

Central Queensland Coal Project

Chapter 11 – Rehabilitation and Decommissioning

Supplementary Environmental Impact Statement



Central Queensland Coal Project
**Chapter 11 – Rehabilitation and
Decommissioning**

20 December 2018

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11 Rehabilitation and Decommissioning

This chapter specifically identifies the following key aspects relating to the rehabilitation of the Project:

- Proposed rehabilitation methods;
- The management of topsoil resources for use in rehabilitation of the site;
- Description of the planned progressive rehabilitation and revegetation of areas across the mine site;
- The integration with ongoing and future rehabilitation activities across the wider mining area; and
- Rehabilitation monitoring and maintenance requirements which may apply.

This chapter sets out acceptable and realistic criteria for rehabilitation and closure that would allow the Project to meet the principles of Ecologically Sustainable Development (ESD) without any unacceptable liability to the State. Without effective rehabilitation, mining has the potential to permanently reduce the capacity of land and ecosystems to provide economic and ecological services and be unsafe for future use.

Matters raised in submission to the Environmental Impact Statement (EIS) and the original Supplementary Environmental Impact Statement (SEIS) relating to Chapter 11 – Rehabilitation and Decommissioning were predominately focused on:

- The number of samples used in the assessment in respect of nominated guidelines;
- The validity of assumptions in respect of regional strata;
- Additional interpretation of the geochemical data; and
- The management of sodic and dispersive soils.

This revised chapter provides additional information in response to the submissions relating to the EIS and SEIS Chapter 11 – Rehabilitation and Decommissioning. Appendix A13 includes the full details of all submissions received for the Project.

11.1 Revised Project Overview

Central Queensland Coal Proprietary Limited (Central Queensland Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponents), propose to develop the Central Queensland Coal Mine Project. As Central Queensland Coal is the senior proponent, Central Queensland Coal is referred to throughout this Supplementary Environmental Impact Statement (SEIS). The Project comprises the Central Queensland Coal Mine where coal mining and processing activities will occur along with a train loadout facility (TLF).

The Project is located 130 km northwest of Rockhampton in the Styx Coal Basin in Central Queensland. The Project is located within the Livingstone Shire Council (LSC) Local Government Area (LGA). The Project is generally located on the “Mamelon” property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on the “Strathmuir”

property, described as real property Lot 9 on MC230. A small section of the haul road to the TLF is located on the “Brussels” property described as real property Lot 85 on SP164785.

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). The Project will be located within Mining Lease (ML) 80187 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent. It is intended that all aspects of the Project will be authorised by a site specific environmental authority (EA).

Development of the Project is expected to commence in 2019 with initial early construction works and extend operationally for approximately 20 years until the depletion of the current reserve, and rehabilitation and mine closure activities are successfully completed.

The Project consists of two open cut operations that will be mined using a truck and shovel methodology. The run-of-mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (2019 - 2022), where coal will be crushed, screened and washed to SSCC grade with an estimate 80% yield. Stage 2 of the Project (2023 - 2038) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2, will be in operation. Rehabilitation works will occur progressively through mine operation, with final rehabilitation and mine closure activities occurring between 2036 to 2038.

A new TLF will be developed to connect into the existing Queensland Rail North Coast Rail Line. This connection will allow the product coal to be transported to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT).

Access to the Project will be via the Bruce Highway. The Project will employ a peak workforce of approximately 275 people during construction and between 100 (2019) to 500 (2030) during operation, with the workforce reducing to approximately 20 during decommissioning. Central Queensland Coal will manage the Project construction and ongoing operations with the assistance of contractors.

This SEIS supports the EIS by responding to the submissions that were made during the public notification period regarding the original EIS and identifies the material changes to the Project.

11.2 Relevant Legislation, Policies and Guidelines

The following provides a summary of the legislation and guidelines relevant to the rehabilitation approach proposed for the Project.

11.2.1 Relevant Legislation

11.2.1.1 Mineral and Energy Resources (Financial Provisioning) Bill 2018

Since the release of the EIS the Queensland Government has introduced the Mineral and Energy Resources (Financial Provisioning) Bill 2017. The Bill:

- Establishes a new financial assurance system for resource activities in Queensland, including a pooled fund for resource entities that meet the criteria; and

- Reforms the mine rehabilitation process, including requirements for upfront commitments to progressive rehabilitation and mine closure through a Progressive Rehabilitation and Closure Plan (PRCP).

The new requirements for financial assurance and rehabilitation for resources activities is expected to commence on 1 July 2019.

The primary change introduced by the Financial Provisioning Bill is that plans of operations for mining projects with site-specific environmental authorities will be replaced with PRCPs, that will:

- Provide the plan for the mining activity;
- Identify the post mining land use; and
- Detail progressive rehabilitation, including milestones and timeframes. Land will be available for rehabilitation generally if it is not being used for mining, does not contain permanent infrastructure and will not be mined within the next 10 years.

A PRCP guideline will be developed, to assist with the preparation of PRCPs. The detail required for the progressive rehabilitation requirements will not be known until the guideline is released. Central Queensland Coal will, once appropriate guidance is developed and disseminated by the Queensland Government, prepare a PRCP.

11.2.1.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) describes the requirements of applications for a site specific environmental authority including how the land which is the subject of the application will be rehabilitated after each relevant activity ceases. This information is used to aid the Department of Environment and Science (DES) in preparing the draft EA for the Central Queensland Coal Project. Rehabilitation requirements are implemented through financial assurance requirements, Plan of Operations and a Rehabilitation Management Plan (RMP), until the guidelines for the preparation of a PRCP are introduced.

Financial Assurance

Queensland's DES will, by condition of the EA, require financial assurances to be lodged before carrying out any activities on the mining leases (s292 of EP Act). Financial assurance provides the government with a financial security to cover any costs or expenses incurred to prevent or minimise environmental harm or rehabilitate or restore the environment, should the EA holder fail to meet their environmental obligations in the EA.

For resource activities, financial assurance is calculated based on the year in which rehabilitation costs are likely to be the highest. The DES Guideline Financial Assurance under the EP Act provides guidance on the circumstances when financial assurance is required, the form of financial assurance, calculation method, application requirements and other matters such as lodging, changing, discharging or claiming financial assurance.

Plan of Operations

The Plan of Operations will detail how the Project will implement progressive rehabilitation throughout the operations. The Plan of Operations will include the following (S288 of EP Act):

- Description of all resources activities that will take place on the site during the time frame covered by the plan;

- Proposed program of actions to comply with EA conditions;
- Rehabilitation program for land disturbed or land that will be disturbed during the period of the plan;
- Proposed amount of financial assurance based on the guidelines for calculating financial assurance; and
- Compliance statement describing how a proponent has complied with the EA conditions.

As part of the Project's EA, the Plan of Operations will be submitted to DES at least 20 business days prior to commencing activities (s287 of the EP Act). The Plan will also be reviewed by an independent, suitably qualified auditor. The Plan of Operations must be renewed on a five-year basis but typically it is renewed more frequently. DES may suspend or cancel the EA in the event of inadequacy or non-compliance of operations in meeting the approved Plan of Operations. It is also an offence under s290 to fail to comply with a Plan of Operations.

Rehabilitation Management Plan

A rehabilitation program for land disturbed during activities associated with the Plan of Operations is a requirement of the EA. A RMP will be developed, guided by the DES Guideline – Rehabilitation requirements for mining resource activities.

Final Rehabilitation Report and EA Surrender

Upon completion of the Project, Central Queensland Coal will be required to submit an EA surrender application. As part of the surrender application, Central Queensland Coal will be required to prepare and submit a progressive or final rehabilitation report to DES for assessment. DES must consider the relevant completion criteria (s318ZI or s268) when deciding whether to certify progressive rehabilitation or whether to approve a surrender application. DES must be satisfied with the rehabilitation before it can certify progressive rehabilitation for part of a mining project or accept the surrender of an environmental authority for the whole of a project.

The discharge of financial assurance is sought after activities have ceased and subject to successful rehabilitation at the time of surrendering the EA. However, DES may, after approving the surrender of an EA, require that the financial assurance remains in force until it is satisfied that no claim is likely to be made in the future (s292 of the EP Act).

11.2.2 Policies

The Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) jointly published the Strategic Framework for Mine Closure (ANZMEC and MCA 2000). The framework recognised that the mining industry is responsible for rehabilitation of mine disturbance in an environmentally and socially acceptable way.

The National Strategy for Ecologically Sustainable Development (COA 1992) promotes economic growth that safeguards the welfare of future generations, provides equity within and between generations, protects biological diversity and maintains essential ecological processes and life support systems.

These policies underpin the Queensland rehabilitation requirements.

11.2.3 Guidelines

The Commonwealth Government's Leading Practice Sustainable Development Program (LPSPD) for the mining industry issued a handbook series in 2006 which has been revised in 2016 (Australian Government 2016). These provide leading practice approaches, attitudes and technologies which have been considered in the proposed rehabilitation of this Project.

Guideline EM1122, Rehabilitation Requirements for Mining Resource Activities (EHP 2014) has been developed by DES and has been used to develop acceptable rehabilitation outcomes and strategies for this Project. The guideline also explains how the administering authority will assess whether progressive or final rehabilitation for either new or established mining projects is satisfactory.

The preferred rehabilitation hierarchy which, in order of decreasing capacity to prevent or minimise environmental harm, is:

- Avoid disturbance that will require rehabilitation;
- Reinstatement a 'natural' ecosystem as similar as possible to the original ecosystem;
- Develop an alternative outcome with a higher economic value than the previous land use;
- Reinstatement the previous land use (e.g. grazing or cropping); and
- Develop lower value land use.

The guideline outlines that the strategies listed higher in the hierarchy should be adopted in preference to those listed lower. The Project is aiming to reinstate a 'natural' ecosystem as similar as possible to the original ecosystem as its final rehabilitation goals and as such the lower criteria are not relevant.

The rehabilitation goals, as described in the guideline require rehabilitation of areas disturbed by mining to result in landforms that are:

- Safe to humans and wildlife;
- Non-polluting;
- Stable; and
- Able to sustain an agreed post mining land use.

11.3 Key Ecosystem Processes and Functions

Under the new LPSPD's Mining Rehabilitation Handbook, the goal of rehabilitation is to reinstate ecosystem functioning and land productivity to re-establish ecosystem structure and function (Australian Government 2016). To acquire a self-sustaining post-mining land use, species compositions like surrounding ecosystems, and an understanding of the processes and influences within those ecosystems, is vital in designing and implementing a RMP. Ecosystems can be examined on a sliding scale from global, regional, local and micro systems and they contain complex interactions of abiotic (geology, soils, water, atmosphere and land form) and biotic components (plants, animals and decomposers) (Chapin, Matson and Vitousek 2011). These interactions determine the ecosystem structure, function and biodiversity and their understanding is fundamental to mine site rehabilitation.

11.3.1 Climate

The climate of a region, particularly rainfall and temperate, influence the species composition of a plant community and the distribution of biomass. Temperature, moisture, carbon dioxide and oxygen availability influence the rates of chemical reactions and biological activity in ecosystem processes (Chapin, Matson and Vitousek 2011). When engineering and restoring ecosystems, it is also important to consider weather extremes (e.g. more frequent cyclones, intense rainfall and longer drought periods) from global warming impacts. Many terrestrial species have shifted their geographic ranges, seasonal activities and migration patterns (IPCC 2014), thus consideration should be given to species that are resilient to climate change.

The Project area has a climate which is characterised by a distinct wet season in the months of December, January and February, with monthly rainfall averages of greater than 100 mm and a distinct dry season between the months April through October with less than 50 mm mean monthly rainfall between these months. Evaporation rates are highest during the summer months, and lowest mid-year. In any given month, the average evaporation is greater than the average rainfall. Natural or induced climate related hazards such as severe storms, cyclones, floods, bushfires and droughts occur and pose risks which require management and climate change predictions show an anticipated increase of these events. A more detailed discussion of the Project area climate is at Chapter 4 – Climate.

11.3.1.1 Key Rehabilitation Considerations

- Engineering for stability and intense rainfall events in site stormwater controls;
- Seeding and vegetation cover to be in place prior to the wet season to reduce erosion risk and increase success of vegetation establishment;
- Selection of species will include those that are most resilient to climate change; and
- Re-establish fish passage opportunities.

11.3.2 Landscape and Landform

To effectively rehabilitate land, it is important to understand the catchment landscape, particularly the landscape processes of weathering and material movement as well as land use and the upstream and downstream ecosystem services. Weathering is fundamental to landscape evolution and topographic development and the development of soil, regoliths and weathering profiles (Turkington *et al.* 2015). Landscape processes cause spatial variation of soil moisture, fertility and rooting depth which drives the distribution of plant species and communities. Key landscape processes which must be considered in mining restoration are outlined in Table 11-1.

Table 11-1 Key landscape processes

Process	Description	Relevance
Water and sediment movement process	The fluvial landscapes and the sediment will be transported from the mountains into the valleys then deltas.	<ul style="list-style-type: none"> ▪ Altering this process and movement of sediment within the landscape can significantly change the downstream landscape; and ▪ Identify potential downstream impact areas if contamination released offsite.

Process	Description	Relevance
Landscape evolution process	The topographically controlled redistribution of materials through gravitational force moving water and sediment downhill, landslides, soil creep.	<ul style="list-style-type: none"> ▪ Controls over soil losses; ▪ Topography and slope influence erosion and deposition (Chapin, Matson and Vitousek 2011); ▪ Physical pathway by which materials move between ecosystems; and ▪ Understand how the rehabilitated site will behave over time.
Physical weathering process	The fracturing and breaking of rocks into smaller fragments caused by heat, freezing of water and expansion, salt crystal growth, wetting and drying, exfoliation.	<ul style="list-style-type: none"> ▪ Understanding the local weathering pressures and processes at the site; ▪ Dissolution of saline content in rock and material overtime; and ▪ Stability and integrity risks of reformed areas.
Chemical weathering	Process through reactions (dissolution, redox reactions, reaction with water, oxygen or carbonic dissolution).	<ul style="list-style-type: none"> ▪ Mining rehabilitation with waste rock management to avoid acid mine drainage; ▪ Soil salinity and toxicity; ▪ Soil sodicity and erosion; and ▪ Development of the soil profile and mineral composition.

These processes will be considered through the application of landform evolution modelling in revising the final landscape design. This will enable engineering of landform restoration to integrate into the surrounding landscape, protect long term stability, avoid detrimental impacts from weathering and obtain a functional landscape system.

Waste rock analysis presented in SEIS Chapter 8 – Waste Rock and Rejects indicates the risk of heavy metals leaching from waste rock is low and will have minimal impact on surface and groundwater. The waste rock was classified as non-acid forming (barren), with generally high acid neutralising capacity, and likely to remain pH neutral to alkaline following excavation. Therefore, dissolution of heavy metals in an acidic environment from physical and chemical weathering processes is unlikely to pose ongoing risks to rehabilitation success.

