SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Chapter 5
Land Resources

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5.0 Land Resources

5.1 Introduction

BM Alliance Coal Operations Pty Ltd (BMA) is seeking approval to develop the Saraji East Mining Lease Project (the Project) involving a single-seam underground mine and supporting infrastructure on Mining Lease Application (MLA) 70383 and MLA 70459 adjacent to, and accessed through, the existing open cut mine pits within Mining Lease (ML) 1775.

This chapter of the Environmental Impact Statement (EIS) provides an assessment of the Project on land based environmental values of the Project Site. The assessment considers the likely nature and extent of potential impacts from the Project and identifies, where appropriate, controls to avoid, mitigate and manage adverse impacts.

This chapter considers:

- potential land degradation and contaminated land
- geology and mineral resources
- land suitability and agriculture
- subsidence.

Related topics are discussed in separate chapters, including:

- **Chapter 4 Land Use and Tenure**
- **Chapter 13 Scenic Amenity and Lighting.**

Further detail on the assessments undertaken and summarised in this chapter are provided in:

- **Appendix B-1 Land Resources and Soils Technical Report**
- **Appendix B-2 Subsidence Modelling**
- **Appendix K-1 Rehabilitation Management Plan**
- **Appendix K-2 Subsidence Management Plan.**

5.2 Legislation and policy

5.2.1 Environmental Protection Act 1994

The primary environmental legislative requirements for the management of soils and contaminated land in Queensland are contained within the *Environmental Protection Act 1994* (Qld) (EP Act) and subsidiary regulations. The EP Act is administered by the Department of Environment and Science (DES).

In Queensland, activities that have been identified as likely to cause land contamination are known as notifiable activities. Notifiable activities are defined in Schedule 3 of the EP Act. Land parcels that have historically been used, or are currently used, for notifiable activities and are reported to the government are recorded on the Environmental Management Register (EMR). Inclusion of a land parcel on the EMR does not necessarily mean that the land is contaminated, as it may or may not pose a risk to human health and/or the environment.

Land parcels that are known to pose a risk to human health and/or the environment are included on the DES Contaminated Land Register (CLR). Land parcels are included on the CLR when an investigation has identified that contaminants are present at concentrations that represent a risk to human health.

As such, action is required to remediate or manage the land to prevent adverse environmental and/or human health impacts.

EMR and CLR searches were undertaken in March 2023 for the major land lots within the Project Site.

5.2.2 Regional Planning Interests Act 2014

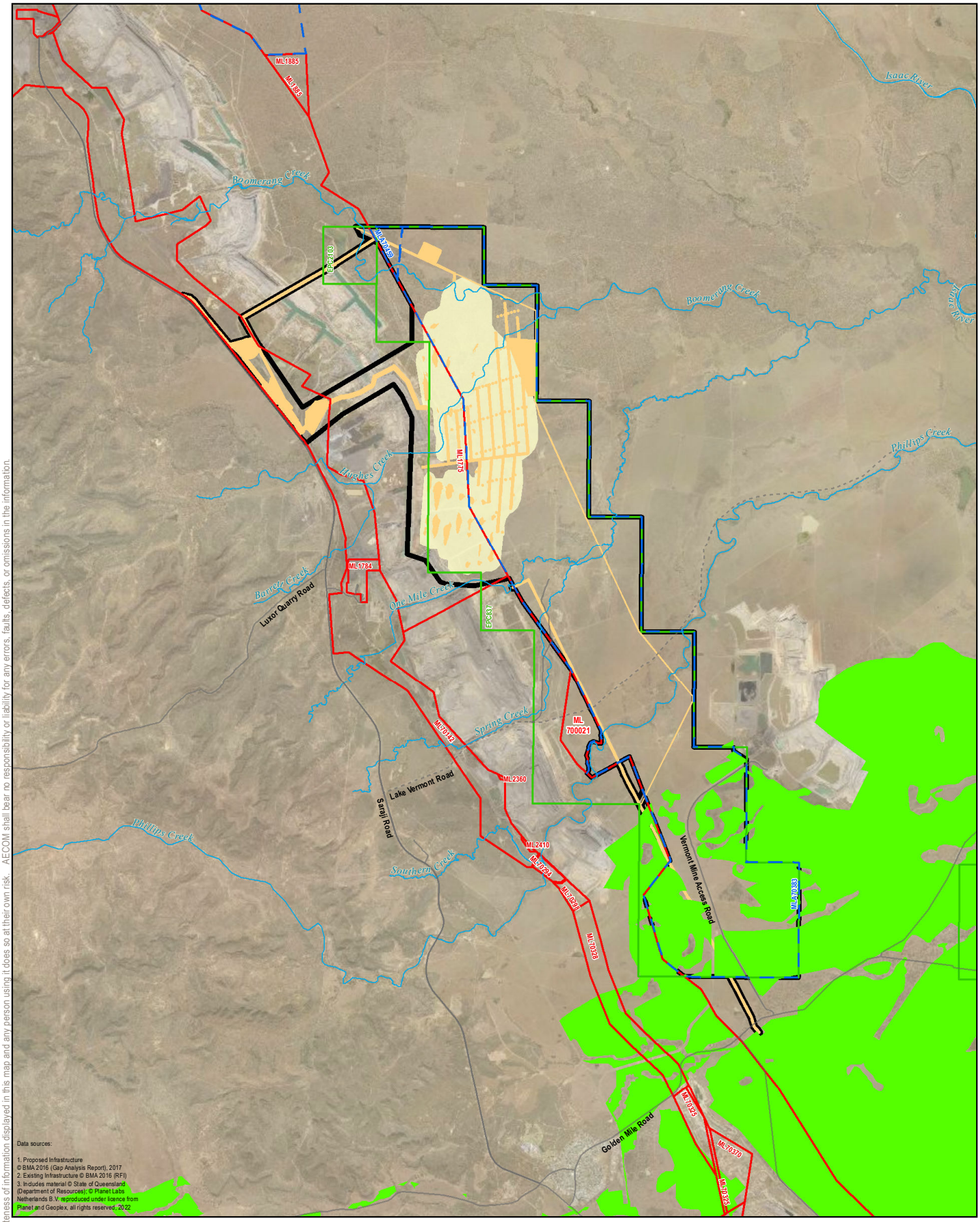
The *Regional Planning Interests Act 2014* (RPI Act) seeks to manage the impact of resource activities on areas that contribute or are likely to contribute to Queensland's economic, social or environmental prosperity. A Regional Interests Development Approval (RIDA) is required when a resource activity is proposed in an area of regional interest.

The RPI Act identifies and protects areas of regional interest from prescribed resource or regulated activities through the protection of:

- living areas in regional communities (Priority Living Area (PLA))
- high-quality agricultural areas from dislocation (Priority Agricultural Area (PAA))
- strategic cropping land (SCL) (Strategic Cropping Area (SCA))
- regionally important environmental areas (Strategic Environmental Area (SEA)).

The SCA is an area of regional interest under the RPI Act and consists of the areas shown on the SCL Trigger Map as SCL. SCL is defined in the RPI Act as land that is highly suitable for cropping, or likely to be highly suitable for cropping, based on a particular set of soil, climate and landscape features. A review of the SCL Trigger Map identified that the southern extent of the Project Site encroaches into an SCA (SCL), as shown in Figure 5-1. This area is herein discussed as the SCL Assessment Area.

As the Project Site intersects land mapped as SCL, an assessment of the Project in accordance with the Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) *RPI Act Statutory Guideline 01/14* was undertaken (DILGP, 2017a) and Regional Interest Development Approval obtained (RPI ref: RIDA 021/001). Regional interest development approval is discussed in **Appendix A-3 Approvals Framework**.



Data sources:

1. Proposed Infrastructure
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2. Existing Infrastructure © BMA 2016 (RFI)
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LEGEND

- Project Site
- Project Footprint - Direct Impact
- Project Footprint - Indirect Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Private Access
- Public Road
- Strategic Cropping Land Trigger Map

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Figure 5-1
Strategic Cropping Land Trigger Map

Environmental Impact Statement
Saraji East Mining Lease Project

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Kilometres

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5.2.3 Mined Land Rehabilitation Policy

The *Mineral and Energy Resources (Financial Provisioning) Act 2018* amends the EP Act, replacing the Plan of Operations and Financial Assurance (FA) with Estimated Rehabilitation Cost (ERC) and Progressive Rehabilitation and Closure Plan (PRCP). The Project will comply with the *Mineral and Energy Resources (Financial Provisioning) Act 2018* and a PRCP will be developed prior to construction commencing.

The Mined Land Rehabilitation Policy (DES, 2018a) is an outcome of the *Mineral and Energy Resources (Financial Provisioning) Act 2018*. The objective of the Mined Land Rehabilitation Policy is for land disturbed by mining activities to be rehabilitated to a safe and stable landform that does not cause environmental harm and is able to sustain a post mining land use which has been approved through a PRCP.

As required by the Terms of Reference (ToR), a Rehabilitation Management Plan (RMP) (refer to **Appendix K-1**) has been developed for the Project. The Project will comply with the *Mineral and Energy Resources (Financial Provisioning) Act 2018*. The Project PRCP is not required to be compiled as part of the EIS however will be developed in combination with the EA approval after completion of the EIS, but prior to construction commencing, and will demonstrate that the proposed Project will:

- be rehabilitated to a safe and stable landform
- not cause environmental harm
- sustain post mining land uses.

5.2.4 National Environmental Protection (Assessment of Site Contamination) Measure 1999

The soil investigation thresholds used in Queensland to evaluate whether land is contaminated are contained in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in April 2013) (National Environment Protection Council (NEPC)). This document presents investigation and screening levels designed to ensure the protection of the environment and/or human health.

These investigation and screening levels are not intended for use as default remediation trigger criteria. Rather, they are intended to prompt an appropriate site-specific assessment when they are exceeded. Similarly, trigger levels nominated for the protection of ecosystem health should be developed on a regional scale, commensurate with land use (NEPC, 1999).

Developing trigger levels on a regional scale is a resource intensive process, therefore such trigger levels may not be developed for some time. In the interim, and for the purposes of this assessment, generic levels based on an assumed urban land use (comprising city, suburban and industrial areas) were adopted.

5.2.5 Mackay, Isaac and Whitsunday Regional Plan 2012

The Mackay, Isaac and Whitsunday Regional Plan 2012 provides future planning decisions for the region over the next two decades. It provides a framework to guide the long term sustainability of the region's communities, strengthen its economy, inform the delivery of social services and infrastructure, and protect its environment.

The plan recognises that the resources sector operates within specific legislation and supports the development of mining projects within the region. The plan also identifies the Bowen Basin as Australia’s largest coal deposit and one of the nation’s largest coal producers, with coal mining being the major industry in the region and the largest employer.

The plan outlines a number of desired regional outcomes (DROs), including the protection of regional landscape values and natural resource management.

An assessment of the DRO’s of the Mackay, Isaac and Whitsunday Regional Plan 2012 against the Project is presented in **Chapter 4 Land Use and Tenure.**

5.3 Methodology

5.3.1 Soils and land suitability

Soils

A detailed assessment of land resources and soil suitability for the Project was undertaken and is presented in **Appendix B-1 Land Resources and Soils Technical Report.**

This assessment included a review of existing soil and land suitability reports in the area to determine soil mapping units (SMUs) and identify their distribution within the Project Site.

Where appropriate, existing land suitability assessments were re-assessed against the Guidelines for Agricultural Land Evaluation in Queensland (GALE) (DSITI and DNRM, 2015). GALE (DSITI and DNRM, 2015) and regional land evaluation frameworks for various regions of Queensland give specific information for appropriate land uses and their associated limitations.

Following the review of the available assessments, data gaps were identified, and additional field soil surveys were undertaken specifically targeting proposed infrastructure areas on the western side of the Project Site. Additional data was also obtained for the southern areas of the Project Site as part of a two stage SCL fieldwork assessment (GTES, 2019).

The field investigation was based upon existing soil survey site locations (GTES, 2011) and free survey techniques (McKenzie et al. 2008 and Gunn et al. 1988) to verify soil types and assign boundaries to map units.

Laboratory analysis was undertaken in line with the Land Suitability Assessment Techniques outlined within the Department of Minerals and Energy (DME) (now Department of Resources (DoR)) guideline Technical Guidelines for Environmental Management of Exploration and Mining in Queensland (DME, 1995d). Information was also sourced from Queensland Department of Primary Industry (DPI, 1991) Guidelines for Agricultural Land Evaluation in Queensland and Shields and Williams Land Resource Survey and Evaluation of the Kilcummin area (DSITI and DNRM, 2015).

Appendix B-1 Land Resources and Soils Technical Report provides a full description of the soils and land resources methodology.

Strategic cropping land

An overhead powerline proposed as part of the Project intersects land mapped as SCL (Figure 5-1). Therefore, an assessment of the site-specific soil conditions against the SCL criteria was required to confirm the actual extent of SCL at a local scale.

The SCL assessment was conducted in accordance with RPI Act Statutory Guideline 08/14 (DILGP, 2017b) which describes how to demonstrate that land in the SCA does not meet the criteria for SCL (Queensland Government, 2017). Additionally, the SCL criteria listed in Schedule 3, Part 2 of the RPI Act were assessed. The assessment comprised:

- a desktop study of relevant information, including satellite imagery, topographic information and regional soils information
- a field investigation to ground-truth the preliminary soil mapping and collect detailed information on soil distribution, topographic constraints, and physical and chemical soil conditions
- ground-truthed soil mapping at an appropriate scale for SCL assessment
- site-specific assessment of SCL map unit polygons against the relevant SCL criteria.

The relevant SCL criteria are presented in Table 5-1. To demonstrate that the land does not meet the SCL criteria, the assessment must demonstrate that it fails at least one of the eight criteria.

Table 5-1 Criteria to meet SCL in the Western Cropping Zone

Criteria	Thresholds for Western cropping zone
Slope	Equal to or less than 3%
Rockiness	Equal to or less than 20% for rocks greater than 60 millimetres (mm) in diameter
Gilgai	Less than 50% of land surface being gilgai of greater than 500 mm in depth
Soil depth	Equal to or greater than 600 mm
Soil wetness	Has favourable drainage
Soil pH	For rigid soils, the soil at 300 mm and 600 mm soil depth must be within the range of pH1:5 5.1 to pH1:5 8.9 inclusive For non-rigid soils, the soil at 300 mm and 600 mm soil depth must be greater than pH1:5 5.0
Salinity	Chloride content is less than 800 milligrams per kilogram (mg/kg) at 600 mm soil depth
Soil water storage	Equal to or greater than 100 mm to a soil depth or soil physico-chemical limitation of equal to or less than 1,000 mm

5.3.2 Queensland Land Agricultural Audit

A desktop review of the Queensland Agricultural Land Audit and the Web-based Agricultural Land Information (WALI) was undertaken to understand the agricultural values within and surrounding the Project Site.

5.3.3 Contaminated land

An assessment of the potential contamination status of the Project Site was undertaken, including:

- desktop review of the current and historical land uses associated with properties within, or adjacent to, the Project Site
- desktop review of additional contamination sources (including Unexploded Ordinances (UXOs)) with the potential to impact the Project
- review of properties potentially impacted by land contamination, focusing on the likelihood of these properties impacting the Project Site, based on their proximity and contaminants of concern
- EMR and CLR searches for the major land lots within the Project Site (March 2023).

BMA will undertake a contaminated land assessment of the Project Site during the detailed design phase of the Project.

5.3.4 Subsidence

A detailed mine subsidence assessment was undertaken and is presented in **Appendix B-2 Subsidence Modelling**.

All longwall panels across the Project Site will extract coal from the Dysart Lower (D24) seams.

The subsidence model was set up to include the major geological strata with properties which reflected the original pre-mining conditions. The model was then stepped through the following stages to simulate the proposed mining operations:

- intact geology brought to equilibrium under applied in situ stress field and gravity
- open cut mining excavations cut into the model
- longwall panels excavated according to scheduled sequence
- longwall coal extraction to uniform height of 3.6 m
- after excavation of each stage, the stresses and deformation were equilibrated
- roof rock mass allowed to collapse onto floor of longwall panel

- histories of displacement over the longwall panels were monitored
- changes in surface elevation were calculated to establish the post-mining topography.

5.3.5 Rehabilitation

Hierarchy

The rehabilitation hierarchy of DES Guideline – Rehabilitation requirements for mining resource activities (EM1122 Guideline) outlines the preferred methodologies to mining activities that minimise the risk of environmental harm. The EM1122 Guideline states that strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override a higher selection. The rehabilitation hierarchy is summarised as follows, in order of decreasing preference:

1. avoid disturbance that will require rehabilitation
2. reinstate a “natural” ecosystem as similar as possible to the original ecosystem
3. develop an alternative outcome with a higher economic value than the previous land use
4. reinstate previous land use (e.g. grazing or cropping)
5. develop lower value land use
6. leave the Project Site in an unusable condition or with a potential to generate future pollution or adversely affect environmental values.

This rehabilitation hierarchy will apply differently to each of the post mining land uses described in Section 5.6.4. In assessing the applicable goals of the hierarchy, BHP will consider the pre-mining land use, any compensation agreements regarding land including stakeholder values, the potential uses of the rehabilitated land and the surrounding environmental values.

