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

Brendan Dillon
Manager – Approvals
Whitehaven Coal Limited

SUBMITTED BY

Francoise Robe. Ph.D.
Technical Director | Associate Principal
Air Quality
Francoise.robe@rwdi.com

Rebecca Warren
Project Manager
Rebecca.Warren@rwdi.com

RWDI Australia Pty Ltd (RWDI)
ABN: 86 641 303 871

BEST MANAGED COMPANIES Platinum member

Certified System Quality ISO 9001 SAI GLOBAL

2026 RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015 for 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.
This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately. Accessible document formats provided upon request. ® RWDI name and logo are registered trademarks in Canada and the United States of America

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	6 February 2026	Holly Scoble Francoise Robe	Francoise Robe Rebecca Warren
B	Final	17 April 2026	Rama Robbi Francoise Robe	Francoise Robe Rebecca Warren

NOTE

The information contained in this document produced by RWDI is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. RWDI undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

RWDI

RWDI is a team of highly specialised consulting engineers and scientists working to improve the built environment through three core areas of practice: building performance, climate engineering and environmental engineering. More information is available at www.rwdi.com.

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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

1 INTRODUCTION 2

2 PROJECT DESCRIPTION 3

2.1 Blackwater North Extension Project 3

2.2 Site Location 3

2.3 Air Pollutants of Concern 5

3 REGULATORY FRAMEWORK 6

3.1 Relevant Legislation 6

3.1.1 Environmental Protection Act 1994 6

3.1.2 National Environmental Protection (Ambient Air Quality) Measure 6

3.1.3 Environmental Authority EPML00717813 7

3.2 Adopted Air Quality Criteria 8

3.3 Sensitive and Commercial Places 8

4 EXISTING ENVIRONMENT 10

4.1 Climatology 10

4.2 Local Meteorology 13

4.2.1 Winds 13

4.2.2 Atmospheric Stability and Mixing Height 15

4.3 Local Ambient Air Quality 16

4.4 Local Terrain and Land Use 19

4.5 Receptors 19

4.6 Background Levels 23

5 AIR QUALITY ASSESSMENT METHODOLOGY 24

5.1 Overview 24

5.2 Assessment Scenarios 25

5.3 Meteorological Modelling 26

5.3.1 TAPM 26

5.3.2 CALMET 26

5.4 Dispersion Modelling - CALPUFF 27

6 DUST EMISSION INVENTORY 29

6.1 Emissions Sources 29

6.2 Mining Activity 29

6.3 Quarries 34

6.4 Applied Mitigation 36

6.5 Emission Rates 36

7 AIR QUALITY IMPACT ASSESSMENT 39

7.1 TSP 39

7.2 PM_{10} 43

7.3 $PM_{2.5}$ 51

7.4 Dust Deposition 58

7.5 Mitigation Control Measures 62

7.5.1 Overall Control Measures 62

7.5.2 Receptor-specific Control Measures 62

7.6 Summary and Discussion 63

8 CONCLUSION 65

9 REFERENCES 66

10 STATEMENT OF LIMITATIONS 67

APPENDIX A - ANNUAL ROM & OVERBURDEN PRODUCTION RATES BY PIT 68

APPENDIX B - BWM ACTIVITY DATA 70

APPENDIX C – EMISSIONS ESTIMATION METHODOLOGY 71

LIST OF FIGURES

Figure 2-1 Project General Arrangement 4
Figure 4-1 Regional Meteorological and Air Quality Monitoring Stations 11
Figure 4-2 Windrose at Blackwater Airport AWS (2013 to 2024) 13
Figure 4-3 Annual Windroses at Blackwater Airport AWS (2020 to 2024) 14
Figure 4-4 Stability Class Frequency vs. Time of the Day at the Centre of the Project Area in 2021 (from CALMET) 15
Figure 4-5 Diurnal Variation of the Mixing Height at the Centre of the Project Area in 2021 (from CALMET) 16
Figure 4-6 Topography and Land Use over the Project Area (CALMET Domain Outlined in Red). 19
Figure 4-7 Sensitive Receptors Locations 22
Figure 5-1 ROM and Overburden Amount for the Selected Modelling Scenarios 25
Figure 6-1 General Arrangement FY30 30
Figure 6-2 General Arrangement FY32 31
Figure 6-3 General Arrangement FY46 32
Figure 6-4 General Arrangement FY55 33
Figure 6-5 Proposed Quarry Locations 35
Figure 7-1 Predicted Annual Average Ground-level TSP Concentrations (µg/m^3) 42
Figure 7-2 Predicted Maximum 24-hour Average Ground-level PM_{10} Concentrations (µg/m^3) 47
Figure 7-3 Predicted Annual Average Ground-level PM_{10} Concentrations (µg/m^3) 50
Figure 7-4 Predicted Maximum 24-hour Average Ground-level $PM_{2.5}$ Concentrations (µg/m^3) 54
Figure 7-5 Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations (µg/m^3) 57
Figure 7-6 Predicted 30-day Average Dust Deposition (mg/m^2/day) 61

LIST OF TABLES

Table 3-1 Adopted Air Quality Criteria 8
Table 4-1 Climate Averages at Blackwater Airport AWS (2013 to 2025) 10
Table 4-2 Monthly Rainfall at Blackwater Airport AWS (2020 to 2025) (mm) 12
Table 4-3 Monthly Minimum and Maximum Temperature at Blackwater Airport AWS 12
Table 4-4 Summary of Particulate Matter Monitoring Results at DETSI Blackwater AQMS (2020 to 2024) (µg/m^3) 17
Table 4-5 Summary of Ambient Dust Deposition Gauge Measurements at BWM by Year 17

Table 4-6 Summary of Ambient Dust Deposition Gauge Measurements at BWM by Location 18
Table 4-7 Receptors 20
Table 4-8 Background Air Quality Adopted for the Assessment 23
Table 5-1 Modelling Scenarios 25
Table 5-2 CALMET Model Setup 27
Table 5-3 CALPUFF Model Setup and Source Configuration 28
Table 6-1 ROM and Overburden Production for the Modelled Years 29
Table 6-2 Emission Inventory for BWM (tonnes/year) 37
Table 6-3 Summary of BWM Particulate Matter Emissions by Activity 38
Table 7-1 Predicted Annual Average Ground-level TSP Concentrations (µg/m^3) 39
Table 7-2 Predicted Maximum 24-hour Average Ground-level PM_{10} Concentrations (µg/m^3) and Number of Days of Predicted Exceedance at Sensitive Receptors 44
Table 7-3 Predicted Annual Average Ground-level PM_{10} Concentrations (µg/m^3) 48
Table 7-4 Predicted Maximum 24-hour Average Ground-level $PM_{2.5}$ Concentrations (µg/m^3) 51
Table 7-5 Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations (µg/m^3) 55
Table 7-6 Predicted 30-day Average Dust Deposition (mg/m^2/day) 58

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

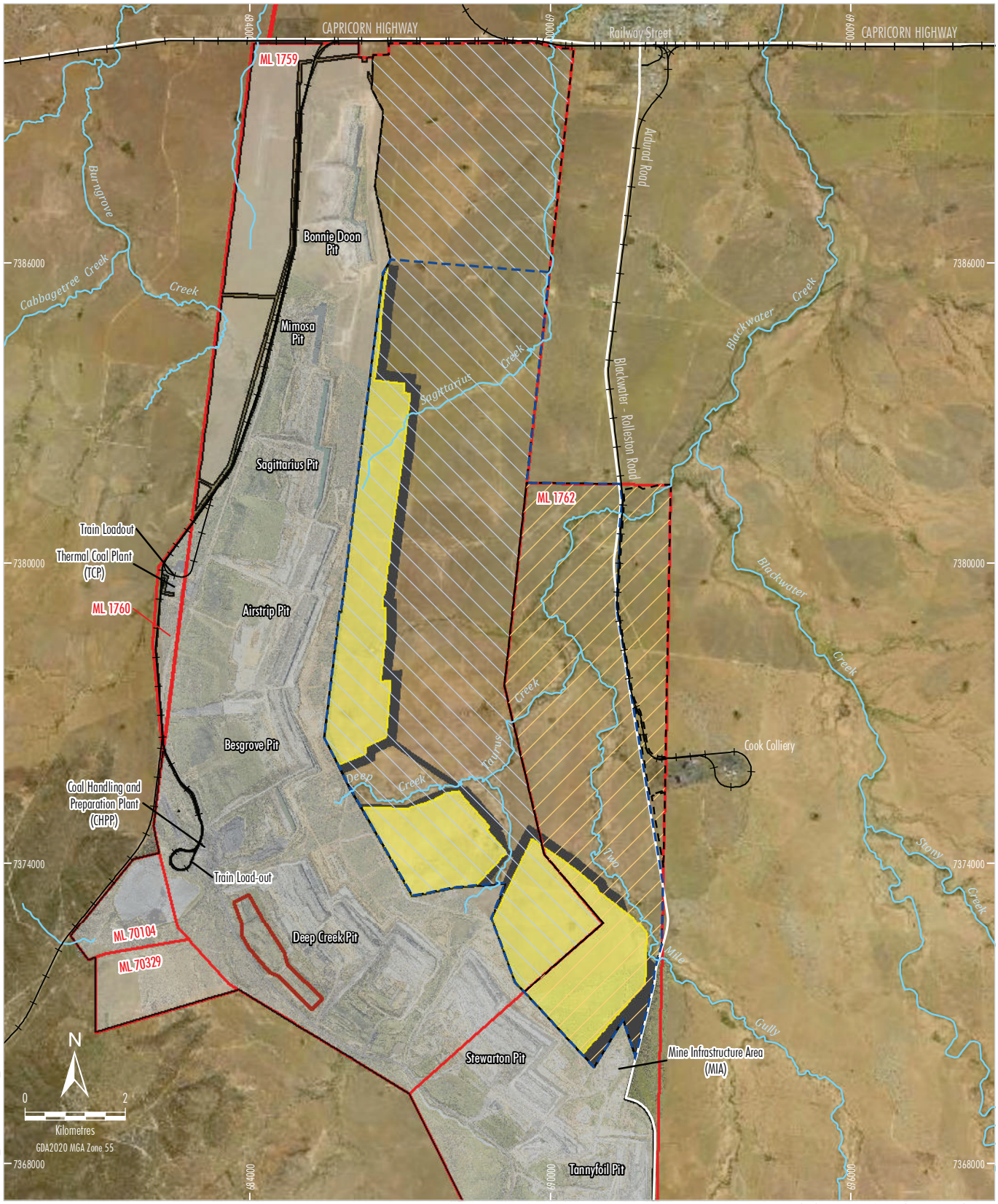
The Project would include the following activities (Figure 2-1):

- 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.

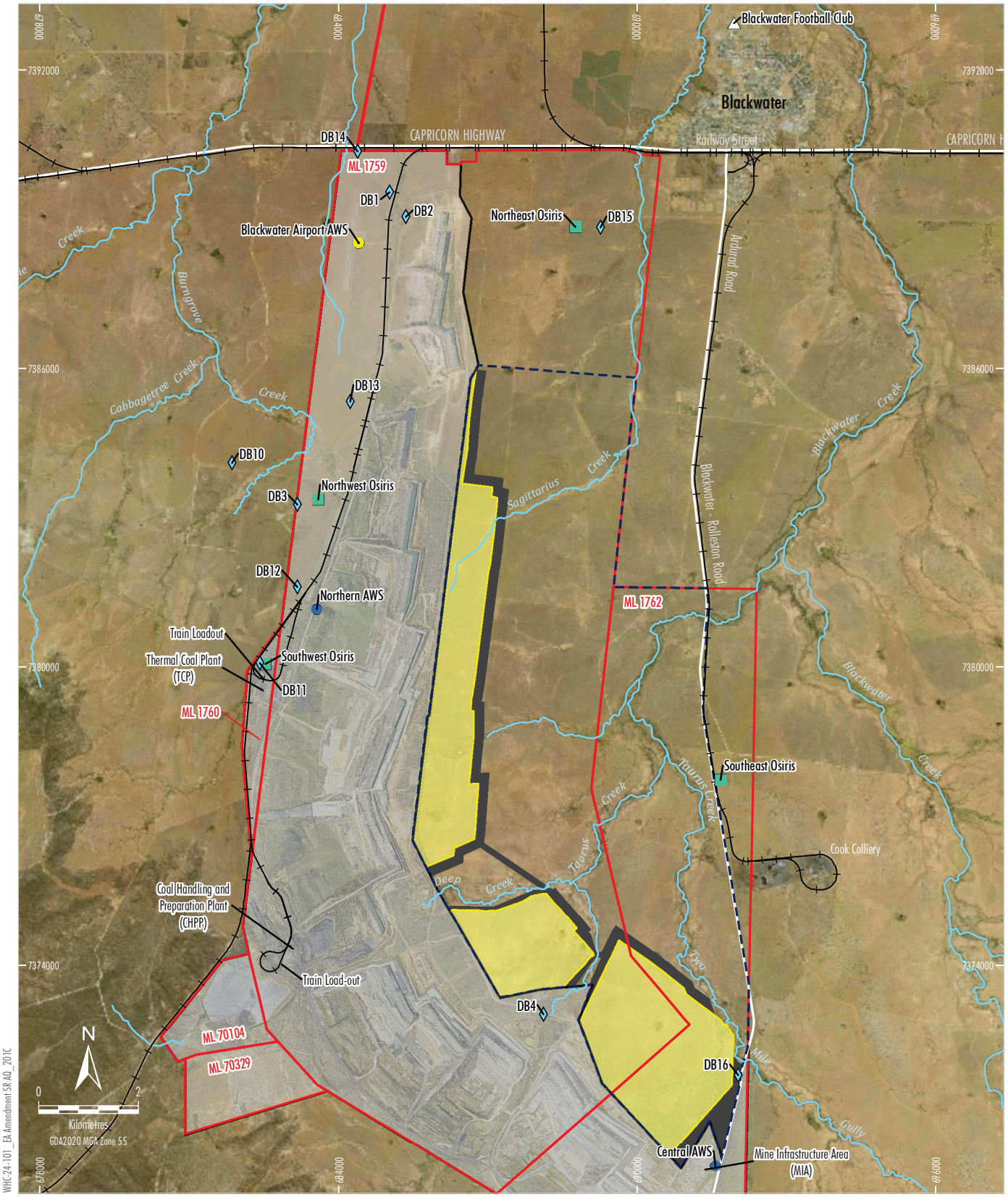
Long-term climate statistics for Blackwater Airport AWS are presented in Table 4-1, Table 4-2 and Table 4-3. Temperature data recorded at the Blackwater Airport AWS indicates that January is typically the hottest and wettest month of the year, and July is the coolest month. Annual statistics of rainfall 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).

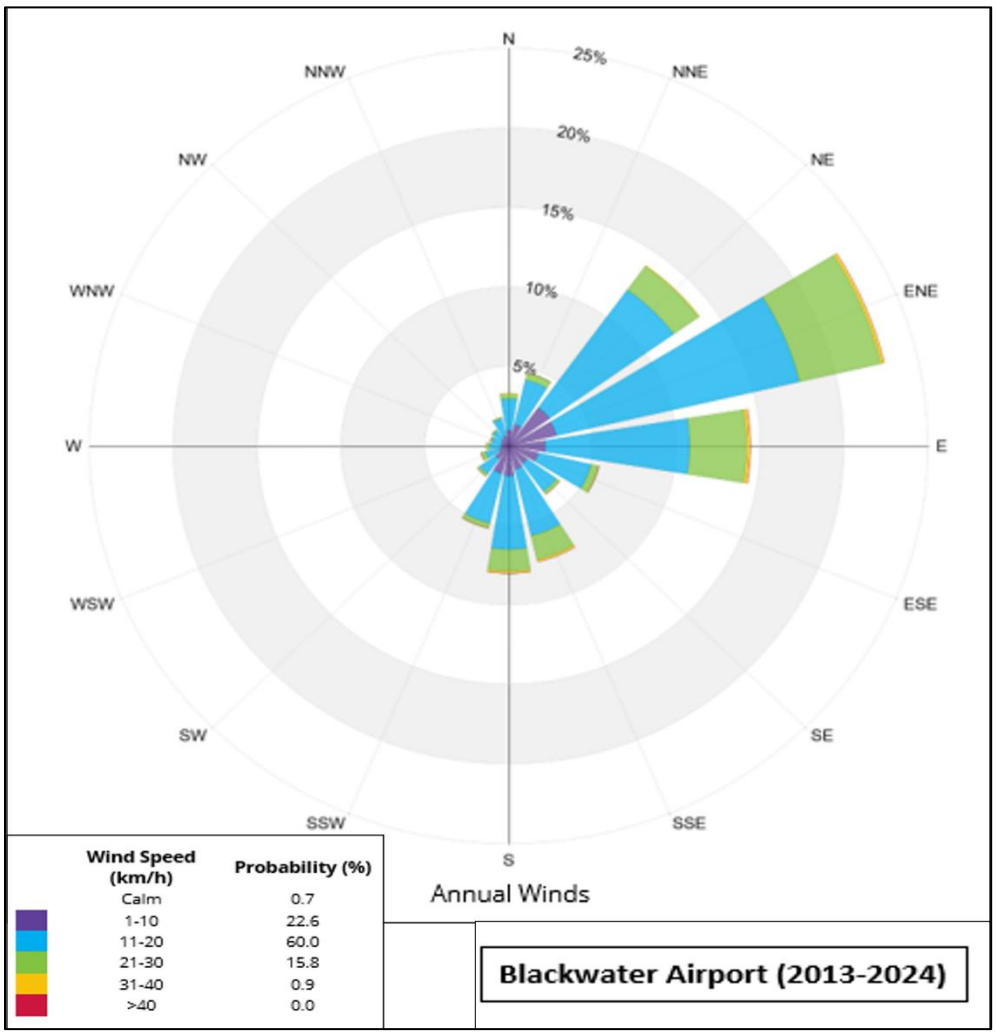


Figure 4-2 Windrose at Blackwater Airport AWS (2013 to 2024)

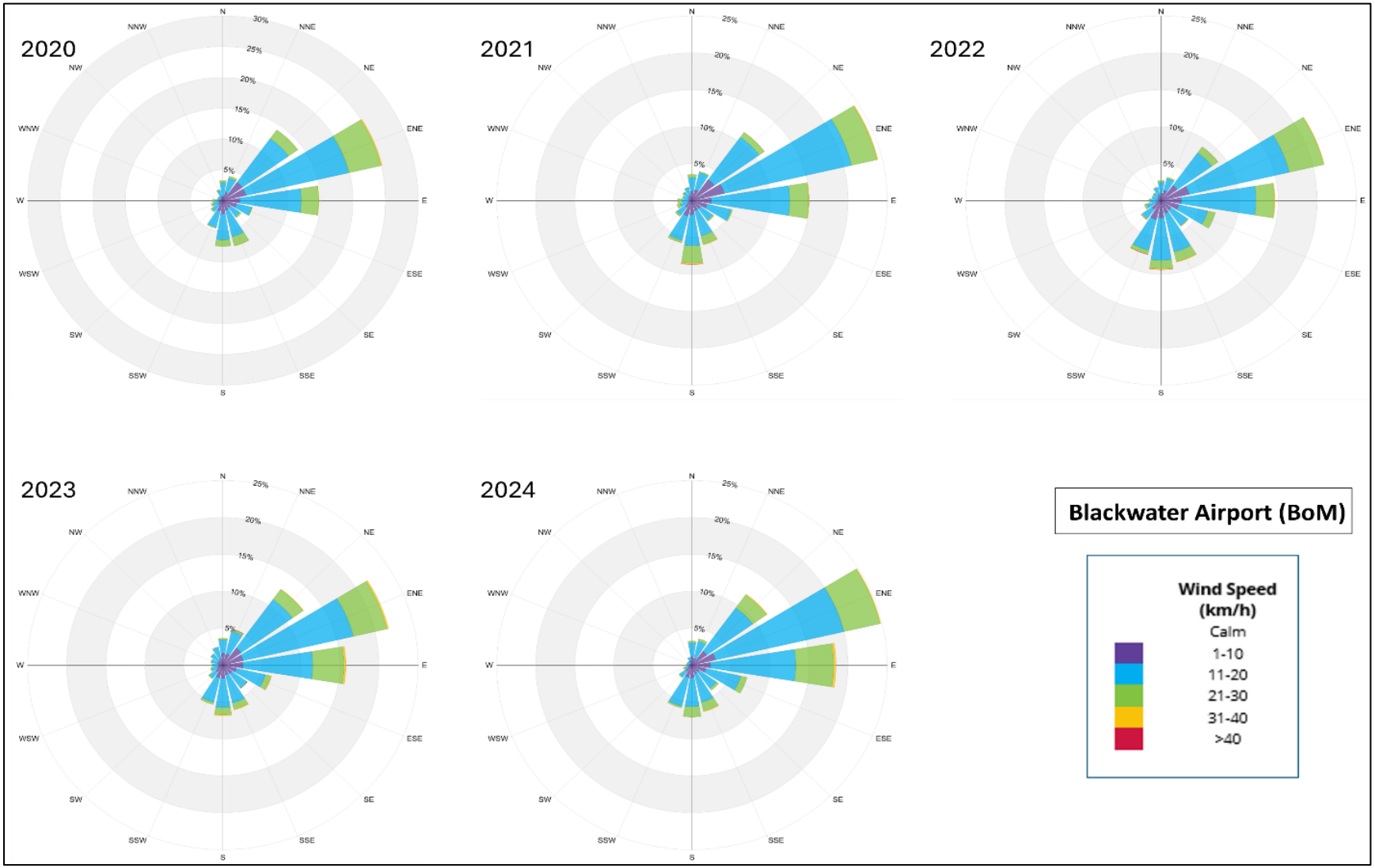


Figure 4-3 Annual Windroses at Blackwater Airport AWS (2020 to 2024)

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.

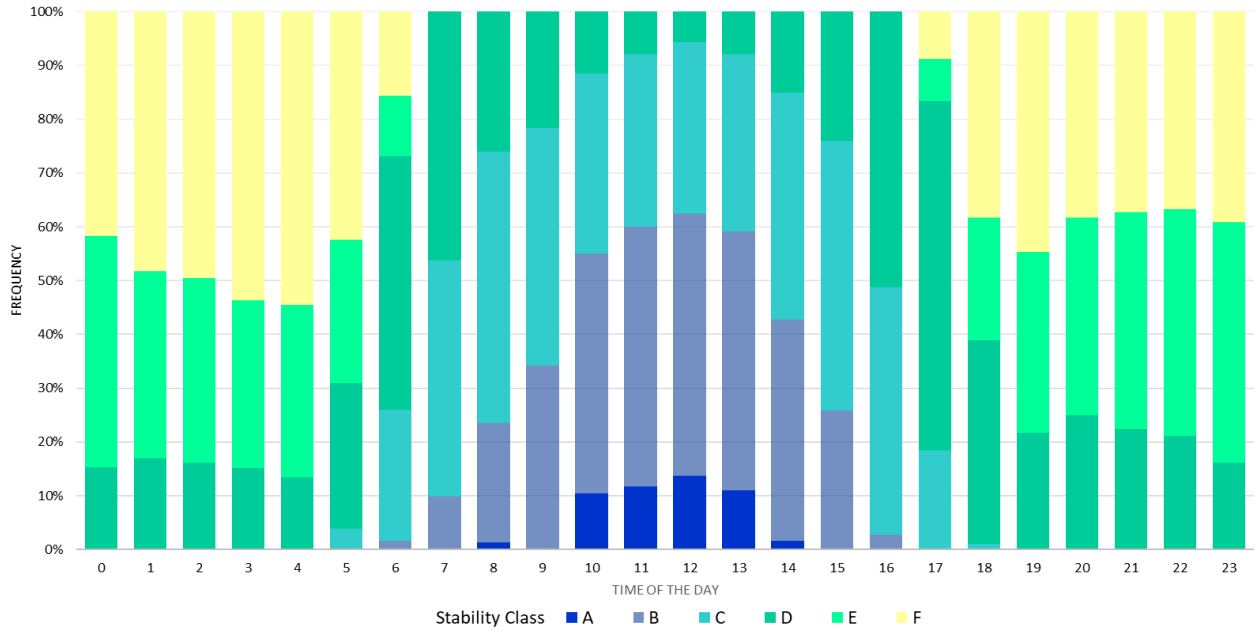


Figure 4-4 Stability Class Frequency vs. Time of the Day at the Centre of the Project Area in 2021 (from CALMET)

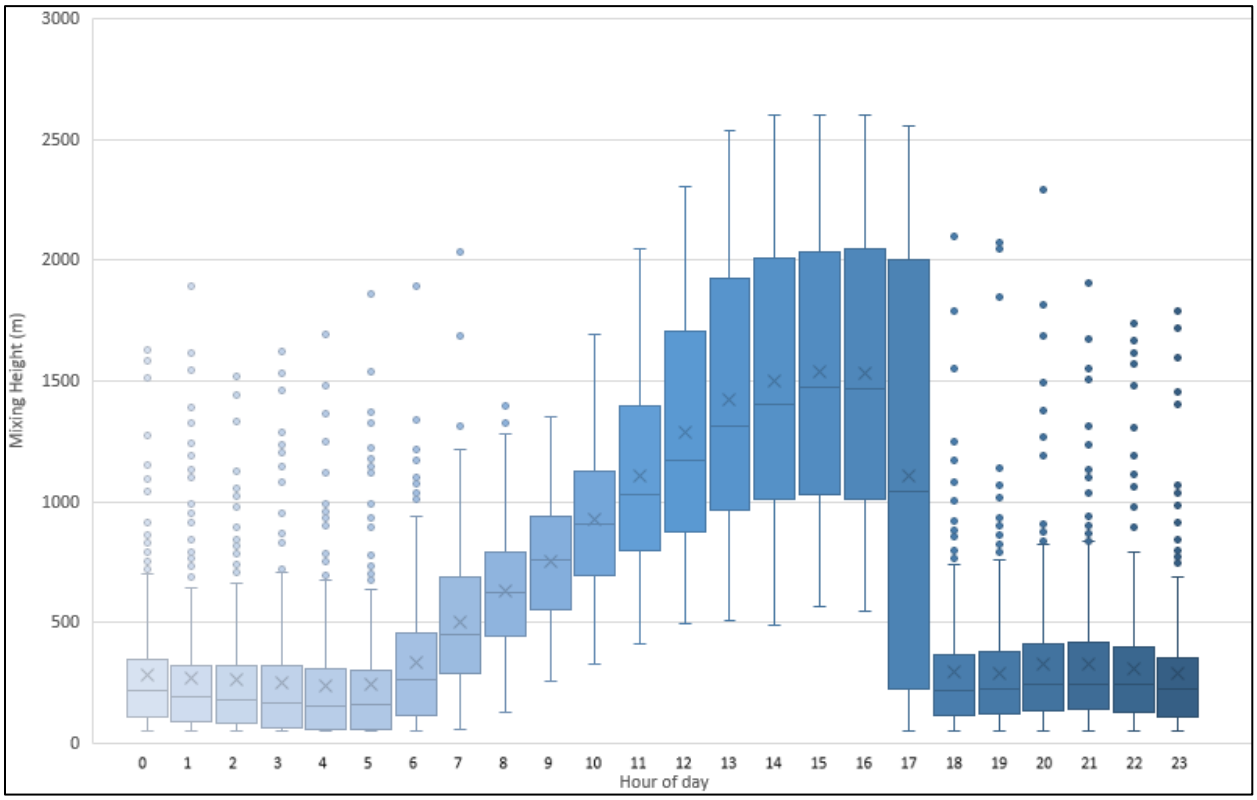


Figure 4-5 Diurnal Variation of the Mixing Height at the Centre of the Project Area in 2021 (from CALMET)

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.

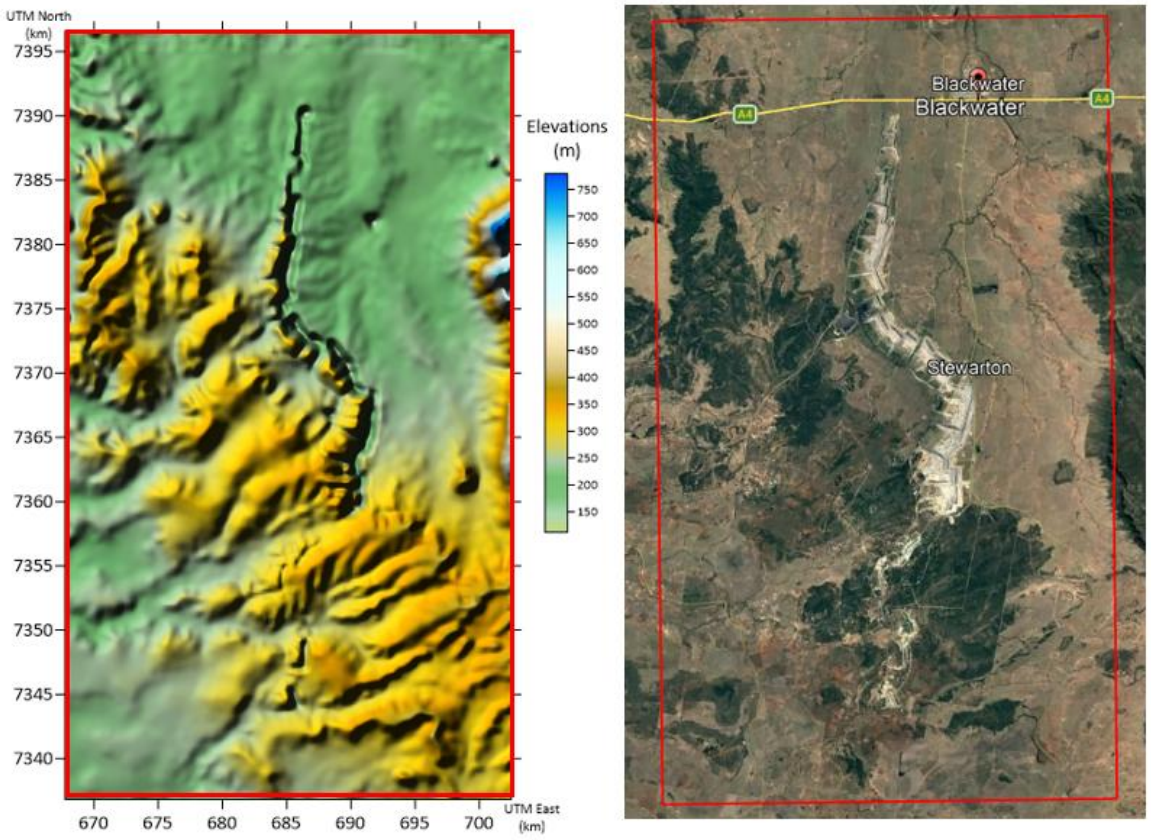


Figure 4-6 Topography and Land Use over the Project Area (CALMET Domain Outlined in Red).

4.5 Receptors

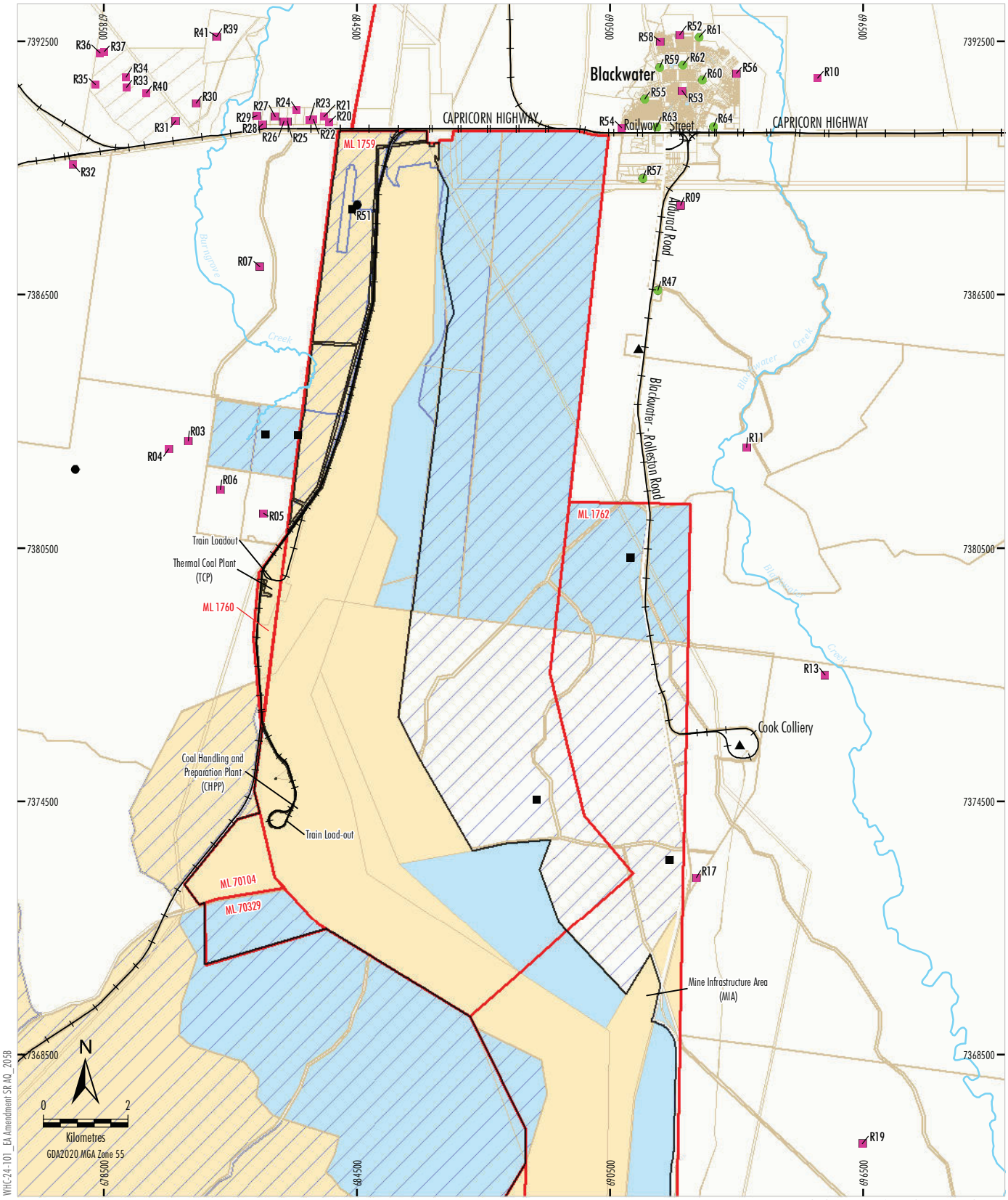
In total, 59 air quality receptors were considered and are summarised as follows (Table 4-7 and Figure 4-7):

