Jul-2025 00:00
Compound	CAS Number	LOR	Unit		EB2523359-011	EB2523359-012	EB2523359-013	EB2523359-014	EB2523359-015
					Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	**52**	**11**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**90**	**249**	**299**	**578**	**149**
Total Alkalinity as CaCO3	----	1	mg/L		**90**	**249**	**299**	**630**	**161**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**3**	<1	**1000**	**537**	**110**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**12**	**20**	**16900**	**1160**	**161**
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**15**	**73**	**1350**	**31**	**35**
Magnesium	7439-95-4	1	mg/L		**4**	**15**	**1290**	**40**	**14**
Sodium	7440-23-5	1	mg/L		**18**	**19**	**8850**	**1000**	**140**
Potassium	7440-09-7	1	mg/L		**5**	**5**	**12**	**10**	**6**
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**2.20**	**5.54**	**504**	**56.5**	**10.0**
ø Total Cations	----	0.01	meq/L		**2.00**	**----**	**----**	**----**	**----**
ø Total Cations	----	0.01	meq/L		**----**	**5.83**	**559**	**48.6**	**9.14**
ø Ionic Balance	----	0.01	%		**----**	**2.57**	**5.20**	**7.52**	**4.72**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MP3	MP4	MP5	RN190143	----
			Sampling date / time	03-Jul-2025 00:00	03-Jul-2025 00:00	03-Jul-2025 00:00	03-Jul-2025 00:00	----
Compound	CAS Number	LOR	Unit	EB2523359-016	EB2523359-017	EB2523359-018	EB2523359-019	--------
				Result	Result	Result	Result	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**117**	**600**	**125**	**48**	----
Total Alkalinity as CaCO3	----	1	mg/L	**117**	**600**	**125**	**48**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**3**	**2**	**2**	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**25**	**30**	**23**	**12700**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**28**	**178**	**30**	**2240**	----
Magnesium	7439-95-4	1	mg/L	**9**	**38**	**9**	**132**	----
Sodium	7440-23-5	1	mg/L	**18**	**24**	**18**	**5970**	----
Potassium	7440-09-7	1	mg/L	**6**	**12**	**7**	**11**	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**3.10**	**12.9**	**3.19**	**359**	----
ø Total Cations	----	0.01	meq/L	**3.07**	**13.4**	**3.20**	**383**	----
ø Ionic Balance	----	0.01	%	**0.50**	**1.85**	**0.18**	**3.15**	----

QUALITY CONTROL REPORT

Work Order	: **EB2523359**	Page	: 1 of 6
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 07-Jul-2025
Order number	: ----	Date Analysis Commenced	: 07-Jul-2025
C-O-C number	: ----	Issue Date	: 14-Jul-2025
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 19		
No. of samples analysed	: 19		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 6702966)									
EB2523359-012	MP2	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	249	248	0.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	249	248	0.6	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6705412)									
EB2522984-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	76	72	4.1	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	76	72	4.1	0% - 20%
EB2523359-010	MB06	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	280	279	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	280	279	0.0	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6705427)									
EB2523450-004	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	32	36	13.7	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	280	278	0.4	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	311	315	1.1	0% - 20%
EB2523359-017	MP4	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	600	601	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	600	601	0.0	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 6708262)									
EB2523603-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	152	164	7.5	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	644	634	1.6	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	796	798	0.2	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6705160)									
EB2523302-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	10	10	0.0	0% - 50%
EB2523359-005	R3	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	5	4	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6709712)									
EB2523450-005	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1110	1120	0.8	0% - 20%
EB2523359-018	MP5	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	2	2	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6714744)									
EB2523359-011	MP1	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	3	3	0.0	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 6705161)									
EB2523302-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	<1	<1	0.0	No Limit
EB2523359-005	R3	ED045G: Chloride	16887-00-6	1	mg/L	24	24	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 6709709)									
EB2523450-005	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	4730	4810	1.8	0% - 20%
EB2523359-018	MP5	ED045G: Chloride	16887-00-6	1	mg/L	23	23	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 6714745)									
EB2523359-011	MP1	ED045G: Chloride	16887-00-6	1	mg/L	12	13	0.0	0% - 50%
ED093F: Dissolved Major Cations (QC Lot: 6703163)									
EB2523114-006	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	15	15	0.0	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	12	12	0.0	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	282	281	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 6703172)									
EB2523040-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
EB2523241-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	24	25	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	14	14	0.0	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 6703173)									
EB2523359-004	R9	ED093F: Calcium	7440-70-2	1	mg/L	15	15	0.0	0% - 50%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED093F: Dissolved Major Cations (QC Lot: 6703173) - continued									
EB2523359-004	R9	ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	12	12	0.0	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	5	5	0.0	No Limit
EB2523359-014	L3	ED093F: Calcium	7440-70-2	1	mg/L	31	31	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	40	40	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	1000	1010	0.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	10	10	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 6702966)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	109	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6705412)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	98.2	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6705427)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	104	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6708262)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	92.1	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6705160)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	94.7	85.0	118
				<1	100 mg/L	108	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6709712)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	99.6	85.0	118
				<1	100 mg/L	104	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6714744)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	97.5	85.0	118
				<1	100 mg/L	103	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 6705161)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	112	90.0	115
				<1	1000 mg/L	105	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 6709709)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	113	90.0	115
				<1	1000 mg/L	110	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 6714745)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	110	90.0	115
				<1	1000 mg/L	107	90.0	115
ED093F: Dissolved Major Cations (QCLot: 6703163)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	102	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	99.5	70.0	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED093F: Dissolved Major Cations (QCLot: 6703172)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	99.6	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	100	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.6	70.0	130
ED093F: Dissolved Major Cations (QCLot: 6703173)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	110	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	113	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	99.0	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	100.0	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6705160)							
EB2523302-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6709712)							
EB2523450-006	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6714744)							
EB2523401-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	89.6	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6705161)							
EB2523302-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	112	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6709709)							
EB2523450-006	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2523359**	Page	: 1 of 7
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 07-Jul-2025
Site	: ----	Issue Date	: 14-Jul-2025
Sampler	: DAVID MOORE	No. of samples received	: 19
Order number	: ----	No. of samples analysed	: 19

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2523302--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2523450--006	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EB2523450--006	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
ED037P: Alkalinity by PC Titrator						
Clear Plastic Bottle - Natural L1	----	----	----	09-Jul-2025	01-Jul-2025	**8**
Clear Plastic Bottle - Natural R5, R6	----	----	----	09-Jul-2025	02-Jul-2025	**7**
Clear Plastic Bottle - Natural R9	----	----	----	09-Jul-2025	03-Jul-2025	**6**
Clear Plastic Bottle - Natural R3, R4	----	----	----	09-Jul-2025	04-Jul-2025	**5**
ED093F: Dissolved Major Cations						
Clear Plastic Bottle - Natural RN165940, RN165949	----	----	----	11-Jul-2025	08-Jul-2025	**3**
Clear Plastic Bottle - Natural MP1	----	----	----	10-Jul-2025	09-Jul-2025	**1**
Clear Plastic Bottle - Natural MB06, MP2, RN132773	----	----	----	11-Jul-2025	09-Jul-2025	**2**
Clear Plastic Bottle - Natural L3, L4, MP3, MP4, MP5, RN190143	----	----	----	11-Jul-2025	10-Jul-2025	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) RN165940, RN165949	**01-Jul-2025**	**----**	----	**----**	**09-Jul-2025**	15-Jul-2025	✓
Clear Plastic Bottle - Natural (ED037-P) MP2, RN132773	**02-Jul-2025**	**----**	----	**----**	**08-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Natural (ED037-P) MB06	**02-Jul-2025**	**----**	----	**----**	**09-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Natural (ED037-P) MP1	**02-Jul-2025**	**----**	----	**----**	**10-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Natural (ED037-P) L3, L4, MP3, MP4, MP5, RN190143	**03-Jul-2025**	**----**	----	**----**	**09-Jul-2025**	17-Jul-2025	✓
Clear Plastic Bottle - Natural (ED037-P) L1	**17-Jun-2025**	**----**	----	**----**	**09-Jul-2025**	01-Jul-2025	×
Clear Plastic Bottle - Natural (ED037-P) R5, R6	**18-Jun-2025**	**----**	----	**----**	**09-Jul-2025**	02-Jul-2025	×
Clear Plastic Bottle - Natural (ED037-P) R9	**19-Jun-2025**	**----**	----	**----**	**09-Jul-2025**	03-Jul-2025	×
Clear Plastic Bottle - Natural (ED037-P) R3, R4	**20-Jun-2025**	**----**	----	**----**	**09-Jul-2025**	04-Jul-2025	×
Clear Plastic Bottle - Natural (ED037-P) L2	**30-Jun-2025**	**----**	----	**----**	**09-Jul-2025**	14-Jul-2025	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) RN165940, RN165949	**01-Jul-2025**	----	----	----	**08-Jul-2025**	29-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) MB06, MP2, RN132773	**02-Jul-2025**	----	----	----	**08-Jul-2025**	30-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) MP1	**02-Jul-2025**	----	----	----	**12-Jul-2025**	30-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) L3, L4, MP3, MP4, MP5, RN190143	**03-Jul-2025**	----	----	----	**10-Jul-2025**	31-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) L1	**17-Jun-2025**	----	----	----	**08-Jul-2025**	15-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) R5, R6	**18-Jun-2025**	----	----	----	**08-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) R9	**19-Jun-2025**	----	----	----	**08-Jul-2025**	17-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) R3, R4	**20-Jun-2025**	----	----	----	**08-Jul-2025**	18-Jul-2025	✓
Clear Plastic Bottle - Natural (ED041G) L2	**30-Jun-2025**	----	----	----	**08-Jul-2025**	28-Jul-2025	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) RN165940, RN165949	**01-Jul-2025**	----	----	----	**08-Jul-2025**	29-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) MB06, MP2, RN132773	**02-Jul-2025**	----	----	----	**08-Jul-2025**	30-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) MP1	**02-Jul-2025**	----	----	----	**12-Jul-2025**	30-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) L3, L4, MP3, MP4, MP5, RN190143	**03-Jul-2025**	----	----	----	**10-Jul-2025**	31-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) L1	**17-Jun-2025**	----	----	----	**08-Jul-2025**	15-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) R5, R6	**18-Jun-2025**	----	----	----	**08-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) R9	**19-Jun-2025**	----	----	----	**08-Jul-2025**	17-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) R3, R4	**20-Jun-2025**	----	----	----	**08-Jul-2025**	18-Jul-2025	✓
Clear Plastic Bottle - Natural (ED045G) L2	**30-Jun-2025**	----	----	----	**08-Jul-2025**	28-Jul-2025	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F) RN165940, RN165949	**01-Jul-2025**	**----**	----	----	**11-Jul-2025**	08-Jul-2025	×
Clear Plastic Bottle - Natural (ED093F) MP1	**02-Jul-2025**	**----**	----	----	**10-Jul-2025**	09-Jul-2025	×
Clear Plastic Bottle - Natural (ED093F) MB06, MP2, RN132773	**02-Jul-2025**	**----**	----	----	**11-Jul-2025**	09-Jul-2025	×
Clear Plastic Bottle - Natural (ED093F) L3, L4, MP3, MP4, MP5, RN190143	**03-Jul-2025**	**----**	----	----	**11-Jul-2025**	10-Jul-2025	×
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1	**17-Jun-2025**	**----**	----	----	**11-Jul-2025**	15-Jul-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R5, R6	**18-Jun-2025**	**----**	----	----	**11-Jul-2025**	16-Jul-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R9	**19-Jun-2025**	**----**	----	----	**11-Jul-2025**	17-Jul-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) R3, R4	**20-Jun-2025**	**----**	----	----	**11-Jul-2025**	18-Jul-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L2	**30-Jun-2025**	**----**	----	----	**11-Jul-2025**	28-Jul-2025	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	6	36	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	5	39	**12.82**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	5	34	**14.71**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	5	38	**13.16**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	4	36	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	6	39	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	34	**8.82**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	6	38	**15.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	3	39	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	34	**8.82**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	38	**7.89**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	2	39	**5.13**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	38	**7.89**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030E. This method is compliant with NEPM Schedule B(3)

Environmental Division
Brisbane
Work Order Reference
EB2523359

CHAIN OF CUSTODY

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BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
ALS Laboratory: please tick
GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4976 7944 E: ALSEnviro.Gladstone@alsglobal.com
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WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW Ph: 02 4225 3125 E: wollongong@alsglobal.com

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CLIENT: DPM Enviroscience Pty Ltd	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☐ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Buderim		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes
PROJECT: Blackwater North Project **PROJECT NO.:** DPM25005	**ALS QUOTE NO.:** EN/333/20	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes
ORDER NUMBER: N/A **PURCHASE ORDER NO.:** N/A	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt
PROJECT MANAGER: David Moore **CONTACT PH:** 0427 694 433		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore **SAMPLER MOBILE:** 0427 694 433	**RELINQUISHED BY:** DAVID MOORE	**RECEIVED BY:** [signature] 7/7/25	**RELINQUISHED BY:** **RECEIVED BY:**
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 7/7/2025 14:30	DATE/TIME: 1430	DATE/TIME: DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Cations & Anions: Major (Ca, Mg, Na, K, Cl, SO_4, Alkalinity) + Ionic Balance (Suite NT-1 & NT-2)								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	L1	17/06/2025	W	P, N	2	✓								
2	R5	18/06/2025	W	P, N	2	✓								
3	R6	18/06/2025	W	P, N	2	✓								
4	R9	19/06/2025	W	P, N	2	✓								
5	R3	20/06/2025	W	P, N	2	✓								
6	R4	20/06/2025	W	P, N	2	✓								
7	L2	30/06/2025	W	P, N	2	✓								
8	RN165940	1/07/2025	W	P	1	✓								
9	RN165949	1/07/2025	W	P	1	✓								
10	MB06	2/07/2025	W	P	1	✓								
11	MP1	2/07/2025	W	P	1	✓								
12	MP2	2/07/2025	W	P	1	✓								
				TOTAL	19									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4979 7944 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Gateway Drive Paget QLD 4740 Ph: 07 4955 5799 E: ALSEnviro.Mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

ORANGE 4/13 Geary Place North Orange NSW 2800 Ph: 02 4423 2063 E: orange@alsglobal.com

PERTH 26 Rigali Way Wangara WA 6065 Ph: 08 9406 1301 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 13 Carlton Street Kirwan QLD 4817 Ph: 07 4773 8500 E: ALSEnviro.Townsville@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Envirosciences Pty Ltd	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Buderim		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Blackwater North Project **PROJECT NO.:** DPM25005	**ALS QUOTE NO.:** EN/333/20	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: N/A **PURCHASE ORDER NO.:** N/A	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: David Moore **CONTACT PH:** 0427 694 433		OFI: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore **SAMPLER MOBILE:** 0427 694 433	**RELINQUISHED BY:** DAVID MOORE	**RECEIVED BY:** DM 7/7/25	**RELINQUISHED BY:** **RECEIVED BY:**
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 7/7/2025 14:30	DATE/TIME: 1430	DATE/TIME: DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	Cations & Anions: Major (Ca, Mg, Na, K, Cl, SO_4, Alkalinity) + Ionic Balance (Suite NT-1 & NT-2)								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
13	RN132773	2/07/2025	W	P	1	✓								
14	L3	3/07/2025	W	P	1	✓								
15	L4	3/07/2025	W	P	1	✓								
16	MP3	3/07/2025	W	P	1	✓								
17	MP4	3/07/2025	W	P	1	✓								
18	MP5	3/07/2025	W	P	1	✓								
19	RN190143	3/07/2025	W	P	1	✓								
				TOTAL	7									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CERTIFICATE OF ANALYSIS

Work Order	: **EB2537754**	Page	: 1 of 5
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 28-Oct-2025 11:15
Order number	: ----	Date Analysis Commenced	: 29-Oct-2025
C-O-C number	: ----	Issue Date	: 04-Nov-2025 15:54
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 14		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	L1	L3	L4	RN 165940	R6
			Sampling date / time	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00
Compound	CAS Number	LOR	Unit	EB2537754-001	EB2537754-002	EB2537754-003	EB2537754-004	EB2537754-005
				Result	Result	Result	Result	Result
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	36	223	181	6350	88
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	15	14	<1	<1	7
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	54	488	198	401	147
Total Alkalinity as CaCO3	----	1	mg/L	69	502	198	401	155
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	352	152	496	4
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	12	948	232	11700	48
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	8	25	38	897	17
Magnesium	7439-95-4	1	mg/L	4	39	21	999	11
Sodium	7440-23-5	1	mg/L	26	939	228	5920	54
Potassium	7440-09-7	1	mg/L	4	11	7	9	9
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	1.72	44.1	13.7	348	4.53
ø Total Cations	----	0.01	meq/L	1.96	45.6	13.7	385	4.33
ø Ionic Balance	----	0.01	%	----	1.65	0.20	4.96	2.27

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	L2	RN 165949	R3	RN 190143	MP1
			Sampling date / time	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00
Compound	CAS Number	LOR	Unit	EB2537754-006	EB2537754-007	EB2537754-008	EB2537754-009	EB2537754-010
				Result	Result	Result	Result	Result
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	172	181	170	5470	324
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	12	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	145	724	164	39	350
Total Alkalinity as CaCO3	----	1	mg/L	145	736	164	39	350
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	111	167	2	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	68	923	87	12300	15
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	31	41	40	1960	92
Magnesium	7439-95-4	1	mg/L	23	19	17	141	23
Sodium	7440-23-5	1	mg/L	96	915	58	5780	25
Potassium	7440-09-7	1	mg/L	10	3	14	10	9
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	7.13	44.2	5.77	348	7.42
ø Total Cations	----	0.01	meq/L	7.87	43.5	6.28	361	7.80
ø Ionic Balance	----	0.01	%	4.97	0.84	4.18	1.88	2.53

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	MP3	MB06	MB13A	MP5	----
			Sampling date / time	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	28-Oct-2025 00:00	----
Compound	CAS Number	LOR	Unit	EB2537754-011	EB2537754-012	EB2537754-013	EB2537754-014	--------
				Result	Result	Result	Result	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**157**	**2180**	**7930**	**133**	**----**
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	**----**
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	**----**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**178**	**251**	**269**	**167**	**----**
Total Alkalinity as CaCO3	----	1	mg/L	**178**	**251**	**269**	**167**	**----**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	**577**	**952**	**4**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**16**	**7190**	**16200**	**15**	**----**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**43**	**461**	**1180**	**35**	**----**
Magnesium	7439-95-4	1	mg/L	**12**	**249**	**1210**	**11**	**----**
Sodium	7440-23-5	1	mg/L	**20**	**4010**	**8240**	**14**	**----**
Potassium	7440-09-7	1	mg/L	**7**	**13**	**12**	**9**	**----**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**4.01**	**220**	**482**	**3.84**	**----**
ø Total Cations	----	0.01	meq/L	**4.18**	**218**	**517**	**3.49**	**----**
ø Ionic Balance	----	0.01	%	**2.13**	**0.36**	**3.50**	**4.80**	**----**

QUALITY CONTROL REPORT

Work Order	: **EB2537754**	Page	: 1 of 5
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 28-Oct-2025
Order number	: ----	Date Analysis Commenced	: 29-Oct-2025
C-O-C number	: ----	Issue Date	: 04-Nov-2025
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 14		
No. of samples analysed	: 14		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 6965489)									
EB2537745-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	94	94	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	94	94	0.0	0% - 20%
EB2537745-017	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	93	90	3.8	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	93	90	3.8	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 6965490)									
EB2537754-011	MP3	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	178	180	0.8	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	178	180	0.8	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6965891)									
EB2537761-015	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	33	33	0.0	0% - 20%
EB2537754-002	L3	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	352	349	0.8	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 6965892)									
EB2537754-012	MB06	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	577	582	0.8	0% - 20%
EB2537952-006	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	29	28	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 6965888)									
EB2537761-015	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	25	26	0.0	0% - 20%
EB2537754-002	L3	ED045G: Chloride	16887-00-6	1	mg/L	948	972	2.5	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED045G: Chloride by Discrete Analyser (QC Lot: 6965889)									
EB2537754-012	MB06	ED045G: Chloride	16887-00-6	1	mg/L	7190	7270	1.0	0% - 20%
EB2537952-006	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	72	72	0.0	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 6963661)									
EB2537528-009	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	28	29	3.7	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	18	18	0.0	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	106	107	0.0	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	23	23	0.0	0% - 20%
EB2537754-004	RN 165940	ED093F: Calcium	7440-70-2	1	mg/L	897	936	4.3	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	999	1030	2.7	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	5920	6080	2.7	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	9	9	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 6965489)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	92.4	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 6965490)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	91.8	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6965891)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	95.0	85.0	118
				<1	100 mg/L	89.2	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6965892)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	91.5	85.0	118
				<1	100 mg/L	91.0	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 6965888)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	115	90.0	115
				<1	1000 mg/L	101	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 6965889)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	114	90.0	115
				<1	1000 mg/L	102	90.0	115
ED093F: Dissolved Major Cations (QCLot: 6963661)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	99.6	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	96.8	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	94.8	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6965891)							
EB2537761-013	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 6965892)							
EB2537754-013	MB13A	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6965888)							
EB2537761-013	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	109	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 6965889)							
EB2537754-013	MB13A	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2537754**	Page	: 1 of 5
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3552-8685
Project	: DPM25005 Blackwater North Project	Date Samples Received	: 28-Oct-2025
Site	: ----	Issue Date	: 04-Nov-2025
Sampler	: DAVID MOORE	No. of samples received	: 14
Order number	: ----	No. of samples analysed	: 14

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2537761--013	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2537754--013	MB13A	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EB2537754--013	MB13A	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA065: Total Hardness as CaCO3							
Clear Plastic Bottle - Natural (ED093F) MP1, MP3, MB06, MB13A, MP5	**28-Oct-2025**	**----**	----	**----**	**03-Nov-2025**	04-Nov-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) L1, L3, L4, RN 165940, R6, L2, RN 165949, R3, RN 190143	**28-Oct-2025**	**----**	----	**----**	**03-Nov-2025**	25-Nov-2025	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
L1, L3, L4, RN 165940, R6, L2, RN 165949, R3, RN 190143, MP1, MP3, MB06, MB13A, MP5	**28-Oct-2025**	**----**	----	----	**31-Oct-2025**	11-Nov-2025	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
L1, L3, L4, RN 165940, R6, L2, RN 165949, R3, RN 190143, MP1, MP3, MB06, MB13A, MP5	**28-Oct-2025**	**----**	----	----	**29-Oct-2025**	25-Nov-2025	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
L1, L3, L4, RN 165940, R6, L2, RN 165949, R3, RN 190143, MP1, MP3, MB06, MB13A, MP5	**28-Oct-2025**	**----**	----	----	**29-Oct-2025**	25-Nov-2025	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F)							
MP1, MP3, MB06, MB13A, MP5	**28-Oct-2025**	**----**	----	----	**03-Nov-2025**	04-Nov-2025	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
L1, L3, L4, RN 165940, R6, L2, RN 165949, R3, RN 190143	**28-Oct-2025**	**----**	----	----	**03-Nov-2025**	25-Nov-2025	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by Auto Titrator	ED037-P	3	23	**13.04**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	23	**8.70**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	4	32	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	32	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. Auto Titrator) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030E. This method is compliant with NEPM Schedule B(3)

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 31 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

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MACKAY Unit 2/26 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.Mackay@alsglobal.com

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TOWNSVILLE 13 Carbon Street Kirwan QLD 4817 Ph: 07 4773 0000 E: ALSEnviro.Townsville@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Enviroscience Pty Ltd	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Buderim		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Blackwater North Project **PROJECT NO.:** DPM25005	**ALS QUOTE NO.:** EN/333/20	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: N/A **PURCHASE ORDER NO.:** N/A	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: David Moore **CONTACT PH:** 0427 694 433		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore **SAMPLER MOBILE:** 0427 694 433	**RELINQUISHED BY:** DAVID MOORE	**RECEIVED BY:** 28/10/25	**RELINQUISHED BY:** **RECEIVED BY:**
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 28/10/2025 11:15	DATE/TIME: 1115	DATE/TIME: DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Anions: Major (Cl, SO_4, Alkalinity) (Suite NT 2)	Cations: Major (Ca, Mg, Na, K), Hardness (Suite NT-1D)							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	L1	20/10/2025	W	P, N	2	✓	✓							
2	L3	20/10/2025	W	P, N	2	✓	✓							
3	L4	20/10/2025	W	P, N	2	✓	✓							
4	RN 165940	20/10/2025	W	P, N	2	✓	✓							
5	R6	21/10/2025	W	P, N	2	✓	✓							
6	L2	22/10/2025	W	P, N	2	✓	✓							
7	RN 165949	22/10/2025	W	P, N	2	✓	✓							
8	R3	22/10/2025	W	P, N	2	✓	✓							
9	RN 190143	23/10/2025	W	P, N	2	✓	✓							
10	MP1	25/10/2025	W	P	1	✓	✓							
11	MP3	25/10/2025	W	P	1	✓	✓							
12	MB06	25/10/2025	W	P	1	✓	✓							
13	MB13A	25/10/2025	W	P	1	✓	✓							
14	MP5	25/10/2025	W	P	1	✓	✓							
				TOTAL	23									

Environmental Division
Brisbane
Work Order Reference
EB2537754

Telephone : +61-7-3552-8666

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Appendix E: Aquatic Macroinvertebrate Data

DPM25005 - Blackwater North Project - June 2025

Sample picked by			DM	CP	DM	CP	DM	CP	DM	CP	DM	CP	CP	CP
Date sampled			20/06/2025	20/06/2025	20/06/2025	20/06/2025	18/06/2025	18/06/2025	18/06/2025	18/06/2025	19/06/2025	19/06/2025	17/06/2025	30/06/2025
Sample processed by			CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP
Date processed			07/07/2025	07/07/2025	07/07/2025	07/07/2025	25/06/2025	27/06/2025	25/06/2025	25/06/2025	25/06/2025	24/06/2025	08/07/2025	07/07/2025
Site name			R3	R3	R4	R4	R5	R5	R6	R6	R9	R9	L1	L2
Habitat type	SIGNAL 2	AUSRIVAS	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	COMP	COMP
ph. Porifera	4	IA019999												
cl. Hydrozoa														
Clavidae	3	IB029999												
Hydridae	2	IB019999												
ph. Nematoda	3	II999999											4	3
ph. Nemertea	3	IH999999												
ph. Nematomorpha	6	IJ999999												
Gordiidae	5	IJ019999												
ph. Platyhelminthes														
Dalyelliidae														
Dugesiidae	2	IF619999												
Provorticidae														
cl. Temnocephalidea	5	IF419999			1					2		2		
s.c. Hirudinea														
Erpobdellidae	1	LH059999												
Glossiphoniidae	1	LH019999												
Hirudinidae	4	LH999999	1											
ph. Annelida														
s.c. Oligochaeta	2	LO999999	4	13		2	5	8					3	1
cl. Bivalvia														
Corbiculidae	4	KP029999												
Hyriidae	5	KP019999												
Sphaeriidae	5	KP039999												
cl. Gastropoda														
Ancylidae	4	KG069999												1
Bithyniidae	3	KG039999												
Glacidorbidae	5	KG099999												
Hydrobiidae	4	KG029999												
Lymnaeidae	1	KG059999												2
Physidae	1	KG089999												1
Planorbidae	2	KG079999											3	2
Thiaridae	4	KG049999												
Viviparidae	4	KG019999												
cl. Arachnida														
s.c. Acarina	6	MM999999					1	3	3	5			19	13
o. Araneae	-	-												
s.c. Branchiura	1	OK999999												
o. Cladocera	-	OG999999	14	9	12	37	6		17	22	7	50	14	8
s.c. Copepoda	-	OJ999999	18	50	23	50	41	21	19	50	15	50	28	18
o. Conchostraca	1	OF999999												
cl. Ostracoda	-	OH999999	4	8			4	1	12	2	6	1	5	4
o. Amphipoda														
Corophiidae	4	OP059999												
Hyalidae	3	-												
Paramelitidae	4	OP069999												
Talitridae	3	OP019999												
o. Isopoda														
Cirolanidae	2	OR129999												
Scyphacidae	2	OR259999												
Sphaeromatidae	1	OR139999												
su.o. Syncarida														
Psammaspididae	-	ON059999												
o. Decapoda														
Atyidae	3	OT019999	9	1							2		8	1
Palaemonidae	4	OT029999	1	4	17	15	3	3	2		1	5	1	1
Parastacidae	4	OV019999	1		2					3	1	1	1	
s.c. Collembola	1	QA999999												
o. Lepidoptera														
Crambidae	2	QL999999											1	2
o. Megaloptera														
Corydalidae	7	QM019999												
Sialidae	5	QM029999												
o. Neuroptera														
Sisyridae	3	QN059999												
o. Coleoptera														
Carabidae	3	QC059999												
Chrysomelidae	2	QCAH9999												3
Curculionidae	2	QCAN9999												
Dytiscidae	2	QC099999	23	15	10	7	8	9	12	7	14	4	17	12
Elmidae	7	QC349999												
Georissidae	-	-												
Gyrinidae	4	QC109999	4	4										

Sample picked by			DM	CP	DM	CP	DM	CP	DM	CP	DM	CP	CP	CP
Date sampled			20/06/2025	20/06/2025	20/06/2025	20/06/2025	18/06/2025	18/06/2025	18/06/2025	18/06/2025	19/06/2025	19/06/2025	17/06/2025	30/06/2025
Sample processed by			CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP
Date processed			07/07/2025	07/07/2025	07/07/2025	07/07/2025	25/06/2025	27/06/2025	25/06/2025	25/06/2025	25/06/2025	24/06/2025	08/07/2025	07/07/2025
Site name			R3	R3	R4	R4	R5	R5	R6	R6	R9	R9	L1	L2
Habitat type	SIGNAL 2	AUSRIVAS	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	COMP	COMP
Haliplidae	2	QC069999												
Heteroceridae	1	QC369999												
Hydraenidae	3	QC139999	31	14	8	11	31		12		10	8	1	5
Hydrochidae	4	QCAO9999	13	1		1	2	1	4		1		6	23
Hydrophilidae	2	QC119999	8			1	3						2	5
Hygrobiidae	1	QC079999												
Limnichidae	4	QC359999												
Nanophyidae	3	-												
Noteridae	4	QC089999	1						7					3
Psephenidae	6	QC379999												
Ptilodactylidae	10	QC399999												
Scirtidae	6	QC209999									3	1		
Spercheidae	2	-												
Sphaeriusidae	7	-												
Staphylinidae	3	QC189999												
o. Diptera														
Athericidae	8	QD229999												
Blephariceridae	10	QD049999												
Ceratopogonidae	4	QD099999	2	10					1				18	10
Chaoboridae	2	QD059999				1		12				3		
s.f. Aphroteniinae	8	QDAA9999												
s.f. Chironominae	3	QDAJ9999	49	42			7	4	12	6			23	26
s.f. Orthocladiinae	4	QDAF9999								1			1	
s.f. Tanypodinae	4	QDAE9999	2	5				4	2	2			5	14
Corethrellidae	-	-												
Culicidae	1	QD079999	2	4		11	1	1			1	1	1	
Dixidae	7	QD069999												
Dolichopodidae	3	QD369999												
Empididae	5	QD359999												
Ephydridae	2	QD789999				2								
Muscidae	1	QD899999												
Pelecorhynchidae	10	QD209999												
Psychodidae	3	QD129999												
Sciomyzidae	2	QD459999												
Simuliidae	5	QD109999												
Stratiomyidae	2	QD249999												
Syrphidae	2	QD439999												
Tabanidae	3	QD239999											2	
Tanyderidae	6	QD039999												
Thaumaleidae	7	QD119999												
Tipulidae	5	QD019999	2						1					
o. Ephemeroptera														
Ameletopsidae	7	QE049999												
Baetidae	5	QE029999	1	5			1						27	9
Caenidae	4	QE089999												
Leptophlebiidae	8	QE069999												
Teloganodidae	9	QE079999												
o. Hemiptera														
Aphelocheiridae	-	-												
Belostomatidae	1	QH629999												
Corixidae	2	QH659999	1	1			1							
Dipsocoridae	-	-												
Gelastocoridae	5	QH649999												
Gerridae	4	QH579999	9		2		5		1		17			
Hebridae	3	QH539999												
Hydrometridae	3	QH549999	6		2									
Leptopodidae	-	QH589999												
Mesoveliidae	2	QH529999												4
Micronectidae	2	-					19	2	8		2		1	1
Naucoridae	2	QH669999												
Nepidae	3	QH619999	1							2				
Notonectidae	1	QH679999	25	11	14	10	13	16	5	1	25	13		1
Ochteridae	2	QH639999												
Pleidae	2	QH689999	3				1						6	17
Saldidae	1	QH609999												
Veliidae	3	QH569999	11		23	3	20	2	29		22	6		3
s.o. Zygoptera														
Argiolestidae	5	-												
Calopterygidae	-	QO109999												
Chlorocyphidae	-	-												
Chorismagrionidae	-	QO189999												
Coenagrionidae	2	QO029999	3										2	13
Diphlebiidae	6	QO099999												
Hemiphlebiidae	-	QO019999												

Sample picked by			DM	CP	DM	CP	DM	CP	DM	CP	DM	CP	CP	CP
Date sampled			20/06/2025	20/06/2025	20/06/2025	20/06/2025	18/06/2025	18/06/2025	18/06/2025	18/06/2025	19/06/2025	19/06/2025	17/06/2025	30/06/2025
Sample processed by			CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP
Date processed			07/07/2025	07/07/2025	07/07/2025	07/07/2025	25/06/2025	27/06/2025	25/06/2025	25/06/2025	25/06/2025	24/06/2025	08/07/2025	07/07/2025
Site name			R3	R3	R4	R4	R5	R5	R6	R6	R9	R9	L1	L2
Habitat type	SIGNAL 2	AUSRIVAS	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	EDGE	BED	COMP	COMP
Isostictidae	3	QO039999												
Lestidae	1	QO059999												
Lestoideidae	9	QO069999												
Platycnemididae	4	QO049999												
Synlestidae	7	QO089999												
s.o. Epiprocta														
Aeshnidae	4	QO129999	1										1	2
Archipetaliidae	-	QO199999												
Austrocorduliidae	10	QO279999												
Austropetaliidae	-	QO209999												
Brachytronidae	-	-												
Cordulephyidae	5	QO289999												
Corduliidae	5	QO169999												
Gomphidae	5	QO139999							1	1				
Gomphomacromiidae	-	QO249999												
Hemicorduliidae	5	QO309999	1				1							1
Libellulidae	4	QO179999											2	5
Lindeniidae	3	QO229999												2
Macromiidae	8	QO269999												
Oxygastridae	-	QO299999												
Petaluridae	-	QO159999												
Pseudocorduliidae	-	QO259999												
Synthemistidae	2	QO239999												
Telephlebiidae	9	QO219999												
o. Plecoptera														
Gripopterygidae	8	QP039999												
o. Trichoptera														
Antipodoeciidae	8	QT169999												
Atriplectididae	7	QT239999												
Calamoceratidae	7	QT249999												
Calocidae	9	QT189999												
Conoesucidae	7	QT159999												
Dipseudopsidae	9	QT269999												
Ecnomidae	4	QT089999												
Glossosomatidae	9	QT029999												
Helicophidae	10	QT199999												
Helicopsychidae	8	QT069999												
Hydrobiosidae	8	QT019999												
Hydropsychidae	6	QT179999												
Hydroptilidae	4	QT039999												
Kokiriidae	3	QT209999												
Leptoceridae	6	QT259999	14	6									1	5
Limnephilidae	8	QT109999												
Odontoceridae	7	QT229999												
Oeconesidae	8	QT129999												
Philopotamidae	8	QT049999												
Philorheithridae	8	QT219999												
Plectrotarsidae	-	QT119999												
Polycentropodidae	7	QT079999												
Psychomyiidae	-	QT099999												
Stenopsychidae	-	QT059999												
Tasimiidae	8	QT139999												
Notes														
Taxa count			**31**	**18**	**11**	**13**	**20**	**14**	**18**	**13**	**15**	**13**	**28**	**34**
Taxa count (per site)			**31**		**17**		**22**		**22**		**17**		**28**	**34**
No. Individuals			**265**	**203**	**114**	**151**	**173**	**87**	**148**	**104**	**127**	**145**	**203**	**221**
PET taxa			**2**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**2**
Plecoptera			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
% Plecoptera			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Ephemeroptera			**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
% Ephemeroptera			**3**	**6**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**4**	**3**
Trichoptera			**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
% Trichoptera			**3**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**3**
% Other taxa			**94**	**89**	**100**	**100**	**95**	**100**	**100**	**100**	**100**	**100**	**93**	**94**
SIGNAL 2 average (Family)			**3.32**	**3.20**	**3.22**	**2.36**	**3.00**	**2.83**	**3.60**	**3.70**	**3.08**	**3.10**	**3.24**	**3.06**
Tolerant taxa (SIGNAL2≤3)			**14**	**8**	**5**	**9**	**11**	**8**	**6**	**4**	**7**	**6**	**14**	**19**
% tolerant taxa			**50**	**53**	**56**	**82**	**65**	**67**	**40**	**40**	**58**	**60**	**56**	**61**

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Sample picked by			DM	CP	DM	CP	CP	CP
Date sampled			22/10/2025	22/10/2025	21/10/2025	21/10/2025	20/10/2025	22/10/2025
Sample processed by			DM	DM	DM	DM	DM	DM
Date processed			05/11/2025	06/11/2025	04/11/2025	04/11/2025	05/11/2025	06/11/2025
Site name			R3	R3	R6	R6	L1	L2
Habitat type	SIGNAL 2	AUSRIVAS	EDGE	BED	EDGE	BED	COMP	COMP
ph. Porifera	4	IA019999						
cl. Hydrozoa								
Clavidae	3	IB029999						
Hydridae	2	IB019999						
ph. Nematoda	3	II999999					1	
ph. Nemertea	3	IH999999						
ph. Nematomorpha	6	IJ999999						
Gordiidae	5	IJ019999						
ph. Platyhelminthes								
Dalyelliidae								
Dugesiidae	2	IF619999						
Provorticidae								
cl. Temnocephalidea	5	IF419999						
s.c. Hirudinea								
Erpobdellidae	1	LH059999						
Glossiphoniidae	1	LH019999						
Hirudinidae	4	LH999999						
ph. Annelida								
s.c. Oligochaeta	2	LO999999	2	7	1	3	4	
cl. Bivalvia								
Corbiculidae	4	KP029999						
Hyriidae	5	KP019999						
Sphaeriidae	5	KP039999						
cl. Gastropoda								
Ancylidae	4	KG069999						
Bithyniidae	3	KG039999						
Glacidorbidae	5	KG099999						
Hydrobiidae	4	KG029999						
Lymnaeidae	1	KG059999						
Physidae	1	KG089999	6	7				7
Planorbidae	2	KG079999	8		1			17
Thiaridae	4	KG049999		1				3
Viviparidae	4	KG019999		2				
cl. Arachnida								
s.c. Acarina	6	MM999999			6	13	29	15
o. Araneae	-	-						
s.c. Branchiura	1	OK999999						
o. Cladocera	-	OG999999				10		1
s.c. Copepoda	-	OJ999999	3	12	5	10	4	2
o. Conchostraca	1	OF999999						
cl. Ostracoda	-	OH999999	2		9	15		1
o. Amphipoda								
Corophiidae	4	OP059999						
Hyalidae	3	-						
Paramelitidae	4	OP069999						
Talitridae	3	OP019999						
o. Isopoda								
Cirolanidae	2	OR129999						
Scyphacidae	2	OR259999						
Sphaeromatidae	1	OR139999						
su.o. Syncarida								
Psammaspididae	-	ON059999						
o. Decapoda								

Sample picked by			DM	CP	DM	CP	CP	CP
Date sampled			22/10/2025	22/10/2025	21/10/2025	21/10/2025	20/10/2025	22/10/2025
Sample processed by			DM	DM	DM	DM	DM	DM
Date processed			05/11/2025	06/11/2025	04/11/2025	04/11/2025	05/11/2025	06/11/2025
Site name			**R3**	**R3**	**R6**	**R6**	**L1**	**L2**
Habitat type	**SIGNAL 2**	**AUSRIVAS**	**EDGE**	**BED**	**EDGE**	**BED**	**COMP**	**COMP**
Atyidae	3	OT019999	1					
Palaemonidae	4	OT029999	16	12	2		5	5
Parastacidae	4	OV019999	1	1	1	1	1	
s.c. Collembola	1	QA999999						
o. Lepidoptera								
Crambidae	2	QL999999						7
o. Megaloptera								
Corydalidae	7	QM019999						
Sialidae	5	QM029999						
o. Neuroptera								
Sisyridae	3	QN059999						
o. Coleoptera								
Carabidae	3	QC059999						
Chrysomelidae	2	QCAH9999						
Curculionidae	2	QCAN9999						
Dytiscidae	2	QC099999	27	11	21	18	16	27
Elmidae	7	QC349999						
Georissidae	-	-						
Gyrinidae	4	QC109999	5	1		1		
Haliplidae	2	QC069999						
Heteroceridae	1	QC369999						
Hydraenidae	3	QC139999	11	6	4	4	3	6
Hydrochidae	4	QCAO9999	5		21	15	8	19
Hydrophilidae	2	QC119999	1		2			3
Hygrobiidae	1	QC079999						
Limnichidae	4	QC359999						
Nanophyidae	3	-						
Noteridae	4	QC089999	3		8			5
Psephenidae	6	QC379999						
Ptilodactylidae	10	QC399999						
Scirtidae	6	QC209999						
Spercheidae	2	-						
Sphaeriusidae	7	-						
Staphylinidae	3	QC189999						
o. Diptera								
Athericidae	8	QD229999						
Blephariceridae	10	QD049999						
Ceratopogonidae	4	QD099999	3	1	12	10	6	4
Chaoboridae	2	QD059999						
s.f. Aphroteniinae	8	QDAA9999				1		
s.f. Chironominae	3	QDAJ9999	12	44	8	8	13	3
s.f. Orthocladiinae	4	QDAF9999			1			
s.f. Tanypodinae	4	QDAE9999	2	8	25	46	12	6
Corethrellidae	-	-						
Culicidae	1	QD079999			4	1		1
Dixidae	7	QD069999						
Dolichopodidae	3	QD369999						
Empididae	5	QD359999						
Ephydridae	2	QD789999						
Muscidae	1	QD899999						
Pelecorhynchidae	10	QD209999						
Psychodidae	3	QD129999						
Sciomyzidae	2	QD459999						
Simuliidae	5	QD109999						
Stratiomyidae	2	QD249999						

Sample picked by			DM	CP	DM	CP	CP	CP
Date sampled			22/10/2025	22/10/2025	21/10/2025	21/10/2025	20/10/2025	22/10/2025
Sample processed by			DM	DM	DM	DM	DM	DM
Date processed			05/11/2025	06/11/2025	04/11/2025	04/11/2025	05/11/2025	06/11/2025
Site name			**R3**	**R3**	**R6**	**R6**	**L1**	**L2**
Habitat type	**SIGNAL 2**	**AUSRIVAS**	**EDGE**	**BED**	**EDGE**	**BED**	**COMP**	**COMP**
Syrphidae	2	QD439999						
Tabanidae	3	QD239999	5					
Tanyderidae	6	QD039999						
Thaumaleidae	7	QD119999						
Tipulidae	5	QD019999						
o. Ephemeroptera								
Ameletopsidae	7	QE049999						
Baetidae	5	QE029999					2	
Caenidae	4	QE089999						
Leptophlebiidae	8	QE069999						
Teloganodidae	9	QE079999						
o. Hemiptera								
Aphelocheiridae	-	-						
Belostomatidae	1	QH629999					4	2
Corixidae	2	QH659999	1		10	1		
Dipsocoridae	-	-						
Gelastocoridae	5	QH649999						
Gerridae	4	QH579999	14	1	2		3	
Hebridae	3	QH539999			1			
Hydrometridae	3	QH549999			1			
Leptopodidae	-	QH589999						
Mesoveliidae	2	QH529999						
Micronectidae	2	-			10	31		
Naucoridae	2	QH669999						2
Nepidae	3	QH619999	2		2		1	1
Notonectidae	1	QH679999	12	13	14	12		1
Ochteridae	2	QH639999						18
Pleidae	2	QH689999	7	1	3	3	2	
Saldidae	1	QH609999						
Veliidae	3	QH569999	22		5	1		
s.o. Zygoptera								
Argiolestidae	5	-						
Calopterygidae	-	QO109999						
Chlorocyphidae	-	-						
Chorismagrionidae	-	QO189999						
Coenagrionidae	2	QO029999					4	6
Diphlebiidae	6	QO099999						
Hemiphlebiidae	-	QO019999						
Isostictidae	3	QO039999						
Lestidae	1	QO059999						
Lestoideidae	9	QO069999						
Platycnemididae	4	QO049999						
Synlestidae	7	QO089999						
s.o. Epiprocta								
Aeshnidae	4	QO129999						
Archipetaliidae	-	QO199999						
Austrocorduliidae	10	QO279999						
Austropetaliidae	-	QO209999						
Brachytronidae	-	-						
Cordulephyidae	5	QO289999						
Corduliidae	5	QO169999						
Gomphidae	5	QO139999		1	2			4
Gomphomacromiidae	-	QO249999						
Hemicorduliidae	5	QO309999						
Libellulidae	4	QO179999	1			1	1	2

Sample picked by			DM	CP	DM	CP	CP	CP
Date sampled			22/10/2025	22/10/2025	21/10/2025	21/10/2025	20/10/2025	22/10/2025
Sample processed by			DM	DM	DM	DM	DM	DM
Date processed			05/11/2025	06/11/2025	04/11/2025	04/11/2025	05/11/2025	06/11/2025
Site name			**R3**	**R3**	**R6**	**R6**	**L1**	**L2**
Habitat type	**SIGNAL 2**	**AUSRIVAS**	**EDGE**	**BED**	**EDGE**	**BED**	**COMP**	**COMP**
Lindeniidae	3	QO229999						
Macromiidae	8	QO269999						
Oxygastridae	-	QO299999						
Petaluridae	-	QO159999						
Pseudocorduliidae	-	QO259999						
Synthemistidae	2	QO239999						
Telephlebiidae	9	QO219999						4
o. Plecoptera								
Gripopterygidae	8	QP039999						
o. Trichoptera								
Antipodoeciidae	8	QT169999						
Atriplectididae	7	QT239999						
Calamoceratidae	7	QT249999						
Calocidae	9	QT189999						
Conoesucidae	7	QT159999						
Dipseudopsidae	9	QT269999						
Ecnomidae	4	QT089999						
Glossosomatidae	9	QT029999						
Helicophidae	10	QT199999						
Helicopsychidae	8	QT069999						
Hydrobiosidae	8	QT019999						
Hydropsychidae	6	QT179999						
Hydroptilidae	4	QT039999						
Kokiriidae	3	QT209999						
Leptoceridae	6	QT259999	2		2	1	3	
Limnephilidae	8	QT109999						
Odontoceridae	7	QT229999						
Oeconesidae	8	QT129999						
Philopotamidae	8	QT049999						
Philorheithridae	8	QT219999						
Plectrotarsidae	-	QT119999						
Polycentropodidae	7	QT079999						
Psychomyiidae	-	QT099999						
Stenopsychidae	-	QT059999						
Tasimiidae	8	QT139999						
Notes								
Taxa count			**26**	**17**	**28**	**22**	**20**	**27**
Taxa count (per site)			**29**		**32**		**20**	**27**
No. Individuals			**174**	**129**	**183**	**206**	**122**	**172**
PET taxa			**1**	**0**	**1**	**1**	**2**	**0**
Plecoptera			**0**	**0**	**0**	**0**	**0**	**0**
% Plecoptera			**0**	**0**	**0**	**0**	**0**	**0**
Ephemeroptera			**0**	**0**	**0**	**0**	**1**	**0**
% Ephemeroptera			**0**	**0**	**0**	**0**	**5**	**0**
Trichoptera			**1**	**0**	**1**	**1**	**1**	**0**
% Trichoptera			**4**	**0**	**4**	**5**	**5**	**0**
% Other taxa			**96**	**100**	**96**	**95**	**90**	**100**
SIGNAL 2 average (Family)			**3.08**	**3.19**	**3.19**	**3.42**	**3.47**	**3.08**
Tolerant taxa (SIGNAL2≤3)			**14**	**7**	**15**	**10**	**9**	**15**
% tolerant taxa			**58**	**44**	**58**	**53**	**47**	**63**

Appendix F: Terrestrial GDE assessment raw field data

Date	Site no.	Soil samples				Rationale	Leaf samples										Distance to channel (m)	Tree intercepting water
		ID	Texture	Reading (Mpa)	Notes	State-mapped	ID	Time (HH:MM)	Tree species	DBH (cm)	Tree height (mAGL)	Sample height (mAGL)	Reading (Mpa)	Latitude (GDA 94)	Longitude (GDA 94)		
20/06/25	TGDE1				Isolated pools in channel	Low confidence	TGDE1-1	4:55		92	18	6	-0.74	-23.6844	148.8627	0	Unlikely
							TGDE1-2	5:02		57	18	4	-0.55	-23.6842	148.8625	25	Yes
							TGDE1-3	5:07	Eucalyptus coolabah	124	20	4	-1.25	-23.6843	148.8621	55	Unlikely
							TGDE1-4	5:12		63	12	6	-0.06	-23.6846	148.8626	5	Yes
							TGDE1-5	5:16		77	13	4	-0.32	-23.6840	148.8630	13	Yes
							TGDE1-6	5:20	Eucalyptus coolabah	60	18	1	-0.29	-23.6845	148.8627	0	Yes
		TGDE1-A-1m	Gravelly clay	-0.02													
		TGDE1-B-1m	Sandy clay	-6.53													
		TGDE1-B-2m	Sandy clay	-3.56													
20/06/25	TGDE2				Isolated pools in channel	Low confidence	TGDE2-1	6:14		79	18	1	-0.58	-23.6784	148.8666	1	Unlikely
							TGDE2-2	6:12		60	22	8	-0.64	-23.6785	148.8663	15	Unlikely
							TGDE2-3	6:07	Eucalyptus coolabah	67	22	7	-0.72	-23.6781	148.8660	30	Unlikely
							TGDE2-4	6:10		70	21	6	-1.10	-23.6777	148.8664	5	Unlikely
							TGDE2-5	5:50		44	19	5	-0.67	-23.6784	148.8661	10	Unlikely
							TGDE2-6	5:53	Eucalyptus coolabah	44	13	4	-0.09	-23.6784	148.8658	30	Yes
		TGDE2-A-1m	Sandy clay	-0.01													
		TGDE2-B-1m	Clay	-2.96													
		TGDE2-B-2m	Sandy clay	-1.08													
24/10/25	TGDE1				Dry channel	Low confidence	TGDE1-1	3:46		92	18	10	-1.60	-23.6844	148.8627	0	Unlikely
							TGDE1-2	3:36		57	18	9	-0.73	-23.6842	148.8625	25	Unlikely
							TGDE1-3	3:56	Eucalyptus coolabah	124	20	5	-1.36	-23.6843	148.8621	55	Unlikely
							TGDE1-4	3:51		63	12	6	-1.00	-23.6846	148.8626	5	Unlikely
							TGDE1-5	3:29		77	13	5	-0.84	-23.6840	148.8630	13	Unlikely
							TGDE1-6	3:41	Eucalyptus coolabah	60	18	2	-1.61	-23.6845	148.8627	0	Unlikely
							TGDE1-7	3:58		73	18	4	-2.16	-23.6841	148.8629	2	Unlikely
							TGDE1-8	3:32		31	10	2	-1.73	-23.6839	148.8629	20	Unlikely
							TGDE1-9	3:27	Eucalyptus melanophloia	53	10	5	-2.25	-23.6839	148.8618	25	Unlikely
							TGDE1-10	4:04		50	11	4	-1.19	-23.6839	148.8627	35	Unlikely
							TGDE1-11	4:01	Eucalyptus populnea	62	12	3	-1.32	-23.6838	148.8629	32	Unlikely
		TGDE1-A-1m	Gravelly clay	-2.44													
		TGDE1-A-2m	Sandy clay	-3.21													
		TGDE1-B-1m	Sandy clay	-5.12													
		TGDE1-B-2m	Sandy clay	-4.22													
24/10/25	TGDE2				Dry channel	Low confidence	TGDE2-1	2:48		79	18	10	-1.10	-23.6784	148.8666	1	Unlikely
							TGDE2-2	2:58		60	22	8	-0.78	-23.6785	148.8663	15	Unlikely
							TGDE2-3	2:40	Eucalyptus coolabah	67	22	6	-1.51	-23.6781	148.8660	30	Unlikely
							TGDE2-4	2:50		70	21	6	-1.84	-23.6777	148.8664	5	Unlikely
							TGDE2-5	2:55		44	19	6	-1.24	-23.6784	148.8661	10	Unlikely
							TGDE2-6	3:00	Eucalyptus coolabah	44	13	5	-0.86	-23.6784	148.8658	30	Unlikely
		TGDE2-A-1m	Sandy clay	-5.99													
		TGDE2-A-2m	Sandy clay	-7.85													
		TGDE2-B-1m	Clay	-3.58													
		TGDE2-B-2m	Sandy clay	-4.19													

Whitehaven

Blackwater North Extension Project

Appendix F
Air Quality Assessment



REPORT

BLACKWATER NORTH EXTENSION PROJECT

BLACKWATER, QUEENSLAND

AIR QUALITY ASSESSMENT
RWDI # 2510129
17 April 2026

SUBMITTED TO

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QUALITY ASSURANCE

RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued for the following scope: The provision of consultancy services in acoustic engineering and air quality; and the sale, service, support and installation of acoustic monitoring and related systems and technologies.

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EXECUTIVE SUMMARY

RWDI Australia Pty Ltd (RWDI) conducted an Air Quality Assessment for the Blackwater North Extension Project (the Project). The Project involves the expansion of the existing open-cut metallurgical coal mine located in the Bowen Basin, Queensland.

The existing Blackwater Mine (BWM) operation is an open-cut coal mine extracting primarily metallurgical coal, located near Blackwater in the Bowen Basin, Queensland. It comprises a series of open-cut mining pits along an approximate 45 kilometres (km) long roughly north-south strike length. The BWM extracts coal using drill and blast methods, draglines, and truck and shovel fleets for overburden removal and haulage. The BWM currently produces up to 19 million tonnes per annum (Mtpa) of ROM coal, predominantly high-quality coking coal for use in steelmaking as well as high energy thermal coal. The amendment proposes to extend the current operation of BWM to the east of current operations until approximately Financial Year 2055 (FY55), at an extraction rate of up to 19 Mtpa.

This Air Quality Assessment was conducted in accordance with regulatory guidelines. Detailed meteorological and air dispersion modelling was performed for four representative scenarios based on the planned mining operations (FY30, FY32, FY46 and FY55). Ground-level concentrations of total suspended particle (TSP), particulate matter less than 10 micrometres (µm) (PM_{10}), particulate matter less than 2.5 µm ($PM_{2.5}$) and dust deposition were predicted at sensitive receptors and over the whole Project area and compared with the relevant criteria. Background dust concentrations were considered in the cumulative impact assessment.

The main findings of the assessment are as follows:

- **TSP:** Predicted cumulative concentrations of TSP *comply* with the relevant air quality objective at all receptors for all scenarios.
- **PM_{10}:** Predicted cumulative concentrations of PM_{10} *comply* with the air quality objectives at most sensitive receptors. Exceedances of the 24-hour PM_{10} objective were predicted at five (5) privately-owned sensitive receptors to the west and north-west of the BWM in the early years of the Project when mining is planned at the northern margin of the BWM, and at one (1) privately-owned sensitive receptor to the south-east of the Project which is affected in later years as the mine moves eastward. Such occurrences can be prevented with a proactive dust management approach, including weather forecasting, real-time monitoring near those residences, and mine activity adjustment when warning levels are reached. Predicted cumulative PM_{10} concentrations also exceeded the annual PM_{10} objective at one (1) privately-owned sensitive receptor, which is located close to the main haul road. Alternative arrangements as defined in Environmental Authority (EA) EPML00717813 would be sought with these receptors.
- **$PM_{2.5}$:** Predicted cumulative concentrations of $PM_{2.5}$ *comply* with the relevant air quality objectives at all public and private sensitive receptors for all modelled scenarios.
- **Dust deposition:** Predicted 30-day dust deposition due the planned BWM mining activities *comply* with the relevant air quality guideline at all public and private sensitive receptors for all modelled scenarios.

1 INTRODUCTION

The Blackwater Mine (BWM) is an existing, open-cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland.

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the *Environmental Protection Act 1994* (EP Act).

The BWM is a joint venture between Whitehaven Coal Limited (Whitehaven) (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven, is the operator of the BWM.

The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at the BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), a thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open-cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at the BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The air quality assessment summarised in the present document has the following main components:

- Description of the regulatory requirements relevant to the Project, including air quality criteria and objectives.
- Characterisation of the existing environment, including climatology and local meteorology, existing ambient air quality, surrounding land use and terrain.
- Identification of nearby sensitive receptors.
- Description of the planned operations and selection of four representative operational scenarios during the life of the Project.
- Description of the sources of air pollutants and development of an emission inventory for the four representative scenarios.
- Meteorological modelling for a full year representing typical meteorological conditions, with input from regional and local meteorological observations and three-dimensional (3D) output suitable to drive the dispersion modelling (including hourly wind speed and direction, temperature, atmospheric stability and inversion height).
- Air quality dispersion modelling using CALPUFF for each operational scenario for the following pollutants: total suspended particle (TSP), particulate matter less than 10 micrometres (µm) (PM_{10}), particulate matter less than 2.5 µm ($PM_{2.5}$) and dust deposition.
- Determination of the incremental and cumulative dust impacts at the receptors associated with planned mining operations, and comparison against the relevant air quality criteria and objectives.
- Drafting of recommendations for mitigation and management measures to limit severity of air quality impacts on sensitive receptors.

2 PROJECT DESCRIPTION

2.1 Blackwater North Extension Project

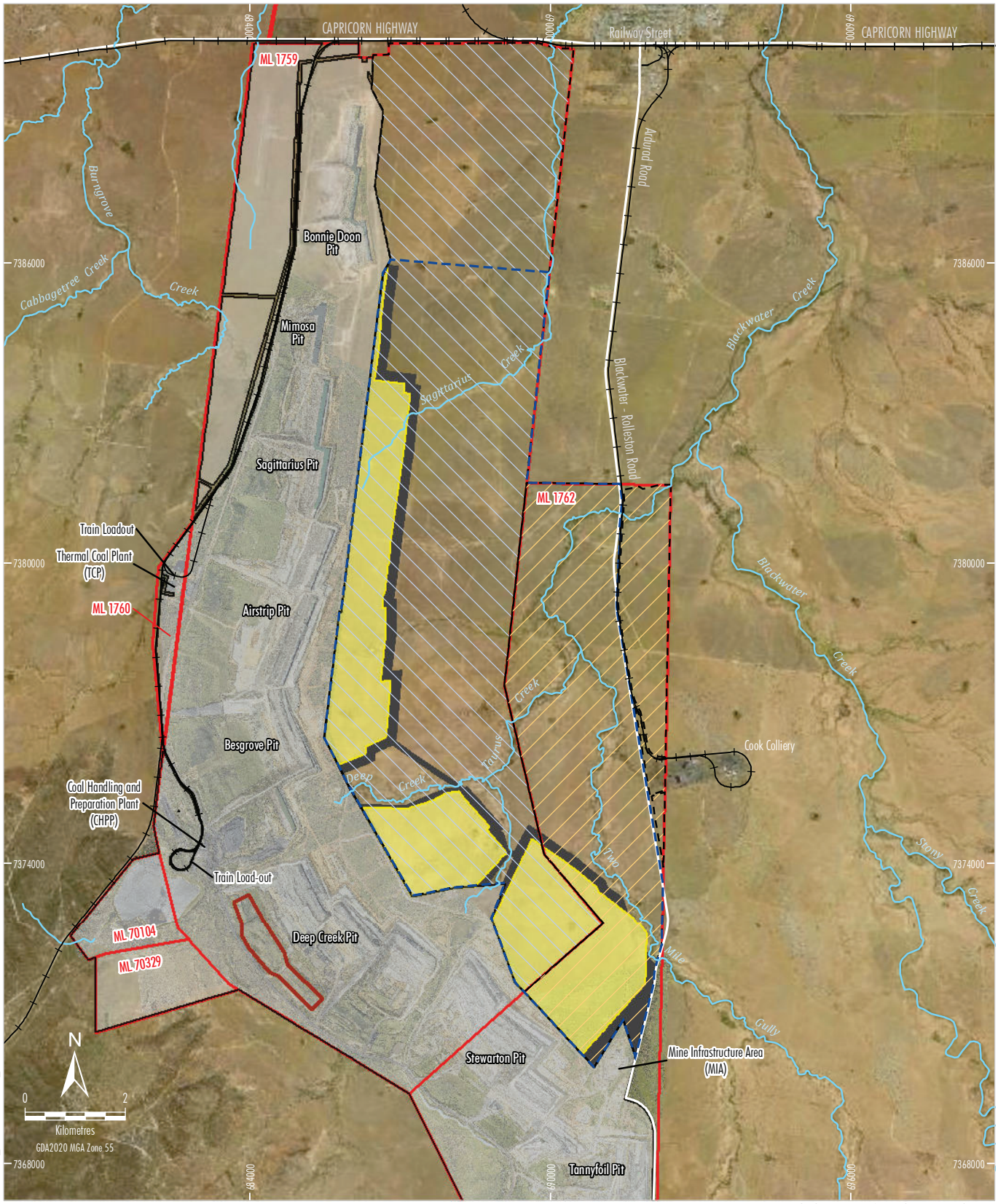
The Project would include the following activities (Figure 2-1):

- extension of open-cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 million tonnes per annum (Mtpa) of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

2.2 Site Location

The BWM is located in the Bowen Basin in Central Queensland, approximately 460 km inland of the Queensland coast and 570 km north-west of Brisbane. It is located approximately 20 km south-west of Blackwater, 70 km south-east of Emerald, 250 km north-west of the Port of Gladstone.

The land uses surrounding the BWM and the town are predominantly rural, comprising of cattle grazing land, grassland and low density regional residential areas. The region is also occupied by several other MLs that are not associated with the Project, which may contribute to a cumulative air quality impact in the area.



LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Approved Disturbance Footprint
- SA 7
- SA 10

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential Semi Permanent Tailings Cell

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Project General Arrangement

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Figure 2-1

2.3 Air Pollutants of Concern

Pollutants of concern for this assessment consist of particulate matter emissions resulting from earthworks, active mining, wheel borne dust along surrounding roads and wind erosion. The following pollutants of concern have been assessed in regard to human health impacts:

TSP – TSP is characterised as less than 100 µm and can impact human health via respiratory effects and cause nuisance impact from dust fallout.

PM_{10} – PM_{10} is generated by earthworks and mining processes and can contain heavy metals and carcinogenic material. PM_{10} is capable of penetrating the lower lungs and can lead to respiratory and cardiopulmonary effects (Queensland Government, 2025).

$PM_{2.5}$ – $PM_{2.5}$ is generated by earthworks and mining processes and can contain heavy metals and carcinogenic material. $PM_{2.5}$ is capable of penetrating the lower lungs and bloodstream and can lead to respiratory and cardiopulmonary effects (Queensland Government, 2025).

Dust deposition – Particulate matter that has fallen out of suspension and can cause nuisance impacts when deposited upon surfaces.

Emissions of other pollutants such as nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2) and volatile organic compounds (VOCs) may be generated by diesel combustion of the mining fleet and generators, and from blasting, but are small and have not been further included in this assessment.

Odour is unlikely to be emitted from typical mining activities. Spontaneous combustion could generate transient odours in the near vicinity, but the potential for this is very low and has not been observed at the BWM.

Greenhouse Gases (GHG) associated with the mining activities, including fugitive methane emissions (Scope 1 emissions), as well as Scope 2 and Scope 3 GHG emissions are discussed in a companion report.

3 REGULATORY FRAMEWORK

3.1 Relevant Legislation

This assessment has been conducted in accordance with the following environmental legislation and policy:

- EP Act;
- *Environmental Protection Regulation 2019* (EP Regulation);
- *Environmental Protection (Air) Policy 2019* (EPP [Air]);
- *Environmental Protection (Air) Amendment Policy 2024* (EPP [Air] Amendment);
- *Guideline - Application requirements for activities with impacts to air* (Department of the Environment, Tourism, Science and Innovation [DETSI], 2024a); and
- *National Environment Protection (Ambient Air Quality) Measure* (Ambient Air Quality NEPM) (National Environmental Protection Council [NEPC], 2021).

3.1.1 Environmental Protection Act 1994

The EP Act aims to protect environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. Division 1, Part 3 of Schedule 8 of the EP Regulation refers specifically to air, stating the Environmental Objective of activities being to "operate in a way that protects the environmental values of air".

The EPP (Air) was made under the EP Act and gazetted in 1997, revised and reissued in 2019 and amended most recently in 2024. The objective of the EPP (Air) is to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the EP Act, i.e. ecologically sustainable development.

3.1.2 National Environmental Protection (Ambient Air Quality) Measure

The Ambient Air Quality NEPM was established under the *National Environment Protection Council Act 1994* to provide a nationally consistent framework for monitoring and reporting on seven common ambient air pollutants. The standards contained in the Ambient Air Quality NEPM informed the objectives specified in the EPP (Air). An update to the Ambient Air Quality NEPM was released in April 2021.

3.1.3 Environmental Authority EPML00717813

Under EA EPML00717813, Whitehaven Blackwater is required to operate in accordance with the air conditions set out in Condition B4 to comply with the following air limits:

> *Monitoring of dust and particulate matter resulting from the mining activities, undertaken in accordance with condition **A11**, must be carried out at a place relevant to the potentially affected sensitive place or commercial place and must not exceed the following levels when measured at any sensitive place or commercial place:*
>
> *a. dust deposition, measured as total insoluble matter, of 120 milligrams per square metre per day, averaged over one month, when monitored in accordance with the most recent version of Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method.*
> *b. a concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (PM10) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of either:*
> *i. Australian Standard AS3580.9.6 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 high volume sampler with size selective inlet – Gravimetric method; or*
> *ii. Australian Standard AS3580.9.8 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 continuous direct mass method using a tapered element oscillating microbalance analyser; or*
> *iii. Australian Standard AS3580.9.9 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 low volume sampler – Gravimetric method; or*
> *iv. Australian Standard AS3580.9.11 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 beta attenuation monitors.*
>
> *NOTE: Exceedances due to events that cannot be managed by the environmental authority holder, such as bushfires, fuel reduction burning for fire management purposes or dust storms, would not be considered to be in breach of condition B4 if the environmental authority holder can demonstrate that the exceedance was caused by such events.*

3.2 Adopted Air Quality Criteria

Air quality criteria adopted for the Project are outlined in Table 3-1.

Table 3-1 Adopted Air Quality Criteria

Pollutant	Averaging Period	Criteria	Source
TSP	Annual	90 µg/m³	EPP (Air) (NEPC, 2021)
PM_{10}	Annual	25 µg/m³	EA EPML00717813 EPP (Air) (NEPC, 2021)
	24-hour[1]	50 µg/m³	
$PM_{2.5}$	Annual	7 µg/m³	EPP (Air) Amendment (NEPC, 2021)
	24-hour[1]	20 µg/m³	
Dust deposition (as insoluble solids)	30-day	120 mg/m²/day	(DETSI, 2024a) EA EPML00717813

Note:

µg/m³ = micrograms per cubic metre; mg/m²/day = milligrams per square metre per day.

1 Clause 18 of the Ambient Air Quality NEPM (NEPC, 2021) states that "*For the purpose of reporting compliance against the PM_{10} and $PM_{2.5}$ 1 day average..., participating jurisdictions shall exclude monitoring data that has been determined as being directly associated with an exceptional event*". Exceptional event is defined in the Ambient Air Quality NEPM (NEPC, 2021) as "fire or dust occurrence that adversely affects air quality at a particular location that causes an exceedance of 1 day average standards for particles that is in excess of normal historical fluctuations and background levels, and is directly related to bushfire, jurisdiction authorised hazard reduction burning or continental scale windblown dust".

3.3 Sensitive and Commercial Places

EA EPML00717813 defines sensitive and commercial places as follows:

> ***Sensitive place*** *means:*
>
> *a) Any of the following:*
> - *i. a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or*
> - *ii. a motel, hotel or hostel; or*
> - *iii. an educational institution; or*
> - *iv. a medical centre or hospital; or*
> - *v. a protected area; or*
> - *vi. a public park or gardens.*
>
> *b) Despite paragraph (a), the following places are not sensitive places:*
> - *I. subject to paragraph (c), a place that is the subject of an alternative arrangement; or*
> - *II. a mining camp (i.e. accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority), whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the environmental authority holders for the mining project, or a related company; or*

III. a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.

c) A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a sensitive place for the purposes of that type(s) of environmental nuisance, however remains a sensitive place for the purpose of other types of environmental nuisances.

***Commercial place** means:*

a) A work place that is used as:
- *i. an office; or*
- *ii. a place of business; or*
- *iii. a place used for commercial purposes.*

b) Despite paragraph (a), the following places are not commercial places:
- *i. subject to paragraph (c), a place that is the subject of an alternative arrangement; or*
- *ii. places that are part of the mining activity; or*
- *iii. employees accommodation or public roads; or*
- *iv. a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.*

c) A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a commercial place for the purposes of that type(s) of environmental nuisance, however remains a commercial place for the purpose of other types of environmental nuisances.

Receptors identified for the Project are detailed in Section 4.5.

4 EXISTING ENVIRONMENT

4.1 Climatology

The BWM is located in central Queensland, which experiences a subtropical climate with hot, wet and stormy summers and drier, cooler winters.

Long-term meteorological data for the area surrounding the site is available from the Blackwater Airport Automatic Weather Station (AWS) operated by the Bureau of Meteorology (BoM), and the Blackwater air quality monitoring station (AQMS) operated by DETSI (DETSI Blackwater AQMS). The Blackwater Airport AWS is located within the existing ML, approximately 1 km west of the main haul road and records observations of several meteorological parameters including wind speed, wind direction, temperature, humidity and rainfall. The DETSI Blackwater AQMS was established in 2019 to the north of the ML, in the Blackwater township, and records observations of wind speed, wind direction, temperature, humidity and rainfall.

Whitehaven Blackwater also operates three weather stations on the ML, where wind speed and direction, temperature, relative humidity, pressure, solar radiation and rainfall have been recorded since 2016.

Figure 4-1 shows the locations of regional meteorological and air quality monitoring stations in the vicinity of the BWM.

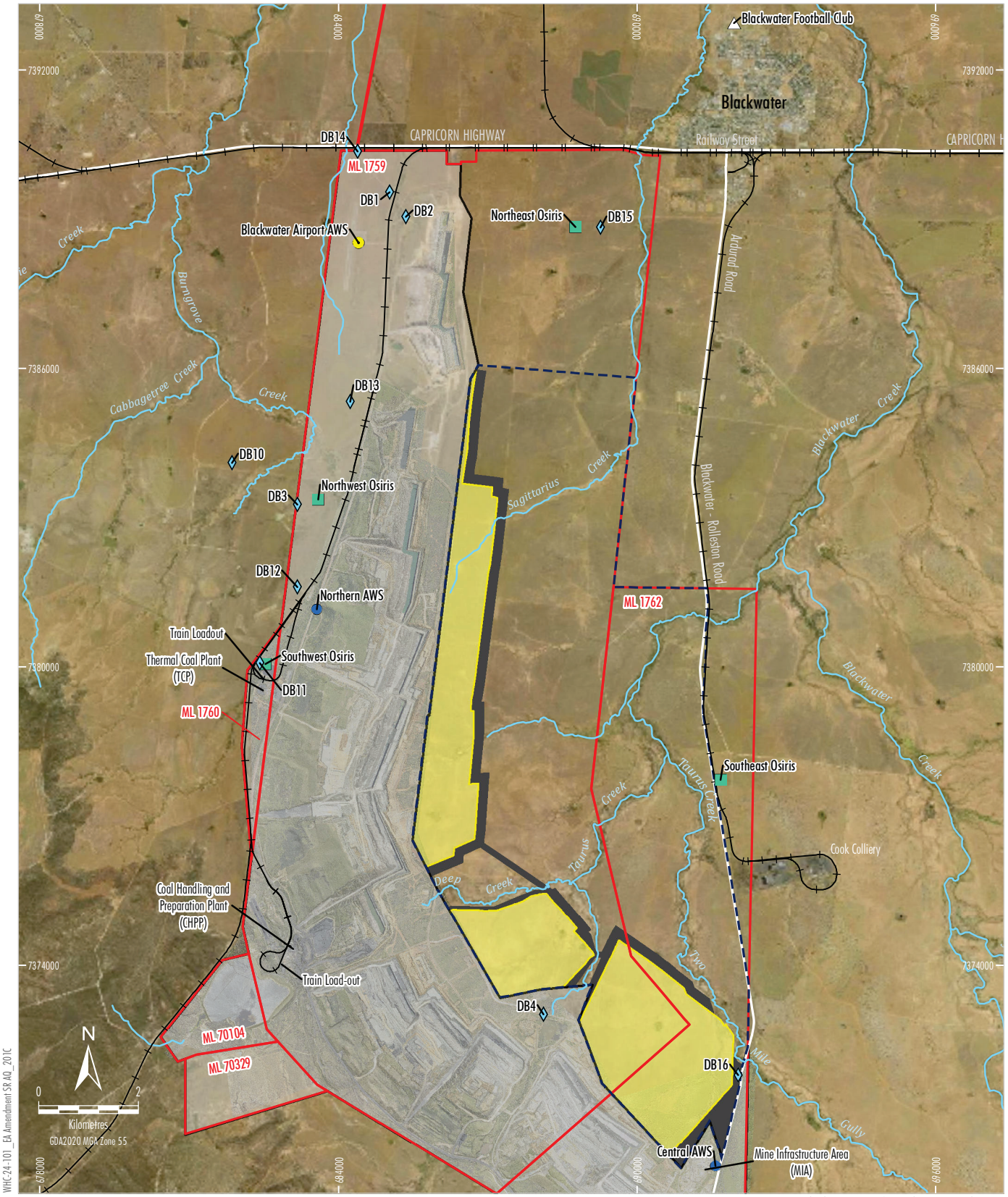
Long-term climate statistics for Blackwater Airport AWS are presented in Table 4-1, Table 4-2 and Table 4-3. Temperature data recorded at the Blackwater Airport AWS indicates that January is typically the hottest and wettest month of the year, and July is the coolest month. Annual statistics of rainfall depict rather large interannual variability, and the region experiences both periods of drought and floods.

Table 4-1 Climate Averages at Blackwater Airport AWS (2013 to 2025)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max temperature (°C)	34.6	34.3	33.2	30.3	27.0	24.2	24.0	26.2	29.5	32.6	34.0	34.8
Min temperature (°C)	22.0	21.7	21.0	16.9	13.2	10.2	9.3	10.0	13.4	17.3	19.4	21.0
Rainfall (mm)	92.3	73.1	65.6	19.7	21.0	19.0	29.9	18.4	17.5	50.3	51.0	72.6
Number of days of rain >= 1 mm	6.4	4.8	4.3	2.1	1.4	2.1	2.1	1.8	1.7	3.5	5.3	4.7

Source: BoM (2026)

Note: °C = degree Celsius; mm = millimetre



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse

Meteorological Stations

- BoM Blackwater Airport AWS
- Whitehaven AWS

Air Quality Monitoring Stations

- DETSI Blackwater AQMS
- Whitehaven Osiris AQMS
- Whitehaven Deposited Dust Gauge
- Existing Blackwater Mine

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Note: [1] Excludes some incidental Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Regional Meteorological and Air Quality Monitoring Station

Figure 4-1

Table 4-2 Monthly Rainfall at Blackwater Airport AWS (2020 to 2025) (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2013-2025	92.3	73.1	65.6	19.7	21.0	19.0	29.9	18.4	17.5	50.3	51.0	72.6	532.1
2020	204.0	66.2	1.6	0.2	2.6	2.2	1.0	0.2	1.2	3.2	6.8	65.6	354.8
2021	52.4	41.8	79.0	6.4	11.2	9.0	46.2	48.2	6.0	118.8	159.6	13.0	591.6
2022	37.6	69.0	3.4	40.4	163.8	9.2	75.6	33.6	68.8	160.4	63.4	66.6	791.8
2023	136.0	2.2	2.0	0.0	0.0	0.2	62.6	0.0	0.0	0.0	135.4	178.6	517
2024	84.0	44.2	11.8	17.2	0.4	50.4	14.2	61.8	4.8	22.2	43.6	54.2	408.8
2025	140.4	24.2	85.8	79.8	47.0	12.4	42.4	17.2	13.0	34.8	34.8	87.8	619.6

From https://www.bom.gov.au/jsp/ncc/cdio/cvg/av and 30-minute data obtained from BoM for Station 035134 (Blackwater Airport AWS)

Table 4-3 Monthly Minimum and Maximum Temperature at Blackwater Airport AWS

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Minimum Temperature (°C)													
2013-2025	21.9	21.7	21.0	16.9	13.4	10.2	9.3	10.0	13.4	17.3	19.4	21.0	16.3
2020	22.8	22.9	19.9	17.6	12.3	11.2	9.1	9.3	15.1	17.4	19.5	21.8	16.6
2021	21.4	22.1	21.2	16.9	12.4	10.6	9.7	11.8	13.1	18.4	19.8	20.9	16.5
2022	22.1	21.1	20.7	18.7	16.3	9.9	8.8	10.3	14.0	17.2	18.0	18.9	16.3
2023	20.9	21.1	21.2	15.8	9.3	10.8	9.8	9.5	13.4	16.3	19.5	21.3	15.7
2024	23.2	22.3	21.3	16.6	13.5	8.5	9.0	11.6	13.2	17.5	20.4	21.9	16.6
2025	21.2	20.8	21.3	15.8	13.9	8.8	8.2	9.7	13.6	18.6	21.3	20.7	16.2
Mean Maximum Temperature (°C)													
2013-2025	34.5	34.2	33.3	30.3	26.8	24.2	24.0	26.2	29.5	32.6	34.0	34.8	30.4
2020	35.3	33.7	31.8	32.1	25.0	24.3	23.5	26.4	29.7	32.5	35.0	35.4	30.4
2021	33.5	35.3	33.2	30.0	27.4	23.5	24.2	26.4	28.4	33.4	30.7	33.2	29.9
2022	36.2	34.7	35.5	30.9	26.0	22.6	20.7	23.6	26.6	30.2	30.6	32.0	29.1
2023	31.9	33.8	34.2	30.9	26.3	27.2	24.5	27.7	30.4	33.5	32.9	34.2	30.6
2024	34.4	33.7	33.3	30.2	27.6	24.4	22.8	26.7	29.5	32.9	34.9	35.2	30.5

From https://www.bom.gov.au/jsp/ncc/cdio/cvg/av from BoM for Station 035134 (Blackwater Airport AWS)

4.2 Local Meteorology

Meteorological conditions strongly influence air quality. Most significantly, wind speed, wind direction, temperature, atmospheric stability and rainfall affect the transport, dispersion and deposition of air pollutants. The following sub-sections discuss the local meteorology near the Project site based on observations at the Blackwater Airport AWS and identify a representative set of meteorological data for use in the dispersion modelling to be undertaken for this assessment.

4.2.1 Winds

Wind speed and wind direction are critical in creating and determining the fate of dust emissions from mining operations through transport and dispersion. Strong winds also contribute to significant surface erosion, adding natural dust emissions, especially in disturbed, non-rehabilitated areas, to the dust created by mining operations.

The windrose plots, based on wind data recorded at the Blackwater Airport AWS between 2013 and 2024, show that winds in the Project area most frequently blow from the north-east towards the south-west quadrants (Figure 4-2 and Figure 4-3).

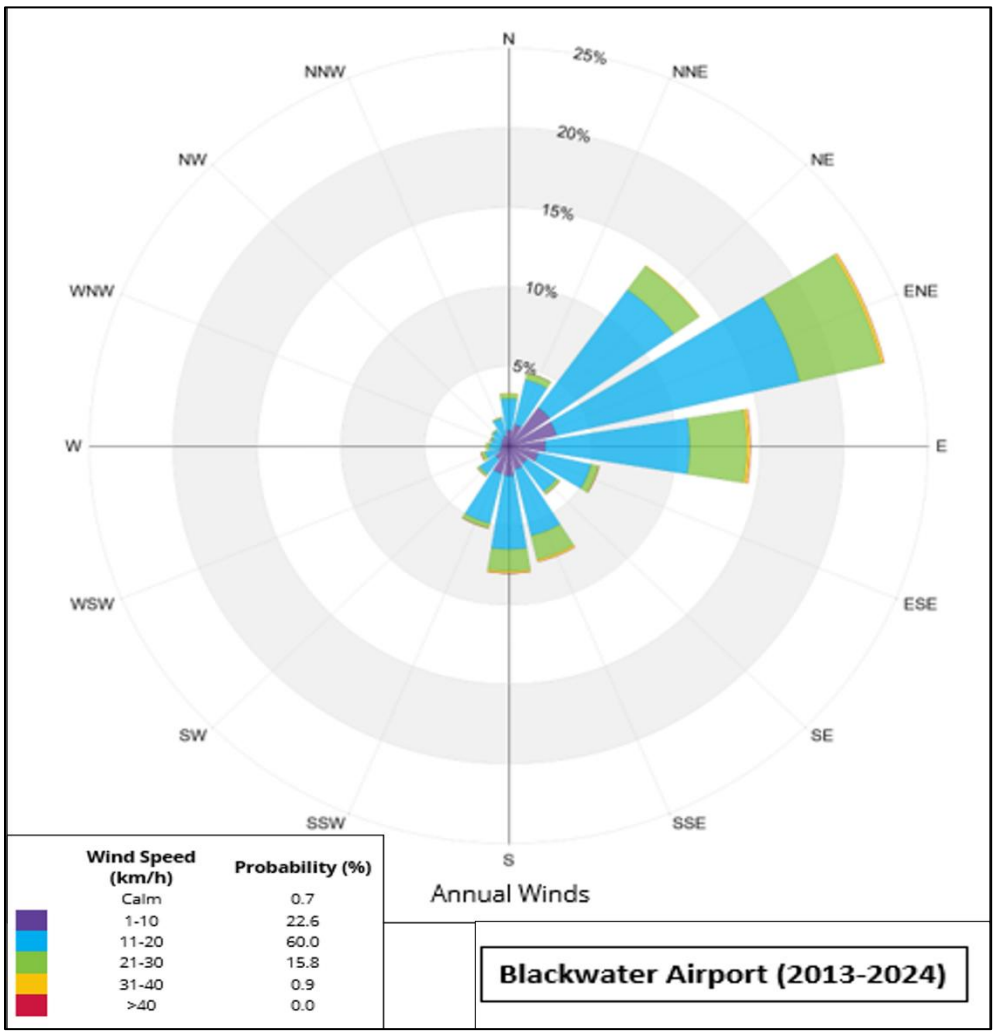


Figure 4-2 Windrose at Blackwater Airport AWS (2013 to 2024)

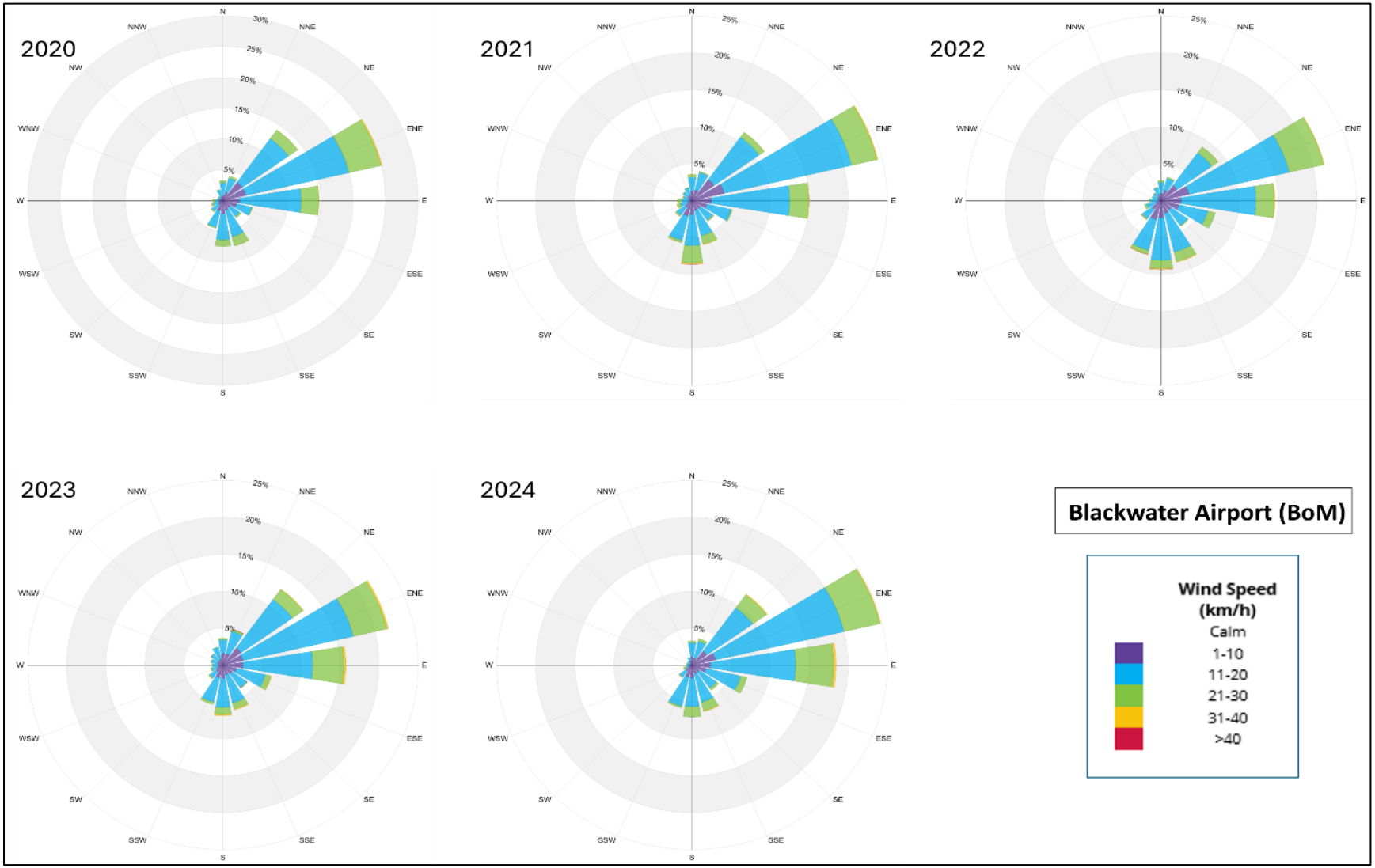


Figure 4-3 Annual Windroses at Blackwater Airport AWS (2020 to 2024)

Based on the climatology, data availability, and annual windroses, 2021 was selected as generally representative of the conditions over the Project area and adopted for modelling purposes. Indeed, 2021 exhibits an average pattern of temperature and rainfall, indicating a representative passage of weather systems throughout the area in 2021. Windroses show little variable from year to year, with dominant northeasterly wind and very rare westerly winds.

4.2.2 Atmospheric Stability and Mixing Height

Atmospheric stability is a measure of the turbulence (both convective and mechanical) experienced by the lower atmospheric boundary layer. Stability Classes range from A (most unstable, reflecting lots of convective turbulence and good dispersion, typical of hot cloudless days) to F (most stable, reflecting poor dispersion conditions, typical of clear nights and light winds); stability class D depicts a neutral atmosphere (typical of cloudy days and windy nights).

The mixing height represents the depth of the lower atmospheric boundary layer where pollutants emitted near the ground typically disperse. During the day, convection builds up the boundary layer, and the mixing height increases after sunrise; once the sun sets, mechanical turbulence dominates and the mixing height typically collapses. Strong thermal inversions can develop at night, especially during calm cloudless nights, effectively trapping dust in open-cut pits and creating poor dispersion conditions overall.

Atmospheric stability and mixing height computed by the meteorological model CALMET (which was used as input to the dispersion model CALPUFF) are displayed in Figure 4-4 and Figure 4-5. CALMET was driven by the surface meteorological observations at the Blackwater Airport AWS, as well as 3D mesoscale The Air Pollution Model (TAPM) model output and terrain and land use data.

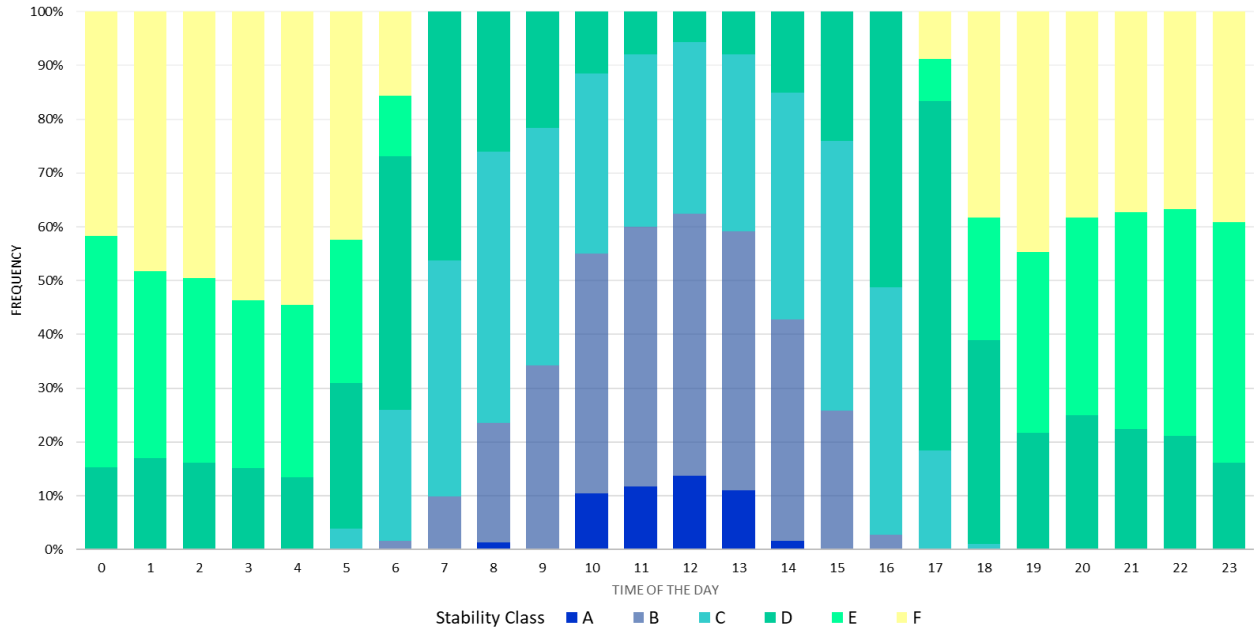


Figure 4-4 Stability Class Frequency vs. Time of the Day at the Centre of the Project Area in 2021 (from CALMET)

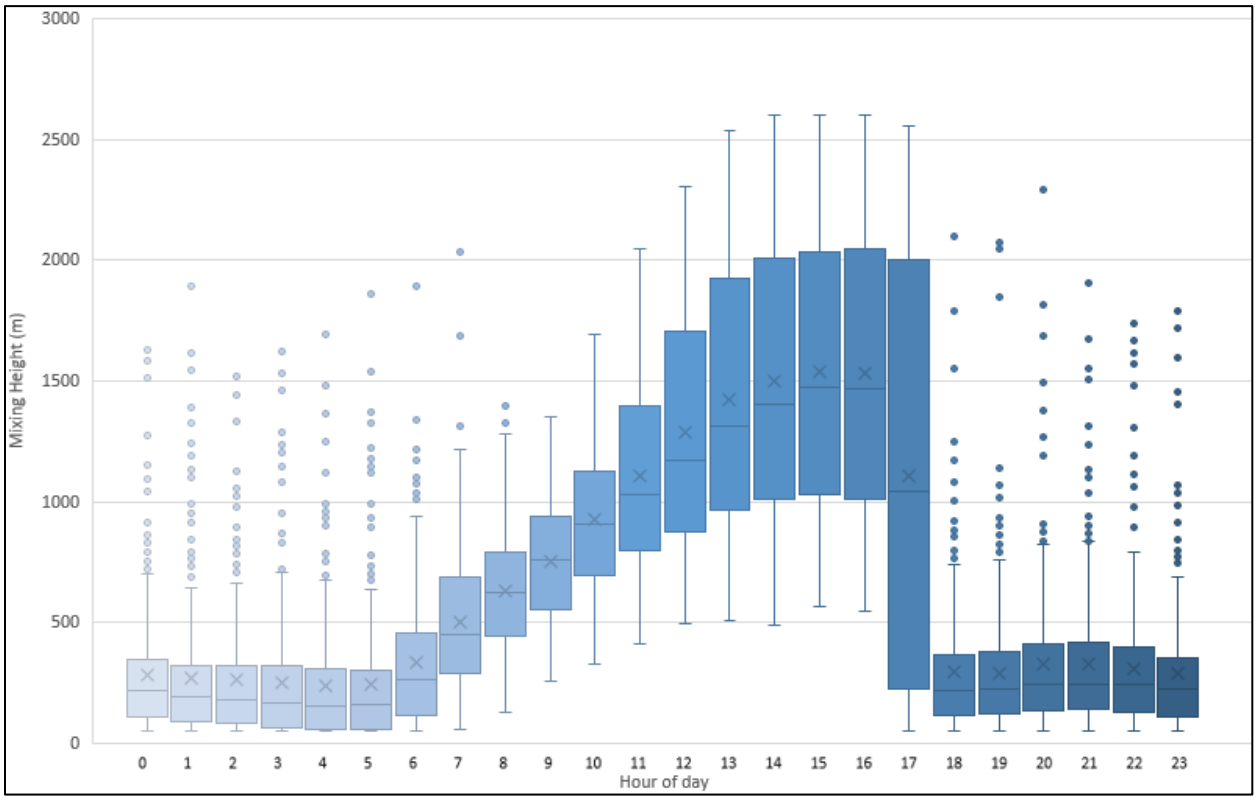


Figure 4-5 Diurnal Variation of the Mixing Height at the Centre of the Project Area in 2021 (from CALMET)

4.3 Local Ambient Air Quality

DETSI has been operating the DETSI Blackwater AQMS within the township of Blackwater, located north of the Blackwater Sports Centre. PM_{10}, $PM_{2.5}$ and meteorological variables have been recorded at that location since February 2019. This location is representative of air quality in the township of Blackwater and was used to determine background ambient air quality for the cumulative air quality assessment. It is affected by dust emissions from the BWM, under south-westerly winds (which are not very frequent), mines north of Blackwater under northerly winds and soil erosion during strong wind episodes, as well as closer anthropogenic and mobile dust emissions in the town. During very windy days, dust levels have occasionally exceeded the 24-hour PM_{10} and $PM_{2.5}$ ambient air quality criteria. Extensive bushfires have also contributed to elevated PM_{10} and $PM_{2.5}$ levels at times[1]. PM_{10} and $PM_{2.5}$ are monitored at the DETSI Blackwater AQMS using scattered light spectrometry (TAPI Model 640X) operated in accordance with the United States Environmental Protection Agency (US EPA) equivalence method designation requirements.

A summary of the PM_{10} and $PM_{2.5}$ monitoring results collected at the DETSI Blackwater AQMS is presented in Table 4-4. In consideration of allowable exceptional circumstances, air quality at Blackwater is generally compliant with the criteria.

[1] For example, DETSI (2025) notes that PM_{10} and $PM_{2.5}$ levels increased in 2023 in most regions due to bushfires and hazard reduction burns.

Table 4-4 Summary of Particulate Matter Monitoring Results at DETSI Blackwater AQMS (2020 to 2024) (µg/m³)

Year	Annual average			24-hour Max				24-hour 70th percentile	
	TSP	PM_{10}	$PM_{2.5}$	PM_{10}		$PM_{2.5}$		PM_{10}	$PM_{2.5}$
Criteria	**90**	**20**	**7**	**50**	**# Exc**	**20**	**# Exc**	**50**	**20**
2020	*no data available*	16.17	5.07	**60.95**	**1**	17.54	0	17.42	5.47
2021		15.54	4.73	**54.57**	**2**	**24.92**	**1**	17.45	5.18
2022		13.91	4.50	32.33	0	8.30	0	15.66	5.17
2023		19.28	6.83	**91.95**	**4**	**62.60**	**11**	21.58	6.54
2024		16.73	5.32	45.89	0	19.18	0	18.53	5.85

Whitehaven Blackwater operates four Osiris AQMS within the boundaries of the ML to monitor TSP, PM_{10} and $PM_{2.5}$ (which are used for diagnostic purposes for dust management only, and not used for compliance monitoring).

Whitehaven Blackwater also operates dust deposition gauges in the vicinity of the BWM (Figure 4-1). Monitoring results at the dust deposition gauges are summarised in Table 4-5 and Table 4-6.

Table 4-5 Summary of Ambient Dust Deposition Gauge Measurements at BWM by Year

	Year			
	2023	**2024**	**2025**	**Jan-2026**
Number of samples	7	89	86	7
Number of exceedances of guideline (120 mg/m²/day)	3	24	12	1
Highest exceedance (date, gauge recorded at)	726 mg/m²/day (14/11/2023, DB5)	836 mg/m²/day (23/10/2024, DB5)	526 mg/m²/day (15/01/2025, DB5)	127 mg/m²/day (28/01/2026, DB12)

Table 4-6 Summary of Ambient Dust Deposition Gauge Measurements at BWM by Location

	# Samples	Median	10th percentile	40th percentile	90th percentile	# Exceedances
DB1	14	49	12	44	142	3
DB2	11	53	30	47	63	0
DB3	21	40	23	40	83	0
DB4	11	316	156	303	360	10
DB5	13	470	231	459	739	13
DB6	0	-	-	-	-	-
DB7	0	-	-	-	-	-
DB8	0	-	-	-	-	-
DB9	20	43	7	35	70	1
DB10	20	78	27	70	161	5
DB11	23	57	14	50	209	5
DB12	19	76	19	64	110	2
DB13	13	57	17	32	111	1
DB14	8	52	25	39	77	0
DB15	8	50	17	47	77	0
DB16	8	55	27	52	76	0

4.4 Local Terrain and Land Use

The region is predominantly rural, with nearby mines located north of the township of Blackwater and forested ridges cutting across the Project area from north-west to south-east (Figure 4-6). The BWM has been in operation since 1967 and is thus visible on the satellite imagery and is part of the current-day topography datasets.

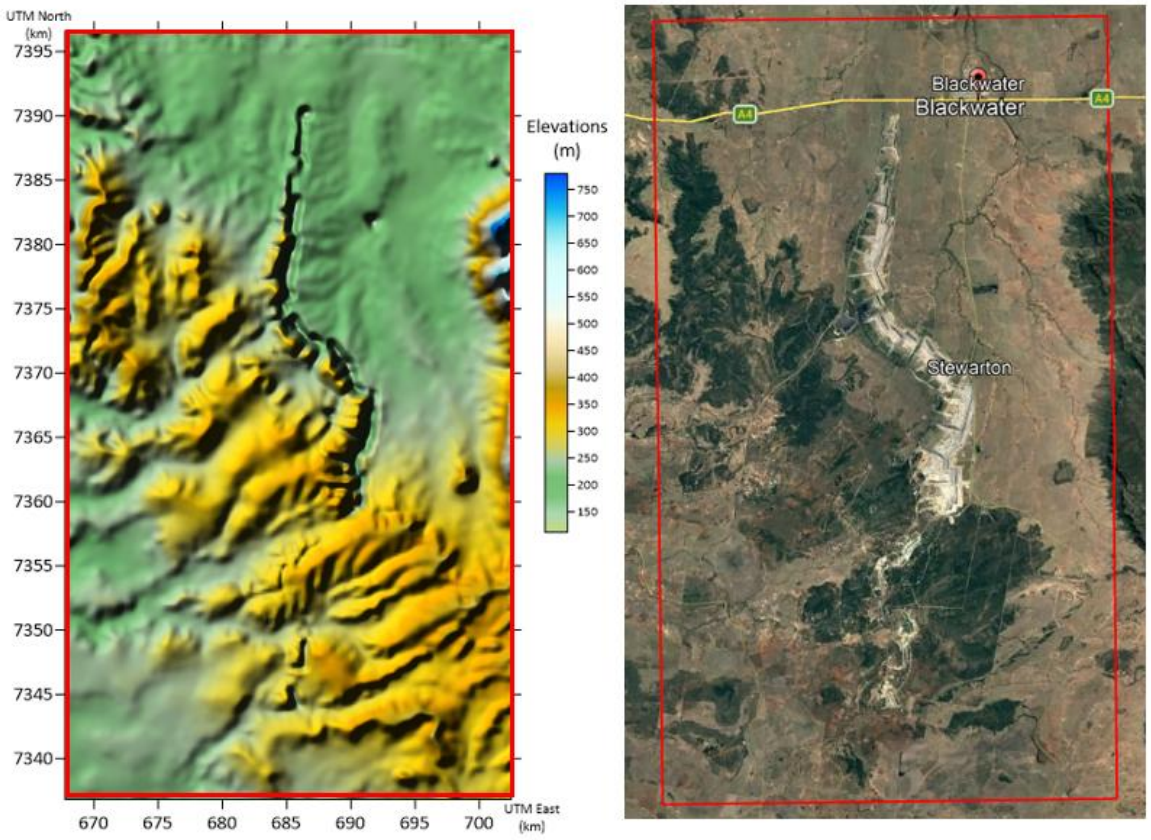


Figure 4-6 Topography and Land Use over the Project Area (CALMET Domain Outlined in Red).

4.5 Receptors

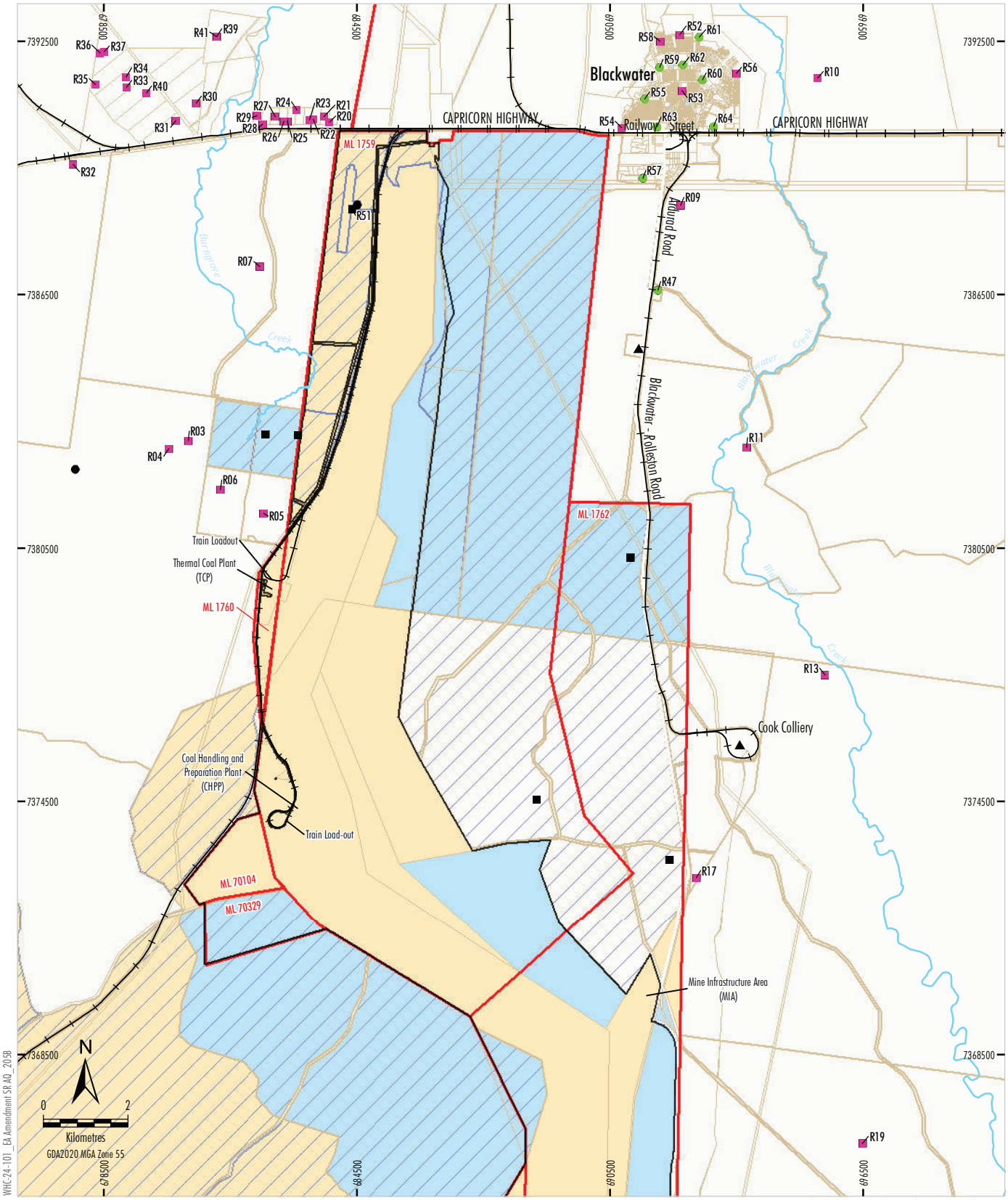
In total, 59 air quality receptors were considered and are summarised as follows (Table 4-7 and Figure 4-7):

- 39 privately-owned sensitive receptors, comprising 34 rural properties and five dwellings representative of Blackwater;
- eight other sensitive receptors, comprising three schools, a childcare centre, a hospital, a medical centre, a camp accommodation and a cemetery (all located in Blackwater except for the cemetery); and
- 12 non-sensitive receptors (including five mine-owned residential dwellings, two privately-owned residential dwellings currently under agreements, and five commercial/industrial receptors in the surrounding rural areas).

Table 4-7 Receptors

Rec ID	Description	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Privately-owned Sensitive Receptors			
R03	Tolmies Creek Homestead (HS)	680506	7383036
R04	Tolmies Creek HS	680046	7382848
R05	Ausbute HS	682295	7381314
R06	-	681271	7381884
R07	Burngrove HS	682199	7387165
R09	Minyango HS	692174	7388618
R10	Cardona HS	695420	7391637
R11	Tantallon HS	693741	7382883
R13	Yarrawonga HS	695598	7377492
R17	Retreat HS	692554	7372690
R19	Tannyfoil HS	696492	7366393
R20	-	683854	7390585
R21	-	683725	7390717
R22	-	683471	7390656
R23	-	683386	7390637
R24	-	683088	7390869
R25	-	682852	7390613
R26	-	682776	7390604
R27	-	682564	7390721
R28	-	682268	7390548
R29	-	682136	7390744
R30	Tulloch Ard HS	680696	7391034
R31	-	680210	7390623
R32	Maryvale HS	677776	7389581
R33	Malamy HS	679048	7391412
R34	Malamy HS	679029	7391655
R35	Sherborne HS	678311	7391482
R36	-	678413	7392228
R37	-	678517	7392258
R39	-	681182	7392608
R40	-	679512	7391279
R41	-	681184	7392609
R42	Monash HS	669266	7367221

Rec ID	Description	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Privately-owned Sensitive Receptors			
R43	-	670323	7368118
R52	Generic Blackwater Town - North	692157	7392658
R53	Generic Blackwater Town - Centre	692206	7391333
R54	Generic Blackwater Town – South-west	690784	7390455
R55	Generic Blackwater Town - East	693500	7391743
R56	Generic Blackwater Town – North-west	691688	7392501
Other Sensitive Receptors			
R57	Blackwater Hospital	691683	7391888
R58	Medical centre	692697	7391586
R59	Blackwater North State School	692620	7392600
R60	Blackwater State High School	692235	7391939
R61	Blackwater State School	691617	7390472
R62	C&K Childcare Centre	691330	7391139
R47	Blackwater Lawn Cemetery	691633	7386604
R63	Camp Accommodation	692964	7390493
Non-sensitive Commercial/Industrial Receptors			
R14	Qcoal (Cook Colliery - north)	693576	7375833
R46	Qcoal (Cook Colliery - south)	692423	7363643
R48	Resource recovery centre	691184	7385223
R49	Quarry	677837	7382368
R64	Blackwater Water Treatment Plant	691286	7389259
Non-sensitive Mine-owned Receptors			
R01	Whitehaven	682332	7383198
R02	Whitehaven	683118	7383184
R12	Whitehaven	690992	7380267
R50	BWM Airport	684514	7388628
R51	BWM Airport caretaker	684398	7388526
Non-sensitive Privately-owned Receptors Currently Under Agreements			
R15	Taurus HS	688762	7374534
R16	Stewarton HS	691913	7373114



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Lessee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Sensitive Receptors Locations

Figure 4-7

4.6 Background Levels

One of the objectives for reviewing the air quality monitoring data was to determine appropriate background levels to be applied in the air quality dispersion modelling. Background air quality concentrations adopted for the quantitative assessment were based on average annual and 70th percentile 24-hour values at the DETSI Blackwater AQMS for the past five years and are summarised in Table 4-8. DETSI does not monitor TSP in Blackwater and background TSP was thus estimated to be twice of the annual PM_{10} baseline concentration (based on typical erosion TSP/PM_{10} ratios).

Baseline dust deposition was estimated based on the gauge data least affected by the BWM (DB1, DB9, DB15), and the 40th percentile of dust deposition data at DB1, DB9, DB15 was used as baseline.

Table 4-8 Background Air Quality Adopted for the Assessment

Pollutant	Averaging Period	Adopted Background
$PM_{2.5}$	24-hour	5.6 µg/m^3
	Annual	5.3 µg/m^3
PM_{10}	24-hour	18.1 µg/m^3
	Annual	16.3 µg/m^3
TSP	Annual	36.3 µg/m^3
Dust deposition	30-day	42.0 mg/m^2/day

5 AIR QUALITY ASSESSMENT METHODOLOGY

5.1 Overview

Air quality dispersion modelling uses computational models to predict cumulative impacts from air pollutants generated by the Project emission sources at sensitive receptors. Although Queensland does not have specific modelling requirements, the *Air – EIS Information Guideline* (DETSI, 2024b), which although the Project is an amendment not an EIS, was used as a guidance for this work. The guideline recommends following the New South Wales (NSW) modelling guidance provided in the *Approved methods for the modelling and assessment of air pollutants in NSW* (NSW Environment Protection Authority, 2022).

Although the Project focuses on the northern part of the BWM, already approved production is ongoing and will continue in the southern part of the BWM, and the cumulative air quality impact of mining activities in the full BWM has to be assessed at the sensitive receptors. Mining activities from all pits, including south of the Project area, haulage and processing thereof at the CHPP and TCP, were thus considered in this assessment. All mining sources that can potentially impact the sensitive receptors were included in the model (including all pit mining activities down to Ramp 62S); haulage and processing of ROM extracted from pits south of Ramp 62S were also included as they will occur on the main haul road, CHPP and TCP areas and may as such affect the sensitive receptors near the Project area. Mining in areas south of Ramp 62S, as well as quarrying, would not contribute materially to air quality at receptors relevant to the Project which are both far and typically upwind of those areas, and were thus not modelled.

Consideration was given to cumulative impacts from other nearby mining operations. However, explicit modelling was not warranted because:

- the Cook Colliery (approximately 14 km south-west of the Project), temporarily ceased operations in 2025;
- the Curragh Mine Complex (approximately 28 km north of the Project) is considered too far north and emissions from this mine would not contribute emissions to receivers on the same day; and
- these mines would be included in the background data used (because Curragh Mine Complex is north of the Project and prevailing winds would not result in impacts from both operations on one day).

The methodology used in this air quality assessment is outlined hereafter:

- **Emissions**: for representative years throughout the lifetime of the Project. The selection of representative assessment scenarios is discussed in Section 5.2 and emission inventories are detailed in Section 6.
- **Meteorological modelling**: 3D meteorological modelling was conducted to drive the transport and dispersion of pollutants over the Project area, for a representative modelling year. The meteorological modelling approach is discussed in Section 5.3.
- **Dispersion modelling**: was conducted with CALPUFF, a regulatory Lagrangian puff model suitable to assess the transport, dispersion and deposition of particulate matter in complex terrain over the Project area and predict impact at the sensitive receptors, using representative 3D meteorological input and time-dependent emission inventories. The CALPUFF set-up is discussed in Section 5.4.

- **Air quality assessment**: predicted cumulative ground-level concentrations of TSP, PM_{10} and $PM_{2.5}$ and dust deposition are summarised and compared with relevant air quality criteria and guidelines in Section 7. Possible mitigation measures are discussed as well.

5.2 Assessment Scenarios

Four representative years were selected throughout the lifetime of the Project. Financial Year 2032 (FY32), FY46 and FY55 represent early, mid and end of the Project lifetime, with high ROM and/or overburden production rates, as the BWM overall expands to the east. An additional early scenario was selected in FY30 when the northernmost activities (i.e. closest to Blackwater township residential areas) are planned.

Based on the indicative Project production rate, four modelling scenarios have been developed. These are outlined in Table 5-1, and respective ROM and overburden amounts are graphically presented in Figure 5-1. A detailed Project production schedule by pit and by year is included in Appendix A.

Table 5-1 Modelling Scenarios

Modelling Year	Total ROM (Mtpa)	Total Overburden (Mbcm)	Comment
FY32	19.0	279.8	First peak year for ROM amount
FY30	14.8	246.4	Production planned in the northernmost pit
FY46	18.8	289.2	Peak overburden amount, similar ROM amount to the peak ROM
FY55	16.0	275.6	End of Project and mining near eastern sensitive receptors

Note: Mbcm = million bank cubic metres

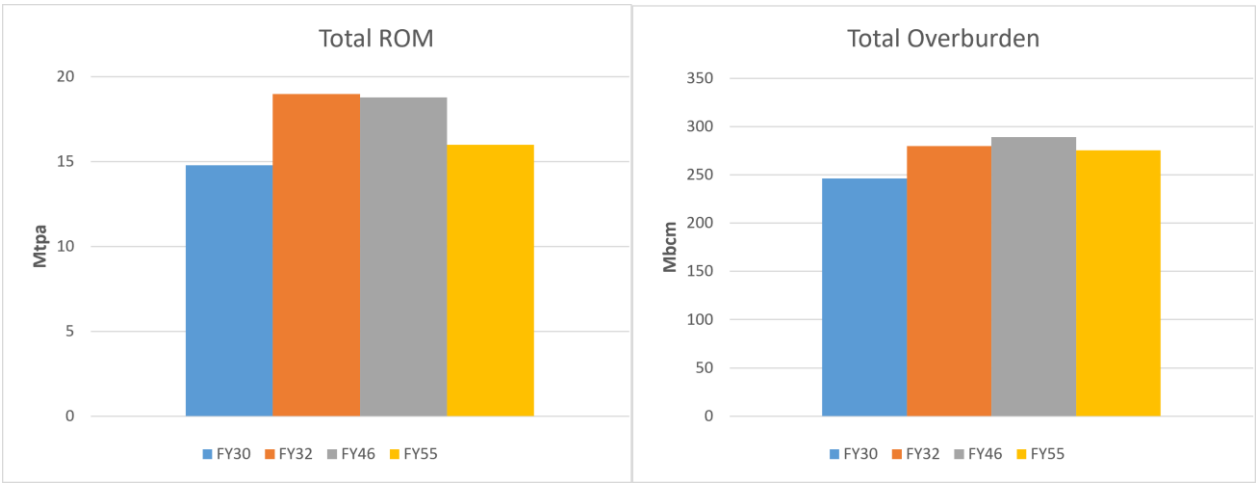


Figure 5-1 ROM and Overburden Amount for the Selected Modelling Scenarios

5.3 Meteorological Modelling

5.3.1 TAPM

TAPM, developed and distributed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), was configured to generate regional wind fields over the Project area.

TAPM is an incompressible, non-hydrostatic, primitive equations prognostic model with terrain-following vertical coordinates for 3D simulations. It predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of large-scale meteorology provided by synoptic analyses. TAPM benefits from having access to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic scale meteorological analyses for various regions around the world.

TAPM was run over nested grids centred on the Project, with increasing horizontal resolution down to 3 km. Hourly upper air soundings were extracted from TAPM for input into CALMET.

5.3.2 CALMET

CALMET is a diagnostic meteorological model that refines prognostic model output (in this case TAPM) by incorporating additional observational data, and the influences of local topography and land uses on the weather. It produces hourly wind and temperature fields on a 3D gridded modelling domain, as well as 3D fields of mixing heights and turbulence-related properties. It is typically used to drive the CALPUFF dispersion model.

CALMET was run at 250 metres (m) resolution over a 35 km by 60 km modelling domain encompassing the whole BWM, sensitive receptors and the township of Blackwater for each scenario, incorporating mine topography based on the planned mining schedule (with the pits getting deeper and moving eastward). The extent of the CALMET domain is outlined in Figure 4-6 and key setup parameters are summarised in Table 5-2.

Hourly output from TAPM was used as input into CALMET in addition to hourly surface observations of winds, temperature relative humidity, precipitation at Blackwater Airport. Hourly observations at the Emerald Airport, west of the Project area were used to provide cloud data to CALMET and supplement any other missing data in the Blackwater Airport records.

Table 5-2 CALMET Model Setup

CALMET Features	Selection
Modelling Year	2021
Horizontal Extent	35 km EW x 60 km NS (140 x 240 grid cells)
Upper Air Data	Hourly upper air soundings extracted from TAPM
Surface Observations	Hourly observations at Blackwater Airport (BoM), supplemented by observations at Emerald Airport (BoM)
Horizontal Resolution	250 m
Vertical Layers	10 Layers with increasing thickness from the surface to 2.8 km
Topography	High resolution topography based on mining schedule for each modelling year
Key input Parameters	TERRAD = 5 km; IEXTRP = -4, R1 = R2 = 1 km

5.4 Dispersion Modelling - CALPUFF

CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation and removal, and is capable of simulating varying wind flow patterns and varying land use.

CALPUFF version 7.2.1 was run in CALMET mode over a 14 km by 30 km modelling domain encompassing the Project area and the sensitive receptors for a full modelling year for each scenario, using meteorological and emission data pertaining to those years. CALPUFF predicted hourly ground-level concentrations of particulate matter concentrations as well as dry and wet dust deposition at the sensitive receptors and at 4,320 additional ground-level receptors spread over the modelling domain. Wet deposition is part of the dust transport and dispersion process and was modelled accordingly in CALPUFF. However wet deposition only accounts for a tiny fraction of the overall dust deposition. Rainfall also significantly reduces dust emissions, during and after a rainy episode, but this mitigating effect was conservatively not taken into account in the emission calculations.

Three particulate matter species were defined based on size, from which $PM_{2.5}$, PM_{10} and TSP impacts could be calculated. All mining sources that can potentially impact the sensitive receptors were included in the model (including all pit mining activities down to Ramp 62S; haulage and processing of ROM extracted from pits south of Ramp 62S, were also included as they will occur on the main haul road, CHPP and TCP areas within the modelling domain). Mining in areas south of Ramp 62S, as well as quarrying, would not contribute materially to air quality at receptors relevant to the Project which are both far and typically upwind of those areas, and were thus not modelled. The CALPUFF modelling domain was outlined in Figure 4-6, key model parameters are summarised in Table 5-3.