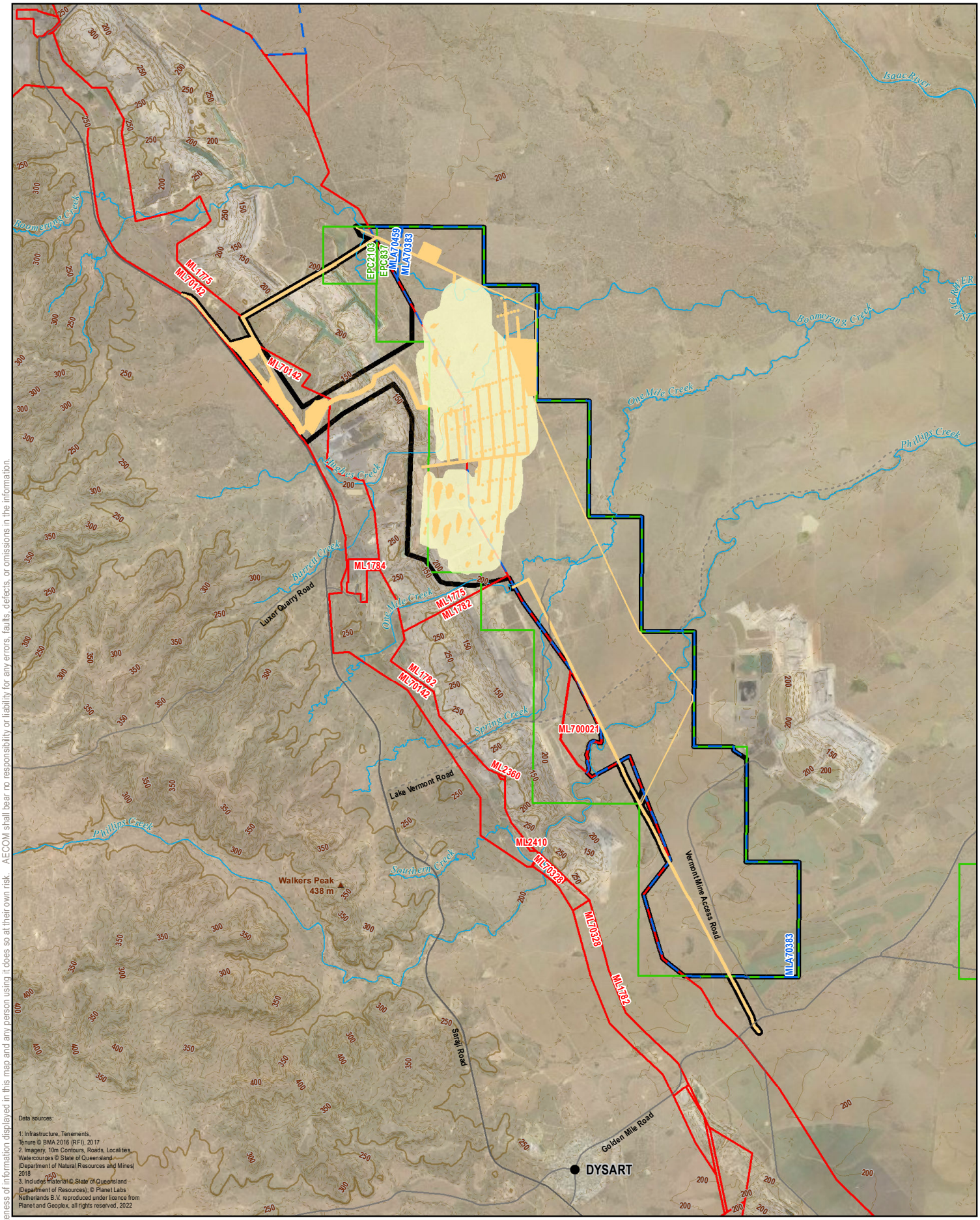
5.4 Description of environmental values

5.4.1 Biophysical

The topography of the Project Site is predominately flat, with channels associated with Phillips, Hughes, One Mile, Boomerang and Plumtree Creeks. The terrain within these catchments is undulating and land use is predominantly grazing and mining activities. In the upper reaches of the catchment, the terrain becomes steeper and possesses tracts of remnant vegetation (Figure 5-2).

Prior to land clearing for agricultural land uses, much of the area supported Brigalow and Belah vegetation on clay soils with tracts of Eucalypt woodlands on the alluvial and sand plains. The original Brigalow and Belah scrub communities have been heavily affected by clearing.

The ecological values of the Project Site are considered typical for the northern Bowen Basin with large areas of land historically cleared for grazing. Although some large areas of remnant vegetation remain, most have been modified to some extent by historical and current land management practices. The most common modifications across the Project Site have been the removal of the shrub and ground layers and replacement with pasture grass species, and the effects of cattle grazing. **Chapter 6 Terrestrial Ecology** provides a detailed discussion on the vegetation within the Project Site.



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LEGEND

- Project Site
- Project Footprint - Direct Impact
- Project Footprint - Indirect Impact
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Private Access
- Public Road
- Regional Locality
- Mountain Peak
- Major Contour (250m)
- Intermediate Contour (50m)
- Minor Contour (10m)

N

Figure 5-2
Local Landscape

Environmental Impact Statement
Saraji East Mining Lease Project

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Kilometres

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5.4.2 Geology

The Project is located on the western limb of the northern Bowen Basin. The strata are relatively undisturbed with a gentle regional dip of 2 degrees (°) to 5° to the east. Faulting is common, though minor, producing local steepening of the coal seam dips to over 10°.

The Permian aged Moranbah Coal Measures (MCM) are the major economic coal resource in the region. Along with Fort Cooper Coal Measures (FCCM), they form part of a thick Permian sequence of regularly layered sedimentary rocks (siltstone, sandstone, mudstone and coal). Locally, the Permian strata are unconformably overlain by up to 57 metres (m) of unconsolidated to semi-consolidated Tertiary sediments and localised unconsolidated Quaternary sediments. The Quaternary alluvial sediments are thickest along the flanks of several of the creeks which traverse the Project Site.

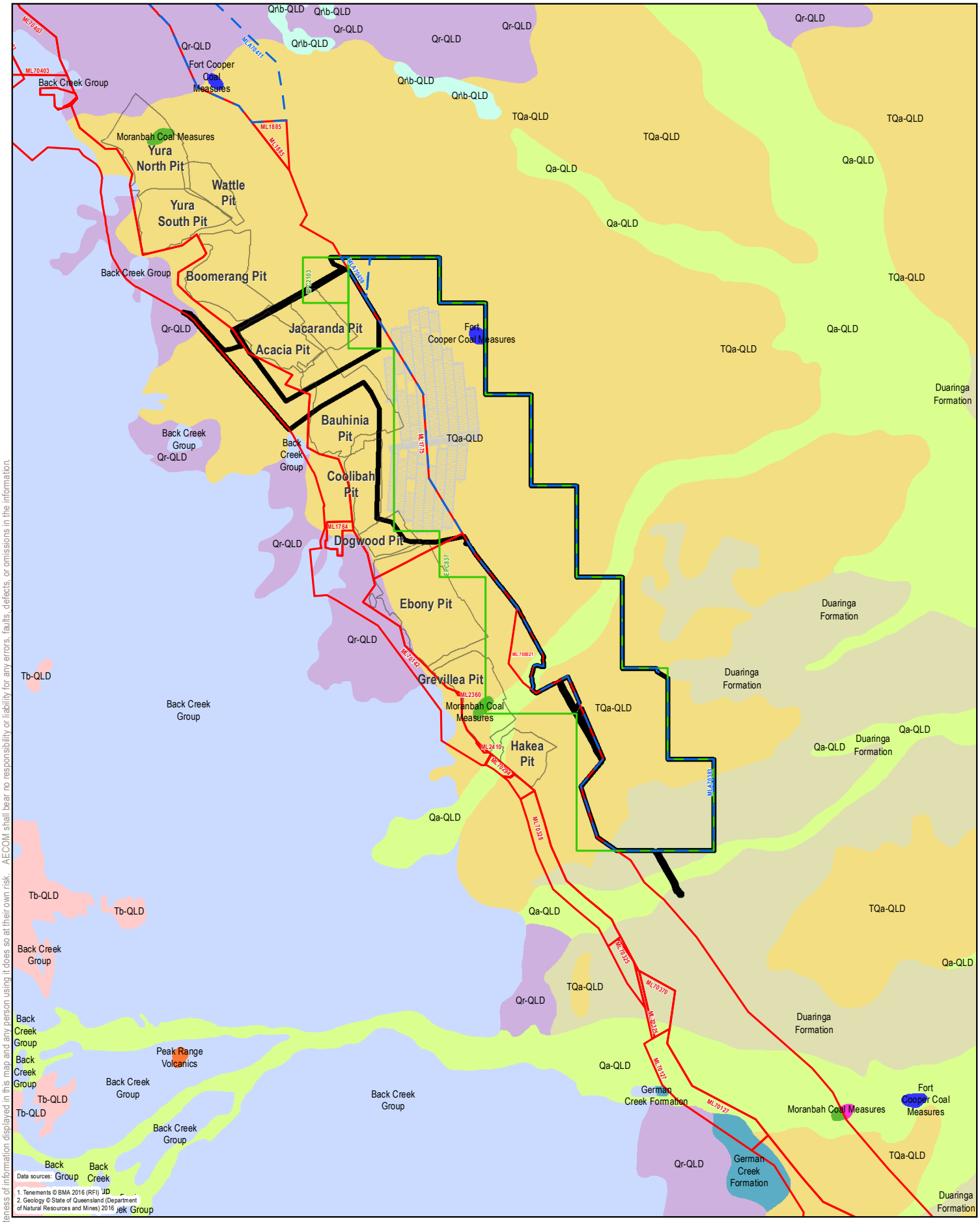
The shallower Tertiary sediments consist of clay, sandy clay, clayey sand and gravel, but have been noted as consisting predominantly of clay. The clay-bound nature of the Tertiary sediments ensures that permeable lenses of sands and gravels are complex in distribution and irregular. In-filled Quaternary alluvial channels associated with the present-day creek courses are locally incised into the Tertiary Formation.

Table 5-2 provides a summary of the major geological units in the vicinity of the Project. The surface geology showing the distribution of the Quaternary alluvium and Tertiary sediments is presented as Figure 5-3. The Permian geology is shown in Figure 5-4.

Table 5-2 Geological units in the vicinity of the Project

Age	Stratigraphic Unit		Description	Average Thickness (m)	Occurrence
Quaternary	Alluvial sediments		Clay, silts, sand, gravel, floodplain alluvium.	0 - 25	Continuous alluvium confined to present day stream and creek channels of the Phillips Creek and Isaac River.
Tertiary	Clay		Clay, clayey sand, sandy clay, sand.	4 - 45	Covers Project area with regular distribution; individual lenses are discontinuous and lensoidal.
	Basal Sand/Gravel		Sand.	0 - 3	Irregular distribution, generally observed where Tertiary sediments are thickest. Not reported within underground mining footprint.
	Duaringa Formation		Mudstone, sandstone, conglomerate, siltstone.	~ 20	Extensive outside of the underground mining footprint to the southeast.
Permian	Fort Cooper Coal Measures (FCCM)	Burngrove Formation	Sandstone, siltstone, mudstone, carbonaceous shale and coal.	Up to 400	Present beneath eastern portion of underground mining footprint.
		Fairhill Formation			

Age	Stratigraphic Unit		Description	Average Thickness (m)	Occurrence
	Moranbah Coal Measures (MCM)	MacMillan Formation	Sandstone, conglomerate, claystone, siltstone, coal. Contains target coal seam – D14/24.	250 – 350	Present beneath entire underground mining footprint.
		German Creek Formation			
Early to Middle Permian	Back Creek Group		Sandstone, siltstone, carbonaceous shale, minor coal.	-	Underlies entire Project area. Outcrops west of Saraji Mine and extends under mined areas to the east.



LEGEND

- Project Site
- Underground Mine Layout
- Existing Open-Cut Extent
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Surface Geology

- Back Creek Group (Pb)
- Duaringa Formation (Tu)
- Fort Cooper Coal Measures (Pwt)
- German Creek Formation (Pbd)
- MacMillan Formation (Pbn)
- Moranbah Coal Measures (Pwb)
- Peak Range Volcanics (Tp)
- Qa-QLD (Qa)
- Qr-QLD (Qr)
- Qr\b-QLD (Qr\b)
- TQa-QLD (TQa)
- Tb-QLD (Tb)

N

Figure 5-3
Surface Geology
(1:100,000)

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Saraji East Mining Lease Project

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Kilometres

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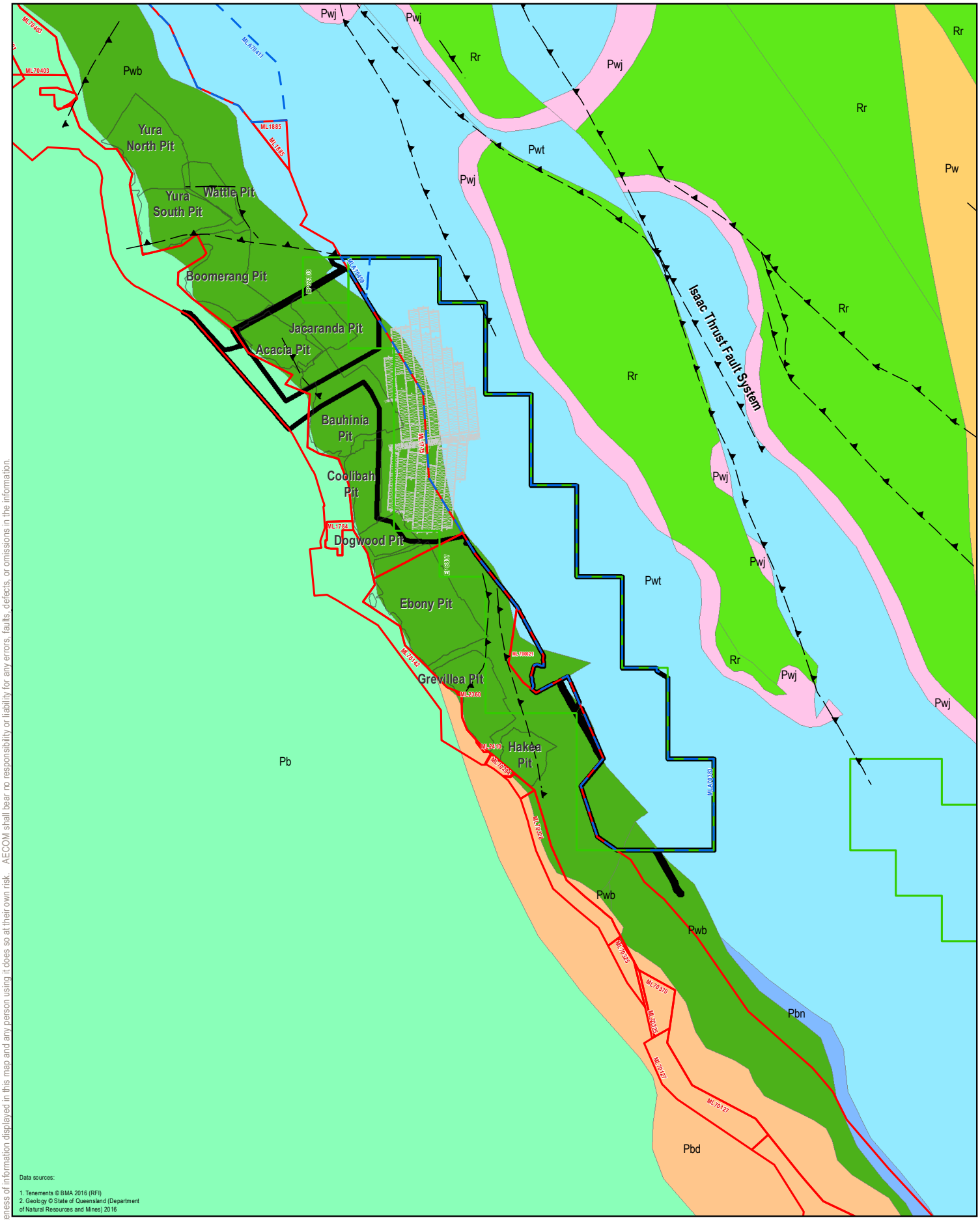

Data sources:

1. Tenements © BMA 2016 (RFI)
2. Geology © State of Queensland (Department of Natural Resources and Mines) 2016

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground Mine Layout
- Existing Open-Cut Extent
- Fault

Bowen Basin Basement Geology

- Pb - Permian Back Creek Group
- Pbd - Permian German Creek Formation
- Pbn - Permian MacMillan Formation
- Pw - Permian Backwater Group
- Pwb - Permian Moranbah Coal Measures
- Pwj - Permian Rangal Coal Measures
- Pwt - Permian Fort Cooper Coal Measures
- Rr - Triassic Rewan Group

N

Figure 5-4
Basement Geology
(1:500,000)

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Saraji East Mining Lease Project

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Kilometres

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Mineral resources

The coal deposit to be mined by the Project is located in the northern part of the Permo-Triassic Bowen Basin, which principally comprises fluvial sediments with some marine sediments. The two major coal bearing regional geological formations of Permian age occur in the Project Site - FCCM and MCM. A Seam Correlation is shown in Figure 5-5.

Six coal seam groups exist within the Project Site. These comprise:

- The Dysart series (equivalent to Goonyella Lower and German Creek/Lilyvale seams)
- Harrow Creek group (Goonyella Middle seam/Aquila/Tieri equivalent)
- P seam
- Q seams (Goonyella Upper equivalent)
- R seam
- S seam (lower-most seam of the overlying FCCM).

The MCM are characterised by several laterally persistent, relatively thick coal seams interspersed with several thin minor seams. The major seams are the Dysart Lower (D24/D14) seams and the Harrow Creek Upper (H16). These major seams are potentially economic underground targets due to coking properties and the potential of high-quality pulverized coal injection resources that occur beyond the coking coal limit.