- 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

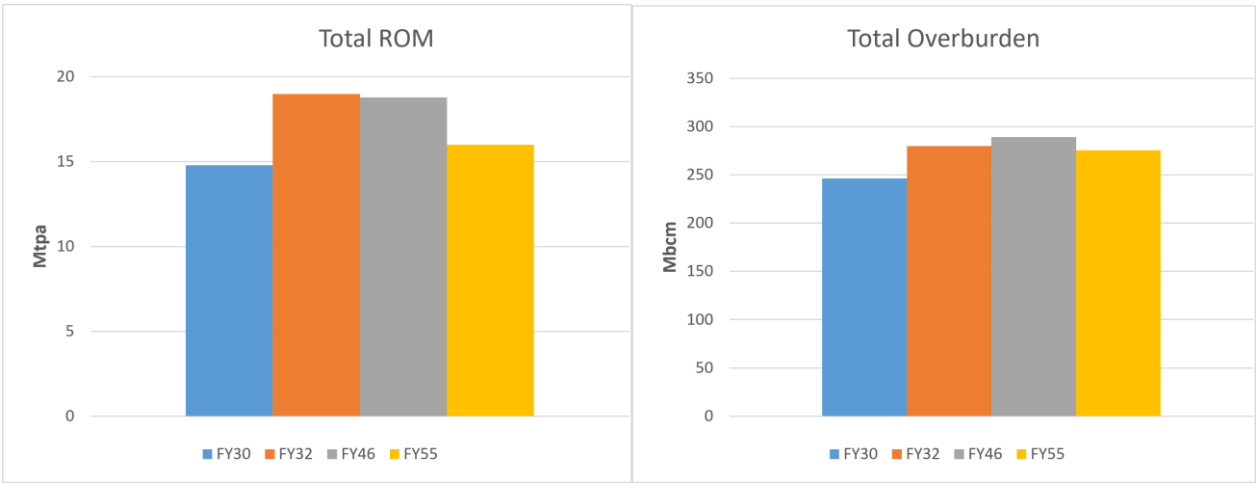


Figure 5-1 ROM and Overburden Amount for the Selected Modelling Scenarios

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

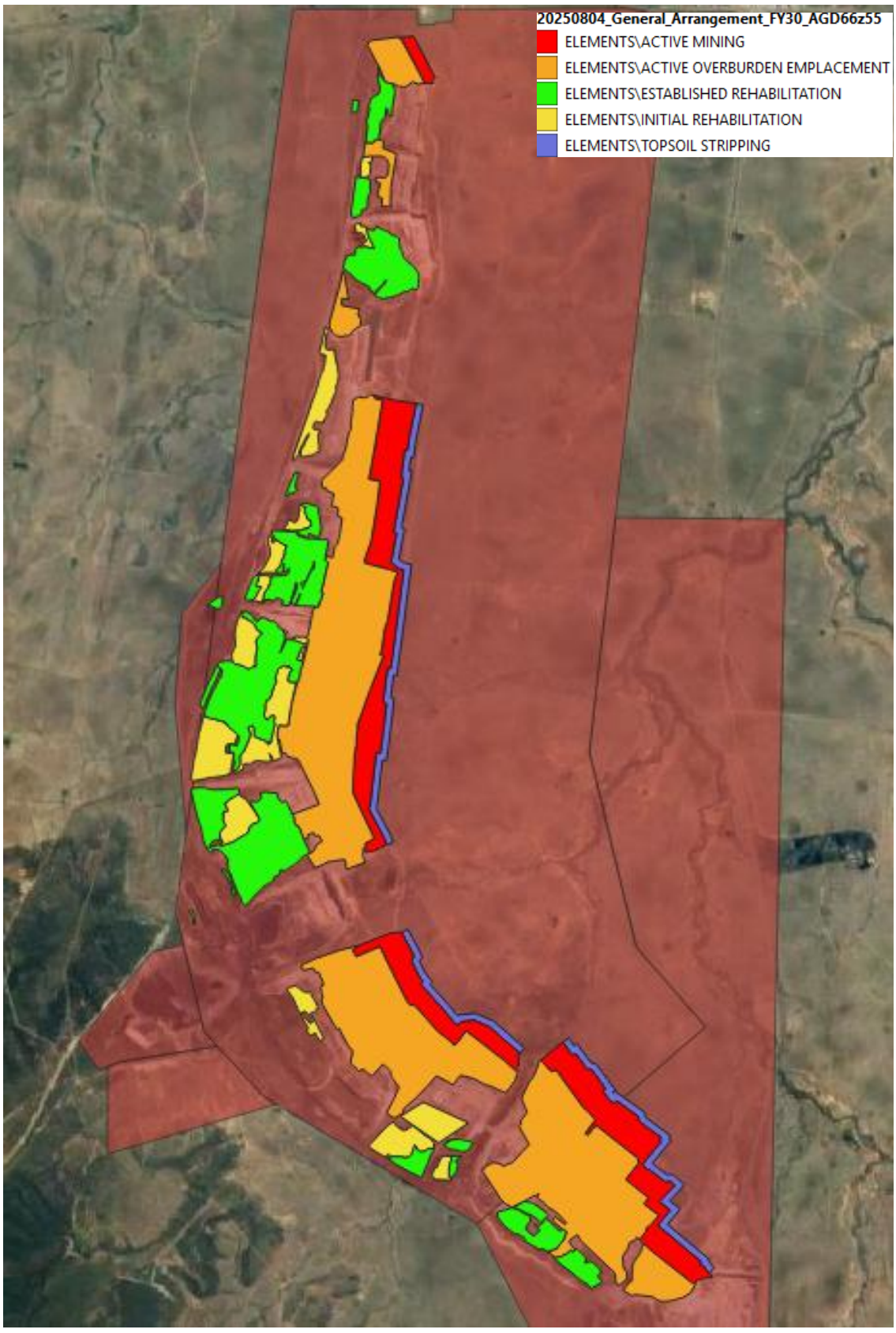


Figure 6-1 General Arrangement FY30

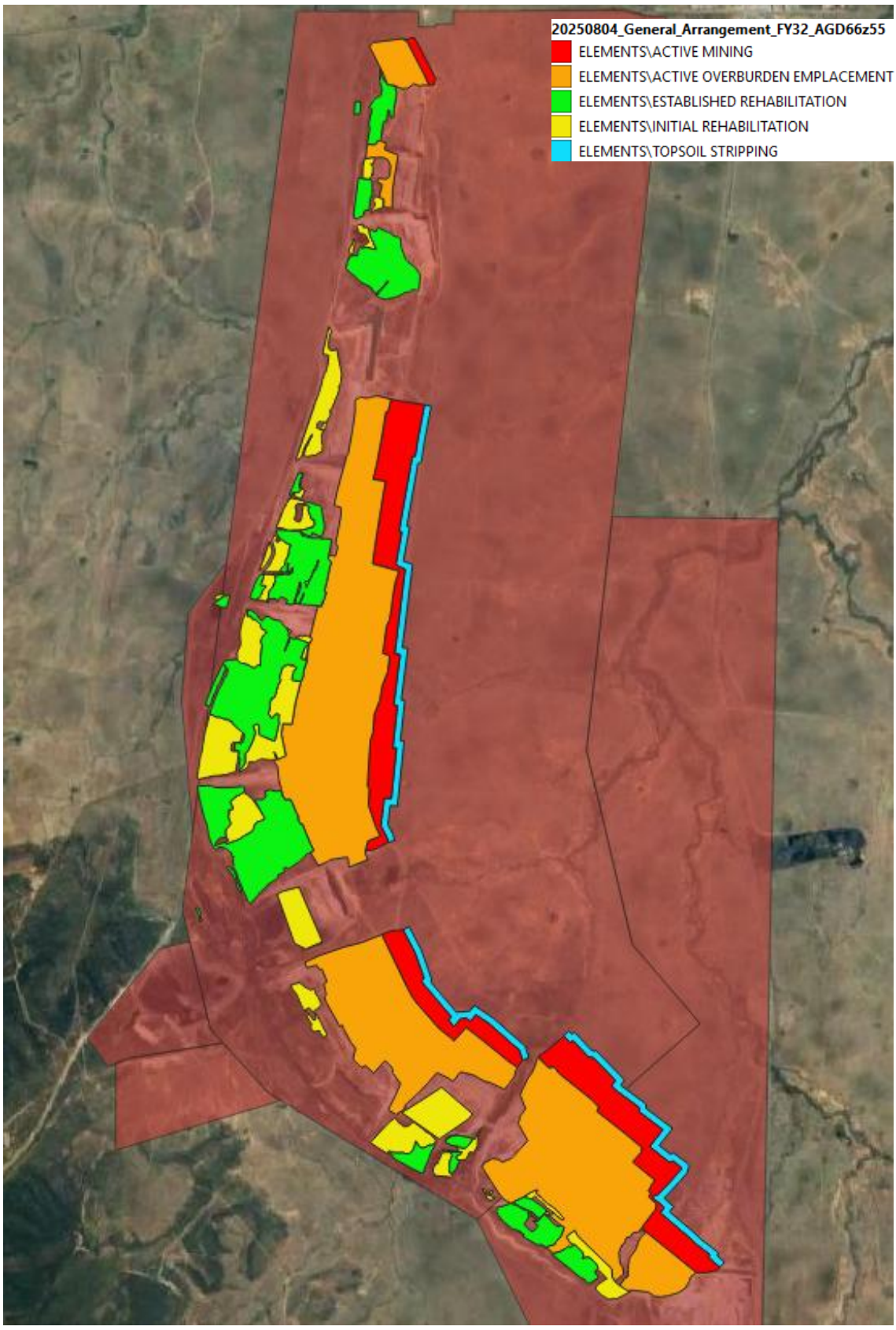


Figure 6-2 General Arrangement FY32

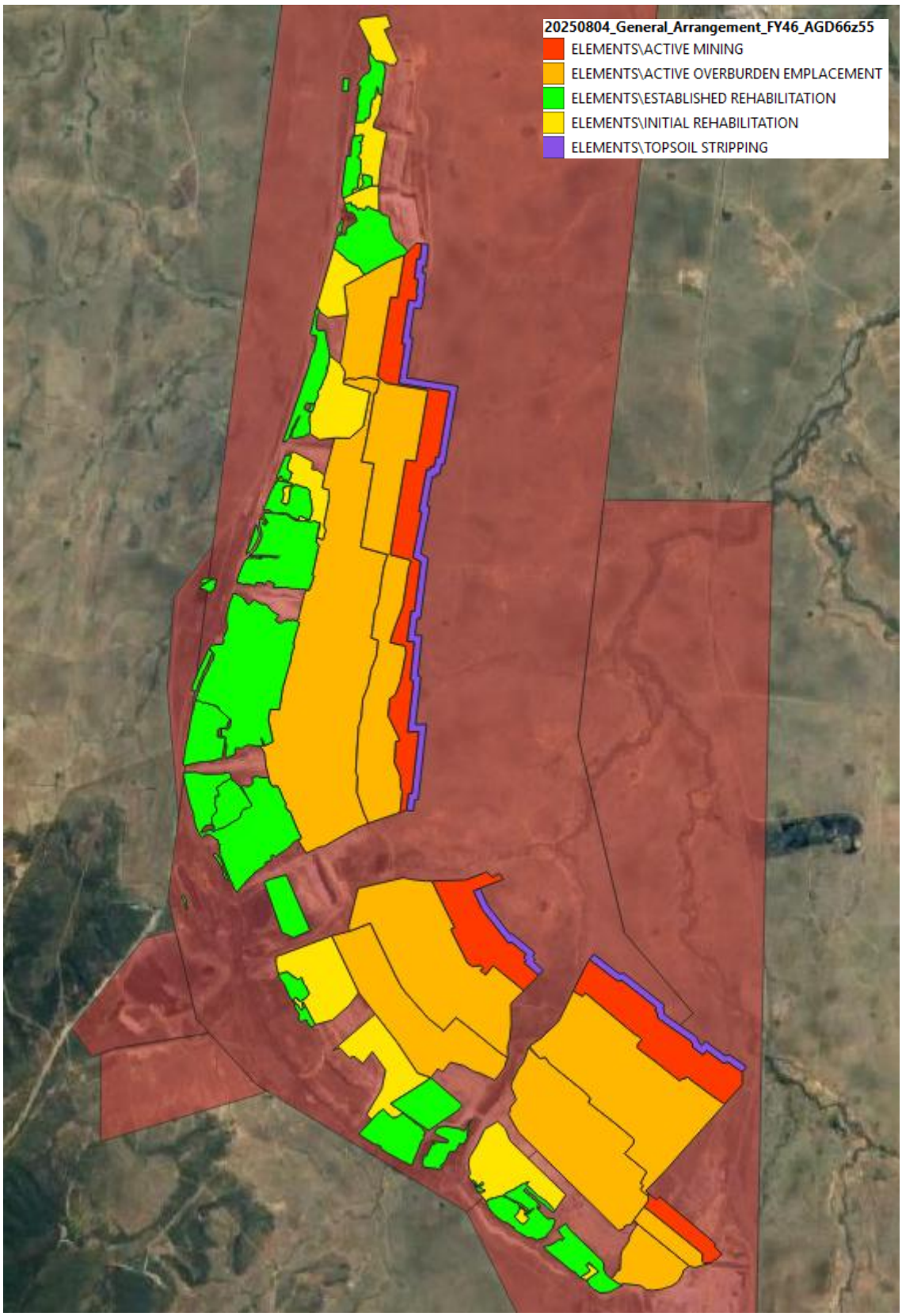


Figure 6-3 General Arrangement FY46

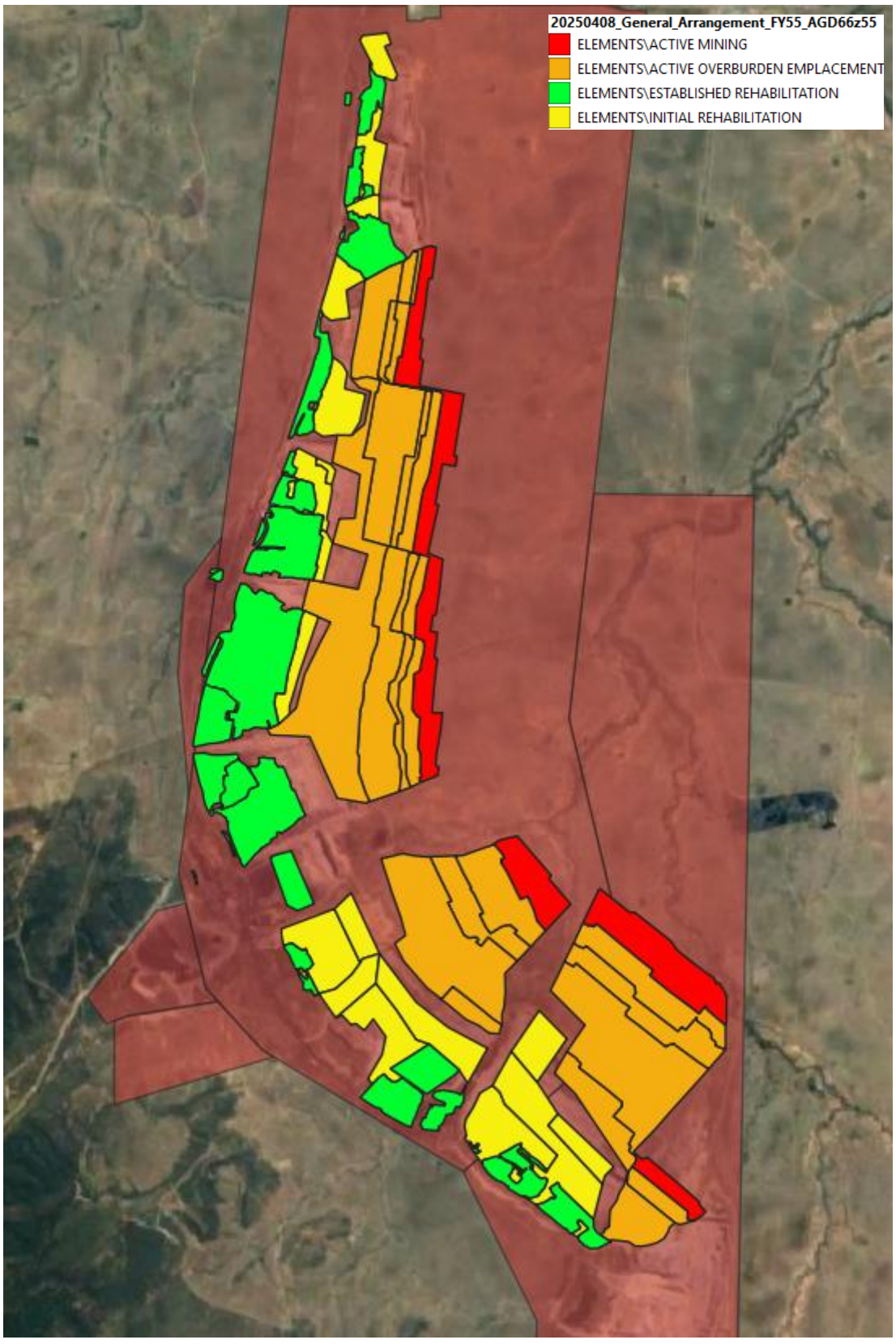
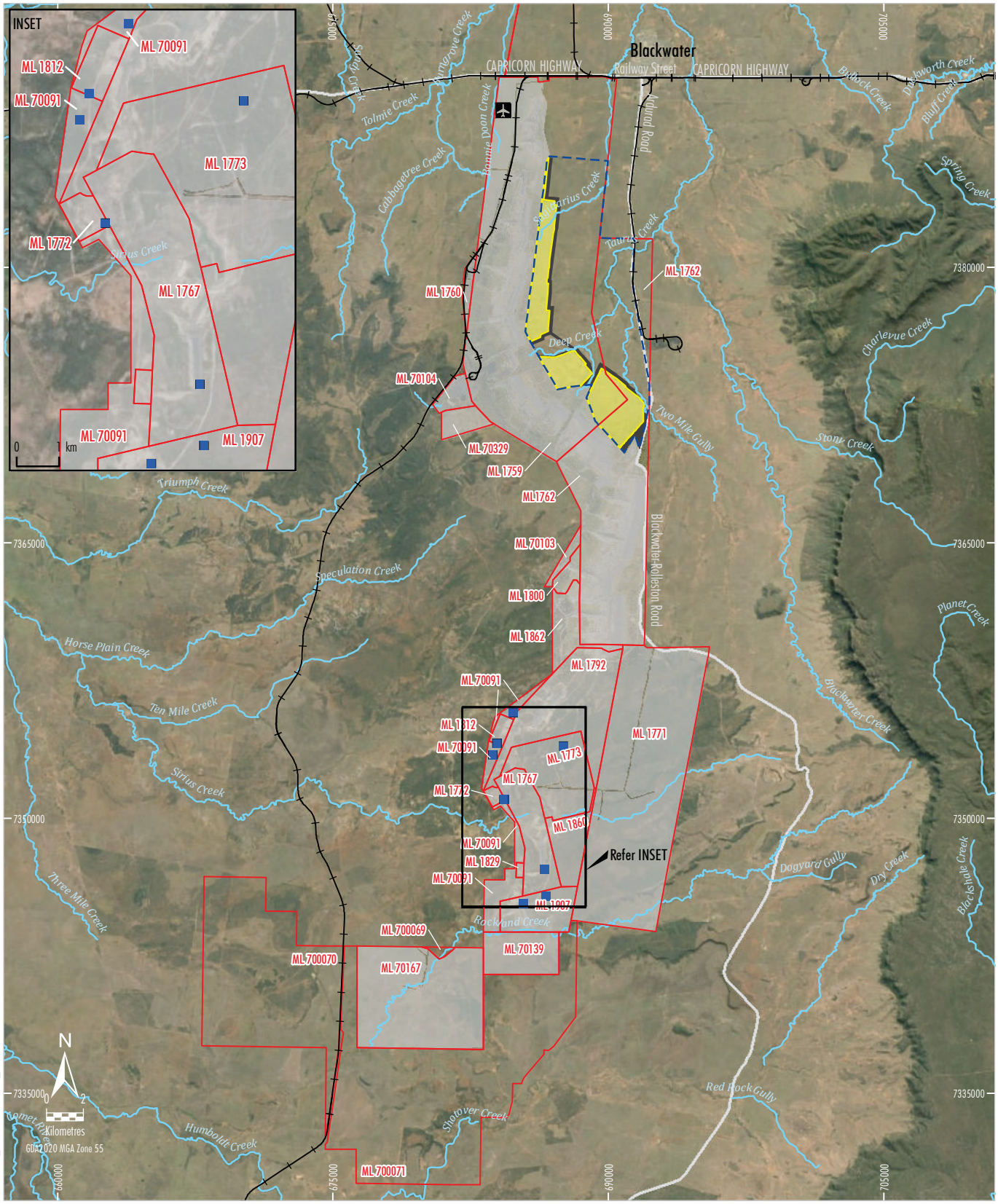


Figure 6-4 General Arrangement FY55

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.

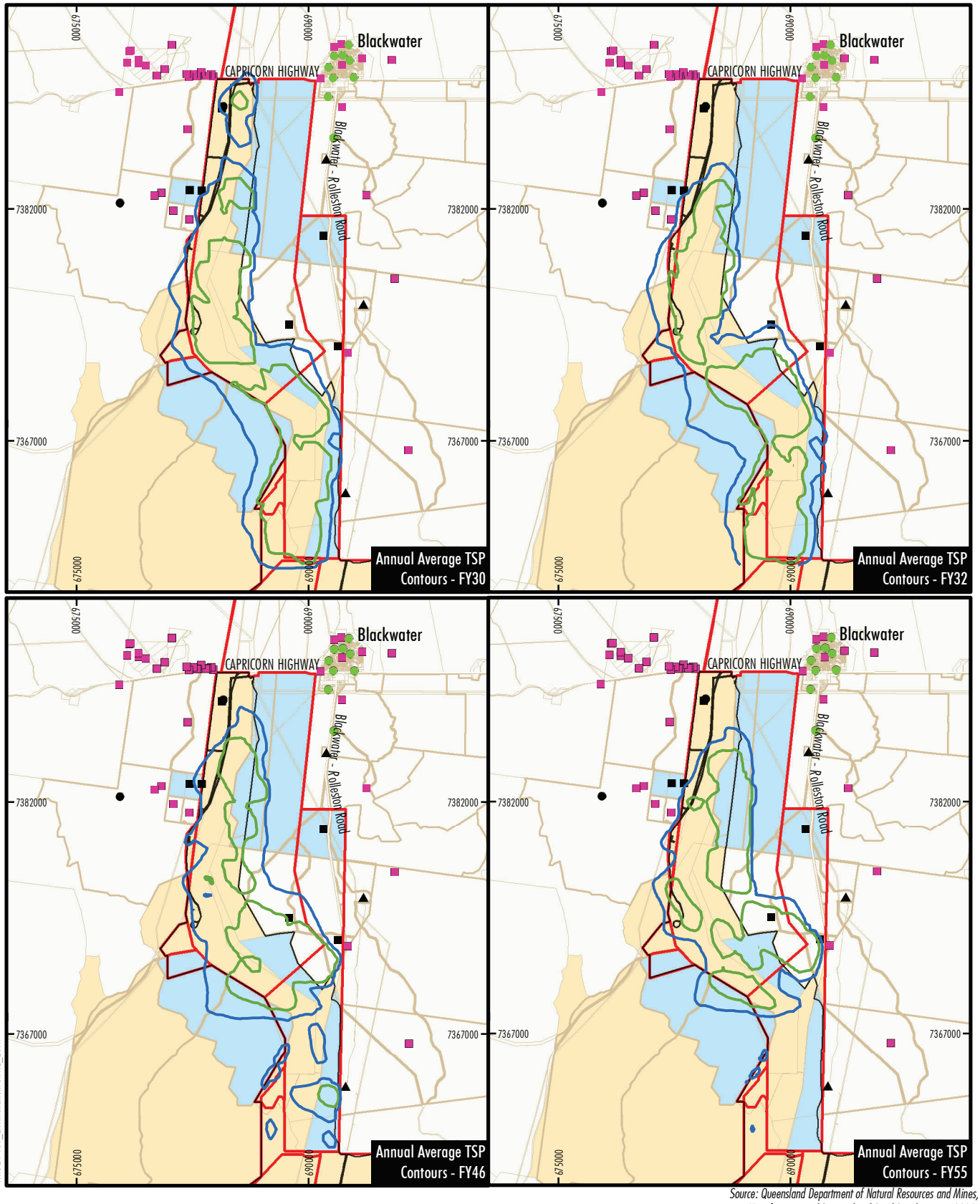
There are no predicted exceedances of the EPP (Air)/NEPM TSP annual average criteria at any of the receptors for any of the scenarios.

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



WHC-24-101_EA Amendment SR AQ_207A

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.

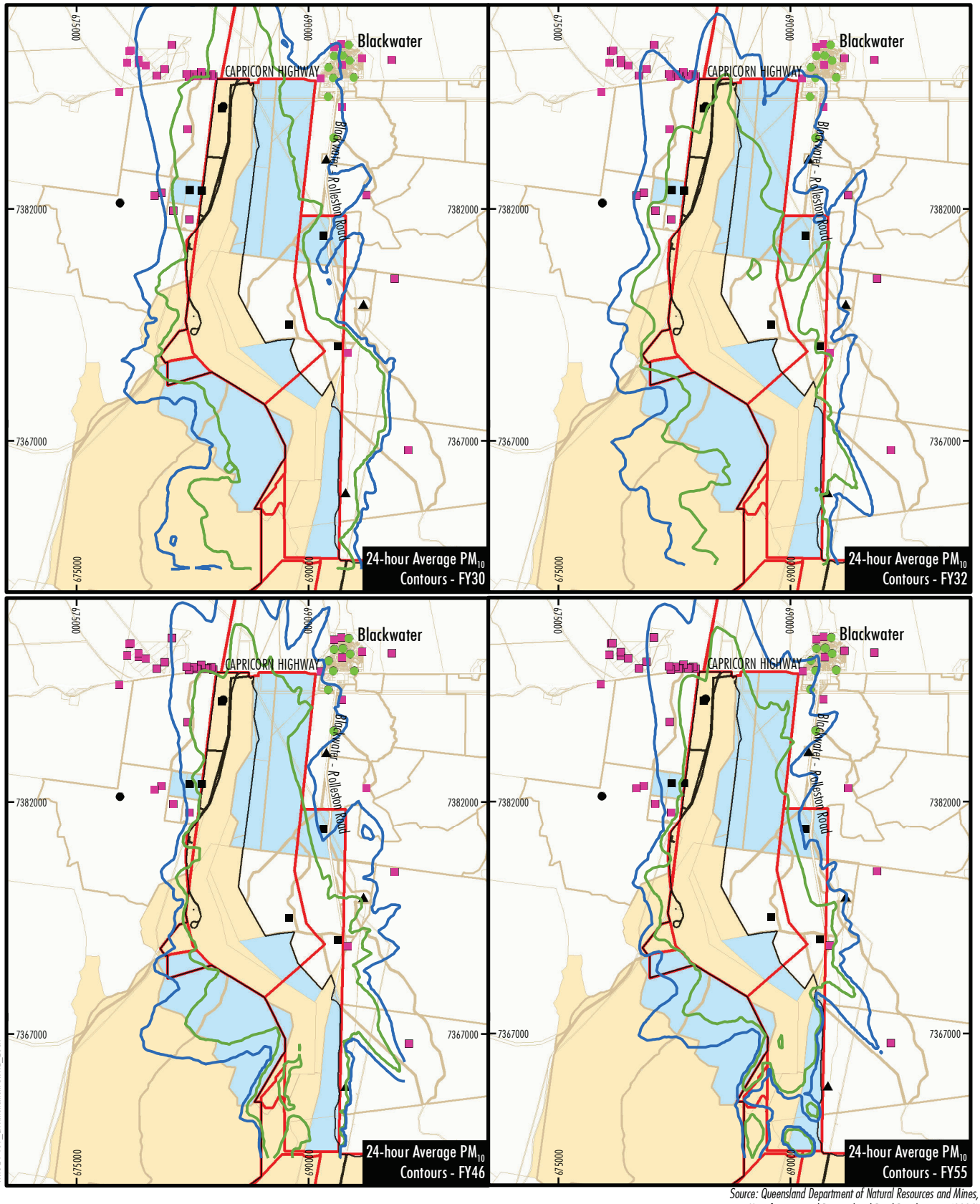
Table 7-2 Predicted Maximum 24-hour Average Ground-level PM_{10} Concentrations ($\mu g/m^3$) and Number of Days of Predicted Exceedance at Sensitive Receptors

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

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 Maximum 24-hour Average Ground-level PM_{10} Concentrations ($\mu g/m^3$)

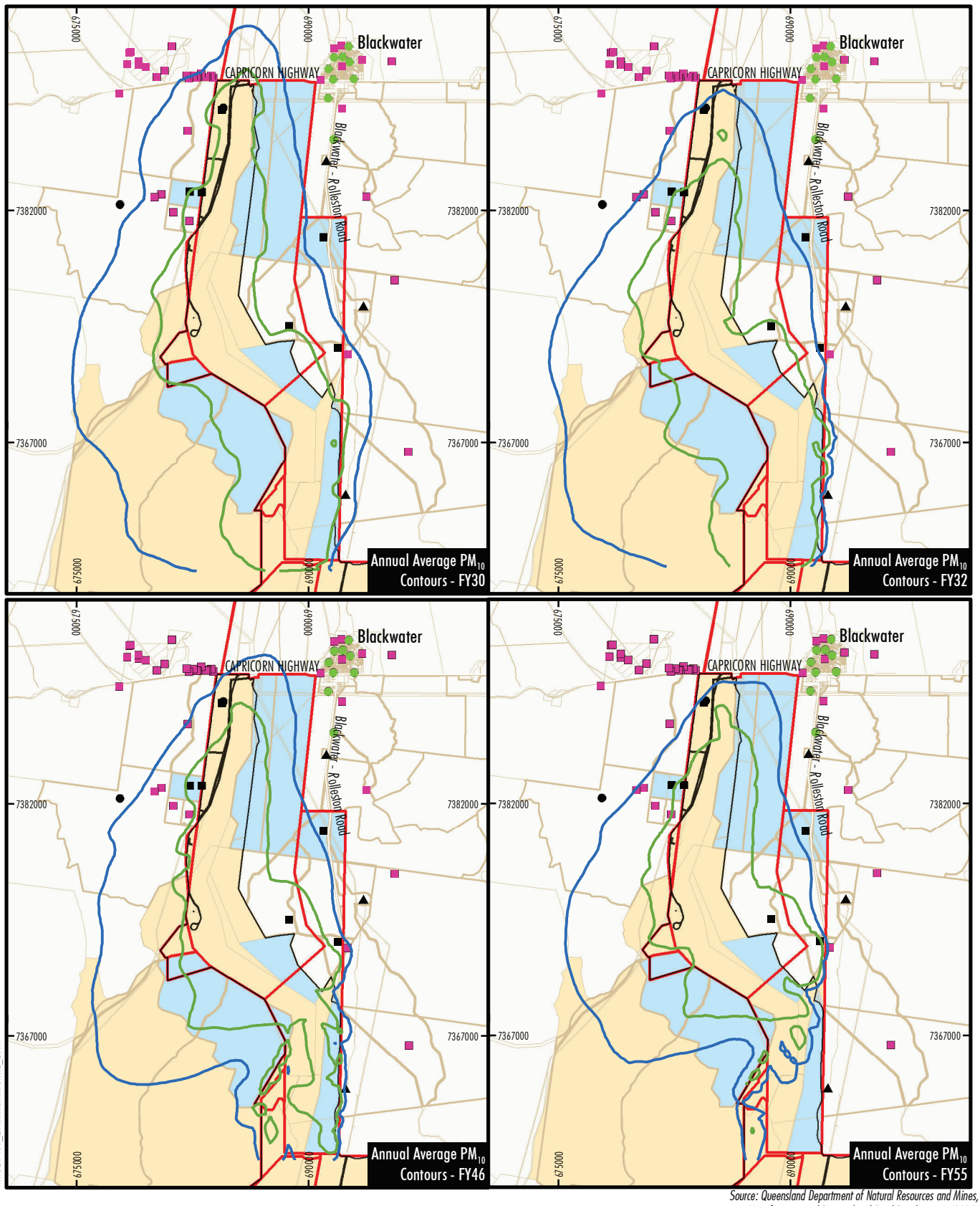
Figure 7-2

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.

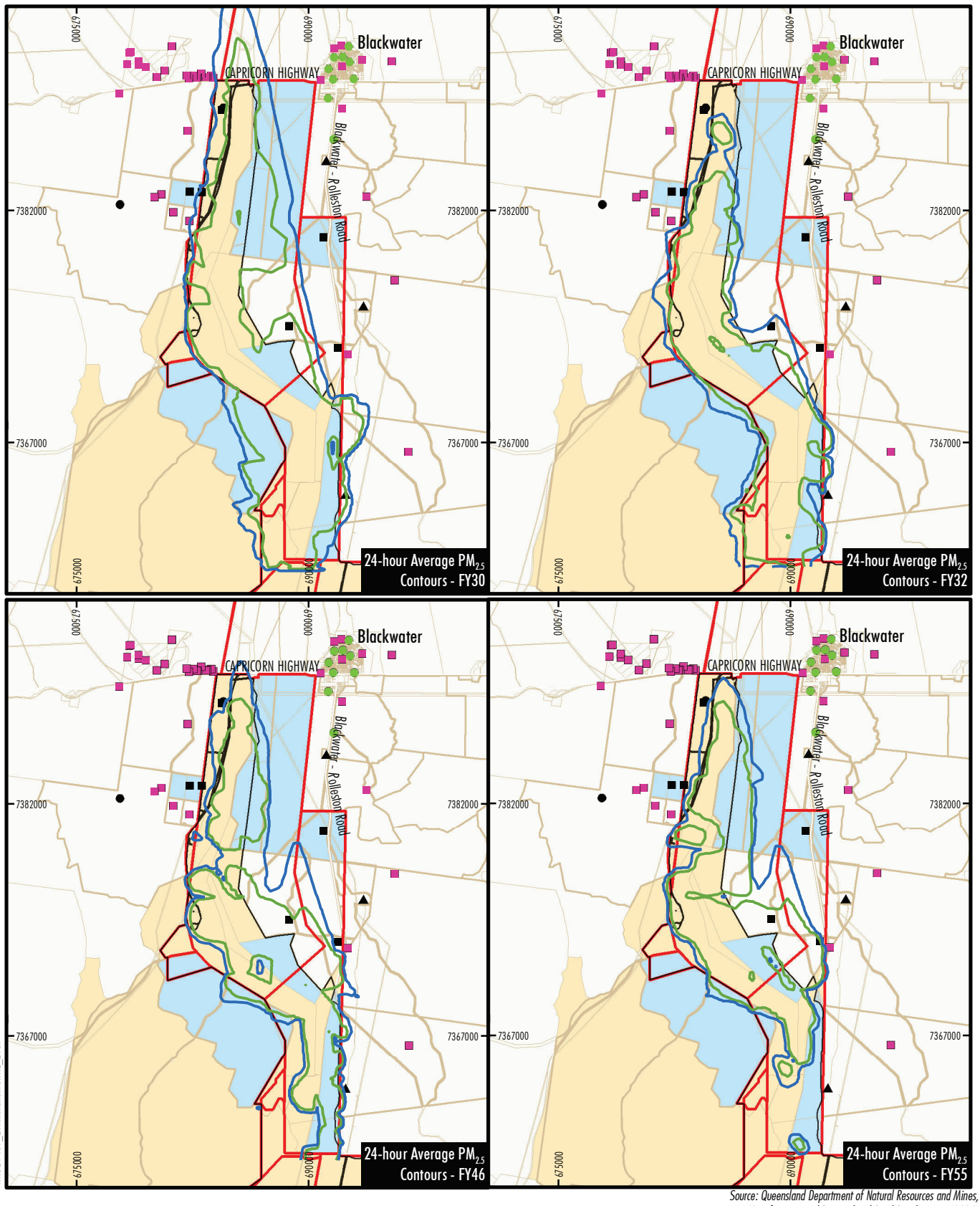
Predicted cumulative annual average ground-level $PM_{2.5}$ concentrations do not exceed the EPP (Air) Amendment/NEPM criteria at any public or private sensitive receptors. Four (4) non-sensitive receptors are predicted to slightly exceed these criteria (mine-owned receptors R50 and R51 in FY32, and 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 $\mu g/m^3$

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

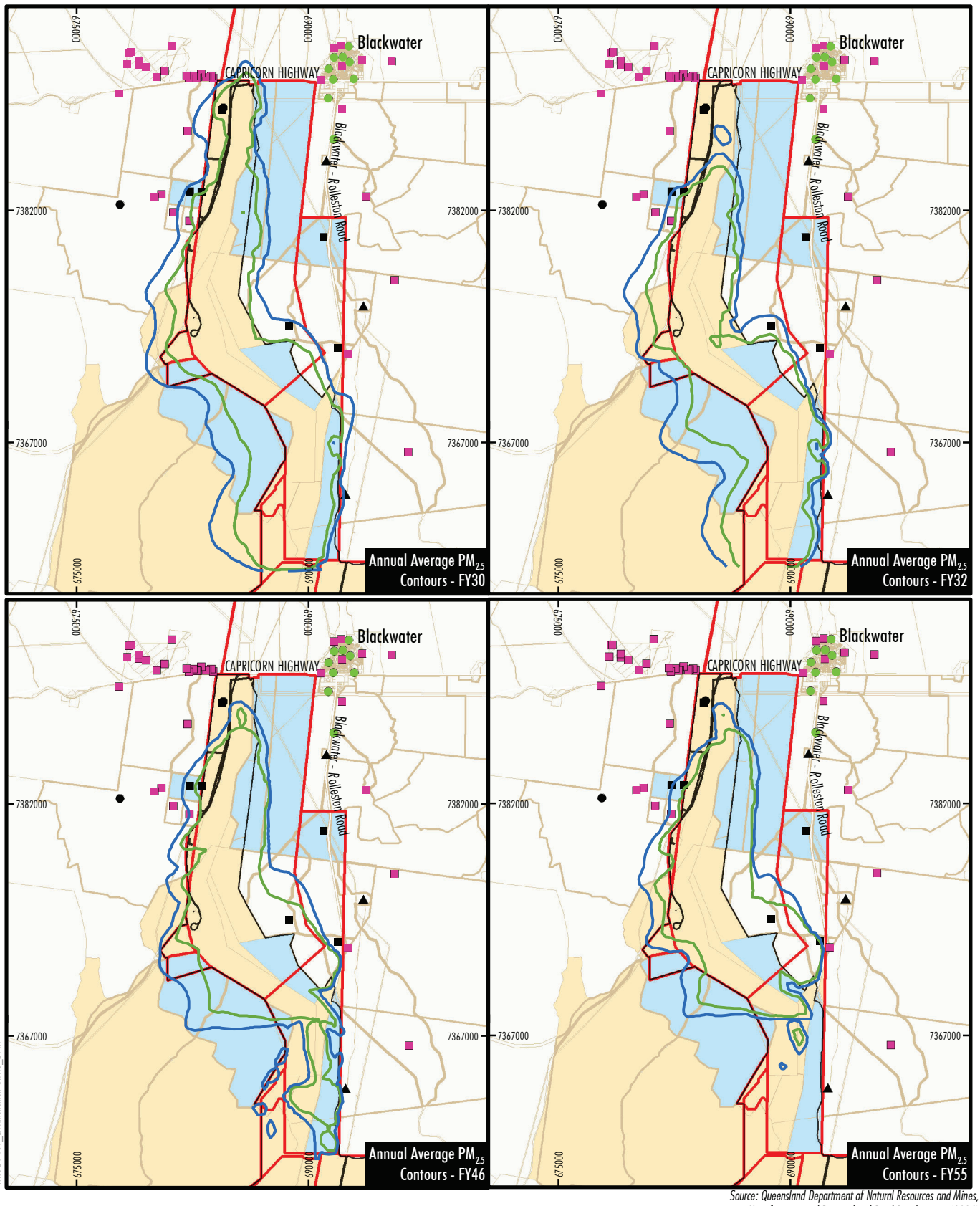
Predicted Maximum 24-hour Average Ground-level $PM_{2.5}$ concentrations ($\mu g/m^3$)

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 $\mu g/m^3$

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 $PM_{2.5}$ 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.

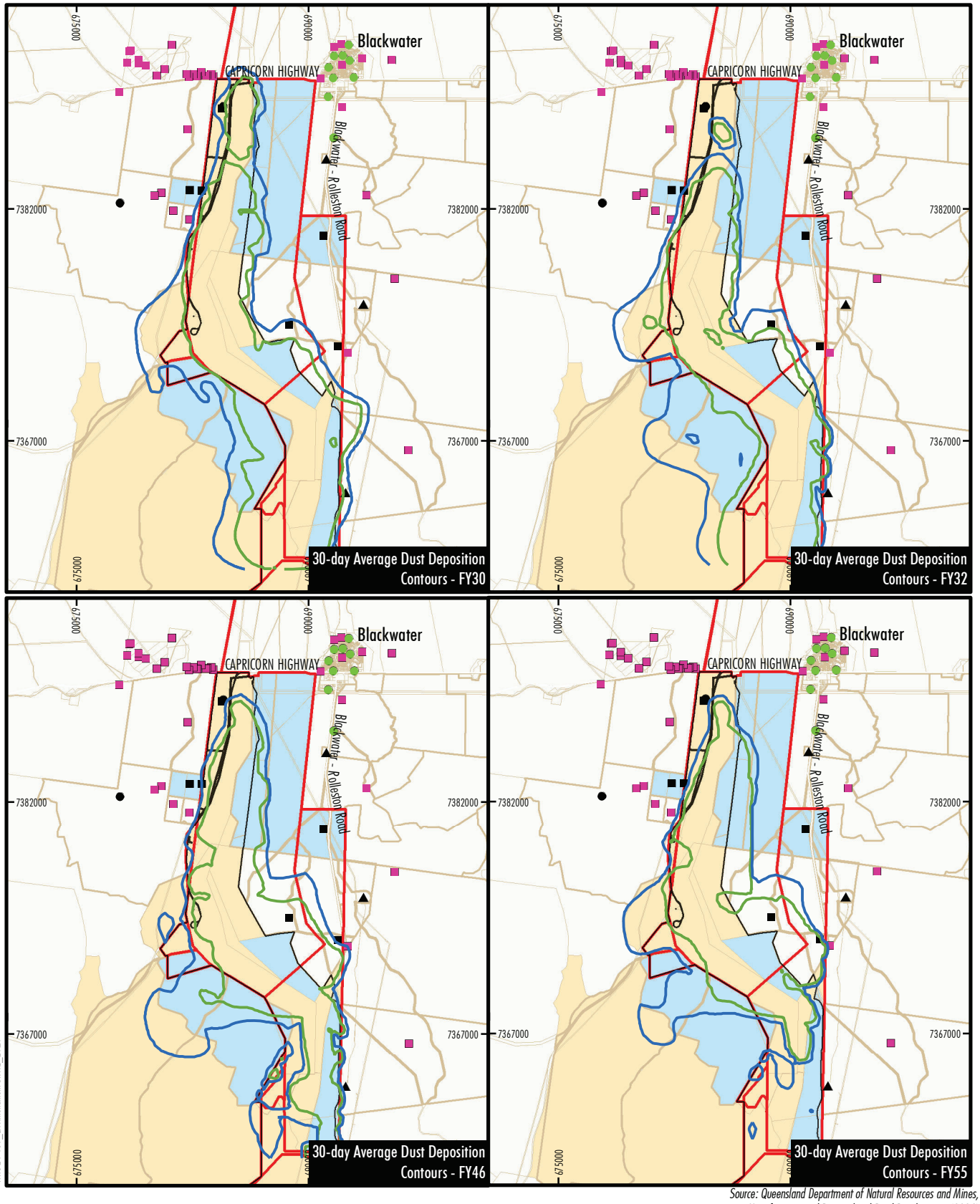
There are no predicted exceedances of the DETSI guideline criterion at any of the sensitive receptors for any of the scenarios. One (1) non-sensitive privately-owned receptor currently under agreements (R15) is predicted to exceed the criterion in FY46 (when the eastward progression of the active pit 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.

