Central Queensland Coal Project

Chapter 5 - Land

Central Queensland Coal

CQC SEIS, Version 3

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Terms and Abbreviations

µm	Micrometres, or micron
AASS	Actual Acid Sulfate Soils
AHD	Australian Height Datum
ALC	Agricultural Land Classes
ANC	Acid Neutralizing Capacity
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
AUSGEO	Geoscience Australia
CEC	Cation Exchange Capacity
CHPP	Coal Handling and Preparation Plant
CLR	Contaminated Land Register
CPESC	Certified Professional in Erosion and Sediment Control
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	(former) Queensland Department of Agriculture, Fisheries and Forestry
DEM	Digital Elevation Model
DES	Queensland Department of Environment and Science
DILGP	(former) Queensland Department of Infrastructure, Local Government and Planning
DNRME	Queensland Department of Natural Resources, Mines and Energy
DTPA	Diethylenetriaminepentaacetic acid
EA	Environmental Authority
EAT	Emerson Aggregate Test
EC	Electrical conductivity
EHP	(former) Queensland Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
ELVIS	Elevation Information System
EMR	Environmental Management Register
EP Act	Queensland *Environmental Protection Act 1994*
EP Regulation	Queensland Environmental Protection Regulation
EPC	Exploration Permit for Coal
ESA	Environmentally Sensitive Area
ESC	Erosion and Sediment Control

ESCP	Erosion and Sediment Control Plan
ESP	Exchangeable Sodium Percentage
EVs	Environmental Values
GBR	Great Barrier Reef
GIS	geographic information system
GQAL	Good quality agricultural land
ha	Hectare
IECA	International Erosion Control Association
km	Kilometres
km^2	Square kilometres
LiDAR	Light Detection and Ranging
m	metre
mAHD	Metres Australia Height Datum
meq/100g	Milliequivalents for 100 grams
MHWS	Mean high water spring
MIA	Mine Infrastructure Area
ML	Mining Lease
MR Act	Queensland *Mineral Resources Act 1989*
N	Nitrogen
NAF	Non-Acid Forming
NAPP	Net Acid Production Potential
NATA	National Association of Testing Authorities
NRM	Natural Resource Management
P	Phosphorus
PAA	Priority agricultural area
PAF	Potentially Acid Forming
PASS	Potential acid sulfate soils
PLA	Priority living area
ROM	Run of Mine
RPI Act	Queensland *Regional Planning Interests Act 2014*
RUSLE	Revised Universal Soil Loss Equation
SCA	Strategic cropping areas

SCL	Strategic Cropping Land
SEIS	Supplementary EIS
SRTM	Shuttle Radar Topography Mission
SPOCAS	Suspended peroxide oxidation-combined acidity and sulfate method
SPP	State Planning Policy
TKN	Total Kjeldahl nitrogen
TLF	Train Loadout Facility
TOC	Total Organic Carbon
ToR	Terms of Reference
VIA	Visual Impact Assessment
ZTV	Zone of Theoretical Visibility

5 Land

5.1 Introduction

This chapter outlines the environmental values (EVs) of the Central Queensland Coal Mine Project (the Project) in the context of topography, geology, mineral reserves, soil types, land use suitability and visual amenity, and assesses the impacts on land resources from the construction and operation of the Project. In particular, the Chapter provides the assessment of land suitability, and a determination against the agriculture state interest provisions of the State Planning Policy (Agricultural Land Classifications (ALC) A and B) and Strategic Cropping Land (SCL) requirements of the *Regional Planning Interests Act 2014*.

This Chapter has been rewritten since that presented in the Supplementary Environmental Impact Statement (SEIS) Version 2 (v2) to include recent work undertaken to assess changes to the Project layout and operations that have occurred since then, and to address comments by regulatory agencies on the SEIS v2. See Chapter 3 – Project Changes and Responses to Regulator Comments for the full description of Project changes since SEIS v2, and the responses to submissions received.

Matters raised in submission to the SEIS v2 (and to the previous SEIS) relating to Land were predominately focused on:

- erosion and sediment control management
- definition of pre-mining land suitability and assessment of good quality agricultural land
- potential to encounter acid sulfate soils (ASS) and management if encountered and
- impacts to off-lease Strategic Cropping Land (SCL).

The updated chapter provides additional information in response to the submissions.

This chapter should also be read in conjunction with Chapter 7 – Waste Management, Chapter 8 – Waste Rock and Rejects and Chapter 11 – Rehabilitation and Decommissioning which provide further technical details of impacts and strategies to manage impacts on land resources.

5.1.1 Environmental Objectives and Outcomes

The environmental objective and performance outcomes relevant to land are provided in Schedule 8, Part 3, Division 1 of the Queensland Environmental Protection (EP) Regulation. Objectives and outcomes for land that are specific to the Project are given in Table 1 of the Project Terms of Reference (ToR). The overarching objective is to operate the Project in a way that protects the environmental values of land including soils, subsoils, landforms and associated flora and fauna.

5.1.1.1 EP Regulation Environmental Objectives and Performance Outcomes

The environmental objective and performance outcomes relating to land outlined in the EP Regulation are:

5.1.1.1.1 Environmental Objective

The activity is operated in a way that protects the environmental values of land, including soils, subsoils, landforms and associated flora and fauna.

5.1.1.1.2 Performance Outcomes

1. There is no actual or potential disturbance or adverse effect to the environmental values of land as part of carrying out the activity.
2. All of the following apply -
   - Activities that disturb land, soils, landforms and the land use, flora and fauna associated with the land will be managed in a way that prevents or minimises adverse effects on the environmental values of land.
   - Areas disturbed will be rehabilitated or restored to achieve sites –
     i. that are safe and stable
     ii. where no environmental harm is being caused by anything on or in the land and
     iii. that are able to sustain an appropriate land use after rehabilitation or restoration.
   - The activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants.
   - The application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils.

5.1.1.2 ToR Environmental Objectives and Outcomes Relevant to the Project

The Environmental Objectives and Outcomes for land given in the Project ToR are replicated below:

- The activity is operated in a way that protects to the greatest extent possible the environmental values of land including soils, subsoils, and landforms.
- The choice of the site, at which the activity is to be carried out, avoids or minimises serious environmental harm on areas of high conservation value and special significance and sensitive land uses at adjacent places.
- The location for the activity on a site protects all environmental values relevant to adjacent sensitive use.
- The design of the facility permits the operation of the activity in accordance with best practice environmental management.

5.1.2 Terms of Reference Addressed in this Chapter

Table 5-1 summarises the requirements from the ToR for the Project relevant to this chapter, and where in this chapter they are addressed.

Table 5-1: ToR cross-reference

Terms of Reference	Section of the EIS
8.2 Land	
Conduct the impact assessment in accordance with the EHP's EIS information guideline—Land, and, if any quarry material is needed for construction of project works including related infrastructure, use EHP's EIS information guideline—Quarry material.	Noted The EIS information guideline – land is included in Section 5.1.3.5 and addressed within this Chapter for groundwater

Terms of Reference	Section of the EIS
Describe potential impacts of the proposed land uses taking into consideration the proposed measures that would be used to avoid or minimise impacts. The impact prediction must address the following matters:	Sections 5.4, 5.5 and 5.7
• Any changes to the landscape and its associated visual amenity in and around the project area.	Section 5.5.5
• Any existing or proposed mining tenement under the *Mineral Resources Act 1989*, petroleum authority under the *Petroleum and Gas (Production and Safety) Act 2004,* petroleum tenure under the *Petroleum Act 1923,* geothermal tenure under the *Geothermal Energy Act 2010* and greenhouse gas tenure under the *Greenhouse Gas Storage Act 2009* overlying or adjacent to the project site.	Section 5.3.9
• Temporary and permanent changes to land uses of the project site and adjacent areas, considering actual and potential agricultural uses, regional plans and local government planning schemes, and any key resource areas that were identified as containing important extractive resources of state or regional significance which the state considers worthy of protection.	Sections 5.4, 5.5.3 and 5.5.5
• Identify any existing or proposed incompatible land uses within and adjacent to the site, including the impacts on economic resources and the future availability and viability of the resource including extraction, processing and transport location to markets.	Section 5.3.9
• Identify any infrastructure proposed to be located within, or which may have impacts on, the Stock Route Network[1,2] and the Stock *Route Management Act 2002.*	Section 5.1.3.3 (no stock routes)
• Propose suitable measures to avoid or minimise impacts related to land use.	Section 5.7
Assess the project against the requirements of the Regional Planning Interests Act 2014[3], including any relevant Regional Plan. Further advice is provided in the 'DILGP Companion guide – A guide for state agencies and proponents on the requirements of the Regional Planning Interests Act 2014 in the planning and development process' (Department of Infrastructure, Local Government and Planning July 2016[4]) and the DAFF Environmental Impact Assessment Companion Guide' (Department of Agriculture, Fisheries and Forestry August 2014[5]).	Section 5.1.3.4 (only SCL identified), Sections 5.3.4.4.4 and 5.5.3
Describe how the project will avoid or minimise impacts on any land identified as Strategic Cropping Land on the Trigger Map for Strategic Cropping Land[6].	Sections 5.3.4.4.4 and 5.5.3
Show how the land form during and after disturbance will be stable over time and will meet any requirements of project or property plans under the *Soil Conservation Act 1986.*	Chapter 11 – Rehabilitation and Decommissioning
Detail any known or potential sources of contaminated land that could be impacted by the project. Describe how any proposed land use may result in land becoming contaminated.	Sections 5.3.7
Identify existing or potential native title rights and interests possibly impacted by the project and the potential for managing those impacts by an Indigenous Land Use Agreement or other measure in accordance with the *Native Title (Queensland)*	Chapter 18 – Cultural Heritage, summarised in Section 5.3.10

[1] https://www.qld.gov.au/environment/land/stock-routes/about/
[2] https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0010/99622/stock-route-management-strategy.pdf
[3] http://www.dilgp.qld.gov.au/planning/regional-planning/regional-planning-interests-act.html
[4] http://www.dilgp.qld.gov.au/planning/regional-planning/rpi-act-forms-guidelines-and-fact-sheets.html
[5] https://publications.qld.gov.au/dataset/daff-environmental-impact-assessment-companion-guide/resource/7b1825c4-5e42-4cf8-aa2d-7fa55c2f5e4c
[6] https://www.dnrm.qld.gov.au/land/accessing-using-land/strategic-cropping-land

Terms of Reference	Section of the EIS
Act 1993 and consistent with the Queensland Government Native Title Work Procedures[7].	

5.1.3 Relevant Legislation, Guidelines and Policy Instruments

Chapter 2 – Legislation and Approvals outlines the regulatory framework relevant to the Project. Those that relate to land resources are:

- *Environmental Protection Act 1994* (EP Act)
- *Biosecurity Act 2014*
- *Stock Route Management Act 2002* and
- *Regional Planning Interests Act 2014*.

The following sections provide a summary of the above legislation and how these pertain to the land resources aspects of the Project.

5.1.3.1 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) is the primary legislation for environmental management and protection in Queensland. It plays an important role in the protection and management of Queensland's environment, particularly in relation to the regulating activities which have potential to release contaminants into the environment (defined as Environmentally Relevant Activities (ERAs)).

The EP Act also governs the management, investigations and remediation of any contaminated land. If land becomes contaminated there is a duty to notify the Department of Environment and Science (DES).

5.1.3.2 Biosecurity Act 2014

The *Biosecurity Act 2014* (Biosecurity Act) has replaced several separate pieces of legislation that were used to manage biosecurity, including the superseded *Land Protection (Pest and Stock Route Management) Act 2002*. The Biosecurity Act deals with pests (such as wild dogs and weeds), diseases (such as foot-and-mouth disease) and contaminants (such as lead on grazing land).

Under the Act, individuals and organisations whose activities pose potential risks to biosecurity will have greater legal responsibility for managing them. This means CQC will have an obligation to undertake all reasonable steps to ensure no spread of pest, disease or contaminant. There are seven categories of restricted matter listed under the Act. Each category places restrictions on the biosecurity matter or requires actions to be taken to minimise the spread and adverse impact of the matter.

5.1.3.3 Stock Route Management Act 2002

The purpose of the *Stock Route Management Act 2002* is to provide management for the stock route network. The *Stock Route Management Act 2002* establishes principles for managing the stock route network and activities. The stock route network provides unique interconnectedness and geographical extent to allow for the movement of wildlife.

[7] https://www.dnrm.qld.gov.au/land/indigenous-land/queensland-government-native-title-work-procedures

There are no stock routes near the Project site.

5.1.3.4 Regional Planning Interests Act 2014

The *Regional Planning Interests Act 2014* (RPI Act) replaced the *Strategic Cropping Land Act 2011* on 13 June 2014. The RPI Act seeks to manage the impacts from resource activities, and other regulated activities through protecting:

- living areas in regional communities
- high-quality agricultural areas from dislocations
- Strategic Cropping Areas (SCA) and
- regionally important environmental areas.

Under the RPI Act, an approval is required when a resource activity or regulated activity is proposed in an area of regional interest. Areas of regional interest are identified as:

- Priority living areas (PLAs)
- Priority agricultural areas (PAAs)
- Strategic Cropping Land (SCL) and
- Strategic environmental areas (SEAs).

A small portion of SCL is mapped in the east of Dam 1. As such, a Regional Interests Development Approval is required to be lodged, with the intent to demonstrate land is not SCL (addressing Required Outcome 1 under the Regional Planning Interests Regulation 2014).

No other areas of regional interest are identified within the Project area.

5.1.3.5 State Planning Policy

5.1.3.6 Applicable Guidelines

Key guidelines relevant to land resources assessment for the Project are as follows:

- Australian Soil and Land Survey Field Handbook Third Edition (NCST 2009)
- The RPI Act Statutory Guideline 01/14. How to demonstrate that land in the strategic cropping area does not meet the criterial for strategic cropping land (DILGP 2017)
- Guidelines for Agricultural Land Evaluation in Queensland (2nd edition) (DSITI & DNRM 2015)
- Best Practice Erosion & Sediment Control, International Erosion Control Association (IECA 2008)
- Guidelines for contaminated land professionals (EHP 2012) and
- ASS guidelines, including Guidelines for sampling and analysis of lowland acid sulfate soils (ASS) in Queensland (Ahern et al. 1998).

This assessment has also been undertaken with reference to the following guideline document:

- The DES ‘EIS Information Guideline – Land’.

5.2 Methods

The assessment of land resources and impacts from the Project have been undertaken using a combination of desktop assessment, field sampling and spatial analysis. These are discussed in the below sections.

5.2.1 Data Review and Desktop Study

A desktop review and assessment were conducted, involving analysis of available soil, geological, agricultural and Project specific mapping, aerial imagery and LiDAR data. The desktop study comprised the collation and review of the following key information:

Mapping, Reports and Guidelines

- Geological mapping, including the 1:100,000 Marlborough (DNR&M 2006) and 1:250,000 St. Lawrence (Malone et al. 1965) and St. Lawrence explanatory notes (Malone 1970).

Available Data

- Land systems - land systems of the Capricornia coast - CCL3 [1:250,000 Scale GIS dataset] (DES 2020): 1:250,000 scale land unit mapping based on the original work by DPI (1995).
- Gamma-radiometric filtered potassium signal from the National Radiometric Mapping version 2.
- ASRIS 2011: National soils mapping dataset made available by CSIRO which provides a general description of soils classified in accordance with the Australian Soil Classification (Isbell 2002).
- ‘Atlas of Australian Soils’ by CSIRO (Isbell et al. 1967), providing general background information on landscape features and general soil families and soil types expected to occur in the region.
- CSIRO Atlas of Australian Acid Sulfate Soils mapping (Fitzpatrick et al. 2011) - this provides an indication of the likelihood of Actual ASS (AASS) or potential ASS (PASS) being present across the Project site.
- Geological information available from CQC, collected as part of exploration works, and including a geological block model. This information was focused primarily on the economic geology for the area.
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australian Soil Resource Information System (ASRIS) datasets and information obtained from the Department of Natural Resources, Mines and Energy (DNRME).
- Coal exploration drillholes and well installation logs, including geology / lithology and some soil descriptions.
- LiDAR elevation data collected in 2011 by CQC for the Project (3 x 3m grid), and data available from 2009 from the Intergovernmental Committee on Surveying and Mapping’s Elevation Information System (ELVIS). Outside the bounds of the above datasets, 1 second hydrologically corrected DEM (Gallant et al. 2011) was utilised.
- Waterways, using the Queensland Government’s *Watercourse lines – Queensland* (DNRME 2019) (these were confirmed as largely suitable as part of the Fluvial Geomorphology assessment (Appendix A5d) and
- Other Geographic Information System (GIS) data, obtained from the Queensland Government’s Spatial Catalogue – Qspatial, including.

5.2.2 Land Suitability Assessment

5.2.2.1 Overview

A land suitability assessment was undertaken including desktop assessment, field surveys and laboratory analyses focusing on characterisation of soils to identify land and suitability classes, provide a description of soil map units, and determine key soil management requirements of soils and subsoils from the perspective of mine rehabilitation.

A detailed field soil survey of the project area was conducted in May 2012 over the (then) mine disturbance area. For this SEIS v3, the land suitability assessment was revised, and the latest additional data from April 2017 incorporated, with the area of investigation defined as the lease boundary + 300 m[8].

The Soil and Land Suitability Assessment is presented in Appendix A3a, and a summary of the methods undertaken provided below.

5.2.2.2 Desktop Assessment

Available soil mapping and land systems information was compiled and assessed over the area of interest, and used to plan the soil sampling exercise. The most up to date soil mapping information was the 'Land systems - land systems of the Capricornia coast - CCL3' (DPI 1995), which was current for both the 2012 and 2017 sampling.

5.2.2.3 Field Sampling

Soil mapping and description followed Australian guidelines for land resource assessment (McDonald et al., 2009). Soil profiles were described initially from reconnaissance survey auger holes to 1.5m or refusal to develop a soil map key. Then detailed soil descriptions and sampling was made from test pits excavated to two metres at selected sites that were considered central to, and typical of, each map unit. Mapping was confirmed from check and exclusion sites that were described from land surface observation and field soil properties to 0.3m depth.

The survey made 145 soil observations, 54 with full profile descriptions and laboratory analysis and 105 check and exclusion sites. The number of full profile descriptions and sites with laboratory data exceeded the survey guidelines (33% compared with 25% guideline). Sample density and the type of sites selected (detailed, exclusion and check sites) was based on Good Quality Agricultural Land (GQAL) / SCL map validation. Laboratory analysis included analysis of:

- Major Nutrients - Total Kjeldahl Nitrogen, Bicarbonate (Colwell) phosphorous, Bicarbonate (Colwell) potassium, CaPO4 Extractable sulfur
- Micronutrients - DTPA extractable iron, copper, zinc, manganese and boron
- Organic Carbon - Walkley Black (dichromate oxidation) and
- General parameters – pH, EC (1:5), Cl (1:5 extract), Exchangeable cations (Ca, Mg, K, Na and CEC), ESP.

Further detail including the sample plan is provided in the Land Suitability Assessment in Appendix A3a, and the location of the sites sampled are shown in Figure 5-1.

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8 Note that the boundary has been truncated slightly in the south of ML 80187 since the assessment was completed, and so the investigation area now extends around 3 km south of ML 80187

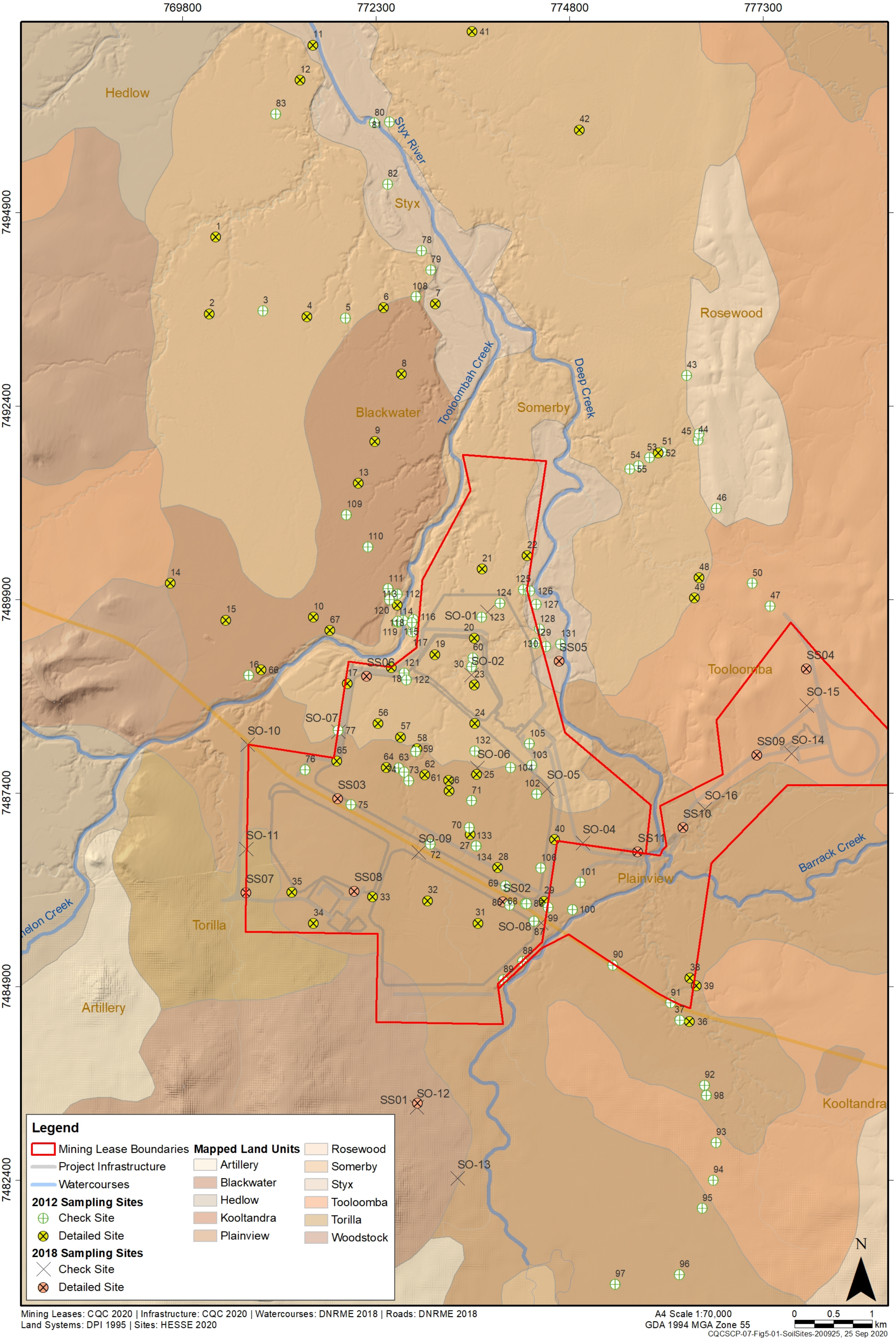


Figure 5-1: Soil sampling locations

5.2.2.4 Analysis and Mapping

Land units are defined and mapped that comprise unique combinations of geology, landform pattern and element and vegetation type. The existing mapped land units were refined and updated by digitising boundaries at 1:10,000 scale on an overlay of basemap coverages including:

- field observations and results
- land systems
- regional geological mapping (St Lawrence 1:250,000 scale)
- Marlborough 1:100,000 scale geological mapping
- 5m contours and slope derived from 1 second hydrologically corrected DEM and
- gamma-radiometric filtered potassium signal.

The filtered potassium gamma radiometric mapping available from AUSGEO was used to refine the land unit boundaries where Sodosols and Vertosols overlap in the Project area. The potassium signal derives from the near surface and is higher for clay than for sand and loam and was used to pick out the Vertosols where the land system mapping was unreliable.

5.2.2.5 Agricultural Land Classification

Strategic cropping land identified in the Project area from SCL trigger mapping (DNRM 2018) was checked against the *Regional Planning Interests Regulation 2014* criteria, outlined in the 'RPI Act Statutory Guideline 01/14. How to demonstrate that land in the strategic cropping area does not meet the criterial for strategic cropping land' DILGP (2017), with land excluded as potential SCL where it is remnant vegetation or has no history of cropping between 1 January 1999 and 31 December 2010. The guideline provides zonal assessment criteria, based on 8 criteria including slope, rock density, soil depth and water storage, with the criteria for the Central Queensland Zone adopted (where the Project is located).

The Project area's overall suitability ranking for each soil type was then determined according to the 'Guidelines for Agricultural Land Evaluation in Queensland' (DSITI and DNRM 2015; DSITIA and DNRM 2013) and translated into Agricultural Land Classes (ALC). These were then compared to the Livingstone Shire Council Planning Scheme (Version 2, 25 June 2018) to identify what was classed as ALC Class A / B lands. Land capability limitations were determined from each soil map unit profile observation based on regional guidelines for the Central Queensland Coast (DSITIA and DNRM 2013).

ALC was then determined based on the most limiting soil factor according to the assessment scheme, and is reported using a four class system (A to D), with Class A being the best quality, and Class D being non-agricultural land. Class C of the agricultural land class system is further divided into three sub-classes of C1, C2 and C3. Class A and B land (Class A / B) is a state interest under the State Planning Policy, and mapped under the Livingstone Shire Council planning scheme. The ALC classes and their descriptions are provided in Table 5-2.