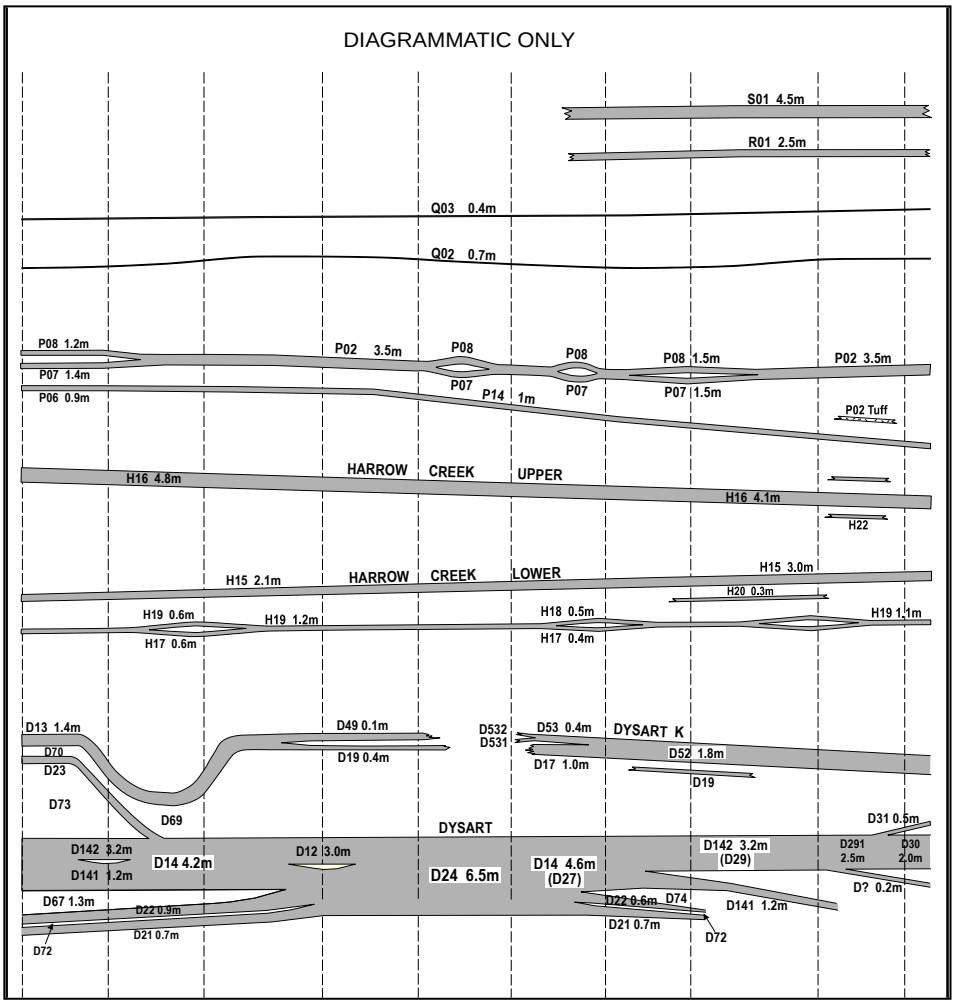


Figure 5-5 Regional stratigraphy

5.4.3 Soils and land suitability

Identification of soils

Twenty-six SMUs, including eleven variants, were identified across the Project Site on the basis of existing soil reports and the targeted soils assessment undertaken for the Project. This included 32 representative sites (of a total of 148 sites) recorded by Emmerton B. (2005) and 14 representative sites (of a total of 270 sites) recorded by GTES (2011). A soil variant may possess attributes that are somewhat different from the mainstream soil attributes but either cannot be mapped at scale or does not constitute any significant deviation from the agricultural suitability or basic soil morphology.

The Project Site includes areas of gently undulating plains with gradational to duplex sandy soils to uniform clays with microrelief to areas of drainage depressions near active alluvia areas.

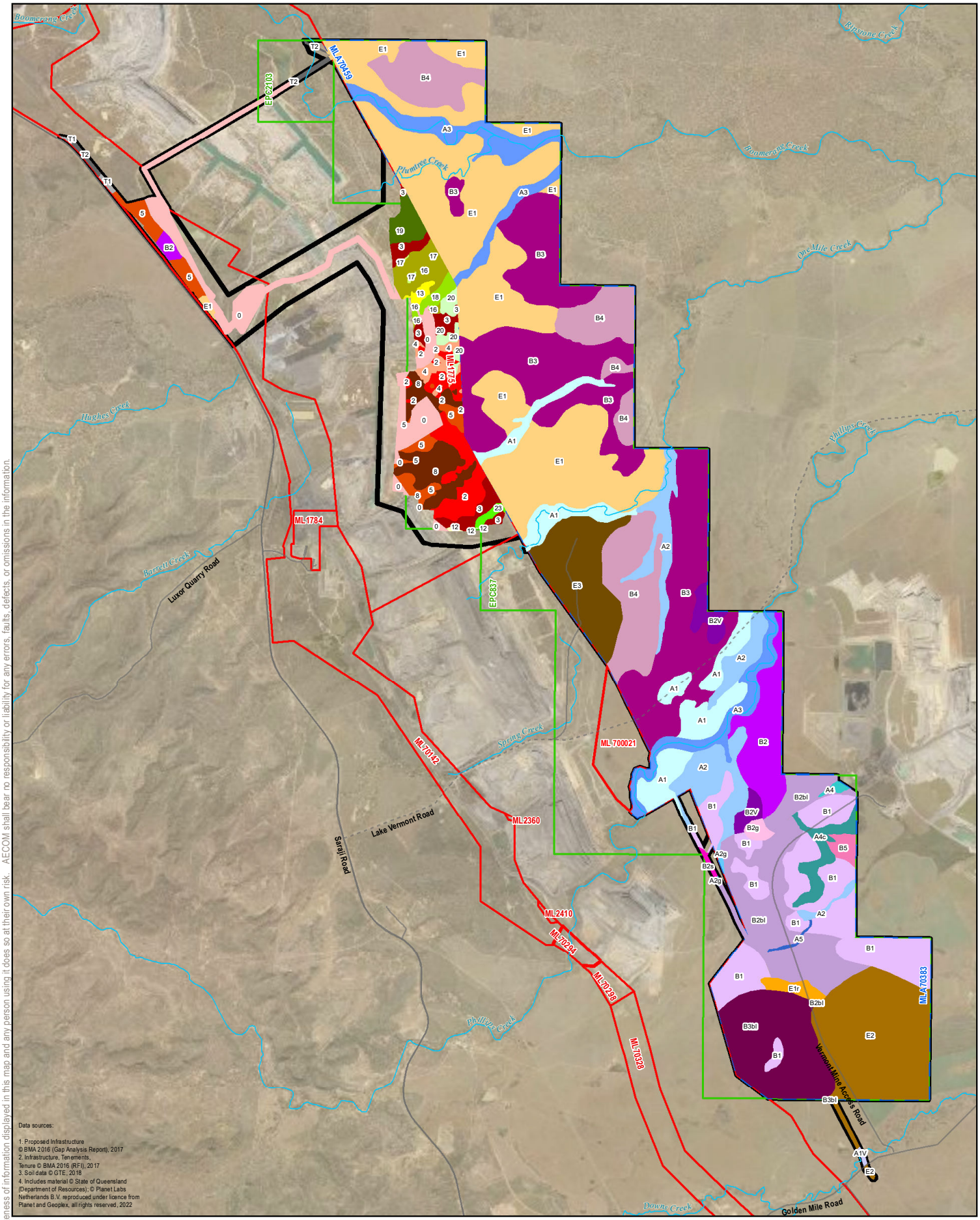
The SMUs are summarised within Table 5-3 and presented in Figure 5-6.

Table 5-3 Summary of SMUs

SMU and Variants	Concept	Representative sites
2/20	Light sandy clay loam duplex soils to non-cracking clays on unconsolidated cainozoic sediments	Site J4, S40 and 104 (Variant)
3	Sandy loam surfaced duplex soils on unconsolidated cainozoic sediments	S12, J31, 33 and 96
4	Cracking clays with minor gilgai supporting brigalow and dawson gum	S41, J27, J32 and 119
5	Cracking and non-cracking clays supporting dawson gum and brigalow on deep tertiary clays	S28 and 76
8	Clay loam duplex soils on sediments supporting dawson gum and brigalow (Breakaway areas)	S7 and 22 (scalded surface)
12	Sandy loam surfaced duplex soils on reworked cainozoic sediments supporting poplar box	J22 and 145
13	Hard-set silty duplex supporting mixed species (heavy shrub layer)	J23, 48, 134 and 138
16/23	Fine sandy loam to silt loam surfaced duplex and gradational soils (older alluvial duplex soils)	S17 (Variant), H32, 42 (Variant) and 60
17	Minor clay soils in anabranches	S32 and 57
18	Loamy sands, loams and gradational soils on stream banks and near stream levees	S51, H32 and 109
19	Loamy sand gradational soils present as relict alluvial levees	S49 and 142
A1 & A1V	Poplar box on deep duplex loams	38
A2	Alluvial brigalow clay drainage lines	21
A2g	Variant of SMU A2, colour of soil profile is grey	N1
A3	Alluvial loamy creek channels	52
A4	Dark brown sands with sandy loam subsoils near drainage lines	N17
A4c	Variant of SMU A4, texture includes higher clay percentage	N20
A5	Dark grey clay loams to grey brown clays within forested drainage line areas	N23
B1	Undulating clay plains under brigalow or belah	1
B2 & B2v	Mixed brigalow scrub on brown cracking clays	27

SMU and Variants	Concept	Representative sites
B2s	Variant of SMU B2, increase of salt content in subsoils	N13
B2g	Variant of SMU B2, colour of soil profile is black, with minor sub-dominant grey	N4
B2bl	Variant of SMU B2, colour of soil profile is black	91-SCL
B3	Cracking dark brigalow clays with gilgai	222 and 223
B3bl	Variant of SMU B3, colour of soil profile is black	5-SCL
B4	Melan holed brigalow clay plains	118 and 117
B5	Deep sandy clay loams with clay subsoils on gently undulating plains of tall woodlands	N28
E1	Eucalypt woodlands on deep sandy loams	173
E1r	Variant of SMU E1 over red clay (minor brown sub-dominant) subsoils on gently undulating plains	10-SCL
E2	Mt Coolibah on dark basalt soils	110-SCL
E3	Poplar box on shallower loams	169
T1	Sandy hard duplex poplar box	51
T2	Deep sandy duplex plains with poplar box and ironbark	21

A detailed description of each SMU is provided in **Appendix B-1 Land Resources and Soils Technical Report**.



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LEGEND

- Project Site
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- Watercourse
- Private Access Road
- Public Road

Soil Mapping Units

0, 2, 3, 4, 5, 8, 12, 13, 16, 17, 18, 19, 20, 23, A1, A1V, A2, A2g, A3, A4, A4c, A5, B1, B2, B2bl, B2g, B2s, B2V, B3, B3bl, B4, B5, E1, E1r, E2, E3, T1, T2

N

Figure 5-6
Soil Mapping Units

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:112,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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Erosion potential

The erosion potential of the 26 SMUs and variants was identified using available laboratory analysis. Six SMUs (SMU 8, 12, 13, 17, 18 and 19) were considered to have high to very high attributes of erosion potential. All remaining SMUs ranged from low to moderate (SMUs 2/20, 4, 16/23, A1, A2, A3, A4, A5, B1, B2, B3, B5, E1, E2, E3, T1 and T2) and moderate to high (SMUs 3, 5 and B4).

Potential acid generating material

The review and assessment of SMUs for actual acid sulfate soils (AASS) and potential acid sulfate soils (PASS) included the indicators of field pH, jarosite in horizon observations, waterlogging and vegetation status.

Review of the SMUs and field indictors reported acidic to neutral pH as a field indicator for the majority except SMU E2. This SMU is strongly alkaline, though results were not below 4.0 pH for AASS. The remaining indicators were not reported or observed; therefore, the SMUs were assessed based upon the information presented as very low field indication of PASS with no indicators of AASS.

Land suitability

The land suitability and major limiting factors of each SMU for rainfed cropping and cattle grazing of improved pastures was assessed.

It is noted that rainfed cropping and dryland cropping are used interchangeably throughout this Chapter of the EIS and both terminologies are considered to have the same land suitability properties. Rainfed cropping is primarily used to describe land suitability for each of the SMU's identified, while dryland cropping is the preferred terminology for discussing rehabilitation.

Data collected on the physical, chemical and nutritional characteristics of the soil was ranked according to a five-class system that applies to grazing, rainfed cropping and conservation as per DME (1995d), and Shields and Williams (1991) (Table 5-4).

Table 5-4 Land suitability classes

Class	Definition
1	Suitable land with negligible limitations which is highly productive requiring only simple management practices to maintain economic production.
2	Suitable land with minor limitations which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production.
3	Suitable land with moderate limitations which either further lower production or require more than those management practices of Class 2 land to maintain economic production.
4	Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term (presently considered unsuitable due to the uncertainty of the land to achieve sustained economic production).
5	Unsuitable land with extreme limitations that preclude its use for the proposed purpose.

Agricultural land classification (ALC) based on GALE (DSITI and DNRM, 2015) relates the suitability of land to specified agricultural uses. The classification rates the ability of land to maintain a sustainable level of productivity. The factors used to classify agricultural land suitability are the soil, topographic and climatic limitations. The classification ranges from A to D and the descriptions are detailed in Table 5-5. Table 5-6 presents a summary of the land suitability for the Project Site.

Table 5-5 Agricultural land classes

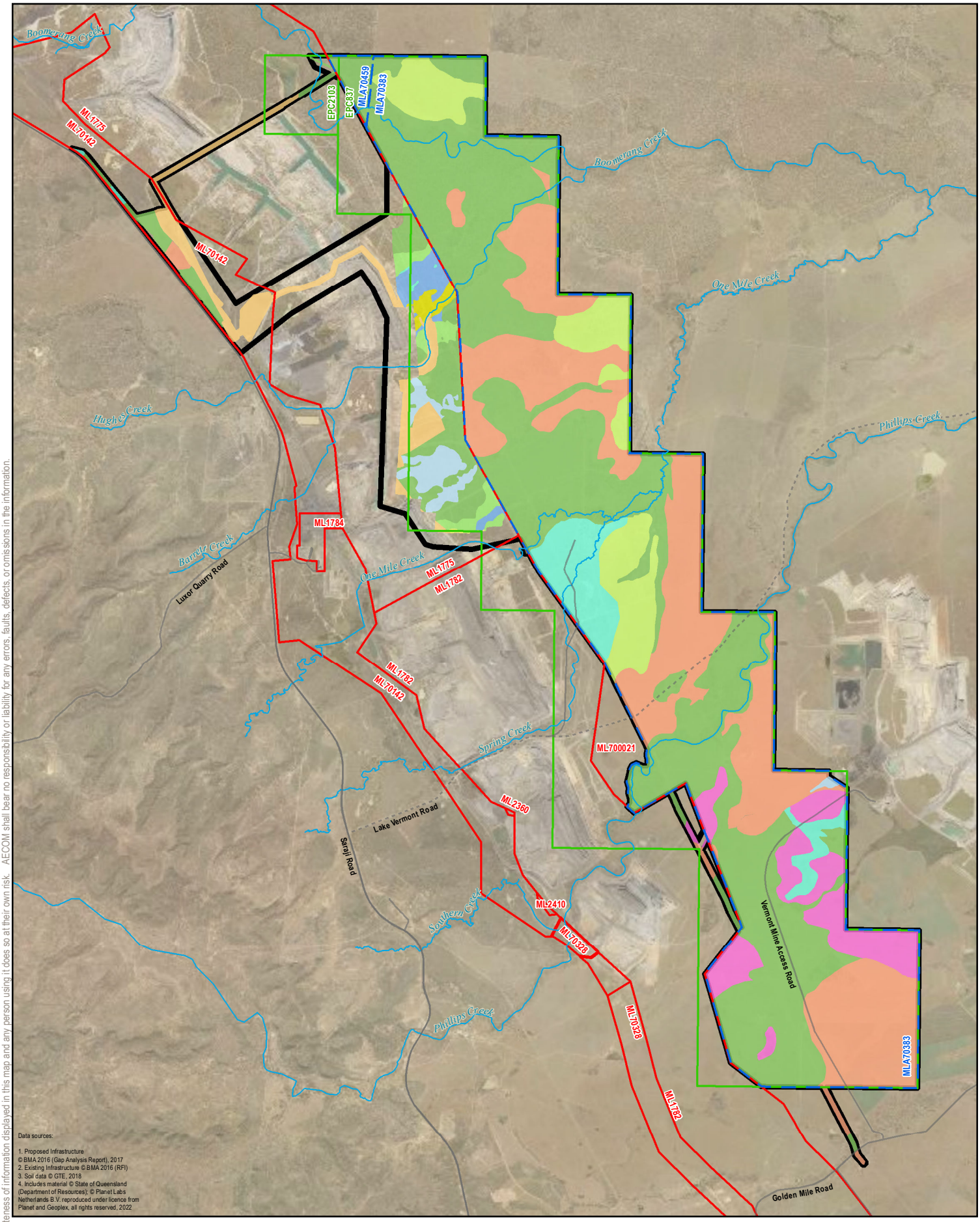
Agricultural land class	Land suitability (cropping)	Land suitability (grazing)	Description
A	-	-	Crop land - land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production.
A1	1-3	1-3	Suitable for a wide range of current and potential broadacre and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

Table 5-6 Land suitability summary for the Project Site

SMU	Rainfed cropping class	Beef cattle grazing class	ALC
2/20	4	3	C1
3	5	4, minor 5 in eroded or drainage areas	C2/C3
4	4	3	C1
5	4	3	C1
8	5	5	C3
12	5	4 levees, 5 on creek beds	C2/C3
13	4 levees, 5 on creek banks	3 levees, 5 on creek banks	C1/C3
16/23	4, minor 5 on stream banks	3, some 4 and 5 on stream banks and overlain banks	C1/C3
17	5	4	C2
18	4 levees, 5 on creek banks	3 levees, 5 on creek banks	C1/C2
19	4	3	C1
A1 & A1V	5	3	C2
A2	5	3	C2
A2g	3	2	A1
A3	5	3	C3
A4	5	5	C3
A4c	5	4	C3
A5	4	3	B
B1	2	1	A1
B2 & B2V	4	2	C1
B2s	3	2	A1
B2g	4	2	B
B2bl	4	3	B
B3	4	2	C1
B3bl	3	3	A
B4	5	3/4	C2
B5	4	3	B
E1	5	3	C2
E1r	4	3	B
E2	2	2	A1
E3	5	4	C3
T1	5	4	C3
T2	5	3	C2

Land management options for SMUs B1 and E2 (and variants A2g, B2s and B2g) were assessed as suitable to marginally suitable for land uses outlined in the regional frameworks and rainfed cropping for the Project Site with soil water availability being the greatest limitation. This limitation was based upon the plant available water capacity (PAWC) attributes with the least acceptable PAWC for Class 3 cotton-furrow assessed at 75-100 mm. Cropping land uses may include cotton, maize, mung bean, safflower, sorghum, soybean and sunflower. Marginal cropping land uses may include barley, chickpea, millet, oak and wheat. SMUs A5, B2bl, B2g, B5 and E1r were assessed as suitable for limited cropping and cotton by furrow irrigation due to PAWC limitations. All other SMUs identified were considered suitable for beef cattle grazing activities either as simple or complex (consisting of two classes) units.