Table 5-3 CALPUFF Model Setup and Source Configuration

Model Feature	Selected Configuration
Modelling Scenarios	FY30, FY32, FY46 and FY55
Horizontal Extent	14 km EW x 30 km NS
Meteorological Input	Hourly CALMET 3D fields (based on 2021 meteorological data, TAPM and scenario-specific topography and land use)
Discrete Receptors	4384 (including sensitive receptors)
Deposition	Size-dependent dry and wet deposition.
Pollutants	$PM_{2.5}$, PM_{10} and TSP modelled as a combination of particulate species P1, P2 and P3 of Geometric Mass Mean Diameters: P1: 1.25 μ; P2: 5 μ; P3: 20 μ and geometric standard deviations for the size distribution of 1.25 μ with $PM_{2.5}$ = P1; PM_{10}= P1 + P2; TSP = P1 + P2 + P3
Emissions Sources	• Area sources: for all mining activities except haulage • Haul roads: lines of volumes sources • Blasting during daytime only (7 am to 6 pm) ; all other sources are 24/7 • Time and wind-speed dependent wind erosion area sources
Key input Parameters	• Puff Mode • Dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables • Terrain adjustment method: Partial plume path adjustment

6 DUST EMISSION INVENTORY

6.1 Emissions Sources

The significant sources of dust emissions associated with the mining operations include:

- **Blasting and drilling:** drilling, preparing and executing blasting.
- **Pit Mining Activities**: draglines, excavators, bulldozing, loaders and shovels.
- **Loading/unloading** of ROM and overburden in the pits, stockpiles, and processing plants.
- **ROM and Overburden Haulage**: ROM coal is transported from the pits up to the main haul road on Komatsu 930E and Caterpillar 793F trucks, then transferred onto Kress 200C trucks and transported to the CHPP and TCP; overburden is transported from the active pits onto the overburden areas behind them.
- **Grading:** preparing and maintain haul roads.
- **ROM Processing**: crushing, grinding, screening, transfer, stockpiling and loading onto trains at the CHPP for the coking coal, and at the TCP for the thermal coal.
- **Wind Erosion:** wind erosion of stockpiles and disturbed areas including the active pit zones, overburden areas, partially rehabilitated areas, and recently stripped areas, under strong winds.

6.2 Mining Activity

Overall ROM and total overburden production breakdown for the four modelled years is summarised in Table 6-1. General Arrangements for FY30, FY32, FY46 and FY55 are displayed in Figure 6-1, Figure 6-2, Figure 6-3 and Figure 6-4 respectively. Detailed ROM and overburden production rates by pit are included in Appendix A for the four modelled scenarios.

Table 6-1 ROM and Overburden Production for the Modelled Years

	FY30	FY32	FY46	FY55
Total ROM (Mt)	14.8	19.0	18.8	16.0
Total Coking Coal (Mt)	12.4	14.5	13.3	10.1
Thermal Coal (Mt)	1.1	2.8	1.9	3.5
% Thermal of total ROM	7.4%	14.7%	10.1%	21.9%
% Coking (incl. rejects)	92.6%	85.3%	89.9%	78.1%
Rejects[1] (Mt)	1.3	1.7	3.6	2.4
% Rejects of Coking Coal	9.5%	10.5%	21.3%	19.2%
Total Overburden (Mbcm)	246.4	279.8	289.2	275.6

Note:

1. Rejects from Total Coking Coal

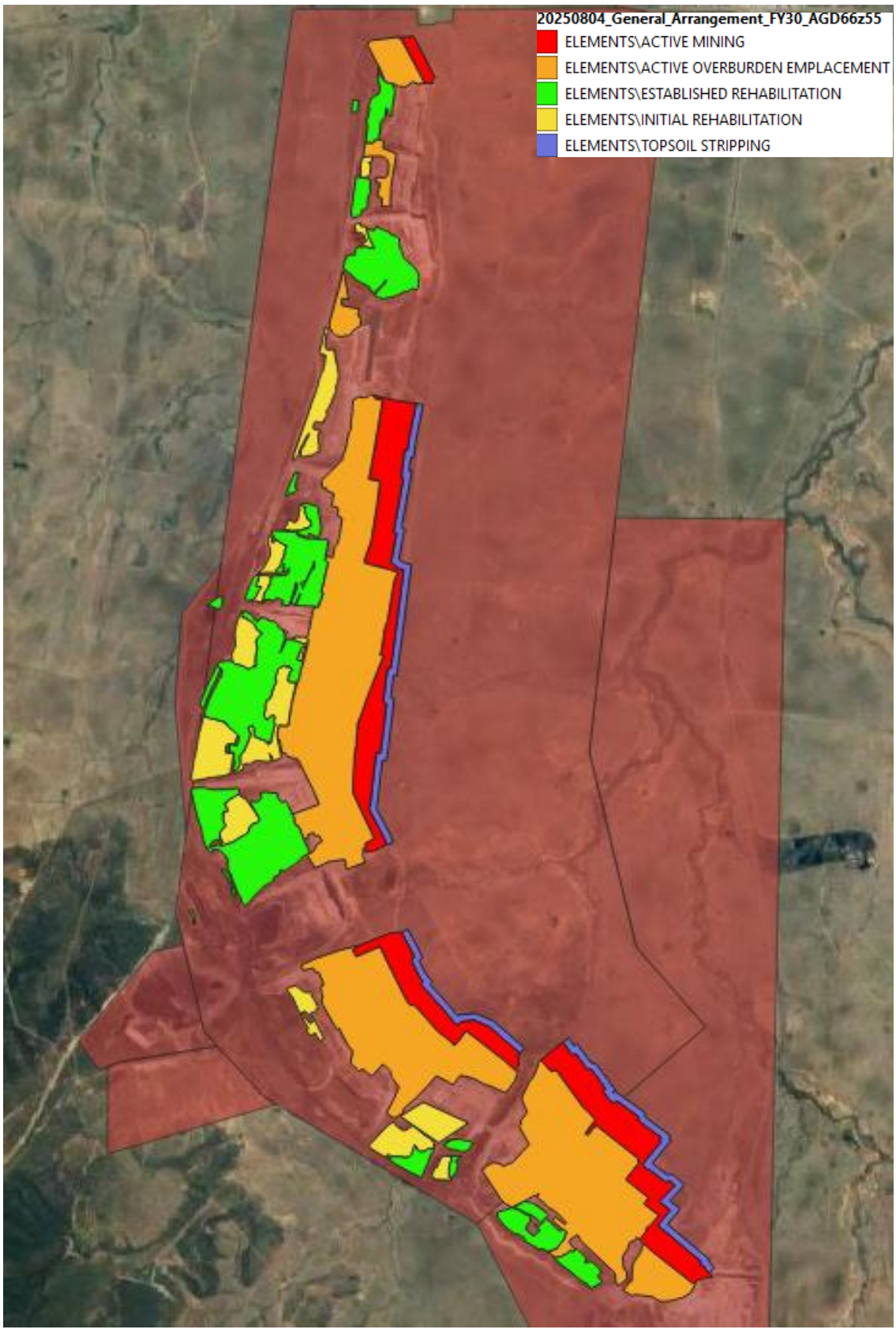


Figure 6-1 General Arrangement FY30

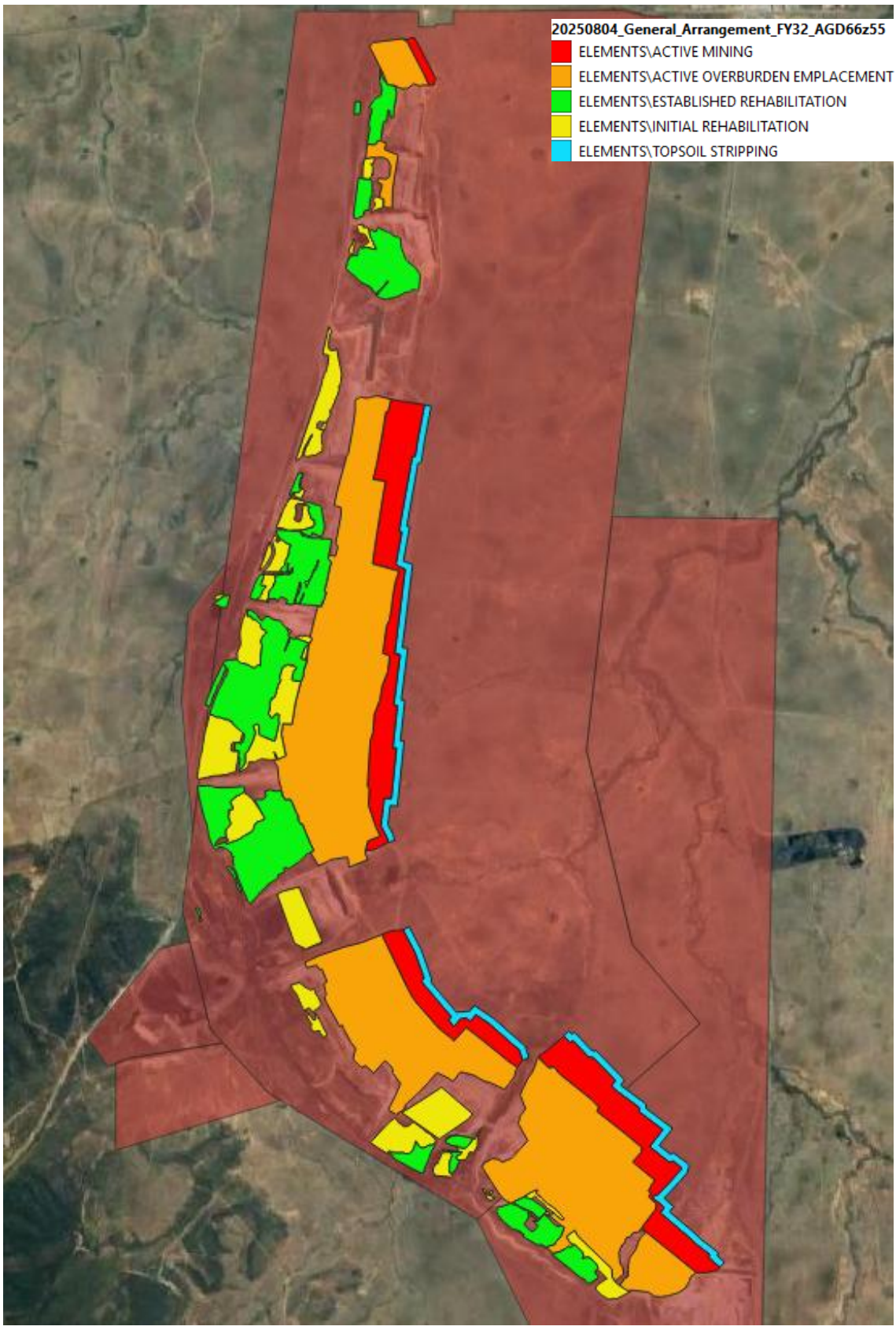


Figure 6-2 General Arrangement FY32

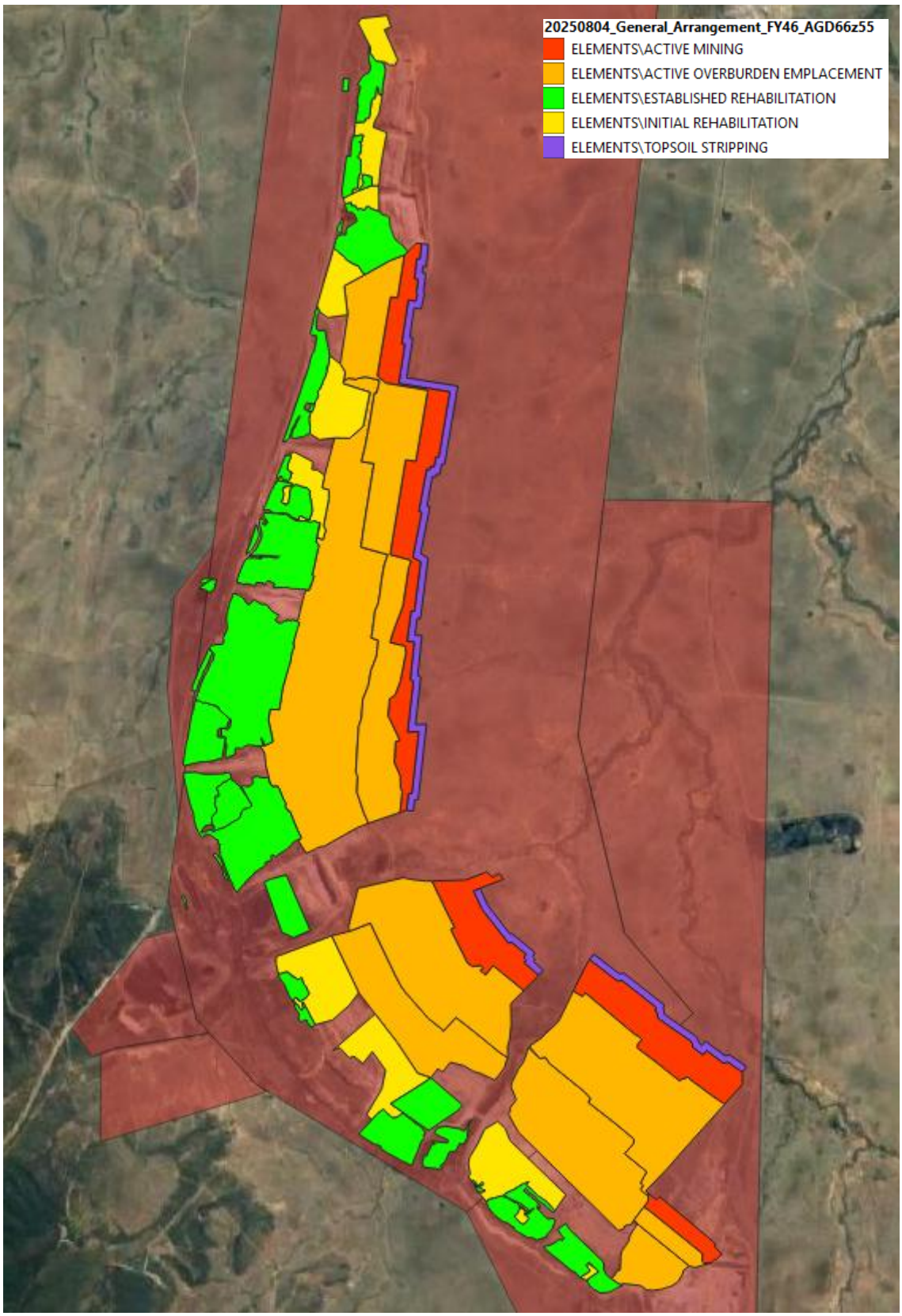


Figure 6-3 General Arrangement FY46

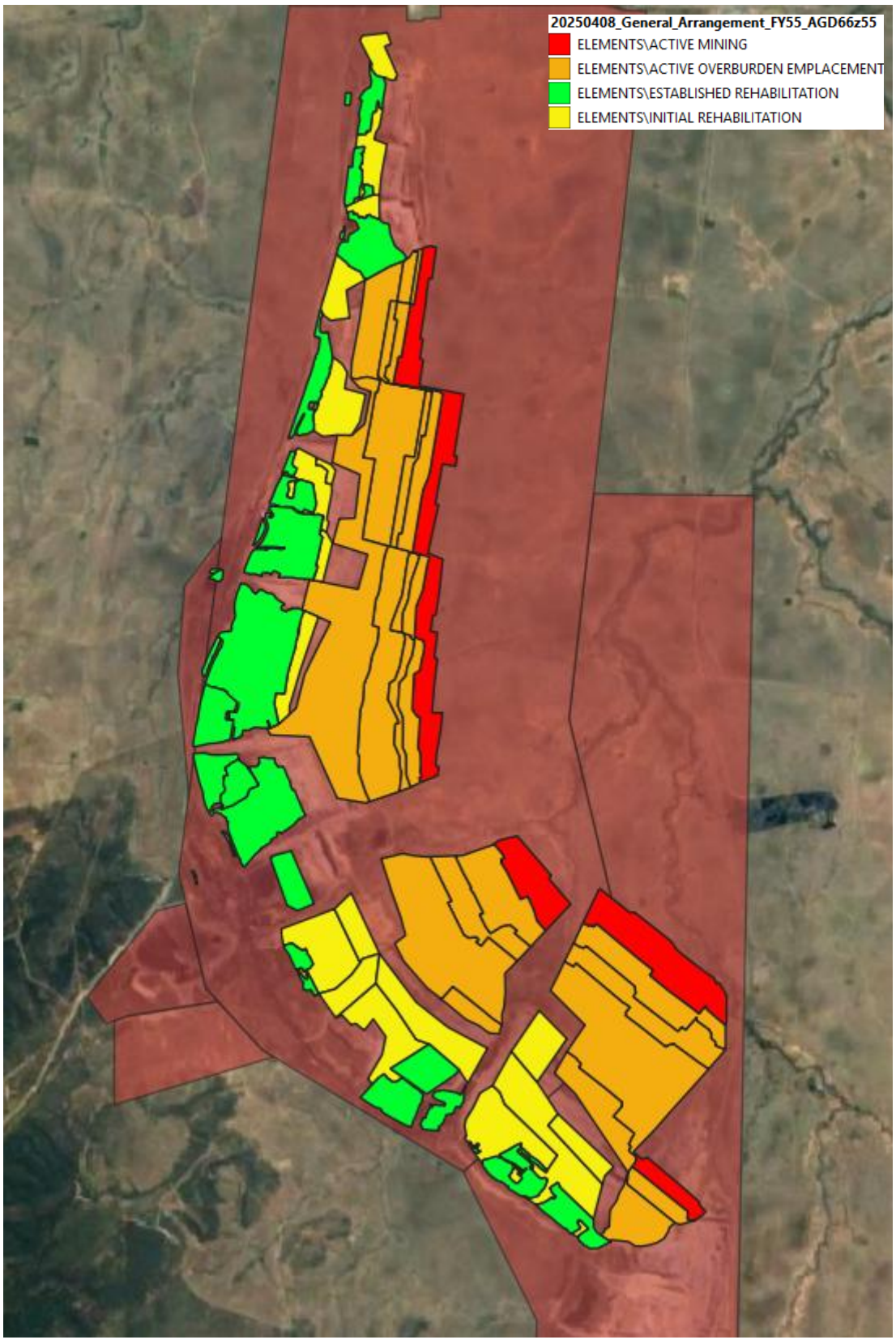
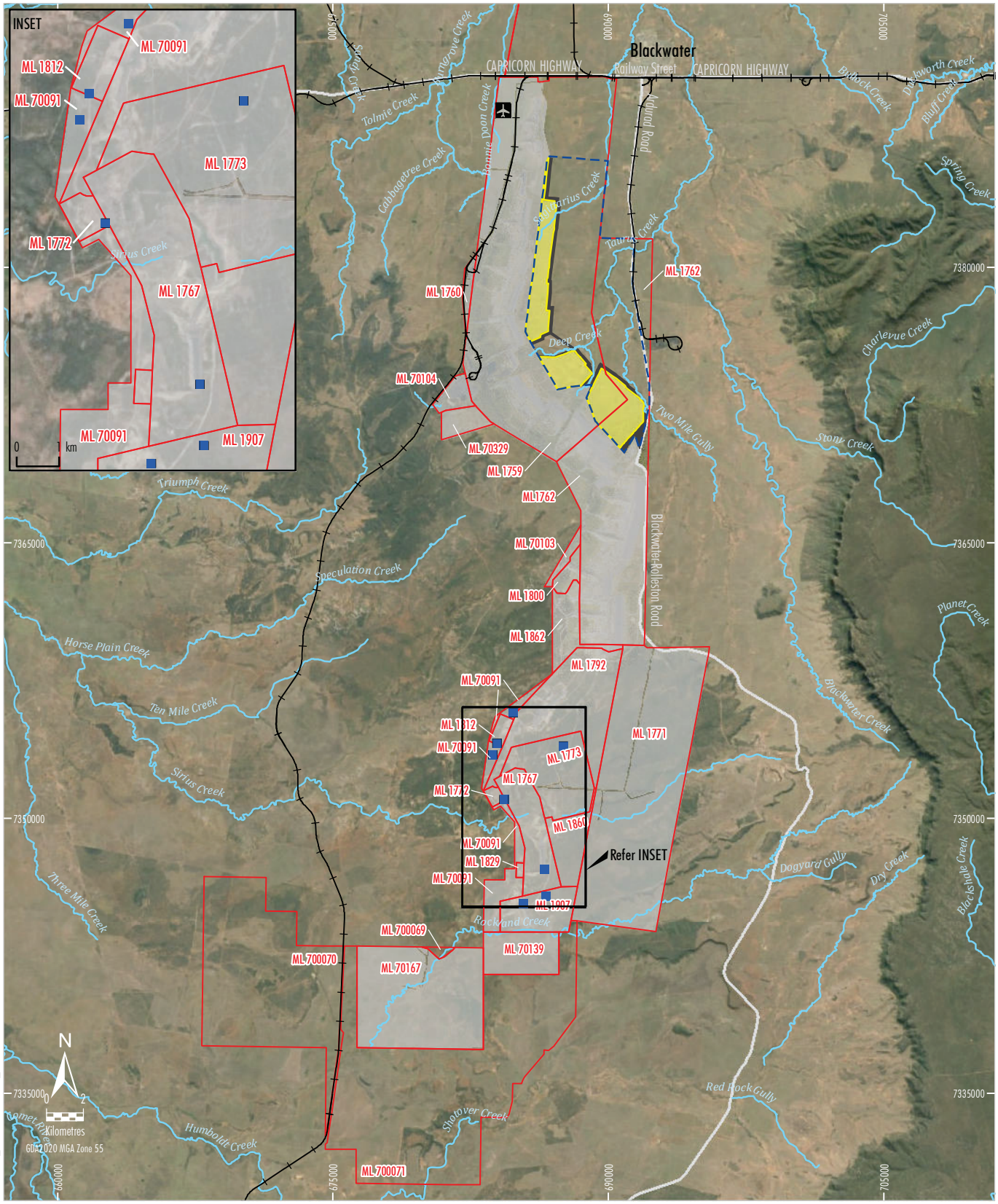


Figure 6-4 General Arrangement FY55

6.3 Quarries

Quarry activities are also planned as part of the Project at eight locations south of the Project Area (Figure 6-5). Activities will take place one location at a time with the use of a mobile screening plant. Material will be used across the whole site for road base, stemming and rehabilitation. It is estimated that approximately 300,000 to 800,000 tonnes of rock will be processed per year, with a daily run rate of 3,000 to 5,000 tonnes per day. Equipment will operate during daylight only. Dust generated by these activities is not expected to significantly affect any of the sensitive receptors, which are located much further north and typically upwind of the quarries; quarry activities were thus not included in the modelling.



WHC-24-101_EA Amendment SR AQ_213A

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)
Orthophoto: Esri (2025); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Airport
- Approved Disturbance Footprint
- Proposed Quarry Location

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Proposed Quarry Locations

Figure 6-5

6.4 Applied Mitigation

Dust mitigation measures which are currently implemented at the BWM have been taken into account in the modelling. These include:

- Watering of main haul roads (75% control with watering > 2 litres per square metre per hour [L/m^2/hr]).
- Watering of pit haul roads (50% control watering approximately 2 L/m^2/hr).
- Water spraying at the CHPP and TCP hoppers (90% efficiency).
- Dragline drop height: 6 m.
- Ongoing revegetation of exposed areas (50% efficiency for partially rehabilitated areas and 100% for fully rehabilitated areas).

6.5 Emission Rates

A full emission inventory has been developed for each scenario based on the BWM production schedule, activities and equipment lists, and in conjunction with published literature from the National Pollutant Inventory (2012) and US EPA AP-42 (1998, 2006). Key parameters describing the specific mining activities at the BWM are summarised in Appendix B and emission parameterisations are included in Appendix C.

Emission rates have been compiled for the planned mining activities across the BWM. The breakdown of the particulate matter emissions for FY30, FY32, FY46 and FY55 is summarised in Table 6-2 and Table 6-3.

On an annual basis and for the BWM, haulage and pit activities emit the most dust. Wind erosion only contributes to dust generation on windy days (when winds are stronger than 5.4 metres per second [m/s]), which occur only approximately 16% of the year. This accounts for the smaller overall contribution of wind erosion to the total dust generation per year; however, on windy days, wind erosion can be a significant contributor to dust levels and could cause exceedances of the 24-hour PM_{10} objectives at some of the sensitive receptors located downwind of the active overburden areas.

Activities related to the production, haulage and disposal of overburden generate the most dust overall. Similarly, wind erosion of active overburden areas dominates the wind erosion landscape.

Table 6-2 Emission Inventory for BWM (tonnes/year)

Activity	FY30			FY32			FY46			FY55		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Pit Operations (drilling, blasting, draglines dozers, excavators)	7,398	1,734	313	8,271	1,910	331	8,415	1,952	338	7,786	1,820	312
Truck Handling (load/dump)												
ROM Stockpile	579	270	41	741	346	52	735	343	51	626	292	44
Overburden (handling)	2,957	1,060	207	3,358	1,203	235	3,470	1,244	243	3,307	1,185	231
CHPP/TCP Operations	396	182	27	491	226	34	484	223	33	417	192	29
Haulage												
Overburden	8,694	2,824	282	9,459	3,070	307	8,390	2,726	273	8,893	2,891	289
ROM Main Haul Road	2,097	602	60	2,861	822	82	3,355	963	96	3,775	1,084	108
ROM within pit	543	176	18	742	239	24	911	296	30	887	288	29
Grading	72	32	2	83	37	3	83	37	3	83	37	3
Wind Erosion												
ROM Stockpiles	23	11	2	23	11	2	23	11	2	23	11	2
Active Pit	799	399	60	813	406	61	638	319	48	1,035	517	78
Active Overburden	3,027	1,513	227	2,747	1,373	206	3,873	1,937	290	3,072	1,536	230
Stripped and partially rehabilitated areas	598	299	45	886	443	66	792	396	59	900	450	67
TOTAL	**27,184**	**9,105**	**1,284**	**30,474**	**10,086**	**1,403**	**31,170**	**10,447**	**1,466**	**30,803**	**10,304**	**1,422**

Table 6-3 Summary of BWM Particulate Matter Emissions by Activity

Activity	FY30			FY32			FY46			FY55		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
TOTAL (tonnes/year)	**27,184**	**9,105**	**1,284**	**30,474**	**10,086**	**1,403**	**31,170**	**10,447**	**1,466**	**30,803**	**10,304**	**1,422**
Activity Contribution (tonnes/year)												
Pit Operations	10,935	3,064	561	12,369	3,459	618	12,620	3,539	632	11,718	3,297	587
CHPP/TCP	396	182	27	491	226	34	484	223	33	417	192	29
Haulage (incl. grading)	11,406	3,635	362	13,146	4,168	416	12,740	4,022	401	13,638	4,301	429
Wind Erosion	4,446	2,223	333	4,468	2,234	335	5,326	2,663	399	5,030	2,515	377
Activity Contribution (% of total)												
Pit Operations	40%	34%	44%	41%	34%	44%	40%	34%	43%	38%	32%	41%
CHPP/TCP	1%	2%	2%	2%	2%	2%	2%	2%	2%	1%	2%	2%
Haulage (incl. grading)	42%	40%	28%	43%	41%	30%	41%	39%	27%	44%	42%	30%
Wind Erosion	16%	24%	26%	15%	22%	24%	17%	25%	27%	16%	24%	27%

7 AIR QUALITY IMPACT ASSESSMENT

CALPUFF air dispersion modelling was conducted for the four emission scenarios to predict hourly $PM_{2.5}$, PM_{10} and TSP concentrations and dust deposition at each of the 4,384 ground-level receptors in the modelling domain. Background concentrations were then added to the incremental model predictions, and the cumulative results are presented and discussed in the following sections.

Maximum cumulative impacts predicted at the sensitive receptors were compared with the relevant air quality criteria and guidelines. Modelling results are also presented as isopleths (concentration and deposition contours) over the modelling domain. To create these contour plots, maximum concentrations and deposition for the relevant temporal average (e.g. 24-hour average) at each of the 4,384 receptors were contoured: these plots thus depict the worst possible conditions predicted at any given point in the modelling domain, but these predictions may have occurred on different days (or months) for each grid point (i.e. these plots are not snapshots).

Note that some of the receptors are within the ML, or are owned by the BWM, and predictions are at those receptors are included for information only. By FY55, R15 will no longer exist as the mining operations would progress eastward.

7.1 TSP

Predicted incremental and cumulative annual average TSP concentrations are compared with the ambient air quality objective (AAQO) in Table 7-1 for the four scenarios. Contour plots of annual average TSP concentrations over the whole modelling domain are displayed in Figure 7-1. Mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

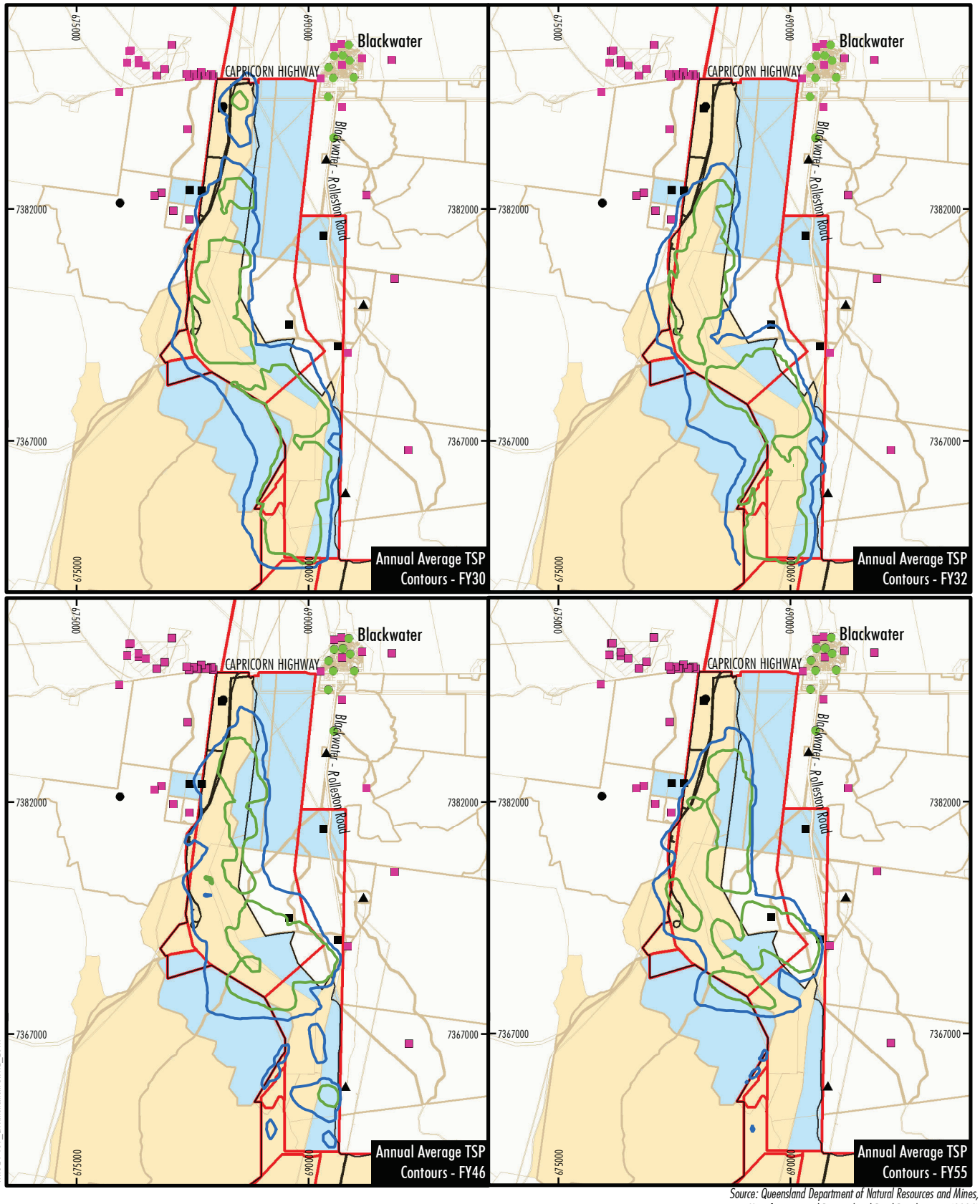
There are no predicted exceedances of the EPP (Air)/NEPM TSP annual average criteria at any of the receptors for any of the scenarios.

Table 7-1 Predicted Annual Average Ground-level TSP Concentrations (μg/m³)

Annual Average TSP								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	90	90	90	90	90	90	90	90
Privately-owned Sensitive Receptors								
R03	8.2	44.5	7.2	43.5	10.7	47.0	7.8	44.1
R04	7.5	43.7	6.6	42.8	9.5	45.7	7.2	43.4
R05	19.4	55.7	20.0	56.2	14.9	51.1	16.9	53.2
R06	12.7	49.0	11.9	48.2	13.6	49.9	12.2	48.4
R07	11.8	48.1	6.3	42.6	7.1	43.3	5.3	41.6
R09	3.2	39.4	3.5	39.8	3.7	39.9	3.4	39.6
R10	1.4	37.6	1.5	37.8	1.5	37.8	1.5	37.7
R11	3.3	39.6	3.6	39.8	3.3	39.6	2.7	39.0

Annual Average TSP								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	90	90	90	90	90	90	90	90
R13	2.1	38.4	2.1	38.4	1.9	38.1	1.4	37.7
R17	8.7	45.0	6.7	43.0	10.9	47.1	6.6	42.9
R19	1.6	37.8	1.1	37.4	0.7	37.0	0.4	36.7
R20	8.5	44.7	4.5	40.8	5.7	41.9	4.8	41.0
R21	7.6	43.9	4.4	40.6	5.4	41.6	4.6	40.8
R22	7.3	43.6	4.3	40.6	5.0	41.3	4.4	40.6
R23	7.2	43.5	4.3	40.6	5.0	41.2	4.3	40.6
R24	6.1	42.4	4.1	40.4	4.5	40.8	4.0	40.2
R25	6.7	42.9	4.2	40.5	4.6	40.8	4.0	40.2
R26	6.6	42.9	4.2	40.5	4.5	40.8	3.9	40.2
R27	6.1	42.3	4.1	40.4	4.3	40.6	3.8	40.0
R28	6.3	42.5	4.2	40.5	4.4	40.6	3.7	40.0
R29	5.7	41.9	4.1	40.3	4.2	40.4	3.6	39.8
R30	4.5	40.8	3.5	39.8	3.5	39.7	3.0	39.3
R31	4.5	40.7	3.4	39.7	3.3	39.6	2.9	39.2
R32	3.2	39.4	2.5	38.7	2.4	38.7	2.1	38.4
R33	3.4	39.6	2.8	39.1	2.7	38.9	2.4	38.6
R34	3.2	39.5	2.8	39.0	2.6	38.9	2.3	38.6
R35	3.0	39.2	2.5	38.7	2.4	38.7	2.1	38.4
R36	2.8	39.0	2.4	38.7	2.3	38.6	2.1	38.4
R37	2.8	39.1	2.5	38.7	2.4	38.6	2.1	38.4
R39	3.8	40.1	3.3	39.5	3.1	39.4	2.8	39.0
R40	3.7	39.9	3.0	39.3	2.9	39.1	2.6	38.8
R41	3.8	40.1	3.3	39.5	3.1	39.4	2.8	39.0
R42	2.5	38.7	2.6	38.9	2.4	38.7	2.4	38.6
R43	3.1	39.4	3.3	39.6	3.0	39.3	3.1	39.3
R52	2.2	38.5	2.4	38.6	2.5	38.7	2.3	38.5
R53	2.4	38.6	2.6	38.9	2.6	38.8	2.4	38.7
R54	3.6	39.9	3.6	39.9	4.3	40.5	4.0	40.2
R55	1.9	38.1	2.1	38.4	2.1	38.4	1.9	38.2
R56	2.5	38.8	2.6	38.9	2.8	39.1	2.6	38.9
Other Sensitive Receptors								
R57	2.6	38.8	2.7	39.0	2.9	39.2	2.7	39.0
R58	2.1	38.4	2.4	38.6	2.3	38.6	2.2	38.4

Annual Average TSP								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	90	90	90	90	90	90	90	90
R59	2.0	38.3	2.2	38.5	2.2	38.5	2.1	38.3
R60	2.2	38.5	2.4	38.7	2.5	38.7	2.3	38.6
R61	2.9	39.2	3.1	39.4	3.2	39.5	3.1	39.3
R62	3.0	39.2	3.1	39.3	3.4	39.6	3.1	39.4
R47	4.1	40.4	4.3	40.5	4.3	40.6	4.0	40.2
R63	2.3	38.6	2.7	38.9	2.7	38.9	2.5	38.7
Non-sensitive Commercial/Industrial Receptors								
R14	4.0	40.2	3.7	40.0	3.4	39.7	2.5	38.8
R46	13.5	49.7	5.5	41.7	4.5	40.7	1.0	37.2
R48	4.6	40.9	4.9	41.1	4.9	41.1	4.5	40.8
R49	5.3	41.6	4.4	40.7	5.8	42.1	4.8	41.1
R64	3.6	39.8	3.8	40.0	4.1	40.4	3.9	40.1
Non-sensitive Mine-owned Receptors								
R01	15.3	51.5	14.4	50.7	20.9	57.2	15.0	51.3
R02	18.2	54.4	18.3	54.6	28.2	64.5	20.7	56.9
R12	5.6	41.9	6.7	43.0	7.1	43.3	6.7	43.0
R50	27.6	63.9	7.0	43.2	9.2	45.4	7.4	43.7
R51	25.2	61.5	7.0	43.2	9.0	45.3	7.3	43.6
Non-sensitive Privately-owned Receptors Currently Under Agreements								
R15	16.0	52.2	23.7	60.0	38.9	75.1	315.6	351.9
R16	9.6	45.8	7.6	43.8	11.9	48.2	15.7	52.0



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LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Annual Average TSP
- 60 $\mu g/m^3$
- Exceedance Cumulative (90 $\mu g/m^3$)

Criteria: 90 $\mu g/m^3$

N

0 5

Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); RWDI (2026); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Predicted Annual Average Ground-level TSP Concentrations ($\mu g/m^3$)

Figure 7-1

7.2 PM_{10}

Predicted incremental and cumulative maximum 24-hour and annual average ground-level PM_{10} concentrations are compared with the respective AAQO in Table 7-2 and Table 7-3 for the four scenarios. Corresponding contour plots of 24-hour and annual average ground-level PM_{10} concentrations over the whole modelling domain are displayed in Figure 7-2 and Figure 7-3. Mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

Predicted cumulative maximum 24-hour average ground-level PM_{10} concentrations exceed the 24-hour EPP (Air)/NEPM PM_{10} criteria at six (6) non-sensitive mine-owned receptors and privately-owned receptors currently under agreements (R1, R2, R15, R16, R50 and R51) and one (1) non-sensitive commercial/industrial receptor (R46). The model also predicted potential exceedances at six (6) privately-owned sensitive receptors (R5, R6, R7, R17, R20 and R21).

- R5 and R6 are located near the BWM western boundary. The model predicted three exceedances at R5 in FY30, two of which were caused by strong wind erosion under south-southeasterly winds (160° -180°) and one during stable calm conditions. One potential exceedance was modelled at both receivers in FY32 on a day starting with a strong night-time inversion under weak south-easterly winds, blowing very undiluted dust from the active overburden areas directly to those receptors.
- R7 sits west of the northern part of the Project. The model predicted only one exceedance at R7 in FY30 under sustained strong winds (> 7 m/s) from the south-southeast (160°-170°), blowing both eroded and operational dust from the overburden and active areas.
- R17 is located near the Project southeastern boundary. The model predicted one exceedance due to sustained wind erosion in the FY30 scenario, and nine and four exceedances due to the approaching mining activities in FY46 and FY55 respectively under rare south-southwesterly or south-westerly wind conditions, with high impact especially around sunrise during the morning inversion break-up (freeing dust that accumulated in the pit overnight), or near sunset when the mixing height collapses trapping and concentrating dust near the surface.
- R20 to R21 are located northwest of the BWM near the Capricorn Highway. Three exceedances were predicted at those locations in the FY30 scenario, when mining is planned in the northernmost part of the Project. Two exceedances were due to very strong sustained southerly winds (165°-185°) creating enhanced erosion of all exposed areas lining up their cumulative impact with R20 and R21 in addition to the mining operations taking place close to those receptors in FY30. The third exceedance was non-erosion related and occurred on a day starting with a strong night-time inversion under weak south-easterly winds, blowing undiluted dust from the northernmost active overburden area directly to those receptors.

These exceedances at privately-owned sensitive receptors can be prevented with a proactive dust management approach, including real-time monitoring and mine activity adjustment when warning levels are reached. In addition, alternative arrangements as defined in EA EPML00717813 would be sought with R5, R6, R7 and R17.

Predicted cumulative annual average ground-level PM_{10} concentrations exceed the annual EPP (Air)/NEPM PM_{10} criteria at five (5) non-sensitive mine-owned receptors and privately-owned receptors currently under agreements (R1, R2, R15, R50 and R51), and also at one (1) privately-owned sensitive receptor (R5), which is located close to the BWM western boundary in FY30 and FY32.

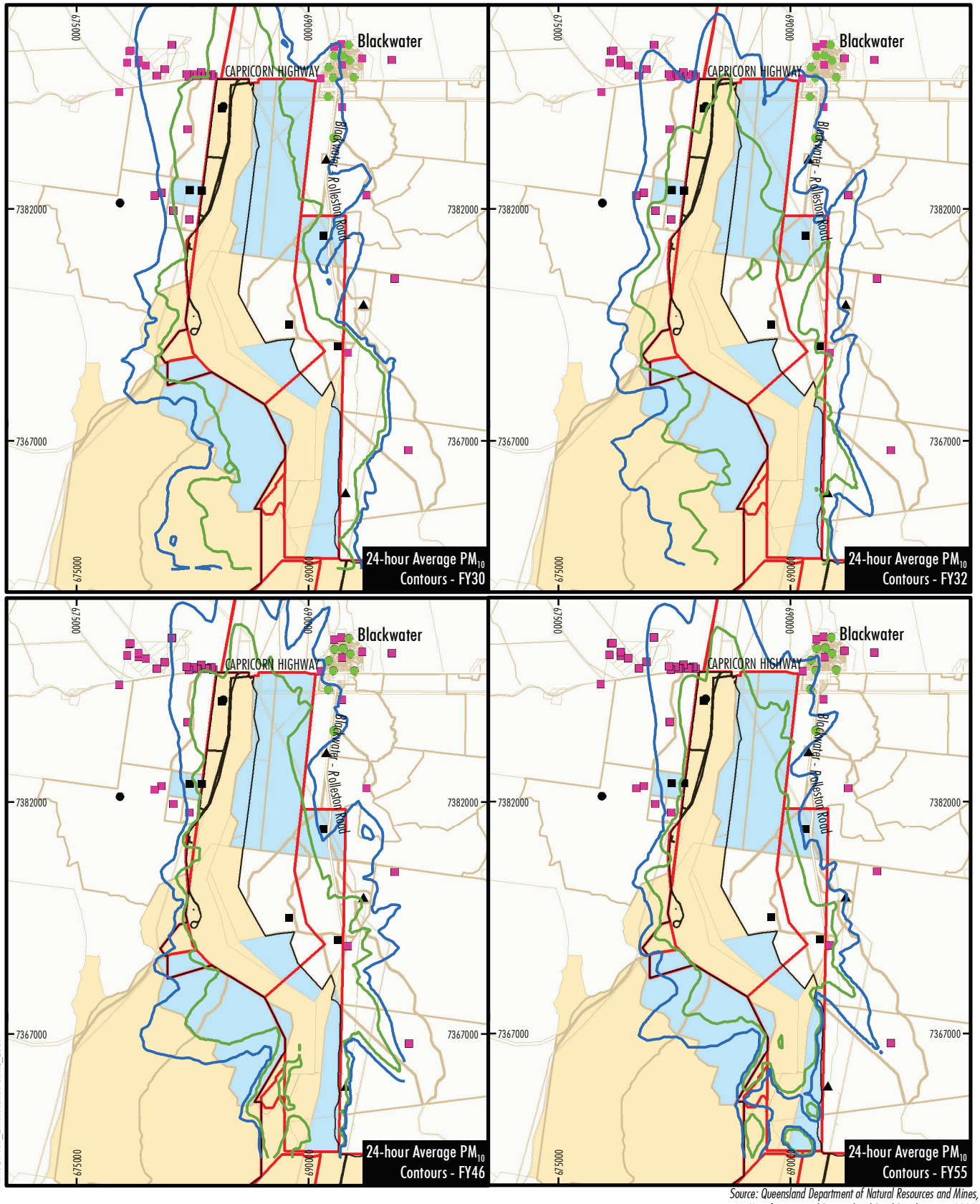
Table 7-2 Predicted Maximum 24-hour Average Ground-level PM_{10} Concentrations ($\mu g/m^3$) and Number of Days of Predicted Exceedance at Sensitive Receptors

Maximum 24-hour Average PM_{10}																
	FY30				FY32				FY46				FY55			
	BWM		Cumulative		BWM		Cumulative		BWM		Cumulative		BWM		Cumulative	
	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc
AAQO	50		50		50		50		50		50		50		50	
Privately-owned Sensitive Receptors																
R03	22.7	0	40.9	0	27.8	0	45.9	0	14.1	0	32.2	0	13.6	0	31.7	0
R04	17.8	0	35.9	0	24.2	0	42.3	0	12.2	0	30.3	0	11.6	0	29.7	0
R05	**52.2**	**1**	**70.3**	**3**	42.0	0	**60.1**	**1**	23.3	0	41.4	0	26.3	0	44.5	0
R06	30.6	0	48.8	0	36.7	0	**54.8**	**1**	17.5	0	35.6	0	17.5	0	35.6	0
R07	35.2	0	**53.4**	**1**	31.0	0	49.1	0	30.6	0	48.8	0	26.6	0	44.7	0
R09	22.0	0	40.1	0	20.5	0	38.6	0	19.7	0	37.8	0	18.3	0	36.4	0
R10	9.5	0	27.6	0	9.0	0	27.1	0	11.2	0	29.3	0	10.0	0	28.1	0
R11	20.9	0	39.0	0	24.6	0	42.7	0	20.9	0	39.0	0	18.4	0	36.5	0
R13	16.8	0	34.9	0	15.5	0	33.6	0	15.7	0	33.8	0	11.3	0	29.4	0
R17	33.3	0	**51.5**	**1**	31.1	0	49.2	0	49.1	0	**67.2**	**9**	38.3	0	**56.4**	**4**
R19	8.3	0	26.4	0	8.2	0	26.3	0	9.8	0	27.9	0	10.7	0	28.8	0
R20	37.8	0	**55.9**	**3**	22.4	0	40.5	0	30.9	0	49.0	0	29.9	0	48.0	0
R21	36.0	0	**54.1**	**3**	21.3	0	39.4	0	30.5	0	48.6	0	29.6	0	47.7	0
R22	31.2	0	49.4	0	20.5	0	38.6	0	31.2	0	49.3	0	30.0	0	48.2	0
R23	30.7	0	48.9	0	20.8	0	38.9	0	31.4	0	49.5	0	30.1	0	48.2	0
R24	29.9	0	48.1	0	20.7	0	38.8	0	30.4	0	48.5	0	29.0	0	47.2	0
R25	31.0	0	49.1	0	21.6	0	39.8	0	30.8	0	49.0	0	29.4	0	47.5	0
R26	31.1	0	49.2	0	22.1	0	40.2	0	30.6	0	48.7	0	29.2	0	47.3	0
R27	30.8	0	49.0	0	22.7	0	40.8	0	29.4	0	47.5	0	28.3	0	46.5	0
R28	31.0	0	49.1	0	24.1	0	42.2	0	28.1	0	46.2	0	27.6	0	45.7	0
R29	30.3	0	48.4	0	23.7	0	41.9	0	27.1	0	45.2	0	26.8	0	44.9	0
R30	27.3	0	45.4	0	22.8	0	40.9	0	19.8	0	38.0	0	21.7	0	39.8	0
R31	26.8	0	44.9	0	21.8	0	39.9	0	18.4	0	36.5	0	19.8	0	37.9	0
R32	14.8	0	32.9	0	14.9	0	33.0	0	9.1	0	27.2	0	8.7	0	26.9	0
R33	22.5	0	40.6	0	17.0	0	35.1	0	14.6	0	32.7	0	15.6	0	33.8	0
R34	22.5	0	40.6	0	17.1	0	35.2	0	14.8	0	32.9	0	15.8	0	33.9	0
R35	18.6	0	36.7	0	13.5	0	31.7	0	11.5	0	29.7	0	12.5	0	30.6	0
R36	19.9	0	38.1	0	14.7	0	32.8	0	12.9	0	31.1	0	13.8	0	31.9	0
R37	20.5	0	38.6	0	15.2	0	33.3	0	13.4	0	31.5	0	14.3	0	32.4	0

Maximum 24-hour Average PM_{10}																
	FY30				FY32				FY46				FY55			
	BWM		Cumulative		BWM		Cumulative		BWM		Cumulative		BWM		Cumulative	
	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc
AAQO	**50**		**50**		**50**		**50**		**50**		**50**		**50**		**50**	
R39	26.7	0	44.9	0	21.5	0	39.6	0	22.1	0	40.3	0	22.9	0	41.0	0
R40	24.4	0	42.6	0	19.1	0	37.2	0	16.3	0	34.4	0	17.5	0	35.6	0
R41	26.7	0	44.9	0	21.5	0	39.6	0	22.1	0	40.3	0	22.9	0	41.0	0
R42	5.9	0	24.1	0	6.0	0	24.1	0	5.2	0	23.4	0	5.1	0	23.3	0
R43	7.8	0	26.0	0	8.1	0	26.2	0	6.6	0	24.7	0	6.4	0	24.6	0
R52	21.7	0	39.8	0	19.3	0	37.4	0	16.6	0	34.7	0	18.2	0	36.3	0
R53	21.4	0	39.5	0	20.2	0	38.3	0	14.8	0	33.0	0	20.9	0	39.0	0
R54	30.5	0	48.6	0	22.0	0	40.2	0	23.5	0	41.7	0	24.8	0	42.9	0
R55	14.8	0	32.9	0	15.9	0	34.0	0	14.3	0	32.4	0	14.3	0	32.4	0
R56	23.0	0	41.1	0	20.4	0	38.5	0	17.5	0	35.6	0	18.7	0	36.8	0
Other Sensitive Receptors																
R57	23.1	0	41.3	0	20.2	0	38.3	0	18.6	0	36.7	0	20.0	0	38.1	0
R58	18.6	0	36.7	0	19.1	0	37.2	0	13.5	0	31.6	0	17.0	0	35.2	0
R59	20.1	0	38.2	0	18.5	0	36.7	0	14.7	0	32.8	0	19.5	0	37.6	0
R60	20.8	0	39.0	0	19.1	0	37.3	0	15.3	0	33.4	0	21.3	0	39.5	0
R61	24.4	0	42.5	0	22.1	0	40.3	0	16.8	0	34.9	0	24.3	0	42.4	0
R62	25.2	0	43.4	0	21.0	0	39.1	0	19.4	0	37.6	0	21.7	0	39.9	0
R47	25.7	0	43.8	0	23.6	0	41.8	0	25.2	0	43.4	0	27.6	0	45.8	0
R63	16.9	0	35.0	0	18.6	0	36.8	0	16.5	0	34.6	0	17.0	0	35.1	0
Non-sensitive Commercial/Industrial Receptors																
R14	16.7	0	34.8	0	18.6	0	36.7	0	31.1	0	49.3	0	23.0	0	41.1	0
R46	**81.0**	**4**	**99.1**	**7**	23.5	0	41.6	0	28.5	0	46.7	0	8.4	0	26.5	0
R48	26.2	0	44.3	0	21.9	0	40.1	0	18.8	0	36.9	0	19.2	0	37.3	0
R49	13.8	0	32.0	0	12.5	0	30.7	0	9.4	0	27.5	0	9.8	0	27.9	0
R64	25.0	0	43.1	0	24.2	0	42.3	0	29.5	0	47.7	0	21.2	0	39.4	0
Non-sensitive Mine-owned Receptors																
R01	38.4	0	**56.5**	**5**	35.1	0	**53.2**	**2**	24.6	0	42.7	**0**	26.4	0	44.6	**0**
R02	43.0	0	**61.2**	**8**	45.3	0	**63.5**	**7**	41.2	0	**59.3**	**5**	35.0	0	**53.1**	**2**
R12	26.0	0	44.1	0	22.9	0	41.1	0	19.7	0	37.8	0	19.5	0	37.6	0
R50	**53.9**	**2**	**72.0**	**12**	30.2	0	48.3	0	39.1	0	**57.3**	**3**	37.3	0	**55.4**	**3**
R51	**51.2**	**1**	**69.4**	**10**	29.9	0	48.0	0	40.5	0	**58.6**	**3**	38.4	0	**56.6**	**2**
Non-sensitive Privately-owned Receptors Currently Under Agreements																

Maximum 24-hour Average PM_{10}																
	FY30				FY32				FY46				FY55			
	BWM		Cumulative		BWM		Cumulative		BWM		Cumulative		BWM		Cumulative	
	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc	Max	# Exc
AAQO	**50**		**50**		**50**		**50**		**50**		**50**		**50**		**50**	
R15	**64.1**	**1**	**82.2**	**10**	**64.1**	**2**	**82.3**	**28**	**77.8**	**14**	**95.9**	**63**	**-**	**-**	**-**	**-**
R16	34.1	0	**52.2**	**1**	27.6	0	45.7	0	42.7	0	**60.8**	**6**	**61.2**	**5**	**79.3**	**22**

Note: Bolded values indicate an exceedance as per EPP (Air) and NEPC (2021).



WHC-24-101_EA Amendment SR AQ_208A

LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

24-hour Average PM_{10}
- 40 $\mu g/m^3$
- Exceedance Cumulative (50 $\mu g/m^3$)

Criteria: 50 $\mu g/m^3$

N

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Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); RWDI (2026); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Predicted Maximum 24-hour Average Ground-level PM_{10} Concentrations ($\mu g/m^3$)

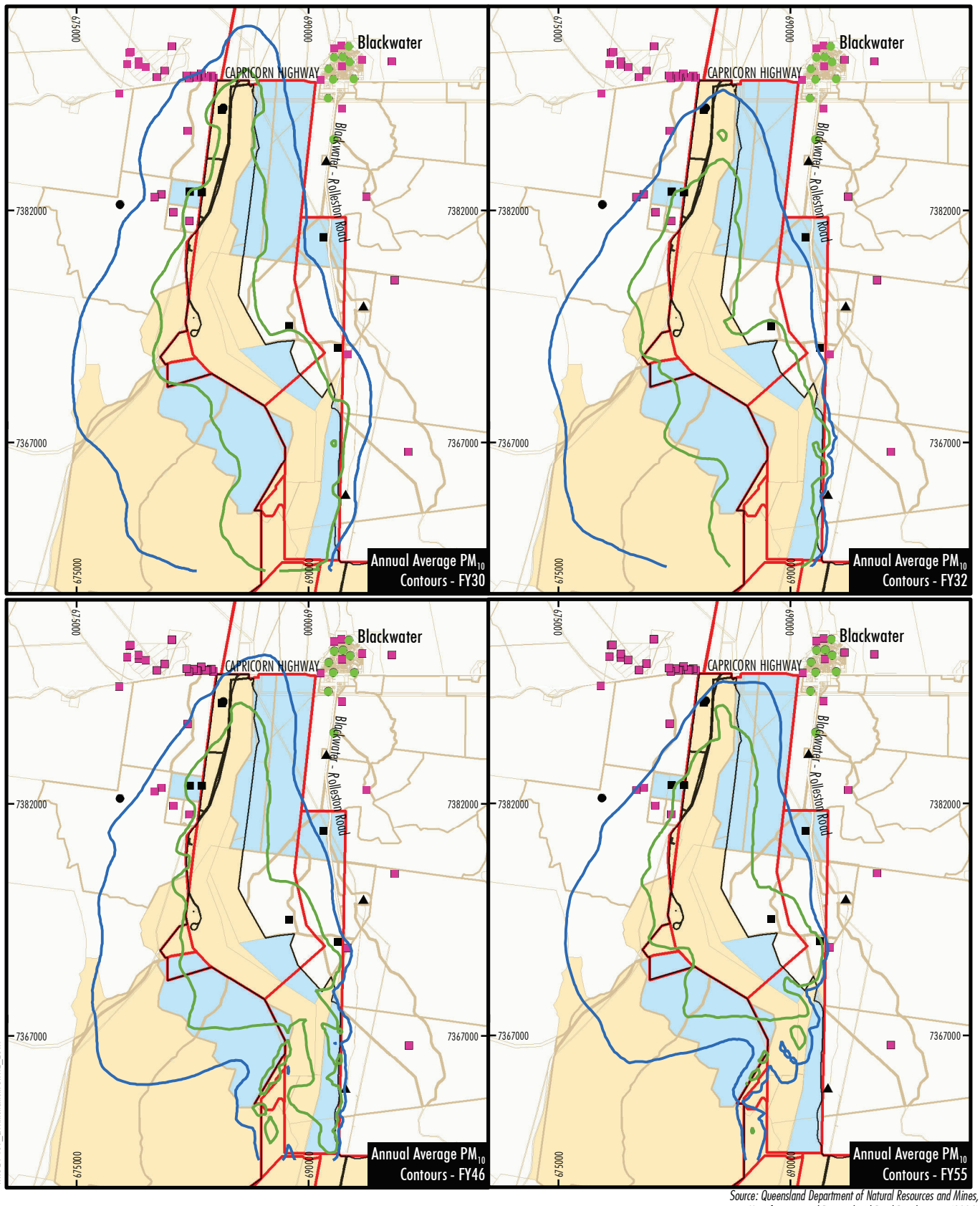
Figure 7-2

Table 7-3 Predicted Annual Average Ground-level PM_{10} Concentrations (µg/m³)

Annual Average PM_{10}								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	25	25	25	25	25	25	25	25
Privately-owned Sensitive Receptors								
R03	4.7	21.0	3.9	20.2	5.3	21.6	4.2	20.5
R04	4.3	20.6	3.5	19.9	4.7	21.0	3.8	20.1
R05	10.2	**26.6**	9.8	**26.1**	7.4	23.7	8.4	24.7
R06	6.9	23.3	6.1	22.4	6.6	23.0	6.1	22.4
R07	6.6	22.9	3.6	19.9	3.7	20.1	3.0	19.3
R09	2.0	18.3	2.0	18.3	2.0	18.3	1.8	18.2
R10	0.9	17.2	0.9	17.2	0.9	17.2	0.9	17.2
R11	2.0	18.3	1.9	18.2	1.7	18.0	1.4	17.7
R13	1.2	17.5	1.1	17.4	0.9	17.2	0.7	17.0
R17	4.7	21.0	3.1	19.4	4.3	20.6	2.8	19.1
R19	0.8	17.1	0.5	16.9	0.4	16.7	0.2	16.6
R20	4.9	21.2	2.6	18.9	3.1	19.4	2.7	19.0
R21	4.5	20.8	2.5	18.9	2.9	19.3	2.6	18.9
R22	4.3	20.7	2.5	18.9	2.8	19.1	2.5	18.8
R23	4.3	20.6	2.5	18.8	2.8	19.1	2.4	18.8
R24	3.7	20.1	2.4	18.7	2.5	18.9	2.3	18.6
R25	4.0	20.3	2.5	18.8	2.6	18.9	2.3	18.6
R26	4.0	20.3	2.5	18.8	2.5	18.9	2.3	18.6
R27	3.7	20.0	2.4	18.8	2.5	18.8	2.2	18.5
R28	3.8	20.1	2.5	18.8	2.5	18.8	2.2	18.5
R29	3.5	19.8	2.4	18.7	2.4	18.7	2.1	18.4
R30	2.8	19.2	2.1	18.4	2.0	18.4	1.8	18.1
R31	2.8	19.1	2.1	18.4	2.0	18.3	1.7	18.1
R32	2.0	18.4	1.5	17.8	1.4	17.8	1.3	17.6
R33	2.2	18.5	1.7	18.0	1.6	17.9	1.4	17.8
R34	2.1	18.4	1.7	18.0	1.6	17.9	1.4	17.8
R35	2.0	18.3	1.5	17.8	1.4	17.8	1.3	17.6
R36	1.8	18.2	1.5	17.8	1.4	17.7	1.3	17.6
R37	1.9	18.2	1.5	17.8	1.4	17.7	1.3	17.6
R39	2.5	18.8	2.0	18.3	1.8	18.2	1.7	18.0
R40	2.4	18.7	1.8	18.2	1.7	18.0	1.5	17.9

Annual Average PM_{10}								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	25	25	25	25	25	25	25	25
R41	2.5	18.8	2.0	18.3	1.8	18.2	1.7	18.0
R42	1.8	18.1	1.8	18.1	1.6	18.0	1.6	18.0
R43	2.3	18.6	2.3	18.6	2.1	18.4	2.1	18.4
R52	1.5	17.8	1.5	17.8	1.5	17.8	1.4	17.7
R53	1.6	17.9	1.6	17.9	1.5	17.8	1.4	17.8
R54	2.3	18.6	2.1	18.4	2.3	18.6	2.2	18.5
R55	1.3	17.6	1.3	17.6	1.2	17.6	1.2	17.5
R56	1.7	18.0	1.6	17.9	1.6	18.0	1.5	17.9
Other Sensitive Receptors								
R57	1.7	18.0	1.6	17.9	1.7	18.0	1.6	17.9
R58	1.4	17.8	1.4	17.8	1.4	17.7	1.3	17.6
R59	1.4	17.7	1.4	17.7	1.3	17.6	1.2	17.6
R60	1.5	17.8	1.5	17.8	1.5	17.8	1.4	17.7
R61	1.9	18.2	1.8	18.1	1.8	18.1	1.7	18.1
R62	1.9	18.3	1.8	18.1	1.9	18.2	1.8	18.1
R47	2.5	18.8	2.4	18.7	2.3	18.6	2.1	18.4
R63	1.5	17.8	1.6	17.9	1.5	17.8	1.4	17.7
Non-sensitive Commercial/Industrial Receptors								
R14	2.2	18.5	1.8	18.2	1.6	17.9	1.2	17.5
R46	6.8	23.2	2.4	18.7	2.0	18.4	0.5	16.8
R48	2.8	19.1	2.6	19.0	2.5	18.8	2.4	18.7
R49	3.1	19.5	2.5	18.8	3.0	19.3	2.6	18.9
R64	2.2	18.6	2.1	18.5	2.2	18.5	2.1	18.4
Non-sensitive Mine-owned Receptors								
R01	8.8	**25.1**	7.6	24.0	9.8	**26.1**	7.7	24.1
R02	10.1	**26.4**	9.5	**25.8**	13.2	**29.5**	10.3	**26.6**
R12	3.2	19.5	3.4	19.7	3.4	19.7	3.2	19.5
R50	13.4	**29.7**	3.9	20.2	4.7	21.1	4.0	20.3
R51	12.5	**28.8**	3.9	20.2	4.7	21.0	3.9	20.3
Non-sensitive Privately-owned Receptors Currently Under Agreements								
R15	8.2	24.6	9.6	**26.0**	15.9	**32.2**	-	**-**
R16	5.1	21.4	3.4	19.8	4.7	21.1	6.1	22.4

Note: Bolded values indicate an exceedance as per EPP (Air) and NEPC (2021).



WHC-24-101_EA Amendment SR AQ_209A

LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Annual Average PM_{10}
- 20 $\mu g/m^3$
- Exceedance Cumulative (25 $\mu g/m^3$)

Criteria: 25 $\mu g/m^3$

N

0 5

Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Predicted Annual Average Ground-level PM_{10} Concentrations ($\mu g/m^3$)

Figure 7-3

7.3 $PM_{2.5}$

Predicted incremental and cumulative maximum 24-hour and annual average ground-level $PM_{2.5}$ concentrations are compared with their respective AAQO in Table 7-4 and Table 7-5 respectively for the four scenarios. Corresponding contour plots of the maximum 24-hour and annual average ground-level $PM_{2.5}$ concentrations over the whole modelling domain are displayed in Figure 7-4 and Figure 7-5. Mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

There are no predicted exceedances of the EPP (Air) Amendment/NEPM 24-hour $PM_{2.5}$ criteria at any of the sensitive receptors for any of the scenarios. One (1) non-sensitive privately-owned receptor currently under agreements (R15) is predicted to exceed these criteria in FY30 and FY46 due to erosion under strong westerly winds.

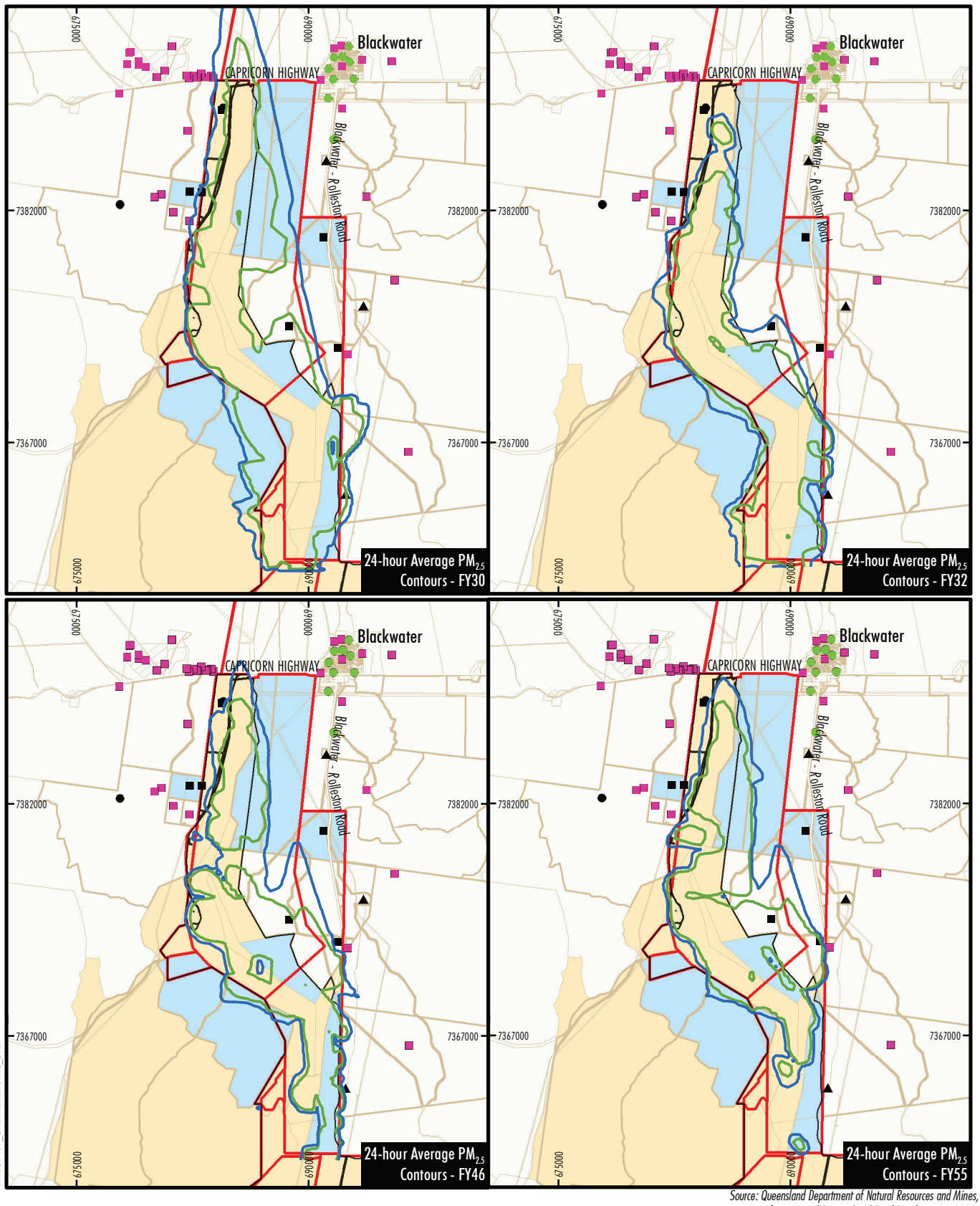
Predicted cumulative annual average ground-level $PM_{2.5}$ concentrations do not exceed the EPP (Air) Amendment/NEPM criteria at any public or private sensitive receptors. Four (4) non-sensitive receptors are predicted to slightly exceed these criteria (mine-owned receptors R50 and R51 in FY32, and mine-owned receptor R2 and privately-owned receptor currently under agreements R15 in FY46). Background $PM_{2.5}$ accounts for 75% of those exceedances which occurred under particular strong winds causing enhanced erosion.

Table 7-4 Predicted Maximum 24-hour Average Ground-level $PM_{2.5}$ Concentrations ($\mu g/m^3$)

Maximum 24-hour Average $PM_{2.5}$								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	20	20	20	20	20	20	20	20
Privately-owned Sensitive Receptors								
R03	4.4	10.0	4.7	10.3	2.4	8.0	2.4	8.1
R04	3.1	8.8	4.1	9.7	2.1	7.7	1.9	7.6
R05	9.1	14.8	6.9	12.5	4.7	10.4	5.2	10.8
R06	5.8	11.4	6.1	11.8	2.9	8.5	3.2	8.9
R07	8.0	13.6	6.3	11.9	5.4	11.0	5.7	11.3
R09	3.4	9.1	2.9	8.5	2.8	8.4	2.7	8.3
R10	1.5	7.1	1.3	6.9	1.5	7.1	1.5	7.1
R11	3.2	8.8	3.5	9.2	2.9	8.5	2.6	8.3
R13	2.6	8.2	2.3	8.0	2.6	8.2	1.6	7.3
R17	5.8	11.5	4.3	10.0	6.9	12.6	5.6	11.3
R19	1.8	7.5	1.2	6.9	1.5	7.2	2.1	7.7
R20	8.8	14.4	5.1	10.8	6.5	12.1	6.1	11.7
R21	8.2	13.9	4.9	10.5	6.5	12.1	6.0	11.7
R22	7.0	12.6	4.4	10.0	6.7	12.3	6.1	11.8
R23	6.7	12.3	4.2	9.8	6.7	12.4	6.2	11.8
R24	6.4	12.1	4.2	9.8	6.6	12.2	6.0	11.7

Maximum 24-hour Average $PM_{2.5}$								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	20	20	20	20	20	20	20	20
R25	6.8	12.4	4.7	10.4	6.6	12.3	6.1	11.7
R26	6.8	12.5	4.8	10.4	6.6	12.2	6.1	11.7
R27	6.8	12.5	4.9	10.6	6.3	12.0	5.9	11.6
R28	6.9	12.6	5.2	10.8	6.0	11.7	5.8	11.4
R29	6.8	12.5	5.1	10.8	5.8	11.5	5.6	11.3
R30	6.6	12.2	4.9	10.5	4.3	10.0	4.8	10.4
R31	6.5	12.1	4.6	10.2	4.0	9.6	4.4	10.0
R32	3.1	8.7	2.2	7.8	1.7	7.3	1.7	7.3
R33	5.6	11.2	3.6	9.2	3.3	8.9	3.5	9.1
R34	5.6	11.2	3.6	9.3	3.3	8.9	3.5	9.1
R35	4.6	10.2	2.8	8.5	2.6	8.2	2.7	8.4
R36	4.9	10.6	3.1	8.8	2.9	8.5	3.0	8.7
R37	5.1	10.7	3.2	8.9	3.0	8.6	3.2	8.8
R39	6.2	11.9	4.7	10.3	4.9	10.5	5.0	10.6
R40	6.0	11.7	4.0	9.7	3.6	9.2	3.9	9.5
R41	6.2	11.9	4.7	10.3	4.9	10.5	5.0	10.6
R42	1.0	6.7	0.9	6.6	1.0	6.6	1.1	6.7
R43	1.2	6.9	1.2	6.9	1.1	6.8	1.2	6.9
R52	3.4	9.0	2.9	8.5	2.3	8.0	2.7	8.3
R53	3.2	8.8	2.9	8.6	2.2	7.9	3.2	8.8
R54	4.7	10.4	3.2	8.8	3.1	8.7	3.6	9.3
R55	2.3	8.0	2.3	8.0	2.2	7.9	2.2	7.8
R56	3.6	9.3	3.0	8.7	2.3	8.0	2.8	8.4
Other Sensitive Receptors								
R57	3.6	9.3	3.0	8.6	2.5	8.2	3.0	8.6
R58	2.8	8.4	2.8	8.4	2.1	7.7	2.6	8.2
R59	3.1	8.7	2.7	8.4	2.2	7.8	3.0	8.6
R60	3.2	8.8	2.8	8.5	2.3	8.0	3.3	8.9
R61	3.6	9.3	3.2	8.9	2.5	8.2	3.6	9.3
R62	3.9	9.5	3.1	8.7	2.8	8.4	3.3	8.9
R47	4.0	9.7	3.5	9.2	3.9	9.6	4.1	9.8
R63	2.6	8.3	2.7	8.3	2.5	8.2	2.6	8.2
Non-sensitive Commercial/Industrial Receptors								
R14	2.6	8.2	2.7	8.3	4.4	10.0	3.3	8.9

Maximum 24-hour Average $PM_{2.5}$								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	20	20	20	20	20	20	20	20
R46	14.0	19.7	3.3	9.0	5.2	10.9	1.7	7.4
R48	3.9	9.6	3.2	8.9	3.1	8.8	2.9	8.5
R49	2.0	7.7	1.8	7.4	1.4	7.1	1.4	7.1
R64	3.7	9.4	3.4	9.1	3.7	9.3	3.2	8.8
Non-sensitive Mine-owned Receptors								
R01	8.7	14.3	6.2	11.8	4.8	10.5	5.5	11.1
R02	9.5	15.1	7.6	13.3	6.8	12.4	6.5	12.1
R12	3.9	9.6	3.3	9.0	3.7	9.4	3.5	9.2
R50	12.0	17.6	6.9	12.5	8.0	13.7	7.5	13.1
R51	11.4	17.0	6.8	12.4	8.4	14.0	7.6	13.3
Non-sensitive Privately-owned Receptors Currently Under Agreements								
R15	15.9	**21.5**	9.8	15.4	14.8	**20.4**	-	-
R16	6.0	11.6	3.9	9.5	5.9	11.6	8.8	14.5



WHC-24-101_EA Amendment SR AQ_210A

LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

24-hour Average $PM_{2.5}$
- 15 $\mu g/m^3$
- Exceedance Cumulative (20 $\mu g/m^3$)

Criteria: 20 $\mu g/m^3$

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Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); RWDI (2026); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

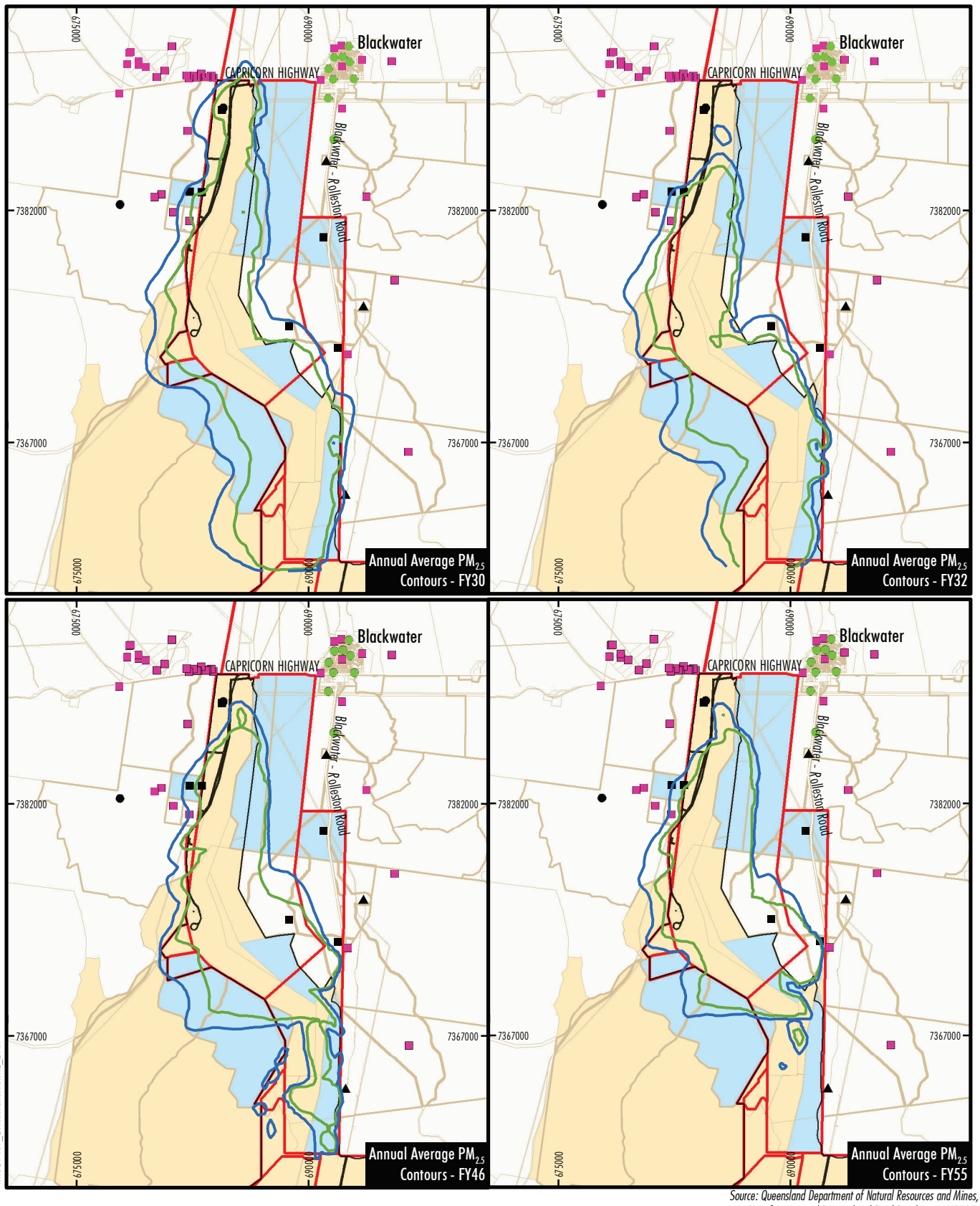
Predicted Maximum 24-hour Average Ground-level $PM_{2.5}$ concentrations ($\mu g/m^3$)

Figure 7-4

Table 7-5 Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations (µg/m³)

Annual Average $PM_{2.5}$								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	7	7	7	7	7	7	7	7
Privately-owned Sensitive Receptors								
R03	0.8	6.0	0.6	5.9	0.8	6.1	0.7	5.9
R04	0.7	6.0	0.5	5.8	0.7	6.0	0.6	5.9
R05	1.6	6.9	1.5	6.8	1.2	6.5	1.3	6.5
R06	1.1	6.4	0.9	6.2	1.0	6.3	0.9	6.2
R07	1.1	6.4	0.6	5.9	0.6	5.9	0.5	5.8
R09	0.3	5.6	0.3	5.6	0.3	5.6	0.3	5.6
R10	0.1	5.4	0.1	5.4	0.1	5.4	0.1	5.4
R11	0.3	5.6	0.3	5.6	0.3	5.5	0.2	5.5
R13	0.2	5.5	0.2	5.5	0.1	5.4	0.1	5.4
R17	0.8	6.0	0.5	5.7	0.6	5.9	0.4	5.7
R19	0.1	5.4	0.1	5.4	0.1	5.3	0.0	5.3
R20	0.9	6.1	0.4	5.7	0.5	5.8	0.4	5.7
R21	0.8	6.1	0.4	5.7	0.5	5.8	0.4	5.7
R22	0.8	6.0	0.4	5.7	0.5	5.7	0.4	5.7
R23	0.7	6.0	0.4	5.7	0.4	5.7	0.4	5.7
R24	0.6	5.9	0.4	5.7	0.4	5.7	0.4	5.7
R25	0.7	6.0	0.4	5.7	0.4	5.7	0.4	5.7
R26	0.7	6.0	0.4	5.7	0.4	5.7	0.4	5.7
R27	0.6	5.9	0.4	5.7	0.4	5.7	0.4	5.6
R28	0.7	5.9	0.4	5.7	0.4	5.7	0.4	5.6
R29	0.6	5.9	0.4	5.7	0.4	5.7	0.3	5.6
R30	0.5	5.8	0.3	5.6	0.3	5.6	0.3	5.6
R31	0.5	5.8	0.3	5.6	0.3	5.6	0.3	5.6
R32	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
R33	0.4	5.7	0.3	5.6	0.3	5.5	0.2	5.5
R34	0.4	5.7	0.3	5.6	0.3	5.5	0.2	5.5
R35	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
R36	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
R37	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
R39	0.4	5.7	0.3	5.6	0.3	5.6	0.3	5.6
R40	0.4	5.7	0.3	5.6	0.3	5.6	0.2	5.5

Annual Average $PM_{2.5}$								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
AAQO	7	7	7	7	7	7	7	7
R41	0.4	5.7	0.3	5.6	0.3	5.6	0.3	5.6
R42	0.3	5.6	0.3	5.6	0.3	5.6	0.3	5.6
R43	0.4	5.7	0.4	5.7	0.4	5.7	0.4	5.6
R52	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R53	0.3	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R54	0.4	5.7	0.3	5.6	0.3	5.6	0.3	5.6
R55	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R56	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
Other Sensitive Receptors								
R57	0.3	5.6	0.2	5.5	0.2	5.5	0.2	5.5
R58	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R59	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R60	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
R61	0.3	5.6	0.3	5.6	0.3	5.6	0.3	5.6
R62	0.3	5.6	0.3	5.6	0.3	5.6	0.3	5.6
R47	0.4	5.7	0.4	5.6	0.3	5.6	0.3	5.6
R63	0.2	5.5	0.2	5.5	0.2	5.5	0.2	5.5
Non-sensitive Commercial/Industrial Receptors								
R14	0.3	5.6	0.3	5.6	0.2	5.5	0.2	5.5
R46	1.1	6.4	0.3	5.6	0.3	5.6	0.1	5.4
R48	0.4	5.7	0.4	5.7	0.4	5.7	0.4	5.6
R49	0.5	5.8	0.4	5.7	0.4	5.7	0.4	5.7
R64	0.4	5.6	0.3	5.6	0.3	5.6	0.3	5.6
Non-sensitive Mine-owned Receptors								
R01	1.4	6.7	1.2	6.5	1.4	6.7	1.2	6.5
R02	1.6	6.9	1.5	6.8	2.0	**7.2**	1.5	6.8
R12	0.5	5.8	0.5	5.8	0.5	5.8	0.5	5.8
R50	2.3	**7.5**	0.6	5.9	0.8	6.0	0.6	5.9
R51	2.1	**7.4**	0.6	5.9	0.7	6.0	0.6	5.9
Non-sensitive Privately-owned Receptors Currently Under Agreements								
R15	1.3	6.6	1.4	6.7	2.4	**7.7**		
R16	0.8	6.1	0.5	5.8	0.7	6.0	0.9	6.2



WHC-24-101_EA Amendment SR AQ_211A

LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

24-hour Average $PM_{2.5}$
- 6.5 $\mu g/m^3$
- Exceedance Cumulative (7 $\mu g/m^3$)

Criteria: 7 $\mu g/m^3$

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Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); RWDI (2026); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Predicted Annual Average Ground-level $PM_{2.5}$ concentrations ($\mu g/m^3$)

Figure 7-5

7.4 Dust Deposition

Predicted 30-day average dust deposition are compared with the DETSI guideline 30-day average dust deposition criterion in Table 7-6 for the four scenarios. Contour plots of the predicted 30-day average dust deposition over the whole modelling domain are displayed in Figure 7-6. Mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

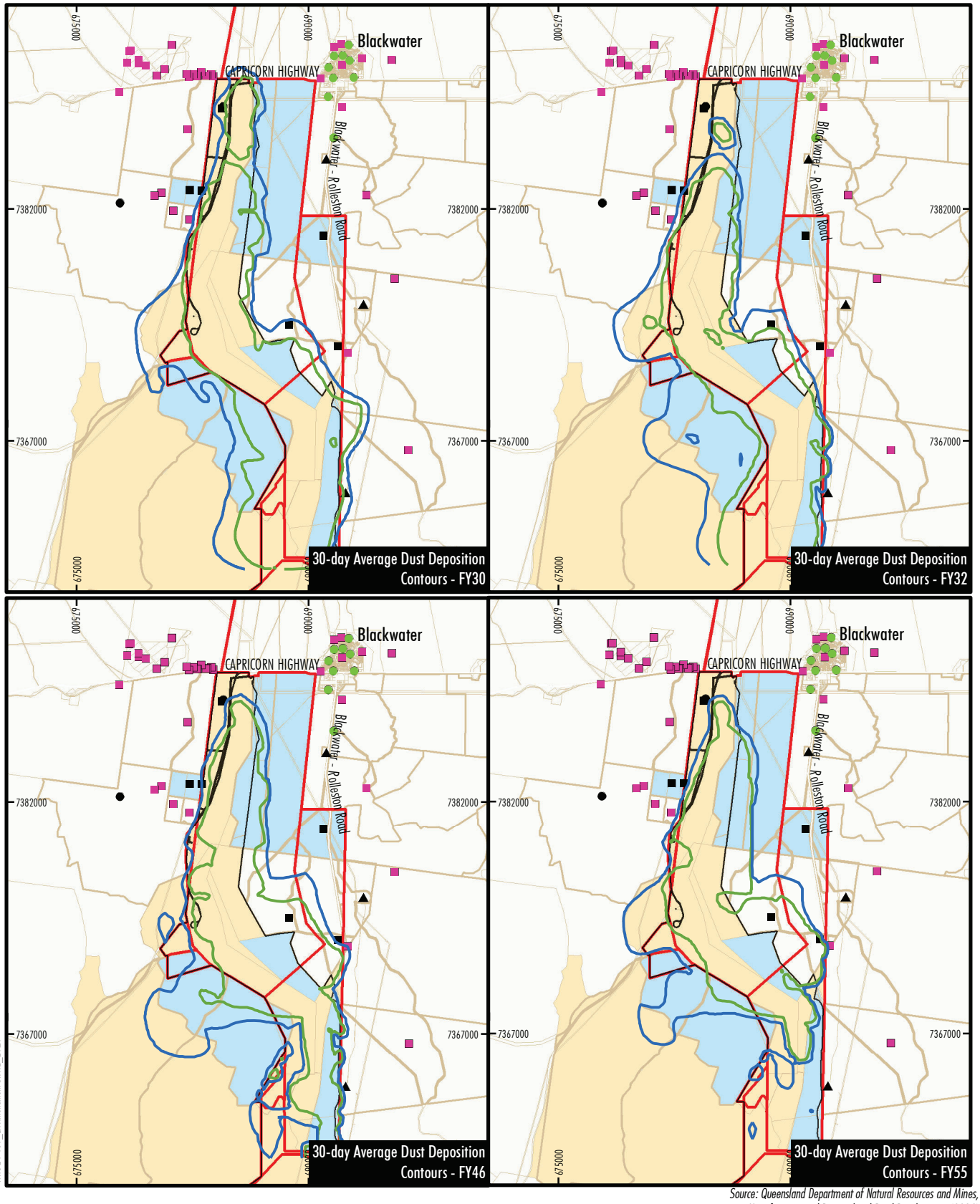
There are no predicted exceedances of the DETSI guideline criterion at any of the sensitive receptors for any of the scenarios. One (1) non-sensitive privately-owned receptor currently under agreements (R15) is predicted to exceed the criterion in FY46 (when the eastward progression of the active pit will have nearly reached R15 by then).

Table 7-6 Predicted 30-day Average Dust Deposition (mg/m²/day)

30-day Average Dust Deposition								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
DETSI Guideline Criterion	120	120	120	120	120	120	120	120
Privately-owned Sensitive Receptors								
R03	15.3	57.3	15.7	57.7	17.6	59.6	13.1	55.1
R04	13.6	55.6	14.3	56.3	16.8	58.8	12.4	54.4
R05	40.6	82.6	40.2	82.2	30.2	72.2	33.6	75.6
R06	22.6	64.6	22.7	64.7	24.7	66.7	21.5	63.5
R07	22.9	64.9	18.9	60.9	17.8	59.8	14.8	56.8
R09	8.7	50.7	10.3	52.3	11.3	53.3	10.2	52.2
R10	4.0	46.0	5.0	47.0	5.1	47.1	4.7	46.7
R11	10.3	52.3	12.2	54.2	11.9	53.9	10.2	52.2
R13	6.6	48.6	6.7	48.7	6.1	48.1	5.3	47.3
R17	33.5	75.5	22.3	64.3	45.6	87.6	35.8	77.8
R19	6.4	48.4	4.1	46.1	3.3	45.3	2.1	44.1
R20	28.4	70.4	18.4	60.4	27.4	69.4	25.1	67.1
R21	26.6	68.6	17.9	59.9	26.4	68.4	24.3	66.3
R22	26.6	68.6	17.7	59.7	25.5	67.5	23.7	65.7
R23	26.6	68.6	17.5	59.5	25.2	67.2	23.5	65.5
R24	24.0	66.0	16.5	58.5	23.4	65.4	22.1	64.1
R25	25.8	67.8	18.0	60.0	23.4	65.4	22.0	64.0
R26	25.6	67.6	18.2	60.2	23.2	65.2	21.8	63.8
R27	24.6	66.6	18.4	60.4	22.4	64.4	21.1	63.1
R28	23.9	65.9	19.1	61.1	21.5	63.5	20.1	62.1
R29	22.8	64.8	18.7	60.7	20.7	62.7	19.5	61.5

30-day Average Dust Deposition								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
DETSI Guideline Criterion	120	120	120	120	120	120	120	120
R30	17.4	59.4	16.6	58.6	14.9	56.9	14.1	56.1
R31	16.6	58.6	15.8	57.8	13.2	55.2	12.5	54.5
R32	9.9	51.9	8.9	50.9	7.6	49.6	7.0	49.0
R33	12.7	54.7	11.8	53.8	9.7	51.7	9.2	51.2
R34	12.4	54.4	11.6	53.6	9.6	51.6	9.2	51.2
R35	10.8	52.8	10.3	52.3	8.3	50.3	7.8	49.8
R36	10.4	52.4	9.9	51.9	8.1	50.1	7.7	49.7
R37	10.6	52.6	10.0	52.0	8.3	50.3	7.9	49.9
R39	14.9	56.9	13.4	55.4	13.5	55.5	12.9	54.9
R40	13.9	55.9	13.2	55.2	10.8	52.8	10.4	52.4
R41	14.9	56.9	13.4	55.4	13.5	55.5	12.9	54.9
R42	6.5	48.5	6.8	48.8	6.5	48.5	6.7	48.7
R43	9.3	51.3	9.8	51.8	9.3	51.3	9.6	51.6
R52	8.5	50.5	10.1	52.1	11.3	53.3	10.3	52.3
R53	11.4	53.4	13.8	55.8	16.8	58.8	15.6	57.6
R54	12.6	54.6	14.2	56.2	18.0	60.0	16.5	58.5
R55	7.8	49.8	9.9	51.9	11.4	53.4	10.3	52.3
R56	9.3	51.3	10.9	52.9	12.2	54.2	11.3	53.3
Other Sensitive Receptors								
R57	10.4	52.4	12.6	54.6	14.7	56.7	13.6	55.6
R58	10.0	52.0	12.3	54.3	14.7	56.7	13.6	55.6
R59	7.9	49.9	9.5	51.5	10.8	52.8	9.8	51.8
R60	9.9	51.9	12.0	54.0	14.3	56.3	13.1	55.1
R61	13.3	55.3	15.8	57.8	20.0	62.0	18.8	60.8
R62	12.4	54.4	14.9	56.9	18.3	60.3	17.0	59.0
R47	9.4	51.4	10.8	52.8	12.4	54.4	11.8	53.8
R63	10.4	52.4	13.1	55.1	15.4	57.4	14.1	56.1
Non-sensitive Commercial/Industrial Receptors								
R14	16.4	58.4	17.9	59.9	17.2	59.2	16.0	58.0
R46	70.7	112.7	25.3	67.3	20.0	62.0	6.4	48.4
R48	10.8	52.8	12.8	54.8	15.0	57.0	14.5	56.5
R49	8.7	50.7	8.4	50.4	10.7	52.7	9.5	51.5
R64	11.0	53.0	13.0	55.0	15.8	57.8	14.3	56.3

30-day Average Dust Deposition								
	FY30		FY32		FY46		FY55	
	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative	BWM	Cumulative
DETSI Guideline Criterion	120	120	120	120	120	120	120	120
Non-sensitive Mine-owned Receptors								
R01	30.4	72.4	33.4	75.4	34.5	76.5	25.4	67.4
R02	41.2	83.2	46.4	88.4	46.5	88.5	36.8	78.8
R12	15.5	57.5	21.2	63.2	23.0	65.0	22.8	64.8
R50	72.5	114.5	22.8	64.8	34.2	76.2	30.5	72.5
R51	67.3	109.3	22.7	64.7	33.6	75.6	29.8	71.8
Non-sensitive Privately-owned Receptors Currently Under Agreements								
R15	56.5	98.5	66.2	108.2	100.2	**142.2**	-	-
R16	34.3	76.3	22.7	64.7	38.6	80.6	56.8	98.8



WHC-24-101_EA Amendment SR AQ_212A

LEGEND

- Mining Lease
- Road
- Property Boundary
- Approved Disturbance Footprint
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

30-day AverageDust Deposition
- 90 mg/m²/day
- Exceedance Cumulative (120mg/m²/day)

Criteria: 120 mg/m²/day

N

0 5

Kilometres

GDA2020 MGA Zone 55

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); RWDI (2026); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Predicted 30-day Average Dust Deposition (mg/m²/day)

Figure 7-6

7.5 Mitigation Control Measures

7.5.1 Overall Control Measures

Control measures that are currently implemented at the BWM are outlined below. These controls would be continued upon commencement of the Project.

- Planning Controls:
  - construction of bunds (if required) in operational areas;
  - utilising of dust forecasting and assessing meteorological conditions to allow for forward planning;
  - minimising exposed surface areas by only clearing vegetation/disturbing areas required for mining activities;
  - progressive rehabilitations to reduce exposed areas and reduce dust;
  - sufficient provision of sheltered dumping during adverse wind conditions;
  - optimising of base construction materials during road design to reduce the silt content of surface and increase the retention of coarser aggregates; and
  - sufficient water within BWM's site water balance model to undertake dust suppression activities;
- Operational Controls:
  - use of a real-time dust monitoring system to clarify and understand where and what operations need to be modified to reduce dust emissions;
  - implementation of the BWM Dust Trigger Action Response Plan (TARP) in conjunction with the real-time monitoring system;
  - limited speed of heavy machinery and vehicle traffic on haul roads;
  - machinery to operate in less exposed/sensitive areas during adverse meteorological conditions;
  - utilisation of available water trucks to provide dust suppression in required locations including haul roads, light vehicle roads and hardstands;
  - progressive backfilling and rehabilitation of overburden dumps;
  - dust suppression sprays installed on the stacker reclaimer units located at both the CHPP and TCP;
  - dust suppression sprays installed on the ROM hoppers located at both the CHPP and TCP; and
  - trains are sprayed with veneer once loaded and prior to departure at the train loadout.

7.5.2 Receptor-specific Control Measures

There were a few predicted potential exceedances of the 24-hour EPP (Air)/NEPM PM_{10} criteria at privately-owned sensitive receptors (R5, R6, R7, R17, R20 and R21). These can be prevented with a proactive dust management approach, including real-time monitoring and weather forecasting, and mine activity adjustment when warning levels are reached:

- Weather forecasting and real-time weather and dust monitoring can ensure that sustained strong wind episodes trigger a reduced and/or more sheltered overburden handling and dumping activity in the pits upwind of those sensitive receivers, along with enhanced watering of the overburden areas.
- For R5, R6 and R7, sustained strong winds from the south-southeast and clear stable nights with weak south-southeasterly winds will have to be monitored closely during the early Project years when the mining activities have not yet materially progressed eastward.

- For R20 and R21, mitigation of overburden handling and dumping activities in Ramp 8 will have to occur when sustained strong southerly winds are picking up and during quiet clear nights when weak south-easterly winds are blowing directly from the northernmost pit to these residences (potentially during early stage of the Project [e.g. FY30]). The implementation of adaptative management measures when winds are blowing from the east-southeast (90º-150º) during night-time is anticipated to achieve compliance with the air quality objectives at these sensitive receptors.
- For R17, potentially during late stage of the Project (e.g. FY46, FY55), a forecast of westerly winds around sunrise should trigger adaptative management measures in the Stewarton and Deep Creek ramps, especially during clear calm (very stable) nights to achieve compliance with the air quality objectives.

NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining (Katestone Environmental Pty Ltd, 2011) found that proactive and reactive management tools were found to be best practice for reducing emissions of particulate matter from open-cut coal mines. Mining operations in Queensland and NSW have successfully demonstrated that proactive dust management can be effectively implemented to minimise dust emissions and achieve compliance with the air quality objectives.

In the event when monitoring indicates that adaptative management measures are not effective, Whitehaven Blackwater would seek an alternative arrangement (as defined in EA EPML00717813) with the requisite sensitive receptor.

7.6 Summary and Discussion

The air quality modelling assessment found the following:

TSP:

- There are no predicted exceedances of the EPP (Air)/NEPM annual TSP criterion at any of the receptors for any of the scenarios.

PM_{10}:

- Predicted cumulative maximum 24-hour average ground-level PM_{10} concentrations exceed the 24-hour EPP (Air)/NEPM PM_{10} criteria at six (6) non-sensitive mine-owned receptors and privately-owned receptors currently under agreements (R1, R2, R15, R16, R50 and R51) and one (1) non-sensitive industrial receptor (R46). Exceedances were also predicted at six (6) privately-owned sensitive receptors (R5, R6, R7, R17, R20 and R21). The predicted exceedances at the privately-owned sensitive receptors occurred on years when mining activity is planned at the northern margin of the BWM, with the exception of R17 which is located south-east of the Project Area and is affected in later years when the mine progresses eastward.
- Such occurrences can be prevented with a proactive dust management approach, including weather forecasting, real-time monitoring near those residences, and mine activity adjustment when warning levels are reached.

- Predicted cumulative annual average ground-level PM_{10} concentrations exceed the annual EPP (Air)/NEPM PM_{10} criteria at five (5) non-sensitive mine-owned receptors and privately-owned receptors currently under agreements (R1, R2, R15, R50 and R51), and also at one (1) privately-owned sensitive receptor (R5) which is located close to the BWM western boundary west of the main haul road in FY30 and FY32.
- Alternative arrangements as defined in EA EPML00717813 would be sought with R5, R6, R7 and R17.

$PM_{2.5}$:

- There are no predicted exceedances of the EPP (Air) Amendment/NEPM 24-hour $PM_{2.5}$ criteria at any of the sensitive receptors for any of the scenarios. One (1) non-sensitive privately-owned receptor currently under agreements receptor (R15) is predicted to exceed the criteria in FY30 and FY46 due to erosion under strong westerly winds.
- Predicted cumulative annual average ground-level $PM_{2.5}$ concentrations do not exceed the EPP (Air) Amendment/NEPM criteria at any public or private sensitive receptors. Four (4) non-sensitive receptors slightly exceed the criteria (mine-owned receptors R50 and R51 in FY32, and mine-owned receptor R2 and privately-owned receptor currently under agreements R15 in FY46). Background $PM_{2.5}$ accounts for 75% of those exceedances which occurred under particular strong winds causing enhanced erosion.

Dust deposition:

- There are no predicted exceedances of the DETSI guideline criterion at any of the sensitive receptors for any of the scenarios. One (1) non-sensitive privately-owned receptor currently under agreements (R15) is predicted to exceed the criterion in FY46 (when the eastward progression of the active pit will have nearly reached R15 by then).

8 CONCLUSION

This Air Quality Assessment has estimated the potential dust impact of the BWM on its surroundings for the Project. The assessment has been conducted in accordance with regulatory guidelines.

Detailed meteorological and air dispersion modelling was conducted for four representative scenarios based on the planned mining operations (FY30, FY32, FY46 and FY55). Ground-level concentrations of TSP, PM_{10}, $PM_{2.5}$ as well as dust deposition were predicted at sensitive receptors and over the whole Project area and compared with the relevant air quality criteria and guideline. Background air quality concentrations and dust deposition were taken into account in the cumulative impact assessment.

The main findings of the assessment are as follows:

- **TSP:** Predicted cumulative concentrations of TSP *comply* with the relevant air quality objective at all receptors for all scenarios.
- **PM_{10}:** Predicted cumulative concentrations of PM_{10} *comply* with the air quality objectives at most sensitive receptors. Exceedances of the 24-hour PM_{10} objective were predicted at five (5) privately-owned sensitive receptors to the west and north-west of the BWM in the early years of the Project when mining is planned at the northern margin of the BWM, and one (1) privately-owned sensitive receptor to the south-east of the Project which is affected in later years as the mine moves eastward. Such occurrences can be prevented with a proactive dust management approach, including weather forecasting, real-time monitoring near those residences, and mine activity adjustment when warning levels are reached. Predicted cumulative PM_{10} concentrations also exceeded the annual PM_{10} objective at one (1) privately-owned sensitive receptor, which is located close to the main haul road. Alternative arrangements as defined in EA EPML00717813 would be sought with these receptors.
- **$PM_{2.5}$**: Predicted cumulative concentrations of $PM_{2.5}$ *comply* with the relevant air quality objectives at all public and private sensitive receptors for all modelled scenarios.
- **Dust deposition:** Predicted 30-day dust deposition due the planned BWM mining activities *comply* with the relevant air quality guideline at all public and private sensitive receptors for all modelled scenarios.

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10 STATEMENT OF LIMITATIONS

This report entitled Blackwater Mine North Extension – AIR QUALITY ASSESSMENT dated 02 April 2026, was prepared by RWDI Australia Pty Ltd ("RWDI") for Whitehaven Coal Limited and Resource Strategies Pty Ltd ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the Project. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the Project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilise the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

APPENDIX A - Annual ROM & Overburden Production Rates by Pit

Pit	Ramp	ROM (Tonnes)				Total Overburden (Mbcm)			
		FY30	FY32	FY46	FY55	FY30	FY32	FY46	FY55
BON	R08N	912,001				10,194,487			
MIM	R14N			413,134				4,374,422	
	R14S			805,683	773,166			14,750,030	11,148,960
SAG	R16N	812,456	773,079		900,710	13,796,220	12,185,180	8,890,365	15,834,443
	R16S		323,706	805,126	353,562	3,972,775	9,356,625	11,231,633	14,016,190
AIR	R20N			712,156	687,283			4,152,901	9,721,275
	R20S	652,934	1,650,899	763,625	721,496	25,750,811	22,073,767	8,288,201	10,018,956
BES	R30N	573,614	1,069,808	764,600	675,445	20,931,313	25,241,869	9,164,565	12,334,657
	R30S								
	R32								
DPC	R32S			516,964				3,680,965	
	R34S	1,615,323		326,138		21,969,536		7,563,501	
	R38N			1,034,035	1,293,936			15,123,133	23,212,589
	R38S			831,443				13,055,327	
STE	R42N	172,952	1,755,518	1,619,743	1,724,833	6,397,099	22,886,459	26,500,232	30,955,380
	R42S		2,049,311	1,680,967	1,498,547	6,304,000	22,959,411	30,188,054	30,963,436
	R46S	1,550,057	1,334,302	1,100,445		10,955,630	14,275,516	19,986,106	
	R47S	1,404,373	1,307,972			16,058,722	19,066,070		

Pit	Ramp	ROM (Tonnes)				Total Overburden (Mbcm)			
		FY30	FY32	FY46	FY55	FY30	FY32	FY46	FY55
TAN	R48N								
	R52N	832,416	467,955			12,073,275	1,334,636		
	R52S	1,120,270	624,283			20,534,159	17,816,610		
WIL	R54S	866,330	1,239,420	1,366,418		17,296,030	18,487,860	20,930,590	
BLA	R56N	1,263,407	1,080,855			17,982,631	15,336,018		
	R56S	662,490	1,483,601			3,288,901	12,716,368		
	R62S	625,659	423,828			7,329,232	8,130,077		
BAS	R63N			1,011,933	1,909,811			16,661,409	22,323,519
	R63S			988,792	696,074			7,596,383	14,959,971
LAL	R64N				212,815				3,369,008
	R64S			275,860				8,583,491	1,030,940
	R66N								
	R66S				496,130				5,743,427
	R68S			324,001				4,118,042	
TON	R78N	889,505	734,921	190,528	876,327	11,066,987	11,213,219	5,256,108	12,579,692
	R78S	536,115	1,252,998	379,214	944,143	8,984,741	13,373,787	6,604,584	12,165,801
TOS	R80N		21,260	333,962	277,074	574,324	3,720,883	5,316,999	2,880,013
	R80S			302,970	432,849	126,619	4,786,577	4,610,244	10,412,830
MAN	R82N			712,617	581,862		3,256,045	10,259,446	9,204,205
	R82S	359,967	1,406,253	1,579,318	989,687	10,857,061	21,577,226	22,310,819	22,710,284

APPENDIX B - BWM Activity Data

Activity	Units	Value
Mine operations		
Hours of operation	hours	24/7 Except for blasting from 7 am to 6 pm
Overburden density	kg/m³	2.2
Overburden moisture content	%	3.2
Overburden silt content	%	6.9
Coal density	kg/m3	1.51
Coal moisture content	%	4.0
Coal silt content	%	5.0
Pit operations		
Drilling/blasting		
Average holes drilled per blast	Holes per blast	500
Average Blasts per week	Blasts/week	3
Average area per blast	m³	793,977
Dragline Drop height	m	6
Dozers/ Excavators/shovels/loaders	operating hours per year	5462
Grading		
Grader Vehicle speed	km/hr	5
Hours of operation per year	Hours of operation per year	5,851
Number of Graders	Units	13 in FY30, 15 in FY32, FY46 and FY55
Total Haulage		
Speed limit	Km/hr	40
930E -loaded	tonnes	505.6
930E -empty	tonnes	215.3
930E - payload	tonnes	360.5
793F -loaded	tonnes	386
793F -empty	tonnes	159.4
793F - payload	tonnes	226.6
Kress 200C III -loaded	tonnes	368.5
Kress 200C III -empty	tonnes	148.5
Kress 200C III - payload	tonnes	220
Wind		
Mean Wind speed	m/s	3.8
Wind erosion above 5.4m/s	% of time at Blackwater Airport	16

APPENDIX C – Emissions Estimation Methodology

Activity	Emission factors	Source
Pit operations		
Drilling	EF_{TSP} = 0.59 (kg/hole) EF_{PM10} = 0.31 (kg/hole) $EF_{PM2.5}$ = 3% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1 (Blasting)
Blasting	$EF_{TSP} = 0.00022 \times A^{1.5}$ (kg/blast) EF_{PM10} = 52% of TSP $EF_{PM2.5}$ = 3% of TSP where A is area blasted (m^2)	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1
Draglines	$EF_{TSP} = 0.0046 \times (d^{1.1}/M^{0.3})$ $EF_{PM10} = 0.0022 \times (d^{0.7}/M^{0.3})$ $EF_{PM2.5}$ = 1.7% of TSP where d is drop height (m), M is the moisture content (%) and EF is in kg/bcm	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1
Bulldozing coal	$EF_{TSP} = 35.6 \times (S^{1.2})/(M^{1.4}))$ $EF_{PM10} = 6.33 \times (S^{1.5})/(M^{1.4}))$ $EF_{PM2.5}$ = 2.2% of TSP where S is silt content (%), M is moisture content (%) and EF is in (kg/hr/vehicle)	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1
Bulldozing overburden	$EF_{TSP} = 2.6 \times (S^{1.2})/(M^{1.3}))$ $EF_{PM10} = 0.34 \times (S^{1.5})/(M^{1.4}))$ $EF_{PM2.5}$ = 10.5% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2

Activity	Emission factors	Source
	where S is silt content (%), M is moisture content (%) and EF is in (kg/hr/vehicle)	$PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1
Excavator / shovels / loaders on overburden in pit	$EF_{TSP} = 0.74 \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4}$ $EF_{PM10} = 0.35 \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4}$ $EF_{PM2.5} = 0.053 \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4}$ where U is mean wind speed (m/s), M is overburden moisture content (%) and EF is in (kg/t)	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Equation 10, Equation 11
Excavator / shovels / loaders on coal in pit	EF_{TSP} (kg/t) $= 0.580/M^{1.2}$ EF_{PM10} (kg/t) $= 0.0447/M^{0.9}$ $EF_{PM2.5}$ (kg/t) = 2.2% of TSP where M is coal moisture content (%)	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Equation 12, Equation 13 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1 (Bulldozers on coal)
ROM truck unloading near haul road)	EF_{TSP} (kg/t) = 0.01 kg/t EF_{PM10} (kg/t) = 0.0042 kg/t $EF_{PM2.5}$ (kg/t) = 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: Conservative assumption
ROM Loading to Kress trucks near haul road	EF_{TSP} (kg/t) = 0.029 kg/t EF_{PM10} (kg/t) = 0.014 kg/t $EF_{PM2.5}$ (kg/t) = 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: Conservative assumption
OVB truck unloading	EF_{TSP} (kg/t) = 0.012 kg/t EF_{PM10} (kg/t) = 0.0043 kg/t $EF_{PM2.5}$ (kg/t) = 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: Conservative assumption
Processing (CHPP and TCP)		

Activity	Emission factors	Source
Dumping coal at main CHPP/TCP stockpiles and into rotary breaker	TSP: 0.01 kg/t PM_{10}: 0.0042 kg/t $PM_{2.5}$: 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: Conservative assumption
Loading coal to truck at main CHPP/TCP stockpiles	EF_{TSP} (kg/t) = 0.029 kg/t EF_{PM10} (kg/t) = 0.014 kg/t $EF_{PM2.5}$ (kg/t) = 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining, Table 2 $PM_{2.5}$: Conservative assumption
Crushing	EF_{TSP} (kg/t) = 0.0006 kg/t EF_{PM10} (kg/t) = 0.00027 kg/t $EF_{PM2.5}$ (kg/t) = 0.00005 kg/t	TSP, PM_{10}, $PM_{2.5}$: AP 42 Chapter 11.19.2.1 Crushed Stone Processing and Pulverized Mineral Processing Table 11.19.2-1
Screening (CHPP only)	EF_{TSP} (kg/t) = 0.0011 kg/t EF_{PM10} (kg/t) = 0.00037 kg/t $EF_{PM2.5}$ (kg/t) = 0.000025 kg/t	TSP, PM_{10}, $PM_{2.5}$: AP 42 Chapter 11.19.2.1 Crushed Stone Processing and Pulverized Mineral Processing Table 11.19.2-1
Conveyors Wind erosion	EF_{TSP} (g/m/s) = 0.031 x 0.2 x (0.00006 x U^2 + -0.0002 x U + 0.0001)/(0.00006 x $Uref^2$ + -0.0002 U*ref* + 0.0001) EF_{PM10} (g/m/s) = 47% of TSP $EF_{PM2.5}$ (g/m/s) = 7% of TSP where U is avg wind speed (m/s), Uref=10 m/s, a = 0.00006, b = -0.0002; c= 0.0001, and total emissions are dependent on conveyor length	TSP, PM_{10}, $PM_{2.5}$: referencing Dawson Air Quality Assessment (Katestone 2024)
Conveyors Transfer points	EF_{TSP} (kg/t) = 0.74*0.0016* $(U/2.2)^{1.3}$ / $(M/2)^{1.4}$ EF_{PM10} (kg/t) = 0.35*0.0016* $(U/2.2)^{1.3}$ / $(M/2)^{1.4}$ $EF_{PM2.5}$ (kg/t) = 7 % of TSP where U is avg wind speed (m/s), M is moisture content (%)	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining Table 2 $PM_{2.5}$: Conservative assumption

Activity	Emission factors	Source
Loading to Train	TSP: 0.0004 kg/t PM_{10}: 0.00017 kg/t $PM_{2.5}$: 7% of TSP	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining Table 2 $PM_{2.5}$: Conservative assumption
Haul Roads		
Grading	TSP = 0.0034 * S2.5 (kg/VKT) PM_{10} = 0.0034 * S2.0 (kg/VKT) $PM_{2.5}$ = 3.1 % of TSP where S is average grader speed in km/h	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining Table 2 $PM_{2.5}$: AP 42 Chapter 11.9 Western Surface Coal Mining Table 11.9-1
Haulage	TSP = $0.4536/1.6093 * 4.9 * (S/12)^{0.7} * (W/3)^{0.45}$ $PM_{10} = 0.4536/1.6093 * 1.5 * (S/12)^{0.9} * (W/3)^{0.45}$ $PM_{2.5}$ = 10% of PM_{10} with EF in kg/VKT	TSP, PM_{10}: NPI Emissions Estimation Technique Manual for Mining Table 2 $PM_{2.5}$: Conservative assumption
Wind Erosion (ROM stockpiles and Active Exposed Surfaces (active pit, active overburden areas, partially rehabilitated areas and stripped areas)		
Wind erosion	TSP = 850 kg/ha/yr PM_{10} = 50% of TSP $PM_{2.5}$ = 7.5 % of TSP with wind speed dependent hourly emission rates (cubic formula by Shao and wind speed threshold of 5.4 m/s)	AP-42 Chapter11.9 Western Surface Coal mining and Chapter 13.2.5 Industrial Wind Erosion

Whitehaven

Blackwater North Extension Project

Appendix G
Greenhouse Gas Management and Abatement Plan



Executive Summary

Overview

The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (QLD).

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML 1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (approximately) of run-of-mine (ROM) coal;
- continued extraction of up to 19 million tonnes per annum of ROM coal;
- continued use of existing BWM infrastructure (e.g. coal handling and preparation plant, thermal coal plant, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

This Greenhouse Gas Management and Abatement Plan (GMAP) has been prepared by Whitehaven Blackwater to detail predicted greenhouse gas emissions at BWM for the proposed Project, as well as greenhouse gas management and abatement measures proposed for the Project. The GMAP considers both Scope 1 and 2 emissions.

Emissions Context

Fugitive emissions in this GMAP have been estimated on the *National Greenhouse and Energy Reporting Act 2007* (NGER) Method 1 basis, as site specific fugitive gas emission estimates and supporting documentation for NGER Method 2 approach (which involves collation of site-specific gas data) are not yet available.

RWDI Australia Pty Ltd (RWDI) (2026) undertook greenhouse gas calculations in accordance with the *Greenhouse Gas Emissions Guideline – Version 1.02 – ESR/2024/6819* (Queensland Department of the Environment, Tourism, Science and Innovation, 2026). The Project would produce an average 0.27 million tonnes of carbon dioxide equivalent per year (Mt CO_2-e per year) of Scope 1 emissions. Along with an average of 0.004 and 7.91 Mt CO_2-e per year of Scope 2 and 3 emissions, respectively.

The approved facility specific Emissions Intensity Determination (EID) for BWM is 0.0527 tonnes of carbon dioxide equivalent per tonne of ROM coal (CER, 2025b). This ranks the BWM as having the 29th lowest emissions intensity among approximately 68 Australian coal mining facilities with published EIDs. Further, the emissions intensity at BWM is lower than the industry default value of 0.0653 t CO_2-e / t ROM, as specified under the Safeguard Rule.

Scope 1 emissions at the BWM (including the Project) are predicted to constitute 47.19 percent (%) fugitive emissions and 49.33% is predicted to be stationary diesel; the other approximately 3.48% of emissions originating from vegetation clearing, explosives and other Scope 1 sources.

Consistent with Whitehaven's adopted greenhouse gas policy, the adopted net emission goals for the Project are reflective of predicted Project net emission reduction targets under the Commonwealth Safeguard Mechanism. The BWM's Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations.

Notwithstanding possible variation to the baseline value, it is anticipated that Whitehaven's implementation of various mitigation measures to minimise the overall generation of greenhouse gas emissions from the Project would result in greenhouse gas emissions being maintained within any varied Safeguard Mechanism baseline emissions value.

Three-Year Plan

Whitehaven would implement adaptive management of greenhouse gas emissions over the life of the BWM, consistent with Australia's emissions reduction requirements as set out under the Safeguard Mechanism.

As part of detailed engineering design and feasibility assessment further quantitative evaluations would be conducted. Such analysis would be undertaken post-approval, and as such a Three-Year Action Plan has been developed to guide these decisions and would be subject to regular reviews, based on the technological, economic, regulatory and Project context at the time.

The Three-Year Action Plan has been developed to align with the current stage of the Project (i.e. environmental approvals) and the information that is presently available for the BWM. The Three-Year Action Plan would be revisited during the course of the Project as the regulatory, operational, technological and commercial context evolves.

The Three-Year Action Plan focuses on activities that increase site-specific information, including targeted trials, and feasibility assessments that enable Whitehaven to identify measures that are reasonable and feasible.

SCOPE 1 – METHANE GAS CAPTURE AND ABATEMENT

Table ES-1 sets out the three-year work program for fugitive emissions management for the Project. Fugitive emissions are a material Scope 1 source at the BWM, but site-specific characterisation and feasibility work for BWM remains at an early stage and would be progressively refined in future GMAP revisions.

Accordingly, the actions in Table ES-1 prioritise establishing a baseline and assess whether gas drainage, capture and abatement options (for example surface-to-inseam drilling and methane flaring or utilisation pathways) are reasonable and feasible for the Project's operational context.

Technology adoption timing and engineering solutions are subject to further feasibility assessment, technology maturation and operational planning considerations.

Table ES-1
Three-Year Action Plan – Fugitive Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Transition to NGER Method 2 Fugitive Emissions Basis	Transition of the BWM fugitive emissions estimates to a NGER Method 2 basis (as updated modelling inputs and supporting documentation become available).	Incorporate fugitive emissions forecasting outputs into the Project fugitive emissions methodology and assumptions.	N/A	Transitioning the Project's fugitive emissions estimates to an NGER Method 2 basis would enhance the accuracy of fugitive emissions estimation. This higher resolution would support more detailed feasibility assessments. In addition, Method 2 will provide a basis to account for gas capture and abatement.
Methane Pre-Drainage Capture and Abatement	Undertake a concept assessment of methane pre-drainage capture and abatement opportunities within the 5-year mine plan, informed by available gas reservoir data and development of the Method 2 gas model. Develop forward work plan for methane gas capture, including field validation if appropriate.	Progress shortlisted concepts through technical and economic feasibility assessment informed by updated gas reservoir information and Method 2 fugitive emissions estimates as appropriate.	Where feasibility assessment supports and recommends progression, arrange a pilot trial program (subject to regulatory requirements) to validate feasibility assumptions or fill data gaps for methane capture and abatement options.	Methane capture and abatement opportunities at BWM are highly site specific and dependent on gas reservoir characteristics, mine sequencing, and operational factors. Subject to outcomes of the concept assessment, feasibility assessment and pilot trial, integrate preferred methane pre-drainage into the next Three-Year Action Plan, considering the mine plan progress and appropriate regulatory approval pathways for development. The staged assessment approach provides a progression from gas modelling to concept development and feasibility screening with emerging industry practice in the Bowen Basin.