Table 5-2: Regional land systems suitability ranking and agricultural land class correlation

Landscape Class	Landscape Description (DME, 1995)	ALC	Pastoral Management and Typical Vegetative Cover	
1	High quality land with few or minor limitations	C1	Good quality grazing and/or highly suitable for pasture improvement	Brigalow vegetation; appropriate for fattening beef cattle; good grazing on sown pastures and can withstand ground disturbance.
2	Land with minor limitations			Brigalow vegetation and/or transitional vegetation to Poplar Box vegetation communities.
3	Moderate limitations to sustaining its use	C2	Moderate quality grazing and/or moderately suitable for pasture improvement.	Eucalypt woodland, Poplar Box, narrow-leaved Eucalyptus, gum-top woodlands; low-moderate PAWC and low-moderate fertility; good grazing on native pastures without ground disturbance; appropriate for beef cattle breeders.
4	Marginal land requiring major inputs to sustain the use	C3	Low quality grazing, grazing of native pastures with limited suitability for pasture improvement.	Tea-tree vegetation; usually characterised by steep country or mangrove flats.
5	Unsuitable due to extreme limitations.	D	Not suitable	Unsuitable due to extreme limitations.

5.2.3 Contaminated Land

A site history of the Project area was compiled and used to identify past and present potentially contaminating activities. This was undertaken in accordance with the Guidelines for contaminated land professionals (EHP 2012) and included:

- a review of the DES Contaminated Land Register (CLR) and Environmental Management Register (EMR) and
- a review of historic aerial photography to identify any potentially contaminating land uses.

5.2.4 Landscape Character and Visual Amenity

5.2.4.1 Visual Impact Assessment Method

The purpose of undertaking a Visual Impact Assessment (VIA) is to examine the extent of visual change to the landscape because of the Project and assess how the change will impact on the area's scenic amenity.

Specifically, the study:

- assesses the existing landscape character of the project area providing comment on the changes already made to the natural landscape since European settlement
- describes existing landscape features, panoramas and views that have or are expected to have value to the community
- identifies the potential sensitive receptors within the immediate landscape where visual amenity may be impacted and
- determines the significance of potential impacts from sensitive receptors. consideration includes:

  - value of existing vegetation as a visual screen
  - identification of the ability of the landscape to absorb change without significant detriment to the existing visual quality and landscape character and
  - ability to mitigate impacts through design considerations.

GIS modelling was utilised to determine potential visibility of the mining operation from a variety of sensitive receptors. This GIS information has been combined with available field data to quantify the landscape change.

The study area for the EIS was defined by the visual catchment of the Project, or the area from which the Project could reasonably be seen. The visual catchment was determined through the review of aerial photographs, topographic maps and landform.

The VIA relied on the following data sources:

- aerial photography
- 1 Second SRTM v1.0 Digital Elevation Models (Geoscience Australia 2011)
- derived hill shade from 1 Second SRTM v1.0 Digital Elevation Models
- homestead locations (DNRME 2018) and
- Queensland Globe (DNRME 2018) feature of Google Earth.

5.2.4.2 Desktop Assessment

When undertaking a VIA, it is generally recognised that there is a limit to the human field of vision. The key factors in determining visual impact are based on:

- the human perception of views and parameters of vision
- the natural topography and topographical change and
- the natural vegetation that has the potential to screen views.

Scientific studies undertaken by Costella (1995) and Ball et al. (2005) identify the relationship between the potential landscape change and the proportion of area the development occupies (i.e. how much can be seen) within the horizontal and vertical line of sight.

The duration in which people view the landscape is a crucial factor in analysing the sensitivity to change. Variations in the landscape are more noticeable from lookouts and permanent viewing points compared to a view while travelling along a road. As such, the relative duration spent at each viewing location has a significant influence on the sensitivity of change to the landscape.

5.2.4.3 Landscape Character

The landscape character assessment included mapping and describing broad landscape character types and any discrete landscape character areas within each character type. The potential impact on landscape character is measured by the responses felt by sensitive receptors towards the combined effects of the new development. Determining the landscape character areas includes consideration of:

- landform
- vegetation
- intensity and
- character of land.

5.2.4.4 Identification of Sensitive Receptors

Potential sensitive visual receptors were identified with the aid of mapping data sources (including GIS) and the soil surveys. They are nominated at locations where the Project may be visible to residents, or areas where visitors spend extended amounts of time. Sensitive receptors include homesteads as well as areas from which transient views are possible, such as roads, service stations and rail lines.

5.2.4.5 Calculation of Zone of Theoretical Visibility

A zone of theoretical visibility (ZTV) is the theoretic assessment of visibility to or from a designated point in the landscape. It uses elevation data to calculate the extent of visibility from that point to anywhere in the study area. The mapping does not consider buildings or vegetation screening and hence reflects a ‘bare-earth landscape’, which represents the "worst case scenario". The ZTV generated for this assessment is based on 1s Shuttle Radar Topography Mission (SRTM) v1.0 Digital Elevation Model (DEM) (Geoscience Australia 2011) and an observer eye height of 1.8 m. A ZTV was generated for each of the relevant homesteads identified for the preliminary investigation area.

5.2.4.6 Visual Sensitivity

Visual sensitivity refers to receptors and their sensitivity to their visual environment. Visual impacts relate to the change that arises in composition of available views as a result of changes to the existing landscape, people’s responses to these changes, and the overall impacts with respect to visual amenity.

For this assessment, key visual receptors include any nearby residents, users of transport routes (road and rail) as well as users of public recreation whom all have differing sensitivities to their visual environment. Generally, sensitivity is derived from a combination of factors including:

- The receptors interest in the visual environment i.e. high, medium or low interest in their everyday visual environment, and the duration of the effect.
- The receptors duration of viewing opportunity, i.e. prolonged, regular viewing opportunities.
- Number of viewers and their distance / angle of view from the source of the effect, extent of screening/filtering of the view, where relevant.
- Magnitude of change in the view (i.e. loss / addition of features that change the view’s composition) and integration of changes within the existing view (form, mass, height, colour and texture).
- Effectiveness of proposed mitigation.

The terminology set out in Table 5-3 has been used to describe visual sensitivity.

Table 5-3: Visual sensitivity definitions

Sensitivity	Definition
High	Occupiers of residential properties with long viewing periods, within proximity to the proposed development. Communities that place value upon the landscape and enjoyment of views of the landscape setting.
Medium	Outdoor workers who may also have intermittent views of the Project site. Viewers at outdoor recreation areas located within proximity but where viewing periods are limited.

Sensitivity	Definition
	Occupiers of residential properties with long viewing periods, at a distance from or screened / filtered views of the Project site.
Low	Road users in motor vehicles, trains or on transport routes that are passing though or adjacent to the study area and have short term / transient views.
Neutral	Viewers from locations where there is screening by vegetation or structures where only occasional views are available and viewing times are short.
Nil	No view of the Project site is possible.

5.2.4.7 Limitations

Key viewing locations were selected as the most sensitive viewing locations or where the Project is likely to be viewed by the greatest number of people via a desktop assessment. Despite this limitation, the most important sensitive receptors, in terms of number of people being affected, have been captured as part of this assessment.

5.3 Description of Environmental Values

5.3.1 Topography

Elevations across the Styx catchment range from 0 to 540 m above sea level. The area predominantly comprises flat or undulating lands, draining via several smaller creeks and tributaries to the Styx River and estuary, and into the Coral Sea (see Figure 5-2). The land within the Project site can be described as gently undulating (see Plate 5-1 to Plate 5-11).

A LiDAR survey was conducted of the EPC 1029 area by CQC in June 2011. Based on this data, elevations within the EPC vary between 4.5 and 155 m Australian Height Datum (AHD), with the ML located between 11.4 and 43.8 m AHD.

Based on the Capricornia Coastal Lands program (DPI 1995), the ML area contains the following geomorphological land units:

- broad, level to gently undulating alluvial plains and fans on alluvium, including some areas of gilgai microrelief (melonhole)
- level to gently undulating plains and rises on sedimentary rocks and unconsolidated sediments, including some minor to severe melonhole
- undulating rises and low hills on deeply weathered sedimentary and metamorphic rocks
- dissected low plateaus on gently dipping sedimentary rocks and
- rolling low hills and rises on hard sedimentary rocks.

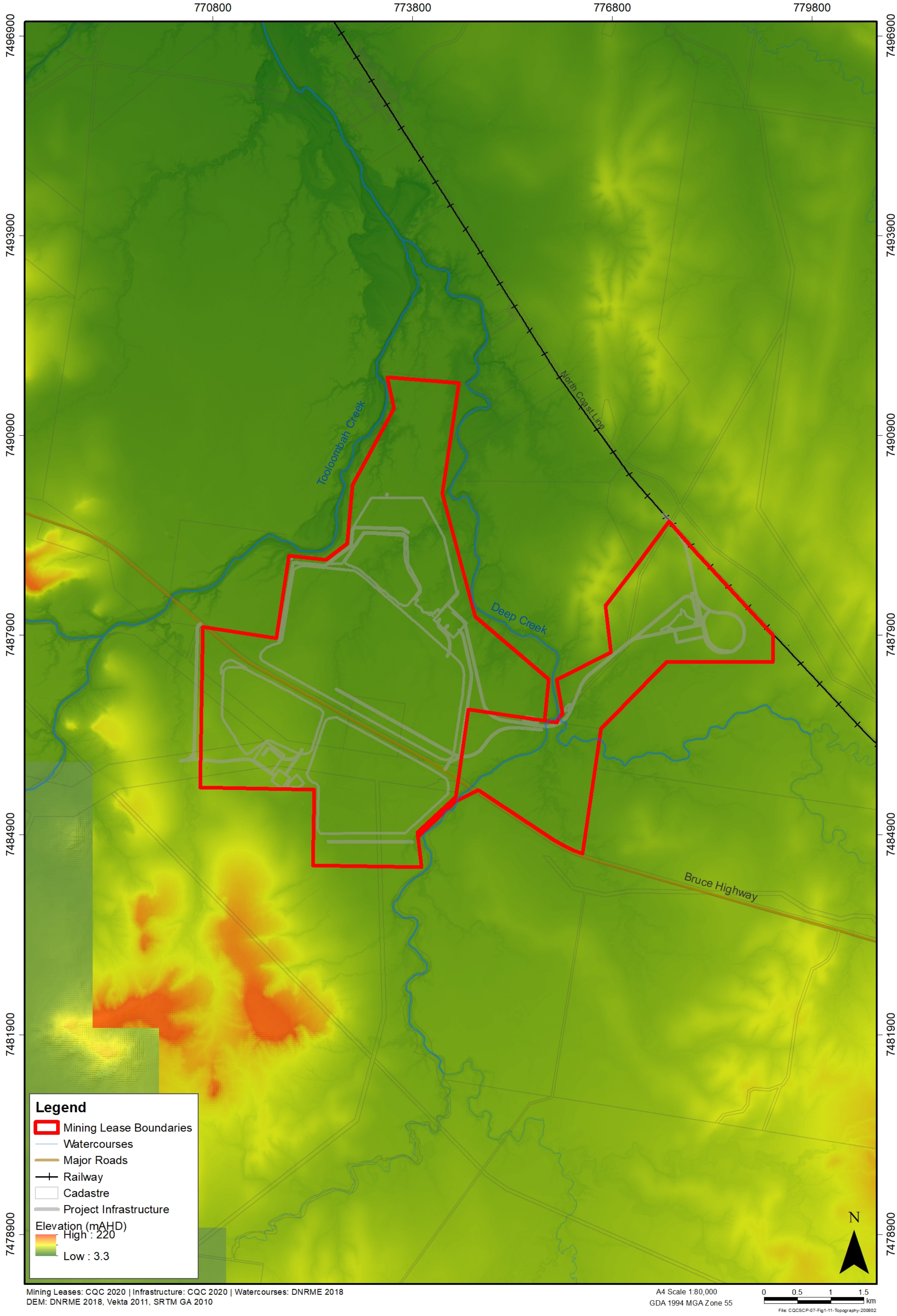


Figure 5-2: Site topography

Plate 5-1: Terrain at the south of Open Cut 1 - waste rock stockpile 1b (SS01 location)

Plate 5-2: Terrain looking south across Open Cut 1 (SS02 location)

Plate 5-3: Terrain looking east across Open Cut 2 (SS03 location)

Plate 5-4: Terrain at the TLF (SS04 location)

Plate 5-5: Terrain next to Deep Creek looking south towards Open Cut 2 (SS05 location)

Plate 5-6: Terrain looking east towards Open Cut 1 (SS07 location)

Plate 5-7: Terrain looking south over Open Cut 2 adjacent to Tooloombah Creek (SS06 location)

Plate 5-8: Terrain looking east towards Open Cut 1 (SS08 location)

Plate 5-9: Terrain looking east towards Open Cut 1 (SS09 location)

Plate 5-10: Terrain looking east towards Open Cut 1 (SS10 location)

Plate 5-11: Terrain looking east towards Open Cut 1 (SS11 location)

5.3.2 Surface Waters

The Project is located within the North East Coast Drainage Division, within the Styx River basin (Queensland river basin 127), a small basin of around 3,000 km^2 discharging into the Coral Sea. The Styx subbasin comprises several coastal catchments, grouped into three overarching areas, with the Project located within the Southern Styx Freshwaters catchment under the EPP (Water and Wetland Biodiversity), and is within the Tooloombah and Deep Creek sub-catchment areas. These Creeks bound the Project, with Tooloombah Creek passing along the western boundary of Mining Lease Application (ML) 80187, and Deep Creek along the east. Both join at the confluence approximately 2.3 km downstream from the Project, and drain into the Styx River and then into the Styx River and Broadsound Estuaries.

The Broad Sound Declared Fish Habitat Area (FHA-047) and a General Use Zone of the Great Barrier Reef Marine Park are located within the Styx River approximately 10 km downstream of the Project lease boundary. The coastal zone and coastal management district extends up (but is essentially confined to) the Styx River to the Deep and Tooloombah Creek confluence, approximately 2.3 km downstream from the Project.

These sensitive areas are shown on Figure 5-3.

The normal tidal limit (mean high water spring, [MHWS]) within the Styx River is located approximately 3.7 km downstream from the Project, with the peak tidal limit (defined by the limit of the highest astronomical tide) extending upstream to the confluence of Deep and Tooloombah Creeks, approximately 2.3 km downstream from the Project.

5.3.3 Geology

5.3.3.1 Regional Geology

The Styx Coal resources lie in the Styx Basin, a small, Early Cretaceous, intracratonic sag basin that covers an area of approximately 300 km^2 onshore and 500 km^2 offshore. The known coal bearing strata of the basin are referred to as the Styx Coal Measures and consist of quartzose, calcareous, lithic and pebbly sandstones, pebbly conglomerate, siltstone, carbonaceous shale and coal. The environment of deposition was freshwater, deltaic to paludal with occasional marine incursions (Taubert 2002). The regional geology of the Styx Basin is shown in Figure 5-4 and summarised in Table 5-4.

Table 5-4: Geological units underlying and overlying the Styx Basin

Period	Group	Sub-group/formation	Dominant lithology
Quaternary	Surficial	Quaternary Alluvial	Alluvium, coastal swamp deposits
Cenozoic	Surficial	Undifferentiated sediment	Sand, soil, alluvium, lateritic gravel
Lower Cretaceous	-	Styx Coal Measures	Quartz sandstone, conglomerate, siltstone, carbonaceous shale, coal
Upper Permian	Back Creek Group	Boomer Formation	Volcanolithic sandstone, claystone, siltstone, pebble conglomerate
Permian	Back Creek Group	Back Creek Group	Undifferentiated: fossiliferous volcanolithic sandstone, siltstone, limestone

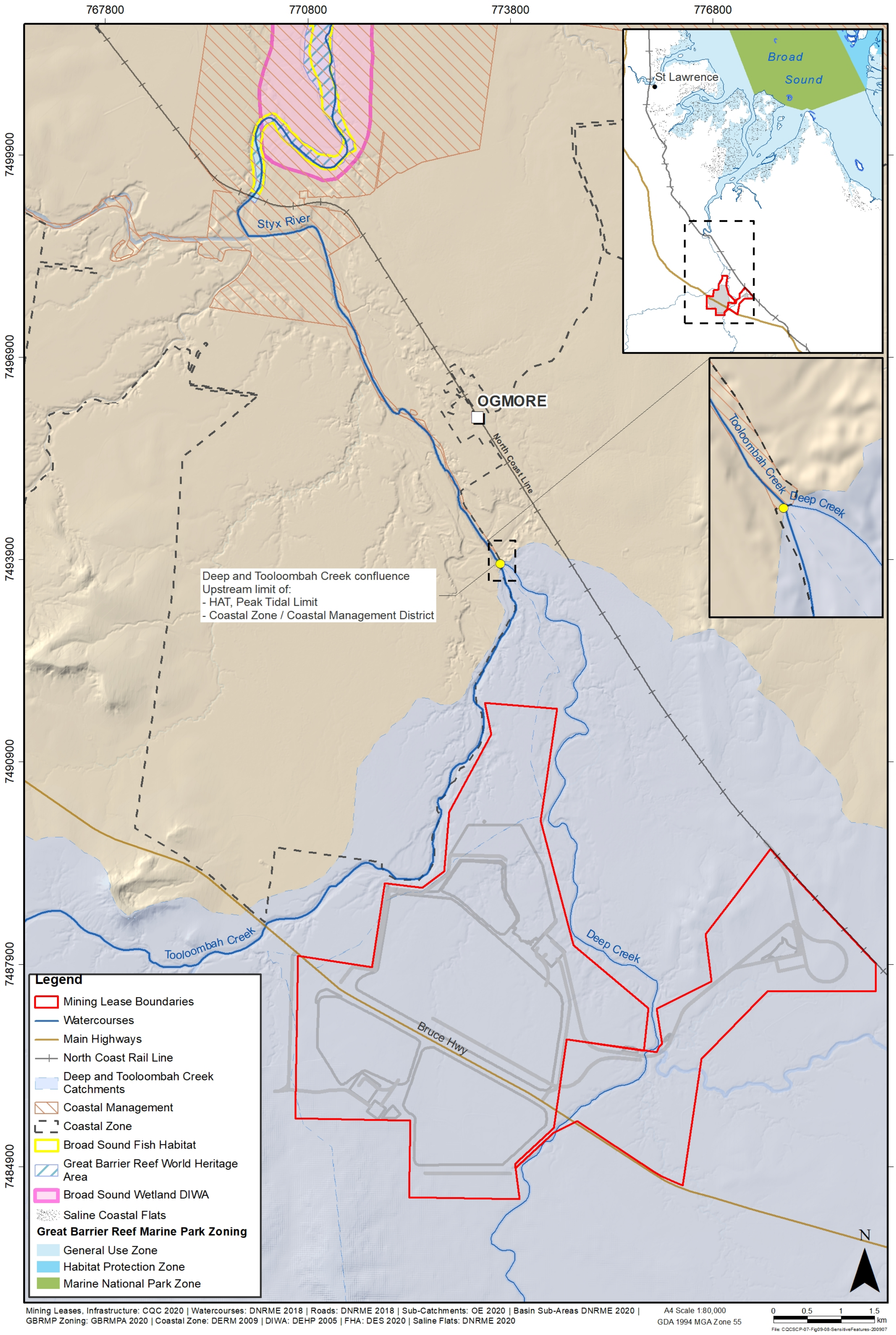


Figure 5-3: Downstream sensitive areas

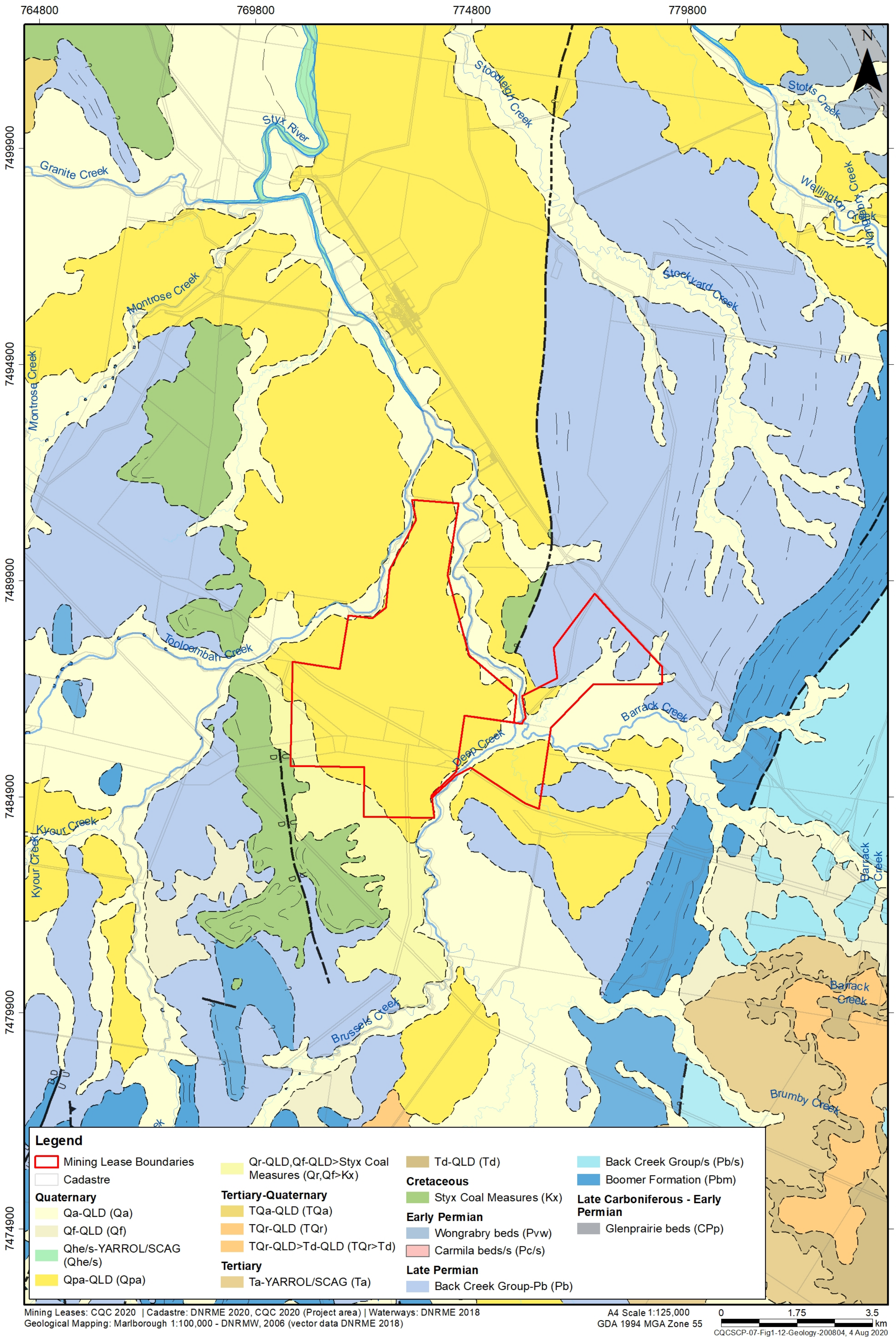


Figure 5-4: Regional geology

The Styx Coal Measures are preserved as basin infill in a half graben geometry which has an overall plunge to the north. Earlier attempts to understand coal-seam geometry are thought to have been incorrect, in assuming that the deposit was basically flat lying rather than incorporating the north and east dipping components.

The majority of the Styx Coal Measures are concealed beneath Quaternary and Tertiary sediment. Queensland Geological Survey mapping shows the eastern margin of the Styx Basin extends to the eastern edge of the terrestrial Cainozoic sediments that conceal it. The Styx Coal Measures outcrop in the western margin of the Styx Basin as low forested hills. These outcrops form a series of detached hills, orientated north-south, that continue for about 60 kilometres northward to the coastline near the Port of St Lawrence. The outcrops generally form small hills and hillocks, but at their greatest height, are 100 metres above the low-lying sediment flats to the east. The hills are probably the coal-barren basal section of the Styx Coal Measures sequence, which consists of thick beds of quartz-dominant sandstones.

The strata of the Styx Basin dip gently to the east, at around three degrees. Tertiary-aged, lateritised sedimentary rocks outcrop to the east of the southern part of the basin. Styx Basin sediments lap onto Permian strata in the west and are faulted against them in the east. The southern part of the basin is bounded to the east by the post-depositional high-angle reverse fault. Adjacent to this fault, the Cretaceous sediments are folded and faulted.

Coal was first discovered in the Styx River area in 1887, and prospecting followed initially for the next 2-3 years. One of the earliest Styx River Coalfield maps was prepared by the Geological Survey of Queensland (W.H. Rands 1892). Development of the Styx River Coalfield began in 1918 at the Styx No.1 State Coal Mine at Bowman, followed shortly thereafter to the south by the Styx No.2 State Coal Mine. In 1924, The Styx No. 3 State Coal Mine began production and was closed in 1964 after 1.5 Million of tons of coal were produced for use in steam trains and other boiler requirements (Malone et al. 1965).