Sodicity of waste rock and coal reject composite samples, in the form of Exchangeable Sodium Potential (ESP: %), were very high (28.9% to 42.7%). Strongly sodic materials are likely to have structural stability problems related to potential dispersion. In addition to potential dispersion, sodic materials often have unbalanced nutrient ratios that can lead to macro-nutrient deficiencies.

11.3.2.1 Key Rehabilitation Considerations

- The Project is in an area subject to infrequent intense rainfalls, heat and is also subject to high winds associated with cyclonic events. The landscape is highly fragmented from extensive vegetation clearing and cattle grazing which increases the physical weathering of the soil surface;
- The region's seasonality makes it prone to wind erosion, particularly during the dry season. Therefore, ground cover should be established prior to the dry season;
- Further minimisation of potential acid generation from waste rock because of physical and chemical weathering, through operational management by replacing areas of risk materials back in-pit and having long-term exposure of weathering to acid neutral materials within residual spoils; and
- Effective management of sodic waste materials back in-pit or within residual spoil areas where slope management and rehabilitation timeframes are key considerations.

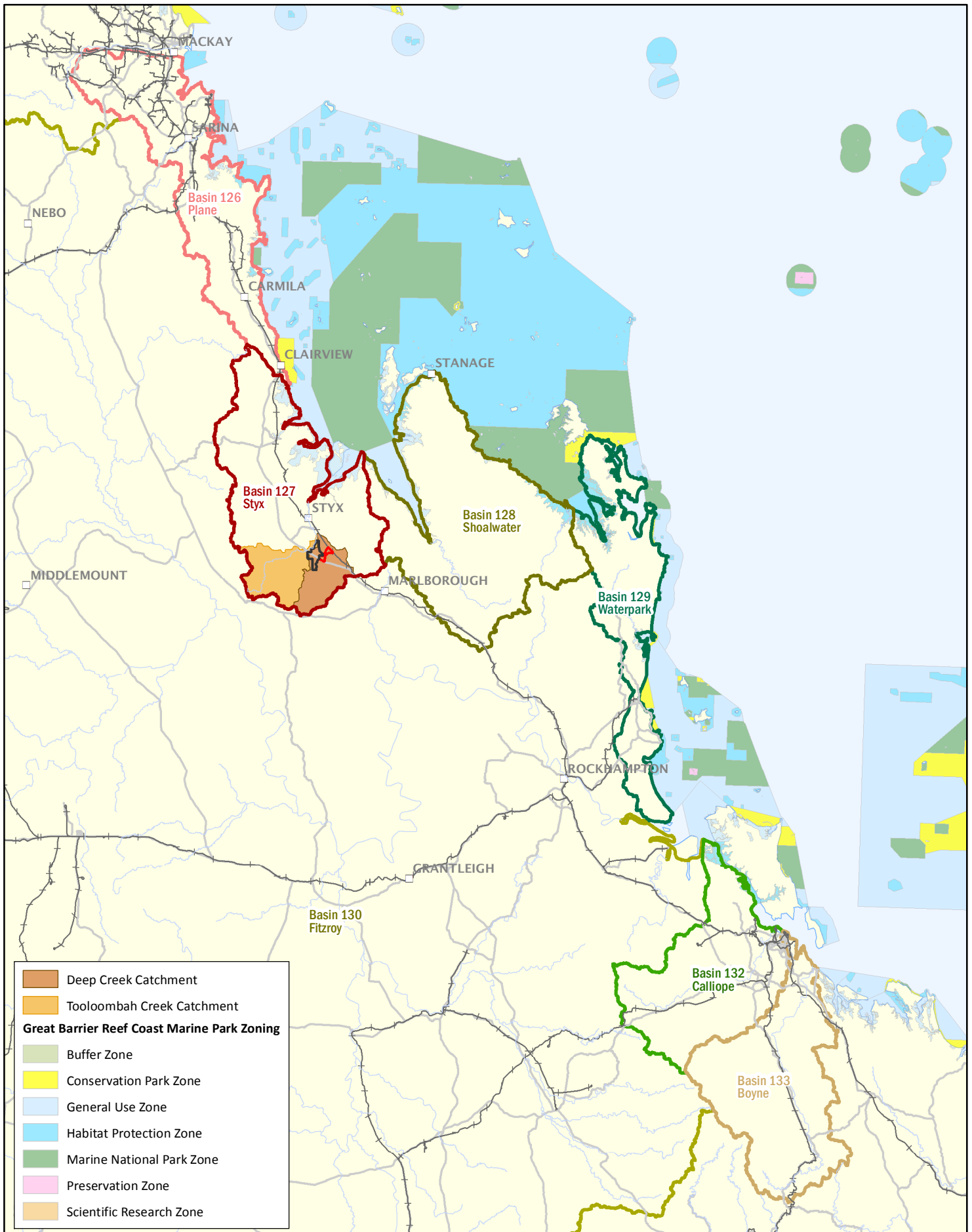
11.3.3 Hydrology

Hydraulic regimes are driven by climatic precipitation and influence structural aspects of the ecosystem such as the floristic structure and plant species distribution through the soil moisture profile, infiltration for plant growth and biomass. They also influence the landscape structure through erosion rates, sediment movement and deposition and soil profile formation. The hydrology can also influence the functional aspects as water movement in the soil and exposed rocks can leach soluble heavy metals and contaminants and transport seeds and organisms into waterways and the downstream environment facilitating dispersal (Gurnell *et al.*, 2008) and genetic diversity (Larsen *et al.*, 2012).

11.3.3.1 Project

The Project is wholly contained within the Styx River Basin, comprising Styx River, Waverley and St Lawrence Creeks. The Styx Basin discharges to the Great Barrier Reef Marine Park (GBRMP) (refer Figure 11-1), which is listed as a World Heritage Area. The Project is bordered by two watercourses as defined under the *Water Act 2000*, namely Tooloombah Creek and Deep Creek (Figure 11-2). These creeks meet at a confluence downstream of the Project area to form the Styx River. The boundary of the Great Barrier Reef Coastal Marine Park is located approximately 10 km downstream of the ML area (General purpose zone), the marine National Park zone is located 40 km downstream of the ML area.

The Fitzroy Basin Association Natural Resource Management (NRM) body manages waters within the Styx Basin. Fitzroy Basin Association NRM body encompasses eight sub-catchments; Lower-Fitzroy, Isaac-Connors, Comet, Upper and Lower Dawson, Styx-Herbert, Water Park and Boyne-Calliope. Due to the NRM comprising an area over 152,000 km², the region has been split into 192 Neighbourhood Catchments. The Project is located within the F3 Neighbourhood Catchment which is described as having a high sediment delivery ratio to the Great Barrier Reef with a low number of landholders within the basin (Fitzroy Basin Association 2015). Sediment in the Fitzroy Region is the most significant risk to the Great Barrier Reef, with an estimated 1.5 million tonnes of extra sediment deposited each year and 83% of the sediment coming from grazing land. It is estimated that the Styx Basin contributes 97,892 t per year. The load contributions from the Styx Basin are based on limited monitoring results. Cattle grazing is the dominant land use of the area (80%) and the basin contains 14% wetland area. Many the wetlands are estuarine systems (8.8%) with approximately 187 lacustrine / palustrine wetlands (EHP 2017). Further information on hydrology is found in Chapter 9 - Surface Water.



	Deep Creek Catchment
	Tooloombah Creek Catchment
Great Barrier Reef Coast Marine Park Zoning	
	Buffer Zone
	Conservation Park Zone
	General Use Zone
	Habitat Protection Zone
	Marine National Park Zone
	Preservation Zone
	Scientific Research Zone

0 20 40 km
 Scale @ A4 1:1,700,000
 Date: 13/11/18
 Drawn: Gayle B.

Legend

	Boyne		Plane		ML 80187
	Calliope		Shoalwater		ML 700022
	Fitzroy		Waterpark		Major rail line
	Styx				Major road
					Major watercourse

Figure 11-1
Fitzroy Basin – Drainage Basins

DATA SOURCE
 QLD Open Source Data, 2018;
 Waratah Coal, 2018



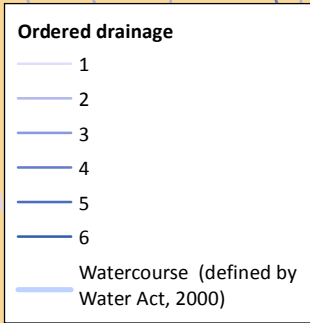
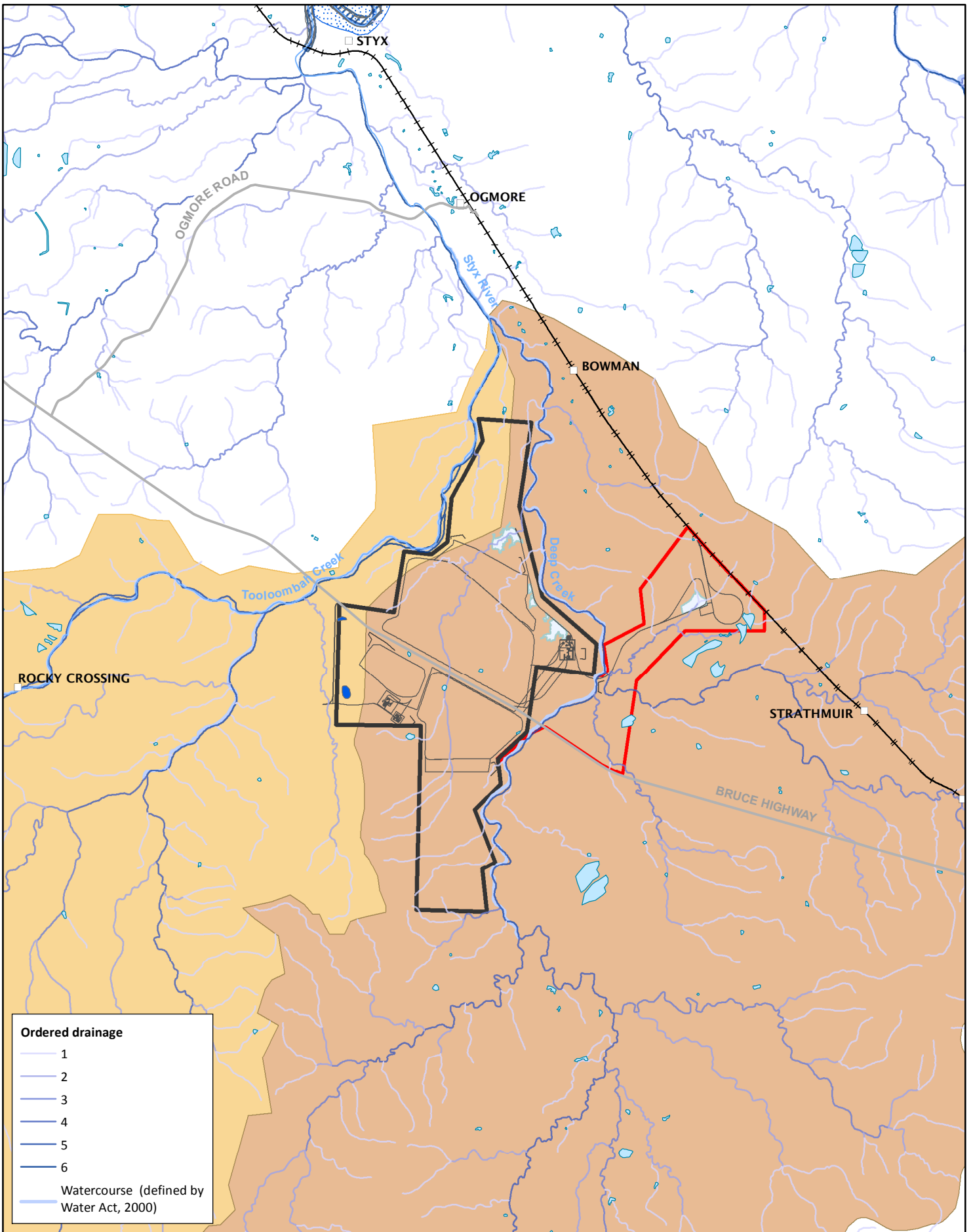


Figure 11-2
Local watercourses, drainage features, wetlands, dams and catchments

DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018



- Legend**
- ML 80187
 - ML 700022
 - Mine infrastructure
 - North Coast Rail Line
 - Main Road
 - Reservoir
 - Directory of important wetland
 - Great Barrier Reef Coast Marine Park Zoning
 - Wetland (VM Act)
 - Drainage Catchment**
 - Deep Creek
 - Toolmoobah Creek



0 1 2 km

Scale @ A4 1:100,000
Date: 14/11/18
Drawn: Gayle B.

11.3.3.2 Key rehabilitation considerations

- The drainage diversions will be removed at mine closure and rehabilitated to a stable, vegetated and self-sustaining condition;
- The environmental dams will be removed at mine closure and rehabilitated to a stable, non-polluting, vegetated and self-sustaining condition;
- The water storage dams required for mining activities will be rehabilitated to a stable, vegetated and self-sustaining condition; and
- The water storage dams not required post mining will be removed at mine closure and rehabilitated to a stable, vegetated and self-sustaining condition.

11.3.4 Geology, Soils and Root Zone Function

Geological processes and structure influence the landscape features and formation, groundwater movement and the physical and chemical properties of the geological rates of weathering, sediment movement and soil properties. In addition to the parent material, soil properties are also determined by climate, organisms, topography and time. Soil age and weathering influences the mineral composition through the solubility and leaching of various elements (Chapin, Matson and Vitousek 2011). The Project's regional geology is located in an Early Cretaceous intra-cratonic sag basin. It probably developed by subsidence of the Strathmuir Synclinorium, an older feature containing Permian Bowen Basin strata (Geoscience Australia, 2008). The Styx Basin plunges to the north northwest, with an elongate shape bounded by the half graben fault to the east and onlapping the Permian Back Creek Group to the west (Arrow Energy, 2005; Waratah Coal, 2008), but the general dip of the Styx Coal Measures sequence is to the east.

Soil has physical, chemical and biological constituents that are essential components in the biogeochemical cycles of water, carbon, minerals and nutrients providing a foundation for vegetation communities. Physical properties such as soil bulk density, texture, structure and pore space influence soil water availability, root penetration, water storage and supply, porosity for transmission of liquids and gases and space for biota. The chemical constituents that influence species diversity and terrestrial primary productivity are nutrient availability, salinity and sodicity (Medinski *et al.*, 2010) and mineralogy. Nutrient availability is impacted by soil pH (Wright 1992), decomposition and microbial activity, mineral weathering and dissolution (Leopold 2012).