Figure 5-7 presents the pre-mine beef cattle grazing suitability results and Figure 5-8 presents the pre-mine rainfed cropping suitability results. ALC over the Project Site are shown in Figure 5-9. In general, the topsoils for the majority of SMUs were assessed as suitable for rehabilitation activities, including as a growth medium for natural vegetation on flat to gently undulating plains.



LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Private Access Road
- Public Road

Grazing Suitability

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 3 / 4
- Class 3 levees, class 5 on creek banks
- Class 4 levees, class 5 on creek banks
- Class 3 some, class 4 and 5 on stream banks and overlain banks
- Class 4 minor, class 5 in eroded or drainage areas
- Disturbance

N

Figure 5-7
Pre-mine Beef Cattle Grazing Suitability

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Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

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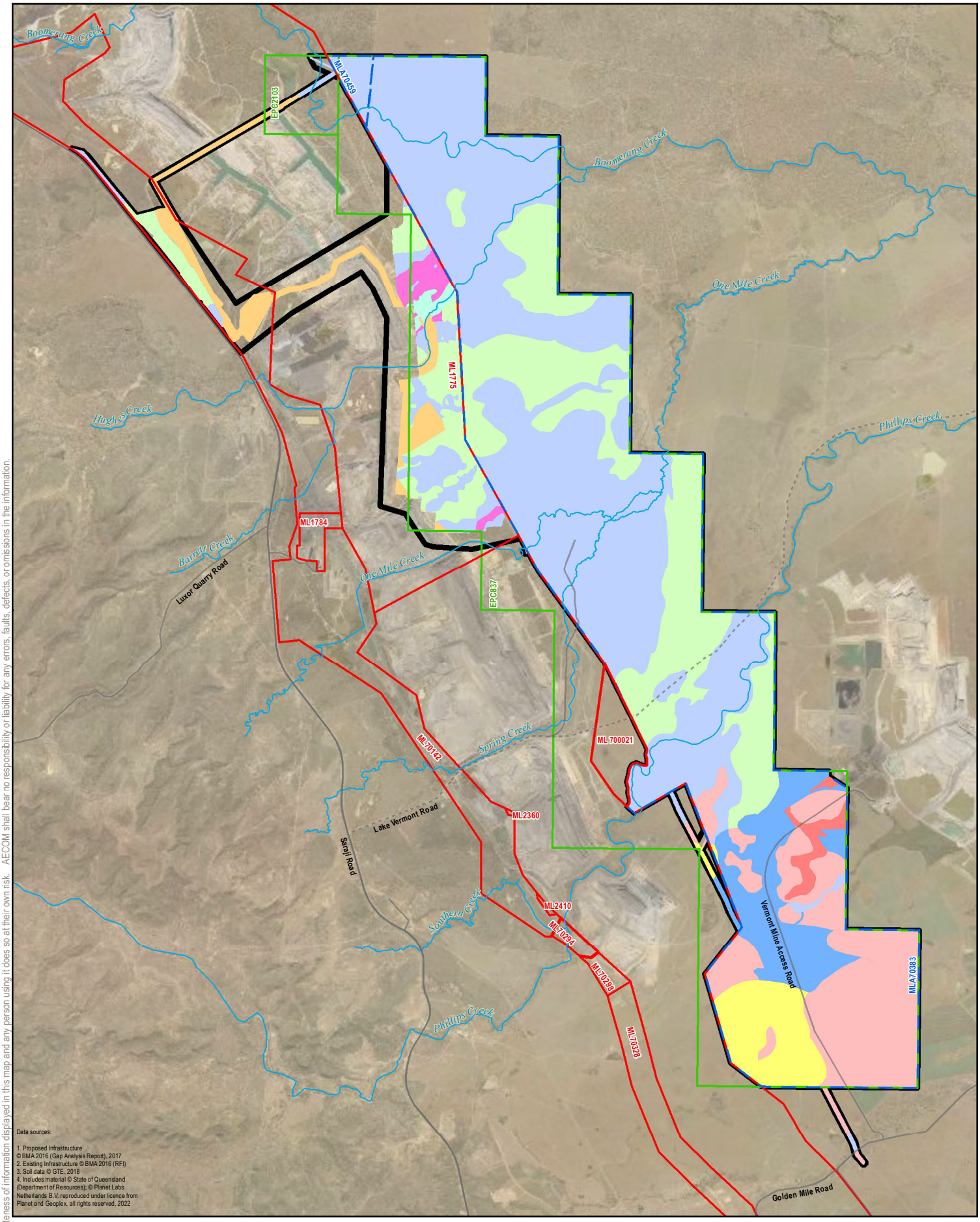

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LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
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- Private Access Road
- Public Road

Cropping Suitability

- Regional Frameworks Class 3
- Regional Frameworks Class 4
- Regional Frameworks Class 5
- Cropping Class 2 / Regional Frameworks Class 3
- Cropping Class 4
- Cropping Class 5
- Class 4 on levees, Class 5 on creek banks
- Class 4 minor, Class 5 on stream banks
- Disturbance

N

Figure 5-8
Pre-mine Rainfed Cropping Suitability

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

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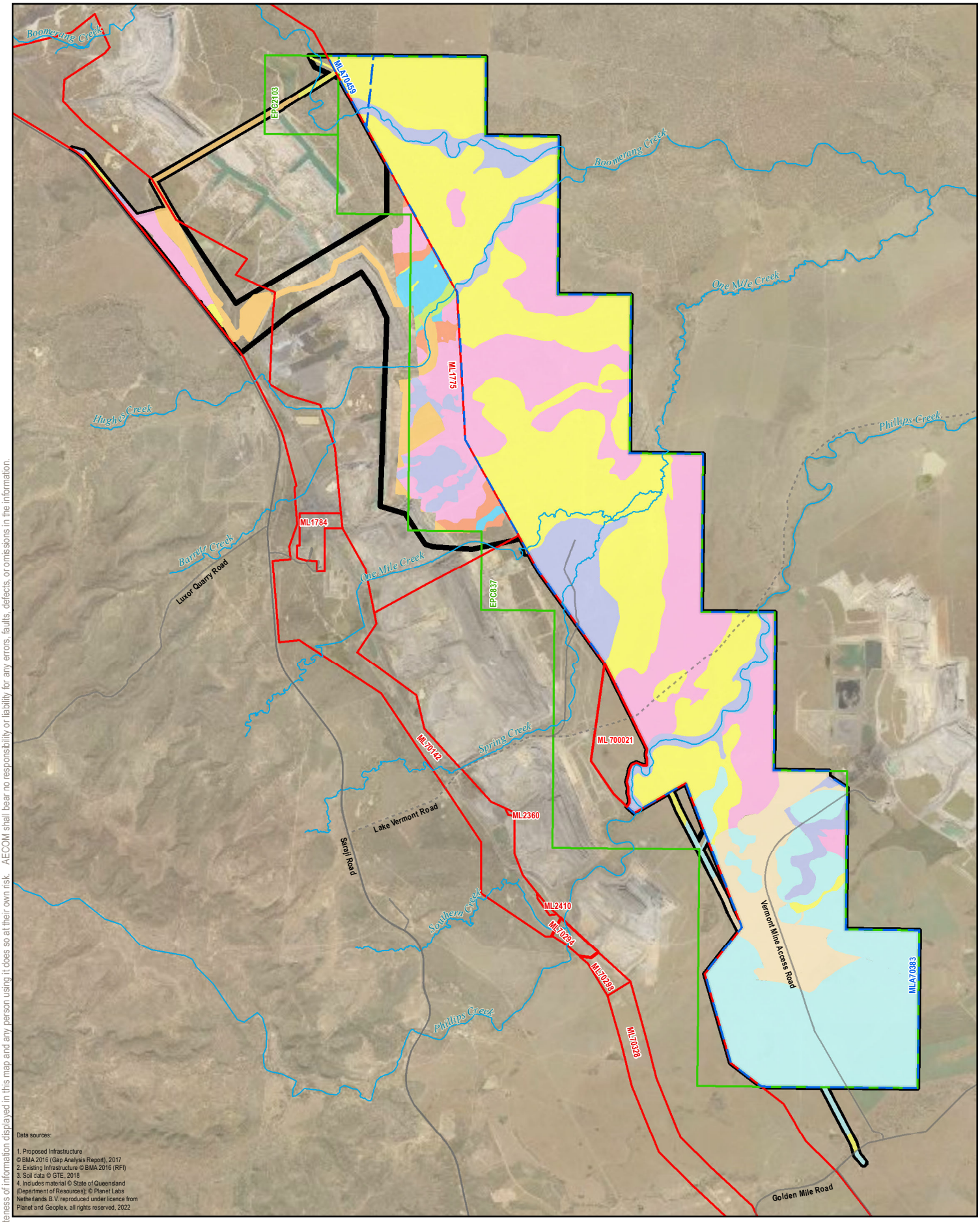

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LEGEND

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- Mining Lease Application (MLA)
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- Private Access Road
- Public Road

Agricultural Land Class

- Class A1
- Class B
- Class C1
- Class C1 / C2
- Class C1 / C3
- Class C2
- Class C2 / C3
- Class C3
- Disturbance

N

Figure 5-9
Agricultural Land Classes

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

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5.4.4 Queensland Agricultural Land Audit

An identification of agricultural values under the Queensland Agricultural Land Audit was undertaken. The following values were identified:

- the southern extent of the Project Site is mapped as Important Agricultural Areas (IAA), defined as 'land that has all of the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and, is strategically significant to the region or the state'. Section 5.4.3 discusses the land suitability of the Project Site.
- the southern extent of the Project Site is mapped as SCA. See Section 5.4.5 for further assessment
- there are no current sheep feedlots, poultry farms, piggeries or cattle feedlots mapped on the Project Site
- small areas in the south of the Project Site are mapped as current broadacre cropping. Section 5.4.3 further discusses the land suitability of the Project Site for broadacre cropping.

5.4.5 Strategic cropping land

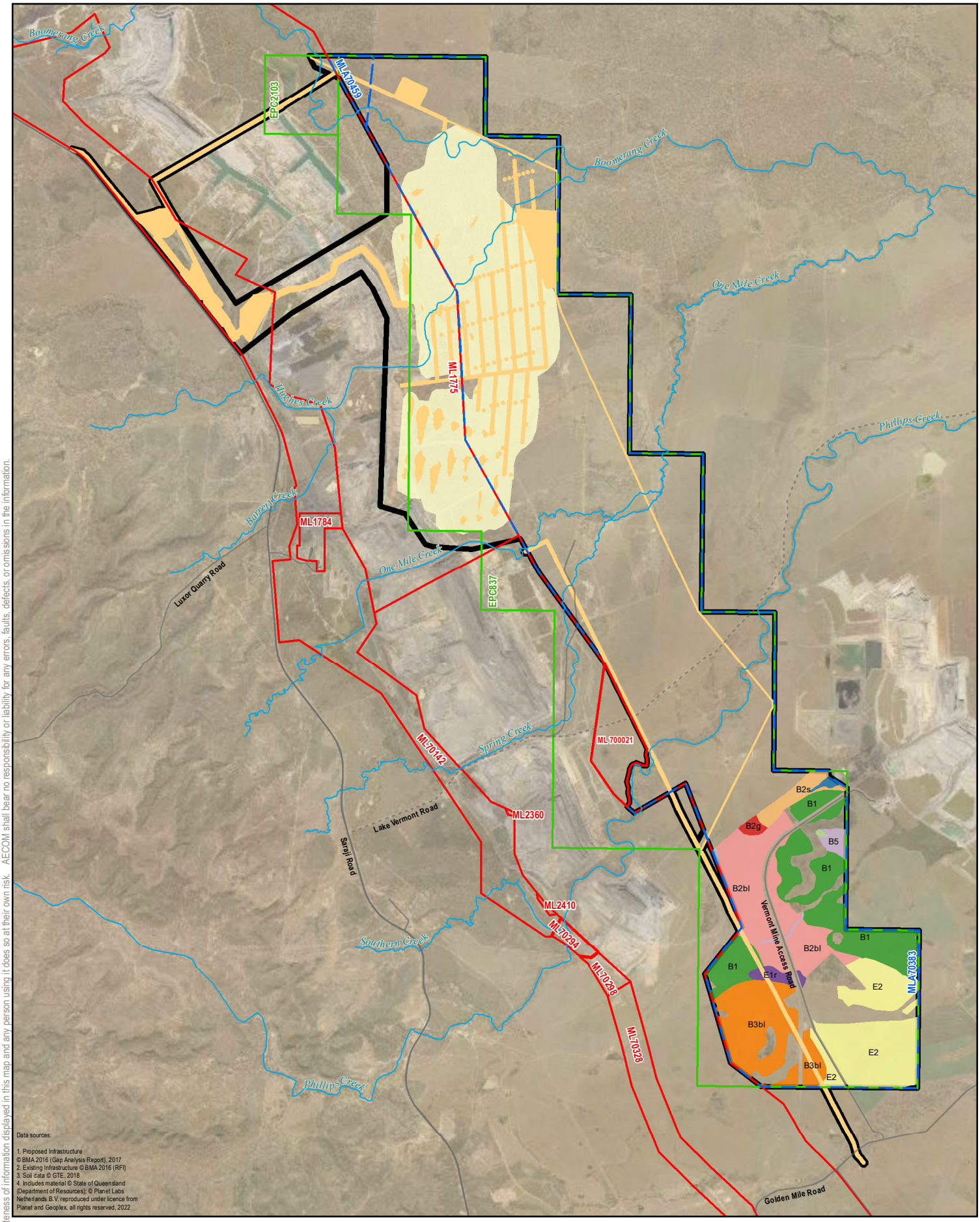
The Project Site and surrounds continue to be used for cattle grazing where mining activity is not currently occurring. The southern extent of the Project Site is mapped within the SCL Trigger Map (refer Figure 5-1). The SCL assessment (based on methods described in Section 5.3.1) identified SMUs within the SCL Assessment Area. Figure 5-10 shows the spatial distribution of these SMUs. The SCL map units were assessed against the SCL criteria outlined in Table 5-7. The findings of the assessment are summarised in Table 5-7. Rows shaded n light grey are likely SCL.

Table 5-7 SCL assessment summary

SMU	SCL map unit	SCL criteria exceedances	SCL status
B2s	1	pH – Sites N6-SCL, N7-SCL and N8-SCL	Not SCL
A4	2	pH – Sites N17, N18 and N19	Not SCL
B1	3	No SCL criteria exceedances reported	Likely SCL
A4c	4	pH – Sites N21 and N22 Chemical limitation for PAWC – Site N20	Not SCL
B2g	5	pH – Sites N4-SCL, N5-SCL and N9-SCL	Not SCL
B2bl	6	pH – Sites N26, N27, N32 and 80-SCL Soil water storage – Site 91-SCL	Not SCL
A2g	7	No SCL criteria exceedances reported	Likely SCL
B2s	8	No SCL criteria exceedances reported	Likely SCL
B1	9	No SCL criteria exceedances reported	Likely SCL
B5	10	pH – Sites N28 and N43	Not SCL
A5	11	pH – Sites N23, N24 and N25	Not SCL
B1	12	No SCL criteria exceedances reported	Likely SCL
B1	13	pH – Site 7-SCL Remaining two sites have no SCL criteria exceedances reported	Likely SCL
E1r	14	Soil water storage – Site 10-SCL, N41 and N42	Not SCL
B1	15	No SCL criteria exceedances reported	Likely SCL
B3bl	16	No SCL criteria exceedances reported	Likely SCL
E2	17	No SCL criteria exceedances reported	Likely SCL

SCL map units 3, 7, 8, 9, 12, 15, 16 and 17 meet the SCL criteria as they did not exhibit any limitation relating to SCL. SCL map unit 13 exhibited limitations relating to SCL criteria soil pH; however, most of the analysed sites did meet the SCL criteria, therefore SCL map unit 13 is likely SCL.

Six SCL map units (1, 2, 4, 5, 10 and 11) do not meet the SCL criterion for soil chemistry as they exceed the relevant pH threshold limitation exceedance. SCL map unit 14 does not meet the SCL criterion for soil water storage and SCL map unit 6 does not meet the SCL criteria for both for soil water storage and for soil chemistry pH limitation exceedance. Table 5-12 presents the verified SCL soil types across the SCL Assessment Area. These verified SCL soil areas are illustrated in Figure 5-11.