5.3.3.2 Regional faults

Regional faults are mapped at the interface of the Styx Basin and Permian Measures of the Bowen Basin, and most notably the Gogango Overfolded Zone to the east/north-east of the CQC Project toward the Marlborough Block. Some regional faulting is also mapped in the areas to the south-west of the CQC Project associated with the inlier of Connors Volcanics.

Of most relevance for the purposes of this SEIS is the fault / interface to the east of the CQC Project in which sediments of Styx Coal Measures are faulted against the Permian Boomer Formation. This mapped fault throw is estimated to be greater than the thickness of the Styx Coal Measures (e.g. in order of hundreds of metres) and has been accounted for in the revised groundwater modelling undertaken to support this version (v3) of the SEIS.

Recent drilling near the banks of Deep Creek demonstrated that this unnamed, north-south trending, inferred fault line coincides in part with the Deep Creek channel. Permian sedimentary rocks of the Back Creek Group were intersected in shallow drill holes located on the eastern side of Deep Creek, while Styx Coal Measures were intersected a short distance away in shallow drill holes near the western bank (Surface Water/Groundwater Interactions Report in Appendix A6d).

From the nearby historic Bowman underground coal mine, a description of the coal seams' structure includes details of multiple faults and substantial folds in the coal measures, that decrease in magnitude with distance westward from the regional fault (Shepherd 1949).

5.3.3.3 Geology of the Project Area

The stratigraphy of the Project area is shown at Figure 5-5. The coal seams are relatively shallow, and the average cumulative thickness of the full sequence of coal (Grey to V_L2 seams) is approximately 6 m, contained within a sequence of approximately 120 m of coal bearing strata.

The coal seams dip generally to the east in the area west of the Bruce Highway, with the Violet seam, the lowest coal seam in the sequence subcropping in the western part of ML 80187. The deposit structure is currently interpreted to be a syncline structure, the axis of which runs northwest / southeast through the mine area. This structural interpretation follows the deposit structure originally described by Morten (1955).

No faults that affect coal seam continuity have been interpreted, and the apparent undulation seen in the floor contours of the coal seams is interpreted to be small scale folding associated with the syncline in the area. Minor tectonic movement is evident within the Project area coal measures as slickensiding on fractured rock surfaces, as noted in some geological logs of recently cored holes; however, no significant displacement of coal seams has been demonstrated, despite considerable attention to that possibility. One geological model that was built in 2017 used a fault to explain an apparent displacement in interpreted seam correlations (Xenith 2017). This interpreted fault feature was later found to be a consequence of the lenticular nature of the coal seams, rather than a fault, and subsequent modelling excluded it.

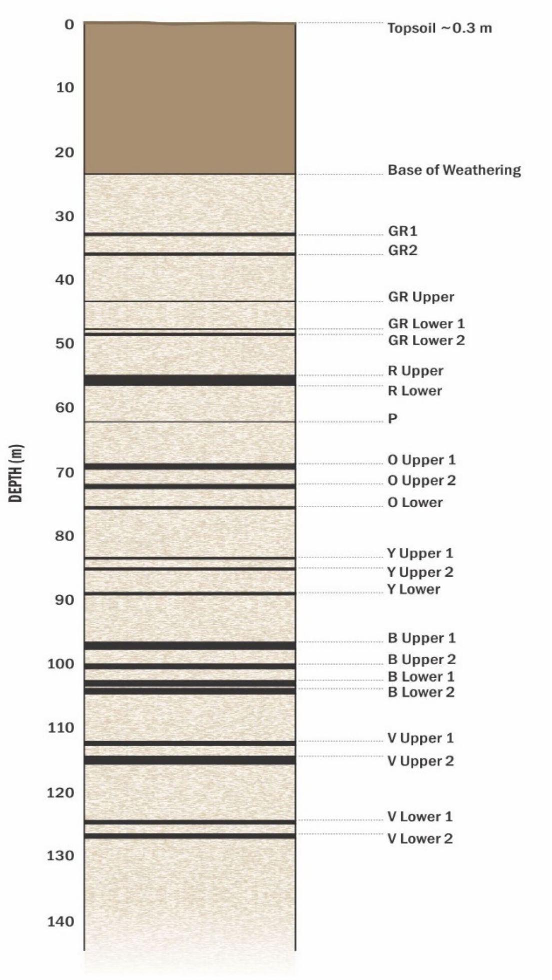


Figure 5-5: Schematic stratigraphic section

The majority of the Styx Coal Measures are concealed beneath Quaternary and Tertiary sediment. Queensland Geological Survey mapping shows the eastern margin of the Styx Basin extends to the eastern edge of the terrestrial Cainozoic sediments that conceal it. The Styx Coal Measures outcrop in the western margin of the Styx Basin as low forested hills. These outcrops form a series of detached hills, orientated north-south, that continue for about 60 kilometres (km) northward to the coastline near the Port of St Lawrence. The outcrops generally form small hills and hillocks, but at their greatest height, are 100 metres above the low-lying sediment flats to the east. The hills are probably the coal-barren basal section of the Styx Coal Measures sequence, which consists of thick beds of quartz-dominant sandstones.

The strata of the Styx Basin dip gently to the east, at around three degrees. Tertiary-aged, lateritised sedimentary rocks outcrop to the east of the southern part of the basin. Styx Basin sediments lap onto Permian strata in the west but are faulted against them in the east. The southern part of the basin is bounded to the east by a post-depositional high-angle reverse fault. Adjacent to this fault, the Cretaceous sediments are folded and faulted.

The Styx Basin sediments were laid down on a coastal plain which developed on the Palaeozoic Strathmuir Synclinorium during the Early Cretaceous. The Styx Basin probably developed by subsidence of the Strathmuir Synclinorium, a Palaezoic feature containing Permian Bowen Basin strata. A schematic geological section (east-west) across the Styx Basin is shown in Figure 5-6 and the supporting description key in Table 5-5.

5.3.3.3.1 Cretaceous Coal Seam Characteristics – Styx Coal Measures

The coal seams that comprise the Styx Coal Measures are generally thin, commonly less than two metres in thickness. Seam splitting is common and seam thicknesses vary considerably. All seams are potentially economically exploitable, despite their relatively small thicknesses. Coal quality throughout the deposit is generally consistent and all seams demonstrate coking properties.

The seams were divided into seam groups and named using a colour scheme. From the base of the Measures to the top, they are tagged as: Violet, Blue, Yellow, Orange, Pink, Red, Green and Grey.

The coal plies may coalesce to form substantially thick seams in parts of the deposit (e.g. Violet and Blue) but in other seams (Orange, Green, Grey) coalescence is not evident in the ML 80187 area. It is common for the coal plies to lense out over moderate distances. The Orange, Green and Grey Seams are characteristically coal ply groups that may coalesce elsewhere in the Styx Basin, but do not coalesce within the proposed mining area. The Red, Yellow and Pink Seams split into two plies in isolated areas. The Red Seam is the most consistent in thickness and quality throughout the ML 80187 area and occurs in the middle of the coal-bearing part of the stratigraphic sequence. The Red Seam commonly exceeds two metres in thickness.

All plies and coalesced seams demonstrate coal quality and seam thickness characteristics that are attractive mining targets. Coal quality analysis and reconciliation with geophysical data show that the majority of ROM coal will require wash-plant treatment to remove partings. Sulfur content is low, even in the raw sample analysis. Pyrite has not been noted in any geological logging or results of quality analysis. Float-sink, drop-shatter, sizing and associated analyses indicate wash-plant yields are likely to be around 80% of ROM coal. Basic seam thickness information is provided in Table 5-6.

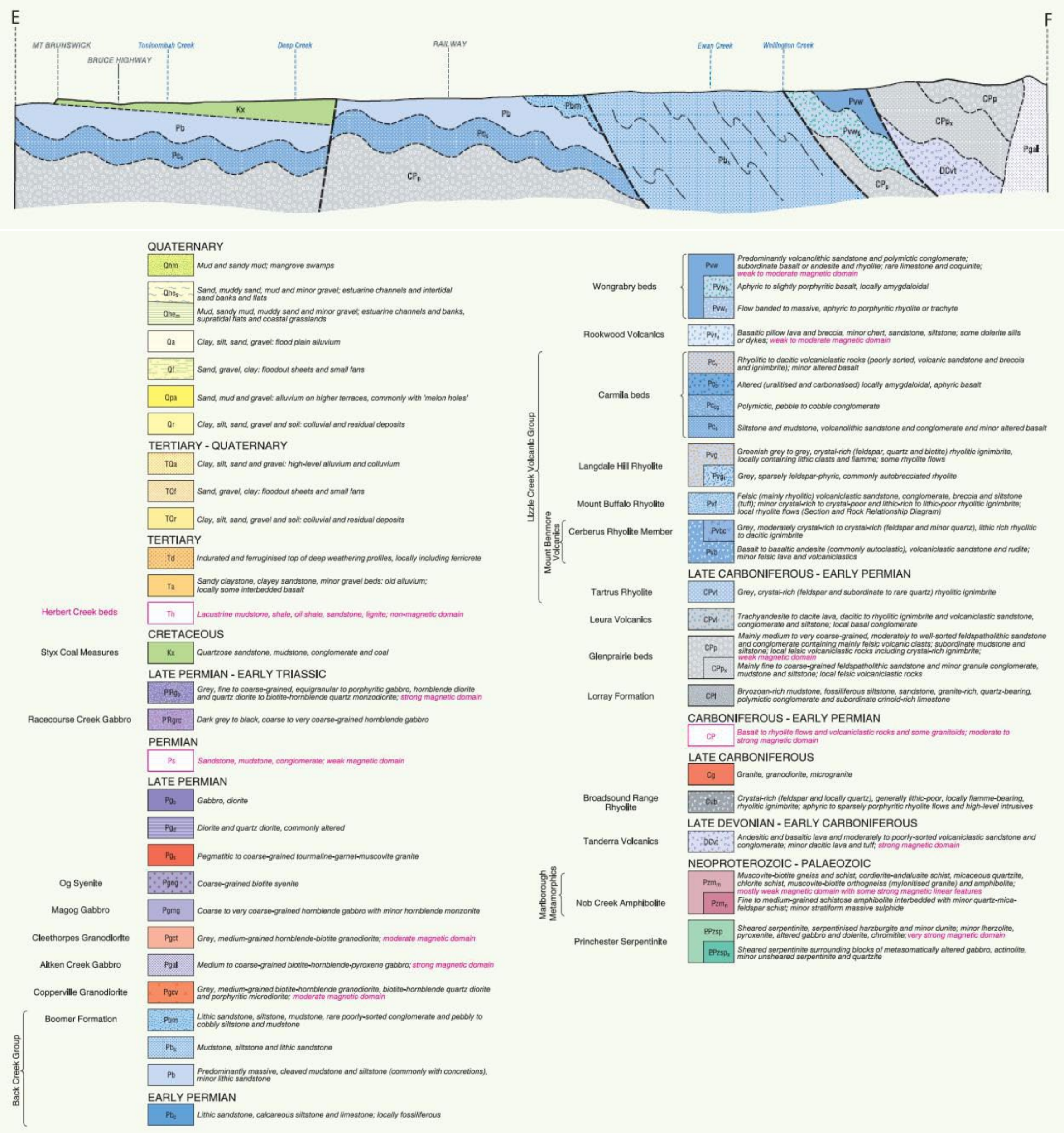


Figure 5-6: Schematic west to east geological cross section from Marlborough Sheet 8852 1:100 000 (After DNRMW, 2006)

Table 5-5: Geological cross section key

Code	Name	Description
Kx	Styx Coal Measures (Early Cretaceous)	Quartz sandstone, conglomerate, siltstone, carbonaceous shale, coal.
Pb	Undifferentiated Back Creek Group (Late Permian)	Undifferentiated: Predominantly massive, cleaved mudstone and siltstone (commonly with concretions), minor lithic sandstone
Pbs	Undifferentiated Back Creek Group (Late Permian)	Mudstone, siltstone and lithic sandstone

Code	Name	Description
Pbm	Boomer Formation (Part of the Back Creek Group, Lower-upper Permian)	Volcanolithic sandstone, claystone, siltstone, pebble conglomerate, litho-feldspathic greywacke.
PCs	Carmilla Beds (Lower Permian)	Acid to intermediate volcanics, conglomerate, sandstone, siltstone, calcareous tuff, limestone.
Pvw	Wongrabry Beds (Early Permian)	Predominantly volcanolithic sandstone and polymictic conglomerate.
Pvwb	Wongrabry Beds (Early Permian)	Aphyric to slightly porphyritic basalt, locally amygdaloidal.
CPp	Glenprairie Beds (Late Carboniferous – Early Permian)	Mainly medium to very coarse-grained, moderately to well-sorted feldspatholitic sandstone and conglomerate containing mainly felsic volcanic clast.
CPpx	Glenprairie Beds (Late Carboniferous – Early Permian)	Mainly fine to coarse-grained feldspatholithic sandstone and minor granule conglomerate, mudstone and siltstone; local felsic volcanoclastic rocks.
DCvt	Tanderra Volcanics (Late Devonian)	Andesitic and basaltic lava and moderately to poorly-sorted volcaniclastic sandstone and conglomerate; minor dacitic lava and tuff.

Table 5-6 Cretaceous coal measures coal seam characteristics

Seam	Ply	Seam thickness (m)			
		Min	Max	Average	Combined Seam Thickness Indicative Average
Grey	GR1	0.11	1.09	0.42	0.79
	GR2	0.10	0.77	0.37	
Green	GR Upper	0.10	0.85	0.34	0.90
	GR Lower1	0.10	0.79	0.37	
	GR Lower2	0.10	0.29	0.19	
Red	R Upper	0.10	2.24	0.81	1.52
	R Lower	0.10	1.32	0.71	
Pink	P	0.10	0.25	0.16	0.16
Orange	O Upper1	0.10	0.60	0.33	0.95
	O Upper2	0.10	0.39	0.26	
	O Lower	0.10	0.71	0.36	
Yellow	Y Upper1	0.10	2.74	0.64	1.31
	Y Upper2	0.10	1.03	0.30	
	Y Lower	0.10	0.78	0.37	
Blue	B Upper1	0.10	1.76	0.56	2.17

Seam	Ply	Seam thickness (m)			
		Min	Max	Average	Combined Seam Thickness Indicative Average
	B Upper2	0.10	1.71	0.71	
	B Lower1	0.10	2.23	0.53	
	B Lower2	0.11	0.88	0.37	
Violet	VI Upper1	0.10	1.35	0.36	1.33
	VI Upper2	0.10	0.30	0.18	
	VI Lower1	0.10	1.19	0.43	
	VI Lower2	0.10	0.74	0.36	

5.3.3.4 Fossils

A review of the Queensland Museum palaeontology database (May 2017) records indicate no significant fossils have previously been identified within the Project area and are considered unlikely to occur. If fossils with the potential to be of paleontological significance are discovered, the immediate site of the fossil find will be isolated and the Queensland Museum will be notified.

Leaf fossils and plant impressions have not been recorded in any of the core-hole logs drilled by CQC. CQC has not initiated any palynological studies to verify the age of the coal measures. Chong (1964) cites earlier studies of fossil macroflora, microflora and microfauna that concur in the assignment of a Lower Cretaceous age to the Styx coal measures.

5.3.4 Land Systems and Soils

5.3.4.1 Mapped Land Units

Land systems are currently mapped at 1:250,000 scale in the Capricornia Coast St. Lawrence-Marlborough Area land systems survey (DPI 1995), with the minimum mapped area approximately 10 km^2. As shown in Figure 5-7, the Tooloombah (Tb), Styx (Sx), Plainview (Pv), Woodstock (Ws), Torilla (Tl) and Somerby (So) land systems were mapped within the lease areas. The Blackwater (Bl) land system was mapped within 300 m north-west across Tooloombah Creek from ML 80187.

A description of these land systems is provided in Table 5-7, which shows the soils comprise mostly of Sodosols (1,982 ha), followed by Vertosols (878 ha), Kandosols (710 ha) and the Styx land unit which is a mix of Tenosols, Rudosols and Vertosols (129 ha). These Australian Soil Orders can generally be described as follows:

- Sodosols - soils which have a clear and strong texture contrast from the A horizon and a sodic B horizon (exchangeable sodium percentage >6%)
- Vertosols - clayey soils (having a field texture of 35% clay or greater throughout the profile) with vertic (shrink-swell) properties (‘cracking clays’)
- Kandosols - soils which lack strong texture contrast, have massive or only weakly structured B horizons and are not calcareous throughout
- Tenosols - soils with generally only weak pedologic organisation apart from the A horizons and

- Rudosols - soils with negligible (rudimentary) pedologic organisation apart from minimal development of an Al horizon or the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.

The general characteristics of these soils are summarised in Table 5-8.

Table 5-7: Land Systems in soil investigation area

Land System	Landform and geology	Major Soils[1]	Remnant Native Vegetation
Plateaus, Sedimentary Rocks, Eucalypt Woodland			
Ws – Woodstock (93 ha) Class C2	Dissected low plateaus gently dipping sedimentary rocks	*Kandosol* Red, massive, gradational loams and clay loams	Eucalypt woodland (narrow-leaved ironbark, pink bloodwood, wattles)
Undulating rises and plains, Sedimentary Rocks Eucalypt woodland			
Tl – Torilla (116 ha) Class C2	Undulating rises and low hills deeply weathered sedimentary and metamorphic rocks	*Kandosol* Red, structured gradational clay loams and uniform clays	Eucalypt woodland (narrow-leaved ironbark, pink bloodwood)
Tb – Tooloombah (501 ha) Class C2	Gently undulating plains and rises sedimentary rocks	*Kandosol* Bleached sandy and loamy surface, brown and grey, sodic duplex soils	Eucalypt woodland (narrow-leaved ironbark, Queensland peppermint)
Undulating rises and plains, Unconsolidated sediments, Brigalow scrub			
Bl – Blackwater (10 ha) Class A	Level to gently undulating plains and rises on cracking clay sediments; melonhole microrelief	*Vertosols* Grey, brown and black cracking clays	Brigalow scrub
So – Somerby (868 ha) Class C1	Level to gently undulating plains and rises on cracking clay sediments melonhole microrelief	*Vertosols* Grey and brown, strongly sodic cracking clay and duplex soils	Brigalow scrub
Undulating rises and plains, Eucalypt woodland			
Pv – Plainview (1,982 ha) Class C2	Gently undulating to level plains on unconsolidated fine and medium textured sediments	*Sodosols* Black and grey, strongly sodic duplex soils; bleached loamy and clay loamy surface, brown and grey, sodic duplex soils	Eucalypt woodland (poplar box, narrow-leaved ironbark)
Floodplains and Local Alluvial Plains, Gradational Soils			
Sx – Styx (129 ha) Class A	Narrow floodplains along the Styx river and Wellington Creek	*Tenosols, Rudosols, Vertosols* Brown, massive fine sandy loams	Eucalypt woodland (blue gum, Moreton Bay ash)

Table notes
[1] *Australian soil order* followed by the major soils description for the land system.

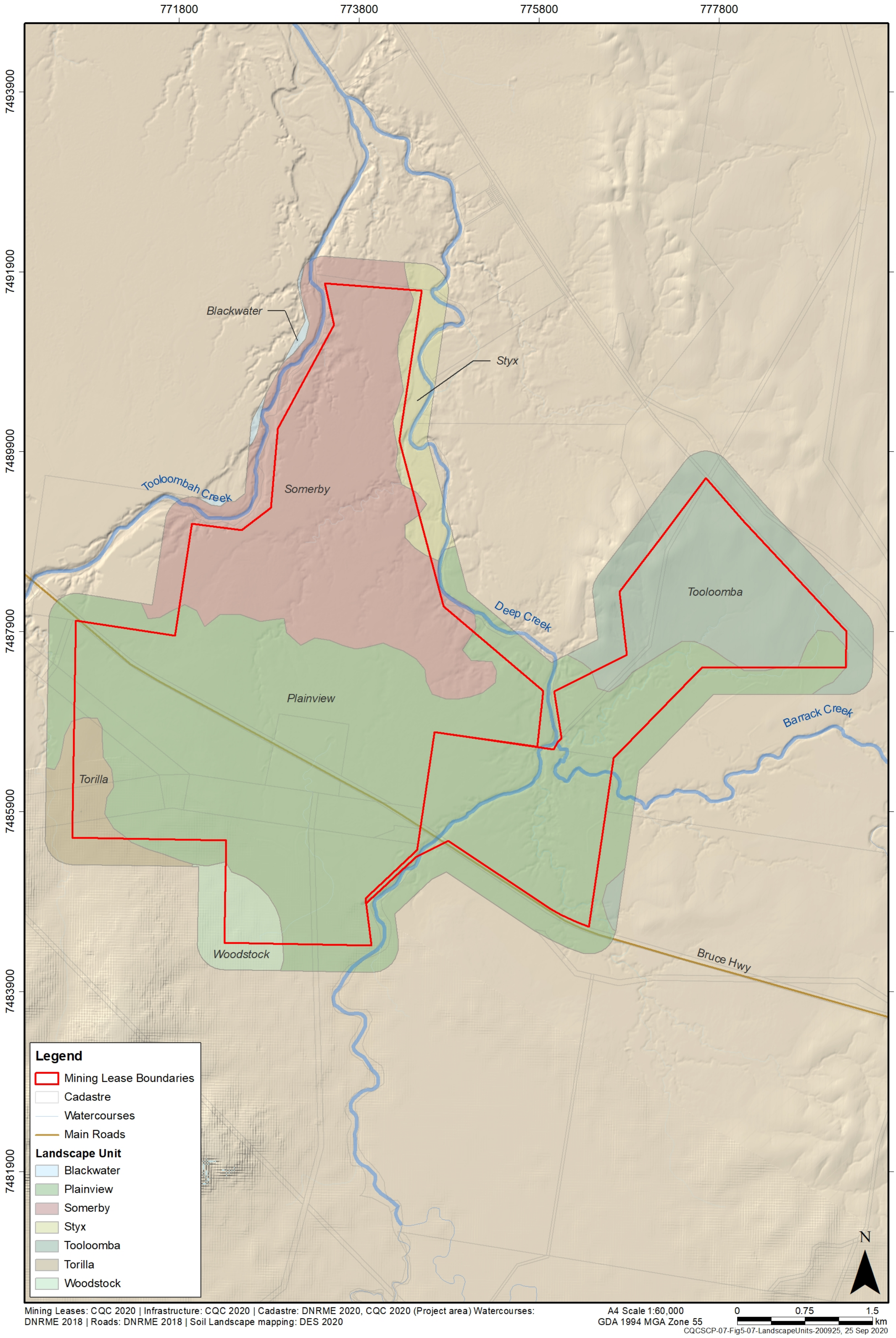


Figure 5-7: Mapped land systems in and adjacent to the lease area

Table 5-8: Characteristics of soil families identified within the Project area

Soil family	Water availability	Drainage	Aeration	Physical root limitation	Erosion hazard	Nutrient availability	Potential toxicities	Workability
Dermosol	Moderate to high.	Tend to be well drained.	Usually well aerated.	Generally, few restrictions.	Depends on vegetation cover, slope and rainfall.	Moderate to high fertility.	Uncommon.	Generally good.
Sodosol	Limited plant water availability.	Most are poorly drained. Generally low permeability.	Depends on site drainage, often poorly aerated.	Clay sodic B horizon generally will restrict root growth.	Depends on vegetation cover, slope and rainfall. Severe on slopes in high intensity rainfall areas.	Mostly deficient in nitrogen and phosphorus.	Secondary salinity may be a problem.	Surface soil subject to crusting and hard setting.
Kandosol	Moderate to high, less in shallower soils.	Most are well drained. Generally high permeability.	Usually well aerated.	Generally, few restrictions.	Depends on vegetation cover, slope and rainfall. Severe on slopes in high intensity rainfall areas.	Mostly deficient in nitrogen and phosphorus.	Uncommon. Potentially aluminium induced by strong acidity.	Generally good. Surface soil subject to crusting and hard setting.
Rudosol	Low to moderate.	Depends on texture.	Depends on texture.	Not typically restrictive for root growth.	Depends on vegetation cover, slope and rainfall.	Typically, low.	Uncommon.	Dependent on parent material.
Vertosol	Moderate to high.	Poor.	Depends on site drainage.	Cracks provide opportunities for root growth.	Depends on vegetation cover, slope and rainfall.	Moderate to high.	Uncommon.	Difficult due to heavy textures.

5.3.4.2 Soil Investigation and Mapping

Combining the available mapping data and the soil field observations and laboratory data, the land systems were refined, and included the definition of five soil mapping units across the investigation area, with a description of each, their ALC Class, the area mapped and area within the disturbance footprint provided in Table 5-9 and shown in Figure 5-8.