Biological soil fauna (moss, algae, lichen, worms and fungi) provide decomposition functions which breakdown organic matter increasing the available nutrients (Voroney and Heck 2015) and releases of carbon to the atmosphere (Chapin, Matson and Vitousek 2011). Decomposition can occur through leaching of materials which are absorbed or react with mineral phase of soil, fragmentation through digestion from soil biota or chemical alteration from soil microbes (bacteria and fungi) (Chapin, Matson and Vitousek 2011). Decomposition also improves soil aggregate formation (van Leeuwen *et al.* 2011), water penetration, resistance to erosion, and other ecosystem services, including water quality, limiting invasive species, and increasing disease prevention. Soil microorganisms produce plant growth stimulating substances and can immobilize heavy metals in the soil. Mining rehabilitation requires the understanding of these processes to engineer the soil profile through the stimulation of bio-weathering, promotion of nutrient cycling and addition of soil biota to support the vegetation community being restored.

The Project area contains several different soil types; Vertosols, Sodosols, Dermosols, Kandosols and Rudosols. The soil properties and land support capabilities are outlined in Chapter 5 – Land. Most soil types have few physical root limitations; however, the clay sodic B horizon of the Sodosol will restrict root growth. Within the Central Queensland Coal mine area, soil salinity is generally low

except for some salt build up found in the B horizons of the Sodosols. The Sodosols are also dispersive and prone to erosion and soil structural decline, if disturbed. For other soil types in the Central Queensland mine area, the non-sodic, minimal dispersive soils within the mine area is suited to pastoral land use. The baseline soil fertility and organic carbon levels within the Project area is low to moderate and most are suitable for pasture production and beef cattle grazing.

11.3.4.1 Key Rehabilitation Considerations

- Loss of topsoil fertility and viability from storage of topsoil over extended time periods;
- Soil pH should be used as an indicator as Kandosols have potential to create aluminium toxicity if conditions become acidic; however, assessment shows soils to be currently neutral to alkaline;
- Vertosols and Sodosols have tendencies to pose secondary salinity problems which need to be addressed within the rehabilitation; and
- Sodic soils have severe erosion potential on slopes in high intensity rainfall and as such, slopes require quick establishment of vegetative cover.

11.3.5 Management of Sodic or Dispersive Soils

Sodicity of waste rock and coal reject composite samples, in the form of Exchangeable Sodium Potential (ESP: %), were very high (28.9% to 42.7%) (see Chapter 5 - Land and Chapter 8 -Waste Rock and Rejects). Strongly sodic materials are likely to have structural stability problems related to potential dispersion. In addition to potential dispersion, sodic materials often have unbalanced nutrient ratios that can lead to macro-nutrient deficiencies. Hence, to promote vegetation growth during rehabilitation.

Sodic and dispersive materials will be identified, selectively handled and placed within the core of waste rock stockpiles away from final surfaces or returned to voids during mining. Where sodic waste materials may be required for use as an additional topsoil, prior treatment would likely be required. The most effective means to ameliorate against sodicity during rehabilitation works is to apply and incorporate gypsum; and / or apply and incorporate an organic amendment e.g. biosolids, composted manure, mulch, straw, etc. Given the volumes involved, these approaches are unlikely to be effective. As such, the following management practices will be employed:

- Test spoil ahead of mining and rehabilitation. The most relevant test is exch. Na %. The approximate threshold levels are:
 - Very low <4%
 - Low 5-8%
 - Moderate 9-12%
 - High 13-15%
 - Very High >15%

Other tests that can be used to determine sodicity are Dispersion % or the Emerson Aggregate Test;

- Selectively bury high to very high exch. Na% (sodic) spoil (if practicable);
- Ensure moderately sodic material is top dressed with topsoil; and

- Low and very low sodic material can be sown with native trees and shrubs without topsoil provided that the spoil has a pH of > 4.5 and < 8.5 and is non-saline. The spoil must be coarsely ripped i.e. rough seedbed preparation with distinct furrows (not smooth).

11.3.6 Terrestrial Ecology

Vegetation communities are composed of many co-existing species. Dominant vegetation species provide canopy structure influencing light infiltration and thus the substructure and species present within the community. Ecological restoration must consider the nutrient and water needs of the species, the synergistically or antagonistically co-existence of plant species and plant interactions with microbes, soil fauna and animals to restore ecosystem function.

Framework species, functional groups and keystone species play a significant role in restoring ecosystem function (van Andel, Grootjans and Aronson 2012). Framework species can be introduced first as they have functional traits of fast growth and fruit / food production, high survival and high tolerance. These species can play a vital role in primary succession providing capacity to deal with the highly-disturbed environment with potentially organic poor (low nitrogen, low water holding capacity) soils (Chapin, Matson and Vitousek 2011). Plant root physiology and rooting depth must be considered, especially in areas of buried sodic or saline material or capped contaminates.

Ecosystem function relates to primary production, decomposition and nutrient cycling. Representation of species within these functional groups facilitates continued development and / or stability of the system (van Andel, Grootjans and Aronson 2012). Nitrogen-fixing species provide nutrient cycling function by accessing nitrogen through symbiotic bacterium relations facilitating the establishment and growth of later successional species. This function is important in areas of low nitrogen and minimal soil development (Chapin, Matson and Vitousek 2011). Keystone species are plants or animals that play a unique and crucial role in the way an ecosystem functions (National Geographic Society 2016) and can be used as indicators of success. Biotic ecosystem structure is shaped by the food chain and the loss of keystone species may alter the ecosystem structure.

The Project area occurs within the Brigalow Belt bioregion. Dominant vegetation communities include open forests (dominated by Brigalow (*Acacia harpophylla*), Black Gidyea (*A. argyrodendron*), Gidgee (*A. cambagei*), Lancewood (*A. shirleyi*), Dawson River Blackbutt (*Eucalyptus cambageana*), River Red Gum (*E. camaldulensis*), Forest Red Gum (*E. tereticornis*)), woodlands (dominated by Silver-leaved Ironbark (*Eucalyptus melanophloia*), Narrow-leaved Ironbark (*E. crebra*), Poplar Box (*E. populnea*), Brown's Box (*E. brownie*), *E. persistens*, Mountain Coolibah (*E. orgadophila*), Coolibah (*E. coolabah*), River Red Gum and Forest Red Gum) and small patches of semi-evergreen vine thicket.

The majority of the Project area occurs in the Marlborough Plains subregion (BRB14) of the Brigalow Belt bioregion. The Marlborough Plains subregion is a characteristically undulating to hilly subregion with a complex geology. The 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 and Tea-tree (*Melaleuca* spp.) with low rises supporting Narrow-Leaved Ironbark. Clearing over the past 150 years has resulted in a highly-fragmented landscape with vegetation generally confined to rockier hilly areas, linear strips of roadside vegetation, riparian vegetation and relatively small isolated remnants. Further detail on the terrestrial ecology of the Project is found in Chapter 14 - Terrestrial Ecology.

Vegetation within the mine area, haul road and TLF is generally representative of the Marlborough Plains subregion comprising:

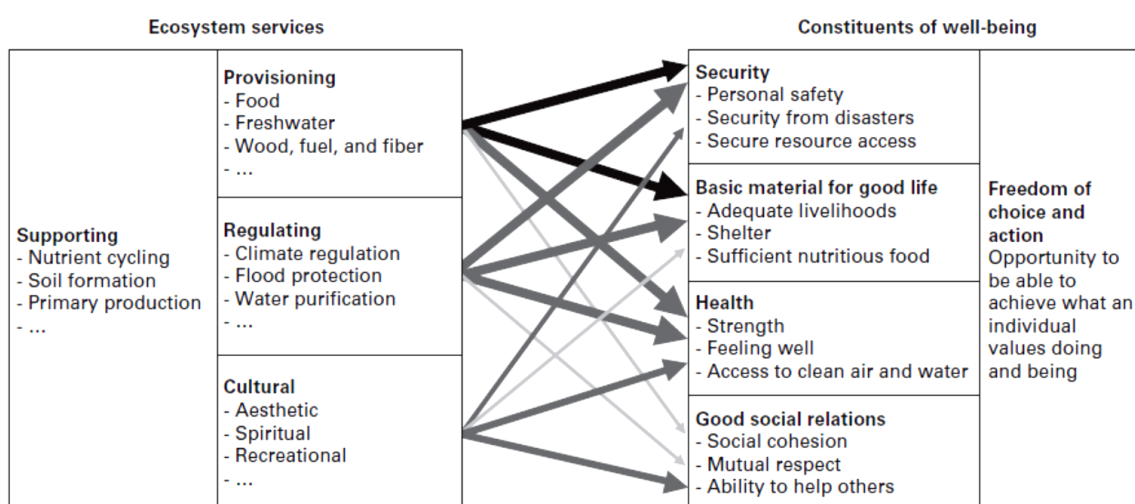
- Large areas of heavily disturbed habitats that have previously undergone significant clearing for cattle production; and
- Smaller pockets of fragmented closed canopy vegetation largely associated with creek systems and rocky areas.

11.3.6.1 Key Rehabilitation Considerations

- Restoration of the current vegetated areas would protect long-term values of Commonwealth and State significant vegetation;
- Protected or threatened species likely in the Project area include Greater Glider (*Petauroides volans*), Squatter Pigeon (*Geophaps scripta*), Ornamental Snake (*Denisonia maculate*) and Koala (*Phascolarctos cinereus*). In consideration vegetation reestablishment outcomes, potential food and habitat needs of these species is included; and
- Framework species of existing Regional Ecosystems onsite to be used in seed mix and flora food and habitat species for keystones species.

11.4 Ecosystem Services

Ecosystem services are ecosystem functions or groups of functions with utility for human society (Muller, Fohrer and Chicharo 2015). The Millennium Ecosystem Assessment (2005) defines four categories: supporting services, provisioning services, regulating services and cultural services, as shown in Figure 11-3.



Source: Bouma and Beukering 2015

Figure 11-3 Ecosystem services

The sustainability of ecosystem services is paramount as human well-being ultimately depends on the health of ecosystems (Bouma and Beukering 2015). Restoration of ecosystems should consider safeguarding these services for future generations. This requires high plant diversity and reduced human stressor impacts.

Several regulating ecosystem services are provided by this ecosystem including local climate, air quality, water flow regulation, water purification, nutrient regulation, erosion regulation and natural hazard protection.

11.5 Current Land Use and Post Mining Land Use

The current land use in the Project area is predominantly grazing with limited areas of native remnant vegetation. Investigations of land use following industry classification methods have been undertaken to define the current land use. This information has in turn allowed for the determination of the final land use, post-mining activities, to allow the development of potential rehabilitation strategies to minimise potential environmental impacts.

Central Queensland Coal intends to manage its operations and conduct decommissioning and rehabilitation activities to ensure that the land disturbed is returned to land suitable for the continued natural regeneration of land undisturbed by mining activities or land that has been rehabilitated to meet conservation objectives. A small section of the Mamelon property, located at the southern extent of the ML boundary, will continue to be set aside for grazing.

11.6 Rehabilitation Framework

The Project is not expected to be decommissioned for approximately 20 years or following depletion of the target coal resource. Progressive rehabilitation is proposed to be carried out as operations progress rather than taking place as a large operation once mining is complete. Rehabilitation of the mine infrastructure area, haul road and TLF will take place once mining is completed and plant and structures have been decommissioned.

The Rehabilitation Framework will be developed and evolve over time to reflect changing regulatory requirements, community values, and lessons learned onsite or at other mines. A RMP or PRCP will be developed based on objectives and goals that seek to provide predetermined land uses for the different land units (domains) of the mine (see Section 11.8). The PRCP will address the seven factors for successful remediation of mine sites with dispersive soils as identified by Dale et al., 2018, namely:

- Soil and spoil characterisation: critical to inform design, treatment management and monitoring of dispersive sites;
- Soil and spoil amelioration: practices that ameliorate dispersive or erosive soil and spoil properties;
- Landform design: design factors that minimise concentration of the erosive force of incident rainfall;
- Practice control factors: soil design and management factors to reduce erosive energy;
- Crop management factors: vegetation management practices to reduce erosive energy;
- Tunnel initiation factors: site and management factors contributing to reduced tunnel development; and
- Monitoring and maintenance: monitoring requirements to guide timely and targeted remedial treatment.

Success criteria for each of these domains will be established which will need to be met to demonstrate rehabilitation. The rehabilitation works will be designed within the constraints of the site's conditions (e.g. the climate, topography and soil / rock types) as well as the mining plan and schedule.

11.7 Rehabilitation Objectives and Performance Criteria

The Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (Department of Minerals and Energy (DME) 1995) and Guideline EM1122, Rehabilitation Requirements for Mining Resource Activities (EHP 2014) (the Guideline) state four general rehabilitation goals. These require rehabilitation of areas disturbed by mining to result in site conditions that are:

- Safe to humans and wildlife;
- Non-polluting;
- Stable; and
- Able to sustain an agreed post-mining land use.

Central Queensland Coal will seek to achieve the following overarching rehabilitation and decommissioning goals to address the general rehabilitation goals as nominated in the Guideline by:

- Providing landforms with the same or similar land use capabilities and / or suitability prior to the disturbance, unless other beneficial land uses are pre-determined and agreed with key stakeholders (post-mining land owners, managers and relevant regulators);
- Rehabilitation of disturbed land so that it presents a negligible safety or environmental risk in terms of stability;
- Providing land that is self-sustaining to agriculture or ecosystem processes where maintenance requirements are negligible and consistent with an agreed post-mining land use; and
- Maintaining the water quality and quantity acceptable for existing and future users within or surrounding the site.

These overarching goals will provide for a post-mining site that is physically safe to human and animals, geotechnically stable, non-polluting and capable of sustaining the agreed land uses. These goals are consistent with the principles of ESD as required by the EP Act.

11.7.1 Short and Long-term Rehabilitation Goals

The above overarching rehabilitation goals can be defined into short-term and long-term goals as outlined in the following sections.

11.7.1.1 Short-term Goals

Short-term rehabilitation goals for the mine are to:

- Minimise clearing and vegetation disturbance consistent with operational requirements;
- Schedule operations including overburden and interburden emplacement and shaping, and revegetation to minimise visual exposure;
- Rehabilitate areas of disturbance no longer required for mining related operations;
- Apply soil (topsoil / subsoil) to the final landform based on material availability and post-mining land use;

- Stabilise all earthworks, drainage lines and disturbed areas to minimise erosion and sedimentation; and
- Control vermin, feral animals and noxious weeds.

11.7.1.2 Long-term Goals

The overall long-term goal is to rehabilitate the land to a low maintenance, stable and safe landform that blends with the surrounding topography and maximises the return of agricultural land suitability comparable to pre-mining levels. These long-term goals will be met by measures including:

- Post-mining land suitability for natural regeneration and sustainable rehabilitation with a small section in the southern section of Mamelon set aside for grazing;
- Providing habitat for fauna and corridors for fauna movement within the final landform;
- Preservation of downstream water quality for ecological and existing beneficial uses;
- Establishment of a low maintenance, geotechnically stable landform commensurate with nature conservation land uses;
- Blending the created landforms to appear as a natural extension of the surrounding environment; and
- Monitoring rehabilitation success in terms of physical and biological parameters.