^ Year 1 is indicatively financial year 2027

SCOPE 1 – DIESEL COMBUSTION

Table ES-2 sets out the three-year work program in relation to the Project's diesel emissions, recognising diesel combustion is a major contributor to the Project's Scope 1 emissions profile and is strongly influenced by haulage requirements and operational practices (e.g. use of draglines instead of diesel haul trucks). The actions in Table ES-2 aim to build operational understanding, including evaluation of near-term fuel substitution options where practicable and assessment of market available hybrid and battery electric alternatives as part of replacement decisions within the equipment procurement cycle.

Table ES-2
Three-Year Action Plan – Diesel Combustion Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Biodiesel/Renewable Diesel	Conduct cost and efficiency review of potential diesel fuel alternatives and review transferability of Maules Creek Coal Mine trial outcomes to the BWM.	Undertake site specific applicability assessment for biodiesel and renewable diesel at the BWM, including fleet compatibility, fuel quality requirements, storage and handling constraints.	Review potential feasibility including the marginal abatement cost of partial implementation.	Moderate trial opportunity, low-risk implementation and potential to modestly reduce diesel fuel emissions.
Hybrid Diesel Equipment	Consult with original equipment manufacturers (OEMs) on the availability and practicability of hybrid diesel equipment alternatives for haul trucks, dozers and loaders, including capital, operating and fuel consumption data	Conduct a procurement evaluation of currently available hybrid diesel equipment vs conventional diesel equipment based on life-of-plant financial and productivity analysis.	Determine potential feasibility of adoption of hybrid equipment in consideration of the BWM replacement schedule. Undertake a review of the readiness of large mining battery electric vehicles and associated infrastructure, to inform future emission reduction plans.	Hybrid diesel/electric equipment has potential to materially reduce diesel combustion emissions.
Tethered Equipment Study	Consult with OEMs on the availability and practicability of electrical tethered equipment as a replacement for existing diesel powered equipment, including capital, operating and electricity consumption data.	Considering the previous consultation, identify the tethered equipment that may be suitable for use at the Project and evaluate the applicable site electrical supply and distribution requirements and any key constraints to adoption.	Determine potential feasibility of adoption of previously identified tethered equipment in consideration of any site constraints and procurement requirements.	The use of electrical equipment would reduce Scope 1 emissions through the displacement of diesel and other direct fuel combustion sources.

^ Year 1 is indicatively financial year 2027

SCOPE 2 – ELECTRICITY FROM MAIN GRID

Table ES-3 sets out the three-year work program for Scope 2 emissions management. The actions in Table ES-3 prioritise improved understanding of electricity demand and efficiency opportunities, alongside a staged review of practicable renewable electricity contracts consistent with broader corporate considerations.

Table ES-3
Three-Year Action Plan – Scope 2 Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Site Electricity Supply – offset Scope 2 emissions	Assess available options and consult with existing suppliers (e.g. GreenPower is currently used for Whitehaven's NSW operations) or alternative renewable electricity providers regarding opportunities to offset Scope 2 emissions at the BWM.	Determine whether it would be reasonable and feasible to offset Scope 2 emissions associated with the site electricity supply (agreement extension or alternative supplier).	Implement extended or new site electricity supply agreement (if applicable).	As the electricity grid is progressively decarbonised, Scope 2 emissions would correspondingly fall.

^ Year 1 is indicatively financial year 2027

Potential Impacts of GHG Emissions on Environmental Values

In Australia, the climate is generally projected to become warmer and drier. Climate change may result in changes to rainfall patterns, run off patterns and river flow.

The Project's contribution to Australian emissions would be relatively small, as estimated annual average Scope 1 and 2 emissions would represent:

- approximately 0.09% and 0.41% in 2030 and 2035 respectively of the estimated total greenhouse gas emissions in QLD from (133 and 48 Mt CO_2-e in 2030 and 2035 respectively); and
- approximately 0.03% and 0.11% of Australia's projected greenhouse gas emissions in 2030 and 2035 respectively (349 and 184 Mt $CO_{2\text{-}e}$ in 2030 and 2035 respectively).

If the Project is approved and proceeds, the Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the Project (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) have together been estimated at approximately 0.28 Mt CO_2-e per year during operations. These emissions would be small in the context of global greenhouse gas emissions.

However, based on a conservative approach that assumes that the Project's emissions are wholly additive, the Project's total emissions equate to an incremental global temperature influence measured at the scale of millionths (Scope 1 and 2) or ten-thousandths of a degree Celsius (°C) (Scope 1, 2 and 3), as follows:

- total Scope 1 and 2 Emissions - Global Surface Temperature Change 0.000008356°C (8.4 millionths of a °C); and
- total Scope 1, 2 and 3 Emissions - Global Surface Temperature Change 0.0002469°C (0.25 thousandths of a °C).

Given the above, the project's incremental contribution to temperature change would be sufficiently minor that no additional impacts on the environmental values would arise.

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1 Introduction

1.1 Purpose of this Document

This Greenhouse Gas Management and Abatement Plan (GMAP) has been prepared by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater) to detail predicted greenhouse gas emissions at Blackwater Mine (BWM) for the proposed Blackwater North Extension Project (the Project), as well as greenhouse gas management and abatement measures proposed for the Project. The GMAP considers both Scope 1 and 2 emissions.

It is noted that this GMAP does not estimate the actual or potential greenhouse gas emission reductions arising from the potential adoption of any identified emission abatement opportunity. Rather, this GMAP is a review of currently available and emerging advanced technologies, to inform Whitehaven Blackwater's identification of reasonable and feasible greenhouse gas emission controls that could potentially be adopted over the life of the Project. Whitehaven Blackwater would revisit these potential emission abatement opportunities prior to the commencement of and during the course of the Project.

1.2 Project Overview

1.2.1 BLACKWATER MINE

The BWM is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland (QLD) (Figure 1).

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the Queensland *Environmental Protection Act 1994* (EP Act).

The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage.

Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

1.2.2 PROJECT SUMMARY

Whitehaven Blackwater proposes to develop the Project, which would extend the current open cut mining development at the BWM, within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759 (Figures 1 and 2). The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML 1762 and SA 10 on ML 1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 million tonnes per annum (Mtpa) of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;



WHC.24-101_EA Amendment SR GHG_201A

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Geoscience Australia (2018)

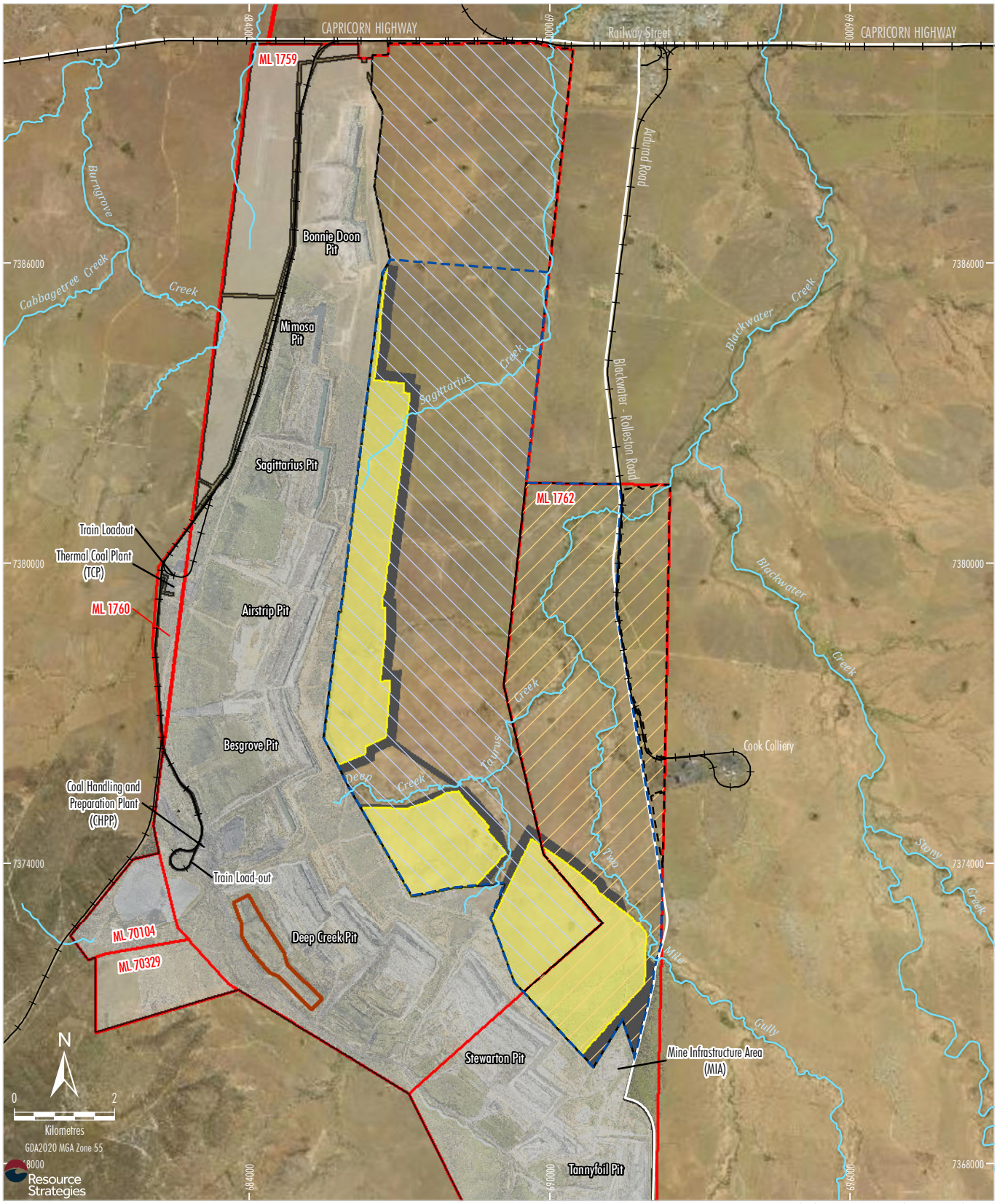
LEGEND
- Road
- Railway
- Coal Terminal
- Blackwater North Extension Project

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BLACKWATER NORTH EXTENSION PROJECT

Regional Location

Figure 1



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Approved Disturbance Footprint
- SA 7
- SA 10

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential Semi Permanent Tailings Cell

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Project General Arrangement

Figure 2

- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

1.3 Limitations

This GMAP has been prepared based on the information that is currently available to Whitehaven Blackwater and its associated technical advisors at the date of publication with respect to both the Project description, available emissions reduction technology and fugitive emission estimates.

Emission reduction opportunities described in this GMAP are reflective of current understanding of key abatement technologies and techniques. Where available, Whitehaven Blackwater has also made reference to international, national and state information sources of particular relevance to emission abatement opportunities of relevance to the sector.

Fugitive emissions in this GMAP have been estimated on the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) Method 1 basis (i.e. default method), as site specific fugitive gas emission estimates and supporting documentation for National Greenhouse and Energy Reporting (NGER) Method 2 approach (which involves collation of site specific gas data) are not yet available. Specialist modelling is progressing and once the Method 2 model is complete , the GMAP would be updated. Until then, this GMAP and associated decarbonisation study on fugitive mitigation measures have been undertaken on that same Method 1 basis.

Detailed engineering design form part of the ongoing adaptive management of greenhouse gas emissions over the life of the mine, consistent with the mine's emissions reduction requirements as set out under the Safeguard Mechanism (Commonwealth Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2025a), and to meet any applicable approval conditions.

Given the Project is subject to approvals and the timeframe between obtaining them and on-ground commencement, it is difficult to predict potential changes in abatement technology, cost/economic context, and the Project regulatory environment (e.g. Safeguard requirements) that may arise.

Further analysis would be undertaken in subsequent revisions of the GMAP, based on the technological, economic and regulatory context at the time of each quantitative review over the life of the Project. This would allow Whitehaven Blackwater to consider the technological, economic and regulatory context at the time of each quantitative review and hence adopt reasonable and feasible emission reduction opportunities that are available at that juncture of the Project's life.

1.4 Current Versions

This is the first version of the GMAP. This version of the GMAP also includes preliminary consideration of potential greenhouse gas emissions abatement opportunities. This section would be updated as part of future revisions.

1.5 Previous Version

This is the first version of the GMAP.

1.6 Applicant Details

The BWM is a joint venture between Whitehaven Coal Limited (Whitehaven) (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater, a wholly owned subsidiary of Whitehaven, is the operator of the BWM.

The contact details for the proponent are:

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1.7 Structure of this Document

This GMAP consists of the following sections:

Section 1: Introduction

Section 2: Key Guidance Framework

Section 3: Greenhouse Gas Emissions Context

Section 4: Reasonable and Feasible Greenhouse Gas Evaluation

Section 5: Three-Year Action Plan

Section 6: Monitoring, Reporting and Review

Section 7: Potential Impacts of Greenhouse Gas Emissions on Environmental Values

Section 8: Conclusion

Appendix A: Summary of Existing and Emerging Scope 1 and 2 Mitigation Measures at Surface Mines

Appendix B: Greenhouse Gas Calculations Report

Appendix C: Loop Decarbonisation Services Peer Review

2 Key Guidance Material

2.1 Global

The international framework addressing greenhouse gas emissions, and the global response to climate change, commenced with adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

The UNFCCC has close to global membership, with 198 Parties (UNFCCC, 2024a). While a number of negotiating sessions are held each year, the largest is the annual Conference of the Parties (UNFCCC, 2024a). Two of the most important progressions of the UNFCCC were at the third Conference of the Parties (in 1997) and the 21st Conference of the Parties (in 2015), with the adoption of the *Kyoto Protocol* and the *Paris Agreement*, respectively.

The *Kyoto Protocol* entered into force in 2005 and imposed limits on the greenhouse gas emissions of developed countries listed in Annex 1 to the UNFCCC, with an initial commitment period of 2008 to 2012 (UNFCCC, 2024b). The second commitment period of the *Kyoto Protocol*, which ended in 2020, was also its final one.

The goal of the *Paris Agreement* is to limit global temperature increases to well below 2 degrees Celsius (°C) above preindustrial levels (UNFCCC, 2024c). In order to achieve that goal, Parties aim to reach peak global emissions as soon as possible, "so as to achieve a balance between anthropogenic emissions by sources and removals by sinks in the second half of this century" (UNFCCC, 2024d).

The Paris Agreement does not specify how global emission reductions are to be achieved. It requires Parties to prepare, communicate and maintain nationally determined contributions (NDCs) and to pursue domestic measures to achieve them (UNFCCC, 2024d; UNFCCC, 2024e). The NDCs are to be communicated every five years, with each successive NDC to represent a progression beyond the previous NDC. A second round of NDCs was due to be submitted in 2025 and a further round is due in 2030 (UNFCCC, 2024e).

Scope 1 greenhouse gas emissions from Project, as well as any Scope 2 and 3 emissions related to the Project that would be emitted in Australia, would be accounted for and managed in accordance with Australia's domestic law adopted to implement Australia's NDC. Greenhouse gas emissions produced in the end-use, overseas jurisdictions would be accounted for and managed in accordance with the laws that have been adopted in those jurisdictions to implement their NDCs.

At the 24th Conference of the Parties to the UNFCCC (in 2018), the *Katowice Climate Package* was agreed. The *Katowice Climate Package* contains, among other things, detailed guidance on the features of NDCs and the information each country should provide to improve transparency regarding NDCs, as well as highlighting the need to ensure that double counting of greenhouse gas emissions is avoided (UNFCCC, 2024e).

At the 26th Conference of Parties (held in 2021), the *Glasgow Climate Pact* was reached. The *Glasgow Climate Pact* reaffirms the long-term global goal to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The agreement also invites Parties to consider further actions to reduce non-carbon dioxide (CO_2) greenhouse gas emissions, including methane (CH_4), by 2030 (UNFCCC, 2024a).

A country can be assisted to meet the emission targets provided for in its NDC by utilising the international trading (or crediting) mechanisms established by Article 6 of the *Paris Agreement*. The effect of Article 6 is that a country that overachieves against its NDC targets can gain greenhouse gas emission credits to sell to other countries, and, conversely, if it falls short, it can purchase international credits approved under the *Paris Agreement* to meet its NDC target.

2.2 Commonwealth – Australian Government

Australia's draft initial NDC in advance of the Paris Agreement communicated a greenhouse gas emission reduction target of 26 to 28% below 2005 levels by 2030 (Commonwealth Department of Industry and Science, 2015).

In 2022 the Commonwealth *Climate Change Act 2022* (Climate Act) was introduced to outline Australia's greenhouse gas emissions reduction targets. Section 10(1) of the Climate Act states:

> *(1) Australia's greenhouse gas emissions reduction targets are as follows:*
>
> *(a) reducing Australia's net greenhouse gas emissions to 43% below 2005 levels by 2030:*
>
> *…*
>
> *(b) reducing Australia's net greenhouse gas emissions to zero by 2050.*

Section 3 of the Climate Act defines the objects of the Act:

> *(aa) to advance an effective and progressive response to the urgent threat of climate change drawing on the best available scientific knowledge; and*
>
> *(a) to set out Australia's greenhouse gas emissions reduction targets which contribute to the global goals of:*
>
> *(i) holding the increase in the global average temperature to well below 2°C above pre-industrial levels; and*
>
> *(ii) pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels; and*
>
> *(b) to promote accountability and ambition by requiring the Minister to:*
>
> *(i) prepare annual climate change statements; and*
>
> *(ii) cause copies of those statements to be tabled in each House of the Parliament; and*
>
> *(c) to ensure that independent advice from the Climate Change Authority informs:*
>
> *(i) the preparation of annual climate change statements; and*
>
> *(ii) the greenhouse gas emissions reduction targets to be included in a new or adjusted nationally determined contribution.*

The Climate Act does not impose specific requirements on Whitehaven Blackwater to implement measures to reduce, avoid and monitor greenhouse gas emissions. Nevertheless, the Climate Act is considered and addressed in this GMAP.

Australia's first NDC under the *Paris Agreement* was amended to commit to further reductions in emissions to achieve the national greenhouse gas target of 43% below 2005 levels by 2030 and reaffirmed the target to achieve net zero emissions by 2050 (Commonwealth Department of Industry, Science, Energy and Resources, 2022).

Australia's second NDC under the *Paris Agreement* has communicated a greenhouse gas emissions reduction target of 62 to 70% below 2005 levels by 2035. The Australian Government identified the following five priorities in achieving net zero by 2050 (Commonwealth DCCEEW, 2025b):

- clean electricity across the economy;
- lowering emissions through electrification and efficiency;
- expanding clean fuel use;
- accelerating new technologies; and
- net carbon removals.

2.2.1 ASSESSMENT

National Greenhouse Account Factors

Australia's National Greenhouse Accounts (NGAs) are prepared by the Commonwealth DCCEEW. The Commonwealth DCCEEW publishes the greenhouse gas emission factors used in preparing the NGAs. The *National Greenhouse Accounts Factors: 2025* (Commonwealth DCCEEW, 2025c) is the latest such publication and has been used to calculate the Project emission projections (Appendix B).

2.2.2 REPORTING

National Greenhouse and Energy Reporting Scheme

The Commonwealth NGER Act is a national framework for reporting greenhouse gas emissions, energy production and energy consumption by corporations. The greenhouse gas emissions and energy data reported under the NGER Act is used by the Commonwealth Government in compiling Australia's national greenhouse gas emission inventory to meet its reporting obligations under the UNFCCC.

Under the NGER Act, corporations that have operational control of facilities must report their greenhouse gas emissions and energy data if they meet the thresholds for reporting. The thresholds are:

a) emitting 25,000 tonnes of carbon dioxide equivalent (t CO_2-e) of greenhouse gas emissions or producing or consuming 100 terajoules (TJ) of energy (for an individual facility); or

b) emitting 50,000 t CO_2-e of greenhouse gas emissions or producing or consuming 200 TJ of energy (cumulatively for all facilities under the operational control of the corporation).

Reporting requirements of the NGER Act include both Scope 1 and Scope 2 emissions. To avoid the double counting of emissions per the UNFCCC rules, the NGER Act does not cover Scope 3 emissions.

Whitehaven Blackwater currently reports all energy production and consumption and greenhouse gas emissions (Scope 1 and Scope 2) from its activities under the NGER Act. Whitehaven Blackwater would continue to comply with its obligations under the NGER Act, including reporting any emissions and energy production and consumption from the Project.

2.2.3 MITIGATION

A range of legislation and policies, including the Safeguard Mechanism (which has legislative effect via the NGER Act), the Renewable Energy Target and the *National Energy Productivity Plan* have been implemented to help Australia meet its greenhouse gas commitments.

In October 2021, the previous Australian Government published *Australia's Long Term Emissions Reduction Plan* (Commonwealth Department of Industry, Science, Energy and Resources, 2021) (the Plan), which includes a range of policy initiatives to deliver net zero greenhouse gas emissions by 2050. The Plan is focused on reducing the cost of low emissions technologies whilst increasing their availability nationwide. As explained below, the current Australian Government has developed a Net Zero Plan that sets out the five decarbonisation priorities and the required enabling actions by Government and other actors.

The NGER Act introduced a single national reporting framework for the reporting and dissemination of corporations' greenhouse gas emissions and energy use.

The Safeguard Mechanism (underpinned by the Commonwealth *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* [Safeguard Rule]) was established through the NGER Act and provides baseline emissions and offset requirements for applicable facilities that emit over 100,000 tonnes of carbon dioxide equivalent per year (t CO_2-e per year) of covered Scope 1 emissions, which currently includes the existing BWM and would extend to include the Project, should it be approved.

The Safeguard Mechanism sets a baseline level of emissions for facilities. If a facility exceeds its baseline level, it is required to surrender to the Clean Energy Regulator (CER) Australian Carbon Credit Units (ACCUs) (or following recent reforms, Safeguard Mechanism credit units [SMCs]) equivalent to the exceedance.

In 2023, the Commonwealth Government introduced reforms to facilitate greater abatement and offset requirements for Safeguard Mechanism facilities (discussed further below).

Reformed Safeguard Mechanism

The Safeguard Mechanism Reforms (Commonwealth DCCEEW, 2024) introduced an amendment to the NGER Act and other legislation (i.e. the Climate Act) to establish the framework to give effect to key elements of the reforms, such as introducing a requirement for facilities to achieve greenhouse abatement via annual downward adjustment of baseline levels.

There are three main types of Safeguard facility baselines:

- standard (which applies to the BWM facility);
- landfill; and
- sectoral (i.e. electricity generators).

Standard baselines are determined based on the amount of product each facility produces in a financial year (FY).

The reforms apply a decline rate to a facility's baseline so that baselines are reduced predictably and progressively over time (initially 4.9% per annum until the end of FY 2030) on a proportionate trajectory consistent with achieving Australia's emission reduction targets of 43% below 2005 levels by 2030, and net zero by 2050 (Commonwealth DCCEEW, 2024) in combination with other greenhouse gas reduction measures in the economy.

At the end of each year, BWM's baseline would therefore be calculated via its:

- production quantities;
- the emissions-intensity values for each product it produces; and
- the decline rate.

It is noted that the target of 43% reduction by 2030 is tied to 2005 emission levels. Table 1 below summarises the Safeguard Mechanism baseline decline rate which has been calculated with sufficient headroom allowance for higher than expected growth at new and existing Safeguard facilities (Commonwealth DCCEEW, 2024).

Table 1
Safeguard Baseline Decline Rate

Financial Year	Baseline Decline Rate (%)	Emission Reduction Contribution (%)
2023-24	4.9	95.1
2024-25	4.9	90.2
2025-26	4.9	85.3
2026-27	4.9	80.4
2027-28	4.9	75.5
2028-29	4.9	70.6
2029-30	4.9	65.7
2030-ongoing	3.285*	-

Source: (CER, 2025a).
* The decline rate indicated in the above table for 2030 onwards is indicative. From 2030, decline rates would be set in 5-year blocks to be consistent with NDC also released in 5-year intervals by the Commonwealth DCCEEW. Accordingly, post-2030 decline rates are expected to vary depending on the future emissions reduction targets adopted by the Australian Government.

From 2030 onwards, Safeguard Mechanism decline rates will be set in five year blocks to align with Australia's NDCs. The Safeguard Mechanism is subject to periodic statutory review, including a scheduled review in FY2027, through which post 2030 decline rates may be amended. As BWM's emissions baseline is directly tethered to the applicable decline rate, any future tightening adopted through these review processes would translate to lower facility baselines and progressively lower net emissions outcomes over time.

Schedule 1 of the Safeguard Rule defines a range of products produced at Safeguard facilities. For each product, Schedule 1 sets out one or more metrics (each of which is a production variable), the units relevant to those production variables and the circumstances in which they are applicable to the particular Safeguard facility. This includes the assignment of a default emission intensity for each production variable. A facility's baseline is therefore adjusted annually based on actual site production metrics.

The predominant production variable for BWM (and the Project) is production of ROM coal. A second production variable (Mine Rehabilitation) does not yet apply to BWM, as it only applies to final rehabilitation activities. The Mine Rehabilitation production variable may apply at the cessation of mining.

While it is acknowledged that the Mine Rehabilitation production variable would begin to apply in the latter stages of BWM's life (i.e. after ROM coal production ceases), the vast majority of Scope 1 emissions from the site would arise from the ROM coal production variable. On this basis, no specific comparison has been made in this Greenhouse Gas Assessment to the Mine Rehabilitation production variable decline rate.

Because of the high diversity of existing emission intensities in the coal sector, a hybrid approach was adopted for existing coal mines. In this case, the ROM Coal Safeguard emissions intensity is calculated by progressively decreasing the proportion of site-specific emissions intensity, which has the effect of achieving a 50% application of the default ROM coal production variable by FY30.

Pursuant to transitional arrangements under the Safeguard Rule, the default ROM coal production variable has been set at 0.0653 tonnes of carbon dioxide equivalent per tonne of run-of-mine coal (t CO_2-e / t ROM coal).

In accordance with Subdivision C of the Safeguard Rule, an emitter may apply to the CER for an emissions intensity determination (EID). Whitehaven Blackwater has an approved EID for the BWM, which was originally developed when fugitive emissions were reported using Method 1 (0.0527 t CO_2-e per tonne of ROM). Whitehaven Blackwater is now transitioning to a higher-order NGER Act reporting method for fugitive emissions (Method 2). The GMAP would be updated to reflect any future EID updates.

Sector Pathways

In the *Sector Pathways Review*, the Commonwealth CCA examined potential technology transition and emissions pathways in six key emission sectors to support Australia's transition to net zero emissions by 2050 (CCA, 2024a):

- electricity and energy;
- transport;
- industry and waste;
- agriculture and land;
- resources; and
- the built environment.

The CCA identified the range of emissions reductions that are achievable through the deployment of available and prospective technologies, and examined the relevant barriers, opportunities and enablers for each key sector. Part 1 of the Sector Pathways Review addresses the Resources sector, which incorporates Australian mining, oil and gas industries (CCA, 2024a).

Key findings of Part 1 of the Sector Pathways Review (Resources) of potential relevance to the Project include (CCA, 2024a):

> *Decarbonisation of the (Resources) sector requires widespread electrification, and deployment of fugitive abatement technologies in oil, gas and coal mining operations.*
> *…*
> *Electrification can play a significant role in reducing emissions from fuel combustion in the sector. Electric mining haulage and equipment is at pilot scale, with widespread adoption expected after 2030.*
> *…*
> *Based on available technologies, several sources of emissions across the sector are expected to remain largely unabated while the activities continue. There are few opportunities to significantly reduce fugitive emissions from surface coal mines.*
> *…*
> *Barriers to electrification and deployment of fugitive abatement measures across the sector include high upfront capital costs, integration challenges within existing facilities and the lack of access to a sufficient firmed supply of renewable electricity.*
> *…*

Section R.2.2.2 (Emissions reduction levers for mining haulage and equipment) of the Sector Pathways Review identifies that combustion of diesel fuels in mining haulage and equipment accounts for approximately 14% of the Australian resources sector emissions (CCA, 2024a).

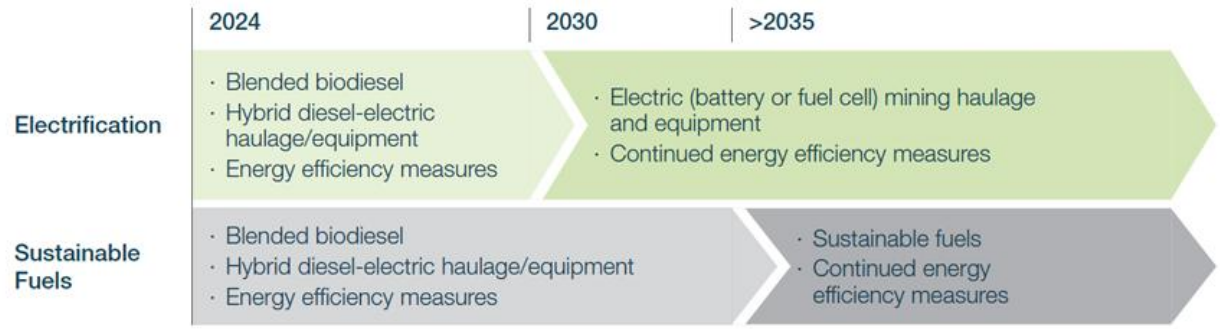
Key emission reduction levers for reducing emissions from mining haulage and equipment, summary readiness and potential barriers to adoption as identified by the CCA (2024a) are reproduced in Table 2.

Figure R.4 of the Sector Pathways Review provides a schematic diagram illustrating two key prospective alternative decarbonisation pathways for mining and haulage equipment, reproduced below as Figure 3.

Table 2
Key Mining Haulage and Equipment Emissions Reduction Levers

Emissions Reduction Levers		Readiness	Barriers of Adoption
Electrification of haulage and equipment	Battery and tethered electric trucks and mining equipment. Trolley assist systems where haul trucks are connected to an overhead cable to power the electric drive.	Demonstration	- low technology maturity; - high capital expenditure; - integration of the required supporting infrastructure to existing mines; - lack of supply of electric haulage and equipment; and - lack of supply of firmed renewable electricity.
Fuel cell electric trucks	Hydrogen fuel cell-powered haulage trucks and mining equipment.	Demonstration	- low technology maturity; - high capital expenditure; and - lack of supply of renewable hydrogen.
Sustainable fuels^	Fuel switching to more lower carbon fuels such as biodiesel or renewable diesel.	Commercial	- high operational expenditure; and - lack of supply of sustainable fuels.

Source: (CCA, 2024a).
^ Uptake of sustainable fuels is also constrained by OEM warranty limits.



Source: (CCA, 2024a).

Figure 3 Prospective Decarbonisation Pathways for Mining and Haulage Equipment

The CCA also noted the following potential limitations with respect to the electrification pathway for mining and haulage equipment (CCA, 2024a):

> *A key prerequisite for mine site electrification is access to a sufficient supply of flexible but firmed electricity. Significantly higher electricity demand and increased variability of demand loads are expected as mines electrify. The ability to provide sufficient electricity, either from onsite generation or the grid, to support the electrification of mines has been identified as a key concern by industry.*
>
> *Electrification of a mine site also requires significant enabling infrastructure, including: charging stations, transmission lines and overhead power lines for trolley assist systems. The dynamic nature of some mining operations presents a challenge for the installation of such semi-permanent infrastructure due to continually evolving mine plans.*

The CCA also noted the following potential limitations with respect to the sustainable fuel pathway for mining and haulage equipment (CCA, 2024a):

> *Various mining companies have proposed the use of sustainable fuels as a long-term decarbonisation strategy due to their benefits as drop-in fuels and the operational flexibility they offer. However limited supply of sustainable fuels (and no current domestic supply chain) and expected competition from other sectors with limited alternatives, such as aviation, introduce uncertainty around the viability of this pathway to decarbonise mining haulage.*
> *…*
>
> *The authority observed there is an information gap relating to the future production, use and import of biofuels in Australia.*

Net Zero Plan

Australia's *Net Zero Plan* (Commonwealth DCCEEW, 2025d) sets the national policy framework for achieving net zero greenhouse gas emissions by 2050, supported by legislated interim targets under the Climate Act. The Australian Government adopted the CCA's recommendation to reduce national emissions by 62 to 70% below 2005 levels by 2035, building on progress already made (emissions were 27% below 2005 levels in 2024 and 29% below in 2025). Australia's *Net Zero Plan* (Commonwealth DCCEEW, 2025c) outlines a coordinated, economy-wide pathway aligned with Australia's obligations under the *Paris Agreement*.

A core feature of Australia's *Net Zero Plan* (Commonwealth DCCEEW, 2025c) is its five decarbonisation priorities, which provide a strategic guide for emissions mitigation across the economy:

1. Clean electricity across the economy – Large-scale renewable energy expansion, firming (batteries, hydro, gas), transmission investment (Rewiring the Nation), offshore wind development, and long-term financing through the Clean Energy Finance Corporation's and Capacity Investment Scheme.
2. Lowering emissions by electrification and efficiency – Rapid electrification of transport, households and industrial processes, improved appliance and building performance standards, expanded energy ratings frameworks, and acceleration of circular economy outcomes.
3. Expanding clean fuel use – Development and deployment of renewable hydrogen, renewable diesel, sustainable aviation fuel and biomethane for hard-to-electrify sectors, supported by new domestic production incentives and waste-to-fuel pathways.
4. Accelerating new technologies – Increased Research and development, innovation and commercialisation support, including battery innovation, low-emissions metals, CH_4 measurement improvements and establishment of the $5 billion Net Zero Fund for industrial decarbonisation and energy efficiency.
5. Net carbon removals scaled up – Continued reliance on land-based sequestration (reforestation, plantations, savanna burning), together with emerging engineered removals (direct air capture, mineralisation) and improvements to the ACCU Scheme.

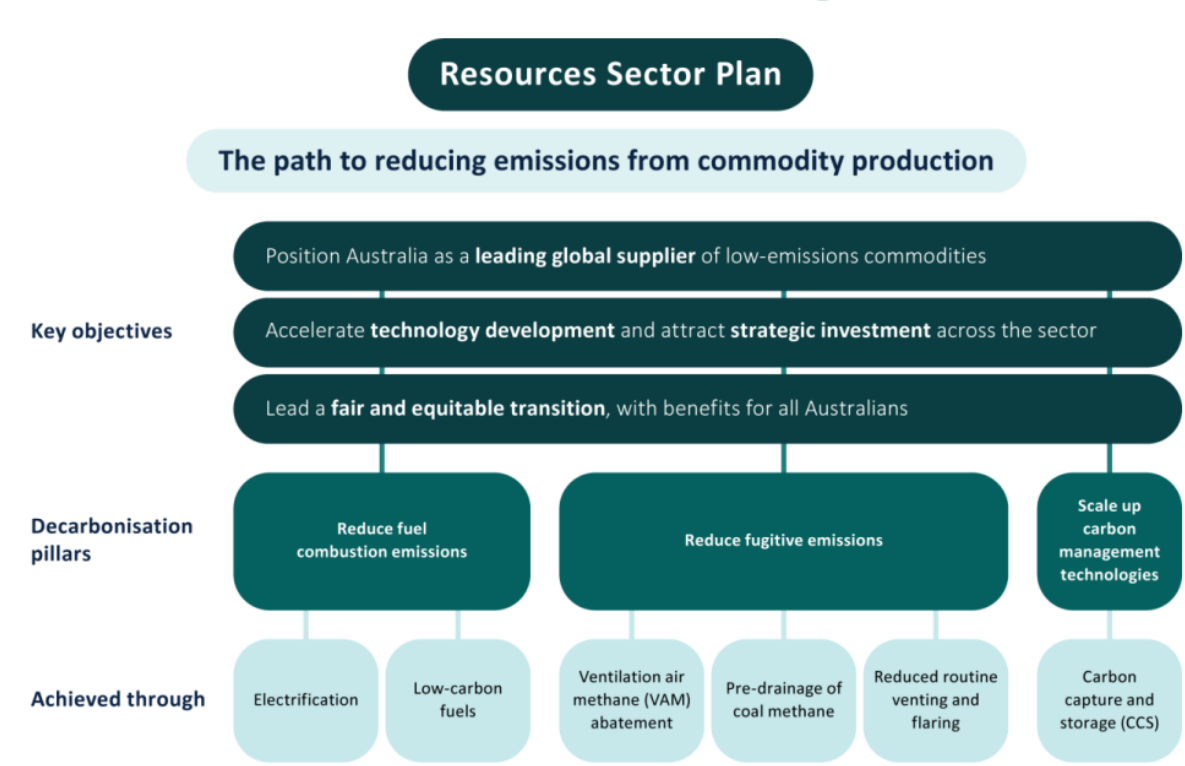
The Net Zero Plan (Commonwealth DCCEEW, 2025c) also provides sector-specific pathways for electricity, transport, industry, resources, agriculture and the built environment. These pathways recognise differing technological readiness and expected rates of decarbonisation. Further discussion on the Resource Sector Plan is provided below.

The Net Zero Plan (Commonwealth DCCEEW, 2025c) embeds a set–do–review–refine policy cycle, supported by annual climate statements to Parliament, independent assessments by the CCA and scheduled reviews of mechanisms such as the Safeguard Mechanism (2026–27).

Resource Sector Plan

The Commonwealth Department of Industry, Science and Resources (DISR) Resources Sector Plan (2025) outlines the national pathway for reducing emissions from the resources sector while maintaining Australia's role as a globally significant producer of minerals, metals and energy commodities (Figure 4). The Resources Sector Plan sits under Australia's Net Zero Plan framework and provides a high-level overview of expected transition trends, indicative decarbonisation timelines and the enabling conditions required for the sector to contribute to the national 2050 net zero target.

The Resources Sector Plan (Commonwealth DISR, 2025) outlines indicative decarbonisation actions expected to occur across the sector over the short, medium and longer term, these actions reflect anticipated technology development pathways, increasing electrification and fuel switching, and the progressive deployment of carbon management and fugitive abatement technologies. A summary of these indicative actions in provided in Table 3.



Source: (Commonwealth DISR, 2025).

Figure 4 DISR Resources Sector Plan

Table 3
Indicative Actions under the Resources Sector Plan

Milestone Year	Key Actions
To 2030	- Reduced routine venting and flaring from oil and gas facilities. - New resources facilities designed for electric power, and improved energy efficiency where technically and commercially feasible. - Demonstration and commercialisation of electrified haulage and equipment. - Demonstration of coal VAM abatement technology in Australian mines. - Expansion of Carbon Capture Storage (CCS).
To 2035	- Increased electrification and energy performance across the sector. - Deployment of heavy electric vehicles and equipment, with greater penetration of low-carbon liquid fuels and renewable energy in remote regions. - Scale-up of coal VAM abatement technology in Australian mines. - Greater use of CH_4 pre-drainage in coal mines. - Adoption of low-carbon fuels (liquid and gaseous) where electrification is not feasible. - Use of CCS continues to grow.
To 2050	- Widespread use of VAM abatement and pre-drainage technologies for coal mines. - Continued use of low-carbon fuels. - Continued use of CCS.

Source: (Commonwealth DISR, 2025).
Notes: VAM = Ventilation air methane, CCS = Carbon Capture Storage.

2.2.4 OFFSETS

The Commonwealth CCA's *Targets, Pathways and Progress* (2024b) paper describes that some sectors have very hard-to-abate emissions and may be unable to achieve net zero, whereas the land sector already achieves net negative emissions by removing carbon from the atmosphere.

In the *Targets, Pathways and Progress* paper, the CCA (2024b) provides a description of Australia's approach to achieve net zero, which is to balance both continuing emissions and offsets or carbon sequestration in a manner that is economically responsible and reflective of the constraints and opportunities available to the various sectors of the Australian economy. Australia has also declared that it would utilise Article 6 of the *Paris Agreement* (international trading of emission allowances) to meet its mitigation targets.

The CCA also articulates that Australia's ambition is not to achieve zero emissions by 2050, it is rather to achieve net zero emissions by 2050 and articulates that Australia would continue to rely (as it has to date) to a large degree on the land sector to remove carbon from the atmosphere and offset emissions that continue to occur elsewhere in the economy.

The CCA (2025) in its advice to the Commonwealth Government on Australia's second NDC also notes the following with respect to the market-based mechanisms set out in the Safeguard Mechanism and associated carbon credit markets:

> *The Safeguard Mechanism and carbon credit arrangements provide a flexible, market-based approach to reducing the emissions intensity of Australia's largest industrial facilities, including manufacturing, mining, oil and gas production, and waste, with some coverage of domestic transport. These policies are designed to recognise the particular challenges faced by Australia's emissions-intensive trade-exposed industries, and to help strengthen their competitiveness as the world moves towards net zero emissions.*

The continuing role of offsets to 2050 was also highlighted in Australia's *Net Zero Plan* as one of the five decarbonisation priorities (Commonwealth DCCEEW, 2025d):

> *Carbon markets are part of a portfolio of measures that will help Australia achieve net zero emissions by 2050.*
> *…*
> *Demand for ACCUs is expected to increase over time, to support participants in compliance and voluntary markets to achieve their emissions reduction goals.*
> *…*
> *The Australian Government will continue to improve the ACCU scheme so it contributes to Australia's net zero transition through:*
> *1. Improving scheme governance, reinforcing integrity and transparency*
> *2. Bringing forward high-integrity supply*
> *3. Facilitating interoperability with the Nature Repair Market*
> *4. Strengthening synergies between carbon removals and other land uses*

2.3 State – Queensland Government

2.3.1 MITIGATION

The Queensland Government previously released the *Pathways to a Clean Growth Economy – Queensland Climate Transition Strategy* (Queensland Climate Transition Strategy) (Department of Environment and Heritage Protection [DEHP], 2017a), which outlined how QLD would transition to a clean growth economy and achieve its target of net-zero emissions by 2050.

Since the release of the Queensland Climate Transition Strategy (DEHP, 2017a), the former Labor Queensland Government also legislated a stronger intermediate emissions reduction target of 75% by 2035 (referred to as '75% by 2035') through the passing of the *Clean Economy Jobs Act 2024*. The timeframe of sector-specific emissions reduction plans to meet the 2035 targets legislated in the *Clean Economy Jobs Act 2024* has been delayed by the current Queensland Government for the foreseeable future. However, QLD's emissions are currently 35% below 2005 levels, which exceeds the first interim emissions reduction target of 30% by 2030 (Queensland Treasury, 2025a).

The Queensland Government also announced that the *Net Zero Roadmap* is in development (Queensland Treasury, 2025a), which would provide a revised pathway for QLD to meet the revised emissions reduction targets legislated in the *Clean Economy Jobs Act 2024*. This roadmap would include new industry specific emissions reduction plans, including a plan for the resources sector.

The *Queensland Climate Adaptation Strategy* (DEHP, 2017b) is also under review by the current Queensland Government (Queensland Treasury, 2025b). Future versions of the strategy would be considered in future revisions of this GMAP.

This GMAP has been produced with consideration of the Queensland *Greenhouse Gas Emissions Guideline – Version 1.02 – ESR/2024/6819* (QLD GHG Guideline) which outlines existing application requirements

under the EP Act for new and existing EAs, and details how to meet these requirements in relation to greenhouse gas emissions (Queensland Department of the Environment, Tourism, Science and Innovation [DETSI], 2026). Future versions of the QLD GHG Guideline would be considered in future revisions of this GMAP. Whitehaven Blackwater understands this guideline is currently in the process of being updated, however, this GMAP has been developed in accordance with Version 1.02 of the guideline. It is noted that, with reference to the GHG Guideline and predicted emissions in Section 3, the Project is considered to be a medium to high emitter.

The QLD GHG Guideline sets out the minimum expectations for GHG emissions information to be provided with applications for new EAs and applications to amend existing EAs. The requirements for development applications, and where they are addressed in this report are summarised in Table 4.

Table 5 shows the content requirements for a GHG Abatement Plan under the QLD GHG Guideline and where each requirement has been addressed in this GMAP.

Table 4
Guideline Greenhouse Gas Emissions – Application Requirements

Requirement	Addressed Within this GMAP
Details of GHG emissions likely to be generated by the activities of the project over its life.	Section 3.1, Appendix B.
An emissions inventory identifying the GHGs to be emitted and the stage of the project at which the emissions will occur, with a breakdown of GHG emissions by source, that: - Estimate the projected annual Scope 1 and Scope 2 CO2-e emissions over the life of the project. Include both unabated emissions and emissions after all avoidance and abatement measures (as outlined in section 3.3) have been accounted for. - Provide an estimate of annual Scope 3 emissions and total Scope 3 emissions over the life of the project.	Section 3, Appendix B.
A determination as to whether the application meets the threshold for medium to high GHG emission category emitting applications, where: - Applications with expected GHG emissions (Scope 1 and Scope 2) of 25,000 tonnes CO2-e or more per year (at any time during the life of the project) are considered medium to high emitters - Applications with expected GHG emissions (Scope 1 and Scope 2) of less than 25,000 tonnes CO2-e per year are considered low emitters.	Section 3.1, Appendix B.
Details of the management practices proposed to be implemented to prevent or minimise adverse impacts in line with the GHG abatement hierarchy and requirements for a GHG abatement plan (for medium to high emitters).	Section 5.
A risk assessment that outlines the scale of expected GHG emissions from the activity and how they are expected to contribute to climate change impacts on Queensland's environmental values.	Section 7.
Applications for activities that meet the medium to high emission category at any point during the carrying out of the authorised activity will be required to include a GHG abatement plan.	This GMAP.

Source: (DETSI, 2026).

Table 5
Content Requirement of a Greenhouse Gas Abatement Plan

Requirement	Description	Addressed Within this GMAP
a) Project details	– Applicant. – Project name and description (including location).	Section 1.
b) Emissions projections and commencing abatement measures	– Emission inventory and estimates as developed in section 3.1 of the guideline. – Management practices proposed to be implemented at commencement to reduce GHG emissions as per section 3.3 of the guideline.	Section 3, Section 4 and Section 5.
c) GHG emissions reference point	– Outline the level of emissions against which ongoing reduction of GHG emissions will be assessed throughout the life of the project (reference point). – This is based on projected GHG emissions prior to implementation of the GHG abatement plan and may include multiple reference points developed for each stage of the activity. – For projects captured by the Commonwealth Safeguard Mechanism, the reference points may be determined by the Safeguard Mechanism (referred to as baseline). – Provide justification for the reference points proposed.	Section 2, Section 3 and Appendix B.
d) Emission reduction targets	– Identify interim Scope 1 and Scope 2 GHG emission reduction targets to be applied throughout the life of the project. – Identify long-term overall Scope 1 and Scope 2 GHG emission reduction targets. – Targets may be set at intervals of up to 5 years to take into account emerging technologies over that period and allow for production variability, provided they result in a reduction of GHG emission at the end of the period. – For projects captured by the Commonwealth Safeguard Mechanism, the emission reduction targets may be determined by the Safeguard Mechanism. – Provide justification for the emission reduction trajectory and targets proposed and how they support the Queensland Government's greenhouse gas emission reduction targets.	Section 3.
e) GHG emission reduction program	– A program that details the GHG emission reduction measures for Scope 1 and 2 that will be implemented throughout the life of the project, as developed in section 3.3 of the guideline and outlined in Part B below.	Section 5
f) Advancing technologies and opportunities	– Provisions for regularly reviewing new technologies to identify opportunities to further reduce emissions and energy efficiency.	Section 4
g) Monitoring and auditing	– A program for monitoring GHG emissions and auditing against GHG emission reduction targets.	Section 6
h) Reporting	– A program for periodic public reporting on progress towards the GHG emission reduction targets outlined in the GHG abatement plan including details about how public reporting will be undertaken. – There is no intent to duplicate reporting requirements. Where companies are already reporting GHG emissions under another framework, this section can refer to that reporting. However, reporting must be against the emission reduction targets stated in the GHG abatement plan and must be publicly available. – Where the GHG abatement plan includes commercial-in-confidence information, the applicant may request that specific details are treated as confidential and are not made publicly available, with justification to support this request.	Section 6

Source: (DETSI, 2026).

It is noted that Appendix C of the QLD GHG Guideline provides some useful guidance of how to apply the guideline to an Environmental Authority Amendment (as is the case for the Project). The Guideline notes:

- *projected GHG emissions as per section 3.1 need only to refer to GHG emissions that will be generated as a result of the proposed amendment, including the determination of the GHG emission category for the application.*
- *proposed management practices as per section 3.3 are only applicable to the GHG emissions that will be generated as a result of the proposed amendment. This includes any GHG abatement plan that may be required for GHG emissions generated by the proposed amendment.*
- *the description of risks and likely magnitude of impacts to environmental values as per section 3.4 only needs to address the risks associated with the GHG emissions that would be generated by the proposed amendment.*

To address this, the "Project only" scenario is identified in Section 3 and abatement opportunities would be evaluated in the context of the Project (Sections 4 and 5).

2.4 Resources Industry

The Minerals Council of Australia released the *Climate Action Plan* in 2020 which details the mineral industry's commitment to the goal of net zero emissions and its actions, among others, on renewable energy investments at mine sites and collaborations with partners on low-emissions technologies and processes. The *Climate Action Plan* outlines a series of actions focused on three key themes: support developing technology pathways to achieve significant reductions in Australia's greenhouse gas emissions, increased transparency on climate change reporting and informed advocacy and knowledge sharing of the sector's responses to addressing climate change. Whitehaven is a member of the Minerals Council of Australia.

Since the release of the *Climate Action Plan* in 2020, the Minerals Council of Australia has also released three annual progress reports for 2021, 2022 and 2023 which tracks the progress toward completing the actions set in the *Climate Action Plan* (Minerals Council of Australia, 2025). Most notably, the 2023 progress report marked the completion of the initial three-year work program, identifying new prospects, accelerating existing actions, and creating lasting pathways toward the industry's ambition of net-zero emissions by 2050 (Minerals Council of Australia, 2023).

In 2021, Whitehaven also became a signatory to the World Coal Association's *Responsible Coal Principles*, which acknowledges the impact of climate change and importance of mitigating emissions from coal, committing to actively supporting low emission coal technologies, investment and innovation (Whitehaven, 2022).

2.5 Other Key Guidance and Industry Review

EMM Consulting Pty Limited (EMM) (2025) undertook a literature review and industry scan of New South Wales (NSW) mines. Although, BWM is outside of NSW, the technical information which came as a result of this report currently forms the most up to date abatement evaluation for surface coal mines in Australia and therefore is relevant to this GMAP. The literature review covered international guidance and measures relating to the mitigation of greenhouse gas emissions from coal mines. The industry scan involved consultation with coal mining companies to better understand what the coal sector is currently doing to mitigate emissions, to identify the most important factors that influence mine operator decision-making, and to identify potential case studies.

Whitehaven Blackwater has considered the literature review undertaken by EMM (2025) as a source of contemporary advice available for coal mines in the development of this GMAP. However, Whitehaven Blackwater has not limited its consideration of potential abatement opportunities to those listed in EMM's (2025) literature review. Existing mitigation measures for Scope 1 and 2 emissions identified by EMM (2025) relevant to surface mines have been reproduced in Table A-1 (Appendix A). Similarly, emerging Scope 1 and 2 mitigation measures for surface mines identified by EMM (2025) have been summarised in Table A-2 (Appendix A).

Most notably, QLD has emerged as the primary Australian jurisdiction where advanced methane measurement and abatement approaches are being actively trialed and progressed at scale, particularly within the Bowen Basin. Recent work supported by the United Nations Environment Programme's International Methane Emissions Observatory has focused on improving the empirical understanding of methane emissions from coal operations in QLD, including targeted studies in the Surat Basin and ongoing investigations in the Bowen Basin (EMM, 2025).

Recent federal funding commitments of $37 million have also supported the deployment of regenerative thermal oxidation technology at the Kestrel Coal Mine in QLD (EMM, 2025). Similarly, Stanmore Resources' Low Emissions Investment Partnerships funded project at the South Walker Creek open cut coal mine is trialing the capture of fugitive coal seam methane and its conversion to on-site electricity generation via a 20MW gas-fired power station.

2.6 Whitehaven Coal Limited

Whitehaven recognises and supports the long-term goal of the *Paris Agreement* to limit global average temperature increases to below 2°C compared to pre-industrial levels, consistent with Australia's national commitments under the accord (Whitehaven, 2025).

Paris-aligned Decarbonisation Goals

Whitehaven recognises and supports the long-term goal of the *Paris Agreement* to limit global average temperature increases to below 2°C compared to pre-industrial levels, consistent with Australia's national commitments. Accordingly, all of Whitehaven's direct-sale customer countries are signatories to the *Paris Agreement* or, in the case of Taiwan, have domestic energy policies that are aligned with the *Paris Agreement* (Whitehaven, 2025). This would also be the case for all of Whitehaven's direct-sale customer countries for the Project's product coal.

Emission Intensity Reduction Targets

Whitehaven recognises and supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the reformed Safeguard Mechanism.

Emissions intensity reduction obligations, as set by the Safeguard Mechanism, apply to four of Whitehaven's operating assets, namely the BWM, Daunia Mine, Narrabri Mine and Maules Creek Coal Mine (MCCM). Together in FY25, these mines accounted for 92% of Whitehaven's total Scope 1 emissions (Whitehaven, 2025). Whitehaven's operating assets covered by the Safeguard Mechanism would be required to reduce their 'baseline' emissions intensity based on a facility-specific ratio and the default 4.9% per year emissions intensity reduction through to FY30 (i.e. Safeguard facilities with a high facility-specific emissions intensity would have to reduce emissions more aggressively compared to facilities with lower historical emissions intensity).

The emissions intensity reduction obligations set by the Safeguard Mechanism at present to the BWM would apply to the Project as well, given that it is intended for the Project to become part of the BWM for Safeguard Mechanism compliance purposes should the Project be approved. Table 6 identifies key existing and potential emissions abatement initiatives Whitehaven have identified for sites under their ownership, along with indicative timing and the abatement potential of each decarbonisation initiative (Whitehaven, 2025).

Table 6
Key Whitehaven Emissions Abatement Initiatives

Abatement Initiative	Description	Indicative Timing	Abatement Potential
Open cut pre-mining gas drainage to flare or generate electricity	Preliminary scoping work into pre-mining gas drainage at QLD mines to abate emissions through methane gas capture to flare and/or generate electricity. Potential opportunity to adapt gas drainage technologies which have historically been implemented at underground mines to apply to an open cut mine setting.	FY25-FY30	Significant
Enhance longwall sealing of goafs	Improve the sealing of goafs (i.e. previously mined areas) in the northern area of the Narrabri Mine, indicatively reducing the release of fugitive emissions into the atmosphere.	FY25-FY30	Minor
Flare pre-mining drainage methane	Narrabri Mine operations have shifted to a new longwall series in the southern section of the mine, where methane concentrations are sufficient to enable flaring of pre-mining drainage methane.	FY25-FY30	Minor
Gas separation and purification	Potential to treat pre-drainage gas through practical use of technologies to increase available concentrations of methane, to flare or beneficially utilise for electricity generation.	FY25-FY30	Moderate
Gas sequestration	Exploring the feasibility of carbon capture and storage of fugitive emissions at the Narrabri Mine. The gas captured would be injected into geological strata, effectively sealing it in those strata.	FY25-FY30	Significant

Table 6 (Continued)
Key Whitehaven Emissions Abatement Initiatives

Abatement Initiative	Description	Indicative Timing	Abatement Potential
Ventilation air methane (VAM) abatement	Underground mines historically emit methane in high volumes and low concentrations. Existing VAM mitigation technology cannot handle the low concentration emitted by the Narrabri Mine, however viable technology may become available.	FY30-FY40	Unknown
Reducing Diesel Emissions	Technologies to reduce diesel emissions in the short term, including technologies to improve operational efficiencies, and investigating diesel substitution options. A trial of renewable diesel was undertaken at the Maules Creek Coal Mine.	FY25-FY30	Moderate
Biological carbon capture and use (CCU) technology	harnesses bacteria and microbial algae to consume carbon emissions at the source, producing saleable by-products such as lipids and proteins for use in renewable diesel production, sustainable aviation fuel, agricultural nutrition, fertilisers and bioplastics.	FY30–FY40	Unknown

Source: (Whitehaven Coal, 2025).

2.6.1 EMISSIONS REDUCTION

Whitehaven currently offsets Scope 2 emissions for its NSW assets and has commenced a process to consider offsetting Scope 2 emissions on a whole-of-portfolio basis (i.e. NSW and QLD). Whitehaven has also committed to a net Scope 1 emissions intensity reduction target for operating mines of 32% by FY30 (Whitehaven, 2025) as implied by the Safeguard Mechanism, which would be revised in line with future revisions of the Safeguard Mechanism and changes to its mine portfolio. A review of the Safeguard Mechanism is scheduled for 2026-27.

Furthermore, consistent with Australian and QLD targets, Whitehaven is undertaking an exercise to explore the decarbonisation potential within the business, including having regard to issues such as capital intensity, complexity and timing. Relevant outcomes from this process would be included in future revisions of this GMAP.

2.6.2 CARBON ABATEMENT OPPORTUNITIES AND INITIATIVES

Whitehaven has identified potential greenhouse gas abatement opportunities through a range of sources, including:

- Existing technical experience and exposure to emerging abatement measures and technologies on other mine sites, including open cut coal mines and other open cut mining sectors.
- Reference to international greenhouse gas abatement documentation.
- Reference to Australian and interstate publications on greenhouse gas abatement.
- Consultation with key consumable suppliers on the status, availability and potential price of low-emission alternatives (e.g. renewable fuels).
- Consultation with key Original Equipment Manufacturers (OEMs) on the development status, availability and potential price of emerging low-emission equipment or technology.
- Participating in industry working groups and committees and attending industry forums and conferences focused on decarbonisation opportunities.
- Obtaining independent subject matter advice.
- Site-specific greenhouse gas abatement opportunity analysis and workshops conducted by Whitehaven.

3 Greenhouse Gas Emissions Context

This section provides an overview of the greenhouse gas emissions context relevant to current mining operations. It outlines Whitehaven's emission reduction objectives, electricity supply characteristics, operational life-of-mine (LOM) considerations, and current key sources of Scope 1 and Scope 2 emissions. It also summaries the composition of the mining fleet and outlines the existing reasonable and feasible mitigation measures currently implemented across site operations.

3.1 Predicted Greenhouse Gas Emissions

RWDI (Appendix B) undertook greenhouse gas calculations in accordance with the QLD GHG Guideline.

In order to quantify the incremental greenhouse gas emissions of the Project, three scenarios have been assessed:

- **Baseline Scenario** (Approved BWM Scenario): Approved life of mine (LOM) as approved by EA EPML00717813 excluding the Project. This scenario assumes continued operations of the BWM at a maximum mining rate of 19.0 Mtpa of ROM coal until 2090 (at an average ROM coal mining rate of approximately 12.8 Mtpa).
- **Project Scenario** (Amended BWM Scenario): Proposed LOM with the Project, incorporating the proposed extension of open-cut mining on SA 7 on ML 1762 and SA 10 on ML 1759. This scenario would extract an additional 200 Mt of ROM coal when compared to the Baseline Scenario, extending operations to approximately 2093 with continued maximum annual ROM coal extraction rate of 19.0 Mtpa (at an average ROM coal extraction rate of approximately 15.0 Mtpa).
- **Project Only Scenario** (Amendment Scenario): This scenario evaluates the net change in emissions resulting from the Project extension by comparing the emissions from Project Scenario against those from Baseline Scenario, thereby quantifying the incremental impact of the proposed amendment.

The greenhouse gas emissions estimated by RWDI (Appendix B) for each scenario are summarised in Table 7.

Table 7
Summary of Estimated Emissions per Scope for All Scenarios

Period	Scenario	Scope 1 (Mt CO_2-e)	Scope 2 (Mt CO_2-e)	Scope 3 (Mt CO_2-e)
Annual Average	Baseline Scenario	0.71	0.047	26.30
	Project Scenario	0.99	0.051	34.21
	Project Only Scenario	0.27	0.004	7.91
Total	Baseline Scenario	47.89	3.14	1,761.93
	Project Scenario	66.18	3.41	2,292.09
	Project Only Scenario	18.30	0.27	530.16

Source: (RWDI, 2026).
Note: million tonnes of carbon dioxide equivalent. (Mt CO_2-e)

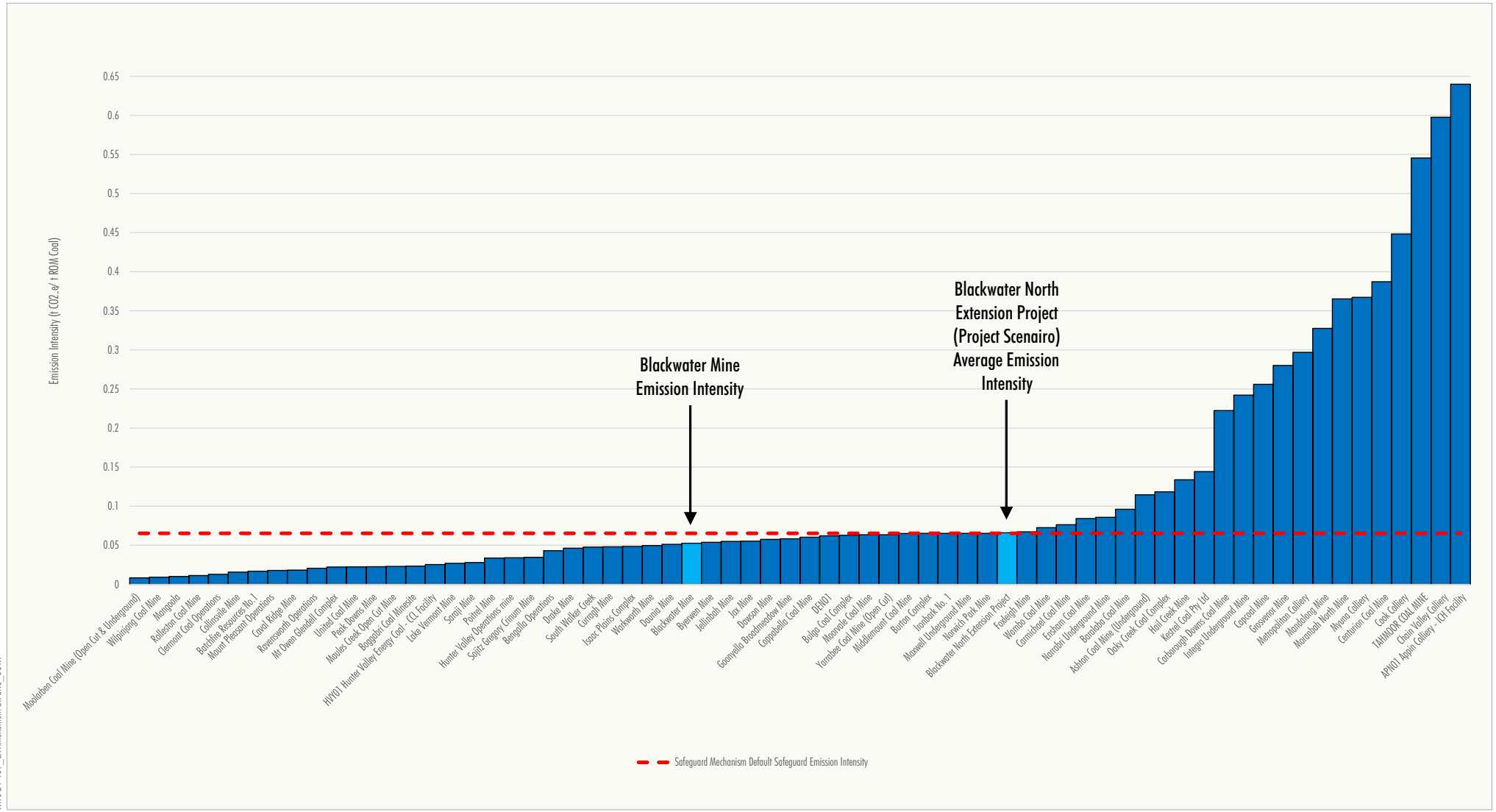
The Project is therefore considered a medium to high emitter under the QLD GHG Guideline.

Note that while the three-year action plan (Section 5) commits to various data collection, trials and operational improvements, the greenhouse gas calculations prepared by RWDI (Appendix B) conservatively exclude any potential emission reductions that may be achieved. For further information regarding calculation methodology and annual emission estimates, refer to Appendix B.

3.2 Predicted Greenhouse Gas Emissions Intensity

The approved facility specific EID for BWM is 0.0527 t CO_2-e / t ROM (CER, 2025b). This ranks the BWM as having the 29th lowest emissions intensity among approximately 68 Australian coal mining facilities with published facility specific EIDs (Chart 1).

The emissions intensity at BWM is lower than the industry default value of 0.0653 t CO_2-e / t ROM, as specified under the Safeguard Rule.



WHC-24-101 _ EA Amendment SR GHG_001A

Source: CER (2026); RWDI (2026)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Australian ROM Coal Emissions Intensity Determinations and Estimated Project Average ROM Coal Emissions Intensity

Chart 1

Under the Project Scenario, the BWM average emissions intensity would increase as mining progresses further and deeper into the pits (approximately 0.066 t CO_2-e / t ROM). Relative to other current Australian ROM coal EIDs, the BWM (including the Project) would rank approximately 44th lowest (excluding the existing BWM) out of approximately 68 facilities (based on historical data determinations) (Chart 1). This increase reflects geological conditions, with deeper target seams requiring greater energy input and less efficient emissions outcomes, and would occur regardless of whether the Project proceeds, as it is inherent to the ongoing progression of mining.

The BWM emissions intensity determinations are currently based on fugitive emissions estimated using NGER Method 1. Accordingly, Method 1 uncertainty should be applied to the reported EIDs. Whitehaven Blackwater is currently progressing toward a site-specific Method 2 determination for fugitive emissions at BWM.

3.3 Whitehaven Emissions Reduction Objective

Whitehaven recognises and supports Australia's commitment to achieving net zero carbon emissions by 2050 and has aligned its decarbonisation goals and business practices with the emissions reduction obligations outlined under the reformed Safeguard Mechanism. Whitehaven operates four facilities that are subject to the Safeguard Mechanism, including BWM, Narrabri Mine, MCCM and Daunia Mine.

Whitehaven would manage each of its major facilities to comply with the reformed Safeguard Mechanism. Where a facility exceeds its Safeguard baseline in a relevant National Greenhouse and Energy Reporting System (NGERS) period, Whitehaven would retire SMCs or ACCUs to achieve the Commonwealth net emission reduction requirements.

3.4 Blackwater Emission Reduction Targets

Consistent with Whitehaven's adopted greenhouse gas policy, the adopted net emission goals for the Project are reflective of predicted Project net emission reduction targets under the Commonwealth Safeguard Mechanism.

The BWM's Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations. Notwithstanding possible variation to the baseline value, it is anticipated that Whitehaven's implementation of various mitigation measures to minimise the overall generation of greenhouse gas emissions from the Project would result in greenhouse gas emissions being maintained within any varied Safeguard Mechanism baseline emissions value.

The anticipated Safeguard Mechanism baseline is shown graphically on Chart 2 and numerically on Table 8.

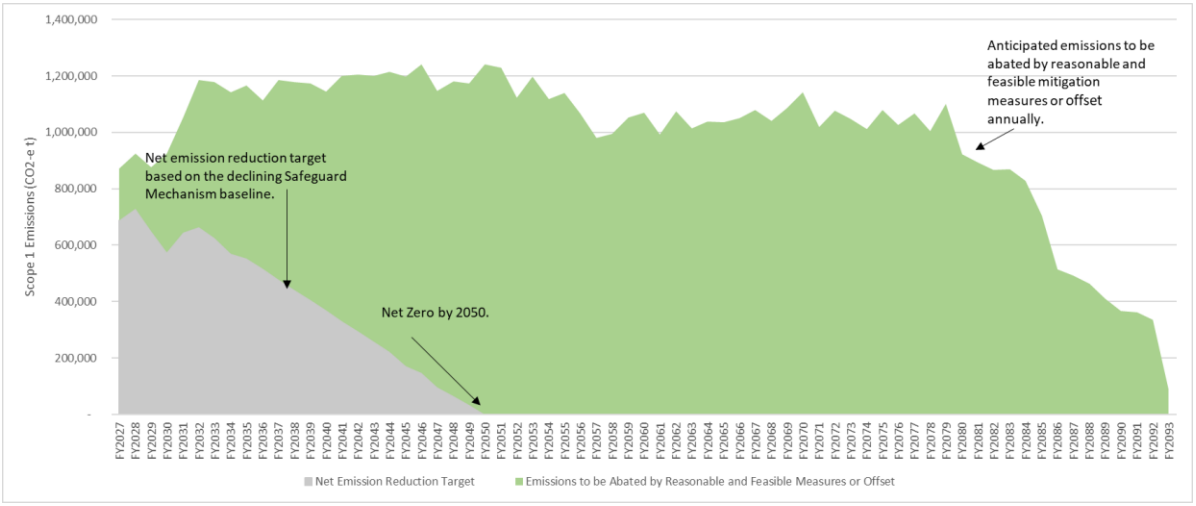


Chart 2 BWM (Including the Project) Gross Emissions and Net Scope 1 Emissions Target

Table 8
Indicative BWM (including the Project) Annual Scope 1 Net Emissions Target

Financial Year	ROM Coal (t)	Anticipated Safeguard Emission Intensity Baseline Forecast (t CO_2-e/t ROM)	Anticipated Safeguard Baseline Forecast (t CO_2-e)
FY2027	15,500,000	0.044	688,152
FY2028	17,100,000	0.043	729,185
FY2029	15,900,000	0.041	648,155
FY2030	14,800,000	0.039	573,692
FY2031	17,500,000	0.037	644,435
FY2032	19,000,000	0.035	662,847
FY2033	19,000,000	0.033	626,022
FY2034	18,400,000	0.031	570,591
FY2035	19,000,000	0.029	552,373
FY2036	19,000,000	0.027	515,548
FY2037	19,000,000	0.025	478,723
FY2038	19,000,000	0.023	441,898
FY2039	19,000,000	0.021	405,073
FY2040	19,000,000	0.019	368,249
FY2041	19,000,000	0.017	331,424
FY2042	19,000,000	0.016	294,599
FY2043	19,000,000	0.014	257,774
FY2044	19,000,000	0.012	220,949
FY2045	17,700,000	0.010	171,526
FY2046	18,800,000	0.008	145,749
FY2047	16,400,000	0.006	95,357
FY2048	16,900,000	0.004	65,509
FY2049	17,200,000	0.002	33,336
FY2050	18,200,000	0.000	0
FY2051- FY2093*	Varies	0.000	0

* Whitehaven would be required to mitigate or offset all Scope 1 emissions post FY2050.

3.5 Electricity Supply Context

BWM is located directly south of Blackwater, where grid electricity is supplied by a 132 kilovolt (kV) primary plant substation (132 kV Blackwater to Bluff) as apart of TransGrid's high-voltage system linking Central West Queensland with the broader QLD grid. The Project would continue to receive electricity from the existing 66 kV transmission line which supplies electricity to the site via an intake switching station (TransGrid, 2025)

TransGrid's *Transmission Annual Planning Report* (2025) discusses various planned electrical infrastructure upgrades to the Central West zone of Queensland, including replacement of the Blackwater 132 kV primary plant to maintain supply reliability in the region.

3.6 Life-Of-Mine Context

The BWM has been in operation since 1967. Mining activities at BWM have been undertaken to date by progressive delivery of major mobile mining equipment in alignment with operational demands and existing mobile fleet equipment lifespan.

Major mobile equipment purchases by Whitehaven would continue to occur as required over the life of the operation. As a result, opportunities for new equipment procurement, replacement or major rebuilds are expected to occur multiple times over the life of the operation.

3.7 Mining Emissions Context

Estimated LOM emissions for the Project have been calculated by RWDI and are presented in Appendix B of the GMAP.

Chart 3 provides a summary of Scope 1 emission sources for the BWM, disaggregated by key source as percentage contributions. Stationary diesel consumption (approximately 49.33%) and fugitive emissions (approximately 47.19%) are the largest contributors to emissions, with the remainder (approximately 3.48%) sourced from vegetation clearing (not reportable under NGER), explosives (not reportable under NGER) and other minor Scope 1 emissions sources.

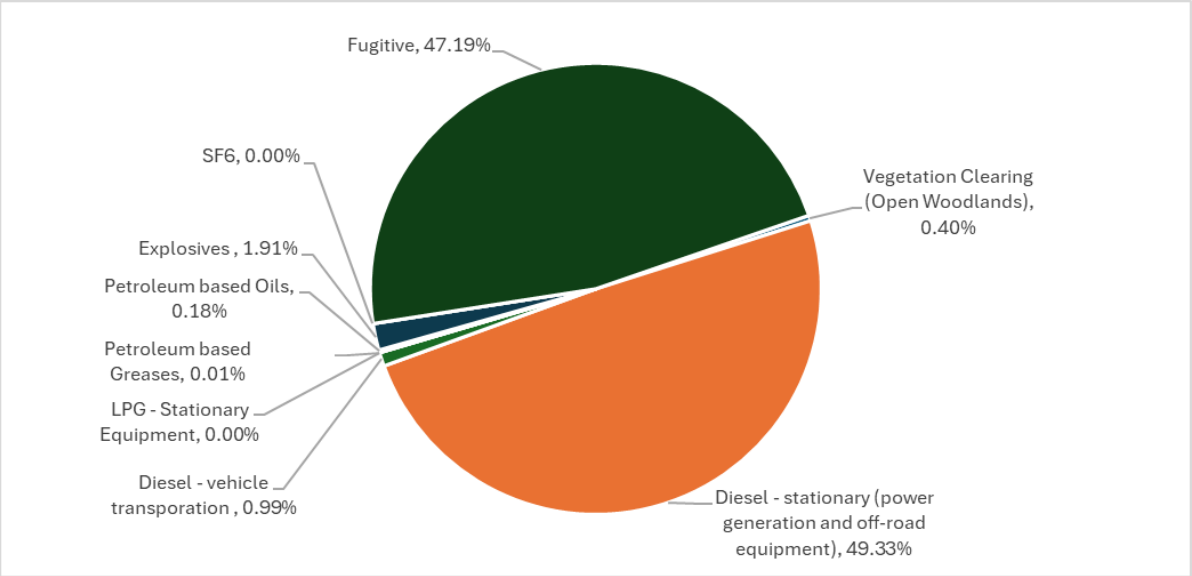


Chart 3 Breakdown of Total Predicted Scope 1 Emissions for the Project by Source

3.7.1 DIESEL CONSUMPTION

As shown in Chart 3, stationary diesel consumption and fugitive emissions are the primary source of greenhouse gas emissions at BWM.

Chart 4 provides a summary of projected diesel consumption at the BWM for the period of the Project and illustrates that over the life of the Project, haul trucks (64%) are predicted to be the largest diesel consumers followed by dig units (14%) and dozers (10%).

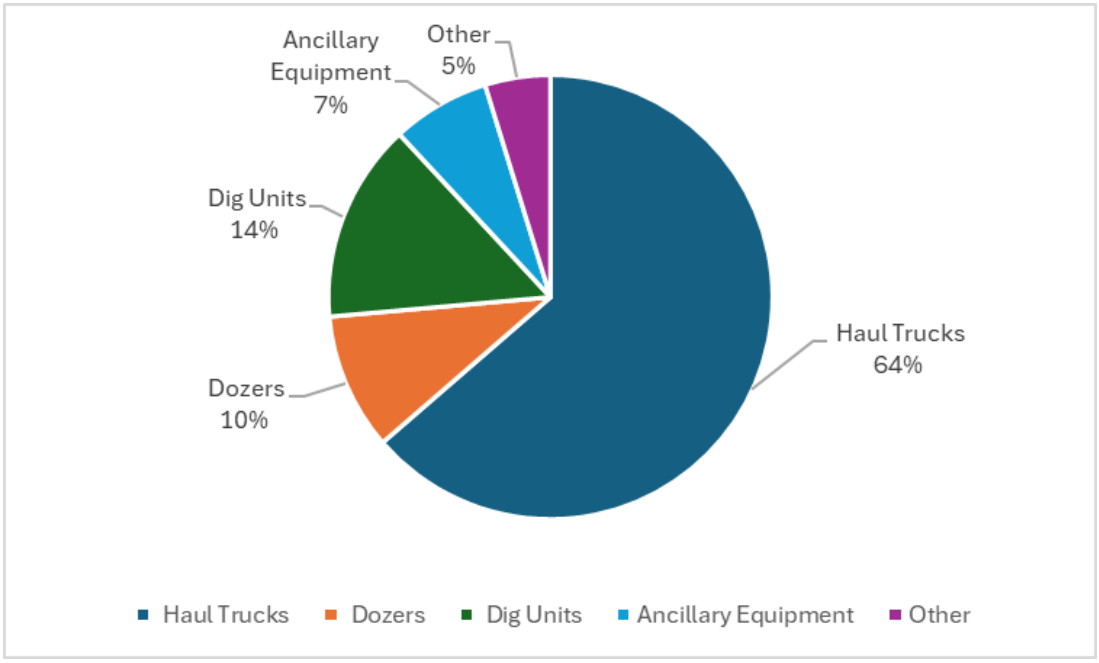


Chart 4 Breakdown of Mobile Fleet Diesel Consumption for the Project

Projected future diesel demand over the life of the operation is expected to follow similar trends and LOM estimates provided in Chart 5.

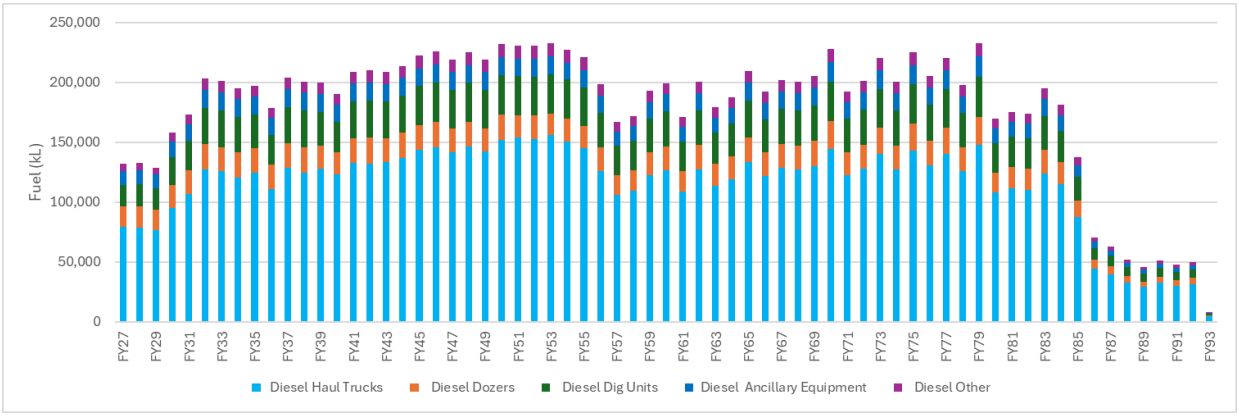


Chart 5 Breakdown of Projected Annual Diesel Consumption for the Project

Haul trucks remain the dominant diesel users throughout the LOM, accounting for roughly half of total fuel consumption. Diesel powered dig units represent the second-largest fuel consumers, followed by dozers and other ancillary equipment. Graders, water carts, service carts and miscellaneous equipment comprise the remaining share.

3.8 Mining Fleet Demands and Scheduling

The mining fleet modelling described below begins in 2027, as a large amount of Blackwater's fleet were previously hired, all of which are set to complete works in 2027. The modelling below shows 100% Whitehaven owned fleet.

Based on indicative average equipment lifespans and replacement purchase windows shown in Chart 6, major fleet replacement activity is concentrated from the early to mid 2030s, with a smaller number of long-life assets extending into the 2050s.

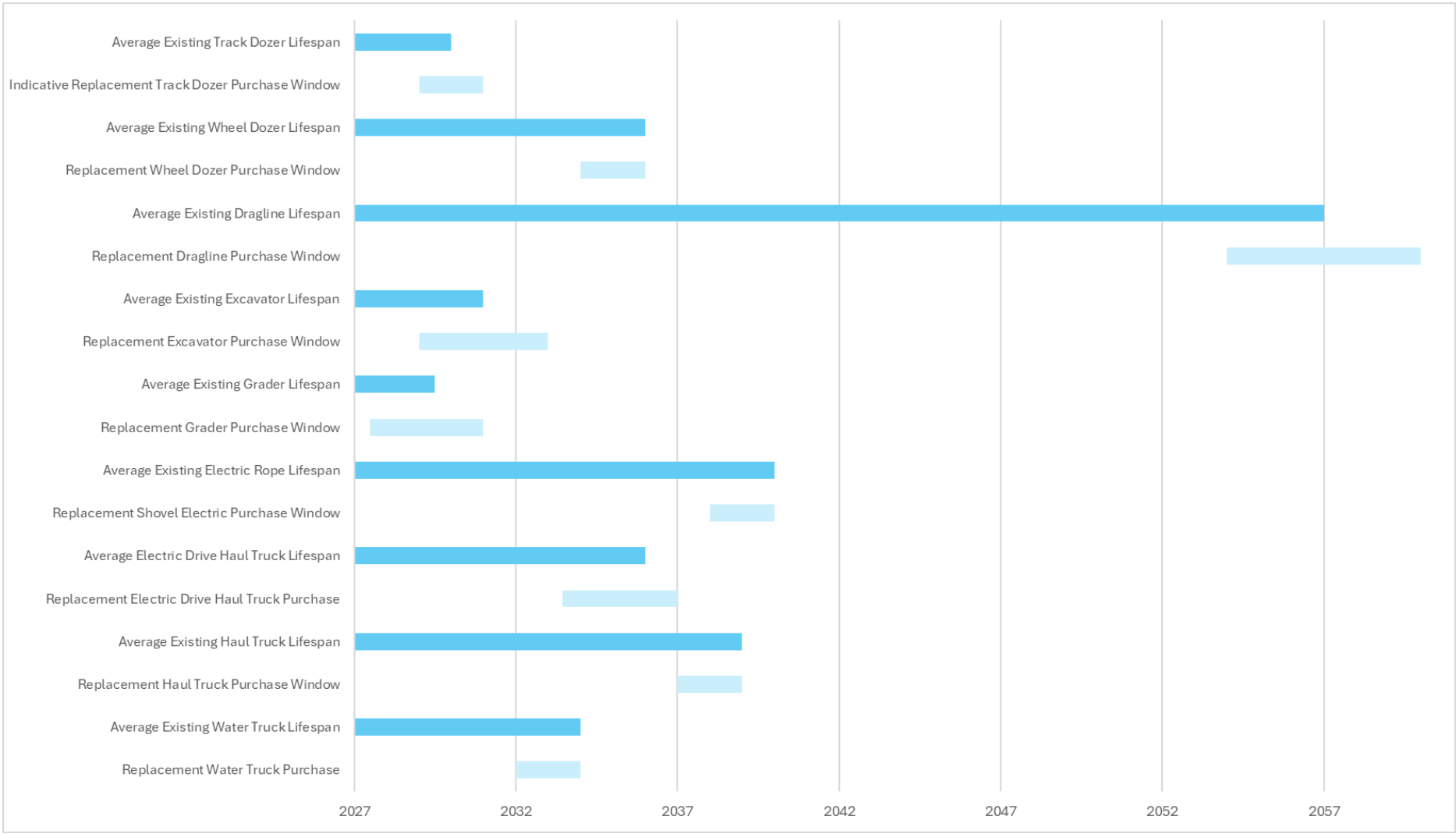


Chart 6 Indicative Fleet Procurement and Replacement Timeline

Specifically, indicative scheduling based on average equipment lifespan shows:

- **Dozers:** Replacement of wheel dozers is anticipated in the early to mid 2030s, with indicative purchase windows centred around 2032 to 2035.
- **Draglines:** Draglines are long life assets, with replacement not anticipated until the mid to late 2050s, consistent with average lifespans extending to approximately 2057.
- **Loaders:** Replacement of excavators and loaders is anticipated in the early 2030s, with indicative replacement windows between approximately 2031 and 2034.
- **Electric Haul Trucks:** Electric drive haul trucks are expected to reach end of average service life in the mid 2030s, with replacement purchase windows occurring around 2034 to 2037.
- **Mechanical Haul Trucks:** Mechanical drive haul trucks exhibit longer average lifespans, with indicative replacement windows in the late 2030s, around 2037 to 2040.

Final fleet composition, procurement timing and associated emissions profiles/technology decisions would continue to include consideration of reasonable and feasible greenhouse gas emission reduction opportunities and particulate emissions.

3.9 Existing Reasonable and Feasible Mitigation Measures

Whitehaven Blackwater currently utilise premium diesel in their QLD operations (Whitehaven, 2025). Premium diesel provides improved engine performance, fuel efficiency and subsequently results in reduced greenhouse gas emissions for the overall project.

In addition, Whitehaven Blackwater implements various controls to reduce diesel consumption including:

- managing dump trucks loading to fill capacity to maximise efficiency (i.e. fuel used per unit of material moved);
- maximising the efficiency of mining fleet through selection of truck size;
- maximising the efficiency of the mining fleet through regular maintenance;
- mine planning efficiencies to minimise the gradient, length and height of loaded haul runs for dump trucks, where practicable;
- in-pit and mobile refuelling facilities;
- monitoring system for heavy vehicle use and fuel burn. This system also determines individual equipment utilisation which assists in maximising fleet efficiency; and
- maximising in-pit dumping.

Lastly, Whitehaven Blackwater uses draglines and electric rope shovels as a significant part of the operation. These are tethered electrical mining equipment and are powered by the electricity grid rather than being diesel fuelled. This practice delivers material savings in diesel use relative to an alternative operation that uses solely diesel fuelled excavators and shovels.

Using draglines instead of conventional diesel excavators and haul trucks results in significant emission savings. Replacing the seven draglines operating at BWM would require approximately seven excavators and 58 haul trucks. This alternative scenario would consume an additional 150,000 litres of diesel each year, equivalent to around 420,000 t CO_2-e annually.

This outcome should be interpreted as part of business-as-usual operations at BWM rather than an additional mitigation commitment. That said, the presence of tethered equipment means a substantial portion of diesel emissions is already avoided in the current operating model, and as the associated electricity emissions intensity is expected to decline over time as the Queensland grid continues to decarbonize, the associated Scope 2 emissions are also anticipated to reduce for the BWM.

4 Reasonable and Feasible Greenhouse Gas Evaluation

4.1 Qualitative Evaluation of Reasonable and Feasible Mitigation Measures

4.1.1 QUALITATIVE EVALUATION METHODOLOGY

Whitehaven Blackwater has qualitatively assessed identified potential emission abatement measures in seven categories:

- **Technology Readiness:** The stage of a technology's development, ranging from feasibility studies to technology demonstrations.
- **Commercial Readiness:** The stage of a technology's commercial application, ranging from small-scale trials to widespread industry adoption. Considers the likelihood of the technology becoming commercially viable over the project life.
- **Capital Expenditure:** Anticipated capital investment required to implement the technology at the BWM.
- **Operational Expenditure:** Anticipated ongoing costs to operate the technology at the BWM when compared to current mining activities.
- **Abatement Effectiveness:** Anticipated greenhouse gas abatement achieved when compared to current mining activities.
- **Site Specific:** Considers the technology's suitability based on BWM's geology, terrain, mine plan and the likely marginal cost of abatement.
- **Summary Evaluation:** Considers all the above categories and if the technology could reasonably and feasibly integrate into the BWM, with the opportunity of a trial (either on or off site) to gather additional data or practical experience to further evaluate potential feasibility.

It is noted that, in the context of the Project, this qualitative evaluation considers Project emissions. However, as required by the QLD GHG Guideline, quantitative evaluation would consider the Project only emissions.

Technology and Commercial Readiness

Standardised technology readiness terminology was originally developed by the National Aeronautics and Space Administration for its development programmes, and has since been adopted by many organisations, including Australia's Defence Force. To standardise the description of the technology readiness and commercial readiness of alternative potential greenhouse gas mitigation technologies, Whitehaven Blackwater has adopted the Australian Renewable Energy Agency (ARENA) (2014) Technology Readiness Levels for Renewable Energy Sectors terminology. This terminology not only describes nine technology readiness levels from basic research to operations, it also helpfully outlines how these technology readiness levels typically relate in practice to commercial readiness levels, which naturally follow after the resolution of technological challenges. A schematic illustration is reproduced from ARENA (2014) in Chart 7 below.

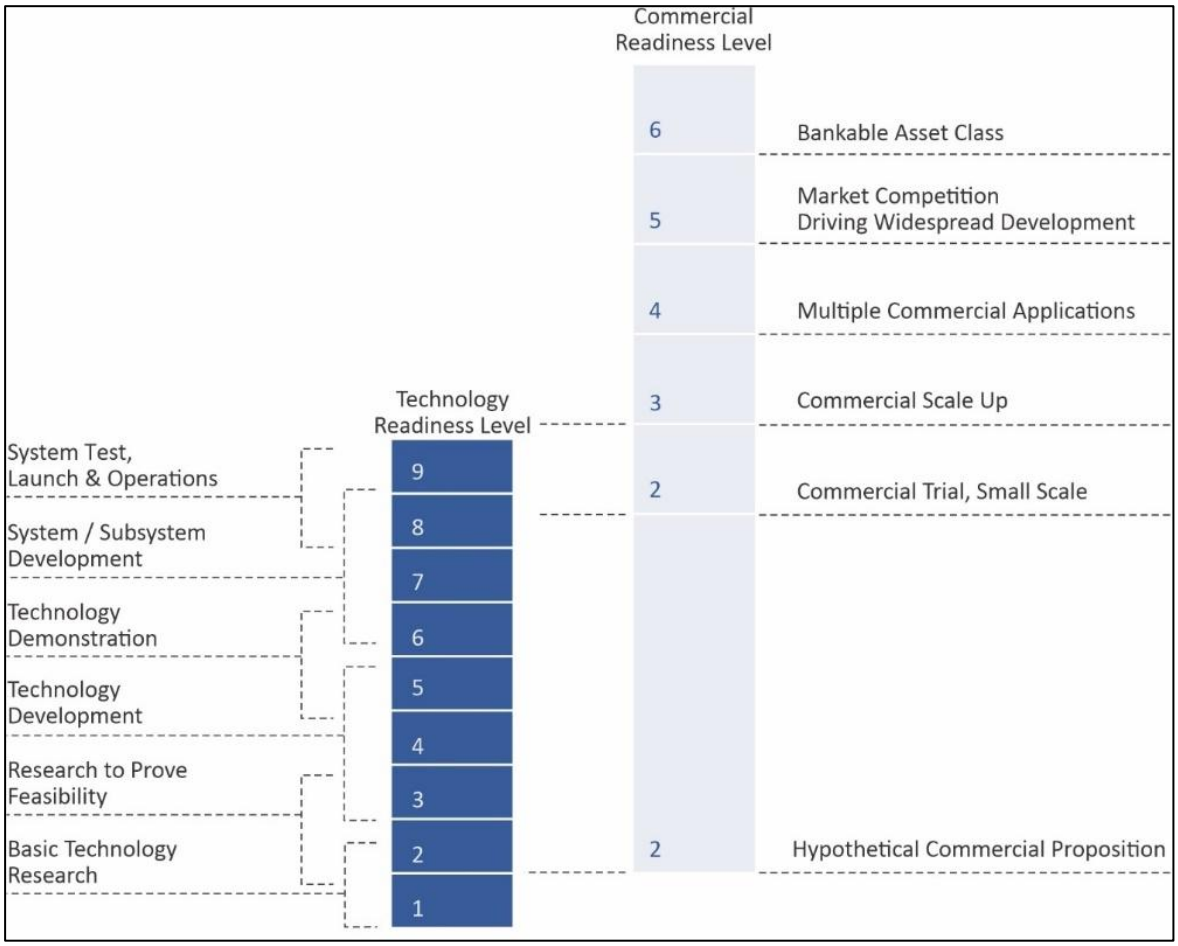
Where practical, Whitehaven Blackwater has used these descriptions to assist in classifying the technology readiness levels and commercial readiness levels of mitigation measures that may potentially be applicable to the Whitehaven Blackwater greenhouse gas emission reduction opportunities. It is noted that Whitehaven Blackwater can potentially be involved at all levels of the technology readiness and commercial readiness levels development pathway of a greenhouse gas mitigation measure. However, the adoption of a greenhouse gas mitigation measure is likely to require commercial readiness at level 4 or above to allow appropriate feasibility assessment.

4.1.2 EVALUATION OF REASONABLE AND FEASIBLE MITIGATION MEASURES

Key potential mitigation measures which have been identified and considered by Whitehaven are described and briefly discussed in Table 9.

Table 10 provides a colour-coded summary of the outcomes of the qualitative mitigation measures assessed by Whitehaven Blackwater. The colour coding represents Whitehaven Blackwater's evaluation of relative positive and negative factors for each opportunity, where dark green and dark red indicate the most positive and most negative factors, respectively. The intent of the colour-coded rating system is to illustrate the opportunities that Whitehaven Blackwater has rated more positively or negatively across many factors when considering potential application to BWM.

Key potential abatement opportunities that are considered to warrant further assessment in the three-year plan are discussed in Section 4.2.



Source: (ARENA, 2014).

Chart 7 Technical Readiness and Commercial Readiness Level Schematic (ARENA, 2014)

Table 9
Summary of Identified Potential Scope 1 and 2 Mitigation Measures

Opportunity Name	Mitigation Hierarchy	Summary Description of Mitigation Measure	Potential Effectiveness at the BWM
Scope 1 - Fugitive			
Pre-mining gas drainage and capture	Reduce	Reduce (pre-drain and capture) methane gas from coal seams prior to mining by drilling gas bores down to and/or within the target coal seams.	Whitehaven Blackwater has identified a broad range of potential fugitive emissions mitigation measures that may be applicable across the BWM. The effectiveness of these measures at the BWM cannot be appropriately assessed at this stage due to the current reliance on NGER Method 1 fugitive emissions estimates, which do not provide sufficient gas reservoir information, such as the resolution on gas content, gas composition, or spatial variability. While gas drainage, capture and abatement technologies have been applied more extensively at underground coal mines, their application at open cut operations remains limited and largely at pilot or demonstration scale. The applicability and potential effectiveness of fugitive emissions mitigation measures at Blackwater would be reviewed once mine specific NGER Method 2 modelling and detailed gas domain data become available. This future assessment would inform whether gas drainage, capture and abatement is practicable for the operation.
Methane flaring	Reduce	Abates (oxidises) methane through a flare system.	
Electricity generation	Reduce	Pre-drainage gas is reticulated to a gas treatment plant for use in gas engines to generate electricity.	
Compressed natural gas (CNG) or LNG generation	Reduce	Pre-drainage gas is reticulated to an appropriate treatment plant for export or local use.	
Scope 1 – Diesel (Fuel)			
Renewable Diesel Fuel Supply	Substitute	Blend site diesel supply with a proportion of renewable diesel.	Renewable diesel (e.g. hydrogenated vegetable oil) can be manufactured from a variety of feedstocks, is commercially available, and is present in small volumes in the Australian fuel market. Lifecycle emission reduction rates for renewable diesel, compared to conventional diesel, range from 75 to 90% (Neste Corporation, 2024; Volvo Penta, 2024). However, these reductions are highly variable and depend largely on the feedstock used (United States Environmental Protection Agency, 2024). Current supply options are limited and cost prohibitive, but costs may improve with Australian industry development.

Table 9 (Continued)
Summary of Identified Potential Scope 1 and 2 Mitigation Measures

Opportunity Name	Mitigation Hierarchy	Summary Description of Mitigation Measure	Potential Effectiveness at the BWM
Scope 1 – Diesel (Fuel) (Continued)			
Biodiesel Fuel Supply	Substitute	Augment site diesel supply with a proportion of biodiesel.	Biodiesel is fuel derived from organic feedstocks and is manufactured through a process of transesterification. It is typically blended with conventional diesel in proportions such as 5% biodiesel (B5) or 20% biodiesel (B20) as diesel engine compatibility (in particular large mining haul truck engines) varies significantly (Australian Clean Energy Finance Corporation and the Minerals Research Institute of Western Australia, 2022). While compatible with many existing diesel engines, higher blends may require equipment modifications or enhanced maintenance protocols. Renewable diesel has largely supplanted biodiesel as the preferred low carbon fuel prospect for the mining industry, primarily since the negative impacts of biodiesel are largely averted due to its chemical similarity to conventional diesel. Biodiesel is currently cost-prohibitive and is less likely to be a long-term solution relative to renewable diesel.
Hydrogen Derived Fuel Supply	Substitute	Utilise alternative hydrogen-derived fuel for a proportion of mobile equipment.	Commercial readiness, energy conversion efficiency limitations and the infrastructure required remain significant limitations for hydrogen-derived fuels. Whitehaven considers it unlikely to become a reasonable and feasible fuel alternative in the near future.
Hydrogen Trickle Feed	Substitute	Augment diesel engines to introduce hydrogen trickle-feed supply.	This parasitic trickle-feed technology has recently become commercially available for a wide range of diesel engine sizes, including light vehicles, heavy on-road trucks, offroad heavy equipment and stationary engines (Alpha H2 Limited [Alpha H2], 2025). Hydrogen trickle-feed systems are designed to be retrofitted to existing diesel engines by mounting the new system on the existing vehicle, connecting to the existing low-voltage electrical system and introducing the hydrogen trickle-feed supply to the diesel engine air intake. Once fitted, the only material ongoing input is distilled water (HYDI, 2025; Alpha H2, 2025). Alpha H2 reports that third-party testing of its parasitic hydrogen trickle-feed system on a heavy semi-trailer and commercial vehicle has verified improvements in performance of approximately 17 to 25% reduction in fuel usage (Alpha H2, 2024a; 2024b). Currently not commercially available for implementation at the BWM.

Table 9 (Continued)
Summary of Identified Potential Scope 1 and 2 Mitigation Measures

Opportunity Name	Mitigation Hierarchy	Summary Description of Mitigation Measure	Potential Effectiveness at the BWM
Scope 1 – Diesel (Fuel) (Continued)			
Retrofitted CNG vehicles	Substitute	Pre-drainage gas is reticulated to a gas treatment plant for use as an alternative to diesel fuels. This would also require modifications to the existing diesel equipment.	Conversion of diesel engines to operate on CNG (dual-fuel systems) requires high-pressure gas storage, injection hardware and on-site gas handling infrastructure. Dual-fuel systems can achieve high diesel-substitution rates and measurable emission reductions, however the effectiveness of the technology is heavily dependent on access to a consistent and affordable local gas supply.
Scope 1 – Diesel (Equipment)			
In pit crushing and conveying	Substitute	In-pit crushing of waste/rock and utilising conveyors for transport of material to reduce diesel combustion for transport of material.	In-pit-crushing and conveying systems are a mature technology with a long history of use in open cut hard rock mining that offers an alternative to conventional truck haulage systems. However, this is not a technology that is currently utilised in coal mining due to high advance rates and dynamic pit construction. The feasibility of implementing in-pit-crushing and conveying systems is context-dependent (i.e. favoured for operations with longer and more stable haul routes) and implementation requires substantial civil works and associated detailed mine planning and design to accommodate the linear conveyor systems. Would require investment in electrical infrastructure to support the additional conveyor drives and associated on-site supply and electricity distribution systems. Coal mines like the BWM which have established draglines, haul truck fleet and mine geometry (including ramps) optimised for conventional truck haulage would present significant barriers of entry.
Trolley Assist	Substitute	Haul trucks connected to overhead catenary lines to draw electricity for climbing steep grades.	Trolley-assist haul trucks are specialised mining vehicles designed to draw power from an overhead or side electrical supply, supplementing their conventional diesel-electric propulsion systems. By electrifying key segments of the haul route (particularly during energy-intensive activities such as uphill hauling) trolley-assist systems can reduce overall diesel consumption, lower greenhouse gas emissions, and improve haulage efficiency.

Table 9 (Continued)
Summary of Identified Potential Scope 1 and 2 Mitigation Measures

Opportunity Name	Mitigation Hierarchy	Summary Description of Mitigation Measure	Potential Effectiveness at the BWM
Scope 1 – Diesel (Equipment) (Continued)			
Trolley Assist (Continued)	Continued.	Continued.	The feasibility of trolley-assist systems is highly dependent on mine layout and topography. These systems require significant capital investment and are subject to operational constraints. Implementation also has implications for site-wide electrical demand and power distribution infrastructure. Similarly to IPCC, trolley assist is best suited to hard rock mining, with coal mine advance rate and dynamic changes to ramps and haul routes presenting significant barriers of entry.
Plug-in (tethered) electric equipment	Substitute	Replace diesel powered loading equipment with plug-in (tethered) electric loading equipment	Plug in electric equipment replaces diesel engines with electric drives and motors supplied via a trailing cable or fixed connection. The emissions benefit at BWM is driven by how much diesel activity can be substituted and the carbon intensity of supplied electricity, noting the site has established grid supply arrangements via high voltage transmission and a site intake connection. At BWM, the practical application is strongest where operating areas are predictable and semi fixed, and where cable management, relocation frequency, and electrical reticulation can be controlled. Uptake would depend on mine planning, the ability to stage electrical distribution upgrades and existing mining fleet lifespan (Chart 4).
Battery electric vehicle	Substitute	Replace mobile diesel equipment with battery electric vehicles (BEVs).	BEVs replace diesel combustion engines by using onboard batteries and electric drivetrains, with charging via fixed or dynamic charging infrastructure and associated power management. For BWM, effectiveness scales with the proportion of mobile diesel plant displaced, the availability and placement of charging to avoid productivity losses, and the ability to manage charging demand against site electrical capacity and distribution. For larger mining equipment categories, battery electric technology remains in active development and trial phases across the sector, including charging system evaluation. Subsequently, BEVs have near term deployment risk and uncertainty for substitution of ultra class haulage.

Table 9 (Continued)
Summary of Identified Potential Scope 1 and 2 Mitigation Measures

Opportunity Name	Mitigation Hierarchy	Summary Description of Mitigation Measure	Potential Effectiveness at the BWM
Scope 1 – Diesel (Equipment) (Continued)			
Hybrid diesel-electric vehicle	Substitute	Diesel-electric hybrid vehicles utilised to reduce consumption of diesel.	Hybrid diesel electric vehicles retain a primary diesel engine but integrate an electric drive and potentially an energy recovery system, typically capturing energy through regenerative braking and redeploying it to support high demand activities such as acceleration or uphill haulage. This configuration can reduce diesel consumption and associated emissions while also improving equipment productivity in duty cycles with frequent braking and variable load and has been noted as having potential to materially reduce fuel consumption and improve cycle times. Note, this differs from existing diesel electric heavy mobile equipment currently operating on site, which uses a diesel engine to generate electricity for electric traction motors but typically has limited energy storage capacity. Hybrid diesel electric equipment can be implemented without new electrical infrastructure. Adoption would be aligned with the fleet replacement schedule (Chart 6) and evaluated against conventional diesel equipment on a whole of plant cost and productivity basis. Based on current evidence, efficiency gains associated with alternative haulage technologies are expected to be limited, with marginal improvements in operational performance relative to diesel fleets constraining near term uptake.
Autonomy	Reduce	autonomous mine vehicles to optimise engine loading, reduce idling and other key benefits.	Autonomy of major plant items (e.g. haul trucks, excavators) can improve productivity and fuel efficiency through optimised operation and reduced idle time.
Scope 2 – Electricity			
Renewable grid electricity	Substitute	Sourcing electricity from renewable-heavy grids reducing indirect emissions intensity.	Electricity consumption accounts for approximately 5% of the combined Scope 1 and 2 emissions at the BWM. Commonwealth DCCEEW (2025e) projects ongoing decarbonisation of the QLD electricity grid, with emission factors expected to be 0.19, and 0.23 t CO_2-e per megawatt-hour by 2030, and 2040 respectively (i.e. based on this forecast, the benefits of establishing a solar farm or a renewable electricity supply contract would decline over time as the grid is progressively decarbonised).
On-site renewable energy	Substitute	Use of on-site renewable electricity generation in the form of solar, wind, geothermal, etc.	
On-site energy storage	Substitute	Energy storage systems to enable greater renewable penetration in high-emission grid periods.	

Table 10
Evaluation Matrix

Opportunity Name	TR	CR	CAPEX	OPEX	Abatement Potential	Site Specific	Summary Evaluation	Key notes
Scope 1 – Diesel (Fuel)								
Renewable Diesel Fuel Supply								Current supply options are limited and is currently cost-prohibitive. Cost may improve with Australian industry development. Any blending proportion is acceptable.
Biodiesel Fuel Supply								The effectiveness of biodiesel in reducing greenhouse gas emissions is limited by safe engine blend limits.
Hydrogen Derived Fuel Supply								Energy conversion efficiency limitations and the infrastructure required remain significant limitations for green hydrogen-derived fuels.
Hydrogen Trickle Feed								Retrofitting existing diesel engines with a parasitic hydrogen trickle-feed system may reduce both fuel consumption and particulate emissions.
Retrofitted CNG vehicles								Retrofitting existing diesel engines with a dual fuel system to allow CNG fuel consumption may reduce both fuel consumption and particulate emissions. Affordable local or on-site supply would be required
Scope 1 – Diesel (Equipment)								
In pit crushing and conveying								Due to the site layout and LOM capacity planning the IPCC option, this abatement option has limited current use at BWM.
Trolley Assist								Due to the dynamic nature of BWM waste haul road networks, the implementation of any fixed electrical assist system is not likely to be suitable for the Project, however, will be continually reviewed during ongoing GMAP reviews.
Plug-in electric equipment								Electric rope shovels are an example of tethered equipment and are already in use at BWM. Further use is not considered feasible (their use is already optimised).

Table 10 (Continued)
Evaluation Matrix

Opportunity Name	TR	CR	CAPEX	OPEX	Abatement Potential	Site Specific	Summary Evaluation	Key notes
Scope 1 – Diesel (Equipment) (Continued)								
Battery electric vehicle								Due to the current state of commercial and technical readiness of large haul truck BEVs, this technology will continue to be monitored during ongoing GMAP reviews.
Hybrid diesel-electric vehicle								Hybrid diesel-electric vehicles are noted as a key potential abatement opportunity for BWM as it may practicably reduce diesel emissions.
Autonomy								The implementation of autonomous haulage is not likely to be suitable for the Project, however, will be continually reviewed during ongoing GMAP reviews.
Scope 2 – Electricity								
Renewable grid electricity								Renewable grid electricity contract supplied by a third party for the mine.
On-site renewable energy								Due to high CAPEX and limited abatement potential due to the projected QLD grid greening for 2050, this abatement option has limited current use at BWM; however, as electricity consumption increases due to other abatement measures, this option may become feasible in the future.
On-site energy storage								Due to high CAPEX and limited abatement potential due to the projected QLD Grid Greening for 2050, this abatement option has limited current use at BWM; however, as electricity consumption increases due to other abatement measures, this option may become feasible in the future.

Table 10 (Continued)
Evaluation Matrix

Opportunity Name	TR	CR	CAPEX	OPEX	Abatement Potential	Site Specific	Summary Evaluation	Key notes
Scope 1 - Fugitive								
Pre-mining gas drainage and capture								Whitehaven Blackwater has completed a high-level assessment of potential fugitive emissions mitigation measures for BWM on a NGER Act Measurement Determination Method 1 basis to inform the GMAP at concept stage. These potential mitigation measures would be revisited and assessed once Method 2 determinations, supporting site specific gas domain inputs are available and progress of the Three-Year Action Plan.
Methane flaring								
Electricity generation								
CNG or LNG generation								

Notes: TR = Technological Readiness, CR = Commercial Readiness, CAPEX = Capital Expenditure, OPEX = Operational Expenditure, Abatement Potential = Effectiveness of Greenhouse Gas Abatement, Site Specific = Effectiveness at BWM, Summary Evaluation = Pre-Project Quantitative Evaluation, IPCC = International Panel on Climate Change.
Colour Legend:

Most Positive	Positive	Neutral	Negative	Most Negative	Not Applicable

4.2 Key Prospective Technologies for the Site

Following the evaluation, the below mitigation measures have been short-listed for potential selection into BWM's decarbonisation plan. The below mitigation measures have been selected for a multitude of reasons, including:

- greenhouse gas abatement potential;
- technology readiness; and
- permitting future scope and scale adjustments to allow for adaptation during the life of the operation where emissions conditions would be experienced.

These options generally support a phased introduction, lowering the capacity intensity while also supporting the opportunity to adopt new technologies as commercial visibility is proven.

4.2.1 SCOPE 1 – GAS CAPTURE AND DRAINAGE OPTIONS

Whitehaven Blackwater has undertaken a high level, conceptual assessment of gas capture, drainage and treatment options for BWM to identify measures that may reduce fugitive CH_4 emissions over time. This assessment was completed on the basis of NGER Act Measurement Determination Method 1 for fugitive emissions and is intended to inform the GMAP at concept stage only.

Fugitive emissions mitigation measures would be revisited and refined once Method 2 determinations and supporting site specific gas domain inputs are available, including improved gas content and composition data, reservoir and drainage characterisation, and other geological and operational parameters that materially influence technical feasibility, extraction performance and the most appropriate treatment pathway for any recovered gas. Until that point, the Three-Year Action Plan focuses on establishing the required baseline and completing the feasibility work needed to confirm whether gas drainage and treatment measures are reasonable and feasible for the Project's operational context (Section 5).

4.2.2 SCOPE 1 – DIESEL COMBUSTION

Whitehaven Blackwater has considered several diesel combustion options, and notes the following are shortlisted to be implemented at BWM:

Alternative Carbon Neutral Diesel Supply

Whitehaven does not consider biodiesel to be a viable long-term pathway for the BWM. Biodiesel is typically supplied as a blend (for example B5 or B20), and equipment compatibility can vary materially for large mining haul trucks and other heavy equipment, which can introduce constraints on the blend level that can be adopted and the durability of any operational benefits. In this context, biodiesel is considered less likely to represent a durable, scalable substitute for conventional diesel at the Project relative to renewable diesel.

Accordingly, the preferred alternative liquid fuel pathway for the Project is renewable diesel (e.g. hydrogenated vegetable oil [HVO]), which is chemically very similar to conventional diesel and is increasingly treated internationally as a drop in option for diesel fleets. Near term uptake at the Project is expected to be limited by Australian supply availability and price.

Whitehaven has undertaken a trial of renewable diesel (HVO) at the MCCM.

The trial involved use of renewable diesel (supplied by Viva Energy Australia [Viva Energy Australia, 2024]), with short-term hire of compliant fuel storage infrastructure. Operationally, no major issues were observed, and ancillary equipment such as lighting plants and gensets showed no noticeable performance reduction. In haul trucks, data indicated somewhat higher fuel consumption compared to conventional diesel (fuel consumption is expected to increase when using HVO as it has slightly lower calorific value than conventional diesel); however, this was based on a relatively short trial period with limited datasets and detailed haul truck data from Cummin's indicated no significant deviations in fuel usage rates after the trial was completed. Operators reported no discernible difference in performance, reliability, or availability, and one generator was observed to run cleaner with reduced visible emissions.

Overall, the trial confirmed the technical feasibility of renewable diesel integration, with no adverse maintenance impacts during the trial period. However, renewable diesel fuel costs in the trial were approximately four times higher than conventional diesel, indicating that any adoption is not viable at current prices in NSW.

Given the limited domestic production capacity and the growing interest in renewable diesel across various sectors, any additional supply that enters the market is likely to be shared across multiple industries. This includes not only road transport but also maritime and other sectors exploring decarbonisation pathways. Importantly, the Australian Government has recently committed $1.1 billion to support and stimulate domestic production of low carbon liquid fuels, which includes renewable diesel, sustainable aviation fuels, and e fuels, as well as explicitly recognising that mining is one of the “hard-to-abate” sectors (Commonwealth DCCEEW, 2025d).

Battery Electric Vehicles and/or Hybrid Diesel Equipment

Battery electric vehicles replace diesel combustion through onboard batteries and electric drivetrains, with charging provided via fixed or mobile infrastructure and associated power management systems. For the BWM, the effectiveness of BEVs would scale with the proportion of mobile diesel plant displaced, the availability and placement of charging infrastructure to avoid productivity losses, and the capacity of the site electrical network to accommodate dynamic charging demand (including consideration of electrical demand from neighbouring mines which are likely to decarbonise at the same time). For large mining equipment categories, including ultra class haulage, battery electric technology remains in active development and trial phases across the sector, with ongoing evaluation of charging systems.

Hybrid diesel-electric equipment provides a near term substitution pathway that can reduce diesel consumption without reliance on site charging infrastructure. Hybrid diesel-electric vehicles retain a primary diesel engine but integrate an electric drive and potentially an energy recovery system, typically capturing energy through regenerative braking and redeploying it to support high demand activities such as acceleration or uphill haulage. This configuration can marginally reduce diesel consumption and associated emissions and can improve productivity in duty cycles with frequent braking and variable load and would be assessed against conventional diesel options on a whole of plant cost and productivity basis as part of procurement decisions aligned with the fleet replacement schedule.

The technical and commercial readiness of BEVs and other electrification pathways will continue to be monitored and reviewed through ongoing GMAP updates, informed by industry trials, OEM developments and site-specific operating factors.

The Three-Year Action Plan is described in Section 5.2, including consultation with OEMs and procurement evaluation of hybrid diesel equipment alternatives for haul trucks, dozers and loaders against conventional diesel equipment based on life of plant financial and productivity analysis.

4.2.3 SCOPE 2 – ELECTRICITY FROM MAIN GRID

Renewable grid electricity

Renewable grid electricity can be pursued through a renewable or carbon neutral electricity supply contract with an electricity retailer or independent power provider, with the contract structured to reduce the indirect emissions intensity associated with purchased electricity. Key constraints for this pathway include limited availability of firmed renewable electricity and limited incentives under the Safeguard Mechanism for Scope 2 abatement in isolation.

At BWM, electricity consumption is currently a minor contributor to the combined Scope 1 and Scope 2 profile so the abatement significance of a renewable electricity contract is expected to be modest in the near term. The relative benefit is also expected to decline over time as the grid progressively decarbonises, meaning any solar farm or carbon neutral electricity supply contract delivers diminishing marginal reductions as grid emission factors fall.

Details on electricity options from the main grid are discussed below and further actions proposed in the Three-Year Action Plan period are described in Section 5.3.

5 Three-Year Action Plan

Whitehaven would implement adaptive management of greenhouse gas emissions over the life of the BWM, consistent with Australia's emissions reduction requirements as set out under the Safeguard Mechanism.

As part of detailed engineering design and feasibility assessment further quantitative evaluations would be conducted. Such analysis would be undertaken post-approval and as such a Three-Year Action Plan has been developed to guide these decisions and would be subject to regular reviews, based on the technological, economic, regulatory and Project context at the time.

The Three-Year Action Plan has been developed to align with the current stage of the Project (i.e. environmental approvals) and the information that is presently available for the BWM. The Three-Year Action Plan would be revisited during the course of the Project as the regulatory, operational, technological and commercial context evolves.

The Three-Year Action Plan focuses on activities that increase site-specific information, including targeted trials and feasibility assessments that enable Whitehaven to identify measures that are reasonable and feasible.

A peer review of this GMAP, including the Three-Year Action Plan was undertaken by Loop Decarbonisation Services (2026), which concluded the GMAP is robust and meets the expectations of a mitigation planning document under the QLD GHG Guideline (Appendix C).

5.1 Scope 1 – Gas Capture and Drainage Options

Table 11 sets out the three-year work program for fugitive emissions management for the Project. Fugitive emissions are a material Scope 1 source at the BWM, but site-specific characterisation and feasibility work for BWM remains at an early stage and would be progressively refined in future GMAP revisions.

Accordingly, the actions in Table 11 prioritise establishing a baseline and assess whether gas drainage, capture and abatement options (for example surface-to-inseam drilling and flaring or utilisation pathways) are reasonable and feasible for the Project's operational context.

Technology adoption timing and engineering solutions are subject to further feasibility assessment, technology maturation and operational planning considerations.

Table 11
Three-Year Action Plan – Fugitive Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Transition to NGER Method 2 Fugitive Emissions Basis	Transition of the BWM fugitive emissions estimates to a NGER Method 2 basis (as updated modelling inputs and supporting documentation become available).	Incorporate fugitive emissions forecasting outputs into the Project fugitive emissions methodology and assumptions.	N/A	Transitioning the Project's fugitive emissions estimates to an NGER Method 2 basis would enhance the accuracy of fugitive emissions estimation. This higher resolution would support more detailed feasibility assessments. In addition, Method 2 will provide a basis to account for gas capture and abatement.
Methane Pre-Drainage Capture and Abatement	Undertake a concept assessment of methane pre-drainage capture and abatement opportunities within the 5-year mine plan, informed by available gas reservoir data and development of the Method 2 gas model. Develop forward work plan for methane gas capture, including field validation if appropriate.	Progress shortlisted concepts through technical and economic feasibility assessment informed by updated gas reservoir information and Method 2 fugitive emissions estimates as appropriate.	Where feasibility assessment supports and recommends progression, arrange a pilot trial program (subject to regulatory requirements) to validate feasibility assumptions or fill data gaps for methane capture and abatement options.	Methane capture and abatement opportunities at BWM are highly site specific and dependent on gas reservoir characteristics, mine sequencing, and operational factors. Subject to outcomes of the concept assessment, feasibility assessment and pilot trial, integrate preferred methane pre-drainage into the next Three-Year Action Plan, considering the mine plan progress and appropriate regulatory approval pathways for development. The staged assessment approach provides a progression from gas modelling to concept development and feasibility screening with emerging industry practice in the Bowen Basin.

^ Year 1 is indicatively financial year 2027

5.2 Scope 1 – Diesel Combustion

Table 12 sets out the three-year work program in relation to the Project's diesel emissions, recognising diesel combustion is a major contributor to the Project's Scope 1 emissions profile and is strongly influenced by haulage requirements and operational practices (e.g. use of draglines instead of diesel haul trucks). The actions in Table 12 aim to build operational understanding, including evaluation of near-term fuel substitution options where practicable and assessment of market available hybrid and battery electric alternatives as part of replacement decisions within the equipment procurement cycle.

Table 12
Three-Year Action Plan – Diesel Combustion Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Biodiesel/Renewable Diesel	Conduct cost and efficiency review of potential diesel fuel alternatives and review transferability of Maules Creek Coal Mine trial outcomes to the BWM.	Undertake site specific applicability assessment for biodiesel and renewable diesel at the BWM, including fleet compatibility, fuel quality requirements, storage and handling constraints.	Review potential feasibility including the marginal abatement cost of partial implementation.	Moderate trial opportunity, low-risk implementation and potential to modestly reduce diesel fuel emissions.
Hybrid Diesel Equipment	Consult with OEMs on the availability and practicability of hybrid diesel equipment alternatives for haul trucks, dozers and loaders, including capital, operating and fuel consumption data	Conduct a procurement evaluation of currently available hybrid diesel equipment vs conventional diesel equipment based on life-of-plant financial and productivity analysis.	Determine potential feasibility of adoption of hybrid equipment in consideration of the BWM replacement schedule. Undertake a review of the readiness of large mining BEVs and associated infrastructure, to inform future emission reduction plans.	Hybrid diesel/electric equipment has potential to materially reduce diesel combustion emissions.
Tethered Equipment Study	Consult with OEMs on the availability and practicability of electrical tethered equipment as a replacement for existing diesel powered equipment, including capital, operating and electricity consumption data.	Considering the previous consultation, identify the tethered equipment that may be suitable for use at the Project and evaluate the applicable site electrical supply and distribution requirements and any key constraints to adoption.	Determine potential feasibility of adoption of previously identified tethered equipment in consideration of any site constraints and procurement requirements.	The use of electrical equipment would reduce Scope 1 emissions through the displacement of diesel and other direct fuel combustion sources.