Table 5-9: Soil mapping units

ID	Soil Mapping Unit	Area Mapped (ha/%)	Area within Disturbance Footprint[1] (ha/%)
1	*Infertile soils formed on deep weathered sedimentary and metamorphic rocks on hillslopes & rises* Red and Brown Gravelly Earths (Kandosols) - Sandy Loam Topsoil over Clay Loam Subsoil (ALC Class C2)	586 / 16%	37 / 3.1%
2	*River flats and terraces* Alluvial Soils Non-gravelly (Tenosols, Rudosols, Vertisols) - Sandy Loam to Clay textures (ALC Class A)	28 / 1.1%	0.8 / 0.1%
3	*River flats and channels* Alluvial Soils Gravelly Shallow (Tenosols, Rudosols) - Sand, Gravel Loam (ALC Class D)	166 / 4.1%	20 / 1.1%
4	*Alluvial plain soils* Brown and Grey Sodic Vertosols - Non-gravelly Medium Clay over Medium Heavy Clay (ALC Class C1)	331 / 9%	61 / 4.1%
5	*Alluvial terrace soils* Vertic Hypernatic Grey and Brown Sodosols - Gravelly Clay-loamy Clayey (ALC Class C2)	2576 / 70%	1254 / 91%
	Total	3,688	1,373

Table notes

[1] this includes the new Mt Bison Road access west (and outside) of the lease

The existing land system mapping did not accurately discriminate between Vertosol soils formed on sediments deposited by Granite, Montrose and Tooloombah Creeks and derived from volcanic uplands to the west, and Sodosol soils derived from long valley deposits of the Styx River and Deep Creek. This assessment has found three alluvial systems with different base levels clustered around 25, 35 and 55 mAHD, associated with alluvial and floodplains of the Styx River and Deep Creek; the terrace plains of Tooloombah Creeks; and a headwater terrace plain of Tooloombah creek to the south west of the lease area.

Consequently, the boundary between Plainview and Blackwater land systems was revised from field observations and the concept of the Plainview land system was refined to colluvial and alluvial material derived from basalt capped highland to the east and deposited by relatively steep Granite, Montrose and Tooloombah Creeks. The Somerby and Styx land systems were associated with the long valley deposits of Deep Creek and the Styx River, varying in age and base level.

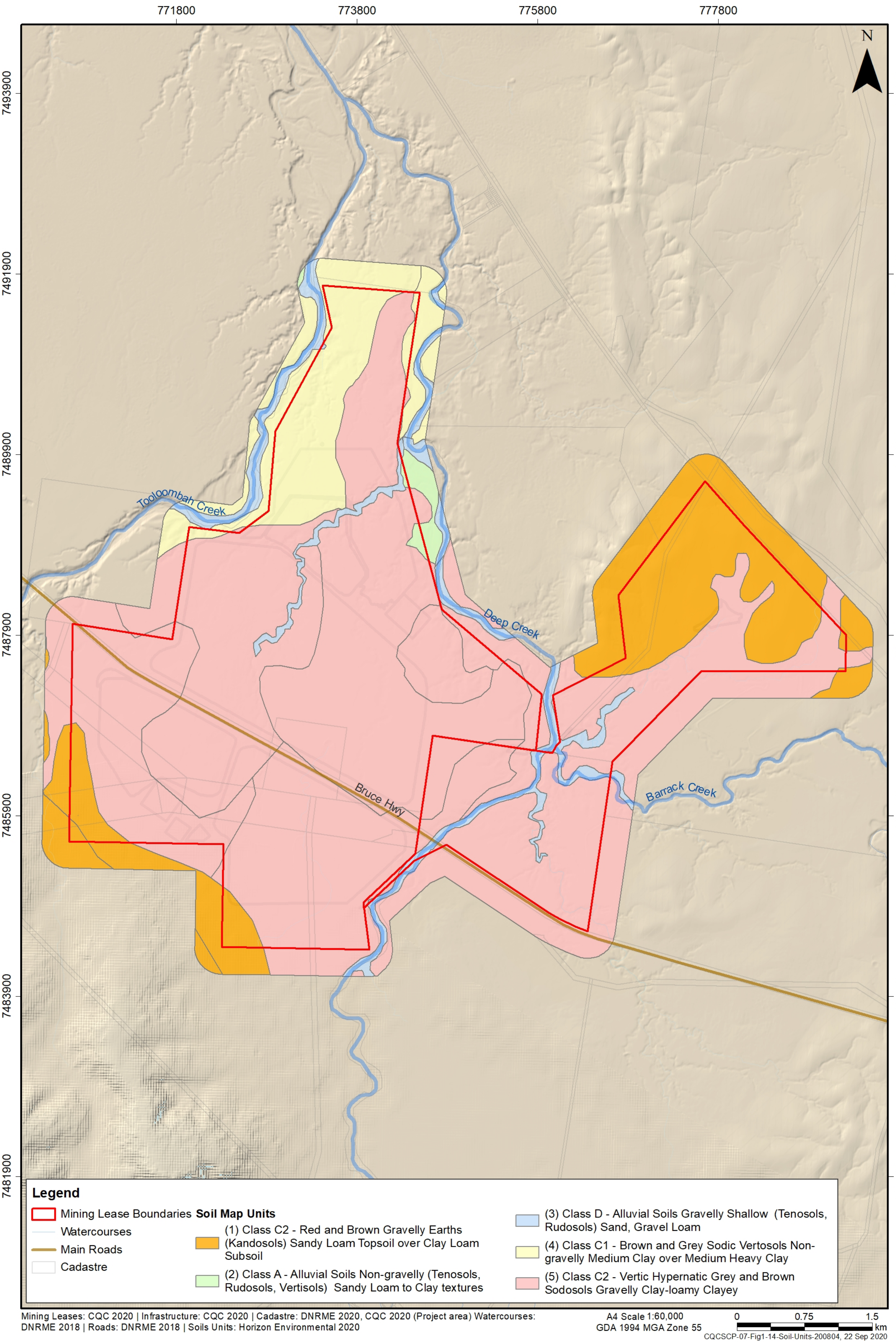


Figure 5-8: Project revised landscape units

This was a refinement of the land systems mapping based on detailed observations and interpretation of clay versus fine sandy loam A horizons using gamma-radiometric mapping (National Radiometric Mapping version 2).

There is a pattern of texture contrast soils with thin fine sandy loam topsoils over sodic, shrink-swell clay subsoils (Sodosols), and uniform shrink-swell clay soils (Vertosols) on the terrace plains and alluvial plains respectively. Vertosols were generally distributed on the alluvial and terrace plain of Tooloombah Creek on the western side of the study area associated with the Blackwater and Somerby land systems. However, Sodosols are associated with these land systems to the east of Tooloombah Creek. This reflects differences in alluvial parent materials between Tooloombah Creek, which drains basalt capped ranges to the west, and Deep Creek draining sedimentary and metamorphic geology to the south and east.

The Project site covers part of the alluvial plain between these two creeks, which is a mixture of materials delivered by both systems. Filtered potassium gamma radiometric mapping available from AUSGEO was used to refine the land unit boundaries where Sodosols and Vertosols overlap in the Project area. The potassium signal derives from the near surface and is higher for clay than for sand and loam and was used to pick out the Vertosols where the land system mapping was unreliable.

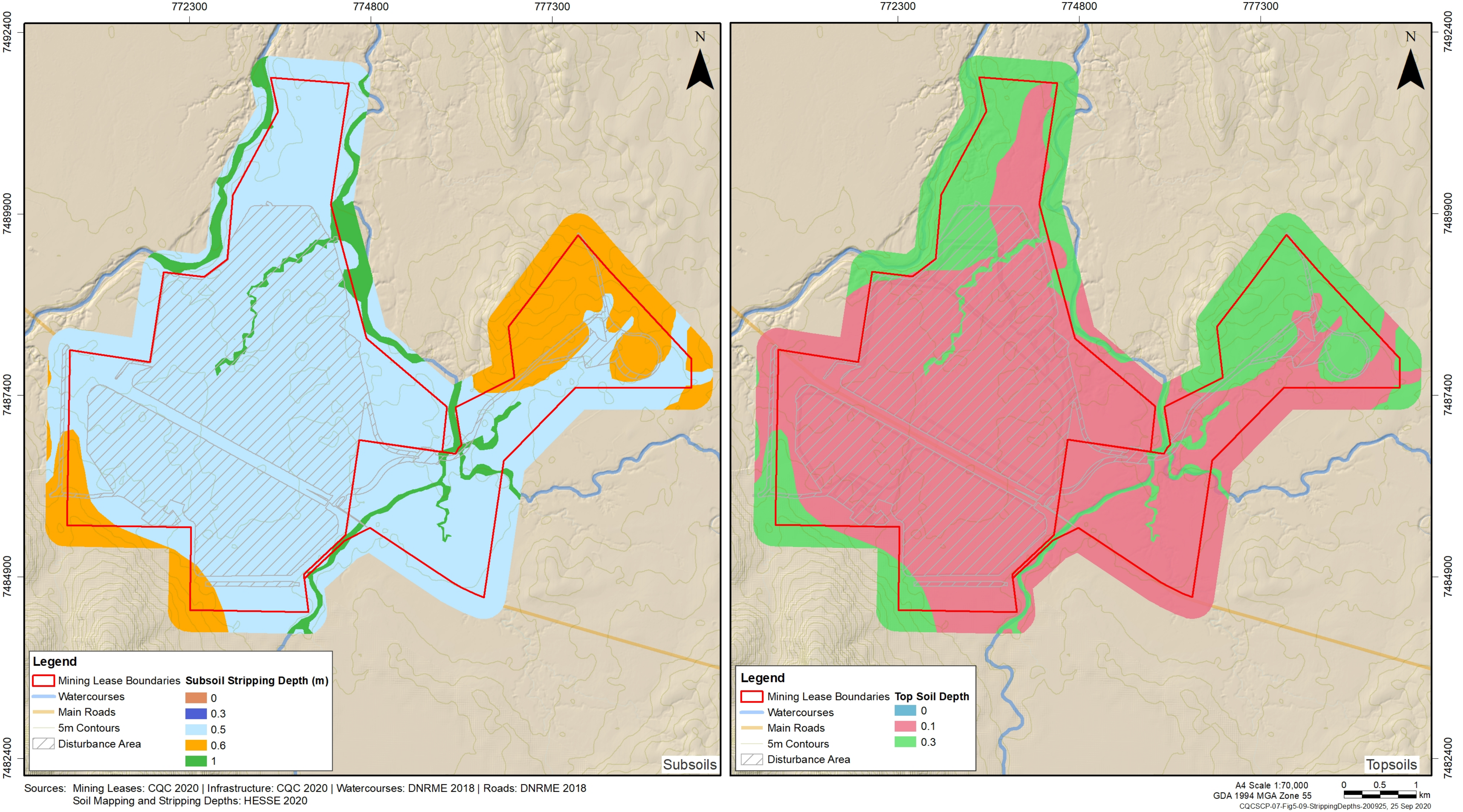
5.3.4.3 Maximum Recommended Stripping Depths

Based on the soil units described in Section 5.3.4.2, the stripping depths for topsoil (primary media) and subsoils (secondary media) were calculated for each soil unit and across the disturbance area for the Project, with the recommended depths (and ALC) provided in Table 5-10, and shown in Figure 5-9.

Stripping depths were determined based on the general soil limitations with subsoil sodicity below 0.2 to 0.3 m a general constraint to topsoil stripping depth, and subsoil stripping depth limited by sodicity and chloride content with depth.

Table 5-10: Soil stripping depths for mapped soil units

Soil Map Unit	Topsoil Stripping Depth (m)	Subsoil Stripping Depth (m)	ALC
Alluvial Soils - Gravelly sandy alluvial soils (Rudosols)			
UNITS 2, 3	0.3	1	D
Earthy Soils – Kandosols Gravelly red and brown earths sandy to loamy over clay loam			
UNIT 1	0.3	0.6	C2
Sodic Texture-contrast Soils – Sodosols Gravelly grey and brown texture contrast soil clay loam over highly sodic cracking clay subsoil (Sodosol)			
UNIT 5	0.1	0.5	C2
Cracking Clay Soils – Vertosols Non-gravelly grey and brown cracking clays with highly sodic subsoils soils (Vertosols)			
UNIT 4	0.3	0.5	C1



Sources: Mining Leases: CQC 2020 | Infrastructure: CQC 2020 | Watercourses: DNRME 2018 | Roads: DNRME 2018
Soil Mapping and Stripping Depths: HESSE 2020

Figure 5-9: Soil stripping depths across the lease area

5.3.4.4 Summary of Key Soil Properties

The below sections discuss the key soil features determined from the soil assessment, as detailed within the Land Suitability Assessment in Appendix A3a. It is discussed in terms of the five soil map units described in Section 5.3.4.2, and based on the recommended stripping depths for each soil unit described in Section 5.3.4.3 to give a clear indication of the expected top and subsoil quality.

Each parameter discussed below (other than soil depth and dispersivity) is shown in Figure 5-10 to Figure 5-20 by soil unit and horizon, being the recoverable topsoil and subsoil and (where data is available) data for deeper soils is included.

5.3.4.4.1 Soil Depth

Soil depth generally extended beyond the sampling limit (1.2 m) but would be expected to be variable across the Project area with shallower soils occurring in undulating terrain to the south and deeper soils being present in the flatter terrain to the north. Depth of topsoils based on the recommended topsoil stripping depth (refer to Section 5.3.4.3) were assessed in the Land Suitability Assessment in Appendix A3a as 0.3 m deep for all units other than the dominant soil unit 5 (the Sodosols) with a topsoil stripping depth of 0.1 m.

5.3.4.4.2 Dispersivity

The Emerson aggregate test (EAT) measures the dispersion potential of soils and has a direct effect on the erosion susceptibility of a soil. The EAT Class of the soil units was identified as Class 3 for soil Units 1, 2 and 3 and Class 2 for Unit 4. For Soil Unit 5, topsoils were Class 2 and subsoils Class 1.

Classes 1 and 2 have a greater dispersive potential and, when disturbed, are prone to erosion and soil structural decline. Class 3 soils are considered to only have moderate dispersive tendencies and will not readily disperse in water.

5.3.4.4.3 Sodicity

Exchangeable Sodium Percentage (ESP) measures the sodicity of a soil which, along with the EAT, is directly related to a soils structural stability and erosion potential. The sodicity ratings for soils, following Northcote and Skene (1972), are as follows:

- Non-sodic: 0 – 6
- Sodic: 6 – 15 and
- Strongly sodic: > 15.

Figure 5-10 shows the average ESP for each soil type and horizon. As can be seen, soil units 2 and 3 can be considered non-sodic, as can many of the soil unit 5 topsoils. However, soil unit 1 and subsoils at units 4 and 5 are considered sodic to strongly sodic. Given that units 4 and 5 represent around 95% of the disturbance area, then sodicity, particularly for subsoils, will be required to be managed in soil stripping, storage and rehabilitation works.

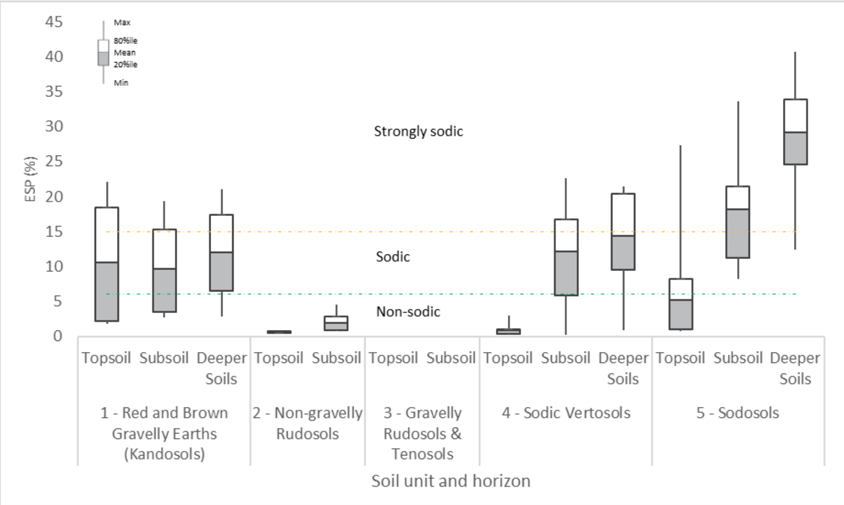


Figure 5-10: Exchangeable sodium percentage (ESP) summarised by soil type and stripping horizon