A Mine Closure Plan (MCP) will be prepared outlining the specific operational activities required to complete the rehabilitation and decommissioning of the Project. The MCP will include monitoring and management of:

- Wastewater collection systems and treatment systems;
- Groundwater quality and levels;
- Surface water quality and flows;
- Seepage rates;
- Erosion rates;
- Integrity and stability of slopes and ramps; and
- Health and resilience of vegetation cover.

Should the guidelines be issued for the PRCP, this will be prepared in place of a MCP.

11.8 Mine Domains

Rehabilitation goals and strategies for the Project were nominated for individual land management units or domains within EIS Chapter 11 – Rehabilitation and Decommissioning. Discrete elements to be rehabilitated within each domain were described. The following section provides an updated description, based on changes to the mine design completed since the release of the EIS.

Since the EIS was released the decision was confirmed that most of the Mamelon Property, including most of the ML, will be destocked and suitable areas outside of the mining disturbance area will be

established as environmental offsets. A small area already cleared for grazing activity at the southern end of the ML may be retained as that land use. The creek lines will also be fenced off where necessary to enable natural regeneration within the riparian areas. The following section also reflects the goal to return the area post-mining to a condition consistent with established offset and biodiversity programs.

11.8.1 Updated Mine Domains

Rehabilitation goals and strategies are nominated for individual land management units or domains with discrete elements to be rehabilitated within each domain. The mine site has been divided into three major management domains and sub-domains. These are provided in Table 11-2 along with the maximum surface area for each domain and shown in Figure 11-4.

Table 11-2 Rehabilitation domains and surface area

Project Component	Approximate area (ha)
Mining and Infrastructure Area	1,090.8
Open Cut 1	247.7
Open Cut 2	500
Waste Rock Stockpile 1a	35.6
Waste Rock Stockpile 1b	83.2
Waste Rock Stockpile 2	124.5
Environmental Dams	24.6
Dam 1	13.7
Dam 2	11.0
Dam 3	3.1
CHPP 1 and 2	27.8
Dam access road	4.6
Mine access and internal roads – Open Cut 1	3.6
Mine access and internal roads – Open Cut 2	4.2
Power supply	1.4
Conveyor	5.8
Haul Road to TLF, Dam 4 and TLF	26
Rail loop and spur line	8
TOTAL	1,124.8

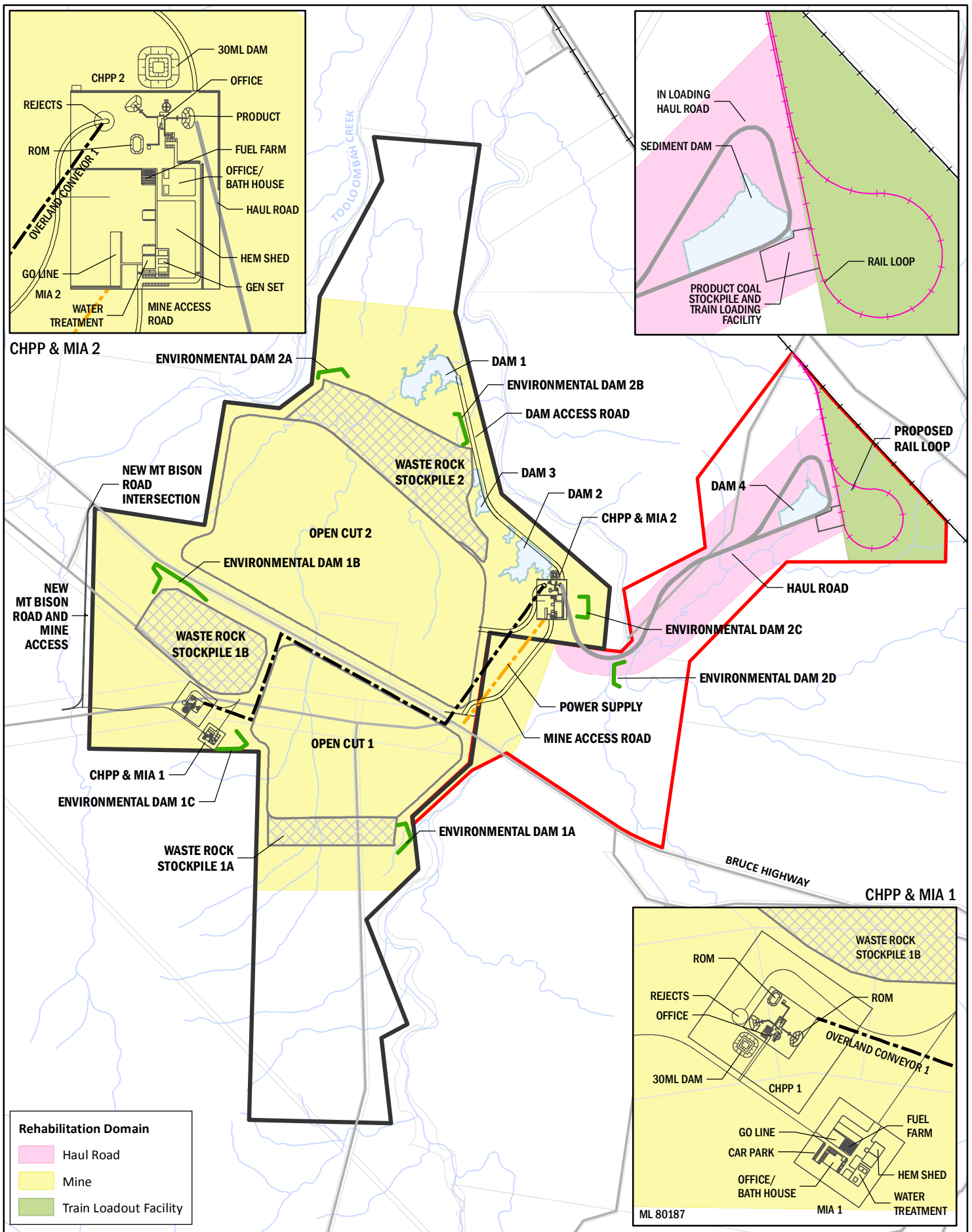


Figure 11-4
Rehabilitation domains

Scale @ A4 1:50,000
Date: 31/10/18
Drawn: Gayle B.

Legend

Haul Road	ML 80187	Main Road
Mine infrastructure	ML 700022	North Coast Rail Line
Overland Conveyor	Cadastral boundary	Watercourse
Power	Open-cut Mine Pit	Dam
Rail Balloon Loop	Waste Rock Area	
Mine Access Road	Environmental Dams	

DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018

Strategies to achieve rehabilitation goals for specific Project domains are provided in Table 11-3.

Table 11-3 Strategies to achieve rehabilitation goals based on individual domains

Goal				
Domain and component	Safe	Non-polluting	Stable landform	Sustains agreed landuse
Mine				
Open cut pits	Backfill to original ground level (or higher to allow for settlement) to the extent possible.	No residual water contained.	Settled, compacted and stabilised.	Return to condition consistent with conservation objectives, established offsets and biodiversity programs.
Waste Rock Stockpiles	Structurally safe to people and animals, hazardous material adequately treated or contained.	Runoff and seepage will be good quality water that is unlikely to affect known environmental values.	Place waste rock above natural surface with minimal slopes.	
Mine infrastructure	Minimise or avoid effects of hazardous materials used onsite by restricting use to contained facilities which are effectively managed with waste removed as required.	After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values. Remediate any residual contamination so that runoff and seepage will not have unacceptable effects on known environmental values.	Remove infrastructure, re-shape disturbed areas to resemble surrounding landscape and establish adequate vegetation cover.	
Water Infrastructure (environmental dams, water supply dams, sediment controls)	Remove hazardous materials.	After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values.	Allow continued use of permanent infrastructure that is stable or is managed under a maintenance program or removal depending on landholder.	
Haul Road				
Road, road furniture, drains, and cut and fill	Removal of all above ground infrastructure. No hazardous structures or chemicals used.	After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values.	Remove infrastructure, reshape disturbed areas to resemble surrounding landscape and establish adequate vegetation cover.	Return to condition consistent with conservation objectives, established offsets and biodiversity programs.
Dam 4	Remove hazardous materials.	After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values.	Allow continued use of permanent infrastructure that is stable or is managed under a maintenance program or removal depending on landholder.	

Goal				
Domain and component	Safe	Non-polluting	Stable landform	Sustains agreed landuse
Train Loadout Facility				
Rail, stockpile, dams	Removal of all above ground infrastructure unless landholder or other project procures site for ongoing use and operation.	Remediate contamination so that runoff and seepage will not have unacceptable effects on known environmental values.	Allow continued use of permanent infrastructure that is stable or is managed under a maintenance program	Return to condition consistent with conservation objectives, established offsets and biodiversity programs.

11.9 Geochemical Analysis of Mineral Waste Material

This section provides the results of the analysis of mineral waste material associated with the Project; the full assessment is at Chapter 8 – Waste Rock and Rejects. The characterisation of the overburden, interburden and CHPP waste streams is based on the analysis and results of the testing carried out by RGS Environmental. The confidence in the geo-statistical classification of the overburden, interburden and CHPP waste streams will be increased through further exploration resource definition drilling, sampling and analyses. This information will be gathered in parallel with the Project's operations to inform mine operations and environmental management. This approach will enable management of acid or saline waste during mining operations, rather than at the final rehabilitation and mine closure.

11.9.1 Acid Generation Potential

The characterisation of the waste rock was undertaken by RGS Environmental in accordance with the Assessment and Management of Acid Drainage Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995) and other applicable best practice guidelines. Rock samples underwent Acid Base Accounting (ABA) assessment, allowing sampled geologies to be classified into non-acid forming (NAF), PAF and uncertain categories. The results of this classification process inferred to have been adopted by RGS Environmental (from NAPP data) are summarised in Table 11-4.

Table 11-4 Geochemical classification of materials to be mined

Category	Total S	S _{cr}	NAPP value	ANC/MPA
Potentially Acid Forming (PAF)	-	-	>10 kg H ₂ SO ₄ /T	<2
Potentially Acid Forming – Low Capacity (PAF-LC)	-	> 0.2%	0 to 10 kg H ₂ SO ₄ /T	-
Uncertain	-	-	-10 to 10 kg H ₂ SO ₄ /T	<2
Non-acid Forming (NAF) (options)	-	≤ 0.2%	-	> 2
		-	< -10 kg H ₂ SO ₄ /T	> 3
Non-acid Forming (NAF) (Barren)	≤ 0.1%	-	-	-

Source: inferred based on RGS Environmental, 2012

Classifications of composite samples, based on average NAPP values, are presented in Chapter 8 – Waste Rock and Rejects, Table 8-6 Geochemical composite sample descriptions. Overall, the risk of acid generation from waste rock and coal reject materials is low, with over 98% of samples analysed classified as NAF (from RGS Environmental, 2012). Statistical evaluation of the ABA classification of waste rock and coal reject materials is presented in Table 11-5 and Table 11-6 respectively.

Table 11-5 Statistical evaluation of ABA of waste rock materials tested

Parameter	pH	EC	Total S	S _{Cr}	MPA	ANC	NAPP	ANC/MPA
	Units	mS/cm	%		kg H ₂ SO ₄ /T			
Minimum	4.8	106.0	0.0	0.0	0.2	5.3	-389.7	0.2
Maximum	10.2	2780.0	8.2	7.6	233.4	390.0	197.2	1273.5
Mean	9.8	612.3	0.2	0.3	3.7	53.7	-50.0	122.5
Median	9.9	612.0	0.0	0.1	0.9	39.8	-38.2	34.0

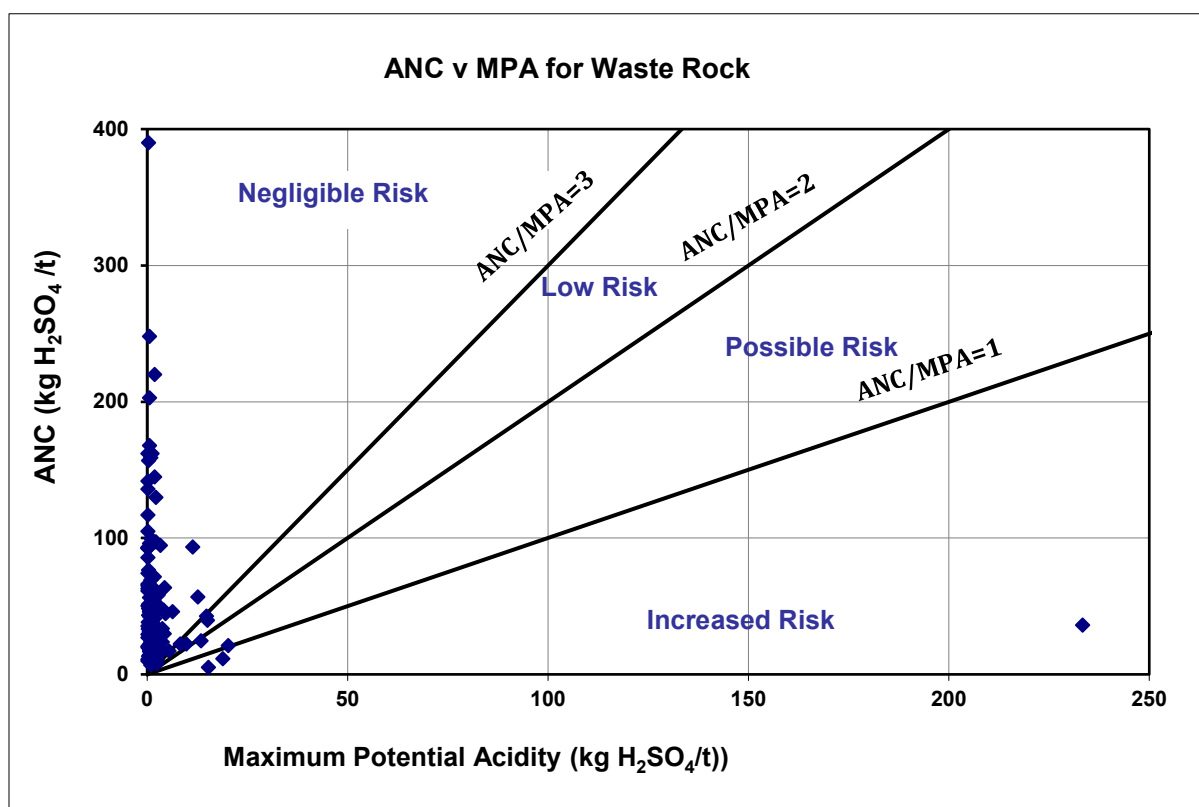
Source: based on RGS Environmental 2012

Table 11-6 Statistical evaluation of ABA of coal reject materials tested

Parameter	pH	EC	Total S	S _{Cr}	MPA	ANC	NAPP	ANC/MPA
	units	mS/cm	%		kg H ₂ SO ₄ /T			
Minimum	8.8	326.0	0.0	0.1	0.2	10.0	-319.1	0.9
Maximum	10.1	768.0	0.7	0.6	18.2	320.0	1.4	348.3
Mean	9.5	538.6	0.1	0.2	2.5	40.3	-37.8	40.6
Median	9.6	510.0	0.1	0.1	1.7	20.1	-19.2	15.5