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LEGEND

- Project Site
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- Public Road

Soil Mapping Units

A2g	B2bl	B5
A4	B2g	E1r
A4c	B2s	E2
B1	B3bl	

N

Figure 5-10
Distribution of Soil Mapping Units in SCL Assessment Area
Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

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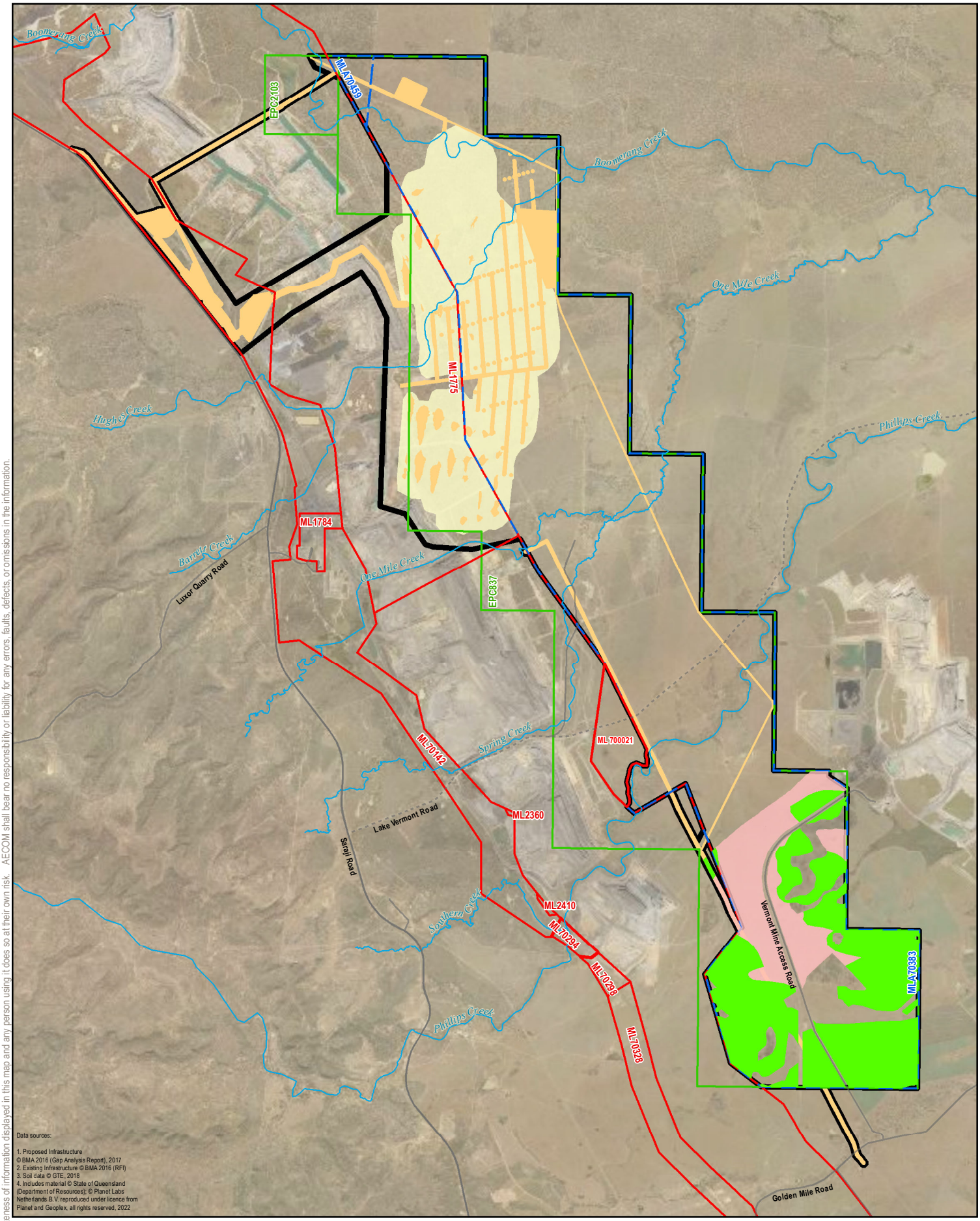

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LEGEND

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- Mining Lease Application (MLA)
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- Private Access Road
- Public Road

Strategic Cropping Land

- SCL - Verified SCL
- SCL - Non - SCL Area

N

Figure 5-11

Verified Strategic Cropping Land

Environmental Impact Statement Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

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5.4.6 Contamination

Potential notifiable activities

Land contamination can arise from a range of land uses and activities. Potential contamination within the Project Site could be the result of previous activities associated with rural and agricultural land uses, such as homestead complexes, stockyards, agricultural infrastructure, equipment laydown areas and landfills. Potential contamination could also be the result of activities associated with the historical use of the Project Site for mining and mineral processing activities.

It should be noted that where a notifiable activity has been identified as potentially occurring:

- land contamination may not be a direct result of the notifiable activity
- the extent (lateral and vertical) of any contamination arising from a notifiable activity does not necessarily extend across the entire land parcel to which the notification relates.

Table 5-8 separates notifiable activities that have potentially occurred within the Project Site, from notifiable activities that are unlikely to have occurred within the Project Site.

Table 5-8 Notifiable activities potentially or unlikely to occur within the Project Site

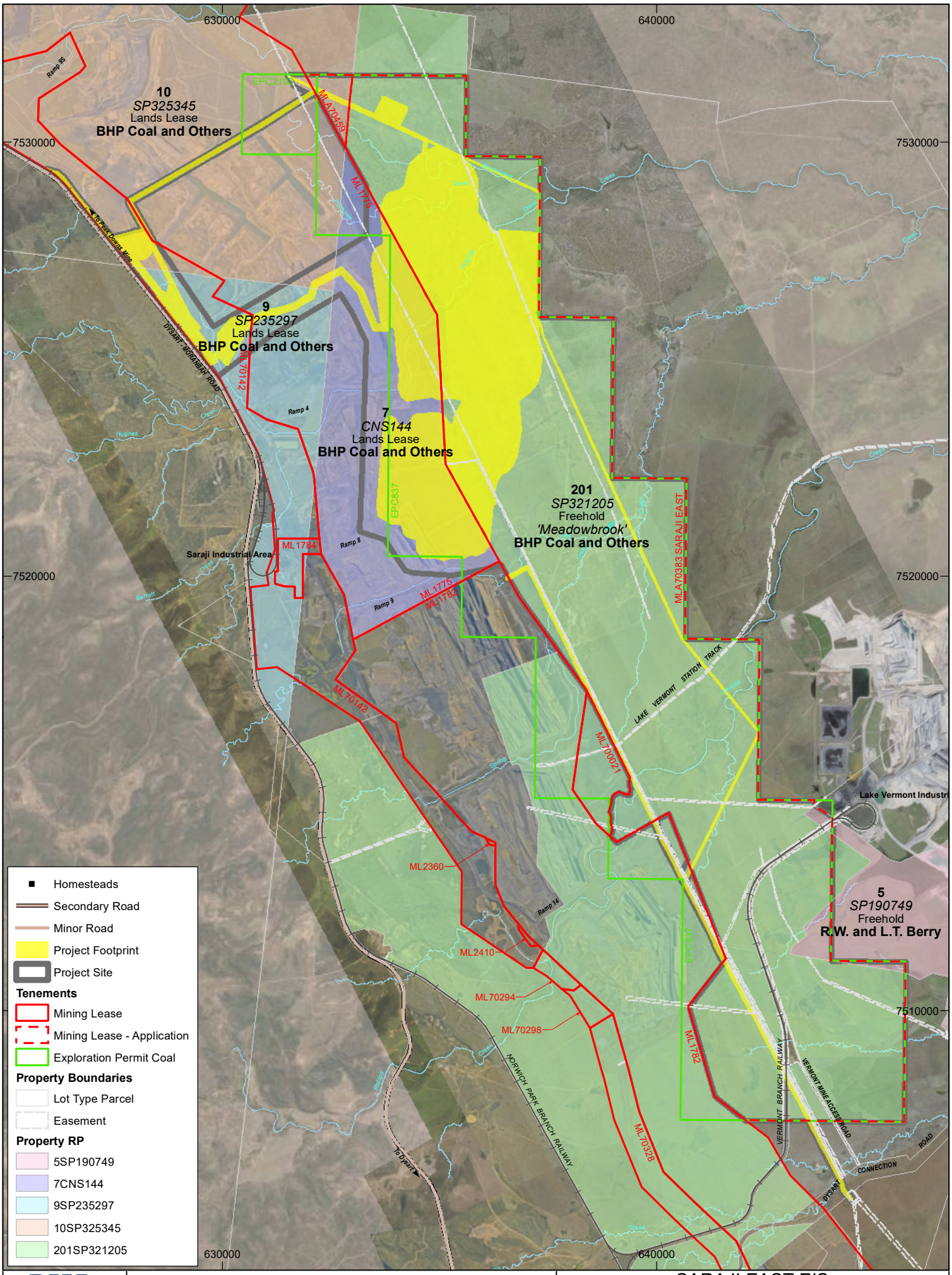
Notifiable activities that potentially occurred within the Project Site	Notifiable activities considered unlikely to have occurred within the Project Site
Abrasive blasting	Asphalt or bitumen manufacture
Aerial spraying	Petroleum or petrochemical industries
Asbestos manufacture or disposal	Smelting or refining
Chemical manufacture or formulation	Tannery, fellmongery or hide curing
Chemical storage	Wood treatment and preservation
Electrical transformers	Battery manufacture or recycling
Engine reconditioning works	Coal fired power station
Explosives production or storage	Coal gas works
Landfill	Drum reconditioning or recycling
Livestock dip or spray race operations	Dry cleaning
Metal treatment or coating	Fertiliser manufacture
Mine wastes	Foundry operations
Mineral processing	Gun, pistol or rifle range
Petroleum product or oil storage	Herbicide or pesticide manufacture
Railway yards	Lime burner
Scrap yards	Paint manufacture or formulation
Waste storage, treatment or disposal	Pest control
	Pharmaceutical manufacture
	Printing
	Service stations

Where DES has been advised that a notifiable activity has been, or is being undertaken, the land parcel where this activity has taken place is listed on the EMR or CLR. It is possible that notifiable activities have occurred, or are occurring, on properties within the Project Site without these properties being listed on the EMR or CLR.

A search of the EMR and the CLR was conducted for the main properties in the Project Site vicinity. Of the lots searched, none were identified on the CLR. All of the lots were identified with notifiable activities occurring. Table 5-9 summarises the search responses received. Lots/Plans associated with the Project Site with a notifiable activity listed are displayed on Figure 5-12. Figure 5-12 shows that each of the lots fall within the Project Site and/or Project Footprint. Some also fall within the existing Saraji Mine. Therefore, from this it can be deduced that the EMR parcels are likely notified for mine-related activities.

Table 5-9 EMR and CLR search results

Lot	CLR Result	EMR Result / Potential notifiable activities
201SP321205	N/A	Notifiable activity associated with mining activities.
9SP235297	N/A	This property is subject to notifying the following activities: • landfill • mine wastes.
10SP137499	N/A	This property is subject to notifying the following activities: • chemical storage • explosives production or storage • petroleum products or oil storage • waste storage treatment or disposal • mine wastes.
7CNS144	N/A	This property is subject to notifying the following activities: • asbestos manufacture or disposal • disposal of waste • mine wastes • scrap yard operating • regulated waste storage treatment or disposal.
5SP190749	N/A	Notifiable activity associated with mining activities.



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Geospatial Team
Brisbane

0 2 4 km

Transverse Mercator Projection
AGD 1966 AMG Zone 55

SARAJI EAST EIS

FIGURE 5-12 LOT/PLANS ASSOCIATED WITH THE PROJECT SITE WITH NOTIFIABLE ACTIVITY LISTED

Drawn: P. Watts	Date: 10/06/2024	Revision:	Fig. 5-12
Checked: K. Taske	Filename: 20240610-1.mxd		

Review of aerial photography

Recent aerial photography of the Project Site was reviewed to identify potential areas of concern with regards to land contamination. A summary of the identified activities is included in Table 5-10.

Table 5-10 Potential for pre-existing notifiable activities to occur within the Project Site

Activity	Activity details	Comment	Occurrences within the Project Site
Stockyard complex	Stockyards, holding yards, potentially including spray races or stock dips.	Potential for use of insecticides in spray races and/or dips.	The presence of stockyards was not identified in aerial photography; however, the resolution of the available imagery may not have been detailed enough to identify stockyards.
Equipment laydown areas	Cleared area where equipment is/may have been stored.	Potential for minor chemical/fuel/oil/ waste oil storage/spills.	Aerial imagery indicates multiple locations across the Project Site that have been used for equipment laydown associated with mining activities.
Farming infrastructure	Silos, above ground storage tanks, machinery storage.	Sheds, above ground storage tanks, silos with potential for minor chemical/ pesticide/fuel/oil/ waste oil storage/spills.	Aerial imagery indicates multiple locations across the Project Site that have been used as homesteads.
Dams	Dams, depending on how they were constructed, may have utilised imported fill, or minor fuel storage associated with pump mechanisms.	Potential for importing of previously contaminated soil, and/or for minor soil contamination associate with pumps etc.	Aerial imagery indicates multiple locations across the Project Site that have been, and are being, used as dams and water/waste storages.
Mining	Potential box cut/borrow pit/quarry.	Potential for minor fuel/chemical/oil/ waste oil storage.	Aerial imagery indicates multiple locations within the vicinity of the Project Site that are, and have been, subject to mining activities.

Unexploded ordinance search

A UXO is any sort of military ammunition or explosive which has failed to explode as intended.

Military ammunition is designed to explode at the time it is used, but for a variety of reasons some military ammunition fails to do so (Department of Defence, 2018a).

In Queensland, DES works with the Department of Defence to manage UXO contamination (NEPM 1999 as varied, NEPC). A review of Department of Defence UXO mapping identified that the Project Site does not contain any known UXO contaminated areas (Department of Defence, 2018b).

It is considered that any future Project works should not be impacted by any UXO. However, care will be taken, and advice from the Department of Defence sought and followed, if any potential devices are identified.

5.5 Potential impacts

5.5.1 Subsidence

A detailed mine subsidence assessment is presented in **Appendix B-2 Subsidence Modelling**. The subsidence modelling assessed the optimised underground layout.

Potential impacts of post-mining subsidence are discussed in the subsections listed below and summarised in Table 5-11:

- first order impacts – direct physical effects of subsidence
- second order impacts – geomorphic response to subsidence
- third order impacts – changes to flood regime, water quantity and quality
- fourth order impacts – impacts on flora and fauna.

Table 5-11 Potential subsidence impacts

Potential impact	Summary
Landform	• subsidence induced depressions over the longwall panels: - over southern panels, maximum surface subsidence (at end of mining) range from 2.0 m to 3.4 m over all longwalls except LW208 where the overburden thickness exceeds 300 m limiting subsidence to 1.4 m - over northern panels, maximum surface subsidence (at end of mining) range between 0.75 m and 2.25 m where the overburden thickness ranges between 250 m and 400 m - over the mains is predicted at approximately 0.2 m. • surface cracks have potential to form above the longwall abutment edge and on either side of the chain pillars (refer to **Appendix B-2 Subsidence Modelling**): - likely to be contained within the panel boundaries for shallow longwalls but may extend beyond these boundaries for the deeper panels - over shallow longwalls (overburden thickness <300 m) extending to a depth of 30 m to 70 m; as a result, surface water flows over these longwalls could infiltrate the underground workings - longwalls at depths greater than 300 m will induce shallow (<15 m) cracks on surface which may form tortuous connectivity with activated joints and bedding planes in the constrained zone.
Surface water	• morphological stability of watercourses: - the creation or alteration of riffle and pool sequences - changes to flood behaviour - incision processes - stream widening - lowering of creek bed and banks - reduced flow due to increased porosity and permeability. - change of water quality due to: ▪ reduction in dissolved oxygen ▪ increased salinity, ▪ increase iron oxides, manganese, and ▪ increase electrical conductivity (EC). - decreased bank stability - erosion and accretion until the bed profile is restored to a stable profile. **Chapter 8 Surface Water** further discusses the scale and likelihood of these impacts.
Groundwater	• seepage via surface cracking - fractures in the Permian rock mass and overlying Tertiary sediments may provide pathways for drainage of groundwater resources.

Potential impact	Summary
Ecology	- dieback of riparian vegetation due to cracks beneath streams - changes to riparian community structure and composition due to water loss and disturbance of the root zone - reduction of creek stability due to the death of fringing vegetation and tree fall - vegetation stress from either mechanical disturbance or water table change - surface cracking and localised changes in topography at the edges of the longwall panels (where slope change is greatest) potentially affecting the health of individual trees and shrubs - localised changes in topography within depressions above longwall panels potentially altering the soil composition and drainage characteristics, resulting in deep depressions becoming ephemerally wet. **Chapter 9 Groundwater** further discusses the scale and likelihood of these impacts.
Aquatic Ecology	- lowering sections of stream bed with changes in bed level - alteration of natural water flow patterns - fish stranding in subsided areas due to restricted fish movement, especially during low flow conditions - loss of fish due to fish passage blockage - hydrological and biological disconnect between the Isaac River and upper catchment areas - bank failure, in-filling of the channel and creation a barrier to fish caused by erosion. **Chapter 7 Aquatic Ecology** further discusses the scale and likelihood of these impacts.
Infrastructure	• existing infrastructure in the Project site - will be relocated outside of the subsidence boundary as part of the Project.