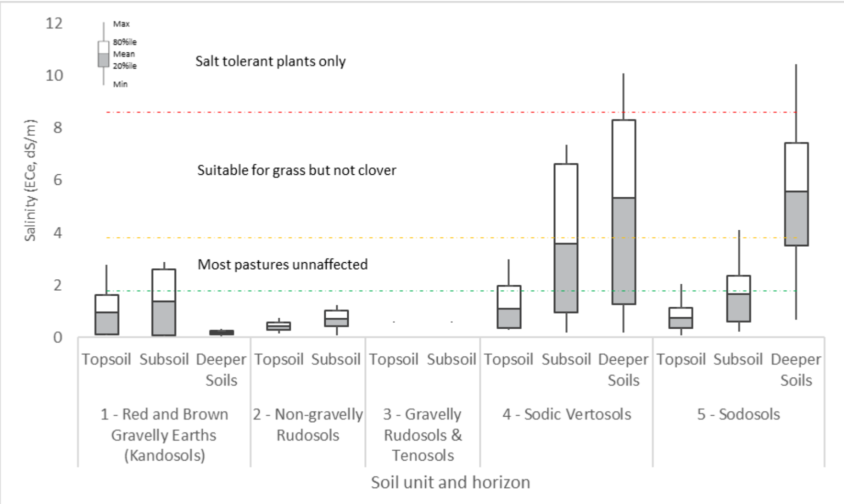


Figure 5-11: Soil salinity (estimated ECe) summarised by soil type and horizon

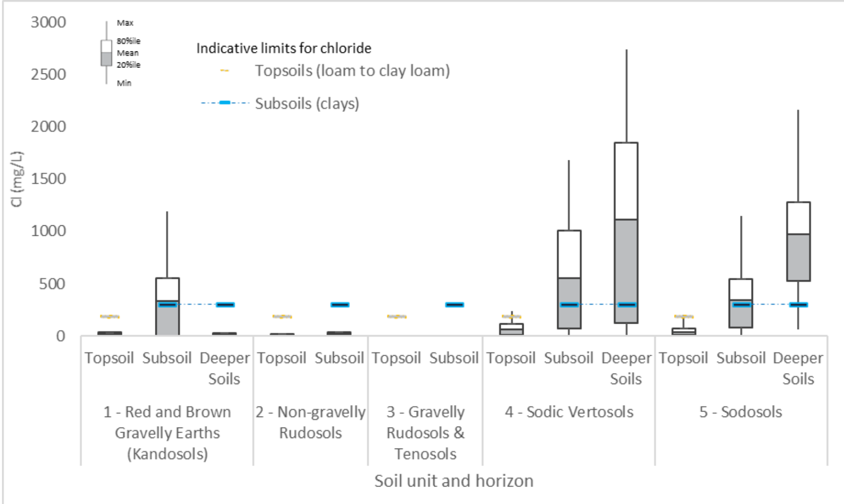


Figure 5-12: Chloride summarised by soil type and horizon

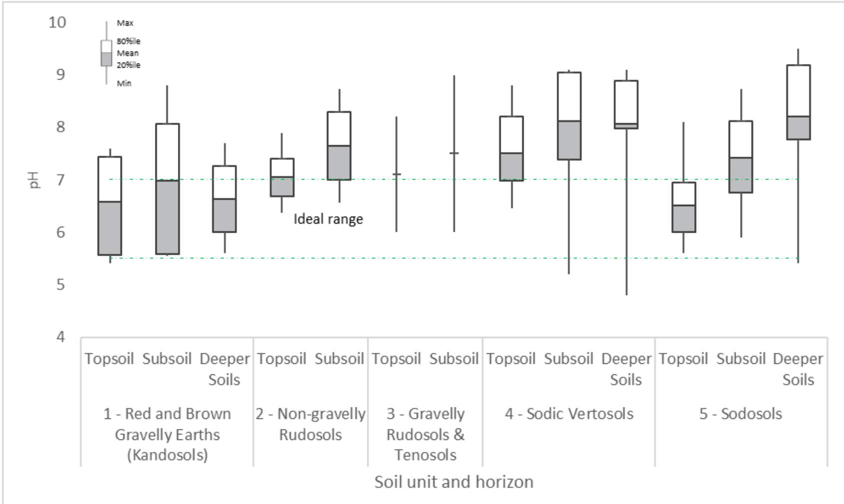


Figure 5-13: Soil pH summarised by soil type and horizon

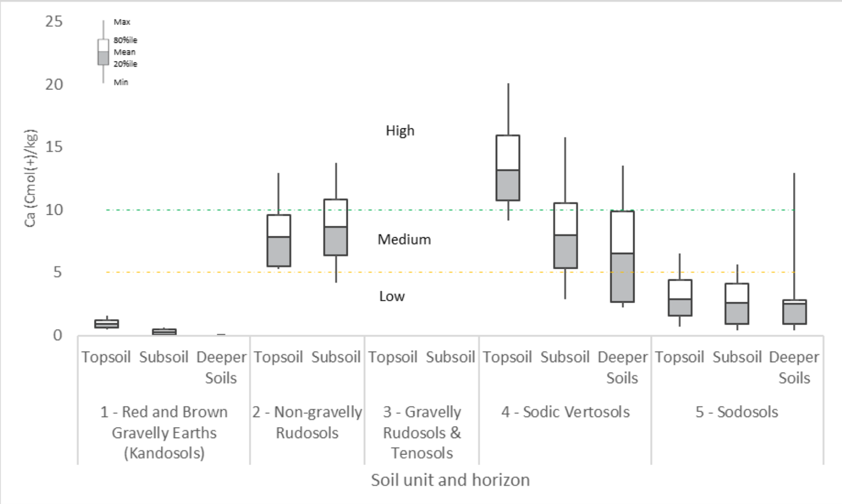


Figure 5-14: Exchangeable calcium summarised by soil type and horizon

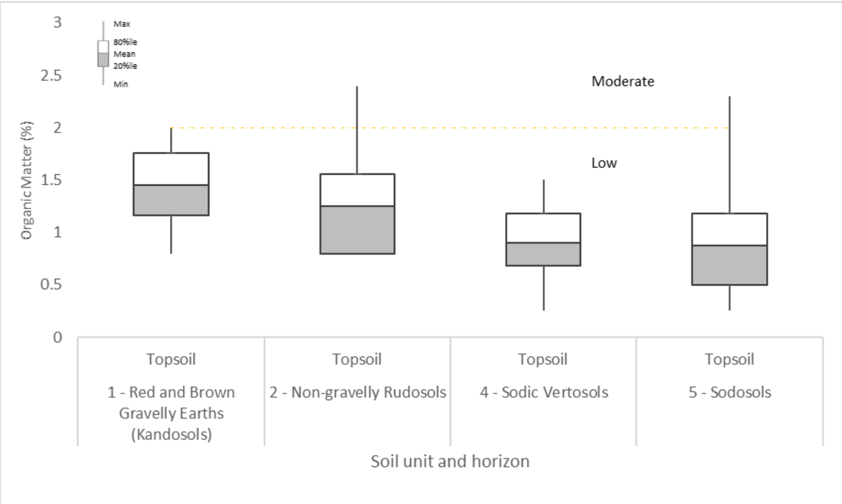


Figure 5-15: Organic matter content summarised by soil type and horizon

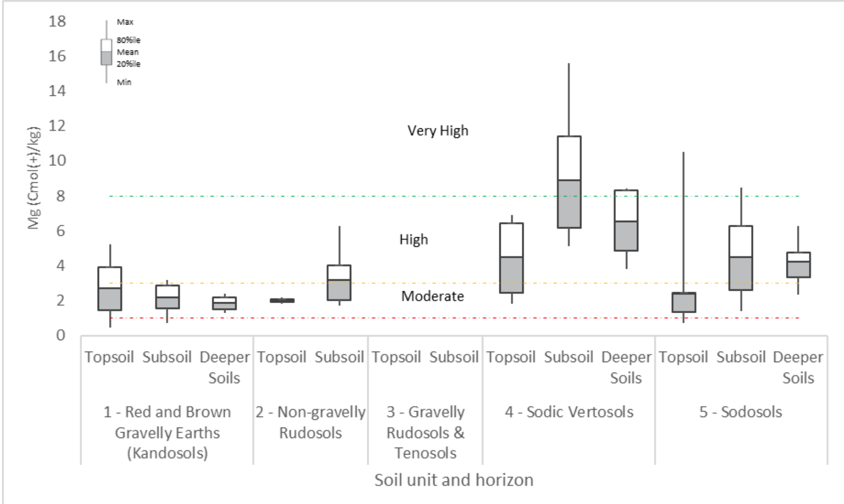


Figure 5-16: Exchangeable magnesium summarised by soil type and horizon

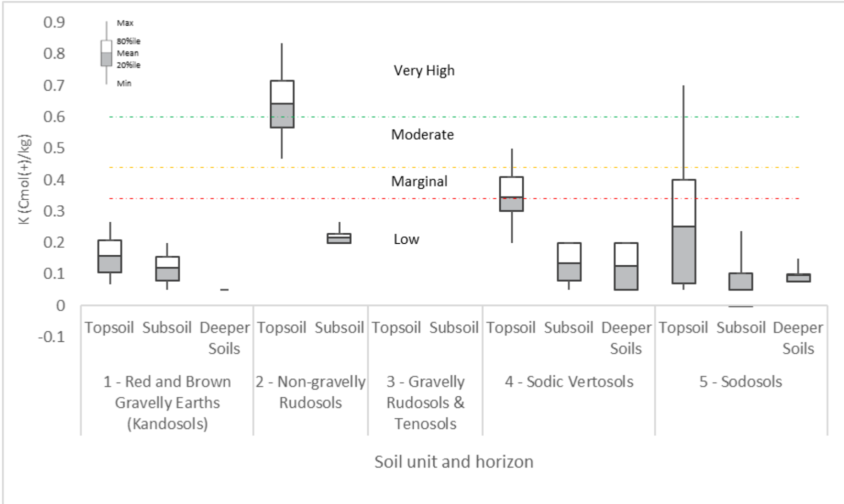


Figure 5-17: Exchangeable potassium summarised by soil type and horizon

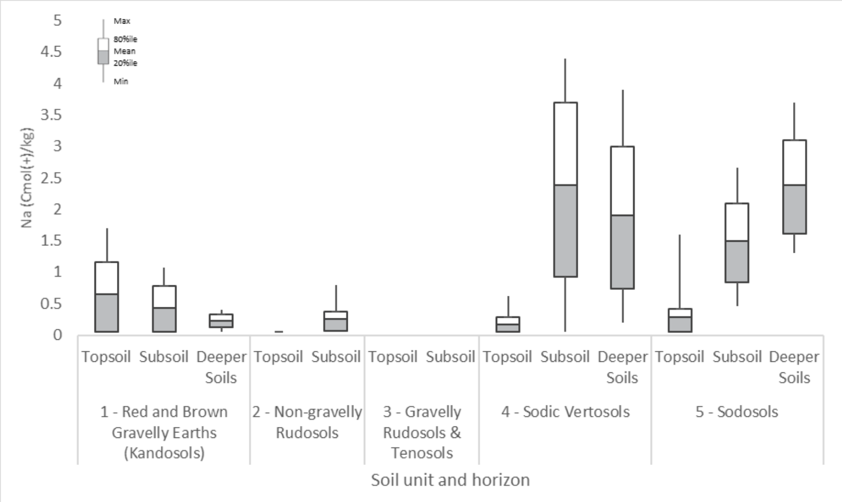


Figure 5-18: Exchangeable sodium summarised by soil type and horizon

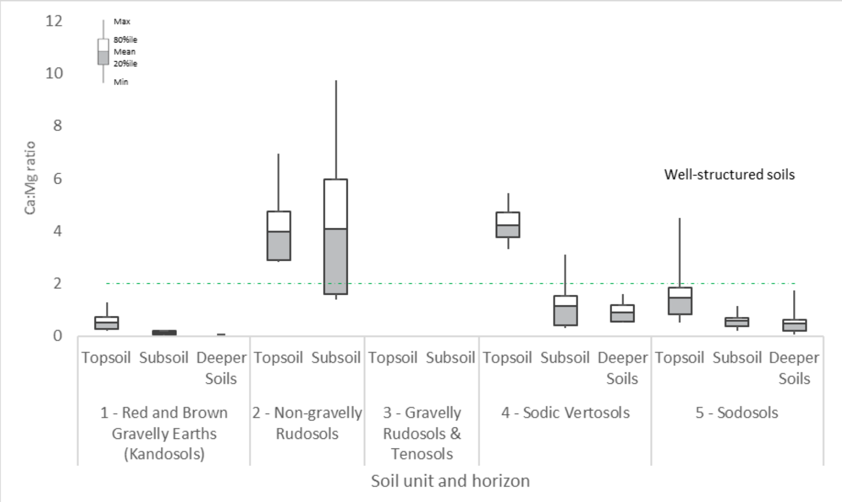


Figure 5-19: Ca:Mg ratio summarised by soil type and horizon

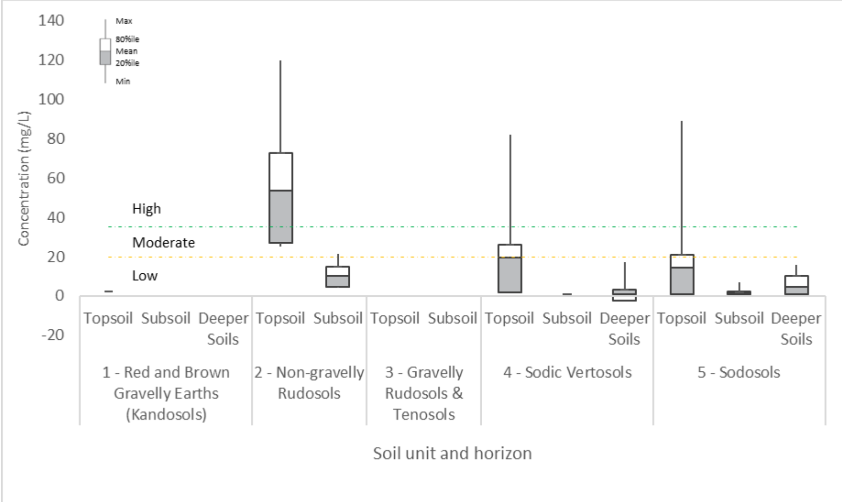


Figure 5-20: Available phosphorous (Colwell extractable) summarised by soil type and horizon

5.3.4.4.4 Soil Erosion Susceptibility

An assessment of soil erosion susceptibility is provided in Table 5-11 for the major soil orders anticipated to be disturbed on the site, which lists influencing factors for each soil type. As the mine is in a sub-tropical climate, soil erosion management shall be undertaken in a two-season approach - wet season (December to March) and dry season (April to November) and conducted under a site Erosion and Sediment Control Plan, a draft of which is provided in Appendix A15a.

As would be expected, the sodic soils have the highest erosion potential when disturbed.

Table 5-11: Soil erosion susceptibility

Soil Order	Sodicity	Emerson Class	Texture	Landform	Vegetation cover	Erosion susceptibility
Dermosol	Non-sodic	Class 3	Loam	Undulating plain	Cleared with mixed eucalypt open forest	Low susceptibility due to low relief and non-dispersive soils
Sodosol	Sodic	Class 3 – Class 1	Clay loam – sandy clay	Gently undulating plains	Cleared	Highly susceptible when disturbed
Kandosol	Non-sodic	Class 4	Clay loam	Undulating rises	Variable but mostly cleared	Moderate-High on slopes in high intensity rainfall areas.
Rudosol	Non-sodic	Class 3	Loamy sand	Gently undulating plain	Grazed but not cleared	Low susceptibility due to sandy texture and flat terrain
Vertosol	Sodic	Class 1 and Class 4	Sandy clay	Level to gently undulating plain	Cleared	High for disturbed soil and stockpiles, but erosion hazard limited by flat terrain

5.3.4.4.5 Salinity

Soil EC measurements from 1 : 5 soil water dilutions ($EC_{1:5}$) are influenced by soil texture. Salts are more readily dissolved from light-textured (sandy) soils and less readily dissolved from heavy-textured (clayey) soils due to clay adsorption processes. To correct for this, $EC_{1:5}$ can be converted to an estimated EC_e (soil EC from a saturated paste extract) using the conversion factors provided by Shaw (1994).

This data is summarised by soil type and horizon in Figure 5-11. This shows generally low salinity across all soil types, with some higher ranges in the Unit 4 and 5 subsoils – for the unit 5 top and subsoils (representing 91% of the soil types to be disturbed by the Project), soils can be considered low risk in terms of salinity. Deeper soils have salinity limitations.

Chloride levels shown in Figure 5-12 compared to indicative 'no limitation' thresholds show that topsoils are generally low in chloride, but that levels increase with depth – the unit 4 and 5 subsoils are elevated in chloride, although unit 5 (representing 91% of the soil types to be disturbed on the site) are only marginally above the indicative threshold.

5.3.4.4.6 Soil pH

Soil pH has a strong influence on the solubility and form of chemical compounds, the availability of ions in the soil solution as well as microbial activity. The optimum pH range for plant growth varies between species with a pH of 5.5–7.0 considered ideal for many native plants and pH 6.0–7.0 best for pasture grass. Plants are fairly tolerant of pH range and it is only if pH is less than 4.5 or greater than 9.0 that pH is likely to have direct effects on plant growth (DME 1995). At a pH outside the optimum range, indirect effects (due to the change in the availability of plant nutrients) can occur.

Soil pH is summarised by soil type and horizon in Figure 5-13, showing that pH mostly ranges (i.e. 20th to 80th percentiles) between 5.6 in Unit 1 topsoils (strongly acidic) to 9.2 in the Unit 5 deeper soils (moderately alkaline). For the recoverable subsoils, the maximum is 9 in unit 4 subsoils, and 8.1 in unit 5 subsoils (representing 91% of the disturbance area).

5.3.4.4.7 Cation Exchange Capacity and Organic Matter

Figure 5-14 shows the average and range of cation exchange capacity (CEC) for the mapped soil units and horizons. This shows that the majority of soils across the Project area contain CEC levels that are considered to be Very Low (<6) to Low (<12), particularly so in the sandy textured red and brown Kandosols, with the exception of the soil unit 4 sodic vertosols, in the moderate range. The dominant soils in the disturbance footprint – the Sodosols – were Very Low for topsoils, and Low for subsoils.

Figure 5-15 shows the level of organic matter in all topsoils (where measured) as low – this matches the CEC measurements, and indicates topsoils could benefit from addition of organic matter while being stored.

5.3.4.4.8 Exchangeable Cations

Exchangeable calcium, magnesium, potassium and sodium levels are summarised by soil type and horizon in Figure 5-14 to Figure 5-18, with the calcium : magnesium ratio provided in Figure 5-19.

The results indicate low calcium in unit 1 and 5 soils, and medium levels in units 2 and 4 (with high in unit 4 topsoils); moderate to high levels of magnesium; generally low levels of potassium, other than unit 2 topsoils (moderate to very high), and unit 4 topsoils (low – marginal); and calcium : magnesium ratios generally below the line indicative of well-structured soils, other than for soil unit 2 (sodium is discussed in Section 5.3.4.4 in terms of ESP).

Given the sodic nature of soils in the disturbance area, the recovered soils (and those left in-situ) could benefit from addition of a calcium source, such as gypsum, to ameliorate sodicity issues and improve soil structure. Balance microfertiliser application would also be beneficial (following the advice of an experienced agronomist).

5.3.4.4.9 Phosphorous

Bicarbonate extractable (Colwell) phosphorous is an indicator of phosphorous availability in the soil, with the results summarised by soil type and horizon provided in Figure 5-20. The results show that levels are generally considered low, other than the soil unit 2 topsoils. Recovered soils could benefit from a balanced fertiliser application to assist growth (following the advice of an experienced agronomist).

5.3.5 Agricultural Land Suitability

The current mapped agricultural land classes and areas of SCL are shown in Figure 5-21, which identifies some areas with high potential for pasture production and an area in the centre of the mine suitable for intensive livestock production. Class A and B ALC lands are mapped approximately coinciding with the SCL lands.

The Project area is suitable for beef cattle grazing on pastures. Whilst some areas are theoretically suitable for cropping there are no cropping activities undertaken within the Mamelon property or the areas associated with the Project on the Brussels property and Strathmuir property.

Based on the field sampling, revised mapping and assessment presented in the Land Suitability Assessment in Appendix A3a, it was found that soil properties over the improved pastureland are generally consistent with ALC Class A / B land on regional land capability mapping. Verification in the field survey after an initial review of cropping history between January 1999 and December 2010 from satellite imagery identified that areas on the SCL trigger map were ponded pastures and there was no cropping activity in the Project area during this period. Based on the evidence it was concluded that no part of the subject area qualified as strategic cropping land under Queensland guidelines.

Areas of ALC Class A / B land in the Project Area were revised from 140 ha to 28 ha in 1:25,000 scale site mapping in this survey (refer Figure 5-8).

5.3.6 Acid Sulfate Soils

Acid sulfate soil (ASS) is the common term given to soil and sediment of marine origin containing iron sulfides (principally iron pyrite), or products of the oxidation of sulfides. These soils are environmentally benign when left undisturbed in an aqueous, anoxic environment, but when exposed to oxygen the iron sulfides break down, releasing sulfuric acid and soluble iron. The release of acidic discharge to streams and rivers can impact both the natural and the built environment. Such effects include infrastructure being eroded away by the acid (such as bridge pilings and other structures in contact with the acidic ground and surface waters), death to aquatic life (such as fish kills and vegetation destruction) and a decrease in the quality of the water for humans and animal life.

Potential acid generation from sulfidic soils is largely confined to present and former wave-protected mangrove and salt marshes and tidal lakes and swamps where fine, very wet sediments can accumulate with organic debris. This is typically below 5 m above sea level, or below 5 m AHD.

ASS can be classified as:

- Actual ASS (AASS) which are soils that have already reacted with oxygen to produce acid or
- Potential ASS (PASS) which is soil that contains iron sulfide but has not been exposed to oxygen (e.g. soil below the water table) and therefore has not produced sulfuric acid (although it has the potential to do so).

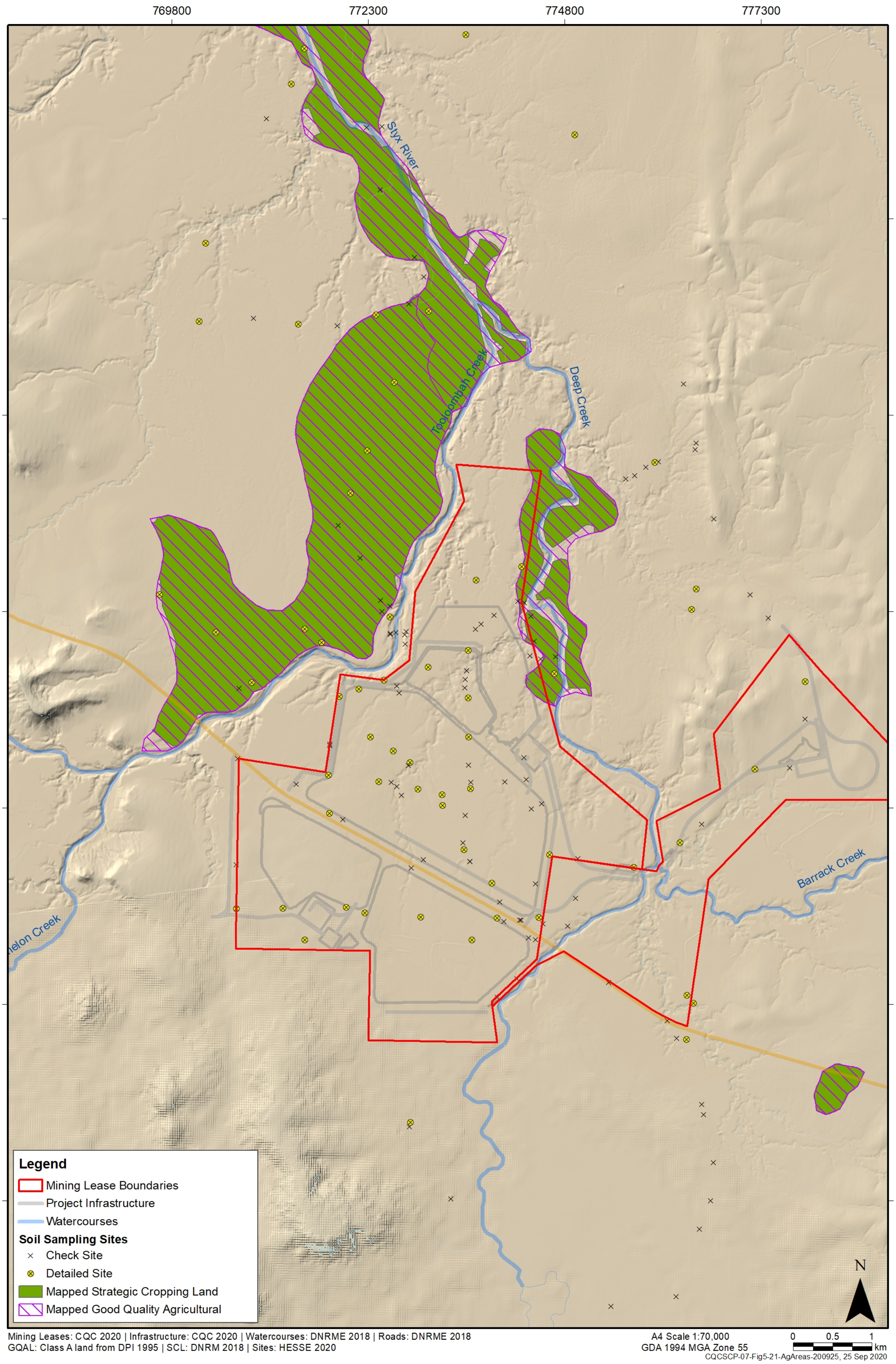


Figure 5-21: Mapped important agricultural areas

The CSIRO National ASS mapping (Fitzpatrick et al. 2011) in relation to the proposed mine, and the location of the 5 m and 20 m AHD contour as well as the predicted groundwater drawdown extent is shown in Figure 5-23. The Project area straddles the low to extremely low ASS categories and is located beyond the 20 m contour. This mapping shows only small pockets of high probability of ASS occurrence (e.g. around 7 km downstream of the Project, below Ogmore).

The morphology of alluvial soils in the Project area, reproduced in Figure 5-22 from the soil survey reporting, were associated with freshwater long valley stream sediments and not marine sediment or weathered coal measures that could be associated with pyrite and ASS. Soil colours also did not indicate ASS conditions, with no Munsell colours less than value 3, chroma 2 (values less than this characterise waterlogging and reducing conditions required for pyrite formation from native sulfate) (Munsell 2000). Neither was organic, peaty material associated Pleistocene near shore environments found in alluvial soils. There was no evidence of ASS morphology from field survey of low-lying alluvial soils (refer soil descriptions in the Land Suitability Assessment in Appendix A3a).

CONCEPT:	Alluvial Soils with minimal profile development associated with overbank flow sediments on Tooloomba and Deep Creek narrow floodplains.
	Basic Grey-Orthic Tenosol Medium Non-gravelly Silty Silty Moderately deep; Stratic Rudosol Non-gravelly Loamy Shallow; Basic Fluvic Clastic Rudosol Non-gravelly Clayey Shallow
DETAILED DESCRIPTION:	Reference sites 007, 008, 011, SS05 in Appendix A.
SURFACE PROPERTIES:	River flats and terraces, cleared for pasture, no rocks, no microrelief, imperfectly drained, slope <1%
EFFECTIVE ROOT DEPTH	1.5 m PAWC 75<100 mm

LAND CAPABILITY	SCL	CAPABILITY	SUITABILITY	AG LAND CLASS	GQAL
	NO	I	S1	B	YES
LIMITATIONS	DRAINAGE, WATER EROSION, PAWC				

RANGE IN CHARACTERISTICS

Depth cm		Morphology	pH	EC dS/m	ESP (%)	Chloride mg/kg	Bicarb P mg/kg	Erosion risk
0		dark grey						
10		**A1** SL-SCL	5.8	0.6		20-30	31-67	DI=3
20								K=0.03
30			7.2	0.6		<10		
40								
50		**B2w**	7.9	0.6		10	2	DI=3
60		SL-MHC						K=0.03
70		**C**						
80		SL-MC						
90		dark	6.4	0.6		50		
100		yellowish						
110		brown						
150			7.3	0.6	0-1	40	6	

Figure 5-22: Alluvial soil morphology

Central QueenslandCoal

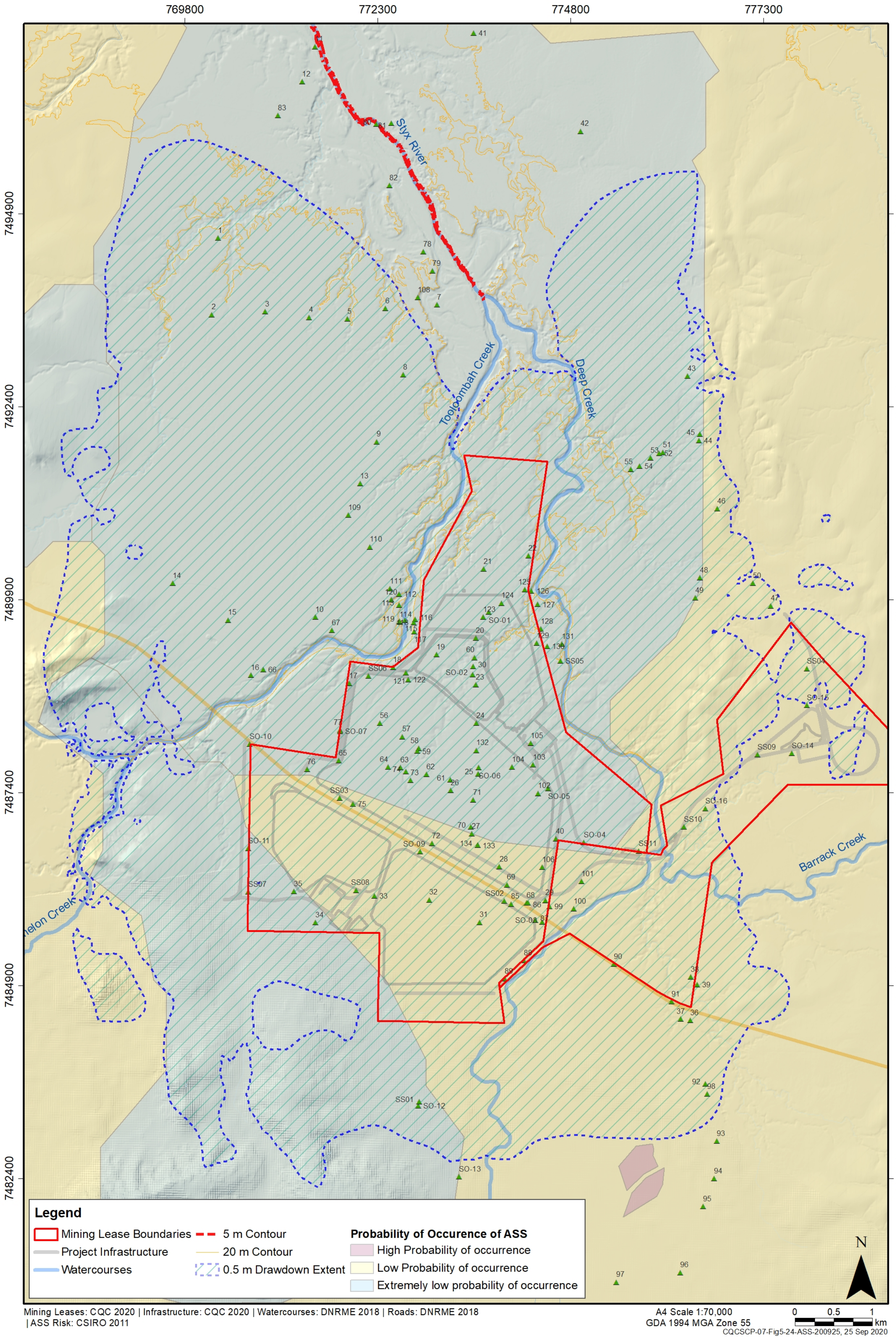


Figure 5-23: Project, dewatering drawdown extent and regional acid sulfate soil (ASS) risk

The modelled <0.5m drawdown extent of the cone of depression from mine dewatering with the regional acid sulfate soil risk mapping shown in Figure 5-23 identifies that areas of acid sulfate soil risk are remote from areas subject to dewatering. Detailed ASS site investigations are recommended for the coastal zone in areas below 5 mAHD, while reconnaissance ASS investigations are recommended for areas between 5 and 20 mAHD. The extent of groundwater impact does not interact with identified ASS risk. Project area land suitability mapping shown in Figure 5-24 shows groundwater drawdown interacting with Kandosols, Vertosols, and Sodosols above 20mAHD. There is therefore no justification for detailed ASS investigations (Dear et al. 2014).

5.3.7 Contaminated Land

As part of the desktop assessment, a search of the DES EMR and CLR database was undertaken to determine whether a notifiable activity had been undertaken within the Project site. The EMR provides information on historic and current land uses, including whether the land has been, or is currently used for a notifiable activity, or has been contaminated by hazardous material.

The CLR includes land that has been proven (through investigation) to be contaminated and is causing or has the potential to cause serious environmental harm. Therefore, land will only be recorded on the CLR when an investigation shows it is contaminated and action must be undertaken to remediate or manage the land.

There are no land parcels within the Project site that are listed on the EMR or CLR.

5.3.8 Land Use

Landuse in the Styx River basin is predominantly ‘Production from relatively natural environments’ (91%) – predominantly grazing - followed by ‘Conservation and natural environments’ (8%) and ‘Intensive uses’ (1%) which comprise transport and communication, residential and farm infrastructure, services and mining (DES 2019). The remainder is predominantly water (saline coastal wetland areas, rivers and dams), with minor areas of dryland and irrigated agriculture (0.5%). The Styx basin has been extensively cleared for grazing.

Cattle grazing is the principal agricultural industry in the Project area, comprising improved and native pasture production. Based on historical studies carried out as part of the SEIS (see Chapter 18 - Cultural Heritage) the first pastoral runs within the Project area were issued licenses in the early 1860s. Since then, cattle grazing has continued across the broader Project area. This was confirmed through a review of information pertaining to land use derived from review of previous land use assessments, aerial photo interpretation and informal discussions with the existing landholders.

Cattle grazing, for both fattening and breeding of stock, has relied on stock dams, fencing and associated access tracks constructed within the Project area.