^ Year 1 is indicatively financial year 2027

5.3 Scope 2 – Electricity from Main Grid

Table 13 sets out the three-year work program for Scope 2 emissions management. The actions in Table 13 prioritise improved understanding of electricity demand and efficiency opportunities, alongside a staged review of practicable renewable electricity contracts consistent with broader corporate considerations.

Table 13
Three-Year Action Plan – Scope 2 Emissions

Measure	Year 1^	Year 2	Year 3	Rationale
Site Electricity Supply – Offset Scope 2 emissions	Assess available options and consult with existing suppliers (e.g. GreenPower is currently used for Whitehaven's NSW operations) or alternative renewable electricity providers regarding opportunities to offset Scope 2 emissions at the BWM.	Determine whether it would be reasonable and feasible to offset Scope 2 emissions associated with the site electricity supply (agreement extension or alternative supplier).	Implement extended or new site electricity supply agreement (if applicable).	As the electricity grid is progressively decarbonised, Scope 2 emissions would correspondingly fall.

^ Year 1 is indicatively financial year 2027

6 Monitoring, Reporting and Review

6.1 Monitoring

Diesel, electricity usage, ROM coal and waste extraction would be monitored for the Project, to track diesel and electricity efficiency.

Greenhouse gas emissions from the Project would be tracked and reported each year in the Australian Government's *National Greenhouse and Energy Reporting Scheme* (Section 6.2).

Whitehaven acknowledges the Australian Government's recent appointment of an expert Panel (the Panel) to provide advice on atmospheric measurement of fugitive methane emissions in Australia (Commonwealth DCCEEW, 2025b). The Panel will run until 2027 and would provide advice to the Australian Government regarding the use of top-down approaches for estimating fugitive methane emissions from coal, oil and gas sector activities and the role top-down approaches could play in the NGER scheme. Future revisions of this plan would incorporate any updates to align with legislative changes as a result of this advice.

6.2 National Greenhouse and Energy Reporting

Annual assessment of greenhouse gas emissions would be reported in accordance with the NGER Act and the most contemporary NGER Determination.

The report would be provided to the CER by the end of October each year, provided in the manner and form in accordance with the requirements of the *Guideline – Manner and Form Sections 19 22G and 22X reports* (CER, 2021a).

Consistent with Whitehaven's corporate reporting framework, NGER data for the BWM is subject to third party independent assurance prior to submission.

6.3 Review

This GMAP would be reviewed, and if necessary revised, at least every three years. Each review would incorporate the outcomes of the current three-year action plan and any other relevant updates across this report, including updates to emissions reduction targets and implementation measures to reflect changes to the Safeguard Mechanism and other applicable requirements, and would establish a new three-year action plan for the subsequent period. Whitehaven Blackwater would also regularly (that is, biennially) assess, review and evaluate greenhouse gas emission abatement opportunities for implementation at the Project, with outcomes used to inform subsequent revisions and inclusion in this GMAP. As described in Section 4.1.1, all future quantitative evaluations would consider the Project only emissions.

7 Potential Impacts of Greenhouse Gas Emissions on Environmental Values

Consideration of the potential implications of climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes.

Although scientific understanding of climate change has improved, projections are still subject to a wide range of uncertainties such as (Commonwealth Scientific and Industrial Research Organisation [CSIRO] and Bureau of Meteorology [BoM], 2015):

> *…scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols; response uncertainty, resulting from limitations in our understanding of the climate system and its representation in climate models; and natural variability, the uncertainty stemming from unperturbed variability in the climate system.*

The sources for climate change projections considered for the Project include the following:

- The Working Group 1 Contribution to the Sixth Assessment Report of the IPCC (IPCC, 2021).
- Climate Change in Australia, produced by CSIRO and BoM (CSIRO and BoM, 2015).
- Information included in the QLD GHG Guideline (DETSI, 2026).

7.1 Climate Change Projections Globally

The IPCC has completed a number of comprehensive assessments of potential climate change, which include projections for both the 'near-term' (for the period 2021 to 2040), and 'long-term' (for the period 2081 to 2100). Summaries of relevant climate projections from the *Working Group 1 Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2021) are provided below:

- 'Near-term' climate projections – projections indicated global mean surface temperatures are likely to increase by 0.4 to 1.1°C based on the range of all climate scenarios and relative to the reference period of 1995 to 2014.
- 'Long-term' climatic projections – global mean surface temperatures are projected to increase by 1.3 to 2.7°C under the SSP2-4.55 climate scenario and 2.5 to 4.9°C under the SSP5-8.56 climate scenario relative to the reference period of 1995 to 2014.

Climate projections suggest that many changes in the climate system are likely to become larger in direct relation to increasing incremental global warming, with a warmer climate likely to intensify very wet and very dry weather and climatic events and seasons, noting the frequency is dependent on location (IPCC, 2021).

Extreme climatic events (e.g. hot extremes [including heatwaves], heavy rainfall events and droughts) are projected to be more frequent if global warming reaches 1.5°C above pre-industrial levels, and even more frequent if global temperatures are raised to 2°C above pre-industrial levels for some regions (IPCC, 2021).

Climate Change 2022: Impacts, Adaptation and Vulnerability – Key Potential Impacts

The IPCC (2021) states that if global warming reaches 1.5°C above pre-industrial levels in the near-term, unavoidable increases in multiple climate hazards would occur and present multiple risks to ecosystems and humans including increased frequency, severity and duration of extreme weather events.

Beyond 2040 and depending on the level of global warming, climate change would lead to numerous risks to natural and human systems, with the magnitude and rate of this strongly dependent on near-term mitigation and adaptation actions (IPCC, 2021).

Multiple climate hazards are also projected to occur simultaneously, and multiple climatic and non-climatic risks would interact, resulting in compounding overall risk and risks cascading across sectors and regions (IPCC, 2021).

7.2 Climate Change Projections for Australia

In Australia, the climate is generally projected to become warmer and drier. Climate change may result in changes to rainfall patterns, runoff patterns and river flow.

It is noted that the RCP8.5 scenario (worst-case) illustrated in Table 14 is a scenario where minimal greenhouse gas emissions controls are introduced and therefore does not reflect the measures currently being pursued by Parties to the *Paris Agreement*.

Table 15 presents two global greenhouse gas emission scenario projections for annual average rainfall in the East Coast South sub-cluster of 'Eastern Australia' for 2030 and 2090 (relative to 1995), based on the Climate Change in Australia impact (CSIRO and BoM, 2015).

Table 14
Climate Change Projections for the East Coast South Sub-cluster, Eastern Australia – Percentage Change in Rainfall (relative to 1995)

Period	2030	2090	
	RCP4.5	RCP4.5	RCP8.5
Summer	+1	0	+10
Autumn	-5	-4	-4
Winter	-3	-10	-17
Spring	-2	-8	-14
Annual	**-2**	**-4**	**-6**

Source: (CSIRO and BoM, 2015).
RCP4.5: Emissions scenario assuming a slow reduction in emissions that stabilises CO_2 concentration at about 540 parts per million (ppm) by 2100.
RCP8.5: Emissions scenario assuming an increase in emission leading to a CO_2 concentration of about 940 ppm by 2100.

7.3 Climate Change Projections for Queensland

In QLD, average temperatures across the state are currently 1°C higher than they were 100 years ago (DETSI, 2026). Climate change is expected by the DETSI (2026) to further impact QLD in the future, including:

- higher temperatures;
- hotter and more frequent hot days;
- harsher fire weather;
- fewer frosts;
- reduced rainfall in the south-east;
- more intense downpours;
- less frequent but more intense tropical cyclones in the north;
- rising sea level;
- more frequent sea-level extremes; and
- warmer and more acidic seas (Queensland Government, 2019).

Human-induced changes to climate can negatively affect environmental values (DETSI, 2026), including:

- human health and wellbeing;
- the health and biodiversity of ecosystems; and
- agricultural use of the environment.

The Australian Government Consistent Climate Scenarios (CCS) project was used to generate climate change adjusted rainfall and evaporation data, which transformed historical climate data from the period between 1960 and 2024 (64 years). The CCS project provides climate projections as a daily time series across Australia on a 0.05-degree grid.

Changes to annual rainfall are predicted to vary across the Central Highlands Region, with average rainfall projected to decrease annually (Trancoso et al., 2024) (Table 15).

Table 15
Climate Change Projections for the Central Highlands Region, Queensland – Change in Rainfall (mm/d)

Period	2050			2090		
Scenario	SSP1-2.6 (mm/d)	SSP2-4.5 (mm/d)	SSP3-7.0 (mm/d)	SSP1-2.6 (mm/d)	SSP2-4.5 (mm/d)	SSP3-7.0 (mm/d)
Summer	-0.1 (-0.8 – 0.6)	-0.3 (-0.9 – 0.5)	-0.1 (-1.3 – 0.6)	-0.3 (-0.7 – 0.3)	-0.3 (-1.1 – 0.5)	-0.1 (-1.1 – 0.4)
Autumn	-0.3 (-0.7 – 0)	-0.2 (-0.5 – 0.2)	-0.2 (-0.7 – 0.3)	-0.2 (-0.8 – 0.1)	-0.4 (-0.8 - -0.2)	-0.5 (-0.8 - -0.1)
Winter	-0.1 (-0.5 – 0.2)	0 (-0.3 – 0.3)	0 (-0.3 – 0.2)	-0.1 (-0.4 – 0.2)	-0.1 (-0.5 – 0.1)	0 (-0.4 – 0.1)
Spring	-0.1 (-0.8 – 0.4)	-0.1 (-0.4 – 0.2)	0 (0.6 – 0.2)	-0.1 (-0.5 – 0.3)	0 (-0.5 – 0.4)	-0.1 (-0.4 – 0.3)
Annual	-0.1 (-0.3 – 0)	-0.1 (-0.3 – 0.2)	-0.1 (-0.5 – 0.3)	-0.2 (-0.3 – 0)	-0.2 (-0.4 – 0.1)	-0.2 (-0.4 – 0)

Note: SSP refers to the Shared Socio-economic Pathway which describing the socio-economic trends underlying the scenario (SSP1 - Low Emissions scenario; SSP2 – Medium Emissions scenario; SSP3 – High Emissions scenario). mm/d = millimetres per day
Values in brackets represent range of predictions.

In addition to the projected changes in rainfall discussed above, Table 16 summarises anticipated variability of in temperature for the Central Highlands Region. These projections indicate that the region is expected to experience an increase in average temperatures.

Table 16
Climate Change Projections for the Central Highlands Region, Queensland – Change in Mean Temperature (°C)

Period	2050			2090		
Scenario	SSP1-2.6 (°C)	SSP2-4.5 (°C)	SSP3-7.0 (°C)	SSP1-2.6 (°C)	SSP2-4.5 (°C)	SSP3-7.0 (°C)
Summer	1 (0.1 – 1.5)	1.4 (0.9 – 2.3)	1.5 (0.8 – 2.6)	1.2 (0.4 – 2)	2.3 (1.3 – 3.3)	3.4 (2.1 – 4.3)
Autumn	1.2 (0.7 – 1.8)	1.5 (0.9 – 2)	1.7 (1.3 – 2.5)	1.4 (0.6 – 2.1)	2.6 (1.8 – 3.5)	3.8 (2.6 – 4.7)
Winter	1.1 (0.6 – 1.8)	1.4 (0.8 – 2)	1.6 (1.2 – 2.4)	1.3 (0.6 – 2.1)	2.5 (1.7 – 3.2)	3.6 (2.7 – 4.3)
Spring	1 (0.3 – 1.7)	1.3 (0.6 – 1.8)	1.4 (0.8 – 2.1)	1.2 (0.2 – 1.8)	2.2 (1.1 – 3.1)	3.4 (2.4 – 4.1)
Annual	1.1 (0.5 – 1.6)	1.4 (0.9 – 1.9)	1.6 (1.1 – 2.4)	1.3 (0.5 – 1.9)	2.4 (1.5 – 3.2)	3.5 (2.7 – 4.2)

Note: SSP refers to the Shared Socio-economic Pathway which describing the socio-economic trends underlying the scenario (SSP1 - Low Emissions scenario; SSP2 – Medium Emissions scenario; SSP3 – High Emissions scenario).
Values in brackets represent range of predictions.

7.4 Potential Impacts of the Project

The Project's contribution to Australian emissions would be relatively small, as estimated annual average Scope 1 and 2 emissions would represent:

- approximately 0.09% and 0.41% in 2030 and 2035 respectively of the estimated total greenhouse gas emissions in QLD from (133 and 48 Mt CO_2-e in 2030 and 2035, respectively); and
- approximately 0.03% and 0.11% of Australia's projected greenhouse gas emissions in 2030 and 2035 respectively (349 and 184 Mt CO_2-e in 2030 and 2035 respectively).

If the Project is approved and proceeds, the Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the Project (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) have together been estimated at approximately 0.28 million tonnes of carbon dioxide per year (Mt CO_2-e per year) during operations. These emissions would be small in the context of global greenhouse gas emissions.

The IPCC reports that every 1,000 gigatonnes (Gt) of cumulative global CO_2-e emissions (at CO_2-e) are likely to increase global mean surface temperature by between 0.27 and 0.63°C, with a central estimate of 0.45°C (IPCC, 2021). These values describe how the global climate system responds to large scale cumulative global emissions. They are not designed to quantify localised effects or to attribute temperature change to any single emissions source.

Nevertheless, an indicative "incremental temperature contribution" has been calculated by applying the IPCC's best-estimate (0.45 °C per 1,000 Gt CO_2-e) to the estimated lifetime Scope 1, Scope 2 and Scope 3 emissions associated with the Project. This approach assumes conservatively that all Project emissions are truly additive at the global level, even though this is unlikely in practice.

It is anticipated that the Scope 3 emissions from the use of Project coal would occur overseas and therefore would not contribute to Australian greenhouse gas emissions or materially factor in Australian greenhouse gas reduction targets. The Project is a continuation of existing operations at the BWM, which has an existing range of direct-sale customer countries that are signatories to the *Paris Agreement* or, in the case of Taiwan, have domestic energy policies that are aligned with the *Paris Agreement* (Whitehaven, 2025). If the Project does not proceed, global demand for metallurgical and thermal coal could be satisfied by other sources.

However, based on a conservative approach that assumes that the Project's emissions are wholly additive, the Project's total emissions equate to an incremental global temperature influence measured at the scale of millionths (Scope 1 and 2) or ten-thousandths of a °C (Scope 1, 2 and 3), as follows:

- total Scope 1 and 2 Emissions - Global Surface Temperature Change 0.000008356°C (8.4 millionths of a °C); and
- total Scope 1, 2 and 3 Emissions - Global Surface Temperature Change 0.0002469°C (0.25 thousandths of a °C).

Given the above, the project's incremental contribution to temperature change would be sufficiently minor that no additional impacts on the environmental values would arise.

8 Conclusion

This GMAP has been prepared by Whitehaven Blackwater to detail predicted greenhouse gas emissions at BWM for the proposed Project, as well as greenhouse gas management and abatement measures proposed for the Project. The GMAP considers both Scope 1 and 2 emissions.

8.1 Emissions Context

Fugitive emissions in this GMAP have been estimated on the NGER Method 1 basis (default), as site specific gas estimates and supporting documentation for NGER Method 2 approach are not yet available.

RWDI (2026) undertook greenhouse gas calculations in accordance with the QLD GHG Guideline. The Project would produce an average 0.27 Mt CO_2-e per year of Scope 1 emissions. Along with an average of 0.004 and 7.91 Mt CO_2-e per year of Scope 2 and 3 emissions, respectively.

The existing EID for ROM coal is 0.0527 t CO_2-e / t ROM (CER, 2025b). This ranks the BWM as having the 29th lowest emissions intensity among approximately 68 Australian coal mining facilities with published EIDs. Further, the emissions intensity at BWM is lower than the industry default value of 0.0653 t CO_2-e / t ROM, as specified under the Safeguard Rule.

Scope 1 emissions at the BWM (including the Project) are predicted to constitute 47.19 % fugitive emissions and 49.33% is predicted to be stationary diesel; the other approximately 3.48% of emissions originating from vegetation clearing, explosives and other Scope 1 sources.

Consistent with Whitehaven's adopted greenhouse gas policy, the adopted net emission goals for the Project are reflective of predicted Project net emission reduction targets under the Commonwealth Safeguard Mechanism. The BWM's Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations.

Notwithstanding a possible variation to the baseline value, it is anticipated that Whitehaven's implementation of various mitigation measures to minimise the overall generation of greenhouse gas emissions from the Project would result in greenhouse gas emissions being maintained within any varied Safeguard Mechanism baseline emissions value.

8.2 Three-Year Plan

The Three-Year Action Plan focuses on activities that increase site-specific information, including targeted trials, and feasibility assessments that enable Whitehaven to identify measures that are reasonable and feasible. The following abatement categories and measures have been identified as potentially being suitable as mitigation measures at BWM over the life of the Project:

- Scope 1 – Gas Capture and Drainage Opportunities:
  - Transition to NGER Method 2 Fugitive Emissions Basis.
  - Methane gas Pre-Drainage and Flaring/utilisation investigations.
- Scope 1 – Diesel Combustion:
  - Biodiesel/Renewable Diesel assessments.
  - Battery Electric Vehicles and/or Hybrid Diesel Equipment investigations.
  - Tethered Equipment Study.
- Scope 2 – Electricity from main grid:
  - Site Electricity Supply – Offset Scope 2 emissions.

8.3 Potential Impacts of GHG Emissions on Environmental Values

In Australia, the climate is generally projected to become warmer and drier. Climate change may result in changes to rainfall patterns, run off patterns and river flow.

The Project's contribution to Australian emissions would be relatively small, as estimated annual average Scope 1 and 2 emissions would represent approximately 0.09% and 0.41% in 2030 and 2035, respectively of the estimated total greenhouse gas emissions in QLD from (133 and 48 Mt CO_2-e in 2030 and 2035, respectively) and approximately 0.03% and 0.11% of Australia's projected greenhouse gas emissions in 2030 and 2035 respectively (349 and 184 Mt $CO_{2\text{-}e}$ in 2030 and 2035, respectively).

If the Project is approved and proceeds, the Project's contribution to global climate change would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the Project (i.e. Scope 1 emissions) and indirect emissions associated with the on-site use of electricity (i.e. Scope 2 emissions) have together been estimated at approximately 0.28 Mt CO_2-e per year during operations. These emissions would be small in the context of global greenhouse gas emissions.

However, based on a conservative approach that assumes that the Project's emissions are wholly additive, the Project's total emissions equate to an incremental global temperature influence measured at the scale of millionths (Scope 1 and 2) or ten-thousandths of a °C (Scope 1, 2 and 3), as follows:

- total Scope 1 and 2 Emissions - Global Surface Temperature Change 0.000008356°C (8.4 millionths of a °C); and
- total Scope 1, 2 and 3 Emissions - Global Surface Temperature Change 0.0002469°C (0.25 thousandths of a °C).

Given the above, the project's incremental contribution to temperature change would be sufficiently minor that no additional impacts on the environmental values would arise.

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Blackwater North Extension Project

Appendix A
Summary of Existing and Emerging Scope 1 and 2 Mitigation Measures at Surface Mines



Table A-1
Summary of Existing Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers
Existing measures for Scope 1 emissions – diesel combustion				
All heavy mining vehicles and equipment	Mine planning	Planning and scheduling mine operations to minimise material handling, optimise payloads, reduce haul route lengths, reduce gradients and avoid unnecessary stops.	Mature	-
	Fleet planning	Structuring of haul truck fleet (e.g. truck capacity) to minimise energy consumption.	Mature	-
	Energy-efficient units	Procurement of energy-efficient vehicles and equipment, including ventilation, lighting and control systems.	Mature	-
	Servicing and maintenance	Maintenance of vehicles and equipment according to manufacturers' specifications.	Mature	-
	Renewable fuels	Switching to biodiesel (likely to be an interim measure).	Mature	- High operational expenditure (OPEX). - Lack of supply. - Vehicle modifications. - Long-term storage. - Increased maintenance.
Light vehicle	Electrification	Hybrid, Battery Electric Vehicle (BEV).	Mature	- High capital expenditure (CAPEX). - Range. - Power limitations.
Haul trucks	Driver training	Eco-driving.	Mature	-
Existing measures for Scope 1 emissions – fugitive methane (Active Surface Mines)				
Drainage gas	None identified	-	-	-

Table A-1 (Continued)
Summary of Existing Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers
Existing measures for Scope 1 emissions – other processes				
Petrol combustion	Electrification	Hybrid, BEV.	Mature	-
	Driver training	Eco-driving.	Mature	-
Ammonium nitrate-fuel oil (ANFO) combustion	Optimised blasting strategy	Optimisation of blasting to minimise the movement of equipment and rehandling of material.	Mature	-
Oils, greases	Recycling	Recycling of oils and greases.	Mature	-
Fugitive sulfur hexafluoride (SF6)	Best practice management	Operational protocols, gas accounting, training, recycling, Leak Detection and Repair (LDAR), equipment upgrades.	Mature	-
Coal oxidation (stockpiles)	Various measures	Covering and sealing stockpiles, dust suppressants, biochemical agents, spraying with water, stockpile management, temperature monitoring.	Mature	- Covering/sealing: operating costs, integration with existing stockpiling infrastructure/methods, re-handling (i.e. adding/removing covers).
Vegetation removal	Best practice management	Minimising vegetation clearing, re-use of the removed vegetation, and rehabilitation of land as quickly as possible	Mature	-

Table A-1 (Continued)
Summary of Existing Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers
Existing measures for Scope 2 emissions				
Purchased electricity	Various energy efficiency measures	Reduction of electricity use through, for example, variable-speed drives on motors, the use of the latest high-efficiency air conditioners, fans and pumps, ventilation system maintenance improvements, timers on air conditioning units and lights.	Mature	-
	Renewable grid electricity	Source renewable energy via an independent power provider.	Mature	- Lack of supply of firmed renewable electricity - Limited incentives under the Safeguard Mechanism

Source: (EMM, 2025).

Table A-2
Summary of Emerging Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers	Risks or Disadvantages
Emerging measures for Scope 1 emissions – diesel combustion					
Haul trucks	Electrification	On-board: hybrid, BEV	Research and Development (R&D) to demonstration (>2030-2035) (possibly earlier for underground mines)	- Technology development needed. - Lack of supply of vehicles. - Lack of supply of firmed renewable electricity. - Integration of the required supporting infrastructure to existing mines. - High CAPEX.	- Risk of collision due to quiet operation - New worker safety issues - Batteries - Battery efficiency affected by climate - Battery fires
		On-board: fuel cell/dihydrogen (H_2)		- Lack of supply of renewable hydrogen. - High cost of renewable hydrogen.	
		Tethering: connection to a fixed electricity supply		- Impractical for haul trucks at surface coal mines due to distances involved.	
		Trolley assist: connection to an overhead cable to power an electric drive		- Likely to be impractical for surface coal mines due to evolving mine plans.	

Table A-2 (Continued)
Summary of Emerging Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers	Risks or Disadvantages
Emerging measures for Scope 1 emissions – diesel combustion					
Other heavy mining vehicles and equipment	Electrification	General electrification of mine equipment other than haul trucks	R&D to demonstration (>2025).	- Technology development needed. - Lack of supply of vehicles. - Lack of supply of firmed renewable electricity. - Integration of the required supporting infrastructure to existing mines. - High CAPEX.	- Battery efficiency affected by climate. - Battery fires. - New worker safety issues.
		Tethering: connection to a fixed electricity supply	Demonstration to mature (>2025).	- Requires high-voltage infrastructure. - Challenged by on-board electric power. - Restricted operational flexibility.	- Safety (high-voltage cables).
		Automation	Demonstration to mature.	- Technology development needed. - High CAPEX.	- New worker safety issues. - Elimination of jobs.
All vehicles and equipment	Renewable fuels	Switching to renewable diesel	Demonstration to mature (>2025).	- High OPEX - Lack of supply, and possible competition from other sectors	-

Table A-2 (Continued)
Summary of Emerging Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers	Risks or Disadvantages
Emerging measures for Scope 1 emissions – fugitive methane (Active Surface Mines)					
Drainage gas	Flaring	Capture of gas through boreholes, followed by combustion in a flare	Reduce (reduces Global Warming Potential [GWP] through conversion of methane [CH_4] to carbon dioxide [CO_2]).	- Lack of financial incentive. - No regulatory driver. - Decreasing CH_4 output over time.	- Air pollution and noise. - Safety (e.g. air ingress). - Residual CO_2 emissions.
	Utilisation (any purpose)	Capture of gas through boreholes, followed by utilisation	Reduce (reduces GWP through conversion of CH_4 to CO_2).	- Cost to purify gas for utilisation. - Low or variable CH_4 concentrations. - Lack of supporting infrastructure for utilisation.	- Residual CO_2 emissions.
Emerging measures for Scope 1 emissions – other processes					
Petrol combustion	None identified	-	-	-	-
ANFO combustion	Waste oils or renewables	Alternative fuels	Demonstration (>2025)	- Compliance with regulations - Market availability	- Blasting safety - Performance consistency
Oils, greases	Alternative lubricants	-	-	-	-
Fugitive SF6	None identified	-	-	-	-

Table A-2 (Continued)
Summary of Emerging Scope 1 and 2 Mitigation Measures at Surface Mines

Greenhouse Gas Source	Mitigation Measures	Notes	Technological Readiness	Potential Barriers	Risks or Disadvantages
Emerging measures for Scope 1 emissions – other processes (Continued)					
Coal oxidation (stockpiles)	None identified	-	-	-	-
Vegetation removal	Pyrolysis	Thermal degradation of vegetation using low-oxygen technology to produce biochar	Demonstration to mature	- Market availability	- Feedstock variability - Fire risk
Emerging measures for Scope 2 emissions					
Purchased electricity	On-site renewable electricity generation	Wind, solar or geothermal power	Demonstration to mature	- High CAPEX - Regulatory approvals - Space constraints	- Reliability (dependency on weather)
-	On-site energy Storage (batteries)	Facilitates the wider electrification of Mining operations	Demonstration to mature (>2025)	- Battery size and robustness needed for mine sites	- Replacement potentially every few years leading to more greenhouse gas lifecycle emissions and costs - Safety (overheating leading to fires or explosions) - Environmental (leaks causing contamination of water/soil)

Source: (EMM, 2025).

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Blackwater North Extension Project

Appendix B
Greenhouse Gas Calculations Report



FINAL REPORT

BLACKWATER NORTH EXTENSION PROJECT GREENHOUSE GAS CALCULATION REPORT

BLACKWATER, QUEENSLAND

GREENHOUSE GAS CALCULATION REPORT
RWDI # 2510129
10 April 2026

SUBMITTED TO

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QUALITY ASSURANCE

RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued for the following scope: The provision of consultancy services in acoustic engineering and air quality; and the sale, service, support and installation of acoustic monitoring and related systems and technologies.

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EXECUTIVE SUMMARY

RWDI Australia Pty Ltd (RWDI) has been engaged by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), to prepare a Greenhouse Gas (GHG) Calculation Report for the proposed Blackwater North Extension Project (the Project). The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland.

This GHG Calculation Report was prepared in accordance with the *Greenhouse Gas Emissions Guideline* (Version 1.02) prepared by Queensland Department of the Environment, Tourism, Science and Innovation (DETSI, 2026) ('The GHG Guideline'). This GHG Calculation Report summarises the methods used to calculate direct (Scope 1), indirect (Scope 2), and other indirect (Scope 3) GHG emissions, and presents a summary of unabated GHG emissions for the:

- Baseline Scenario i.e. already approved for BWM life-of-mine (LOM).
- Project Scenario i.e. the amended BWM LOM.
- Project Only Scenario i.e. the Project amendment only (Baseline minus Project).

The report also provides a comparison of the Project (Project Only) unabated emissions against national and Queensland state emissions reduction targets for 2030 to 2050. GHG emissions mitigation and management practices, a GHG abatement plan and associated risk assessment are not discussed in this report.

Scope 1, 2 and 3 emissions were estimated based on data available at the time of writing and the relevant guidelines and standards. Based on calculations and assumptions as outlined in this report, assessment results indicate:

- Estimated annual Scope 1 plus Scope 2 GHG emissions from the (unabated) Project Only Scenario range from negative 47 (i.e. a GHG emission saving of 49 kilotonnes [kt]) to 695 kt carbon dioxide equivalent (CO_2e) per year.
- Annual Project Only emissions are estimated to be:
    - 0.03 and 0.11 percent (%) of Australia's target emissions in 2030 and 2035, respectively.
    - 0.09 and 0.41% of Queensland's target emissions in 2030 and 2035, respectively.
- Diesel consumption from stationary power generation and off-road equipment, together with fugitive emissions, represent the largest contributors to the unabated Project Only Scope 1 emissions; accounting for 64% and 32% of total Scope 1 emissions, respectively. Fugitive emissions were estimated based on Method 1 (default).

As part of implementing the Project, the Proponent will seek to mitigate GHG emissions as documented in the Decarbonisation Study Report.

1 INTRODUCTION

1.1 Project Description

RWDI Australia Pty Ltd (RWDI) has been engaged by Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), to prepare a Greenhouse Gas (GHG) Assessment for the proposed Blackwater North Extension Project (the Project). The Blackwater Mine (BWM) is an existing, open cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland.

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the *Environmental Protection Act 1994* (EP Act).

The BWM is a joint venture between Whitehaven Coal Limited (Whitehaven) (70%), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater, a wholly owned subsidiary of Whitehaven, is the operator of BWM.

The existing BWM comprises a series of open-cut mining pits along an approximate 80 km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train-load out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices).

Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (**Figure 1**), which would extend the current open cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at BWM allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

The Project would include the following activities:

- extension of open cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 Mtpa of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of a waste rock emplacement landform;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation activities of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.

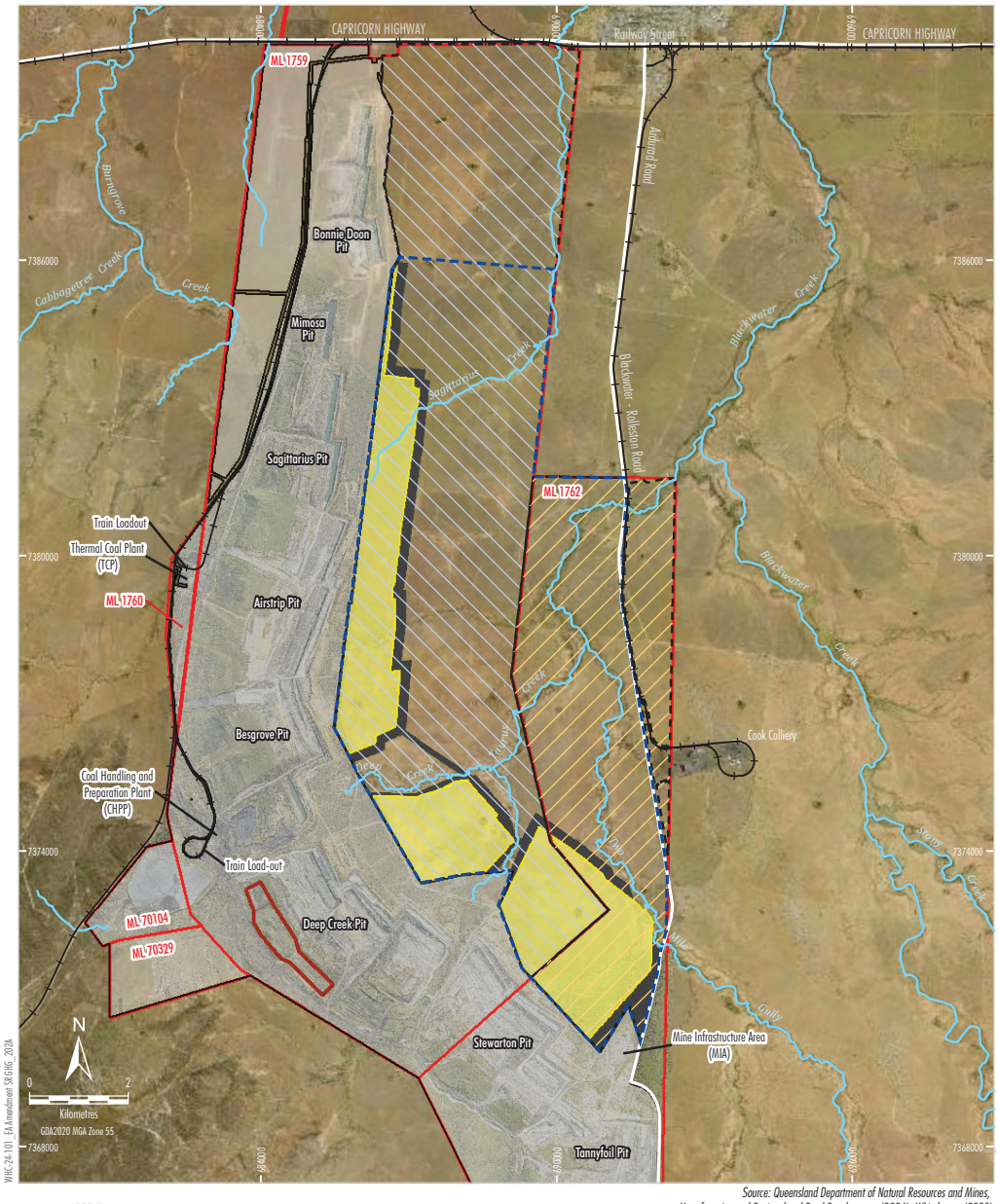


Figure 1: Blackwater North Extension Project

1.2 Project Scenarios

The following terminology is used through the report to describe the individual components of the Project:

- **Baseline Scenario** (Approved BWM Scenario): Approved life of mine (LOM) as approved by EA EPML00717813 excluding the Project Amendment. This scenario assumes continued operations of the BWM at the authorised maximum extraction rate of 19.0 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 2090 (at an average ROM coal extraction rate of approximately 12.8 Mtpa).
- **Project Scenario** (Amended BWM Scenario): Proposed LOM with the Project Amendment, incorporating the proposed extension of open-cut mining on SA 7 on ML 1762 and SA 10 on ML 1759. This amendment would enable extraction of an additional 200 Mt of ROM coal when compared to the Baseline Scenario, extending operations to approximately 2093 with continued maximum annual ROM coal extraction rate of 19.0 Mtpa (at an average ROM coal extraction rate of approximately 15.0 Mtpa).
- **Project Only Scenario** (Amendment Scenario): the Project Amendment only. This scenario evaluates the net change in emissions resulting from the Project extension by comparing the emissions from Project Scenario against those from Baseline Scenario, thereby quantifying the incremental impact of the proposed amendment.

1.3 Objectives

This report has been developed to support the Environmental Assessment Amendment Application for the Project, in alignment with the requirements of EP Act. This GHG Calculation Report has been prepared to fulfill the requirements outlined in the *Greenhouse Gas Emissions Guideline* (Version 1.02) prepared by Queensland Department of the Environment, Tourism, Science and Innovation ([DETSI], 2026 ('The GHG Guideline'), supporting the EA amendment application for the Project.

The primary objectives of this GHG Calculation Report are to estimate the anticipated GHG emissions for the Baseline Scenario, Project Scenario and Project Only Scenario. This includes:

- A detailed inventory of projected annual direct Scope 1emissions (methodology and results are provided in Section 5.2 and Section 6.1, respectively).
- A detailed inventory of projected annual indirect Scope 2 emissions (methodology and results are provided in Section 5.3 and Section 6.1, respectively).
- An indicative estimate of annual Scope 3 emissions associated with the Project (methodology and results are provided in Section 5.5 and Section 6.2, respectively).
- Assessment of contribution to State and National emissions (Section 7).

2 BACKGROUND

2.1 Overview of the Greenhouse Gas Protocol

The GHG Protocol, developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), is the globally recognized standard for GHG accounting and reporting (WRI and WBCSD, 2004). It provides a comprehensive framework that includes accounting standards, sector-specific guidance, calculation tools, and training resources to support businesses and governments in measuring and managing GHG emissions. The protocol enables consistent and transparent reporting across operations, value chains, products, cities, and policies, facilitating emissions reductions across both private and public sectors. Emissions are categorized into three scopes based on their emission sources as shown in **Figure 2**.

2.2 Scope 1 (Direct GHG Emissions)

Organizations report greenhouse GHG emissions from sources they own or control as Scope 1 emissions, which fall within the defined boundary of the organization (WRI and WBCSD, 2004). For the coal mining sector, emissions primarily result from operational activities associated with the Project, including GHG emissions from:

i) vegetation clearing;
ii) fugitive emissions of methane (CH_4) and carbon dioxide (CO_2) during coal extraction;
iii) emissions of CO_2, CH_4, and nitrous oxide (N_2O) from the combustion of fossil fuels, oils, and greases in both mobile and stationary equipment and;
iv) leakage of sulphur hexafluoride (SF_6) from high-voltage circuit breakers.

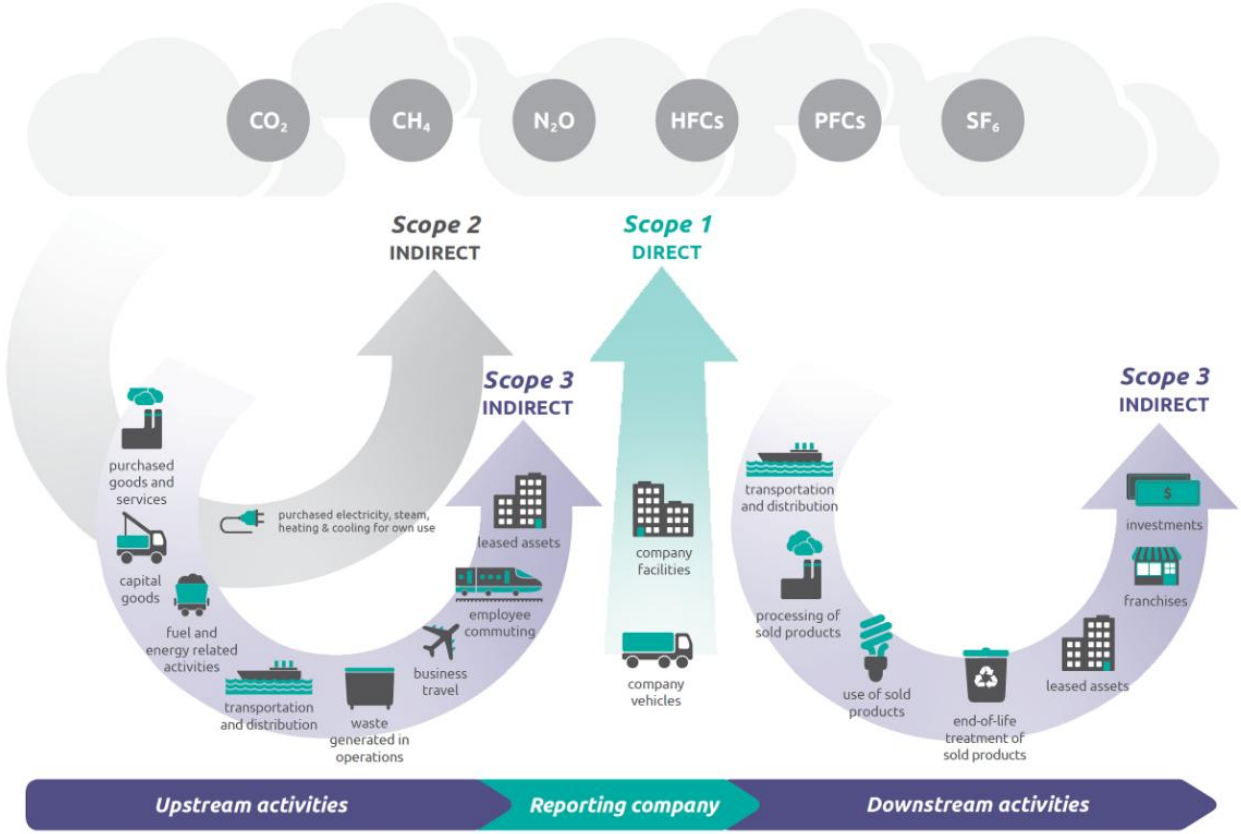
2.3 Scope 2 (Indirect GHG Emissions)

Organizations account for GHG emissions resulting from the generation of energy such as electricity, steam, heating, and cooling, that is purchased and used in their owned or controlled operations as Scope 2 emissions (WRI and WBCSD, 2004). Although the organization consumes the energy, the associated emissions occur at the external facility where the energy is produced. These emissions are considered indirect but are attributed to the organization due to its role as the end user of the energy.

2.4 Scope 3 (Other indirect GHG Emissions)

Scope 3 emissions refer to indirect GHG emissions that occur outside the organization's direct control, both upstream and downstream of its operations (WRI and WBCSD, 2004). These emissions may arise from a wide range of activities, including:

i) the extraction and production of purchased materials and fuels;
ii) transportation of goods and fuels, employee business travel, commuting, and the distribution of sold products;



Source: (WRI and WBCSD, 2011)

Figure 2: Overview of GHG Protocol scopes and emissions across the value chain

iii) emissions related to electricity generation not covered under Scope 2, such as those from fuel extraction, production, and transmission losses;
iv) emissions from leased assets, franchises, and outsourced activities, provided these are not included under the organization's chosen consolidation approach and;
v) the use and disposal of sold products, waste generated during operations, and waste associated with the production of purchased inputs.

2.5 Global Warming Potential

Global Warming Potential (GWP) is a measure developed by the Intergovernmental Panel on Climate Change (IPCC) to compare the relative climate impact of different GHGs over a specific time horizon, typically 100 years. It quantifies how much heat a GHG traps in the atmosphere compared to CO_2, which has a GWP of 1 (Greenhouse Gas Protocol, 2024). The 100-year GWPs from the Fifth Assessment Report have been applied in this assessment, in alignment with Australia's current GHG reporting requirements (Department of Climate Change, Energy, the Environment and Water [DCCEEW], 2025a) as shown in **Table 1**.

Table 1: GHGs and 100-year Global Warming Potentials

Emission Source	Emission Factor
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous oxide (N_2O)	265
Sulphur hexafluoride (SF_6)	23,500

Source: DCCEEW (2025a)

3 RELEVANT LEGISLATIONS

3.1 Australian Legislation

Australia ratified the Paris Agreement in November 2016, joining global efforts to combat climate change through legally binding commitments under the UNFCCC. Initially, Australia pledged to reduce GHG emissions by 26–28% below 2005 levels by 2030 (DCCEEW, 2015). On 16 June 2022, the Australian Government submitted an updated Nationally Determined Contribution (NDC) to the UNFCCC, committing to a more ambitious target of 43% emissions reduction below 2005 levels by 2030, affirming the commitment to achieve net-zero emissions by 2050 (DCCEEW, 2022).

In September 2025, Australia further strengthened its climate ambition by submitting a new NDC that sets a target to reduce emissions by 62–70% below 2005 levels by 2035. This target is supported by a comprehensive Net Zero Plan and six sector-specific emissions reduction strategies, aimed at ensuring a fair and economically beneficial transition to a low-carbon future (DCCEEW, 2025b).

3.1.1 National Greenhouse and Energy Reporting Framework

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes the legislative foundation for the NGER Scheme, a unified national system for collecting data on GHG emissions, energy production, and energy consumption from Australian corporations (DCCEEW, 2025a).

Administered by the Clean Energy Regulator, the NGER Scheme requires corporations to register and report annually if they meet specific thresholds. As of 2025, these thresholds for Scope 1 and Scope 2 GHG emissions remain at 25,000 tonnes (t) of CO_2e per year for a single facility, or 50,000 t CO_2e per year for a corporation. Entities exceeding these limits must report Scope 1 (direct emissions) and Scope 2 (indirect emissions from electricity use) data (DETSI, 2025).

The legislative framework supporting the NGER Act includes the *National Greenhouse and Energy Reporting Regulations 2008.* The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Determination) provides the methods and criteria for calculating greenhouse gas emissions and has been updated annually since 2009, with the last update issued in 2025. These instruments provide the technical foundation for how emissions and energy data must be calculated and reported. The Measurement Determination outlines approved methodologies for estimating Scope 1 and Scope 2 emissions, estimation of the production and consumption of energy and assessing uncertainty. It ensures consistency and accuracy across reporting entities by specifying measurement criteria, data sources, and calculation procedures.

3.1.2 Safeguard Mechanism

The Safeguard Mechanism, established under the NGER Act, is a key policy tool used by the Australian Government to manage emissions from the country's largest industrial facilities. Originally legislated in 2014 and implemented in 2016, the mechanism was significantly reformed in 2023 to align with Australia's national climate targets.

The mechanism applies to facilities that emit more than 100,000 t of CO_2e annually (Scope 1 emissions). These facilities from sectors such as mining, manufacturing, oil and gas, transport, and waste, account for approximately 31% of Australia's total GHG emissions (DCCEEW, 2025c). Under the reformed framework, each facility is assigned an emissions baseline, which represents the maximum allowable net emissions. These baselines are designed to decline predictably over time, following a trajectory consistent with Australia's commitment to reduce emissions by 43% below 2005 levels by 2030, and to achieve net zero emissions by 2050. From 2023 to 2030, baselines will decrease at a rate of 4.9% per year (DCCEEW, 2025c). Facilities that exceed their baseline must offset the excess emissions by surrendering either Australian Carbon Credit Units or Safeguard Mechanism Credits (SMCs). Conversely, facilities that emit below their baseline may be eligible to generate SMCs, which can be traded or banked for future compliance.

3.1.3 Queensland State Legislation

The Queensland Government has demonstrated a strong commitment to climate action through both national and international partnerships and progressive state policy. Since joining the Under2 Coalition in 2017, Queensland has continued to align its actions with the goals of the Paris Agreement, working to limit global temperature rise to well below 2°C, with efforts to pursue 1.5°C (Queensland Government, 2024a).

The Queensland Government has enacted a suite of progressive legislative and policy measures to accelerate the state's transition to a low-emissions economy. The Clean Economy Jobs Act 2024 legally enshrines Queensland's emissions reduction targets: a 30% cut below 2005 levels by 2030, 75% by 2035, and net zero by 2050 (Queensland Government, 2024b). This Act also establishes the Clean Economy Expert Panel to guide implementation and monitor progress. Complementing this is the Queensland Climate Transition Bill 2023, which proposes a strategic phase-out of fossil fuel exports and the creation of the Climate Transition Authority to oversee a just transition for affected communities and industries (Queensland Government, 2023a). The Queensland Renewable Energy Zones Policy 2025 supports the development of large-scale renewable infrastructure, aiming to meet ambitious targets of 70% renewable energy by 2032 and 80% by 2035, while ensuring grid reliability and economic growth. These efforts are further guided by Queensland's 2035 Clean Economy Pathway, which outlines sector-specific strategies to meet the 75% emissions reduction goal by 2035 (Queensland Government, 2024c).

4 GHG ASSESSMENT METHODOLOGY

4.1 Overview

The GHG Guideline outlines the process to be followed based on the type of application. The procedure specific to amendment applications is summarised below.

Step 1: Identify the GHG emissions likely to be generated throughout the life of the project, only in relation to the amendment.

Step 2: Determine if the application meets the medium to high GHG emission category, only in relation to the amendment.

Step 3: Identify the management practices proposed to be implemented to prevent or minimise adverse impacts, only in relation to the amendment.

Step 4: Identify if a GHG abatement plan will be required to accompany the application, only in relation to the amendment.

Step 5: Describe the impacts of climate change on environmental values and the risk and likely magnitude of such impacts based on the relative scale of the project's net GHG emissions, only in relation to the amendment.

Step 3 to Step 4 were outside of the scope of this report and are addressed in detail in a separate document, the Decarbonisation Study Report, prepared by Phronis Consulting. Step 5 is considered in this report for unmitigated GHG emission only.

Scope 3 emissions have been calculated in accordance with the GHG Guideline as combined Scope 1 and 2 emissions are expected to be greater than 25 kt CO2-e/year.

4.2 Identification of GHG emission sources

The GHG Guideline specifies that, in relation to the amendment, applications must meet the following requirements when identifying GHG emissions expected to be generated throughout the life cycle of the project:

- Include an emissions inventory identifying the GHG to be emitted and the stage of the project at which the emissions will occur. Include a breakdown of GHG emissions by source.
- Estimate the projected annual Scope 1 and Scope 2 CO_2e emissions over the life of the project. Include both unabated emissions and emissions after all avoidance and abatement measures have been accounted.
- Provide an estimate of annual Scope 3 emissions and total Scope 3 emissions over the life of the project.

This results in the following outcome:

- Definition of the GHG assessment boundary, emission sources, and relevant amendment phases.
- Identification of emission scenarios.
- Development of emission scenarios reflecting both mitigated and unmitigated conditions (the present report has

Note: the present report only considers unmitigated conditions.

4.2.1 GHG Assessment Boundary and Emission Sources

The GHG emission inventory for the Project has been developed based on specific boundary considerations. Since the Project does not include a distinct construction phase beyond land clearing, which is considered part of routine mining operations, a separate inventory for construction-related emissions was not prepared. Emissions associated with the decommissioning and rehabilitation of the mine are expected to occur at the end of its operational life. However, due to uncertainties regarding the timing and nature of these activities, and the minimal impact of the Project on overall emissions during closure, these emissions were not included in the current assessment.

The evaluation encompasses Scope 1, Scope 2, and Scope 3 emissions related to the BWM. Scope 1 and Scope 2 emissions are confined to the BWM site, while significant emissions from activities occurring outside this geographical boundary are addressed under Scope 3.

4.2.2 GHG Emission Sources

The GHG emission sources associated with the BWM site were identified through a review of previous inventories for both the currently approved operations and the BWM - North Extension Project (SLR Consulting Australia Pty Ltd and BHP Mitsubishi Alliance, 2023; Whitehaven, 2025). The following sources were considered in this assessment:

Scope 1 emissions include:

- Vegetation clearing activities.
- Combustion of fossil fuels in mobile and stationary equipment (e.g. removal of overburden, mining coal, construction activities, mine service activities, decommissioning activities, rehabilitation activities and generation of electricity).
- Use of explosives.
- Use of oils and greases.
- Fugitive emissions from coal extraction.
- Leakage of SF_6 from electrical switchgear.

Scope 2 emissions include:

- Electricity consumption at the project site (e.g. for conveyors, the CHPP, amenities, etc.).

Scope 3 emissions include:

- Transmission losses from electricity use.
- Rail transport of product coal through the Bauhinia railway line.
- Shipping of coal from Port of Gladstone to other international ports.
- Combustion of exported coal.
- Extraction, production and transport of liquid fuels, oils and greases.

4.2.3 GHG Assessment Scenarios

The Project builds upon and expands the activities of the previously approved BWM operation. For the purposes of this GHG Calculation Report, the boundary has been defined to include the material currently present on-site. This encompasses direct emissions from on-site mining activities (Scope 1), indirect emissions from electricity usage related to BWM operations (Scope 2), and a review of upstream and downstream emissions (Scope 3) as shown in **Figure 3** to ensure a thorough evaluation.

The assessed scenarios are described in Section 1.2 of this report and include the Baseline, Project, and Project Only cases. For the Baseline Scenario, emissions were assessed up to 2090, assuming mine decommissioning occurs between 2091 and 2093. The Project and Project Only Scenarios were assessed through to 2093.

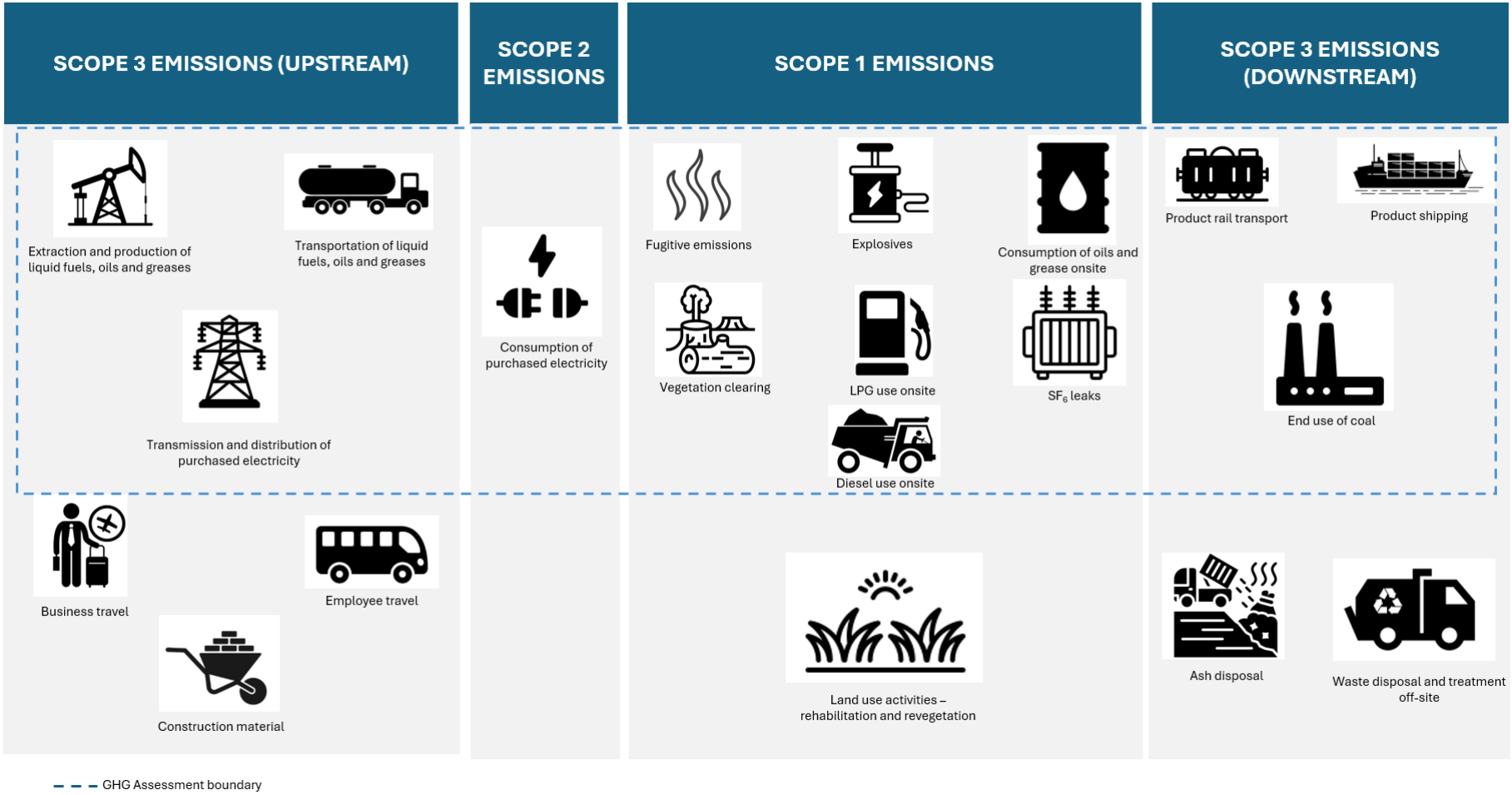


Figure 3: GHG assessment boundary and emission sources

5 CALCULATING GHG EMISSIONS

The GHG emissions associated with the BWM have been evaluated on an annual basis over the full duration of the BWM's lifecycle. Emissions estimates for each scenario were primarily guided by the following methodologies and regulatory frameworks:

- *Greenhouse Gas Protocol: The GHG Protocol for Project Accounting* developed by the WRI and the WBCSD (WRI and WBCSD, 2004).
- *Australian National Greenhouse Accounts Factors - For individuals and organisations estimating greenhouse gas emissions 2025* (DCCEEW, 2025a).
- NGER Scheme and NGER Determination (see Section 3.1.1).

5.1 Scope 1 Emission Factors

The emission factors and energy content for each of the emissions sources that have been used in the assessment for Scope 1 are summarised in **Table 2**.

Table 2: Scope 1 Emission Factors

Emission Source	Energy Content Factor (GJ/kL) or (GJ/t)	Scope 1 Emission Factors					
		CO_2	CH_4	N_2O	Total	Units	Note
Vegetation Clearance (woodland/forest/grassland/others)							
Open Shrubland Class G	-	-	-	-	113	t CO_2e/ha	[1]
Fuel Use – Stationary Combustion (from power generation and off-road equipment)							
Diesel	38.6	69.9	0.1	0.2	70.2	kg CO_2e/GJ	[2]
Liquid Petroleum Gas	25.7	60.2	0.2	0.2	60.6	kg CO_2e/GJ	[2]
Fuel Use - Transport							
Diesel (Heavy duty - Euro I)	38.6	69.9	0.2	0.4	70.5	kg CO_2e/GJ	[3]
Gasoline (Cars and commercial light vehicles)	34.2	67.4	0.02	0.2	67.62	kg CO_2e/GJ	[3]
Oils and Greases							
Petroleum based oils	38.8	13.9	0	0	13.9	kg CO_2e/GJ	[2]
Petroleum based greases	38.8	3.5	0	0	3.5	kg CO_2e/GJ	[2]
SF_6 leakage							
Gas-insulated switchgear and circuit breaker applications	-	-	-	-	0.0089	kg SF_6/kg SF_6	[4]
Explosives							
Ammonium Nitrate Fuel Oil (ANFO)	-	-	-	-	0.1778	t CO_2e/t explosive	[5]

Notes:

[1] Based on Table 2 of *Appendix E Vegetation Emissions Methodology from Greenhouse Gas Assessment Workbook for Road Projects* (Transport Authorities Greenhouse Group [TAGG], 2013).

[2] Based on Table 8 of *Australian National Greenhouse Accounts Factors - For individuals and organisations estimating greenhouse gas emissions* (DCCEEW, 2025a).

[3] Based on Table 9 of *Australian National Greenhouse Accounts Factors - For individuals and organisations estimating greenhouse gas emissions* (DCCEEW, 2025a).

[4] Based on Section 4.102 Method 1 from NGER Determination.

[5] Included using obsolete value from AGO (2004) – there is no reliable estimate of N_2O released.

t = tonnes, kg = kilogramme, GJ = gigajoule, ha = hectare

5.2 Scope 1 Emissions Calculation Methodologies

5.2.1 Clearing of Vegetation

The GHG emissions from vegetation clearing were included as Scope 1 emissions in the calculation because the removal of vegetation eliminates a natural carbon sink. When vegetation is cleared, its ability to absorb and store CO_2 from the atmosphere ceases. As a result, the amount of CO_2 that would have been sequestered by the vegetation remains in the atmosphere, leading to a direct increase in atmospheric GHG concentrations. The disposal of cleared vegetation, whether sent to landfill, where it may decompose anaerobically, or to facilities for combustion, results in further GHG emissions.

GHG emissions from land clearing are not reportable under the NGER Scheme.

The Carbon Gauge Tool Guideline developed by the TAGG was used to estimate GHG emissions from land clearing (TAGG, 2013). This guideline provides a simplified approach to estimate carbon sink losses using maps that show the maximum potential biomass (maxbio) class for all regions of Australia. The maxbio class represents the estimated maximum tonnes of dry vegetation matter per hectare for a given location and is outlined in Table 2 of Appendix E – Vegetation Emissions Methodology (TAGG, 2013). The user identifies the proposed clearance areas corresponding to each vegetation class, and the accompanying workbook provides Vegetation Clearance Emission Factors (in t CO_2-e/ha) based on the vegetation class information from Table 1 of Appendix E of the guideline.

The method described in the guide evaluates GHG emissions resulting from land clearing by accounting for both the carbon currently stored in vegetation and the carbon that would have been absorbed over time had the vegetation remained intact. This technique adopts a cautious stance and relies on several key assumptions:

- All carbon pools (woody biomass, non-woody biomass, debris, and soil) are completely removed.
- All removed carbon is converted to CO_2 and released into the atmosphere.
- Potential carbon sequestration from future revegetation of the project site is excluded.

Based on the Plant Community Type Mapping undertaken for the project, Vegetation Class G, Class 1 with the emission factor of 113 t CO_2e/ha was selected for the Project, are shown in **Table 2**.

Emissions for each year and scenario were calculated using the following equation:

$$Emissions_{vegegation\ clearing}(t\ of CO_{2e}) = Alea\ Cleared\ (ha) \times Emission\ factor\ (\frac{tCO2e}{ha})$$

where:

Area cleared was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3.

5.2.2 Fuel, Petroleum Oil and Greases Combustion

Emissions resulting from fossil fuel (diesel and liquid petroleum gas), petroleum oil and greases combustion were calculated for each year and scenario using the following equation:

$$Emissions_{Combustion}(t\ of CO_2e)$$
$$= Quantity\ of\ Fuel, Oil, Greeses\ (kL) \times Energy\ Content\ of\ Fuel\ \left(\frac{GJ}{kL}\right) \times Emission\ factor_{Scope\ 1}\ \left(\frac{kg\ CO2e}{GJ}\right) \times 10^{-3}$$

where:

Quantity of fuel, petroleum oil and greases was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3.

Energy content values specific to each fuel type, petroleum oil or grease (expressed in gigajoules per kilolitre, GJ/kL) along with the corresponding Scope 1 emission factors (expressed in kg CO_2e/GJ), were obtained from **Table 2**.

5.2.3 Construction Emissions

A separate evaluation of the construction phase was deemed unnecessary, as the mine has been operational for several decades. Any emissions linked to construction activities have been accounted into the early years of the Project.

5.2.4 SF_6 Leakage

Emissions resulting from SF_6 gas-insulated electrical equipment were calculated for each year and scenario using the following equation:

$$Emissions_{SF6\ Leakage}\ (t\ of CO_2e) = Quantity\ of\ SF_6\ (t) \times \text{Default annual leakage rate of } SF_6\ \times GWP_{SF_6}$$

where:

Quantity of SF_6 expected to be present in the installed components was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3. The default annual SF_6 leakage rate was obtained from **Table 2**, along with the GWP value for SF_6 listed in **Table 1**.

5.2.5 Explosives

There is no published emission factor for blasting under the NGER scheme. However, for completeness Scope 1 emissions from the use of heavy ANFO (ammonium nitrate and fuel oil) explosives have been estimated using the following equation:

$$Emissions_{Explosives}(t\ of CO_2e) = Quantity\ of\ Explosives\ (kt) \times Emission\ factor_{Scope\ 1}\ \left(\frac{t\ CO_2e}{t\ of\ Explosive}\right) \times 10^3$$

Quantity of explosives was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3 and presented in the Calculation Report for information purpose only. The emissions factor for explosives (heavy ANFO) is included in **Table 2** and sourced from AGO (2004).

5.2.6 Fugitive Emissions

Fugitive emissions associated with the Project would arise from the exposure of coal seams during coal extraction activities. Fugitive emissions from coal extraction are estimated using the Method 1 approach outlined in the NGER Determination.

Fugitive emissions from extraction of coal were calculated for each year and scenario using the following equation:

$$Emissions_{Fugitive}\ (t\ of CO_2e)$$

$$= Quantity\ of\ ROM\ coal\ (Mt) \times Default\ Queensland\ Methane\ Emission\ Factor\ (\frac{t\ of CO_{2e}}{t\ of\ ROM\ Coal}) \times 10^6$$

where:

Quantity of ROM coal was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3. Default Queensland Methane Emission Factor is 0.031 (t of CO_2e/t of ROM coal) as per Method 1 – extraction of coal fugitive emission approach outlined in the NGER Determination.

5.3 Scope 2 Emission Factors

Scope 2 GHG emissions, which are indirect emissions associated with electricity usage, were calculated by applying Queensland's grid emission factor sourced from the latest national emissions projections from (DCCEEW, 2025d). The emission factors are presented in **Table 3**. Emission factors for the Queensland electricity grid are projected through to the year 2040, based on data from (DCCEEW, 2025d). For the period between 2041 and 2093, the projected 2040 emission factor was applied to be conservative. Australia's national objective is to achieve net zero GHG emissions by 2050.

Table 3: Projected Scope 2 Emission Factors for Queensland's Electricity Grid

Year	Projected Scope 2 Emission Factors for Queensland's Electricity Grid (t CO_2e/MWh)
2027	0.49
2028	0.41
2029	0.32
2030	0.19
2031	0.19
2032	0.17
2033	0.19
2034	0.21
2035	0.25
2036	0.26
2037	0.24
2038	0.23

Year	Projected Scope 2 Emission Factors for Queensland's Electricity Grid (t CO_2e/MWh)
2039	0.23
2040	0.23
2041	0.23*
2042	0.23*
2043	0.23*
2044	0.23*
2045	0.23*
2046	0.23*
2047	0.23*
2048	0.23*
2049	0.23*
2050 to 2093	0.23*

Notes: MWh = megawatt-hour

* For the period between 2041 and 2093, the projected 2040 emission factor was applied to be conservative. Australia's national objective is to achieve net zero GHG emissions by 2050.

It should be noted that if QLD electricity sector decarbonisation occurs more slowly or more rapidly than assumed by DCCEEW (2025d), Scope 2 emissions may be higher or lower than the estimated values. This uncertainty is inherent to this forward-looking methodology. To provide a conservative estimate over the long term, the 2040 electricity emission factor was held constant for the period 2041 to 2093, notwithstanding Australia's objective to achieve net zero greenhouse gas emissions by 2050.

5.4 Scope 2 Emissions Calculation Methodologies

Indirect emissions associated with electricity usage were calculated for each year and scenario using the following equation:

$$Emissions_{Scope\ 2}\ (t\ of\ CO_{2e})$$

$$= Projected\ Electricity\ Usage\ (GWh) \times Projected\ Scope\ 2\ Queensland\ EF\ \left(\frac{tCO_2e}{MWh}\right) \times 10^3$$

where:

Projected electricity usage was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3. Projected Scope 2 Emission Factors for Queensland's Electricity Grid were obtained from **Table 3**.

5.5 Scope 3 Emission Factors

The emission factors and energy content (where applicable) for each emission source used in the Scope 3 assessment are summarised in **Table 4**. Scope 3 emission factors for electricity transmission losses are summarised in **Table 5**.

As shown in **Table 5**, projected emission factors for electricity transmission losses are available for the Queensland grid through 2040 (DCCEEW, 2025d). For the period between 2041 and 2093, a 2040 emission factor was applied to be conservative. Australia's national objective is to achieve net zero GHG emissions by 2050.

Table 4: Scope 3 Emission Factors

Emission Source	Energy Content Factor (GJ/kL) or (GJ/t)	Scope 3 Emission Factors					
		CO_2	CH_4	N_2O	Total	Units	Note
Fuel Use – Stationary Combustion (from power generation and off-road equipment)							
Diesel	38.6	-	-	-	17.3	kg CO_2e/GJ	[1]
Liquid Petroleum Gas	25.7	-	-	-	20.2	kg CO_2e/GJ	[1]
Fuel Use - Transport							
Diesel	38.6	-	-	-	17.3	kg CO_2e/GJ	[2]
Gasoline	34.2	-	-	-	17.2	kg CO_2e/GJ	[2]
Oils and Greases							
Petroleum based oils	38.8	-	-	-	18	kg CO_2e/GJ	[1]
Petroleum based greases	38.8	-	-	-	18	kg CO_2e/GJ	[1]
Downstream							
Rail transport	-	27.49	0.02	0.28	27.79	t CO_2e/Mt-km	[3]
Ship transport (Average Bulk Carrier)	-	3.49	0.001	0.04	3.53	t CO_2e/Mt-km	[4]
Thermal coal	27	90	0.04	0.2	90.24	kg CO_2e/GJ	[5]
Coking coal	30	91.8	0.03	0.2	92.03	kg CO2-e/GJ	[5]

Notes:

[1] Based on Table 8 of Australian National Greenhouse Accounts Factors for Individuals and Organisations Estimating Greenhouse Gas Emissions 2025, (DCCEEW, 2025a).

[2] Based on Table 9 of Australian National Greenhouse Accounts Factors for Individuals and Organisations Estimating Greenhouse Gas Emissions 2025, (DCCEEW, 2025a).

[3] Based on data for Freighting goods, Rail – Freight Train, from UK Government GHG Conversion Factors for Company Reporting, Department for Energy Security and Net Zero (UK Government, 2025).

[4] Based on data for Freighting goods, Bulk Carrier – Average data, from UK Government GHG Conversion Factors for Company Reporting, Department for Energy Security and Net Zero (UK Government, 2025).
[5] Based on Table 4 of Australian National Greenhouse Accounts Factors for Individuals and Organisations Estimating Greenhouse Gas Emissions 2025, (DCCEEW, 2025a): Scope 1 Bituminous Coal emission factors for thermal coal and Scope 1 Coking Coal emission factors for coking coal, respectively.
km = kilometre

Table 5: Related Scope 3 Emission Factors for Electricity Transmission Losses

Year	Projected Scope 3 Emission Factors for Queensland's Electricity Grid ($t CO_2e/MWh$)
2027	0.07
2028	0.06
2029	0.04
2030	0.02
2031	0.03
2032	0.03
2033	0.03
2034	0.03
2035	0.04
2036	0.03
2037	0.04
2038	0.03
2039	0.03
2040	0.03
2041	0.03*
2042	0.03*
2043	0.03*
2044	0.03*
2045	0.03*
2046	0.03*
2047	0.03*
2048	0.03*
2049	0.03*
2050 to 2093	0.03*

* For the period between 2041 and 2093, a 2040 emission factor was applied to be conservative. Australia's national objective is to achieve net zero GHG emissions by 2050.

5.6 Scope 3 Emissions Calculation Methodologies

Scope 3 emissions can encompass a broad range of sources, both upstream and downstream of the Project. For upstream emissions, this assessment includes those associated with fossil fuel (diesel and liquid petroleum gas), petroleum oil and greases supply to the site, and electricity transmission. However, emissions from company and employee travel, as well as those linked to the production of construction materials or delivery of new mobile equipment, have not been estimated as this is an amended project. For downstream emissions, this assessment includes final transportation and utilization of coal products. Downstream Scope 3 emissions are highly variable, depending on the destination country, transportation methods, handling processes, and the type of coal product being utilized (i.e., thermal or coking coal). This analysis provides estimates for rail transport to the port, international shipping, and coal combustion.

5.6.1 Scope 3 Fuel, Petroleum Oil and Greases Combustion

Scope 3 emissions resulting from fossil fuel (diesel and liquid petroleum gas), petroleum oil and greases supply to the site, were calculated for each year and scenario using the following equation:

$$Emissions_{Scope\ 3\ Fuels,Oil,Greases}\ (t\ of CO_2e)$$

$$= Quantity\ of\ Fuel\ (kL) \times Energy\ Content\ of\ Fuel\ \left(\frac{GJ}{kL}\right) \times Emission\ factor_{Scope\ 3}\ \left(\frac{kgCO_2e}{GJ}\right) \times 10^{-3}$$

where:

Quantity of fuel, petroleum oil and greases was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3.

Energy content values specific to each fuel type, petroleum oil or grease (expressed in GJ/KL) along with the corresponding Scope 3 emission factors (expressed in $kgCO_2e/GJ$), were obtained from **Table 4**.

5.6.2 Scope 3 Emissions from Electricity Transmission Losses

Scope 3 emissions from electricity transmission losses were calculated for each year and scenario using the following equation:

$$Emissions_{Electricity\ Scope\ 3}\ (t\ of CO_2e)$$

$$= Projected\ Electricity\ Usage\ (GWh) \times Projected\ Scope\ 3\ Queensland\ EF\ \left(\frac{tCO_2e}{MWh}\right) \times 10^3$$

where:

Projected electricity usage was obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.3. Projected Scope 3 Emission Factors for Queensland's Electricity Grid were obtained from **Table 3**.

5.6.3 Scope 3 Product Transportation Emissions

Product transportation emissions include both domestic transport (via rail to Gladstone using the Bauhinia Line of 250 km one way and by bulk carrier within Australia) and international shipping (via bulk carrier).

International shipping destinations include Japan, India, Korea, the Netherlands, China, Taiwan, Indonesia, France, Vietnam and Belgium. For a conservative assessment, transportation emissions were included for both outbound and return journeys. The average round-trip shipping distance was calculated based on weighted average production data for fiscal years 2025 and 2026, as summarised in **Table 6**.

Table 6: Weighted Average Shipping Distance with Return for Bulk Carrier

Location	Port	2025 Product Allocation	2026 Product Allocation	2025-2025 Product Weighted Average	Oneway distance (km)	Weighted Average Shipping Distance with Return (km)
Japan	Port of Kochi	46.6%	45.5%	46.3%	7,000	6,486
India	Cochin	24.6%	24.0%	24.5%	12,500	6,120
Korea	Yeosu	8.4%	10.9%	9.0%	7,500	1,355
Australia	Port of Eden Marina	0.5%	0.4%	0.5%	2,000	20
The Netherlands	Rotterdam	0.9%	0.0%	0.7%	18,000	248
China	Shanghai	10.9%	5.6%	9.5%	8,000	1,524
Taiwan	Kao-Hsiung	0.9%	2.9%	1.4%	7,500	215
Indonesia	Terminal Penumpang Gapura Surya Nusantara	0.1%	0.0%	0.1%	5,500	9
France	Rotterdam	1.5%	2.1%	1.7%	18,000	603
Vietnam	Vung Tua Port Green	4.8%	6.4%	5.2%	7,500	779
Belgium	Rotterdam	0.7%	2.1%	1.1%	18,000	385
Total		100%	100%	100%	-	**17,744**

Scope 3 product transportation emissions were calculated for each year and scenario using the following equation:

$$Emissions_{Scope\ 3\ Coal\ Transportation}\ (t\ of CO_2e)$$

$$= Quantity\ of\ Transported\ Product\ \ (Mt) \times Travelled\ Distance\ with\ Return\ (km) \times$$

$$\times\ Emission\ factor_{Scope\ 3\ Transport}\ \left(\frac{tCO_2e}{Mt-km}\right)$$

where:

Quantity of transported product obtained from the data provided by BWM for each scenario, as summarised in Appendix A, Table A.1 to Table A.4.

Travelled distance with return for rail transportation corresponds to 500 km (Bauhinia Line from BWM location to Gladstone). Travelled distance with return for bulk carrier corresponds to product destination weighted average shipping distance of 17,744 km as per **Table 6**.

Scope 3 emission factors for rail and bulk carrier transportation (expressed in t CO_2e/Mt-km), were obtained from **Table 4**.

5.6.4 Scope 3 Coal Combustion Emissions

Scope 3 coal combustion emissions include the final use of coal products at their destination and encompass both thermal coal and coking coal.

Scope 3 emissions from coal combustion were calculated for each year and scenario using the following equation:

$$Emissions_{Scope\ 3\ Coal\ Combustion}\ (t\ of CO_2e)$$

$$= Quantity\ of\ Final\ Product(Mt) \times Energy\ Content\ of\ Final\ Product\left(\frac{GJ}{kt}\right) \times$$

$$\times Emission\ factor_{Scope\ 3\ Final\ Product}\ \left(\frac{kgCO_2e}{GJ}\right) \times 10^3$$

where:

Quantity of thermal and coking coal was provided by BWM for each scenario, as summarised in Appendix A, Table A.4.

Energy content values specific to each coal type (expressed in GJ/kt) and corresponding Scope 3 emission factors (expressed in kgCO_2e/GJ), were obtained from **Table 4**.

6 QUANTIFIED GHG EMISSIONS

6.1 Scope 1 and Scope 2 Emissions

Appendix B provides the complete emissions inventory for Scope 1 and Scope 2 across all scenarios. **Table 7** summarises the estimated total unabated Scope 1 and Scope 2 emissions for each year of the Project, including Baseline Scenario, Project Scenario and Project Only Scenario. A graphical representation of annual GHG emissions for Project and Project only scenarios are shown in **Figure 4** and **Figure 5**, respectively. Diesel consumption from stationary power generation and off-road equipment, together with fugitive emissions, represented the largest contributors to the Project's cumulative Scope 1 emissions. Together, these two sources accounted for approximately 49% and 48% of total Scope 1 emissions in the Project Scenario, respectively. For the Project Only scenario, these two sources accounted for approximately 66% and 31% of total Scope 1 emissions, respectively.

The annual average Scope 1 and 2 emissions for Baseline Scenario, Project Scenario and Project Only Scenario would be approximately 797,266 t CO_2e/year, 1,038,721 t CO_2e/year, 277,154 t CO_2e/year respectively.

The Project will support an increase in average ROM production from 12 Mtpa to 15 Mtpa (approximately 23% increase).

The Scope 1 GHG emissions intensity at BWM is anticipated to change from approximately 0.0586 t CO_2e/t ROM (Baseline scenario) to approximately 0.0660 tCO_2e/t ROM (Project scenario), an increase of approximately 11%, that is related to geologic conditions.

According to the criteria outlined in Section 3.2 of the Guideline (DETSI, 2025), which defines medium to high Scope 1 and Scope 2 GHG emission sources as those producing 25,000 t of CO_2e or more annually, the Project falls within the medium to high emitter category.

Table 7: Results of Scope 1 and 2 emissions

Year	Scope 1 and Scope 2 emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY27	959,363	979,223	19,860
FY28	968,664	1,017,002	48,338
FY29	995,551	946,061	-49,490
FY30	846,517	965,678	119,160
FY31	932,501	1,094,412	161,912
FY32	956,354	1,223,947	267,593
FY33	915,513	1,221,781	306,268

Year	Scope 1 and Scope 2 emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY34	996,453	1,190,861	194,408
FY35	1,030,128	1,223,622	193,494
FY36	986,748	1,173,207	186,460
FY37	991,025	1,240,787	249,762
FY38	948,125	1,230,800	282,675
FY39	972,400	1,225,614	253,215
FY40	947,730	1,198,105	250,376
FY41	926,256	1,252,521	326,264
FY42	909,161	1,256,875	347,715
FY43	942,564	1,251,955	309,391
FY44	887,367	1,266,776	379,410
FY45	836,796	1,249,557	412,760
FY46	829,682	1,293,983	464,301
FY47	754,918	1,197,886	442,968
FY48	737,458	1,231,707	494,250
FY49	675,232	1,224,143	548,911
FY50	662,869	1,292,977	630,108
FY51	632,334	1,280,721	648,387
FY52	585,646	1,172,436	586,790
FY53	553,136	1,247,865	694,728
FY54	548,599	1,166,467	617,868
FY55	551,068	1,190,023	638,955
FY56	944,287	1,117,802	173,515
FY57	952,571	1,030,645	78,073
FY58	935,898	1,044,912	109,014
FY59	925,481	1,102,242	176,762
FY60	954,569	1,120,956	166,386

Year	Scope 1 and Scope 2 emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY61	958,682	1,042,769	84,087
FY62	935,886	1,124,519	188,633
FY63	983,059	1,064,885	81,826
FY64	939,921	1,088,419	148,498
FY65	1,009,863	1,083,870	74,008
FY66	963,778	1,101,262	137,485
FY67	1,028,565	1,128,766	100,201
FY68	988,940	1,090,933	101,993
FY69	1,020,414	1,137,485	117,070
FY70	979,740	1,192,284	212,544
FY71	995,008	1,067,799	72,791
FY72	995,196	1,126,208	131,013
FY73	913,160	1,095,745	182,585
FY74	885,328	1,059,884	174,556
FY75	767,503	1,128,833	361,330
FY76	585,048	1,074,610	489,562
FY77	583,228	1,116,236	533,008
FY78	584,821	1,053,502	468,681
FY79	557,486	1,149,251	591,766
FY80	579,677	971,701	392,023
FY81	572,079	941,438	369,359
FY82	546,703	912,406	365,703
FY83	490,767	913,816	423,049
FY84	484,174	874,413	390,239
FY85	479,078	749,622	270,543
FY86	449,538	559,462	109,924
FY87	423,102	538,303	115,201

Year	Scope 1 and Scope 2 emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY88	433,508	507,500	73,992
FY89	394,969	453,714	58,745
FY90	302,821	410,666	107,846
FY91	-	405,002	405,002
FY92	-	377,808	377,808
FY93	-	127,669	127,669
Average	**797,266***	**1,038,721**	**277,154**

* For the Baseline Scenario Average, FY91 to FY93 are excluded.

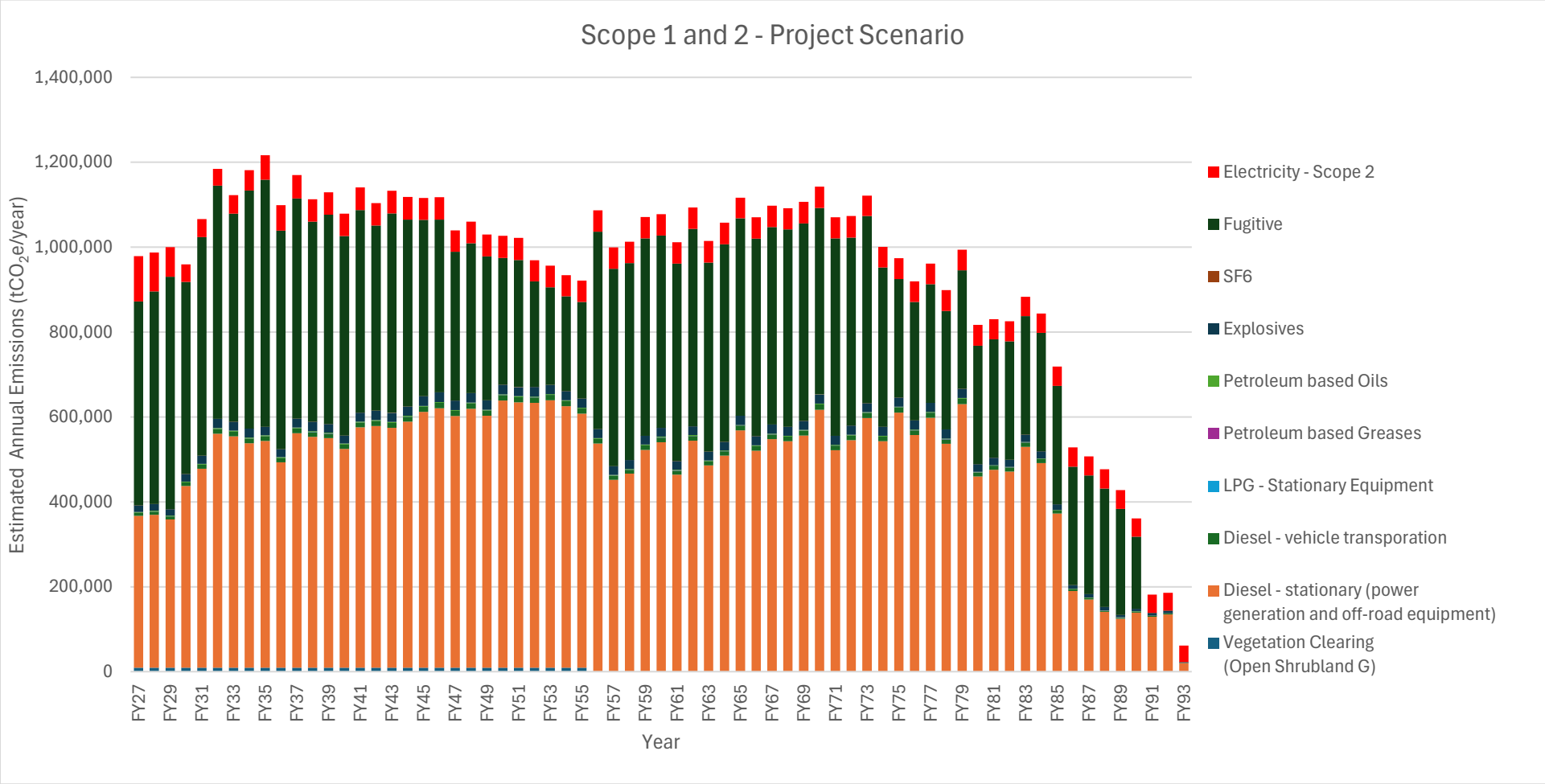


Figure 4: Scope 1 and 2 Project Scenario Emissions

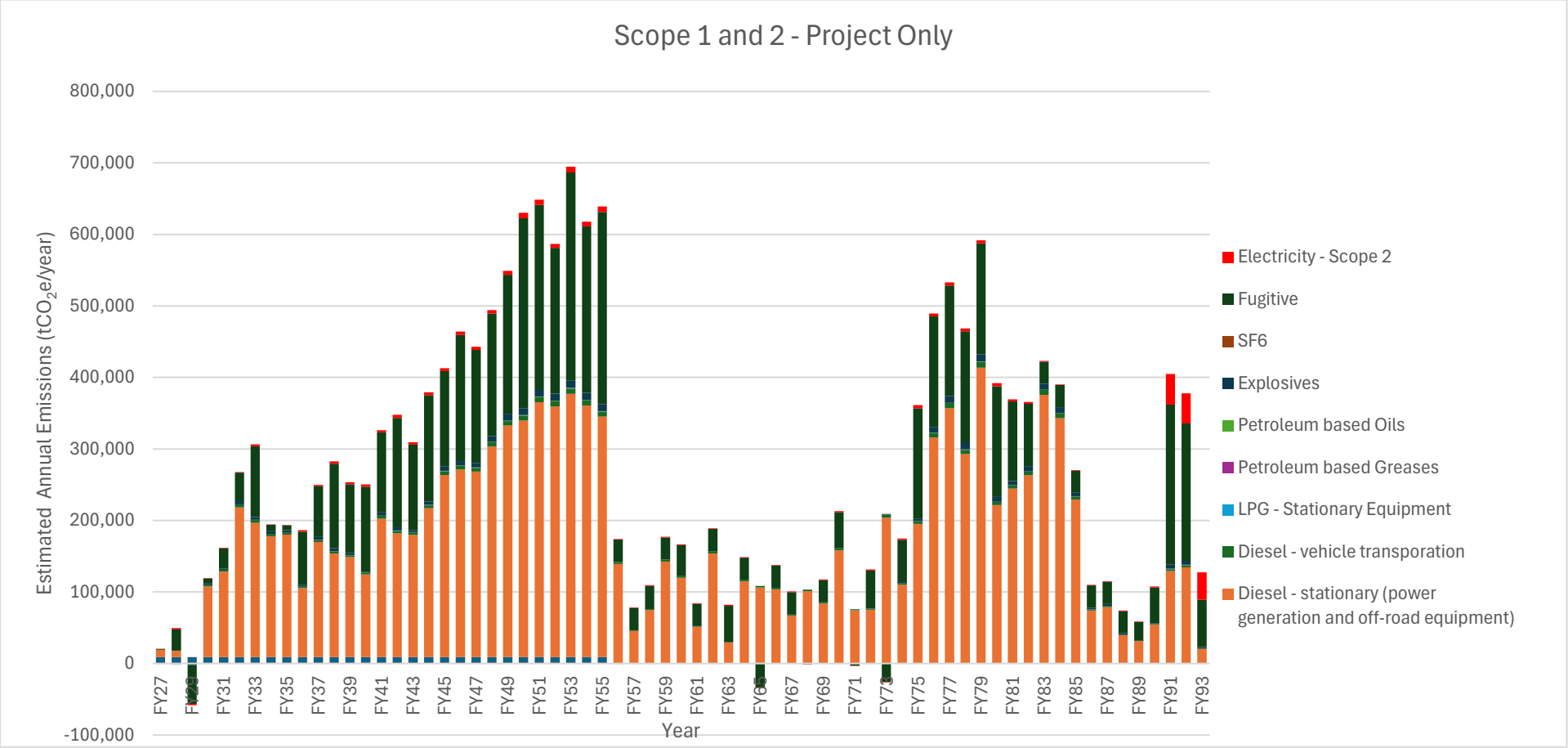


Figure 5: Scope 1 and 2 Project Only Scenario Emissions

6.2 Scope 3 Emissions

Appendix B provides the complete emissions inventory for Scope 3 across all scenarios. **Table 8** summarises the estimated total Scope 3 emissions for each year of the Project, including Baseline Scenario, Project Scenario and Project Only Scenario. Graphical representations of the annual Scope 3 GHG emissions for the Project and Project only scenarios are shown in **Figure** 6 and **Figure 7** respectively. These results indicate that the dominant source of Scope 3 emissions is the downstream combustion of the produced coal, which accounts for roughly 97% and 96% of the cumulative Scope 3 emissions in the Project and Project Only Scenarios, respectively.

Table 8: Results of Scope 3 emissions

Year	Scope 3 Emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY27	32,938,720	38,314,140	5,375,421
FY28	33,342,849	41,101,983	7,759,134
FY29	37,415,526	37,747,807	332,280
FY30	30,966,010	38,062,999	7,096,989
FY31	36,002,466	42,453,938	6,451,472
FY32	38,921,351	48,328,080	9,406,729
FY33	32,894,655	46,793,910	13,899,254
FY34	39,157,149	44,641,917	5,484,769
FY35	40,534,107	47,604,716	7,070,609
FY36	36,378,975	47,873,479	11,494,505
FY37	36,586,723	43,491,113	6,904,390
FY38	32,894,617	47,361,218	14,466,602
FY39	34,098,776	46,590,519	12,491,743
FY40	32,713,107	46,267,999	13,554,892
FY41	33,818,960	42,511,227	8,692,267
FY42	30,431,149	44,798,548	14,367,398
FY43	33,132,393	44,481,379	11,348,987
FY44	31,077,553	42,101,071	11,023,517
FY45	29,574,405	43,525,220	13,950,815

Year	Scope 3 Emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY46	28,657,423	42,676,553	14,019,131
FY47	24,249,666	35,018,332	10,768,666
FY48	25,283,843	39,724,961	14,441,117
FY49	23,626,304	45,184,651	21,558,348
FY50	21,396,013	44,350,859	22,954,846
FY51	21,370,845	43,077,329	21,706,484
FY52	18,036,746	30,842,432	12,805,686
FY53	16,481,227	38,821,524	22,340,298
FY54	15,971,704	33,645,091	17,673,387
FY55	16,356,002	37,613,508	21,257,506
FY56	34,348,226	36,449,440	2,101,214
FY57	34,087,894	35,986,823	1,898,929
FY58	33,359,865	36,000,687	2,640,822
FY59	33,053,768	35,998,470	2,944,702
FY60	32,751,903	35,319,696	2,567,792
FY61	33,363,258	34,972,824	1,609,566
FY62	32,076,582	34,854,900	2,778,317
FY63	32,023,594	35,039,474	3,015,881
FY64	32,328,274	34,908,240	2,579,966
FY65	33,238,282	30,079,471	(3,158,810)
FY66	32,094,697	35,418,311	3,323,614
FY67	33,303,681	35,031,798	1,728,117
FY68	31,676,124	32,192,635	516,510
FY69	32,227,432	35,260,983	3,033,551
FY70	30,670,811	34,833,577	4,162,766
FY71	32,350,650	32,408,202	57,552
FY72	30,705,005	34,912,531	4,207,526

Year	Scope 3 Emissions (t CO_2e/year)		
	Baseline Scenario	Project Scenario	Project Only Scenario (Difference)
FY73	30,404,107	28,381,212	(2,022,895)
FY74	25,959,784	30,659,050	4,699,266
FY75	18,845,996	30,744,116	11,898,119
FY76	18,818,039	30,232,745	11,414,706
FY77	19,562,449	30,038,772	10,476,323
FY78	18,800,135	29,184,179	10,384,044
FY79	19,130,973	30,694,625	11,563,652
FY80	18,018,844	29,010,256	10,991,412
FY81	19,556,918	26,432,091	6,875,173
FY82	18,479,542	25,249,680	6,770,138
FY83	18,004,753	20,884,063	2,879,310
FY84	18,533,047	20,859,326	2,326,279
FY85	18,585,054	20,618,091	2,033,037
FY86	18,472,304	20,365,598	1,893,294
FY87	18,176,571	20,451,228	2,274,658
FY88	17,817,880	20,754,163	2,936,283
FY89	16,419,672	18,024,453	1,604,781
FY90	10,372,130	13,843,987	3,471,858
FY91	-	14,777,563	14,777,563
FY92	-	12,281,205	12,281,205
FY93	-	3,924,205	3,924,205

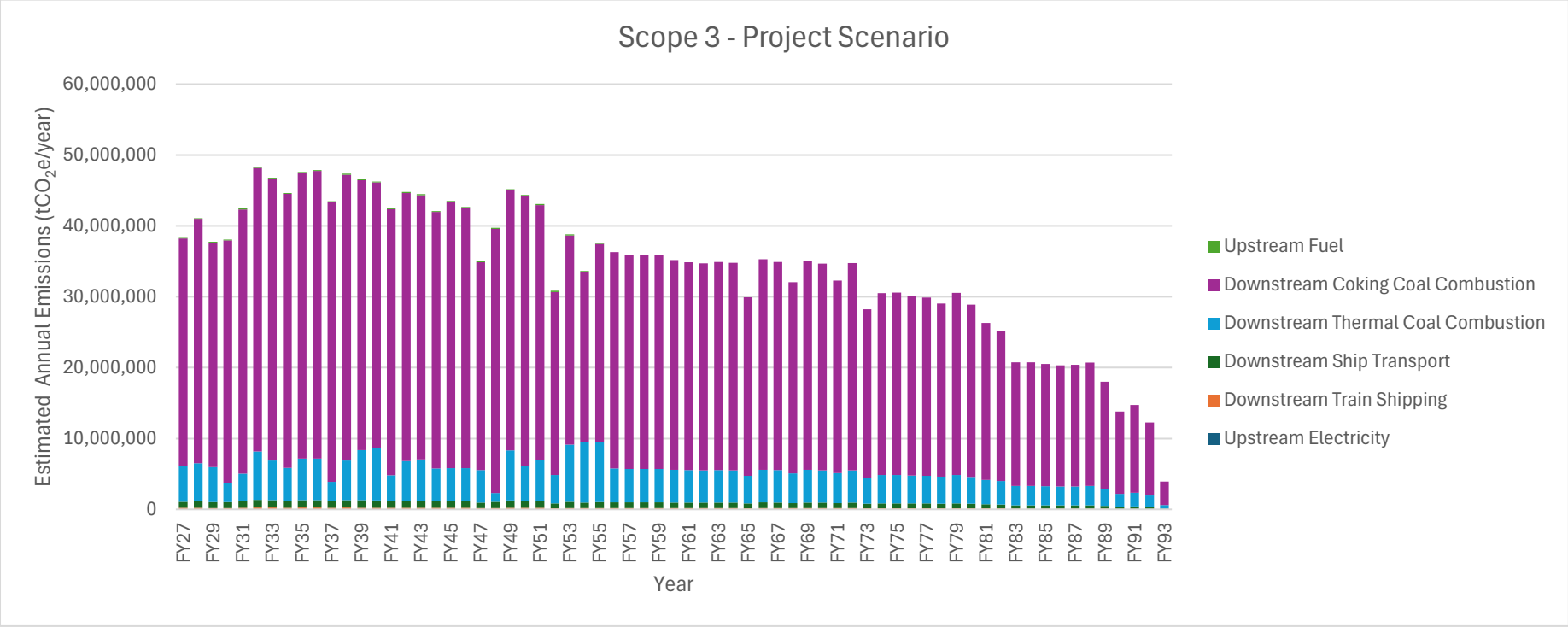


Figure 6: Scope 3 Project Scenario Emissions

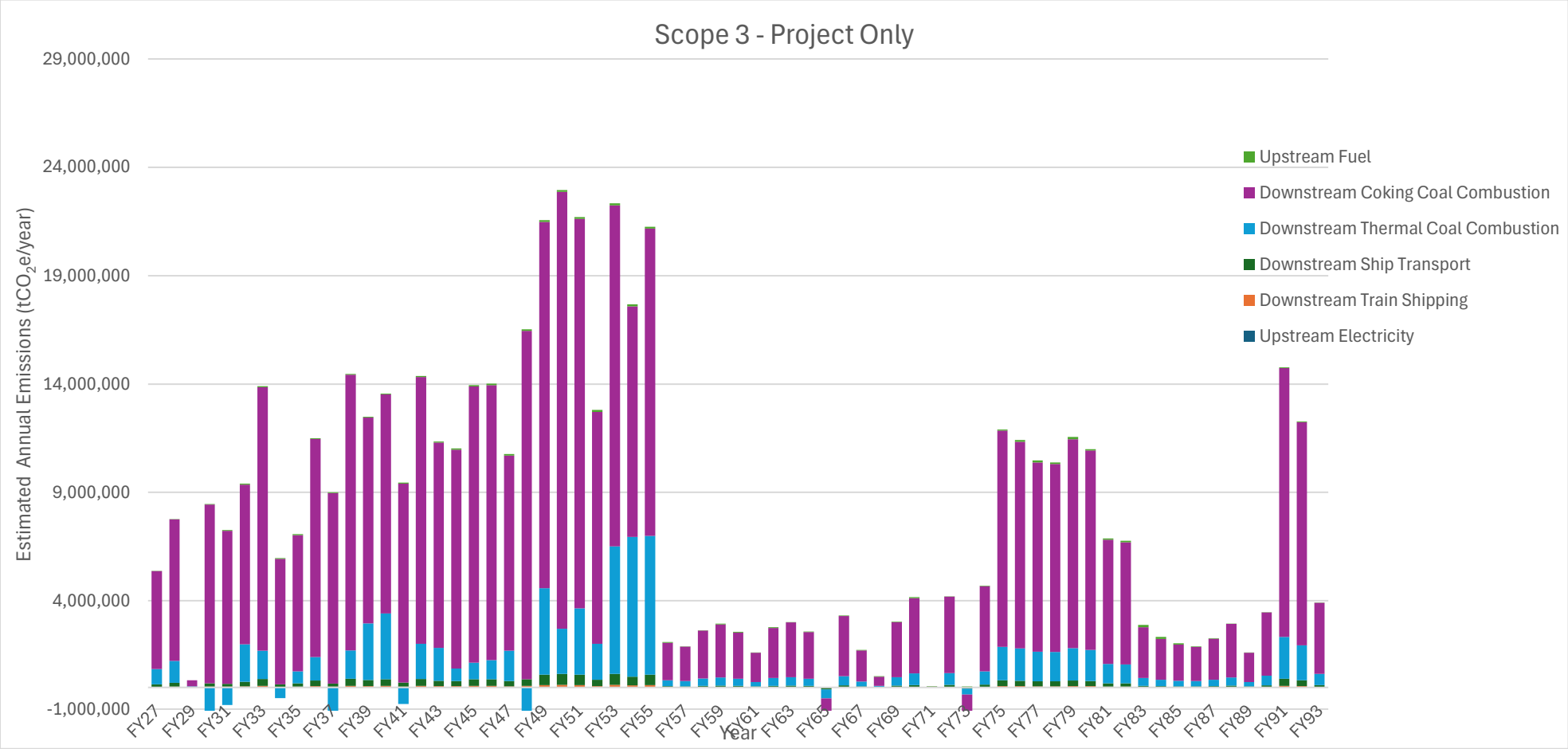


Figure 7: Scope 3 Project Only Scenario Emissions

7 COMPARISON OF ESTIMATED PROJECT EMISSIONS WITH QUEENSLAND AND NATIONAL EMISSION BUDGETS

Since 2015, a total of 196 Parties including Australia, have adopted the Paris Agreement, a global accord designed to tackle climate change and limit future warming. The Agreement's central objective is to keep the rise in global average temperatures well below 2°C above pre-industrial levels, while also pursuing efforts to restrict warming to 1.5°C.

7.1 National and Queensland Reduction Targets

Australia and Queensland have both set ambitious GHG emissions reduction targets compared with their 2005 emission levels. Nationally, Australia aims to cut emissions 43% below 2005 levels by 2030 and further accelerate reductions to 62–70% below 2005 levels by 2035, ultimately reaching net-zero by 2050 (DCCEEW, 2025e).

Queensland, has legislated reductions for the same periods, targeting a 30% reduction by 2030, then increasing to 75% below 2005 levels by 2035, and net-zero by 2050 (Queensland Government, 2024b).

Australia and Queensland's current annual GHG emissions and reduction targets are summarised in **Table 9.**

Table 9: National and State Current Emissions and Reduction Targets for CO_2e

Jurisdiction	Current Emissions [1] (Mt)	2030 Target (Mt)	2035 Target (Mt)	2050 Target (Mt)
Australia Target	-	43% below 2005	62–70% below 2005	Net zero
Queensland Target	-	30% below 2005	75% below 2005	Net zero
Australia	446	349	184	-
Queensland	126	133	48	-

Note: [1] Average Australian GHG emissions for 2023–2025 (DCCEEW, 2025d) and average Queensland GHG emissions for 2022–2023 (Queensland Government, 2023b and Queensland Government, 2024d).

7.2 Project Contribution

Table 10 presents a comparison of the total estimated Scope 1 and Scope 2 emissions for the Project and Project Only Scenarios for 2030 and 2035.

Annual Project Only emissions are estimated to be:

- 0.03 and 0.11% of Australia's target emissions in 2030 and 2035, respectively.
- 0.09 and 0.41% of Queensland's target emissions in 2030 and 2035, respectively.

Table 10: Comparison of Estimated Project and Project Only Emissions with National and Queensland Emissions and Reduction Targets

Emission/Year	2030	2035
Scope 1 and 2 Project Only (Mt of CO_2e)	0.12	0.19
Australia Target (Mt of CO_2e)	349	184
Queensland Target (Mt of CO_2e)	133	48
Project Only % contribution to Australia Target	0.03	0.11
Project Only % contribution to Queensland Target	0.09	0.41

8 CONCLUSION

This report presents the findings of the GHG Calculation Report for the proposed Project, involving the expansion of the existing open-cut metallurgical coal mine located in the Bowen Basin, Queensland.

Scope 1, 2 and 3 emissions were estimated based on data available at the time of writing and the relevant guidelines and standards. Based on calculations and assumptions as outlined in this report, assessment results indicate:

- Estimated annual Scope 1 plus Scope 2 GHG emissions from the (unabated) Project Only Scenario range from negative 49 (i.e. a GHG emission saving of 49 Kt) to 695 kt CO_2e per year.
- Annual Project Only emissions are estimated to be:
    - 0.03 and 0.11% of Australia's target emissions in 2030 and 2035, respectively.
    - 0.09 and 0.41% of Queensland's target emissions in 2030 and 2035, respectively.
- Diesel consumption from stationary power generation and off-road equipment, together with fugitive emissions, represent the largest contributors to the unabated Project Only Scope 1 emissions; accounting for 64% and 32% of total Scope 1 emissions, respectively. Fugitive emissions were estimated based on Method 1.

The Project is unlikely to materially increase the national effort required to reach Australia's 2030, 2035 and 2050 GHG mitigation targets. Further, the Project in isolation is unlikely to limit Australia achieving its national mitigation targets. As part of implementing the Project, the Proponent will seek to mitigate GHG emissions as documented in the Decarbonisation Study Report.