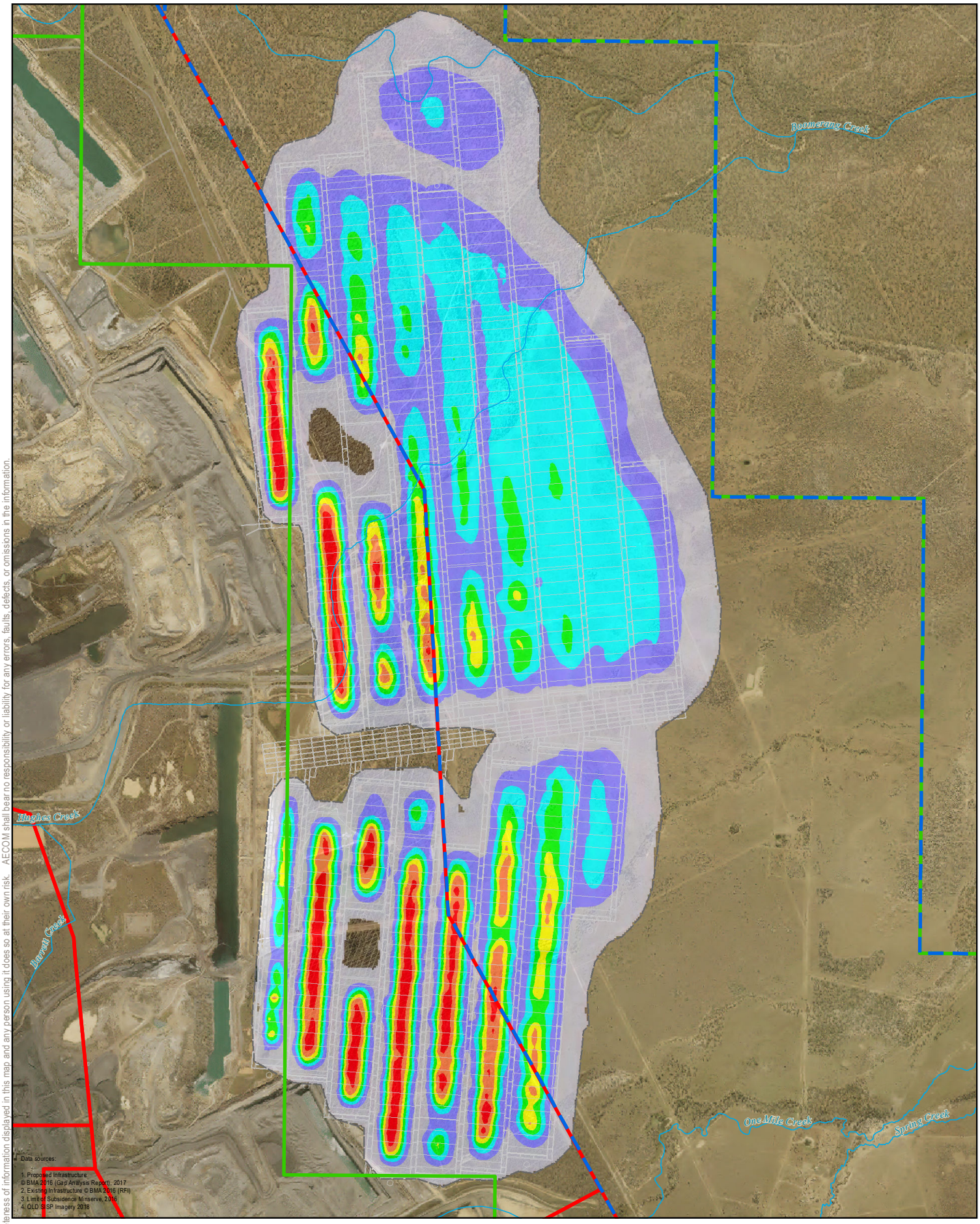
Pre-mining land use in the Project Site is predominantly cattle grazing. Due to the gradual nature of the subsidence, it is expected that grazing activities will continue during mining operations but out of direct operational areas where surface equipment is present or while any related subsidence occurs.

The modelled predicted subsidence impact can be seen in Figure 5-13.

The modelled predicted subsidence impacts are outlined below:

- There is significantly more subsidence induced over the southern panel compared with the northern panel. This can be attributed to the thickness of Dysart seam overburden. It is observed that subsidence in excess of 2.25 m correlates directly with 250 m contour.
- The fully extracted longwalls in southern panel are predicted to show maximum surface subsidence in the range 2.0 m to 3.4 m over all longwalls except LW208 where the overburden thickness exceeds 300 m thus limiting subsidence to 1.4 m.
- Over all longwalls in the northern panel the maximum surface subsidence ranges between 0.75 m and 2.25 m where the overburden thickness ranges between 250 m and 400 m.
- The extent of subsidence over longwalls as projected onto E-W cross-sections shows that goafing of overburden strata extends through the Permian strata and up into the Tertiary sediments over longwalls where the overburden thickness is less than 250 m.
- For the current mining layout goafing is confined to Permian strata below Harrow Creek seam when the overburden thickness exceeds 250 m.
- Depending on the dimensions of the barrier pillar and thickness of overburden, subsidence is predicted to vary across their length from 0m and 0.5 m.
- Surface subsidence over the Mains will be about 0.2 m.

Existing infrastructure in the Project Site will be relocated outside of the subsidence boundary as part of the Project.



LEGEND

- Underground Mine Layout
- Limit Of Subsidence
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse

Modelled Subsidence Contour

- < 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- > 3.0m

N

Figure 5-13
Subsidence contours and extent

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.25 0.5 1
Kilometres

Scale: 1:40,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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DATE: 25/06/2024 VERSION: 3

AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

5.5.2 Soils and land suitability

Topsoil stripping associated with development of surface infrastructure may potentially impact future land use if not managed appropriately. Potential impacts may include but are not limited to:

- incorrect stripping depths of a SMU
- mixing of higher quality soil with low quality during stockpiling phase
- erosion of areas which have been stripped or stockpile areas
- identification of rehabilitation soils and their maintenance
- incorrect placement of soils.

The desktop, field and laboratory observations of existing soils shows very low field indication of PASS with no indicators of AASS across all 23 SMUs.

5.5.3 Contaminated land

Potential land contamination impacts within the Project Site may result from the disturbance of existing contaminated land, or contamination caused by activities associated with the Project. Impacts have the potential to harm human, surface water, groundwater and soil health, leading to degradation of the natural environment, and a reduction in the productive capability of the land and the sustainable use of natural resources.

As identified in Section 5.4.6, all of the main properties are listed on the EMR. Some Project activities have the potential to contaminate the Project Site as a result of the generation and handling of wastes, including mineral wastes. A discussion of the potential impacts associated with mineral waste can be found in **Chapter 10 Geochemistry and Mineral Waste**.

Disturbance of existing contaminated soils

Project activities have the potential to disturb existing contaminated land or groundwater during the construction, operation, decommissioning and rehabilitation phases. The disturbance of contaminated land or groundwater has the potential to contaminate previously unaffected soil or groundwater and affect human health through ingestion/dermal contact.

In the case that any existing (but unregistered) notifiable activities are positively identified during pre-construction works, in accordance with Section 320A(2) of the EP Act, landowners, or occupiers are required to notify DES so that the affected land parcels may be included on the EMR.

Project activities with the potential to cause land contamination

Project activities and areas within the Project Site with the potential to cause land contamination include:

- coal transportation
- coal handling facility, including conveyors
- refuelling areas
- chemical stores
- water treatment plants
- maintenance areas
- spoil and overburden storage and disposal
- haul roads.

Contamination sources from operations can include, but are not limited to, the following:

- spills of fuels, greases and lubricating oils which may cause localised contamination
- ineffective mineral waste disposal leading to soil and groundwater contamination as a result of leaching

- cargo spills during coal transportation on mine haul roads
- ignition of unprocessed coal releasing fly ash and other harmful emissions
- change in chemical or physical composition of natural soil in areas where mining has occurred, or overburden is dumped
- change in chemical or physical composition of natural soil in areas where dust suppression constitutes using water containing dissolved salts.

Demolition of buildings and infrastructure within the Project Site also has the potential to contaminate soils if not managed effectively. These activities have the potential to increase the risk of contaminants impacting human health and sensitive environmental receptors.

In consideration of the scale of the Project, significant environmental and/or health risks could occur if contaminated material is not identified prior to construction works, potentially exposing workers, members of the community and the environment to contaminants.

5.6 Mitigation and management measures

5.6.1 Subsidence

A Subsidence Management Plan (SMP) (**Appendix K-2**) has been prepared for the Project. The proposed approach to managing subsidence is to use proactive measures to predict and potentially improve the overall condition of the potentially affected areas, so that any adverse effects of subsidence are minimised.

The order of controls for subsidence management is:

- mitigation (pre and post subsidence)
- monitoring and rehabilitation.

Monitoring

Appendix K-2 Subsidence Management Plan provides an overview of the monitoring requirements pre and post mining to ensure relevant data is captured for:

- landform
- surface water
- groundwater
- ecology
- infrastructure.

The SMP includes a risk assessment that will be reviewed and updated as needed prior to commencement. A pre-subsidence risk assessment will be conducted prior to Project commencement and will include a cross section of suitably qualified personnel. The findings of the risk assessment and monitoring will be used to identify suitable measures to mitigate the environmental risks. Monitoring of potential subsidence areas will be undertaken prior to any panel being subsided to ensure that any subsidence impacts are quickly identified and appropriate mitigations applied. Monitoring for surface subsidence parameters will commence after cessation of subsidence movements and will continue periodically. A summary of monitoring requirements is provided in Table 5-12.

Table 5-12 Summary of monitoring requirements

Subsidence impact	Methodology	Parameters	Frequency
Landform	• geomorphological condition/status surveys • photographic recording of reach condition • aerial LiDAR and/or remote sensing technology where applicable.	• assessment of impacts on: - soils - sediment accumulation - watercourse stability - land use related to water availability or quality (e.g. cattle grazing).	• prior to subsidence • aerial survey LiDAR to be flown annually • annually or in accordance with EA conditions during the operational and closure phases of the Project.
Surface water	• pre-subsidence surveys of the channel geometry of specific reaches of Boomerang, Plumtree Creek and Hughes Creek and their surroundings • photographic recording of the creeks as they pass over the subsided area, as well as for 1km upstream of the subsidence area and downstream of the subsided areas to the extent of the ML.	• pre-subsidence: - pool/riffle sequences - bed controls - entry points of other watercourses and localised tributaries - existing bed and bank scour points - any infrastructure located within the watercourse - channel slope - channel description including flow channel dimensions - riparian vegetation conditions - flow - peak discharge flow - erosion points - overflow and flood points - floodplain description - catchment size - catchment relief • post-subsidence: - erosion or accretion processes that have occurred as a result of subsidence - migration of head cut erosion within watercourses and tributaries - localised changes to stream bed slope	• prior to subsidence • annually or in accordance with EA conditions during the operational and closure phases of the Project.

Subsidence impact	Methodology	Parameters	Frequency
		- localised widening of channels - destabilisation of stream bed and banks including fracturing and incision - localised changes to bank heights - active searches for cracks within a 50m radius of monitoring locations - monitoring of select ponding water quality (EC) and level - monitoring of surface water quality (pH, EC and turbidity).	
Groundwater	• groundwater Technical Impact Assessment completed as part of the Project EIS • groundwater monitoring program.	• water level measurement • water quality field conductivity measurement • chemical analysis of water samples to be taken annually • groundwater level rebound • groundwater flow patterns.	• prior to subsidence (already completed as part of the Project EIS) • annually or in accordance with EA conditions during the operational and closure phases of the Project.
Ecology	• ecological studies completed as part of the Project EIS • remnant vegetation and regrowth monitoring.	• pre-subsidence: - flora: ▪ height class and life form of the dominant species within each strata (emergent, canopy, subcanopy, understory) ▪ foliage projective cover ▪ coarse woody debris ▪ groundcover composition ▪ native and introduced plant species richness ▪ native and introduced plant species relative abundance ▪ tree health parameters - fauna:	• prior to subsidence (already completed as part of the Project EIS) • annually or in accordance with EA conditions during operational and closure phases of the Project.

Subsidence impact	Methodology	Parameters	Frequency
		▪ intensive trapping ▪ microhabitat search program • post-subsidence: - remnant vegetation: ▪ discoloration ▪ partial defoliation ▪ increased pathogenic attack ▪ tree death - regrowth.	
Infrastructure	• photographic recording.	• photographic records of - pipelines - electricity transmission infrastructure - watercourse related infrastructure - dams and collection ponds - bores - windmills.	• prior to subsidence • annually or in accordance with EA conditions during operational and closure phases of the Project.

Management of subsidence

Potential mitigation measures for the management of subsidence are listed in Table 5-13. These measures will be applied as necessary to achieve the most practicable environmental outcomes. Progressive rehabilitation will be conducted as the mine advances and panels subside. Further detail regarding the implementation of rehabilitation is provided in Section 5.6.4. Mitigation measures will be selected based on the type and scale of impacts observed as a result of monitoring.

Ongoing reporting will be conducted during the operation of the Project, in accordance with the EA and **Appendix K-2 Subsidence Management Plan**.

Table 5-13 Indicative mitigation techniques

Subsidence impact	Mitigation measure
Landform	• embankment arming • bed stabilisation such as pervious weirs • geomorphological modelling to predict high energy areas of the subsided landform • grazing access/controls to mitigate vegetation stripping and bank damage • channel re-profiling and construction of contour banks • vegetation planting • erosion control matting in high energy or erosive areas • construction of drop structures at head cut erosion features • ripping • tyning • grading • compaction • crack infilling with concrete or clay • progressive rehabilitation.
Surface water	• embankment arming • bed stabilisation such as pervious weirs • geomorphological modelling to predict high energy areas of the subsided landform • grazing access/controls to mitigate vegetation stripping and bank damage • channel re-profiling and construction of contour banks • vegetation planting • erosion control matting in high energy or erosive areas • construction of drop structures at head cut erosion features • ripping • tyning • grading • compaction • crack infilling with concrete or clay • progressive rehabilitation.
Ecology	• investigate and establish offsets • revegetate areas impacted • utilise dead vegetation in habitat creation • regrading to promote drainage.
Infrastructure	• repair infrastructure as required • where possible, remove all infrastructure within the subsidence zone prior to the subsiding of any panel.

5.6.2 Soils and land suitability

Post mining land use suitability is influenced by various factors including changes to physical, chemical and biological properties of soil, slope and slope length, soil depth and the quality of the underlying spoil. Given that Project involves underground mining, the extent of surface disturbance will be limited. The proposed rehabilitation for the Project is discussed in Section 5.6.4.

Topsoil management

Table 5-14 presents the recommended topsoil strip depth and use for topsoil. Any disturbance or stripping of soil within SCA areas is only allowed as per the existing, approved Regional Interests Development Approval (RIDA), as outlined in the Restoration Plan to Support RIDA Application Saraji East Project (GTE, 2021) and RPI 121/001.

There are no further SCA areas that are approved by RPI 121/001, outside of the project site disturbance footprint that can be disturbed for stripping and stockpiling. Any disturbance of SCA not subject to an existing RIDA would require separate approval under the *Regional Planning Interests Act 2014* (Qld).

Table 5-14 Recommended topsoil strip depth and recommended use

SMU	Recommended topsoil strip depth	Recommended topsoil use
2/20	0.00-0.30 metres below ground level (mbgl)	Strip the A horizon of the duplex soils (20 to 30 centimetres (cm)) avoiding the lighter coloured B horizon clays. Where clay soils are present, stripping should only take place to a maximum of 30 cm. Poorer surface structural characteristics are indicated and replacement should only be on relatively low slope angles.
12	0.00-0.40 mbgl	Strip the upper 40 cm, avoiding lower A2 or B horizon materials. Replacement should only be on very low slope angles as nutrition is low and structure is weak.
13	0.00-0.25 mbgl	Strip the A horizon (15 to 25 cm) avoiding B horizon clays which are generally dispersive. Only reuse the soil on almost flat areas (<0.5%) as the soil has very poor physical characteristics with low infiltration rates and is prone to surface sealing. If sufficient volumes of other soils are available for rehabilitation, the SMU may be better discarded.
16/23	0.00-0.25 mbgl	Strip the A horizon material (20 to 25 cm) avoiding bleached A2 material (where present) or B horizon clays. The material should only be used on flatter slopes as structural instability is indicated.
17	Nil	Generally nil, minor SMU with little seed source.
18	0.00-0.50 mbgl	Strip the surface 50 cm as soil in most areas, however close to the creek systems, around 90 cm of useable material (essentially a germination medium for flatter slopes) may be present. Avoid the inclusion of lower clay layers as some of these materials in the Hughes and Spring creek areas may be very dispersive. Overall structure is weak and the material should not be reused on steep slopes.
19	0.00-0.50 mbgl	Strip the surface 50 cm as better quality soil.
3	0.00-0.30 mbgl	Strip the upper A horizon (20 to 30 cm) avoiding the lighter coloured A2 or B horizon clays. Replacement should only be on very low slope angles as nutrition is low and structure is weak.
4	0.00-0.30 mbgl	For use as topsoil, limit stripping to the surface 30 cm in most areas (avoiding light brown subsoil materials). Patches of very dark clays containing carbonate could be taken to a total depth of 50 cm. The soils are suitable for replacement on elevated slopes as good nutrition and reasonable structural characteristics are evident. Initial plant establishment may be slowed by salinity.
5	0.00-0.20 mbgl	Strip the surface 20 cm as topsoil and a seed source in most areas. In occasional areas depth may be as little as 10 cm (structure is poor and the material should not be reused on steep slopes).
8	0.00-0.15 mbgl	The surface 10 to 15 cm (A horizon) may be useful on very flat areas (do not strip the scalded areas).
A1	0.00-0.40 mbgl	Topsoil may be retrieved for the major extent of the sandy A horizon. The material is suitable for use on all level to gently sloping rehabilitation areas.
A2	0.00-0.30 mbgl	Topsoil should only be retrieved from the upper 20 cm as salinity risk increases below this level. The material is suitable for use on lower sloping rehabilitation areas and should ideally be placed to a depth of 20 cm.

SMU	Recommended topsoil strip depth	Recommended topsoil use
A2g	0.00-0.10	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Recommended for slope and level plain application.
A3	0.00-0.50 mbgl	Topsoil strip depth may extend well past the nominated 50 cm strip depth although more intensive testing for EC and structural assessments should be conducted beforehand. The sandy loam topsoil may be taken until hard clayey subsoil is encountered. The material is suitable for use on most level to gently sloping rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
A4	Nil	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Not suitable due to texture grade of the surface.
A4c	0.00-0.10	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Highly suitable - Recommended for slope and level plain application.
A5	0.00-0.10	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Suitable - Recommended for slope and level plain application.
B1	0.00-0.50 mbgl	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Excellent quality topsoil which could be taken deeper than the 50 cm nominated depth (up to 90cm) or double stripped. The material is suitable for use on all rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
B2	0.00-0.30 mbgl	Topsoil should not be taken deeper than the 30 cm nominated depth as below this depth the subsoil is quite hard and coarse structured which would seal if placed on rehabilitation. The material is suitable for use on flatter rehabilitation areas as it tends to erode. It should ideally be placed to a depth of 20 cm or more.
B2bl	0.00-0.10	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Suitable - Recommended for slope and level plain application.
B2g	Nil	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Not suitable due to texture grade of the surface.
B2s	0.00-0.15	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Highly suitable - Recommended for slope and level plain application.
B3	0.00-0.30 mbgl	These soils are traditionally variable in quality – particularly between mounds and depression positions. The mounds are better quality than many other melon hole situations and are not excessively saline or sodic above about 50 cm depth. Nevertheless, topsoil should not be taken deeper than the 30 cm because of the risk of contamination from saline subsoil. The material is suitable for use on flatter rehabilitation areas as it tends to erode. It should ideally be placed to a depth of 20 cm or more.
B3bl	0.00-0.10	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; Highly suitable - Recommended for slope and level plain application.