The Mamelon property is generally considered suitable for beef cattle grazing on pastures. Whilst some areas within Mamelon and the adjoining Brussels Strathmuir properties are theoretically suitable for cropping, this type of agriculture enterprise has not occurred at these properties.

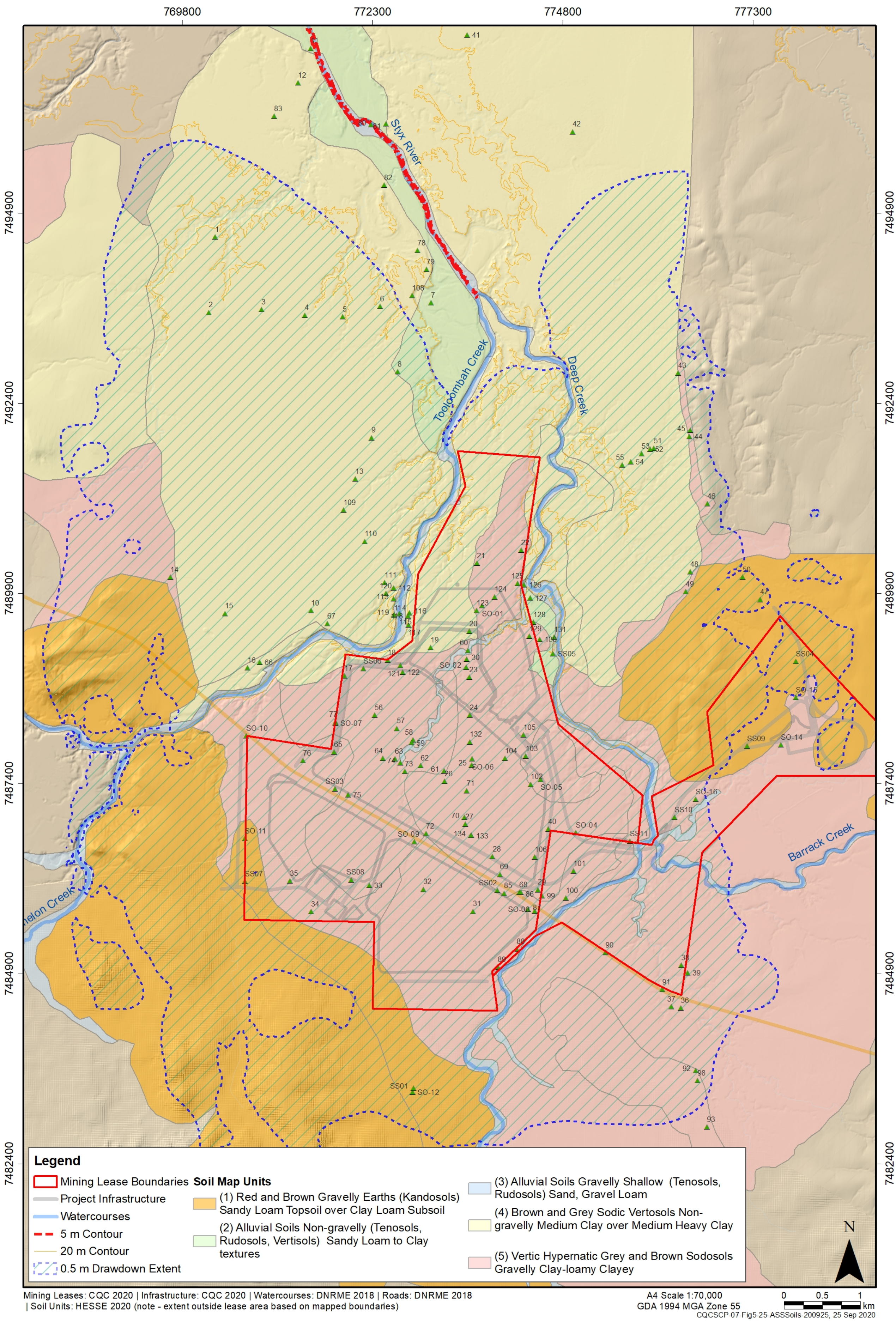


Figure 5-24: Dewatering drawdown extent and soil map units

CQC will manage its operations and conduct decommissioning and rehabilitation activities to ensure that the land disturbed is returned to land suitable for grazing (i.e. the current land use). As part of the mining operations, and to effectively provide for offset areas determined across the Mamelon property, CQC has committed to destocking the majority of the Mamelon property once mining activities commence. A small section of the property, located at the southern extent of the ML boundary, will continue to be set aside for ongoing grazing. The destocking will enable the undisturbed land, including the riparian corridors and associated buffer zones, and the areas under rehabilitation, to regenerate without competing grazing pressures.

This approach to destock the property is consistent with the Reef 2050 Plan which recognises the extent to which grazing contributes annually to the sediment load reporting to the Great Barrier Reef (GBR). This is discussed further in Chapter 9 – Surface Water and in the Sediment Loads Assessment in Appendix A15b.

The rehabilitation strategy is provided in Chapter 11 – Rehabilitation and Decommissioning.

5.3.9 Land Ownership and Tenure

Land tenure and ownership is addressed in Section 1.8.2 of Chapter 1 – Introduction and Project Description. This identifies the Project as generally being located on the following properties:

- Mine and associated infrastructure: the 'Mamelon' property (Lot 10 on MC493, Lot 1 on RL3001, Lot 11 on MC23 and Lot 9 on MC496), all of which are freehold tenures, currently owned by QNI Metals Pty Ltd.
- Haul road and the TLF: Lot 10 on MC493 (Mamelon), Lot 85 and part of Lot 87 on SP164785 (Brussels), and Lot 107 on SP316283 (Strathmuir), all of which are freehold tenures.

Several road reserves will be impacted by the Project, including the east-west oriented Mount Bison Road and other unnamed road reserves within the Mamelon property. CQC is working with State and Local government to have the Mount Bison Road realigned, resulting in the road connecting to the Bruce Highway closer to Tooloombah Creek.

Resource tenures covering the Project include EPC 1029, MDL 468, ML 80187 and ML 700022. All are owned by CQC or Fairway Coal (i.e. the Proponent). A number of other EPCs, EPMs and MLs owned by other entities exist within the vicinity of the Project, but none overlap the Project lease area.

5.3.10 Native Title

Native title is discussed in Chapter 18 - Cultural Heritage. Essentially, there is a native title claim over the Project area. However, both EPC 1029 and MDL 468 were granted over Native Title extinguished land only, and the CQC applications for ML 80187 and ML 700022 are both over 100% Exclusive Land where Native Title is not applicable.

5.3.11 Environmentally Sensitive Areas

ESAs mapping identified a Category B ESA within the ML (Figure 5-25). This Category B ESA is associated with remnant vegetation listed as Endangered under the VM Act. A number of Category A, B and C ESAs are located within the wider locality (within 25 km of the Project area), including various protected areas and nature refuges (Table 5-12). Tooloombah Creek Conservation Park (Category A) is located less than 1 km west of the ML boundary.

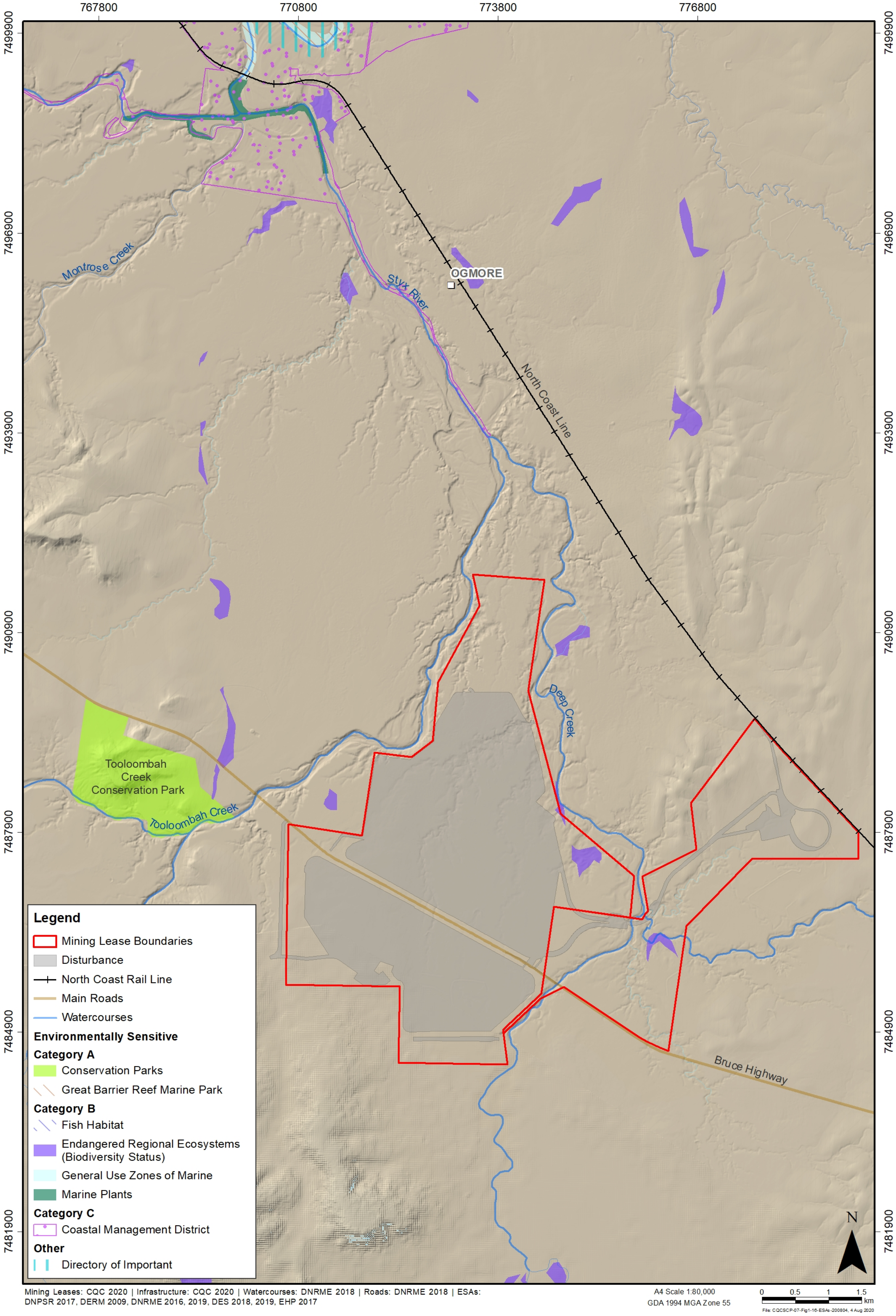


Figure 5-25: Location of Environmentally Sensitive Areas within 50 km of the Project area

The Great Barrier Reef World Heritage Area and Marine Park boundaries and Broad Sound Fish Habitat Area overlap (all Category B) and are located just under 10 km north of the Project. Waters associated with the Styx River are also designated as a 'coastal management district' which is also a Category C ESA.

Table 5-12: Environmentally Sensitive Areas within 25 km of the Project area

Environmentally Sensitive Area	Category	Approximate distance from Project Site (km)
Tooloombah Creek Conservation Park	Category A	0.70
Great Barrier Reef World Heritage Area	Category B	9.70
Bukkula Conservation Park	Category A	14.50
Marlborough State Forest	Category C	14.20
Eugene State Forest	Category C	21.50
Mt Buffalo State Forest	Category C	21.80
Develin Nature Refuge	Category C	22.40
Burwood Nature Refuge	Category C	19.20
Great Barrier Reef Marine Park – general use area	Category B	9.70
Fish Habitat Area – Broad Sound	Category B	9.80
Endangered remnant vegetation	Category B	0.08
Marine Plants	Category B	4.00
Coastal Management District	Category C	3.80

5.3.12 Landscape

5.3.12.1 Landscape Character

The Project area and surrounding terrain is classified as predominately flat or undulating. The topography typically ranges from 4.5 to 155 m AHD within the ML with the mine area located between 11.4 to 43.8 m AHD.

The land surrounding the Project area is predominately used for cattle grazing. The closest protected area is the Tooloombah Creek Conservation Park which is located approximately 1 km to the east. The areas of known or potential nature conservation values which are of State or regional interest and are within 30 km of the Project include Bukkulla Conservation Park, Marlborough State Forest, Mount Buffalo State Forest and Eugene State Forest.

The Project area consists of several wetlands of varying size. Most of these have been artificially created ('turkey nest' dams and dammed creek lines). There are two wetlands recorded as having high ecological significance located in the western portion of the ML, the more southern of which has been mapped as a Wetland Protection Area. A wetland listed in the Directory of Important Wetlands, Broad Sound, is located 8 km directly north, or 9.7 km downstream of the Project. The lower Styx River forms part of the catchment of the wetland.

The Project is largely located within the Marlborough Plains subregion, one of the 13 subregions of the Brigalow Belt North bioregion. The southern portion of the ML occurs in the adjacent Nebo-Connors Ranges subregion. Large sections of the Brigalow Belt North bioregion have been cleared of remnant native vegetation for grazing, agriculture and mining.

Remaining vegetation is generally confined to rockier hilly areas, linear strips of roadside vegetation, riparian vegetation and relatively small isolated remnants.

Thus, clearing over the past 150 years has resulted in a highly-fragmented landscape with remnant vegetation patches separated by large expanses of cleared land.

5.3.12.2 Creeks and Drainage Lines

The Project is situated within the lower catchments of Tooloombah Creek and Deep Creek, which are sub-catchments within the Styx River catchment. Both creeks feed directly into the Styx River (3.3 km downstream of the Project) which discharges into the Broad Sound area. The haul road to the TLF crosses Deep Creek. Tooloombah Creek and Deep Creek are non-perennial or ephemeral, and only flow during and immediately following rainfall events.

Both Deep and Tooloombah Creek are defined watercourses under the *Water Act 2000* and are both located outside the Project site, however several of their tributary drainage features reside within the lease boundary. These drainage features are minor in nature, are ranked as either first or second order drainage features and are classified as non-perennial. This implies that the drainage features do not continually contain water and the stream flow is seasonal in nature and directly following rainfall events. The Project surface infrastructure is predominantly located within the Deep Creek catchment. Clean water catchment diversions are proposed to prevent contamination through contact with stockpiling, processing and mine pit areas. The diversions direct water to the same watercourse in which they would otherwise discharge to, albeit further downstream than the diversion discharge location. The proposed diversions are discussed in detail in Chapter 9 – Surface Water.

5.3.12.3 Vegetation

Vegetation within the Marlborough Plains subregion is dominated by alluvial plains and colluvial slopes, usually supporting woodlands characterised by Poplar Gum (*Eucalyptus platyphylla*), Ghost Gum (*Corymbia dallachiana*), Forest Red Gum (*E. tereticornis*) and paperbarks (*Melaleuca* spp.) with low rises supporting Narrow-Leaved Ironbark (*E. crebra*).

Areas to the north and east of the Project site have been substantially impacted by vegetation clearing associated with cattle grazing activity. Connectivity between remaining tracts of vegetation is tenuously maintained by thin strips of riparian vegetation along creek lines such as Tooloombah Creek and Deep Creek which border the Project. Nevertheless, woodland and open forest habitat remaining in the south and east of the site remains contiguous with an extensive tract of remnant vegetation, which includes Tooloombah Creek Conservation Park. To the west of the Project remains extensive tracts of remnant forest associated with the nearby Broadsound Range.

Vegetation within the Project site and immediate surrounds comprises:

- Heavily disturbed habitats that have previously undergone significant clearing for cattle production. Where this habitat occurs north of the Bruce Highway it is often dominated by patches of regrowth Brigalow.
- Substantial areas of less disturbed eucalypt woodland.
- Smaller pockets of relatively closed canopy (open forest) vegetation generally with a dense weedy shrub layer. These are largely associated with the creek systems adjacent to the Project (ML) boundary.

5.3.12.4 Night Lighting

The rural location of the Project means that there is no existing night-time illumination of the land within the proposed development area. The largest source of night-time lighting emissions nearby is expected to be from vehicle movements on the Bruce Highway. It is not anticipated that light spill from the nearby towns of Marlborough and Ogmore would result in levels of glow in the night sky.

5.4 Potential Impacts

The potential impacts to land resources and to land uses as a result of construction, operation and rehabilitation phases of the Project are summarised in Table 5-13.

Table 5-13: Potential impacts on land and surrounding land uses

Element	Potential Impact	Addressed or comments
Land Resources	Erosion and soil loss during construction, operations and rehabilitation	Section 5.5.1
	Contamination of soil resources	Section 5.3.7 (no contaminated land identified), Section 5.5.4.2 (soil availability and quality)
Rehabilitation	Inadequate soil for rehabilitation works	Section 5.5.4.1
	Soil fertility, sodicity and other factors impacting on the success of rehabilitation	Section 5.5.4
Agricultural land use	Removal of ALC Class A/B lands and/or SCL on the lease site (i.e. Mamelon)	Section 5.5.2
	Introduction and/or spread of weeds	Chapter 14 - Terrestrial Ecology
	Disturbance to stock route	N/A – no stock routes mapped
	Impacts to water supply (surface and/or groundwater)	Chapter 9 – Surface Water and Chapter 10 - Groundwater
Urban, Residential, Recreational uses	Air and noise impacts	Chapter 12 - Air Quality and Chapter 13 - Noise and Vibration
	Visual impacts	Section 5.5.5.1
Mining	Cumulative impacts on and with other mining operations	Only historic mining operations are present in proximity to the site, and cumulative impact will occur in that regard
Industrial	Air and noise impacts	Chapter 12 - Air Quality and Chapter 13 - Noise and Vibration
	Impacts to water supply (surface and/or groundwater)	Chapter 9 – Surface Water and Chapter 10 - Groundwater

5.5 Impact Assessment

5.5.1 Clearing and Disturbance

The total area to be disturbed is 1,373 ha, comprising 1,360 ha within the lease, and allowing for 12 ha for clearing associated with the new Mt Bison Road access to the west of ML 80187 (11.5 ha) and some allowance for clearing for the Bruce Highway intersection (in the road reserve) for the eastern access road (0.5 ha). The disturbance footprint for each piece of infrastructure, organised by mining domain (refer Chapter 11 - Rehabilitation and Decommissioning) is shown in Table 5-14. Note that these represent the disturbance / clearing footprint, rather than the infrastructure area itself. As such, the areas provided are that of the infrastructure plus the associated clearing footprint, and so will differ from the areas that may be reported in other chapters, such as Chapter 1 – Introduction and Project Description.

Table 5-14: Rehabilitation domains and disturbance area

Project Component	Approximate area (ha)
Mine Domain: Mining and Infrastructure Area	1287.2
Open Cut 1	255.7
Open Cut 2	531.6
Waste Rock Stockpile 1	152.6
Waste Rock Stockpile 2	76
Environmental Dams	6.6
Dam 1, Dam access road and Embankment / Levee	157.8
MIA & CHPP 1 and 2	39.5
Catchment Diversion Drains	18.6
Mine access and internal roads – Open Cut 1	6.9
Mine access and internal roads – Open Cut 2	9.2
Power supply	4.2
Conveyor	10.6
Ancillary areas within mining and infrastructure area	17.9
Mine Domain: Haul Road to TLF and Environmental Dams, Dam 4 and TLF	55.1
Mine Domain: Rail loop and spur line	17.9
Total Mining Domains (inside lease)	1360.2
Clearing area outside lease (Mt Bison Road / western access) and Bruce Highway intersection works on road reserve, eastern access)	12.4

Clearing of land and disturbance of soils by tracking, ripping or stripping risks the potential destabilisation and structural collapse of soils, which can increase potential for erosion and sedimentation of nearby waterways. The impact of this depends on the natural fragility of soils and soil-landscape systems, surface cover and management, and the erosive nature of the local climate.

One way of determining erosion hazard for a site, and one that feeds directly into both soil management and sediment control design, is the use of the RUSLE equation – the Revised Universal Soil Loss Equation, after IECA (2008).

The RUSLE is often used to estimate the average long term annual soil loss resulting from sheet and rill erosion under a series of specified conditions.

The RUSLE formula is as follows:

A = K x R x LS x P x C, where (Table 5-15)

The inputs to the RUSLE equation as adopted in the draft Erosion and Sediment Control Plan in Appendix A15a are summarised in Table 5-15.

Table 5-15 RUSTLE erosion hazard

RUSTLE Factor	Description	Value	Comment
K	Soil erodibility factor	0.06	Adopted conservative soil erodibility factor derived from Table E4 of IECA, with additional 20% increase to account for the surface and subsoils as well as overburden and interburden material which are likely sodic and dispersive
R	Rainfall erosivity factor	3,665	Adopted based on the 2yr 6hr event
LS	Slope length/gradient factor	Variable	Based on catchment characteristics
P	Erosion control practice factor	1.3	Default conservative construction phase value representing a compacted and smooth surface
C	Ground cover management factor	1.0	Default conservative construction phase value representing no ground cover or management

The RUSLE was utilised in the draft Erosion and Sediment Control Plan in Appendix A15a to determine the unmitigated erosion rate from various parts of the Project catchment, defined based on the dam they report to (since all areas of the site drain to a catchment dam). This has been summarised in Table 5-16. As can be seen, the overall erosion risk is at worst Moderate, and this is due to the waste rock stockpiles, with higher slopes than other areas on the site. Surfaces of these stockpiles will be stabilised as outlined in Chapter 8 - Waste Rock and Rejects, and so the erosion risk shown will not be realised. Regardless, all surfaces will be reporting to a dam for settlement prior to any reuse on-site or release from the site.

Table 5-16: Estimated worst-case operational sediment generation

Dam	Estimated Catchment Area (ha)	Estimated Average Soil Loss (t/ha/a)	Erosion[1]
ED 2D1	18	58	Very Low
ED 2D2	11	56	Very Low
Dam 4	45	53	Very Low
ED 1C	18	128	Very Low
ED 1B	165	420	Moderate
Dam 1	1,015	142	Moderate
Total	1,272	173	Moderate

Table notes

1 Erosion risk from IECA (2008): Very Low (0 – 150 t/ha/a); Low (>150 – 225 t/ha/a); Moderate (>225 – 500 t/ha/a); High (>500 – 1500 t/ha/a); Extreme (>1500 t/ha/a).

5.5.2 Soil Stripping

The Project will disturb approximately 1,360 hectares of land inside the mining lease during the course of mining operations, plus another 12 ha relating to external road works – for the purposes of this SEIS v3, this has been incorporated into the assessment. Suitable topsoil and subsoil resources will initially be stripped from these disturbance areas for ultimate reuse in the Project's progressive rehabilitation activities. Topsoil and subsoil materials will be stripped, handled and stored to prevent excessive soil deterioration.

The Land Suitability Assessment in Appendix 3a estimated that approximately 1.4 Million cubic metres of suitable primary media and approximately 6.3 Million cubic metres of secondary media would be available for use in final rehabilitation activities (assuming 10% soil loss) and allowing for stripping of soil across the entire potential disturbance footprint. Further analysis (refer Section 5.5.2) apportioning stripping requirements by different disturbance types indicates around 80% of this would need to be stripped, the remainder being utility areas and the like where surface cover could be retained, and soil stripping would not be required. Based on this, an examination of the mining domains and sub-domains was undertaken, with a soil stripping ratio provided for each as follows:

- 100% of available stripping depth - pits, spoil dumps, MIA/CHPP, haul roads, levee (to west of Open Cut 2), TLF, dams other than Dam 1, catchment diversion drains.
- Topsoil stripped only – conveyor near the Bruce Highway, and Bruce Highway works (this allows that the conveyor doesn't need subsoils stripped, and the Bruce Highway works are mostly on existing road or verges.
- 50% topsoil stripped only - conveyor and power from the Bruce Highway - allows for topsoil stripping for the conveyor but not power achieving an overall average of 50% topsoil stripping for these two units (which are collocated in the spatial mapping).
- 50% topsoil and 50% subsoil stripped - allows for 50% recovery for the new Mt. Bison Road and the Western Mine Access road (existing road, not requiring full stripping) and
- No stripping allowance - Dam 1, infill areas (no infrastructure).

This is shown in Figure 5-26.

5.5.3 Agricultural Land (ALC Class A / B and SCL)

As noted in Section 5.3.4.4.4, mapped SCL on the Project site has been found to be not SCL, following the Land Suitability Assessment outlined in Appendix A3a. Since the SCL is mapped within the Project area, a Regional Interests Development Approval is required to be lodged, with the intent to demonstrate land is not SCL (addressing Required Outcome 1 under the Regional Planning Interests Regulation 2014).

Approximately 3 ha of mapped ALC Class A / B land is within the Project disturbance area, on the eastern wall of Dam 1, however this has been revised down to 0.8 ha – given the isolated section of Class A land (27 ha along Deep Creek) and the very small corner to be impacted, this is not considered to be a significant impact. Compared to the overall extent of Class A / B land mapped in the Styx Basin (5,000 ha), this represents less than 0.02%, and would be replaced with Class C2 agricultural land post-mining.