9 REFERENCES

Bureau of Meteorology (2026) "*Climate Statistics for Australian Locations – Blackwater Airport".* Accessible at: https://www.bom.gov.au/climate/averages/tables/cw_035134_All.shtml

Department of Tourism, Environment, Science and Innovation (2024a) "*Guideline - Application requirements for activities with impacts to air*". Accessible at: https://www.des.qld.gov.au/policies?a=272936:policy_registry/era-gl-air-impacts.pdf

Department of Tourism, Environment, Science and Innovation (2024b) "*Air – EIS information guideline*". Accessible at: https://www.des.qld.gov.au/policies?a=272936:policy_registry/eis-tm-air-information-guide.pdf

Department of Tourism, Environment, Science and Innovation (2025) "*Particulate concentrations*". Accessible at: https://www.stateoftheenvironment.detsi.qld.gov.au/pollution/air-quality/particulate-concentrations

Katestone Environmental Pty Ltd (2011) "*NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*". Accessible at: https://www.epa.nsw.gov.au/sites/default/files/ke1006953volumei.pdf

National Environment Protection Council (2021) "*National Environment Protection (Ambient Air Quality) Measure. Variation to the Ambient Air Quality NEPM – 2021*". Accessible at: https://www.nepc.gov.au/nepms/ambient-air-quality

National Pollutant Inventory (2012) "*Emission Estimation Technique Manual for Mining. Version 3.1*". Accessible at: https://www.dcceew.gov.au/sites/default/files/documents/mining.pdf

New South Wales Environmental Protection Authority (2022) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*". Accessible at: https://www.epa.nsw.gov.au/sites/default/files/22p3963-approved-methods-for-modelling-and-assessment-of-air-pollutants.pdf

Queensland Government (2025) *"Particles".* Accessible at: https://www.qld.gov.au/environment/management/monitoring/air/air-pollution/pollutants/particles

United States Environmental Protection Agency (1998) "*Compilation of Air Pollutant Emissions Factors from Stationary Sources, AP 42, Fifth Edition, Volume I Chapter 11.9: Western Surface Coal Mining*". Accessible at: https://www.epa.gov/sites/default/files/2020-10/documents/c11s09.pdf

United States Environmental Protection Agency (2006) "*Compilation of Air Pollutant Emissions Factors from Stationary Sources, AP 42, Fifth Edition, Volume I Chapter 13.2.5: Industrial Wind Erosion*". Accessible at: https://www.epa.gov/sites/default/files/2020-10/documents/13.2.5_industrial_wind_erosion.pdf

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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
OVERVIEW 1
EMISSIONS CONTEXT 1
THREE-YEAR PLAN 2
Scope 1 – Methane Gas Capture and abatement 2
Scope 1 – Diesel Combustion 3
Scope 2 – Electricity from main grid 4
POTENTIAL IMPACTS OF GHG EMISSIONS ON ENVIRONMENTAL VALUES 5
1 INTRODUCTION 1
1.1 PURPOSE OF THIS DOCUMENT 1
1.2 PROJECT OVERVIEW 1
1.2.1 Blackwater Mine 1
1.2.2 Project Summary 1
1.3 LIMITATIONS 4
1.4 CURRENT VERSIONS 4
1.5 PREVIOUS VERSION 4
1.6 APPLICANT DETAILS 4
1.7 STRUCTURE OF THIS DOCUMENT 5
2 KEY GUIDANCE MATERIAL 6
2.1 GLOBAL 6
2.2 COMMONWEALTH – AUSTRALIAN GOVERNMENT 6
2.2.1 Assessment 7
2.2.2 Reporting 7
2.2.3 Mitigation 8
2.2.4 Offsets 13
2.3 STATE – QUEENSLAND GOVERNMENT 14
2.3.1 Mitigation 14
2.4 RESOURCES INDUSTRY 17
2.5 OTHER KEY GUIDANCE AND INDUSTRY REVIEW 17
2.6 WHITEHAVEN COAL LIMITED 18
2.6.1 Emissions Reduction 19
2.6.2 Carbon Abatement Opportunities and Initiatives 19
3 GREENHOUSE GAS EMISSIONS CONTEXT 20
3.1 PREDICTED GREENHOUSE GAS EMISSIONS 20
3.2 PREDICTED GREENHOUSE GAS EMISSIONS INTENSITY 21
3.3 WHITEHAVEN EMISSIONS REDUCTION OBJECTIVE 23
3.4 BLACKWATER EMISSION REDUCTION TARGETS 23
3.5 ELECTRICITY SUPPLY CONTEXT 24
3.6 LIFE-OF-MINE CONTEXT 25
3.7 MINING EMISSIONS CONTEXT 25
3.7.1 Diesel Consumption 25
3.8 MINING FLEET DEMANDS AND SCHEDULING 26
3.9 EXISTING REASONABLE AND FEASIBLE MITIGATION MEASURES 28
4 REASONABLE AND FEASIBLE GREENHOUSE GAS EVALUATION 29
4.1 QUALITATIVE EVALUATION OF REASONABLE AND FEASIBLE MITIGATION MEASURES 29
4.1.1 Qualitative Evaluation Methodology 29
4.1.2 Evaluation of Reasonable and Feasible Mitigation Measures 29
4.2 KEY PROSPECTIVE TECHNOLOGIES FOR THE SITE 39
4.2.1 Scope 1 – Gas Capture and Drainage Options 39
4.2.2 Scope 1 – Diesel Combustion 39
4.2.3 Scope 2 – Electricity from Main Grid 40
5 THREE-YEAR ACTION PLAN 41
5.1 SCOPE 1 – GAS CAPTURE AND DRAINAGE OPTIONS 41

5.2 SCOPE 1 – DIESEL COMBUSTION 42
5.3 SCOPE 2 – ELECTRICITY FROM MAIN GRID 43
6 MONITORING, REPORTING AND REVIEW 45
6.1 MONITORING 45
6.2 NATIONAL GREENHOUSE AND ENERGY REPORTING 45
6.3 REVIEW 45
7 POTENTIAL IMPACTS OF GREENHOUSE GAS EMISSIONS ON ENVIRONMENTAL VALUES 46
7.1 CLIMATE CHANGE PROJECTIONS GLOBALLY 46
7.2 CLIMATE CHANGE PROJECTIONS FOR AUSTRALIA 47
7.3 CLIMATE CHANGE PROJECTIONS FOR QUEENSLAND 47
7.4 POTENTIAL IMPACTS OF THE PROJECT 49
8 CONCLUSION 50
8.1 EMISSIONS CONTEXT 50
8.2 THREE-YEAR PLAN 50
8.3 POTENTIAL IMPACTS OF GHG EMISSIONS ON ENVIRONMENTAL VALUES 50
9 REFERENCES 52

LIST OF TABLES

Table 1 Safeguard Baseline Decline Rate
Table 2 Key Mining Haulage and Equipment Emissions Reduction Levers
Table 3 Indicative Actions under the Resources Sector Plan
Table 4 Guideline Greenhouse Gas Emissions – Application Requirements
Table 5 Content Requirement of a Greenhouse Gas Abatement Plan
Table 6 Key Whitehaven Emissions Abatement Initiatives
Table 7 Summary of Estimated Emissions per Scope of All Scenarios
Table 8 Indicative BWM (including the Project) Annual Scope 1 Net Emissions Target
Table 9 Summary of Identified Potential Scope 1 and 2 Mitigation Measures
Table 10 Evaluation Matrix
Table 11 Three-Year Action Plan – Fugitive Emissions
Table 12 Three-Year Action Plan – Diesel Combustion Emissions
Table 13 Three-Year Action Plan – Scope 2 Emissions
Table 14 Climate Change Projections for the East Coast South Sub-cluster, Eastern Australia – Percentage Change in Rainfall (relative to 1995)
Table 15 Climate Change Projections for the Central Highlands Region, Queensland – Change in Rainfall (mm/d)
Table 16 Climate Change Projections for the Central Highlands Region, Queensland – Change in Mean Temperature (°C)

LIST OF FIGURES

Figure 1 Regional Location
Figure 2 Project General Arrangement
Figure 3 Prospective Decarbonisation Pathways for Mining and Haulage Equipment
Figure 4 DISR Resources Sector Plan

LIST OF CHARTS

Chart 1 Australian ROM Coal Emissions Intensity Determinations and Estimated Project Average ROM Coal Emissions Intensity
Chart 2 BWM (Including the Project) Gross Emissions and Net Scope 1 Emissions Target
Chart 3 Breakdown of Total Predicted Scope 1 Emissions for the Project by Source
Chart 4 Breakdown of Mobile Fleet Diesel Consumption for the Project
Chart 5 Breakdown of Projected Annual Diesel Consumption for the Project
Chart 6 Indicative Fleet Procurement and Replacement Timeline
Chart 7 Technical Readiness and Commercial Readiness Level Schematic (ARENA, 2014)

LIST OF APPENDICES

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

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

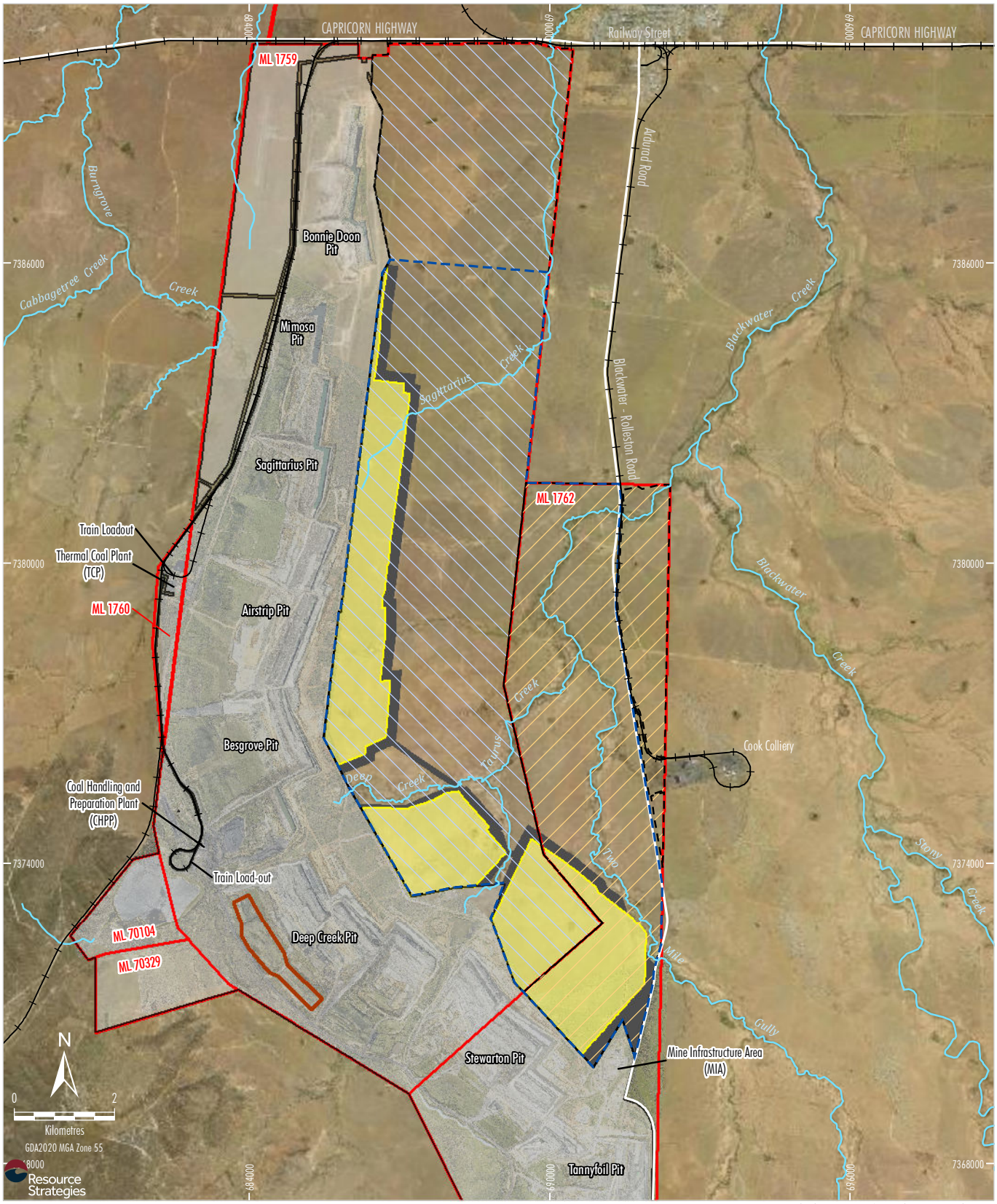
- Road
- Railway
- Coal Terminal
- Blackwater North Extension Project

Whitehaven

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:

Whitehaven Blackwater Pty Ltd
Level 28, 259 George St
SYDNEY NSW 2000
Phone: (02) 8222 1100
Website: https://whitehavencoal.com.au/

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).

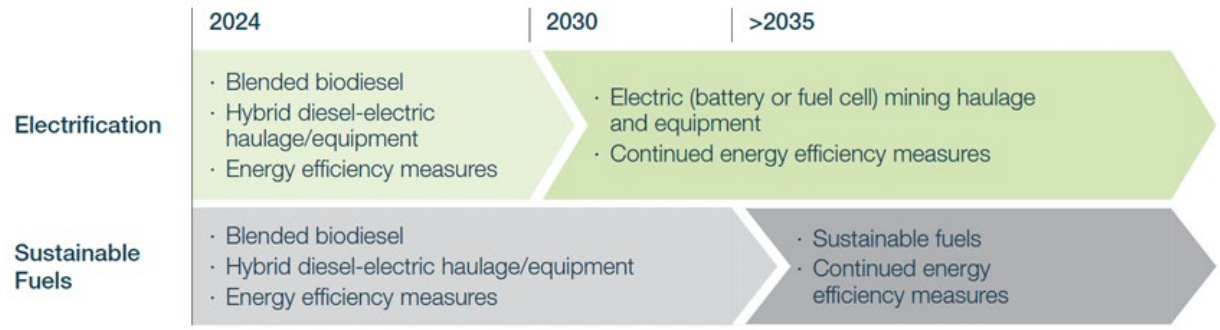
Key emission reduction levers for reducing emissions from mining haulage and equipment, summary readiness and potential barriers to adoption as identified by the CCA (2024a) are reproduced in Table 2.

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.

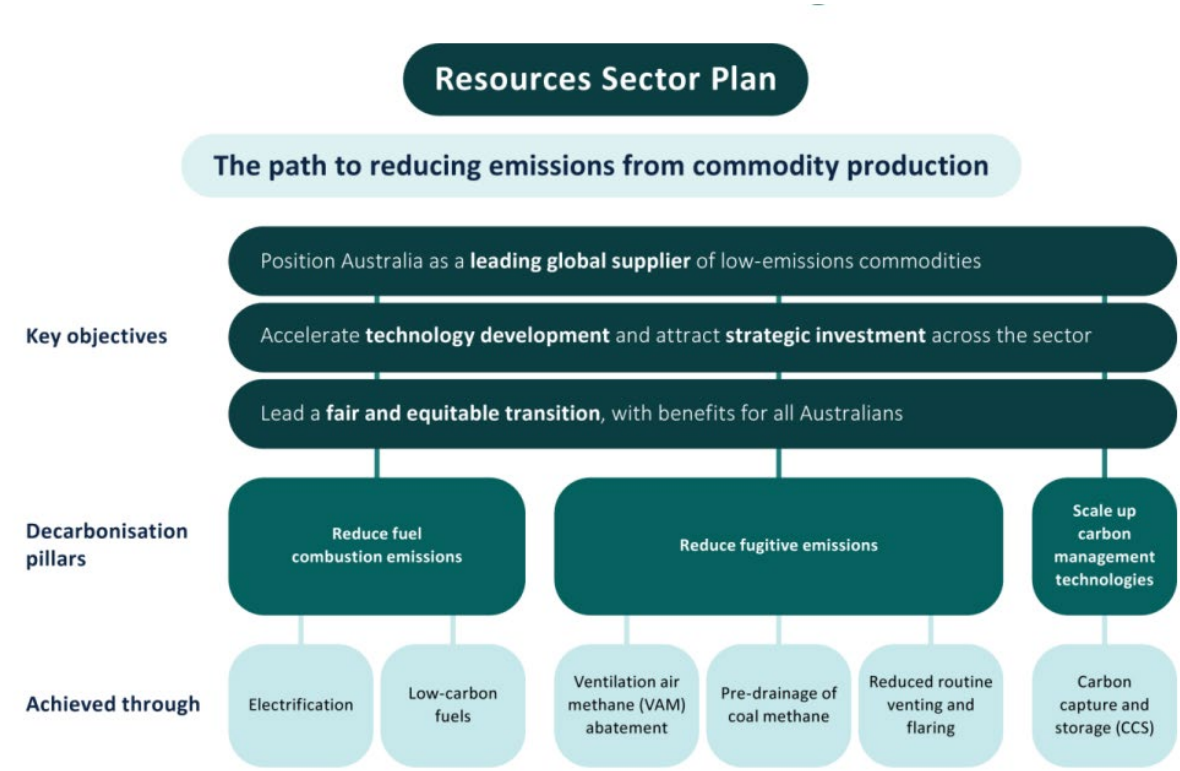
The Net Zero Plan (Commonwealth DCCEEW, 2025c) also provides sector-specific pathways for electricity, transport, industry, resources, agriculture and the built environment. These pathways recognise differing technological readiness and expected rates of decarbonisation. Further discussion on the Resource 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.

It should be noted that, as the Project Only Scenario represents the mathematical difference between the Project scenario and the Baseline scenario and as a result of this, some individual years may report negative values for production metrics such as ROM coal or waste movement while some material consumption (e.g. diesel consumption) remains positive in those years. These values are an artefact of comparing two independently optimised mine plans and reflect differences in mining sequence, pit development, haulage requirements and scheduling between the scenarios. The Project Only Scenario should not be taken as a standalone or physically achievable mining schedule as it is only used to isolate the greenhouse gas emissions attributable to the Project.

For example, the Project changes the mine plan and life of mine schedule. As a result, activities such as overburden emplacement, haulage, rehabilitation, construction, decommissioning, clearing and other operations may occur at different times between the Baseline and Project scenarios and are not directly linked to annual ROM coal production or waste movement (i.e. even if ROM coal or waste are negative or 0 in the Project Only Scenario, it does not mean the same ROM coal or waste has been moved between the Baseline and Project Scenarios).

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)

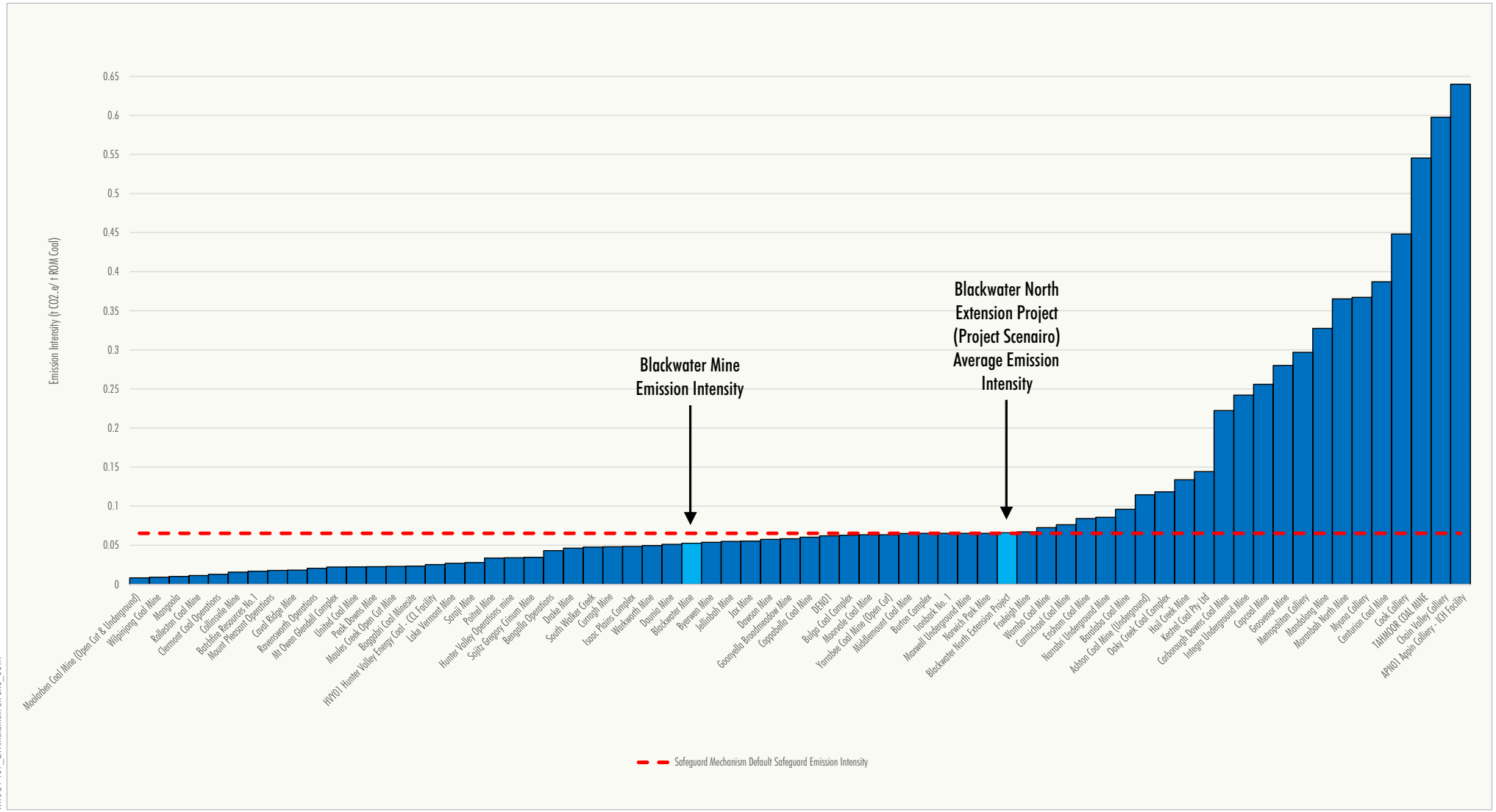
The Project is therefore considered a medium to high emitter under the QLD GHG Guideline.

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.



Source: CER (2026); RWDI (2026)

WHC-24-101 _ EA Amendment SR GHG_001A

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.

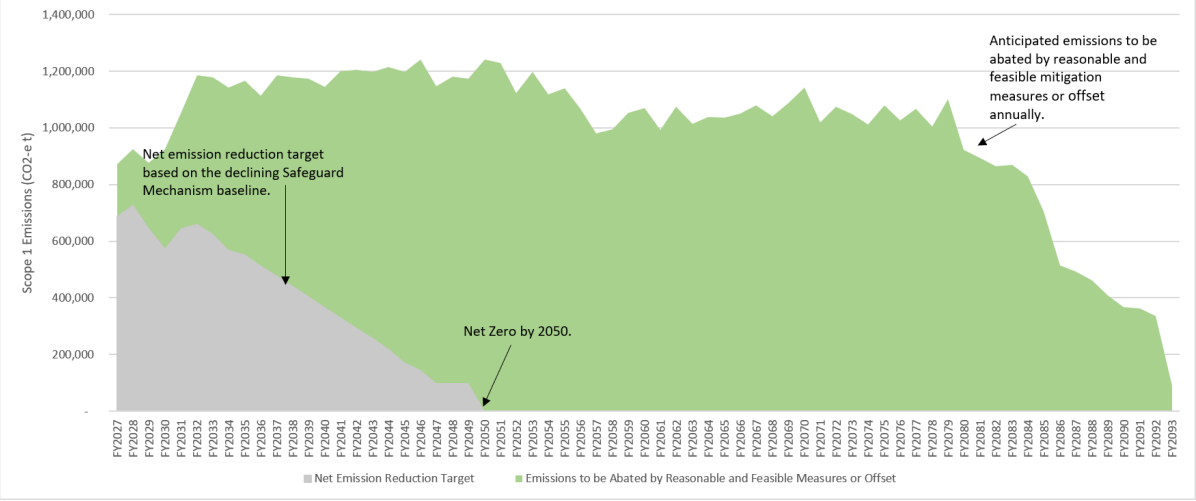


Chart 2 BWM (Including the Project) Gross Emissions and Net Scope 1 Emissions Target

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	100,000^
FY2048	16,900,000	0.004	100,000^
FY2049	17,200,000	0.002	100,000^
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.
^ The calculated production adjusted baseline falls below 100,000 t CO_2-e from FY2047 to FY2049 due to the declining emissions intensity forecast. In accordance with section 10(1) of the Safeguard Rule, the applicable safeguard baseline has been set to 100,000 t CO_2-e for those years.

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.

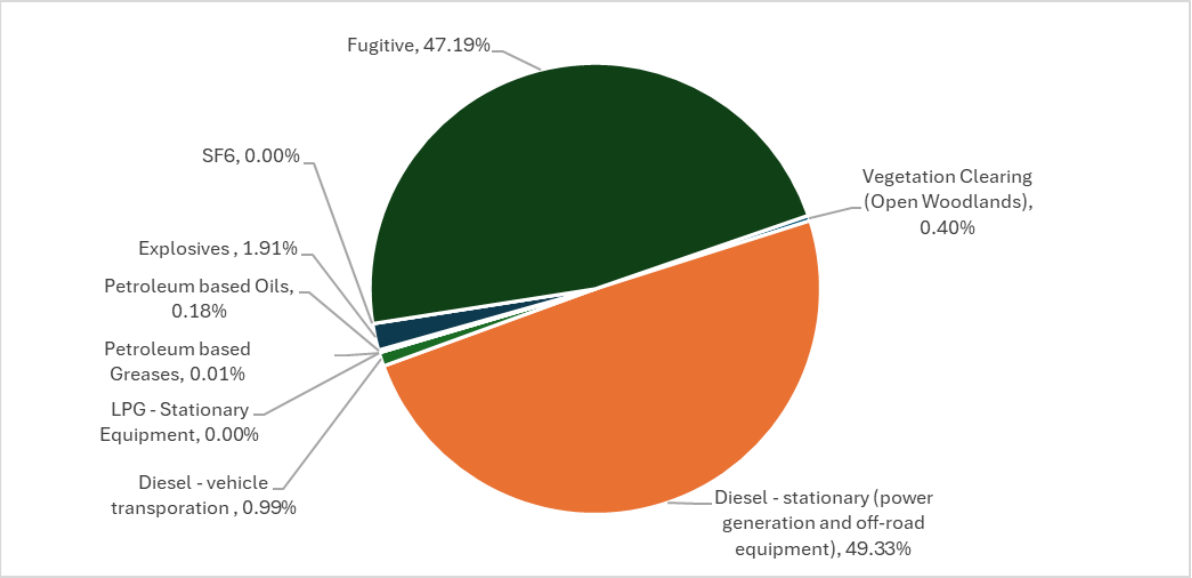


Chart 3 Breakdown of Total Predicted Scope 1 Emissions for the Project by Source

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%).

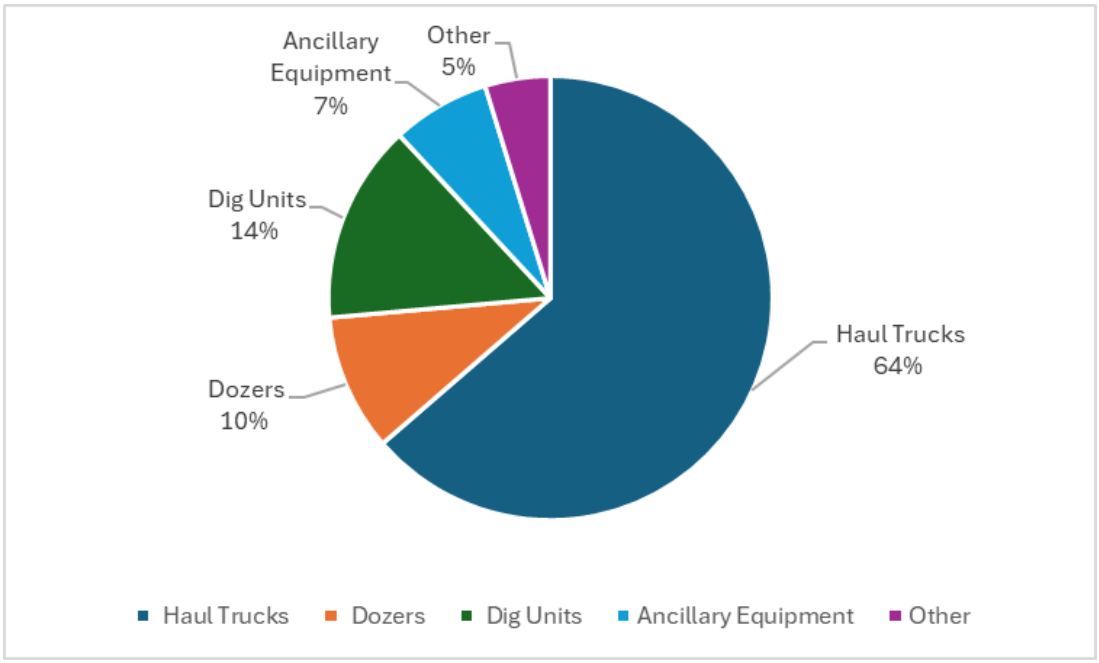


Chart 4 Breakdown of Mobile Fleet Diesel Consumption for the Project

Projected future diesel demand over the life of the operation is expected to follow similar trends and LOM estimates provided in Chart 5.

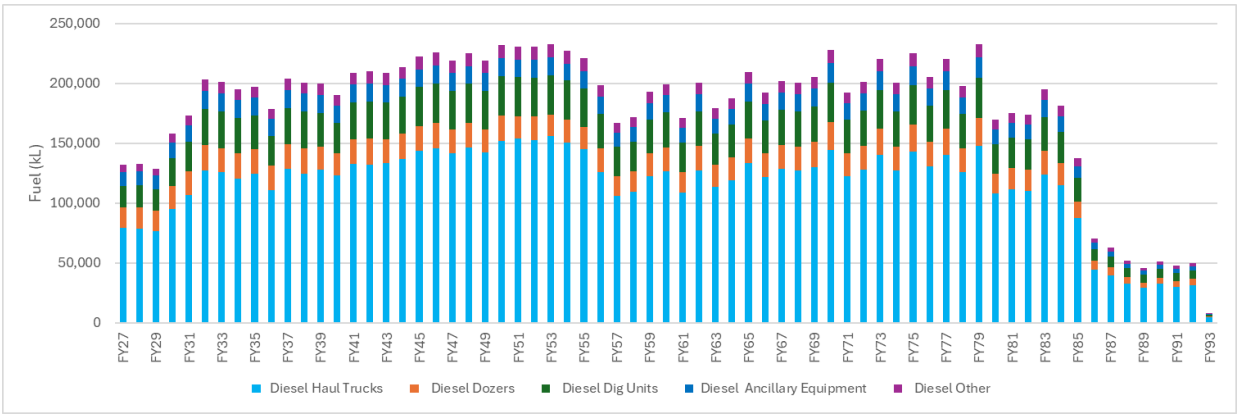


Chart 5 Breakdown of Projected Annual Diesel Consumption for the Project

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.

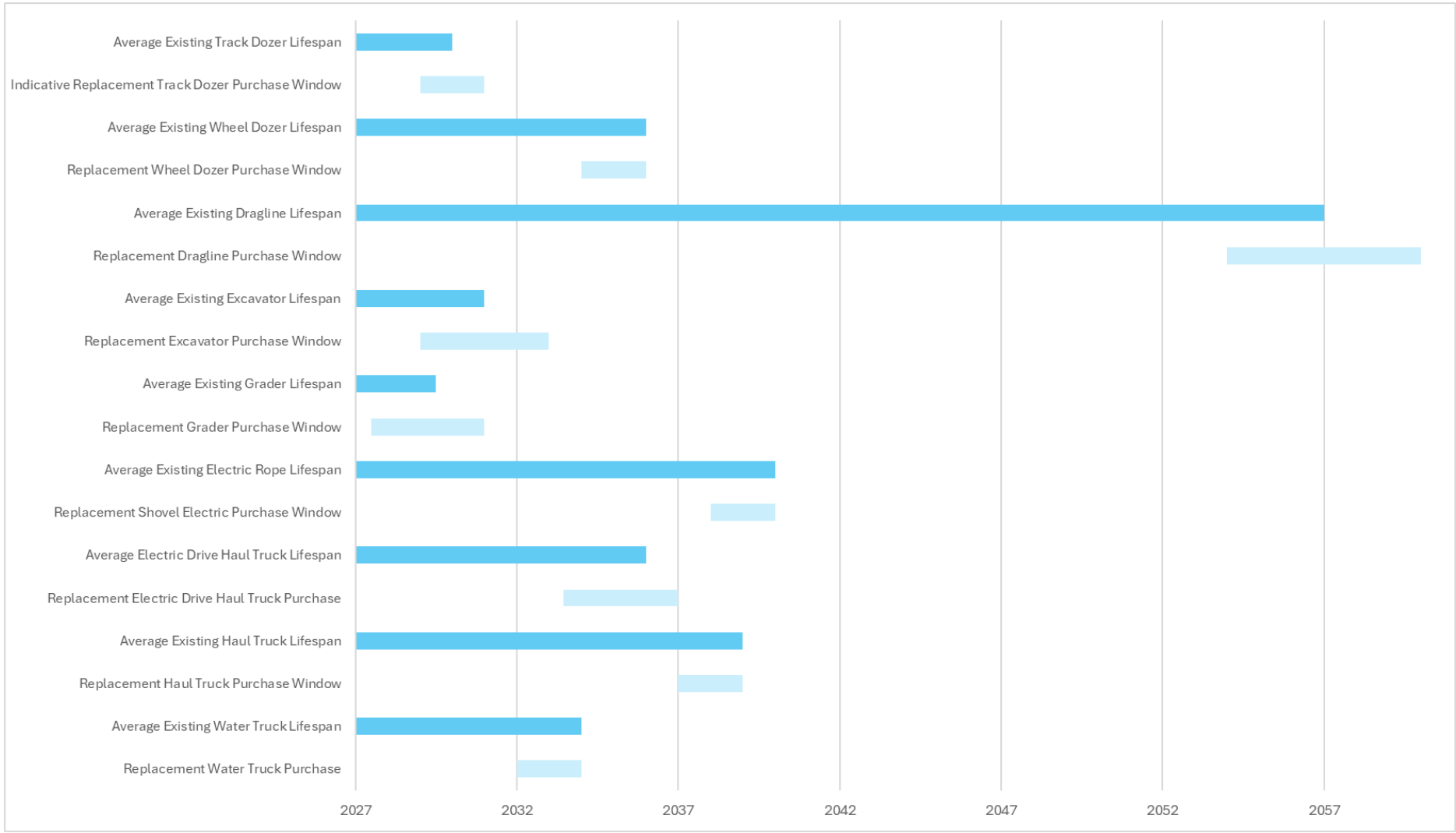


Chart 6 Indicative Fleet Procurement and Replacement Timeline

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

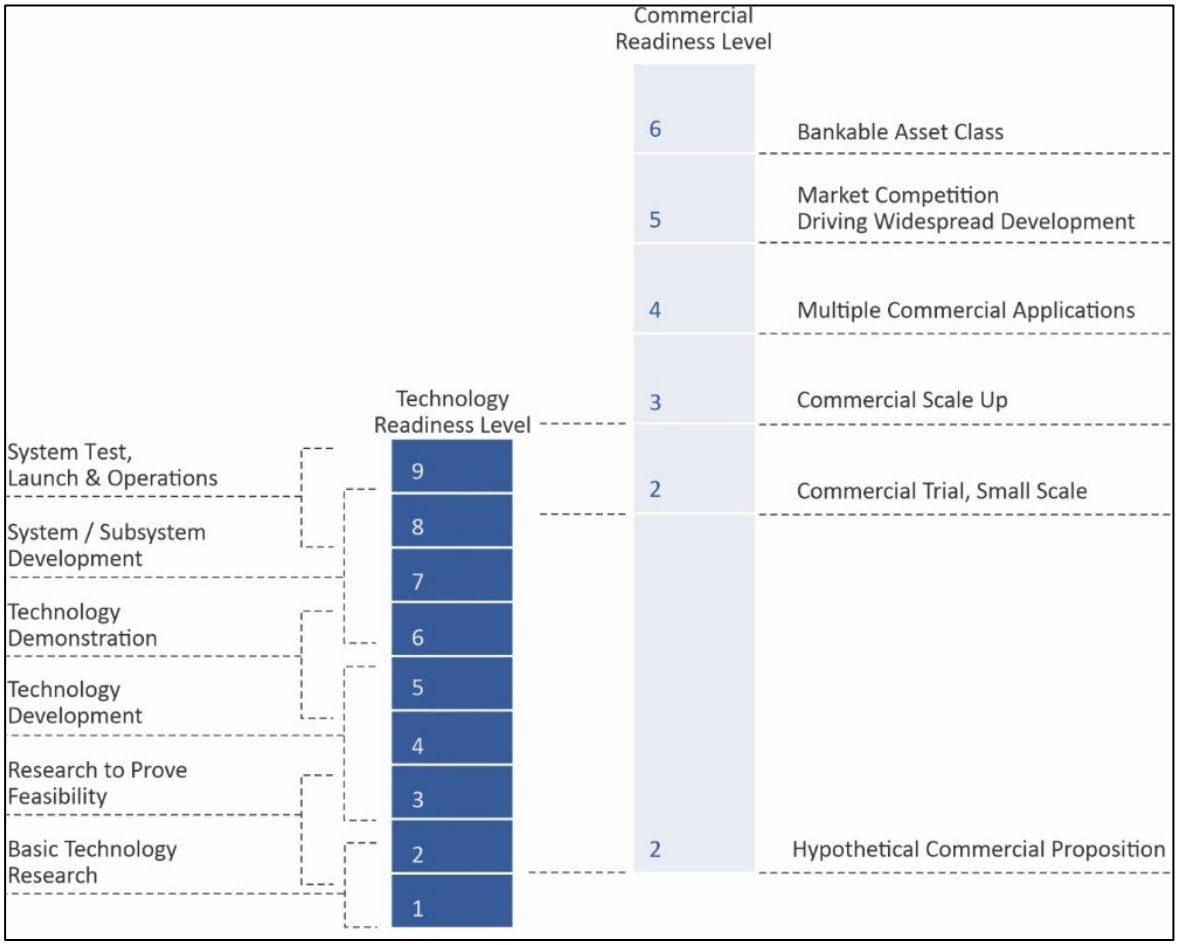
Standardised technology readiness terminology was originally developed by the National Aeronautics and Space Administration for its development programmes, and has since been adopted by many organisations, including Australia's Defence Force. To standardise the description of the technology readiness 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.

9 References

Alpha H2 Limited (2024a) *Alpha H2 completes third-party testing of its hydrogen injection system*
Website: https://alphah2.com/alpha-h2-completes-third-party-testing-of-its-hydrogen-injection-system/

Alpha H2 Limited (2024b) *Alpha H2 Hydrogen Technology Presentation*
Website: https://unitedhydrogenlimited.com/wp-content/uploads/2025/01/Alpha-H2-Limited-Investor-Presentation-Sept-2024-1.0m.pdf?utm_source=chatgpt.com

Alpha H2 Limited (2025) *Frequently Asked Questions (FAQs)*
Website: https://store.alphah2.com/

Australian Clean Energy Finance Corporation and the Minerals Research Institute of Western Australia (2022) *Roadmap to decarbonisation – Mining in a low-emissions economy*

Australian Renewable Energy Agency (2014) Technology Read*iness Levels for Renewable Energy Sectors*

Clean Energy Regulator (2025a) *Safeguard Baselines*

Clean Energy Regulator (2025b) *Emissions-intensity determination data*

Climate Change Authority (2024a) *Sector Pathways Review*

Climate Change Authority (2024b) *Targets, Pathways and Progress*

Climate Change Authority (2025) *2035 Target Advice*

Commonwealth Department of Climate Change, Energy, the Environment and Water (2024) *Safeguard Mechanism – About the Safeguard Mechanism and the reforms*
Website: https://www.dcceew.gov.au/sites/default/files/documents/safeguard-mechanism-reformsfactsheet-2023.pdf

Commonwealth Department of Climate Change, Energy, the Environment and Water (2025a) *Safeguard Mechanism*
Website: https://www.dcceew.gov.au/climatechange/emissions-reporting/nationalgreenhouse-energy-reportingscheme/safeguard-mechanism

Commonwealth Department of Climate Change, Energy, the Environment and Water (2025b) *Australia's 2035 Nationally Determined Contribution*

Commonwealth Department of Climate Change, Energy, the Environment and Water (2025c) *Australian National Greenhouse Accounts Factors: 2025*

Commonwealth Department of Climate Change, Energy, the Environment and Water (2025d) *Net Zero Plan*

Commonwealth Department of Climate Change, Energy, the Environment and Water (2025e) *Australia's emissions projections 2025*

Commonwealth Department of Industry and Science (2015) *Australia's Intended Nationally Determined Contribution to a new Climate Change Agreement*

Commonwealth Department of Industry, Science, Energy and Resources (2021) *Australia's Long Term Emissions Reduction Plan*

Commonwealth Department of Industry, Science, Energy and Resources (2022) *Australia's Nationally Determined Contribution Communication 2022*

Commonwealth Department of Industry, Science and Resources (2025) *Resources Sector Plan*

Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology (2015) *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*

Department of Environment and Heritage Protection (2017a) *Pathways to a Clean Growth Economy – Queensland Climate Transition Strategy*

Department of Environment and Heritage Protection (2017b) *Pathways to a climate resilient Queensland – Queensland Climate Adaptation Strategy 2017 – 2030*

Department of the Environment, Tourism, Science and Innovation (2026) *Guideline: Greenhouse Gas Emissions (ESR/2024/6819)*

EMM Consulting Pty Ltd (2025) *Greenhouse Gas Mitigation Guide for NSW Coal Mines: Literature Review and Industry Scan*

HYDI (2025) *Diesel Conversion - Hydrogen Direct Application to Diesel Engines*
Website: https://hydi.com.au/

Intergovernmental Panel on Climate Change (2021) *Working Group 1 Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*

Minerals Council of Australia (2023) *Climate Action Plan – Progress Report 2023*
Website: https://minerals.org.au/wp-content/uploads/2023/08/MCA-Climate-Action-Plan-Progress-Report-2023.pdf

Minerals Council of Australia (2025) *Climate Action Plan*
Website: https://minerals.org.au/policies/energy-and-climate-change/climate-action-plan/

Neste Corporation (2024) *What is Neste MY Renewable Diesel?*
Website: https://www.neste.com/products-and-innovation/neste-my-renewable-diesel/productinformation

Queensland Treasury (2025a) *Net Zero by 2050*
Website:https://www.treasury.qld.gov.au/policies-and-programs/climate/net-zero-roadmap/

Queensland Treasury (2025b) *Queensland's climate adaption strategy*
Website: https://www.treasury.qld.gov.au/policies-and-programs/climate/climate-adaptation-strategy/

Queensland Government (2019) *Climate change in the South East Queensland region.*

RWDI Australia Pty Ltd (2026) *Blackwater North Extension Project Greenhouse Gas Calculations Report.*

Trancoso, R, McGloin, R, Putland, D, Syktus, J, Ahrens, D, Chapman, S, Owens, D, Toombs, N, Eccles R and Zhang, H. (2024). *Queensland Future Climate Services - downscaled CMIP6 climate projections for Queensland's regions and locations*,
Website: https://www.longpaddock.qld.gov.au/qld-future-climate/.

Transgrid (2025) *2025 Transmission Annual Planning Report*
Website: https://www.transgrid.com.au/tapr/

United Nations Framework Convention on Climate Change (2024a) *United Nations Framework Convention on Climate Change*
Website: https://unfccc.int/process-and-meetings/united-nations-framework-convention-on-climate-change

United Nations Framework Convention on Climate Change (2024b) *The Kyoto Protocol*
Website: https://unfccc.int/process-and-meetings/the-kyoto-protocol

United Nations Framework Convention on Climate Change (2024c) *The Paris Agreement*
Website: https://unfccc.int/process-and-meetings/the-paris-agreement

United Nations Framework Convention on Climate Change (2024d) *Key Aspects of the Paris Agreement*

Website: https://unfccc.int/most-requested/key-aspects-of-the-paris-agreement

United Nations Framework Convention on Climate Change (2024e) *Nationally Determined Contributions (NDCs)*
Website: https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs

United States Environment Protection Agency (2024) *Lifecycle Greenhouse Gas Results*

Whitehaven Coal Limited (2022) *Sustainability Report 2022*

Whitehaven Coal Limited (2025) *Sustainability Report 2025*

Viva Energy Australia (2024) *ECOCLEAN Diesel*

Volvo Penta (2024) *How HVO can benefit you on land and at sea*
Website: https://www.volvopenta.com/about-us/how-hvo-can-benefit-you/

Whitehaven

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).

Whitehaven

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

Brendan Dillon
Manager – Approvals
Whitehaven Coal Limited

SUBMITTED BY

Francoise Robe, Ph.D.
Technical Director | Associate Principal
Air Quality
Francoise.robe@rwdi.com

Rebecca Warren
Project Manager
Rebecca.warren@rwdi.com

RWDI Australia Pty Ltd (RWDI)
ABN: 86 641 303 871

2026 RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015 for 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.
This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately. Accessible document formats provided upon request. ® RWDI name and logo are registered trademarks in Canada and the United States of America

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	5 February 2026	Alena Saprykina	Francoise Robe
B	Updated Draft	11 February 2026	Alena Saprykina	Rebecca Warren
C	Updated Draft	31 March 2026	Alena Saprykina Cameron McNaughton	Francoise Robe
D	Final	10 April 2026	Alena Saprykina Cameron McNaughton	Francoise Robe

NOTE

The information contained in this document produced by RWDI is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. RWDI undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

RWDI

RWDI is a team of highly specialised consulting engineers and scientists working to improve the built environment through three core areas of practice: building performance, climate engineering and environmental engineering. More information is available at www.rwdi.com.