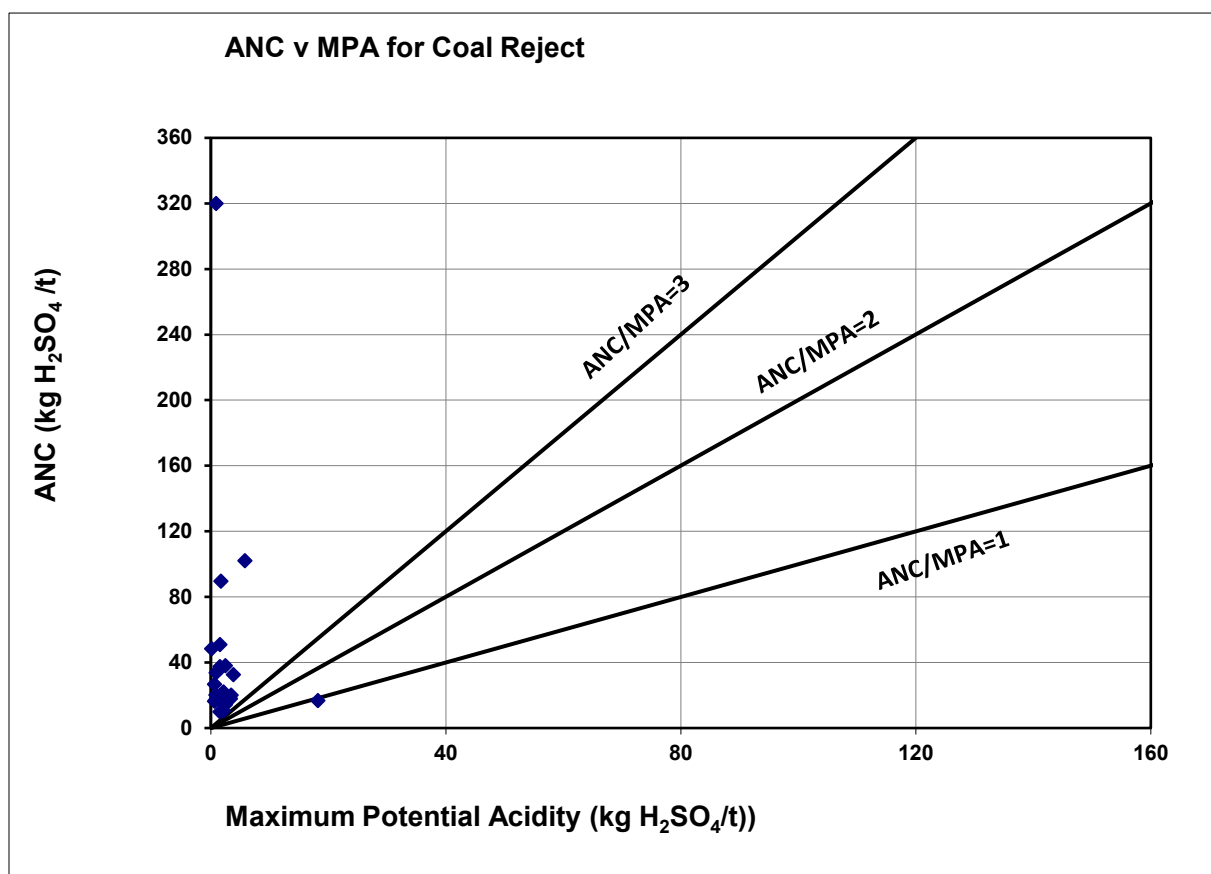
Source: based on RGS Environmental 2012

The mean NAPP values for waste rock and coal reject samples tested were -50.0 and -37.8 kg H₂SO₄/T, respectively, whilst the mean ANC / MPA ratios were 122.5 and 406.6, respectively; indicating NAF and “low risk” (ANC / MPA) acid forming characteristics (see Figure 11-5). The cumulative distribution of total sulphur (%S) in waste rock and coal reject samples containing ≤0.3% S was 93% and 96%, respectively (see Figure 11-6).



Source: RGS Environmental, 2012

Figure 11-5 Acid-base account - waste rock



Source: RGS Environmental, 2012

Figure 11-6 Acid-base account - coal reject samples

11.9.2 Geochemical Characterisation

Geochemical characterisation was undertaken for 174 samples (including overburden and potential coal reject samples) from 15 bore holes covering a range of depths from 11.6 meters below ground level (mbgl) to 147 mbgl in various lithologies. The majority of samples were classifiable as non-acid forming (NAF). A total of four samples had positive Net Acid Production Potential (NAPP), two of which were classifiable as potentially acid forming (PAF; with ANC / MPA ratio <2 and NAPP >10 kg H₂SO₄/t), two as low capacity PAF (with Sulphide-sulphur (SCR) >0.2 % and NAPP between 0 and 10 kg H₂SO₄/t) and one sample was classified as uncertain (UC; with ANC / MPA ratio <2 and NAPP <0 kg H₂SO₄/t). A summary of the geochemical characterisation (for all 174 samples) is provided in Table 11-7. Although coal reject samples are likely to be treated separately (in terms of their handling / storage) they were considered together with overburden in the following summary to consider the risk of acid generation and potential trends for mine waste overall.

Table 11-7 Summary of geochemical characterisation

Borehole	No. of Samples	Depth Range	Max NAPP kg H ₂ SO ₄ /t	Lithology for Samples with Positive NAPP (and depth of sample)	Sample Classifications
STX083	10	12.1 -75	-9.8	-	100% Samples Non-acid forming
STX095	14	24.4 -79	-13.5	-	
STX099C	11	20.5 -69	-5.4	-	
STX101C	20	19.6 -73.7	-10.3	-	
STX103C	14	15.4 -71.2	-16.8	-	
STX104CR	4	30.2 -98.1	-33.4	-	
STX105	10	26 -69.2	-12.6	-	
STX122C	11	22 -75.1	-8.3	-	

Borehole	No. of Samples	Depth Range	Max NAPP kg H ₂ SO ₄ /t	Lithology for Samples with Positive NAPP (and depth of sample)	Sample Classifications
STX124	11	23.6 -76.2	-26.7	-	
STX134C	11	23.2 -78.1	-10.6	-	
STX135C	10	11.6 -70.4	-10.8	-	
STX136C	11	14 -74.6	214.3	Sandstone (Pyritic) (20.35 – 20.6 m)	91% Non-acid forming and 9% potentially acid forming
STX139C	9	33.9 -72.5	-15.4	-	100% Non-acid forming
STX145C	17	14 -128.6	4.3 9.3	Mudstone/Siltstone (64 – 64.5 m) and Siltstone (87.8 – 88.2 m)	94% Non-acid forming and 6% potentially acid forming
STX148C	11	59.6 -147	18.9	Sandstone (Pyritic)	79% Non-acid forming, 14% uncertain and 7% potentially acid forming (low capacity)

The only clear indicator for the presence of acid generating materials based on the geochemical data collected to date is the presence of pyritic materials amongst the samples. In terms of acid generation, the coal reject samples were similar (sulphur content and acid neutralisation capacity) to overburden samples (one sample was identified as having acid production potential > acid neutralising capacity).

The data distribution shows that the frequency of samples with sulphur content (acid generation capacity) in excess of its neutralising capacity is very low. The majority of samples had low total sulphur content with some neutralising capacity (generally greater than its acid production potential) (refer to Figure 11-7).

Overall, approximately 98 % of mining waste materials tested were classifiable as non-acid forming. Whilst some material may occur with uncertain or potentially acid forming characteristics, the potentially acid forming materials appear to be visually distinguishable in the field (through the rare occurrence of pyrite). When pyritic materials are identified, it is recommended these materials are managed by selective handling and encapsulation.

A kinetic leach study was also undertaken to support the conclusion for low acid generation potential. Although no visual indicators were noted for presence of pyrite the oxidation of composite materials showed no indication of acidification over the study period. Previous experience has shown that when a small amount of acid generating materials is mixed with non-acid forming materials (with acid neutralisation potential), the net acid generation potential of the overall mixture may be effectively buffered.

Considering the above, the data collected to date is considered sufficient to support the conclusion that the risk of acid generation from waste rock is low.

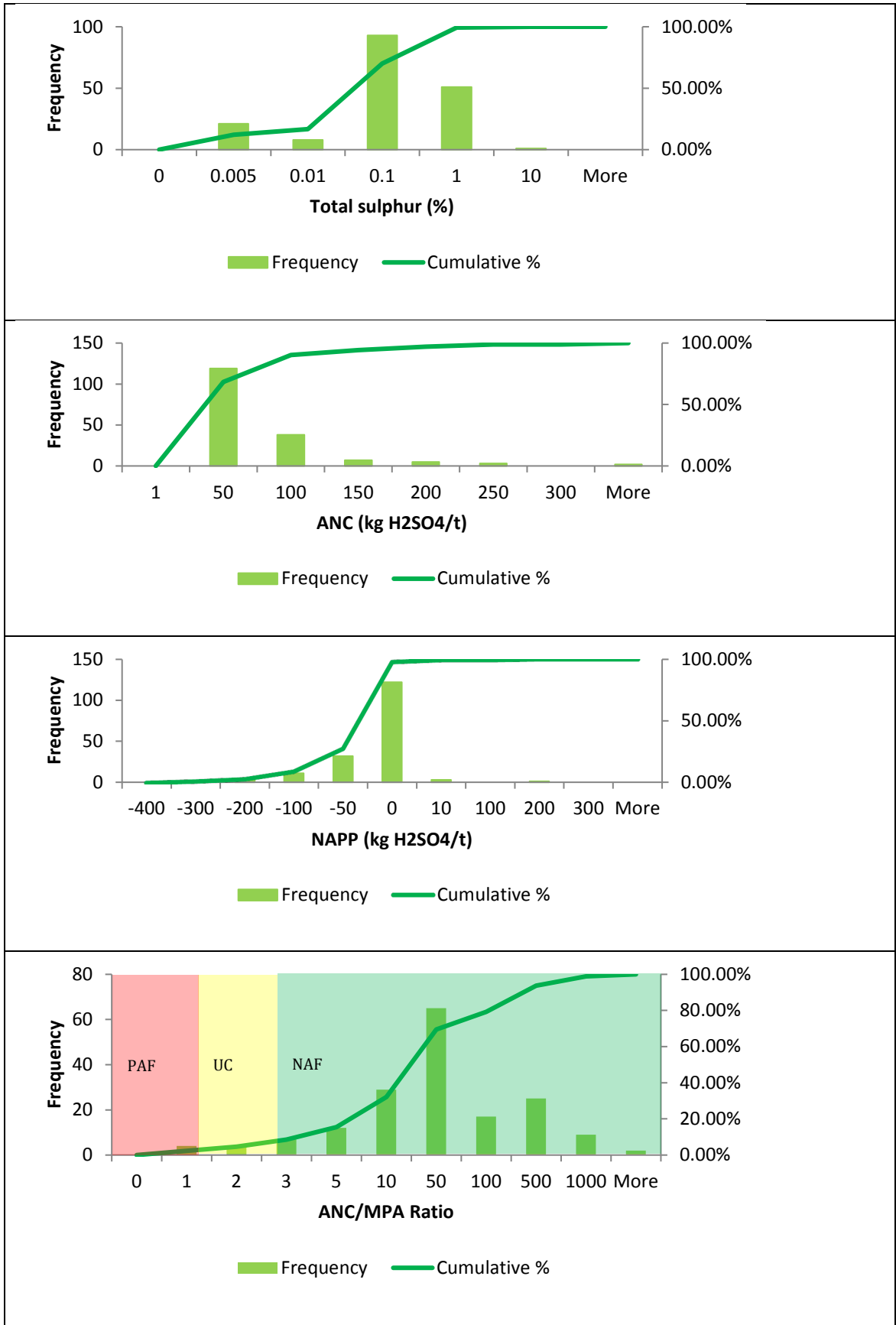


Figure 11-7 Geochemical data distribution

11.9.3 Multi-element Solid and Solutions (Leachate Potential)

A total of 15 composite samples were analysed by ALS (2018) for solid and solution concentrations of multi-elements to determine the level of risk associated with leachate generated from waste rock (12 composite samples) and coal rejects (three composite samples).

The concentrations of solid multi-element analyses were compared to the Health-based Investigation Levels for parks, recreation, open space and playing fields (“HIL(E)”) in the National Environment Protection (Assessment of Site Contamination) Measure (NEPM 2013) by RGS Environmental in 2012. The NEPM was revised and released in 2013 and as such, the results from RGS Environmental’s work has been compared to the equivalent criteria, HIL-C (Recreational C), and the Ecological Investigation Levels (EILs) from NEPM 2013, where relevant. The soil results have been compared with recreational use criteria as they reflect the likely post mining land use.

The concentration of multi-elements in composite samples was also compared to the average abundance of the element, based on Bowen (1979). The comparison methodology used the Global Abundance Index (GAI), with the following formula:

$$GAI = \text{Int} \left(\log_2 \left(\frac{\text{Measured Concentration}}{1.5 \times \text{Average Abundance}} \right) \right)$$

A zero or positive GAI value indicates enrichment of the element in the sample when compared to average-crustal abundances. The generally accepted methodology is that if a sample’s element has a GAI of 3 or higher, it signifies enrichment that warrants further evaluation. The actual enrichment ranges for the GAI values are as follows (from GARD Guide):

- GAI=0 represents <3 times median soil content;
- GAI=1 represents 3 to 6 times median soil content;
- GAI=2 represents 6 to 12 times median soil content;
- GAI=3 represents 12 to 24 times median soil content;
- GAI=4 represents 24 to 48 times median soil content;
- GAI=5 represents 48 to 96 times median soil content; and
- GAI=6 represents more than 96 times median soil content.

Of the fifteen composite samples analysed, one sample (2, carbonaceous mudstone) revealed GAI values of 0 (iron, manganese) and 1 (arsenic, zinc). All remaining samples and elements revealed GAI values less than 0, whilst all concentrations of elements analysed were below the HIL-C and EILs (NEPM 2013).

The leachate analysis results of the fifteen composite samples undertaken by RGS Environmental were compared to the following assessment criteria:

- ANZECC / ARMCANZ 2000 Trigger Values for slightly to moderately disturbed aquatic ecosystems (95% level of protection);
- ANZECC / ARMCANZ 2000 Primary Industries (Irrigation) and General Water Use, Long Term Trigger Values; and
- ANZECC / ARMCANZ 2000 Primary Industries Livestock Drinking Water Quality.