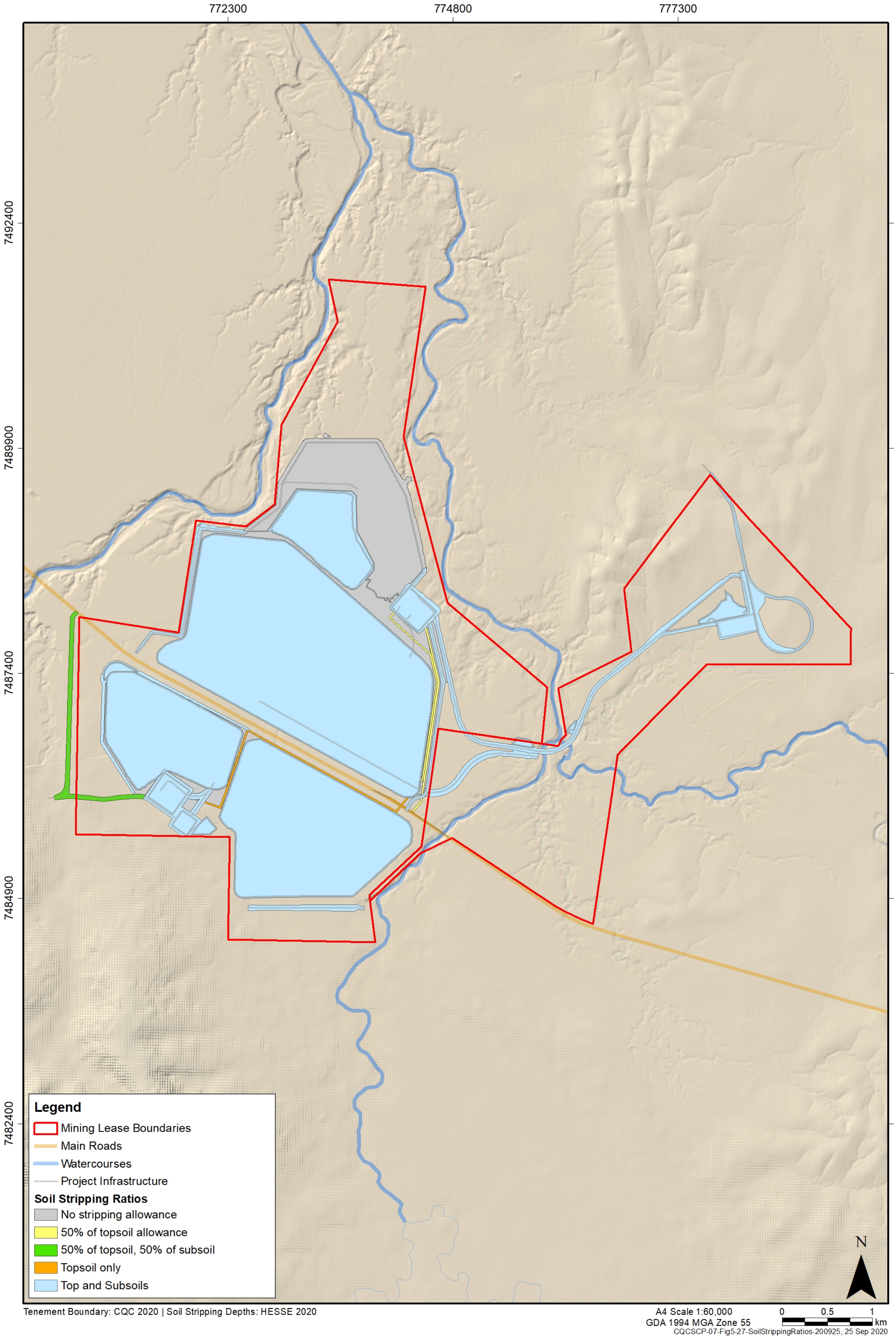


Figure 5-26: Soil stripping ratios for different mine areas

Approximately 61 ha of Class C1 agricultural land, and 1,254 ha of Class C2 agricultural land is disturbed by the Project, suitable for extensive dryland grazing of native or improved pastures, representing the bulk of the Project disturbance area.

Class D land is associated within the 1st order drainage feature disturbed by Open Cut 2, Waste Rock Stockpile 2 and Dam 1.

The ALC classifications to be disturbed by the Project are shown in Figure 5-27. The rehabilitation strategy presented in Chapter 11 - Rehabilitation and Decommissioning outlines the reestablishment of a post mining low intensity cattle grazing landuse, consistent with ALC Class C2 and the current uses on the site.

5.5.4 Soil Availability and Quality for Rehabilitation

5.5.4.1 Soil mass balance

Based on the above and the rehabilitation strategy and schedule presented in Chapter 11 - Rehabilitation and Decommissioning, a soil balance was undertaken, as summarised in Table 5-17, and based on the following assumptions:

- 10% handling loss for soil recovery, after HESSE (2020).
- Replacement Depths – Topsoil, 0.1 m; Subsoil 0.5 m, after recommendations in the Land Stability Assessment in Appendix A3c and
- Stockpile heights of 2 m for topsoil and 6 m for subsoil, as described in Chapter 11 - Rehabilitation and Decommissioning.

This shows that the soils can be stored and reused for full site rehabilitation. Sufficient flood-free area exists across the site for stockpile storage.

Table 5-17: Soil stripping, stockpiling and rehabilitation balance

Year	Stripping (volume by year) (m^3)		Rehabilitation requirements (m^3)		Stockpile area requirements (ha)		
	Topsoils	Subsoils	Topsoil	Subsoil	Topsoil	Subsoil	Total
1	384,654	1,421,461	0	0	19	24	43
2	25,088	125,440	0	0	20	26	46
3	25,787	128,933	0	0	22	28	50
4	31,497	148,590	9,397	46,986	23	30	53
5	50,808	228,741	0	0	25	33	59
6	27,433	137,166	0	0	27	36	63
7	38,909	194,545	0	0	29	39	68
8	39,594	197,797	0	0	31	42	73
9	34,305	170,677	0	0	32	45	78
10	287,312	1,349,788	0	0	47	68	114
11	84,888	424,441	0	0	51	75	126
12	142,792	713,962	35,058	175,292	56	84	140
13	16,922	84,608	152,660	763,298	50	74	123
14	33,365	166,819	64,200	320,998	48	72	120
15	0	0	11,387	56,937	48	71	118
16	37,875	189,375	23,146	115,730	48	72	120
17	14,765	73,826	99,570	497,850	44	66	110

Year	Stripping (volume by year) (m^3)		Rehabilitation requirements (m^3)		Stockpile area requirements (ha)		
	Topsoils	Subsoils	Topsoil	Subsoil	Topsoil	Subsoil	Total
18	23,225	116,123	192,260	961,300	36	53	88
19	1,530	7,648	32,260	161,302	34	50	85
Final Rehabilitation			661,383	3,228,956	1	1	2
Maximum stockpile area required					***56***	***84***	***140***

5.5.4.2 Soil Quality and Fertility

Limitations to top and subsoil reuse were identified in Section 5.3.4.4, with low soil fertility, particularly available phosphorous, a limitation to topsoil fertility, and sodicity, chloride content and fertility a constraint to subsoil reuse. The recoverable top and subsoils across the disturbance area, based on the recommended stripping depths, have the following general characteristics:

- Soils are low risk in terms of salinity, but some elevated chloride levels exist in subsoils.
- Soil sodicity, particularly in subsoils, is a key limitation for recovered soils.
- Given the soil sodicity, dispersivity of recovered soils is also a potential issue, particularly for subsoils.
- pH is generally within reasonable limits, and soil amelioration and fertiliser application would need to consider pH with any application.
- Organic matter and CEC are generally low in topsoils, and an application of organic matter would be highly beneficial where practicable while soils are stored.
- Exchangeable cations indicate the addition of a calcium source as would be undertaken in ameliorating sodic issues would be beneficial, and that a balanced fertiliser application regime should be followed with the advice of an experienced agronomist.

Amendment and amelioration of soils will be required to ensure they remain stable while stockpiled and can provide good quality rehabilitation material. Ideally, recovered subsoils would be reinstated below the topsoils in the rehabilitation program. However, their use as a primary growth medium could be considered following gypsum and fertiliser amendment, and the addition of organic matter.

Soil quality could also decline when initially disturbed and/or stripped, and when stockpiled, due to weed infestation, erosion, loss of soil fertility (leaching) and/or decline in soil biology. Proper amelioration, storage and reuse in accordance with the soil management measures outlined in Section 5.7 will ensure soils are protected for future rehabilitation works.

5.5.5 Visual Amenity Assessment

The VIA process utilised a combination of GIS topographical analysis and field surveys to determine the potential impact of the Project’s components on various sensitive receptors (see Figure 5-28) including the towns of Ogmore and Marlborough, local roads and other sensitive receptors nominated below. An assessment of the sensitive receptors can be found in Table 5-18.

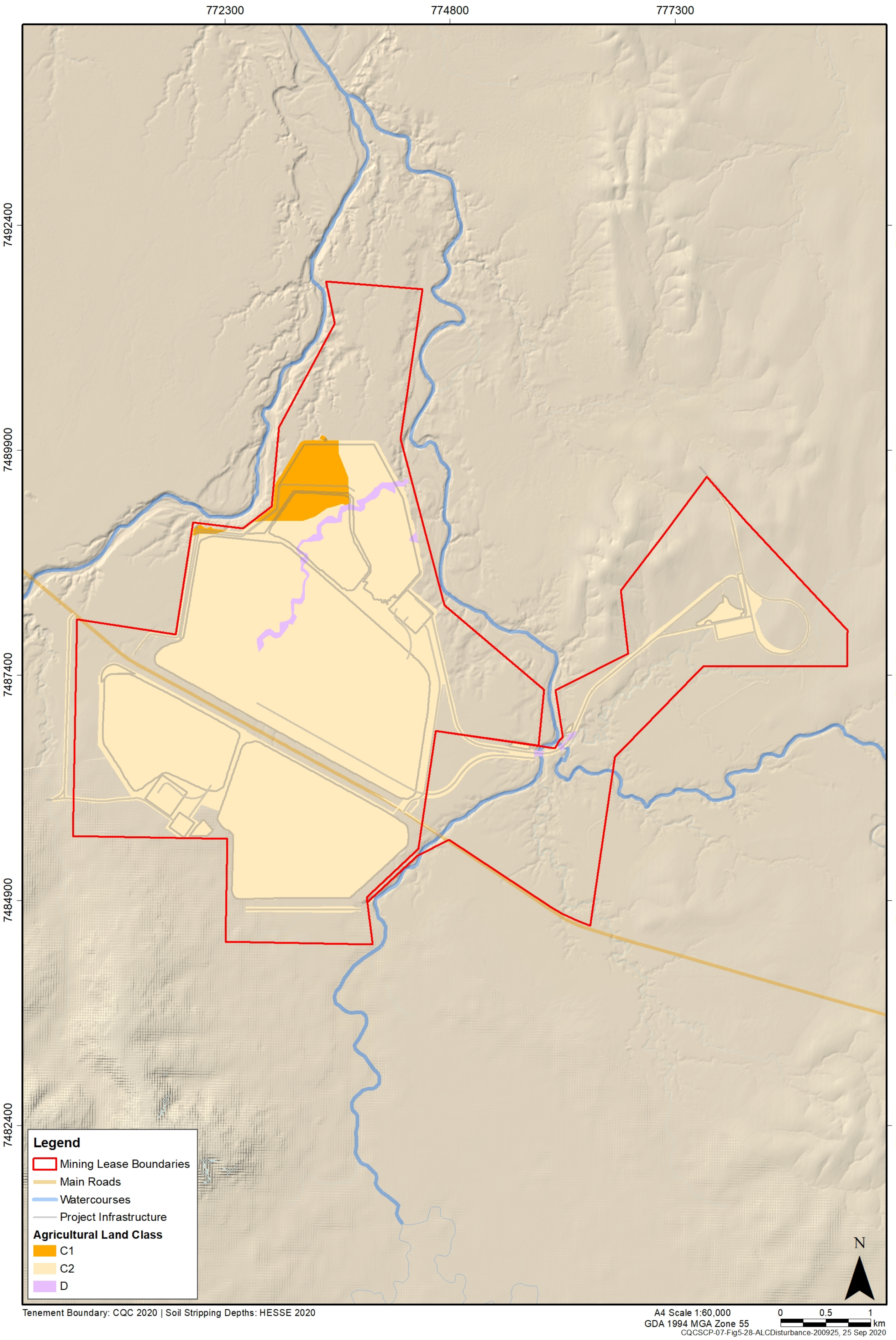


Figure 5-27: Agricultural land classes disturbed by the Project

5.5.5.1 Ogmore Township

The Project is located approximately 10 km southwest of the Ogmore township. As discussed in Section 5.2.4, a theoretical assessment of visibility was undertaken from the Project mine area using a ZTV assessment at 5 m above ground level. ZTV is the theoretic assessment of visibility to or from a designated point in the landscape.

There are several topographical rises and vegetation between the town and the Project. The rises coupled with the vegetation between the points of interest means that the Project will not be visible from the Ogmore township. It is highly unlikely that the night lighting from the Project would be visible at Ogmore because of the lighting from traffic on the Bruce Highway and the township is already lit by some street lighting and this existing artificial lighting would restrict views of the wider night sky.

5.5.5.2 Homesteads

Six inhabited homesteads and the Ogmore township were identified as sensitive receptors within the study area (see Table 5-18). In addition, there are three uninhabited homesteads. The impact to homesteads were branded into two categories using the ZTV assessment. Homesteads and their view potential were rated:

- Potentially impacted: where Project components are located in ZTV. These areas require further assessment considering additional landscape buffers such as vegetation and other features.
- Not impacted: where Project components are not located in ZTV. Site surveys were used where possible to determine whether the Project would be viewable from several sensitive receptor locations.

5.5.5.3 Other

Three uninhabited structures have been identified within the study area. One is a pump shed, one is a dilapidated dwelling and one could potentially be inhabited. Although the two dwellings are currently vacant, only one could potentially be inhabited in the future, while the other is unliveable due to being in a severe state of disrepair and is extremely unlikely to be renovated. Whilst at some later stage these dwellings may be utilised as residences, at this point in time neither are considered as receptors.

The Tooloombah Creek Service Station is considered a sensitive receptor for this visual assessment, given its proximity to the Project. The ZTV assessment identified that any infrastructure at a height of 5m at the designated point within the Project site will not be visible from the Tooloombah Creek Service Station.

It should be noted that the assessment used the ZTV findings, along with mathematics to further define the actual visual impact to the sensitive receptors. The human eye cannot see past 5 km into the horizon (at sea level) given the curve of the Earth's surface; however, if an object is at a greater height than sea level the distance the human eye can see is increased (Wolchover 2012). The mathematics behind this uses Pythagoras theorem to calculate the distance the human eye can see from a defined height (5 m for infrastructure) taking into account the earth's radius. As such, at a height of 5 m the infrastructure can be seen from up to 8 km away. There are many factors that can affect this result, and these are discussed in Table 5-18.

The mining operations will be visible to vehicles travelling in both directions along the Bruce Highway without any mitigation. Earthen mounds will be constructed from waste material derived from the overburden and established as screens between the Bruce Highway and the mining pits. The screens will be over-planted initially with a cover crop to control erosion and planted out with endemic native species as part of the progressive rehabilitation program. Native vegetation will be retained, to the extent practicable, between the Bruce Highway and the screens to further soften the visual influence of the screens to people travelling on the Bruce Highway.

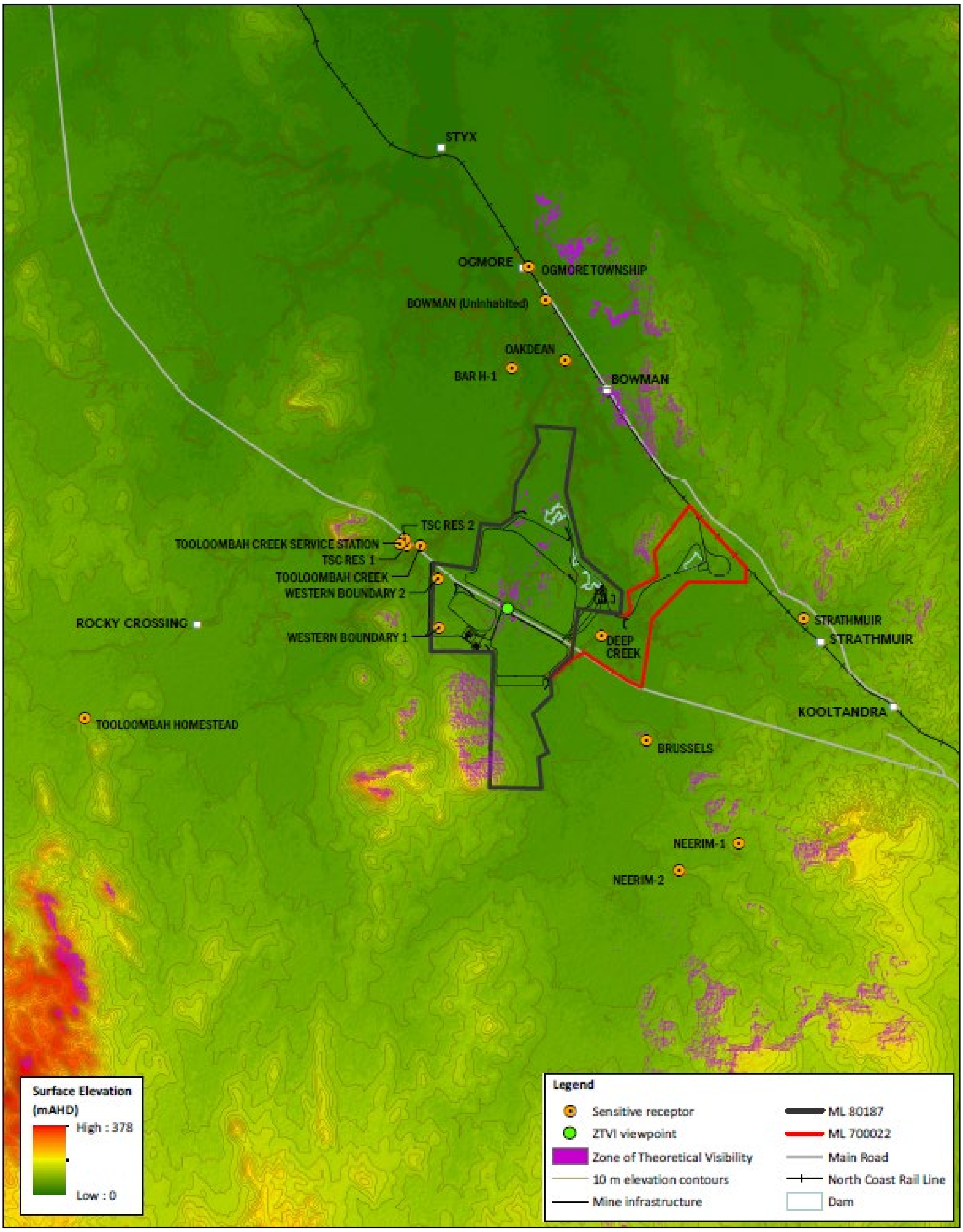


Figure 5-28: Viewshed modelling (from CDM Smith 2018)

Table 5-18: Visual receptor analysis

Receptor name	ZTV Classification	Topography and existing natural elements	Visual impact
Ogmore Township	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Ogmore Township.	Nil
Oakdean	Potentially impacted Sensitive receptor is located within ZTV and is within 8 km from the Project site.	The Oakdean homestead is located approximately 5.5 km north of the Project site. The homestead and Project is separated by riparian vegetation associated with the Styx River as such the impact is expected to minimal as this vegetation will potentially screen the visibility of the Project. Lighting from the Project is likely to be visible given the proximity of the homestead to the Project.	Medium
Bowman (uninhabited)	Potentially impacted Sensitive receptor is located within ZTV and is within 8 km from the Project site.	The Bowman receptor is located approximately 7.5 km north of the Project site. The homestead and Project is separated by riparian vegetation associated with the Styx River as such the impact is expected to minimal as this vegetation will potentially screen the visibility of the Project. Lighting from the Project is unlikely to be visible given the proximity of the homestead to the Project.	Low
Strathmuir	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Strathmuir homestead.	Nil
Brussels	Potentially impacted Sensitive receptor is located within ZTV and is within 8 km from the Project site.	The Brussels homestead is located approximately 3.2 km southeast of the Project site. The homestead and Project is separated by riparian vegetation associated with the Deep Creek as such the impact is expected to minimal as this vegetation will potentially screen the visibility of the Project. Lighting from the Project is likely to be visible given the proximity of the homestead to the Project.	Medium
Neerim-1	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Neerim-1 homestead.	Nil

Receptor name	ZTV Classification	Topography and existing natural elements	Visual impact
Neerim-2	Potentially impacted Sensitive receptor is located within ZTV and is within 8 km from the Project site.	The Neerim-2 homestead is located approximately 7.7 km south of the Project site. The homestead and Project is separated by riparian vegetation associated with an unnamed creek as such the impact is expected to minimal as this vegetation will potentially screen the visibility of the Project. Lighting from the Project is unlikely to be visible given the proximity of the homestead to the Project.	Low
Tooloombah Creek Service Station	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Tooloombah Creek Service Station.	Nil
Bar H-1	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Bar H-1 homestead.	Nil
Bar H-2 (uninhabited)	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Bar H-2 infrastructure.	Nil
Bar H-3 (uninhabited)	Not impacted Sensitive receptor is not located within ZTV from the Project site.	Natural topographic rises and distances to the designated point at which the ZTV was measured makes the Project un-viewable from the Bar H-3 infrastructure.	Nil

5.6 Qualitative Risk Assessment

Potential impacts on ecological values have been assessed utilising the risk assessment framework outlined in Chapter 1 - Introduction and Project Description.

For the purposes of this risk assessment, levels are defined as follows:

- Extreme – Works must not proceed until suitable mitigation measures have been adopted to minimise the risk.
- High – Works should not proceed until suitable mitigation measures have been adopted to minimise the risk.
- Medium – Acceptable with formal review. Documented action plan to manage risk is required and
- Low - Acceptable with review.