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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 6

1 INTRODUCTION 7

1.1 Project Description 7

1.2 Project Scenarios 9

1.3 Objectives 9

2 BACKGROUND 10

2.1 Overview of the Greenhouse Gas Protocol 10

2.2 Scope 1 (Direct GHG Emissions) 10

2.3 Scope 2 (Indirect GHG Emissions) 10

2.4 Scope 3 (Other indirect GHG Emissions) 10

2.5 Global Warming Potential 12

3 RELEVANT LEGISLATIONS 13

3.1 Australian Legislation 13

3.1.1 National Greenhouse and Energy Reporting Framework 13

3.1.2 Safeguard Mechanism 13

3.1.3 Queensland State Legislation 14

4 GHG ASSESSMENT METHODOLOGY 15

4.1 Overview 15

4.2 Identification of GHG emission sources 15

4.2.1 GHG Assessment Boundary and Emission Sources 16

4.2.2 GHG Emission Sources 16

4.2.3 GHG Assessment Scenarios 17

5 CALCULATING GHG EMISSIONS 19

5.1 Scope 1 Emission Factors 19

5.2 Scope 1 Emissions Calculation Methodologies 21

5.2.1 Clearing of Vegetation 21

5.2.2 Fuel, Petroleum Oil and Greases Combustion 22

5.2.3 Construction Emissions 22

5.2.4 SF_6 Leakage 22

5.2.5 Explosives 22

5.2.6 Fugitive Emissions 23

5.3 Scope 2 Emission Factors 23

5.4 Scope 2 Emissions Calculation Methodologies 24

5.5 Scope 3 Emission Factors 25

5.6 Scope 3 Emissions Calculation Methodologies 27

5.6.1 Scope 3 Fuel, Petroleum Oil and Greases Combustion 27
5.6.2 Scope 3 Emissions from Electricity Transmission Losses 27
5.6.3 Scope 3 Product Transportation Emissions 27
5.6.4 Scope 3 Coal Combustion Emissions 29

6 QUANTIFIED GHG EMISSIONS 30

6.1 Scope 1 and Scope 2 Emissions 30

6.2 Scope 3 Emissions 36

7 COMPARISON OF ESTIMATED PROJECT EMISSIONS WITH QUEENSLAND AND NATIONAL EMISSION BUDGETS 41

7.1 National and Queensland Reduction Targets 41

7.2 Project Contribution 42

8 CONCLUSION 43

9 REFERENCES 44

10 STATEMENT OF LIMITATIONS 46

LIST OF APPENDICES

Appendix A: Activity Data
Appendix B: Detailed Emission Estimates

LIST OF FIGURES

Figure 1: Blackwater North Extension Project
Figure 2: Overview of GHG Protocol scopes and emissions across the value chain
Figure 3: GHG assessment boundary and emission sources
Figure 4: Scope 1 and 2 Project Scenario Emissions
Figure 5: Scope 1 and 2 Project Only Scenario Emissions
Figure 6: Scope 3 Project Scenario Emissions
Figure 7: Scope 3 Project Only Scenario Emissions

LIST OF TABLES

Table 1: GHGs and 100-year Global Warming Potentials
Table 2: Scope 1 Emission Factors
Table 3: Projected Scope 2 Emission Factors for Queensland's Electricity Grid
Table 4: Scope 3 Emission Factors
Table 5: Related Scope 3 Emission Factors for Electricity Transmission Losses
Table 6: Weighted Average Shipping Distance with Return for Bulk Carrier
Table 7: Results of Scope 1 and 2 emissions
Table 8: Results of Scope 3 emissions
Table 9: National and State Current Emissions and Reduction Targets for CO2e
Table 10: Comparison of Estimated Project and Project Only Emissions with National and Queensland Emissions and Reduction Targets

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.

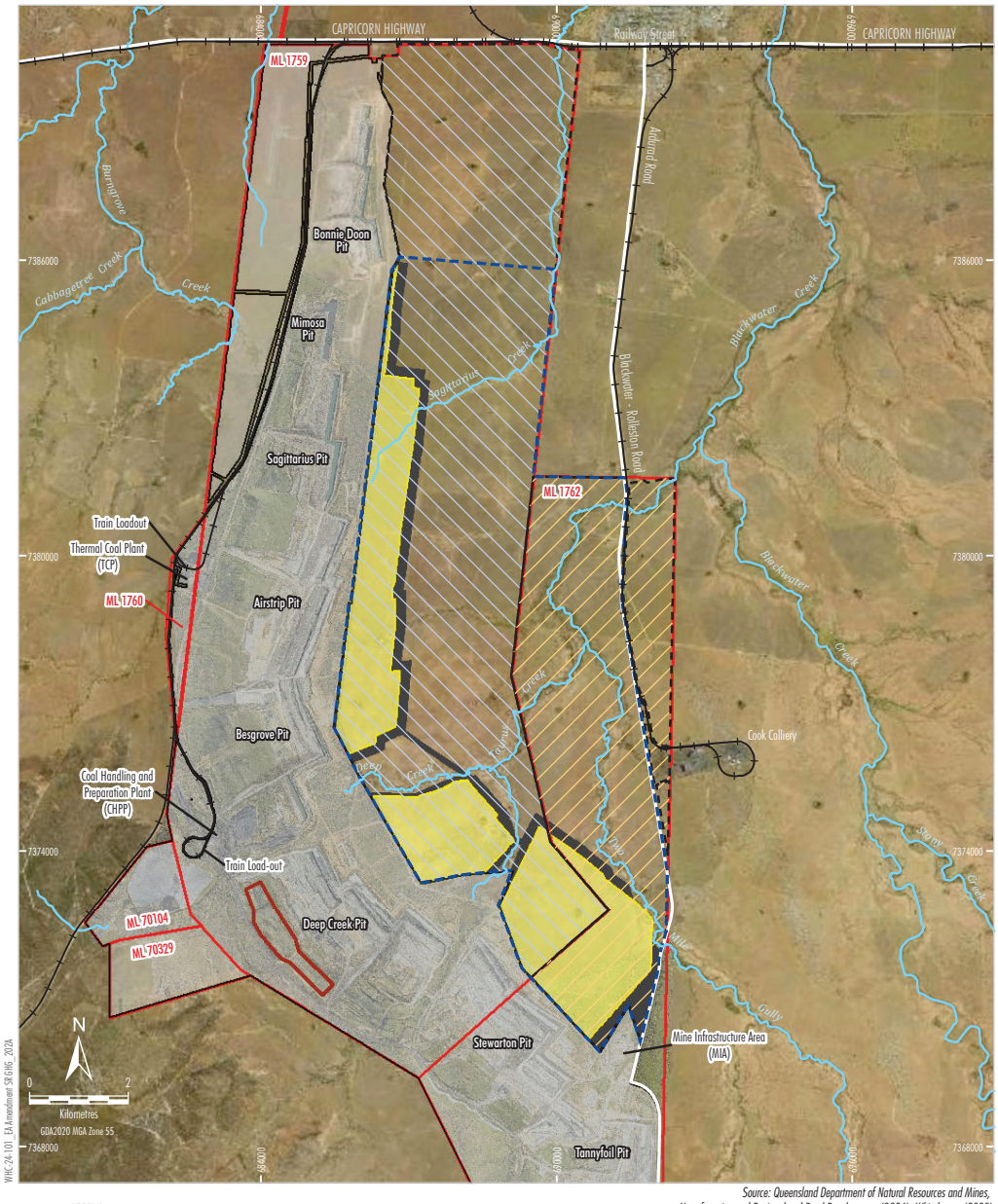


Figure 1: Blackwater North Extension Project

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.

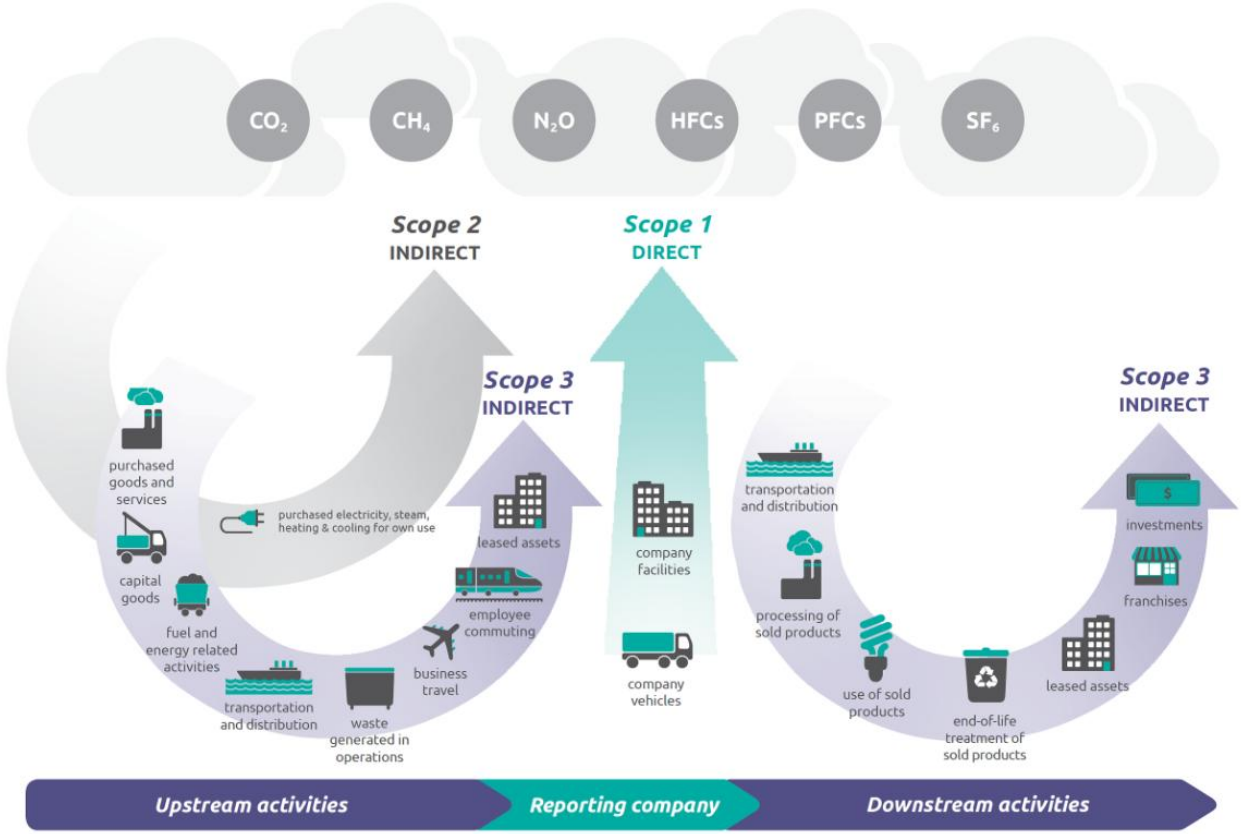
2.3 Scope 2 (Indirect GHG Emissions)

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.

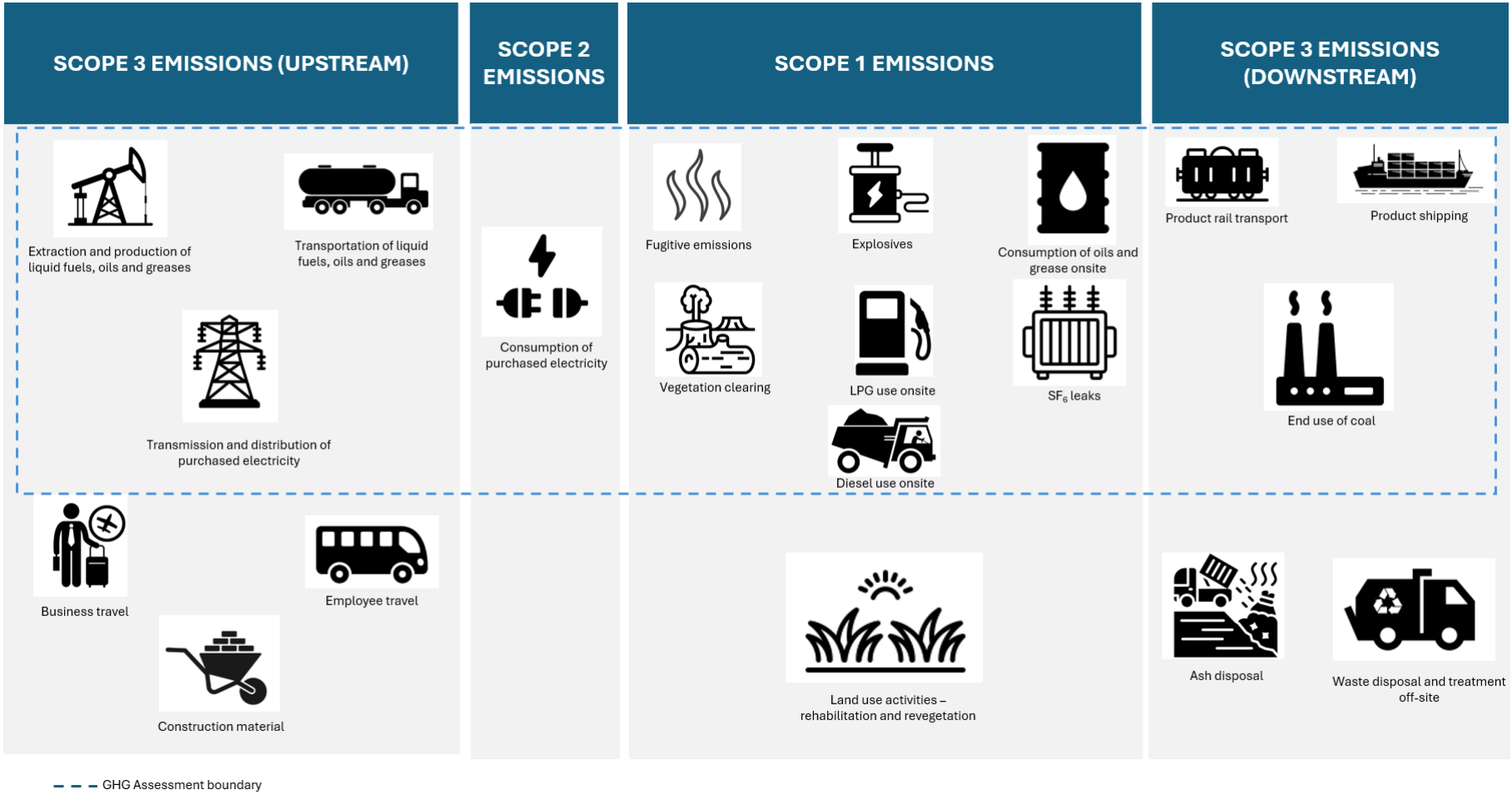


Figure 3: GHG assessment boundary and emission sources

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.

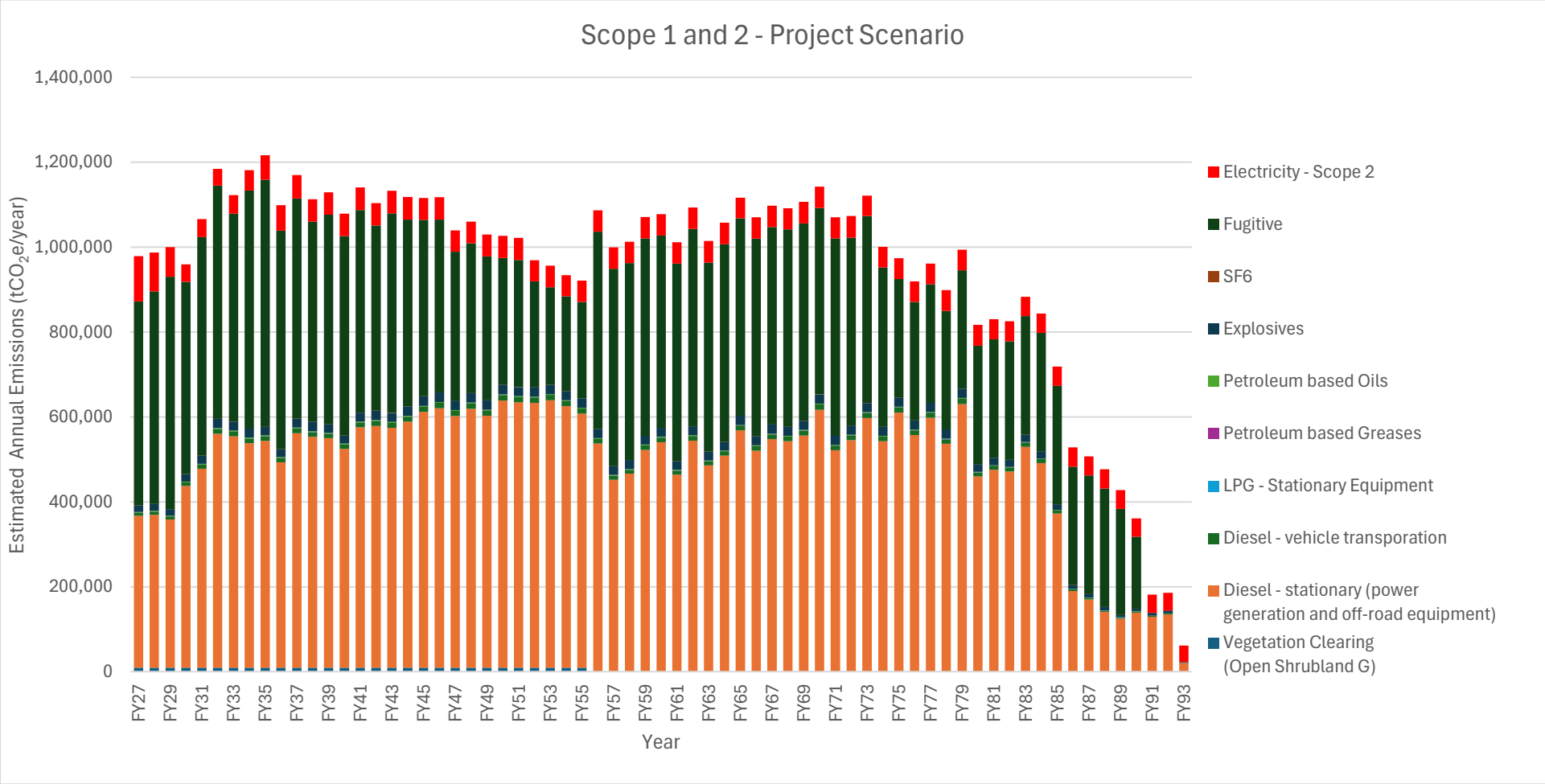


Figure 4: Scope 1 and 2 Project Scenario Emissions

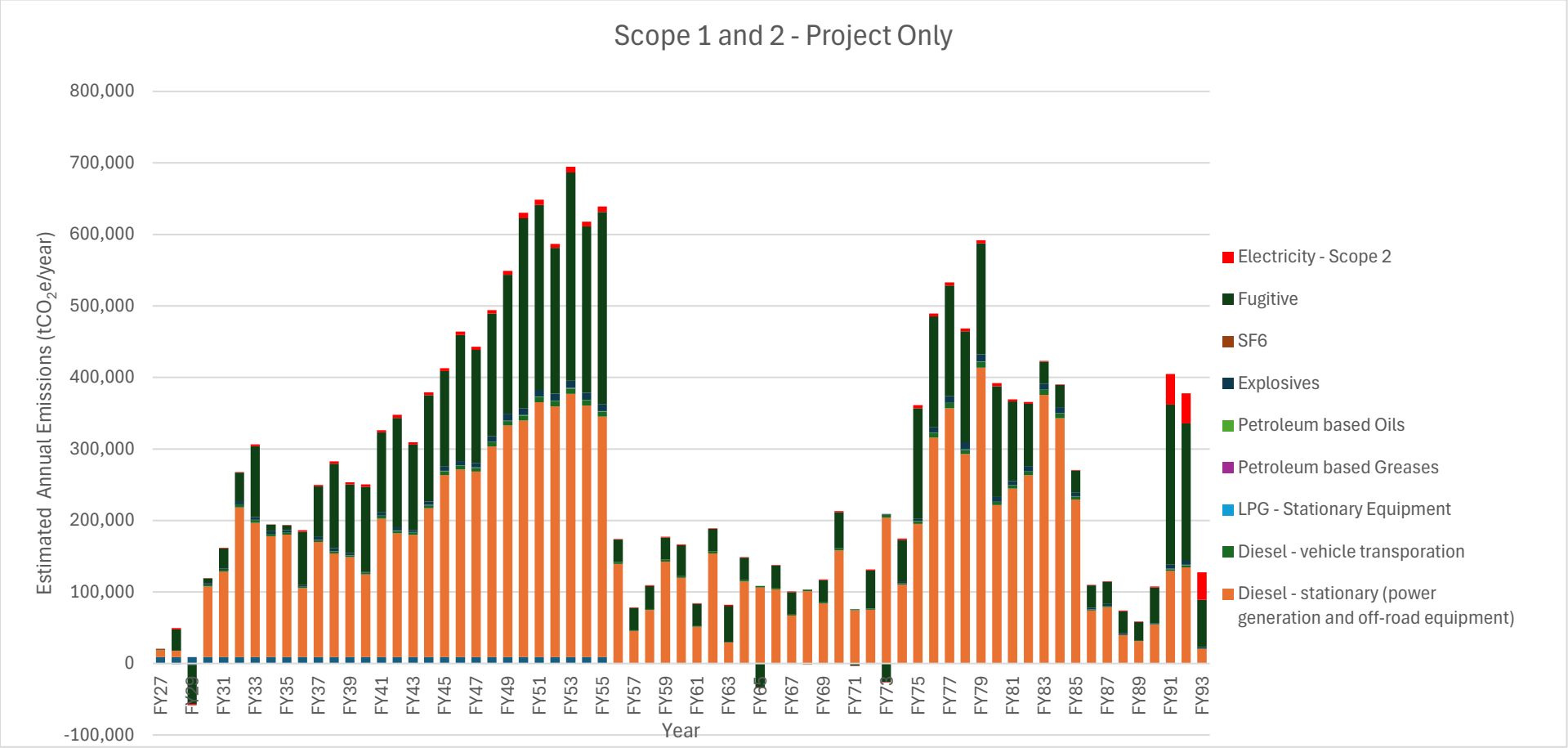


Figure 5: Scope 1 and 2 Project Only Scenario Emissions

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

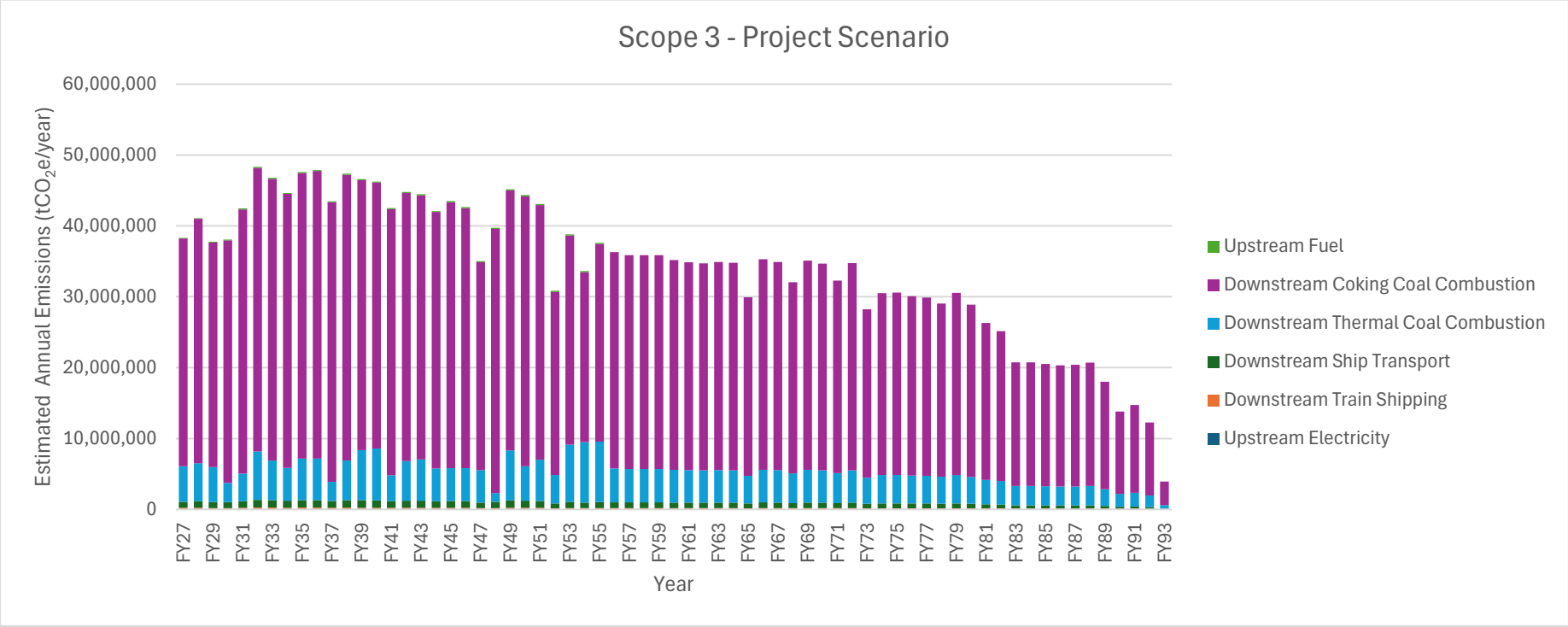


Figure 6: Scope 3 Project Scenario Emissions

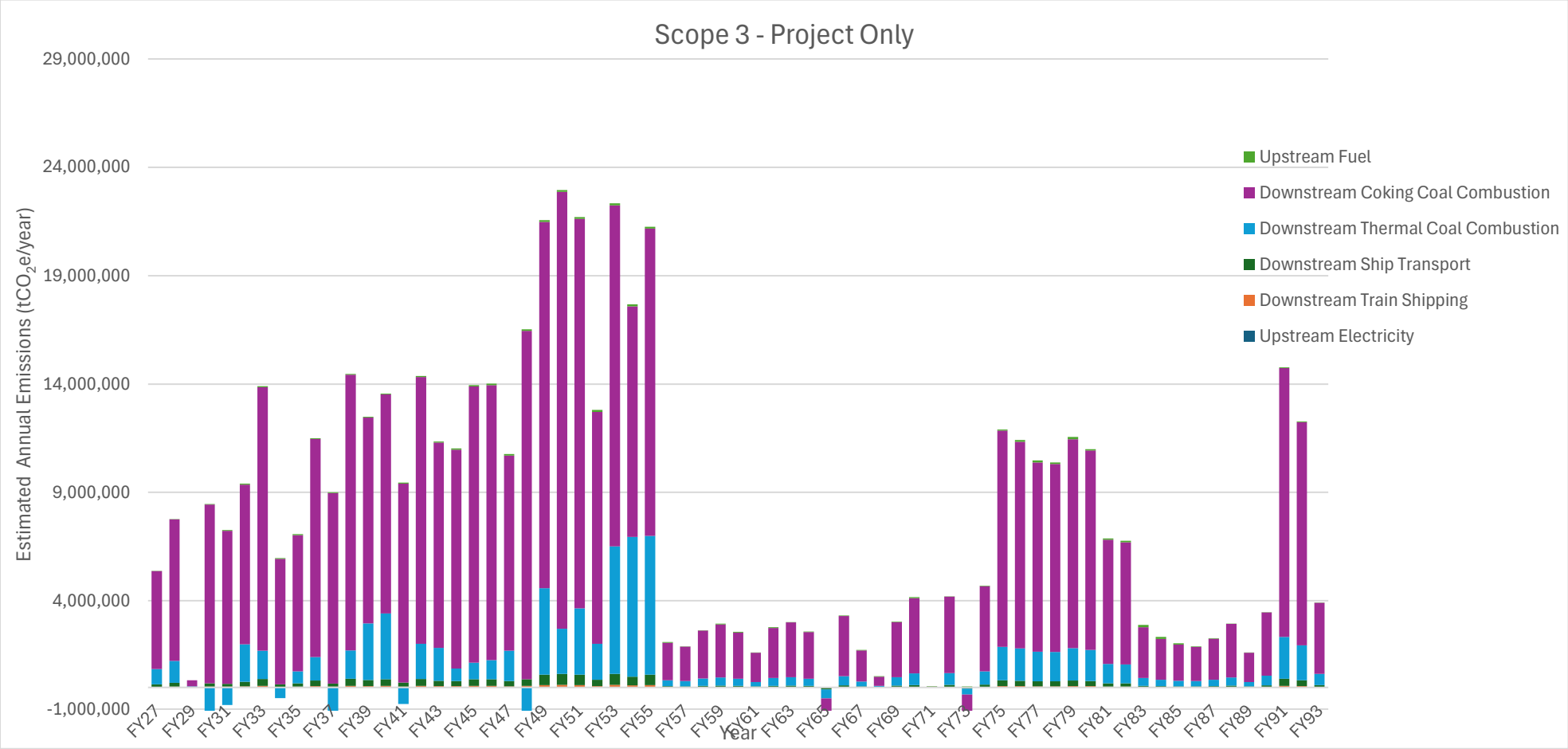


Figure 7: Scope 3 Project Only Scenario Emissions

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.

9 REFERENCES

Australian Government Department of Climate Change, Energy, the Environment and Water, 2025. Quarterly update of Australia's National Greenhouse Gas Inventory: December 2024. Accessed January 2026: Quarterly Update of Australia's National Greenhouse Gas Inventory - December 2024.

Australian Greenhouse Office, 2004. AGO Factors and Methods Workbook

Department of the Environment, Tourism, Science and Innovation (DETSI), 2026. Greenhouse gas emissions guideline. Queensland Government. Accessed January 2026: Greenhouse gas emissions.

DCCEEW, 2015. Department of Climate Change, Energy, the Environment and Water. 2015. Summary of Australia's 2030 emissions reduction target. Australian Government. Accessed January 2026: Australia's 2030 Emissions Reduction Target.

DCCEEW, 2022. Department of Climate Change, Energy, the Environment and Water. 2022. Australia's Nationally Determined Contribution. Australian Government. Accessed January 2026. AUSTRALIA'S NATIONALLY DETERMINED CONTRIBUTION.

DCCEEW, 2025a. Australian National Greenhouse Accounts Factors. Australian Government: Department of Climate Change, Energy, the Environment and Water. Accessed January 2026: Australian National Greenhouse Accounts Factors 2025.

DCCEEW, 2025b. Department of Climate Change, Energy, the Environment and Water. 2025. International climate action. Australian Government. Accessed January 2026: International climate action - DCCEEW.

DCCEEW, 2025c. Department of Climate Change, Energy, the Environment and Water. 2025. Safeguard Mechanism overview. Australian Government. Accessed January 2026: Safeguard Mechanism overview - DCCEEW.

DCCEEW, 2025d. Department of Climate Change, Energy, the Environment and Water. 2025. Australia's Emissions Projections 2025. Australian Government. Accessed January 2026: Australia's Emissions Projections 2025.

DCCEEW, 2025e. Department of Climate Change, Energy, the Environment and Water. 2025. Net Zero. Australian Government. Accessed January 2026: Net Zero - DCCEEW.

Greenhouse Gas Protocol, 2024. IPCC Global Warming Potential Values. Accessed January 2026: Microsoft Word - Global-Warming-Potential-Values.docx.

Intergovernmental Panel on Climate Change, 2025. About the IPCC. Accessed January 2026: About — IPCC.

National Greenhouse and Energy Reporting (Measurement) Determination 2008, including amendments from the National Greenhouse and Energy Reporting (Measurement) Amendment (2023 Update) Determination 2023. Australian Government. Accessed January 2026: National Greenhouse and Energy Reporting (Measurement) Determination 2008 - Federal Register of Legislation.

Queensland Government, 2023a. Queensland Climate Transition Bill 2023. Queensland Legislation. Accessed January 2026: Queensland Climate Transition Bill 2023 - Queensland Legislation - Queensland Government.

Queensland Government, 2023b. Emissions Data. Accessed January 2026: Emissions data | Environment, land and water | Queensland Government.

Queensland Government, 2024a. State of Environment Report 2024. Government leading by example. Accessed January 2026: Government leading by example | State of the Environment Report 2024.

Queensland Government, 2024b. Clean Economy Jobs Act 2024. Queensland Legislation. Accessed January 2026: Clean Economy Jobs Act 2024 - Queensland Legislation - Queensland Government.

Queensland Government, 2024c. Queensland's 2035 clean economy pathway. Accessed January 2026: Queensland's 2035 Clean Economy Pathway:75% by 2035.

Queensland Government, 2024d. State of Environment Report 2024. Total annual greenhouse gas emissions. Accessed January 2026: Total annual greenhouse gas emissions | State of the Environment Report 2024.

SLR Consulting Australia Pty Ltd and BHP Mitsubishi Alliance, 2023. Blackwater Mine – North Extension Project. Environmental Authority Amendment Supporting Information Document.

Transport Authorities Greenhouse Group (TAGG), 2013. Greenhouse Gas Assessment Workbook for Road Projects. Accessed January 2026: Greenhouse Gas Assessment Workbook for Road Projects.

UK Government, 2025. UK Government GHG Conversion Factors for Company Reporting, Department for Energy Security and Net Zero.UK Government. Accessed January 2026: ghg-conversion-factors-2025-full-set.xlsx.

Whitehaven, 2025. Blackwater North Extension Project. Initial Advice Statement.

WRI and WBCSD, 2004. The Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard (Revised Edition). Geneva: The World Resources Institute and the World Business Council for Sustainable Development. Accessed January 2026: ghg-protocol-revised.pdf.

WRI and WBCSD, 2011. Greenhouse Gas Protocol - Corporate Value Chain (Scope 3) Accounting and Reporting Standard. Accessed January 2026: Cor porate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf.

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

07 3112 7230
www.loopdecarb.com.au
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

---

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.

07 3112 7230
sbyrom@loopdecarb.com.au
Level 3, 10 Market St, Brisbane, 4000

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
Technical Director
Rebecca.warren@rwdi.com

Whitehaven Coal Limited
Level 31, 12 Creek Street
Brisbane QLD 4001

RWDI Australia Pty Ltd (RWDI)
ABN: 86 641 303 871

© 2023 RWDI Australia Limited. ("RWDI") ALL RIGHTS RESERVED
RWDI Australia Pty Ltd operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015 for 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.
This document is intended for the sole use of the party to whom it is addressed and may contain information that is privileged and/or confidential. If you have received this in error, please notify us immediately. Accessible document formats provided upon request. ® RWDI name and logo are registered trademarks in Canada and the United States of America.

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Final	1 April 2026	Roman Haverkamp	Rebecca Warren

NOTE

All materials specified by RWDI Australia Pty Ltd (RWDI) have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

The information contained in this document produced by RWDI is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. RWDI undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

RWDI

RWDI is a team of highly specialised consulting engineers and scientists working to improve the built environment through three core areas of practice: building performance, climate engineering and environmental engineering. More information is available at www.rwdi.com.

AAAC

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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY **1**

1 INTRODUCTION **3**

1.1 Overview of the Blackwater Mine 3

1.2 Objectives of this Assessment 3

2 PROJECT DESCRIPTION **5**

3 EXISTING NOISE ENVIRONMENT **7**

3.1 Noise-sensitive Receptors 7

3.2 Previous Noise Monitoring 10

3.2.1 Noise Monitoring Locations 10

3.2.2 Noise Monitoring Results 12

4 OPERATIONAL NOISE CRITERIA **14**

4.1 Noise Policies & Guidelines 14

4.2 Assessment Strategy 14

4.3 Environmental Authority Noise Criteria 15

4.4 Modifying Factor Adjustments 15

4.4.1 Low-frequency Noise 15

4.4.2 Tonal Noise 16

4.4.3 Impulsive Noise 16

5 OPERATIONAL NOISE ASSESSMENT **17**

5.1 Noise Modelling Methodology 17

5.1.1 Predictive Noise Model 17

5.1.2 Noise Assessment Scenarios 17

5.1.3 Meteorology 18

5.1.4 Noise Modelling Assumptions 21

5.1.5 Mobile Equipment / Fixed Plant 22

5.1.6 Equipment Sound Power Levels 26

5.1.7 Quarries 27

5.2 Proactive Noise Management 29

5.2.1 Description of Proactive Noise Management System 29

5.2.2 Application of Proactive Noise Management System 29

5.3 Operational Noise Predictions & Discussion 32

5.4 Night-time Maximum Noise Level Event Assessment 34
5.4.1 Assumptions and Methodology 34
5.4.2 Maximum Noise Level Event Predictions & Discussion 35
5.5 Low-frequency Noise Assessment 36
5.5.1 Representative Receptors 36
5.5.2 Low-frequency Noise Results 39
5.6 Cumulative Noise Assessment 39
5.6.1 Nearby Industrial Operations 40
5.6.2 Cumulative Noise Predictions 40
6 ROAD TRAFFIC NOISE 42
7 RAIL TRANSPORTATION NOISE 43
8 BLASTING ASSESSMENT 44
8.1 Introduction 44
8.2 Blast Impact Assessment Criteria 44
8.3 Prediction of Airblast Overpressure and Ground Vibration Levels 45
8.4 Blasting Minimum Compliance Distances 46
8.5 Discussion 48
9 CONCLUSION 49
10 STATEMENT OF LIMITATIONS 50
11 REFERENCES 51

LIST OF APPENDICES

Appendix A: Glossary of Acoustic Terms
Appendix B: Land Ownership Details
Appendix C: Meteorology
Appendix D: Operational Noise Predictions
Appendix E: Operational Noise Predictions - Unmitigated
Appendix F: Noise Contours
Appendix G: Night-time Maximum Noise Level Event Predictions
Appendix H: Low-frequency Noise Prediction Methodology
Appendix I: Blasting Prediction Curves & Equations

LIST OF FIGURES

Figure 1-1: Existing Blackwater Mine 4
Figure 2-1: Project General Arrangement 6
Figure 3-1: Noise-Sensitive Receptor Locations 9
Figure 3-2: Noise Monitoring Locations 11
Figure 5-1: Proposed Quarry Locations 28
Figure 5-2: LFN Zones 38
Figure 8-1: Minimum Compliance Distances for Large Production Blasts (4,500 kg MIC) 47

LIST OF TABLES

Table 3-1: Noise Monitoring Locations (EMM, 2021) 10
Table 3-2: Unattended Noise Monitoring Results (EMM, 2021) 12
Table 3-3: Attended Noise Monitoring Results (EMM, 2021) 12
Table 4-1: EA EPML00717813 Noise Criteria 15
Table 4-2: Project-specific LFN Assessment Criteria 16
Table 5-1: Noise Assessment Scenarios and Rationale 18
Table 5-2: Assessment Meteorological Parameters 20
Table 5-3: Air Temperature & Relative Humidity 21
Table 5-4: Indicative Equipment Schedule 23
Table 5-5: Indicative Equipment SWLs 26
Table 5-6: Indicative Quarry Equipment and SWLs 27
Table 5-7: Indicative Examples of Proactive Mitigation Measures (FY50, Winter) 30
Table 5-8: Indicative Proactive Mitigation Measures Implementation Frequencies 31
Table 5-9: Residual $L_{Aeq,15min}$ Noise Exceedances 33
Table 5-10: Residual Noise Exceedance Levels at Privately-owned Receptors 34
Table 5-11: Night-time Maximum Noise Level Event Sources and SWLs 35
Table 5-12: Residual $L_{A1,15min}$ Noise Exceedances 36
Table 5-13: LFN Zones & Representative Receptors 36
Table 5-14: LFN Results (Night) 39
Table 5-15: Cumulative Noise Predictions 40
Table 8-1: EA EPML00717813 Blast Criteria 44
Table 8-2: Blasting Minimum Compliance Distances 48

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**).