Concentrations of major ions, metals and metalloids were either below the analytical limits of reporting (LoR) and / or the assessment criteria in most composite samples, except for those parameters listed in Table 11-8.

Table 11-8 Composite waste rock and coal reject solution results greater than criteria

Parameter	95% protection of freshwater	Long-term trigger values for irrigation and general water use	Stock watering
Al	X		
As	X		
Mo		X	
Se	X	X	X
V	X		

These exceedances were generally marginally greater than the laboratory LoR and within an order of magnitude of the LoR. Concentrations of dissolved aluminium (Al), arsenic (As), molybdenum (Mo), selenium (Se) and vanadium (V) in the six KLC samples were consistent with the multi-element solution concentrations from the 15 composite waste rock and potential coal reject samples (RGS, 2012). Over the seven leach events, the concentrations of dissolved elements, in addition to parameters such as pH, SO_4^{2-} , EC and alkalinity, were broadly consistent.

The KLC results indicate that leachate from waste rock and coal reject materials may contain elevated concentrations of dissolved As, Mo, Se and V when compared to potential water quality monitoring criteria and this should be considered in regard to leachate / drainage management options and risk assessments regarding the waste rock stockpiles. Selenium reached a maximum leachate concentration of 0.09 mg/L which is more than four times the ANZECC stock watering guideline value. It should be noted that elevated As, Mo, Se and V concentrations in coal mine waste leachates are encountered in other coal deposits and projects in Queensland. The KLC testing was conducted over a period of twelve weeks, and therefore these results do not provide reliable information on the longer-term leachate characteristics of the tested materials. Concentrations of Mo and Se in the solid composite samples were below the laboratory limit of reporting, whilst the solid concentrations of As and V were below the EILs (NEPM 2013) and had GAI values of 0 (<3 times the median soil value).

Metal / metalloid concentrations in water extracts (RGS, 2012) were generally consistent across composition samples and therefore likely consistent with existing concentrations within the regional geology and associated aquifer. The concentrations are within the same order of magnitude as the assessment criteria. The waste rock was classified as acid consuming and likely to remain pH neutral to alkaline following excavation. Therefore, dissolution of heavy metals in an acidic environment is unlikely.

11.9.4 Saline and Sodic Drainage Potential

The characterisation of the waste rock was undertaken in accordance with the Assessment and Management of Saline and Sodic Waste Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995). Salinity and sodicity affect the erodibility of mining waste, with salinity generally suppressing the degree of dispersion and sodicity increasing the likelihood of clay dispersion when wet. Sodic waste can also have extremely low permeability, impeded drainage, hard-set when dry and have potential for tunnel erosion.

Composite waste rock and potential coal reject samples were analysed and classified in accordance with the indicative criteria (Table 11-9) for saline and sodic material summarised in Table 11-10.

Table 11-9 Indicative saline and sodic material

Parameter	Very low	Low	Medium	High	Very high
pH (1:5)	<4.5	4.5-5.5	5.5-7.0	7.0-9.0	>9.0
Electrical conductivity (EC) (dSm ⁻¹) (1:5)	<0.15	0.15-0.45	0.45-0.9	0.9-2.0	>2.0
Electrical conductivity (dSm ⁻¹) (saturation extract)	<2	2-4	4-8	8-16	>16
Chloride (ppm)	<100	100-300	300-600	600-2000	>2000
Exchangeable Sodium Percentage ESP (%)	<2	2-6	6-12	12-20	>20
Cation Exchange Capacity (CEC) (meq/100g)	<6*	6-12	12-25	25-40	>40
Calcium /Magnesium Ratio (Ca:Ma ratio)	<1	1-2	2-5	>5	

Source: DME 1995

Table 11-10 Saline and sodic drainage potential results

Parameter	Composite Sample														
	Overburden												Potential Coal Reject		
	1	2	4	5	6	7	9	10	11	12	13	14	3	8	15
pH (1:5)	9.6	9.8	9.9	9.8	9.6	9.9	9.9	10.0	9.6	8.6	10.0	9.0	9.2	9.5	9.8
EC (dSm ⁻¹) (1:5)	0.63	0.65	0.66	0.57	0.64	0.53	0.61	0.61	0.55	0.65	0.56	0.42	0.51	0.59	0.55
ESP (%)	34.6	39.5	41.8	31.7	34.7	42.8	28.9	32.2	33.1	34.2	42.7	34.4	36.3	36.6	39.2
CEC (meq/100g)	69	80.2	78.7	58.4	70	61.8	75.4	72.9	67.4	76.1	65.5	55.2	57.9	74.5	70
Ca:Mg ratio	2.3	10.4	6.7	5.7	1.9	5.3	3.6	4.7	13.6	2.4	5.4	14.5	0.9	4.8	3.4
Salinity Classification	Medium														
Sodicity Classification	Very High														

Composite waste rock and potential coal reject samples were alkaline (greater than pH 7) displaying a very high pH (8.6 to 10.0 pH). The salinity (measured using EC) (1:5) of the samples was generally moderate (0.42 to 0.66 dS/m).

Sodicity of waste rock and coal reject composite samples, in the form of Exchangeable Sodium Potential (ESP: %), were very high (28.9% to 42.7%). Strongly sodic materials are likely to have structural stability problems related to potential dispersion. In addition to potential dispersion, sodic materials often have unbalanced nutrient ratios that can lead to macro-nutrient deficiencies. Hence, to promote vegetation growth during rehabilitation, the addition of fertilisers is often required.

11.9.5 Kinetic Leach Column Results

Interpretation of the (incomplete) KLC testing program results is based on data provided by RGS Environmental from the 2012 program. Charts of pH, EC, cumulative sulphate release rate, net alkalinity and residual ANC are presented in Figure 11-8 to Figure 11-12.