SMU	Recommended topsoil strip depth	Recommended topsoil use
B4	0.00-0.20 mbgl (mound) and 0.00 mbgl (depression)	Melon hole soils often vary considerably between mounds and depression positions. The flat areas between depressions (mounds) offer rehabilitation potential however the dark crusting clay depressions should be avoided. It is important that stripping does not go too deep as useable topsoil will be contaminated. The material is preferred on flatter rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
B5	Nil	Not suitable due to structure grade (Massive). Soil amelioration and mixing of other suitable topsoils may improve soils to 0.00-0.20 mbgl.
E1	0.00-0.50 mbgl	The loose surface topsoil for reuse in mine rehabilitation may be stripped moist or dry. These soils offer large quantities of good porous material with a variety of applications in mine rehabilitation. Stripping depth will normally exceed 60 cm. The material is suitable for use on most rehabilitation areas as it tends to infiltrate water rapidly and remain loose. It should ideally be placed to a depth of 20 cm or more.
E1r	Nil	Not suitable due to the texture grade (Sandy). Soil amelioration and mixing of other suitable topsoils may improve soils to 0.00-0.15 mbgl.
E2	0.00-0.40 mbgl	Areas located within SCA area are not under approval for stripping. For areas outside of SCA; These soils are high quality clay soils with a high moisture retention capacity however the establishment of permanent pasture cover on rehabilitation may take considerable time as problems occur with germination of fine seeded plants in the shrinking and swelling medium. The soils are often saline below 50 cm depth so a depth cut off of 40 cm is nominated. The material is more suited for use on flatter rehabilitation areas as it tends to erode and the establishment of a protective surface cover may take longer than expected. It should ideally be placed to a depth of 20 cm or more.
E3	0.00-0.20 mbgl	Stripping of these soils should not proceed into the clayey subsoil as the material is hard, impervious and generally dispersive. It is preferable to take less soil than risk contamination with the poor subsoil. Use should normally be limited to rehabilitation of level sites.
T1	0.00-0.20 mbgl	The upper sandy loam may be stripped to the harder pale coloured clay subsoil. In most cases 20 cm of soil would be available for stripping. The preferred rehabilitation application is flat sites only due to high erosion potential.
T2	0.00-0.20 mbgl	The T2 SMU at 10 – 20 cm horizon is a well-drained and higher quality soil which overlies very dense fine sandy loam. It is expected to set hard and seal if placed over rehabilitation. The preferred rehabilitation application is flat sites only due to high erosion potential.

5.6.3 Contaminated land

A search of the EMR and CLR was conducted identifying all of the major land lots for this Project are listed on the EMR. As there is a potential for contamination to exist at the site, a preliminary site investigation will be undertaken during the detailed design phase to identify the location and nature of any contamination that will potentially be encountered during Project works.

If the preliminary investigation identifies that contamination is significant, a detailed site investigation will be undertaken prior to construction of the Project to assess the health and environmental risks of the contaminants. A management and remediation plan will then be developed in order to minimise the impact of these contaminants.

Where practical, the following measures will be implemented prior to commencing Project works:

- directing excavation works, spoil or topsoil storage during planned operations and remediation to avoid potentially contaminated areas
- design drainage to minimise the amount of run-off occurring near, or across, potentially contaminated land
- undertake an environmental assessment of potentially contaminated sites that will be impacted during the operational phase of the Project.

5.6.4 Rehabilitation

As required by the ToR, a Rehabilitation Management Plan (RMP) has been developed for the Project (**Appendix K-1**). The RMP (**Appendix K-1**) covers rehabilitation of the Project's underground operations, including the areas to be disturbed that overlap the Saraji Mine, plus land disturbed by mining activities on MLA 70383 and MLA 70459.

The RMP presents the preliminary mitigation, adaptive management and monitoring approach to be implemented following construction and subsidence of each panel to ensure the final landform is a safe, non-polluting and stable landform, and supports a sustainable land use.

During detailed design, and progressively throughout the mining process, subsidence modelling and the SMP (**Appendix K-2**) will be updated in response to revised predictions based on Lidar-derived surface level data for the most recent subsided panels.

Once subsided and stable, progressive rehabilitation can occur in accordance with the RMP (**Appendix K-1**). The RMP (**Appendix K-1**) will be incorporated and replaced by the PRCP once finalised. The RMP (**Appendix K-1**) may be further refined as part of the development of the PRCP. Environmental Authority (EA) conditions for the Project will detail the requirement for the development of the PRCP.

NOTE: This plan has been drafted in support of the Project Environmental Impact Statement (EIS) and will be finalised prior to commencement of mining activities. The finalised plan will be assessment and certified by appropriately qualified and experienced person and provided to the administering authority for comment.

The Saraji Mine RMP establishes site-wide strategies to achieve rehabilitation by prioritising stability of the final landform, and the return of land use to grazing, where appropriate. This approach recognises the challenging nature of the spoil material, the climate, the elevated spoil landforms and significant change in local topography, and the scarcity of topsoil resources. In accordance with the existing Saraji Mine RMP and existing approved EA conditions, rehabilitation of disturbed land will commence within two years of the mined area becoming available. Post-mining rehabilitation as outlined in the RMP is detailed below.

The Project PRCP is not required to be compiled as part of the EIS however will be developed in combination with the EA approval after completion of the EIS, but prior to construction commencing, and will demonstrate that the proposed Project will:

- be rehabilitated to a safe and stable landform
- not cause environmental harm
- sustain post mining land uses.

Rehabilitation works of the open cut mine and infrastructure at Saraji Mine will be carried out under the Saraji Mine RMP (or Saraji Mine PRCP once approved). The Saraji Mine RMP establishes rehabilitation goals, objectives and strategies to achieve rehabilitation by prioritising stability of the final landform, and the return of land use to cattle grazing, woodland habitat, watercourse and water storage where appropriate. This approach recognises the closure landform, the climate and the topsoil resources.

The Saraji Mine RMP recognises the final voids will not have a post-mining land use and provides for appropriate rehabilitation to achieve a safe, stable and non-polluting landform.

The current scope and timing of the Project will not change the rehabilitation objectives for the Saraji Mine. The existing Saraji Mine EA conditions will not need to be amended to allow rehabilitation to progress when Saraji Mine areas become available for rehabilitation. In the event the Project extends beyond the current mine life of Saraji Mine, the final closure and rehabilitation of the final void and shared infrastructure will be transferred to the Project in cooperation and agreement with DES and amended EA conditions.

5.6.4.1 Post mining land use

BHP's Queensland Coal Rehabilitation Completion Criteria (BHP, 2018c) outlines the completion criteria for meeting satisfactory rehabilitation for post mining land uses. Post mining land uses across BHP's operations typically include:

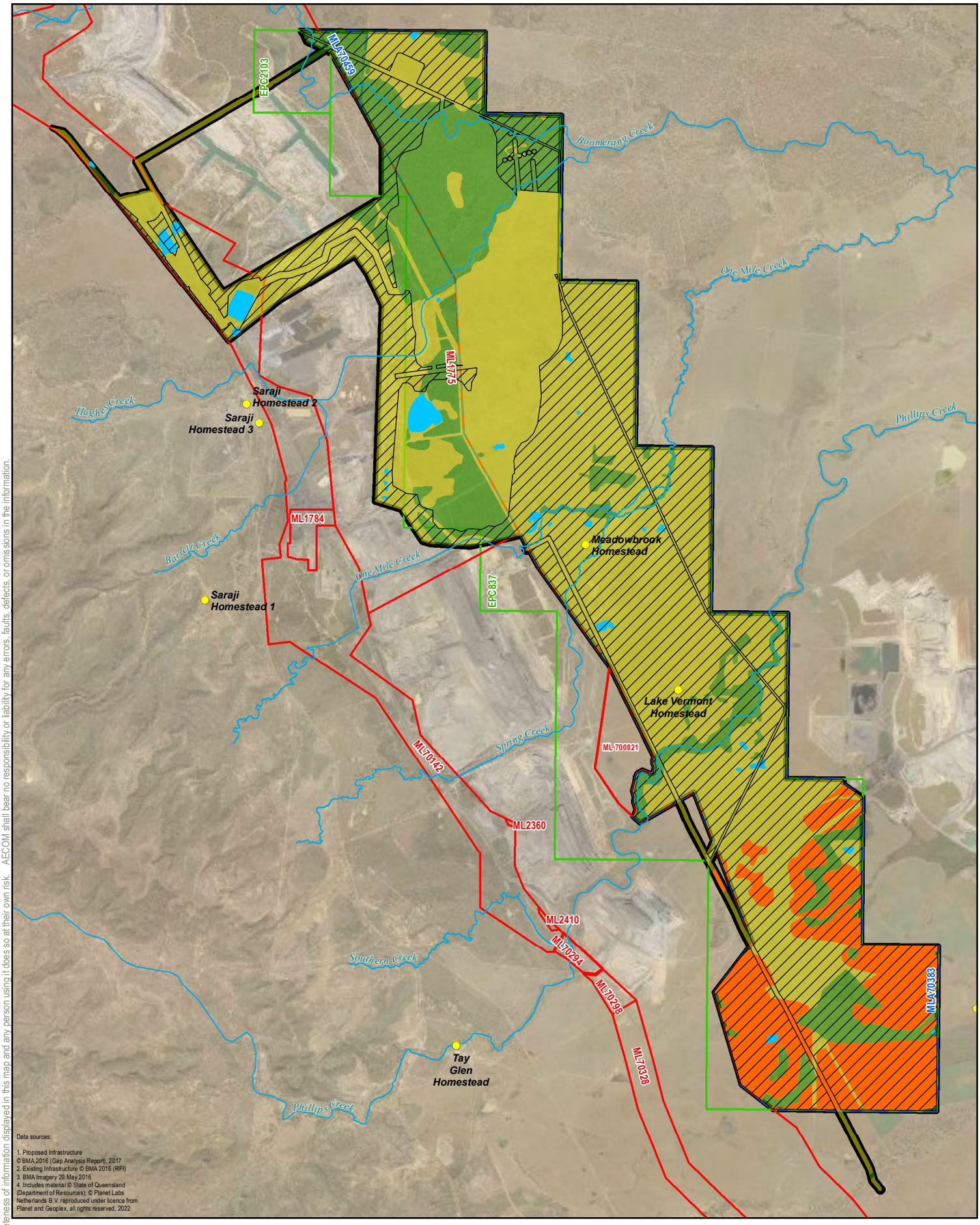
- cattle grazing (including supporting water storage)
- dryland cropping
- woodland habitat
- watercourses.

Queensland Coal Rehabilitation Completion Criteria notes that final voids are not considered a post mining land use as they are difficult to justify as an acceptable rehabilitation post mining land use. No voids are proposed as part of the Project (areas within existing ML's will be subject to rehabilitation as approved for the existing Saraji Mine).

The final landform at the Project Site will be suitable primarily for cattle grazing, with dryland cropping where SCL is verified (as identified in the southern portion of the Project Site) and woodland habitat restored in impacted areas. The disturbance domains and potential PMLUs for the Project are summarised in Table 5-15. Indicative post mining land uses proposed for the Project are illustrated in Figure 5-14.

Table 5-15 Indicative post mining land use for each domain

Domain	Post mining land uses		
	Grazing land	Woodland habitat	Dryland cropping
Surface infrastructure	X		X
Mining impacted areas	X	X	



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LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse
- Homestead

Post Mine Land Use

- Water storage
- Woodlands habitat
- Cattle grazing
- Rainfed cropping
- Undisturbed Area

N

Figure 5-14
Indicative Post Mine Land Use

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BMA
BHP Mitsubishi Alliance

DATE: 21/06/2024 VERSION: 4

Filename: L:\Secure\Projects\605X\60507031\4. Tech Work Area\4.98 GIS 2021\02_MXDs\01 Environmental Impact Statement\05 Land and Soil\60507031_G368_v4_A4P.mxd

5.6.4.2 Rehabilitation phasing

A plan and schedule for progressive rehabilitation will be established (as part of the future PRCP) to ensure rehabilitation occurs progressively in-line with the proposed mining sequence. Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities, or where subsidence has concluded, to reduce the amount of disturbed land at any one time.

Broadly the rehabilitation process will require rehabilitation milestones such as those below. Not all milestones will be relevant to all disturbance domains.

1. Infrastructure decommissioning and removal – services will be disconnected, removal of surface built and service infrastructure, monitoring equipment and boreholes unless demonstrated to be beneficial to the PMLU.
2. Remediation and/or management of contaminated land – relevant areas of surface disturbance will be subject to contaminated land investigations and any consequential actions to remediate.
3. Landform development and reshaping – incorporates subsidence crack repairs and reshaping of the final landform where required.
4. Surface preparation– incorporates soil preparation and other activities that may be required such as ripping, topsoiling and amelioration.
5. Revegetation – incorporates aspects such as seeding and fertilising.
6. Achievement of surface requirements – through monitoring and implementation of any improvements or maintenance.
7. Achievement of PMLU to a stable condition - the land is determined safe, structurally stable, does not cause environmental harm and is able to sustain the relevant PMLU.

A conceptual rehabilitation program will be implemented using the RMP (**Appendix K-1**) and progressive rehabilitation based on current objectives for the Project and current anticipated dates of mine closure. A detailed rehabilitation schedule will be refined and submitted as part of the future PRCP and submitted in combination with the EA approval prior to construction commencing.

The timing of rehabilitation activities are dependent on the mining schedule and when areas are deemed ‘available for rehabilitation’ in accordance with the PRCP guideline. The PRCP will be submitted to the DES for approval prior to construction commencing.

The construction phase for the initial development of the Project is anticipated to span approximately two years – after which areas with construction infrastructure not proposed to be used during operational activities (for example the construction accommodation village) will be assessed for availability for rehabilitation. The majority of rehabilitation activities for the Project will occur during the operation period as subsidence impacts are realised and toward the end of mining when infrastructure is no longer required and decommissioned.

Subsidence impacts will be managed and remediated in response to monitoring as per the SMP and will be staged over the life of the Project in line with the mining schedule. It is anticipated that subsidence management will commence approximately two years after completion of mining of each longwall panel (generally one panel per year). The two-year timeframe allows for the full extent of subsidence impacts to be realised. This timeframe is also consistent with the approved progressive rehabilitation timeframe within the EA for the BMA underground Broadmeadow Mine. At this time (i.e. two years after completion of mining each longwall panel) the relevant area would be considered available for rehabilitation.

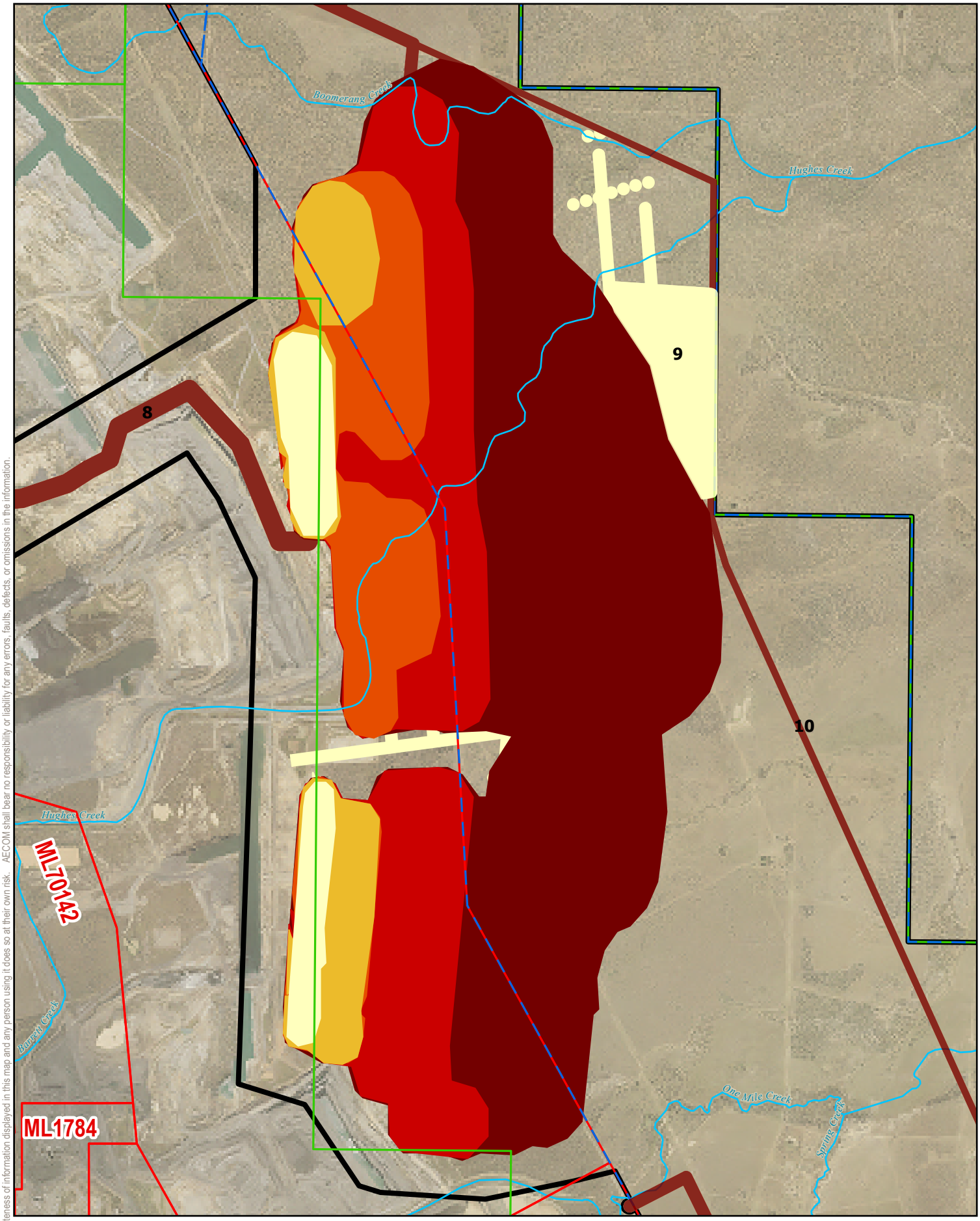
An indicative rehabilitation schedule is shown in Table 5-16. The current proposed mining sequence and timing for land available for progressive rehabilitation is shown in Figure 5-15. This will be revised as part of the PRCP.