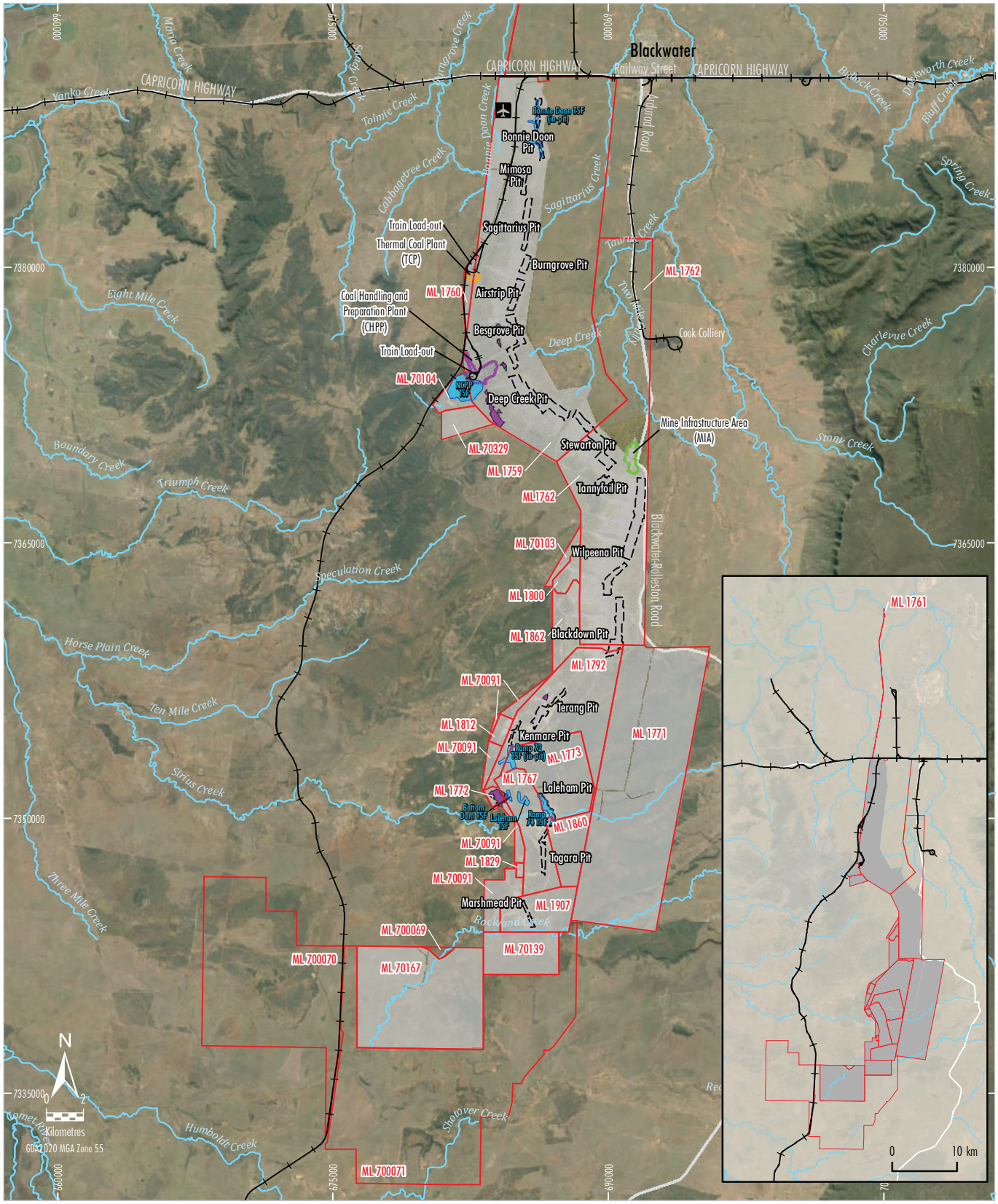
Whitehaven Blackwater proposes to develop the Blackwater North Extension Project (the Project), which would extend the current open-cut mining development at the BWM to within Surface Area (SA) 7 on Mining Lease (ML) 1762 and SA 10 on ML 1759. The Project is expected to optimise mining operations at 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

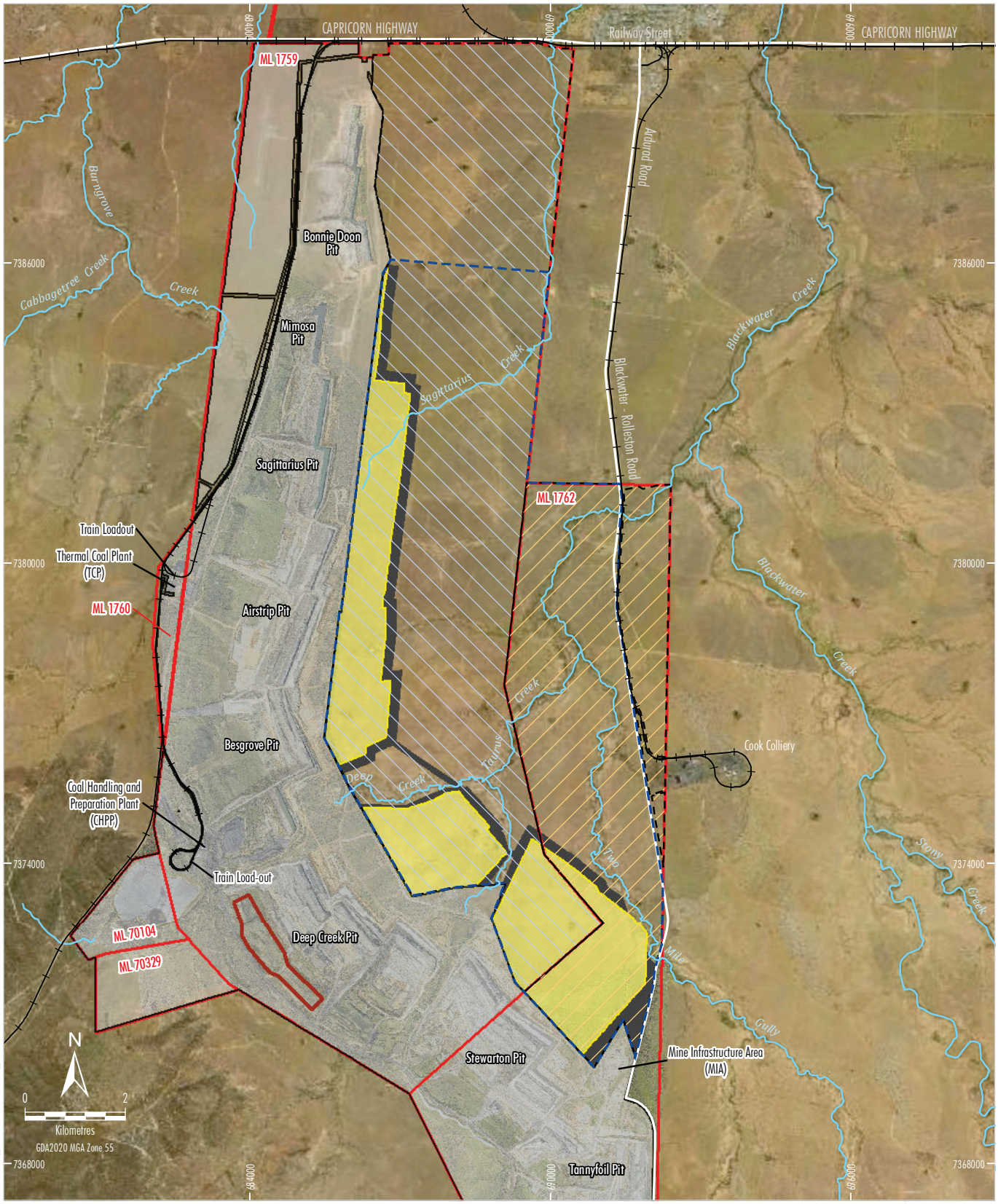
Existing Blackwater Mine

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.

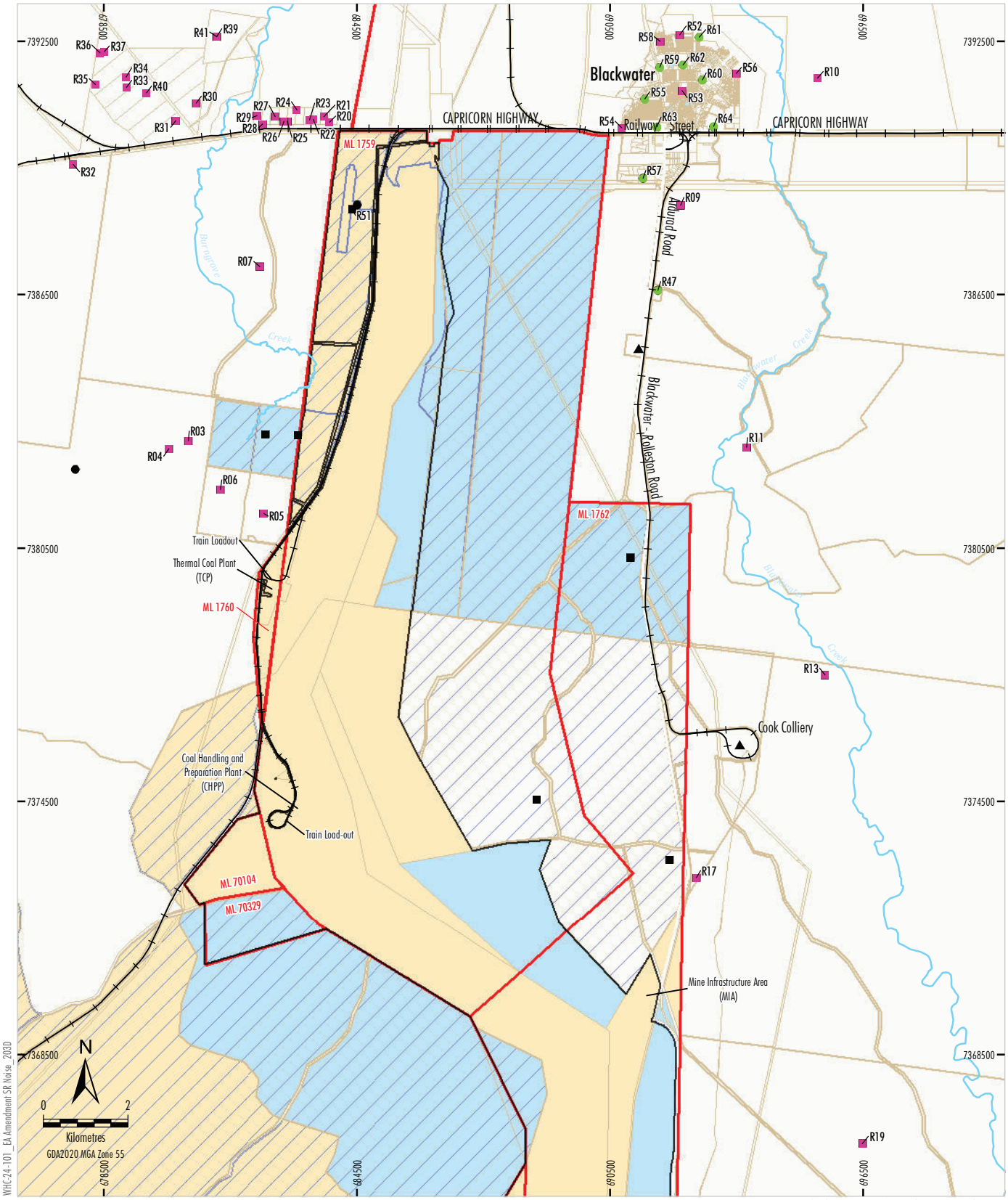
In total, 59 noise-sensitive receptors were considered and are summarised as follows:

- 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)

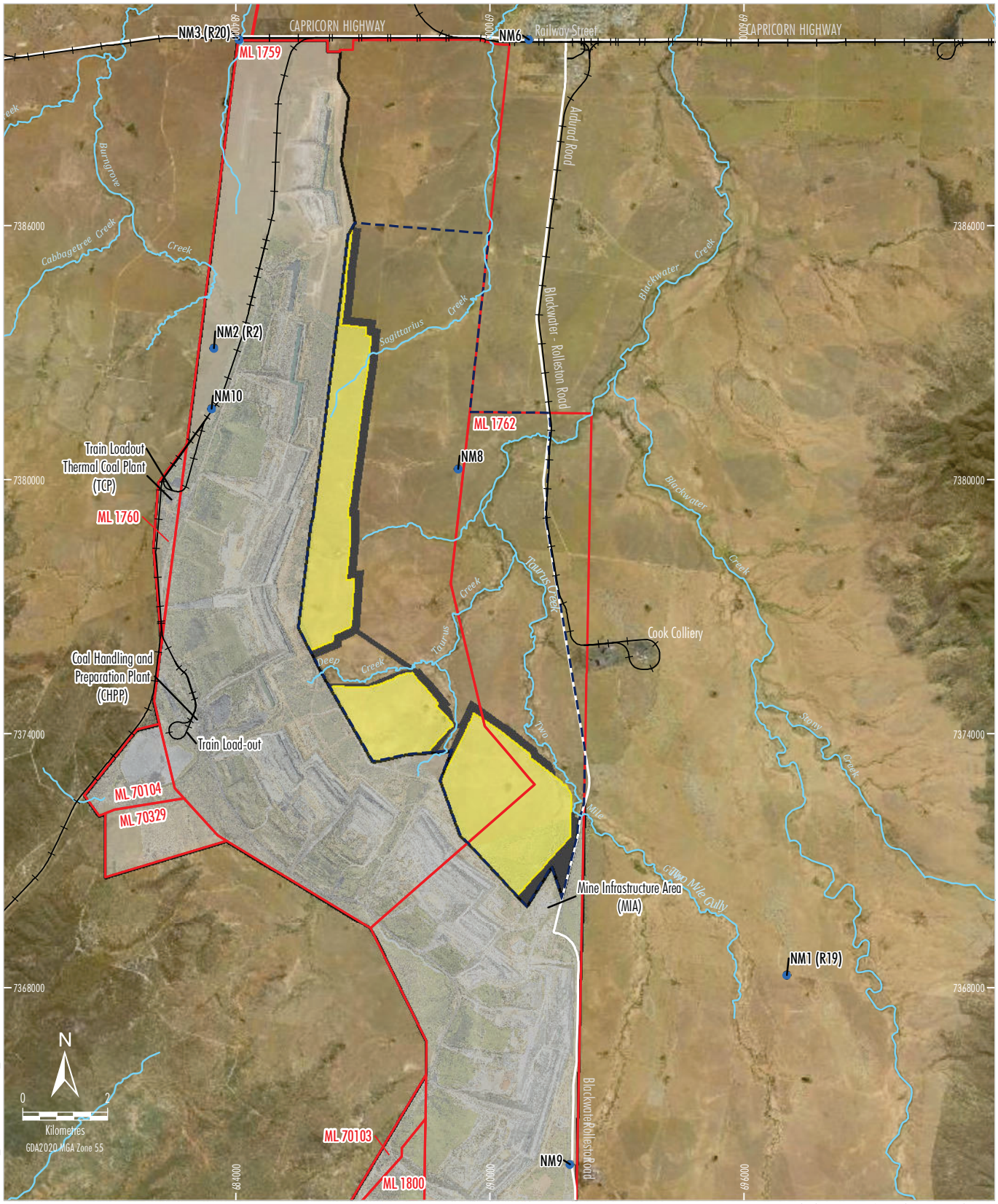
3.2.1 Noise Monitoring Locations

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.

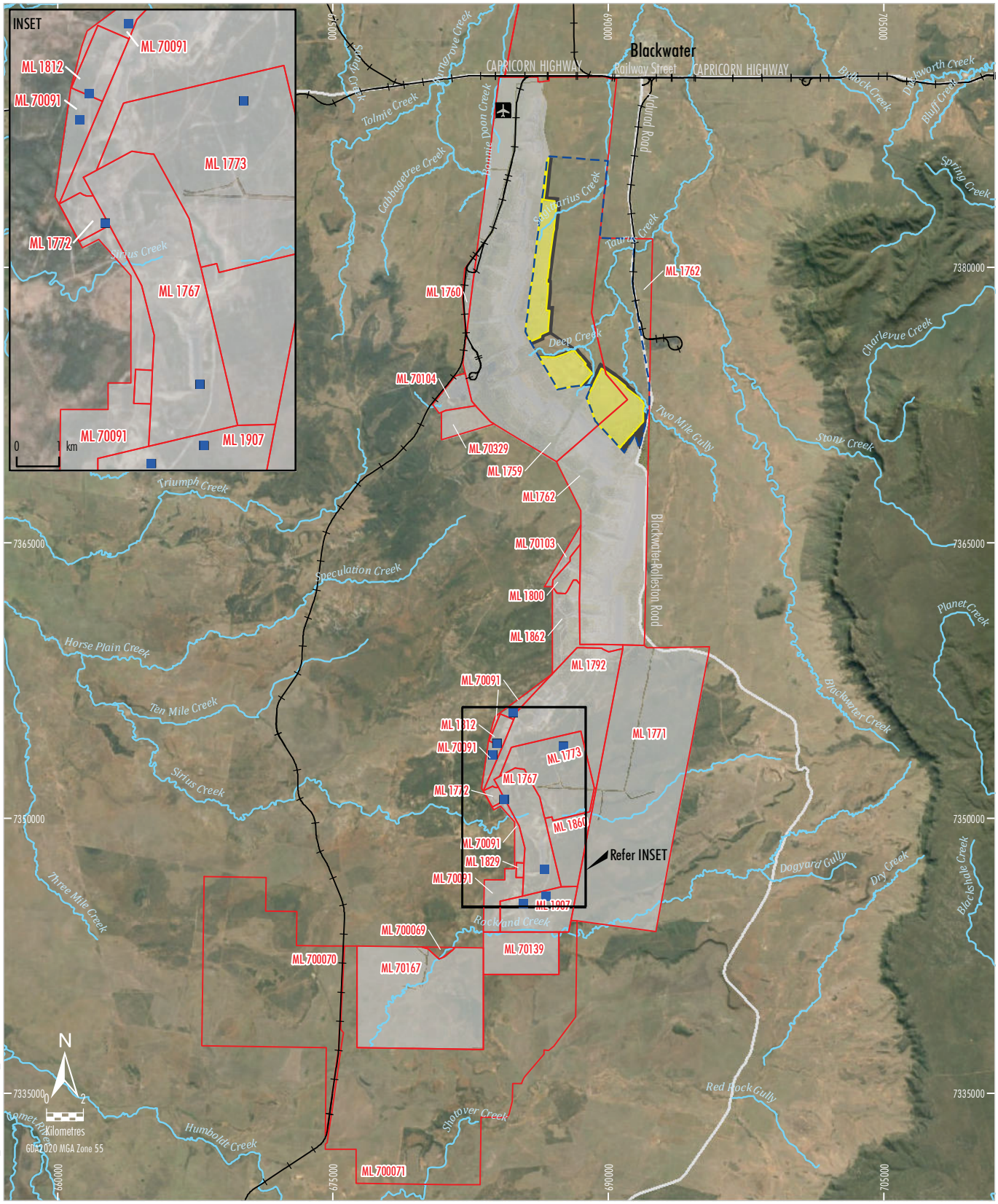
5.1.7 Quarries

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.



WHC-24-101_EA Amendment SR Noise_204A

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.

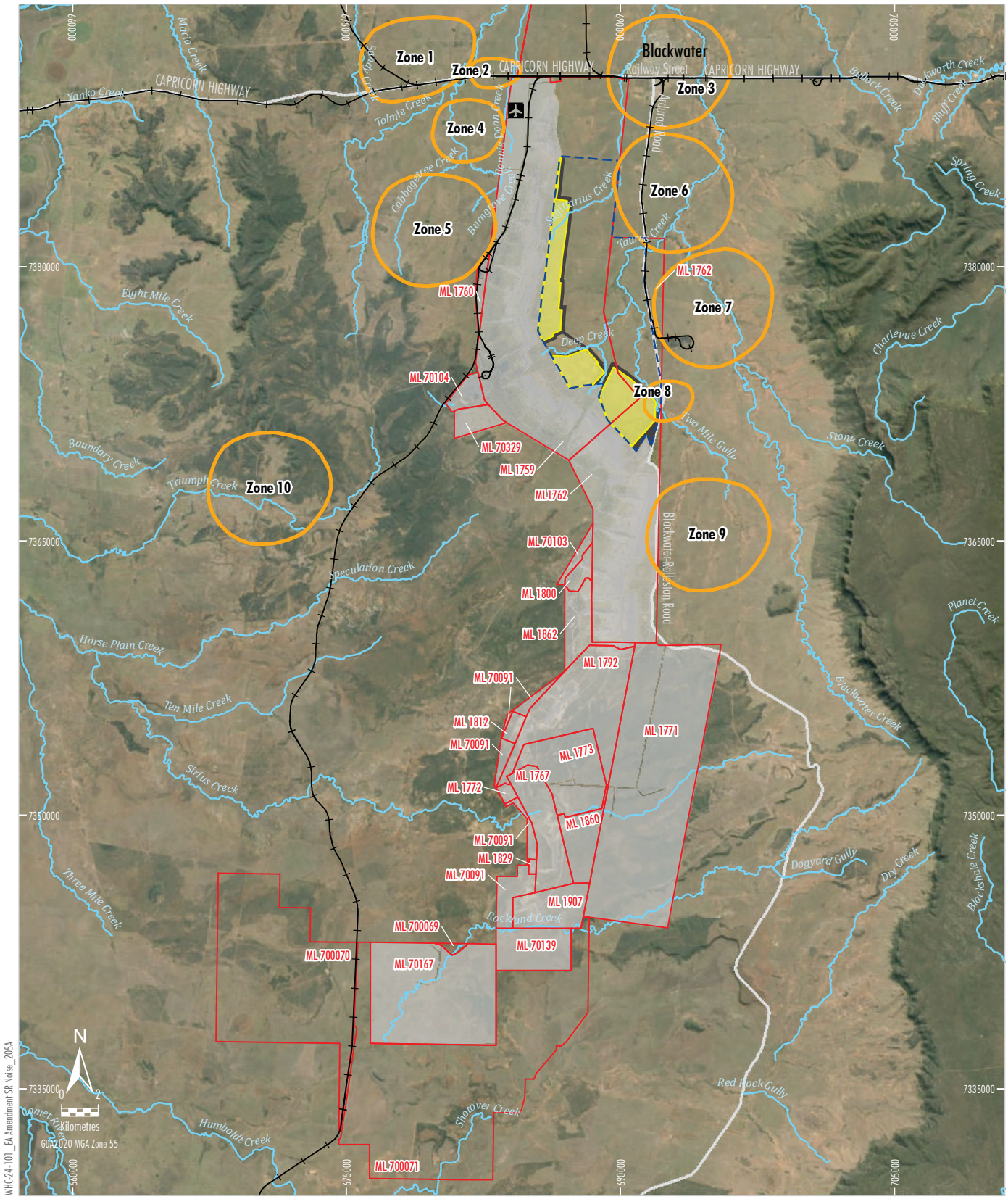
Figure 5-2 shows the location of the LFN zones. Representative receptors are included in **Table 5-13**.

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.

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

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.

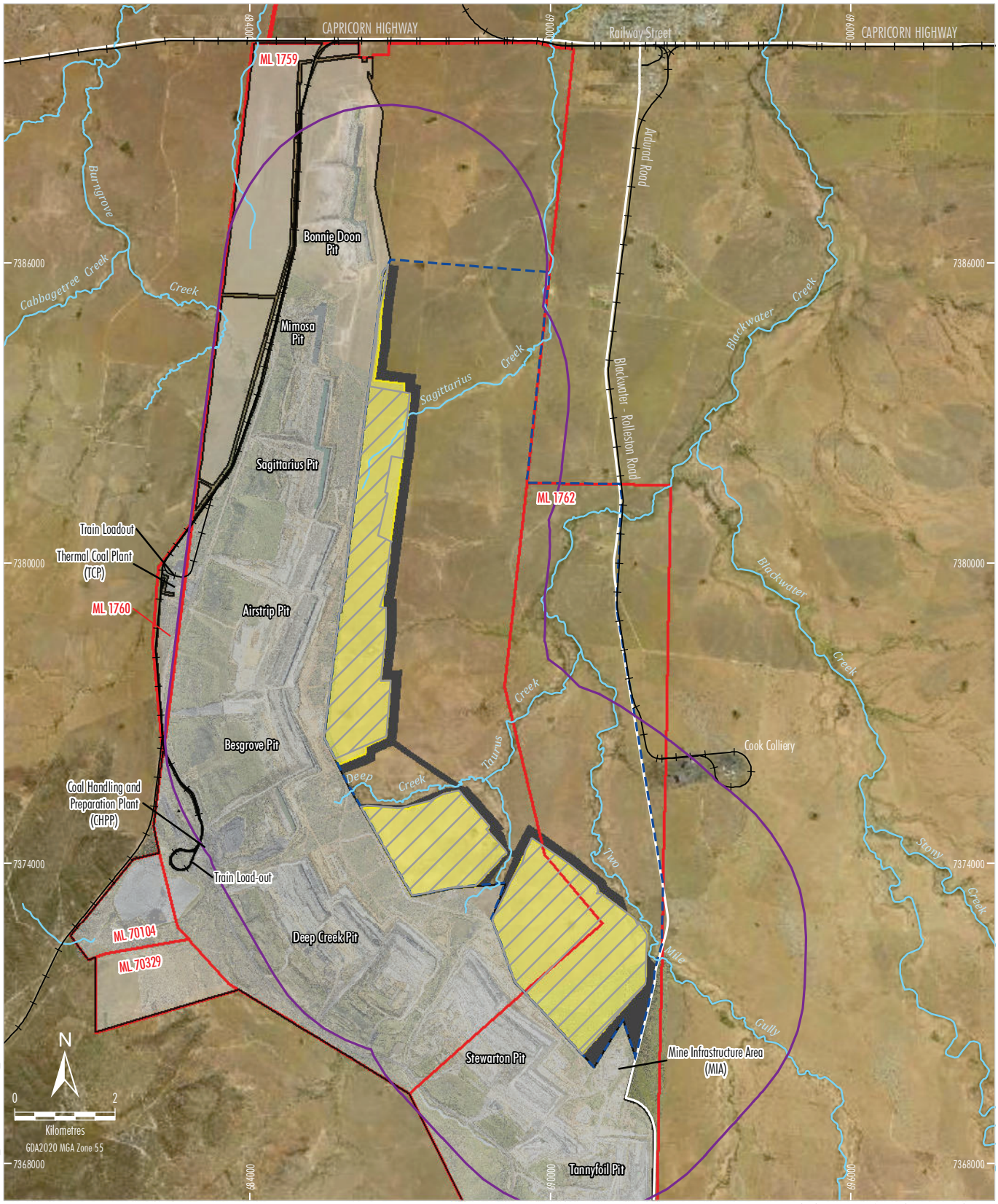
8.4 Blasting Minimum Compliance Distances

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)

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

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.

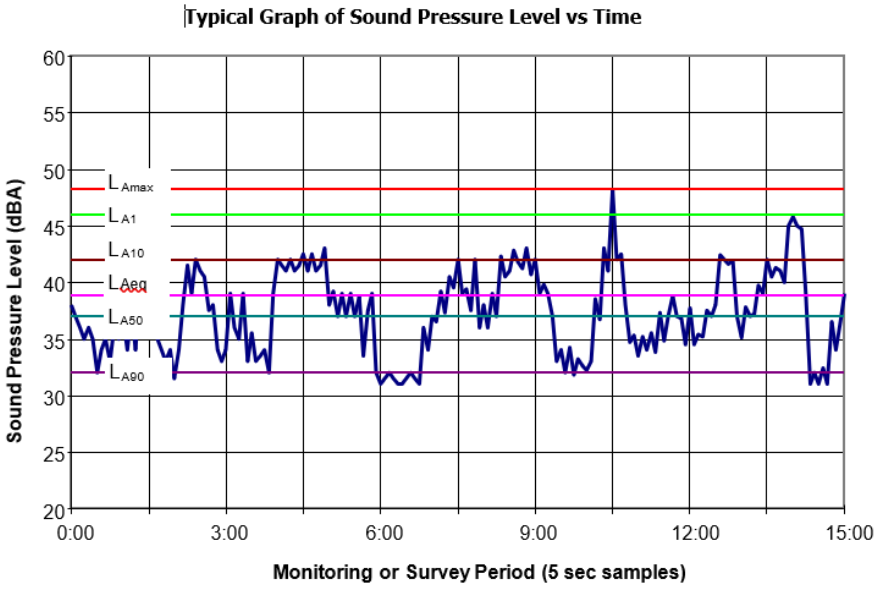
L_{A10} – The noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

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

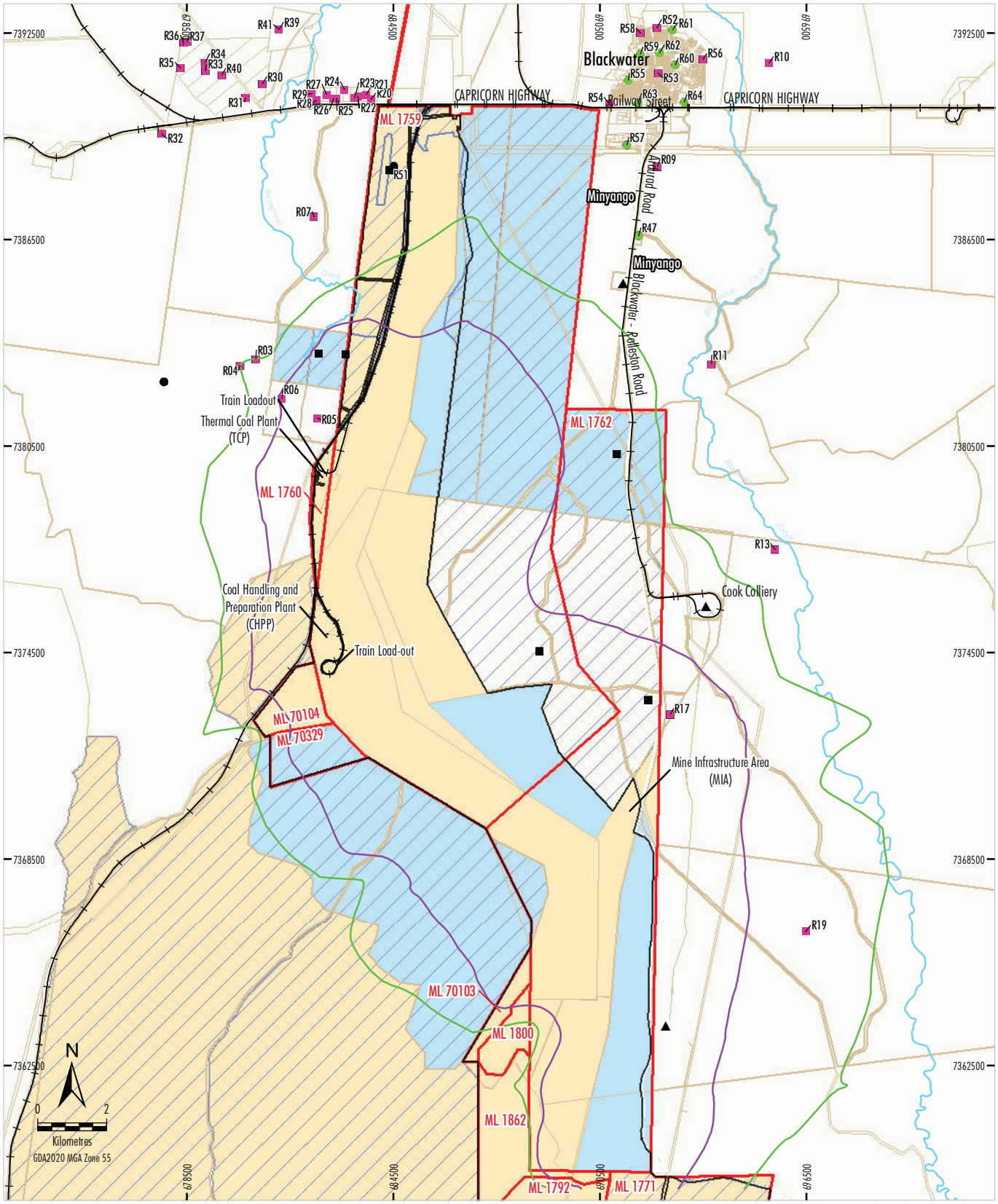
Rec ID	$L_{Aeq,15min}$ Operational Noise Predictions (dBA)												BWM EA $L_{Aeq,15min}$ Noise Criteria (dBA)
	FY30			FY32			FY50			FY55			
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	
Privately-owned Residential Receptors													
R11	32	33	38	31	32	35	37	38	41	37	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