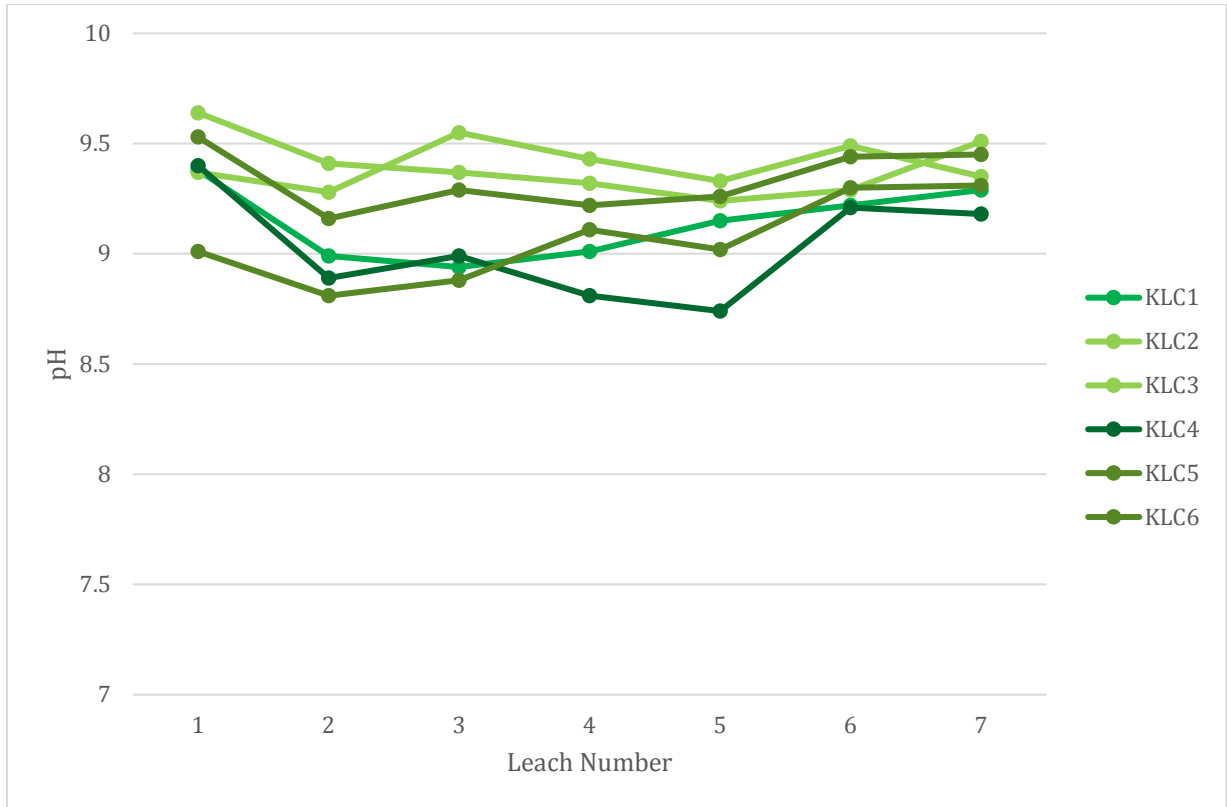


Figure 11-8 Kinetic leach columns – pH

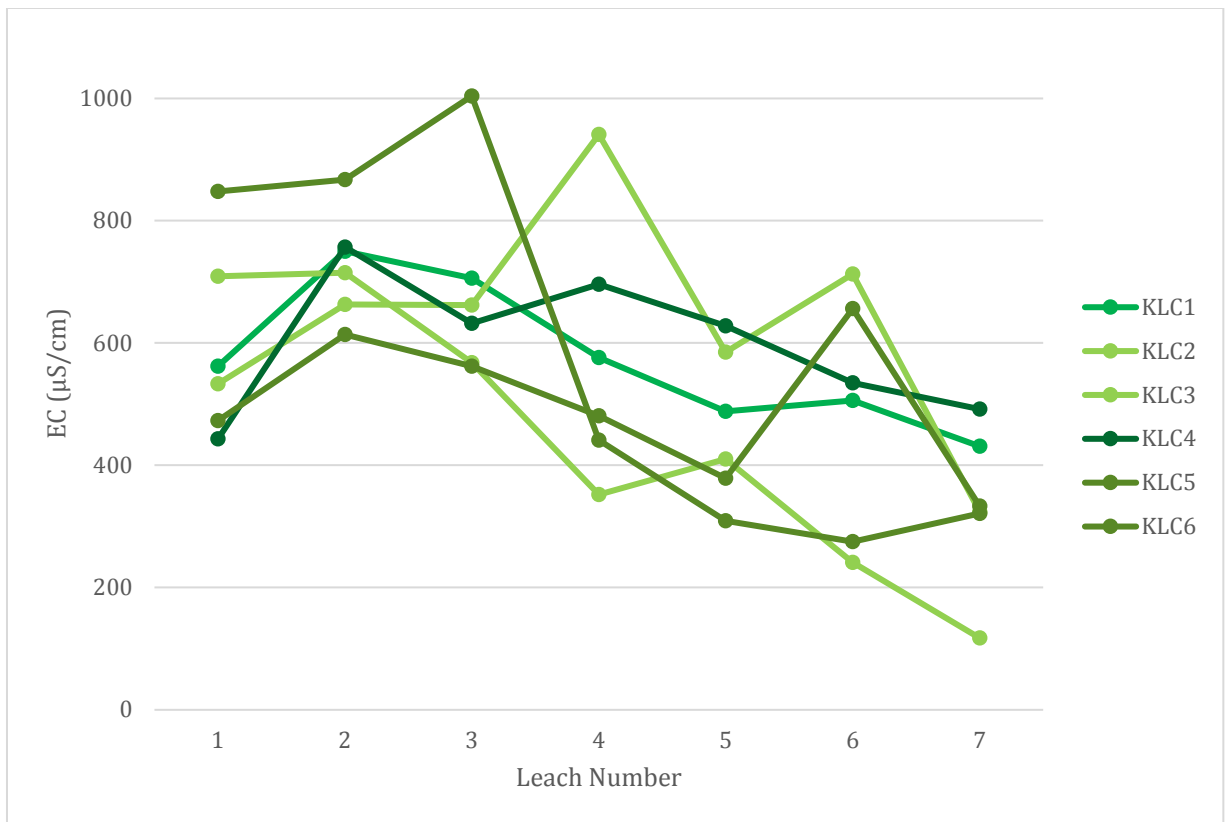


Figure 11-9 Kinetic leach columns - EC

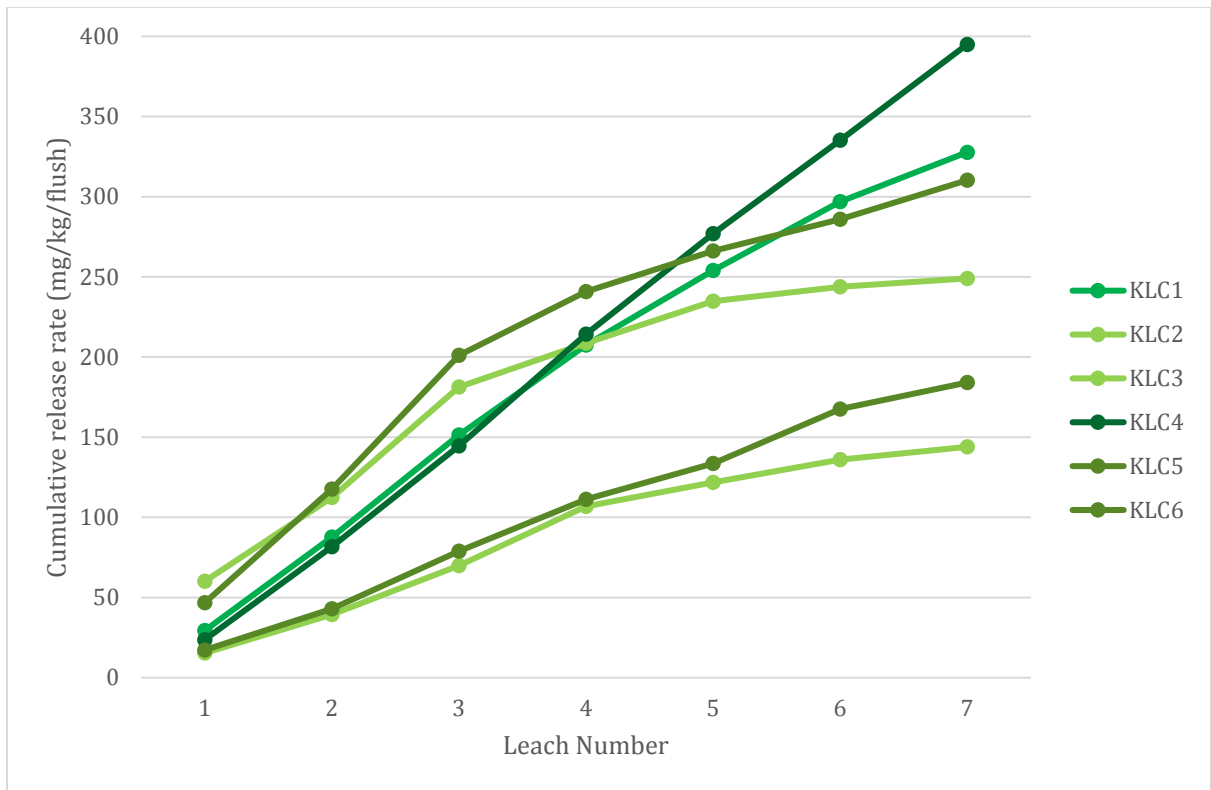


Figure 11-10 Kinetic leach columns - cumulative SO4 release rate

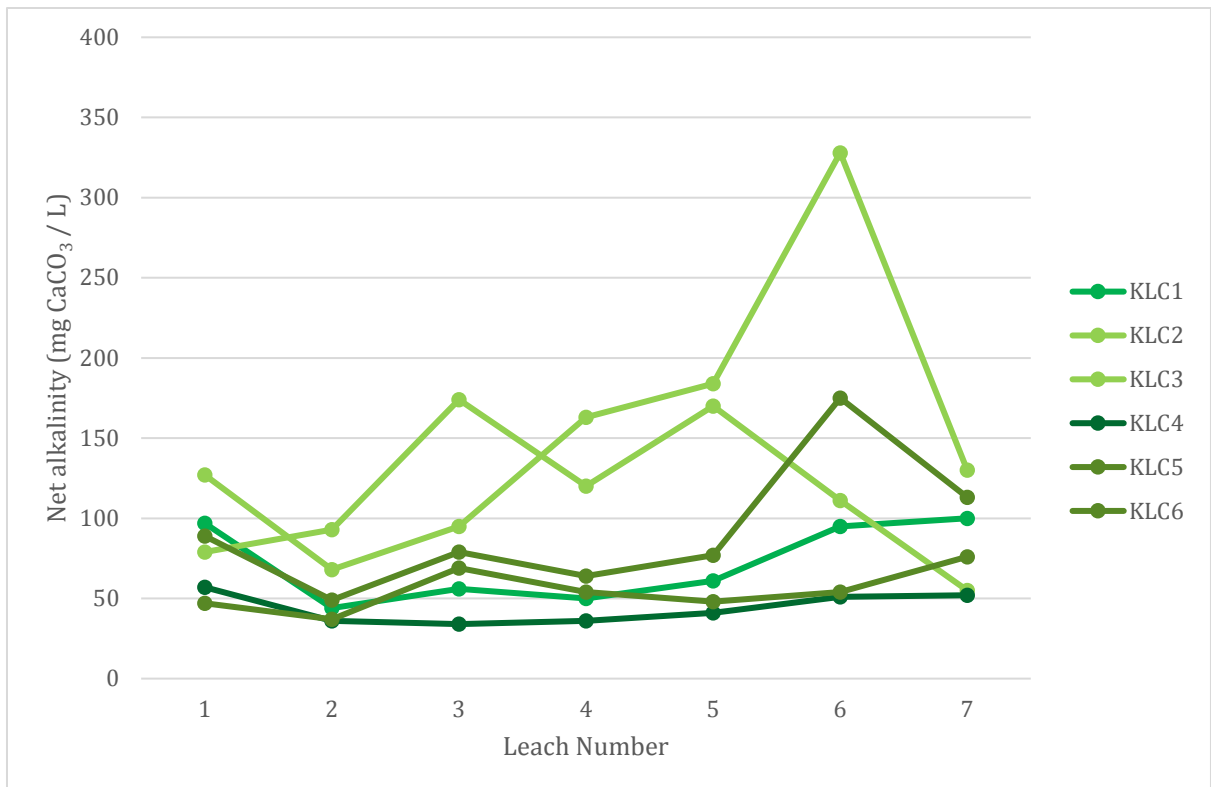


Figure 11-11 Kinetic leach columns - net alkalinity

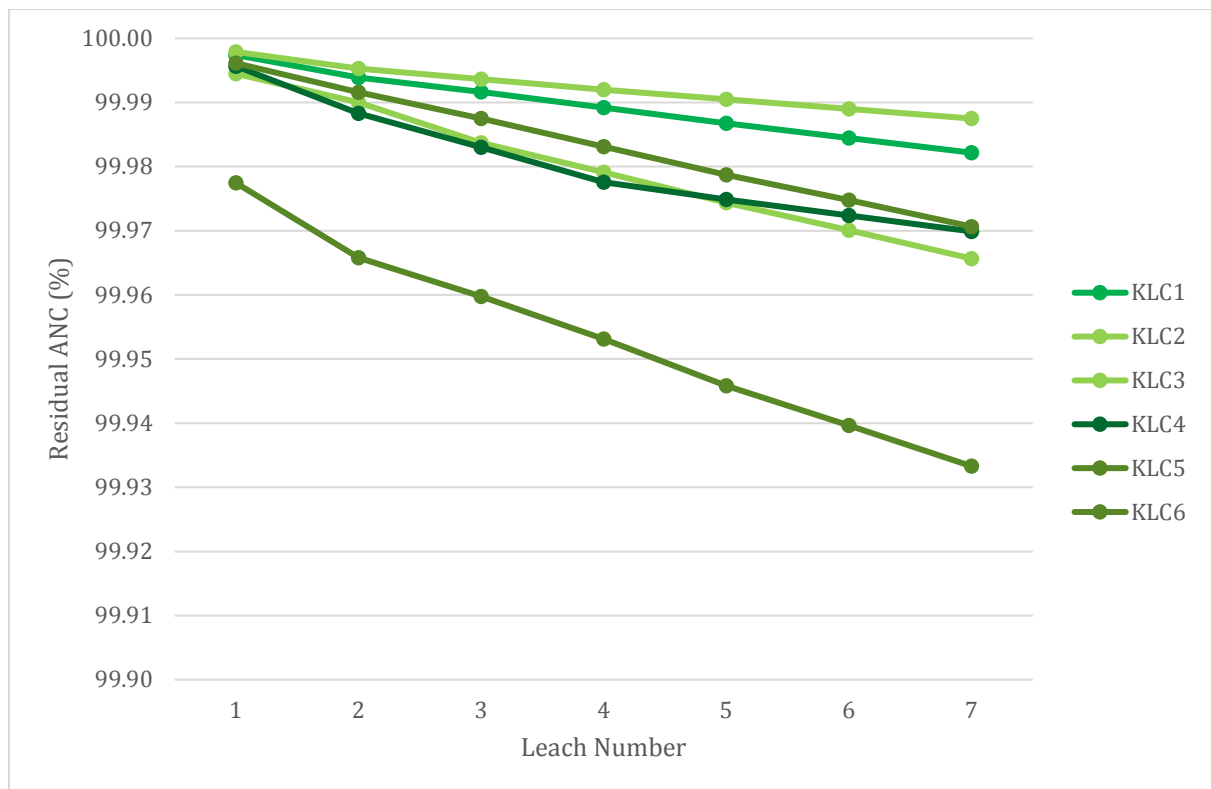


Figure 11-12 Kinetic leach columns - residual ANC

All six composite samples revealed consistent alkaline conditions over the recorded KLC testing period, with pH values at leach number 7 returning to the initial leach (1) pH value after an initial slight reduction.

The salinity (measured as EC) over the leach (flush) events was relatively stable over the testing period, with an overall broad decrease in EC values over time. Column samples KLC3 (overburden sandstone) and KLC6 (potential coal reject) demonstrated minor variation in measured EC values, though the overall trend was of decreasing salinity.

The net alkalinity and residual ANC charts indicate that the composite waste samples continue to produce alkalinity at or greater than the initial leach value; whilst the residual ANC values after the seventh leach event ranged from 99.94% to 99.99%, indicating the materials will continue to produce alkalinity (alkaline leachate) commensurate with the high average ANC of the static solid laboratory results.

The average sulphate generation rate and calculated sulphide oxidation rate (Bennett et al. 2000) for the six KLC composite samples is presented in Table 11-11. The sulphate generation rates of 1.01 to 3.99 mg SO₄/kg/week (correlating with oxidation rates ranging from 1.09 to 2.69 kg/O₂/m³/sec) are low, which correlates with the cumulative sulphate release and residual ANC rates, indicating neutral to alkaline leachate production with low acidity (Bennet et al. 2000).

Table 11-11 Average sulphate generation rate and sulphide oxidation rates for KLC composite samples

Sample	Lithology	Sample Type	Sulphate Generation Rate (mg SO ₄ / kg /week)	Oxidation Rate (kg/O ₂ /m ³ /s)
KLC1	Carbonaceous Mudstone	Overburden	3.54	2.39 x 10 ⁻¹¹
KLC2	Mudstone and Coal	Overburden	2.90	1.96 x 10 ⁻¹¹
KLC3	Sandstone	Overburden	1.01	1.09 x 10 ⁻¹¹
KLC4	Carbonaceous Siltstone and Coal	Overburden	3.99	2.69 x 10 ⁻¹¹
KLC5	Carbonaceous Mudstone (Roof and Floor) and Siltstone (Floor)	Potential Coal Reject	3.41	2.30 x 10 ⁻¹¹
KLC6	Mudstone (Roof and Floor)	Potential Coal Reject	1.99	1.35 x 10 ⁻¹¹

11.9.6 CHPP Fine Rejects Analysis

In addition to potential coal rejects, CHPP fine rejects were analysed by ALS (2018) in order to obtain a better understanding of the process waste stream composition and chemistry. Twenty-one process (pulp) samples were analysed for pH, NAPP, EC, NAG and composition (total sulfur and metals). The following sections provide a brief overview of the fines composition and chemistry.

EC and pH

The fine reject samples were alkaline with pH ranging from pH 9 - 10.1. There was no significant difference between the pH values of fine rejects and the samples from the various coal seams tested or the waste rock materials (refer to Figure 11-13).

Based on the DME criteria electrical conductivity of the fine reject samples ranged from very low to moderate (0.137 - 0.764 dS/m), with a median EC of 0.5 dS/m, with samples generally being low to moderately saline (refer to Figure 11-13). The fine rejects did not differ from other material types tested.

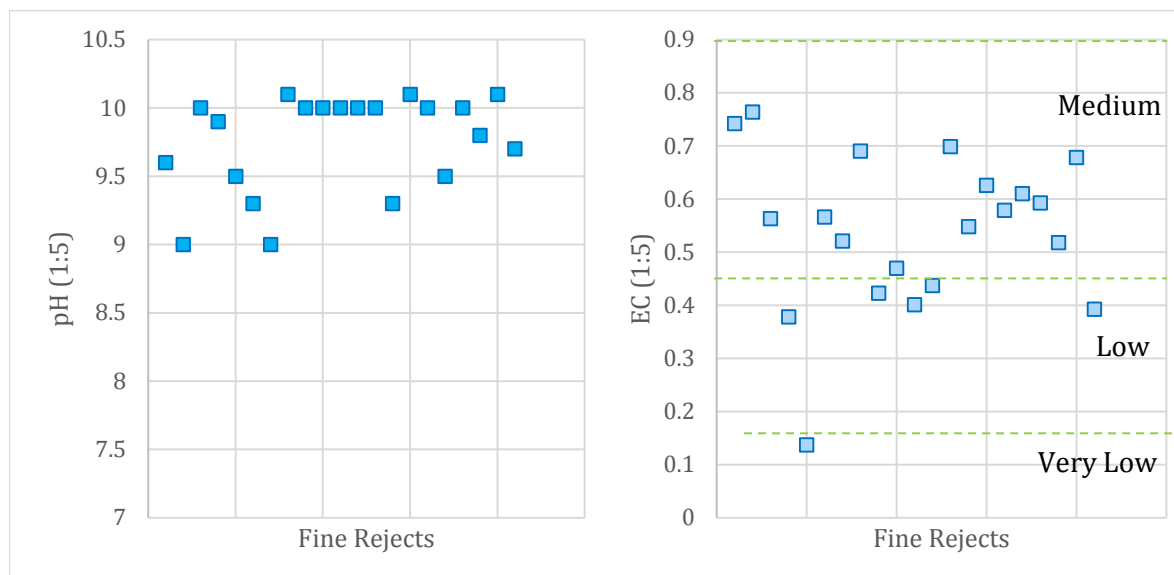


Figure 11-13 Fine Reject Analysis: pH and EC

Acidity

In general, the fine reject samples showed low acid production potential. Although some samples had slightly elevated total sulfur contents (up to 1.3%), all but one fine reject sample had net negative acid production potential (refer to Table 11-12). This is likely due to the high buffering capacity present in these materials; Figure 11-14 provides an overview of the acid base account for the fine rejects.

Table 11-12 Statistical evaluation of ABA of coal reject materials tested

Parameter	pH OX	EC	Total S	MPA	ANC	NAPP	ANC/MPA
	units	mS/cm	%	kg H ₂ SO ₄ /T			
Minimum	3.3	0.14	0.1	3.1	11.4	-322.7	0.73
Maximum	11.1	0.76	1.3	39.8	349	4.2	22.5
Mean	8.5	0.5	0.4	13.1	101.8	-88.7	7.5
Median	8.7	0.6	0.3	10.4	64.3	-51.4	5.6

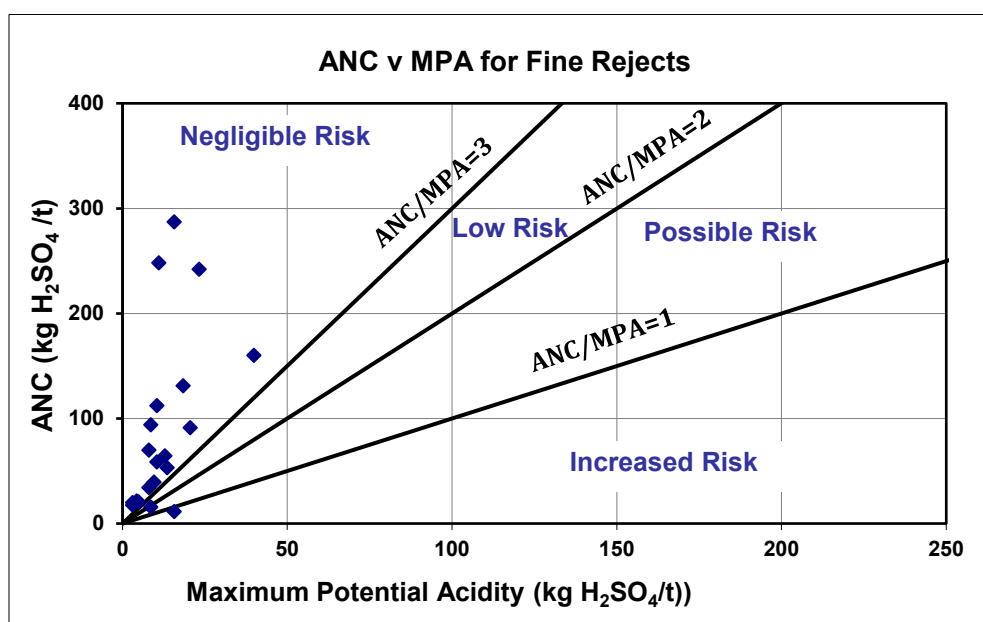


Figure 11-14 Acid-base account – fine rejects

Similar to the potential rejects and waste rock the fine rejects were largely classifiable as NAF with ANC/MPA ratios indicative of negligible risk (refer to Figure 11-14). The acid potential for the fine rejects (tested to date) can be summarised as follows:

- One sample was potentially acid forming (PAF-low capacity) (with NAPP 4.2 kg H₂SO₄/t);
- All other samples were non-acid forming (NAF) (most with relatively high buffering capacity); and
- Seven samples were acid consuming with acid neutralization capacity greater than 100 kg H₂SO₄/t.