Table 5-16 Indicative rehabilitation schedule

Project phase	Activity	Years
Construction	Construction of the Project	1-2
	Decommission and removal of construction infrastructure no longer required and rehabilitation of the area (up to and including revegetation)	3-5*
	Ongoing monitoring and maintenance of construction infrastructure areas to demonstrate achievement of PMLU	6-20
Operational	Underground mining	3-22
	Longwall panel subsidence period (approximately 2 year from end of mining each panel) and management of subsidence under SMP	3-24
	Rehabilitation of subsidence areas and incidental mine gas (IMG) network disturbance (up to and including revegetation)	5-24 (up to 2 years after panel subsides)
	Ongoing monitoring and maintenance of subsidence areas to demonstrate achievement of PMLU#	25-44
Closure	Decommission and removal of Project surface infrastructure not required by Saraji Mine or the PMLU and rehabilitation of the area (up to and including revegetation)	23-27*
	Ongoing monitoring and maintenance of surface infrastructure areas to demonstrate achievement of PMLU#	28-47

* Dependent on contaminated land investigation outcomes

Dependent on PMLU



LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Watercourse

Subsidence Areas by Year

- 3
- 4
- 6
- 10
- 20

Surface Infrastructure

8 Conveyor
9 Construction Village
10 Transport and Infrastructure Corridor

N

Figure 5-15
Indicative progressions of subsided areas available for rehabilitation

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometers
Scale: 1:42,682 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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DATE: 24/06/2024 VERSION: 2

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Filename: L:\Secure\Projects\605X\605070314. Tech Work Area\4.98 GIS 2021\02_MXDs\01 Environmental Impact Statement\K-1 Subsidence and Rehab Plans\Rehab Management Plan\60507031_G449_RehabilitationTimeframe_v0.aprx Layout: F5_15_60507031_G449_v0_A4P_RehabilitationPhasing

5.6.4.3 Rehabilitation objectives, indicators and completion criteria

The objectives, completion criteria, and indicators detailed in Table 5-17 have been drawn from BHP's Queensland Coal Rehabilitation Completion Criteria (BHP, 2018). The criteria, objectives and goals outlined in Table 5-17 are preliminary and final rehabilitation milestone criteria will be developed as part of the PRCP.

Final landform design parameters to be adopted to rehabilitate the mine domains will be identified in EA conditions to achieve the nominated PMLU. The design of each domain and integration into the final landform will ensure that design criteria parameters in EA are met and will incorporate appropriate permanent drainage measures to manage surface water flows, control erosion and ensure a free draining landform.

On completing each rehabilitation milestone, BMA will demonstrate milestone criteria have been met and land is progressing toward the planned PMLU. The PRCP will outline and detail the rehabilitation milestone criteria and when each milestone is to be achieved.

Table 5-17 Indicative completion criteria, objectives and indicators

Post mining land use	Goal	Objective	Indicator	Criteria
Cattle grazing	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
		Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	Groundcover >50% 70% of slopes within the Project disturbance footprint ≤20%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH Electrical conductivity (EC) Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (Water)) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Within the Project disturbance footprint, cattle grazing land suitability class of 2 or 3, or not different from pre-mining class if ≥4 Outside of the Project disturbance footprint, cattle grazing land suitability class not different from pre-mining class
Woodland habitat	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference

Post mining land use	Goal	Objective	Indicator	Criteria
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5 unless an alternative is justified by an appropriately qualified engineer
		Rehabilitation is erosionally stable	Groundcover (steep slopes, >15%)	80%
			Groundcover (lesser slopes, ≤15%)	50%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Native bushland characteristics	Species richness Trees Shrubs Grasses	Species richness composing of: • ≥2 native tree species • ≥3 native shrub species • ≥4 native grass species.
			Tree canopy cover	≥16% by native tree species
Watercourse	Safe to humans and wildlife	Safety hazards are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is erosionally stable	Geomorphic index (IDC method)	Greater or equal to upstream or downstream values.

Post mining land use	Goal	Objective	Indicator	Criteria
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Able to sustain an agreed post mining land use	Riparian vegetation	Riparian vegetation index (IDC method)	Greater or equal to upstream or downstream values.
Water storage	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of Safety	≥1.5
		Rehabilitation is erosionally stable (banks and immediate surrounds)	Groundcover	>50%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Rehabilitation retains water that is a potential resource for cattle grazing, with quality according to ANZECC guidelines version October 2000	TDS Calcium Magnesium Nitrate Nitrite Sulphate	≤5,000 milligrams per litres (mg/L) ≤1,000 mg/L ≤2,000 mg/L ≤400 mg/L ≤30 mg/L ≤1,000 mg/L

Post mining land use	Goal	Objective	Indicator	Criteria
Dryland cropping	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
		Rehabilitation is erosionally stable	Percentage of cultivation at >1% slope gradient with functional contour banks	100% of rehabilitated areas
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Rehabilitation is suitable for sustainable cropping	Land suitability assessment for cropping	Within the Project disturbance footprint, cropping land suitability class of 2 or 3, or not different from pre-mining class if ≥4 Outside of the Project disturbance footprint, cropping land suitability class not different from pre-mining class

5.6.4.4 Rehabilitation methods

All areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining landcover or to a condition where maintenance requirements are consistent with an agreed PMLU (Table 5-17). Rehabilitation will be undertaken progressively, primarily driven by the mine plan.

All rehabilitation methods will be conducted to:

- minimise the potential for erosion
- minimise surface water impacts including bedload sediment interruption, bank erosion, loss of flow and ponding
- revegetate previously vegetated areas to be self-sustaining vegetation communities
- ensure the vegetation within the rehabilitated area is not significantly different to surrounding landscapes of similar landform subject to the same land use.

The rehabilitation methods are discussed individually below.

5.6.4.4.1 Progressive rehabilitation

Progressive rehabilitation in accordance with this RMP, and subsequent PRCP, will commence up to two years after a panel subsides and stabilises.

Subsidence management will be required during the operational phase of the Project with management strategies to be assessed on a case-by-case basis in accordance with the SMP. The primary management strategies for subsidence areas (on the land and within the creeks) are surface crack repairs where required, watercourse management and in some cases, drainage establishment for ponding. Drainage will be permanently retained in the post-mining land use ensuring a free draining land form. The requirement for management will be identified as part of the routine subsidence monitoring during operations and incorporated into planning for progressive rehabilitation.

5.6.4.4.2 Surface infrastructure

General surface infrastructure

General surface infrastructure areas include the construction camp, buildings, powerlines, pipelines, monitoring equipment, bores, roads and hardstands. Surface infrastructure for the Project not required for Saraji Mine or beneficial for the PMLU will be removed and the area rehabilitated once underground mining is complete (unless infrastructure is not required after completion of the construction phase). Shared infrastructure with Saraji Mine will be decommissioned and rehabilitated as per the rehabilitation schedule for Saraji Mine.

Built infrastructure will be decommissioned and removed. Priority will be to repurpose, salvage or recycle any infrastructure to be removed. Decommissioning of built infrastructure (with no beneficial use to the post mining land use) will include removing concrete to a depth of 0.5 m below the surface or covering to a minimum depth of 0.5 m to enable establishment of the PMLU. Demolition and disposal within the Saraji Mine mining voids or spoil dumps, will only be undertaken when repurpose, salvage or recycle alternatives are deemed by BMA not to be viable. This approach is in line with the waste and resource management hierarchy outlined in the Queensland Waste Management and Resource Recovery Strategy created under the *Waste Reduction and Recycling Act 2011* (Qld).

A contamination risk assessment will be conducted on areas that have been used for a notifiable activity(ies) under the *Environmental Protection Act 1994* (Qld) or are likely to be contaminated. A contaminated land assessment will be undertaken where required in accordance with the National Environment Protection (Assessment of Site Contamination) Measure. The contaminated land investigation will assess the site for the presence of contamination with the potential to adversely impact the nominated PMLUs and/or environmental values. Should land contamination be identified, the potential risks will be assessed and, where required, remediation will be undertaken and/or a Site Management Plan developed to allow the ML area to be safely utilised for the nominated PMLUs.

Once infrastructure is removed and contamination activities are complete, the remaining rehabilitation activities involving landform reshaping, topsoiling and seeding can commence.

IMG infrastructure

IMG infrastructure (for gas drainage) will be installed and then removed progressively as mining progresses across each panel.

Following construction interim rehabilitation measures will be undertaken including:

- removal of temporary facilities associated with drilling
- rehabilitation of the bulk of the drilling pad area, leaving only a small area immediately around the well
- rehabilitation over installed gas and water pipeline trenches
- reinstatement of vegetation along riparian corridors.

Once mining of each panel is complete, final decommissioning of this IMG will be undertaken progressively and include:

- removal of all facilities above ground surface level associated with wells will be removed
- cut, grout and cap wells below ground level to create a seal in accordance with guidelines on decommissioning of gas wells current at the time, and monitor during subsidence, repairing where standpipes have become exposed
- rip pads around each well, topsoil, seed and fertilise the disturbed areas as necessary to support the PMLU
- empty and make safe water and gas pipelines.

Vent shafts and boreholes

Ventilation shafts, service boreholes, dewatering and monitoring boreholes will be decommissioned once they are no longer needed for the underground operations. This may occur progressively during, or at the end of, underground operations. Decommissioning includes sealing, capping and grouting and will be completed in accordance with relevant standards and guidelines, in particular the relevant requirements of the Minimum Construction Requirements for Water Bores in Australia (Land and Water Biodiversity Committee, 2003) or other relevant guidelines in place at the time of decommissioning.

Underground access

Decommissioning of the underground access will be required after final mining. Any mining equipment or service supply lines and cables that are no longer required and are not readily recoverable for salvage or reuse will be left in the underground mine. Entrances to the underground workings will then be blocked off and sealed to prevent access.

A final safety inspection and certification against mine safety legislation in place at the time of closure will be required.

Raw and process water dams

Water storages created for the Project are unlikely to have any beneficial use for the future land use as they do not capture overland flow. The storages will have contained mine affected water and will need to be emptied.

The rehabilitation of water storages will include:

- treatment of water stored to meet water quality requirements if required
- removal of contained sediments for disposal if required
- breaching of the walls so that the storage can no longer contain water
- grading and re-profiling of the area to restore drainage.

The area is then topsoiled and seeded.

5.6.4.4.3 Soil management

Underground mining will result in subsidence of the land surface and this will not significantly disturb the topsoil (apart from cracking) and does not necessitate its recovery. Exceptions to this may occur in some instances post subsidence where re-contouring, drainage control or crack repair is required and, as such, topsoil salvage may be required prior to any earthworks.

Construction of surface infrastructure will require management of topsoil. Appropriate topsoil management is crucial to successful rehabilitation of disturbed areas.

A general overview of the soil stripping, stockpiling and application process is detailed below.

Topsoil stripping

Topsoil is stripped according to the recommended depths from the pre-mining soil surveys. Deep ripping can help maximise soil recovery. Machinery used is to be weed free. Topsoil is to be used progressively where possible to reduce topsoil stockpiles and storage time, but there is limited opportunity for direct use for underground operations as the majority of progressive rehabilitation areas i.e. subsidence, generally do not require topsoil replacement.

Topsoil stockpiling

Stockpile locations will aim to be close to disturbance areas within the Project Footprint based on the following:

- not within proximity to overland water flow areas or drainage lines
- protected from wind prone areas
- areas that are not subject to stock grazing, machinery or vehicle movement
- areas that are not subject to drainage from higher areas to prevent erosion.

Stockpiles will be low mounds at a maximum height of 3 m, with a greater number of lower mounds preferable. Topsoil that will remain stockpiled for an extended period will be sown with species as needed.

Topsoil application process

A pre-mining land resources and soil investigation of the Project Site identified the land capabilities of the soil. This investigation identified that the soil classes were within the ranges suitable to create stable landforms compatible with the surrounding landscape and planned PMLUs.

There should be sufficient topsoil on site for rehabilitation, but if quantities are not sufficient alternative options will be implemented, such as low intensity application of topsoil with additional ameliorants, development of an alternative growth media with sub soil or with the use of ameliorants to improve organic matter, will be utilised.

An assessment of the growth media characteristics will be completed by an appropriately qualified person to determine the amelioration requirements to suit the revegetation plan.

Erosion and sediment control

Potential hazards arise from exposed soil being subject to erosion during rehabilitation. Sediment and erosion controls that may be employed include:

- minimising erosion of exposed land by restricting clearing areas, minimising soil exposure, and diverting potential runoff from undisturbed areas
- preventing exposed subsoils through minimising length of time subsoils are exposed and using erosion control measures such as gravelling, mulching, sediment fencing, and erosion control blankets
- contour ripping.

5.6.4.4.4 Revegetation

Appropriate seed mix for revegetation will be selected based on the PMLU. Where the post mining land use is grazing, the species composition will aim to include a suitable mix of palatable, perennial and productive (3P) grasses and legumes.

Native vegetation outside of the surface infrastructure footprint will be retained to be compatible with the pre-existing land use for biodiversity values observed during the baseline ecological studies. Species selection for areas to be returned to woodland habitat will aim to achieve woodland habitat similar to the surrounding vegetation communities.

The provenance (where the seed comes from) is considered important for all species. Seeds will be sourced as locally as possible from natural populations. Although the local provenance boundary locations may differ between species, seed should ideally be obtained from the Brigalow Belt North bioregion.

Proof of provenance will be sought from the seed supplier(s) along with germination and viability certificates for all purchased seeds.

5.6.4.5 Rehabilitation monitoring

Rehabilitation monitoring will be undertaken in accordance with the PRCP at the time of rehabilitation. The purpose of rehabilitation monitoring is to track rehabilitation progress against milestone criteria and to demonstrate achievement of the PMLUs, as well as identify any issues affecting the rehabilitation that will require future maintenance action.

A combination of monitoring, reporting and data analysis approaches will be used to demonstrate the achievement of the rehabilitation milestones as shown in Table 5-18.

Table 5-18 Rehabilitation milestones with relevant reporting requirements

Rehabilitation milestone	Reporting requirements
Infrastructure decommissioning and removal	Undertake and document visual inspections
Remediation and/or management of contaminated land	Contaminated Land Investigation Document including a site suitability statement completed by a Suitably Qualified Person confirming the land does not present an unacceptable risk to proposed future land uses or the environment
Landform development and reshaping	Survey/LiDAR of landform Analyse final landform against design
Surface preparation	Document growth media depth Document growth media assessment Document ameliorants and physical treatments applied
Revegetation	Document seed mix, purity information, planting timing, seed application rates and areas
Achievement of surface requirements	Undertake and report rehabilitation monitoring
Achievement of post-mining land use to a stable condition	Undertake and report rehabilitation monitoring

5.6.4.6 Maintenance

Maintenance will be implemented when monitoring identifies issues with the rehabilitation, or when milestone criteria are not being met. To select the most appropriate corrective actions, rehabilitation monitoring data will be analysed to identify the likely cause(s). Required maintenance/corrective actions will be entered into the BMA work management system for actioning and record management.

5.7 Summary and conclusions

The assessment of potential impacts to land resources and soils included consideration of subsidence, geology, mineral resources, contamination and rehabilitation.

Reviews of previous reports and a field assessment identified that there are 26 SMUs and 11 variants within the Project Site. Two SMUs and four variants were assessed as suitable for cropping. All other SMUs identified were considered suitable for beef cattle grazing activities. The remaining SMUs were assessed as suitable for grazing either as simple or complex (consisting of two classes) units.

The southern extent of the Project Site (the location of the proposed overhead powerline) is mapped as SCL as regulated under the RPI Act. A field assessment of these mapped areas identified 17 SCL map units within the Project Site, of which nine (SCL map units 3, 7, 8, 9, 12, 13, 15, 16 and 17) meet the SCL criteria.

Any disturbance or stripping of soil within SCA areas is only allowed as per the existing, approved Regional Interests Development Approval (RIDA), as outlined in the Restoration Plan to Support RIDA Application Saraji East Project (GTE, 2021) and RPI 121/001.

There are no further SCA areas that are approved by RPI 121/001, outside of the project site disturbance footprint that can be disturbed for stripping and stockpiling. Any disturbance of SCA not subject to an existing RIDA would require separate approval under the Regional Planning Interests Act (2014).

Subsidence modelling undertaken for the Project predicted maximum subsidence is 3.5 m over the southern panels.

During the operation of the mine, existing land uses such as grazing may be able to continue within the proposed mining lease in areas not directly impacted by the mine and supporting infrastructure.

A Subsidence Management Plan (**Appendix K-2**) has been prepared for the Project. The proposed approach to managing subsidence is to use proactive measures to predict and potentially improve the overall condition of the potentially affected areas, but where monitoring finds an impact, measures will be implemented so that any adverse effects of subsidence are minimised.

BHP has prepared a Rehabilitation Management Plan (**Appendix K-1**) in line with the Mined Land Rehabilitation Policy (DES, 2018a) and BHP's Queensland Coal Rehabilitation Completion Criteria (BHP, 2018c).

The proposed post mining land use will be an undulating landscape that could be used as grazing land, consistent with the surrounding pastoral land use that dominates the region. Native vegetation outside of the surface infrastructure footprint will be retained in a way that is compatible with the pre-existing land use for biodiversity values. Where vegetation mortality occurs as a result of persistent ponding, drainage will be permanently retained in the post-mining land use ensuring a free draining land form.

Disturbed land will be developed to a condition that is self-sustaining or to a condition where maintenance requirements are consistent with an agreed post mining land use.