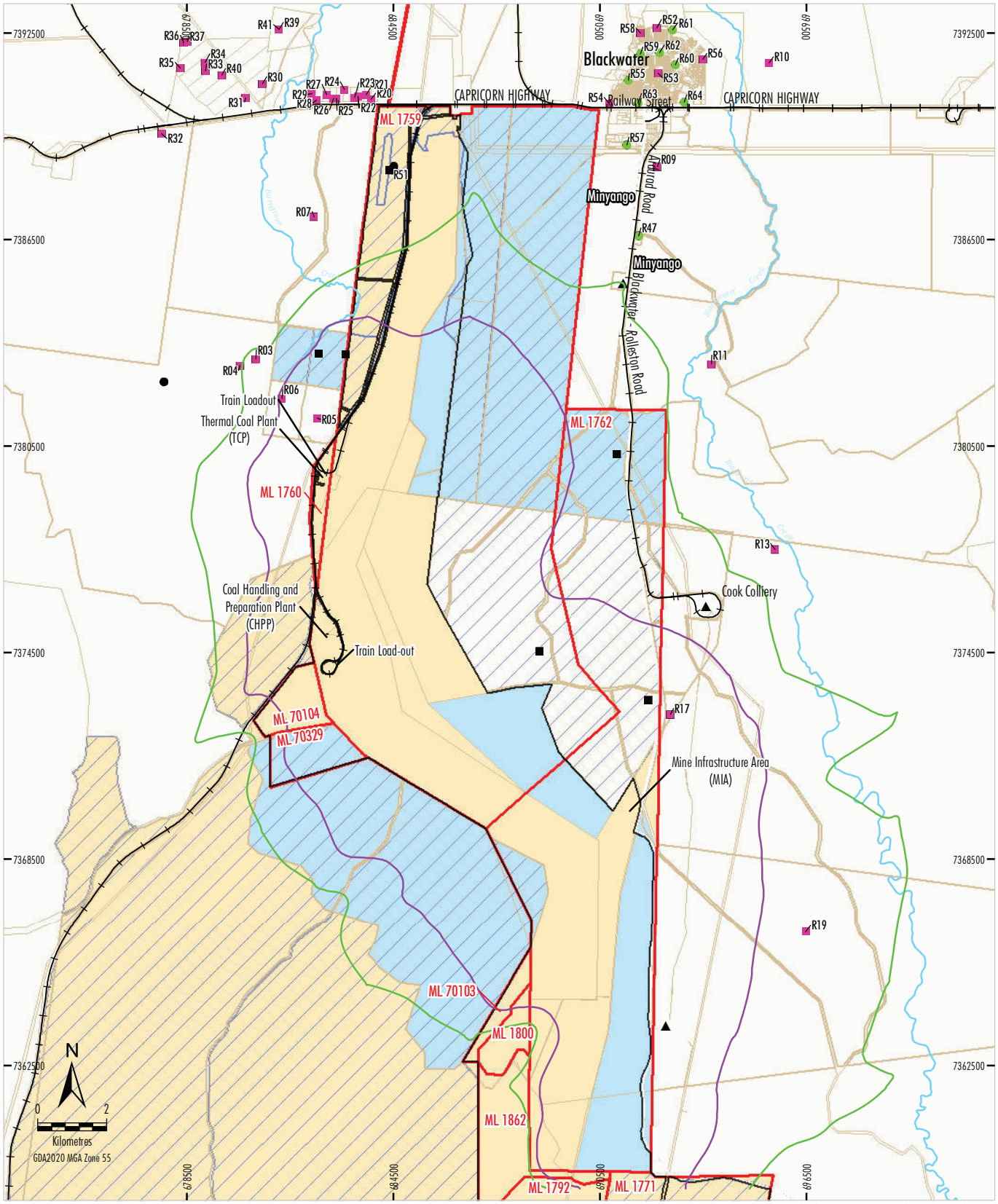
Noise Contour (Day)
- 35 dBA
- 40 dBA

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

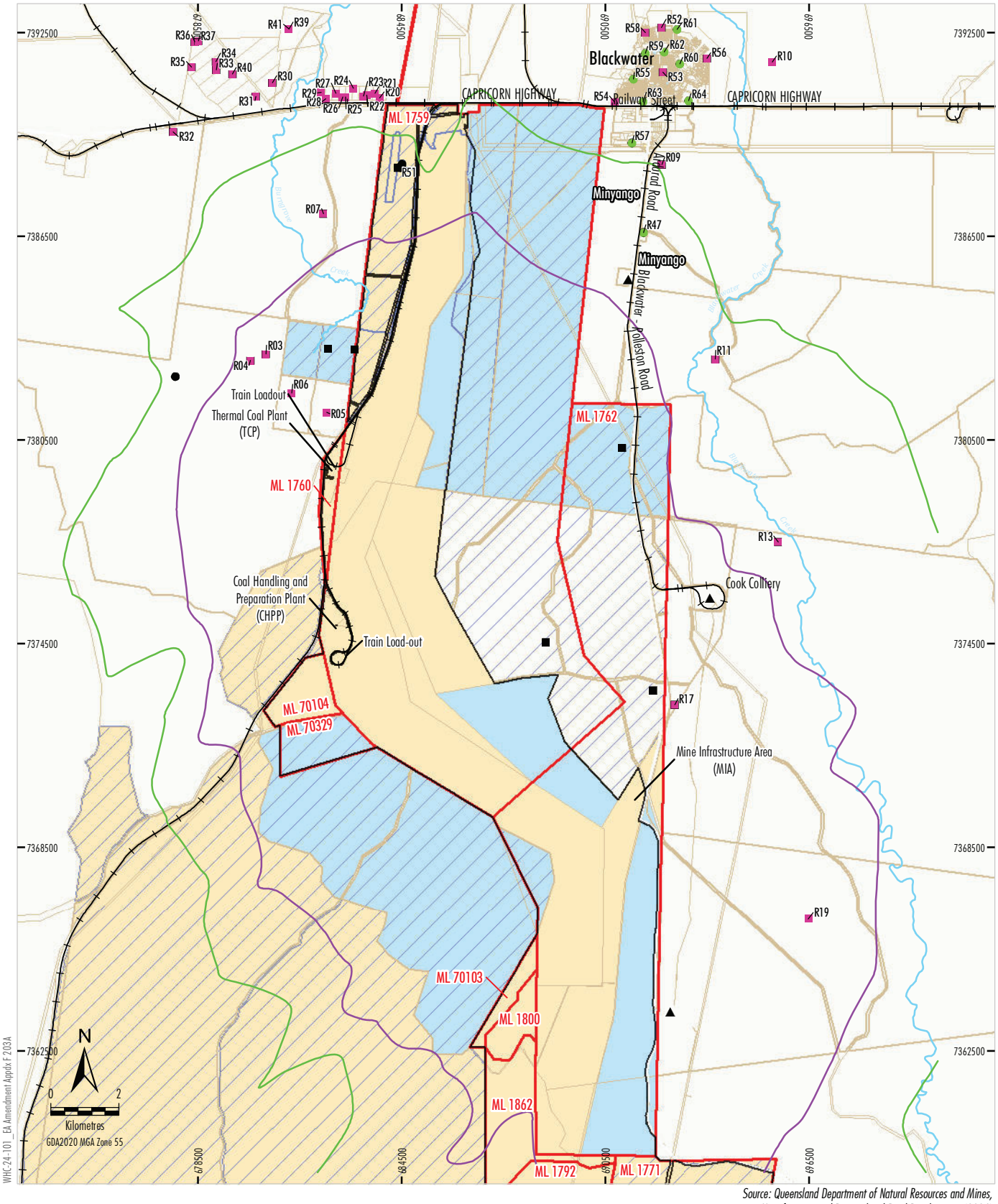
Noise Contour (Eve)
- 35 dBA
- 40 dBA

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

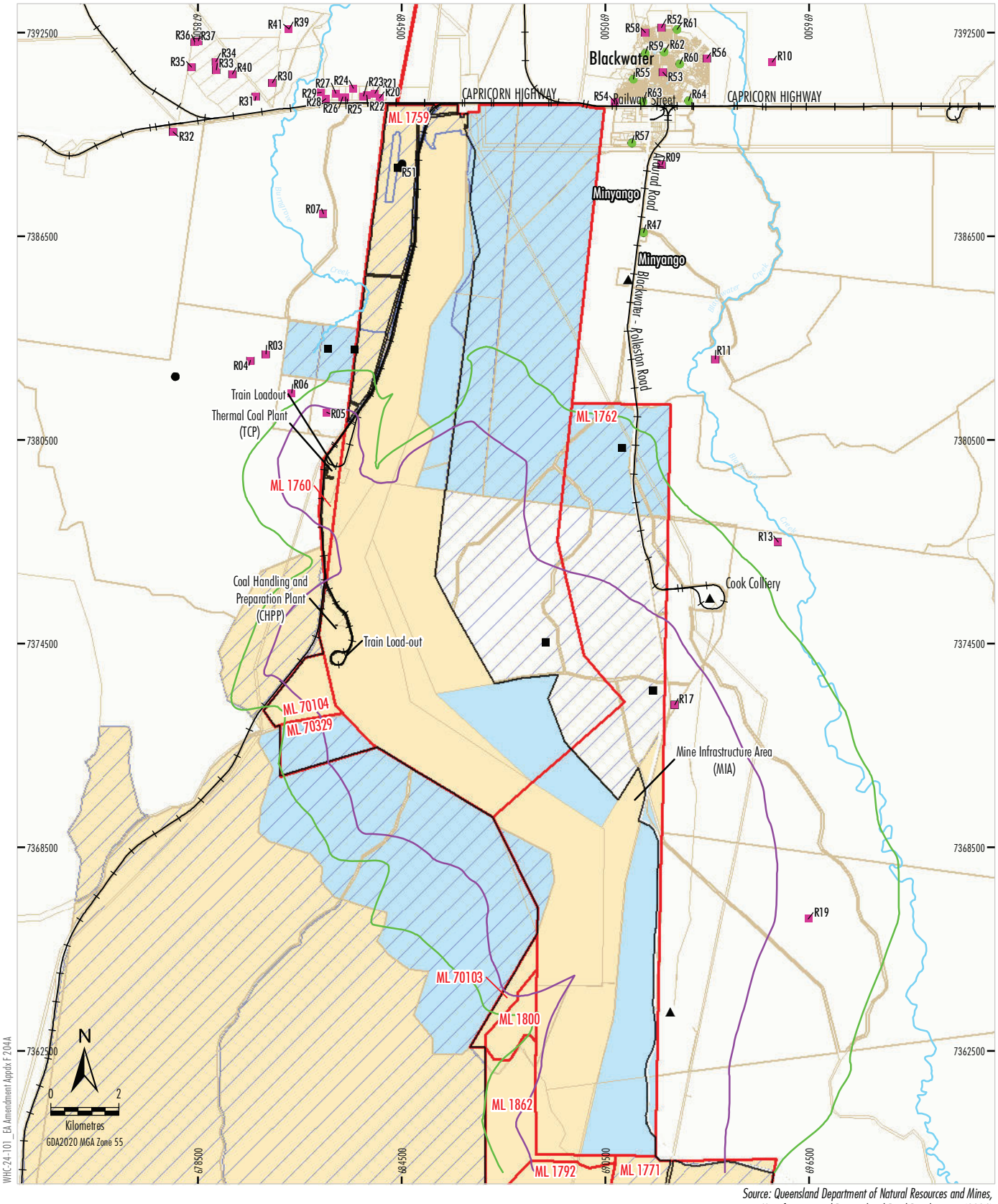
Noise Contour (Night)
- 35 dBA
- 40 dBA

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

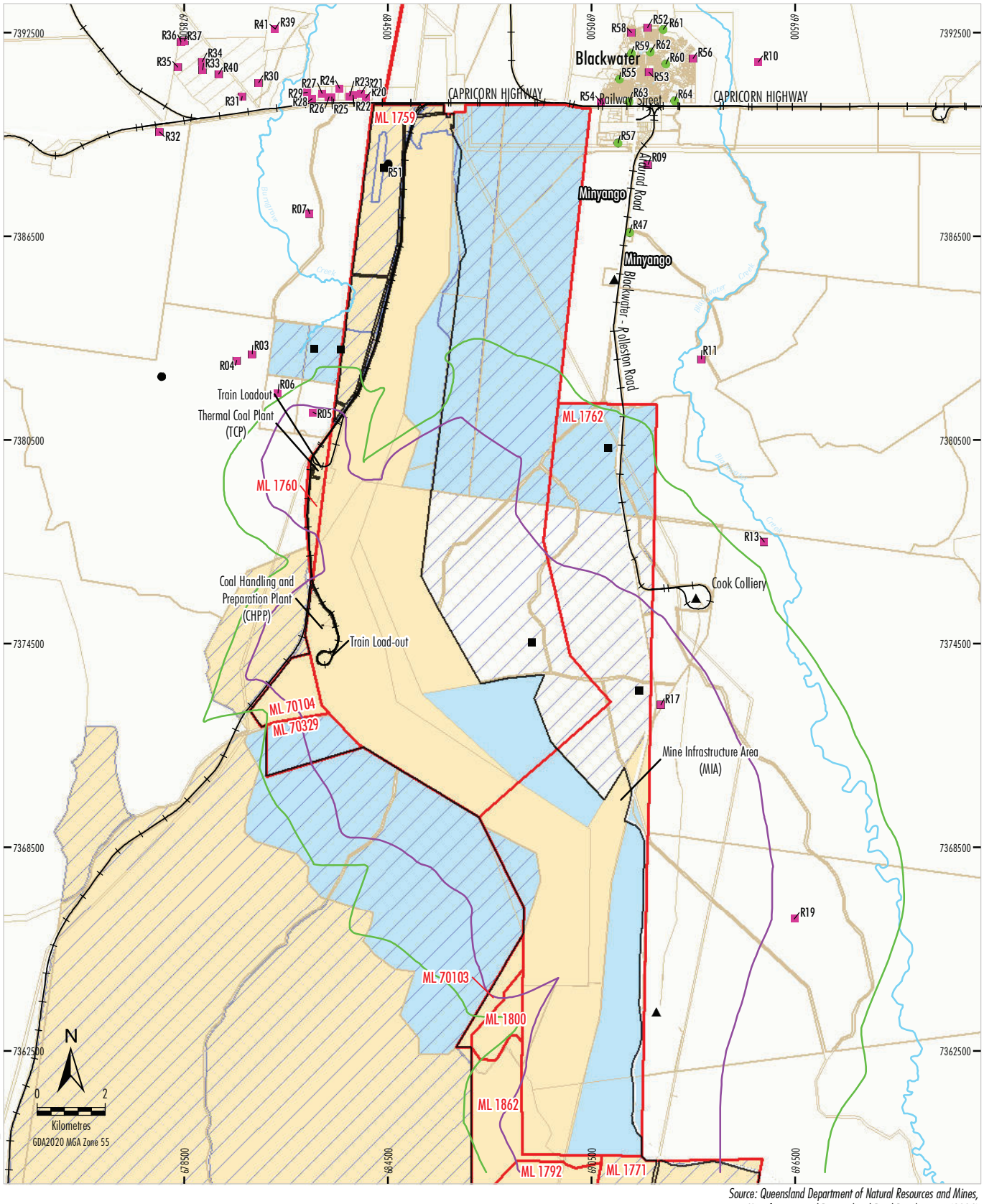
Noise Contour (Day)
- 35 dBA
- 40 dBA

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

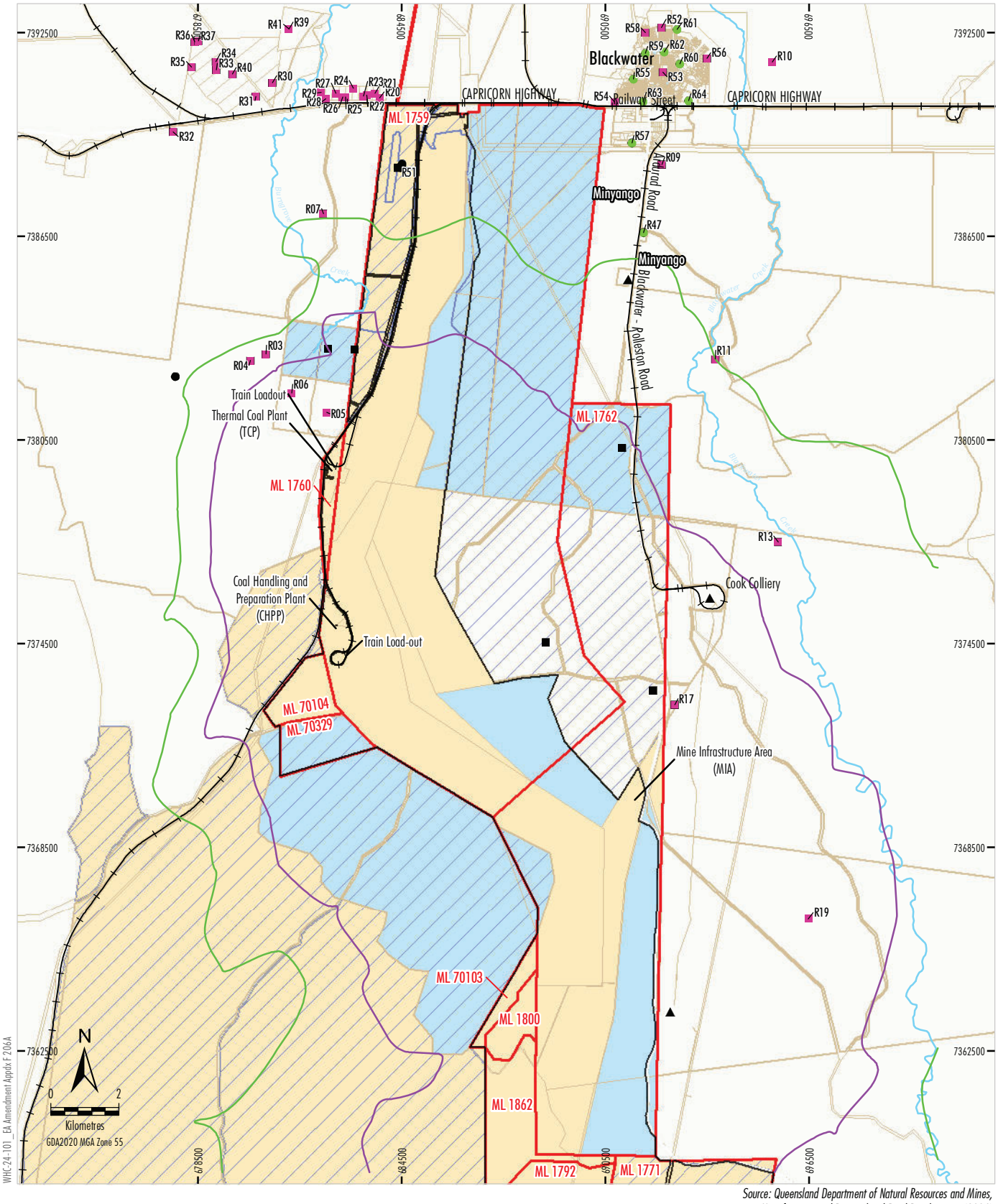
Noise Contour (Eve)
- 35 dBA
- 40 dBA

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

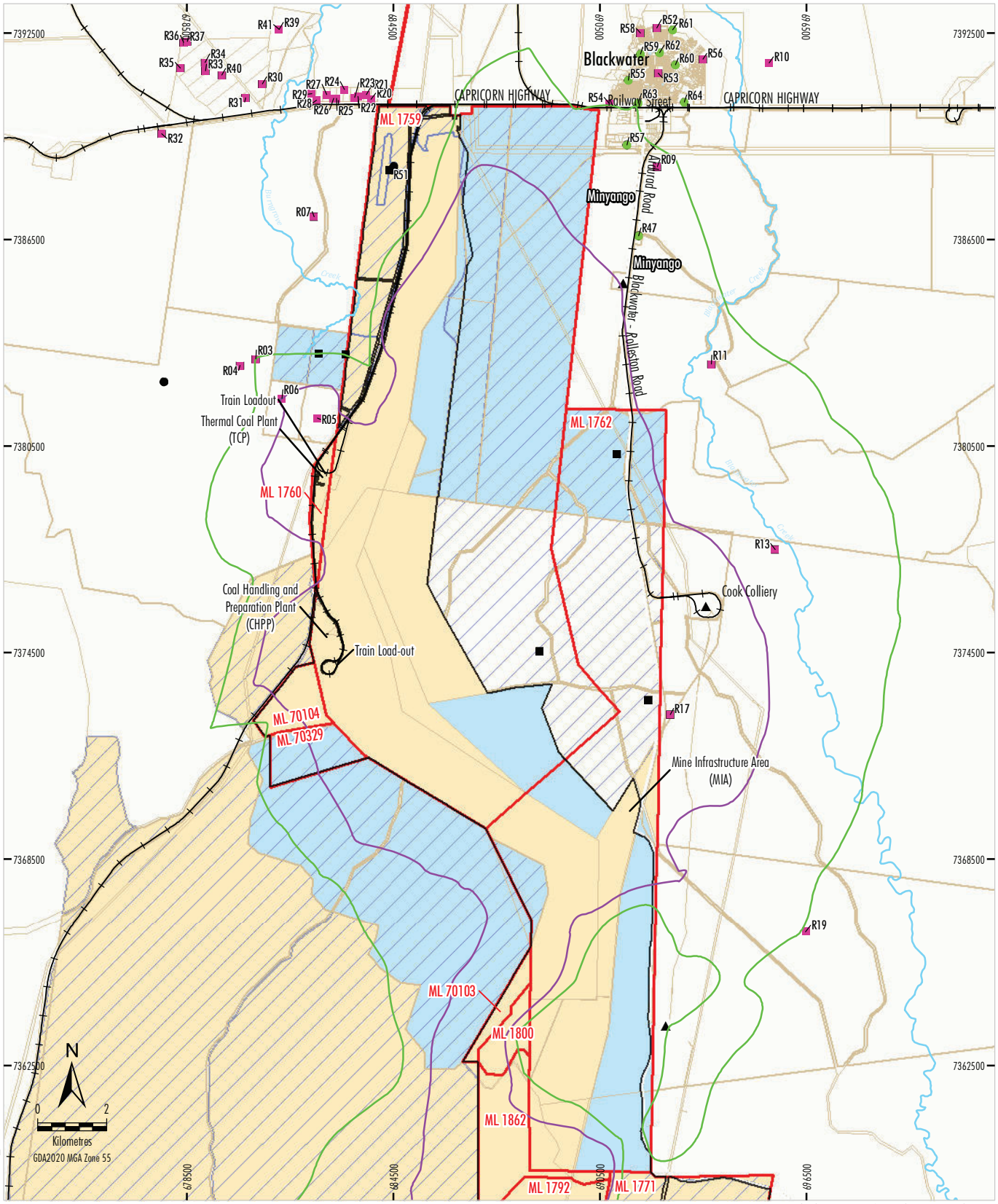
Noise Contour (Night)
- 35 dBA
- 40 dBA

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

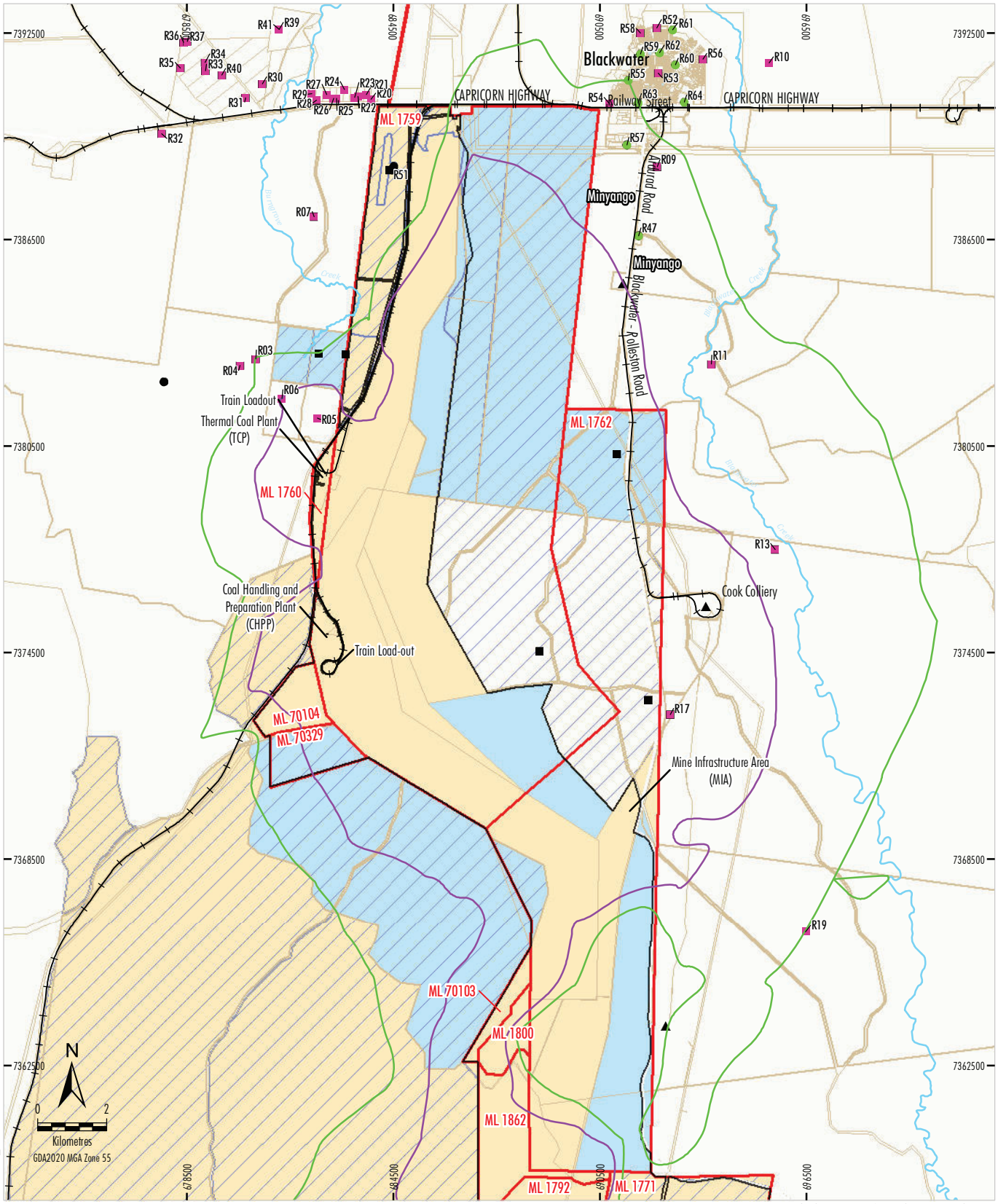
Noise Contour (Day)
- 35 dBA
- 40 dBA

Whitehaven

BLACKWATER NORTH EXTENSION PROJECT

Operational $L_{Aeq,15min}$ Noise Contours (Day) FY 2050

Figure F-7



WHC-24-101_EA Amendment Appdx F 208A

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

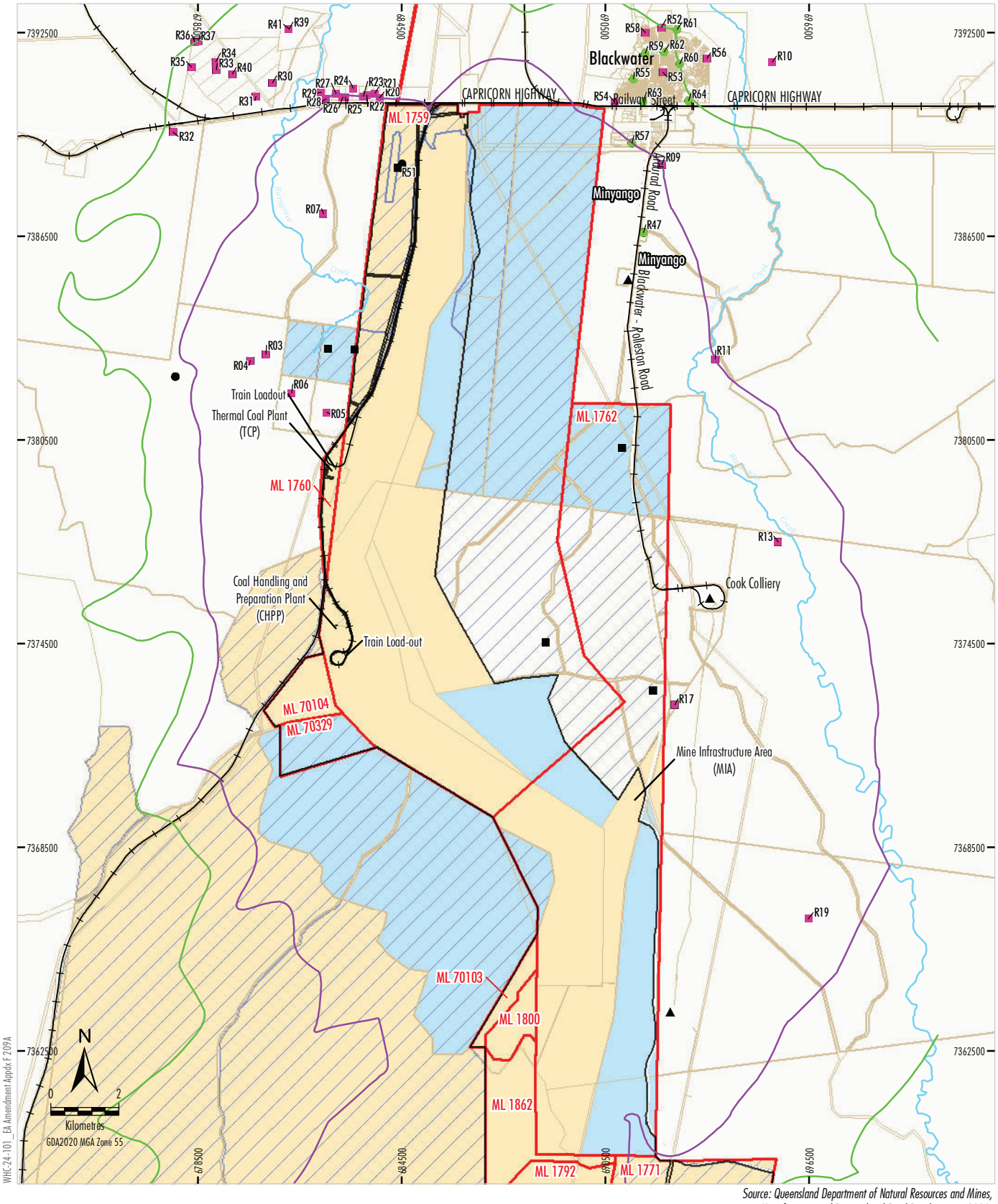
Noise Contour (Eve)
- 35 dBA
- 40 dBA

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

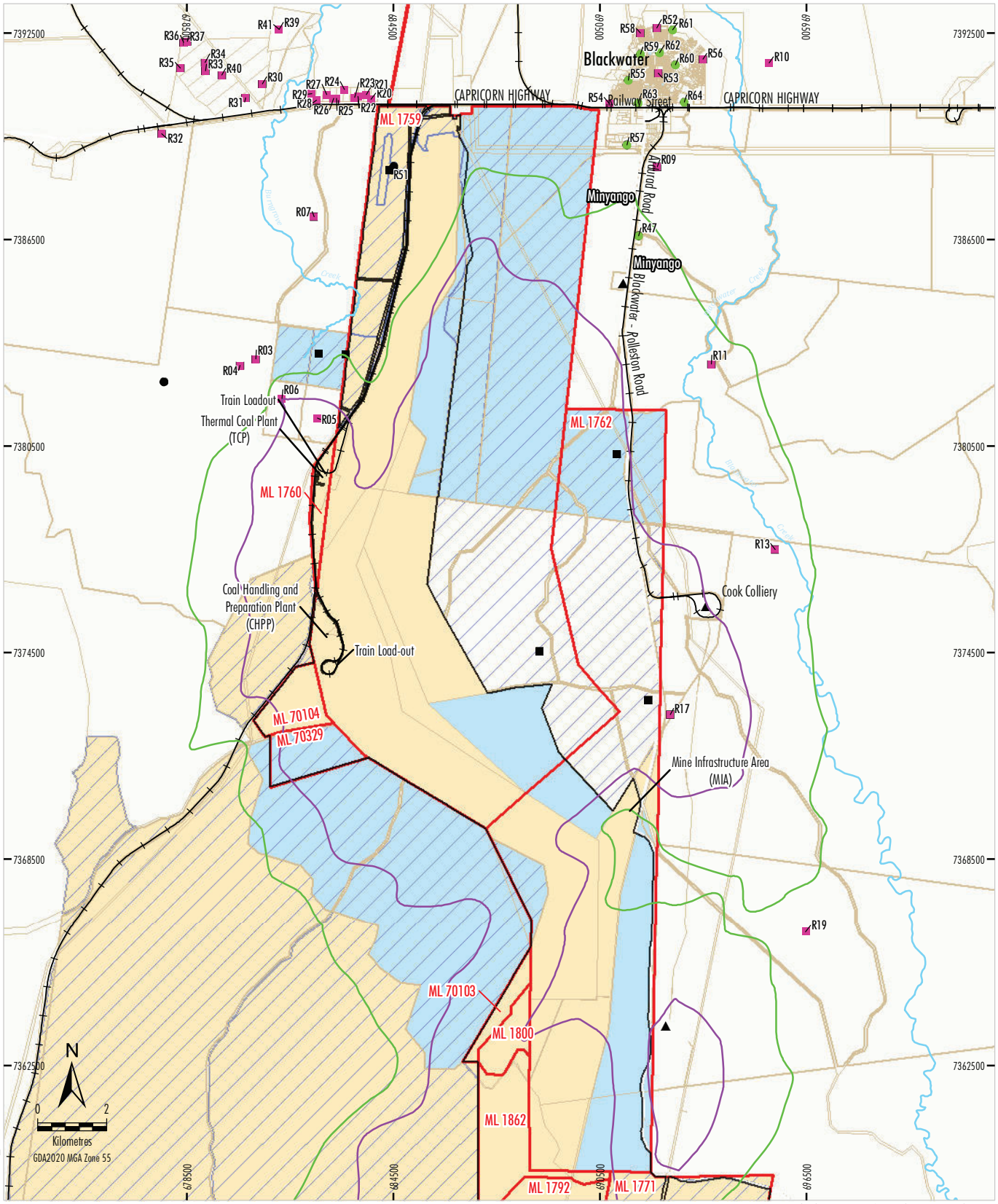
Noise Contour (Night)
- 35 dBA
- 40 dBA

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

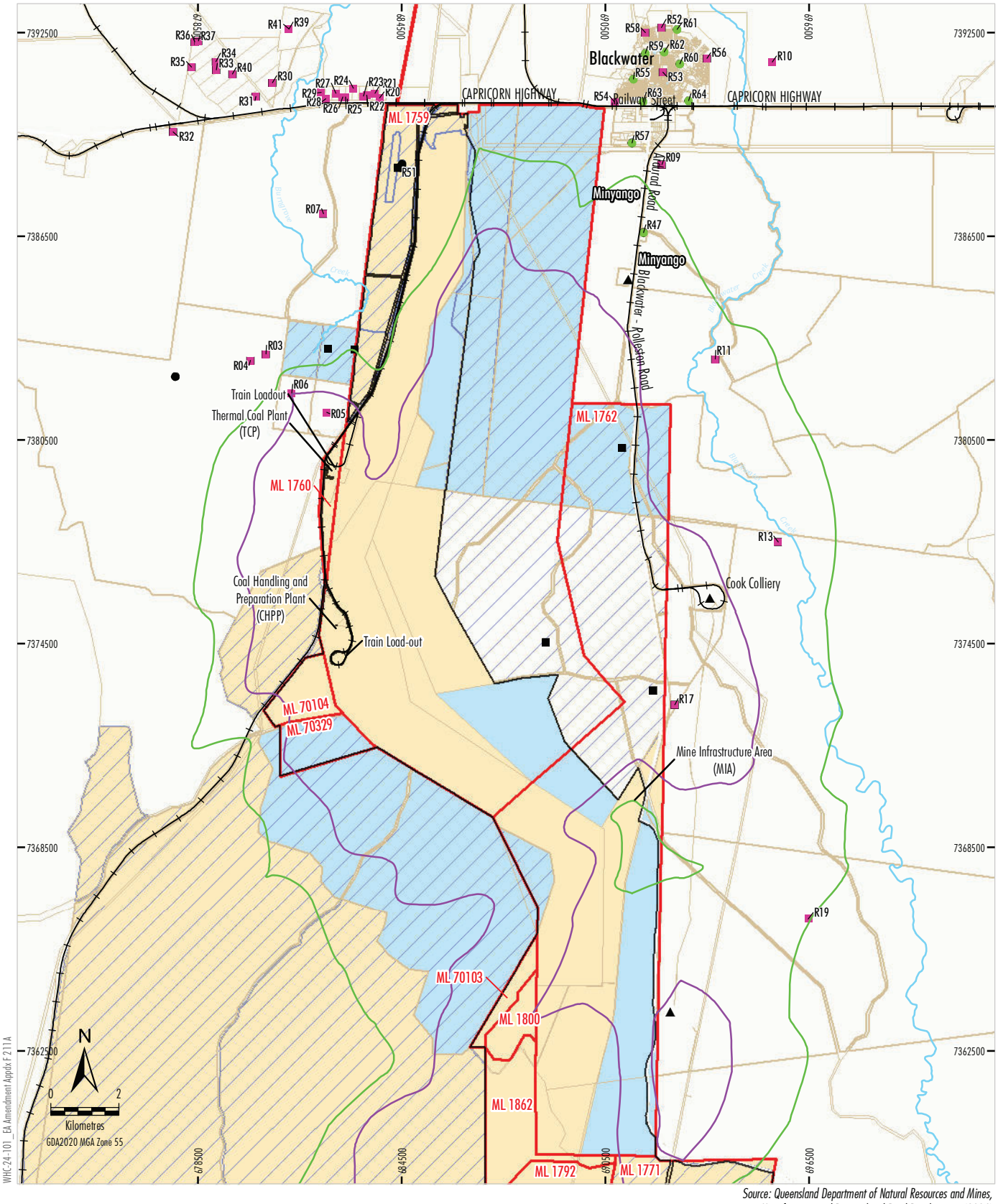
Source: Queensland Department of Natural Resources and Mines, Manufacturing and Regional and Rural Development (2024); Whitehaven (2026)

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

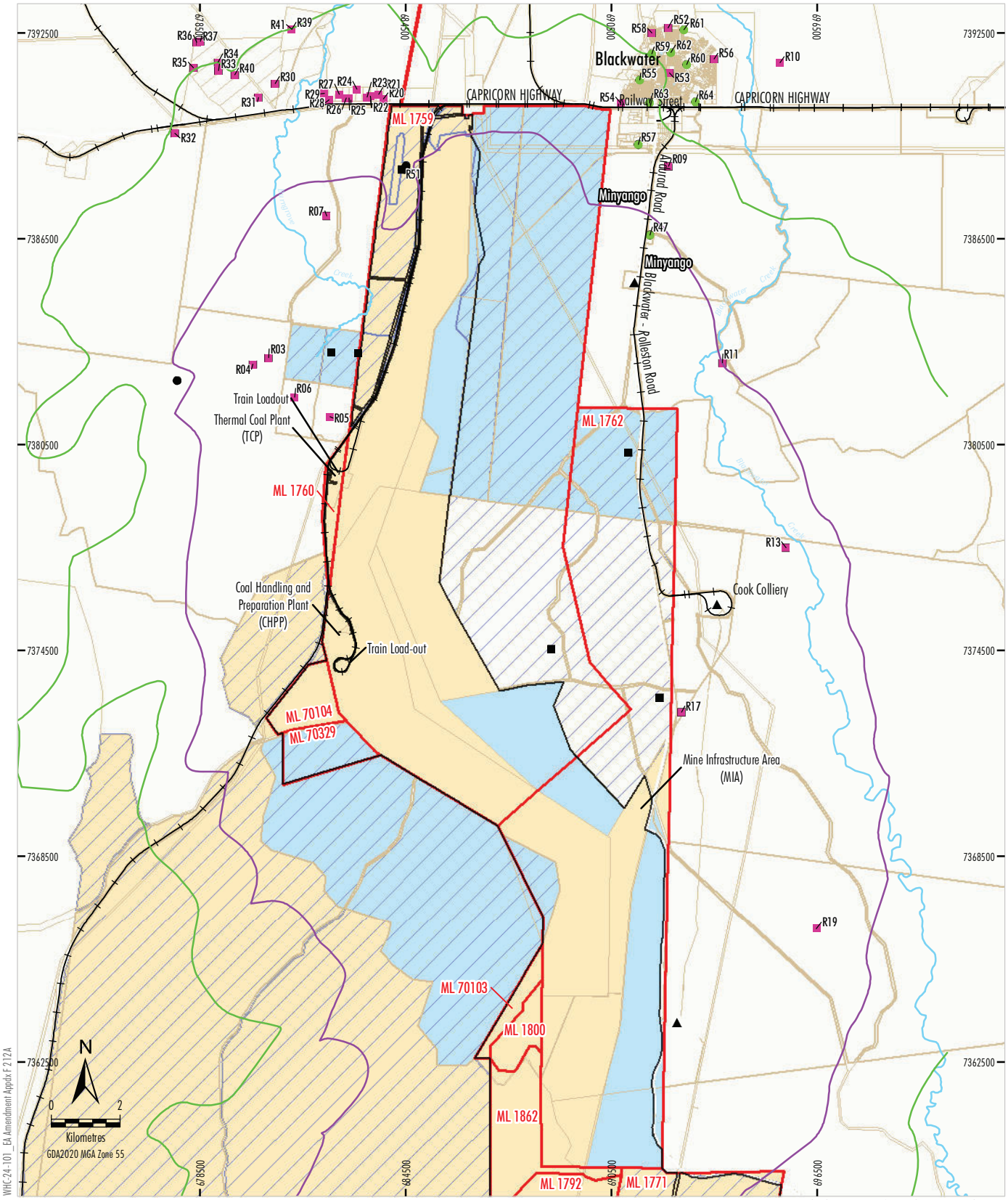
Noise Contour (Eve)
- 35 dBA
- 40 dBA

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).

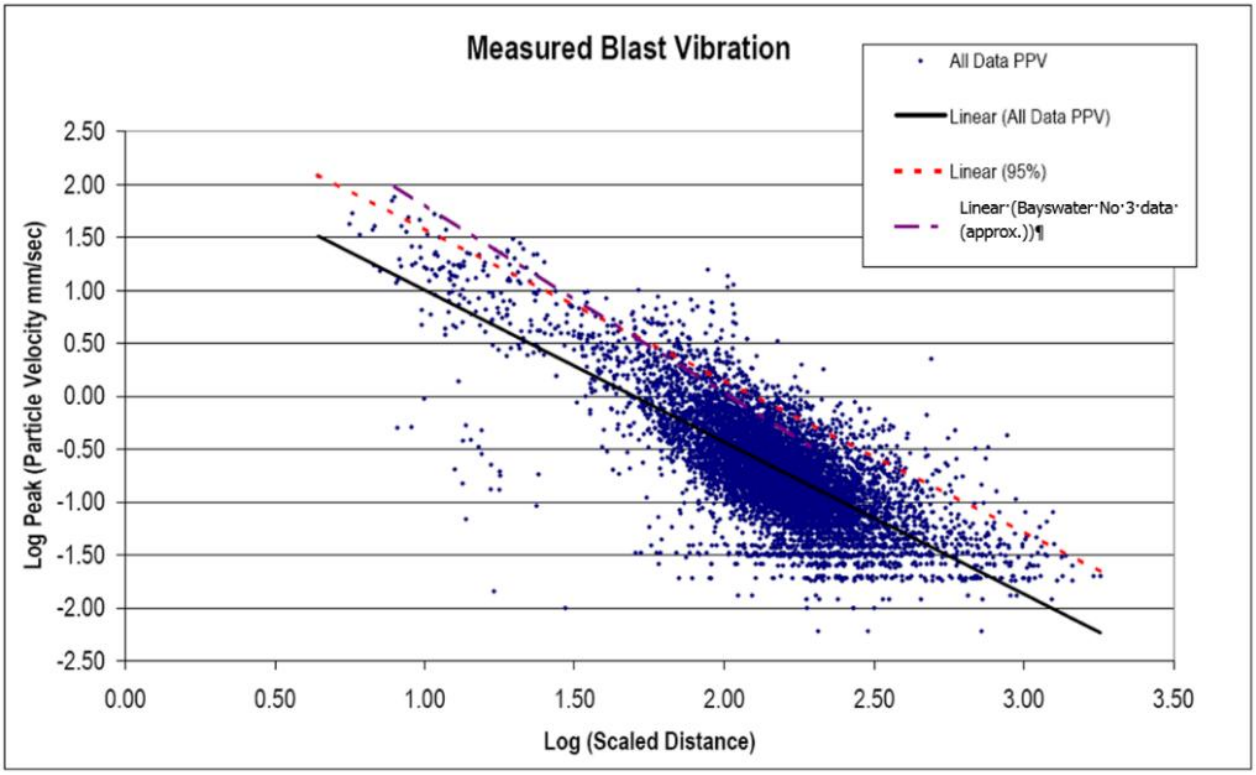


Figure I-1: Measured Peak Particle Velocity from Blasts at Mt Arthur North (logarithmic scale) and Comparison with Data from Bayswater No 3

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.

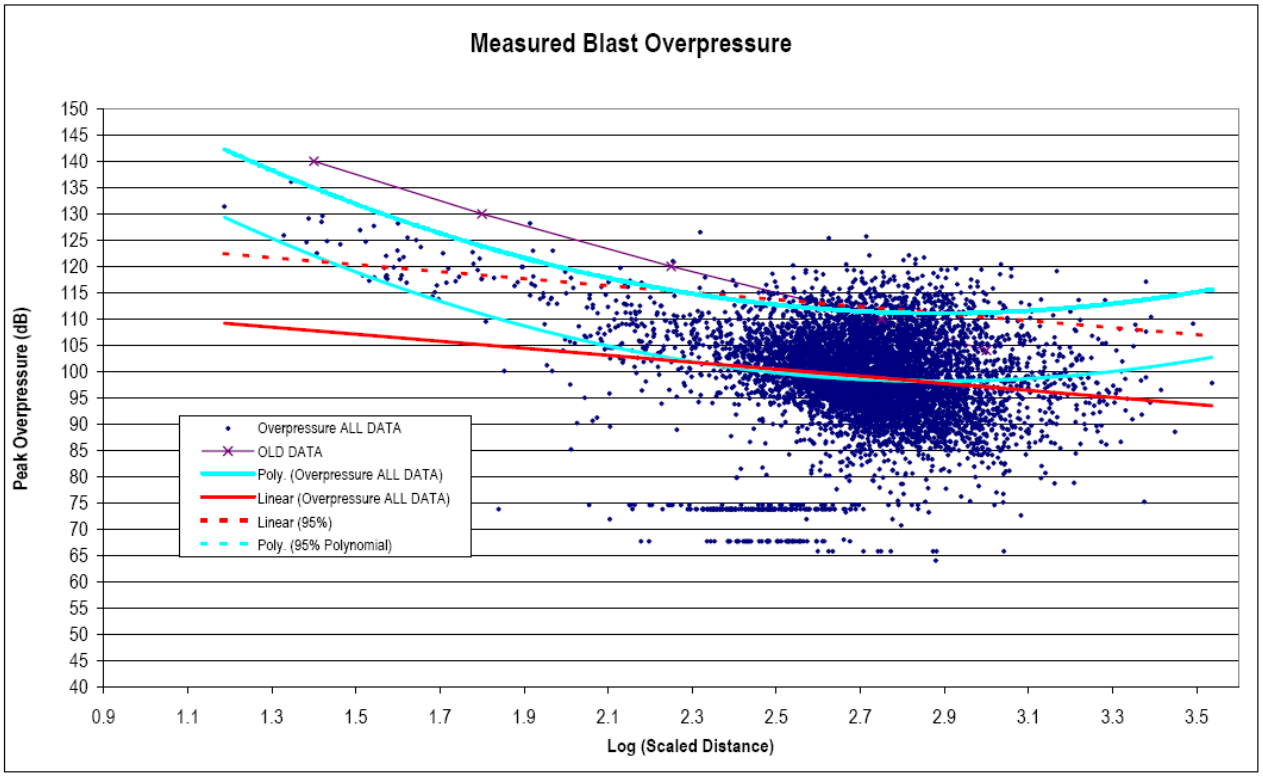


Figure I-2: Measured Peak Overpressure from Blasts at Mt Arthur North, and Comparison with Data from Bayswater No 3

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		
Job Number	25-063-201	**Client**	Whitehaven Blackwater Pty Ltd
Report Number	25-063-201 / R001		
Author	Dr. Ian P. Swane (Terrenus Earth Sciences)		

DOCUMENT ISSUE

Document Status	Issued To	Date Issued
DRAFT v0	Whitehaven Blackwater Pty Ltd and Resource Strategies	2 August 2025
FINAL DRAFT	Whitehaven Blackwater Pty Ltd and Resource Strategies	14 October 2025
FINAL	Whitehaven Blackwater Pty Ltd and Resource Strategies	23 January 2026

© Terrenus Earth Sciences, 2026
www.terrenus.com.au

PO Box 132, Wilston QLD 4051
Ph. 0414 924 233

Limitations and disclaimer:

This report documents the work undertaken by Terrenus Earth Sciences (Terrenus). Terrenus Earth Sciences is the registered trading name of Terrenus Pty Ltd as trustee for the Swane Family Trust.

This document has been produced by Terrenus as supporting information for environmental and mine planning aspects of the Blackwater North Extension Project (the Project). This document may contain confidential information. The document is intended for specific use by Whitehaven Blackwater Pty Ltd [a subsidiary of Whitehaven Coal Limited (WHC)] and their appointed advisors (Resource Strategies [RS], on behalf of WHC and Whitehaven Blackwater Pty Ltd) – herein called 'the Client'. The concepts and information contained in this document are the property of Terrenus. Use or copying of this document in whole or in part without the written permission of Terrenus constitutes an infringement of copyright.

This report should be read in full. While the findings presented in this report are based on information that Terrenus considers reliable unless stated otherwise, the accuracy and completeness of source information cannot be guaranteed, although Terrenus has taken reasonable steps to verify the accuracy of such source data. Terrenus has made no independent verification of this information beyond the agreed scope of works and Terrenus assumes no responsibility for any inaccuracies or omissions outside of Terrenus' direct control. Furthermore, the information compiled in this report addresses the specific needs of the Client, so may not address the needs of third parties using this report for their own purposes. Thus, Terrenus and its employees accept no liability for any losses or damage for any action taken or not taken on the basis of any part of the contents of this report. Those acting on information provided in this report do so entirely at their own risk.

This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

No AI Training: Without in any way limiting Terrenus' exclusive rights under copyright, any use of this document to 'train' generative AI technologies to generate text, images, figures, graphs or tables is expressly prohibited. Terrenus reserves all rights to license uses of this work for generative AI training and development of machine learning language models.

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

Executive Summary iii
Glossary of Terms xvii

TABLE of CONTENTS

1 Introduction and Context 21
1.1 Objective 21
1.2 Material Types and Quantities 23
1.3 Geological Background 23

2 Potential Environmental Geochemical Hazards 27
2.1 Acid and Metalliferous Drainage 27
2.2 Salinity, Sodicity and Dispersion 27

3 Assessment Methodology 28
3.1 Information Review 28
3.2 Sample Collection 28
3.3 Sample Characterisation 30
3.4 Geochemical Source Hazard Assessment 33

4 Results 39
4.1 Mineralogy 39
4.2 Acid-Base Accounting (Potential for Acid Generation) 41
4.3 Total Metals and Metalloids 56
4.4 Initial Solubility in Deionised Water 57
4.5 'Saline' Water Solubility of Tailings and Rejects 61
4.6 Characteristics of Tailings Liquor (Water) 62
4.7 Peroxide Leachate Solutions 62
4.8 Cation Exchange Capacity, Sodicity and Dispersion of Spoil 64
4.9 Kinetic Column Leaching of Tailings 65
4.10 OxCon Test-work of Tailings 66

5 Summary of Geochemical Characteristics 68
5.1 AMD Potential of Mineral Waste and Coal 68
5.2 Salinity, Sodicity and Dispersion Potential of Mineral Waste and Coal 73

6 Management and Mitigation Measures 75
6.1 Spoil Management Strategy 75
6.2 Validation of Spoil Characteristics 75
6.3 Tailings and Rejects Management Strategy 75
6.4 Validation of Tailings and Rejects Characteristics 76
6.5 ROM Coal 76

7 References 77

APPENDICES

Appendix A. Drill-hole Information for Spoil and Coal Samples

TABLES and FIGURES

Tables

Table 3-1. Preliminary acid and metalliferous drainage classification criteria
Table 3-2. Sulfur category
Table 3-3. ANC category
Table 3-4. Soil salinity classification
Table 3-5. Soil pH type
Table 3-6. Geochemical abundance index
Table 3-7. Soluble trace element concentration category and associated cut-off values
Table 3-8. Sodicity classification
Table 3-9. Emerson classification
Table 4-1. Acid-base accounting results statistics for spoil samples
Table 4-2. Acid-base accounting results statistics for tailings and rejects samples
Table 4-3. Acid-base accounting results statistics for coal samples
Table 4-4. Geochemical classification of samples
Table 4-5. Samples subjected to deionised water solubility tests
Table 4-6. Summary of OxCon results for the tailings samples

Figures

Figure 1-1. Geochemical sampling locations
Figure 1-2. Geological long-section – Sagittarius Pit to Stewarton Pit
Figure 1-3. Geological cross-sections – Burngrove Pit and Deep Creek Pit
Figure 3-1. Classification of soluble metals and metalloids as a function of pH
Figure 4-1. Mineral distribution within spoil samples
Figure 4-2. Mineral distribution within tailings and rejects samples

Figure 4-3. Distribution of total sulfur in spoil and coal
Figure 4-4. Distribution of total sulfur in tailings and rejects
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
Figure 4-7. Distribution of acid neutralising capacity in spoil and coal
Figure 4-8. Distribution of acid neutralising capacity in tailings and rejects
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
Figure 4-10. Distribution of the ratio of acid neutralising capacity to maximum potential acidity in spoil and coal
Figure 4-11. Distribution of the ratio of acid neutralising capacity to maximum potential acidity in tailings and rejects
Figure 4-12. Distribution of net acid producing potential in spoil and coal
Figure 4-13. Distribution of net acid producing potential in tailings and rejects
Figure 4-14. Distribution of net acid generation pH
Figure 4-15. Geochemical classification of samples
Figure 4-16. Frequency distribution of geochemical abundance indices of selected elements
Figure 4-17. Electrical conductivity distribution
Figure 4-18. pH distribution
Figure 4-19. Sum of key environmental metals versus pH in deionised water extracts in spoil
Figure 4-20. Sum of key environmental metals versus pH in deionised water extracts in tailings, rejects and coal
Figure 4-21. Sum of key environmental metals versus pH in saline water extracts and tailings liquor
Figure 4-22. Sum of key environmental metals versus pH in peroxide (NAG) leachate solution
Figure 4-23. Cation exchange capacity and exchangeable sodium percentage of spoil
Figure 4-24. Sum of key environmental metals versus pH in kinetic column leachate solution
Figure 4-25. Sum of key environmental metals versus pH in OxCon leachate solution

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.