A qualitative risk assessment is outlined in Table 5-19. It outlines the potential impacts, the initial risk, proposed control measures (as detailed in the previous section), and the residual risk following the implementation of those measures

Table 5-19: Qualitative risk assessment

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
Soil and Land Disturbance (Construction Operation and Decommissioning)	The Project will disturb 1,373 ha of land (including the Mt Bison Road intersection external to the lease). The clearing of vegetation and other earthmoving activities associated with construction of the mine and mine facilities can initiate soil erosion if not done in a controlled manner, releasing sediments into nearby water systems and decreasing the overall value of the land. Minimising disturbance will be vital in minimising associated impacts to land and soils. The impacts resulting from each of individual disturbance activities will vary, however they are not anticipated irreversible. The key potential soil impacts that will affect the Project site are physical soil disturbance, contamination of soils and degradation of soils. The physical degradation of soil may occur because of the use of heavy machinery, leading to severely limited revegetation potential, decreased water infiltration and, in some instances, increased erosion. Soil quality can also be affected by poor topsoil stripping and handling. The clearing of vegetation and other earthmoving activities associated with construction of the mine and mine facilities can initiate soil erosion if not done in a controlled manner, releasing sediments into nearby water systems and decreasing the overall value of the land.	High	To protect the surrounding environment, works will be undertaken in a manner such that the impact to soils, landforms and any receiving waters is minimal. This will be achieved by the scheduling of construction activities and the dedication of specific work areas. The following mitigation measures are proposed: • No Go Zones shall be established prior to clearing / grubbing activities and maintained throughout the life of the Project. This will be achieved by installing physical demarcation along work area perimeters to visibly delineate the maximum allowable area of disturbance • All vehicle movements will be restricted to stabilised access locations. Stabilised access points and nominated construction and haul roads will prevent excessive ground disturbance from the movement of vehicles and machinery across the Project site • The scheduling of works will also assist in minimising ground disturbance by ensuring that activities are organised sequentially with areas of disturbance reflecting construction activities taking place at that time • No surfaces will be left open if they are not being worked on and all areas will have topsoil pulled back over and be suitably compacted once construction work in the area has finished. Grassed areas cleared for construction of any mine-related infrastructure will be re-contoured and landscaped once construction is complete to minimise erosion impacts • Where significant excavation is required, excavated material will be deposited upslope of the work and diversion measures to control soil and water flows will be installed	Low

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
			(including banks and berms). Any diversion measures will discharge to a stabilised control or sedimentation trap • Excavations shall be kept open for the shortest period possible and this will be achieved by incorporating a more detailed construction schedule into the Project planning phase • Preserving as much of the vegetated areas and areas with stable grass cover will greatly reduce the soil disturbance and subsequent erosion hazard, as well as provide a natural sediment filter and • Sediment fences or other appropriate ESC will be installed downslope of any disturbed lands. The implementation of effective ESC measures (described in detail in Section 5.11) will assist in achieving further protection of the surrounding environment.	
Soil and Land Contamination (Construction, Operation and Decommissioning)	Contamination can affect future soil use and land suitability. If not managed correctly, contamination of soils may occur because of activities related to things such as the CHPP, ROM dump station and mine affected water dams. Storage of hazardous and other chemicals also presents a risk to soils as spills can result in significant contamination. ASS or PASS are not anticipated to occur within the Project area. As such there is very little, if any, risk of ASS-related contamination.	Medium	The main objectives of the soil management measures nominated herein are to, near as practical, return the land to pre-existing environmental conditions by: • Provision of appropriate spill control materials including booms and absorbent materials at refuelling facilities at all times to contain spills • Ensure all refuelling facilities and the storage and handling of oil and chemicals comply with relevant Australian Standards. Management and mitigation measures for wastewater are discussed in Chapter 7 - Waste Management • Ensure all staff are made aware of the potential for groundwater quality to be impacted and the requirement to report any spills • Establish procedures to ensure safe and effective fuel, oil and chemical storage and handling. This includes storing these	Low

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
			materials within roofed, bunded areas to contain spills and prevent uncontrolled discharge to the environment • Appropriate waste rock and rejects management and disposal (see Chapter 8 – Waste Rock and Rejects, which addresses mineral waste management) • As much as possible, avoiding impact to any areas of soil with sodic properties • Maintaining topsoil quantity and quality • Restoring land use and capability for conservation objectives • Returning the land to a stable landform (i.e. no major erosion) and • Minimising dust generation.	
Erosion and Soil Stability (Construction Operation and Decommissioning)	Mining activities increase the potential risk of erosion when soils are being disturbed, particularly when soils are subject to flooding and wind, are sodic in nature, or are on steep slopes. Within the Project site erosion is most likely to occur in areas because of excavation activities, including: • Cut and cover • Topsoil stripping and stockpiling of materials and • Construction of infrastructure areas including roads, machinery pads and dams. Across the Project site there are some areas with subsoils (B horizons) displaying strongly sodic or dispersive properties. These soil properties will further increase the likelihood of erosion occurring if not properly managed. Sodosols within the central section of the transport corridor have physical and chemical properties that make them relatively more susceptible	High	The draft ESCP will be revised and updated as required prior to construction commencing. This relates to the whole Project and identifies the risk of erosion and sedimentation within each area of the Project based on the soil type present. The detailed ESCP will include: • Size and location of all ESCs • Design of ESCs to be able to cope with the required rainstorm event for the area • Areas requiring soil stabiliser • The period of maximum disturbance for each area (with critical works being scheduled for the dry season as much as practical) and • Boundaries of areas to be cleared and clear delineation on Project drawings. Any sediment collection structures will be inspected at intervals prescribed in the ESCP and after each significant rainfall event.	Low

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
	to erosion (highly sodic). The risk of erosion on land within the transport corridor is most likely to occur following site clearance and prior to construction of the road.		Soil stabiliser will be applied across the site in locations deemed necessary in the ESCP. The ESCP will specify the required application rate and frequency and this will be adhered to throughout the construction phase until soils are stabilised with permanent controls or are revegetated. Temporary and permanent stormwater and drainage controls will be designed to be able to withstand the required stormwater capacity for a given average recurrence interval storm event. All temporary controls must be in place and working prior to ground disturbance and construction activities commencing. Dust suppression methods (application of water) for stockpiles, roads and other exposed surfaces will be implemented during the construction and operational phases. All direct runoff from contaminated surfaces (stockpiles) will be re-directed into environmental dams to avoid contamination to surrounding areas. A detailed ESCP will prepared by a CPESC. This will consider these variables in a seasonal context to measure (using the RUSLE) and manage the risk of soil erosion across the Project site. Soil conservation and site rehabilitation will also be integrated into the detailed ESCP.	
Visual Amenity (Construction Operation and Decommissioning)	The VIA assessment undertaken included 11 of the homesteads near the Project that had the potential to be impacted by changes in the visual landscape because of the Project. Of the 11 homesteads that the study comprised, none are at risk of visual impacts. Three homesteads (Oakdean, Brussels and Neerim-2) will have a low visibility of the Project. This is minimal since natural rises between the homesteads and the Project, and the existing vegetation, will provide a natural screen.	Low	No mitigation for visual amenity required, beyond the installation and management of a visual buffer between the Project and the Bruce Highway (vegetated bund).	Low

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
	In addition, an analysis has been undertaken to assess the impact the Project is likely to have on people travelling along the Bruce Highway and local road network surrounding the Project. The topography and existing vegetation in the area in unlikely to provide a natural screen, and as such mining operations will be visible from the road.			
Night Lighting	Lighting impacts are expected to be high for the Brussels and Oakdean given their proximity to the Project. Lighting impacts are not expected at any other sensitive receptors.	High	Lighting to be used at the two MIAs will be designed to minimise upwards light spill. This will include the use of towers designed to a minimum height, positioning of towers to adequately illuminate working areas and directional shields attached to lamps to minimise horizontal and upwards spill.	Low

5.7 Mitigation, Management and Monitoring

5.7.1 Soil Management Plan

A detailed soil management plan will be developed for the Project prior to any soil stripping works commencing, including additional soil monitoring where required. A draft soil management plan is included in the draft EMP in Appendix 12 (in the Land Use Management Plan), with the key elements of that plan summarised below.

Soil Stripping and Recovery

As part of minimising erosion across the site, vegetation clearing and soil stripping will be minimised to the amount necessary for each stage of the Project. Prior to clearing, additional soil confirmation testing will be conducted, to verify the soil types and stripping depths, including testing for salinity and sodicity.

Following vegetation clearing, soil will be stripped to the recommended stripping depths outlined in Section 5.3.4.3, as amended by the pre-clearing soil testing. The following stripping measures will be adopted:

- Areas of sodic soils will be pre-treated with gypsum or similar to stabilise soils prior to stripping, with application rates of 5 t/ha (and ongoing stockpile treatment of the same per year) expected to have a seasonal protective effect.
- Stripped soils will be maintained in a slightly moist condition, and will be wetted if too dry, and allowed to dry if excessively wet. This will then be placed directly onto dedicated stockpile areas (or directly onto prepared disturbed areas for rehabilitation).
- Recovery, movement and emplacement of recovered soils will be undertaken so as to minimise compression, trafficking and loss of material. On placement in stockpiles, soil surfaces will be left in a coarse condition where possible to promote infiltration and to minimise erosion and anaerobic zones forming.

Soil Stockpile Management

Stockpiles will be emplaced and managed to minimise erosion from rain and wind, avoid traffic, to minimise deterioration and maximise opportunities for reuse. Soil testing will be conducted by an experienced agronomist to determine amelioration requirements, and application of gypsum and balanced fertiliser applied as required. Vegetation will be encouraged to grow to stabilise stockpile surfaces and encourage good soil biology to be retained until reuse.

The height of topsoil stockpiles will be limited to 2 - 3m in height for topsoils, and up to 6 m in height for subsoils, with suitable batters (generally 1:3). Topsoils and subsoils will be stored separately and not mixed, and neither will be used as backfill material.

Ongoing weed management and vegetation inspections and management will be undertaken to ensure soils remain suitable for rehabilitation.

The following mitigation measures will be implemented to avoid losing materials from stockpiles during periods of rain or high winds:

- stockpiles will be located at least 100 m away from drainage lines / waterways

- stockpiles which are exposed for prolonged periods or have been identified as problem soils will be stabilised where required using chemical surface stabilisers or by other acceptable methods e.g. vegetation
- excavated soil will be stockpiled separately from other materials (e.g. vegetation), where it can be readily recovered for reuse and
- stockpiles will not impede natural or constructed surface drainage channels or access tracks.

5.7.2 Management of Potential Contaminants

The following management measures will be implemented to minimise the risk of contaminant spillages impacting on land and soil resources:

- Appropriate spill control materials including booms and absorbent materials will be onsite at refuelling facilities at all times. These will be used for mitigating and managing events where a substance is spilled.
- All refuelling facilities and the storage and handling of oil and chemicals will comply with relevant Australian Standards.
- Procedures will be established at the mine for safe and effective fuel, oil and chemical storage and handling, in accordance with relevant standards, including AS1940 - The storage and handling of flammable and combustible liquids. This includes storing these materials within roofed, bunded areas with a storage capacity of 100% of the largest vessel and 10% of the second largest vessel. The bunding will have floors and walls that are lined with an impermeable material to prevent leaching and spills.
- Wash-down areas for plant and equipment will be clearly marked to prevent contaminated water from leaching into soils or flowing into nearby watercourses.
- The Emergency Response Plan for the site (refer Chapter 21 - Hazard and Risk) will include controls required to ensure adequate control of wastes and other potential pollutants on the site, including:
  - Prior to the start of the wet season, the site will be prepared by ensuring all waste materials, receptacles and storages are properly contained and stable, and will be able to withstand wet season rainfall without leaching or other loss of contaminants.
  - A site audit will be conducted prior to each wet season with the results provided internally in written form.

A similar process will occur prior to forecast storms or other extreme weather events, whereby all wastes are contained and restrained so as to avoid loss of materials during the event.

5.7.3 Visual Impacts

The VIA identified visual impacts of the Project without mitigation to:

- Vehicles travelling along the Bruce Highway (in both directions) and
- Several homesteads in proximity to the Project due to lighting impacts.

Earthen mounds will be constructed from waste material derived from the overburden and established as screens between the Bruce Highway and the mining pits. The screens will be over-planted initially with a cover crop to control erosion and planted out with endemic native species as part of the progressive rehabilitation program.

Native vegetation will be retained, to the extent practicable, between the Bruce Highway and the screens to further soften the visual influence of the screens to people travelling on the Bruce Highway.

Lighting to be used at the two MIAs will be designed to minimise upwards light spill. This will include the use of towers designed to a minimum height, positioning of towers to adequately illuminate working areas and directional shields attached to lamps to minimise horizontal and upwards spill.

5.7.4 Construction Management

CQC proposed to implement a construction management plan to minimise the potential impacts of construction. This is incorporated into the draft EMP in Appendix A12, and will include (in relation to land resources) erosion risk minimisation and soil management procedures.

Erosion risk management will follow the requirements of the ESCP (a draft of which is included in Appendix A15a), which will be updated prior to works commencing and as required throughout construction (and operations) to ensure it remains current. General construction management measures to be adopted are summarised below.

5.7.4.1 Pre-Construction

General mitigation measures to limit the impacts of land disturbance include the following:

- as an overriding principal, minimising all land disturbance, including vegetation clearance, to only that immediately required to achieve development requirements
- where possible, vehicle movements will be restricted to existing roads to minimise ground and vegetation disturbance
- ‘No Go Zones’ will be shown on the ESC Design Drawings and marked on site prior to any clearing
- an ESC briefing will be provided as part of the site induction. All relevant personnel shall be trained in the requirements of the most current ESCP
- installation of perimeter ESCs will be done prior to any construction
- works will be scheduled to minimise the area of active disturbance at any one time and
- nominated ESCs will be installed in predetermined locations and downslope of any disturbed lands.

Vegetation Clearing

All clearing works will be conducted in accordance with the following vegetation and soil management requirements:

- Land clearing limited to an area of land suitable to complete eight weeks’ worth of construction work if rainfall is predicted (as per IECA Table 4.4.7).
- Maximum of 50 days after commencement of site stabilisation, for identified areas, before specified minimum ground cover (e.g. organic or rock mulch, synthetic blankets, vegetation or combination thereof) is achieved in all areas except for active areas including haul roads.
- Root stock will be retained in the ground after clearing to reduce erosion and to facilitate rapid rehabilitation, where possible. This is excluding areas of permanent infrastructure, access routes, where operational activities may be impacted, and mining pits where root stock would cause an issue for coal quality.

- Vegetation will be progressively cleared where practical to minimise the area of soil exposed.
- Identify, isolate and protect all mature native vegetation where appropriate. Protected vegetation areas will be identified and clearly marked out on site before commencing clearing works.
- Vegetation that is cleared is to be preferentially mulched and used to stabilise exposed soils on site or strategically placed to provide habitat for fauna where possible.

Earthworks

It is anticipated that civil works required during the construction phase for Open Cut 2, MIA1, CHPP2 and the TLF, and associated infrastructure on the north eastern side of the Bruce Highway will be completed in approximately seven months from commencement; however, there may be requirements for further civil works during the operations and decommissioning phases. Typical civil works that will be undertaken as part of the development include, civil earthworks, installation of permanent and temporary drainage, and trenching and laying of reticulated services and any other underground pipelines and services. All earthworks and ground disturbances will conform to the following minimum standards:

- Use of any existing clearings through riparian vegetation, if any, will be maximised while new clearing is minimised.
- Construction activities in or around watercourses will cease if a risk assessment indicates that any forecast rainfall event could cause unacceptable environmental harm or impact on safely. Construction activities may not recommence until a site inspection has determined that the watercourse has returned to stable flow (or no flow) conditions.
- Diverting uncontaminated storm water run-off around areas disturbed by construction activities and/or other potentially contaminating activities.

Access Tracks

- existing tracks or final access road alignments will be used whenever possible. The duplication of parallel/multiple tracks or turnouts are to be avoided
- access track drains are to discharge runoff water in a manner which does not lead to erosion or movement of sediment to surface waters
- vehicle movement over both retained vegetation and newly cleared areas where the topsoil is yet to be stripped will be minimised
- suitable sheeting material will be placed on all internal haul roads to provide additional cover and minimise sediment runoff, as well as providing suitable all-weather access
- maximum permitted vehicle speeds identified in the site HSE will be adhered to
- all construction vehicles, plant and equipment will be permitted only within designated construction areas, and will not be allowed within any ‘No-Go’ or environmentally sensitive exclusion zones and
- vehicle movement within the site will be required to remain on designated site access routes whenever possible.

Construction of new access tracks may be required during construction. Where possible, access tracks will be constructed to:

- maintain a vegetation buffer between any access tracks and nearby watercourses
- be positioned along contour lines limiting grade changes

- minimise the disturbance of existing ground and
- limit construction taking place across existing drainage lines, where construction across drainage lines is unavoidable, provide a means for the transport of water preventing concentrated runoff.

5.7.4.2 Construction Phase

Site clearance activities will be staged during the construction phase on an as needed basis to coincide with construction requirements and to minimise the extent and duration of cleared areas at any one time. Suitable soil resources for use in rehabilitation will be stripped from areas where construction and mining operations will occur. Topsoils and subsoils will be stripped, handled and stored in accordance with the soil management plan (refer Section 5.7.1) in a manner in line with industry best practice to prevent the deterioration of soil quality. Where practical, CQC will undertake construction activities with a high potential to create erosion risk during the drier months, generally between April and December.

The ESCs nominated in this plan are to be in place before any clearing and construction works take place and must remain in place until final rehabilitation has been completed and a stable site achieved. The following mitigation measures will be implemented during construction:

- surface water run-on will be diverted around the perimeter of work areas to the extent possible
- ESC awareness briefings will occur as part of site inductions. All relevant personnel shall be trained in the requirements of the most current ESCP
- all reasonable and practicable measures will be implemented to control flow velocities in such a manner that prevents soil erosion along drainage paths and at the entrance and exit of all drains and drainage pipes during all storms up to the relevant design storm discharge and
- dust suppression measures (use of water trucks and spraying stockpiles with suitable soil binders) will be implemented.

Surface Water Management

The following measures will be implemented to manage impacts to local waterways:

- average slope gradients will be maintained as close as possible to pre-existing slope gradients, whilst allowing for natural drainage
- the erosion potential of longer slopes will be minimised using contour diversion berms
- slope gradients adjacent to waterways will be minimised
- where it is not possible to maintain riparian wetland vegetation, any vegetation that has been cleared near waterways will be removed from the area and stockpiled away from the watercourse with appropriate erosion controls
- all water that discharges to a waterway will meet water quality criteria, as listed in the EA
- any earthworks that are being carried out near drainage lines will be revegetated and stabilised immediately on completion of the work wherever possible and will minimise slope gradients while maintaining appropriate drainage requirements in areas adjacent to drainage lines and
- temporary earth banks (or other appropriate controls) will be installed along cleared slopes, diverting dirty water away from drainage lines and into vegetated areas.

Dust Control

Dust will be maintained using water trucks on haul roads and sprays will be used if required to control dust at topsoil and product stockpiles.

5.7.4.3 Inspection and Maintenance

Site inspections will be undertaken in accordance with the frequencies shown in Table 5-20 when active construction activities are taking place. Normal routine inspections of the construction area will be performed weekly when active construction activities are taking place. Active construction areas will be inspected at least once per week.

Table 5-20: Summary of monitoring, trigger values and corrective actions

Monitoring Measure	Frequency	Trigger value	Corrective Action
Inspection of sediment fences, ESC devices, disturbed areas, topsoil stockpiles	Weekly	Structural integrity is retained. 70% capacity of sediment fences remains and 50% capacity for drop inlet structures remains	Maintenance to restore capacity of ESC device and then address source instability. Other corrective actions as appropriate determined on a case-by-case basis.
Inspection of the integrity of diversion bunds, sediment fences and stormwater drainage channels to verify their condition and effectiveness.	Weekly in response to rainfall events (>25mm in 24 hours (maximum once a day))	Structural integrity is retained. 70% capacity of sediment fences remains and 50% capacity for drop inlet structures remains	Maintenance to restore capacity of ESC device and then address source instability.
Inspection of stormwater discharge outlets from site.	Weekly	No offsite build up of sediment on land. No offsite scouring to the bed or banks of any watercourse or land.	Inspect ESC measures in the catchment draining to the stormwater discharge to ensure they are functional and that the capacity is retained. Undertake maintenance or repairs as necessary. Review the adequacy of the installed ESC measures in the catchment draining to the stormwater discharge and assess whether additional measures could be practicably implemented.
Inspection of the integrity and capacity of environmental dams.	Weekly	Accumulation of gross pollutants (litter and waste). Sediment accumulation such that 70% of capacity of environmental dam.	Remove accumulated gross pollutants and sediment to restore capacity of environmental dam.

Observations made during inspections, along with data captured during environmental monitoring events (i.e. water quality monitoring) will be used to identify required preventative and/or corrective actions. The information will be used:

- to document compliance with the ESCP and the Project's EA conditions and
- as the rationale for modifying the ESCP so that the necessary changes to control measures and/or procedures can be developed and implemented to avoid findings of future potential non-compliance.

Once a preventative or corrective action is identified the closeout of the action is to be tracked to ensure actions are addressed in a timely manner to minimise the likelihood of recurrence.

The erosion control devices shall be maintained on a regular basis as directed by the site environmental manager. The effectiveness of strategies and controls will be monitored by environment and construction staff daily. Maintenance may include replacing structures that are not functioning properly and will be identified through regular site inspections and the development of corrective actions.

5.8 Cumulative Impacts

The Project may have impacts on environmental values that act cumulatively with those of other projects in the region. As such, reasonably foreseeable future projects should be considered, in the context that these projects may have environmental impacts that act cumulatively with those of the Project.

The area surrounding the Project is relatively undeveloped, dominated by rural lands that are used for grazing. There are no known large-scale industrial or mining developments proposed within the catchment of the Project. The Commonwealth Department of Defence is currently developing an expansion of the existing Shoalwater Bay Defence Training Area. A future expansion of the existing Shoalwater Bay Defence Training Area is located partly in the catchment of Broad Sound, approximately 50 km to the north-east of the Project. However, there are no land related impacts arising from either project that could act cumulatively to provide for greater land resources impacts. The potential cumulative impacts of land erosion and sedimentation into the downstream Broad Sound and parts of the GBR have been addressed elsewhere (including Chapter 9 – Surface Water) as low, and the overall sedimentation rate is expected to reduce significantly in the Project area.

Rehabilitation works reinstating a post-mining grazing landuse will avoid impacts on the total grazing lands available in the area and in terms of the Styx Basin, and there is no impact to confirmed SCL land, and very minimal impacts to ALC Class A / B land to cumulatively act with other developments in the Styx Basin.

Overall, as there are no known current, or proposed, significant developments that will be additive to this Project, there are unlikely to be surface water cumulative impacts associated with the Project.

5.9 Conclusion

The Project will occupy land that is presently used for cattle grazing for both fattening and breeding of stock. There are no occupied homesteads within the proposed mining lease boundaries but there are various farm access tracks, two windmills, two dams, two vacant homesteads and farming infrastructure and fence lines along paddock boundaries. No other infrastructure such as water, power, telecommunications or gas pipelines are present within the Project disturbance area.

There is one ESA on the Project site, but this will not be directly affected by the Project, and offsets are proposed for the clearing of other areas of remnant vegetation. There are no National Parks, nature refuges or declared catchments within the Project site, or registered areas of existing contaminated land.

Soils within the Project area have a low to moderate erosion potential although sodicity and fertility issues were identified in soils to be stripped, stockpiled and reused in rehabilitation – a soil management and amelioration program will be undertaken to protect soils to both minimise on-site erosion and ensure availability for and success of rehabilitation works.

In terms of agriculture, the soils provide moderate quality grazing pastures with some areas of good quality grazing land over vertosols in the north of the Project site. A small area of mapped SCL will be disturbed by the Project, however the soil assessment work conducted has shown this not to be SCL – a Regional Interests Development Approval is required to be lodged, with the intent to demonstrate land is not SCL (addressing Required Outcome 1 under the Regional Planning Interests Regulation 2014). A small area of mapped ALC Class A / B land will also be impacted. However, the soil survey work has revised down the area and the boundary of the soil unit, and so only a very small part is impacted (0.8 ha or less than 0.02% of the total ALC Class A / B land in the Styx Basin).

Physical impacts to the land will include land clearing and topsoil removal for the open-cut pits, mineral waste rock stockpiles, water storage dams and other surface infrastructure including the haul road and TLF. Measures to minimise these impacts include:

- sensitive clearance, handling and storage of topsoils
- establishing appropriate soil erosion and sediment controls and
- progressive rehabilitation of disturbed land will occur in a manner which allows the land to be returned to land suitable for a post-mining grazing landuse.

Grazing management on the site will include destocking, protection of remaining vegetation areas and improvement to riparian vegetation. Restocking post-closure will be accommodated by the rehabilitation of the site to a post-mining grazing land use generally consistent with ALC Class C2 land.

Finally, visual impacts due to the Project visibility from the Bruce Highway will be mitigated through the installation of vegetated bunds, and lighting installed in the MIAs and other areas designed to minimise upwards light spill and avoid impacts on sensitive receptors.

5.10 Commitments

Central Queensland Coal's commitments, in relation to the land are provided in Table 5-21.

Table 5-21: Commitments – Land

Commitments
Soils and landforms
Revise, update and implement the ESCP prior to and during construction.
Schedule construction activities and dedicate specific work areas to minimise the impact to soils, landforms and any receiving waters.
Establish No Go Zones, prior to clearing / grubbing activities, and maintain throughout the life of the Project. This will be achieved by installing physical demarcation along work area perimeters to visibly delineate the maximum allowable area of disturbance.
Restrict vehicle movements to stabilised access locations. Stabilised access points and nominated construction and haul roads will prevent excessive ground disturbance from the movement of vehicles and machinery across the Project site.
No surfaces will be left open if they are not being worked on and all areas will have topsoil pulled back over and be suitably compacted once construction work in the area has finished. Grassed areas cleared for construction of any mine-related infrastructure will be re-contoured and landscaped once construction is complete to minimise erosion impacts.
Where significant excavation is required, excavated material will be deposited up-slope of the work and diversion measures to control soil and water flows will be installed (including banks and berms). Any diversion measures will discharge to a stabilised control or sedimentation trap.
Excavations shall be kept open for the shortest period of time possible and this will be achieved by incorporating a more detailed construction schedule into the Project planning phase.
Topsoil management
Topsoil and subsoil stripping during construction to be carried out under an approved Permit to Work and supervision of Environmental staff.
Prior to stripping, additional soil testing will be conducted to include at least salinity (EC), exchangeable cations, ESP and chloride to confirm the stripping depths for top and subsoils. All vegetation will be cleared progressively to the minimum extent required for the impending future works.
Supervisors and earthmoving plant operators will be trained to visually identify the topsoil and subsoil layers to ensure that stripping operations are conducted in accordance with stripping plans and in-situ soil conditions.
Care will be taken to ensure soil moisture conditions are appropriate for stripping and stockpiling, for example the moisture content of the topsoil material is not too dry or too wet.
All soils to be appropriately stockpiled away from mining operations for future rehabilitation use.
Soil that has been stockpiled until it is reused will be protected from excessive disturbance or traffic, and stockpiled and kept away from drainage lines.
Drainage will be constructed to manage or divert surface water flows around soil stockpiles and maintained to ensure proper functioning.
Weed and pests will be monitored and controlled as required on soil stockpiles.
Contamination
Provision of appropriate spill control materials including booms and absorbent materials at refuelling facilities to contain spills.
Ensure all refuelling facilities and the storage and handling of oil and chemicals to comply with relevant Australian Standards.
Ensure all staff to be made aware of the potential for groundwater quality to be impacted and the requirement to report any spills.

Commitments
Establish procedures to ensure safe and effective fuel, oil and chemical storage and handling. This includes storing these materials within roofed, bunded areas to contain spills and prevent uncontrolled discharge to the environment.
Returning the land to a stable landform (i.e. no major erosion) with no greater soil management inputs than those required for the change from the current land use of livestock grazing to conservation purposes.
Night lighting
Lighting to be used at the Mine Infrastructure Area will be designed to minimise upwards light spill.
Towers designed to a minimum height, positioning of towers to adequately illuminate working areas and directional shields attached to lamps to minimise horizontal and upwards spill.