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10 STATEMENT OF LIMITATIONS

This report entitled Blackwater North Extension Project Greenhouse gas Calculation Report, dated 10 April 2026, was prepared by RWDI Australia Pty Ltd ("RWDI") for Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("the Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

APPENDIX A

Appendix A

Activity Data

Table A.1: Baseline Scenario Activity Data in the Emission Estimates

Baseline Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY27	15.5	11.8	130,890	2,566	78,040	15,116	18,227	10,829	6,111	128,324	3.3	3,341	605	0.121	91	218	0.0
FY28	16.1	11.9	132,411	2,596	79,622	16,947	15,914	11,150	6,182	129,815	3.5	3,483	631	0.121	97	220	0.0
FY29	17.7	13.4	131,727	2,583	79,205	16,628	16,009	11,151	6,150	129,144	3.8	3,809	690	0.121	96	226	0.0
FY30	14.6	11.1	123,940	2,430	74,062	15,761	15,299	10,602	5,786	121,510	3.1	3,148	570	0.121	89	214	0.0
FY31	16.6	12.9	131,565	2,580	76,745	15,974	19,073	11,052	6,142	128,986	3.6	3,580	649	0.121	98	222	0.0
FY32	17.7	13.9	128,774	2,525	75,767	14,828	18,952	10,690	6,012	126,249	3.8	3,823	692	0.121	99	226	0.0
FY33	15.8	11.8	134,511	2,637	79,862	15,384	19,038	11,310	6,280	131,874	3.4	3,409	618	0.121	100	219	0.0
FY34	18.1	14.0	135,658	2,660	80,386	15,564	19,330	11,385	6,333	132,998	3.9	3,906	708	0.121	99	227	0.0
FY35	18.8	14.5	136,839	2,683	81,351	15,728	19,303	11,385	6,388	134,155	4.0	4,051	734	0.121	99	230	0.0
FY36	16.6	13.0	145,913	2,861	90,224	14,533	20,355	11,128	6,812	143,052	3.6	3,581	649	0.121	97	222	0.0
FY37	16.7	13.1	147,533	2,893	89,837	16,347	20,218	11,351	6,888	144,640	3.6	3,606	653	0.121	100	222	0.0
FY38	15.2	11.8	150,397	2,949	93,161	14,913	21,136	11,216	7,021	147,448	3.3	3,279	594	0.121	100	216	0.0
FY39	15.9	12.2	151,030	2,961	92,952	15,347	21,540	11,179	7,051	148,069	3.4	3,430	621	0.121	102	219	0.0
FY40	15.2	11.7	150,666	2,954	92,088	16,271	20,977	11,342	7,034	147,712	3.3	3,270	592	0.121	101	216	0.0
FY41	15.4	12.1	140,328	2,752	85,931	14,740	19,779	10,576	6,551	137,577	3.3	3,321	602	0.121	95	217	0.0
FY42	14.1	10.9	149,317	2,928	91,653	15,688	21,010	11,068	6,971	146,390	3.0	3,035	550	0.121	101	212	0.0
FY43	15.1	11.8	148,626	2,914	90,566	16,232	20,861	11,114	6,939	145,712	3.3	3,269	592	0.121	104	216	0.0
FY44	14.2	11.1	139,856	2,742	85,414	14,982	19,389	10,799	6,529	137,113	3.1	3,066	555	0.121	97	213	0.0
FY45	13.4	10.6	131,019	2,569	79,369	14,808	17,621	10,535	6,117	128,450	2.9	2,890	523	0.121	94	210	0.0
FY46	13.1	10.2	131,585	2,580	79,041	15,201	18,251	10,369	6,143	129,005	2.8	2,829	512	0.121	96	209	0.0
FY47	11.3	8.7	125,812	2,467	76,567	14,083	16,790	10,031	5,874	123,345	2.4	2,438	442	0.121	90	202	0.0
FY48	11.4	9.0	118,922	2,332	72,039	13,680	15,532	9,789	5,552	116,591	2.4	2,453	444	0.121	84	202	0.0
FY49	10.9	8.4	101,802	1,996	61,775	11,986	12,803	8,491	4,753	99,806	2.4	2,359	427	0.121	73	200	0.0

Baseline Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY50	9.6	7.6	112,474	2,205	69,881	11,296	14,704	9,138	5,251	110,269	2.1	2,074	376	0.121	78	196	0.0
FY51	9.7	7.6	101,210	1,985	62,948	10,433	13,104	8,015	4,725	99,225	2.1	2,084	377	0.121	70	196	0.0
FY52	8.0	6.4	103,082	2,021	64,241	10,186	13,603	8,218	4,812	101,061	1.7	1,733	314	0.121	71	190	0.0
FY53	7.4	5.9	98,762	1,937	62,214	9,501	12,779	7,721	4,611	96,826	1.6	1,597	289	0.121	68	187	0.0
FY54	7.2	5.7	99,495	1,951	62,030	9,758	13,176	7,936	4,645	97,544	1.5	1,552	281	0.121	69	186	0.0
FY55	7.3	5.8	98,820	1,938	62,019	9,604	12,731	7,914	4,613	96,882	1.6	1,582	287	0.121	67	187	0.0
FY56	15.0	12.3	150,015	2,941	91,269	16,502	20,314	11,984	7,003	147,073	3.2	3,237	586	0.121	120	216	0.0
FY57	15.0	12.2	153,071	3,001	93,128	16,839	20,728	12,229	7,146	150,070	3.2	3,237	586	0.121	120	216	0.0
FY58	15.0	11.9	147,373	2,890	89,661	16,212	19,956	11,773	6,880	144,483	3.2	3,228	585	0.121	120	216	0.0
FY59	15.0	11.8	143,075	2,805	87,046	15,739	19,374	11,430	6,679	140,269	3.2	3,237	586	0.121	120	216	0.0
FY60	14.6	11.7	158,393	3,106	96,366	17,424	21,449	12,654	7,395	155,288	3.1	3,153	571	0.121	120	214	0.0
FY61	15.0	11.9	155,326	3,046	94,500	17,087	21,034	12,409	7,251	152,281	3.2	3,237	586	0.121	120	216	0.0
FY62	15.0	11.5	146,914	2,881	89,382	16,161	19,894	11,737	6,859	144,034	3.2	3,237	586	0.121	120	216	0.0
FY63	14.4	11.4	171,742	3,367	104,487	18,892	23,256	13,720	8,018	168,374	3.1	3,101	562	0.121	120	213	0.0
FY64	15.0	11.6	148,403	2,910	90,288	16,325	20,096	11,856	6,928	145,493	3.2	3,237	586	0.121	120	216	0.0
FY65	15.0	11.9	173,922	3,410	105,814	19,132	23,552	13,894	8,120	170,511	3.2	3,237	586	0.121	124	216	0.0
FY66	15.0	11.5	156,916	3,077	95,467	17,261	21,249	12,536	7,326	153,839	3.2	3,237	586	0.121	124	216	0.0
FY67	15.0	11.9	180,823	3,546	110,012	19,891	24,486	14,446	8,442	177,277	3.2	3,237	586	0.121	124	216	0.0
FY68	15.0	11.3	166,201	3,259	101,116	18,283	22,506	13,278	7,759	162,942	3.2	3,237	586	0.121	124	216	0.0
FY69	15.0	11.5	177,815	3,487	108,183	19,560	24,079	14,205	8,301	174,329	3.2	3,237	586	0.121	124	216	0.0
FY70	14.2	11.0	172,688	3,386	105,063	18,996	23,385	13,796	8,062	169,302	3.1	3,056	554	0.121	124	213	0.0
FY71	15.0	11.6	168,440	3,303	102,479	18,529	22,809	13,456	7,864	165,137	3.2	3,237	586	0.121	124	216	0.0
FY72	14.3	11.0	176,880	3,468	107,614	19,458	23,952	14,131	8,258	173,412	3.1	3,084	559	0.121	124	213	0.0
FY73	14.2	10.9	148,148	2,905	90,133	16,297	20,061	11,835	6,916	145,243	3.1	3,066	555	0.121	115	213	0.0
FY74	12.1	9.3	162,865	3,193	99,087	17,916	22,054	13,011	7,603	159,671	2.6	2,610	473	0.121	115	205	0.0
FY75	9.0	6.7	156,327	3,065	95,109	17,197	21,169	12,489	7,298	153,262	1.9	1,942	352	0.121	109	193	0.0
FY76	9.0	6.7	90,837	1,781	55,265	9,992	12,301	7,257	4,241	89,056	1.9	1,942	352	0.121	81	193	0.0

Baseline Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY77	9.0	7.0	90,747	1,779	55,210	9,983	12,289	7,250	4,237	88,968	1.9	1,942	352	0.121	72	193	0.0
FY78	9.0	6.7	91,707	1,798	55,794	10,088	12,419	7,326	4,281	89,909	1.9	1,942	352	0.121	66	193	0.0
FY79	9.0	6.8	81,642	1,601	49,671	8,981	11,056	6,522	3,811	80,041	1.9	1,942	352	0.121	66	193	0.0
FY80	9.0	6.4	89,819	1,761	54,646	9,881	12,163	7,176	4,193	88,058	1.9	1,942	352	0.121	66	193	0.0
FY81	9.0	7.0	87,027	1,706	52,947	9,573	11,785	6,952	4,063	85,321	1.9	1,942	352	0.121	66	193	0.0
FY82	9.0	6.6	78,328	1,536	47,655	8,616	10,607	6,258	3,657	76,793	1.9	1,942	352	0.121	55	193	0.0
FY83	9.0	6.4	57,844	1,134	35,192	6,363	7,833	4,621	2,700	56,709	1.9	1,942	352	0.121	53	193	0.0
FY84	9.0	6.6	55,671	1,092	33,870	6,124	7,539	4,447	2,599	54,580	1.9	1,942	352	0.121	49	193	0.0
FY85	9.0	6.6	53,973	1,058	32,837	5,937	7,309	4,312	2,520	52,914	1.9	1,942	352	0.121	46	193	0.0
FY86	9.0	6.6	43,665	856	26,566	4,803	5,913	3,488	2,039	42,809	1.9	1,942	352	0.121	37	193	0.0
FY87	9.0	6.5	34,234	671	20,828	3,766	4,636	2,735	1,598	33,563	1.9	1,942	352	0.121	32	193	0.0
FY88	9.0	6.4	38,068	746	23,161	4,188	5,155	3,041	1,777	37,322	1.9	1,942	352	0.121	32	193	0.0
FY89	8.1	5.9	35,040	687	21,318	3,855	4,745	2,799	1,636	34,353	1.7	1,737	315	0.121	32	190	0.0
FY90	5.5	3.7	31,783	623	19,337	3,496	4,304	2,539	1,484	31,160	1.2	1,181	214	0.121	28	180	0.0
FY91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FY92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FY93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table A.2: Project Scenario Activity Data in the Emission Estimates

Project Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY27	15.5	13.7	134,832	2,644	79,624	16,578	18,114	11,578	6,295	132,188	3.3	3,345	606	0.121	89	218	80
FY28	17.1	14.7	135,741	2,662	78,505	18,015	18,365	11,858	6,337	133,080	3.7	3,690	668	0.121	91	224	80
FY29	15.9	13.5	131,562	2,580	76,640	16,767	17,975	11,458	6,142	128,982	3.4	3,431	621	0.121	87	219	80
FY30	14.8	13.5	161,158	3,160	95,210	18,789	23,712	12,763	7,524	157,998	3.2	3,193	578	0.121	104	215	80
FY31	17.5	15.1	176,622	3,463	106,573	19,688	25,312	13,340	8,246	173,159	3.8	3,776	684	0.121	109	225	80
FY32	19.0	17.3	207,567	4,070	127,301	21,208	30,418	14,880	9,690	203,497	4.1	4,100	743	0.121	123	231	80
FY33	19.0	16.8	205,208	4,024	125,729	20,052	30,989	14,833	9,580	201,184	4.1	4,100	743	0.121	121	231	80
FY34	18.4	15.9	199,234	3,907	120,692	20,724	29,985	14,625	9,301	195,328	4.0	3,970	719	0.121	120	228	80
FY35	19.0	17.0	201,263	3,946	124,559	20,866	28,092	14,404	9,396	197,317	4.1	4,100	743	0.121	113	231	80
FY36	19.0	17.1	182,285	3,574	111,177	20,470	24,719	13,835	8,510	178,711	4.1	4,100	743	0.121	106	231	80
FY37	19.0	15.4	208,060	4,080	128,484	20,549	30,399	14,836	9,713	203,980	4.1	4,100	743	0.121	119	231	80
FY38	19.0	17.0	204,942	4,018	124,221	21,381	30,748	15,007	9,568	200,924	4.1	4,100	743	0.121	124	231	80
FY39	19.0	16.7	203,583	3,992	127,745	19,465	28,341	14,535	9,504	199,591	4.1	4,100	743	0.121	115	231	80
FY40	19.0	16.6	194,096	3,806	122,840	19,087	25,225	14,077	9,061	190,290	4.1	4,100	743	0.121	105	231	80
FY41	19.0	15.1	213,179	4,180	133,073	20,402	30,780	14,791	9,952	208,999	4.1	4,100	743	0.121	120	231	80
FY42	19.0	15.9	214,410	4,204	131,926	22,263	30,921	15,087	10,010	210,206	4.1	4,100	743	0.121	126	231	80
FY43	19.0	15.8	212,937	4,175	133,323	20,057	30,691	14,750	9,941	208,762	4.1	4,100	743	0.121	121	231	80
FY44	19.0	15.0	218,202	4,278	137,061	21,176	30,649	14,852	10,187	213,923	4.1	4,100	743	0.121	124	231	80
FY45	17.7	15.5	226,905	4,449	143,518	20,649	32,802	14,894	10,593	222,456	3.8	3,819	692	0.121	128	226	80
FY46	18.8	15.2	230,264	4,515	146,010	20,896	33,074	15,019	10,750	225,749	4.1	4,057	735	0.121	129	230	80
FY47	16.4	12.5	223,416	4,381	141,912	19,485	32,578	14,630	10,430	219,035	3.5	3,539	641	0.121	125	221	80
FY48	16.9	14.0	229,796	4,506	146,644	20,376	32,737	14,805	10,728	225,290	3.6	3,647	661	0.121	128	223	80
FY49	17.2	16.2	223,604	4,384	142,280	19,132	32,649	14,719	10,439	219,219	3.7	3,711	672	0.121	126	224	80
FY50	18.2	15.8	236,948	4,646	151,737	21,663	32,862	14,978	11,062	232,302	3.9	3,927	711	0.121	129	228	80
FY51	18.0	15.3	235,333	4,614	153,996	18,276	32,874	14,585	10,987	230,718	3.9	3,884	704	0.121	121	227	80
FY52	14.6	11.0	235,056	4,609	152,366	20,214	32,378	14,515	10,974	230,447	3.1	3,150	571	0.121	128	214	80

Project Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY53	16.8	14.0	237,236	4,652	155,791	18,369	32,742	14,607	11,075	232,585	3.6	3,625	657	0.121	123	222	80
FY54	14.7	12.2	231,898	4,547	150,726	19,286	32,345	14,168	10,826	227,351	3.2	3,172	575	0.121	124	215	80
FY55	16.0	13.6	225,365	4,419	145,149	18,296	32,518	14,462	10,521	220,946	3.4	3,452	625	0.121	123	219	80
FY56	16.0	13.0	202,391	3,968	125,998	19,953	28,746	14,278	9,449	198,423	3.4	3,452	625	0.121	117	219	0
FY57	16.0	12.9	170,229	3,338	105,976	16,782	24,178	12,009	7,947	166,891	3.4	3,452	625	0.121	117	219	0
FY58	16.0	12.9	175,494	3,441	109,254	17,301	24,925	12,380	8,193	172,053	3.4	3,452	625	0.121	117	219	0
FY59	16.0	12.9	196,650	3,856	122,424	19,386	27,930	13,873	9,181	192,794	3.4	3,452	625	0.121	117	219	0
FY60	16.0	12.6	203,555	3,991	126,723	20,067	28,911	14,360	9,503	199,564	3.4	3,452	625	0.121	117	219	0
FY61	16.0	12.5	174,703	3,426	108,761	17,223	24,813	12,324	8,156	171,278	3.4	3,452	625	0.121	117	219	0
FY62	16.0	12.4	204,870	4,017	127,541	20,197	29,098	14,452	9,564	200,853	3.4	3,452	625	0.121	117	219	0
FY63	16.0	12.5	182,864	3,586	113,842	18,027	25,972	12,900	8,537	179,279	3.4	3,452	625	0.121	117	219	0
FY64	16.0	12.5	191,549	3,756	119,248	18,884	27,206	13,513	8,943	187,793	3.4	3,452	625	0.121	117	219	0
FY65	13.9	10.7	213,889	4,194	133,156	21,086	30,379	15,089	9,985	209,695	3.0	3,008	545	0.121	122	212	0
FY66	16.0	12.7	196,002	3,843	122,021	19,323	27,838	13,827	9,150	192,159	3.4	3,452	625	0.121	122	219	0
FY67	16.0	12.5	206,152	4,042	128,339	20,323	29,280	14,543	9,624	202,109	3.4	3,452	625	0.121	122	219	0
FY68	15.0	11.5	204,286	4,006	127,178	20,139	29,015	14,411	9,537	200,281	3.2	3,231	585	0.121	122	216	0
FY69	16.0	12.6	209,369	4,105	130,342	20,640	29,737	14,770	9,774	205,264	3.4	3,452	625	0.121	122	219	0
FY70	15.8	12.4	232,240	4,554	144,581	22,895	32,985	16,383	10,842	227,686	3.4	3,404	617	0.121	122	219	0
FY71	14.9	11.6	196,424	3,851	122,283	19,364	27,898	13,857	9,170	192,572	3.2	3,219	583	0.121	122	215	0
FY72	16.0	12.5	205,208	4,024	127,752	20,230	29,146	14,476	9,580	201,184	3.4	3,452	625	0.121	122	219	0
FY73	13.4	10.1	224,912	4,410	140,019	22,173	31,944	15,866	10,500	220,502	2.9	2,887	523	0.121	122	210	0
FY74	14.0	10.9	204,338	4,007	127,210	20,144	29,022	14,415	9,540	200,331	3.0	3,021	547	0.121	122	212	0
FY75	14.0	11.0	229,781	4,506	143,050	22,653	32,636	16,210	10,727	225,275	3.0	3,021	547	0.121	122	212	0
FY76	14.0	10.8	209,772	4,113	130,593	20,680	29,794	14,798	9,793	205,659	3.0	3,021	547	0.121	122	212	0
FY77	14.0	10.7	225,132	4,414	140,156	22,194	31,975	15,882	10,510	220,718	3.0	3,021	547	0.121	122	212	0
FY78	14.0	10.4	201,983	3,960	125,744	19,912	28,688	14,249	9,430	198,022	3.0	3,021	547	0.121	122	212	0
FY79	14.0	10.9	237,315	4,653	147,740	23,395	33,706	16,741	11,079	232,662	3.0	3,021	547	0.121	122	212	0

Project Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY80	14.0	10.4	173,146	3,395	107,792	17,069	24,592	12,215	8,083	169,751	3.0	3,021	547	0.121	101	212	0
FY81	12.6	9.4	179,038	3,511	111,460	17,650	25,429	12,630	8,358	175,528	2.7	2,714	492	0.121	97	207	0
FY82	11.8	9.0	177,412	3,479	110,447	17,490	25,198	12,515	8,283	173,933	2.5	2,548	462	0.121	97	204	0
FY83	10.0	7.4	199,278	3,907	124,061	19,646	28,303	14,058	9,303	195,371	2.2	2,158	391	0.121	97	197	0
FY84	10.0	7.4	184,844	3,624	115,074	18,223	26,253	13,040	8,630	181,220	2.2	2,158	391	0.121	95	197	0
FY85	10.0	7.4	140,212	2,749	87,289	13,823	19,914	9,891	6,546	137,463	2.2	2,158	391	0.121	74	197	0
FY86	10.0	7.3	71,575	1,403	44,559	7,056	10,166	5,049	3,341	70,171	2.2	2,158	391	0.121	50	197	0
FY87	10.0	7.3	63,964	1,254	39,820	6,306	9,085	4,512	2,986	62,709	2.2	2,158	391	0.121	47	197	0
FY88	10.0	7.4	52,983	1,039	32,985	5,223	7,525	3,738	2,474	51,944	2.2	2,158	391	0.121	41	197	0
FY89	8.9	6.4	46,782	917	29,124	4,612	6,644	3,300	2,184	45,865	1.9	1,920	348	0.121	32	193	0
FY90	7.1	4.9	52,288	1,025	32,552	5,155	7,427	3,689	2,441	51,263	1.5	1,529	277	0.121	32	186	0
FY91	7.2	5.3	48,619	953	30,268	4,793	6,905	3,430	2,270	47,666	1.6	1,557	282	0.121	32	187	0
FY92	6.2	4.4	50,660	993	31,539	4,994	7,195	3,574	2,365	49,667	1.3	1,336	242	0.121	32	183	0
FY93	2.1	1.4	7,725	151	4,809	762	1,097	545	361	7,574	0.5	463	84	0.121	8	168	0

Table A.3: Project Only Scenario Activity Data in the Emission Estimates

Project Only Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY27	0.0	1.9	3,942	77	1,583	1,462	-113	749	184	3,864	0.0	4	1	0.0	-3	0	80
FY28	1.0	2.8	3,330	65	-1,118	1,068	2,451	708	155	3,265	0.2	207	37	0.0	-6	4	80
FY29	-1.8	0.1	-165	-3	-2,565	138	1,966	307	-8	-162	-0.4	-378	-68	0.0	-8	-7	80
FY30	0.2	2.4	37,218	730	21,148	3,028	8,413	2,161	1,738	36,488	0.0	45	8	0.0	15	1	80
FY31	0.9	2.2	45,057	883	29,828	3,714	6,240	2,289	2,104	44,174	0.2	196	35	0.0	11	3	80
FY32	1.3	3.4	78,793	1,545	51,534	6,381	11,465	4,190	3,678	77,248	0.3	277	50	0.0	24	5	80
FY33	3.2	5.0	70,696	1,386	45,867	4,668	11,951	3,523	3,300	69,310	0.7	691	125	0.0	21	12	80
FY34	0.3	1.9	63,576	1,247	40,307	5,160	10,655	3,240	2,968	62,329	0.1	64	12	0.0	20	1	80
FY35	0.2	2.5	64,424	1,263	43,208	5,138	8,789	3,020	3,008	63,161	0.0	49	9	0.0	15	1	80
FY36	2.4	4.1	36,372	713	20,953	5,937	4,363	2,707	1,698	35,659	0.5	519	94	0.0	9	9	80
FY37	2.3	2.3	60,527	1,187	38,646	4,202	10,182	3,484	2,826	59,340	0.5	494	89	0.0	19	9	80
FY38	3.8	5.2	54,546	1,070	31,060	6,468	9,611	3,791	2,546	53,476	0.8	820	149	0.0	24	14	80
FY39	3.1	4.5	52,553	1,030	34,793	4,118	6,802	3,356	2,453	51,522	0.7	670	121	0.0	14	12	80
FY40	3.8	4.9	43,430	852	30,752	2,815	4,249	2,735	2,028	42,578	0.8	829	150	0.0	4	14	80
FY41	3.6	3.0	72,850	1,428	47,143	5,662	11,001	4,215	3,401	71,422	0.8	778	141	0.0	25	14	80
FY42	4.9	5.0	65,093	1,276	40,273	6,574	9,911	4,019	3,039	63,816	1.1	1,065	193	0.0	25	18	80
FY43	3.9	4.0	64,311	1,261	42,757	3,825	9,830	3,636	3,002	63,050	0.8	831	150	0.0	17	14	80
FY44	4.8	3.9	78,346	1,536	51,646	6,194	11,259	4,053	3,658	76,810	1.0	1,034	187	0.0	27	18	80
FY45	4.3	4.9	95,886	1,880	64,149	5,841	15,181	4,359	4,476	94,006	0.9	929	168	0.0	34	16	80
FY46	5.7	5.0	98,679	1,935	66,969	5,695	14,823	4,651	4,607	96,745	1.2	1,227	222	0.0	33	21	80
FY47	5.1	3.8	97,604	1,914	65,345	5,402	15,787	4,599	4,557	95,690	1.1	1,101	199	0.0	35	19	80
FY48	5.5	5.0	110,873	2,174	74,605	6,696	17,205	5,016	5,176	108,699	1.2	1,194	216	0.0	44	21	80
FY49	6.3	7.8	121,802	2,388	80,505	7,147	19,847	6,228	5,686	119,413	1.4	1,353	245	0.0	52	23	80
FY50	8.6	8.2	124,474	2,441	81,857	10,368	18,158	5,840	5,811	122,033	1.9	1,853	336	0.0	51	32	80
FY51	8.3	7.7	134,123	2,630	91,048	7,844	19,770	6,570	6,262	131,493	1.8	1,800	326	0.0	51	31	80
FY52	6.6	4.6	131,974	2,588	88,125	10,028	18,776	6,296	6,161	129,387	1.4	1,417	257	0.0	57	25	80

Project Only Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY53	9.4	8.1	138,474	2,715	93,577	8,868	19,963	6,886	6,465	135,759	2.0	2,028	367	0.0	55	35	80
FY54	7.5	6.5	132,403	2,596	88,696	9,528	19,169	6,232	6,181	129,807	1.6	1,620	293	0.0	56	28	80
FY55	8.7	7.8	126,545	2,481	83,129	8,692	19,788	6,548	5,908	124,064	1.9	1,870	339	0.0	55	32	80
FY56	1.0	0.7	52,377	1,027	34,730	3,450	8,431	2,293	2,445	51,350	0.2	216	39	0.0	-2	4	0
FY57	1.0	0.7	17,158	336	12,848	-57	3,449	-220	801	16,822	0.2	216	39	0.0	-2	4	0
FY58	1.0	0.9	28,122	551	19,592	1,089	4,969	607	1,313	27,570	0.2	224	41	0.0	-2	4	0
FY59	1.0	1.0	53,575	1,050	35,377	3,648	8,556	2,443	2,501	52,524	0.2	216	39	0.0	-2	4	0
FY60	1.4	0.9	45,162	886	30,357	2,643	7,462	1,706	2,108	44,276	0.3	300	54	0.0	-2	5	0
FY61	1.0	0.6	19,377	380	14,261	136	3,780	-84	905	18,997	0.2	216	39	0.0	-2	4	0
FY62	1.0	1.0	57,956	1,136	38,159	4,036	9,203	2,716	2,706	56,819	0.2	216	39	0.0	-2	4	0
FY63	1.6	1.1	11,123	218	9,355	-865	2,716	-820	519	10,905	0.4	351	64	0.0	-2	6	0
FY64	1.0	0.9	43,145	846	28,960	2,559	7,110	1,657	2,014	42,299	0.2	216	39	0.0	-2	4	0
FY65	-1.1	-1.1	39,967	784	27,342	1,954	6,827	1,194	1,866	39,183	-0.2	-229	-41	0.0	-2	-4	0
FY66	1.0	1.2	39,087	766	26,554	2,061	6,589	1,291	1,825	38,320	0.2	216	39	0.0	-2	4	0
FY67	1.0	0.6	25,329	497	18,327	432	4,793	97	1,182	24,832	0.2	216	39	0.0	-2	4	0
FY68	0.0	0.2	38,085	747	26,062	1,856	6,509	1,134	1,778	37,339	0.0	-5	-1	0.0	-2	0	0
FY69	1.0	1.1	31,554	619	22,160	1,080	5,658	564	1,473	30,935	0.2	216	39	0.0	-2	4	0
FY70	1.6	1.5	59,552	1,168	39,518	3,899	9,600	2,588	2,780	58,385	0.3	348	63	0.0	-2	6	0
FY71	-0.1	0.0	27,984	549	19,804	835	5,089	400	1,306	27,435	0.0	-18	-3	0.0	-2	0	0
FY72	1.7	1.5	28,328	555	20,138	773	5,193	346	1,322	27,772	0.4	369	67	0.0	-2	6	0
FY73	-0.8	-0.7	76,765	1,505	49,886	5,876	11,883	4,031	3,584	75,259	-0.2	-180	-33	0.0	7	-3	0
FY74	1.9	1.7	41,473	813	28,124	2,229	6,968	1,404	1,936	40,660	0.4	411	74	0.0	7	7	0
FY75	5.0	4.2	73,454	1,440	47,941	5,456	11,467	3,721	3,429	72,014	1.1	1,079	195	0.0	13	19	0
FY76	5.0	4.1	118,935	2,332	75,328	10,688	17,493	7,541	5,553	116,603	1.1	1,079	195	0.0	41	19	0
FY77	5.0	3.7	134,385	2,635	84,945	12,212	19,687	8,632	6,274	131,750	1.1	1,079	195	0.0	50	19	0
FY78	5.0	3.7	110,276	2,162	69,950	9,824	16,269	6,922	5,148	108,114	1.1	1,079	195	0.0	56	19	0
FY79	5.0	4.1	155,673	3,052	98,069	14,414	22,650	10,219	7,268	152,621	1.1	1,079	195	0.0	56	19	0

Project Only Scenario																	
Year	ROM	Product	Total Diesel	Diesel Transport	Diesel Haul Trucks	Diesel Dozers	Diesel Dig Units	Diesel Ancillary Equipment	Diesel Other	Diesel Station (Haul+Dozers+Dig Units+Ancillary +Other)	LPG	Petroleum based oils	Petroleum based greases	SF_6	Explosives	Electricity	Total surface disturbance area
	Mt	Mt	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	kL	t	kt	GWh	ha
FY80	5.0	3.9	83,327	1,634	53,146	7,189	12,429	5,039	3,890	81,693	1.1	1,079	195	0.0	35	19	0
FY81	3.6	2.4	92,011	1,804	58,513	8,077	13,644	5,678	4,296	90,207	0.8	772	140	0.0	31	13	0
FY82	2.8	2.4	99,083	1,943	62,793	8,873	14,591	6,258	4,626	97,141	0.6	606	110	0.0	41	11	0
FY83	1.0	1.0	141,435	2,773	88,869	13,283	20,471	9,437	6,603	138,662	0.2	216	39	0.0	44	4	0
FY84	1.0	0.8	129,173	2,533	81,204	12,099	18,715	8,592	6,030	126,640	0.2	216	39	0.0	46	4	0
FY85	1.0	0.7	86,240	1,691	54,452	7,885	12,606	5,579	4,026	84,549	0.2	216	39	0.0	27	4	0
FY86	1.0	0.7	27,909	547	17,993	2,253	4,253	1,561	1,303	27,362	0.2	216	39	0.0	13	4	0
FY87	1.0	0.8	29,729	583	18,992	2,540	4,449	1,777	1,388	29,146	0.2	216	39	0.0	15	4	0
FY88	1.0	1.0	14,915	292	9,824	1,036	2,370	696	696	14,623	0.2	216	39	0.0	9	4	0
FY89	0.8	0.6	11,742	230	7,806	757	1,900	501	548	11,512	0.2	182	33	0.0	-1	3	0
FY90	1.6	1.2	20,505	402	13,215	1,658	3,123	1,150	957	20,103	0.3	348	63	0.0	4	6	0
FY91	7.2	5.3	48,619	953	30,268	4,793	6,905	3,430	2,270	47,666	1.6	1,557	282	0.121	32	187	0
FY92	6.2	4.4	50,660	993	31,539	4,994	7,195	3,574	2,365	49,667	1.3	1,336	242	0.121	32	183	0
FY93	2.1	1.4	7,725	151	4,809	762	1,097	545	361	7,574	0.5	463	84	0.121	8	168	0

Table A.4: Production Schedule by Coal Type for Emission Scenarios

Year	Product Coal (Mtpa)								
	Baseline Scenario			Project Scenario			Project Only Scenario		
	Thermal	Coking	Total	Thermal	Coking	Total	Thermal	Coking	Total
FY27	1.8	10.0	11.8	2.1	11.6	13.7	0.3	1.6	1.9
FY28	1.8	10.1	11.9	2.2	12.5	14.7	0.4	2.4	2.8
FY29	2.0	11.4	13.4	2.0	11.5	13.5	0.0	0.1	0.1
FY30	1.7	9.4	11.1	1.1	12.4	13.5	-0.6	3.0	2.4
FY31	1.9	10.9	12.9	1.6	13.5	15.1	-0.3	2.6	2.2
FY32	2.1	11.8	13.9	2.8	14.5	17.3	0.7	2.7	3.4
FY33	1.8	10.0	11.8	2.3	14.4	16.8	0.5	4.4	5.0
FY34	2.1	11.9	14.0	1.9	14.0	15.9	-0.2	2.1	1.9
FY35	2.2	12.3	14.5	2.4	14.6	17.0	0.2	2.3	2.5
FY36	2.0	11.1	13.0	2.4	14.7	17.1	0.4	3.6	4.1
FY37	2.0	11.1	13.1	1.1	14.3	15.4	-0.9	3.2	2.3
FY38	1.8	10.0	11.8	2.3	14.6	17.0	0.5	4.6	5.2
FY39	1.8	10.4	12.2	2.9	13.8	16.7	1.1	3.4	4.5
FY40	1.8	9.9	11.7	3.0	13.6	16.6	1.2	3.7	4.9
FY41	1.8	10.3	12.1	1.5	13.6	15.1	-0.3	3.3	3.0
FY42	1.6	9.2	10.9	2.3	13.7	15.9	0.7	4.5	5.0
FY43	1.8	10.1	11.8	2.4	13.5	15.8	0.6	3.4	4.0
FY44	1.7	9.4	11.1	1.9	13.1	15.0	0.2	3.7	3.9
FY45	1.6	9.0	10.6	1.9	13.6	15.5	0.3	4.6	4.9
FY46	1.5	8.7	10.2	1.9	13.3	15.2	0.4	4.6	5.0
FY47	1.3	7.4	8.7	1.9	10.6	12.5	0.6	3.3	3.8
FY48	1.4	7.7	9.0	0.5	13.5	14.0	-0.9	5.8	5.0
FY49	1.3	7.2	8.4	2.9	13.3	16.2	1.6	6.1	7.8
FY50	1.1	6.5	7.6	2.0	13.8	15.8	0.9	7.3	8.2
FY51	1.1	6.5	7.6	2.4	13.0	15.3	1.3	6.5	7.7
FY52	1.0	5.5	6.4	1.7	9.4	11.0	0.7	3.9	4.6
FY53	0.9	5.0	5.9	3.3	10.7	14.0	2.4	5.7	8.1
FY54	0.9	4.8	5.7	3.5	8.7	12.2	2.6	3.9	6.5
FY55	0.9	5.0	5.8	3.5	10.1	13.6	2.6	5.1	7.8

Year	Product Coal (Mtpa)								
	Baseline Scenario			Project Scenario			Project Only Scenario		
	Thermal	Coking	Total	Thermal	Coking	Total	Thermal	Coking	Total
FY56	1.8	10.4	12.3	2.0	11.1	13.0	0.1	0.6	0.7
FY57	1.8	10.4	12.2	1.9	10.9	12.9	0.1	0.6	0.7
FY58	1.8	10.1	11.9	1.9	10.9	12.9	0.1	0.8	0.9
FY59	1.8	10.0	11.8	1.9	10.9	12.9	0.2	0.9	1.0
FY60	1.8	9.9	11.7	1.9	10.7	12.6	0.1	0.8	0.9
FY61	1.8	10.1	11.9	1.9	10.6	12.5	0.1	0.5	0.6
FY62	1.7	9.7	11.5	1.9	10.6	12.4	0.1	0.8	1.0
FY63	1.7	9.7	11.4	1.9	10.6	12.5	0.2	0.9	1.1
FY64	1.7	9.8	11.6	1.9	10.6	12.5	0.1	0.8	0.9
FY65	1.8	10.1	11.9	1.6	9.1	10.7	-0.2	-1.0	-1.1
FY66	1.7	9.7	11.5	1.9	10.8	12.7	0.2	1.0	1.2
FY67	1.8	10.1	11.9	1.9	10.6	12.5	0.1	0.5	0.6
FY68	1.7	9.6	11.3	1.7	9.8	11.5	0.0	0.1	0.2
FY69	1.7	9.8	11.5	1.9	10.7	12.6	0.2	0.9	1.1
FY70	1.6	9.3	11.0	1.9	10.6	12.4	0.2	1.3	1.5
FY71	1.7	9.8	11.6	1.7	9.8	11.6	0.0	0.0	0.0
FY72	1.6	9.3	11.0	1.9	10.6	12.5	0.2	1.3	1.5
FY73	1.6	9.2	10.9	1.5	8.6	10.1	-0.1	-0.6	-0.7
FY74	1.4	7.9	9.3	1.6	9.3	10.9	0.3	1.4	1.7
FY75	1.0	5.7	6.7	1.6	9.3	11.0	0.6	3.6	4.2
FY76	1.0	5.7	6.7	1.6	9.2	10.8	0.6	3.5	4.1
FY77	1.0	5.9	7.0	1.6	9.1	10.7	0.6	3.2	3.7
FY78	1.0	5.7	6.7	1.6	8.9	10.4	0.6	3.1	3.7
FY79	1.0	5.8	6.8	1.6	9.3	10.9	0.6	3.5	4.1
FY80	1.0	5.5	6.4	1.6	8.8	10.4	0.6	3.3	3.9
FY81	1.0	5.9	7.0	1.4	8.0	9.4	0.4	2.1	2.4
FY82	1.0	5.6	6.6	1.4	7.7	9.0	0.4	2.0	2.4
FY83	1.0	5.5	6.4	1.1	6.3	7.4	0.1	0.8	1.0
FY84	1.0	5.6	6.6	1.1	6.3	7.4	0.1	0.7	0.8
FY85	1.0	5.7	6.6	1.1	6.3	7.4	0.1	0.6	0.7

Year	Product Coal (Mtpa)								
	Baseline Scenario			Project Scenario			Project Only Scenario		
	Thermal	Coking	Total	Thermal	Coking	Total	Thermal	Coking	Total
FY86	1.0	5.6	6.6	1.1	6.2	7.3	0.1	0.6	0.7
FY87	1.0	5.5	6.5	1.1	6.2	7.3	0.1	0.7	0.8
FY88	1.0	5.4	6.4	1.1	6.3	7.4	0.2	0.9	1.0
FY89	0.9	5.0	5.9	1.0	5.5	6.4	0.1	0.5	0.6
FY90	0.6	3.2	3.7	0.7	4.2	4.9	0.2	1.1	1.2
FY91	0.0	0.0	0.0	0.8	4.5	5.3	0.8	4.5	5.3
FY92	0.0	0.0	0.0	0.7	3.7	4.4	0.7	3.7	4.4
FY93	0.0	0.0	0.0	0.2	1.2	1.4	0.2	1.2	1.4

APPENDIX B

Appendix B

Detailed Emission Estimates

Table B.1: Baseline Scenario Detailed Emission Estimates

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream/ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY27	0	347,721	6,984	5	82	1,802	16,222	25	479,936	852,778	106,585	15,226	163,592	737,430	31,932,308	90,163	32,938,720	959,363	33,898,083
FY28	0	351,762	7,065	5	86	1,878	17,284	25	500,363	878,469	90,195	13,199	165,610	746,527	32,326,217	91,296	33,342,849	968,664	34,311,513
FY29	0	349,944	7,029	6	94	2,054	17,011	25	547,183	923,345	72,206	9,026	185,924	838,097	36,291,372	91,108	37,415,526	995,551	38,411,077
FY30	0	329,258	6,613	5	77	1,698	15,825	25	452,320	805,822	40,695	4,284	153,841	693,477	30,029,045	85,364	30,966,010	846,517	31,812,528
FY31	0	349,515	7,020	6	88	1,931	17,425	25	514,372	890,381	42,119	6,650	178,896	806,420	34,919,688	90,812	36,002,466	932,501	36,934,967
FY32	0	342,100	6,871	6	94	2,062	17,551	25	549,244	917,953	38,402	6,777	193,447	872,012	37,759,967	89,148	38,921,351	956,354	39,877,706
FY33	0	357,342	7,177	5	84	1,839	17,694	25	489,791	873,958	41,555	6,561	163,403	736,580	31,895,473	92,638	32,894,655	915,513	33,810,168
FY34	0	360,389	7,239	6	96	2,107	17,662	25	561,189	948,712	47,741	6,820	194,599	877,202	37,984,714	93,814	39,157,149	996,453	40,153,601
FY35	0	363,524	7,302	6	100	2,185	17,546	25	581,979	972,666	57,462	9,194	201,443	908,055	39,320,694	94,722	40,534,107	1,030,128	41,564,235
FY36	0	387,631	7,786	6	88	1,931	17,204	25	514,438	929,109	57,639	6,651	180,724	814,661	35,276,545	100,394	36,378,975	986,748	37,365,722
FY37	0	391,935	7,872	6	89	1,945	17,759	25	518,084	937,714	53,311	8,885	181,743	819,252	35,475,347	101,496	36,586,723	991,025	37,577,748
FY38	0	399,542	8,025	5	81	1,769	17,736	25	471,157	898,339	49,786	6,494	163,351	736,345	31,885,289	103,139	32,894,617	948,125	33,842,742
FY39	0	401,225	8,059	5	84	1,850	18,049	25	492,718	922,015	50,385	6,572	169,347	763,376	33,055,795	103,686	34,098,776	972,400	35,071,176
FY40	0	400,257	8,039	5	80	1,764	17,974	25	469,836	897,980	49,749	6,489	162,446	732,264	31,708,597	103,311	32,713,107	947,730	33,660,837
FY41	0	372,794	7,488	5	82	1,791	16,962	25	477,156	876,304	49,952	6,516	167,990	757,255	32,790,750	96,450	33,818,960	926,256	34,745,216
FY42	0	396,675	7,967	5	75	1,637	17,984	25	435,985	860,352	48,808	6,366	151,082	681,039	29,490,446	102,216	30,431,149	909,161	31,340,310
FY43	0	394,838	7,931	5	80	1,763	18,530	25	469,647	892,820	49,744	6,488	164,541	741,712	32,117,703	101,948	33,132,393	942,564	34,074,957
FY44	0	371,539	7,463	5	75	1,653	17,207	25	440,467	838,434	48,933	6,383	154,334	695,698	30,125,215	95,923	31,077,553	887,367	31,964,920
FY45	0	348,063	6,991	4	71	1,558	16,693	25	415,161	788,567	48,230	6,291	146,875	662,076	28,669,286	89,877	29,574,405	836,796	30,411,201
FY46	0	349,566	7,021	4	70	1,526	17,005	25	406,476	781,693	47,989	6,259	142,305	641,474	27,777,180	90,205	28,657,423	829,682	29,487,105
FY47	0	334,230	6,713	4	60	1,315	15,948	25	350,199	708,493	46,425	6,055	120,365	542,575	23,494,645	86,027	24,249,666	754,918	25,004,584
FY48	0	315,928	6,346	4	60	1,323	14,918	25	352,369	690,972	46,485	6,063	125,540	565,905	24,504,896	81,439	25,283,843	737,458	26,021,301
FY49	0	270,447	5,432	4	58	1,272	13,008	25	338,876	629,122	46,110	6,014	117,339	528,937	22,904,085	69,929	23,626,304	675,232	24,301,536
FY50	0	298,798	6,001	3	51	1,119	13,876	25	298,021	617,894	44,975	5,866	106,193	478,693	20,728,439	76,820	21,396,013	662,869	22,058,882
FY51	0	268,873	5,400	3	51	1,124	12,462	25	299,383	587,322	45,013	5,871	106,105	478,297	20,711,266	69,306	21,370,845	632,334	22,003,179

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream/ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY52	0	273,846	5,500	3	43	935	12,665	25	249,016	542,033	43,613	5,689	89,489	403,396	17,467,905	70,267	18,036,746	585,646	18,622,392
FY53	0	262,371	5,270	2	39	861	12,077	25	229,421	510,068	43,069	5,618	81,754	368,528	15,958,057	67,270	16,481,227	553,136	17,034,363
FY54	0	264,318	5,309	2	38	837	12,228	25	222,952	505,710	42,889	5,594	79,214	357,075	15,462,100	67,722	15,971,704	548,599	16,520,303
FY55	0	262,523	5,273	2	39	853	11,999	25	227,342	508,057	43,011	5,610	81,130	365,715	15,836,250	67,296	16,356,002	551,068	16,907,070
FY56	0	398,527	8,005	5	80	1,746	21,286	25	465,000	894,673	49,615	6,471	170,595	768,999	33,299,312	102,848	34,348,226	944,287	35,292,513
FY57	0	406,648	8,168	5	80	1,746	21,286	25	465,000	902,957	49,615	6,471	169,288	763,107	33,044,139	104,890	34,087,894	952,571	35,040,465
FY58	0	391,508	7,864	5	79	1,741	21,286	25	463,808	886,317	49,582	6,467	165,679	746,841	32,339,800	101,077	33,359,865	935,898	34,295,763
FY59	0	380,090	7,634	5	80	1,746	21,286	25	465,000	875,866	49,615	6,471	164,168	740,030	32,044,884	98,214	33,053,768	925,481	33,979,248
FY60	0	420,786	8,452	5	78	1,700	21,286	25	452,958	905,289	49,280	6,428	162,614	733,023	31,741,464	108,374	32,751,903	954,569	33,706,473
FY61	0	412,638	8,288	5	80	1,746	21,286	25	465,000	909,067	49,615	6,471	165,670	746,798	32,337,924	106,395	33,363,258	958,682	34,321,940
FY62	0	390,291	7,839	5	80	1,746	21,286	25	465,000	886,271	49,615	6,471	159,287	718,025	31,092,021	100,778	32,076,582	935,886	33,012,469
FY63	0	456,247	9,164	5	76	1,672	21,286	25	445,510	933,986	49,073	6,401	158,941	716,467	31,024,539	117,245	32,023,594	983,059	33,006,653
FY64	0	394,246	7,919	5	80	1,746	21,286	25	465,000	890,307	49,615	6,471	160,536	723,656	31,335,838	101,772	32,328,274	939,921	33,268,195
FY65	0	462,038	9,280	5	80	1,746	22,074	25	465,000	960,248	49,615	6,471	164,985	743,712	32,204,300	118,813	33,238,282	1,009,863	34,248,144
FY66	0	416,860	8,373	5	80	1,746	22,074	25	465,000	914,163	49,615	6,471	159,344	718,282	31,103,143	107,457	32,094,697	963,778	33,058,474
FY67	0	480,372	9,649	5	80	1,746	22,074	25	465,000	978,951	49,615	6,471	165,288	745,077	32,263,423	123,422	33,303,681	1,028,565	34,332,246
FY68	0	441,527	8,868	5	80	1,746	22,074	25	465,000	939,325	49,615	6,471	157,227	708,742	30,690,027	113,657	31,676,124	988,940	32,665,065
FY69	0	472,382	9,488	5	80	1,746	22,074	25	465,000	970,800	49,615	6,471	159,936	720,950	31,218,662	121,413	32,227,432	1,020,414	33,247,847
FY70	0	458,761	9,214	5	75	1,648	22,074	25	439,044	930,847	48,893	6,377	152,198	686,071	29,708,325	117,840	30,670,811	979,740	31,650,551
FY71	0	447,476	8,988	5	80	1,746	22,074	25	465,000	945,393	49,615	6,471	160,581	723,858	31,344,588	115,152	32,350,650	995,008	33,345,659
FY72	0	469,898	9,438	5	76	1,663	22,074	25	443,013	946,192	49,004	6,392	152,354	686,775	29,738,821	120,662	30,705,005	995,196	31,700,200
FY73	0	393,568	7,905	5	75	1,654	20,448	25	440,544	864,225	48,935	6,383	150,951	680,448	29,464,864	101,461	30,404,107	913,160	31,317,267
FY74	0	432,664	8,690	4	64	1,408	20,383	25	374,976	838,215	47,113	6,145	128,761	580,423	25,133,543	110,912	25,959,784	885,328	26,845,112
FY75	0	415,296	8,341	3	48	1,047	19,296	25	279,000	723,057	44,446	5,797	93,343	420,767	18,220,095	105,995	18,845,996	767,503	19,613,500
FY76	0	241,316	4,847	3	48	1,047	14,315	25	279,000	540,601	44,446	5,797	93,422	421,121	18,235,437	62,262	18,818,039	585,048	19,403,087
FY77	0	241,077	4,842	3	48	1,047	12,739	25	279,000	538,782	44,446	5,797	97,131	437,842	18,959,477	62,202	19,562,449	583,228	20,145,677
FY78	0	243,628	4,893	3	48	1,047	11,730	25	279,000	540,374	44,446	5,797	93,329	420,706	18,217,459	62,843	18,800,135	584,821	19,384,955
FY79	0	216,889	4,356	3	48	1,047	11,670	25	279,000	513,039	44,446	5,797	95,011	428,287	18,545,755	56,122	19,130,973	557,486	19,688,459
FY80	0	238,613	4,793	3	48	1,047	11,702	25	279,000	535,231	44,446	5,797	89,443	403,187	17,458,835	61,582	18,018,844	579,677	18,598,521

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream/ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY81	0	231,196	4,644	3	48	1,047	11,670	25	279,000	527,633	44,446	5,797	97,116	437,773	18,956,514	59,718	19,556,918	572,079	20,128,997
FY82	0	208,086	4,180	3	48	1,047	9,867	25	279,000	502,256	44,446	5,797	91,777	413,706	17,914,353	53,909	18,479,542	546,703	19,026,245
FY83	0	153,667	3,086	3	48	1,047	9,444	25	279,000	446,321	44,446	5,797	89,479	403,350	17,465,897	40,230	18,004,753	490,767	18,495,521
FY84	0	147,895	2,971	3	48	1,047	8,738	25	279,000	439,728	44,446	5,797	92,119	415,248	17,981,105	38,779	18,533,047	484,174	19,017,222
FY85	0	143,383	2,880	3	48	1,047	8,245	25	279,000	434,632	44,446	5,797	92,383	416,441	18,032,787	37,645	18,585,054	479,078	19,064,132
FY86	0	116,001	2,330	3	48	1,047	6,637	25	279,000	405,091	44,446	5,797	91,856	414,063	17,929,825	30,762	18,472,304	449,538	18,921,841
FY87	0	90,947	1,827	3	48	1,047	5,758	25	279,000	378,655	44,446	5,797	90,414	407,563	17,648,333	24,464	18,176,571	423,102	18,599,673
FY88	0	101,132	2,031	3	48	1,047	5,775	25	279,000	389,061	44,446	5,797	88,614	399,449	17,296,996	27,024	17,817,880	433,508	18,251,388
FY89	0	93,086	1,870	3	43	937	5,774	25	249,601	351,339	43,630	5,691	81,659	368,097	15,939,392	24,833	16,419,672	394,969	16,814,640
FY90	0	84,435	1,696	2	29	637	4,924	25	169,664	261,412	41,408	5,401	51,541	232,336	10,060,652	22,199	10,372,130	302,821	10,674,950
FY91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FY92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FY93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table B.2: Project Scenario Detailed Emission Estimates

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY27	9,028	358,193	7,194	5	82	1,804	15,772	25	480,500	872,604	106,618	15,231	190,362	858,102	37,157,647	92,799	38,314,140	979,223	39,293,363
FY28	9,028	360,608	7,243	6	91	1,990	16,242	25	530,100	925,334	91,668	13,415	204,257	920,737	39,869,884	93,691	41,101,983	1,017,002	42,118,985
FY29	9,028	349,505	7,020	5	84	1,850	15,535	25	492,900	875,953	70,108	8,763	187,583	845,575	36,615,200	90,686	37,747,807	946,061	38,693,867
FY30	9,028	428,131	8,599	5	79	1,722	18,444	25	458,800	924,834	40,844	4,299	187,583	845,575	36,915,288	110,254	38,062,999	965,678	39,028,677
FY31	9,028	469,213	9,424	6	93	2,037	19,322	25	542,500	1,051,648	42,765	6,752	209,815	945,791	41,170,518	121,062	42,453,938	1,094,412	43,548,350
FY32	9,028	551,420	11,076	6	101	2,211	21,861	25	589,000	1,184,729	39,218	6,921	240,384	1,083,589	46,855,194	141,993	48,328,080	1,223,947	49,552,027
FY33	9,028	545,153	10,950	6	101	2,211	21,474	25	589,000	1,177,948	43,832	6,921	233,436	1,052,271	45,360,864	140,418	46,793,910	1,221,781	48,015,690
FY34	9,028	529,283	10,631	6	98	2,141	21,273	25	570,400	1,142,886	47,974	6,853	220,931	995,899	43,281,912	136,322	44,641,917	1,190,861	45,832,778
FY35	9,028	534,672	10,739	6	101	2,211	20,165	25	589,000	1,165,948	57,674	9,228	236,215	1,064,798	46,156,692	137,783	47,604,716	1,223,622	48,828,339
FY36	9,028	484,256	9,727	6	101	2,211	18,872	25	589,000	1,113,226	59,981	6,921	237,605	1,071,062	46,432,782	125,110	47,873,479	1,173,207	49,046,687
FY37	9,028	552,730	11,102	6	101	2,211	21,216	25	589,000	1,185,420	55,367	9,228	213,983	964,582	42,160,998	142,322	43,491,113	1,240,787	44,731,900
FY38	9,028	544,447	10,935	6	101	2,211	21,985	25	589,000	1,177,740	53,060	6,921	236,215	1,064,798	45,913,044	140,240	47,361,218	1,230,800	48,592,019
FY39	9,028	540,835	10,863	6	101	2,211	20,484	25	589,000	1,172,554	53,060	6,921	232,047	1,046,008	45,166,212	139,332	46,590,519	1,225,614	47,816,134
FY40	9,028	515,632	10,357	6	101	2,211	18,684	25	589,000	1,145,045	53,060	6,921	230,657	1,039,744	44,857,680	132,997	46,267,999	1,198,105	47,466,105
FY41	9,028	566,328	11,375	6	101	2,211	21,386	25	589,000	1,199,460	53,060	6,921	209,815	945,791	41,202,960	145,740	42,511,227	1,252,521	43,763,748
FY42	9,028	569,599	11,441	6	101	2,211	22,403	25	589,000	1,203,815	53,060	6,921	220,931	995,899	43,428,234	146,563	44,798,548	1,256,875	46,055,423
FY43	9,028	565,686	11,362	6	101	2,211	21,474	25	589,000	1,198,895	53,060	6,921	219,541	989,636	43,119,702	145,579	44,481,379	1,251,955	45,733,334
FY44	9,028	579,673	11,643	6	101	2,211	22,029	25	589,000	1,213,716	53,060	6,921	208,425	939,528	40,797,102	149,095	42,101,071	1,266,776	43,367,847
FY45	9,028	602,793	12,107	6	94	2,060	22,802	25	548,700	1,197,616	51,940	6,775	215,373	970,845	42,177,552	154,675	43,525,220	1,249,557	44,774,777
FY46	9,028	611,717	12,287	6	100	2,188	22,944	25	582,800	1,241,095	52,888	6,898	211,204	952,055	41,349,282	157,114	42,676,553	1,293,983	43,970,536
FY47	9,028	593,524	11,921	6	87	1,908	22,166	25	508,400	1,147,066	50,821	6,629	173,688	782,940	33,902,963	152,113	35,018,332	1,197,886	36,216,218
FY48	9,028	610,473	12,262	6	90	1,967	22,706	25	523,900	1,180,456	51,251	6,685	194,530	876,893	38,490,390	156,463	39,724,961	1,231,707	40,956,668
FY49	9,028	594,023	11,931	6	91	2,002	22,327	25	533,200	1,172,634	51,510	6,719	225,099	1,014,690	43,785,762	152,382	45,184,651	1,224,143	46,408,795
FY50	9,028	629,474	12,643	6	97	2,118	23,014	25	564,200	1,240,606	52,371	6,831	219,541	989,636	42,973,380	161,471	44,350,859	1,292,977	45,643,836
FY51	9,028	625,182	12,557	6	96	2,095	21,534	25	558,000	1,228,522	52,199	6,809	212,594	958,318	41,739,252	160,356	43,077,329	1,280,721	44,358,050
FY52	9,028	624,448	12,542	5	77	1,699	22,741	25	452,600	1,123,166	49,270	6,427	152,845	688,987	29,834,607	159,566	30,842,432	1,172,436	32,014,868
FY53	9,028	630,239	12,659	6	89	1,955	21,898	25	520,800	1,196,700	51,165	6,674	194,530	876,893	37,582,014	161,414	38,821,524	1,247,865	40,069,389
FY54	9,028	616,058	12,374	5	78	1,711	22,132	25	455,700	1,117,110	49,356	6,438	169,519	764,149	32,547,510	157,475	33,645,091	1,166,467	34,811,558

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY55	9,028	598,701	12,025	5	85	1,862	21,815	25	496,000	1,139,547	50,476	6,584	188,972	851,839	36,412,770	153,344	37,613,508	1,190,023	38,803,532
FY56	0	537,670	10,799	5	85	1,862	20,879	25	496,000	1,067,326	50,476	6,584	180,889	815,400	35,308,565	138,003	36,449,440	1,117,802	37,567,242
FY57	0	452,229	9,083	5	85	1,862	20,879	25	496,000	980,169	50,476	6,584	178,691	805,492	34,879,531	116,525	35,986,823	1,030,645	37,017,468
FY58	0	466,216	9,364	5	85	1,862	20,879	25	496,000	994,436	50,476	6,584	178,742	805,725	34,889,595	120,041	36,000,687	1,044,912	37,045,600
FY59	0	522,417	10,493	5	85	1,862	20,879	25	496,000	1,051,766	50,476	6,584	178,661	805,358	34,873,699	134,168	35,998,470	1,102,242	37,100,712
FY60	0	540,762	10,861	5	85	1,862	20,879	25	496,000	1,070,480	50,476	6,584	175,256	790,009	34,209,068	138,780	35,319,696	1,120,956	36,440,652
FY61	0	464,114	9,322	5	85	1,862	20,879	25	496,000	992,293	50,476	6,584	173,623	782,651	33,890,452	119,513	34,972,824	1,042,769	36,015,592
FY62	0	544,255	10,932	5	85	1,862	20,879	25	496,000	1,074,043	50,476	6,584	172,935	779,550	33,756,173	139,658	34,854,900	1,124,519	35,979,419
FY63	0	485,795	9,757	5	85	1,862	20,879	25	496,000	1,014,409	50,476	6,584	173,928	784,026	33,949,974	124,963	35,039,474	1,064,885	36,104,359
FY64	0	508,866	10,221	5	85	1,862	20,879	25	496,000	1,037,943	50,476	6,584	173,246	780,948	33,816,701	130,762	34,908,240	1,088,419	35,996,659
FY65	0	568,214	11,413	5	74	1,622	21,652	25	432,163	1,035,168	48,702	6,352	149,115	672,173	29,106,518	145,313	30,079,471	1,083,870	31,163,342
FY66	0	520,698	10,458	5	85	1,862	21,652	25	496,000	1,050,786	50,476	6,584	175,772	792,337	34,309,882	133,736	35,418,311	1,101,262	36,519,573
FY67	0	547,660	11,000	5	85	1,862	21,652	25	496,000	1,078,290	50,476	6,584	173,813	783,504	33,927,384	140,514	35,031,798	1,128,766	36,160,564
FY68	0	542,705	10,900	5	79	1,743	21,652	25	464,230	1,041,340	49,593	6,469	159,674	719,771	31,167,635	139,086	32,192,635	1,090,933	33,283,568
FY69	0	556,207	11,172	5	85	1,862	21,652	25	496,000	1,087,008	50,476	6,584	174,944	788,603	34,148,190	142,662	35,260,983	1,137,485	36,398,468
FY70	0	616,966	12,392	5	84	1,836	21,652	25	489,041	1,142,002	50,283	6,559	172,739	778,662	33,717,723	157,895	34,833,577	1,192,284	36,025,861
FY71	0	521,817	10,481	5	79	1,736	21,652	25	462,460	1,018,255	49,544	6,462	160,775	724,731	31,382,409	133,825	32,408,202	1,067,799	33,476,002
FY72	0	545,153	10,950	5	85	1,862	21,652	25	496,000	1,075,732	50,476	6,584	173,222	780,839	33,812,003	139,883	34,912,531	1,126,208	36,038,739
FY73	0	597,500	12,001	4	71	1,557	21,652	25	414,717	1,047,527	48,218	6,289	140,618	633,869	27,447,862	152,575	28,381,212	1,095,745	29,476,957
FY74	0	542,842	10,903	5	74	1,629	21,652	25	434,000	1,011,131	48,753	6,359	152,034	685,333	29,676,377	138,946	30,659,050	1,059,884	31,718,934
FY75	0	610,433	12,261	5	74	1,629	21,652	25	434,000	1,080,080	48,753	6,359	152,374	686,862	29,742,584	155,937	30,744,116	1,128,833	31,872,949
FY76	0	557,278	11,193	5	74	1,629	21,652	25	434,000	1,025,857	48,753	6,359	149,892	675,677	29,258,242	142,575	30,232,745	1,074,610	31,307,356
FY77	0	598,084	12,013	5	74	1,629	21,652	25	434,000	1,067,482	48,753	6,359	148,875	671,090	29,059,616	152,832	30,038,772	1,116,236	31,155,008
FY78	0	536,585	10,778	5	74	1,629	21,652	25	434,000	1,004,748	48,753	6,359	144,694	652,243	28,243,509	137,374	29,184,179	1,053,502	30,237,680
FY79	0	630,450	12,663	5	74	1,629	21,652	25	434,000	1,100,498	48,753	6,359	152,102	685,637	29,689,559	160,968	30,694,625	1,149,251	31,843,877
FY80	0	459,978	9,239	5	74	1,629	17,997	25	434,000	922,947	48,753	6,359	143,923	648,769	28,093,087	118,117	29,010,256	971,701	29,981,957
FY81	0	475,631	9,553	4	67	1,464	17,186	25	389,978	893,908	47,530	6,200	131,060	590,785	25,582,248	121,799	26,432,091	941,438	27,373,530
FY82	0	471,310	9,466	4	63	1,374	17,198	25	366,098	865,539	46,867	6,113	125,175	564,258	24,433,559	120,575	25,249,680	912,406	26,162,086
FY83	0	529,401	10,633	3	53	1,164	17,229	25	310,000	868,508	45,308	5,910	103,353	465,891	20,174,055	134,855	20,884,063	913,816	21,797,880
FY84	0	491,055	9,863	3	53	1,164	16,942	25	310,000	829,106	45,308	5,910	103,278	465,551	20,159,371	125,216	20,859,326	874,413	21,733,740

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY85	0	372,486	7,482	3	53	1,164	13,101	25	310,000	704,314	45,308	5,910	102,225	460,803	19,953,742	95,412	20,618,091	749,622	21,367,712
FY86	0	190,145	3,819	3	53	1,164	8,945	25	310,000	514,154	45,308	5,910	101,195	456,161	19,752,754	49,577	20,365,598	559,462	20,925,060
FY87	0	169,925	3,413	3	53	1,164	8,411	25	310,000	492,995	45,308	5,910	101,647	458,199	19,840,978	44,495	20,451,228	538,303	20,989,531
FY88	0	140,755	2,827	3	53	1,164	7,365	25	310,000	462,192	45,308	5,910	103,193	465,167	20,142,731	37,162	20,754,163	507,500	21,261,664
FY89	0	124,281	2,496	3	47	1,035	5,650	25	275,818	409,356	44,358	5,786	89,614	403,959	17,492,269	32,825	18,024,453	453,714	18,478,167
FY90	0	138,909	2,790	2	38	824	5,680	25	219,601	367,870	42,796	5,582	68,769	309,995	13,423,462	36,179	13,843,987	410,666	14,254,653
FY91	0	129,161	2,594	2	38	840	5,678	25	223,751	362,090	42,911	5,597	73,433	331,018	14,333,763	33,752	14,777,563	405,002	15,182,565
FY92	0	134,584	2,703	2	33	721	5,711	25	192,000	335,779	42,029	5,482	60,990	274,926	11,904,874	34,933	12,281,205	377,808	12,659,013
FY93	0	20,523	412	1	11	249	1,458	25	66,448	89,129	38,541	5,027	19,500	87,900	3,806,238	5,541	3,924,205	127,669	4,051,874

Table B.3: Project Only Scenario Detailed Emission Estimates

Year	Scope 1										Scope 2	Scope 3							Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY27	9,028	10,472	210	0	0	2	-450	0	564	19,826	33	5	26,770	120,672	5,225,339	2,635	5,375,421	19,860	5,395,280
FY28	9,028	8,847	178	0	5	112	-1,042	0	29,737	46,865	1,473	216	38,647	174,210	7,543,667	2,395	7,759,134	48,338	7,807,472
FY29	9,028	(439)	(9)	(1)	(9)	(204)	-1,476	0	(54,283)	(47,392)	(2,099)	(262)	1,659	7,478	323,828	(422)	332,280	(49,490)	282,790
FY30	9,028	98,873	1,986	0	1	24	2,619	0	6,480	119,012	149	16	33,741	152,098	6,886,243	24,891	7,096,989	119,160	7,216,149
FY31	9,028	119,698	2,404	0	5	106	1,897	0	28,128	161,266	646	102	30,918	139,372	6,250,830	30,250	6,451,472	161,912	6,613,384
FY32	9,028	209,321	4,204	0	7	149	4,310	0	39,756	266,776	816	144	46,936	211,577	9,095,227	52,845	9,406,729	267,593	9,674,322
FY33	9,028	187,811	3,772	1	17	372	3,780	0	99,209	303,991	2,277	360	70,033	315,691	13,465,391	47,780	13,899,254	306,268	14,205,522
FY34	9,028	168,895	3,392	0	2	35	3,611	0	9,211	194,174	234	33	26,332	118,698	5,297,198	42,508	5,484,769	194,408	5,679,177
FY35	9,028	171,149	3,438	0	1	26	2,619	0	7,021	193,282	212	34	34,772	156,744	6,835,998	43,062	7,070,609	193,494	7,264,104
FY36	9,028	96,625	1,941	1	13	280	1,668	0	74,562	184,118	2,342	270	56,880	256,401	11,156,237	24,717	11,494,505	186,460	11,680,965
FY37	9,028	160,795	3,230	1	12	266	3,458	0	70,916	247,706	2,056	343	32,240	145,330	6,685,651	40,826	6,904,390	249,762	7,154,153
FY38	9,028	144,906	2,910	1	20	442	4,249	0	117,843	279,401	3,274	427	72,864	328,454	14,027,755	37,102	14,466,602	282,675	14,749,277
FY39	9,028	139,611	2,804	1	16	361	2,435	0	96,282	250,539	2,675	349	62,699	282,632	12,110,417	35,647	12,491,743	253,215	12,744,958
FY40	9,028	115,375	2,317	1	20	447	710	0	119,164	247,065	3,311	432	68,211	307,480	13,149,083	29,686	13,554,892	250,376	13,805,268
FY41	9,028	193,533	3,887	1	19	420	4,424	0	111,844	323,157	3,108	405	41,825	188,536	8,412,210	49,291	8,692,267	326,264	9,018,532
FY42	9,028	172,925	3,473	2	26	574	4,419	0	153,015	343,463	4,252	555	69,849	314,860	13,937,788	44,347	14,367,398	347,715	14,715,113
FY43	9,028	170,848	3,432	1	20	448	2,944	0	119,353	306,074	3,316	433	55,000	247,924	11,001,999	43,631	11,348,987	309,391	11,658,377
FY44	9,028	208,134	4,180	2	25	558	4,822	0	148,533	375,283	4,127	538	54,091	243,830	10,671,887	53,171	11,023,517	379,410	11,402,927
FY45	9,028	254,731	5,116	1	23	501	6,110	0	133,539	409,050	3,711	484	68,498	308,770	13,508,266	64,798	13,950,815	412,760	14,363,576
FY46	9,028	262,151	5,265	2	30	662	5,939	0	176,324	459,401	4,899	639	68,899	310,581	13,572,102	66,909	14,019,131	464,301	14,483,431
FY47	9,028	259,294	5,208	2	27	594	6,218	0	158,201	438,572	4,396	573	53,323	240,365	10,408,318	66,087	10,768,666	442,968	11,211,634
FY48	9,028	294,545	5,916	2	29	644	7,788	0	171,531	489,483	4,766	622	68,990	310,988	13,985,494	75,025	14,441,117	494,250	14,935,367
FY49	9,028	323,576	6,499	2	33	729	9,319	0	194,324	543,512	5,399	704	107,760	485,753	20,881,677	82,453	21,558,348	548,911	22,107,259
FY50	9,028	330,676	6,642	3	46	999	9,139	0	266,179	622,712	7,396	965	113,348	510,943	22,244,941	84,651	22,954,846	630,108	23,584,954
FY51	9,028	356,309	7,157	3	44	971	9,072	0	258,617	641,201	7,186	937	106,488	480,022	21,027,986	91,050	21,706,484	648,387	22,354,871
FY52	9,028	350,602	7,042	2	35	764	10,076	0	203,584	581,133	5,657	738	63,356	285,591	12,366,702	89,300	12,805,686	586,790	13,392,476
FY53	9,028	367,868	7,389	3	50	1,094	9,821	0	291,379	686,632	8,096	1,056	112,776	508,364	21,623,957	94,144	22,340,298	694,728	23,035,026
FY54	9,028	351,740	7,065	3	40	874	9,904	0	232,748	611,400	6,467	844	90,305	407,074	17,085,410	89,753	17,673,387	617,868	18,291,254

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY55	9,028	336,178	6,752	3	46	1,009	9,816	0	268,658	631,490	7,465	974	107,842	486,123	20,576,520	86,048	21,257,506	638,955	21,896,461
FY56	0	139,144	2,795	0	5	116	-407	0	31,000	172,653	861	112	10,294	46,401	2,009,253	35,154	2,101,214	173,515	2,274,729
FY57	0	45,582	916	0	5	116	-407	0	31,000	77,212	861	112	9,403	42,386	1,835,393	11,636	1,898,929	78,073	1,977,003
FY58	0	74,707	1,501	0	6	121	-407	0	32,192	108,120	894	117	13,063	58,884	2,549,795	18,964	2,640,822	109,014	2,749,836
FY59	0	142,327	2,859	0	5	116	-407	0	31,000	175,900	861	112	14,492	65,327	2,828,816	35,954	2,944,702	176,762	3,121,464
FY60	0	119,976	2,410	0	7	162	-407	0	43,042	165,190	1,196	156	12,642	56,986	2,467,603	30,405	2,567,792	166,386	2,734,179
FY61	0	51,476	1,034	0	5	116	-407	0	31,000	83,225	861	112	7,954	35,853	1,552,529	13,118	1,609,566	84,087	1,693,652
FY62	0	153,964	3,092	0	5	116	-407	0	31,000	187,772	861	112	13,649	61,525	2,664,152	38,880	2,778,317	188,633	2,966,950
FY63	0	29,548	593	1	9	190	-407	0	50,490	80,423	1,403	183	14,987	67,559	2,925,434	7,718	3,015,881	81,826	3,097,707
FY64	0	114,619	2,302	0	5	116	-407	0	31,000	147,636	861	112	12,710	57,292	2,480,862	28,990	2,579,966	148,498	2,728,464
FY65	0	106,176	2,133	(0)	(6)	(123)	-422	0	(32,837)	74,920	(912)	(119)	(15,870)	(71,539)	(3,097,783)	26,501	(3,158,810)	74,008	(3,084,803)
FY66	0	103,838	2,086	0	5	116	-422	0	31,000	136,623	861	112	16,428	74,055	3,206,739	26,280	3,323,614	137,485	3,461,099
FY67	0	67,288	1,352	0	5	116	-422	0	31,000	99,339	861	112	8,525	38,427	1,663,961	17,092	1,728,117	100,201	1,828,318
FY68	0	101,177	2,032	(0)	(0)	(3)	-422	0	(770)	102,014	(21)	(3)	2,447	11,030	477,608	25,428	516,510	101,993	618,503
FY69	0	83,825	1,684	0	5	116	-422	0	31,000	116,209	861	112	15,008	67,653	2,929,528	21,249	3,033,551	117,070	3,150,621
FY70	0	158,206	3,178	1	9	188	-422	0	49,997	211,155	1,389	181	20,540	92,591	4,009,398	40,055	4,162,766	212,544	4,375,310
FY71	0	74,341	1,493	(0)	(0)	(10)	-422	0	(2,540)	72,862	(71)	(9)	194	873	37,822	18,672	57,552	72,791	130,343
FY72	0	75,255	1,512	1	9	199	-422	0	52,987	129,540	1,472	192	20,867	94,064	4,073,182	19,221	4,207,526	131,013	4,338,539
FY73	0	203,932	4,096	(0)	(4)	(97)	1,204	0	(25,827)	183,303	(718)	(94)	(10,333)	(46,580)	(2,017,002)	51,113	(2,022,895)	182,585	(1,840,310)
FY74	0	110,178	2,213	1	10	222	1,269	0	59,024	172,916	1,640	214	23,273	104,910	4,542,834	28,034	4,699,266	174,556	4,873,822
FY75	0	195,137	3,919	2	27	582	2,356	0	155,000	357,023	4,307	562	59,031	266,095	11,522,490	49,942	11,898,119	361,330	12,259,449
FY76	0	315,962	6,346	2	27	582	7,338	0	155,000	485,256	4,307	562	56,471	254,556	11,022,805	80,313	11,414,706	489,562	11,904,268
FY77	0	357,007	7,171	2	27	582	8,914	0	155,000	528,701	4,307	562	51,744	233,248	10,100,139	90,630	10,476,323	533,008	11,009,331
FY78	0	292,958	5,884	2	27	582	9,922	0	155,000	464,374	4,307	562	51,364	231,537	10,026,050	74,531	10,384,044	468,681	10,852,725
FY79	0	413,560	8,307	2	27	582	9,982	0	155,000	587,459	4,307	562	57,091	257,350	11,143,804	104,846	11,563,652	591,766	12,155,418
FY80	0	221,365	4,446	2	27	582	6,295	0	155,000	387,717	4,307	562	54,480	245,583	10,634,253	56,535	10,991,412	392,023	11,383,435
FY81	0	244,435	4,910	1	19	417	5,516	0	110,978	366,275	3,084	402	33,944	153,012	6,625,735	62,081	6,875,173	369,359	7,244,532
FY82	0	263,224	5,287	1	15	327	7,332	0	87,098	363,283	2,420	316	33,398	150,552	6,519,206	66,666	6,770,138	365,703	7,135,842
FY83	0	375,734	7,547	0	5	116	7,784	0	31,000	422,187	861	112	13,874	62,541	2,708,157	94,625	2,879,310	423,049	3,302,359

Year	Scope 1										Scope 2	Scope 3						Direct & Indirect	All scopes
	Vegetation Clearing	Diesel - Stationary	Diesel - Vehicle Transport	LPG - Stationary Equipment	Petroleum Greases	Petroleum Oils	Explosives	SF_6	Fugitive	Total Scope 1	Electricity	Electricity	Train	Shipping	Coal combustion	Upstream\ Downstream Fuel	Total Scope 3	Total Scope 1+2	Total Scope 1+2+3
FY84	0	343,159	6,893	0	5	116	8,204	0	31,000	389,378	861	112	11,159	50,304	2,178,266	86,437	2,326,279	390,239	2,716,518
FY85	0	229,103	4,602	0	5	116	4,855	0	31,000	269,682	861	112	9,841	44,362	1,920,955	57,767	2,033,037	270,543	2,303,580
FY86	0	74,144	1,489	0	5	116	2,308	0	31,000	109,063	861	112	9,339	42,098	1,822,929	18,815	1,893,294	109,924	2,003,218
FY87	0	78,978	1,586	0	5	116	2,653	0	31,000	114,340	861	112	11,233	50,636	2,192,645	20,031	2,274,658	115,201	2,389,858
FY88	0	39,623	796	0	5	116	1,590	0	31,000	73,131	861	112	14,579	65,718	2,845,736	10,138	2,936,283	73,992	3,010,275
FY89	0	31,195	627	0	4	98	-125	0	26,217	58,017	728	95	7,956	35,861	1,552,877	7,992	1,604,781	58,745	1,663,526
FY90	0	54,474	1,094	1	9	187	756	0	49,938	106,458	1,388	181	17,228	77,659	3,362,810	13,980	3,471,858	107,846	3,579,703
FY91	0	129,161	2,594	2	38	840	5,678	25	223,751	362,090	42,911	5,597	73,433	331,018	14,333,763	33,752	14,777,563	405,002	15,182,565
FY92	0	134,584	2,703	2	33	721	5,711	25	192,000	335,779	42,029	5,482	60,990	274,926	11,904,874	34,933	12,281,205	377,808	12,659,013
FY93	0	20,523	412	1	11	249	1,458	25	66,448	89,129	38,541	5,027	19,500	87,900	3,806,238	5,541	3,924,205	127,669	4,051,874

Whitehaven

Blackwater North Extension Project

Appendix C
Loop Decarbonisation Services Peer Review



POWERED BY Mitchell TALISMAN

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Level 3, 10 Market St, Brisbane, 4000

Subject: Independent Peer Review – Greenhouse Gas Management and Abatement Plan

Project: Blackwater North Extension Project

Date: 13 April 2026

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1. Introduction

At the request of Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), I have undertaken an independent peer review of the Greenhouse Gas Management and Abatement Plan (April 2026, Document No. 01315554) (GMAP) prepared for the Blackwater North Extension Project (the Project).

This peer review evaluates the GMAP's methodology, technical soundness, and regulatory alignment with both current and emerging greenhouse gas (GHG) management and abatement expectations in Queensland and under Commonwealth frameworks, specifically the Queensland Greenhouse Gas Emissions Guideline - Version 1.02 - ESR/2024/6819 (QLD GHG Guideline) and the Commonwealth Safeguard Mechanism. It is acknowledged that this is a qualitative evaluation appropriate to the current environmental approvals stage of the Project. The GMAP is positioned as an initial input into further planning and is intended to inform forthcoming Project phases.

I confirm that I am suitably qualified and independent to conduct this review, as detailed in Appendix A and B. My experience in the field of decarbonisation across industry and academia in policy, strategy and project execution qualifies me as an expert in this field. In addition to working in the mining and energy industries for 15 years, I am a PhD candidate in Australian energy policy at the University of Queensland, and have authored over 22 publications, including 9 peer reviewed journal articles on climate and energy transition. I have worked both in house for a major mining company and in consulting, advising mining companies, government bodies, industry bodies, and universities on best practice emissions reduction in the mining and energy sectors. Additionally, I plan and execute operational decarbonisation projects within active mining operations.

2. Scope of Peer Review

This peer review process focused on:

- The methodology used for identifying and prioritising mitigation options;
- Consistency with Commonwealth and State emissions reduction legislation and regulations, environmental assessment and sectoral guidance, specifically consideration of the Queensland Greenhouse Gas Emissions Guideline - Version 1.02 - ESR/2024/6819 and the Commonwealth Safeguard Mechanism;

- Consideration of current and emerging technologies, including commercial and technological readiness;
- Evaluation of opportunities for abatement focused on Scope 1 and 2 emissions;
- Adaptive management intent, including future quantitative analysis through the Three-Year Action Plan;
- Provision of feedback on draft Report for inclusion in final Report.

3. Summary of Findings

3.1. QLD GHG Guideline Compliance and Framing

The GMAP has been prepared in accordance with the QLD GHG Guideline, with each content requirement for a Greenhouse Gas Abatement Plan addressed across the document (Table 5 of the GMAP). This is a notable strength of the document and reflects a disciplined approach to regulatory alignment.

The GMAP is explicitly framed as a qualitative assessment of emissions abatement options, appropriate to the Project's current approvals stage. The document recognises the limitations of projecting specific abatement outcomes at this point and commits to ongoing refinement through a Three-Year Action Plan and subsequent GMAP revisions. This framing is appropriate and reflects best practice for large infrastructure and resources projects under development.

3.2. Methodology and Hierarchy Alignment

The evaluation approach is comprehensive and well-structured. The GMAP clearly categorises proposed measures according to the GHG mitigation hierarchy (avoid, reduce, substitute, offset) and provides site-specific commentary on the feasibility of each abatement opportunity at the Blackwater Mine (BWM).

The adoption of the ARENA Technology Readiness Level and Commercial Readiness Level (TRL/CRL) framework is consistent with industry best practice and provides a transparent basis for comparing abatement options across differing stages of technical maturity.

The polycentric evaluation approach, which balances cost, technology readiness, and site-specific operational constraints, is a notable strength. For an operation with the complexity and scale of the BWM, this multi-criteria lens is appropriate and avoids an overly simplistic ranking of abatement measures.

3.3. Emissions Context and Safeguard Mechanism

The GMAP clearly articulates the BWM's emissions intensity position relative to other Australian ROM coal facilities, noting the existing EID of 0.0527 t CO_2-e/t ROM ranks BWM 29th lowest among approximately 68 Australian coal mining facilities with published EIDs, below the industry default value of 0.0653 t CO2-e/t ROM. This contextualisation is useful for assessing the Project's relative performance under the Safeguard Mechanism.

The GMAP appropriately acknowledges that the current EID is based on NGER Method 1 fugitive estimates and that Whitehaven Blackwater is progressing transition to Method 2. This is a material disclosure and the Three-Year Action Plan's prioritisation of the Method 2 transition as Year 1 activity is technically sound and operationally appropriate. Transition to Method 2 is a necessary prerequisite for meaningful gas drainage feasibility assessment and for accurately accounting for any future abatement achieved.

The indicative Safeguard Mechanism baseline forecast presented in Table 8 of the GMAP, extending through to net zero by FY2050, provides a clear long-term compliance trajectory consistent with Whitehaven's corporate commitments and the reformed Safeguard Rule's requirements.

3.4. Scope of Mitigation Options and Technical Maturity

A comprehensive range of mitigation opportunities is presented across Scope 1 fugitive, Scope 1 diesel combustion, and Scope 2 electricity categories. Each option's feasibility is evaluated with regard to TRL and CRL, which is consistent with industry frameworks.

The treatment of fugitive emissions abatement is pragmatic and appropriately reflects the current stage of site-specific characterisation. The GMAP acknowledges that gas drainage, capture and abatement effectiveness cannot be adequately assessed under Method 1, and that the applicability of pre-mining gas drainage at the BWM is contingent on Method 2 outputs and supporting gas domain data. This is technically defensible and consistent with emerging industry practice in the Australian coal industry.

For diesel combustion, the evaluation of hybrid diesel-electric vehicles as a priority near-term pathway, alongside the deferral of battery electric vehicles to a monitoring and review posture, is well-reasoned given current commercial readiness constraints for ultra-class haulage equipment. The treatment of renewable diesel (HVO) is thorough, with appropriate reference to the Maules Creek Coal Mine trial outcomes and the current price and supply limitations in the Australian market.

3.5. Three-Year Action Plan

The Three-Year Action Plan (Tables 11–13) is a well-structured, staged work program that appropriately prioritises the collection of site-specific data, including the transition to Method 2 and a concept-level assessment of methane pre-drainage, before committing to specific abatement investments. This approach is appropriate to the current stage of the Project and consistent with the QLD GHG Guideline's requirement for a GHG emission reduction program detailing measures across the life of the project.

The framing of Year 1 as indicatively FY2027, and the explicit commitment to revisit and revise the GMAP and Three-Year Action Plan at least every three years, reflects sound adaptive

management intent consistent with the QLD GHG Guideline and the Safeguard Mechanism's compliance obligations.

3.6. Forward Planning and Quantitative Commitments

The GMAP appropriately identifies that detailed quantitative evaluation of specific abatement measures will be undertaken post-approval and incorporated into future GMAP revisions as part of the ongoing adaptive management framework. The acknowledgment that greenhouse gas calculations prepared by RWDI (Appendix B) conservatively exclude potential emission reductions is a transparent and appropriate disclosure at this stage of project development.

4. Provision of Feedback on Draft GMAP

Feedback was provided during the peer review process on the draft GMAP to Whitehaven Blackwater. Feedback focused predominantly on the treatment of TRLs and CRLs for individual abatement technologies, the contextualisation of fugitive emissions, and the articulation of the Three-Year Action Plan rationale for fugitive emissions management. The comments and suggestions made to Whitehaven Blackwater were adequately considered and incorporated into the final GMAP.

5. Conclusion

The Greenhouse Gas Management and Abatement Plan represents a well-structured and policy-aligned foundation for the Project's future climate planning. The qualitative approach is appropriate to this approvals stage and demonstrates Whitehaven Blackwater's commitment to identifying and implementing reasonable and feasible mitigation options across the life of the Project.

The GMAP is robust, meets the content requirements of the Queensland GHG Guideline for a Greenhouse Gas Abatement Plan, and reflects emerging industry practice in fugitive emissions characterisation and diesel decarbonisation for open cut coal mines in Queensland.

Yours sincerely,



Steph Byrom
General Manager, Decarbonisation
Loop Decarbonisation Services

Appendix A: Declaration of Independence

Declaration of Independence

I declare that:

- I have no financial interest in Whitehaven Coal or the Blackwater North Extension Project;
- I have not participated in the preparation of this Report or any related EIS documentation;
- I have no affiliations with any party that may be directly or indirectly affected by the outcomes of this review.

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Steph Byrom

General Manager, Decarbonisation Services

SUMMARY

Steph is a dedicated professional with fifteen years of experience in the field of mine decarbonisation and policy, currently serving as the General Manager of Decarbonisation at Loop Decarbonisation Solutions. Loop is at the forefront of providing strategic and technical solutions, particularly for the mining industry, where Steph plays a pivotal role in helping clients to operationalise their decarbonisation strategies. Her work involves identifying opportunities for emissions reduction and implementing innovative and cost-effective projects to accelerate the transition to a low-carbon economy.

Steph has extensive experience as an independent peer reviewer of GHG Abatement Assessments and approvals documentation for coal mines across both Queensland and New South Wales, providing rigorous technical review of emissions reduction pathways and compliance frameworks. This peer review work spans a breadth of mine types and regulatory contexts, encompassing assessments prepared under the NSW EPA Guide for Large Emitters as well as the Queensland Greenhouse Gas Emissions Guideline, and reflects her deep familiarity with the methodological and regulatory standards expected of credible abatement analysis.

EDUCATION

PhD Candidate (Australian Climate and Energy Policy)
University of Queensland
Master of Sustainable Systems (Environmental Markets)
University of Queensland
Bachelor of Arts (International Relations)
University of Queensland

PROFESSIONAL MEMBERSHIPS

Fellow of AusIMM

PROFESSIONAL EXPERIENCE

General Manager, Decarbonisation Services

Loop Decarb / Talisman Technical, Brisbane, Australia, 2023 – Present

Leads end-to-end decarbonisation solutions for mining operations, combining technical innovation with regulatory compliance.

Key Achievements:

- Co-developed an innovative gas management solution for open cut coal mines with JV partner Mitchell Services.

- Led first deployments of open cut predrainage in the Bowen Basin.
- Integrated decarbonisation strategies across corporate and operational levels.

General Manager, Decarbonisation Services

Palaris, Brisbane, Australia, 2022 – 2023

Built and scaled the Decarbonisation Services business unit to support mining clients with net zero pathways.

Key Achievements:

- Created frameworks to guide clients in electrification and emissions reduction.
- Delivered concept and pre-feasibility studies across commodities and mine types.

Senior Manager, Climate Change and Energy Transition

KPMG, Brisbane, Australia, 2021 – 2022

Provided strategic decarbonisation and ESG advice to clients in energy and natural resources.

Key Achievements:

- Founded the Women in ESG Community of Practice.
- Participated in "Leading with Pride" leadership program for emerging LGBT+ leaders.
- Developed a mining sector decarbonisation framework with holistic ESG integration.

Principal Consultant, Energy Technology and Policy

Gamma Energy Technology, Brisbane, Australia, 2015 – 2021

Delivered technical analysis and policy advice on electricity systems and decarbonisation.

Key Achievements:

- Presented research at major industry conferences (IEAGHGT, APPEA, SPE Asia Pacific).
- Co-developed the Surat Basin CCS Hub and contributed to CCS hub studies.
- Served as subject matter expert for AEMO and CSIRO studies.

Analyst, Product and Technology

Rio Tinto Energy, Various Locations, 2011 – 2015

Various roles, including Analyst – Product & Technology, Environment Operations Graduate, and Product Stewardship Graduate.

Key Achievements:

- Supported climate reporting under the Clean Energy Act and NGERS.
- Built a greenhouse and energy data tool for efficient regulatory compliance.
- Advised senior leadership and represented Rio Tinto in industry associations.

Whitehaven

Blackwater North Extension Project

Appendix H
Noise and Blasting Assessment



REPORT

BLACKWATER NORTH EXTENSION PROJECT

QUEENSLAND

NOISE AND BLASTING ASSESSMENT

RWDI # 2510129

1 April 2026

SUBMITTED TO

Brendan Dillon
Manager - Approvals
Whitehaven Coal Limited

SUBMITTED BY

Roman Haverkamp
Senior Engineer
Roman.haverkamp@rwdi.com

Rebecca Warren
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DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Final	1 April 2026	Roman Haverkamp	Rebecca Warren

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This firm is a member firm of the Association of Australasian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

QUALITY ASSURANCE

RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued for the following scope: The provision of consultancy services in acoustic engineering, air quality and wind engineering; and the sale, service, support and installation of acoustic monitoring and related systems and technologies.

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EXECUTIVE SUMMARY

RWDI Australia Pty Ltd (RWDI) has completed a comprehensive Noise and Blasting Assessment for the proposed Blackwater North Extension Project (the Project) at the Blackwater Mine (BWM), which seeks an amendment to Environmental Authority (EA) EPML00717813 to support extended open-cut mining operations within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759.

The assessment has evaluated operational noise, night-time maximum noise level events, low-frequency noise (LFN), cumulative noise, and blasting impacts in accordance with EA EPML00717813 noise criteria and relevant Queensland legislation and guidelines.

Noise Criteria

EA EPML00717813 noise criteria, as summarised in **Table 1**, were used for the assessment.

Table 1: EA EPML00717813 Noise Criteria

Receptors	Noise Limits (A-weighted decibels [dBA])			
	Day $L_{Aeq,15min}$	Evening $L_{Aeq,15min}$	Night $L_{Aeq,15min}$	Night $L_{A1,15min}$
Sensitive place or Commercial place	40	40	40	45

Notes:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm – 10.00 pm; Night = 10.00 pm – 7.00 am.
2. Noise criteria do not apply to non-sensitive receptors.

In accordance with EA EPML00717813 requirements, tonal, low-frequency and impulsive noise, which have the potential to generate annoyance in the surrounding community, have also been considered.

Operational Noise Assessment

Predictive noise modelling indicated that most of the noise-sensitive receptors surrounding the BWM would comply with EA EPML00717813 $L_{Aeq,15min}$ criteria across all assessed years and operating scenarios. Residual exceedances were identified at 11 receptors, including eight privately-owned receptors and three non-sensitive industrial receptors. It is understood these receptors would be managed via commercial noise agreements with Whitehaven Blackwater (i.e. "Alternative Arrangements" under EA EPML00717813).

Table 2 provides a summary of the residual noise exceedance levels at the eight privately-owned receptors predicted to experience noise exceedances.

Table 2: Residual Noise Exceedance Levels at Privately-owned Receptors

Exceedance Category	Number of Receptors	Receptor IDs
Negligible (1-2 decibels [dB])	1	R07
Marginal (3-5 dB)	4	R03, R04, R13, R19
Significant (>5 dB)	3	R05, R06, R17

Night-time Maximum Noise Level Event Assessment

Assessment of night-time maximum noise level events against EA EPML00717813 $L_{A1,15min}$ criterion showed compliance at all but five privately-owned and non-sensitive industrial receptors, namely R05, R06, R14, R17 and R46. These receptors are subject to operational $L_{Aeq,15min}$ exceedances, and therefore expected that they would be covered by commercial noise agreements (i.e. "Alternative Arrangements" under EA EPML00717813).

Low-frequency Noise Assessment

Assessment against the *Guideline - Streamlined model conditions for petroleum activities* (Department of Environment, Science and Innovation [DESI], 2024) LFN outdoor criteria showed compliance at all receptors. The Project is therefore unlikely to generate LFN that could be perceived by the community and cause annoyance.

Cumulative Noise Assessment

To minimise background creep in the areas surrounding the Project, the assessment considered cumulative noise from the Project and nearby industries, and assessed it against the (site-specific) EA EPML00717813 noise criteria.

Cumulative noise was found to generally comply with the site-specific EA EPML00717813 noise criteria, indicating the Project would not lead to unreasonable background noise levels in the area. It is noted that day and evening exceedances are expected in north Blackwater under conservative assumptions.

Road Traffic and Rail Transportation Noise Assessment

Given that the Project does not involve any increase in public road traffic or rail movements, additional impacts from road traffic and rail transportation noise are not expected and did not warrant further assessment.

Blasting Assessment

Blasting assessment indicated that localised maximum instantaneous charge (MIC) restrictions would be required at Stewarton Pit to maintain compliance at receptor R17. Based on current blast management practices at the BWM, it is expected that airblast overpressure and ground vibration from the Project could be effectively controlled to meet all blasting criteria and minimise the risk of significant impacts at surrounding receptors.

1 INTRODUCTION

1.1 Overview of the Blackwater Mine

The Blackwater Mine (BWM) is an existing, open-cut metallurgical coal mine located approximately 20 kilometres (km) south-west of Blackwater in the Bowen Basin, Queensland.

The BWM has been in operation since 1967 and operates in accordance with, amongst other authorisations, Environmental Authority (EA) EPML00717813, granted under the *Environmental Protection Act 1994* (EP Act).

The BWM is a joint venture between Whitehaven Coal Limited (Whitehaven) (70 percent [%]), Nippon Steel Corporation (20%) and JFE Steel Corporation (10%). Whitehaven Blackwater Pty Ltd (Whitehaven Blackwater), a wholly owned subsidiary of Whitehaven, is the operator of the BWM.

The existing BWM comprises a series of open-cut mining pits along an approximate 80-km long strike length. The BWM extracts coal using drill and blast methods, draglines, dozers and truck and shovel fleets for overburden removal and haulage. Existing infrastructure at the BWM includes two rail spurs and balloon loops from the Bauhinia Railway Line, a coal handling and preparation plant (CHPP), a thermal coal plant (TCP), product stockpiles, run-of-mine (ROM) coal stockpiles, tailings storage facility, in-pit spoil (i.e. waste rock) dumps, train load-out facilities, water management infrastructure and other supporting infrastructure (e.g. haul roads, access roads, laydown areas, electricity transmission lines, workshops and offices) (**Figure 1-1**).

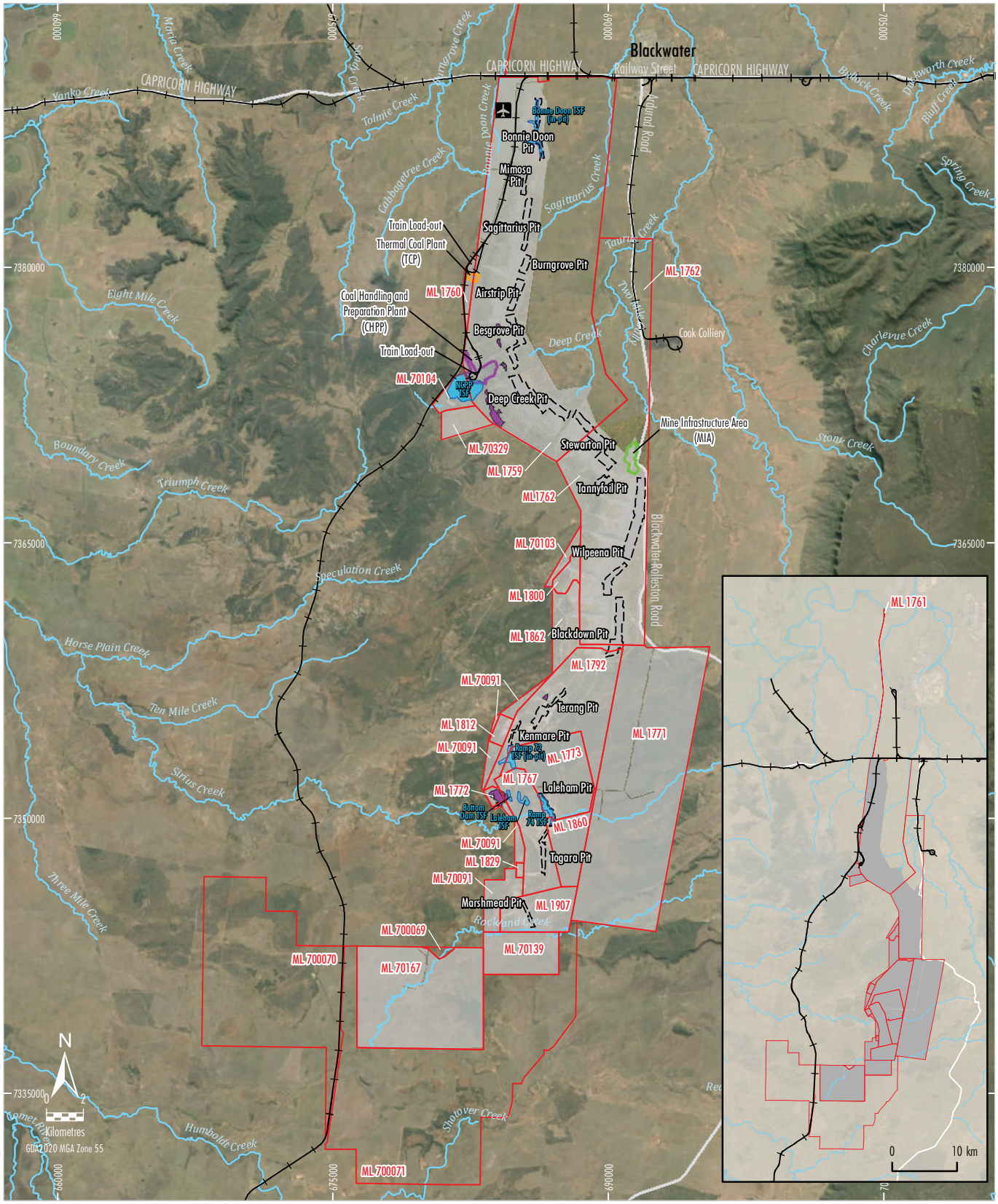
Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open-cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at the BWM, allowing ongoing employment and economic benefits from the BWM to the local area, region, and State of Queensland.

1.2 Objectives of this Assessment

RWDI Australia Pty Ltd (RWDI) has been commissioned to prepare a Noise and Blasting Assessment in support of the EA Amendment Application under section 226 of the EP Act. The primary objective of the assessment is to predict noise and blasting emissions associated with the Project, and assess them against relevant EA EPML00717813 noise criteria.

The assessment provides a quantitative analysis of operational noise, night-time maximum noise level events, low-frequency noise (LFN) and cumulative noise. It also identifies noise mitigation and management measures required for the Project. In addition, the assessment includes a blast analysis to determine mass of explosive requirements and minimum compliance distances.

As the Project does not introduce any additional road and rail movements beyond those currently approved, road and rail noise have been addressed qualitatively.



WHC-24-101_EA Amendment SR Noise_201A

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Esri (2025); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Airport
- Approved Disturbance Footprint
- Pit
- Indicative TCP Extent
- Indicative MIA Extent
- Indicative CHPP Extent
- Tailings Storage Facility (TSF)
- Reject Stockpile

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

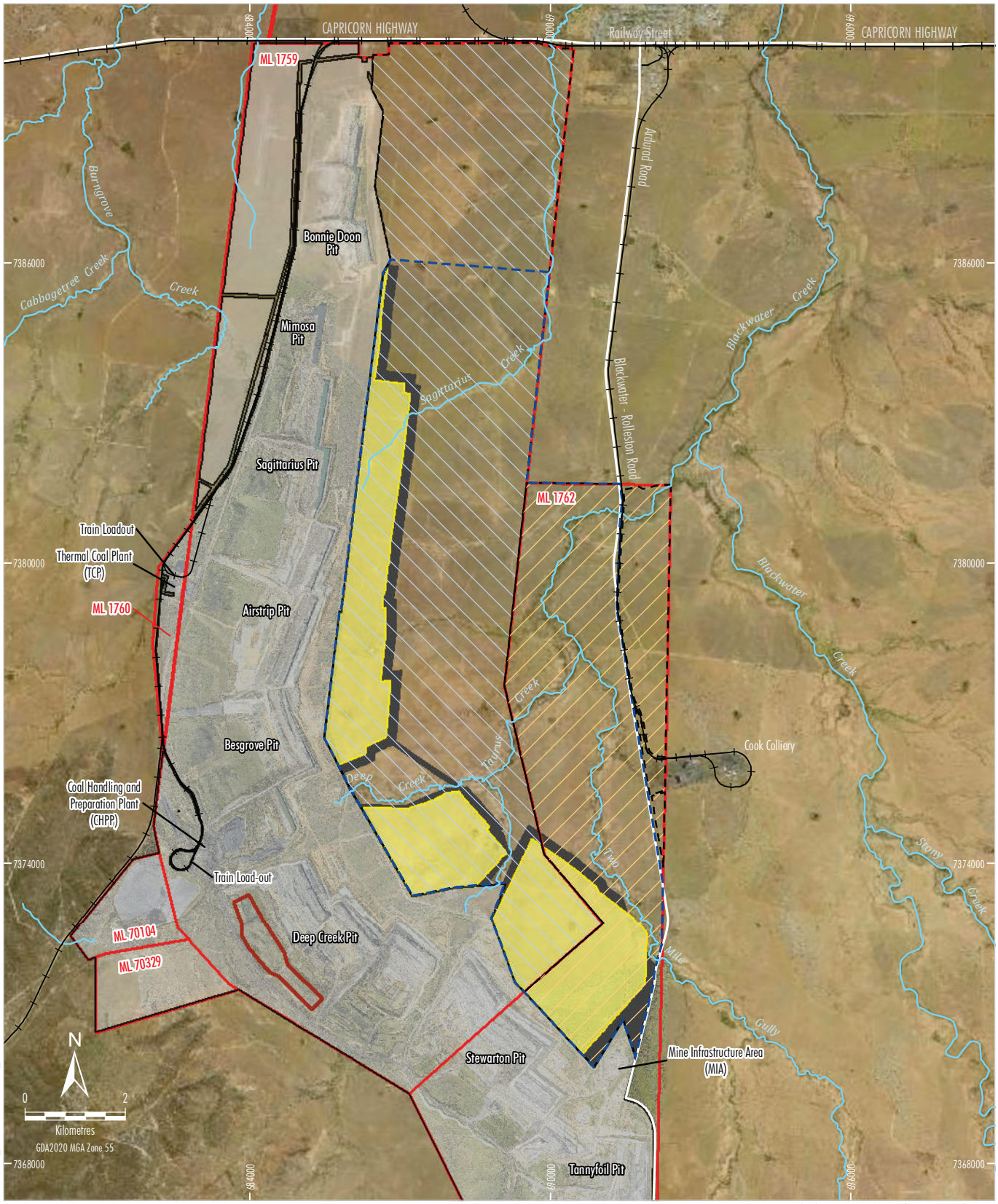
Existing Blackwater Mine

Figure 1-1

2 PROJECT DESCRIPTION

The Project would include the following activities **(**Figure 2-1**)**:

- extension of open-cut operations into SA 7 on ML1762 and SA 10 on ML1759 to allow mining of additional coal reserves to approximately 2055;
- extraction of an additional 200 million tonnes (Mt) (approximately) of ROM coal;
- continued extraction of up to 19 million tonnes per annum (Mtpa) of ROM coal;
- continued use of existing BWM infrastructure (e.g. CHPP, TCP, ROM and product coal stockpiles, train load-out, water management, tailings management and other supporting infrastructure);
- construction and operation of new water management and water storage infrastructure in support of extended mining operations;
- development of waste rock emplacement areas;
- continued co-disposal of coarse rejects with waste rock and disposal of tailings into an approved tailings storage facility or in-pit void;
- construction of semi-permanent tailings cells to be utilised for the disposal of fine rejects;
- progressive rehabilitation of the Project;
- ongoing exploration activities in the Project area; and
- other associated infrastructure, equipment and activities.



LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Approved Disturbance Footprint
- SA 7
- SA 10

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area
- Potential Semi Permanent Tailings Cell

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Project General Arrangement

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Figure 2-1

3 EXISTING NOISE ENVIRONMENT

3.1 Noise-sensitive Receptors

The assessment considers all surrounding noise-sensitive receptors potentially impacted by the Project. They include, but are not limited to, all receptor types subject to EA EPML00717813 noise criteria and defined in EA EPML00717813 as sensitive and commercial places.

EA EPML00717813 defines sensitive and commercial places as follows:

> ***Sensitive place*** *means:*
>
> *a) Any of the following:*
> - *i. a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises; or*
> - *ii. a motel, hotel or hostel; or*
> - *iii. an educational institution; or*
> - *iv. a medical centre or hospital; or*
> - *v. a protected area; or*
> - *vi. a public park or gardens.*

> *b) Despite paragraph (a), the following places are not sensitive places:*
> - *I. subject to paragraph (c), a place that is the subject of an alternative arrangement; or*
> - *II. a mining camp (i.e. accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority), whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the environmental authority holders for the mining project, or a related company; or*
> - *III. a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.*

> *c) A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a sensitive place for the purposes of that type(s) of environmental nuisance, however remains a sensitive place for the purpose of other types of environmental nuisances.*

> ***Commercial place*** *means:*
>
> *a) A work place that is used as:*
> - *i. an office; or*
> - *ii. a place of business; or*
> - *iii. a place used for commercial purposes.*

> *b) Despite paragraph (a), the following places are not commercial places:*
> - *i. subject to paragraph (c), a place that is the subject of an alternative arrangement; or*
> - *ii. places that are part of the mining activity; or*
> - *iii. employees accommodation or public roads; or*

iv. a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.

c) A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a commercial place for the purposes of that type(s) of environmental nuisance, however remains a commercial place for the purpose of other types of environmental nuisances.

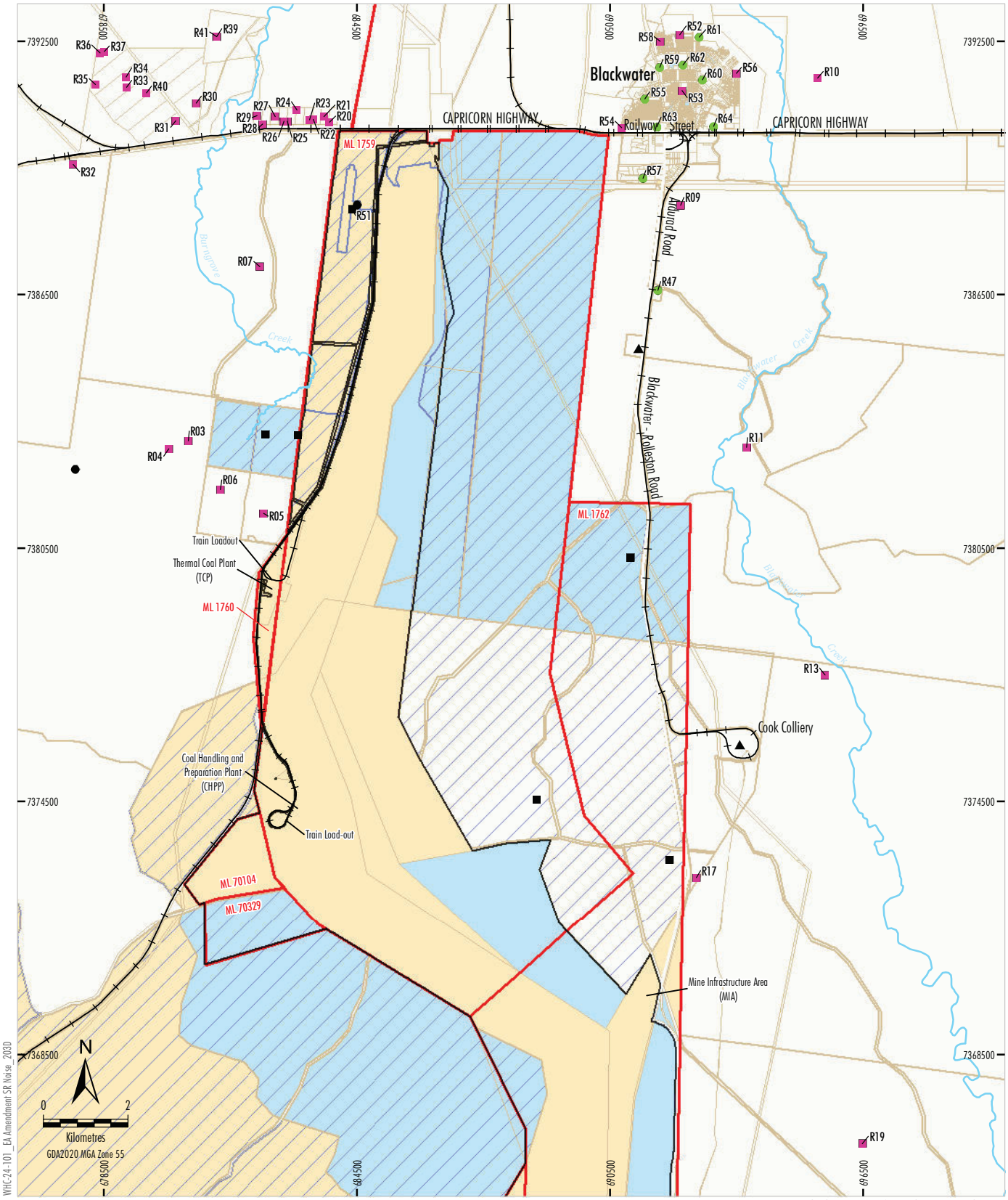
In total, 59 noise-sensitive receptors were considered and are summarised as follows:

- 39 privately-owned receptors – comprising 34 rural properties and five dwellings representative of Blackwater;
- eight other receptor types – comprising three schools, childcare, hospital, medical centre, camp accommodation and cemetery (all located in Blackwater except for the cemetery which is on the south of the Capricorn Highway); and
- 12 non-sensitive receptors (including five mine-owned residential dwellings, two privately-owned residential dwellings currently under agreements, and five commercial/industrial receptors in the surrounding rural areas).

Including all receptors within Blackwater was considered impractical; therefore, five key receptors representative of the township were strategically selected for the assessment. The representative Blackwater receptors include the dwellings potentially most impacted by the Project (i.e. receptors in the south and south-west of the township).

The mine-owned receptors and privately-owned receptors currently under agreements are not subject to EA EPML00717813 noise criteria and are included for information only.

Figure 3-1 shows all noise-sensitive receptors surrounding the Project and included in the assessment. A detailed land ownership list (with geographic coordinates) is provided in **Appendix B**.



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Lessee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Noise-sensitive Receptors Locations

Figure 3-1

3.2 Previous Noise Monitoring

In April and May 2020, EMM Consulting Pty Ltd (EMM) conducted a baseline unattended noise monitoring survey at four receptor locations surrounding the BWM to quantify the existing noise environment, with supplementary attended measurements conducted at the four locations and a further five locations to characterise the noise environment and determine the site's noise contribution (EMM, 2021).

The details provided in this section were obtained from the noise assessment recently conducted for the BWM (SLR Consulting Australia Pty Ltd [SLR], 2023)

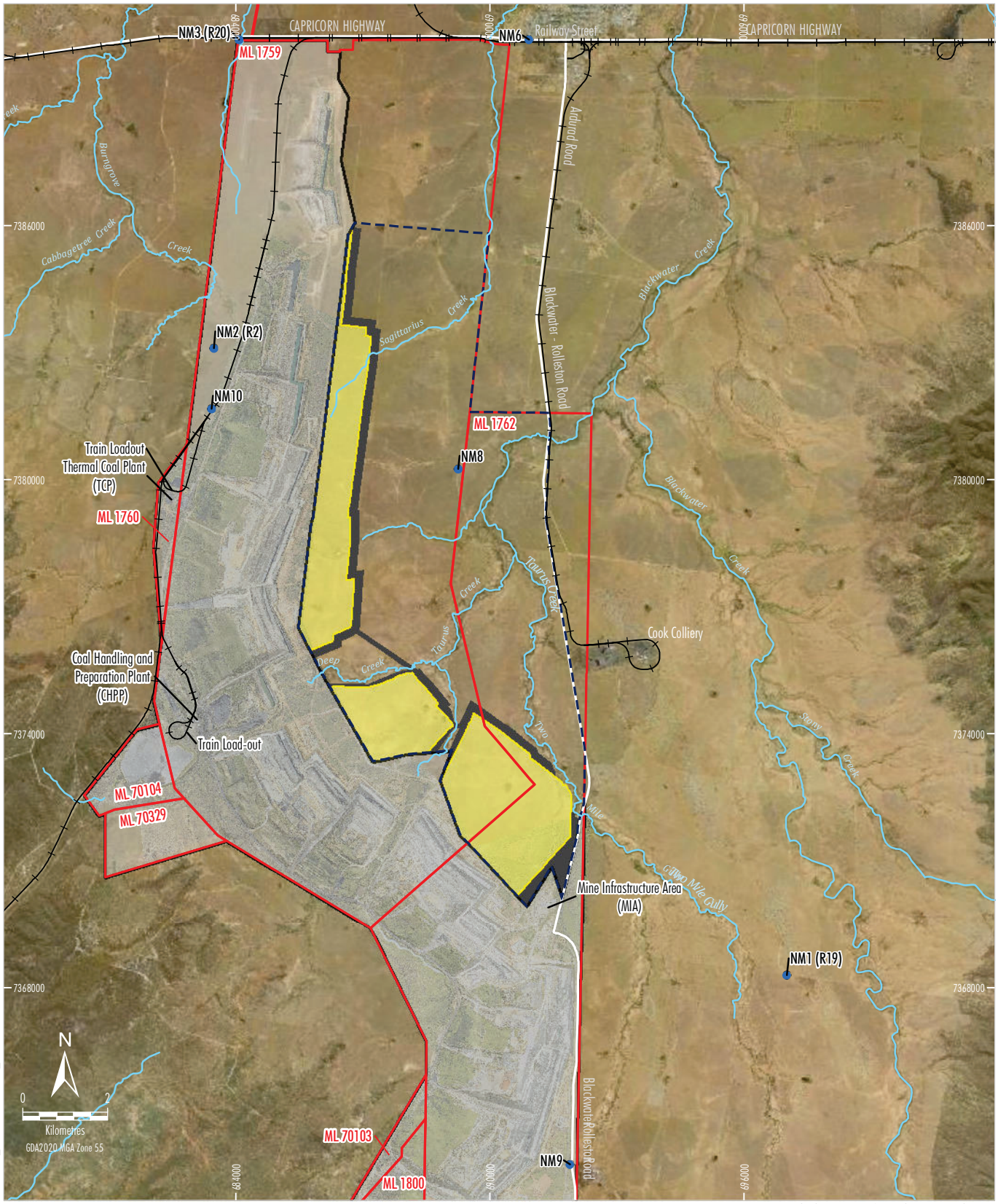
3.2.1 Noise Monitoring Locations

The monitoring locations are summarised in **Table 3-1** and presented on **Figure 3-2**.

It is noted two of the five only-attended noise monitoring locations were used by EMM for noise model verification purposes only and as such have not been discussed further in this report.

Table 3-1: Noise Monitoring Locations (EMM, 2021)

Location ID (RWDI ID)	Method	Coordinates (MGA zone 55)	
		Easting	Northing
NM1 (R19)	Unattended and attended	697016	7368303
NM2 (R2)	Unattended and attended	683482	7383106
NM3 (R20)	Unattended and attended	684074	7390392
NM6	Unattended and attended	690925	7390392
NM8	Attended	689250	7380257
NM9	Attended	691900	7363829
NM10	Attended	683428	7381676



WHC-24-101_EA Amendment SR Noise_211A

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Noise Monitoring Location
- Existing Blackwater Mine
- Project Components[1]
- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

Note: [1] Excludes some incidental Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Noise Monitoring Locations

Figure 3-2

3.2.2 Noise Monitoring Results

A summary of the EMM unattended noise monitoring results is provided in **Table 3-2**.

Table 3-2: Unattended Noise Monitoring Results (EMM, 2021)

Location ID (RWDI ID)	L_{A90} Noise Levels[2] (A-weighted decibels [dBA])			$L_{Aeq,Period}$ Noise Levels (dBA)			L_{A1} Noise Levels (dBA)		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
NM1 (R19)	25	32	28	40	47	46	57	55	58
NM2 (R2)	27	27	24	47	46	43	57	55	57
NM3 (R20)	30	33	27	63	59	59	79	77	82
NM6	43	42	38	68	65	64	81	79	85

Notes:

1. Day: 7.00 am – 6.00 pm Monday to Saturday, 8.00 am – 6.00 pm Sundays and public holidays; Evening: 6.00 pm – 10.00 pm; Night: 10.00 pm – 7.00 am.
2. It is understood that L_{A90} noise levels are interpreted to be Rating Background Levels (RBL).

Background noise levels (L_{A90}) at NM1, NM2 and NM3 were characteristic of a rural environment, while those at NM6 were influenced by activities occurring in and around Blackwater. The L_{Aeq} and L_{A1} noise levels at NM3 and NM6 were influenced by road traffic noise from the Capricorn Highway.

The results of the EMM attended noise measurements are summarised in **Table 3-3**.

Table 3-3: Attended Noise Monitoring Results (EMM, 2021)

Location ID (RWDI ID)	Start Date and Time	Measured Noise Levels (dBA)				BWM Contribution[1] $L_{Aeq,15min}$ (dBA)	Comments
		L_{A90}	L_{Aeq}	L_{A10}	L_{A1}		
NM1 (R19)	17/04/20 9.53am	21	27	28	37	Inaudible	BWM noise inaudible. Noise sources include occasional wind, birdsong and insects.
NM2 (R2)	17/04/20 2.02pm	34	35	37	38	<20	BWM noise occasionally audible. Mine noise includes distant engine revs (approx. 20 dBA) and horn blasts (approx. 22 dBA). Other noise sources include occasional wind, passing vehicles on Blackwater Airport Road, birdsong and insects.
NM3 (R20)	17/04/20 2.54pm	34	47	50	58	Inaudible	BWM noise inaudible. Noise sources include occasional wind, passing vehicles on Capricorn Highway, birdsong and insects.

Location ID (RWDI ID)	Start Date and Time	Measured Noise Levels (dBA)				BWM Contribution[1] $L_{Aeq,15min}$ (dBA)	Comments
		L_{A90}	L_{Aeq}	L_{A10}	L_{A1}		
NM6	20/04/20 6.30am	58	70	74	80	Inaudible	BWM noise inaudible. Noise sources include vehicles passing on Capricorn Highway, birdsong and insects.
NM8	19/04/20 4.14pm	28	31	34	37	26	BWM noise audible. Mine noise includes distant engine revs (28 dBA) and horn blasts (32 dBA). Other noise sources include wind, birdsong and insects.
NM9	19/04/20 4.47pm	42	50	46	63	42[2]	BWM noise audible. Mine noise includes engine revs (45 dBA), light vehicles on mine (49 dBA), dozer tracks (43 dBA) and horn blasts (45 dBA). Other noise sources include vehicles passing on Blackwater Rolleston Road, birdsong and insects.
NM10	19/04/20 5.42pm	47	59	54	73	42[2]	BWM noise audible. Mine noise includes engine revs (50 dBA), bucket noise (50 dBA), haul trucks (59 dBA) and horn blasts (48 dBA). Other noise sources include vehicles passing on Blackwater Airport Road, birdsong and insects

Notes:

1. BWM noise contribution was determined using in-field observations and post-analysis of data as required.
2. Although the stated BWM contribution noise level is above EA EPML00717813 noise criteria (**Table 4-1**), this noise monitoring location does not represent a noise-sensitive receptor.

Attended monitoring indicated that noise from the BWM was either inaudible or negligible at all four unattended noise measurement locations. At NM1 and NM2, the measured noise levels and observed sources were consistent with those expected in a typical rural setting. At NM3 and NM6, the acoustic environment was influenced by road traffic noise from the Capricorn Highway.

4 OPERATIONAL NOISE CRITERIA

4.1 Noise Policies & Guidelines

The relevant Queensland legislation and guidelines applicable to the Project for managing and assessing operational noise include:

- EP Act;
- *Environmental Protection Regulation 2019* (EP Regulation);
- *Environmental Protection (Noise) Policy 2019* (EPP [Noise]);
- *Ecoaccess Guideline - Planning for Noise Control Guideline* (Department of Environment and Heritage Protection [DEHP], 2016);
- *Ecoaccess Guideline for the Assessment of Low Frequency Noise* (Environmental Protection Agency [EPA], 2004);
- *Guideline – Application requirements for activities with noise impacts* (Department of Environment, Science and Innovation [DESI], 2025); and
- *Noise Measurement Manual* (NMM) (Department of Environment and Science [DES], 2020).

Additional guidance was obtained through reference to the following guideline:

- *Guideline - Streamlined model conditions for petroleum activities* (DESI, 2024).

The EP Act and subordinate legislation (EP Regulation and EPP [Noise]) set acoustic quality objectives to prevent and minimise adverse effects on environmental values of the acoustic environment, including health, wellbeing and amenity.

4.2 Assessment Strategy

As this Project is an amendment of EA EPML00717813, it is considered appropriate to assess noise levels against the criteria within. This approach is considered suitable for the Project as opposed to nominating new and more stringent criteria for the following reasons:

- The current operational constraints and mitigation/management commitments currently in place at the BWM are controlled by EA EPML00717813 noise criteria. Implementing new and more stringent criteria would not be considered practical or reasonable for an operation that has been running for many years.
- The Project would continue using the same mining methods, equipment and infrastructure as current operations, with no increase in the annual ROM coal extraction rate. Notwithstanding the extension of open-cut operations into SA 7 and SA 10, it is considered that the Project would generally not result in significant changes to overall noise emissions from the BWM.
- No noise and blast complaints were received in the last three years, which suggests that EA EPML00717813 noise criteria are effective in protecting the community's acoustics amenity.
- The BWM has been operating since 1967, and much of the surrounding community (including Blackwater) is developed largely because of the BWM.

4.3 Environmental Authority Noise Criteria

Under EA EPML00717813, Whitehaven Blackwater is required to operate in accordance with the noise conditions set out in Conditions C1-C4 and comply with the noise limits summarised in Table C1.

Conditions C1 and C2 stipulate that noise generated by the BWM must comply with the noise limits summarised in Table C1 at all surrounding sensitive and commercial places (refer to **Section 3** for definitions) so as not to cause any environmental noise nuisance.

EA EPML00717813 noise criteria are summarised in **Table 4-1**. These criteria would be used for the assessment.

Table 4-1: EA EPML00717813 Noise Criteria

Receptors	Noise Limits (dBA)			
	Day $L_{Aeq,15min}$	Evening $L_{Aeq,15min}$	Night $L_{Aeq,15min}$	Night $L_{A1,15min}$
Sensitive place or Commercial place	40	40	40	45

Notes:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm –10.00 pm; Night = 10.00 pm – 7.00 am.
2. Noise criteria do not apply to non-sensitive mine-owned receptors and privately-owned receptors currently under agreements.

4.4 Modifying Factor Adjustments

Tonal, low-frequency and impulsive noise have the potential to generate annoyance in the surrounding community and have therefore been considered in the assessment.

According to Table C1 of EA EPML00717813, noise limits apply to levels adjusted for tonal character ($L_{Aeq,15min}$ and $L_{A1,15min}$) and impulsiveness of the sound ($L_{A1,15min}$). Condition C3 also states that compliance assessment should be conducted according to the NMM, which requires consideration of tonality, impulsiveness and LFN.

4.4.1 Low-frequency Noise

An LFN assessment has been conducted to evaluate the likelihood that noise-sensitive receptors would be exposed to dominant LFN from the Project.

The *Ecoaccess Guideline for the Assessment of Low Frequency Noise* prescribes an assessment approach based on internal noise levels. Sound transmission through building envelopes can vary significantly between residences; therefore, internal noise level assessments are recommended only when investigating existing LFN issues through direct measurement. Owing to the uncertainties in sound transmission loss from structures, predicting and assessing internal noise levels during the planning phase is not feasible.

The *Guideline - Streamlined model conditions for petroleum activities*, relevant to operations of industrial sites in rural Queensland, provides guidance for assessing outdoor LFN. It specifies that LFN must not exceed the following external LFN assessment criteria simultaneously:

- 60 C-weighted decibels (dBC) measured outside the sensitive receptor; and
- the difference between the external A-weighted and C-weighted noise levels is no greater than 20 decibels (dB).

A summary of the LFN assessment criteria used for the Project is summarised in **Table 4-2**.

Table 4-2: Project-specific LFN Assessment Criteria

Guideline	LFN Assessment Criteria (External)
Guideline - Streamlined model conditions for petroleum activities	– 60 dBC; and – dBC – dBA ≤ 20 dB

Note:

1. The *Guideline - Streamlined model conditions for petroleum activities* does not specify a frequency range for its LFN criteria. Consequently, the criteria were assumed to apply across the full range potentially influenced by mining noise at receptor locations, namely 10 to 630 hertz (Hz).

The LFN criteria provided in the *Guideline - Streamlined model conditions for petroleum activities* are intended for use when conducting measurements following a valid LFN complaint lodged with the administrative authority. Given that the guideline does not specify any penalty for instances where LFN is identified, exceedances of the criteria should be interpreted as indicative of potential perception and annoyance, which may require confirmation through measurement.

4.4.2 Tonal Noise

The potential for the Project to generate tonal noise was considered in the assessment but deemed irrelevant and not assessed quantitatively in the assessment for the following reasons:

- Large-scale mining operations are not expected to generate tonal noise due to the large number of noise sources on site and the considerably large distances separating noise sources and receptors. Site noise for such operations would typically consist of a steady, broadband humming noise associated with diesel powered equipment.
- Mining equipment and plant generally do not produce tonal noise. While mechanical faults can sometimes cause certain machines to generate tonal noise, this assessment assumes that all equipment is properly maintained and operating in good working order.

4.4.3 Impulsive Noise

The potential for impulsive noise was considered but determined to be irrelevant due to the typical nature of maximum noise level events at open-cut coal mines. Therefore, impulsive noise was not addressed quantitatively in the assessment.

5 OPERATIONAL NOISE ASSESSMENT

5.1 Noise Modelling Methodology

5.1.1 Predictive Noise Model

Operational noise levels at nearby receptors were predicted using the Environmental Noise Model (ENM), a proprietary computer program from RTA Technology Pty Ltd. This modelling software is widely recognised by environmental authorities across Australia as one of the most appropriate and reliable predictive tools currently available.

Based on noise characteristics and locations of major mobile equipment/fixed plant, intervening terrain to nearby noise-sensitive receptors, and local meteorology, the computer model generates predictions of total operational $L_{Aeq,15min}$ noise levels from the Project (including the continued use of existing infrastructure and ongoing mining activities within the approved disturbance footprint) at each receptor.

The noise prediction model incorporates the following factors:

- location of all noise sources and receptor points;
- source and receptor heights;
- separation distances between sources and receptors;
- ground type across propagation paths;
- terrain and barrier attenuation; and
- meteorological effects.

5.1.2 Noise Assessment Scenarios

Noise modelling was undertaken for Financial Year 2030 (FY30), FY32, FY50 and FY55 assessment scenarios. These scenarios were selected to represent operations with the greatest potential for noise impacts on surrounding noise-sensitive receptors. Considerations included:

- proximity of active pits to nearby receptors (noting pits would also progress eastward throughout the life of the Project);
- mobile equipment operating in active pits;
- yearly fleet schedule (for entire site); and
- annual ROM coal production and overburden removal rates.

Table 5-1 provides a description of the rationale for selecting each scenario.

Table 5-1: Noise Assessment Scenarios and Rationale

Assessment Scenario	Rational
FY30	– High level of activities, that are relatively close to the north-east and north-west rural properties. – Considerable increase in total mobile fleet relative to prior years. – Considerable increase in annual overburden removal rate relative to prior years.
FY32	– High level of activities, that are relatively close to central-east rural properties. – Considerable increase in total mobile fleet relative to prior years. – Considerable increase in annual overburden removal rate. – Near-peak annual ROM coal production rate.
FY50	– High level of activities within SA 10, that are relatively close to the north-east and north-west rural properties. – High level of activities within SA 7 and SA 10, that are relatively close to central-east rural properties. – Peak annual overburden removal rate.
FY55	– High level of activities within SA 10, that are relatively close to the north-east and north-west rural properties. – High level of activities within SA 7 and SA 10, that are closest to central-east rural properties.

5.1.3 Meteorology

5.1.3.1 Effects of Meteorology on Noise Propagation

Certain meteorological conditions can increase noise levels by focusing sound-wave propagation paths at a receptor location. Such refraction of sound waves would occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and/or where there is a wind gradient (wind velocities increasing with height) toward the receptor.

With a wind gradient, when wind speed increases with altitude due to reduced friction away from the ground, the higher wind speeds aloft bend sound waves downward toward the ground in downwind conditions. This can result in an operation being heard much farther away.

During a temperature inversion, the air near the ground is cooler than the air above. Since sound travels faster in warmer air, the upper layers have a higher sound speed than the lower layers, which causes downward refraction of sound waves back toward the ground instead of dispersing upward. As a result, noise from an operation can be heard much farther away as sound waves are trapped and guided along the surface. This is especially prevalent on cloudless nights with little wind.

During inversion conditions, drainage flow wind, which is the localised drainage of cold air travelling in the direction of decreasing altitude, can also contribute to noise propagation. Drainage flow is a function of the local topography and is only relevant for receptors at a lower altitude relative to the site with no intervening higher ground (e.g. hills).

5.1.3.2 Prevalence of Noise-Enhancing Meteorological Conditions

The *Ecoaccess Guideline - Planning for Noise Control Guideline* requires that noise modelling of large and complex projects should consider meteorological conditions. The guideline provides a methodology for assessing the prevalence of noise-enhancing conditions and implementing them in the assessment process.

Gradient Winds

According to the *Ecoaccess Guideline - Planning for Noise Control Guideline*, wind effects need to be assessed where wind is considered significant and a feature of the area. This is the case where source-to-receptor wind speeds (at 10 metres [m] above ground level [AGL]) of 3 metres a second (m/s) or below occur for 30% of the time or more in any assessment period (day, evening and night) and season.

The guideline provides two ways to assess gradient winds:

1. using a wind rose to determine whether wind is a feature and only apply source-to-receptor winds if, and where, applicable (noting that if only source-to-receptor wind speeds of below 3 m/s exceed the threshold of occurrence then the highest wind speed below 3 m/s is used); or
2. assuming that wind is a feature of the area (foregoing the need to use a wind rose) and applying a 'maximum impact' scenario with 3 m/s source-to-receptor winds.

The first approach was adopted as it better reflects actual noise levels for assessment.

Wind roses provide representation of wind speeds in specific direction intervals (typically in 8 or 16 directions). However, the wind direction interval that enhances noise propagation is not represented in fixed angular spacing (like in a wind rose), but rather covers a much broader range centred on the source-receptor axis. In environmental noise modelling, ±45 degrees (°) around the source-receptor axis (and sometimes even wider) is often considered "downwind" for enhanced noise propagation.

In light of the above, gradient winds were processed following the more conservative methodology prescribed by the New South Wales (NSW) *Noise Policy for Industry* (NPfI) (NSW Environment Protection Authority, 2017), which accounts for these broader downwind conditions centred on the source-receptor axis. **Appendix C** provides a detailed description of the analysis and its results.

The analysis was based on data from the Bureau of Meteorology (BoM) weather station located at Blackwater Airport directly west of the site for the period January 2021 to December 2024. The BoM data is considered representative of the general surroundings.

Analysis of the BoM data following the NPfI methodology indicate that winds up to 3 m/s are not deemed significant during the day, evening or night periods, and therefore do not warrant assessment. As such, noise emissions were modelled under calm conditions, represented as 0.5 m/s winds in accordance with the NPfI.

Temperature Inversions

According to the *Ecoaccess Guideline - Planning for Noise Control Guideline*, temperature inversions should be assessed if they occur for more than 30% of the total night period during winter (June, July and August), where the night period is taken to be 6.00 pm to 7.00 am. If deemed a feature of the site, inversions should be assessed for the night period only (i.e. 10.00 pm – 7.00 am).

Given the site's location in a non-arid region, the guideline recommends assessing moderate inversions (stability category F) with a vertical temperature gradient of +3 degrees Celsius (°C) per 100 m.

The guideline also stipulates that drainage flow wind during inversions should only be considered for receptors at a lower altitude relative to the site with no intervening higher ground.

There are two options for deciding on temperature inversion parameters to be used:

1. using parameters determined by measurements and only assess inversions (including drainage flow) if deemed a feature of the site; or
2. assuming default parameters of moderate inversions combined with a 2 m/s source-to-receptor drainage flow where applicable.

The first approach was adopted: an analysis of BoM data (**Appendix C**) showed that moderate-to-strong inversions (stability categories F and G) occurred at levels relatively close to the 30% threshold (i.e. 26.8% in winter). Furthermore, a similar analysis using 2021 CALMET meteorological model data indicated that moderate-to-strong inversions exceeded the 30% occurrence threshold. Temperature inversions were therefore included in the assessment, assuming a moderate inversion strength applicable to non-arid regions.

With surrounding noise-sensitive receptors located at comparable altitudes relative to the site, drainage flow winds were not assessed, and temperature inversions were modelled with 0.5 m/s winds (representative of calm conditions) in accordance with the NPfI.

5.1.3.3 Assessment Meteorological Parameters

Based on the above analysis, meteorological conditions assumed for the assessment are summarised in **Table 5-2**. Whilst neutral conditions were assessed for the day and evening periods, noise-enhancing conditions were assumed at night.

Table 5-2: Assessment Meteorological Parameters

Assessment Period[1]	Classification	Meteorological Parameters
Day	Neutral	0.5 m/s source-to-receptor[2] wind combined with stability category D[3]
Evening	Neutral	0.5 m/s source-to-receptor[2] wind combined with stability category D[3]
Night	Noise-enhancing	0.5 m/s source-to-receptor[2] wind combined with stability category F[4]

Notes:

1. Day: 7.00 am – 6.00 pm; Evening: 6.00 pm – 10.00 pm; Night: 10.00 pm – 7.00 am.
2. Source-to-receptor wind direction was modelled using the closest direction in a 16-direction compass to the source-to-receptor direction.
3. Stability category D modelled using vertical temperature gradient of -0.5°C/100 m in accordance with the NPfI.
4. Stability category F modelled using vertical temperature gradient of 3°C/100 m.

With regards to air temperature and relative humidity, average values for winter months (which is generally taken to be the worst-case for noise transmission) were assumed in noise modelling. These are presented in **Table 5-3**.

Table 5-3: Air Temperature & Relative Humidity

Assessment Period[1]	Air Temperature (°C)	Relative Humidity (%)
Day	20.7	47.3
Evening	15.9	59.9
Night	12.5	75.3

Note:

1. Day: 7.00 am – 6.00 pm; Evening: 6.00 pm – 10.00 pm; Night: 10.00 pm – 7.00 am.

5.1.4 Noise Modelling Assumptions

Noise modelling was based on the following assumptions:

Scenarios

- As the Project operations would operate 24 hours, noise predictions were provided for the day (7.00 am - 6.00 pm), evening (6.00 pm - 10.00 pm) and night (10.00 pm - 7.00 am) periods, with consideration of different meteorology for each period.
- The noise modelling represents a 'typical worst-case' 15-minute operating period, assuming continuous operation of all mobile equipment (including campaign equipment) under normal operating conditions.
- For each noise-sensitive receptor, noise modelling considers the closest and most exposed in-pit coal loading location.
- Modelling conservatively assumes the train loading process to take place at both the CHPP and TCP simultaneously. This includes additional handling processes and a train on the rail loop.
- Both the CHPP and TCP trains were conservatively assumed to have four locomotives.