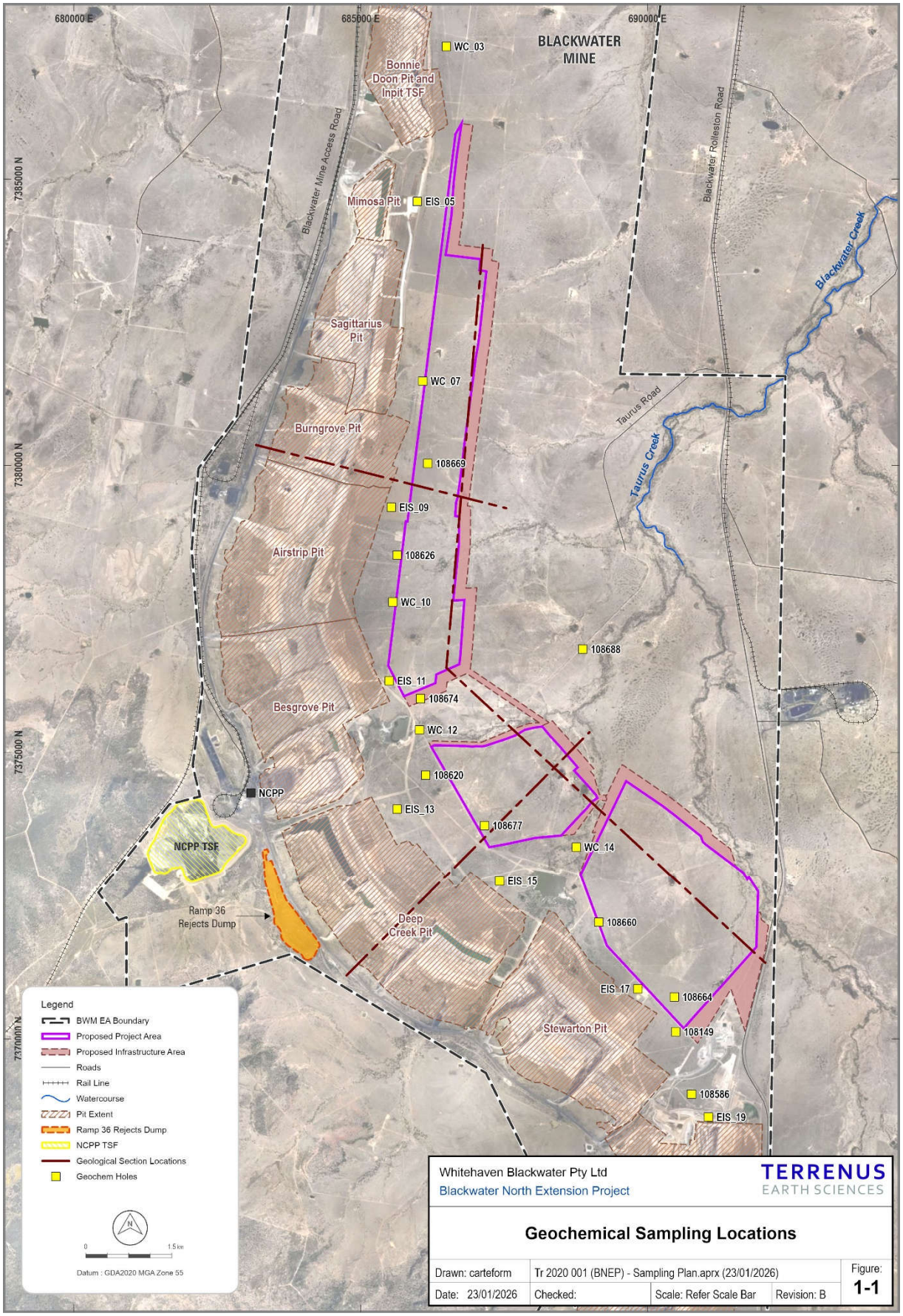
Coal would be mined by conventional open cut methods and spoil (waste rock) would be disposed into in-pit dumps behind the active mining face – as is currently undertaken at BWM. Run-of-mine (ROM) coal would be trucked to the BWM North Coal Preparation Plant (NCPP) for processing – consistent with existing 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.

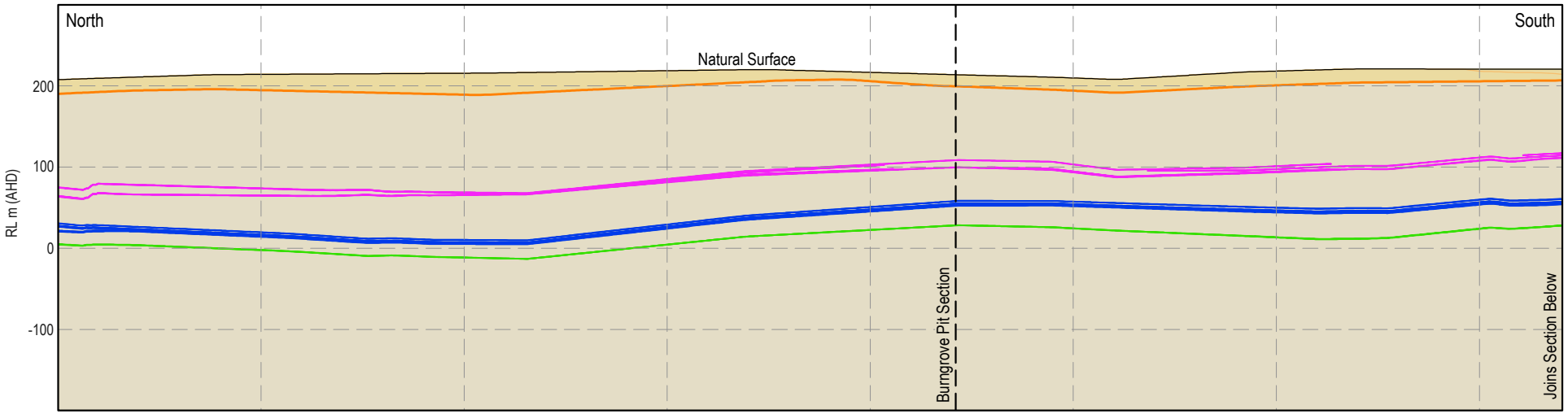
The RCM are overlain by the Early Triassic-age Rewan Formation; and most of the northern mining area is also capped by a thin veneer of Quaternary-age sediments (typically alluvial sediments).

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**.

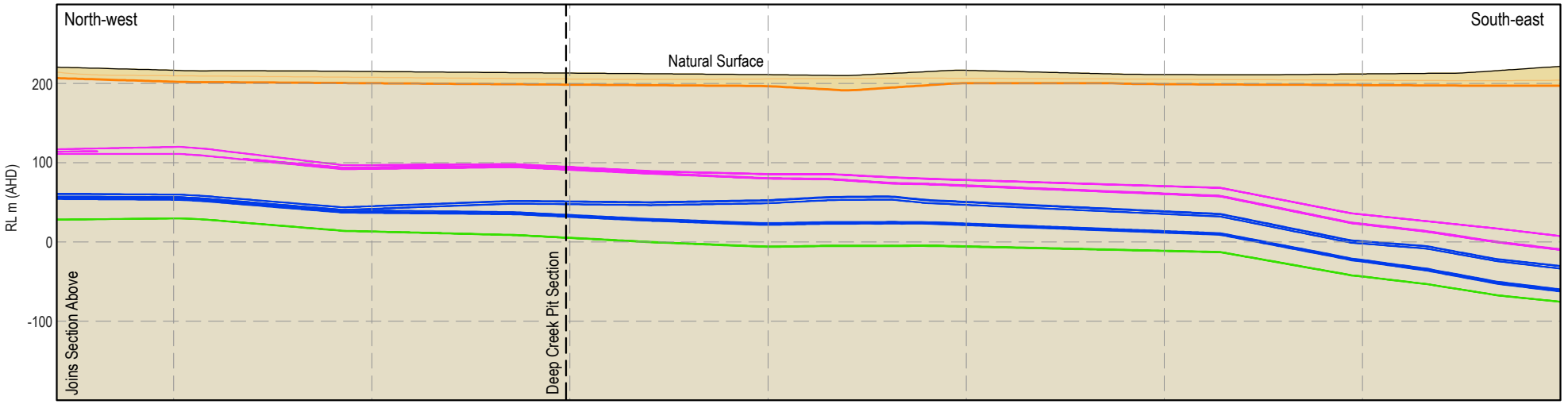
LONG SECTION | Sagittarius Pit to Besgrove Pit

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

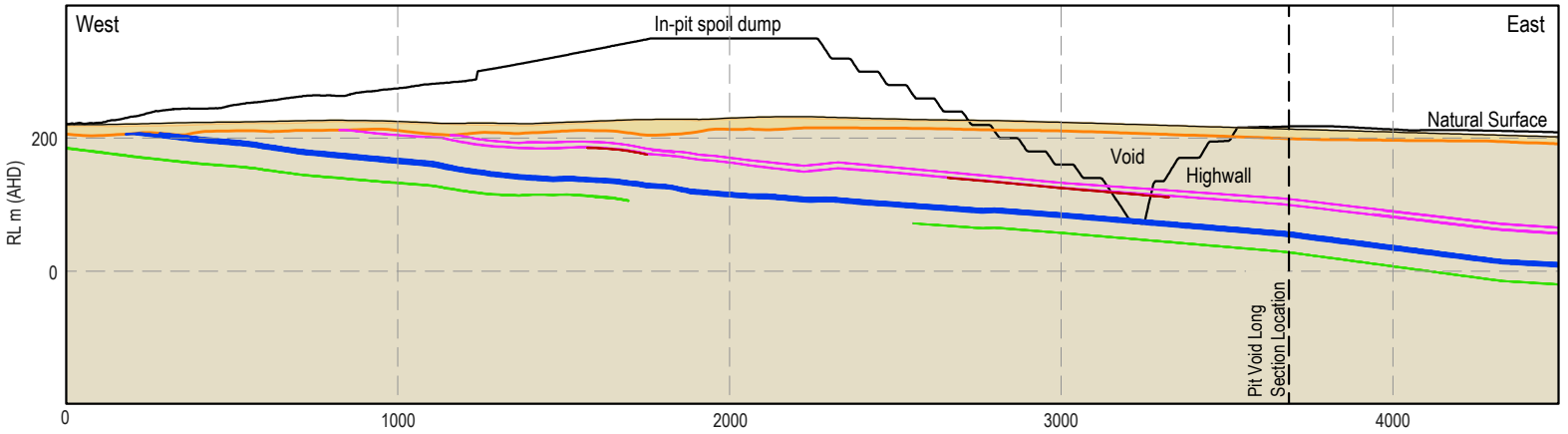
Minserve CAD File: Bhpb008m05.dwg

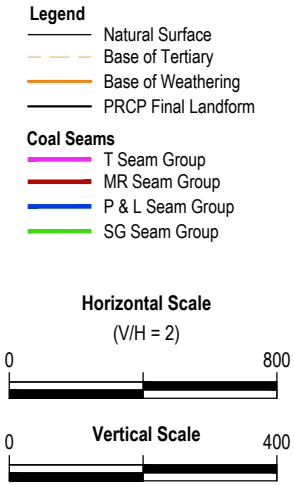
Pit/void highwall long-section

Figure **1-2**

CROSS SECTION | Burngrove Pit

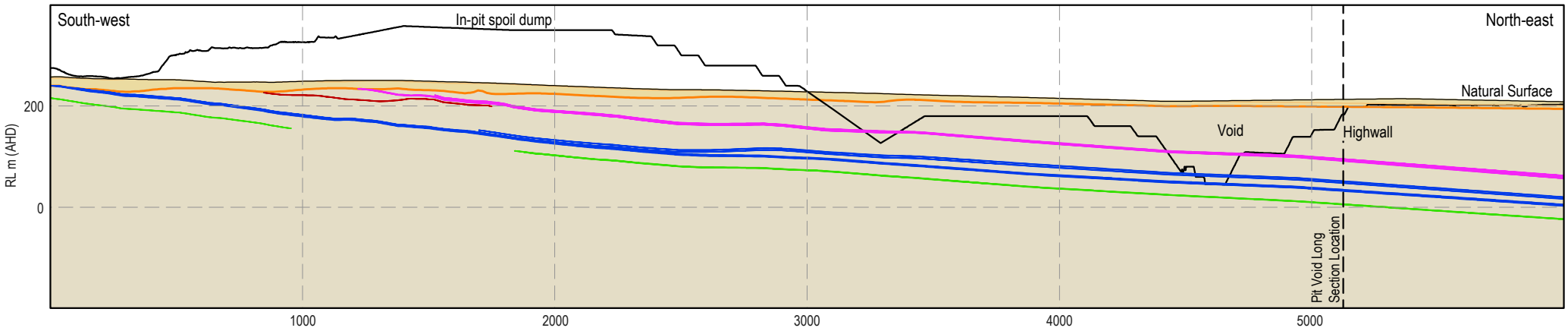
Viewed Looking North





CROSS SECTION | Deep Creek Pit

Viewed Looking North-west



Minserve CAD File: Bhpb008m06.dwg

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.

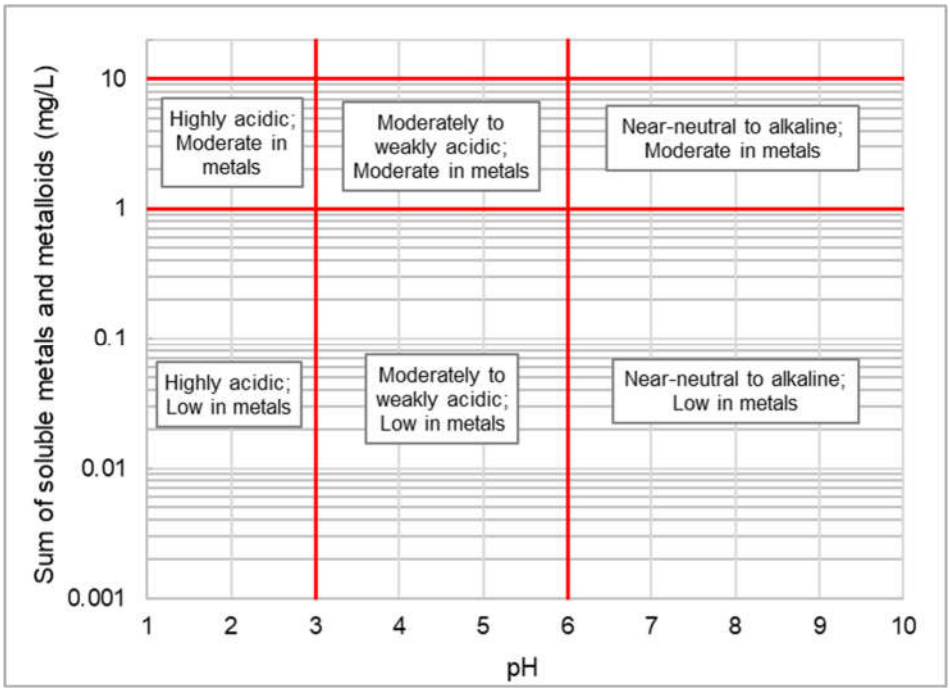
Table 3-7. Soluble trace element concentration category and associated cut-off values

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

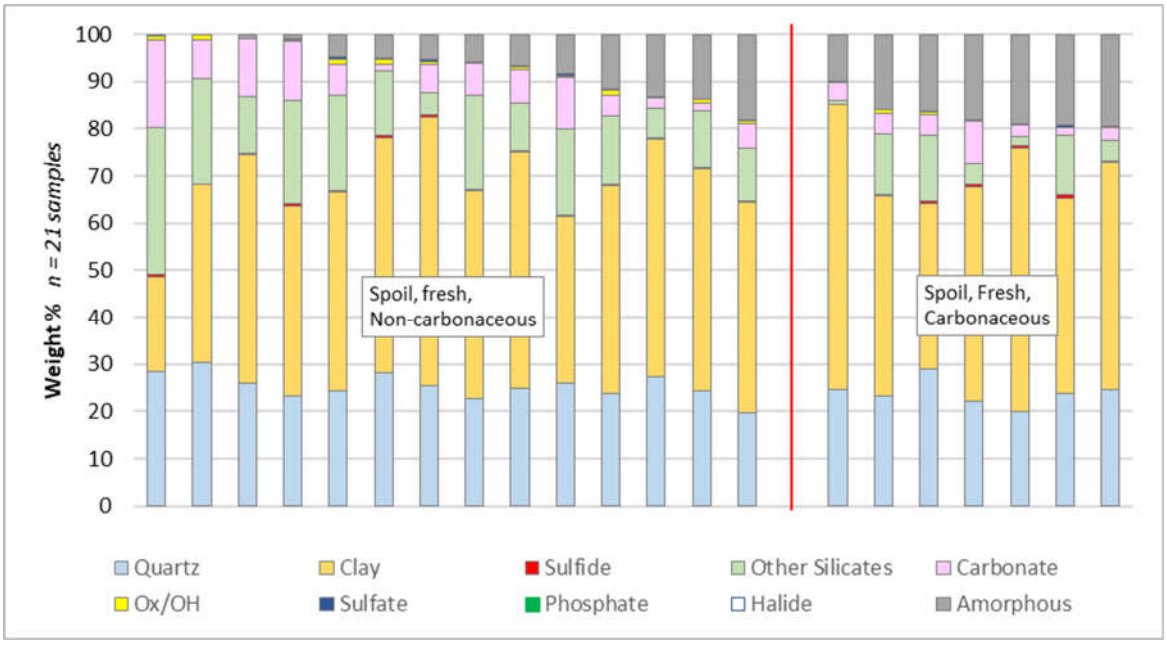
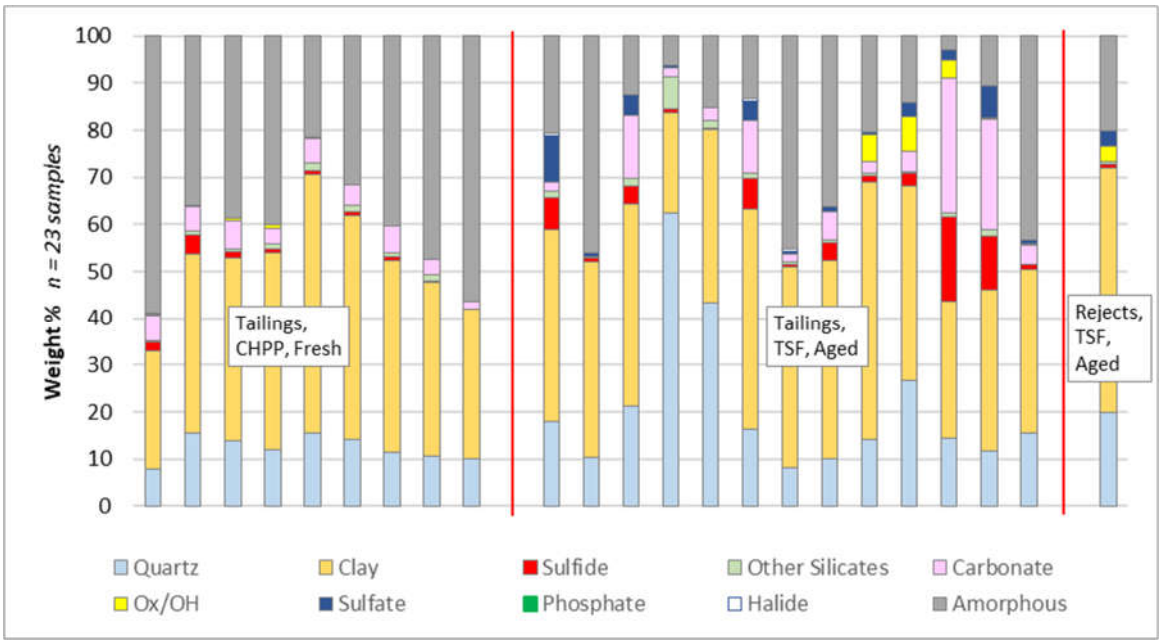


Figure 4-2. Mineral distribution within tailings and rejects samples



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

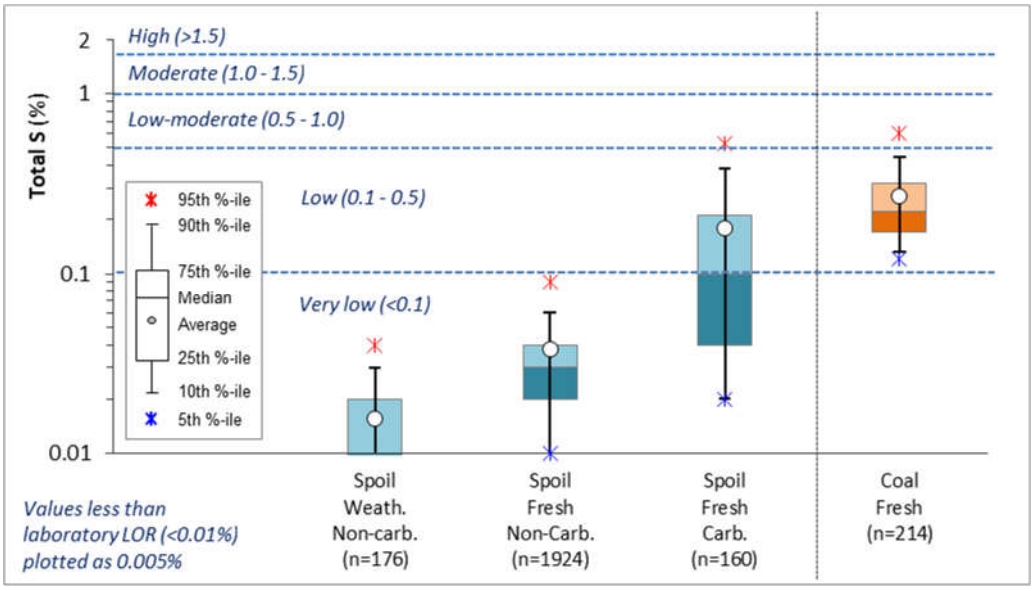
1. Total S values less than laboratory limit of reporting (LOR) were assigned a value of 0.5xLOR for statistical calculations.
2. Values in parentheses are the total S statistics for samples with Scr results.
3. NAGpH is final pH as NAG single addition and/or NAG extended and/or Stage 1 sequential NAG.

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.

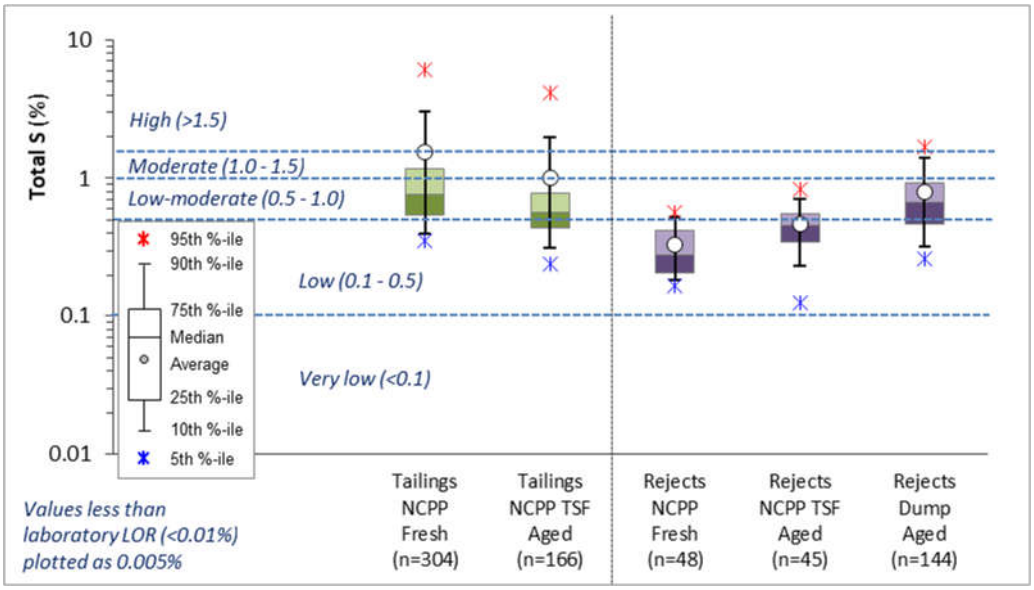
Figure 4-3. Distribution of total sulfur in spoil and coal



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

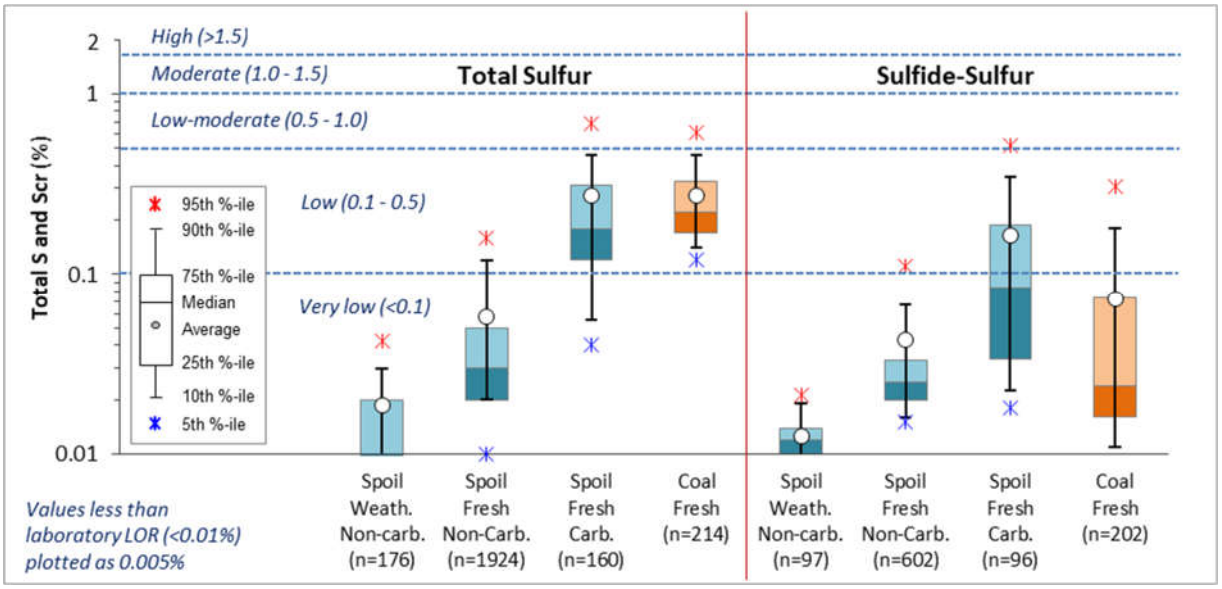
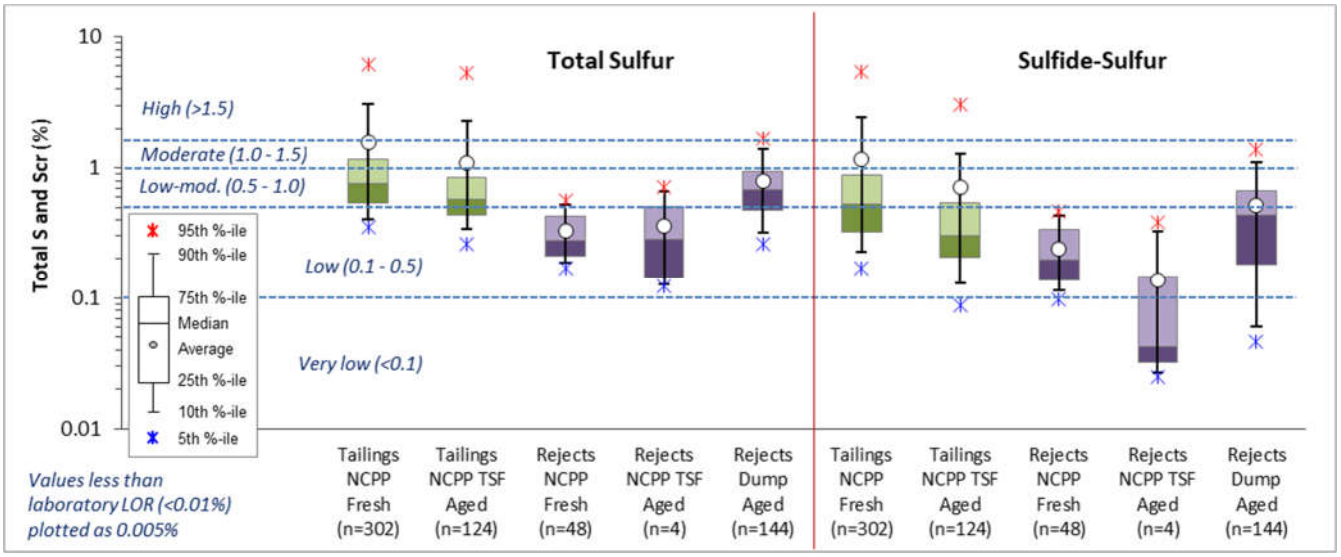


Figure 4-6. Distribution of total sulfur and chromium reducible sulfur (sulfide) in tailings and rejects



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

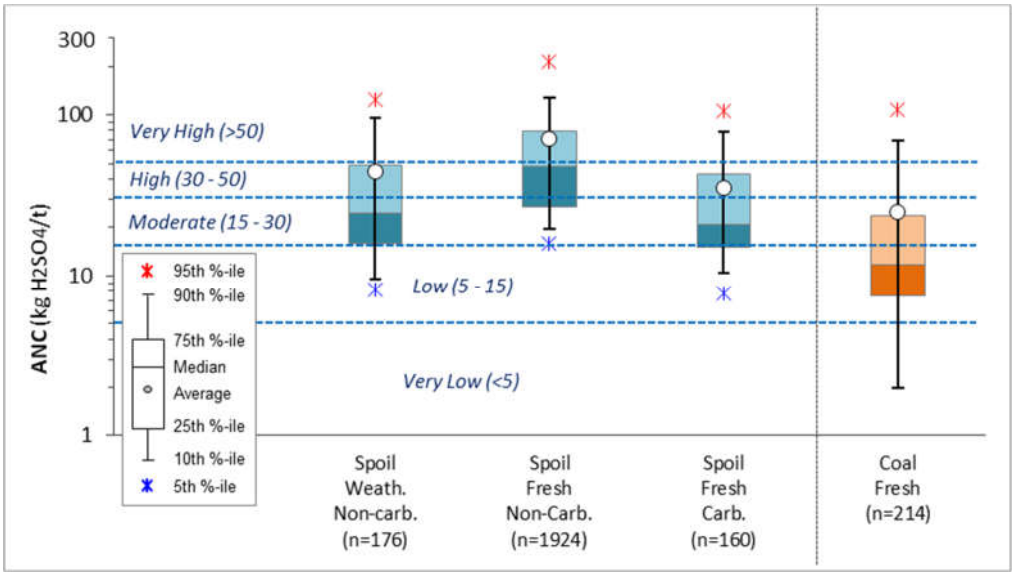
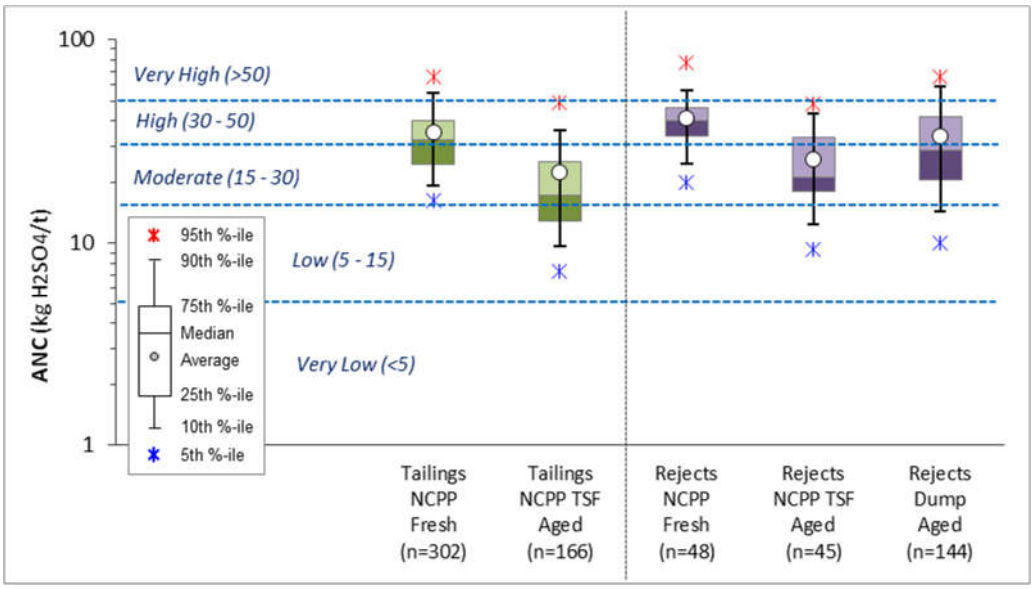


Figure 4-8. Distribution of acid neutralising capacity in tailings and rejects



Available Acid Neutralising Capacity

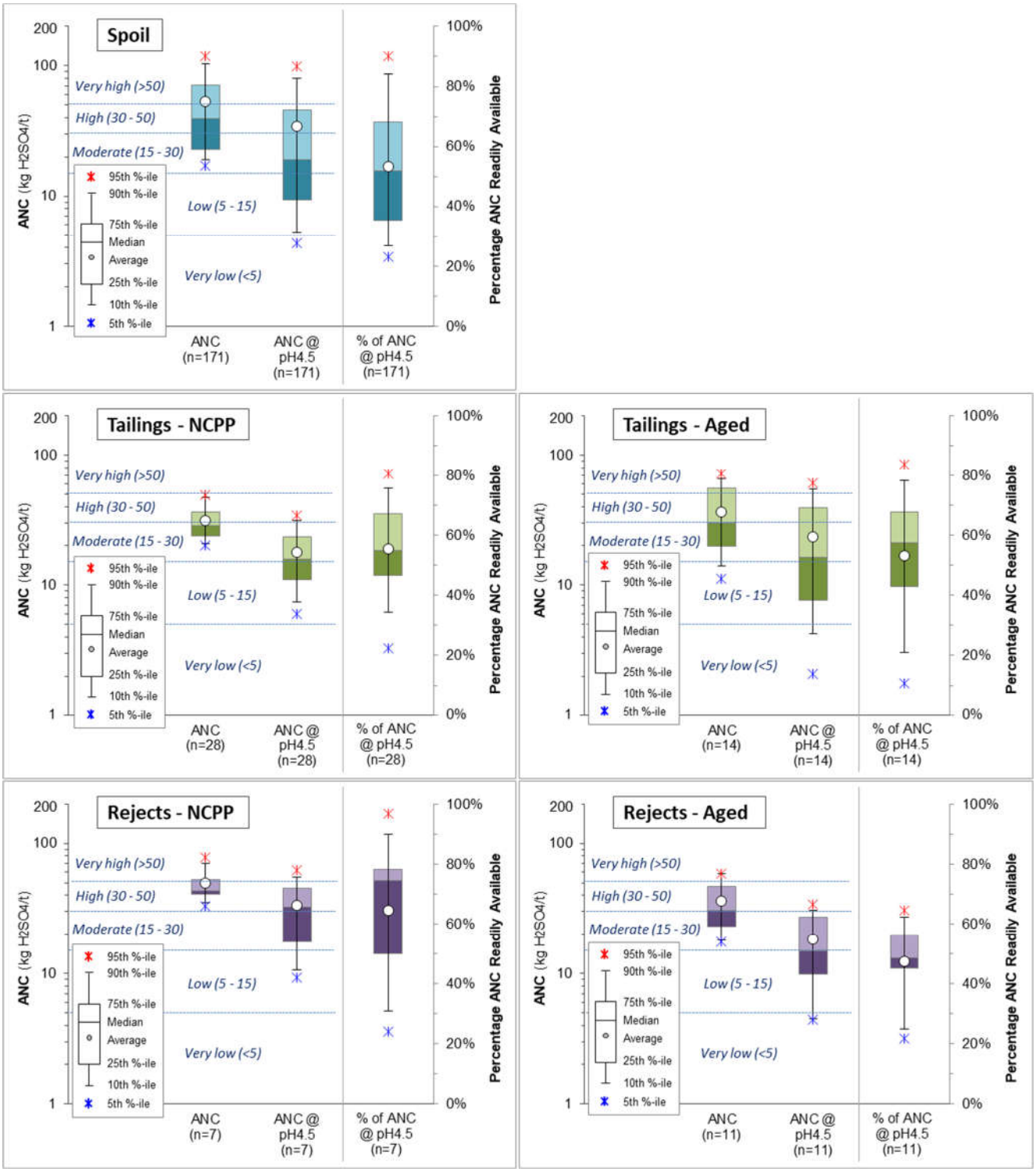
ABCC tests were undertaken on samples to assess the proportion of ANC that may be 'readily available' (i.e. short-acting) in these materials under field conditions. 'Readily availability' is regarded as the proportion of ANC that is available for buffering reactions at pH 4.5. The results are summarised 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

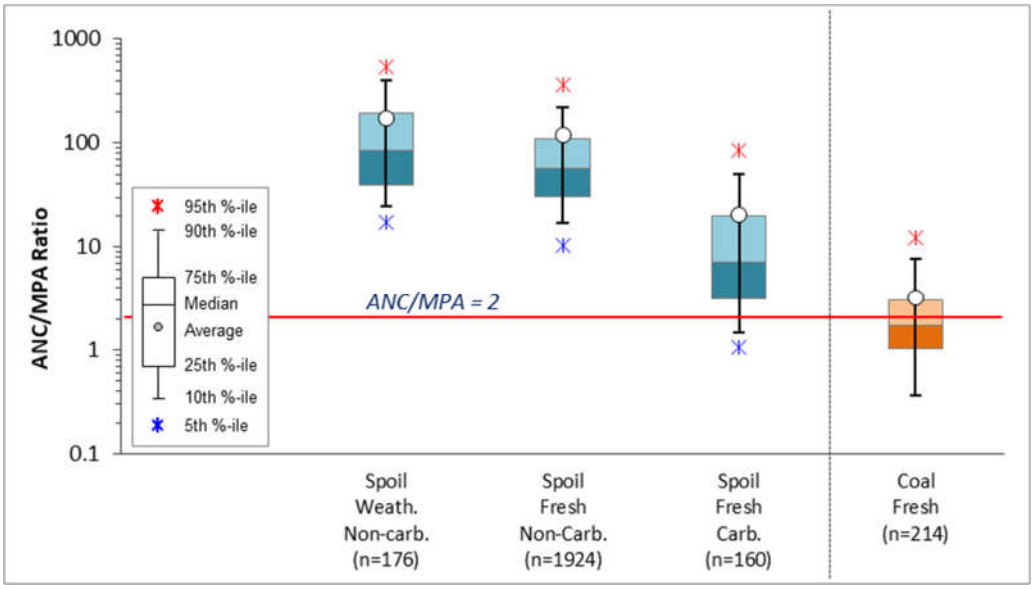


Acid Neutralising Capacity / Maximum Potential Acidity Ratio

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:

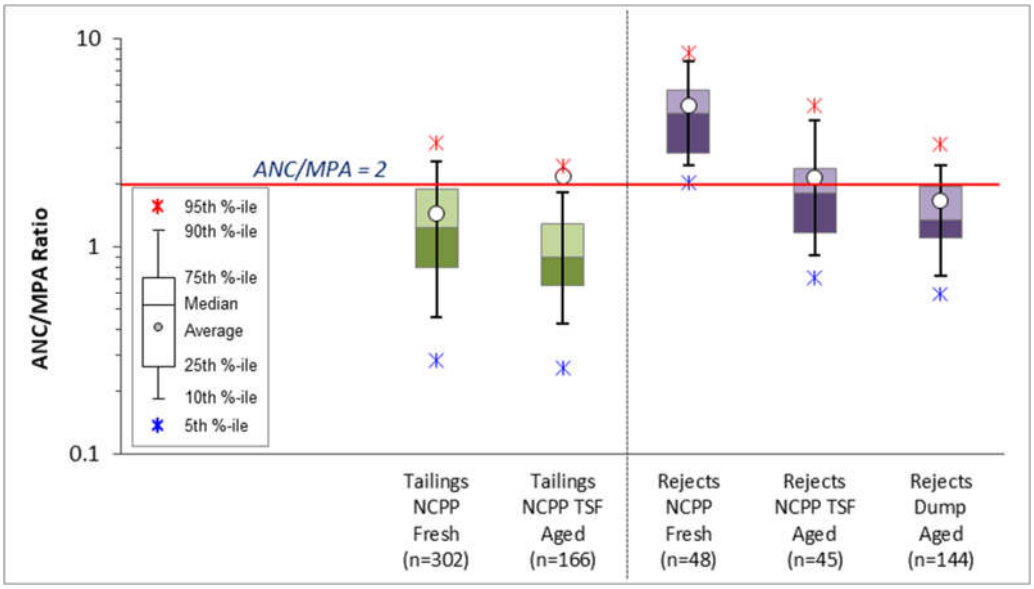
- Just under 99% of 2260 spoil samples have an ANC/MPA ratio greater than two – noting that 85% of all spoil samples are fresh, non-carbonaceous. Approximately 86% of fresh carbonaceous spoil samples (137 out of 160 samples) have an ANC/MPA ratio greater than two.
- Approximately 77% and 92% of fresh 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.