Sources

- Noise modelling includes all major mobile equipment and fixed plant expected to contribute to BWM's noise emissions as perceived by the surrounding noise-sensitive receptors. Mobile equipment and fixed plant not expected to contribute materially under any meteorological conditions have been omitted from the modelling.
- Travelling mobile equipment such as dump trucks (coal and waste rock), water carts and graders were modelled as line sources representing haul paths. For each path, the acoustic energy of trucks was evenly distributed along the length of the haul string. For water carts and graders, the energy was spread across all haul paths and allocated in proportion to the number of trucks using each path.
- All other mobile equipment (i.e. draglines, electric rope shovels, excavators, wheel loaders, dozers and drills) and infrastructure items were modelled as point sources.
- Trains on rail loops were modelled as line sources the length of the train, with the acoustic energy distributed equally across the length of the train to simulate the moving locomotives.
- Each conveyor system was modelled as a representative line source.

5.1.5 Mobile Equipment / Fixed Plant

The mobile fleet for the Project would mostly consist of equipment already used in the approved BWM operations. However, it is envisaged that the fleet could be subject to change throughout the life of the Project. For fixed plant, the Project would rely on the ongoing use of the existing BWM infrastructure, including the CHPP, TCP, ROM/product coal stockpiles, train load-out and rail infrastructure.

Table 5-4 presents an indicative list of mobile equipment and fixed plant considered for noise assessment. It is important to note that only the mobile equipment in service is included.

Table 5-4: Indicative Equipment Schedule

Equipment		Function	Equipment Quantity				Assessment Period[1]
			FY30	FY32	FY50	FY55	
Mobile Equipment							
Draglines	Marion 8200	Overburden removal	2	2	2	2	Day, Evening, Night
	Marion 8050	Overburden removal	3	3	3	3	Day, Evening, Night
	Bucyrus Erie 1370W	Overburden removal	2	2	2	2	Day, Evening, Night
Electric rope shovels	CAT 7495	Overburden loading	1	1	1	1	Day, Evening, Night
	P&H 4100	Overburden loading	1	1	1	1	Day, Evening, Night
Excavators	CAT 6040	ROM coal loading	1	1	1	1	Day, Evening, Night
	CAT 6060	Overburden loading	4	5	6	6	Day, Evening, Night
	Liebherr 9800	Overburden loading	4	5	5	5	Day, Evening, Night
Wheel Loaders	Komatsu WA1200	ROM coal loading	4	4	4	4	Day, Evening, Night
	Komatsu WA400	CHPP ROM stockpile	1	1	1	1	Day, Evening, Night
	Komatsu WA400	TCP ROM stockpile	1	1	1	1	Day, Evening, Night
Track Dozers	CAT D11	Overburden dozer fleet	12	12	18	18	Day, Evening, Night
	CAT D11	Pit support	21	23	24	24	Day, Evening, Night
	CAT D11	TCP product stockpile	2	2	2	2	Day, Evening, Night
	CAT D10	Pit support	8	9	8	8	Day, Evening, Night
Haul Trucks	Komatsu 930E	Overburden haulage	66	87.4	101	104	Day, Evening, Night

Equipment		Function	Equipment Quantity				Assessment Period[1]
			FY30	FY32	FY50	FY55	
	CAT 793	Overburden, ROM coal and parting haulage	9	13	13	13	Day, Evening, Night
	Kress 200CIII Coal Hauler	ROM coal haulage	8	8	8	8	Day, Evening, Night
Drills	-	Drill and blast	6	6	9	8	Day, Evening, Night
Water Carts	CAT 789	Haul road maintenance	5.1	5.6	5.6	5.6	Day, Evening, Night
	CAT 785	Haul road maintenance	1.7	1.9	1.9	1.9	Day, Evening, Night
Graders	CAT 24M	Haul road maintenance	6.5	7.5	7.5	7.5	Day, Evening, Night
	CAT 18M	Haul road maintenance	3.2	3.7	3.7	3.7	Day, Evening, Night
CHPP and TCP Fixed Plant							
CHPP	ROM hopper/primary crusher	ROM coal processing	1	1	1	1	Day, Evening, Night
	Secondary sizing station	ROM coal processing	1	1	1	1	Day, Evening, Night
	Coal preparation plant	ROM coal processing	1	1	1	1	Day, Evening, Night
	Stacker	Raw coal stockpile	1	1	1	1	Day, Evening, Night
	Stacker	Product coal stockpile	1[2]	1[2]	1[2]	1[2]	Day, Evening, Night
	Reclaimer	Product coal stockpile	2	2	2	2	Day, Evening, Night
	Rejects bin	Rejects	1	1	1	1	Day, Evening, Night
	Train loadout bin	Train loading	1	1	1	1	Day, Evening, Night
	Transfer station	Coal handling	3	3	3	3	Day, Evening, Night

Equipment		Function	Equipment Quantity				Assessment Period[1]
			FY30	FY32	FY50	FY55	
	Conveyor systems	Coal handling	-	-	-	-	Day, Evening, Night
TCP	ROM hopper/rotary breaker	ROM coal processing	1	1	1	1	Day, Evening, Night
	Rejects bin	Rejects	1	1	1	1	Day, Evening, Night
	Train loadout bin	Train loading	1	1	1	1	Day, Evening, Night
	Transfer station	Coal handling	2	2	2	2	Day, Evening, Night
	Conveyor systems	Coal handling	-	-	-	-	Day, Evening, Night
Rail							
Locomotives[3]		Train loading	8	8	8	8	Day, Evening, Night

Notes:

1. Day: 7.00 am – 6.00 pm; Evening: 6.00 pm – 10.00 pm; Night: 10.00 pm – 7.00 am.
2. Although two product coal stockpile stackers are operating at the CHPP, only one is assumed to be operating at a time.
3. Modelling assumes two trains (one at the CHPP and the other at the TCP) with four locomotives per train.

5.1.6 Equipment Sound Power Levels

Table 5-5 summarises the indicative sound power levels (SWLs) assumed for noise modelling.

Most of the nominated SWLs for mobile equipment are based on the noise assessment recently conducted for the BWM (SLR, 2023) and are consistent with RWDI's technical database.

It is noted that the SWLs do not reflect leading practice mining equipment for noise performance as the Project's mobile fleet and infrastructure would generally consist of the equipment already in use at the BWM.

Table 5-5: Indicative Equipment SWLs

Equipment	Model	SWL/Item (dBA)	SWL Reference
Mobile Equipment			
Draglines	Marion 8200	118	SLR (2023)
	Marion 8050	118	SLR (2023)
	Bucyrus Erie 1370W	118	SLR (2023)
Electric rope shovels	CAT 7495	123	SLR (2023)
	P&H 4100	123	SLR (2023)
Excavators	CAT 6040	118	SLR (2023)
	CAT 6060	125	SLR (2023)
	Liebherr 9800	126	SLR (2023)
Wheel Loaders	Komatsu WA1200	119	SLR (2023)
	Komatsu WA400	112	RWDI propriety database
Track Dozers	CAT D11	119	SLR (2023)
	CAT D10	116	SLR (2023)
Haul Trucks	Komatsu 930E	124	SLR (2023)
	CAT 793	119	SLR (2023)
	Kress 200CIII Coal Hauler	119	Kress (2016)
Drills	Drill	118	SLR (2023)
Water Carts	CAT 789	118	SLR (2023)
	CAT 785	118[1]	SLR (2023)
Graders	CAT 24M	116	SLR (2023)
	CAT 18M	113	SLR (2023)
CHPP and TCP Fixed Plant			
Coal preparation plant		120[2]	RWDI propriety database
Reclaimer		101	RWDI (2025)
Rejects bin		103[2]	RWDI propriety database
Rotary breaker/primary crusher		106	RWDI (2025)
Secondary sizing station		116[2]	RWDI propriety database

Equipment	Model	SWL/Item (dBA)	SWL Reference
Stacker		95	RWDI (2025)
Train loadout bin		108[2]	RWDI propriety database
Transfer station		110[2]	RWDI propriety database
Coal chute		98	RWDI propriety database
Conveyor systems		79/m[3]	RWDI (2025)
Rail			
Locomotive		102[4]	RWDI propriety database

Notes:

1. Conservatively based on CAT 789 water cart SWL.
2. Partly or wholly uncladded structure.
3. SWL per linear metre.
4. SWL per locomotive during loading process.

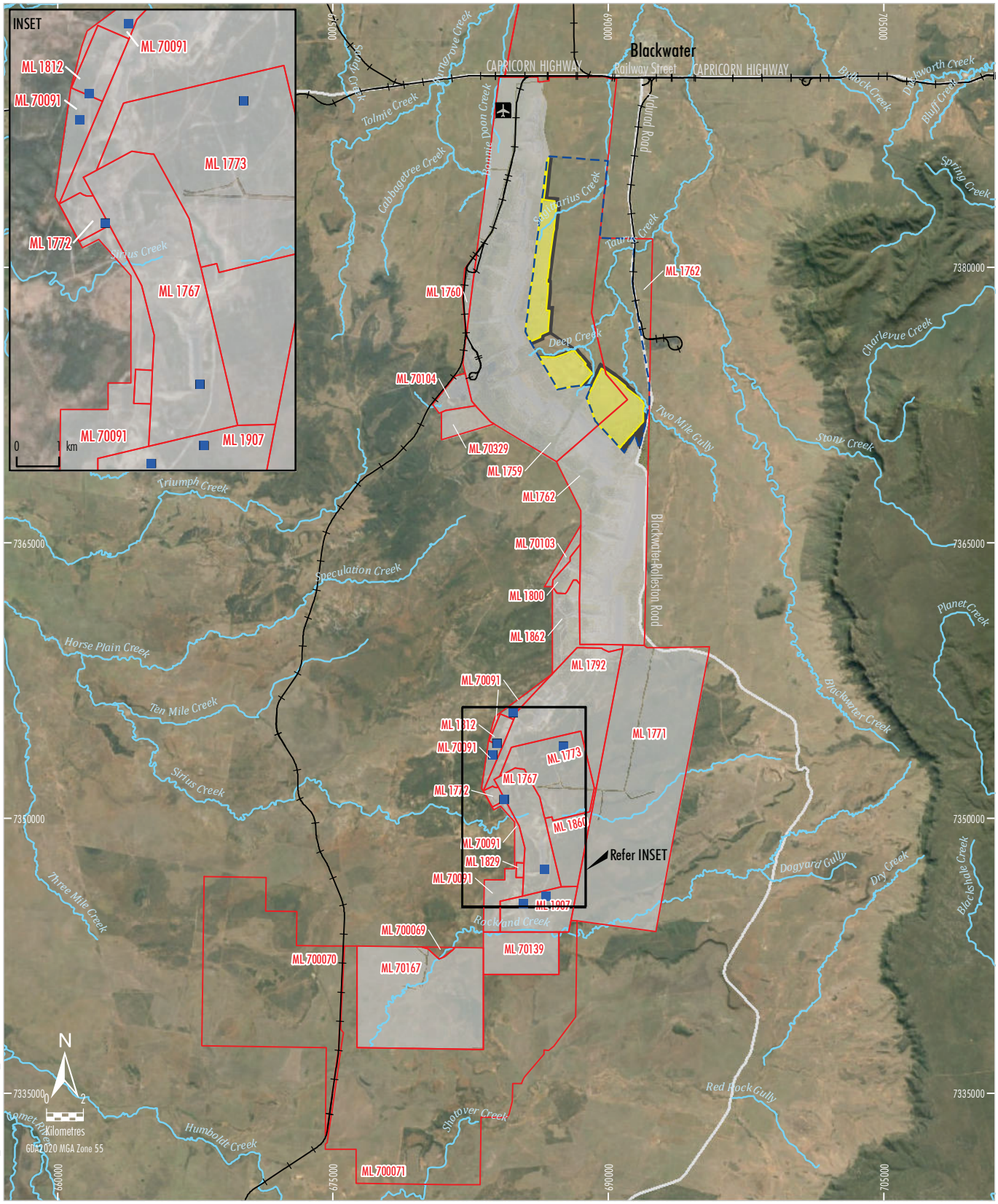
5.1.7 Quarries

It is understood that quarries would be used as part of the Project at various locations in the southern part of the BWM, in the vicinity of Laleham, Togara South and North Marshmead Pits **(Figure 5-1)**. Only one quarry would operate at any given time, with operations occurring for 12 hours per day during daytime. The equipment proposed for use at the quarries, along with their associated SWLs, are summarised in **Table 5-6**.

Table 5-6: Indicative Quarry Equipment and SWLs

Equipment	SWL/Item (dBA)	SWL Reference
100 tonne Excavator	113	RWDI (2025)
Jaw Crusher	117	RWDI (2025)
Cone Crusher	112	RWDI (2025)
Mobile Screen	109	RWDI (2025)
Trommel	109	RWDI (2025)

A sensitivity analysis was conducted and confirmed that noise generated by the quarries would not contribute to overall noise levels from the BWM at any surrounding receptors under any of the assessed scenarios. Therefore, the quarries have not been considered quantitatively in the assessment.



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Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)
Orthophoto: Esri (2025); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Airport
- Approved Disturbance Footprint
- Proposed Quarry Location

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Proposed Quarry Locations

Figure 5-1

5.2 Proactive Noise Management

5.2.1 Description of Proactive Noise Management System

A proactive noise management system that would integrate predictive meteorological forecasting with real-time noise monitoring to support day-to-day operational planning would be implemented. This system would be designed to manage noise levels during periods when meteorological conditions are likely to amplify noise, therefore reduce the risk of noise-related non-compliance.

Noise-enhancing conditions would be identified through a combination of noise and meteorological data monitoring and forecasting. Noise monitoring would highlight noise level trends at a location, while meteorological data monitoring and forecasting would indicate the likelihood that these trends would persist or intensify.

The proactive noise management system would incorporate a Trigger Action Response Plan (TARP), enabling the operator to anticipate and adjust activities before potential exceedances occur. A tiered warning system would alert when noise levels from mining operations increase and approach EA EPML00717813 noise criteria. If warning trigger thresholds are exceeded, automatic alerts monitored by the Remote Operating Centre would prompt Whitehaven Blackwater to activate the TARP. Once activated, the TARP would guide the modification of mining activities to reduce intrusive noise and prevent noise exceedances.

5.2.2 Application of Proactive Noise Management System

Following initial modelling for the Project, a risk of negligible (1 dB) night-time exceedances was identified in FY50 under noise-enhancing meteorological conditions (as defined in **Table 5-2**) at receptors R20, R21, R22 and R23 located along the Capricorn Highway north-west of the site. A similar negligible (1 dB) night-time exceedance risk was also identified at receptor R11, north-east of the Project, in FY50 and FY55. For these receptors, Whitehaven Blackwater identified appropriate proactive mitigation measures that would be applied, and implementation frequencies were investigated.

5.2.2.1 Proposed Proactive Mitigation Measures

Indicative examples of proactive measures, focusing on the worst-case scenario (FY50) and season (winter), are provided in **Table 5-7**. The table also includes estimated percentages of the night period during which each mitigation measure would be required.

It is important to note that the examples of proactive measures outlined in **Table 5-7** relate specifically to the FY50 assessment scenario. While proactive mitigation would not be required for much of the Project's life (as shown in **Table 5-8**), some years may necessitate more extensive measures with higher implementation frequencies.

Table 5-7: Indicative Examples of Proactive Mitigation Measures (FY50, Winter)

Indicative Examples of Proactive Mitigation Measures	Approximate Total Site Noise Reduction	Estimated Percentage of Night Period[1,2]
R20, R21, R22 and R23 (Capricorn Highway receptors)		
Shutdown 5 haul trucks associated with the northernmost overburden fleet	1 dB	8.6 %
Shutdown 7 haul trucks associated with the northernmost overburden fleet	2 dB	10.7 %
Shutdown 8 haul trucks associated with the northernmost overburden fleet and the northernmost drill	3 dB	4.3 %
R11 (north-east rural property)		
Shutdown 7 haul trucks associated with the most exposed overburden fleet(s)	1 dB	15.2 %
Shutdown 11 haul trucks associated with the most exposed overburden fleet(s)	2 dB	6.5 %

Notes:

1. Night = 10.00 pm – 7.00 am.
2. Frequencies are based on the night period only and not the entire 24-hour period

It should be noted that, when implementing the TARP, the proactive mitigation measures outlined in **Table 5-7** are indicative examples only, and Whitehaven Blackwater may invoke other measures to maintain compliance with EA EPML00717813 noise criteria.

5.2.2.2 Implementation Frequencies

To assess whether proactive noise controls – implemented as modifications to planned operations – are feasible without impacting the overall production schedule, the periods expected to require such mitigation have been considered.

Using statistical data on local meteorological conditions from the Blackwater Airport BoM weather station (January 2021 – December 2024), along with noise predictions, an analysis was undertaken to determine how often proactive mitigation measures would be required. **Table 5-7** presents indicative seasonal frequencies of these occurrences to maintain night-time compliance at the five identified receptors. Proactive noise mitigation would also be required during the evening period, though less frequently than at night.

Table 5-8: Indicative Proactive Mitigation Measures Implementation Frequencies

Season	Night Period[1] Implementation Frequencies[2]			
	FY30	FY32	FY50	FY55
R20, R21, R22 and R23 (Capricorn Highway receptors)				
Spring	0%	0%	11.8%	0%
Summer	0%	0%	12.6%	0%
Autumn	0%	0%	21.9%	0%
Winter	0%	0%	25.1%	0%
R11 (north-east rural property)				
Spring	0%	0%	8.5%	8.1%
Summer	0%	0%	8.1%	7.7%
Autumn	0%	0%	17.1%	15.7%
Winter	0%	0%	21.7%	20.1%
All five receptors combined				
Spring	0%	0%	15.1%	8.1%
Summer	0%	0%	15.7%	7.7%
Autumn	0%	0%	27.6%	15.7%
Winter	0%	0%	32.1%	20.1%

Notes:

1. Night = 10.00 pm – 7.00 am.
2. Frequencies are based on the night period only and not the entire 24-hour period.

As shown in **Table 5-7**, proactive mitigation for the Capricorn Highway receptors would only be triggered in FY50. However, this only considers the four noise assessment scenarios. Analysis of individual noise source contributions in FY50 indicates that receptors R20 to R23 are predominantly influenced by the northernmost overburden fleet (aligned with the northern boundary of the study area). This suggests that proactive mitigation for the Capricorn Highway receptors is likely to be required in any year with substantial pit activity occurring in the northernmost area, rather than only in FY50. Conversely, proactive mitigation is generally not expected to be necessary in years when all substantial pit activities occur further south.

It is noted that pits at the north would not extend into the proposed extension areas within SA 7 and SA 10, and all pit activities in this northern area would remain within the approved disturbance footprint for the entire life of the Project.

For receptor R11, **Table 5-7** shows that proactive mitigation would be required under the FY50 and FY55 scenarios. Analysis of noise contributions suggests that it is more likely proactive mitigation would be required when a substantial number of relatively exposed overburden fleets (i.e. four or more) operate between Deep Creek Pit and Bonnie Doon Pit during the later years of the Project, when mining progresses into the proposed extension areas and closer to R11.

The proactive mitigation frequencies for the Capricorn Highway receptors (upper rows in **Table 5-7**) and for R11 (middle rows) should not be considered cumulatively, as some meteorological conditions that trigger mitigation are common between receptors (e.g. stability categories F and G with southerly wind component). The cumulative mitigation frequencies to maintain night-time compliance across all five identified receptors are presented in the lower rows of **Table 5-7**.

Whitehaven Blackwater has confirmed that the projected implementation frequencies are feasible and can be integrated into operational planning without affecting the Project schedule. The operational noise predictions are presented in **Appendix D** and discussed in **Section 5.3,** with assuming the implementation of proactive noise mitigation measures for receptor R11 in the north-east, and receptors R20, R21, R22 and R23 along the Capricorn Highway. In addition, the unmitigated operational noise predictions for these receptors are presented in **Appendix E**.

5.3 Operational Noise Predictions & Discussion

Operational $L_{Aeq,15min}$ noise predictions for all four noise assessment scenarios are presented in **Appendix D**. For each prediction, the noise level represents the assessment meteorological condition (**Section 5.1.3.3**) producing the maximum predicted value. Non-sensitive mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

As described in **Section 5.2.2**, night-time noise emissions would be proactively managed to ensure compliance is achieved at receptor R11 in the north-east, and receptors R20, R21, R22 and R23 along the Capricorn Highway north-west of the site. The results presented in **Appendix D** present unmitigated noise levels, except for the Capricorn Highway receptors in FY50, and receptor R11 in FY50 and FY55, where night-time predictions include proactive mitigation.

Results indicate that noise predictions would meet EA EPML00717813 noise criteria for most of the noise-sensitive receptors. However, residual noise exceedances are found at 11 noise-sensitive receptors, including eight privately-owned receptors, as summarised in **Table 5-9**. It is understood that Whitehaven Blackwater would enter commercial noise agreements (i.e. “Alternative Arrangements” under EA EPML00717813) with these noise-sensitive receptors which may experience noise exceedances.

Figures illustrating indicative day, evening and night noise contours of EA EPML00717813 noise criteria are included in **Appendix F**. These contours represent noise levels without proactive mitigation, except in the north-east (near receptor R11) where proactive noise controls have been applied for the FY50 and FY55 night scenarios, and in the north-west (near R20, R21, R22, and R23), where proactive mitigation has been applied for the FY50 night scenario. Note that the contours are based on interpolation, and therefore **Appendix D** should be consulted for results at modelled receptors.

Table 5-9: Residual $L_{Aeq,15min}$ Noise Exceedances

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (dBA)												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-Owned Residential Receptors													
R03	35	36	42	28	29	38	35	35	43	34	34	43	40/40/40
R04	35	35	42	28	29	38	34	34	42	33	33	43	40/40/40
R05	48	48	52	41	42	47	47	47	48	47	47	48	40/40/40
R06	41	41	46	33	34	42	40	40	45	40	40	44	40/40/40
R07	31	32	38	27	28	34	31	31	42	30	30	41	40/40/40
R13	33	34	38	34	34	38	38	39	43	36	37	42	40/40/40
R17	42	43	49	42	43	48	50	51	55	50	50	56	40/40/40
R19	37	38	43	38	39	44	35	35	42	34	35	42	40/40/40
Industrial Receptors													
R14	39	39	44	38	38	43	43	43	48	40	41	46	40/40/40
R46	44	45	50	44	44	51	35	35	43	43	43	48	40/40/40
R48	34	35	39	32	32	36	40	40	44	38	39	43	40/40/40

Note:

1. Noise exceedances highlighted in red.

To quantify residual noise exceedance levels, affected receptors have been classified into three exceedance categories, based on the maximum noise impact observed across all time periods and assessment scenarios. The categories are defined as follows:

- Negligible: 1-2 dB above EA EPML00717813 noise criteria.
- Marginal: 3-5 dB above EA EPML00717813 noise criteria.
- Significant: >5 dB above EA EPML00717813 noise criteria.

Table 5-10 provides a summary of the residual noise exceedance levels for the eight privately-owned receptors predicted to experience exceedances.

Table 5-10: Residual Noise Exceedance Levels at Privately-owned Receptors

Exceedance Category	Number of Receptors	Receptor IDs
Negligible (1-2 dB)	1	R07
Marginal (3-5 dB)	4	R03, R04, R13, R19
Significant (>5 dB)	3	R05, R06, R17

In addition, there are three non-sensitive industrial receptors that would potentially experience residual noise exceedances. These non-sensitive industrial receptors are Cook Colliery and associated rail loading facility (R14 and R46), as well as a resource recovery centre (R48). It is noted that the Cook Colliery and associated rail loading facility have temporarily ceased operations.

5.4 Night-time Maximum Noise Level Event Assessment

Night-time maximum noise level events associated with the Project and with the potential to cause sleep disturbance were considered in the assessment. The night-time maximum noise level event assessment was based on EA EPML00717813 $L_{A1,15min}$ noise criterion (**Table 4-1**).

5.4.1 Assumptions and Methodology

The night-time maximum noise level event SWLs adopted for the assessment are summarised in **Table 5-11**. Because no site-specific measurements were available, the assessment adopted highly conservative SWLs for impact noise generated by mobile equipment. For fixed infrastructure impact noise, the SWL reflects the upper end of the typical L_{AFmax} SWL range from comparable sites. It is noted that that $L_{A1,15min}$ SWLs are expected to be lower than L_{AFmax} SWLs; however, $L_{A1,15min}$ SWLs were conservatively assumed to be equivalent to L_{AFmax} SWLs for assessment purposes. As a result, it is expected that actual night-time maximum noise level events from the Project would a lot of the times have lower SWLs.

Table 5-11: Night-time Maximum Noise Level Event Sources and SWLs

Night-time Maximum Noise Level Event Sources	L_{AFmax} SWL[1] (dBA)
Impact noise associated with mobile equipment (draglines, electric rope shovels, excavators, track dozers, wheel loaders and haul trucks)	128
Fixed infrastructure impact noise	125

Notes:

1. $L_{A1,15min}$ SWLs were conservatively assumed to be equivalent to L_{AFmax} SWLs for assessment purposes.

The $L_{A1,15min}$ noise assessment applied the same night-time noise-enhancing meteorological conditions (**Section 5.1.3.3**) and scenario assumptions (**Section 5.1.4**) used for the $L_{Aeq,15min}$ operational noise assessment.

All potential night-time maximum noise level events were modelled in the ENM, with only the highest predicted $L_{A1,15min}$ level considered for each receptor. Because these night-time maximum noise level events would occur during ongoing operations, the highest $L_{A1,15min}$ level was added to the corresponding $L_{Aeq,15min}$ operational noise level (**Appendix D**) prior to comparison with EA EPML00717813 $L_{A1,15min}$ criterion. This approach may be conservative in some instances, as predicted $L_{Aeq,15min}$ noise emissions and night-time maximum noise level events may reflect different controlling meteorological conditions unlikely to occur simultaneously.

5.4.2 Maximum Noise Level Event Predictions & Discussion

Night-time $L_{A1,15min}$ noise predictions are presented in **Appendix G**. Non-sensitive mine-owned receptors and privately-owned receptors currently under agreements are included for information only.

Noise results indicate that night-time $L_{A1,15min}$ noise levels would comply with EA EPML00717813 $L_{A1,15min}$ criterion for most noise-sensitive receptors with applicable noise criteria (47 out of 52 receptors). However, residual $L_{A1,15min}$ exceedances are found at five noise-sensitive receptors, including three privately-owned receptors, as summarised in **Table 5-12**. These receptors were also identified as exceeding EA EPML00717813 $L_{Aeq,15min}$ criterion (**Section 5.2.2.2**) and are expected to enter commercial noise agreements with Whitehaven Blackwater (i.e. "Alternative Arrangements" under EA EPML00717813).

It is noted that the two non-sensitive industrial receptors – Cook Colliery and associated rail loading facility – have temporarily ceased operations and, by their nature, are not sensitive to sleep disturbance (i.e. they are workplaces rather than residences).

Table 5-12: Residual $L_{A1,15min}$ Noise Exceedances

Rec ID	$L_{A1,15min}$ Night-time Maximum Noise Predictions (dBA)				BWM EA $L_{A1,15min}$ Noise Criteria (dBA)
	FY30	FY32	FY50	FY55	
Privately-Owned Residential Receptors					
R05	56	50	52	52	45
R06	48	45	47	46	45
R17	50	49	56	57	45
Industrial Receptors					
R14	44	44	48	47	45
R46	51	56	44	51	45

Note:
1. Noise exceedances highlighted in red.

Results indicate that $L_{A1,15min}$ noise levels would typically emerge over predicted $L_{Aeq,15min}$ operational noise levels by 1-4 dB at most receptor locations. This is consistent with RWDI's experience from attended monitoring around open cut coal mines and is largely attributable to the high overall site SWLs.

5.5 Low-frequency Noise Assessment

An assessment was conducted to evaluate the likelihood that LFN from the Project may potentially be perceived by the community and cause annoyance.

5.5.1 Representative Receptors

For practical reasons, the LFN assessment was conducted on a selection of key privately-owned residential receptors deemed representative of various zones with similar expected LFN content.

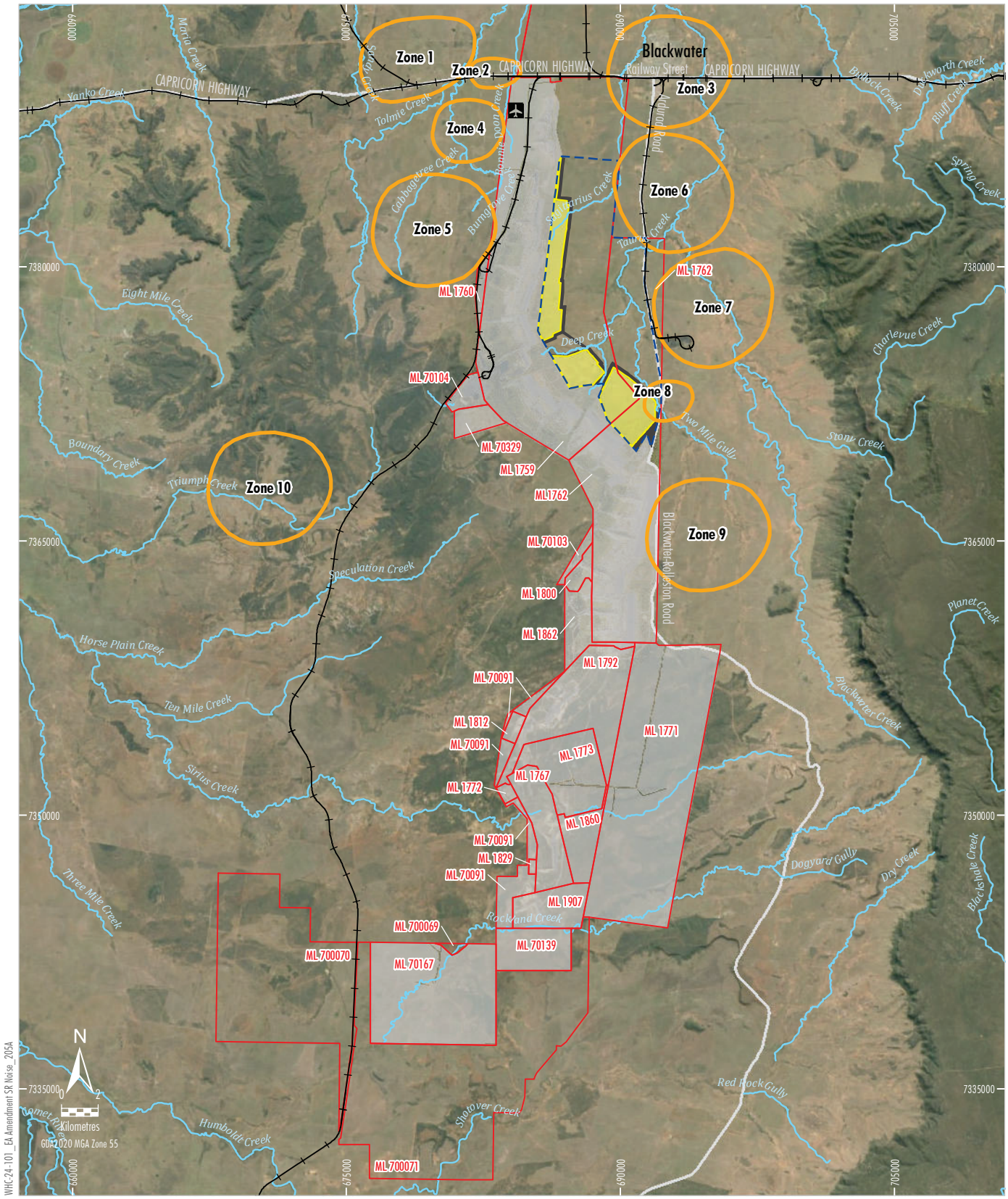
Figure 5-2 shows the location of the LFN zones. Representative receptors are included in **Table 5-13**.

The criteria used for the LFN assessment (**Table 4-2**) include the difference between C-weighted and A-weighted levels to identify the potential for an unbalanced spectrum. As noise with unbalanced spectra do not necessarily occur at the closest and most impacted receptor, receptors located further away from the Mine were also included.

Table 5-13: LFN Zones & Representative Receptors

LFN Zone	Representative Receptors	Bearing from Site
1	R40	North-west
2	R22	North-northwest
3	R53	North-east
4	R07	West

LFN Zone	Representative Receptors	Bearing from Site
5	R06	West
6	R11	East
7	R13	East
8	R17	East
9	R19	East
10	R43	West



WHC-24-101_EA Amendment SR Noise_205A

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)
Orthophoto: Esri (2025); Whitehaven (2025)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Airport
- Approved Disturbance Footprint
- LFN Zones

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

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LFN Zones

Figure 5-2

5.5.2 Low-frequency Noise Results

LFN predictions, assessed against the relevant criteria (**Table 4-2**), are summarised in **Table 5-14**. The assessment has focused on the night period where potential LFN issues are expected to be most significant due to noise-enhancing meteorological conditions. Exceedances are shown in red.

Table 5-14: LFN Results (Night)

LFN Zones	LFN Predictions (dBC)[1]				dBC – dBA[1]			
	FY30	FY32	FY50	FY55	FY30	FY32	FY50	FY55
1	50	48	53	52	18.8	20.0	17.2	17.9
2	51	49	56	54	17.7	19.0	15.5	16.5
3	47	44	51	50	16.2	17.2	15.1	16.5
4	54	52	57	56	16.6	18.5	15.8	16.3
5	60	58	60	60	14.6	16.4	15.3	15.5
6	52	50	56	56	15.6	15.8	15.5	15.7
7	53	52	57	57	15.1	15.4	14.8	15.2
8	62	61	67	68	13.2	13.6	12.5	12.0
9	58	58	58	58	15.1	13.7	16.5	16.3
10	40	40	44	44	16.4	16.9	17.6	17.3

Note:

1. The *Guideline - Streamlined model conditions for petroleum activities* is based on noise levels within the range 10 to 630 Hz.

Assessment against the *Guideline – Streamlined model conditions for petroleum activities* LFN outdoor criteria shows compliance at all zones. While Zone 8 is predicted to experience LFN above 60 dBC, the difference between the external C-weighted and A-weighted noise level is expected to remain below 20 dB, therefore demonstrating compliance.

In conclusion, the LFN assessment results suggest that the Project is unlikely to generate LFN that could be perceived by the community and cause annoyance. It is understood that Whitehaven Blackwater would conduct monitoring and implement appropriate measures should any LFN impacts be experienced by the community.

5.6 Cumulative Noise Assessment

The EPP (Noise) requires that, to the extent it is reasonable to do so, noise must be managed to prevent or minimise 'background creep'. This term refers to the gradual increase in the overall background noise level in an area, as measured and quantified under the NMM. The policy's explanatory notes (QLD Government, 2019) state that the aim is to ensure background noise does not steadily increase over time to a level that becomes unreasonable for the area.

To minimise background creep in the areas surrounding the Project, the assessment has considered cumulative noise from the Project and nearby industries, and assessed it against the (site-specific) EA EPML00717813 noise criteria. This approach would ensure background noise from all industrial operations (including the Project) is not deemed unreasonable for the area as it does not exceed the levels permitted for the approved BWM operations.

5.6.1 Nearby Industrial Operations

The Curragh Mine Complex, including the Curragh Coal Mine and Mammoth Underground Mine, located approximately 6 km north of Blackwater, was identified as the only nearby industrial operation with the potential to contribute to cumulative noise levels in the areas surrounding the Project.

While the Cook Colliery (R46) and its associated rail loading facility (R14) were included in the assessment as receptors, they have temporarily ceased operations in November 2025, and therefore were not considered as noise sources in the cumulative noise assessment. Similarly, the nearby quarry (R49) and the resource recovery centre (R48) were assessed as receptors but not treated as industrial noise sources for the cumulative assessment, as their noise emissions are not expected to affect nearby receptors.

5.6.2 Cumulative Noise Predictions

Noise impact assessments associated with the existing and future Curragh Mine Complex operations were not publicly available at the time this report was prepared. As such, the cumulative assessment relied on the consolidated Curragh Mine Complex EA EPML00643713.

In the absence of noise predictions, Curragh Mine Complex noise was conservatively assumed to just comply with the Curragh Mine Complex EA EPML00643713 noise criteria at the closest and most exposed receptors to the Curragh Mine Complex along the northern boundary of Blackwater, namely receptors R52, R56 and R59. To estimate Curragh Mine Complex noise levels at receptors closer to the BWM site, the levels at R52, R56, and R59 were adjusted to reflect the additional distance between those north Blackwater receptors and the other receptors further south.

For the cumulative assessment, the Curragh Mine Complex noise levels (adjusted where necessary) were added to the Project noise levels, based on the maximum impacts observed across all assessment scenarios. **Table 5-15** presents the resulting cumulative noise levels for receptors in areas most likely to experience cumulative impacts.

Table 5-15: Cumulative Noise Predictions

Receptor Area	$L_{Aeq,15min}$ Noise Predictions (dBA)									BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	Project[1]			Curragh Mine Complex			Cumulative			
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	
North Blackwater[2]	31-32	32-33	35-36	42	42	37	42	42-43	39	40
South-west Blackwater[3]	35	36	39	36[5]	36[5]	31[5]	39	39	40	40

Receptor Area	$L_{Aeq,15min}$ Noise Predictions (dBA)									BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	Project[1]			Curragh Mine Complex			Cumulative			
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	
Capricorn Highway North-west of BWM[4]	30	30	40[6]	31[5]	31[5]	26[5]	33	34	40[6]	40

Notes:

1. Project noise levels based on the maximum noise impact observed across all assessment scenarios.
2. North Blackwater represented by receptors R52, R56 and R59.
3. South-west Blackwater represented by receptor R54.
4. Capricorn Highway north-west of the BWM represented by receptor R20.
5. Level estimated from Curragh Mine Complex noise contribution at receptors in north Blackwater, by applying conservative corrections for additional geometrical spreading, air absorption and ground effects.
6. Noise level incorporates proactive noise mitigation measures.
7. Noise exceedances highlighted in red.

As shown in **Table 5-15**, cumulative noise levels in north Blackwater may exceed EA EPML00717813 noise criteria during the day and evening periods. At these receptors, exceedances would already occur due to noise from the Curragh Mine Complex, and the Project's contribution – which is significantly lower than that of the Curragh Mine Complex – would have a negligible influence on overall cumulative levels and is not expected to contribute to background creep.

It is noted that cumulative exceedances of EA EPML00717813 noise criteria are based on the assumption that daytime and evening Curragh Mine Complex noise emissions are higher than at night. In practice (and assuming Curragh Mine Complex activities would remain consistent over the 24-hour period), this is unlikely, as night-time conditions typically enhance noise propagation and result in higher noise levels.

In south-west Blackwater and along the Capricorn Highway (north-west of the BWM), cumulative noise levels are expected to comply with EA EPML00717813 noise criteria, noting that this assumes the implementation of proactive noise mitigation for the Capricorn Highway receptors. Preliminary analysis of cumulative noise at other nearby receptors indicates that compliance would also be achieved at all other surrounding locations, including receptors in central Blackwater and rural properties along Oliffe Road.

As the Project and nearby industries would generally comply with the site-specific EA EPML00717813 noise criteria, it is possible to conclude that the Project would therefore not result in unreasonable background noise levels for the area.

6 ROAD TRAFFIC NOISE

The Project does not involve any increase in the annual ROM coal production rate, and peak operational workforce numbers would generally remain consistent with the currently approved BWM operations. It is also expected that the number of deliveries and contractors accessing the site would remain generally unchanged.

While construction activities associated with the Project would require some additional personnel, the small number of workers involved and the relatively short construction periods mean that any increase in road traffic noise would be negligible when compared with traffic noise from the approved operations and existing baseline traffic levels.

Given these considerations, further assessment of road traffic noise associated with the Project was not considered necessary, and is therefore not discussed further.

7 RAIL TRANSPORTATION NOISE

The Project does not propose any changes to the currently approved BWM coal transport rate. As with existing operations, peak coal production would generate an annual daily average of five to six laden trains to the CHPP, and an annual weekly average of two to three laden trains to the TCP.

Accordingly, an assessment of rail transportation noise associated with the Project along the rail network was not considered necessary and is not discussed further in this assessment.

8 BLASTING ASSESSMENT

8.1 Introduction

Blasting for the Project would continue in line with current practices at the BWM, occurring approximately one to three times per week. Blasts are used to break overburden and interburden, including through-seam blasting when required, typically at depths between 6 m and 65 m. Depending on operational needs, blasting may take place on any day of the week during daylight hours. The primary explosive used is ammonium nitrate-fuel oil (ANFO), which is the most commonly used blasting agent in the Queensland mining industry.

An assessment was conducted to evaluate potential impacts from blasting activities within the proposed open-cut extension area on nearby receptors and public infrastructure (including roadways, railways, water pipelines and electricity transmission lines).

8.2 Blast Impact Assessment Criteria

Under EA EPML00717813, blasting activities must comply with the vibration and airblast overpressure criteria outlined in Tables C2 and C3 of EA EPML00717813 (summarised in **Table 8-1)**. According to Conditions C5 and C7, those criteria must be achieved at all surrounding sensitive and commercial places (refer to **Section 3** for definitions) so as not to cause any environmental noise nuisance.

The criteria summarised in **Table 8-1** are adopted as human comfort noise and vibration criteria for all identified receptors, with the exception of non-sensitive receptors. It is noted that EA EPML00717813 blast criteria are more stringent than the building damage criteria; therefore, achieving compliance with the human comfort criteria would ensure compliance with the building damage criteria.

Table 8-1: EA EPML00717813 Blast Criteria

Receptors	Parameter	Blast Criteria
All receptors (except non-sensitive receptors)	Ground vibration	5 millimetres per second (mm/s) peak particle velocity[1] (PPV) for nine out of ten consecutive blasts and not greater than 10 mm/s PPV at any time
	Airblast overpressure	115 dBL Peak (dB [Linear peak]) for nine out of ten consecutive blasts and not greater than 120 dBL Peak at any time

Note:

1. PPV corresponds with vector peak particle velocity (VPPV) as per the *Guideline – Noise and Vibration from Blasting* (DES, 2022) .

8.3 Prediction of Airblast Overpressure and Ground Vibration Levels

Airblast overpressure and ground vibration levels from blasting are related to the "scaled distance" from the blast, which is defined as:

- Scaled distance $= \frac{D}{W^{1/3}}$ for airblast overpressure; and
- Scaled distance $= \frac{D}{W^{1/2}}$ for ground vibration,

where D is the distance from the blast in m and W is the maximum instantaneous charge (MIC) of explosive in kilograms (kg) of ANFO equivalent.

Predictive curves relating scaled distance to overpressure and ground vibration levels were developed using blast monitoring data collected across multiple sites, typically at distances between 2 km and 7 km. RWDI has used data from over 7,600 blast records from operations in the Hunter Valley, NSW, to derive these relationships. Those predictive curves allow for the prediction of not the mean level of overpressure or vibration, as in a standard "site law" or Australian Standard (AS) 2187.2, but the 95th percentile value, representing the level which would be exceeded by only 5% of blasts, given the inherent variability in overpressure or vibration for the same scaled distance. It is also noted that the predictive curves have shown general consistency with monitoring records at various sites across Australia.

The underlying datasets, together with the derived prediction curves (valid for distances up to 10 km), are presented in **Appendix I**.

For airblast overpressure, the data is best represented by a curvilinear relationship with the logarithm of scaled distance:

- Overpressure (dB) = 201.1 – 62.313 log(SD) + 10.79 (log[SD])^2

where SD is the scaled distance for overpressure.

For ground vibration, the relationship was found to be linear when expressed in terms of the logarithm of PPV:

- Log(PPV) = 3.015 - 1.4359 log(SD)

where SD is the scaled distance for vibration.

These equations were applied to predict airblast overpressure and ground vibration levels for the blasting assessment.

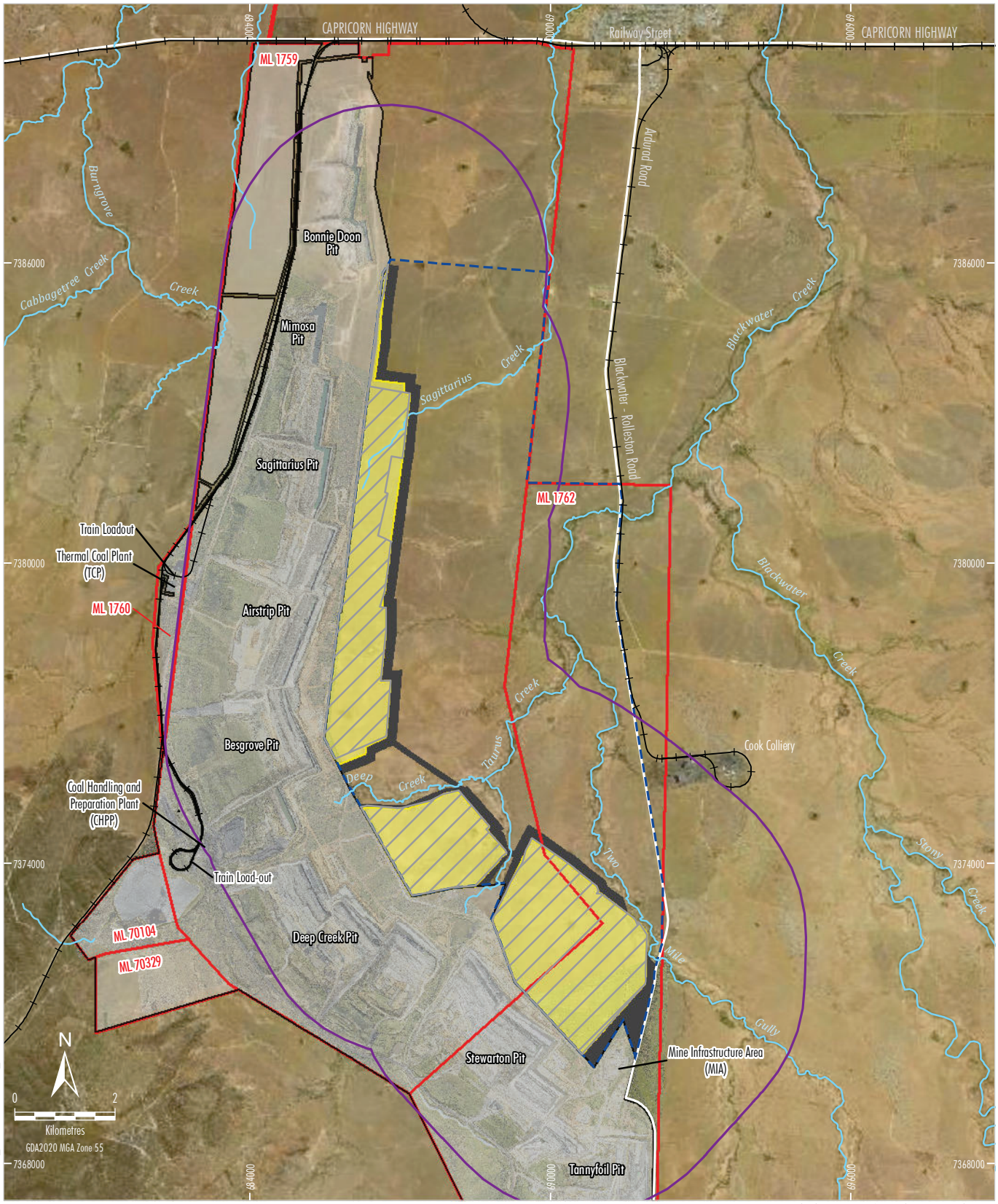
8.4 Blasting Minimum Compliance Distances

Blast design parameters and shot sizes would vary throughout the life of the Project, influenced by factors such as blast application, coal seam depth, and open-cut bench configuration. Assuming that any blast size may be required within the proposed blasting areas, minimum offset distances to achieve compliance were established for three representative blast types. The assessment adopted MICs consistent with the upper range of those typical used at the BWM:

- pre-split blast: MIC of 550 kg;
- coal blast: MIC of 1,000 kg; and
- production blast: MIC of 4,500 kg.

Compliance distances, relative to the proposed blasting areas, are provided in **Table 8-2**.

Figure 8-1 shows the proposed blasting areas and the minimum compliance distances for large production blasts at the BWM (4,500 kg MIC). For receptors, the minimum compliance distances are based on the controlling criterion, namely the human comfort airblast overpressure criterion.



LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Approved Disturbance Footprint
- Proposed Blasting Areas
- Minimum Compliance Distances (MIC 4500kg)
- Receptors

Project Components[1]

- Study Area
- Proposed Open Cut Extension
- Proposed Infrastructure Area

Note: [1] Excludes some ancillary Project components such as water management, access tracks, topsoil stockpiles, power supply, temporary offices, and other ancillary works and construction disturbance.

Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2025)
Orthophoto: Queensland Department of Resources (2017); Whitehaven (2025)

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Minimum Compliance Distances for Large Production Blasts (4,500 kg MIC)

Figure 8-1

Table 8-2: Blasting Minimum Compliance Distances

Receptors	Parameter	Blasting Criteria	Required Distance to Comply (m)		
			550 kg MIC	1,000 kg MIC	4,500 kg MIC
Human Comfort					
All receptors (except non-sensitive receptors)	Ground vibration	5 mm/s VPPV	962	1,297	2,752
	Airblast overpressure	115 dBL (Peak)	1,580	1,929	3,184

8.5 Discussion

Most receptors are located outside the minimum compliance distances identified in **Table 8-2**; however, receptor R17, situated approximately 630 m from the proposed blasting areas, lies within the minimum compliance distance for all three blast types. To achieve compliance at R17, the MIC for blasts at the closest point within the Stewarton Pit blasting area would likely need to be limited to 35 kg.

For other pits within the proposed blasting areas, typical blasting activities are expected to comply with receptor criteria without restrictions. However, it is anticipated that MIC limitations may be necessary should very large production blasts exceeding 7,300 kg MIC be used at Deep Creek Pit.

Notwithstanding the above, based on blast management practices currently implemented at the BWM, it is expected that airblast overpressure and ground vibration from the Project can be effectively controlled to meet all blasting criteria and minimise the risk of significant impacts at surrounding receptors.

9 CONCLUSION

This assessment has evaluated the potential noise and blasting impacts associated with the Project against EA EPML00717813 and with reference to the relevant Queensland legislation and guidelines.

The key findings are summarised below:

- The operational noise assessment has indicated that the majority of surrounding noise-sensitive receptors would comply with EA EPML00717813 $L_{Aeq,15min}$ noise criteria under all assessed scenarios. Residual exceedances were identified at 11 receptors, including eight privately-owned receptors and three non-sensitive industrial receptors; however, these receptors are expected to be subject to commercial noise agreements with Whitehaven Blackwater (i.e. "Alternative Arrangements" under EA EPML00717813).
- The assessment has assumed a proactive noise management system – including predictive meteorological forecasting, real-time noise monitoring, and a TARP – would be implemented to maintain ongoing compliance at receptors along the Capricorn Highway north-west of the site, and at receptor R11 to the north-east of the site. Analysis of implementation frequencies has confirmed that these proactive measures are feasible and can be integrated into operational planning without affecting the Project schedule.
- The assessment of night-time maximum noise level events has predicted compliance at all but five receptors, including three privately-owned receptors and two non-sensitive industrial receptors. These receptors are among the receptors subject to $L_{Aeq,15min}$ operational noise exceedances, and are expected to enter commercial noise agreements with Whitehaven Blackwater (i.e. "Alternative Arrangements" under EA EPML00717813).
- The LFN assessment results suggest that the Project is unlikely to generate LFN that could be perceived by the community and cause annoyance.
- The cumulative noise assessment has confirmed that the Project together with nearby industries would generally comply with the site-specific EA EPML00717813 noise criteria, indicating the Project would not lead to unreasonable background noise levels in the area. It is noted that day and evening exceedances are expected in north of Blackwater under conservative assumptions. Such exceedances are attributable to existing Curragh Mine Complex noise contributions, with the Project's contribution being generally negligible and not materially influencing cumulative levels.
- Given that the Project does not involve any increase in public road traffic or rail movements, additional impacts from road traffic and rail transportation noise are not expected and did not warrant further assessment.
- The blasting assessment has indicated that localised MIC restrictions would be required at Stewarton Pit to maintain compliance at receptor R17. Based on current blast management practices at the BWM, it is expected that airblast overpressure and ground vibration from the Project can be effectively controlled to meet all blasting criteria and minimise the risk of significant impacts at surrounding receptors.

10 STATEMENT OF LIMITATIONS

This report entitled *Blackwater North Extension Project – Noise and Blasting Assessment*, dated 1 April 2026, was prepared by RWDI Australia Pty Ltd ("RWDI") for Whitehaven Coal Limited ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilise the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

11 REFERENCES

Department of Environment and Heritage Protection (2016) *Ecoaccess Guideline - Planning for Noise Control Guideline*

Department of Environment and Science (2020) *Noise Measurement Manual*

Department of Environment and Science (2022) *Guideline – Noise and Vibration from Blasting*

Department of Environment, Science and Innovation (2024) *Guideline - Streamlined model conditions for petroleum activities*

Department of Environment, Science and Innovation (2025) *Guideline – Application requirements for activities with noise impacts*

EMM Consulting Pty Ltd (2021) *B180329_R5_Northern baseline noise levels_v.01*

Environmental Protection Agency (2004) *Ecoaccess Guideline for the Assessment of Low Frequency Noise*

NSW Environment Protection Authority (2017) *Noise Policy for Industry*

QLD Government (2019) *Environmental Protection (Noise) Policy 2019 – Explanatory notes for SL 2019 No. 154*

RWDI (2025) *Maules Creek Coal Mine Continuation Project – Noise and Blasting Assessment*

SLR Consulting Australia Pty Ltd (2023) *Blackwater Mine – North Extension Project – Noise and Vibration Impact Assessment*

Wilkinson Murray Pty Limited (2016) *Bulga Village Noise Audit – Final Report*

APPENDIX A

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

L_{AFmax} – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The noise level which is exceeded for 1 percent (%) of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

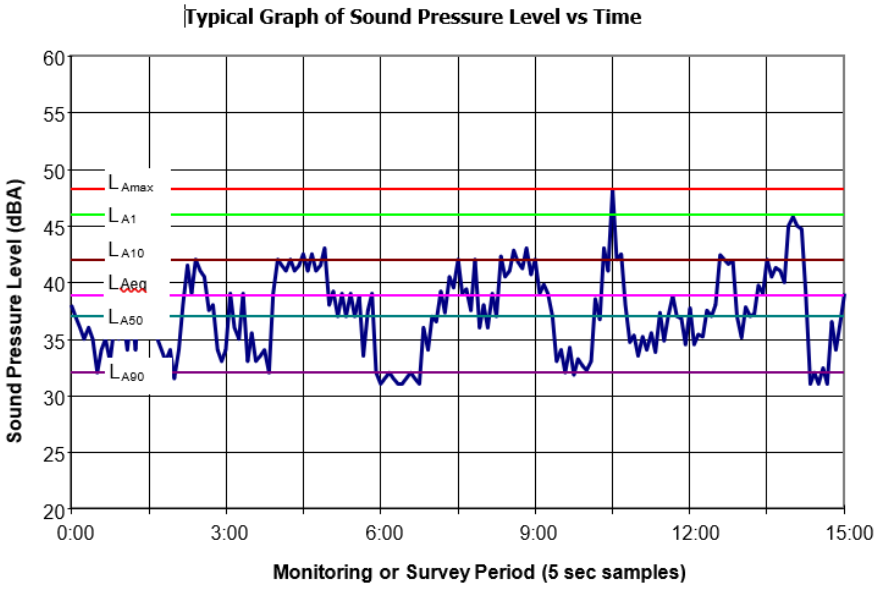
L_{A10} – The noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

L_{A90} – The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (day, evening and night) for each day. It is determined by calculating the 10th percentile (lowest 10%) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is, therefore, a RBL value for each period – day, evening and night.



APPENDIX B

LAND OWNERSHIP DETAILS

Table B-1: Privately-owned Residential Receptors

Rec ID	Landholder	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Privately-owned Residential Receptors			
R03	Tolmies Creek Homestead (HS)	680506	7383036
R04	Tolmies Creek HS	680046	7382848
R05	Ausbute HS	682295	7381314
R06	-	681271	7381884
R07	Burngrove HS	682199	7387165
R09	Minyango HS	692174	7388618
R10	Cardona HS	695420	7391637
R11	Tantallon HS	693741	7382883
R13	Yarrawonga HS	695598	7377492
R17	Retreat HS	692554	7372690
R19	Tannyfoil HS	696492	7366393
R20	-	683854	7390585
R21	-	683725	7390717
R22	-	683471	7390656
R23	-	683386	7390637
R24	-	683088	7390869
R25	-	682852	7390613
R26	-	682776	7390604
R27	-	682564	7390721
R28	-	682268	7390548
R29	-	682136	7390744
R30	Tulloch Ard HS	680696	7391034
R31	-	680210	7390623
R32	Maryvale HS	677776	7389581
R33	Malamy HS	679048	7391412
R34	Malamy HS	679029	7391655
R35	Sherborne HS	678311	7391482
R36	-	678413	7392228
R37	-	678517	7392258
R39	-	681182	7392608
R40	-	679512	7391279
R41	-	681184	7392609
R42	Monash HS	669266	7367221

Rec ID	Landholder	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Privately-owned Residential Receptors			
R43	-	670323	7368118
R52	Generic Blackwater Town - North	692157	7392658
R53	Generic Blackwater Town - Centre	692206	7391333
R54	Generic Blackwater Town – South-west	690784	7390455
R55	Generic Blackwater Town - East	693500	7391743
R56	Generic Blackwater Town – North-west	691688	7392501

Table B-2: Other Receptor Types

Rec ID	Description	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Other Receptor Types			
R57	Blackwater Hospital	691683	7391888
R58	Medical centre	692697	7391586
R59	Blackwater North State School	692620	7392600
R60	Blackwater State High School	692235	7391939
R61	Blackwater State School	691617	7390472
R62	C&K Childcare Centre	691330	7391139
R47	Blackwater Lawn Cemetery	691633	7386604
R63	Camp Accommodation	692964	7390493

Table B-3: Non-sensitive Receptors

Rec ID	Landholder	Coordinates (GDA 2020 / MGA zone 55)	
		Easting	Northing
Mine-owned Receptors			
R01	Whitehaven Coal Limited (Whitehaven)	682332	7383198
R02	Whitehaven	683118	7383184
R12	Whitehaven	690992	7380267
R50	Blackwater Mine (BWM) Airport	684514	7388628
R51	BWM Airport caretaker	684398	7388526
Privately-owned Receptors Currently Under Agreements			
R15	Taurus HS	688762	7374534
R16	Stewerton HS	691913	7373114
Commercial/Industrial Receptors			
R14	Qcoal (Cook Colliery - north)	693576	7375833
R46	Qcoal (Cook Colliery - south)	692423	7363643
R48	Resource recovery centre	691184	7385223
R49	Quarry	677837	7382368
R64	Blackwater Water Treatment Plant	691286	7389259

APPENDIX C

METEOROLOGY

C.1 Assessment of Gradient Winds

For each season and assessment period (i.e. day, evening, night), the following process was followed:

1. Convert sigma-theta observations from raw data into Pasquill-Gifford (PG) stability categories using the sigma-theta methodology prescribed in the *Noise Policy for Industry* (NPfI) (New South Wales Environment Protection Authority, 2017). We assumed a surface roughness of 0.1 metres (m).
2. Cull out any data with PG stability category other than A, B, C or D and winds greater than 3 metres per second (m/s) (where winds are rounded to one decimal place).
3. Group all wind directions into a 16-direction wind compass (22.5 degree (°) angle per direction), with North ranging 348.75° – 11.25°.
4. For each of the above 16 directions, add the four closest directions (2 x 22.5° arcs on either side) to generate 16 totals (112.5° angle per direction).
5. Divide the number of entries in each of the 16 totals over base data (for each season and assessment period individually) to establish a percentage of occurrence.
6. Assess percentage of occurrence against occurrence threshold of 30%. If a source-to-receptor wind is found to occur for 30% or more (rounded to one decimal place), a 3 m/s light wind in the direction in question is considered a feature of the area.

Table C-1 summarises percentages of occurrence for the worst-case seasons, noting the frequencies are conservative in that they consider all winds within a 112.5° angle. Results indicate that all winds up to 3 m/s are below the 30% threshold and are thus not considered a feature of the area.

Table C-1: Frequencies of Occurrence – Gradient Winds

Wind Direction	Day	Evening	Night
N	10.3%	1.7%	3.1%
NNE	11.6%	2.9%	6.3%
NE	12.1%	4.1%	8.1%
ENE	11.3%	4.6%	8.9%
E	11.3%	5.3%	8.9%
ESE	11.7%	5.0%	7.3%
SE	12.3%	5.0%	6.0%
SSE	11.7%	4.8%	5.7%
S	11.5%	4.9%	4.6%
SSW	10.8%	4.2%	4.2%
SW	9.8%	3.4%	3.7%
WSW	8.4%	2.2%	2.3%
W	6.7%	1.2%	1.2%
WNW	6.6%	0.6%	0.4%
NW	8.0%	0.7%	0.4%
NNW	8.7%	0.9%	0.9%

C.2 Assessment of Temperature Inversions

For each season, the following process was followed:

1. Convert sigma-theta observations from raw data into PG stability categories using the sigma-theta methodology prescribed in the NPfI. We assumed a surface roughness of 0.1 m.
2. For the night-time period 6.00 pm – 7.00 am, cull out any data with PG stability category other than F or G.
3. Divide the number of resultant samples over the total night-time data (including all PG stability categories [A-G]), for each season individually, to establish a percentage of occurrence.
4. Assess percentage of occurrence (rounded to one decimal place) against 30% threshold of occurrence.

Table C-2 summarises frequencies of occurrence of moderate-to-strong temperature inversions for each season. Inversions are found to be below but relatively close to the 30% threshold of occurrence (i.e. 26.8% in winter).

Table C-2: Frequencies of Occurrence - Temperature Inversions

Spring	Summer	Autumn	Winter
16.5%	15.7%	22.2%	26.8%

APPENDIX D

OPERATIONAL NOISE PREDICTIONS

Table D-1: Operational Noise Predictions - Privately-owned Residential Receptors

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (A-weighted decibel [dBA])												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-owned Residential Receptors													
R03	35	36	42	28	29	38	35	35	43	34	34	43	40/40/40
R04	35	35	42	28	29	38	34	34	42	33	33	43	40/40/40
R05	48	48	52	41	42	47	47	47	48	47	47	48	40/40/40
R06	41	41	46	33	34	42	40	40	45	40	40	44	40/40/40
R07	31	32	38	27	28	34	31	31	42	30	30	41	40/40/40
R09	31	31	35	29	29	32	36	37	40	34	34	38	40/40/40
R10	26	26	29	23	24	26	29	29	33	26	27	31	40/40/40
R11	32	33	38	31	32	35	37	38	40[2]	37	37	40[2]	40/40/40
R13	33	34	38	34	34	38	38	39	43	36	37	42	40/40/40
R17	42	43	49	42	43	48	50	51	55	50	50	56	40/40/40
R19	37	38	43	38	39	44	35	35	42	34	35	42	40/40/40
R20	28	29	33	27	28	31	30	30	40[2]	28	28	38	40/40/40
R21	28	29	33	27	28	30	30	30	40[2]	28	28	38	40/40/40
R22	28	29	34	28	28	31	30	31	40[2]	28	28	38	40/40/40
R23	28	29	34	28	28	31	30	31	40[2]	28	28	38	40/40/40
R24	28	29	34	27	28	30	30	30	40	28	28	38	40/40/40
R25	28	29	34	27	28	31	29	30	40	28	28	38	40/40/40
R26	28	29	34	27	28	31	29	30	40	27	28	38	40/40/40

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (A-weighted decibel [dBA])												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-owned Residential Receptors													
R27	28	28	34	27	27	30	29	30	40	27	28	38	40/40/40
R28	28	28	34	26	27	31	29	30	40	27	27	37	40/40/40
R29	27	28	33	26	26	30	29	29	39	26	26	37	40/40/40
R30	27	28	33	26	27	30	28	29	38	27	27	36	40/40/40
R31	27	28	33	26	27	30	28	28	38	27	27	36	40/40/40
R32	27	27	33	25	25	30	27	28	36	25	26	36	40/40/40
R33	27	27	32	25	25	29	27	28	36	26	26	35	40/40/40
R34	27	27	32	25	25	29	27	27	36	26	26	35	40/40/40
R35	27	27	32	24	25	29	27	27	36	25	26	35	40/40/40
R36	26	27	31	24	25	28	27	27	35	25	26	34	40/40/40
R37	26	27	31	24	25	28	27	27	35	25	26	34	40/40/40
R39	26	27	31	25	26	29	28	28	37	26	27	35	40/40/40
R40	27	27	32	25	26	29	27	28	37	26	27	35	40/40/40
R41	26	27	31	25	26	29	28	28	37	26	27	35	40/40/40
R42	20	20	26	15	16	26	20	20	27	20	21	27	40/40/40
R43	20	20	25	15	16	24	21	22	28	21	21	28	40/40/40
R52	27	27	30	24	25	27	32	32	35	30	30	34	40/40/40
R53	28	29	31	25	26	28	33	34	37	31	31	35	40/40/40
R54	30	30	33	27	28	30	35	36	39	32	33	37	40/40/40
R55	26	27	29	23	24	27	30	30	34	26	27	31	40/40/40

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (A-weighted decibel [dBA])												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-owned Residential Receptors													
R56	27	28	30	26	26	28	32	33	36	30	31	34	40/40/40

Notes:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm – 10.00 pm; Night = 10.00 pm – 7.00 am.
2. Noise level incorporates proactive noise mitigation measures.
3. Noise exceedances highlighted in red.

Table D-2: Operational Noise Predictions - Other Receptor Types

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (dBA)												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Other Receptor Types[2]													
R57	28	28	31	25	25	28	33	33	36	31	31	35	40/40/40
R58	27	27	30	22	22	26	31	31	35	27	28	32	40/40/40
R59	27	27	30	22	23	26	31	32	35	29	29	33	40/40/40
R60	28	28	31	24	24	27	32	33	36	30	31	34	40/40/40
R61	29	30	33	27	27	30	35	35	39	32	33	36	40/40/40
R62	29	29	32	26	26	29	34	35	38	32	32	36	40/40/40
R47[3]	33	33		31	31		38	39		36	37		40/40/40
R63	26	26	29	23	24	28	32	32	35	27	28	32	40/40/40

Notes:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm to 10.00 pm; Night = 10.00 pm – 7.00 am.

2. Other receptor types include: three schools, a childcare, hospital, medical centre, camp accommodation and a cemetery (all located in Blackwater except for the cemetery).
3. Assumed not in use at night.

Table D-3: Operational Noise Predictions – Non-sensitive Receptors

Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (dBA)												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Mine-owned Receptors													
R01	41	41	47	30	30	40	35	35	43	34	34	42	n/a[2]
R02	47	47	52	30	30	41	35	36	43	35	35	42	n/a[2]
R12	38	39	43	36	37	41	41	42	46	41	41	47	n/a[2]
R50	29	30	36	28	29	33	32	32	42	29	30	40	n/a[2]
R51	30	30	36	29	29	33	32	32	42	29	30	39	n/a[2]
Privately-owned Receptors Currently Under Agreements													
R15	43	43	49	45	46	50	52	53	57	61	61	62	n/a[2]
R16	42	43	50	43	44	48	50	50	56	52	53	58	n/a[2]
Commercial/Industrial Receptors													
R14	39	39	44	38	38	43	43	43	48	40	41	46	40/40/40
R46	44	45	50	44	44	51	35	35	43	43	43	48	40/40/40
R48	34	35	39	32	32	36	40	40	44	38	39	43	40/40/40
R49	28	29	36	22	22	29	29	29	39	30	31	39	40/40/40
R64	31	31	34	28	29	31	36	37	40	34	34	38	40/40/40

Notes:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm – 10.00 pm; Night = 10.00 pm – 7.00 am.
2. Mine-owned receptors and privately-owned receptors current under agreements are not subject to noise criteria and are included for information only.
3. Noise exceedances highlighted in red.

APPENDIX E

OPERATIONAL NOISE PREDICTIONS - UNMITIGATED

Table E-4: Unmitigated Operational Noise Predictions

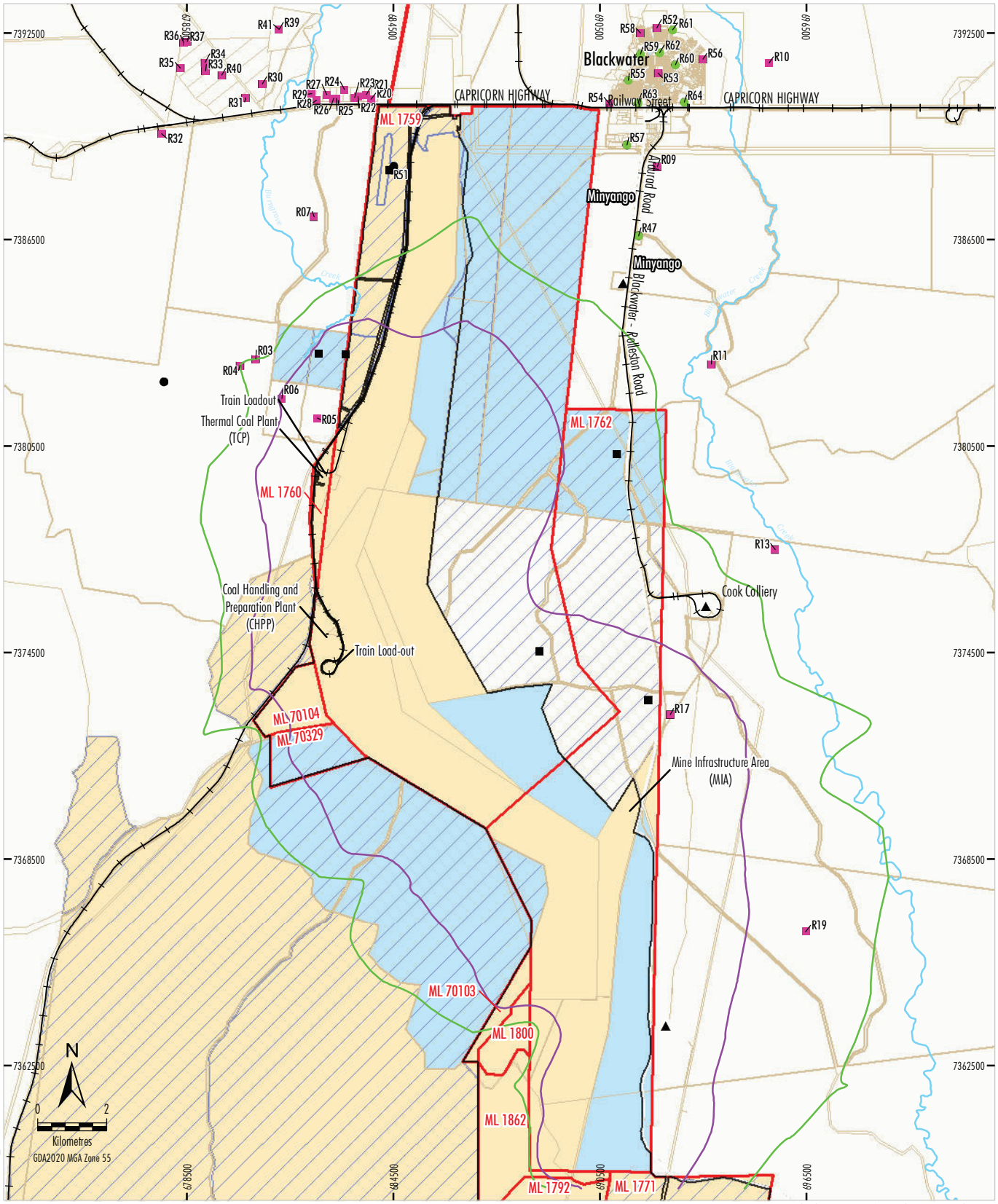
Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (dBA)												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-owned Residential Receptors													
R11	32	33	38	31	32	35	37	38	41	37	37	41	40/40/40
R20	28	29	33	27	28	31	30	30	41	28	28	38	40/40/40
R21	28	29	33	27	28	30	30	30	41	28	28	38	40/40/40
R22	28	29	34	28	28	31	30	31	41	28	28	38	40/40/40
R23	28	29	34	28	28	31	30	31	41	28	28	38	40/40/40

Note:

1. Day = 7.00 am – 6.00 pm; Evening = 6.00 pm – 10.00 pm; Night = 10.00 pm – 7.00 am.

APPENDIX F

NOISE CONTOURS



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

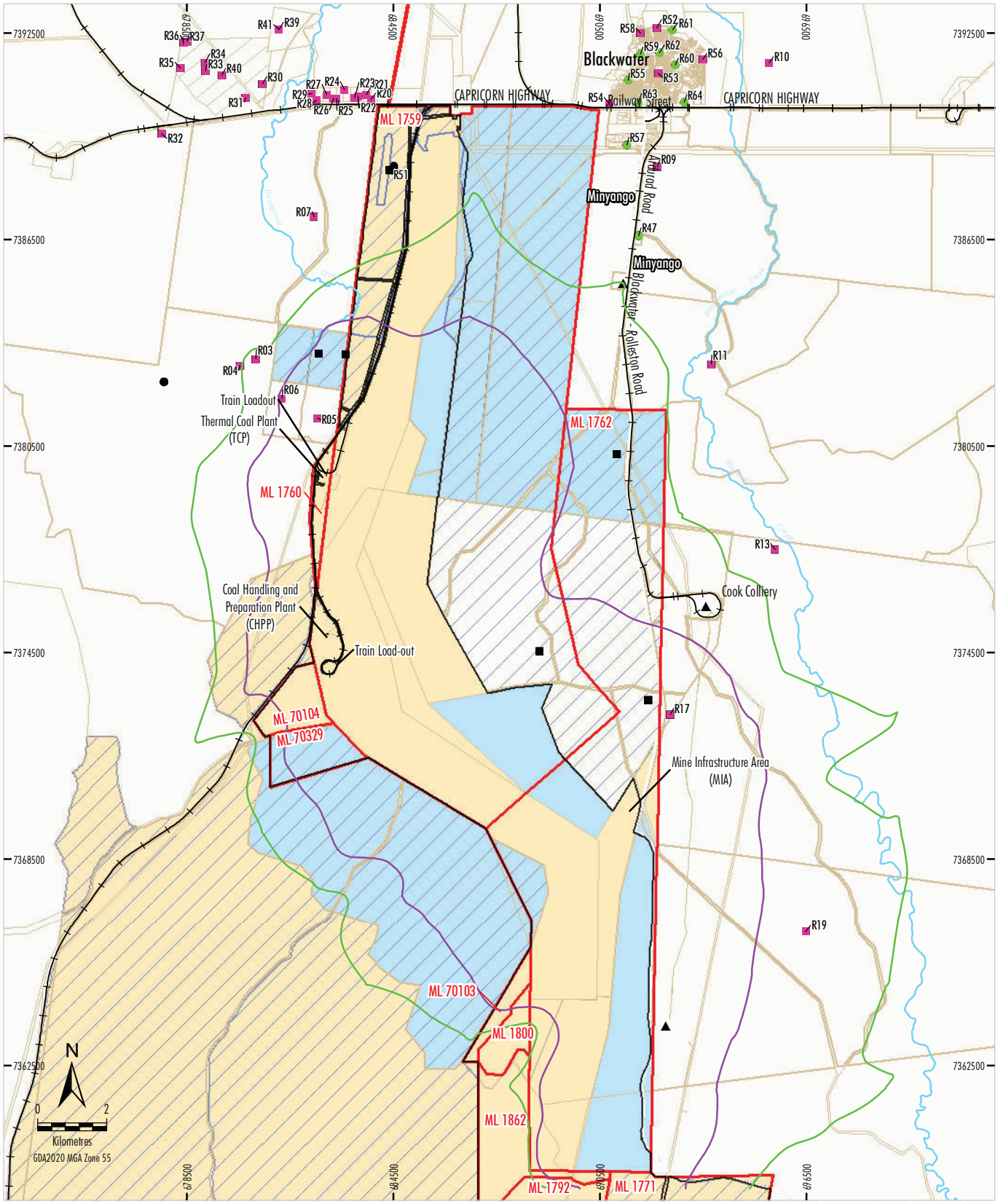
Noise Contour (Day)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Day)
FY 2030

Figure F-1



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

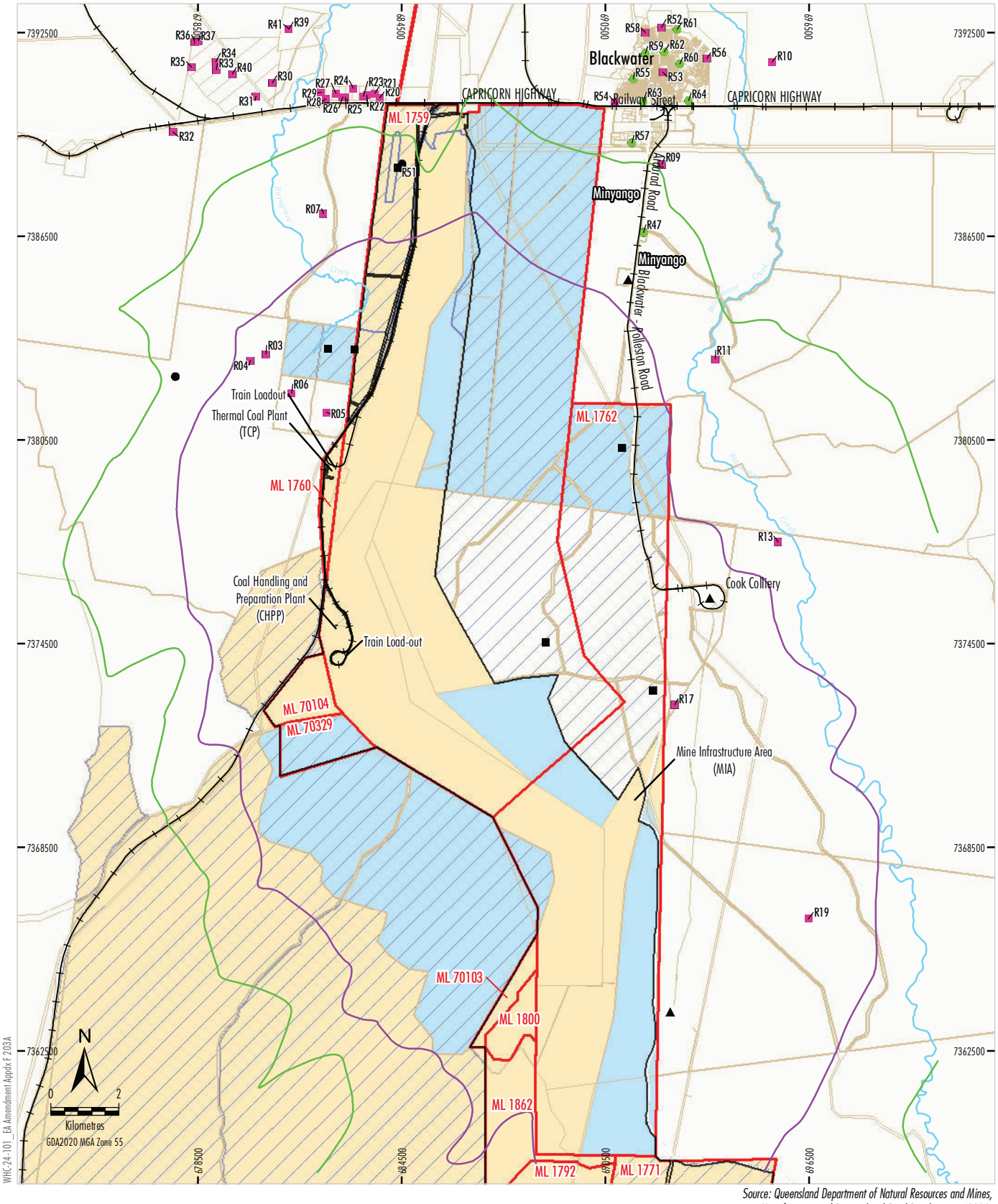
Noise Contour (Eve)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Eve) FY 2030

Figure F-2



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

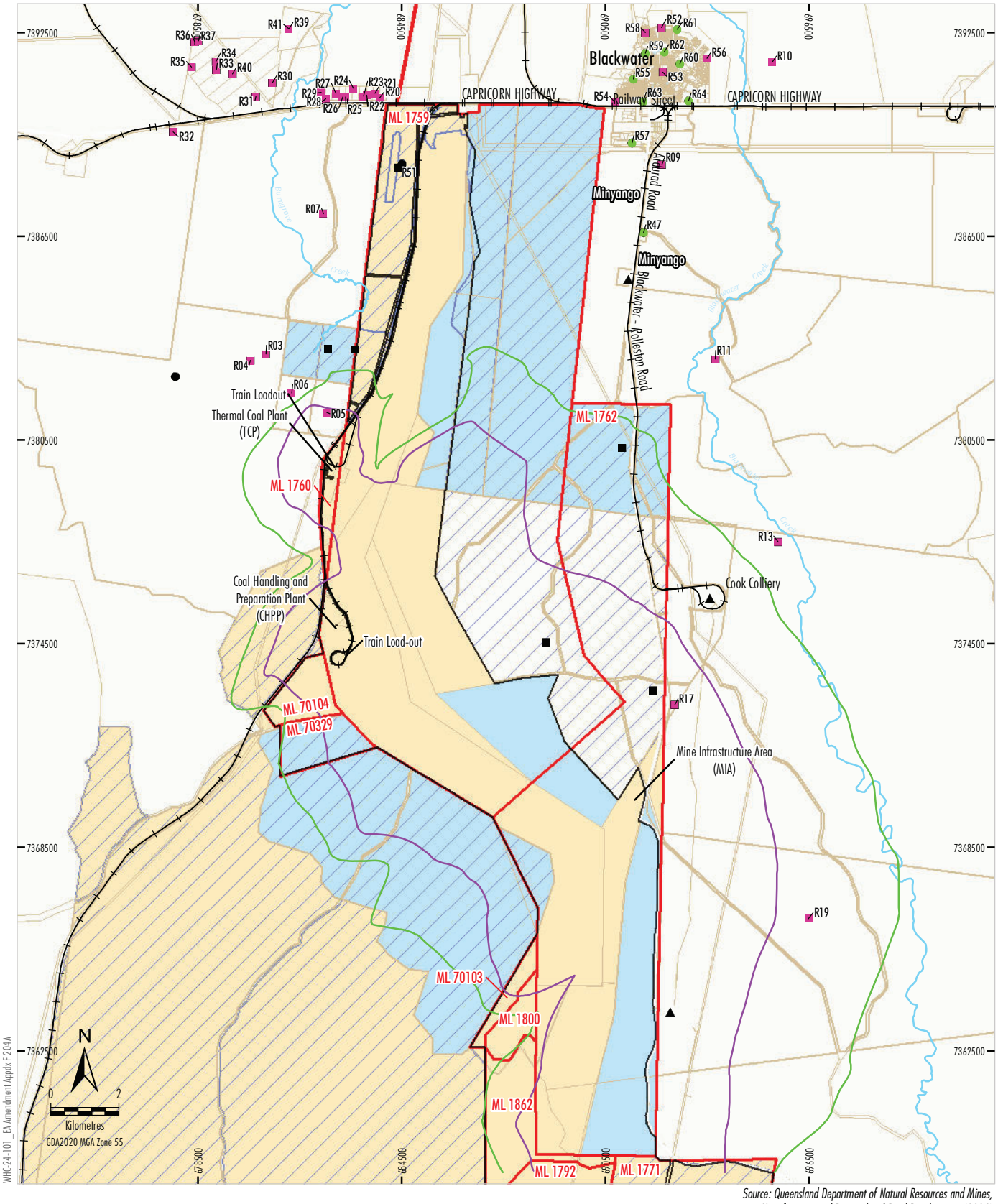
Noise Contour (Night)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Night) FY 2030

Figure F-3



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

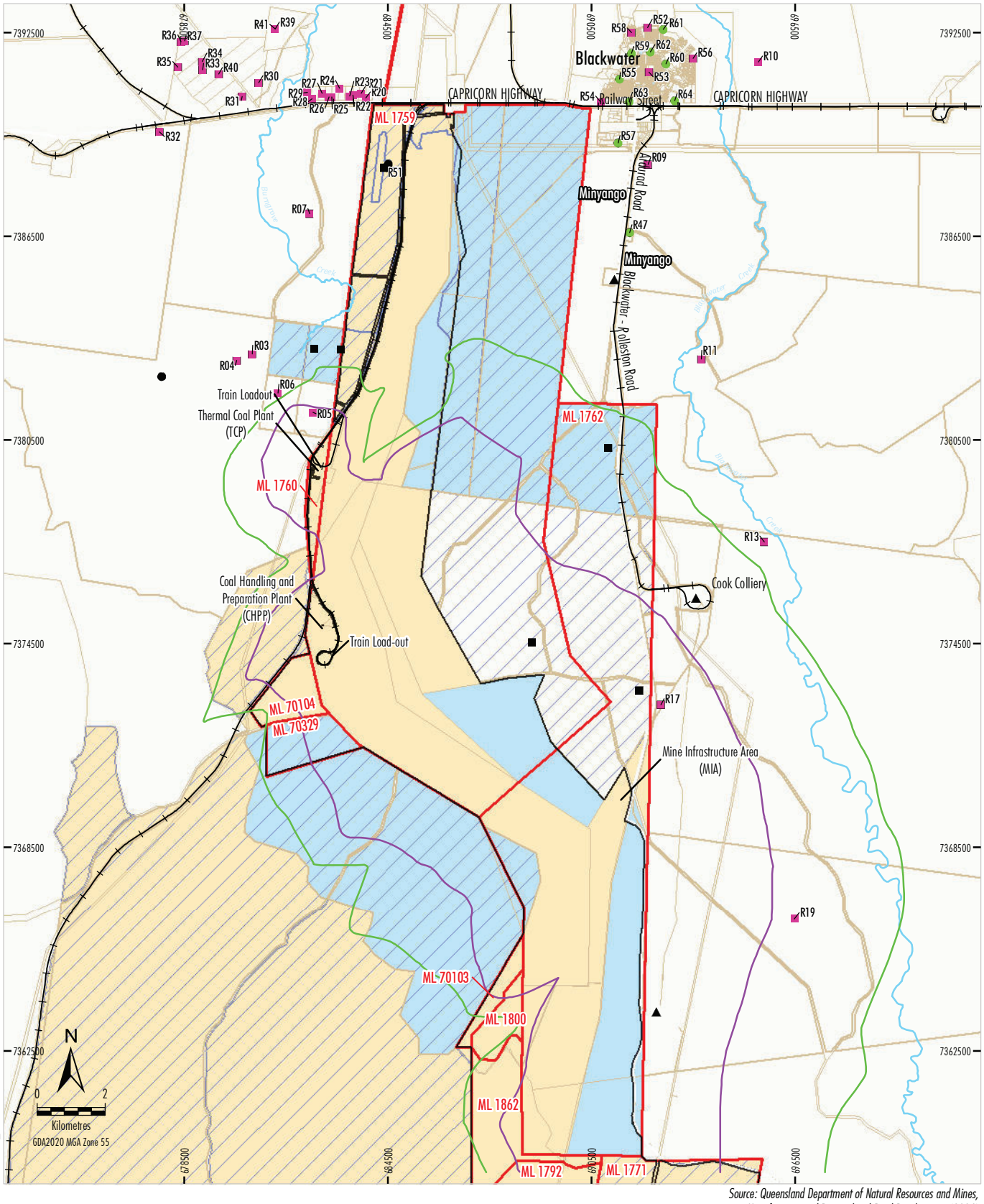
Noise Contour (Day)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Day)
FY 2032

Figure F-4



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

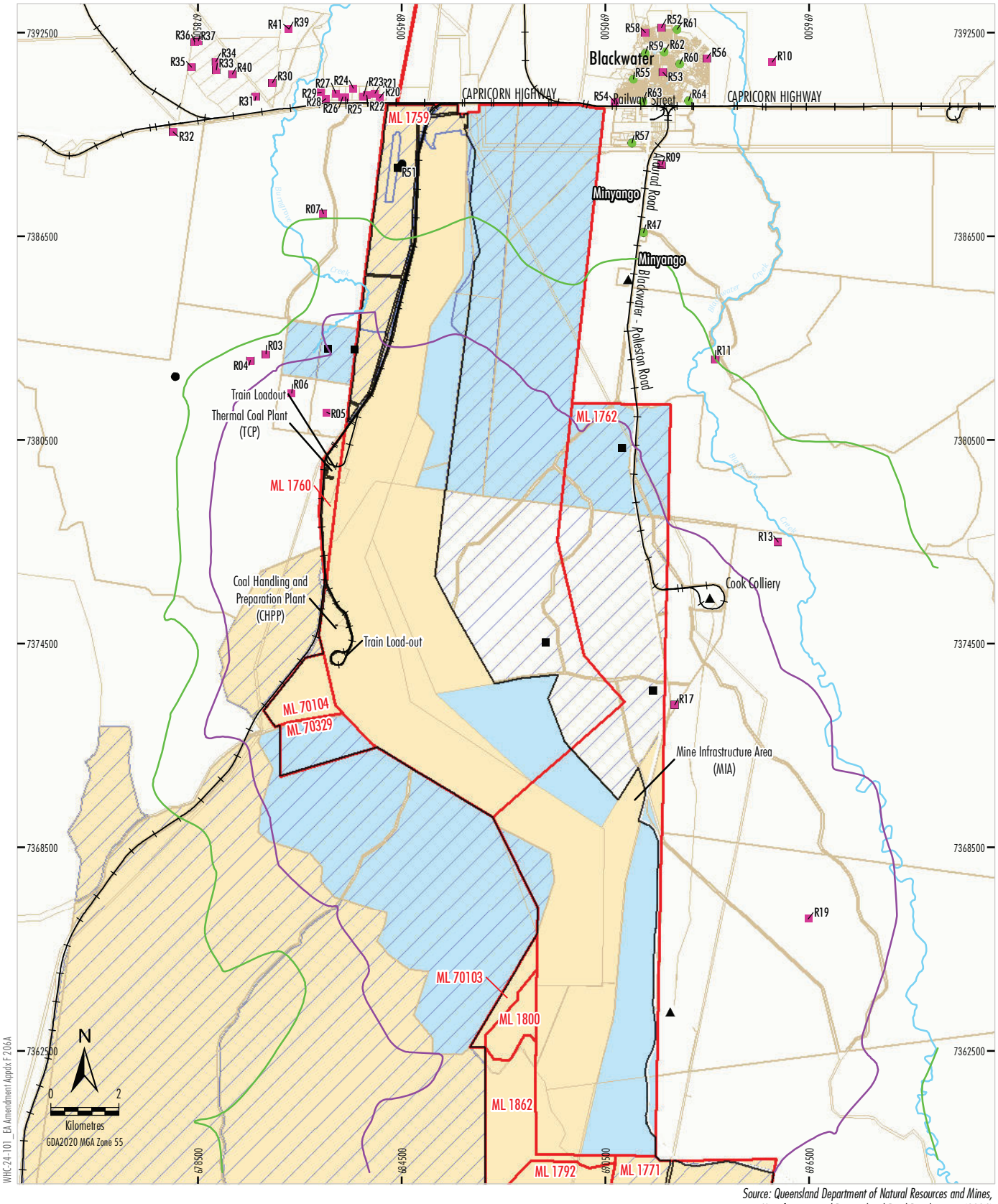
Noise Contour (Eve)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Eve) FY 2032

Figure F-5



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

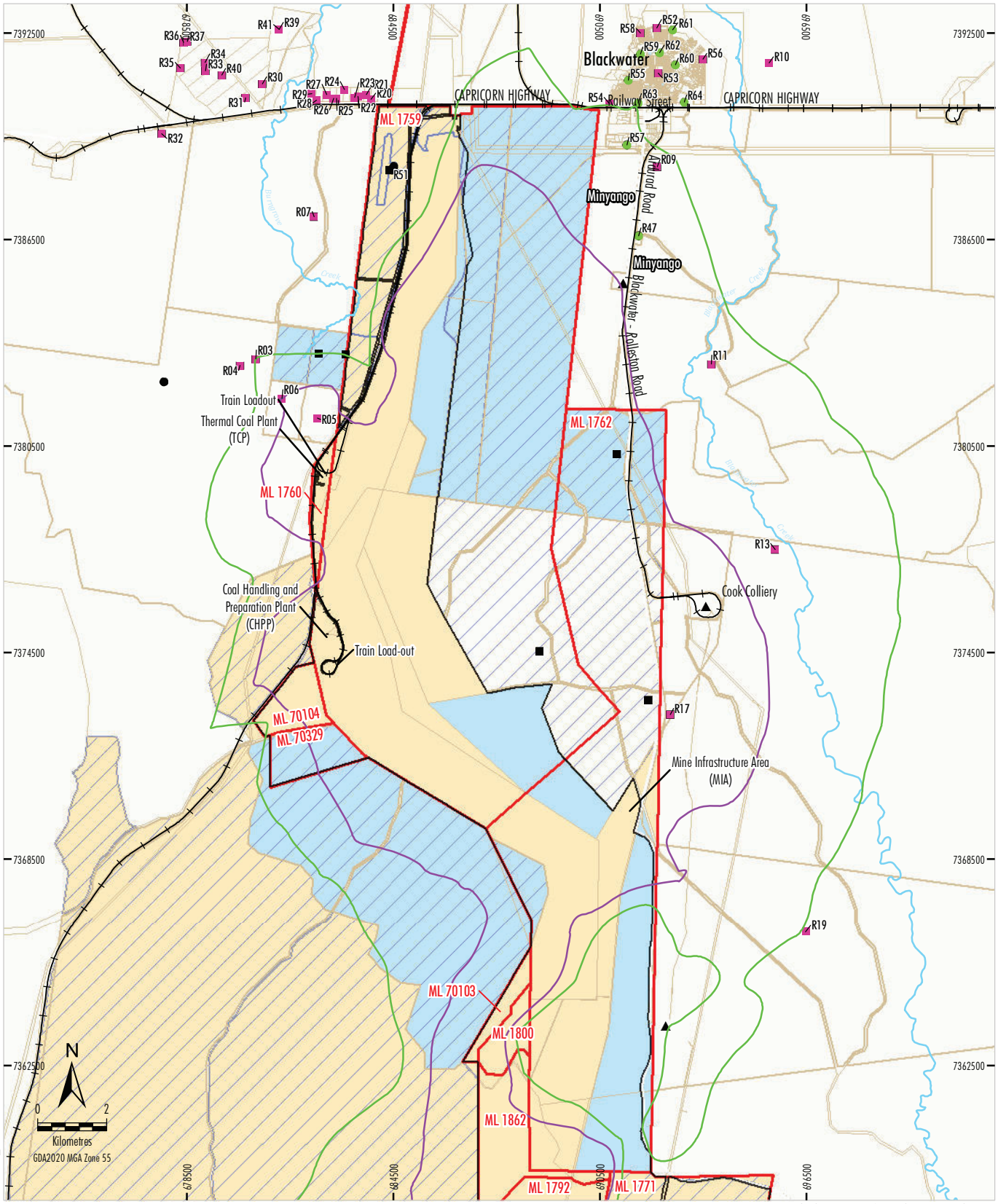
Noise Contour (Night)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Night) FY 2032

Figure F-6



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

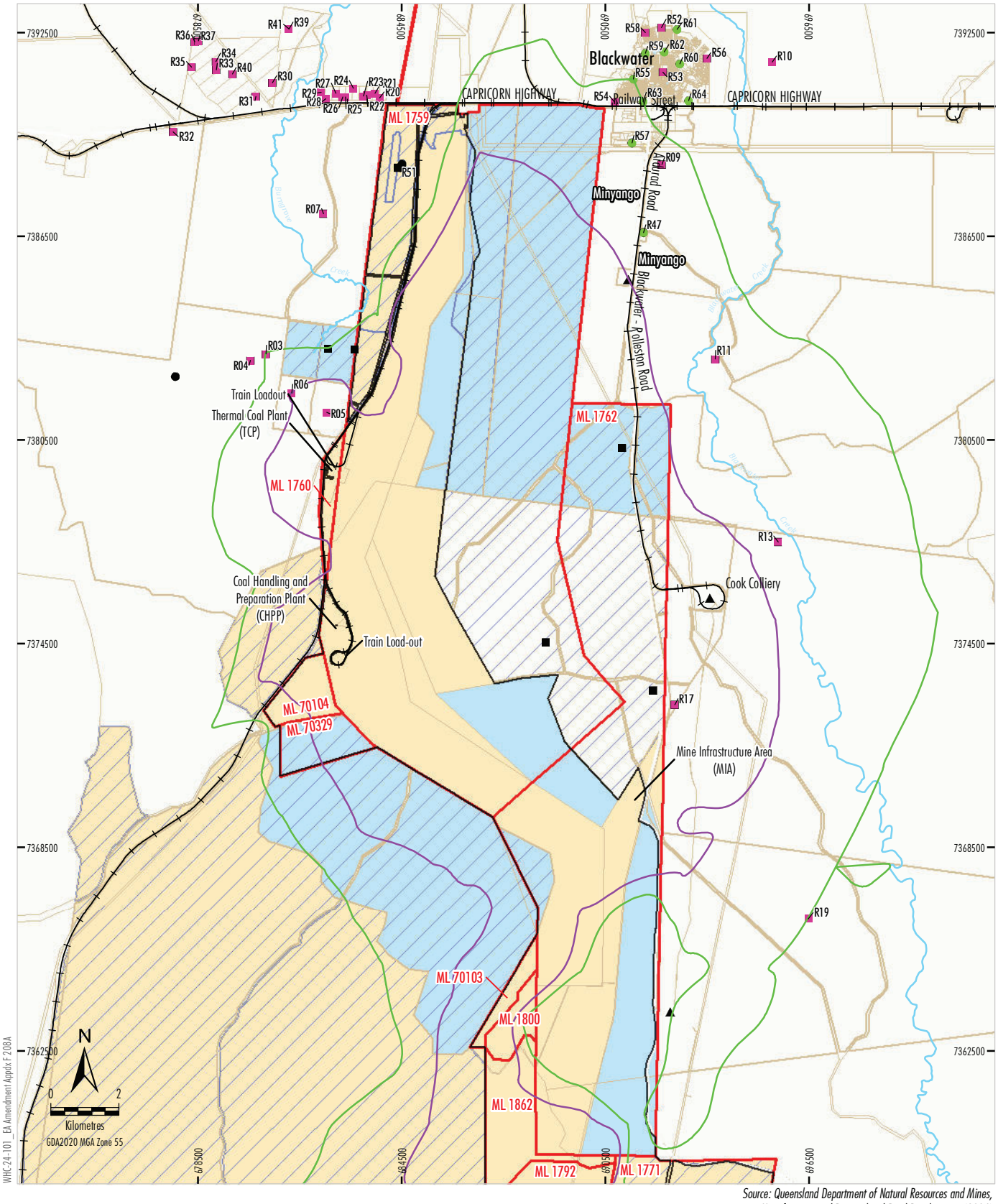
Noise Contour (Day)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Day) FY 2050

Figure F-7



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

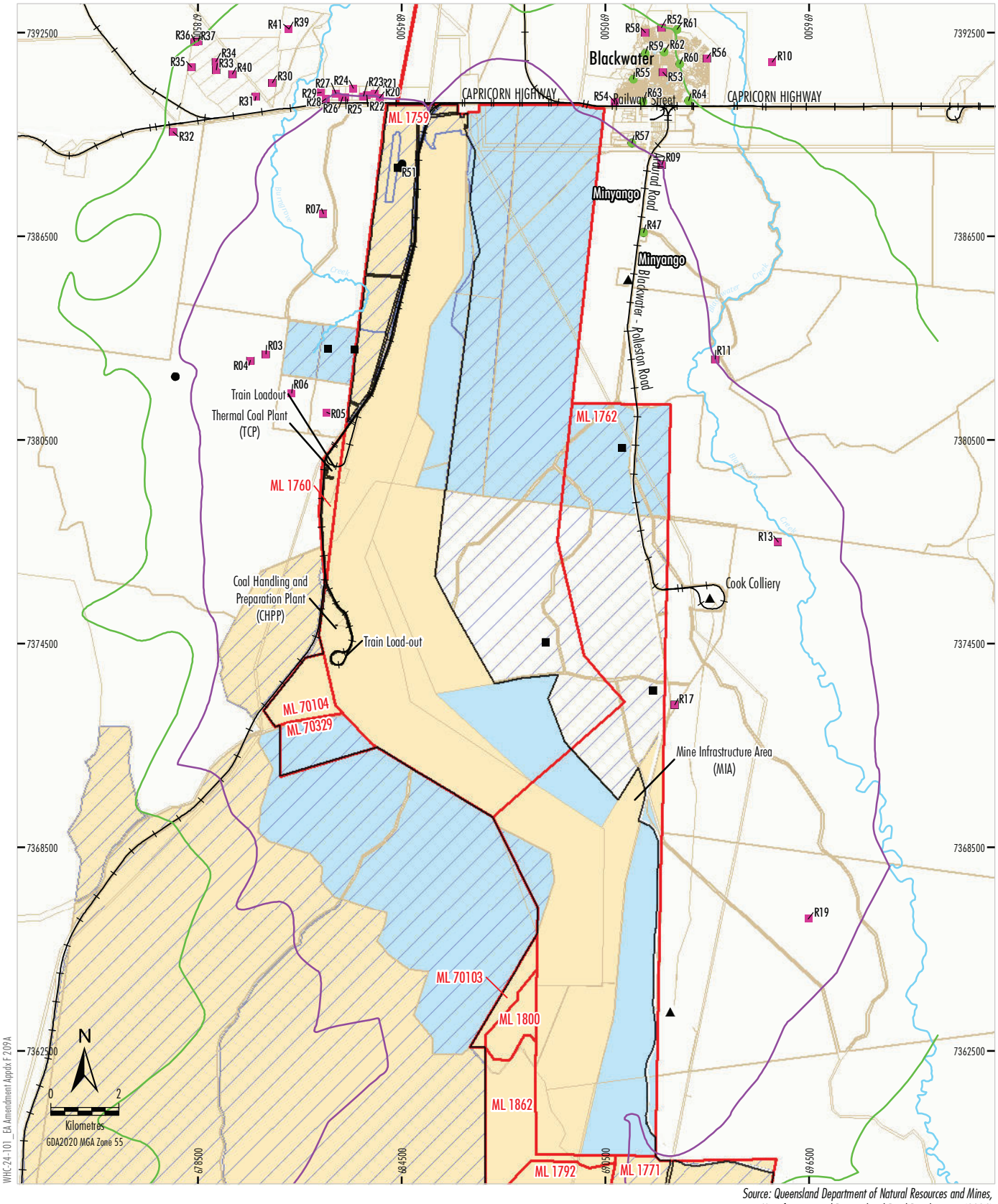
Noise Contour (Eve)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Eve) FY 2050

Figure F-8



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

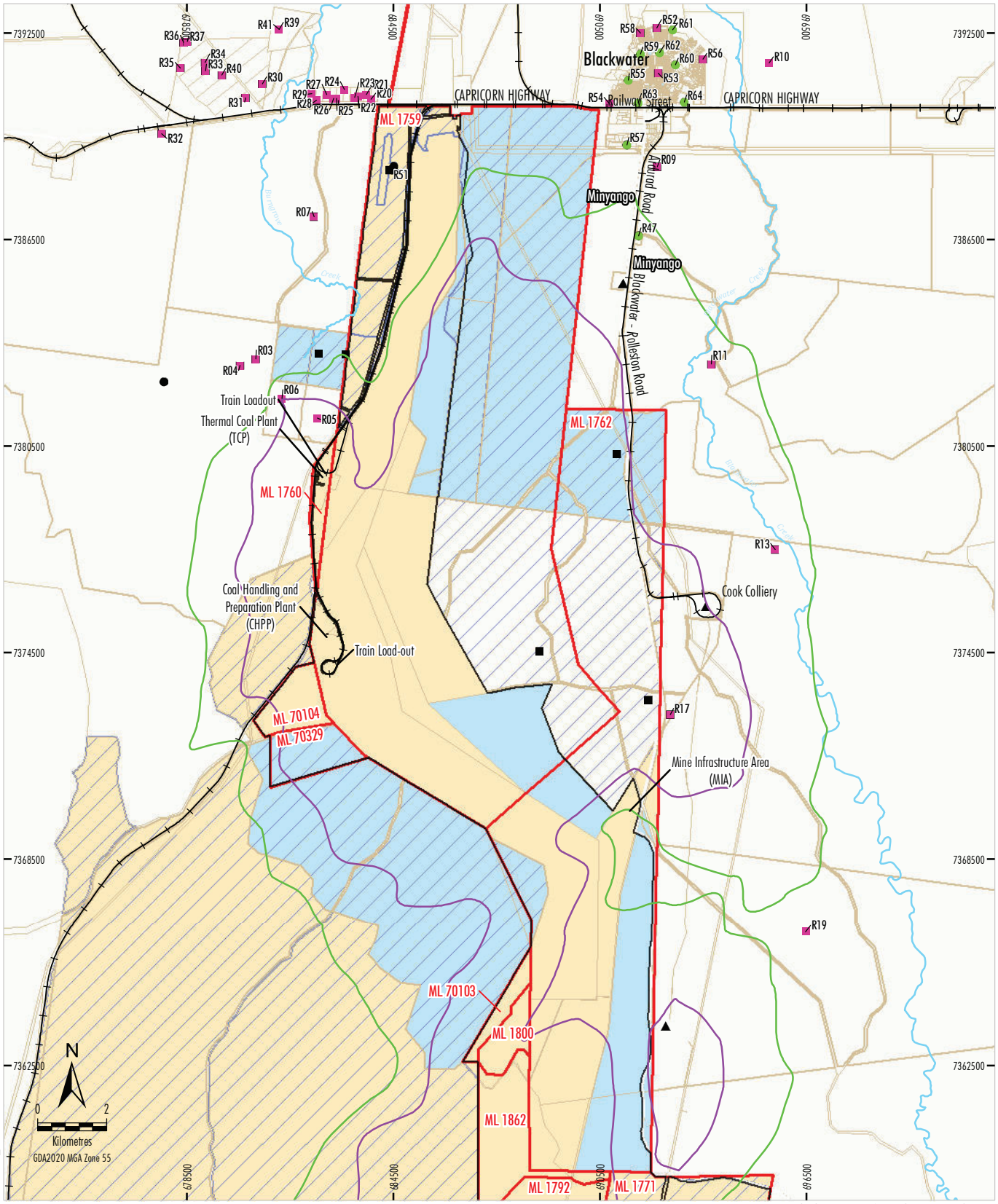
Noise Contour (Night)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Night) FY 2050

Figure F-9



LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Noise Contour (Day)
- 35 dBA
- 40 dBA

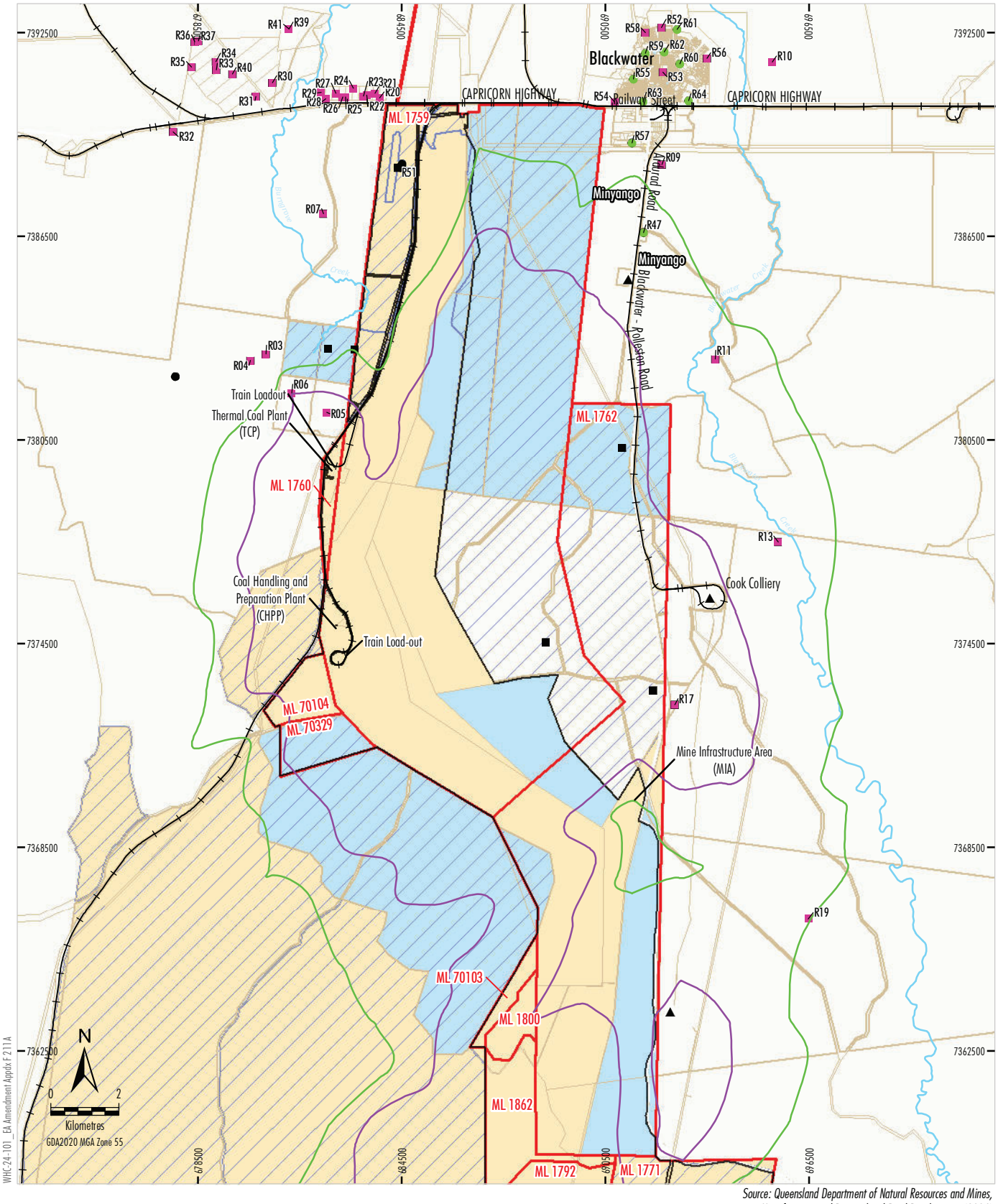
Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Day)
FY 2055

Figure F-10



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

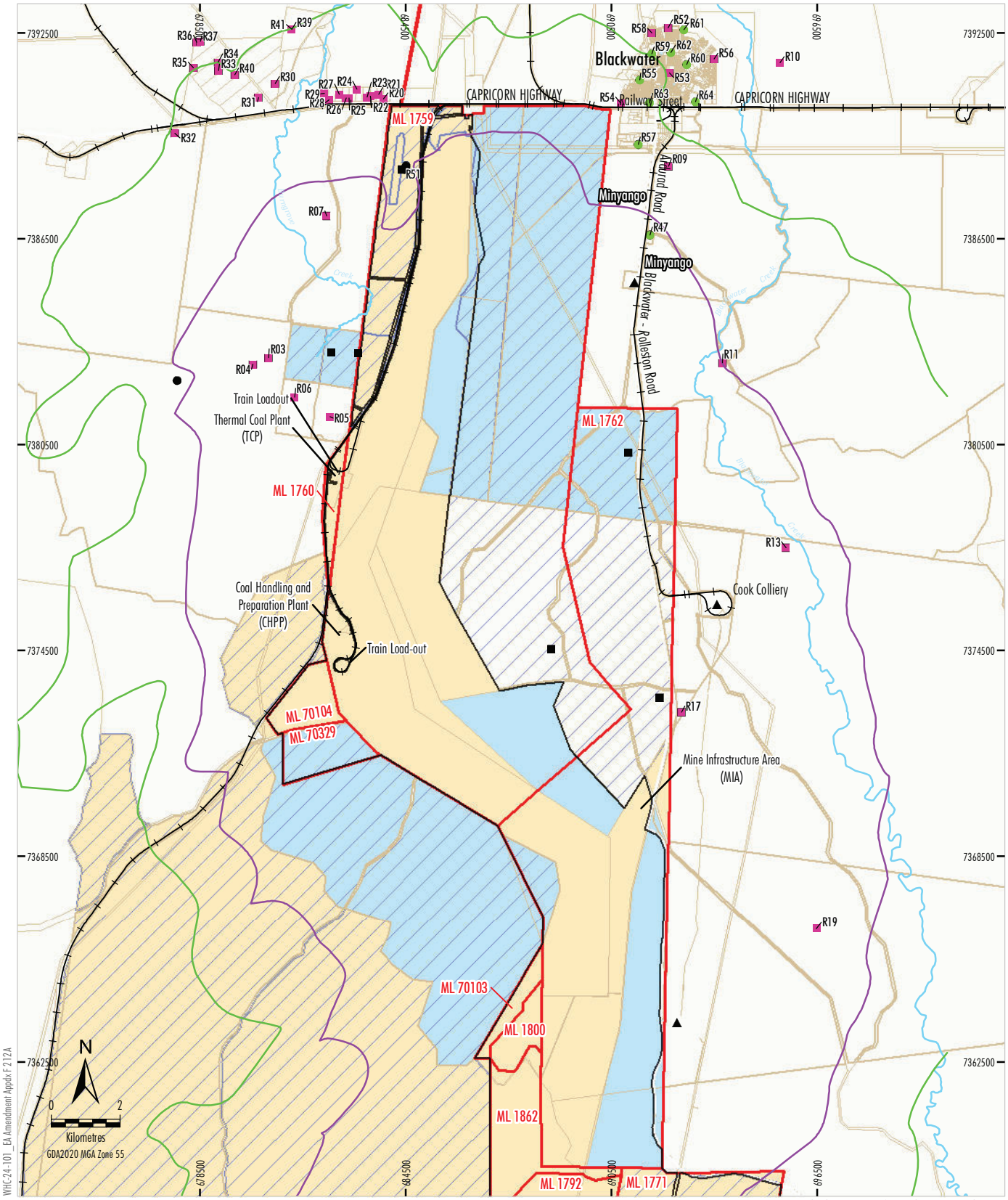
Noise Contour (Eve)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Eve) FY 2055

Figure F-11



Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

LEGEND

- Mining Lease
- Railway
- Road
- Watercourse
- Property Boundary
- Approved Disturbance Footprint
- Leassee or Agistee Boundary
- Whitehaven Freehold Land
- Whitehaven Leasehold Land

Sensitive Receiver
- Community
- Private

Non-sensitive Receiver
- Mine-owned or Privately-owned
- Under Agreement
- Commercial
- Community

Noise Contour (Night)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Night) FY 2055

Figure F-12

APPENDIX G

NIGHT-TIME MAXIMUM NOISE LEVEL EVENT PREDICTIONS

Table G-1: Night-time Maximum Noise Level Event Predictions – Privately-owned Residential Receptors

Rec ID	$L_{A1,15min}$ Night-time Maximum Noise Predictions (dBA)				BWM EA $L_{A1,15min}$ Noise Criteria (dBA)
	FY30	FY32	FY50	FY55	
Privately-owned Residential Receptors					
R03	43	39	44	43	45
R04	44	39	43	43	45
R05	56	50	52	52	45
R06	48	45	47	46	45
R07	39	35	43	41	45
R09	36	33	41	39	45
R10	30	27	33	31	45
R11	39	36	41[2]	41[2]	45
R13	39	38	43	43	45
R17	50	49	56	57	45
R19	44	45	42	43	45
R20	35	32	41[2]	39	45
R21	35	31	41[2]	39	45
R22	35	32	42[2]	39	45
R23	35	32	41[2]	39	45
R24	35	31	41	38	45
R25	35	32	41	39	45
R26	35	32	41	39	45
R27	35	32	41	38	45
R28	35	32	41	38	45
R29	34	32	40	37	45
R30	34	31	39	37	45
R31	34	31	39	37	45
R32	34	31	37	36	45
R33	33	30	37	36	45
R34	33	30	37	35	45
R35	33	30	36	35	45
R36	32	30	36	35	45
R37	32	30	36	35	45
R39	33	30	38	36	45
R40	33	30	38	36	45
R41	33	30	38	36	45
R42	27	27	28	28	45

Rec ID	$L_{A1,15min}$ Night-time Maximum Noise Predictions (dBA)				BWM EA $L_{A1,15min}$ Noise Criteria (dBA)
	FY30	FY32	FY50	FY55	
Privately-owned Residential Receptors					
R43	27	26	28	29	45
R52	31	29	36	34	45
R53	33	29	38	35	45
R54	35	31	41	38	45
R55	31	28	35	32	45
R56	32	29	37	35	45

Notes:

1. Night = 10.00 pm – 7.00 am.
2. Noise level incorporates proactive noise mitigation measures (for the $L_{Aeq,15min}$ component but not the $L_{A1,1min}$ component).
3. Noise exceedances highlighted in red.

Table G-2: Night-time Maximum Noise Level Event Predictions – Other Receptor Types

Rec ID	$L_{A1,15min}$ Night-time Maximum Noise Predictions (dBA)				BWM EA $L_{A1,15min}$ Noise Criteria (dBA)
	FY30	FY32	FY50	FY55	
Other Receptor Types[2]					
R57	33	29	37	35	45
R58	31	27	36	32	45
R59	32	28	36	33	45
R60	32	29	37	34	45
R61	34	31	40	37	45
R62	33	30	39	36	45
R47[3]					45
R63	30	29	36	33	45

Notes:

1. Night = 10.00 pm – 7.00 am.
2. Other receptor types include: three schools, a childcare, hospital, medical centre, camp accommodation and a cemetery (all located in Blackwater except for the cemetery).
3. Assumed not in use at night.

Table G-3: Night-time Maximum Noise Level Event Predictions – Non-sensitive Receptors

Rec ID	$L_{A1,15min}$ Night-time Maximum Noise Predictions (dBA)				BWM EA $L_{A1,15min}$ Noise Criteria (dBA)
	FY30	FY32	FY50	FY55	
Mine-owned Receptors					
R01	51	41	47	43	n/a[2]
R02	56	42	49	43	n/a[2]
R12	44	42	47	47	n/a[2]
R50	38	34	43	41	n/a[2]
R51	38	34	44	41	n/a[2]
Privately-owned Receptors Currently Under Agreements					
R15	50	52	61	63	n/a[2]
R16	51	49	57	59	n/a[2]
Commercial/Industrial Receptors					
R14	44	44	48	47	45
R46	51	56	44	51	45
R48	40	36	45	44	45
R49	38	30	39	40	45
R64	36	33	42	38	45

Notes:

1. Night = 10.00 pm – 7.00 am.
2. Mine-owned receptors and privately-owned receptors current under agreements are not subject to noise criteria and are included for information only.
3. Noise exceedances highlighted in red.

APPENDIX H

LOW-FREQUENCY NOISE PREDICTION METHODOLOGY

All operational noise predictions presented in the assessment are based on octave band levels ranging from 31.5 hertz (Hz) to 16 kilohertz (kHz). Predictions do not include one-third octave band levels in frequency bands ranging down to 10 Hz or 20 Hz as required by the relevant guidelines for assessing low-frequency noise (LFN). Noise predictions were, therefore, extrapolated in the lower frequencies using a generic LFN spectrum shape representative of large open-cut coal mining operations.

As part of a noise audit conducted at Bulga Village (Wilkinson Murray [now RWDI], 2016), a typical low-frequency spectrum profile of long-distance mining noise was measured in third-octave bands between 10 Hz and 160 Hz. The spectrum presented in **Table H-1** represents an average of 130 LFN measurements, normalised to a consistent broadband level, from an open-cut coal mining complex comparable to the Project (i.e. Wambo Coal Mine, Bulga Coal Mine and Mount Thorley Warkworth Coal Mines). These low-frequency measurements were taken approximately 3–4 kilometres (km) from the mine along propagation paths similar to those surrounding the Project.

Table H-1: Representative LFN Spectrum Profile

Survey Location	Third Octave Band Centre Frequency (Hz)												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Bulga Village	49	54	55	52	51	51	51	52	49	50	48	45	40

For the extrapolation of noise predictions at lower frequencies, the following methodology was applied:

1. Interpolate one-third octave band levels from the predicted night-time octave band noise levels (31.5 Hz to 16 kHz).
2. Normalise the representative LFN spectrum shape (**Table H-1**) to the one-third octave band predictions using the 63 Hz one-third octave band level (generally considered a relatively reliable band of the predicted spectrum).
3. Combine the normalised LFN spectrum shape to the one-third octave band predictions to generate a complete spectrum (10 Hz to 630 Hz or 20 Hz to 200 Hz depending on the guideline).

APPENDIX I

BLASTING PREDICTION CURVES AND EQUATIONS

Figure I-1 illustrates the measured data and associated linear trend lines for ground vibration. The figure shows a revised best fit line – a 95th percentile line – and the previously adopted 95th percentile based on 1999 data from Bayswater No 3. The correlation with the old data is close, although the new 95th percentile shows slightly lower vibration levels at shorter scaled distance – in the order of 0.2 to 0.3 millimetres per second (mm/s).

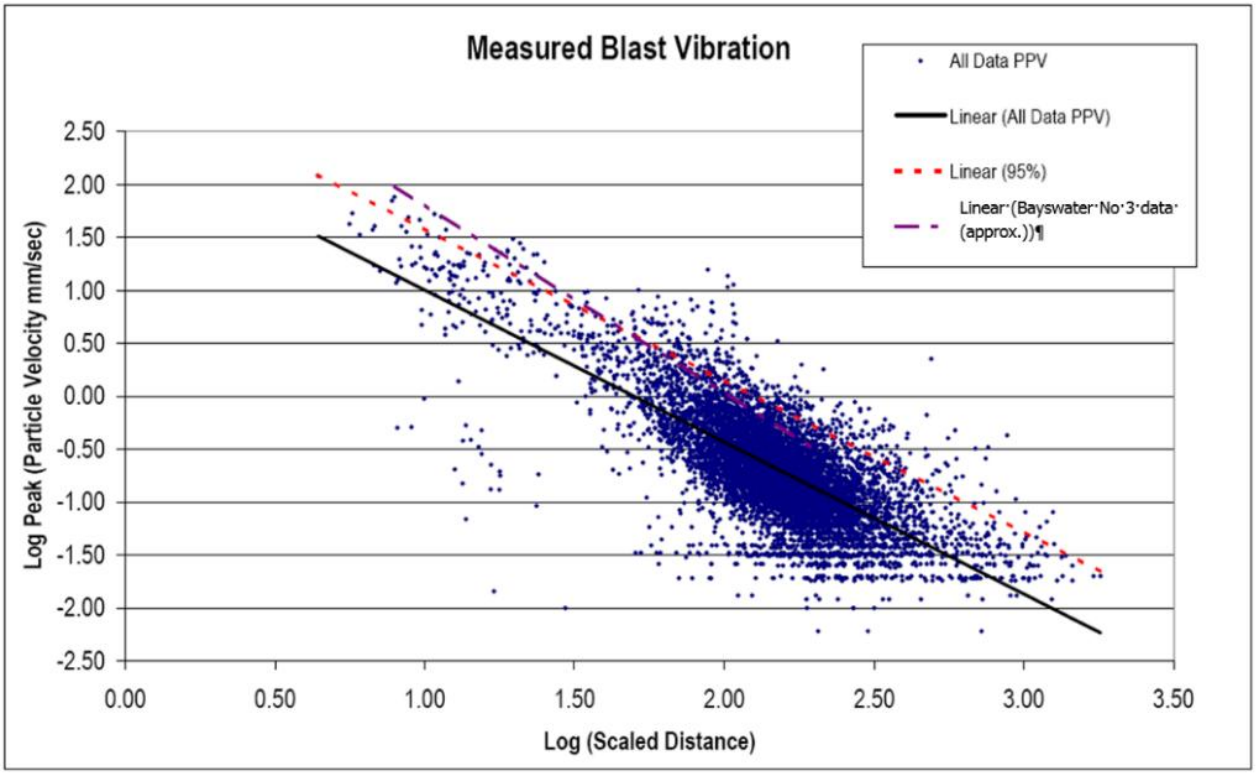


Figure I-1: Measured Peak Particle Velocity from Blasts at Mt Arthur North (logarithmic scale) and Comparison with Data from Bayswater No 3

Figure I-2 shows airblast overpressure data. Analysis of the data showed that the relationship between measured peak overpressure and scaled distance is better defined with a polynomial equation (blue) at close range rather than a standard linear equation (red). At relatively low values of scaled distance, the new polynomial 95th percentile curve is approximately 5 decibels (dB) lower than the linear trend line derived from the previous Bayswater No 3 data.

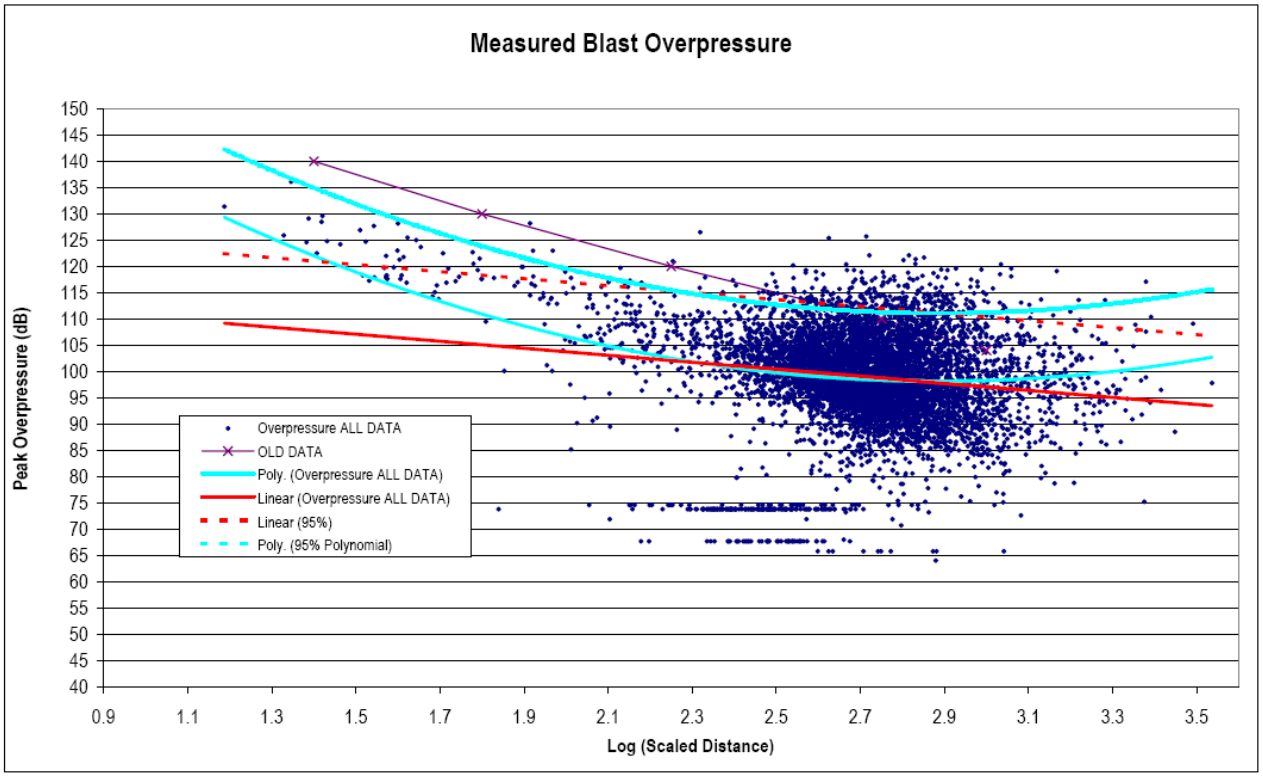


Figure I-2: Measured Peak Overpressure from Blasts at Mt Arthur North, and Comparison with Data from Bayswater No 3

Whitehaven

Blackwater North Extension Project

Appendix I
Geochemistry Assessment



TERRENUS
EARTH SCIENCES

Geochemical Assessment of Potential Spoil and Coal Reject Materials

BLACKWATER NORTH EXTENSION PROJECT

Prepared for:

Whitehaven Blackwater Pty Ltd

Geochemical Assessment of Potential Spoil and Coal Reject Materials

BLACKWATER NORTH EXTENSION PROJECT

Prepared for:

Whitehaven Blackwater Pty Ltd

DOCUMENT CONTROL

Report Title	Environmental Geochemical Assessment of Potential Spoil and Coal Reject Materials		
Project Name	Blackwater North Extension Project		
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Author	Dr. Ian P. Swane (Terrenus Earth Sciences)		

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EXECUTIVE SUMMARY

This report serves to document and discuss the environmental geochemical characteristics of mineral waste materials associated with the Blackwater North Extension Project (the Project), being developed by Whitehaven Blackwater Pty Ltd, a subsidiary of Whitehaven Coal Limited (WHC). The Project proposes an eastern extension of WHC's existing Blackwater Mine (BWM), as a continuation of BWM operations. The geochemical assessment was completed to assist with mine planning and as part of the environmental regulatory documentation for the Project.

The objective of the assessment is to evaluate the geochemical nature of mineral waste currently at BWM and mineral waste likely to be generated by the Project, and identify relevant environmental issues/opportunities that may be associated with mining, handling and storing mineral waste to inform appropriate rehabilitation and management strategies.

BWM mines spoil (overburden/interburden) and run-of-mine (ROM) coal from the Rangal Coal Measures (RCM) and the Project proposes to mine the same geologic materials as are currently mined at BWM. Therefore, drill-hole, tailings and rejects samples from, or associated with, the current approved mining area at BWM are representative of these same materials to be mined from the Project – hence geochemical data from BWM is representative of materials expected to be mined at the Project.

Material Types

BWM has three main types of mineral waste, and the geochemical characteristics and potential hazards associated with mineral waste materials at BWM and the Project are discussed by type:

- Spoil (overburden and interburden) comprises approximately 99% per cent (%) of all mineral waste at BWM (WHC, 2025) and includes Tertiary- and Permian-age weathered waste and Permian-age fresh (unweathered) waste. The Project is expected to produce spoil as a similar proportion of mineral waste to that currently produced at BWM. In the northern mining area, which includes the Project, approximately 15% of the spoil is weathered and the remaining 85% (approximately) of spoil is fresh.
- Tailings are (and would continue to be) generated at the BWM North Coal Preparation Plant (NCPP) from processing ROM coal and typically represent the clay, silt and fine sand fractions of ROM waste. Since late 2023, tailings from the NCPP have been disposed as a slurry into Bonnie Doon in-pit tailings storage facility (TSF). Prior to this, tailings from NCPP were disposed as a slurry into the above-ground NCPP TSF (the NCPP TSF is currently inactive). Tailings comprise approximately 0.5% of all mineral waste at BWM – with this approximate proportion expected for the remaining life of asset mine plan at BWM, including tailings generated by processing ROM coal from the Project. The Project would not contain any disposed tailings as all tailings from the NCPP would remain at BWM.
- Rejects are (and would continue to be) generated at the NCPP, and potentially a negligible amount from the Thermal Coal Plant (TCP), from processing ROM coal. Rejects typically represents coarser and rockier seam roof, partings and floor material. Rejects are trucked to several locations for disposal into spoil. Historically, rejects were also disposed onto out-of-pit rejects dumps – the main historic rejects dump being Ramp 36 rejects dump. Some rejects have been used in construction of the NCPP TSF embankments and infrastructure pads. Rejects comprise approximately 0.5% of all mineral waste at BWM – with this approximated proportion expected for the remaining life of asset mine plan. The Project would not contain any rejects as all rejects from the NCPP (and TCP) would remain at BWM.

Coal is also included in the assessment; however, coal is generally not considered mineral waste, with the exception of small quantities of sub-economic seams that may report to the spoil dumps, and remnant coal exposed on pit highwalls (such as in residual voids).

Sample Collection

Sampling and laboratory test-work has been undertaken by previous site owners (BM Alliance Coal Operations Pty Ltd [BMA]), WHC and consultants throughout the development and operation of BWM. The BWM geochemical database contains all available geochemical data for mineral waste samples at BWM, including data from drill-holes located within the Project footprint. The geochemical database was provided to Terrenus for this assessment. The assessment is based on detailed geochemical results for 3182 samples.

Drill-hole sampling was used to collect spoil and coal samples for geochemical assessment. Geochemical data is available for 2260 spoil samples and 214 coal samples collected between 2020 and 2025 from 22 drill-holes located throughout the northern mining area at BWM and in the vicinity of the Project.

Geochemical data is available for 471 tailings samples comprising 305 fresh tailings samples collected from the NCPP and 166 aged tailings samples collected from shallow grab samples and geotechnical investigation drill-holes within the NCPP TSF.

Geochemical data is available for 237 rejects samples comprising 48 fresh rejects samples collected from the NCPP, 45 aged rejects samples collected from geotechnical investigation drill-holes within the NCPP TSF, and 144 aged rejects samples collected from drill-holes and test-pit excavations within Ramp 36 rejects dump.

Acid and Metalliferous Drainage Potential of Mineral Waste and Coal Material Types

Mineral waste samples have undergone environmental geochemical characterisation and assessment with regard to their potential to generate acid and metalliferous drainage (AMD), which comprises acid drainage (AD), neutral and metalliferous drainage (NMD) and/or saline drainage (SD) (salinity due to sulfate derived from sulfide oxidation). Additionally, samples have been assessed with regard to their potential to generate salinity (non-oxidative) and, for spoil materials, their sodicity and dispersion potential.

Acid and Metalliferous Drainage Potential of Spoil – Non-Carbonaceous

Non-carbonaceous spoil, which comprises about 92% of spoil at BWM (WHC, 2025), is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage), which is typical for mine spoil in the Bowen Basin.

Based on the results, non-carbonaceous spoil from the Project has a negligible potential to generate AMD as either AD and/or NMD and/or SD.

The total sulfur (S) concentration of non-carbonaceous spoil is very low, with a 95th percentile total S concentration of 0.09%. As such, and combined with moderate to high acid neutralising capacity (ANC) values (median 45 kilograms of sulfuric acid per tonne of rock [kg H_2SO_4/t]), which is significantly higher than the maximum potential acidity (MPA) (median 0.9 kg H_2SO_4/t), greater than 99% of non-carbonaceous spoil samples tested were classified as non-acid forming (NAF), with one sample classified as UC(NAF) (uncertain, but expected to be NAF). Less than 0.4% of non-carbonaceous spoil

samples were classified as potentially acid forming (PAF), PAF-LC (PAF, low capacity) or UC(PAF) (uncertain, but expected to be PAF or PAF-LC) or NAF-S (NAF, but with total S greater than 1%).

The test-work undertaken has demonstrated that the ANC for the non-carbonaceous spoil is generally expected to be about 40-70% available under field conditions (based on 25th and 75th percentile values). Mineralogical analysis indicates that iron-dolomite and calcite are the main carbonate minerals contributing to the acid buffering potential of non-carbonaceous spoil. Overall, non-carbonaceous spoil has excess acid neutralising capacity and is expected to be bulk acid consuming.

Total metal and metalloid concentrations from 264 non-carbonaceous spoil samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. Six samples (out of 264) were significantly enriched with regard to one or more of arsenic (As), barium (Ba), mercury (Hg) and/or S. The enrichment in these elements in a very small number of samples is not cause for concern. In summary, non-carbonaceous spoil (as a bulk material) has low enrichment in total metals and metalloids compared to un-mineralised rocks.

Soluble multi-element results (from 264 non-carbonaceous samples) indicate that leachate from this material is expected to contain low concentrations of soluble metals and metalloids. Approximately 11% of these samples (almost all NAF) produced leachate with low-moderate soluble metal and metalloid concentrations under near-neutral to alkaline pH, largely driven by higher concentrations of soluble aluminium (Al) and/or As. Peroxide leaching undertaken on a single non-carbonaceous spoil sample classified as UC(PAF), showed that 'PAF' material, when oxidised, has the potential to generate low pH leachate (AD) with elevated sulfate and soluble metal and metalloid concentrations.

For the key aspects assessed, including acid-base accounting (ABA) components (total S, sulfide [Scr], ANC), total metals and metalloids, and soluble metals and metalloids, the assessment has demonstrated that non-carbonaceous spoil from the Project can be expected to have AMD characteristics that are comparable to non-carbonaceous spoil currently mined at BWM.

Acid and Metalliferous Drainage Potential of Spoil – Carbonaceous

Carbonaceous spoil represents approximately 8% of spoil material at BWM (WHC, 2025) and, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage) similar to non-carbonaceous spoil. Essentially all carbonaceous spoil is fresh (unweathered).

Based on the results from 160 samples, most carbonaceous spoil has a generally low to moderate potential to generate AD and/or NMD and/or SD. Some carbonaceous spoil – mostly associated with coal seams – has a greater potential to generate low-level AD and/or NMD and/or SD.

The total S concentration of carbonaceous spoil is very low to low, with a 95th percentile total S concentration of 0.52%.

Approximately 92% (147 out of 160 samples) of carbonaceous spoil samples were classified as NAF, which includes two samples classified as UC(NAF). The remaining 8% of carbonaceous spoil samples were classified as PAF-LC or UC(PAF), including two samples classified as NAF-S. Three samples had moderate to high total S concentrations (S greater than 1%). Of the 13 samples classified as 'PAF' (of any type), all except two were closely associated with coal seams and could potentially end up as coarse reject if mined with ROM coal.

The test-work undertaken has demonstrated that the ANC for the carbonaceous spoil is generally expected to be about 20-35% available under field conditions (based on 25th and 75th percentile values),

which is only about half that of non-carbonaceous spoil. Mineralogical analysis indicates that iron-dolomite is expected to be the main carbonate mineral contributing to the acid buffering potential of carbonaceous spoil. ANC is only slightly lower, overall, compared to non-carbonaceous spoil, however the much lower availability of the ANC under field conditions in carbonaceous spoil (compared to non-carbonaceous spoil) is likely due to carbonaceous spoil having less calcite than non-carbonaceous spoil coupled with a much higher amorphous (non-crystalline) content and lower overall carbonate content.

Total metal and metalloid concentrations from 39 carbonaceous spoil samples tested are generally very low compared to the average elemental abundance in soil in the Earth's crust, and very similar to the assay concentrations from non-carbonaceous spoil. Seven out of 39 carbonaceous spoil samples – all classified as 'PAF' of some type – were significantly enriched with regard to one or more of As, Hg and/or S – and all seven samples were closely associated with coal seams. The enrichment in these elements in a small proportion of spoil is not cause for concern. In summary, carbonaceous spoil (as a bulk material) has low enrichment in total metals and metalloids compared to un-mineralised rocks.

Soluble multi-element results (from 39 samples) indicate that leachate from carbonaceous spoil is expected to contain generally low concentrations of soluble metals and metalloids – similar to the non-carbonaceous spoil samples. Of the 39 samples, all except three had low soluble metal and metalloid concentrations under pH-neutral to alkaline conditions. Three samples (two NAF and one UC[PAF]) had moderate soluble metal and metalloid concentrations under pH-neutral to alkaline conditions. Two fresh carbonaceous spoil samples, both classified as UC(NAF), underwent peroxide leaching and both were confirmed as NAF, however one of the samples produced leachate with moderate metal and metalloid concentrations.

For the key aspects assessed, including ABA components (total S, Scr, ANC), total metals and metalloids, and soluble metals and metalloids, the assessment has demonstrated that carbonaceous spoil from the Project can be expected to have AMD characteristics that are comparable to non-carbonaceous spoil currently mined at BWM.

Acid and Metalliferous Drainage Potential of Tailings

The geochemical characteristics differed slightly between fresh tailings from the NCPP versus aged tailings from NCPP TSF for different parameters. However, the overall AMD hazard posed by tailings from the two sources (fresh vs aged) was generally similar. As such, the discussion that follows only differentiates between the two tailings sources where the differences between the two sources was significant for some parameters and worthy of discussion. Else, the AMD potential of tailings is discussed as a bulk material.

Based on the results, approximately half of BWM tailings have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, and the remaining half (approximately) have a relatively low potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce tailings with AMD potential similar to fresh tailings currently produced at BWM NCPP.

Fresh tailings from the NCPP are expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage). Overall, aged tailings have lower pH compared to fresh tailings, however the pH in aged tailings was generally pH-neutral to alkaline. The difference in pH observed between fresh and aged tailings (and the differences within the aged tailings) may be due to a number of factors, however the most likely cause is oxidation processes consuming readily available neutralising minerals, leading to aged tailings generally having a low(er) acid neutralising potential.

The total S concentration of tailings ranges from low to high, but is generally low-moderate to moderate, with a 75th percentile total S concentration of 1.04%; with total S in fresh NCPP tailings being only marginally higher than aged tailings. Based on median values, Scr accounts for approximately 69% of total S in fresh NCPP tailings and 50% of total S in aged tailings – the lower proportion of Scr in aged tailings (compared to fresh tailings) is likely due to some sulfide in aged tailings being oxidised to sulfate.

As a bulk material, tailings have generally moderate ANC (median 28 kg H_2SO_4/t); with ANC in fresh NCPP tailings being higher than aged tailings. Combined with low-moderate MPA values (median 21 kg H_2SO_4/t) reflective of the range of total S values, approximately 52% of the tailings samples were classified as NAF or UC(NAF). The remaining 48% of samples were classified as PAF, PAF-LC or UC(PAF), including 4% of tailings samples classified as NAF-S.

The test-work undertaken has demonstrated that the ANC for both fresh and aged tailings (combined) is generally expected to be about 45-68% available under field conditions. However, the 'field availability' of ANC generally ranged from about 20 to 85%. Iron-dolomite and calcite are expected to be the main carbonate minerals contributing to the acid buffering potential of tailings. All tailings have appreciable concentrations of siderite (an iron carbonate mineral), however, siderite provides no net acid neutralising capacity. Overall, carbonate concentrations were similar between fresh and aged tailings.

Total metal and metalloid concentrations from 42 fresh and 14 aged tailings samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. However, about one-quarter of fresh NCPP tailings samples and about half of the aged tailings samples were significantly enriched with S, including two aged tailings samples with significant enrichment in Ag. All of the tailings samples that were significantly enriched in S were classified as 'PAF' of some type.

Solubility data indicate that fresh NCPP tailings samples under freshwater (deionised water) leaching conditions are expected to have low soluble metal and metalloid concentrations and have near-neutral to alkaline pH. For the aged tailings, five of the 20 samples had moderate soluble metal and metalloid concentrations under pH-neutral to alkaline conditions. A further two aged tailings samples (both classified as PAF) produced acidic leachate with highly elevated metal and metalloid concentrations – confirming their PAF classification. These results suggests that, overtime, some tailings can generate AD as field ANC is consumed. Under saline leaching conditions tailings produced low concentrations of soluble metals and metalloids.

Peroxide leaching undertaken on 41 tailings samples (fresh and aged, and about half of the samples classified as 'PAF') showed that when exposed to highly oxidising conditions 'PAF' tailings can produce weakly to highly acidic leachate with moderate to elevated soluble metal and metalloid concentrations. It must be noted that samples with potentially high organic carbon (C-org) concentrations, such as some tailings samples, may be influenced by organic acids producing acidity and correspondingly elevated soluble metal and metalloid concentrations unrelated to AMD. As such, the results for such coaly/carbonaceous samples should be interpreted with this in mind. Nevertheless, 'PAF' tailings have typically produced moderate to elevated soluble metal and metalloid concentrations from the freshwater and peroxide leaching tests. These results indicate that 'PAF' tailings have the potential to generate low pH leachate (AD); however, the salinity (sulfate) loads are not expected to be high – due to generally low total S concentrations (with minor exceptions).

Acid and Metalliferous Drainage Potential of Rejects

The geochemical characteristics differed markedly between fresh and aged rejects for several geochemical parameters – unlike tailings, where the geochemical differences were minor between fresh

and aged tailings. For context, some of the aged rejects sampled from deep within Ramp 36 rejects dump are from the early 1970s, and are 40-50 years older than the fresh NCPP rejects.

Based on the results, fresh NCPP rejects have a low potential to generate AMD as either AD and/or NMD and/or SD. Comparatively, about one-third of aged rejects – more from Ramp 36 rejects dump than NCPP TSF – have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD. The remaining two-thirds of aged rejects have a relatively low to low-moderate potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce rejects with AMD potential similar to fresh rejects currently produced at BWM NCPP.

Fresh rejects from the NCPP are expected to generate highly pH-alkaline contact water (run-off and seepage). Aged rejects have much lower pH compared to fresh rejects and are expected to generate pH-neutral to alkaline contact water (run-off and seepage). The difference in pH observed between fresh and aged rejects may be due to a number of factors, however the most likely cause is oxidation processes in aged rejects consuming readily available neutralising minerals, leading to aged rejects having a low(er) remnant acid neutralising potential.

The total S concentration of fresh rejects is generally low, with a median value of 0.28%. Aged rejects from NCPP TSF generally had low to low-moderate total S values (median 0.46%). Aged rejects from Ramp 36 rejects dump generally had low-moderate total S values (median 0.68%). The reason(s) for differences in total S between the three sources of rejects (NCPP, NCPP TSF and Ramp 36 rejects dump) is unclear. However, the most likely reason is due to changes in geochemistry of ROM coal being processed. That is, ROM coal becoming less S-rich over time due to a change in the relative proportions of the various coal seams/plys being mined and processed.

Based on median values, Scr accounts for approximately 74% of total S in fresh NCPP rejects and 61% of total S in aged rejects – the difference between fresh and aged likely due to sulfide oxidation from the aged samples.

Rejects have generally moderate to high ANC (median 30 kg H_2SO_4/t); with ANC in fresh rejects being generally higher (median 40 kg H_2SO_4/t) compared to aged rejects (median 27 kg H_2SO_4/t). Combined with low to moderate MPA values (median 16 kg H_2SO_4/t), resulted in all of the fresh rejects and about two-thirds of the aged rejects being classified as NAF or UC(NAF). Approximately one-third of aged rejects – predominantly from Ramp 36 rejects dump – were classified as PAF, PAF-LC or UC(PAF), including 11% of aged dump rejects classified as NAF-S.

Test-work indicated that about 50-78% of the ANC in fresh rejects (based on 25th and 75th percentile values) is expected to be available under field conditions; and about 45-56% available for the aged rejects (also based on 25th and 75th percentile values).

Total metal and metalloid concentrations from 13 fresh and 17 aged rejects samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. No fresh NCPP rejects showed significant enrichment in any elements, and four of the aged rejects samples were significantly enriched with S, which is consistent with ABA data for these samples – and all four were classified as 'PAF' of some type.

Solubility data from 32 rejects samples tested (fresh and aged, and most of the samples classified as NAF or UC[NAF]) indicate that leachate from rejects under freshwater (deionised water) leaching conditions is generally expected to have low soluble metal and metalloid concentrations and have near-neutral to alkaline pH, with minor exceptions.

Peroxide leaching undertaken on six aged rejects samples (four classified as 'PAF' and two as UC[NAF]) showed that when exposed to highly oxidising conditions 'PAF' rejects can produce weakly to highly acidic leachate with moderate soluble metal and metalloid concentrations. The results suggest that under acid/acidic conditions, some rejects are capable of generating moderate metal and metalloid loads, however the salinity (sulfate) loads are not expected to be high – due to the generally low total S concentration (with some exceptions).

Acid and Metalliferous Drainage Potential of Coal

Coal is not regarded as waste and ROM coal remains on-site for a relatively short period of time. However, some minor coal seams/plys would report directly as waste, and remnant coal (seams) would be exposed on the highwalls of residual voids at closure.

Coal represents about 7% (on average) of all lithological material at BWM in the vicinity of the Project and about 5-7% of the highwall meterage along the approximate line of the geological long-section. Assuming the large majority of this will report as ROM coal, we can conservatively assume that coal would represent a very small proportion of mineral waste (i.e. nominally 1-2% at the most). Most ROM coal from the Project would be from the same seams as are currently mined at BWM in the vicinity of the Project.

Based on the results, and as a bulk material, ROM coal is conservatively assessed as having a low-moderate to moderate potential to generate AMD as either AD, NMD and/or SD. A small proportion of coal would have a moderate to moderate-high potential to generate AMD. ROM coal, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage).

The total S concentration of coal is generally low; with a median value of 0.22%. Approximately 13% (median value) of the total S is present as sulfide (Scr), with the bulk of the total S likely present as organic S (S-org), which does not contribute to AMD. Coal samples have a wide range of ANC values; however, the median ANC, overall, is low (median 12 kg H_2SO_4/t). As such, 72% of coal samples were classified as NAF or UC(NAF). Of the remaining 28% (approximately) of coal samples, almost all were classified as PAF-LC. Two samples were classified as PAF and one sample classified as NAF-S – noting that the AMD classification is based on total S, which for coal samples likely leads to a highly conservative classification.

Of the 59 coal samples classified as 'PAF' (including NAF-S), all except two samples were from the P and L seam group; with two samples from the T seam group.

These results suggest that coal stored on the ROM pad, coal located within pit walls and un-economic coal seam material reporting as spoil (mixed with non-coal spoil) would likely be bulk NAF. The exception is predominantly coal from the P and L seam group, where it is expected that a small proportion of coal may pose a higher AMD hazard due to the higher S grade. However, it is expected that the bulk AMD source hazard for all coal is low.

Assay data for 37 coal samples show that the total metal and metalloid concentrations are low compared to the average elemental abundance in soil in the Earth's crust. One coal sample was significantly enriched with regard to As and S.

Soluble multi-element results from 37 coal samples tested, with a range of NAF to PAF classifications, indicate that contact water (run-off and seepage) from coal is generally expected to contain low

concentrations of soluble metals and metalloids. One coal sample classified as PAF-LC produced weakly acidic leachate with low soluble metal and metalloid concentrations.

Salinity, Sodicity and Dispersion Potential of Mineral Wastes and Coal

Salinity, Sodicity and Dispersion Potential of Spoil – Non-Carbonaceous

Non-carbonaceous spoil has low median and 95th percentile electrical conductivity (EC)$_{1:5}$ values of 390 and 549 microSiemens per centimetre (μS/cm), respectively, and has very low total S concentrations. On this basis, contact water (run-off and seepage) is expected to be generally non-saline to slightly saline, as a result of dissolution of geogenic salts more so than from sulfide oxidation (sulfate salinity). Weathered non-carbonaceous spoil generally has slightly higher EC$_{1:5}$ values, overall, compared to fresh non-carbonaceous spoil.

Non-carbonaceous spoil has modest cation exchange capacity (CEC) values and high exchangeable sodium percentage (ESP) values, resulting in all samples being classified as 'sodic' to 'strongly sodic' based on CEC and ESP data alone and, therefore, has potential for dispersion. Based on Emerson aggregate class testing to directly measure dispersion, about 56% of the 262 non-carbonaceous samples tested displayed some degree of dispersion. Therefore, based on the CEC, ESP and Emerson aggregate class test results, a significant proportion of non-carbonaceous spoil at BWM and the Project is expected to be sodic and dispersive to varying degrees.

Salinity, Sodicity and Dispersion Potential of Spoil – Carbonaceous

Carbonaceous spoil has low median and 95th percentile EC$_{1:5}$ values of 362 and 547 μS/cm, respectively, and has very low to low total S concentrations. On this basis, contact water (run-off and seepage) is expected to be similar to non-carbonaceous spoil. That is, generally non-saline to slightly saline, primarily as a result of dissolution of geogenic salts more so than from sulfide oxidation (sulfate salinity).

Carbonaceous spoil samples (all fresh) had similar CEC values compared to fresh non-carbonaceous spoil, but generally higher ESP values compared to non-carbonaceous spoil – resulting in all carbonaceous samples being classified as 'strongly sodic', with potential for dispersion. Based on Emerson aggregate class testing to directly measure dispersion, about 52% of the 33 carbonaceous samples tested displayed some degree of dispersion. Therefore, based on the CEC, ESP and Emerson aggregate class test results, a significant proportion of carbonaceous spoil at BWM and the Project is expected to be sodic and dispersive to varying degrees.

Salinity Potential of Tailings

Tailings samples have EC$_{1:5}$ values ranging from 97 to 8900 μS/cm, with median and 95th percentile EC$_{1:5}$ values of 711 and 2070 μS/cm, respectively. Fresh and aged tailings are generally slightly to moderately saline – and both tailings types have generally low-moderate to moderate total S concentrations. Therefore, tailings are generally slightly to moderately saline with a low to low-moderate potential for SD (from sulfide oxidation).

Salinity Potential of Rejects

Rejects samples have EC$_{1:5}$ values ranging from 229 to 2830 μS/cm, with median and 95th percentile EC$_{1:5}$ values of 761 and 2404 μS/cm, respectively. Fresh NCPP rejects were generally non-saline, whereas aged rejects were generally slightly to moderately saline. Overall, as a bulk material, rejects are

assessed as being slightly to moderately saline. Most fresh rejects have low total S concentrations, whereas most aged rejects have low to low-moderate total S concentrations. Therefore, based on the total S concentrations, the potential for SD (from sulfide oxidation) from rejects is low to low-moderate.

Salinity Potential of Coal

Coal has low median and 95th percentile $EC_{1:5}$ values of 103 and 309 μS/cm, respectively; and has generally low total S concentrations. On this basis, contact water (run-off and seepage) from coal, as a bulk material, is expected to be non-saline, either as a result of dissolution of geogenic salts and/or from sulfide oxidation (sulfate salinity).

Management and Mitigation Measures

Spoil Management Strategy

The management of spoil (overburden and interburden) generated by the Project would be consistent with the current approved BWM waste management strategy – comprising the disposal of spoil from the Project into in-pit dumps behind the active mining face, then progressively rehabilitated – with run-off and seepage captured by the mine water management system.

Spoil comprises approximately 99% of the mineral waste at BWM, of which about 92% of spoil is non-carbonaceous. These approximate proportions are expected to continue as mining progresses eastwards into the Project. The assessment has found no difference between the geochemical characteristics of spoil from current BWM compared to the spoil expected to be mined from the Project.

Spoil is overwhelmingly NAF with excess ANC and has a negligible risk of developing AMD, including AD, NMD and/or SD. Furthermore, surface water run-off and seepage from bulk spoil is expected to be non-saline to slightly saline with low soluble metal and metalloid concentrations. However, spoil is expected to be sodic to strongly sodic with potential for dispersion and erosion.

Where highly sodic and/or dispersive spoil is identified it should, wherever practicable, not report to final landform surfaces and should not be used in construction activities. Tertiary spoil has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004 and 2019).

It is unlikely that sodic and potentially dispersive spoil would be able to be selectively handled and emplaced during operation of the Project, as is the case at BWM. Therefore, in the absence of such selective handling, spoil landforms would need to be constructed and progressively rehabilitated to minimise erosion.

Surface water run-off and seepage from spoil, including any rehabilitated areas, should be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major ions and a broad suite of soluble metals and metalloids at high resolution analysis.

With the implementation of the proposed management and mitigation measures spoil is regarded as posing a low risk of environmental harm.

Validation of Spoil Characteristics

The AMD hazard posed by existing spoil at BWM is well understood, and the geochemical characteristics (AMD hazard) of future spoil generated by BWM and the Project are expected to be similar to the current

spoil being produced at BWM. Nevertheless, WHC would continue to undertake geochemical test-work of overburden and interburden throughout development of the Project. Test-work would, at minimum, comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), ABA parameters, S speciation, and total and soluble metals and metalloids analysis at high resolution.

Tailings and Rejects Management Strategy

Fresh tailings and rejects samples from the NCPP are those types regarded as being most representative of current tailings and rejects at BWM and are likely to represent short- to medium-term tailings and rejects expected to be generated in the early years of the Project. Tailings and rejects each comprise approximately 0.5% of mineral waste at BWM; and these approximate proportions are expected to be similar from the Project.

Approximately half of BWM tailings has a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, and the remaining half (approximately) has a relatively low potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce tailings with AMD potential similar to fresh tailings currently produced at BWM NCPP.

Fresh NCPP rejects have a low potential to generate AMD as either AD and/or NMD and/or SD. Comparatively, about one-third of aged rejects have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, with the remaining two-thirds of aged rejects having a relatively low to low-moderate potential to generate AMD. ROM coal from the Project is expected to produce rejects with AMD potential similar to fresh rejects currently produced at BWM NCPP.

At BWM, tailings are currently being disposed into Bonnie Doon in-pit TSF and rejects are currently primarily disposed into in-pit spoil disposal areas within Besgrove and Deep Creek pits. The management of tailings and rejects generated by the Project would be consistent with the current approved strategies for managing tailings and rejects at BWM, including potential future dewatering of tailings and subsequent co-disposal of coal rejects (mixed fine and coarse rejects) into spoil dumps, subject to the conditions of the BWM Environmental Authority.

Validation of Tailings and Rejects Characteristics

The AMD hazard posed by existing tailings and rejects at BWM is well understood, and the geochemical characteristics (AMD hazard) of future tailings and rejects generated by the Project are expected to be similar to the current tailings and rejects being produced at BWM. Nevertheless, WHC would continue to undertake geochemical test-work of tailings and rejects samples during operations at BWM and throughout development of the Project. Test-work would, at a minimum, comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), ABA parameters, S speciation, and total and soluble metals and metalloids analysis at high resolution.

Run-of-Mine Coal

ROM coal is not mining waste, and surface water run-off and seepage from ROM pads would be managed as part of the mine water management system.

ROM coal from BWM is conservatively assessed as having a low-moderate to moderate potential to generate AMD as either AD, NMD and/or SD. A small proportion of coal – mostly from the P and L seam group – would have a moderate to moderate-high potential to generate AMD. ROM coal, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage).

ROM coal is stored for a very short period of time (typically days to weeks) compared to mineral waste materials, which are stored in perpetuity. Management practices are therefore different for ROM coal (compared to mineral wastes) and are largely based around the operational (day-to-day) management of surface water run-off from ROM pads.

Surface water run-off from ROM pads would be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major ions, and a broad suite of soluble metals and metalloids at high resolution analysis.

Blackwater North Extension Project

Geochemical Assessment of Potential Spoil and Coal Reject Materials

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GLOSSARY of TERMS

Acid	A measure of hydrogen ion (H^+) concentration in water; generally expressed as pH.
Acidity	A measure of hydrogen concentration and latent acidity generated by metal hydroxylation, expressed as mg/L.
ABA	Acid-Base Account. Evaluation of the balance between acid generation and acid neutralisation processes. Generally determined by the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below. See also MPA and ANC.
AD	Acid drainage. A component of AMD, AD occurs where drainage is acidic as a result of sulfide oxidation reactions, and contains elevated trace metals and metalloids in solution.
AMD	Acid and metalliferous drainage. AMD has three components: acid drainage (AD), pH-neutral and metalliferous drainage (NMD) and/or sulfide-derived saline drainage (SD) – and/or any combination of these, all generated by sulfide oxidation processes +/- neutralisation reactions.
ANC	Acid neutralising capacity, expressed as kg H_2SO_4 per tonne of rock/material. A measure of a sample's maximum potential ability to neutralise acid.
ANC/MPA	Ratio of the acid neutralising capacity (ANC) to the maximum potential acidity (MPA) of a sample. Used to assess the risk of a sample generating acid conditions. See also ANC and MPA.
BWM	Blackwater Mine.
C-org	Organic carbon.
CHPP	Coal handling and preparation plant. BWM has two CHPPs associated with the northern mining area: the current (operational) CHPP, called NCPP, which is located near the BWM industrial area; and a small thermal coal plant called TCP.
Co-Disposal	The practice of disposing different waste types together. For example, disposing coarse reject amongst spoil.
EA	Environmental Authority. A permit issued by the Queensland Department of the Environment, Tourism, Science and Innovation (DETSI) to allow the EA holder (in this case, Whitehaven Blackwater Pty Ltd and South Blackwater Coal Ltd) to undertake an 'environmentally relevant activity'. Mining is an example of an environmentally relevant activity.
EC	Electrical conductivity, expressed as μS/cm.
Interburden	Potential spoil material located between mined coal seams. See also Overburden, Mineral waste and Spoil.
Kinetic test	Procedure used to measure the geochemical/weathering behaviour of a sample of mine material over time.
Mineral waste	Material comprising mine spoil, ± coarse/fine reject, ± waste coal. Sometimes called 'mine waste' or 'mining waste'.

MPA	Maximum potential acidity. Calculated by multiplying the total sulfur (S) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne of rock/material (kg H_2SO_4/t). Assumes all sulfur is present as sulfide and will oxidise to generate acid.
NAG	Net acid generating test. A pulp sample is reacted with hydrogen peroxide to encourage rapid oxidation. Any acid generated through oxidation may be consumed by neutralising components in the sample. Any remaining acidity (after neutralising material is consumed) is measured and expressed as kg H_2SO_4/t. At the conclusion of the NAG test the resulting liquor is called peroxide (NAG) leachate, and can be analysed for various parameters, such as soluble metals.
NAPP	Net acid producing potential, expressed as kg H_2SO_4 per tonne of rock/material (kg H_2SO_4/t). Calculated by subtracting the ANC from the MPA.
NCPP	North coal handling and preparation plant; the current (operational) CHPP located near the BWM industrial area.
NMD	Neutral and metalliferous drainage. A component of AMD, NMD occurs where drainage is pH-neutral or higher yet contains elevated trace metals and metalloids in solution.
S-org	Organic sulfur.
Overburden	Mineral (mining) waste located above (overburden proper) or between (interburden) coal seams and reports to spoil dumps. Typically comprises non-coaly and non-carbonaceous material, such as sandstone, siltstone and claystone/mudstone, but also includes a small percentage of carbonaceous material (e.g. carbonaceous siltstone) and sub-economic waste coal.
OxCon	Oxygen consumption test. A type of kinetic (dynamic) test for estimating the sulfide oxidation rates, acidity generation rates and carbonate neutralisation rates for sulfidic geological materials.
PAF	Potentially acid forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions. A sample classified as PAF has an acid generating potential (MPA) that exceeds the inherent acid neutralising capacity (ANC) of the material. This means that such a material is likely to generate acidic drainage (AD) if exposed to atmospheric conditions. See also PAF-LC.
PAF-LC	Potentially acid forming (low capacity). Geochemical classification criterion for a sample that has the potential to generate relatively low-level AD.
Ply(s)	The individual coal seams within a seam group and separated by interburden. A seam group is typically comprised of several plys.
Product coal	Coal produced from a CHPP after being washed/processed. Coal that is ready for sale.
Rejects	Coarse sand to cobble-sized rock material produced during coal processing. Rejects are typically associated with the roof, floor and partings of coal seams and are separated from ROM coal in the CHPP. Current rejects produced at BWM are disposed within in-pit spoil dumps in the general vicinity of the NCPP. Historic rejects from NCPP have been disposed into rejects dumps (stockpiles) and within disused pits. Rejects have also been used in construction activities, such as NCPP TSF embankments and used for capping/construction of pads.

Rejects dump	In-pit or out-of-pit landform containing rejects.
Residual void	The term given to an open-pit after mining has ceased and any rehabilitation of the pit has been undertaken (i.e. post-closure).
ROM	Run-of-Mine. The term given to mined coal before being processed at the CHPP.
ROM pad	Location where ROM coal is temporarily stored pending processing at the CHPP.
S	Sulfur.
Scr	Chromium reducible sulfur. Analytical procedure to determine the sulfide-sulfur concentration in a sample. This typically represents the proportion of sulfur associated with sulfide (reactive) minerals.
SD	Saline drainage. A component of AMD, SD occurs where drainage is saline due to elevated sulfate as a result of sulfide oxidation and neutralisation reactions.
SO_4	Sulfate.
Spoil	Rock material overlying and between 'target' coal seams, which reports as waste. Waste rock overlying a coal seam is called overburden. Waste rock between mined coal seams is called interburden. See also Overburden and Interburden.
Spoil dump	In-pit or out-of-pit spoil disposal location.
Static test	Procedure for characterising the geochemical nature of a sample at one point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid-Base Account.
Tailings	Very fine to medium grained sand, silt and clay-sized material, which is commonly coaly and carbonaceous, produced during coal washing. Tailings are associated with coal seams and are separated from ROM coal in the NCPP. Tailings produced at BWM are disposed within Tailings Storage Facilities (TSFs – also called tailings dams).
TSF	Tailings storage facility. A dam or pit used to dispose tailings, which are delivered to the TSF as a slurry. The tailings solid forms a 'beach' and the water drains to one end of the TSF in an area referred to as the decant pond. The decant water is recycled back into the mine water management system. The current (operational) TSF is Bonnie Doon in-pit TSF [active since late 2023]. Prior tailings were disposed into the above-ground NCPP TSF.
Uncertain	In the context of classifying a material or sample as NAF or PAF. An 'Uncertain' (UC) classification applies when there is an apparent conflict in results such that neither NAF nor PAF classification can be given, or there is insufficient information to unequivocally classify as NAF or PAF. UC samples are given a tentative sub-classification as UC(NAF) or UC(PAF) where preliminary data suggests the sample is expected to be NAF or PAF, respectively.
UC(NAF)	In the context of classifying a material or sample as NAF or PAF. A material or sample has an uncertain geochemical classification, but the available data suggests the sample is expected to be NAF.
UC(PAF)	In the context of classifying a material or sample as NAF or PAF. A material or sample has an uncertain geochemical classification, but the available data suggests the sample is expected to be PAF.

Waste coal	Sub-economical coal that reports directly to the spoil dumps as waste (i.e. not ROM coal). Waste coal can be fresh or weathered (oxidised). All weathered/oxidised and coked (cindered) coal is waste.
Water extract	A method to determine the water-soluble parameters in soil. Solid samples undergo a bottle leach method where 10 g of pulped solid (100% passing 212 μm) is combined with 50 grams of water (leaching fluid) into a glass bottle. Depending on the type of leaching undertaken the leaching fluid may be deionised water (DI water extract) or saline water (saline water extract). The 1:5 solution (1 part solid to 5 parts water) is tumbled end-over-end for at least one hour. Solutes are leached from the pulp by the continuous suspension and agitation. The water extract solution is measured for pH and electrical conductivity (EC) prior to filtering for solute analysis (e.g. metals and metalloids, and major ions).

1 Introduction and Context

Terrenus Earth Sciences (Terrenus) has completed a geochemical assessment of potential mineral waste (sub-soil and rock) from the Blackwater North Extension Project (the Project), being developed by Whitehaven Blackwater Pty Ltd, a subsidiary of Whitehaven Coal Limited (WHC). The Project proposes an eastern extension of WHC's existing Blackwater Mine (BWM), as a continuation of BWM operations. The geochemical assessment was completed to assist with mine planning and as part of the environmental regulatory documentation for the Project. The Project setting is shown at Figure 1-1.

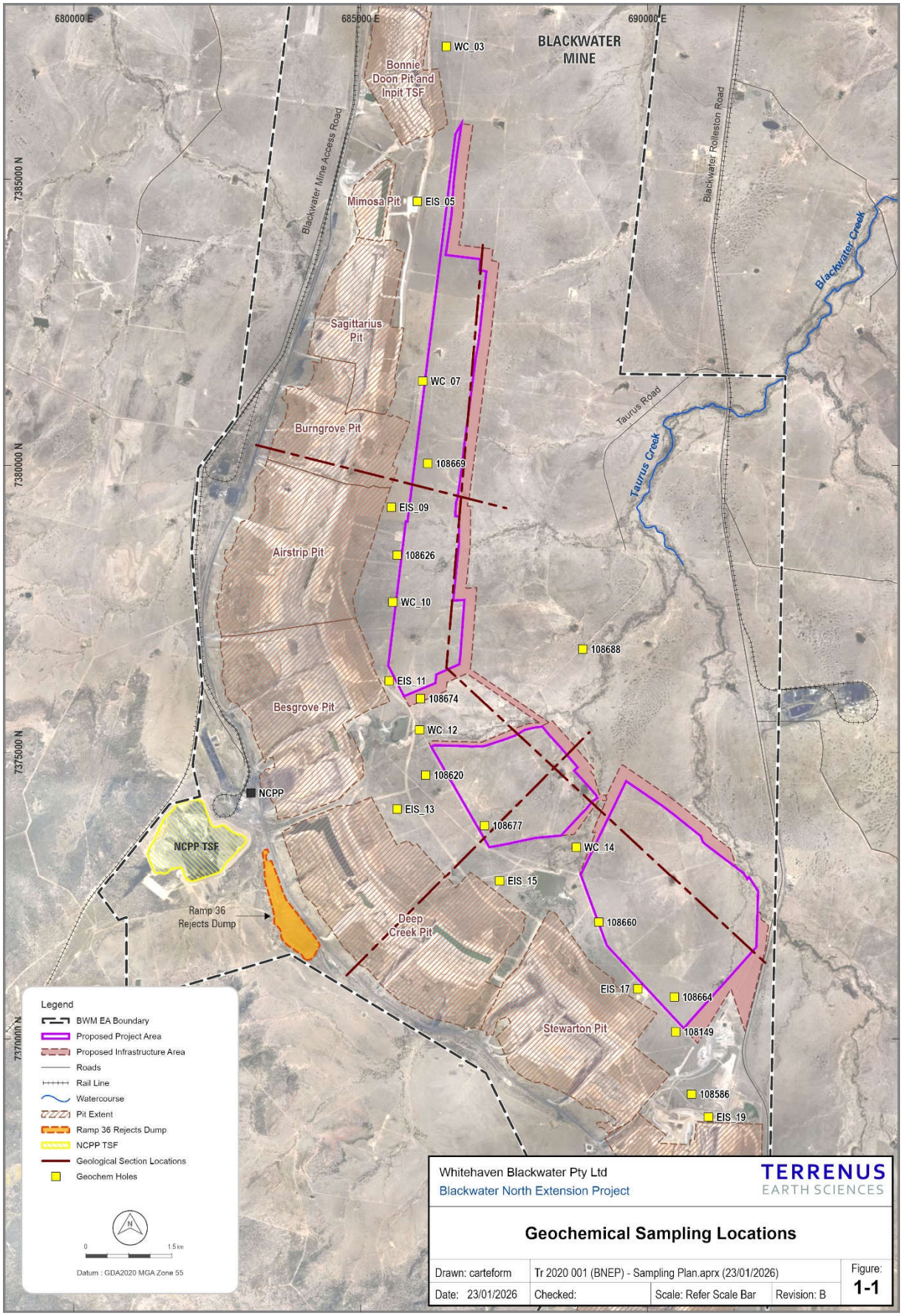
Coal would be mined by conventional open cut methods and spoil (waste rock) would be disposed into in-pit dumps behind the active mining face – as is currently undertaken at BWM. Run-of-mine (ROM) coal would be trucked to the BWM North Coal Preparation Plant (NCPP) for processing – consistent with existing ROM coal processing at BWM. Coal rejects from the NCPP comprising tailings (fine rejects) and coarse rejects would be disposed at BWM under BWM's approved management measures for such materials; including potential future dewatering of tailings and subsequent co-disposal of rejects and dewatered tailings into spoil dumps.

BWM is a very large mine with a strike length of approximately 65 kilometres (km) and is informally divided into two mining areas: north and south, based on historical ownership. The northern area of BWM is the current mining area – from Bonnie Doon Pit at the northern end through to Blackdown Pit at the southern end. Only those facilities associated with the northern mining area are relevant to the Project, as shown in Figure 1-1. The southern mining area and associated facilities are not relevant to this geochemical assessment or the Project.

1.1 Objective

The objective of the assessment (consistent with Condition E14 of Environmental Authority EPML00717813) is to evaluate the geochemical nature of mineral waste currently at BWM and mineral waste likely to be generated by the Project, and identify relevant environmental issues/opportunities that may be associated with mining, handling and storing mineral waste to inform appropriate rehabilitation and management strategies.

Figure 1-1. Geochemical sampling locations



1.2 Material Types and Quantities

BWM has three main types of mineral waste, and the geochemical characteristics and potential hazards associated with mineral waste materials at BWM and the Project are discussed by type:

- Spoil (overburden and interburden) currently comprises approximately 99% of all mineral waste at BWM (WHC, 2025) and includes Tertiary- and Permian-age weathered waste and Permian-age fresh (unweathered) waste. The Project is expected to produce spoil as a similar proportion of mineral waste to that currently produced at BWM. In the northern mining area, which includes the Project, approximately 15% of the spoil is weathered and the remaining 85% (approximately) of spoil is fresh.
- Tailings are (and will continue to be) generated at the NCPP from processing ROM coal; and typically represent the clay, silt and fine sand fractions of ROM waste. Since late 2023, tailings from the NCPP have been disposed as a slurry into Bonnie Doon in-pit tailings storage facility (TSF). Prior to this, tailings from NCPP were disposed as a slurry into the above-ground NCPP TSF (the NCPP TSF is currently inactive). Tailings comprise approximately 0.5% of all mineral waste at BWM – with this approximate proportion expected for the remaining life of asset mine plan at BWM, including tailings generated by processing ROM coal from the Project. The Project would not contain any tailings as all mineral waste from the NCPP would remain at BWM.
- Rejects are (and would continue to be) generated at the NCPP, and potentially a negligible amount from the Thermal Coal Plant (TCP), from processing ROM coal. Rejects typically represents coarser and rockier seam roof, partings and floor material. Rejects are trucked to several locations for disposal into spoil. Historically, rejects were also disposed onto out-of-pit rejects dumps – the main historic rejects dump being Ramp 36 rejects dump. Some rejects have been used in construction of the NCPP TSF embankments and infrastructure pads. Rejects comprise approximately 0.5% of all mineral waste at BWM – with this approximated proportion expected for the remaining life of asset mine plan. The Project would not contain any rejects as all mineral waste from the NCPP (and TCP) would remain at BWM.

Coal is also included in the assessment; however, coal is generally not considered mineral waste, with the exception of small quantities of sub-economic seams that may report to the spoil dumps, and remnant coal exposed on pit highwalls (such as in residual voids).

1.3 Geological Background

The lithology at the Project is consistent with the lithology of the current and future northing mining areas at BWM.

BWM sits on the eastern flanks of the Comet Ridge, a major regional anticline. Throughout most of the northern mining area at BWM the sediments strike north-south and dip gently towards the east with average bedding dips of 3-5 degrees (although there are steeper areas associated with faulting). The lithology at BWM is characterised by typical basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone (typically fine- to medium-grained), carbonaceous sediments and coal seams.

Minor basalt is encountered within Tertiary-age material. At the Project, the depth to base of weathering averages about 17 metres (m) below the natural surface throughout, but ranges from about 10 to 30 m below the natural surface, depending on the local topography.

In coal environments (i.e. at coal mines) fresh carbonaceous materials typically have higher sulfide concentrations compared to fresh non-carbonaceous materials and, as such, typically pose a greater environmental geochemical hazard compared with fresh non-carbonaceous material. Comparatively, non-carbonaceous lithologies are essentially void of (or have a negligible amount of) carbonaceous material and thus have low or nil sulfide mineral concentration. The key exception is that non-carbonaceous materials located within coal seams or immediately above and below (within approximately 0.5 to 1 m of) coal seams tend to have a higher sulfide concentration compared to bulk overburden/interburden located away from seams.

The economic coal seams in the Blackwater area are contained within the late Permian-age Rangal Coal Measures (RCM). BWM currently exposes three principal seam groups from the RCM – called the tops, middles and lowers. The northern mining area predominately mines the lower seam groups (P and L seams) and lesser proportion of the middle (MR) and top (T) seam groups. The seams split and re-join through the mine often creating upper and lower sub-sections of itself, typically called riders (e.g. Top Rider [TR] and Middle Rider [MR]). This splitting is especially evident with the P & L seam group, which splits into upper and lower seams.

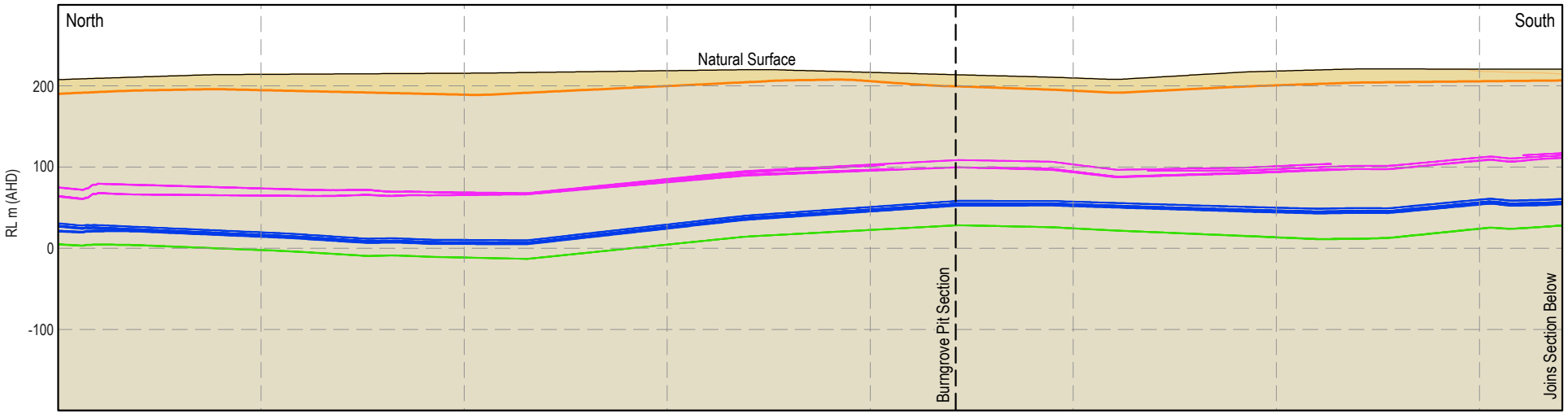
The RCM are overlain by the Early Triassic-age Rewan Formation; and most of the northern mining area is also capped by a thin veneer of Quaternary-age sediments (typically alluvial sediments).

Underlying the RCM is the Late Permian-age Burngrove Formation (which outcrops west of the site) and has geological similarities with the host rock of the RCM.

A geological long-section (indicatively north-south) through the Project is provided in **Figure 1-2**. Geological cross-sections (indicatively west-east) through two of the BWM pits and into the Project area (including current topography) are provided at **Figure 1-3**. The seam groups are shown in the geological sections. The locations of the geological sections are shown in **Figure 1-1**.

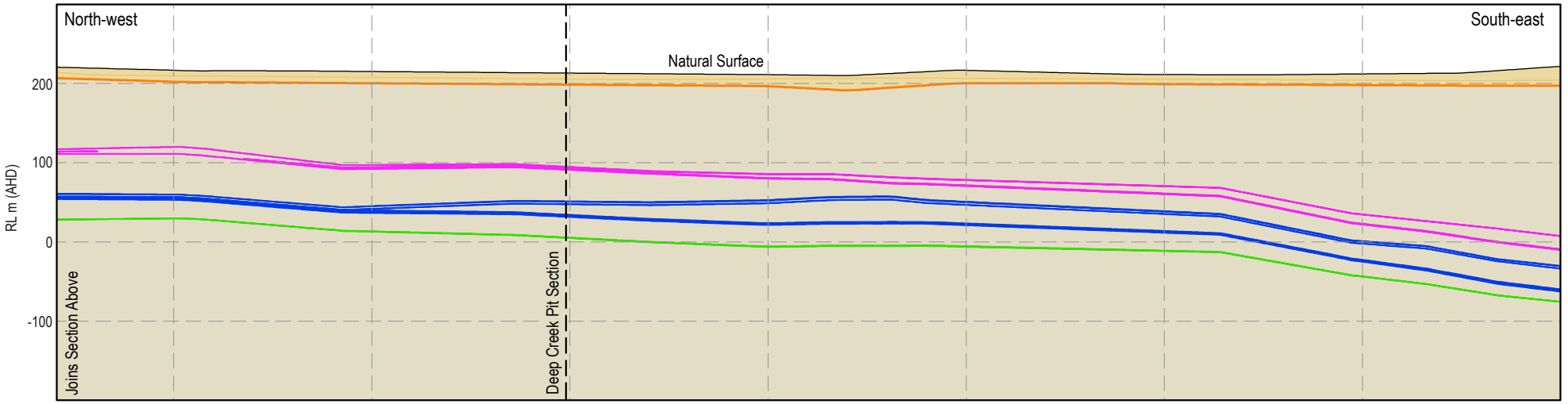
LONG SECTION | Sagittarius Pit to Besgrove Pit

Viewed Looking East



LONG SECTION | Besgrove Pit to Stewarton Pit

Viewed Looking North-west



Legend

- Natural Surface
- Base of Tertiary
- Base of Weathering

Coal Seams

- T Seam Group
- MR Seam Group
- P & L Seam Group
- SG Seam Group

Horizontal Scale

0 (V/H = 4) 800m

Vertical Scale

0 200m

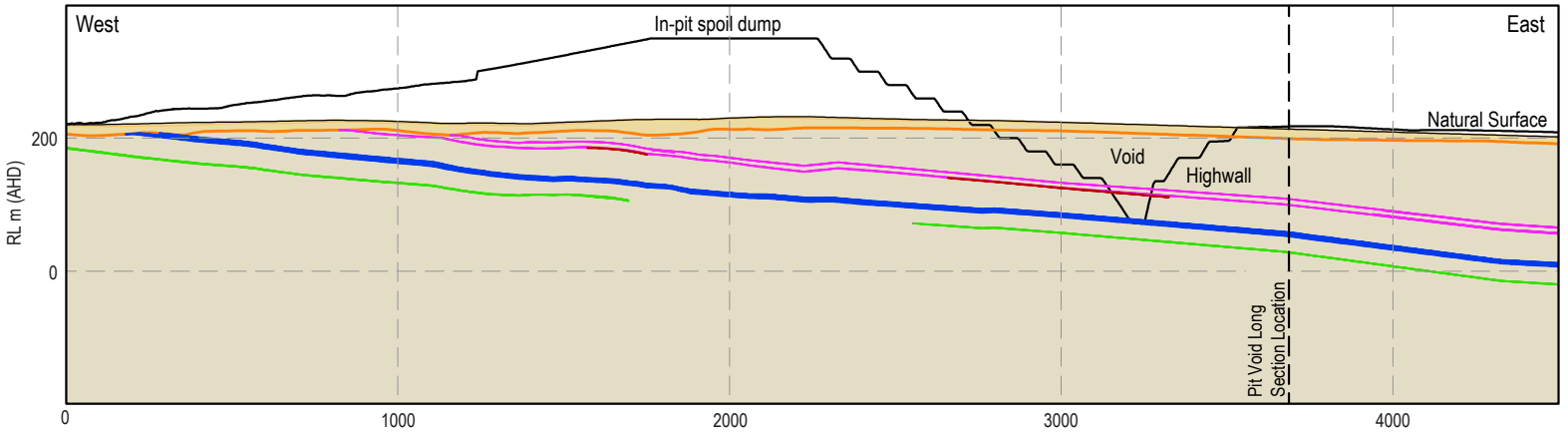
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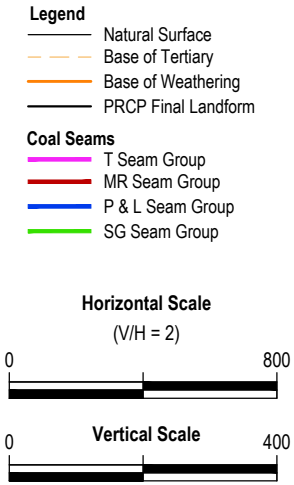
Pit/void highwall long-section

Figure **1-2**

CROSS SECTION | Burngrove Pit

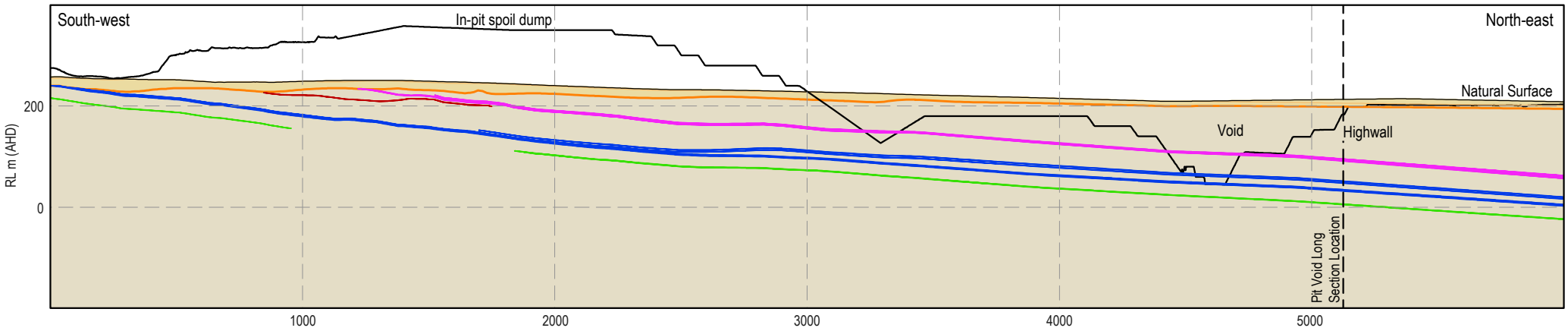
Viewed Looking North





CROSS SECTION | Deep Creek Pit

Viewed Looking North-west



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Pit cross-sections

Figure **1-3**

2 Potential Environmental Geochemical Hazards

2.1 Acid and Metalliferous Drainage

The term 'AMD' is used to describe low-quality seepage or drainage (from soil and rock) that has been affected by the oxidation of sulfide minerals (primarily pyrite and marcasite) and/or by the dissolution of acid generating sulfate minerals and associated neutralisation reactions, if any. The term AMD is used to describe any drainage type affected by this process.

- AMD may be produced when sulfide minerals (such as pyrite) are exposed to oxygen and water. Oxidation of sulfide minerals may result in the production of acid(ity), sulfate (SO_4) and, depending on mineralogy, the release of metals and salinity. AMD comprises three key components, which are defined below as per recognised Australian and international guidelines (International Network for Acid Prevention [INAP], 2009[1], Department of Industry, Innovation and Science [DIIS], 2016[2]).
- Acid drainage (AD): where contact water is acidic and, in most cases, also contains 'elevated' concentrations of metals and metalloids. This drainage type is generated when the acid generating capacity exceeds the acid neutralisation capacity of a sample.
- Neutral and metalliferous drainage (NMD): where contact water is pH-neutral/alkaline and contains 'elevated' concentrations of metals and metalloids. This drainage type is generated when the acid neutralising capacity exceeds the acid generating capacity of a sample.
- Saline drainage (SD): where contact water contains elevated sulfate concentration due to oxidation of sulfide minerals, and very low metal and metalloid concentrations. This drainage type is generated when the acid neutralising capacity vastly exceeds the acid generating capacity of a sample with high sulfide concentration.

Whether contact water is impacted by AD, NMD and/or SD largely depends on the relative proportion of acid generating minerals (sulfide / sulfate) and acid neutralising minerals (carbonate) in the source materials. In this assessment unless specified otherwise, the term AMD is broadly used to describe AD, NMD and/or SD.

2.2 Salinity, Sodicity and Dispersion

An assessment of salinity characteristics of mineral waste materials has been undertaken on materials using available electrical conductivity (EC) data. An assessment of sodicity and dispersion characteristics of potential final landform materials has also been undertaken using exchangeable cation and Emerson Class data from overburden/interburden samples. Salinity released from the dissolution of geogenic salts (non-oxidative) is a separate and distinct process from SD associated with sulfide oxidation.

1 INAP, 2009. Global Acid Rock Drainage Guide. https://www.gardguide.com/index.php?title=Main_Page.

2 DIIS, 2016, Preventing Acid and Metalliferous Drainage. Handbook from Australian Federal Government's Leading Practice Sustainable Development Program for the Mining Industry. https://www.industry.gov.au/data-and-publications/leading-practice-handbook-preventing-acid-and-metalliferous-drainage.

3 Assessment Methodology

This section provides the methodology used for the geochemical assessment of spoil, tailings and rejects (mineral wastes) and coal at BWM and for these same mineral wastes and coal expected to be generated by the Project.

3.1 Information Review

Sampling and laboratory test-work has been undertaken by previous site owners (BM Alliance Coal Operations Pty Ltd [BMA]), WHC and consultants throughout the development and operation of BWM. The BWM geochemical database contains all available geochemical data for mineral waste samples at BWM, including data from drill-holes located within the Project footprint. The geochemical database was provided to Terrenus for this assessment.

The Project proposes to mine the same geologic materials as are currently mined from the existing BWM northern mining area. Therefore, drill-hole, tailings and rejects samples from, or associated with, the current approved northern mining area at BWM are representative of these same materials to be mined from the Project – hence geochemical data from the northern mining area at BWM is representative of materials expected to be mined at the Project.

3.2 Sample Collection

Drill-hole Samples – Representing Spoil, Run-of-Mine Coal, Pit Walls and Pit Floor

All data used to assess spoil, ROM coal (and potentially pit walls and floor) has been derived from drill-hole sampling. Drill-hole samples of relevance to the Project have been collected between 2020 and 2025 from 22 drill-holes located throughout the northern mining area at BWM (Figure 1-1); including one drill-hole (hole 108688) located approximately 1.5 km east of the proposed disturbance area at the Project and approximately 3.5 km east of current Besgrove Pit highwall.

Most drill-holes are distributed along geological strike (approximately north-south) typically within about one km east of the current pit highwalls at BWM and intersect all current and near-future mined geological units. Drill-hole 108688, located east of the Project, intersects the same geological units and coal seams as per the holes closer to the current mining area. As such, the drill-hole samples that have undergone test-work are representative of the geology/stratigraphy at BWM from existing mining (disturbance areas) and the proposed new mining area associated with the Project. At all drill-holes, sampling was undertaken from surface or near-surface to full drill-hole depth (approximately to below the lowest mined seam).

Geochemical data comprising, at a minimum, total S and acid neutralising capacity (ANC) results, is available for 2474 drill-hole samples collected from the 22 drill-holes in the vicinity of the Project (geochemical data from drill-holes away from the Project is excluded from this assessment).

Geochemical samples collected and tested were sourced from the following key mineral waste domains:

- Weathered, non-carbonaceous spoil: 176 samples, identified as "Spoil Weath". No carbonaceous spoil material was encountered or sampled in the drill-holes.
- Fresh, non-carbonaceous spoil: 1924 samples, identified as "Spoil Fresh Non-Carb".
- Fresh, carbonaceous spoil. Carbonaceous samples typically include carbonaceous siltstone, carbonaceous sandstone, carbonaceous mudstone and coaly shale, but also includes similar coaly and carbonaceous materials other than coal: 160 samples, identified as "Spoil Fresh Carb".
- Fresh, coal: 214 samples, identified as "Coal Fresh".

All samples were collected from drill-core. Samples were collected as discrete samples – typically a 20 centimetre (cm) interval of core within targeted sampling zones. Most samples were collected semi-continuously across the entire stratigraphic sequence, with greater emphasis placed on those stratigraphies posing a greater AMD hazard, such as carbonaceous spoil plus material located within and very close to coal seams, which includes roof/parting/floor (carbonaceous and non-carbonaceous), and coal.

Approximately 12% of the spoil samples were sampled close to seams – typically interburden or parting between plys of the same seam group. As such, seam and near-seam zones were proportionally oversampled (relative to sampling of thick overburden/interburden areas well away from seams) to target seam zones that were interpreted as posing a higher AMD hazard compared to general spoil well away from seams. Therefore, this sampling technique is potentially biased towards higher AMD hazard materials.

Most fresh coal would report to ROM coal and be processed. A small fraction of coal would be mined as spoil (waste) due to coal quality and mining considerations, and a small proportion of coal would remain exposed in seams on pit walls and floor at closure. The coal samples discussed herein represent 'pure' coal and do not include non-coal roof, parting and floor samples that would ordinarily be mined with the seam as ROM coal. Carbonaceous roof, parting or floor samples are included in the "fresh, carbonaceous" sample group.

The geochemical sampling locations are shown on **Figure 1-1**. Drill-hole information is provided in **Appendix A**.

Tailings Samples – Representing Very Fine to Fine-Grained Coal Process Waste

Geochemical data is available (within the geochemical database) for 471 tailings samples of relevance to the Project, comprising:

- 305 fresh tailings samples collected from the NCPP (identified as "Tailings NCPP Fresh"); and
- 166 aged tailings samples collected from shallow grab samples and geotechnical investigation drill-holes within NCPP TSF (identified as "Tailings NCPP TSF Aged").

Tailings samples collected from the NCPP are deemed to be representative of fresh tailings currently and recently produced at BWM. Tailings samples collected from NCPP TSF are deemed to be representative of aged tailings within the TSF at BWM.

ROM coal from the Project is expected to produce tailings that are geochemically similar to (consistent with) tailings produced from processing ROM coal from current BWM operations.

Rejects Samples – Representing Mid- to Very Coarse Coal Process Waste

Geochemical data is available (within the geochemical database) for 237 rejects samples of relevance to the Project, comprising:

- 48 fresh rejects samples collected from the NCPP (identified as "Rejects NCPP Fresh");
- 45 aged rejects samples collected from geotechnical investigation drill-holes within NCPP TSF (identified as "Rejects NCPP TSF Aged"); and
- 144 aged rejects samples collected from investigation drill-holes within Ramp 36 rejects dump (identified as "Rejects Dump Aged").

Rejects samples collected from the NCPP are deemed to be representative of fresh rejects currently and recently produced at BWM. Rejects samples collected from Ramp 36 rejects dump, primarily, and other rejects (e.g. NCPP TSF embankments) are deemed to be representative of aged rejects that may be found at older rejects disposal areas. Ramp 36 rejects dump was operational between approximately 1967 and 2007. Since 2007, rejects from NCPP have primarily been disposed into in-spoil rejects dumps within the Besgrove and Deep Creek pit shells.

ROM coal from the Project is expected to produce rejects that are geochemically similar to (consistent with) rejects produced from processing ROM coal from current BWM operations.

3.3 Sample Characterisation

The aim of the environmental geochemical test-work is to understand the geochemical characteristics of the mineral waste materials with respect to AMD, geogenic salinity, erosion and dispersion potential; and to inform management and closure options for these materials.

A phased approach was implemented to define the geochemical behaviour of the key material types generated at BWM (and expected to be generated at the Project), as discussed below.

Solid Samples – Static Tests

Samples have generally undergone similar test-work methods. Test-work was generally undertaken in stages, with most samples being subjected to 'screening' tests followed by more detailed test-work undertaken on selected samples. Almost all samples have undergone 'screening' tests (stage 1 tests) for:

- pH and electrical conductivity (EC) on 1:5 weight:volume (w:v) water extract – an end-over-end bottle leach at 1:5 w:v solid:water ratio using deionised water. The procedure was undertaken on pulped samples (100% passing 212 microns).
- Net acid producing potential (NAPP) test, which comprises total S and ANC determination. The NAPP test provides the fundamental information about the theoretical maximum amount of acid-producing and acid-neutralising material that a sample could produce.

Based on the results of the screening tests, selected samples were subjected to some or all of the following tests:

- Total carbon (total C), and organic carbon (C-org);
- Total sulfate (SO_4);
- Sulfide (chromium reducible sulfur – Scr) – a test to determine the proportion of total S present as sulfide;
- Acid buffering characterisation curve (ABCC) – a test to determine the proportion of ANC that's in a readily-available form, and to provide an indication of the carbonate mineralogy of the neutralising material;
- Net acid generation (NAG) (single addition) – a test that encourages the oxidation of a sample to determine if acid can be produced, and how much acid could be produced;
- Sequential net acid generation test (S-NAG) – a refinement of the single addition NAG test to resolve potential issues associated with incomplete oxidation of samples with high sulfide concentration;
- Extended boil net acid generation test (NAG extended) – a refinement of the NAG test to resolve uncertainty due to potential organic acid interference (where non-acid generating organic acids can provide false positive results in the NAG test);
- Total metals and metalloids by 4-acid (mixed) or 2-acid (aqua regia) digest with analysis by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and/or Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) and Flow Injection Mercury System (FIMS);
- Quantitative x-ray diffraction (QXRD) – to determine the mineralogical composition;
- Short-term leaching tests, including:
    - Deionised water extract leach procedure – a one hour end-over-end bottle leach at 1:5 w:v (solid:water) ratio using de-ionised water, with filtered leachate analysed for:
        - major and minor ions (calcium [Ca], magnesium [Mg], sodium [Na], potassium [K], SO4, chloride [Cl] and fluoride [F]);
        - alkalinity (total alkalinity, bicarbonate [HCO_3] and carbonate [CO_3]) and acidity (pH dependent);
        - soluble metals and metalloids (approximately 28 elements by ICP-MS, ICP-AES and FIMS).
    - Saline water extract leach procedure – a one-hour end-over-end bottle leach at 1:5 w:v (solid:water) ratio using saline water (2 g/L sodium chloride [NaCl]), with filtered leachate analysed for the soluble analytes listed above.
    - Peroxide (NAG) leach – analysis of the solution on completion of the NAG or NAG Extended test, with filtered leachate analysed for the same (or similar) suite of soluble analytes as listed above.
- Exchangeable cations (Ca, Mg, Na, K) with pre-treatment for salinity, if required. Results were used to calculate the cation exchange capacity (CEC); and
- Emerson Aggregate Class testing.

For most samples, laboratory test work was undertaken by ALS Environmental (ALS) Brisbane, using National Association of Testing Authorities (NATA) accredited methods (where such accreditation exists). Mineralogical analysis (QXRD) was undertaken by a university (research) mineralogical laboratory in Melbourne (via Earth Systems Consulting).

Solid Samples – Kinetic OxCon Tests

Oxygen consumption and carbon dioxide (CO_2) generation test-work (referred to herein as OxCon tests) was undertaken by Earth Systems (Melbourne) on five fresh tailings samples from NCPP, one aged tailings sample collected from NCPP TSF, and three composite carbonaceous spoil samples from drill-cores. The samples were selected on the basis of earlier static test results.

OxCon is a laboratory-scale kinetic geochemical test for the estimation of sulfide oxidation rates, acidity generation rates and carbonate neutralisation rates for sulfidic geological materials.

Prior to the OxCon test the sample is 'washed' to remove any pre-existing salts and oxidation products (e.g. sulfate). Test-work then involves isolating a known mass of sulfide-bearing material in a known volume of oxygen inside a sealed vessel and allowing sulfide oxidation to proceed. Once the test is initiated, oxygen in the vessel is consumed via sulfide oxidation. Oxygen consumption is measured directly and logged over the test-work period (1-8 weeks, depending upon the sample). CO_2 generation is measured hourly and logged to estimate of the extent of acid neutralisation by carbonate minerals or the rate of biological C-org oxidation, if any, during testing.

At the conclusion of the OxCon test, the solid undergoes a bottle leaching procedure at a 1:2 w:v (solid:water) ratio and the leachate was analysed to determine the pH, acidity/alkalinity and concentration of soluble metals and metalloids, and salts.

Solid Samples – Kinetic Leaching Tests

Free-draining kinetic column leaching data is available for five fresh NCPP tailings samples and one aged tailings sample collected from NCPP TSF. The samples were selected for column leaching test-work on the basis of earlier static test results. These are the same tailings samples that also underwent OxCon test-work.

Column leaching is a laboratory-scale kinetic geochemical test for the estimation of sulfide oxidation rates, acidity generation rates and element leaching – over time – for geological materials. The intent of the column leaching program was to characterise leachate from samples subjected to routine wetting and drying cycles, which simulates exposure to 'atmospheric conditions'. Crushed samples are loosely packed into a two litre funnel and a known quantity/mass of deionised water is slowly added to the top of each sample and the water allowed to slowly free-drain through the sample matrix and collected as 'column leachate'. The leachate collected from each column test was analysed to determine the pH, acidity/alkalinity, and concentration of soluble metals and metalloids, and salts. Between leaching (wetting) events the sample matrix was allowed to dry and oxidise using heat lamps. The column leaching test method was based upon a modified AMIRA (2002) method.

Tailings Liquor Samples

Tailings samples collected from the NCPP are collected as a slurry – representative of the tailings slurry that reports to TSFs for disposal. At the TSF the water drains to one end of the TSF, called a decant pond/area, and is collected for re-use in the NCPP. Geochemical data is available (in the geochemical

database) for tailings liquor from 51 sampling events undertaken at the NCPP between August 2020 and August 2023. The liquor samples were analysed for a typical suite of water quality parameters, such as pH and EC, major ions, and soluble metals and metalloids.

3.4 Geochemical Source Hazard Assessment

Geochemical data was assessed with regard to the samples potential to generate AMD. Only after making such an assessment to understand the potential AMD hazard can appropriate AMD specific management measures be formulated to adequately mitigate the risks, as required.

Acid and Metalliferous Drainage Classification

The Acid-Base Account (ABA) method was used to assess the acid-neutralising and acid-generating characteristics of the samples in order to determine an acid (AD) classification for the rejects.

The maximum potential acidity (MPA) and ANC represent each side of the acid-base account. MPA is calculated from total S and is the theoretical maximum potential acidity that can be generated if all of the S, assumed to be associated entirely with pyritic sulfide, is able to oxidise and generate acid (H_2SO_4). ANC represents the theoretical maximum amount of acid-neutralising capacity of a sample assuming all neutralising material is in a readily available form. The net acid producing potential (NAPP) is the difference between the MPA and the ANC. In simple terms, a negative NAPP indicates an excess of ANC and the sample is likely to be non-acid forming (NAF) and a positive NAPP indicates an excess of MPA and the sample is likely to be potentially acid forming (PAF) – though there can be exceptions to this simplified interpretation. Note that NAF samples have the potential to generate NMD and SD, depending on the sulfide concentration.

Sample classification of mineral wastes follows some general rules. Samples were initially classified using total S, NAPP and ANC/MPA ratio (and NAG data, where available), into three broad categories:

- **NAF:** Non-acid Forming;
- **PAF:** Potentially Acid Forming; and
- **Uncertain (UC):** Those samples with inconclusive results, leading to a degree of uncertainty about their ability to generate acid.

Where available, additional geochemical information such as pH, Scr, ABCC, NAG extended and NAG sequential results were used to resolve acid classification uncertainties. The general approach was to build in a level of conservatism in the preliminary classification, as shown in **Table 3-1**.

Samples with a UC classification are given a tentative sub-classification of UC(NAF) or UC(PAF), where preliminary data suggests the sample is expected to be NAF or PAF, respectively.

Table 3-1. Preliminary acid and metalliferous drainage classification criteria

Preliminary Classification	Sulfur %	NAPP kg H_2SO_4/t	ANC/MPA ratio	NAG pH (if data available)
NAF	≤ 0.01	-	-	-
	≤ 1	< 0	≥ 2	-
	≤ 1	< 0	-	≥ 4.5
NAF-Sulfur (NAF-S)	> 1	< 0	≥ 2	-
	> 1	< 0	-	≥ 4.5
PAF – Low Capacity (PAF-LC)	≤ 1	≥ 0 and < 10	< 2	-
	-	≥ 0 and < 10	-	< 4.5
PAF	-	≥ 10	< 2	-
	-	≥ 10	-	< 4.5
Uncertain	Any result outside of the above criteria, or results that appear to significantly conflict with the expected result based on lithology			

Sulfur Category

To ensure a consistent approach to describe the samples geochemical characteristics, specific total S cut-off values were used to discuss S data, as shown in Table 3-2.

Table 3-2. Sulfur category

Sulfur category	Total S (wt. %)	Sulfur category	Total S (wt. %)
Very low	< 0.1	Moderate	1.0 – 1.5
Low	0.1 – 0.5	High	> 1.5
Low-moderate	0.5 – 1.0		

Acid Neutralising Capacity Category

To ensure a consistent approach to describe the samples geochemical characteristics, specific ANC cut-off values were used to discuss ANC data as shown in Table 3-3.

Table 3-3. ANC category

ANC category	ANC (kg H_2SO_4/t)	ANC category	ANC (kg H_2SO_4/t)
Very low	< 5	High	30 - 50
Low	5 - 15	Very high	> 50
Moderate	15 - 30		

Soil Salinity

The term 'soil' salinity (and 'soil' pH – refer below) is an industry-adopted term to refer to the salinity and pH measured on any solid geologic matrix, such as soil, spoil, rock, sediment, tailings, reject, *etc*. That is, in this context, the term 'soil' applies to all solid samples, not just shallow surface (root zone) material.

Classifying whether a sample is non-saline, highly saline, or somewhere in between will depend upon the methods used to measure soil salinity. Soil salinity data is obtained from a 1:5 (w:v) water extract procedure on pulp samples (pulping the sample minimises the potential to underestimate salinity of sandy samples/materials). The soil salinity classes shown in Table 3-4 are expressed in units of microSiemens per centimetre (μS/cm) and are based on a 1:5 w:v method. These soil salinity classes are used as an indicative guide. The classes are broadly based on soil salinity classes reported by DME (1995).

Table 3-4. Soil salinity classification

Soil salinity classification	EC1:5 (µS/cm)	Soil salinity classification	EC1:5 (µS/cm)
Non-saline	< 450	Saline	2000 - 4000
Slightly saline	450 - 900	Strongly saline	> 4000
Moderately saline	900 - 2000	--	--

Soil pH Type

Classifying whether a sample is acid, pH-neutral or alkaline (or somewhere in between) depends upon the methods used to measure soil pH. Soil pH data is obtained from a 1:5 (w:v) water extract procedure on pulp samples. The soil pH types shown in Table 3-5 are used as an indicative guide.

Table 3-5. Soil pH type

Soil pH type	pH1:5	Soil pH type	pH1:5
Highly acid	< 3.0	Near neutral	6.0 – 7.5
Moderately acid	3.0 – 4.5	Alkaline	7.5 – 9.0
Weakly acid	4.5 – 6.0	Highly alkaline	> 9.0

Mineralogy

Potential Mineralogical data (QXRD) provides supporting information for the geochemical data, particularly with regard to sulfide and carbonate mineralogy of a sample, showing results for mineralogical forms (e.g. what sulfide or carbonate minerals are present) and their concentrations (reported in weight per cent [wt.%]). These data are also used to validate the results from ABCC test-work and assist with interpretation of the ABA data.

Element Enrichment

The total concentrations for each element were compared to the average elemental abundance in soil in the Earth's crust (Australian Institute of Mining and Metallurgy [AusIMM] 2011; Bowen 1979) to measure how the total elemental concentrations in the samples compare against average elemental concentrations in un-mineralised soil (worldwide). Such a comparison is undertaken to identify samples that contain what may be regarded as 'elevated' concentrations of metals and metalloids to identify potential elements of concern. However, enrichment in any metals and metalloids in the solids does not directly translate to enhanced leachability or mobilisation and/or bioavailability of that specific element.

From the comparison with average crustal abundance in rocks a geochemical abundance index (GAI) was calculated. The GAI quantifies an assay result for a particular element in terms of the average

abundance for that element (in sedimentary rocks). The index, based on a log 2 scale, is expressed in seven integer increments (0 to 6), which correspond to enrichment factors from 0 to over 96 times average crustal abundance, as shown in Table 3-6.

Table 3-6. Geochemical abundance index

GAI	Enrichment factor	GAI	Enrichment factor
0	Less than 3-fold enrichment	4	24 to 48-fold enrichment
1	3 to 6-fold enrichment	5	48 to 96-fold enrichment
2	6 to 12-fold enrichment	6	Greater than 96-fold enrichment
3	12 to 24-fold enrichment		

As a general rule, a GAI greater than or equal to three indicates enrichment compared to un-mineralised soil/rock that may warrant further investigation to assess the mobility of these elements under laboratory conditions.

Elements identified as enriched may not necessarily be a concern for revegetation and rehabilitation, human and animal health or drainage water quality. Similarly, if an element is not enriched it does not mean it would not be mobilised, because under some conditions (e.g. low pH, reducing conditions) the geochemical behaviour of metals and metalloids such as aluminium (Al), arsenic (As), copper (Cu), cadmium (Cd) and zinc (Zn) can change (i.e. become less or more mobile).

Solubility

Metal and metalloid mobility from samples has been assessed using deionised water and peroxide (NAG) leaching methods. The deionised water leaches assess the initial solubility under fresh water conditions, whereas the peroxide leach assesses the solubility after the samples have been oxidised.

The solubility data from bottle leaching provides an indication of likely solubility/release of salt, and metals and metalloids under field pH and redox (oxidation) conditions (and/or low-pH conditions, where applicable). Peroxide (NAG) leachate data provides an indication of potential acidity and concentrations of metals and metalloids that could be released from samples that are fully and rapidly oxidised. This test provides an assumed 'worst case' scenario in terms of metal and metalloid mobility.

To ensure a consistent approach to describe the samples geochemical characteristics, specific concentration cut-off values were used to discuss leachate composition as shown in Table 3-7.

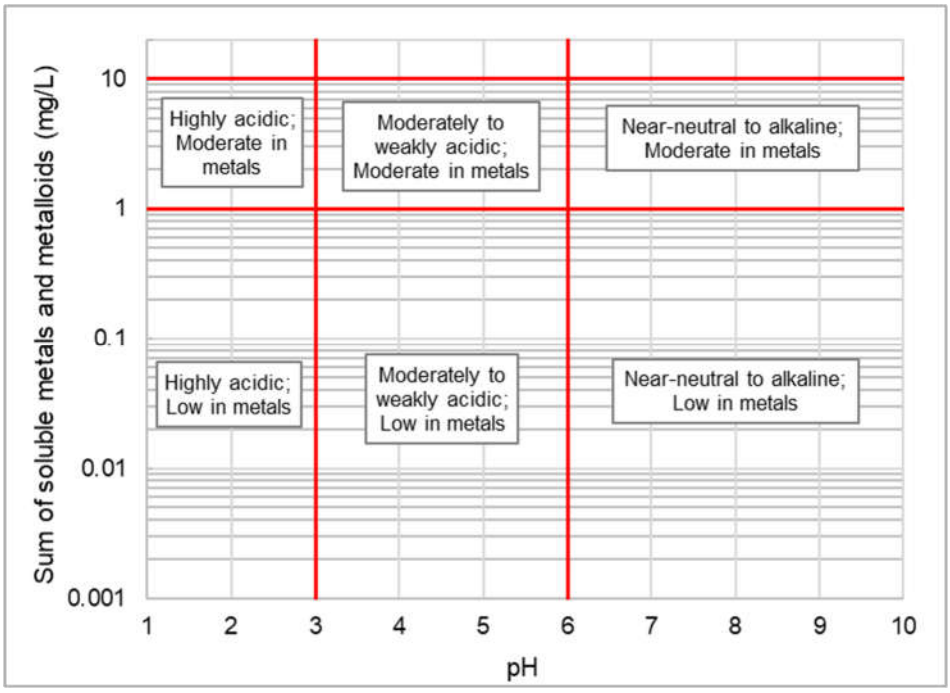
Table 3-7. Soluble trace element concentration category and associated cut-off values

Classification	Trace element soluble concentration (mg/L)	Classification	Trace element soluble concentration (mg/L)
Close to detection	≤ 0.001	Moderate	>0.1 – 1.0
Very low	>0.001 – 0.05	High	> 1.0 - 10
Low	>0.05 – 0.1	Very high	> 10

A classification scheme initially developed by Ficklin *et al*. (1992) has been adapted to summarise major attributes of the solubility data by plotting pH against the sum of soluble metal and metalloid concentrations for groups of elements, with the classification scheme shown in Figure 3-1. The soluble

metal and metalloid concentrations are shown as the sum of soluble (dissolved) metal and metalloid concentrations for Al, antimony (Sb), As, Cd, cobalt (Co), chromium (Cr), Cu, lead (Pb), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), uranium (U) vanadium (V) and Zn. These elements are chosen because they're potentially environmentally important elements (as relevant to Permian coal deposits) and/or many of the elements remain in solution across a wide range of pH and are not only associated with AD conditions, but also with NMD/SD conditions.

Figure 3-1. Classification of soluble metals and metalloids as a function of pH



No comparison is made between leachate results and water quality guideline values, such as Australian and New Zealand Guidelines [ANZG] (2018) (or the draft ANZG 2023 guidelines), as such a comparison is inappropriate. The guideline values provided in ANZG (2018/2023) are for receiving water environments (e.g. creeks), whereas the soluble element data in this assessment is 'point source' obtained from a finely pulped sample subjected to rigorous and artificial extraction to obtain a concentration approaching 'near maximum'. Furthermore, contact water will undergo a number of geochemical reactions along a pathway from source to receptor, including retardation, adsorption and precipitation. Dilution is also likely, which would attenuate the concentration as seepage/contact water migrates from the source. These processes are not accounted for in a laboratory setting.

Sodicity and Dispersion

Potential spoil samples (representing material that is likely to report to final landform surface) are broadly classified with respect to sodicity on the basis of the exchangeable sodium percentage (ESP) value, as shown in Table 3-8 (after Northcote and Skene, 1972; and Isbell, 2002).

The sodicity will depend upon a range of factors, such as clay mineralogy, soil sodium concentration, soil salinity and irrigation water (rainwater) chemistry, which may enhance or limit that potential for soil to be sodic or become sodic over time. Therefore, values of 6% ESP and 14% ESP to represent soils as being sodic or strongly sodic are used as a general guide only and should not be taken as definitive. Sodicity assessments only apply to materials likely to report to final landform surfaces, such as overburden/interburden (i.e. not rejects, tailings or waste coal).

Table 3-8. Sodicity classification

Sodicity classification	ESP (%)
Non-sodic	≤ 6
Sodic	6 - 14
Strongly sodic	> 14

Sodicity information is broadly used to understand potential revegetation and dispersion aspects, and is supported by Emerson aggregate test information, which provides a direct measure of soil slaking and dispersion based on the Standards Australia (2017) classification. Soils are divided into classes on the basis of their coherence in water and presence (or absence) of calcium-rich minerals (Table 3-9). Slaking occurs when dry soil crumbs, after being immersed in deionised water, break up and run along the bottom of the beaker into a flat pile. Most dry soil crumbs slake when immersed in deionised water. Dispersion describes the tendency for the clay fraction of a soil to go into colloidal suspension in deionised water. Materials are generally regarded as being dispersive (or prone to dispersion) if they have an Emerson aggregate class number of three or less.

Table 3-9. Emerson classification

Class	Description	Class	Description
1	Slaking and complete dispersion	5	No calcite or gypsum present; dispersion
2	Slaking and some dispersion	6	No calcite or gypsum present; flocculation
3	Dispersion (remoulded)	7	Non-slaking and swelling
4	Calcite or gypsum present; no dispersion	8	Non-slaking and non-swelling

Using Coal Quality Data for Acid and Metalliferous Drainage Classification

Coal quality data has been used to aid with the assessment of AMD hazard associated with coal seams. In particular, the BWM coal quality database was used to supplement the geochemical database and provide additional understanding of the AMD potential of likely ROM coal, remnant coal, waste coal and rejects. Coal plys were grouped into their respective seam groups on a per-pit basis, such as T, MR, P & L Upper, P & L Lower for each pit group.

Total S concentration can be used conservatively to assess the AMD hazard for any given sample; thus, statistical analyses were conducted on total S as a function of seam group and for all seams combined to define the AMD hazard of coal. The data was used to understand the S grade range for each seam group to gain an understanding of the potential AMD hazard posed by each coal seam group. The results were then compared with detailed geochemical data available for coal to 'calibrate' the coal quality total S data.

Acid producing sulfate minerals, such as jarosite, may be present within weathered coal and carbonaceous material, however, mineralogical data available from BWM shows that jarosite is an insignificant mineral at BWM.

4 Results

The geochemical results are discussed herein, and are graphically presented by way of comparison between the different mineral waste types.

4.1 Mineralogy

Data is available for 44 samples that underwent mineralogical analysis by QXRD. The samples comprised 21 spoil samples from exploration drill-holes, 22 tailings samples (fresh and aged) and one aged rejects sample. The samples were selected to cover a broad range of mineral waste types. The results are summarised in Figure 4-1 for spoil samples and Figure 4-2 for tailings and rejects samples.

Across the material types tested, the key acid generating mineral is pyrite (+/- marcasite), and the key acid neutralising minerals are iron-dolomite (ankerite-dolomite), calcite and lesser rhodochrosite (a manganese carbonate mineral). All samples have appreciable concentration of siderite (an iron carbonate mineral), however, siderite provides no net acid neutralising capacity. In particular:

- Spoil samples are dominated by clay and quartz minerals (silicate group minerals) with variable contributions of non-crystalline (amorphous) material, carbonate and other silicate minerals. Amorphous (non-crystalline) material was detected in most spoil samples, and was generally present in greater proportions in the carbonaceous samples (median 18%) compared to the non-carbonaceous spoil (median 6%). The nature of the non-crystalline material is largely unknown, although for carbonaceous spoil it's likely associated with C-org.
- Tailings and rejects samples are dominated by clay and quartz minerals (silicate group minerals) and non-crystalline (amorphous) material, with variable contributions of carbonate and other silicate minerals. Generally, the fresh tailings samples had a greater proportion of amorphous (non-crystalline) material (median 40%) compared to the aged tailings (median 15%). The nature of the non-crystalline material in tailings and rejects is likely associated with C-org.
- Spoil samples have low sulfide mineral proportions (median 0.3%). Comparatively, tailings samples have higher sulfide mineral proportions (median 1.1%), of which the aged tailings had generally higher sulfide proportions compared to fresh tailings. Sulfide minerals, where present, are represented by pyrite, which was detected in all samples, and marcasite, which was detected in approximately 38% of spoil samples and 83% of tailings and rejects samples.
- Spoil samples (all fresh) have very low sulfate mineral concentrations (median 0.2%, and present in 14 samples), with sulfate present as jarosite. Aged tailings samples have higher sulfate mineral concentrations (median 1.0%), with sulfate preset in all of the aged tailings and rejects samples. The main sulfate minerals observed in aged tailings (and the aged rejects sample) are jarosite, bassanite, gypsum and/or barite – the presence of these minerals (especially jarosite) suggests that sulfide oxidation has occurred. Fresh tailings have no sulfate present.
- Overall, carbonate group minerals predominantly comprise iron-dolomite, calcite and siderite in variable proportions, with lesser rhodochrosite. ABCC data suggested that iron-dolomite (i.e. ankerite), dolomite and siderite were the likely dominant carbonate minerals, which is broadly consistent with the mineralogy data.

- In non-carbonaceous spoil iron-dolomite, calcite and siderite are the main carbonate minerals. In carbonaceous spoil, iron-dolomite and siderite are present in similar proportions to non-carbonaceous spoil, however calcite concentrations are much lower.
- Carbonate concentrations were generally similar between fresh NCPP tailings samples compared to aged NCPP TSF samples, although the aged samples had a much greater range of carbonate proportions compared to fresh tailings – the highest being two aged tailings samples from NCPP TSF containing 24% and 29% carbonate, present mostly as siderite in both samples.

Figure 4-1. Mineral distribution within spoil samples

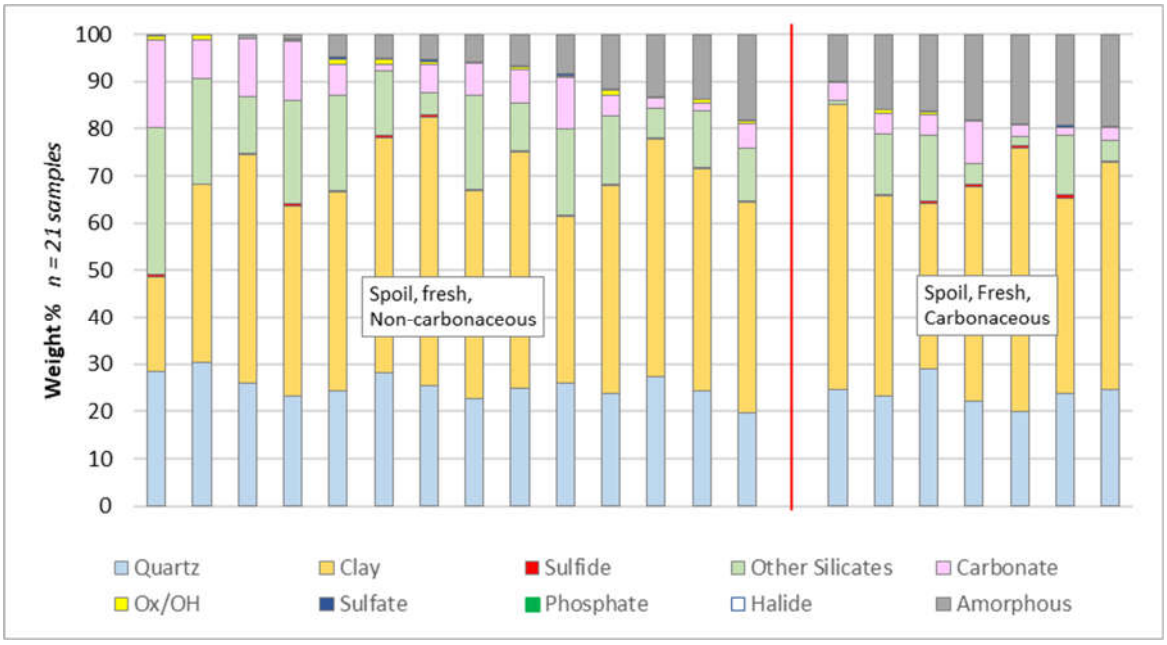
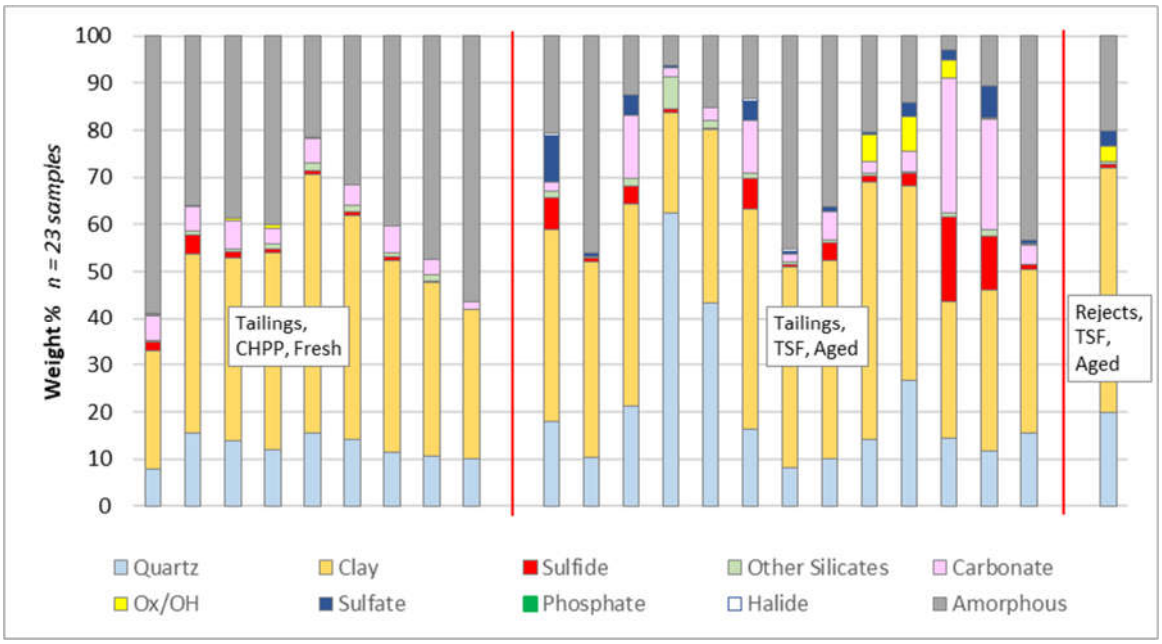


Figure 4-2. Mineral distribution within tailings and rejects samples



4.2 Acid-Base Accounting (Potential for Acid Generation)

ABA is a theoretical balance between the potential for a sample to generate acid and neutralise acid, and is expressed in units of kilograms of sulfuric acid per tonne of sample (kg H_2SO_4/t). The ABA results are statistically summarised in **Table 4-1** (spoil), **Table 4-2** (tailings and rejects) and **Table 4-3** (coal) and discussed. As explained in **Section 3.3**, not all samples were subjected to all tests.

Table 4-1. Acid-base accounting results statistics for spoil samples

		Total S[1]	Scr[2]	ANC	MPA	NAPP	ANC/MPA	NAGpH[3]
		%	%	kg H2SO4/t			ratio	pH units
Spoil Weath. Non-carbonaceous	Count (n)	176	97 (97)	176	176	176	176	1
	Maximum	0.35	0.03 (0.35)	408	11	-0.8	2266	-
	95th percentile	0.04	0.02 (0.04)	124	1.2	-8.0	538	-
	75th percentile	0.02	0.01 (0.02)	49	0.6	-16	196	-
	Median	0.01	0.01 (0.01)	25	0.3	-24	85	10.0
	25th percentile	<0.01	0.01 (<0.01)	16	<0.3	-49	39	-
	5th percentile	<0.01	<0.01 (<0.01)	8.2	<0.3	-123	17	-
	Minimum	<0.01	<0.01 (<0.01)	4.7	<0.3	-407	1.1	-
Spoil Non-carbonaceous	Count (n)	1924	602 (602)	1924	1924	1924	1924	39
	Maximum	1.84	1.67 (1.84)	842	56	44	3546	11.2
	95th percentile	0.09	0.11 (0.16)	214	2.8	-15	368	10.6
	75th percentile	0.04	0.03 (0.05)	80	1.2	-26	110	10.1
	Median	0.03	0.03 (0.03)	48	0.9	-47	56	8.4
	25th percentile	0.02	0.02 (0.02)	27	0.6	-79	30	7.3
	5th percentile	0.01	0.02 (0.01)	16	0.3	-213	10	2.7
	Minimum	<0.01	<0.01 (<0.01)	4.7	<0.3	-842	0.2	2.6
Spoil Carbonaceous	Count (n)	160	96 (96)	160	160	160	160	45
	Maximum	2.58	1.79 (2.58)	300	79	25	240	9.2
	95th percentile	0.52	0.52 (0.69)	105	16	-0.4	85	8.5
	75th percentile	0.21	0.19 (0.31)	43	6.4	-9.9	20.0	7.5
	Median	0.1	0.08 (0.18)	21	3.1	-16	7.2	6.8
	25th percentile	0.04	0.03 (0.12)	15	1.2	-37	3.1	4.6
	5th percentile	0.02	0.02 (0.04)	7.8	0.6	-105	1.1	2.9
	Minimum	<0.01	0.01 (0.02)	<0.5	<0.3	-296	0.4	2.8
Spoil ALL	Count (n)	2260	795 (795)	2260	2260	2260	2260	85
	Maximum	2.58	1.79 (2.58)	842	79	44	3546	11.2
	95th percentile	0.13	0.16 (0.27)	205	4.0	-11	369	10.6
	75th percentile	0.04	0.04 (0.07)	76	1.2	-23	109	8.5
	Median	0.03	0.03 (0.03)	43	0.9	-42	55	7.4
	25th percentile	0.02	0.02 (0.02)	24	0.6	-74	28	4.9
	5th percentile	<0.01	0.01 (<0.01)	13	<0.3	-204	6.3	2.9
	Minimum	<0.01	<0.01 (<0.01)	<0.5	<0.3	-842	0.2	2.6

1. Total S values less than laboratory limit of reporting (LOR) were assigned a value of 0.5xLOR for statistical calculations.
2. Values in parentheses are the total S statistics for samples with Scr results.
3. NAGpH is final pH as NAG single addition and/or NAG extended and/or Stage 1 sequential NAG.

Table 4-2. Acid-base accounting results statistics for tailings and rejects samples

		Total S[1]	Scr[2]	ANC	MPA	NAPP	ANC/MPA	NAGpH[3]
		%	%	kg H2SO4/t			ratio	pH units
Tailings NCPP Fresh	Count (n)	304	302 (302)	302	304	302	302	286
	Maximum	20.5	16.3 (20.5)	129	628	583	6.6	9.8
	95th percentile	6.05	5.41 (6.08)	65	185	113	3.2	9.0
	75th percentile	1.16	0.88 (1.17)	40	36	6.8	1.9	8.3
	Median	0.76	0.53 (0.76)	32	23	-5.4	1.2	6.4
	25th percentile	0.54	0.32 (0.54)	24	17	-16	0.8	3.4
	5th percentile	0.35	0.17 (0.35)	16	11	-29	0.3	2.5
	Minimum	0.20	0.08 (0.20)	<0.5	6.1	-54	<0.1	1.8
Tailings TSF Aged	Count (n)	166	124 (124)	166	166	166	166	64
	Maximum	8.68	7.29 (8.68)	236	266	222	88	9.6
	95th percentile	4.12	3.07 (5.26)	50	126	72	2.5	7.9
	75th percentile	0.78	0.54 (0.85)	25	24	8.0	1.3	4.0
	Median	0.57	0.30 (0.58)	17	17	1.9	0.9	3.2
	25th percentile	0.44	0.21 (0.44)	13	14	-4.2	0.7	2.9
	5th percentile	0.24	0.09 (0.26)	7.3	7.4	-16	0.3	2.3
	Minimum	0.02	0.03 (0.03)	<0.5	0.6	-208	<0.1	2.1
Rejects NCPP Fresh	Count (n)	48	48 (48)	48	48	48	48	48
	Maximum	0.78	0.63 (0.78)	86	24	-1.3	17	9.4
	95th percentile	0.57	0.47 (0.57)	77	17	-7.8	8.6	9.3
	75th percentile	0.42	0.34 (0.42)	47	13	-24	5.7	8.8
	Median	0.28	0.20 (0.28)	40	8.6	-29	4.4	8.6
	25th percentile	0.21	0.14 (0.21)	34	6.4	-37	2.8	8.4
	5th percentile	0.17	0.10 (0.17)	20	5.2	-64	2.0	7.9
	Minimum	0.14	0.05 (0.14)	13	4.3	-81	1.1	6.3
Rejects TSF Aged	Count (n)	45	4 (4)	45	45	45	45	3
	Maximum	1.19	0.44 (0.76)	72	36	5.8	8.9	8.3
	95th percentile	0.84	0.38 (0.71)	48	26	4.1	4.8	8.2
	75th percentile	0.56	0.15 (0.51)	33	17	-3.9	2.4	8.0
	Median	0.46	0.04 (0.29)	21	14	-9.9	1.8	7.6
	25th percentile	0.35	0.03 (0.14)	18	11	-16	1.2	7.1
	5th percentile	0.13	0.02 (0.12)	9.3	3.9	-37	0.7	6.6
	Minimum	0.04	0.02 (0.12)	<0.5	1.2	-55	<0.1	6.5
Rejects Dump Aged	Count (n)	144	144 (144)	144	144	144	144	144
	Maximum	3.45	3.06 (3.45)	104	106	88	11	9.2
	95th percentile	1.68	1.37 (1.68)	66	51	17	3.1	8.8
	75th percentile	0.93	0.67 (0.93)	42	29	-1.8	2.0	8.0
	Median	0.68	0.44 (0.68)	29	21	-7.8	1.4	6.8
	25th percentile	0.47	0.18 (0.47)	21	14	-17	1.1	4.1
	5th percentile	0.26	0.05 (0.26)	10	8.0	-38	0.6	2.9
	Minimum	0.09	0.02 (0.09)	6.8	2.8	-90	0.2	2.3

1. Total S values less than laboratory limit of reporting (LOR) were assigned a value of 0.5xLOR for statistical calculations.
2. Values in parentheses are the total S statistics for samples with Scr results.
3. NAGpH is final pH as NAG single addition and/or NAG extended and/or Stage 1 sequential NAG.

Table 4-3. Acid-base accounting results statistics for coal samples

		Total S[1]	Scr[2]	ANC	MPA	NAPP	ANC/MPA	NAGpH[3]
		%	%	kg H2SO4/t			ratio	pH units
Coal	Count (n)	214	202 (202)	214	214	214	214	112
	Maximum	1.1	0.78 (1.11)	282	34	17	29	11.1
	95th percentile	0.6	0.31 (0.61)	108	18	6.1	12	8.6
	75th percentile	0.32	0.07 (0.33)	24	9.8	-0.4	3.1	6.5
	Median	0.22	0.02 (0.22)	12	6.7	-4.9	1.7	4.3
	25th percentile	0.17	0.02 (0.17)	7.5	5.2	-14	1.0	3.0
	5th percentile	0.12	<0.01 (0.12)	<0.5	3.7	-90	<0.1	2.5
	Minimum	0.06	<0.01 (0.06)	<0.5	1.8	-270	<0.1	2.2

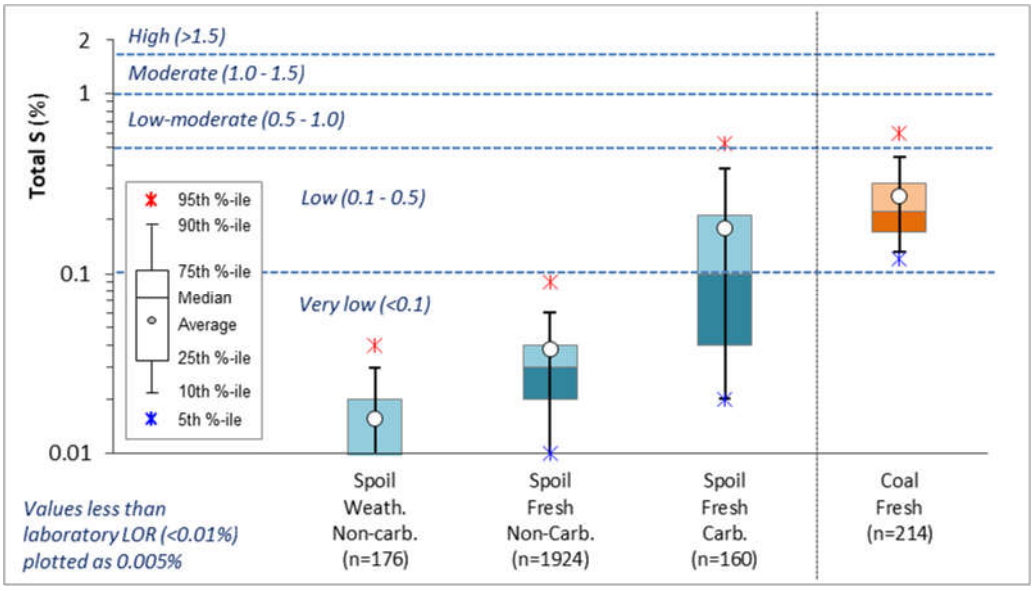
1. Total S values less than laboratory limit of reporting (LOR) were assigned a value of 0.5xLOR for statistical calculations.
2. Values in parentheses are the total S statistics for samples with Scr results.
3. NAGpH is final pH as NAG single addition and/or NAG extended and/or Stage 1 sequential NAG.

Sulfur and Sulfide

The total S distribution is presented in **Figure 4-3** (spoil and coal) and **Figure 4-4** (tailings and rejects). The total S concentration for spoil samples was generally very low to low. Spoil has a very low median total S of 0.03% and a low 95th percentile value of 0.13%. Carbonaceous spoil samples had higher total S values compared to non-carbonaceous spoil. Of the 2260 spoil samples, only five samples had moderate or high total S values (greater than 1%) and were all closely associated with seams (i.e. parting or thicker interburden between plys).

Coal samples from drill core had generally low total S values, with median and 75th percentile values of 0.22% and 0.32%, respectively.

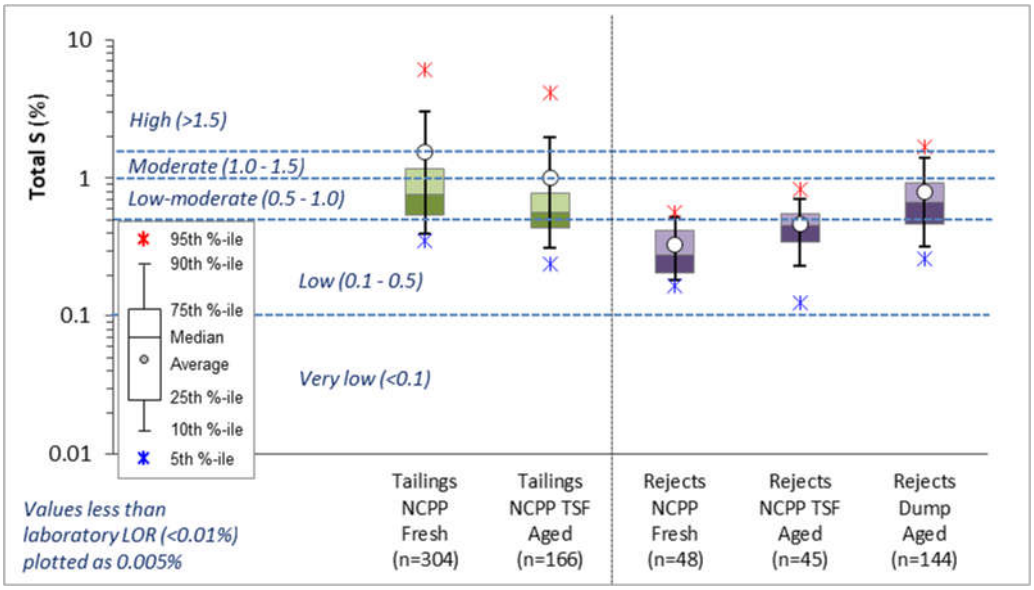
Figure 4-3. Distribution of total sulfur in spoil and coal



The total S concentration of most rejects and tailings samples was generally higher than most spoil samples and generally in the range of low to low-moderate. As evident in **Figure 4-4**, NCPP tailings had slightly higher, but similar total S concentration compared to tailings samples from the NCPP TSF.

Comparatively, the total S concentration of fresh NCPP rejects was lower than aged rejects from the NCPP TSF and lower again compared to aged rejects from Ramp 36 rejects dump.

Figure 4-4. Distribution of total sulfur in tailings and rejects



Scr data is available for 795 spoil samples, 426 tailings samples, 196 rejects samples and 202 coal samples (Table 4-1). The total S and Scr distribution for all samples is shown at Figure 4-5 (spoil and coal) and Figure 4-6 (tailings and rejects). Total S values are shown only for the same samples that underwent Scr tests.