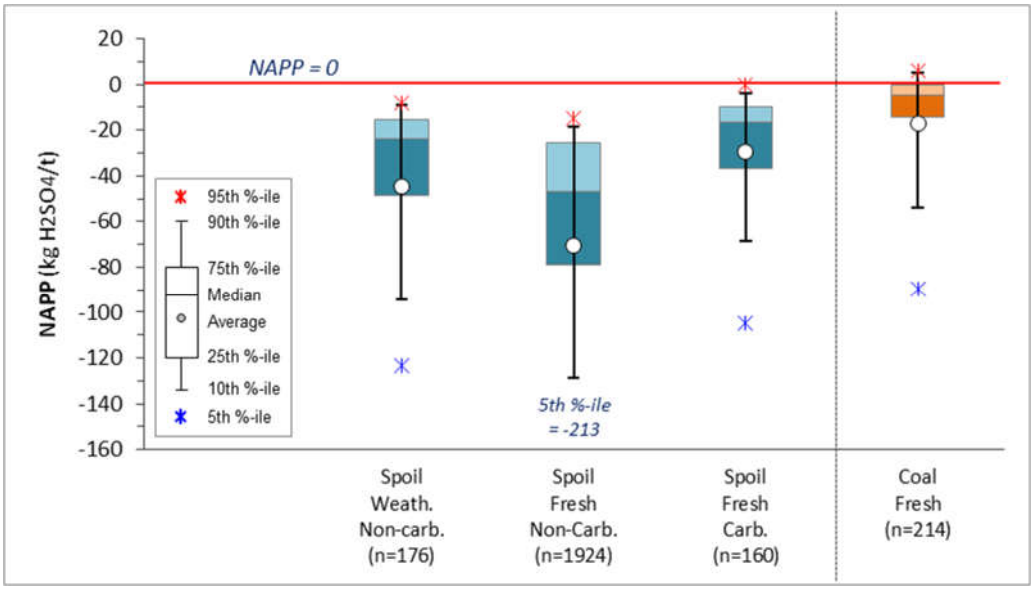
Figure 4-11. Distribution of the ratio of acid neutralising capacity to maximum potential acidity in tailings and rejects



Net Acid Producing Potential

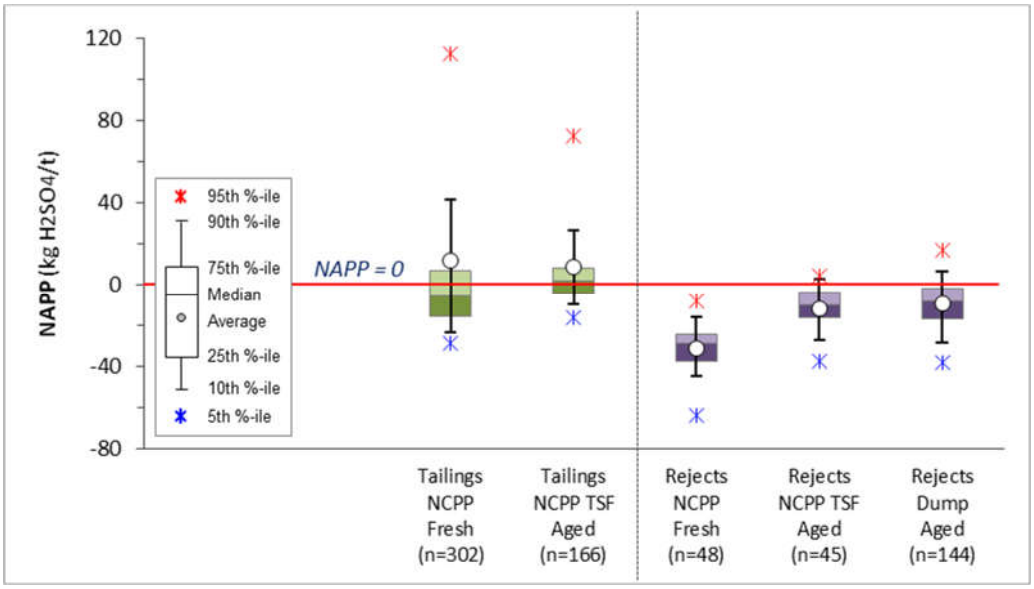
Based on the generally low MPA and higher ANC values (relative to the MPA), the calculated NAPP values are negative for over 99% of spoil samples (10 out of 2260 spoil samples had positive NAPP values, of which most were carbonaceous spoil samples). The results, shown in **Figure 4-12** (spoil and coal) 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

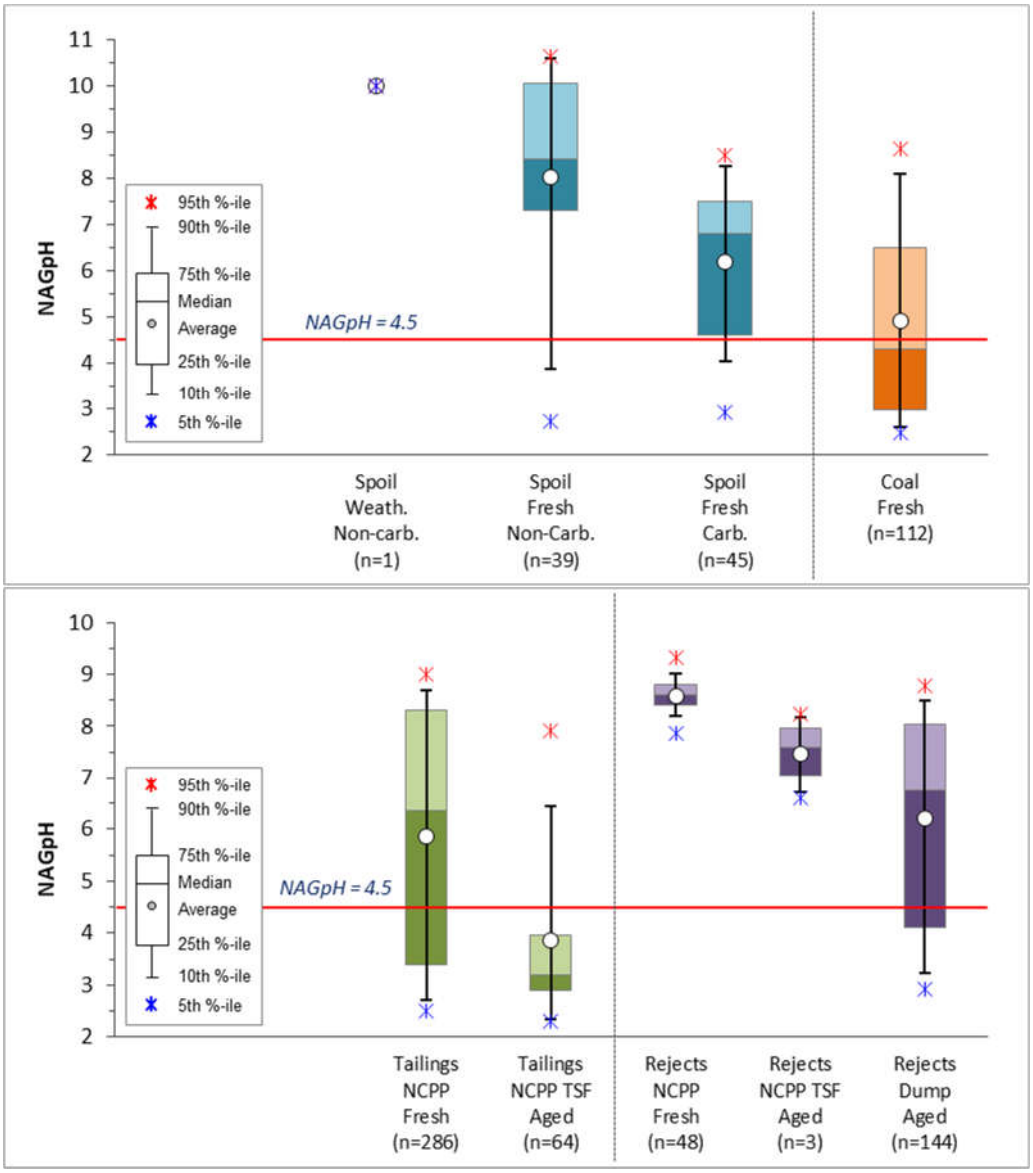
NAG test results are used in conjunction with NAPP values in determining the acid classification of samples. The calculated NAPP value assumes that all S (or sulfide) will oxidise to generate acid (MPA) and that all neutralising material in a sample is in a readily available form to neutralise any acid 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

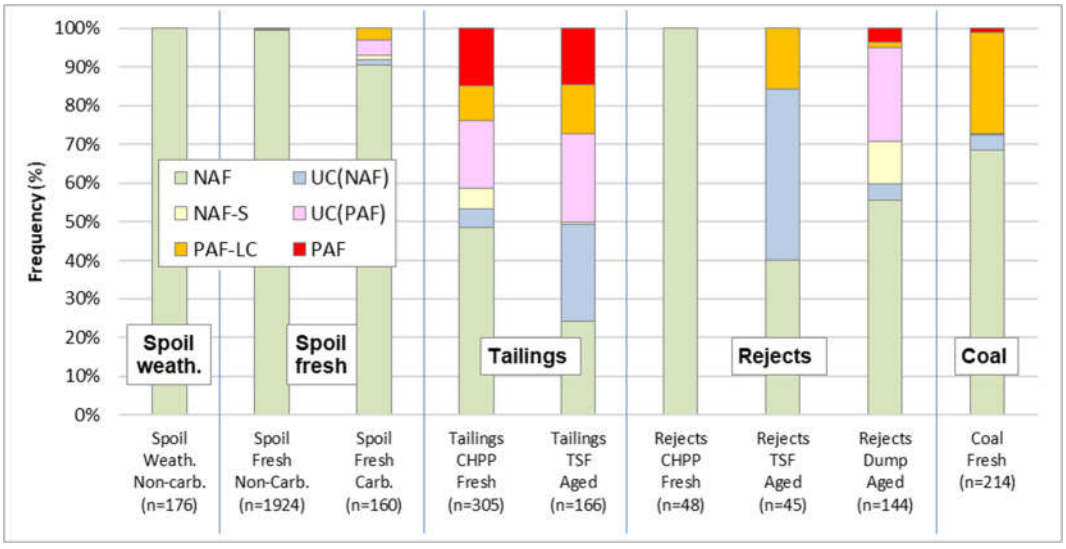


Table 4-4. Geochemical classification of samples

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

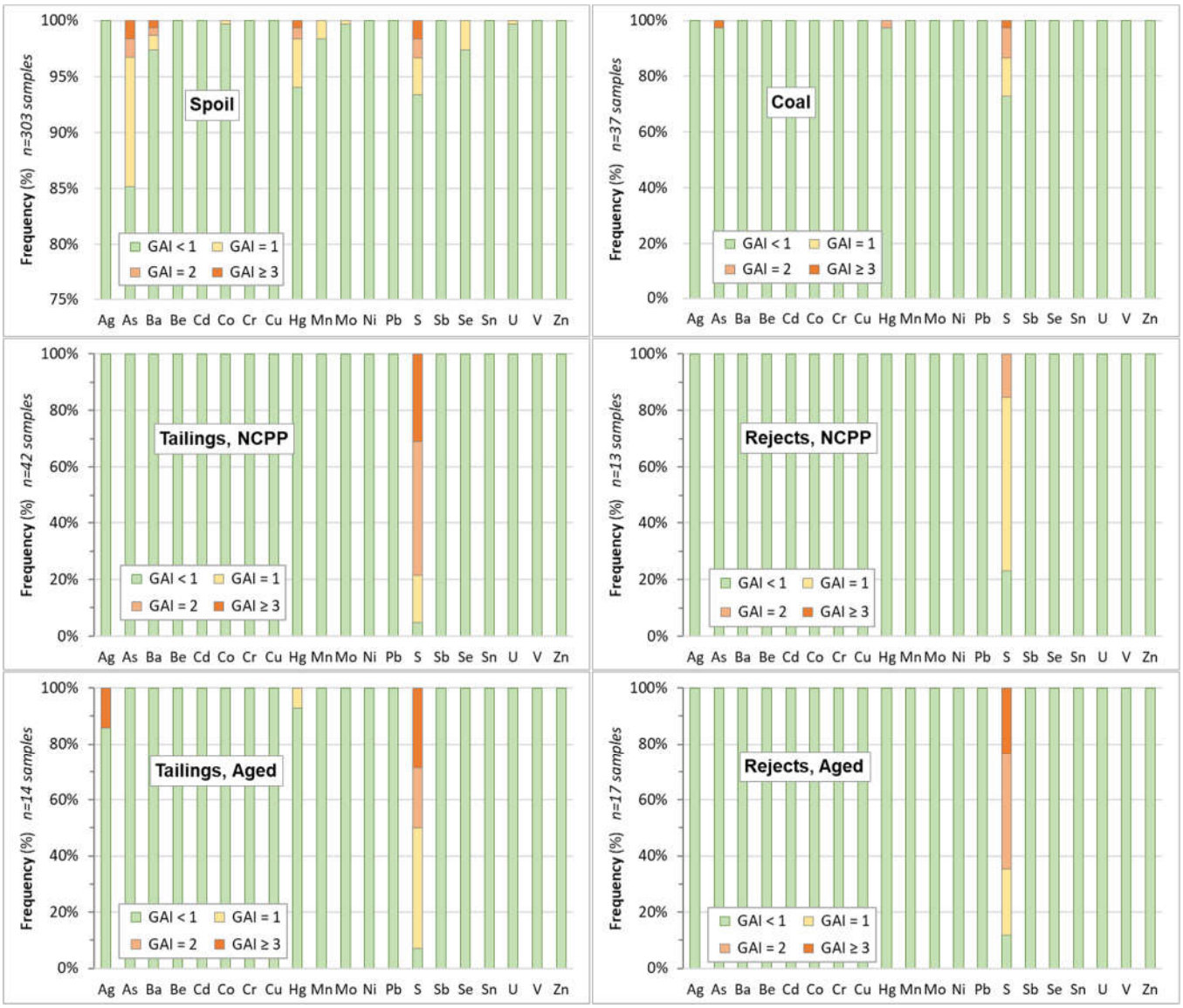
similar to existing ROM coal at BWM (from existing pits in the vicinity of the Project), rejects generated from ROM coal at the Project are expected to have similar geochemical characteristics to existing rejects.

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.

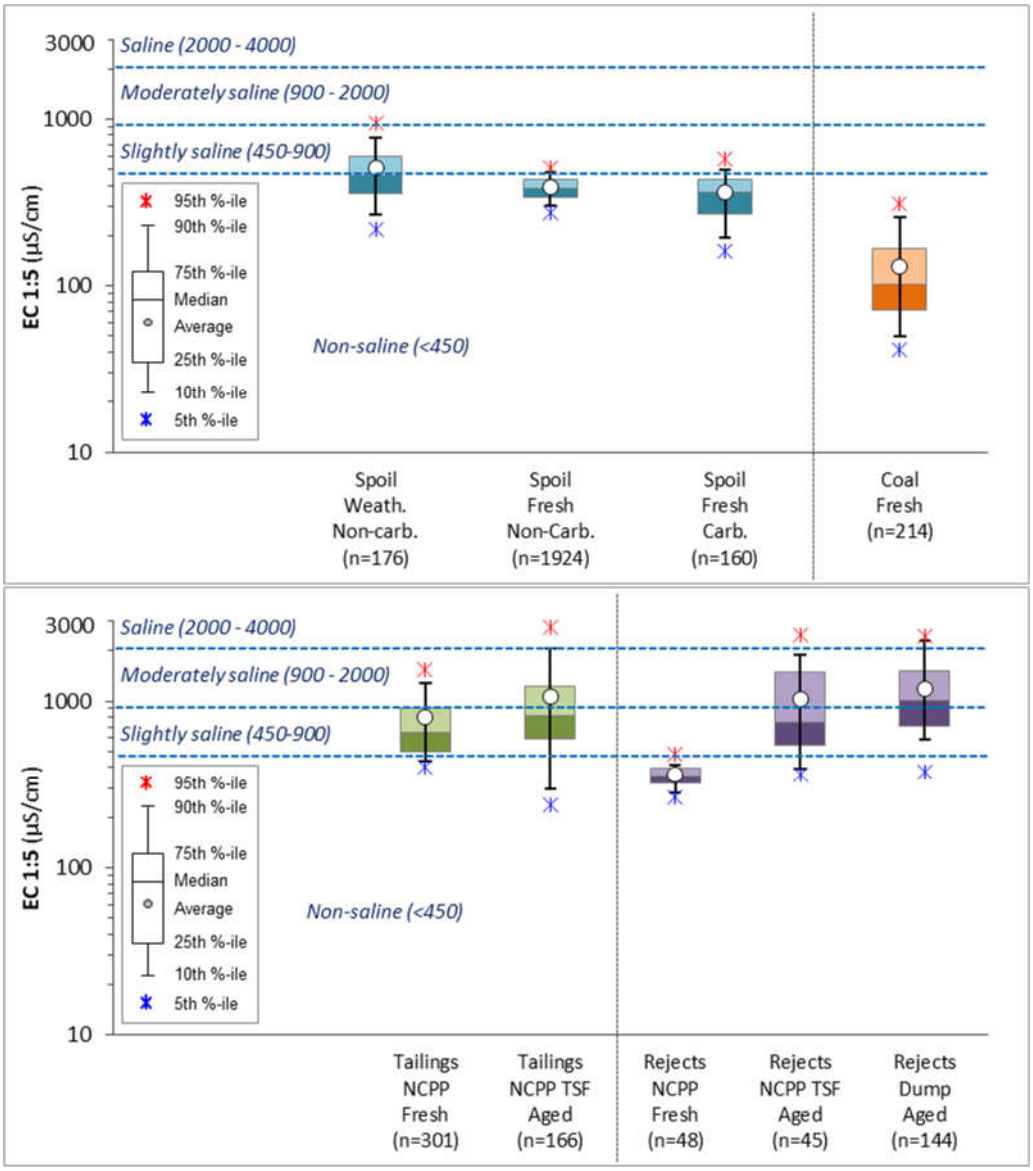
The test-work has found that spoil is generally pH-alkaline to highly alkaline and non-saline to slightly saline; and that tailings and rejects are generally pH-alkaline and slightly to moderately saline. All mineral wastes generally have low concentrations of soluble metals and metalloids – within the 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.

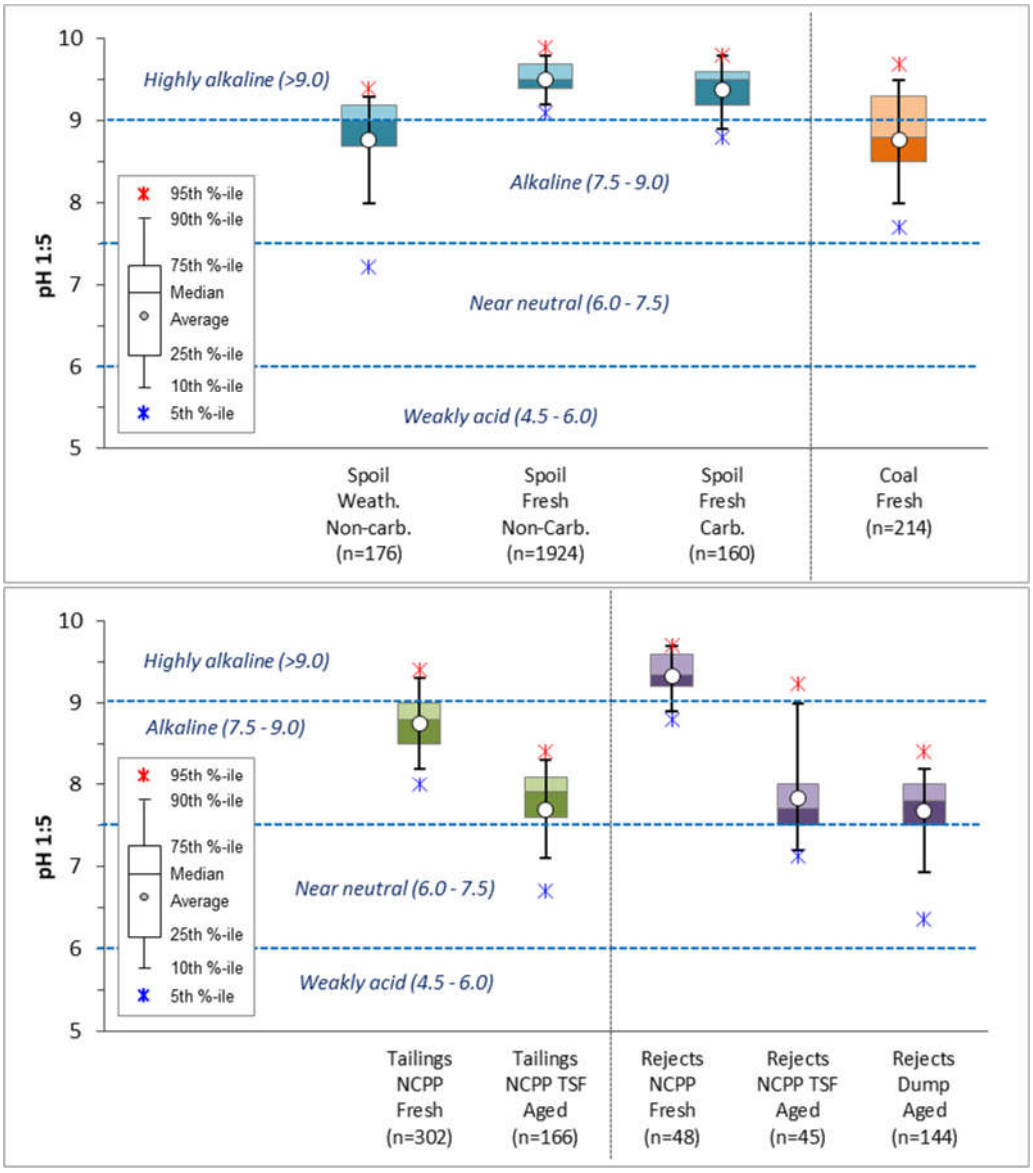
Figure 4-17. Electrical conductivity distribution



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

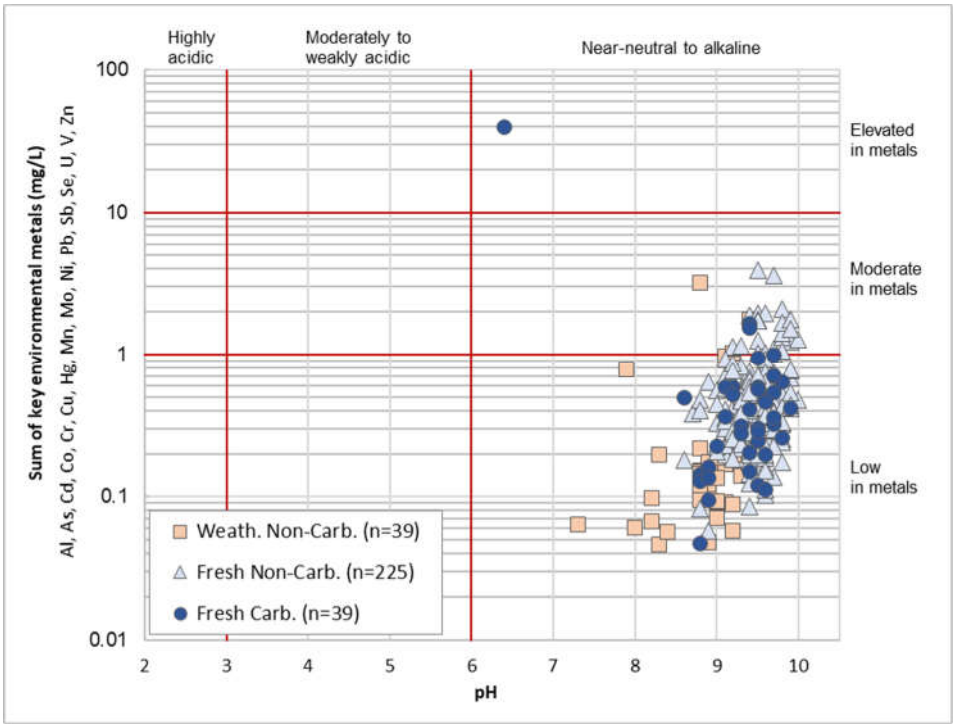


Soluble Metals and Metalloids

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.

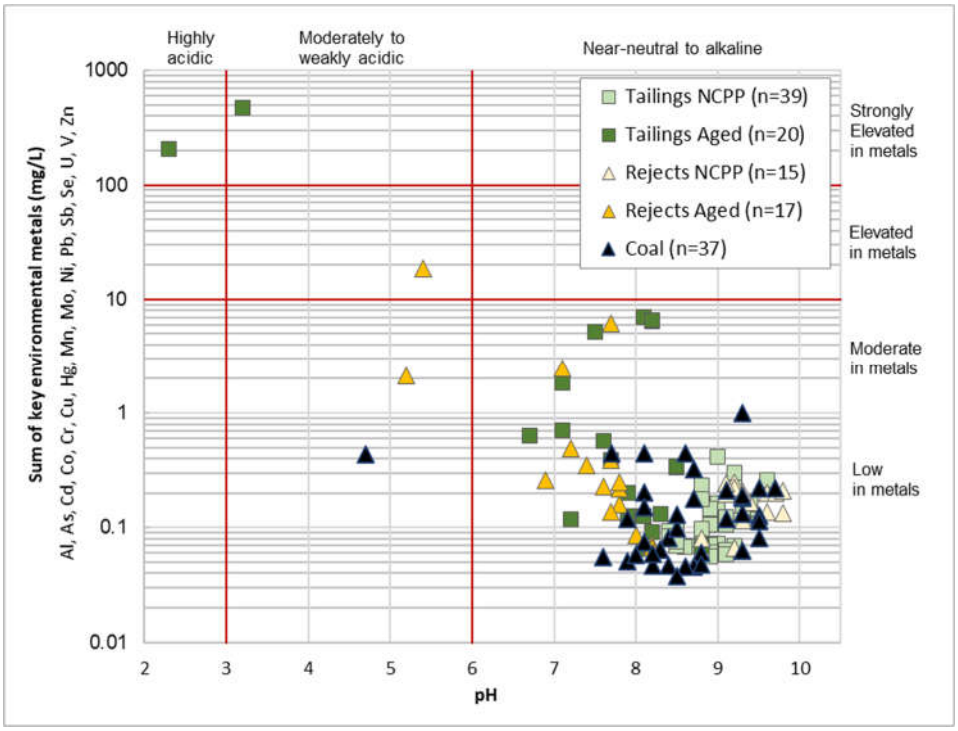
Figure 4-19. Sum of key environmental metals versus pH in deionised water extracts in spoil



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



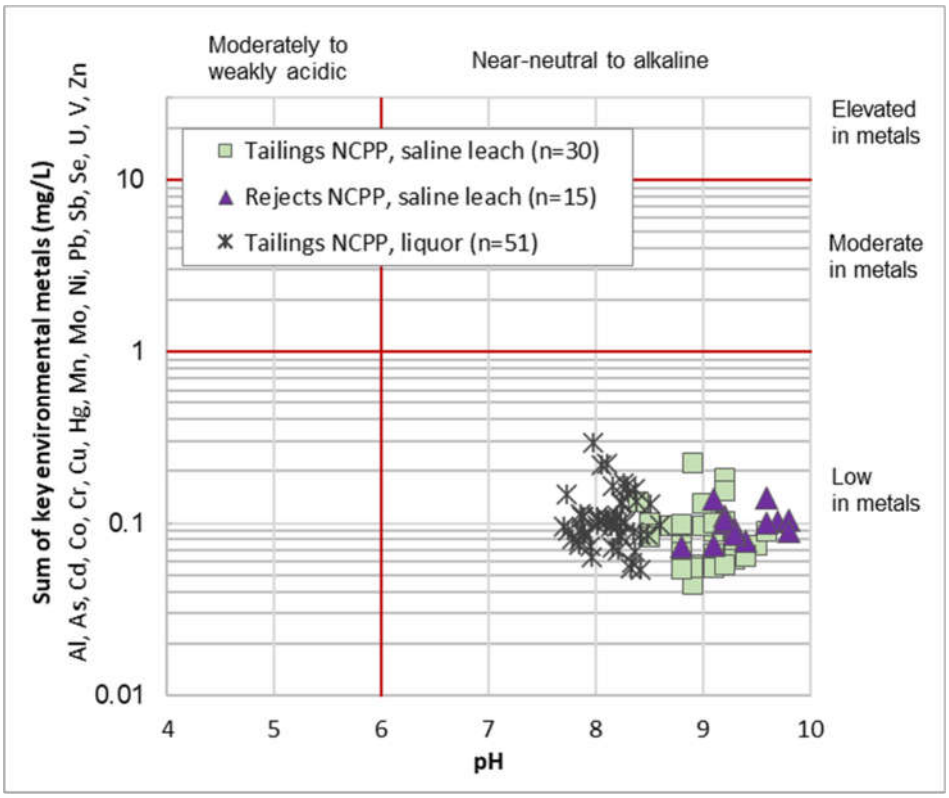
In pH-neutral to alkaline waters, many metals and metalloids cannot remain in solution and, thus, trace metal and metalloid concentrations are generally low. Comparatively, in acid(ic) waters, many metals and metalloids are moderately to highly soluble and will remain in solution and, thus, trace metal 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

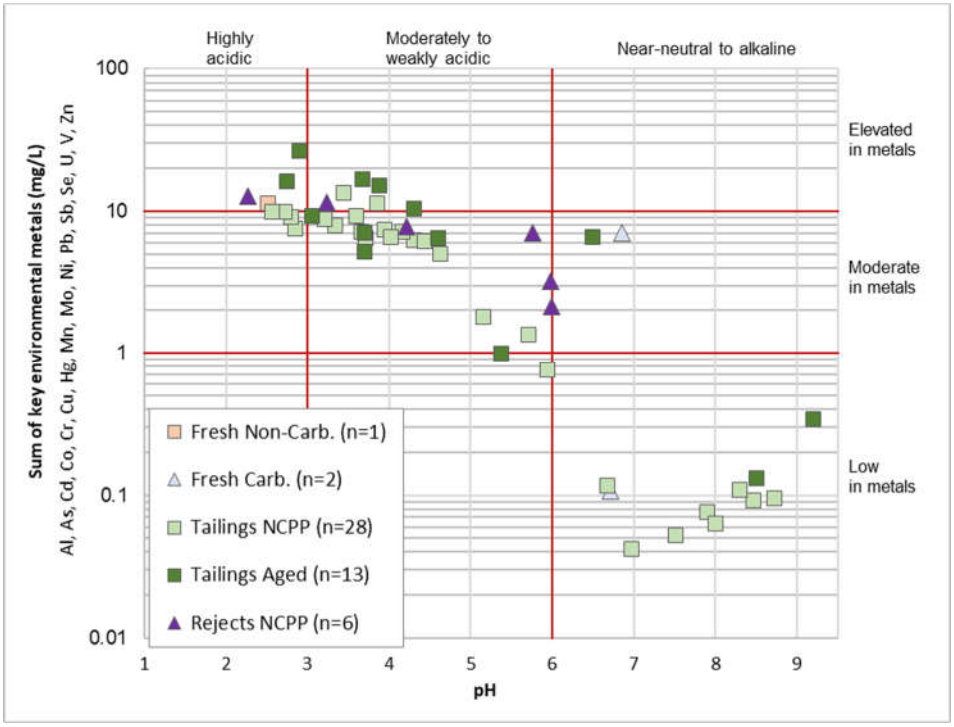
resulting leach representing an assumed 'worse case' scenario in term of metal and metalloid mobility. The purpose of this test is to understand what metals and metalloids can be mobilised following full oxidation. The samples submitted for this test were selected to assess the hazard of similar waste 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.

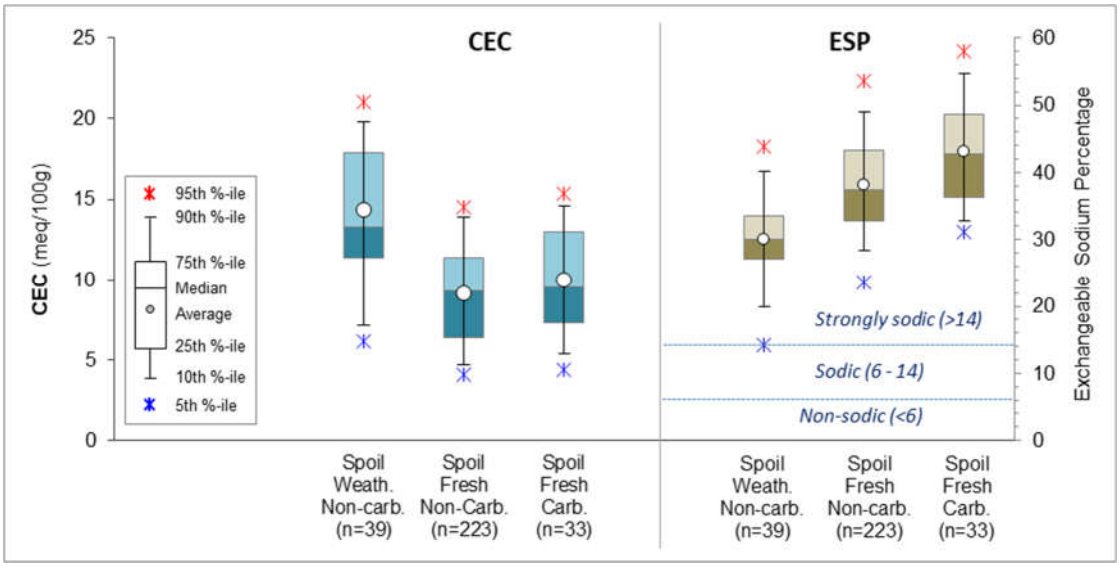
4.8 Cation Exchange Capacity, Sodicity and Dispersion of Spoil

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.

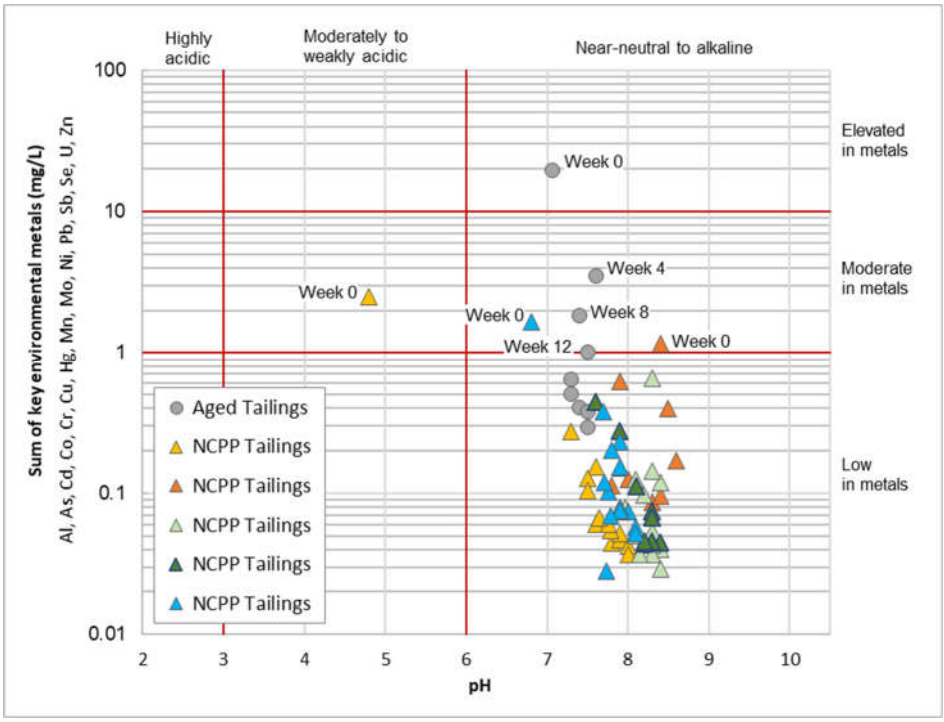
The salinity of the samples (column leachate) for fresh tailings samples ranged from 563 to 9460 μS/cm, with a moderately saline median value of 1230 μS/cm. The sulfate release rates for fresh NCPP tailings samples ranged from 22 mg/kg/week to 57 mg/kg/week.

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:

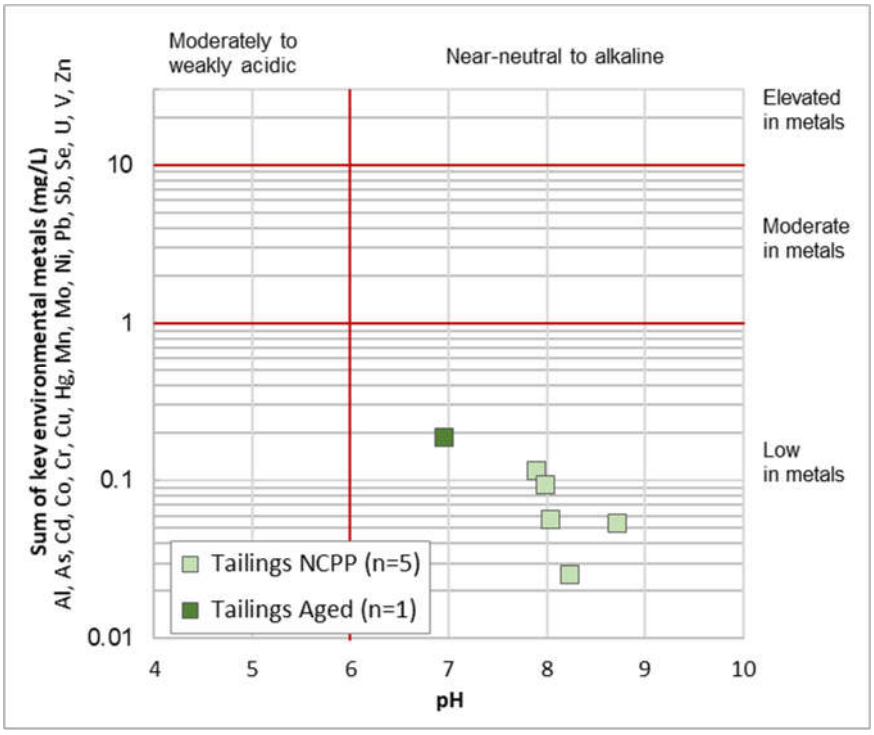
- Two of the five fresh NCPP tailing samples were confirmed to be NAF and are unlikely to generate AD or NMD (negligible risk) and with a low/negligible risk of generating SD. The remaining three fresh NCPP tailings samples were confirmed as PAF or PAF-LC and were found to pose a moderate to moderate-high 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

ACARP (2004) [Australian Coal Association Research Program]. *Rehabilitation of Dispersive Tertiary Spoil in the Bowen Basin*. Report C12031, July 2004.

ACARP (2019) [Australian Coal Association Research Program]. *Prediction of Long-Term Salt Generation from Coal Spoils*. Report C25039, January 2019.

AMIRA (2002). *ARD Test Handbook – AMIRA Project P387A: Prediction & Kinetic Control of Acid Mine Drainage*. EGi and Ian Wark Research Institute.

ANZG (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra, ACT. Available at www.waterquality.gov.au/anz-guidelines.

AusIMM (2011) [Australasian Institute of Mining and Metallurgy]. *Field Geologist's Manual. Fifth Edition. Monograph 9.* December 2011. Carlton, VIC.

Bowen, H.J.M. (1979). *Environmental Geochemistry of the Elements*. Academic Press, New York.

DIIS (2016) [Department of Industry, Innovation and Science]. Leading Practice Sustainable Development Program for the Mining Industry. Preventing Acid and Metalliferous Drainage. September 2016, Canberra ACT.

DME (1995) [Queensland Department of Minerals and Energy]. *Draft Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland, Technical Guideline – Assessment and Management of Acid Drainage*. Part B – Section 13 – Assessment and Management of Saline/Sodic Wastes. January 1995.

Ficklin, W.H., Plumlee, G.S., Smith, K.S., and McHugh, J.B. (1992). Geochemical classification of mine drainages and natural drainages in mineralized areas: Proceedings, 7th Internal Water-Rock Interaction Conference, Park City, Utah, 1992, pp. 381–384.

INAP (2009) [International Network on Acid Prevention]. Global Acid Rock Drainage Guide (GARD Guide). Available at: http://www.gardguide.com.

Isbell, R.F. (2002). *The Australian Soil Classification* (revised edition). CSIRO Publishing. Victoria.

Northcote, K.H. and Skene, J.K.M. (1972). *Australian Soils with Saline and Sodic Properties*. CSIRO Australia, Soil Publication No. 27, Canberra.

WHC (2025). Blackwater Mine – Progressive Rehabilitation and Closure Plan. Version 2.0, 16 May 2025.

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
EARTH SCIENCES