Figure 4-5. Distribution of total sulfur and chromium reducible sulfur (sulfide) in spoil and coal

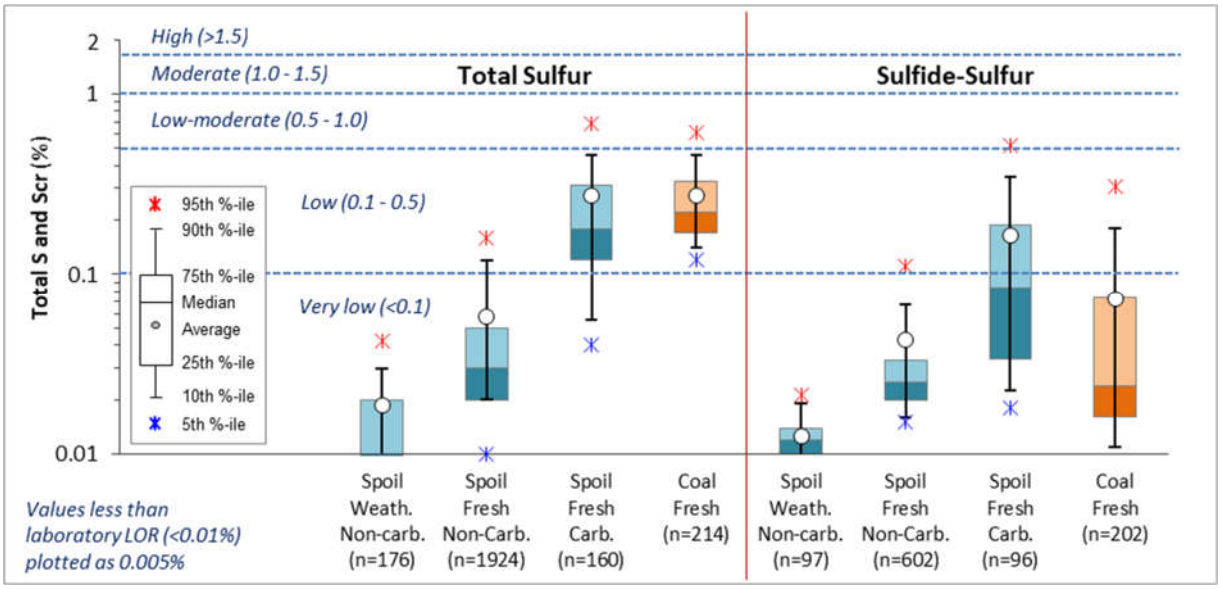
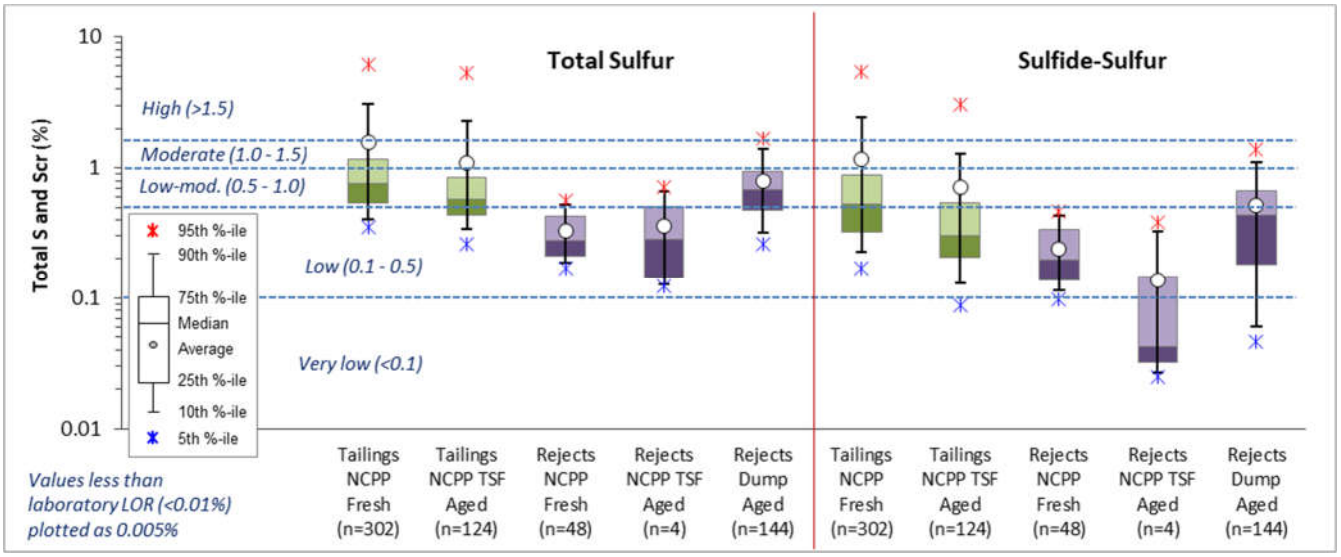


Figure 4-6. Distribution of total sulfur and chromium reducible sulfur (sulfide) in tailings and rejects



As a proportion of total S, Scr accounts for:

- Spoil samples: 83% (median value) of total S in all spoil, which ranges from 57% (median value) in fresh carbonaceous samples through to 85% (median value) in fresh non-carbonaceous samples and 100% in weathered samples. The lower proportion, generally, of Scr in carbonaceous spoil (compared to non-carbonaceous spoil) is likely due to a larger proportion of total S being present as organic S (S-org) in the carbonaceous samples.
- Tailings samples: Scr accounts for approximately 69% (median value) of total S in fresh NCPP tailings and 50% (median value) of total S in aged tailings – the slightly lower proportion of Scr in aged tailings (compared to fresh tailings) is likely due to some sulfide in aged tailings being oxidised to sulfate. No sulfate data is available for aged samples.
- Rejects samples: Based on median values, Scr accounts for approximately 74% of total S in fresh NCPP rejects and 61% of total S in aged rejects – of which almost all aged rejects samples are from the Ramp 36 rejects dump. Again, the slightly lower proportion of Scr in aged rejects (compared to fresh rejects) is likely due to some sulfide in aged rejects being oxidised to sulfate. No sulfate data is available for aged rejects samples.
- Coal samples: Scr accounts for approximately 13% (median value) of total S in coal samples. The very low proportion of Scr (compared to other fresh material types) is likely due to a significant proportion of total S being present as S-org in the coal samples.

These results indicate that the MPA that could be generated by most samples from these material domains is generally low and that using total S as an indication of AMD hazard will result in a conservative outcome.

Maximum Potential Acidity

The MPA is calculated from total S, therefore the MPA distribution for each material type mimics the total S distribution for the same samples (refer to **Figure 4-3**). Due to the generally very low to low total S (and Scr) values for spoil samples the MPA was correspondingly low, with 75th and 95th percentile MPA values of 1.2 and 4.0 kg H_2SO_4/t, respectively (n=2260 samples). As such, spoil represented by these samples is expected to have negligible potential to generate acid/acidity and negligible potential to release

sulfate-derived salinity from sulfide oxidation. The small proportion of spoil with 'high' MPA (as a result of the high total S) would be well mixed throughout the bulk spoil and, as such, would not lead to spoil generating acid/acidity or sulfate-derived salinity. Additionally, of the nine spoil samples with 'high' MPA (>20 kg H_2SO_4/t), all were closely associated with coal seams.

Coal samples (n=214) produced MPA values generally higher than spoil – as expected by the higher overall total S values of coal samples. Coal samples had 75th and 95th percentile MPA values of 9.8 and 18 kg H_2SO_4/t, respectively. As discussed above, the proportion of total S associated with sulfide minerals in coal samples is low (13% of total S as Scr), with most S associated with S-org. Therefore, MPA values calculated from total S for coal samples is very conservative. Comparatively, the 95th percentile MPA value for coal samples calculated from Scr (n=202) is 9.5 kg H_2SO_4/t – i.e. about half of the 95th percentile MPA value calculated from total S.

Tailings and rejects produced total S values generally ranging from low to low-moderate (with some moderate and higher values), which resulted in a correspondingly similar low to low-moderate range of MPA values. Tailings and rejects have 75th percentile MPA values ranging from 13 to 36 kg H_2SO_4/t, with fresh NCPP tailings having the highest MPA values corresponding to their higher total S values.

Acid Neutralising Capacity

The ANC distribution is presented in **Figure 4-7** (spoil and coal) and **Figure 4-8** (tailings and rejects) which shows that ANC values of spoil samples is generally moderate to very high and spans a very large range, from less than 0.5 to 842 kg H_2SO_4/t, with a high median ANC value of 43 kg H_2SO_4/t. Over 90% of spoil samples have an ANC greater than 17 kg H_2SO_4/t which, if all ANC was readily available, would neutralise the acidity generated by material containing 0.56% S. Less than 0.6% of spoil samples had total S values greater than 0.56%.

Coal samples had a wide range of ANC values from very low to very high, but the overall ANC was low, with 10th percentile and median ANC values of 2.0 and 12 kg H_2SO_4/t, respectively.

The ANC for tailings and rejects samples (combined) was generally moderate to high, with median ANC values ranging from 17 to 40 kg H_2SO_4/t and an overall (combined) median ANC of 29 kg H_2SO_4/t.

Figure 4-7. Distribution of acid neutralising capacity in spoil and coal

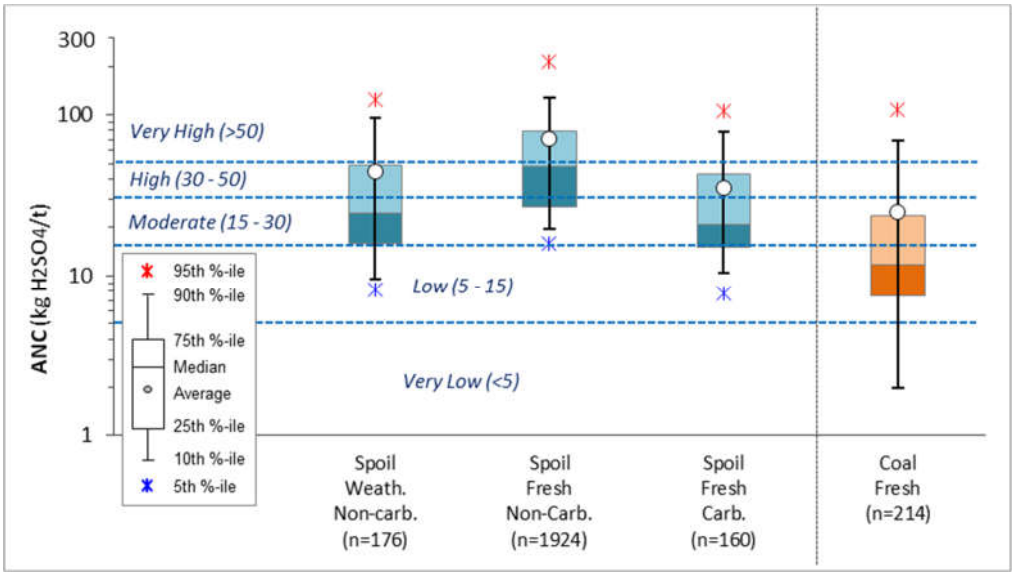
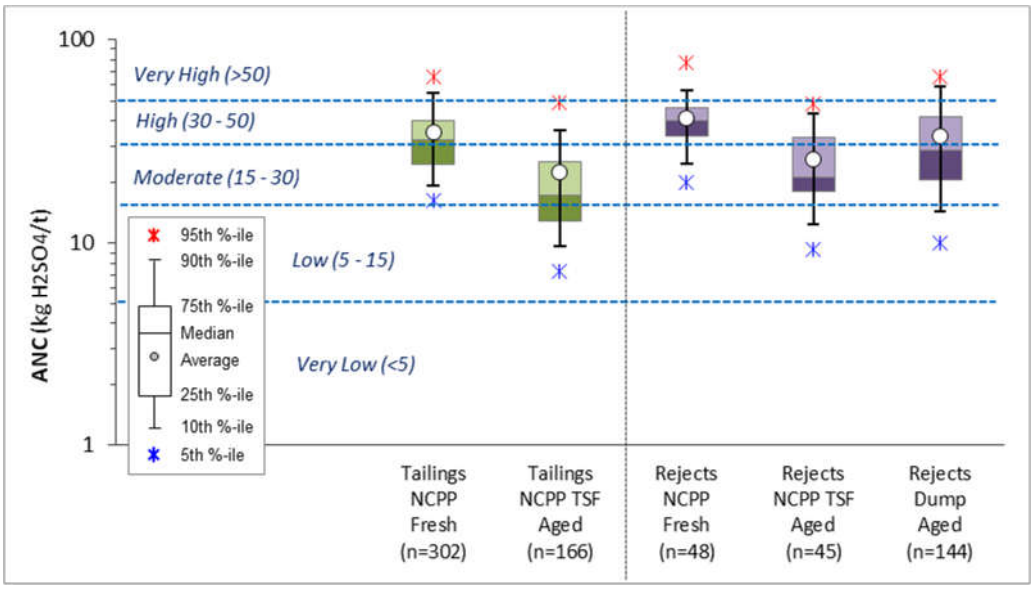


Figure 4-8. Distribution of acid neutralising capacity in tailings and rejects



Available Acid Neutralising Capacity

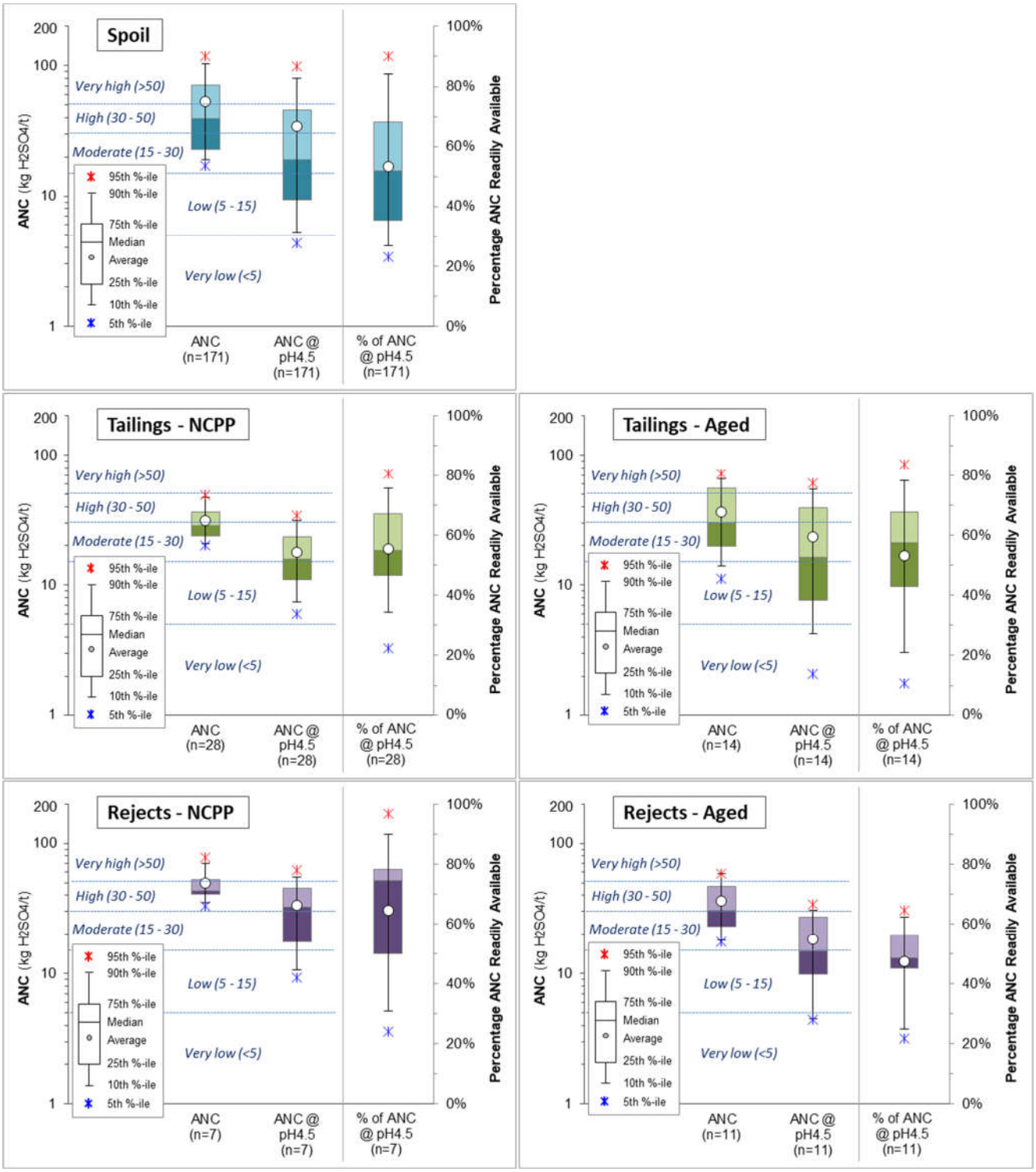
ABCC tests were undertaken on samples to assess the proportion of ANC that may be 'readily available' (i.e. short-acting) in these materials under field conditions. 'Readily availability' is regarded as the proportion of ANC that is available for buffering reactions at pH 4.5. The results are summarised as follows and in Figure 4-9.

- Spoil samples (n=171). The proportion of ANC likely available under field conditions ranged from eight to nominally 100% of the ANC, with a median of approximately 52%.
- Tailings, fresh (n=28). The proportion of ANC likely available under field conditions ranged from 18 to 84% of the ANC, with a median of approximately 55%;
- Tailings, aged (n=14). The proportion of ANC likely available under field conditions ranged from zero to 93% of the ANC, with a median of approximately 58%;
- Rejects, fresh (n=7). The proportion of ANC likely available under field conditions ranged from 17 to nominally 100% of the ANC, with a median of approximately 74%;
- Rejects, aged (n=11). Comprising 10 samples from Ramp 36 rejects dump and one sample from NCPP TSF embankment. The proportion of ANC likely available under field conditions ranged from 19 to 67% of the ANC, with a median of approximately 49%.

The shape of the ABCCs (the reaction rate curves) can also be used to infer potential carbonate mineralogy based on standard curves/data for different carbonate minerals at varying ANC values. For the spoil samples, iron dolomite appears to be the dominant carbonate mineral based on the ABCCs, with dolomite, calcite and siderite. Of the 171 spoil sample results, about 60 of the samples appear to have some presence of siderite, based on the ABCC data alone. Siderite is fairly common throughout the Permian sediments of the Bowen Basin, albeit in relatively small amounts. For the tailings and rejects samples, iron dolomite is also the dominant carbonate mineral based on the ABCCs, with minor siderite. Several samples appear to have trace amounts of dolomite.

Based on the above, and supported by the mineralogy data (**Section 4.1**), the carbonate mineral in bulk spoil, tailings and rejects is likely to be iron dolomite +/- siderite with varying influence from dolomite and calcite.

Figure 4-9. Distribution of acid neutralising capacity as total, acid neutralising capacity at pH 4.5 and proportion (%) of acid neutralising capacity expected to be readily available

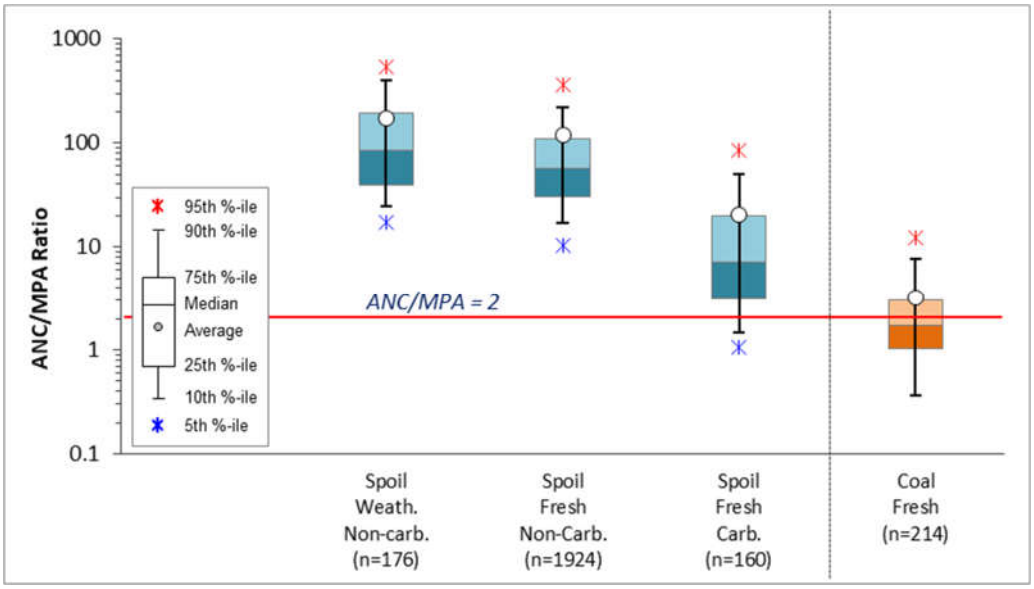


Acid Neutralising Capacity / Maximum Potential Acidity Ratio

Generally, those samples with an ANC/MPA ratio greater than two are considered to have a negligible/low risk of acid generation (DIIS, 2016; INAP, 2009[3]), especially where sulfide concentration is very low and reactive ANC is moderate to high. The results, illustrated in **Figure 4-10** (spoil and coal) and **Figure 4-11** (tailings and rejects) show that:

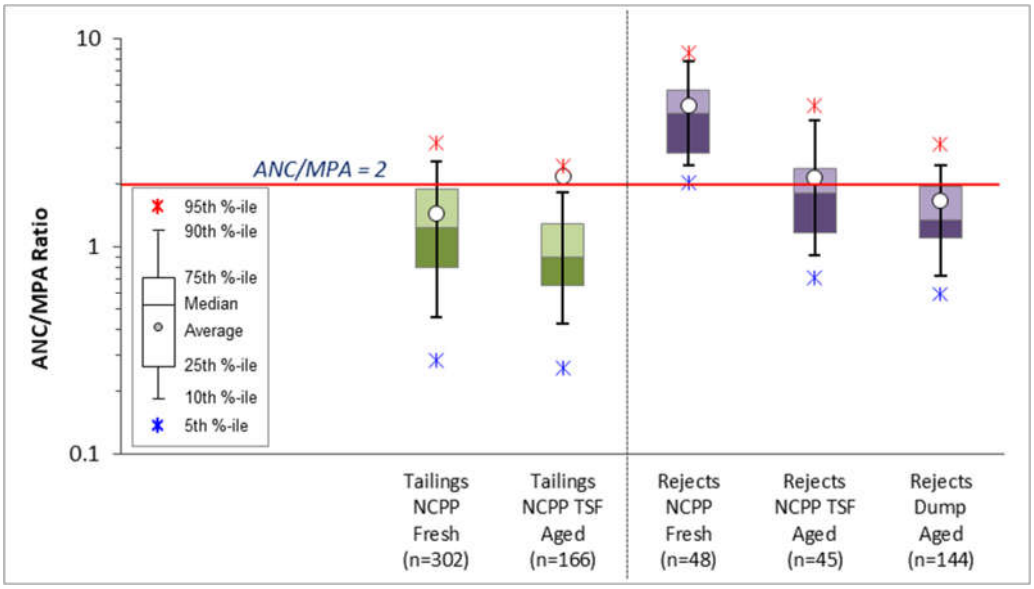
- Just under 99% of 2260 spoil samples have an ANC/MPA ratio greater than two – noting that 85% of all spoil samples are fresh, non-carbonaceous. Approximately 86% of fresh carbonaceous spoil samples (137 out of 160 samples) have an ANC/MPA ratio greater than two.
- Approximately 77% and 92% of fresh and aged tailings, respectively, had ANC/MPA ratios less than or equal to two. Similarly, 77% of aged dump rejects also had ANC/MPA ratios less than or equal to two. Approximately 64% of aged TSF rejects had ANC/MPA ratios less than or equal to two.
- In stark contrast to all other tailings and rejects samples, only 6% of 48 fresh NCPP rejects samples had ANC/MPA ratios less than or equal to two. Fresh NCPP rejects samples generally have higher ANC and lower total S (therefore lower MPA) compared to all other rejects and tailings types – resulting in an overall higher ANC/MPA ratio compared to other rejects and tailings.
- Approximately 45% of coal samples had ANC/MPA ratios greater than two.

Figure 4-10. Distribution of the ratio of acid neutralising capacity to maximum potential acidity in spoil and coal



3 INAP (2009) considers that mine materials with an ANC/MPA ratio greater than two are likely to be NAF unless significant preferential exposure of sulfide minerals occurs along fracture planes, in combination with insufficiently reactive ANC.

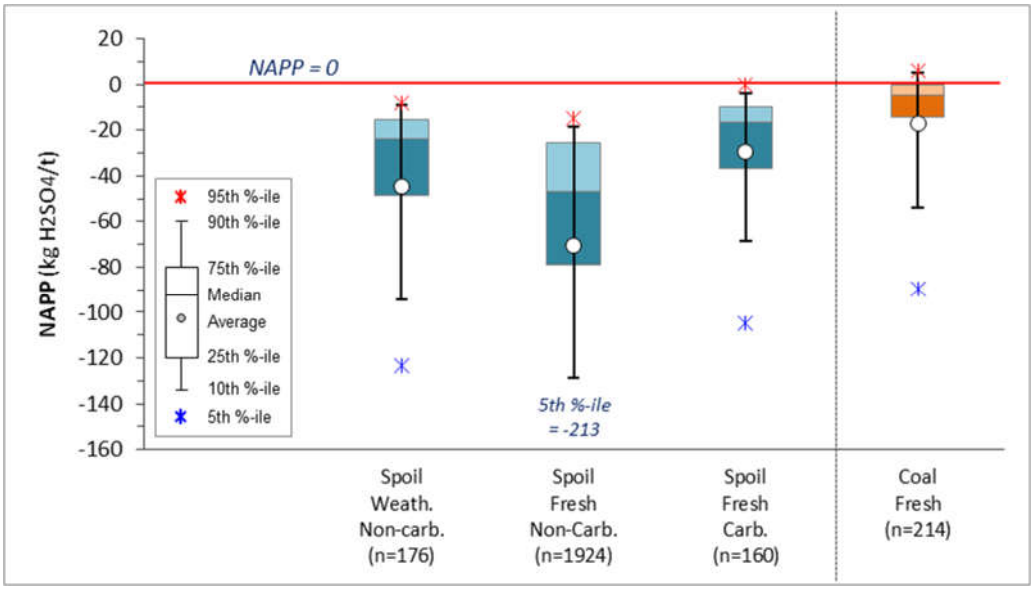
Figure 4-11. Distribution of the ratio of acid neutralising capacity to maximum potential acidity in tailings and rejects



Net Acid Producing Potential

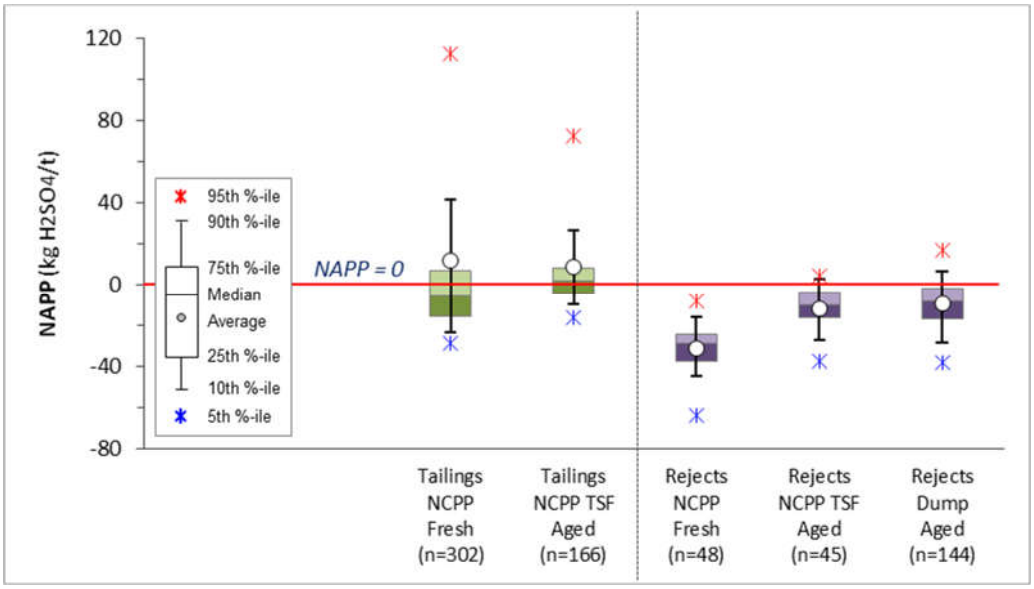
Based on the generally low MPA and higher ANC values (relative to the MPA), the calculated NAPP values are negative for over 99% of spoil samples (10 out of 2260 spoil samples had positive NAPP values, of which most were carbonaceous spoil samples). The results, shown in **Figure 4-12** (spoil and coal) indicate that overall, there is significantly excess neutralising capacity (ANC) compared to potential acidity (MPA) for spoil samples. The calculated NAPP values are low negative for about 77% of the coal samples; and about 23% of the coal samples had low positive NAPP values, with a maximum NAPP value of 17 kg H_2SO_4/t.

Figure 4-12. Distribution of net acid producing potential in spoil and coal



The results for tailings and rejects samples are presented in **Figure 4-13**. Tailings samples have a mix of low negative and low positive NAPP values, with about 56% of all tailings samples having negative NAPP values. Comparatively, about 83% of all rejects samples have negative NAPP values, including all 48 fresh NCPP rejects samples.

Figure 4-13. Distribution of net acid producing potential in tailings and rejects



Net Acid Generation Capacity

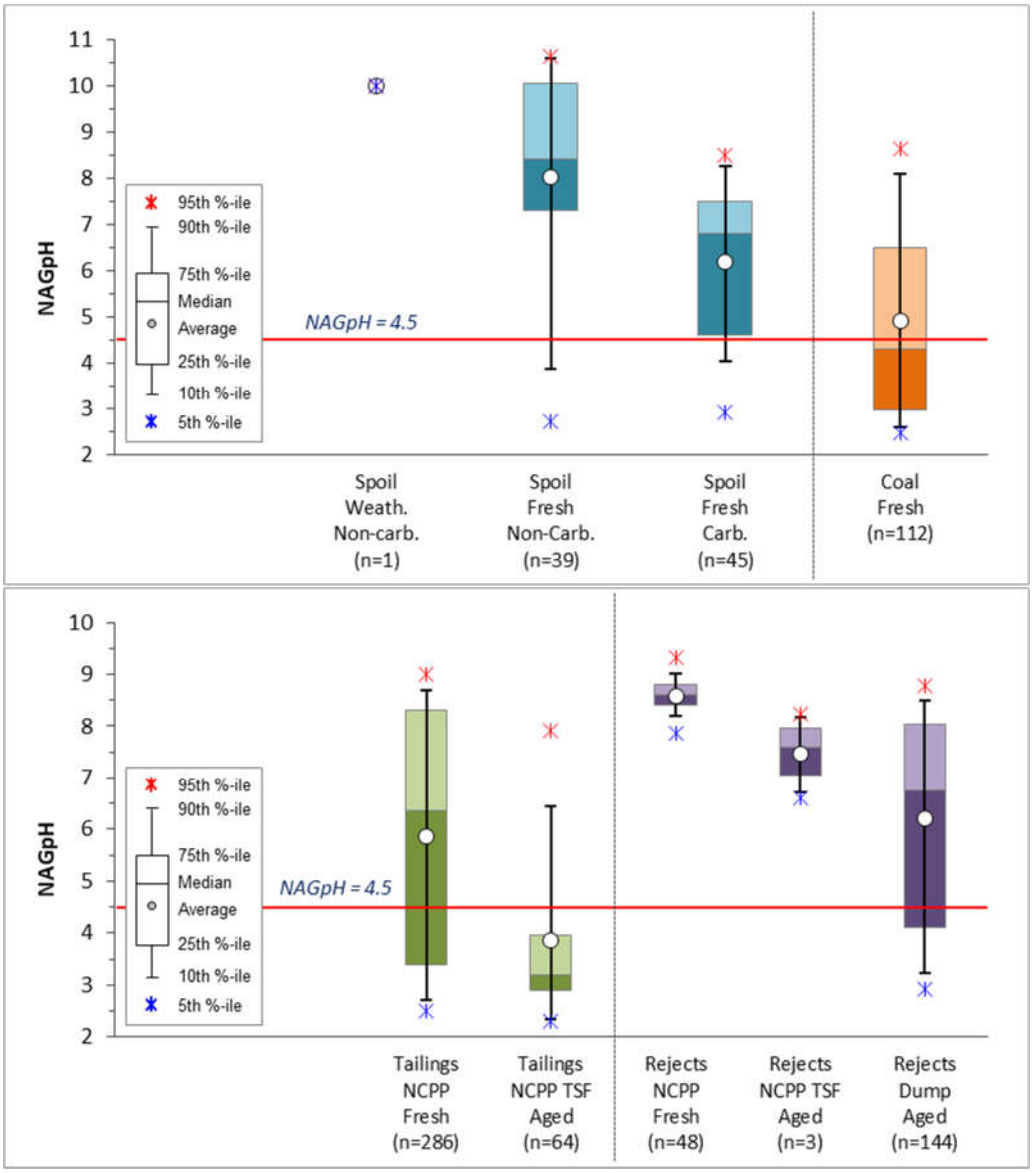
NAG test results are used in conjunction with NAPP values in determining the acid classification of samples. The calculated NAPP value assumes that all S (or sulfide) will oxidise to generate acid (MPA) and that all neutralising material in a sample is in a readily available form to neutralise any acid that could be generated (ANC). Unlike the theoretical basis of the NAPP test, in a NAG test a sample is encouraged to oxidise by reaction with hydrogen peroxide and any acid generated through oxidation may be consumed by neutralising components in the sample. Any remaining acidity is measured and expressed as kg H_2SO_4/t.

Samples with NAGpH values greater than pH 4.5 are considered to be NAF. Samples with NAGpH values less than or equal to pH 4.5 (i.e. acid-generating) would also be expected to have measurable NAG capacity (i.e. NAG capacity greater than 0.1 kg H_2SO_4/t). As a guide, NAG capacity values between 0.1 and 5 kg H_2SO_4/t are considered 'low capacity' (AMIRA, 2002).

NAG test data (a combination of single addition and extended boil NAG) is available for 85 spoil samples (all except one sample being fresh), 112 coal samples, 350 tailings samples and 195 rejects samples (**Table 4-1**) – with the NAGpH distribution for these samples shown in **Figure 4-14**.

It should be noted that NAG test data is predominantly available for carbonaceous and coal samples, much more so than non-carbonaceous samples. Therefore, the number and percentage of samples with a given NAGpH value (e.g. greater than or less than pH 4.5) is not a proportional representation of NAGpH statistics for each mineral waste and coal group.

Figure 4-14. Distribution of net acid generation pH



Fifteen (15) spoil samples (out of 85) had NAGpH values less than or equal to pH 4.5 and, of these 15 samples, 10 samples were located close to coal seams. For spoil samples, NAG tests were typically undertaken on samples with moderate or higher total S and on samples that had an 'uncertain' preliminary AMD classification. As such, the number of spoil samples that underwent NAG testing is not a proportional representation of all spoil. Only about 4% of all spoil samples underwent NAG testing.

Approximately 77% of all tailings and rejects samples (combined) have NAG test data available. Of those tailings and rejects samples that underwent NAG testing, about 58% of fresh NCPP tailings and about 22% of aged tailings tested had NAGpH values greater than pH 4.5. For the rejects samples, all of the fresh NCPP rejects samples and 73% of the aged rejects samples tested had NAGpH values greater than pH 4.5 (noting that all except three of the aged rejects samples were from the Ramp 36 rejects dump).

Of the 214 coal samples with geochemical data, 112 samples underwent NAG testing. Of these 112 samples, 47% had NAGpH values greater than pH 4.5.

The NAG test can be influenced by organic acid (i.e. organic acid can produce NAGpH between approximately pH 4 to 4.5, thus providing a 'false positive' for sulfuric acid). Organic acid is typically produced by samples with high C-org content, such as coal and highly carbonaceous samples. To attempt to resolve some of the uncertainty with the 'single addition' NAG test for coaly and carbonaceous samples, 139 samples underwent an Extended Boil NAG method (NAG extended). These samples included spoil (3 samples), tailings (26 samples), rejects (5 samples) and coal (105 samples).

Sixty-four (64) of these 139 samples (i.e. 46% of samples) returned Extended NAGpH values greater than pH4.5, suggesting that for just under half of the mostly coal and tailings samples tested the acidity generated in the 'single addition' NAG test was likely associated – to some extent – with the oxidation of C-org and potentially less so with sulfide oxidation.

Acid and Metalliferous Drainage Classification

The ABA results presented in this section have been used to classify the acid forming nature of the samples following the classification criteria outlined in **Section 3.4**. Additional relevant data, such as ABCC and Extended NAG test results were used to aid in the classification of samples where there was uncertainty following the preliminary AMD classification. The acid forming nature of these samples is summarised in **Figure 4-15** and **Table 4-4**.

Figure 4-15. Geochemical classification of samples

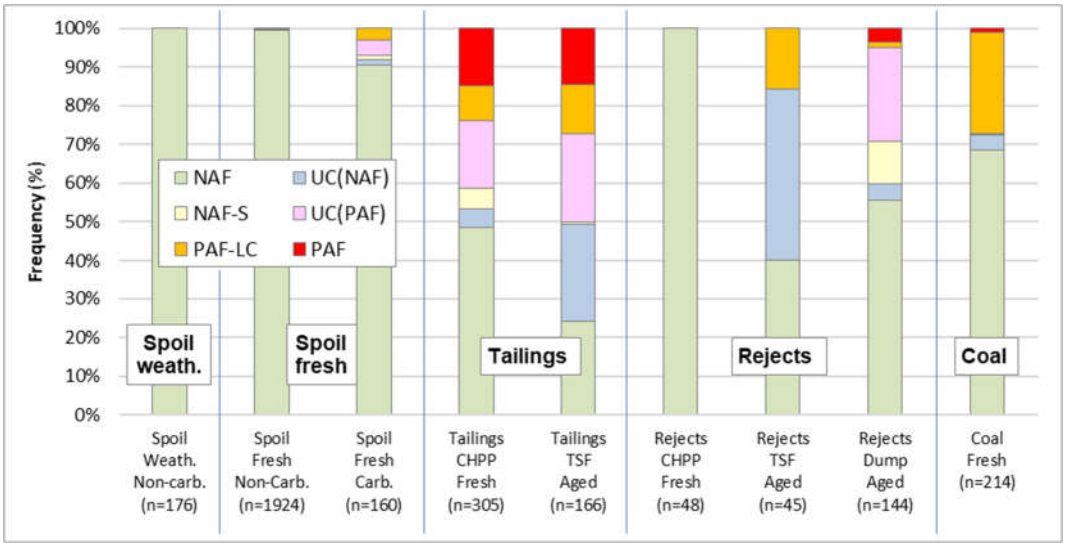


Table 4-4. Geochemical classification of samples

Material Type	NAF	UC(NAF)	NAF-S	UC(PAF)	PAF-LC	PAF
	No. and percentage of samples					
Spoil samples						
Spoil: weathered, non-carb. (n=176)	176 (all)	0	0	0	0	0
Spoil: non-carbonaceous (n=1924)	1916 (>99%)	1 (<0.1%)	0	4 (0.2%)	1 (<0.1%)	2 (0.1%)
Spoil: carbonaceous (n=160)	145 (91%)	2 (1.3%)	2 (1.3%)	6 (3.8%)	5 (3.1%)	0
All Spoil (n=2260)	*2237 (99%)*	*3 (~0.1%)*	*2 (~0.1%)*	*10 (~0.4%)*	*6 (~0.3%)*	*2 (~0.1%)*
	2240 (99 %)		***20 (1 %)***			
Coal samples						
Coal: fresh (n=214)	147 (69%)	8 (3.7%)	1 (0.5%)	0	56 (26%)	2 (0.9%)
	155 (72 %)		***59 (28 %)***			
Tailings samples						
Tailings: NCPP, fresh (n=305)	148 (49%)	15 (4.9%)	16 (5.2%)	53 (17%)	28 (9.2%)	45 (15%)
Tailings: TSF, aged (n=166)	40 (24%)	42 (25%)	1 (0.6%)	38 (23%)	21 (13%)	24 (14%)
All Tailings (n=471)	188 (40%)	57 (12%)	17 (3.6%)	91 (19%)	49 (10%)	69 (15%)
	245 (52 %)		***226 (48 %)***			
Rejects samples						
Rejects: NCPP, fresh (n=48)	48 (all)	0	0	0	0	0
Rejects: TSF, aged (n=45)	18 (40%)	20 (44%)	0	0	7 (16%)	0
Rejects: R34/36 dump, aged (n=144)	80 (56%)	6 (4.2%)	16 (11%)	35 (24%)	2 (1.4%)	5 (3.5%)
All Rejects (n=237)	146 (62%)	26 (11%)	16 (6.8%)	35 (15%)	9 (3.8%)	5 (2.1%)
	172 (73 %)		***65 (27 %)***			

Percentages are approximate (rounded).

Spoil

The classifications in **Table 4-4** show that approximately 99% of spoil samples were classified as NAF or were expected to be NAF and have been classified as UC(NAF). These spoil samples and spoil material represented by these samples have very low to low S concentration, significant excess ANC (relative to the MPA) and clearly have negligible capacity to generate AMD. Approximately 1% of spoil samples were classified as 'PAF' of some type, including two spoil samples classified as NAF-S.

Data show that potential spoil, as a bulk material, would be overwhelmingly NAF – and essentially all spoil away from seams (which is the overwhelming bulk of spoil) is expected to be NAF. Furthermore, the very low to low S concentration in spoil indicates that the sulfate concentration that could be generated in spoil from sulfide oxidation (in addition to any salinity unrelated to sulfide oxidation) would also be very low. New spoil generated from the Project is expected to have similar geochemical characteristics to existing spoil.

Spoil expected to be 'PAF' of some type is mostly carbonaceous and is mostly associated with seams, as seam roof, parting or floor, which may largely report to the NCPP as ROM coal and leave the NCPP as rejects. PAF spoil is also likely to be associated with thicker interburden zones between seam plys of the same seam group. That is, PAF spoil is rarely encountered well away from seams. In context, of the 20 'PAF' / NAF-S spoil samples, 15 samples (i.e. 75%) were located within 1 m above or below seams.

Coal

Approximately 72% of coal samples (155 out of 214) were classified as NAF or UC(NAF). Coal represented by these samples has low sulfur values, excess ANC (relative to the MPA) and clearly has negligible capacity to generate acidity or release significant sulfate from sulfide oxidation. New coal generated from the Project is expected to have similar geochemical characteristics to existing coal.

Coal samples had higher total S values and marginally lower ANC compared to spoil, which resulted in 26% of coal samples classified as PAF-LC, two samples classified as PAF and one sample classified as NAF-S. The proportion of PAF (of any kind) and NAF-S samples is comparable across all coal seam groups currently being mined at BWM. It is worth noting that most of the 'PAF' samples were classified as PAF-LC, suggesting that 'PAF' coal is unlikely to generate significant acid(ity). Furthermore, the Scr content of coal samples was generally very low, suggesting that the 'PAF' (of any type, including NAF-S) classification is conservative for most coal samples. On the other side of the acid-base account, it is recognised that ANC is likely an overestimate, however the AMD classification already takes this into account by requiring an ANC/MPA ratio greater than two for a sample to be assessed as NAF.

These results suggest that coal represented by these samples and stored on a ROM pad, located within pit walls and un-economic coal seam material reporting as spoil (mixed with non-coal spoil) would likely be bulk NAF. A small proportion of coal from all seam groups poses a greater, but relatively low AMD source hazard. As the same coal seams dip eastwards from the existing BWM into the Project, coal generated at the Project is expected to have similar geochemical characteristics to existing coal at BWM (from existing pits in the vicinity of the Project).

Tailings

Just under half (48%) of tailings samples across both fresh and aged types were classified as 'PAF' of some type, including 17 tailings samples classified as NAF-S. Of the 226 'PAF' / NAF-S tailings samples, 69 samples (i.e. approximately 31%) were classified as PAF specifically and 140 were classified as UC(PAF) or PAF-LC. From an acid generating perspective, a significant proportion of tailings located at NCPP TSF and Bonnie Doon TSF pose a potential AMD source hazard with respect to AD and/or NMD/SD; and overall, are expected to generate low to moderate acidity loads.

Since ROM coal generated at the Project is expected to be very similar to existing ROM coal at BWM (from existing pits in the vicinity of the Project), tailings generated from ROM coal at the Project are expected to have similar geochemical characteristics to existing tailings.

Rejects

The results show that all 48 fresh NCPP rejects samples and about 66% of aged rejects samples (124 of 189 samples) were classified as NAF or UC(NAF). The remaining 34% of aged rejects samples had some type of broader 'PAF' classification, including 16 samples classified as NAF-S. Therefore, from an acid generating perspective, about one-third of the aged rejects samples pose a potential AMD source hazard with respect to AD and/or NMD/SD. Since ROM coal generated at the Project is expected to be very

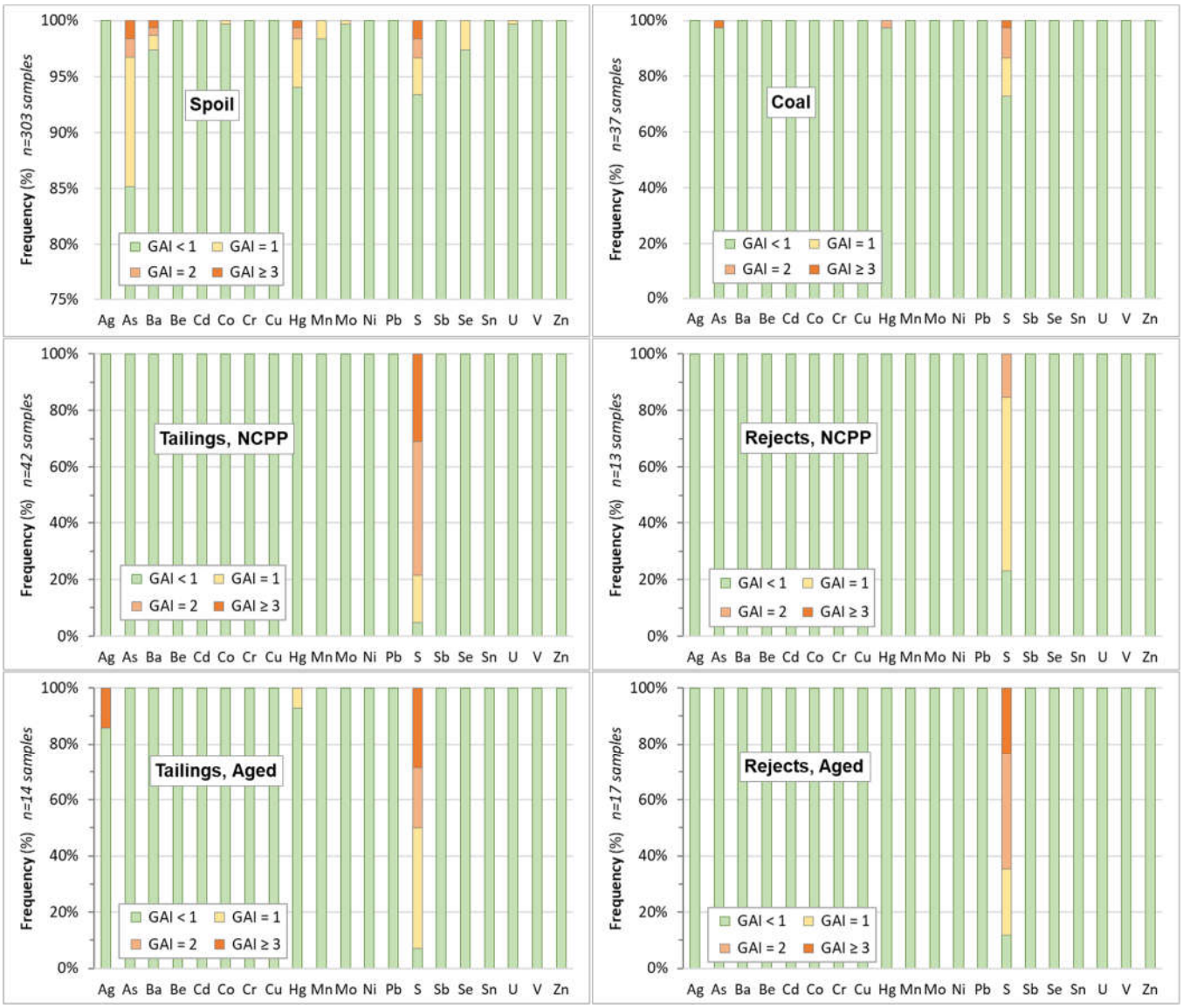
similar to existing ROM coal at BWM (from existing pits in the vicinity of the Project), rejects generated from ROM coal at the Project are expected to have similar geochemical characteristics to existing rejects.

4.3 Total Metals and Metalloids

Multi-element (metal and metalloid) data is available for 426 samples comprising 303 spoil samples, 37 coal samples, 56 tailings samples (42 fresh and 14 aged) and 30 rejects samples (13 fresh and 17 aged). The degree of enrichment with respect to elements potentially of environmental interest for the spoil, coal, tailings and rejects materials is shown in Figure 4-16.

Overall, the results suggest that bulk mineral waste materials have generally low levels of metal and metalloid enrichment. These results are consistent with Permian-age coal measures throughout eastern Australia. Excluding total S, a small proportion of samples (of all material types) have a moderate or higher degree of enrichment in some metals, such as silver (Ag), As, barium (Ba), Hg and/or Se, however, enrichment in these materials in a small number of samples is not cause for concern.

Figure 4-16. Frequency distribution of geochemical abundance indices of selected elements



The GAI values show that 13 (out of 303) spoil samples were significantly enriched [GAI ≥3] with regard to one or more of As, Ba, Hg and/or S. The level of S enrichment in these samples is consistent with the ABA data for these same samples. The enrichment in As, Ba and/or Hg in a small number of samples is not cause for concern. The GAI values also show that about 21% of spoil (~16% of non-carbonaceous spoil and ~54% of carbonaceous spoil) samples tested had minor or moderate enrichment (GAI = 1 or 2) with regard to As, Ba, Co, Hg, Mn, Mo, S, Se and/or U.

One coal sample was significantly enriched in As and S, and 10 coal samples had minor or moderate enrichment (GAI = 1 or 2) with regard to Hg and/or S.

About one-quarter of fresh NCPP tailings samples, about half of the aged tailings samples and four of the aged rejects samples were significantly enriched with S, including two aged tailings samples with significant enrichment in Ag. No fresh NCPP rejects showed significant enrichment in these same (or any) elements. The GAI values also show that most tailings and rejects samples tested, including most fresh NCPP rejects samples, had minor or moderate enrichment (GAI = 1 or 2) with regard to S.

4.4 Initial Solubility in Deionised Water

Water extract test results are available for a wide range of samples (**Table 4-5**). EC and pH results are available for 3178 and 3179 samples, respectively, and test results for major ions and soluble metals and metalloids are available for 431 samples.

Therefore, a large dataset is available to assess the potential for leaching of salt and environmentally important elements from mineral wastes (spoil, tailings and rejects) and coal at BWM – and the Project, given that the Project would produce mineral wastes comparable to those already produced at BWM. Water extract tests provide a preliminary indication of the elements that may be readily mobilised from any given material type.

Table 4-5. Samples subjected to deionised water solubility tests

Material type	pH and EC	Soluble metals and metalloids
	Number of samples	
Spoil	2260	303
Tailings	468 (pH) / 467 (EC)	59
Rejects	237	32
Coal	214	37

The samples underwent a 1:5 w:v (solid:water) deionised water bottle leach procedure on fine pulps. Note that the use of fine pulped materials in water extract tests enables a high level of reaction and dissolution. The results from these tests are summarised and discussed below.

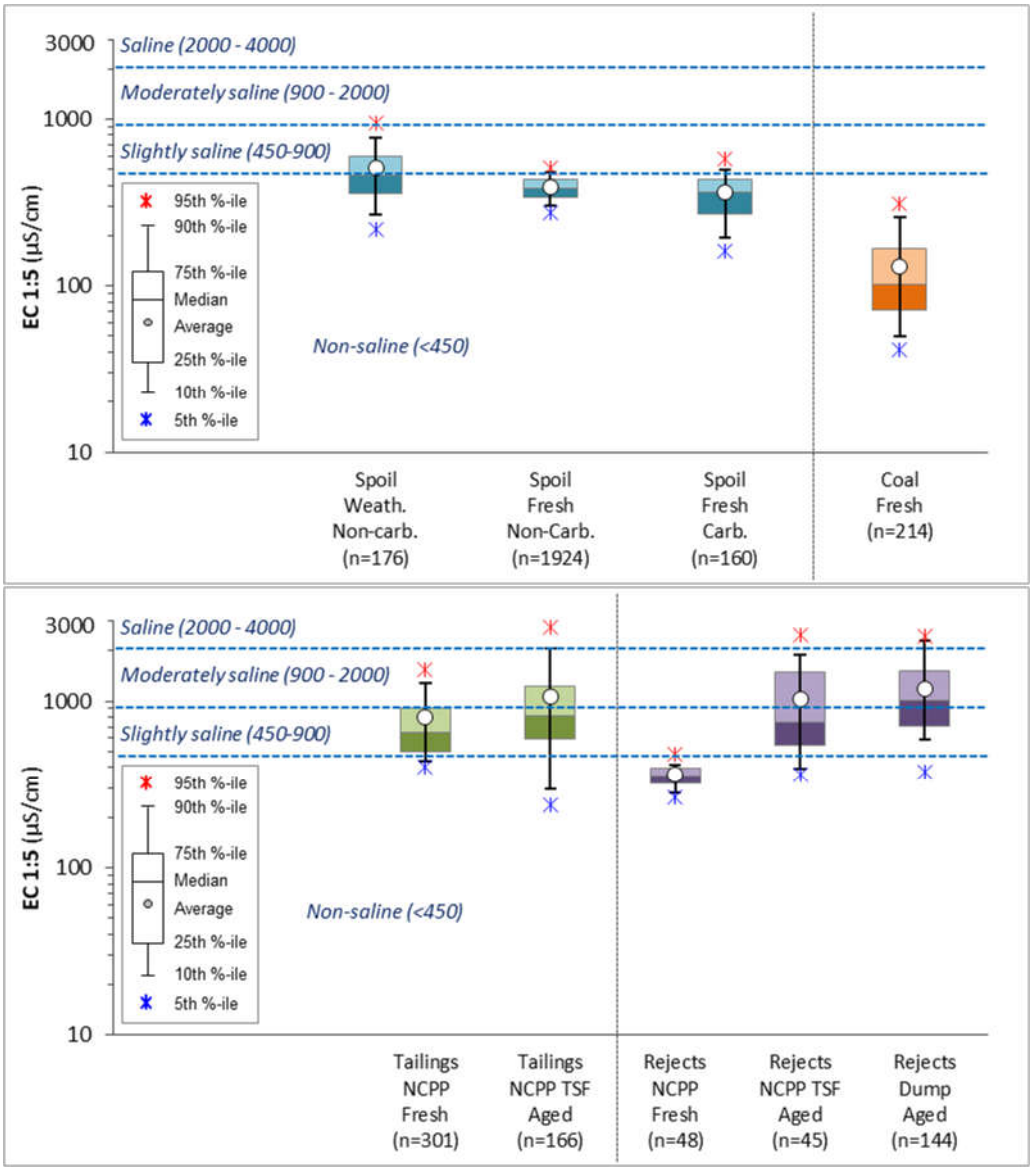
The test-work has found that spoil is generally pH-alkaline to highly alkaline and non-saline to slightly saline; and that tailings and rejects are generally pH-alkaline and slightly to moderately saline. All mineral wastes generally have low concentrations of soluble metals and metalloids – within the range typical for Permian sedimentary materials in the Bowen Basin. For many samples, the soluble metal and metalloid concentrations are below or marginally above the laboratory limit of reporting (LOR).

Electrical Conductivity and pH

$EC_{1:5}$ data is available for 3178 samples at 1:5 w:v on pulp (**Figure 4-17** and **Table 4-5**). The $EC_{1:5}$ of 2260 spoil samples spanned a large range from 69 to 1670 μS/cm, with low median and 75th percentile $EC_{1:5}$ values of 389 and 440 μS/cm, respectively. The results show that spoil, as a bulk material, is generally non-saline to slightly saline. These $EC_{1:5}$ results are common (if not typical) for Bowen Basin Permian-age and Tertiary-age material in the region.

Coal samples are generally non-saline. Fresh NCPP tailings samples and aged rejects samples are generally slightly to moderately saline, whereas fresh NCPP rejects samples have lower $EC_{1:5}$ values and are generally non-saline. Tailings samples have a 75th percentile $EC_{1:5}$ of 711 μS/cm. Rejects samples have a 75th percentile $EC_{1:5}$ of 761 μS/cm.

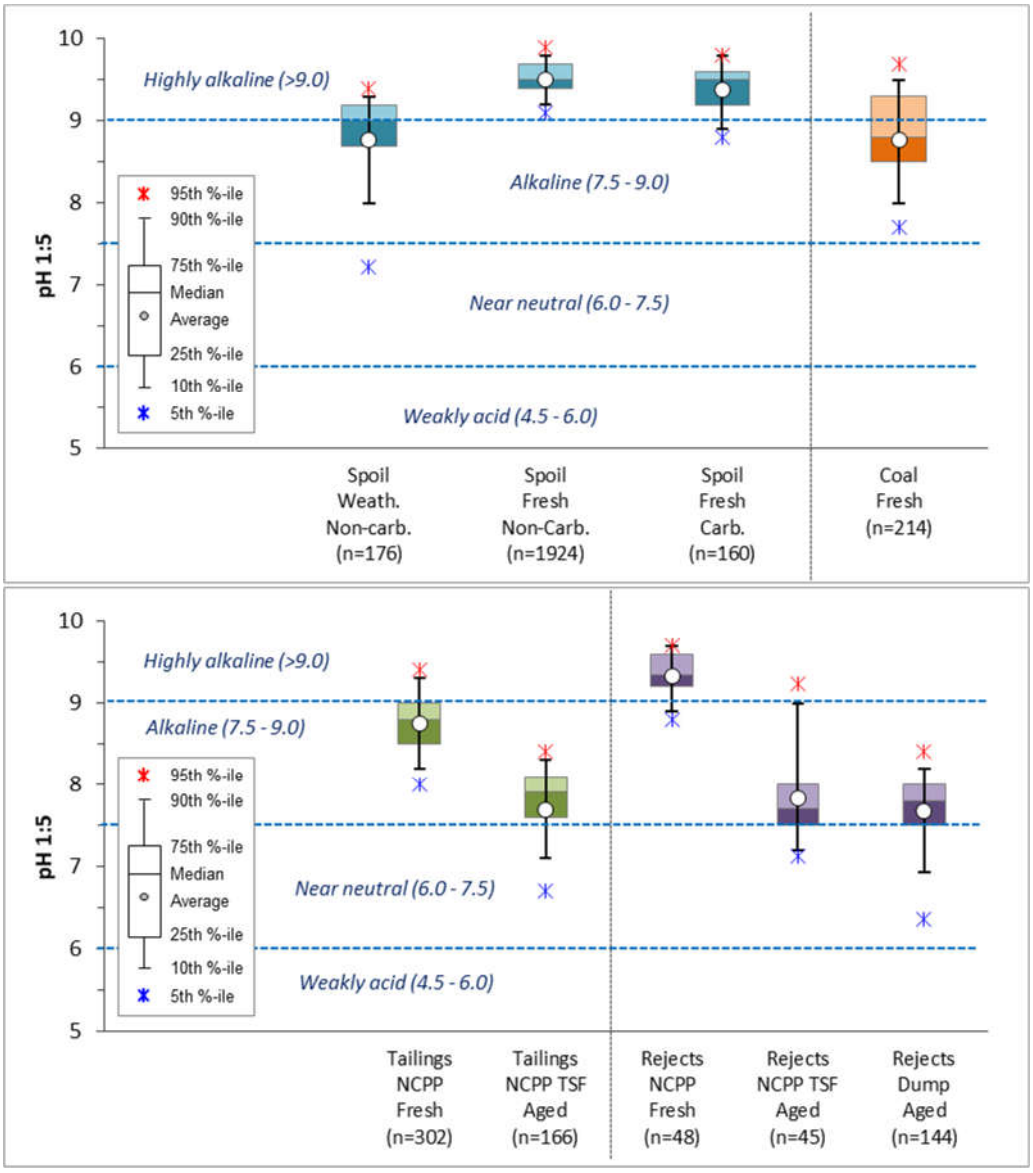
Figure 4-17. Electrical conductivity distribution



As shown in **Table 4-5** and presented in **Figure 4-18**, $pH_{1:5}$ data is available for 3,179 samples at 1:5 w:v on pulp. The pH distribution by material type shows most samples to be generally alkaline to highly alkaline. Some aged tailings and aged rejects samples were weakly to moderately acidic. These pH results are common (if not typical) for Bowen Basin Permian-age and Tertiary-age material in the region.

Of the 3,179 samples, 21 samples (less than 1% of samples) had $pH_{1:5}$ values less than or equal to pH 6.0; comprising three spoil samples, two coal samples, eight tailings samples and eight rejects samples. Of the 21 samples with $pH_{1:5}$ values less than or equal to pH 6.0, 15 were weakly acid with $pH_{1:5}$ values between 4.5 and 6.0; five samples (four tailings and one coal) were moderately acid with $pH_{1:5}$ values between 3.0 and 4.5 and the remaining sample (an aged tailings sample) was highly acidic with a $pH_{1:5}$ value of 2.3.

Figure 4-18. pH distribution

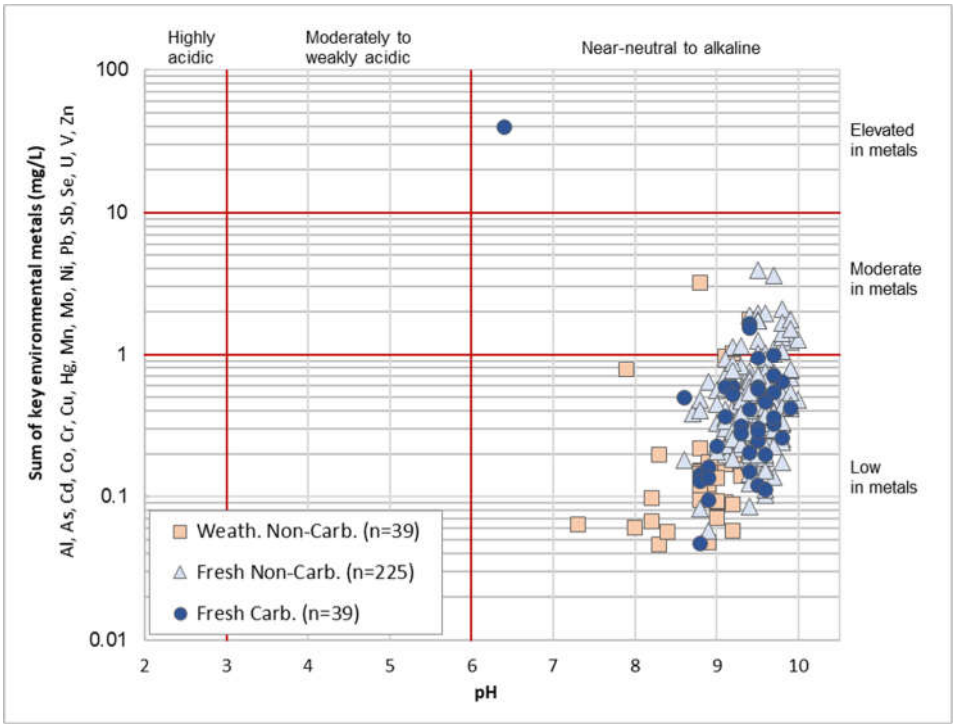


Soluble Metals and Metalloids

Deionised water extract (leaching) data for major ions and a broad suite of metals and metalloids are available for 431 samples (**Table 4-5**). All samples underwent a 1:5 w:v (solid:water) water extract procedure on pulps, and were analysed under ICP-MS method. The sum of 16 potentially environmentally important elements are plotted as a function of pH in **Figure 4-19** (spoil) and **Figure 4-20** (tailings, rejects and coal) in a modified version of what is referred to as a Ficklin plot (after Ficklin et al., 1992). The 16 selected metals and metalloids comprise: Al, As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, U, V and Zn.

Of the 431 samples, 387 samples (90% of samples tested) have low soluble metal and metalloid concentrations and have near-neutral to alkaline pH – indicating that under freshwater leaching conditions soluble metal and metalloid concentrations are low for most mineral waste and coal materials.

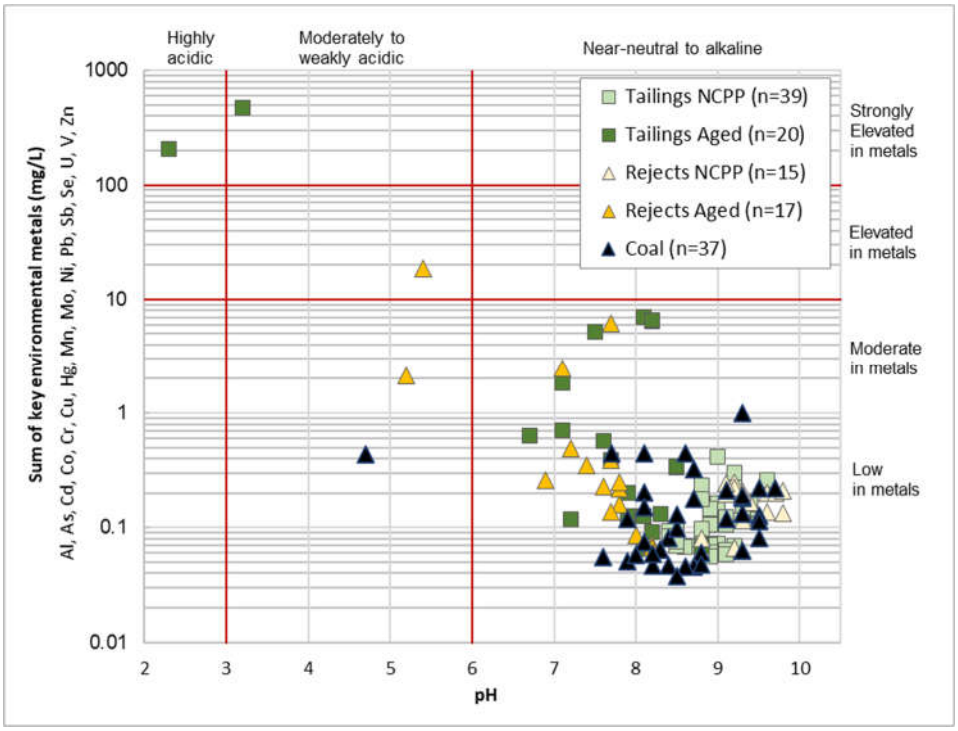
Figure 4-19. Sum of key environmental metals versus pH in deionised water extracts in spoil



One tailings sample and two rejects samples have moderate to very high soluble metal and metalloid concentrations associated with moderately to weakly acidic pH (pH 3.0 to 6.0); and all three samples were classified as PAF. One additional tailings sample, classified as PAF, was highly acidic (pH 2.3) and produced leachate with very high soluble metal and metalloid concentrations. One coal sample produced low soluble metal and metalloid concentrations at pH 4.7 (weakly acid) – and was classified as PAF-LC.

An additional 38 samples (30 spoil, five aged tailings, two aged rejects and one coal) had moderate soluble metal and metalloid concentrations associated with pH-neutral to alkaline conditions. One of the 30 spoil samples was classified as UC(PAF) and the remaining 29 spoil samples were classified as NAF. The tailings and rejects samples had a range of NAF and UC(PAF) classifications.

Figure 4-20. Sum of key environmental metals versus pH in deionised water extracts in tailings, rejects and coal



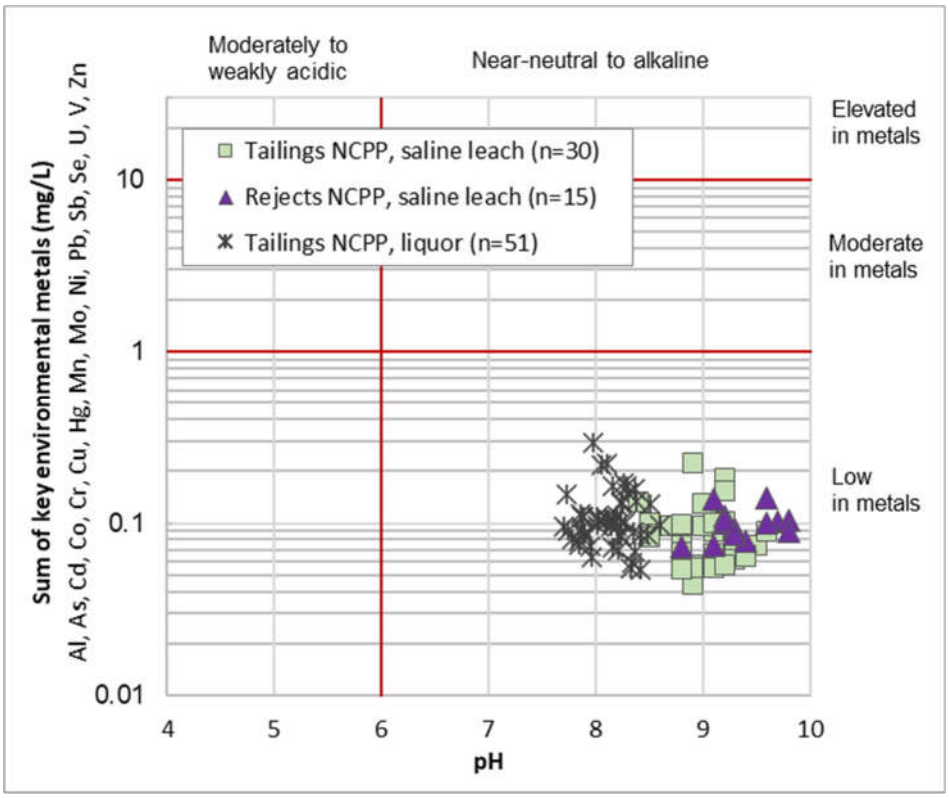
In pH-neutral to alkaline waters, many metals and metalloids cannot remain in solution and, thus, trace metal and metalloid concentrations are generally low. Comparatively, in acid(ic) waters, many metals and metalloids are moderately to highly soluble and will remain in solution and, thus, trace metal and metalloid concentrations in acid(ic) water are generally high. Notable exceptions to these general rules include elements such as As, Mn, Sb and Se, which remain soluble through a wide pH range. Other trace metals that are somewhat soluble under pH-neutral to alkaline conditions include Cd, Cr, Mo and Zn. As such, under the pH-alkaline conditions of the leachate, the mobility of these elements would not be inhibited.

4.5 'Saline' Water Solubility of Tailings and Rejects

Thirty (30) tailings and 15 rejects samples underwent a 1:5 w:v (solid:water) mildly saline (brackish) water extract procedure on pulps using a 2 g/L NaCl leaching solution. This leach was undertaken to determine the solubility of metals and metalloids under 'brackish' conditions – which better simulate the normal (brackish) water quality of the NCPP process water. Note that the salinity of NCPP process water varies from fresh to brackish on a day-to-day basis depending upon the source of the water from within the mine water management system. The sum of the concentration of 16 environmentally important elements are plotted as a function of pH from the saline leach solution for tailings and rejects in Figure 4-21 (along with the data for the tailings liquor solutions – see Section 4.6 below). The 16 selected metals and metalloids are the same elements as per the 1:5 deionised water leach. The calculated total dissolved solids (TDS) concentration of the saline leachate from the tailings and rejects samples ranged from approximately 1600 mg/L to 2480 mg/L, with a median calculated TDS value of 2295 mg/L for the tailings samples and 1961 mg/L for the rejects samples.

The results have shown that the solubility of tailings and rejects is low under 'brackish' leaching conditions.

Figure 4-21. Sum of key environmental metals versus pH in saline water extracts and tailings liquor



4.6 Characteristics of Tailings Liquor (Water)

Water quality data for tailings liquor is available for 51 tailings slurry samples collected from the NCPP (at the thickener underflow). The sum of the concentration of 16 environmentally important elements are plotted as a function of pH from the tailings liquor solution in **Figure 4-21** (along with the data for the saline leach solutions from **Section 4.5**). The 16 selected metals and metalloids are the same elements as per the 1:5 deionised water leach, saline water leach and peroxide leach.

All liquor samples have near neutral to alkaline pH and low soluble metal and metalloid concentrations. The liquor is highly saline, with EC values ranging from 2210 to 5410 μS/cm (median 4220 μS/cm) and a median calculated TDS concentration of 2820 mg/L. The dominant cation is Na and the dominant anions are Cl and SO_4 (equally dominant). Tailings liquor has generally moderate alkalinity, typically 290-425 mg/L as $CaCO_3$, and essentially all present as bicarbonate alkalinity.

4.7 Peroxide Leachate Solutions

Peroxide leachate (NAG leach) data is available for 50 samples, namely:

- 3 spoil samples (non-carbonaceous and carbonaceous; classified as UC[NAF] and UC[PAF]);
- 41 tailings samples of all classifications (NAF, UC[NAF], NAF-S, UC[PAF], PAF-LC and PAF); and
- 6 rejects samples of mixed classifications (UC[NAF], UC[PAF],PAF-LC and PAF).

Peroxide leachate is the solution resulting from a single addition (standard) NAG test after the sample has been oxidised with peroxide to encourage oxidation and associated neutralising reactions, if ANC is available. The test encourages complete and rapid oxidation and associated neutralisation, with the

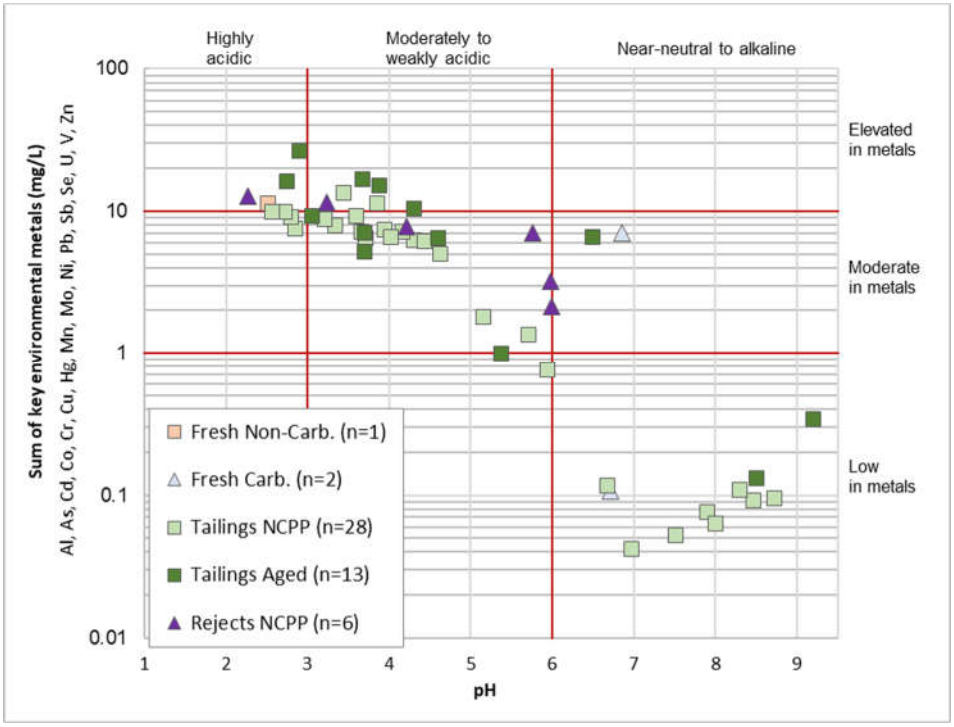
resulting leach representing an assumed 'worse case' scenario in term of metal and metalloid mobility. The purpose of this test is to understand what metals and metalloids can be mobilised following full oxidation. The samples submitted for this test were selected to assess the hazard of similar waste type or to assist clarifying borderline geochemical properties.

It must be noted that samples with potentially high C-org concentration, such as some tailings and some reject samples, may be influenced by organic acids producing acidity and correspondingly elevated soluble metal and metalloid concentrations unrelated to AMD. As such, the results for highly carbonaceous samples should be interpreted with this in mind.

The sum of the concentration of 16 environmentally important elements are plotted as a function of pH from the peroxide leachate solution in **Figure 4-22**. The 16 selected metals and metalloids are the same elements as per the 1:5 deionised water leach and the saline leach.

After undergoing a peroxide (NAG) leach a significant number of samples have acidic pH (ranging from weakly to highly acidic) and moderate to elevated soluble metal and metalloid concentrations – primarily due to the low pH enhancing solubility.

Figure 4-22. Sum of key environmental metals versus pH in peroxide (NAG) leachate solution



The results suggest that under acid/acidic conditions, materials represented by these samples are capable of generating elevated metal and metalloid loads for several metals and metalloids. Of the 50 samples subjected to peroxide (NAG) leaching, 33 samples (66% of samples) had total S concentration greater than 0.5%, and of these 33 samples, 17 samples had total S concentration greater than 1% – meaning those samples with moderate or greater total S are capable of generating SO_4 (and salinity). However, for the most part, SO_4 (and salinity) loads are not expected to be elevated due to the generally low total S concentrations. These data suggest that if PAF/PAF-LC material is allowed to oxidise without ANC available in the bulk media to buffer acidity, material similar to that tested might mobilise metals and metalloids at elevated concentrations, over time.

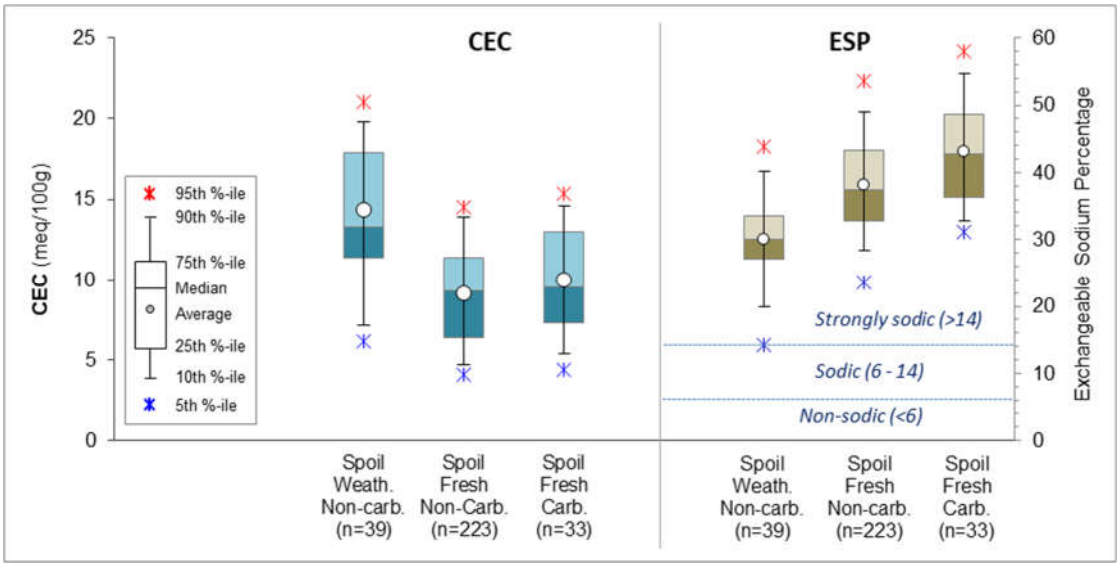
4.8 Cation Exchange Capacity, Sodicity and Dispersion of Spoil

Exchangeable cation concentrations are used to evaluate the potential 'soil quality' of materials. CEC and ESP data are available for 295 spoil samples. The results are summarised in **Figure 4-23**.

The CEC spans a large range from less than one milliequivalents per 100 grams (meq/100g) to 30 meq/100g, with a relatively low median CEC value of 9.6 meq/100g. The CEC for weathered spoil was generally higher than fresh spoil.

The ESP results generally ranged from 8.1% to 100%, with a high median ESP of 37%. Approximately 98% of samples had ESP values greater than 14% and a further 2% of samples had ESP values between 6% and 14%. Therefore, based on the ESP values alone, all of the spoil samples are regarded as being 'sodic' to 'strongly sodic' and, as such, mine spoil at BWM and the Project can be expected to have potential for dispersion.

Figure 4-23. Cation exchange capacity and exchangeable sodium percentage of spoil



All 295 spoil samples also underwent Emerson aggregate class tests to determine whether these samples were dispersive. Emerson aggregate class tests are a direct measure of soil dispersion, whereas ESP values are used as an indirect measure of the potential for a sample to have structural stability problems and hence may be dispersive. It should be noted that Emerson aggregate tests are designed for soil testing, not for crushed drill-core. Therefore, the results should be interpreted with this in mind.

The results show that about 55% of samples (162 out of 295 samples) had an Emerson Class of two (some dispersion; slaking) and three samples had an Emerson Class of three (dispersion; calcite or gypsum present) – meaning about 56% of samples were dispersive to some degree. The remaining 44% of samples (130 samples out of 295) had Emerson Class values suggesting no dispersion. In summary, the Emerson Class testing suggests a significant proportion of the samples (about 56% of samples) may be prone to dispersion. Refer to **Section 3.4** for class descriptions.

Therefore, based on the CEC, ESP and Emerson aggregate class test results, a significant proportion of spoil at BWM and the Project is expected to be sodic and dispersive to varying degrees. These

exchangeable cation (and Emerson aggregate class) results are common for Bowen Basin Permian-aged and Tertiary-aged material in the region.

The environmental significance of exchangeable cation values and sodicity levels in spoil material in terms of potential erosion and dispersion is outlined in **Section 6**, however readers should consult the separate soils assessment undertaken as part of the environmental approvals for the Project for a detailed assessment of soil properties with regard to rehabilitation.

4.9 Kinetic Column Leaching of Tailings

Data is available for free-draining kinetic column leaching test-work on one aged tailings sample from NCPP TSF classified as PAF and five fresh NCPP tailings samples with mixed classifications (NAF, NAF-S, PAF-LC and PAF).

The samples were selected for column leaching test-work on the basis of static test results and had a range of AMD classifications from NAF to PAF (based on the static test-work). The column leaching method followed a modified AMIRA (2002) method[4], where samples were leached at four-weekly intervals with moistening and drying steps between the leaching events. The aged tailings sample and two of the fresh tailings samples were leached for 32 weeks (nine leach cycles including initial flush). The remaining three fresh tailings samples were leached for 52 weeks (14 leach cycles including initial flush).

The sum of the concentration of 15 environmentally important elements are plotted as a function of pH from the column leaching solutions in **Figure 4-24**. The 15 selected metals and metalloids are the same as the elements as per the 1:5 deionised water leach, saline leach and peroxide leach – excluding vanadium (V), for which no data was available.

For the fresh NCPP tailings samples, most of the leachate was low in soluble metal and metalloid concentrations with the exception of the initial (Week 0) leaching events for three samples, which produced initial leachate with moderate soluble metal and metalloid concentrations. Solute concentrations are typically higher in the initial flush as pre-existing salts are leached. Excluding the initial flush from one of the fresh NCPP tailings samples that produced weakly acidic leachate, all fresh tailings samples had near neutral to alkaline pH.

For the aged NCPP TSF tailings sample, the initial (Week 0) flush was elevated in soluble metals and metalloids, followed by moderate metal and metalloid concentrations during the leaching events at Weeks 4, 8 and 12. Beyond the Week 12 leach, the soluble metal and metalloid concentration from aged tailings leachate was low – and at near-neutral to alkaline pH.

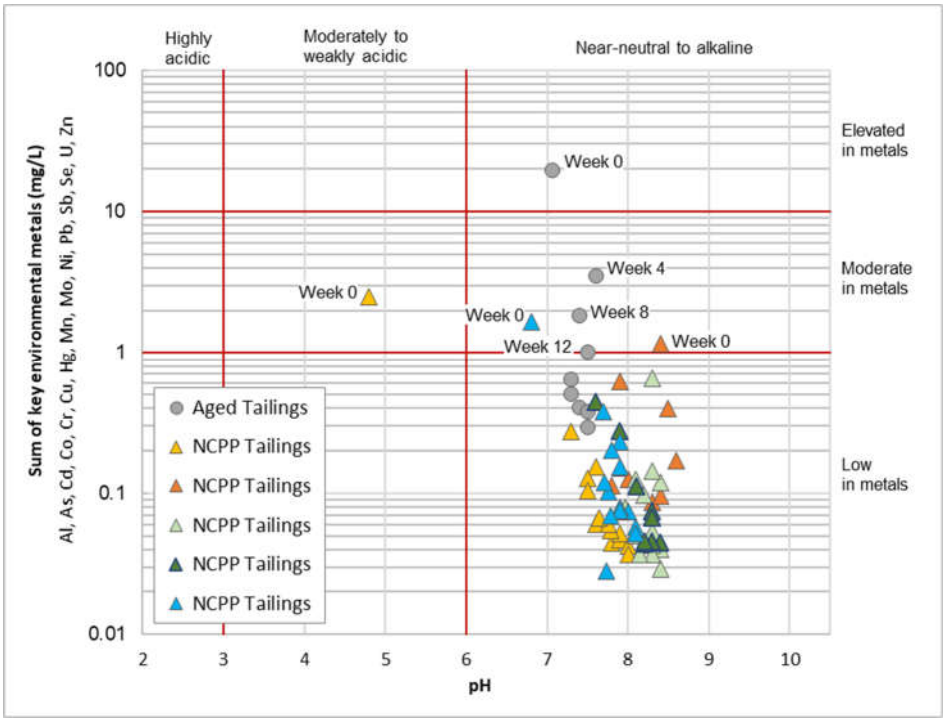
The salinity of the samples (column leachate) for fresh tailings samples ranged from 563 to 9460 μS/cm, with a moderately saline median value of 1230 μS/cm. The sulfate release rates for fresh NCPP tailings samples ranged from 22 mg/kg/week to 57 mg/kg/week.

For the aged tailings sample, the salinity ranged from 2110 to 6930 μS/cm with a saline median value of 2210 μS/cm. The aged tailings sample released sulfate at a rate of 147 mg/kg/week, which was the highest among all samples leached.

4 Modifications to the 'standard' method were needed due to the very fine particle size of the samples

The column leaching showed that none of the tailings samples were acid forming (i.e. no samples produced AD) throughout the leaching period. The aged tailings sample released higher levels of salt and elevated metal and metalloid concentrations compared to fresh samples.

Figure 4-24. Sum of key environmental metals versus pH in kinetic column leachate solution



4.10 OxCon Test-work of Tailings

Data is available for OxCon test-work undertaken on six samples, comprising one aged tailings sample from NCPP TSF classified as PAF and five fresh NCPP tailings samples with mixed classifications (NAF, NAF-S, PAF-LC and PAF). The test-work – summarised in **Table 4-6** – found that:

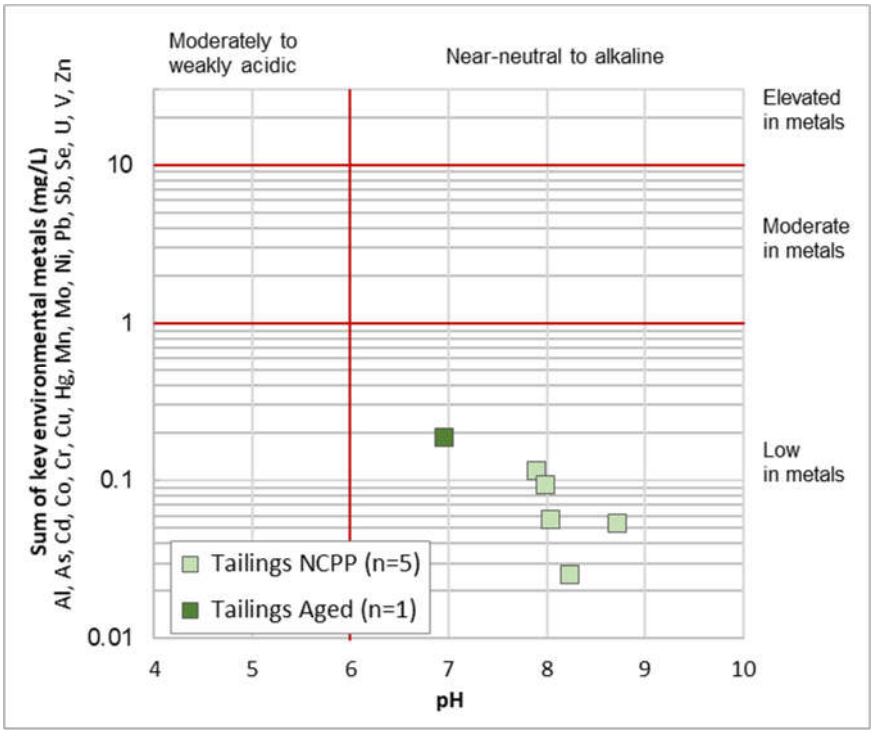
- Two of the five fresh NCPP tailing samples were confirmed to be NAF and are unlikely to generate AD or NMD (negligible risk) and with a low/negligible risk of generating SD. The remaining three fresh NCPP tailings samples were confirmed as PAF or PAF-LC and were found to pose a moderate to moderate-high risk of generating AD and low potential for SD.
- The aged tailings sample from NCPP TSF was confirmed as PAF and found to pose a high potential for generating AD and low potential for SD.

At the conclusion of the OxCon test, the solid underwent a bottle leaching procedure at a 1:2 w:v (solid:water) ratio and the leachate was analysed to determine the pH, acidity/alkalinity and concentration of soluble metals and metalloids, and salts. The sum of the concentration of 16 environmentally important elements are plotted as a function of pH from the post-OxCon leachate solution in **Figure 4-25**. The 16 selected metals and metalloids are the same elements as per the 1:5 deionised water leach, saline leach and peroxide (NAG) leach. As evident in **Figure 4-25** all six samples have near-neutral to alkaline pH and low soluble metal and metalloid concentrations.

Table 4-6. Summary of OxCon results for the tailings samples

Sample ID:	BWM Tails 31-08-20	BWM Tails 03-09-20	BWM Tails 04-09-20	BWM Tails 09-09-20	BWM Tails 18-09-20	BWM-NCPP-CPT51-INT06
Type / Source	Tailings fresh NCPP	Tailings fresh NCPP	Tailings fresh NCPP	Tailings fresh NCPP	Tailings fresh NCPP	Tailings aged NCPP TSF
Preliminary (pre-OxCon) AMD Classification	PAF	PAF	NAF-S	PAF-LC	NAF	PAF
Avg. O_2 consumption rate (mmol O2/kg /day)	0.48	0.31	0.60	0.51	0.43	0.63
Max. acidity generation Rate (kg H_2SO_4/t /year)	9.3	5.9	11	9.7	8.2	12
Pyrite oxidation rate (wt.% pyrite/year)	55	12	53	80	0.57	11
Longevity of sulfide Oxidation (years)	10	35	10	5	2	38
Lag time until ANC Consumed (years)	approx. 4	approx. 9	n/a	<1	n/a	approx. 4
Peak net acidity generation Rate (kg H_2SO_4/t /year)	1.2	2.1	<0.1	8.3	<0.1	7.9
AMD Classification Based on OxCon Test	PAF-LC	PAF	NAF	PAF-LC	NAF	PAF

Figure 4-25. Sum of key environmental metals versus pH in OxCon leachate solution



5 Summary of Geochemical Characteristics

The geochemical characteristics of overburden/interburden (spoil) from the northern mining area at BWM and the Project have been assessed, as have the geochemical characteristics of tailings and rejects from BWM. Also assessed were coal samples that may report as ROM coal or as waste to the spoil dumps. The assessment was undertaken to understand the environmental geochemical characteristics of these samples, as being representative of their respective mineral waste types at BWM and the Project.

Based on the BWM Progressive Rehabilitation and Closure Plan (WHC, 2025) spoil comprises approximately 99% of the mineral waste at BWM, of which about 92% is non-carbonaceous. Tailings and rejects comprise approximately 0.5% each of mineral waste at BWM. These approximate proportions are expected to remain the same as mining progresses into the Project.

Spoil is overwhelmingly comprised of non-carbonaceous material. Carbonaceous spoil (of which almost all is fresh/unweathered) comprises a small proportion of the spoil. These proportions are expected to remain unchanged as mining progresses eastwards into the Project.

5.1 AMD Potential of Mineral Waste and Coal

Acid and Metalliferous Drainage Potential of Spoil – Non-Carbonaceous

Non-carbonaceous spoil, which comprises about 92% of spoil at BWM (WHC, 2025), is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage), which is typical for mine spoil in the Bowen Basin.

Based on the results of 2100 samples, non-carbonaceous spoil from the Project has a negligible potential to generate AMD as either AD and/or NMD and/or SD.

The total S concentration of non-carbonaceous spoil is very low, with a 95th percentile total S concentration of 0.09%. As such, and combined with moderate to high ANC values (median 45 kg H_2SO_4/t), which is significantly higher than the MPA (median 0.9 kg H_2SO_4/t), greater than 99% of non-carbonaceous spoil samples tested were classified as NAF, with one sample classified as UC(NAF). Less than 0.4% of non-carbonaceous spoil samples were classified as PAF, PAF-LC, UC(PAF) or NAF-S.

The test-work undertaken has demonstrated that the ANC for the non-carbonaceous spoil is generally expected to be about 40-70% available under field conditions (based on 25th and 75th percentile values). Mineralogical (QXRD) analysis indicates that iron-dolomite and calcite are the main carbonate minerals contributing to the acid buffering potential of non-carbonaceous spoil. Overall, non-carbonaceous spoil has excess acid neutralising capacity and is expected to be bulk acid consuming.

Total metal and metalloid concentrations from 264 non-carbonaceous spoil samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. Six samples (out of 264) were significantly enriched with regard to one or more of As, Ba, Hg and/or S. The enrichment in these elements in a very small number of samples is not cause for concern. In summary, non-carbonaceous spoil (as a bulk material) has low enrichment in total metals and metalloids compared to un-mineralised rocks.

Soluble multi-element results (from 264 non-carbonaceous samples) indicate that leachate from this material is expected to contain low concentrations of soluble metals and metalloids. Approximately 11%

of these samples (almost all NAF) produced leachate with moderate soluble metal and metalloid concentrations under near-neutral to alkaline pH, largely driven by higher concentrations of soluble Al and/or As. Peroxide (NAG) leaching undertaken on a single non-carbonaceous spoil sample classified as UC(PAF), showed that 'PAF' material, when oxidised, has the potential to generate low pH leachate (AD) with elevated sulfate and soluble metal and metalloid concentrations.

For the key aspects assessed, including ABA components (total S, Scr, ANC), total metals and metalloids, and soluble metals and metalloids, the assessment has demonstrated that non-carbonaceous spoil from the Project can be expected to have AMD characteristics that are comparable to non-carbonaceous spoil currently mined at BWM.

Acid and Metalliferous Drainage Potential of Spoil – Carbonaceous

Carbonaceous spoil represents approximately 8% of spoil material at BWM (WHC, 2025) and, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage), similar to non-carbonaceous spoil. Essentially all carbonaceous spoil is fresh (unweathered).

Based on the results from 160 samples, most carbonaceous spoil has a generally low to moderate potential to generate AD and/or NMD and/or SD. Some carbonaceous spoil – mostly associated with coal seams – has a greater potential to generate low-level AD and/or NMD and/or SD.

The total S concentration of carbonaceous spoil is very low to low, with a 95th percentile total S concentration of 0.52%.

Approximately 92% (147 out of 160 samples) of carbonaceous spoil samples were classified as NAF, which includes two samples classified as UC(NAF). The remaining 8% of carbonaceous spoil samples were classified as PAF-LC or UC(PAF), including two samples classified as NAF-S. Only three samples had moderate to high total S concentrations (S >1%). Of the 13 samples classified as 'PAF' (of any type), all except two were closely associated with coal seams and could potentially end up as coarse reject if mined with ROM coal.

The test-work undertaken has demonstrated that the ANC for the carbonaceous spoil is generally expected to be about 20-35% available under field conditions (based on 25th and 75th percentile values), which is only about half that of non-carbonaceous spoil. Mineralogical (QXRD) analysis indicates that iron-dolomite is expected to be the main carbonate mineral contributing to the acid buffering potential of carbonaceous spoil. ANC is only slightly lower, overall, compared to non-carbonaceous spoil. However, the much lower availability of the ANC under field conditions in carbonaceous spoil (compared to non-carbonaceous spoil) is likely due to carbonaceous spoil having less calcite than non-carbonaceous spoil coupled with a much higher amorphous content and lower overall carbonate content.

Total metal and metalloid concentrations from 39 carbonaceous spoil samples tested are generally very low compared to the average elemental abundance in soil in the Earth's crust, and very similar to the assay concentrations from non-carbonaceous spoil. Seven out of 39 carbonaceous spoil samples – all classified as 'PAF' of some type – were significantly enriched with regard to one or more of As, Hg and/or S – and all seven samples were closely associated with coal seams. The enrichment in these elements in a small proportion of spoil is not cause for concern. In summary, carbonaceous spoil (as a bulk material) has low enrichment in total metals and metalloids compared to un-mineralised rocks.

Soluble multi-element results (from 39 samples) indicate that leachate from carbonaceous spoil is expected to contain generally low concentrations of soluble metals and metalloids – similar to the non-

carbonaceous spoil samples. Of the 39 samples, all except three had low soluble metal and metalloid concentrations under pH-neutral to alkaline conditions. Three samples (two NAF and one UC[PAF]) had moderate soluble metal and metalloid concentrations under pH-neutral to alkaline conditions.

Two fresh carbonaceous spoil samples, both classified as UC(NAF), underwent peroxide leaching and both were confirmed as NAF, however one of the samples produced leachate with moderate metal and metalloid concentrations.

For the key aspects assessed, including ABA components (total S, Scr, ANC), total metals and metalloids, and soluble metals and metalloids, the assessment has demonstrated that carbonaceous spoil from the Project can be expected to have AMD characteristics that are comparable to non-carbonaceous spoil currently mined at BWM.

Acid and Metalliferous Drainage Potential of Tailings

The geochemical characteristics differed slightly between fresh tailings from the NCPP versus aged tailings from NCPP TSF for different parameters. However, the overall geochemical (AMD) hazard posed by tailings from the two sources (fresh vs aged) was generally similar. As such, the discussion that follows only differentiates between the two tailings sources where the differences between the two sources was significant for some parameters and worthy of discussion. Else, the AMD potential of tailings is discussed as a bulk material.

Based on the results, approximately half of BWM tailings has a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, and the remaining half (approximately) has a relatively low potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce tailings with AMD potential similar to fresh tailings currently produced at BWM NCPP.

Fresh tailings from the NCPP are expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage). Overall, aged tailings have lower pH compared to fresh tailings, however the pH in aged tailings was generally pH-neutral to alkaline. The difference in pH observed between fresh and aged tailings (and the differences within the aged tailings) may be due to a number of factors, however the most likely cause is oxidation processes consuming readily available neutralising minerals, leading to aged tailings generally having a low(er) acid neutralising potential.

The total S concentration of tailings ranges from low to high, but is generally low-moderate to moderate, with a 75th percentile total S concentration of 1.04%; with total S in fresh NCPP tailings being only marginally higher than aged tailings. Based on median values, Scr accounts for approximately 69% of total S in fresh NCPP tailings and 50% of total S in aged tailings – the lower proportion of Scr in aged tailings (compared to fresh tailings) is likely due to some sulfide in aged tailings being oxidised to sulfate.

As a bulk material, tailings have generally moderate ANC (median 28 kg H_2SO_4/t); with ANC in fresh NCPP tailings being higher than aged tailings. Combined with low-moderate MPA values (median 21 kg H_2SO_4/t) reflective of the range of total S values, approximately 52% of the tailings samples were classified as NAF or UC(NAF). The remaining 48% of samples were classified as PAF, PAF-LC or UC(PAF), including 4% of tailings samples classified as NAF-S.

The test-work undertaken has demonstrated that the ANC for both fresh and aged tailings (combined) is generally expected to be about 45-68% available under field conditions. However, the 'field availability' of ANC generally ranged from about 20-85%. Iron-dolomite and calcite are expected to be the main carbonate minerals contributing to the acid buffering potential of tailings. All tailings have appreciable

concentrations of siderite (an iron carbonate mineral), however, siderite provides no net acid neutralising capacity. Overall, carbonate concentrations were similar between fresh and aged tailings.

Total metal and metalloid concentrations from 42 fresh and 14 aged tailings samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. However, about one-quarter of fresh NCPP tailings samples and about half of the aged tailings samples were significantly enriched with S, including two aged tailings samples with significant enrichment in Ag. All of the tailings samples that were significantly enriched in S were classified as 'PAF' of some type.

Solubility data indicate that fresh NCPP tailings samples under freshwater (deionised water) leaching conditions are expected to have low soluble metal and metalloid concentrations and have near-neutral to alkaline pH. For the aged tailings, five of the 20 samples had moderate soluble metal and metalloid concentrations under pH-neutral to alkaline conditions. A further two aged tailings samples (both classified as PAF) produced acidic leachate with highly elevated metal and metalloid concentrations – confirming their PAF classification. These results suggests that, overtime, some tailings can generate AD as field ANC is consumed. Under saline leaching conditions tailings produced low concentrations of soluble metals and metalloids.

Peroxide leaching undertaken on 41 tailings samples (fresh and aged, and about half of the samples classified as 'PAF') showed that when exposed to highly oxidising conditions 'PAF' tailings can produce weakly to highly acidic leachate with moderate to elevated soluble metal and metalloid concentrations. It must be noted that samples with potentially high C-org concentrations, such as some tailings samples, may be influenced by organic acids producing acidity and correspondingly elevated soluble metal and metalloid concentrations unrelated to AMD. As such, the results for such coaly/carbonaceous samples should be interpreted with this in mind. Nevertheless, 'PAF' tailings have typically produced moderate to elevated soluble metal and metalloid concentrations from the freshwater and peroxide (NAG) leaching tests. These results indicate that 'PAF' tailings have the potential to generate low pH leachate (AD), however the salinity (sulfate) loads are not expected to be high – due to generally low total S concentrations (with minor exceptions).

Acid and Metalliferous Drainage Potential of Rejects

The geochemical characteristics differed markedly between fresh and aged rejects for several geochemical parameters – unlike tailings, where the geochemical differences were minor between fresh and aged tailings. For context, some of the aged rejects sampled from deep within Ramp 36 rejects dump are from the early 1970s, and are 40-50 years older than the fresh NCPP rejects.

Based on the results, fresh NCPP rejects have a low potential to generate AMD as either AD and/or NMD and/or SD. Comparatively, about one-third of aged rejects – more from Ramp 36 rejects dump than NCPP TSF – have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD. The remaining two-thirds of aged rejects have a relatively low to low-moderate potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce rejects with AMD potential similar to fresh rejects currently produced at BWM NCPP.

Fresh rejects from the NCPP are expected to generate highly pH-alkaline contact water (run-off and seepage). Aged rejects have much lower pH compared to fresh rejects and are expected to generate pH-neutral to alkaline contact water (run-off and seepage). The difference in pH observed between fresh and aged rejects may be due to a number of factors, however the most likely cause is oxidation processes in

aged rejects consuming readily available neutralising minerals, leading to aged rejects having a low(er) remnant acid neutralising potential.

The total S concentration of fresh rejects is generally low, with a median value of 0.28%. Aged rejects from NCPP TSF generally had low to low-moderate total S values (median 0.46%). Aged rejects from Ramp 36 rejects dump generally had low-moderate total S values (median 0.68%). The reason(s) for differences in total S between the three sources of rejects (NCPP, NCPP TSF and Ramp 36 rejects dump) is unclear. However, the most likely reason is due to changes in geochemistry of ROM coal being processed. That is, ROM coal becoming less S-rich over time due to a change in the relative proportions of the various coal seams/plys being mined and processed.

Based on median values, Scr accounts for approximately 74% of total S in fresh NCPP rejects and 61% of total S in aged rejects – the difference between fresh and aged likely due to sulfide oxidation from the aged samples.

Rejects have generally moderate to high ANC (median 30 kg H_2SO_4/t); with ANC in fresh rejects being generally higher (median 40 kg H_2SO_4/t) compared to aged rejects (median 27 kg H_2SO_4/t). Combined with low to moderate MPA values (median 16 kg H_2SO_4/t), resulted in all of the fresh rejects and about two-thirds of the aged rejects being classified as NAF or UC(NAF). Approximately one-third of aged rejects – predominantly from Ramp 36 rejects dump – were classified as PAF, PAF-LC or UC(PAF), including 11% of aged dump rejects classified as NAF-S.

Test-work indicated that about 50-78% of the ANC in fresh rejects (based on 25th and 75th percentile values) is expected to be available under field conditions; and about 45-56% available for the aged rejects (also based on 25th and 75th percentile values).

Total metal and metalloid concentrations from 13 fresh and 17 aged rejects samples tested are very low compared to the average elemental abundance in soil in the Earth's crust. No fresh NCPP rejects showed significant enrichment in any elements, and four of the aged rejects samples were significantly enriched with S, which is consistent with ABA data for these samples – and all four were classified as 'PAF' of some type.

Solubility data from 32 rejects samples tested (fresh and aged, and most of the samples classified as NAF or UC[NAF]) indicate that leachate from rejects under freshwater (deionised water) leaching conditions is generally expected to have low soluble metal and metalloid concentrations, and have near-neutral to alkaline pH, with minor exceptions.

Peroxide leaching undertaken on six aged rejects samples (four classified as 'PAF' and two as UC[NAF]) showed that when exposed to highly oxidising conditions 'PAF' rejects can produce weakly to highly acidic leachate with moderate soluble metal and metalloid concentrations. The results suggest that under acid/acidic conditions, some rejects are capable of generating moderate metal and metalloid loads, however the salinity (sulfate) loads are not expected to be high – due to the generally low total S concentration (with some exceptions).

Acid and Metalliferous Drainage Potential of Coal

Coal is not regarded as waste and ROM coal remains on-site for a relatively short period of time. However, some minor coal seams/plys will report directly as waste, and remnant coal (seams) will be exposed on the highwalls of residual voids at closure.

Coal represents about 7% (on average) of all lithological material at BWM in the vicinity of the Project and about 5-7% of the highwall meterage along the approximate line of the geological long-section. Assuming the large majority of this will report as ROM coal, we can conservatively assume that coal will represent a very small proportion of mineral waste (i.e. nominally 1-2% at the most). Most ROM coal from the Project will be from the same seams as are currently mined at BWM in the vicinity of the Project.

Based on the results, and as a bulk material, ROM coal is conservatively assessed as having a low-moderate to moderate potential to generate AMD as either AD, NMD and/or SD. A small proportion of coal would have a moderate to moderate-high potential to generate AMD. ROM coal, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage).

The total S concentration of coal is generally low; with a median value of 0.22%. Approximately 13% (median value) of the total S is present as Scr (sulfide), with the bulk of the total S likely present as S-org, which does not contribute to AMD. Coal samples have a wide range of ANC values; however, the median ANC, overall, is low (median 12 kg H_2SO_4/t). As such, 72% of coal samples were classified as NAF or UC(NAF). Of the remaining 28% (approximately) of coal samples, almost all were classified as PAF-LC. Two samples were classified as PAF and one sample classified as NAF-S – noting that the AMD classification is based on total S, which for coal samples likely leads to a highly conservative classification.

Of the 59 coal samples classified as 'PAF' (including NAF-S), all except two samples were from the P and L seam group; with two samples from the T seam group.

These results suggest that coal stored on the ROM pad, coal located within pit walls and un-economic coal seam material reporting as spoil (mixed with non-coal spoil) would likely be bulk NAF. The exception is predominantly coal from the P and L seam group, where it is expected that a small proportion of coal may pose a higher AMD hazard due to the higher S grade. However, it is expected that the bulk AMD source hazard for all coal is low.

Assay data for 37 coal samples show that the total metal and metalloid concentrations are low compared to the average elemental abundance in soil in the Earth's crust. One coal sample was significantly enriched with regard to As and S.

Soluble multi-element results from 37 coal samples tested, with a range of NAF to PAF classifications, indicate that contact water (run-off and seepage) from coal is generally expected to contain low concentrations of soluble metals and metalloids. One coal sample classified as PAF-LC produced weakly acidic leachate with low soluble metal and metalloid concentrations.

5.2 Salinity, Sodicity and Dispersion Potential of Mineral Waste and Coal

Salinity, Sodicity and Dispersion Potential of Spoil – Non-Carbonaceous

Non-carbonaceous spoil has low median and 95th percentile $EC_{1:5}$ values of 390 and 549 μS/cm, respectively, and has very low total S concentration. On this basis, contact water (run-off and seepage) is expected to be generally non-saline to slightly saline, as a result of dissolution of geogenic salts more so than from sulfide oxidation (sulfate salinity). Weathered non-carbonaceous spoil generally has slightly higher $EC_{1:5}$ values, overall, compared to fresh non-carbonaceous spoil.

Non-carbonaceous spoil has modest CEC values and high ESP values, resulting in all samples being classified as 'sodic' to 'strongly sodic' based on CEC and ESP data alone and, therefore, with potential

for dispersion. Based on Emerson aggregate class testing to directly measure dispersion, about 56% of the 262 non-carbonaceous samples tested displayed some degree of dispersion. Therefore, based on the CEC, ESP and Emerson aggregate class test results, a significant proportion of non-carbonaceous spoil at BWM and the Project is expected to be sodic and dispersive to varying degrees.

Salinity, Sodicity and Dispersion Potential of Spoil – Carbonaceous

Carbonaceous spoil has low median and 95th percentile $EC_{1:5}$ values of 362 and 547 μS/cm, respectively, and has very low to low total S concentration. On this basis, contact water (run-off and seepage) is expected to be similar to non-carbonaceous spoil. That is, generally non-saline to slightly saline, primarily as a result of dissolution of geogenic salts more so than from sulfide oxidation (sulfate salinity).

Carbonaceous spoil samples (all fresh) had similar CEC values compared to fresh non-carbonaceous spoil, but generally higher ESP values compared to non-carbonaceous spoil – resulting in all carbonaceous samples being classified as 'strongly sodic', with potential for dispersion. Based on Emerson aggregate class testing to directly measure dispersion, about 52% of the 33 carbonaceous samples tested displayed some degree of dispersion. Therefore, based on the CEC, ESP and Emerson aggregate class test results, a significant proportion of carbonaceous spoil at BWM and the Project is expected to be sodic and dispersive to varying degrees.

Salinity Potential of Tailings

Tailings samples have $EC_{1:5}$ values ranging from 97 to 8900 μS/cm, with median and 95th percentile $EC_{1:5}$ values of 711 and 2070 μS/cm, respectively. Fresh and aged tailings are generally slightly to moderately saline – and both tailings types have generally low-moderate to moderate total S concentration. Therefore, tailings are generally slightly to moderately saline with a low to low-moderate potential for SD (from sulfide oxidation).

Salinity Potential of Rejects

Rejects samples have $EC_{1:5}$ values ranging from 229 to 2830 μS/cm, with median and 95th percentile $EC_{1:5}$ values of 761 and 2404 μS/cm, respectively. Fresh NCPP rejects were generally non-saline, whereas aged rejects were generally slightly to moderately saline. Overall, as a bulk material, rejects are assessed as being slightly to moderately saline. Most fresh rejects have low total S concentration, whereas most aged rejects have low to low-moderate total S concentration. Therefore, based on the total S concentrations, the potential for SD (from sulfide oxidation) from rejects is low to low-moderate.

Salinity Potential of Coal

Coal has low median and 95th percentile $EC_{1:5}$ values of 103 and 309 μS/cm, respectively; and has generally low total S concentration. On this basis, contact water (run-off and seepage) from coal, as a bulk material, is expected to be non-saline, either as a result of dissolution of geogenic salts and/or from sulfide oxidation (sulfate salinity).

6 Management and Mitigation Measures

6.1 Spoil Management Strategy

The management of spoil (overburden and interburden) generated by the Project will be consistent with the current approved BWM waste management strategy – comprising the disposal of spoil from the Project into in-pit dumps behind the active mining face, then progressively rehabilitated – with run-off and seepage captured by the mine water management system.

Spoil comprises approximately 99% of the mineral waste at BWM, of which about 92% of spoil is non-carbonaceous. These approximate proportions are expected to continue as mining progresses eastwards into the Project. The assessment has found no difference between the geochemical characteristics of spoil from current BWM compared to the spoil expected to be mined from the Project.

Spoil is overwhelmingly NAF with excess ANC and has a negligible risk of developing AMD, including AD, NMD and/or SD. Furthermore, surface water run-off and seepage from bulk spoil is expected to be non-saline to slightly saline with low soluble metal and metalloid concentrations. However, spoil is expected to be sodic to strongly sodic with potential for dispersion and erosion.

Where highly sodic and/or dispersive spoil is identified it should, wherever practicable, not report to final landform surfaces and should not be used in construction activities. Tertiary spoil has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004 and 2019).

It is unlikely that sodic and potentially dispersive spoil will be able to be selectively handled and emplaced during operation of the Project, as is the case at BWM. Therefore, in the absence of such selective handling, spoil landforms would need to be constructed and progressively rehabilitated to minimise erosion.

Surface water run-off and seepage from spoil, including any rehabilitated areas, should be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major anions, major cations and a broad suite of soluble metals and metalloids at high resolution analysis.

With the implementation of the proposed management and mitigation measures spoil is regarded as posing a low risk of environmental harm.

6.2 Validation of Spoil Characteristics

The AMD hazard posed by existing spoil at BWM is well understood, and the geochemical characteristics (AMD hazard) of future spoil generated by BWM and the Project are expected to be similar to the current spoil being produced at BWM. Nevertheless, WHC will continue to undertake geochemical test-work of overburden and interburden throughout development of the Project. Test-work would, at minimum, comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), ABA parameters, S speciation, and total and soluble metals and metalloids analysis at high resolution.

6.3 Tailings and Rejects Management Strategy

Fresh tailings and rejects samples from the NCPP are those types regarded as being most representative of current tailings and rejects at BWM and are likely to represent short- to medium-term tailings and

rejects expected to be generated in the early years of the Project. Tailings and rejects each comprise approximately 0.5% of mineral waste at BWM; and these approximate proportions are expected to be similar from the Project.

Approximately half of BWM tailings has a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, and the remaining half (approximately) has a relatively low potential to generate AMD as either AD and/or NMD and/or SD. ROM coal from the Project is expected to produce tailings with AMD potential similar to fresh tailings currently produced at BWM NCPP.

Fresh NCPP rejects have a low potential to generate AMD as either AD and/or NMD and/or SD. Comparatively, about one-third of aged rejects have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, with the remaining two-thirds of aged rejects having a relatively low to low-moderate potential to generate AMD. ROM coal from the Project is expected to produce rejects with AMD potential similar to fresh rejects currently produced at BWM NCPP.

At BWM, tailings are currently being disposed into Bonnie Doon in-pit TSF and rejects are currently primarily disposal into in-pit spoil disposal areas within Besgrove and Deep Creek pits. The management of tailings and rejects generated by the Project will be consistent with the current approved strategies for managing tailings and rejects at BWM, including potential future dewatering of tailings and subsequent co-disposal of coal rejects (mixed fine and coarse rejects) into spoil dumps, subject to the conditions of the BWM Environmental Authority.

6.4 Validation of Tailings and Rejects Characteristics

The AMD hazard posed by existing tailings and rejects at BWM is well understood, and the geochemical characteristics (AMD hazard) of future tailings and rejects generated by the Project are expected to be similar to the current tailings and rejects being produced at BWM. Nevertheless, WHC will continue to undertake geochemical test-work of tailings and rejects samples during operations at BWM and throughout development of the Project. Test-work would, at minimum, comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), ABA parameters, S speciation, and total and soluble metals and metalloids analysis at high resolution.

6.5 ROM Coal

ROM coal is not mining waste, and surface water run-off and seepage from ROM pads will be managed as part of the mine water management system.

ROM coal from BWM is conservatively assessed as having a low-moderate to moderate potential to generate AMD as either AD, NMD and/or SD. A small proportion of coal – mostly from the P and L seam group – would have a moderate to moderate-high potential to generate AMD. ROM coal, as a bulk material, is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage).

ROM coal is stored for a very short period of time (days to weeks) compared to mineral waste materials, which are stored in perpetuity. Management practices are therefore different for ROM coal (compared to mineral wastes) and are largely based around the operational (day-to-day) management of surface water run-off from ROM pads.

Surface water run-off from ROM pads would be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major anions, major cations, and a broad suite of soluble metals and metalloids at high resolution analysis.

7 References

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Appendix A

Drill-hole Information for Spoil and Coal Samples

Table A1. Drill-hole information for spoil and coal samples

Drill-hole ID	Easting (m)	Northing (m)	General Location (pit area)	Collar RL (m)	Depth (m)	Type of Samples	Zone Sampled	Total No. of Samples	No. of Weath. Samples	No. of Fresh Samples	Year Drilled & Sampled
BWM_EIS_05	685874	7384430	Mimosa	218.13	131.41	core	All (incl. seams)	116	25	91	2020
BWM_EIS_09	685420	7379087	Airstrip (north)	228.63	126.33	core	All (incl. seams)	100	10	90	2020
BWM_EIS_11	685382	7376066	Besgrove	233.65	149.70	core	All (incl. seams)	115	9	106	2020
BWM_EIS_13	685520	7373834	Deep Creek (north)	235.04	128.69	core	All (incl. seams)	117	11	106	2020
BWM_EIS_15	687308	7372572	Deep Creek (south)	229.32	131.71	core	All (incl. seams)	117	13	104	2020
BWM_EIS_17	689718	7370690	Stewarton	233.92	167.25	core	All (incl. seams)	119	14	105	2020
BWM_EIS_19	690949	7368459	Between Stewarton & Tannyfoil	244.60	129.84	core	All (incl. seams)	104	15	89	2020
BWM_EIS_WC03	686379	7387132	Bonnie Doon	unknown	111.52	core	All (incl. seams)	93	18	75	2021
BWM_EIS_WC07	685968	7381298	Sagittarius	unknown	163.74	core	All (incl. seams)	168	12	156	2021
BWM_EIS_WC10	685448	7377438	Airstrip / Besgrove	unknown	138.45	core	All (incl. seams)	211	22	189	2021
BWM_EIS_WC12	685912	7375212	Besgrove	unknown	135.49	core	All (incl. seams)	165	12	153	2021
BWM_EIS_WC14	688645	7373170	Deep Creek	unknown	148.21	core	All (incl. seams)	208	4	204	2021
108149	690379	7369944	Stewarton	232.95	189.50	core	over/inter burden	140	0	140	2020
108586	690656	7368859	Stewarton / Tannyfoil	242.08	162.44	core	over/inter burden	38	2	36	2024
108620	686018	7374426	Deep Creek	223.21	152.61	core	over/inter burden	80	0	80	2025
108626	685520	7378253	Airstrip	219.83	147.22	core	over/inter burden	76	0	76	2025
108660	689036	7371854	Stewarton	224.81	156.28	core	over/inter burden	69	0	69	2025

Drill-hole ID	Easting (m)	Northing (m)	General Location (pit area)	Collar RL (m)	Depth (m)	Type of Samples	Zone Sampled	Total No. of Samples	No. of Weath. Samples	No. of Fresh Samples	Year Drilled & Sampled
108664	690355	7370550	Stewarton	229.52	207.77	core	over/inter burden	85	0	85	2025
108669	686055	7379851	Burngrove	232.59	165.17	core	over/inter burden	75	0	75	2025
108674	685930	7375759	Besgrove	224.03	192.94	core	over/inter burden	80	0	80	2025
108677	687045	7373549	Deep Creek	220.89	174.96	core	over/inter burden	78	0	78	2025
108688	688757	7376617	Besgrove (east of Project)	200.79	189.48	core	All (incl. seams)	120	9	111	2025

TERRENUS
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