Metals

The elemental composition of fine rejects was similar to the potential rejects and waste rock samples. Each component was below its respective HIL and EIL. Comparison to the GAI showed that

all elements except mercury were equal to or less than zero. This would suggest that metals do not concentrate as a result of processing.

No leachate analysis was conducted on the fine reject samples; however, it would be expected that leaching properties would remain similar to the untreated potential coal rejects and waste rock. Depending on the particle size distribution, the fine rejects may show a minor increase in leaching due to increased surface area. The leaching of metals and salts from fine rejects would be expected to decrease over time as long as the materials do not acidify (as seen in the kinetic leach results in Section 11.9.5).

11.10 Management of Mineral Waste Material Prior to Rehabilitation and Mine Closure

Mineral waste rock has the potential to impact on environmental values depending on the waste rock size and characteristics and how waste rock is managed during operations and rehabilitation. The waste rock is expected to have a low capacity to be potentially acid forming and moderate saline drainage potential. The waste rock has potential to be highly sodic. There is some potential for leachate from extracted waste rock and fine rejects to enter local waterways and degrade water quality. The leaching of mine water into waterways can result in negative impact on aquatic organisms, changes in water quality which can in turn affect water availability for humans, and livestock.

Sodic and highly sodic materials have potential to cause slaking, are dispersive, and tend to be highly erodible. Mine waste (overburden and interburden) materials, particularly those placed in-pit, will be appropriately shaped and monitored to create structurally and chemically suitable landforms (i.e. prevention of ponding of water on saline sodic soils) for successful rehabilitation.

Should AMD / SNMD enter groundwater then the following impacts may occur:

- Changes to the salinity of groundwater within the water table;
- Changes to pH of groundwater and the mobilisation of dissolved metals;
- Effects on stock watering and aquatic ecology dependent on shallow groundwater; and
- The salinity of rejects is expected to be low and the sodicity is variable. Surface salinity contents of exposed reject surfaces can increase by oxidation, capillary action and surface evaporation. No deleterious metal concentrations have been detected in tested coal samples.

Rainfall on the reject disposal areas is unlikely to cause any significant mobilisation of contaminants within the solid reject material given geochemistry of rejects.

The management measures for the potential impacts are discussed in the following sections.

11.10.1 Waste Rock Stockpiles Design and Disposal Method

The detailed design of the management of waste rock generated by the Project will account for:

- Climate, topography and location of sensitive receptors within the Project area i.e. Tooloombah Creek and Deep Creek;
- The geochemical characteristics of the waste rock and its variations across the mine;
- Expected water balance and water quality controls within the waste rock stockpiles;
- Measures that provide for safe operations;

- Compliance requirements of the Project's EA and minimum performance standards for the mining industry;
- Costs (in terms of net present value); and
- Facilitating progressive rehabilitation and optimising for mine closure outcomes.

Waste rock management will occur as part of the overall mine plan (the Plan of Operations). Accordingly, any changes to the Plan of Operations will also require review and, if necessary, updates to the Project-specific Mineral Waste Management Plan (MWMP). This will ensure that any staging requirements are adequately financed and timed to occur as part of site operations, rather than as two separate, unintegrated operations.

The proposed disposal method for waste rock is to initially truck rejects to an out-of-pit waste rock stockpile area during the development phase of each open cut. This area would be graded and compacted to ensure no internal pooling of water and to minimise the infiltration into soils within the disposal area. The cells will be bunded around its perimeter to capture and divert and water away from the cells and to contain water within it.

As operations progress through the open cuts, the area behind the working face will receive the waste rock where it will be permanently disposed of to fill the void. Any surplus material will remain in the waste rock stockpile areas. This provides an opportunity to minimise land disturbance by the Project and to provide a final landform at the end of the mine life. The siting of the waste rock stockpile areas has accounted for sensitive site receptors, surface and groundwater drainage impacts, proximity to the CHPPs and health and safety risks. These factors will continue to be considered during detailed design of the waste rock stockpiles.

The disposal of waste rock whether out-of-pit or in-pit will be designed in a manner that avoids and minimises the potential for the waste rock to cause environmental harm through erosion. Weathered rock (i.e. oxide zone) will be placed at the base of the waste rock stockpiles and capped beneath unweathered materials (i.e. interburden and overburden from transition or primary zones). This measure will cover the rock with most potential to disperse and reduce erosion impacts. Sourcing of material with low sodicity will be important for shaping and rehabilitating the out-of-pit waste rock stockpiles.

Thus, it is proposed that materials characterised and validated as non-dispersive and non-sodic are used for the outer slopes of waste rock stockpiles to limit dispersion and erosion, with identified sodic materials disposed of within the central (inner) zones of waste rock stockpiles. Surface runoff and seepage from waste rock stockpiles and any rehabilitated areas will be monitored for a standard suite of water monitoring parameters in accordance with the Project-specific MWMP. The locations of the proposed waste rock stockpiles are shown in Figure 11-15.

In terms of mine closure planning, this approach means that the waste rock used for the final landform covering should comprise material that has a relatively low salinity and low potential for dispersion. All spoil will be placed at angle of repose for geotechnical stability and will be further flattened prior to final rehabilitation. The waste rock is therefore not considered to pose significant management issues to the Project with respect to erosion, subject to the sourcing of suitable material for the outer layers of the waste rock stockpiles.

Where rock from the Project area is used in the construction of roads and hard-standing areas, for example, engineering and geotechnical testing will be undertaken to prior to their use to determine the propensity of the materials to erode given their potential sodicity. More sodic and dispersive materials will be identified and selectively handled.

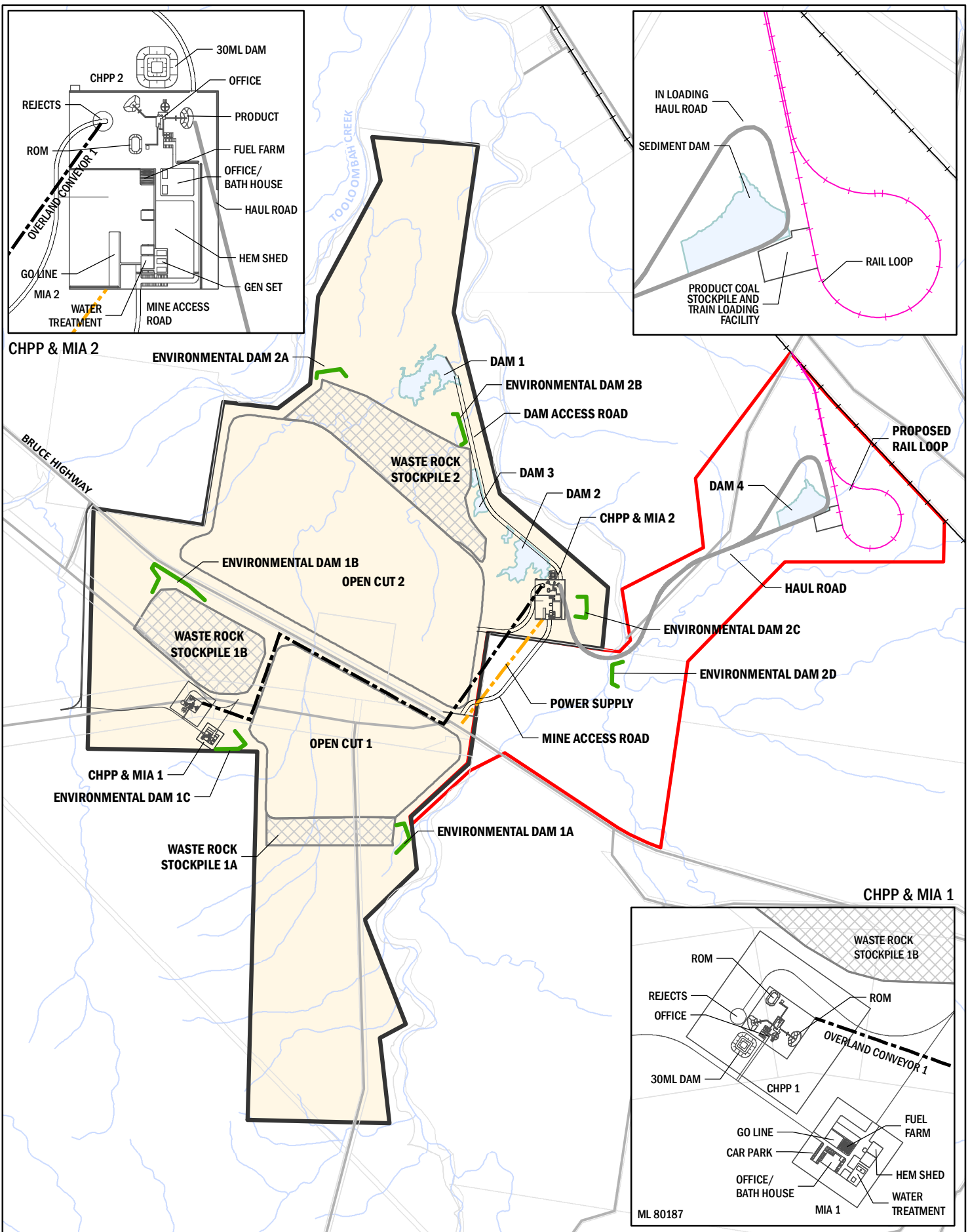


Figure 11-15
Project area layout



0 0.5 1 km

Scale @ A4 1:50,000
Date: 14/11/18
Drawn: Gayle B.

Legend

- | | | |
|---------------------|--------------------|-----------------------|
| Haul Road | ML 80187 | Main Road |
| Mine infrastructure | ML 700022 | North Coast Rail Line |
| Overland Conveyor | Cadastral boundary | Watercourse |
| Power | Open-cut Mine Pit | Dam |
| Rail Balloon Loop | Waste Rock Area | |
| Mine Access Road | Environmental Dams | |

DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018



11.10.2 Coarse and Fine Rejects Disposal Method and Containment

The management of coarse and fine rejects will follow the principles of waste rock management described above. It will also follow the management principles set out in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995). It should be noted that the majority of overburden is a valuable resource for rehabilitation of the mine, with only a very small portion of overburden having potential to generate acidic drainage. Rejects management will:

- Produce stable rejects that will be mixed with overburden and buried in-pit;
- Minimise disturbance to the environment by strategically and heavily diluting all rejects with overburden material in a centre location at the base of the out-of-pit waste rock stockpiles in the initial years of operation, prior to Steady State Mining and all rejects in the open cut mine void, after mining operations have reach Steady State; and
- Minimise risks to the environment through appropriate design and construction of rejects management facilities and waste rock stockpiles.

Dried coarse rejects and filter pressed rejects will be mixed with overburden waste and strategically placed within both the out-of-pit waste rock stockpiles and in the open cut mine void. All overburden will be characterised, and the benign material will be preferentially placed in the upper layers and on the surface of the waste rock stockpiles, ensuring the surface material contains a percentage of clay, prior to top soiling and seeding. If PAF or saline material is unavoidably placed near the surface of the waste rock stockpiles, this area will be capped with inert material prior to top soiling and seeding. The reject solids will be monitored to determine pH, EC, sulphur species and acid neutralising capacity (initially monthly) until geochemical trends have been established. Monitoring will then continue annually.

Waste rock pile embankments will be monitored for performance. This will ensure stability of the embankments during operations and embankment raising. Piezometers will be installed to check groundwater levels (see Chapter 10 – Groundwater regarding groundwater monitoring).

Survey monuments would be installed along each embankment of the waste rock stockpiles. These monuments would be surveyed on a regular basis to detect any embankment movements. The information derived from both piezometers and monuments will be used to assess the overall stability of the embankments.

A meteorological station is installed near at the site to monitor and record rainfall and evaporation data.

In terms of mine closure planning, this approach means that the waste rock used for the final landform covering should comprise material that has a relatively low salinity and low potential for dispersion.

11.10.3 Water and Fine Rejects

Fine rejects will be dewatered prior to their disposal using filter press technology to treat the rejects. The coal fraction of the rejects will be beneficiated using spirals with desliming cyclone overflow being pumped to the fine rejects thickener where flocculent will be added. The thickened fine rejects are then passed through a filter press where the moisture content is reduced to approximately 26%. A dry paste like material is produced and these pressed fine rejects are then discharged onto the rejects conveyor for disposal via the reject bin.

Haul trucks which offload coal at the ROM stockpiles, will be backloaded at the reject bin to transport rejects to the pit. A more detailed description is provided in Chapter 3 – Description of the Project.

Filtering fine rejects is not new and more mines are choosing the process to reduce water consumption, limit seepage from the fine rejects and build a stable stack not subject to slope failure or flow (Murphy and Caldwell, 2012). Within Australia, the Dartbrook Coal Mine (Bickert 2004) uses this membrane filter press technology as does Daunia, Bengalla, Maules Creek, Moolarben and Cavil Ridge. Several mines located overseas also use this technology including:

- Alamo Dorado and El Sauzal mines in Mexico;
- Greens Creek and Pogo mines in Alaska;
- La Coipa in Chile;
- Raglan in Canada;
- Coeur Manquiri mine in Boliva; and
- South African coal mines (Murphy and Caldwell, 2012).

Central Queensland Coal proposes to manage rejects through design measures that avoid the production of a fine rejects slurry stream and measures to achieve the reuse of the solids. This approach is consistent with the adopted waste management hierarchy (see EIS Chapter 7 – Waste Management). The proposed management of rejects further meets the objectives of the Tailings Management Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995). These objectives being:

- Filter press produces stable fine rejects which are rehabilitated within the landform;
- The process of creating a solid waste minimises and avoids additional disturbance required for traditional wet slurry disposal cells;
- It minimises the threats to the environment both during mining and after rehabilitation. Dry overburden integration and stacking minimises seepage, removing the risks of groundwater contamination. This waste management option has a higher operational cost; however, lower rehabilitation costs and avoids lengthy ongoing closure monitoring requirements of traditional tailings settlement ponds; and
- Adequate environmental protection is achieved through the minimisation of water consumption, as water is recovered and reused in processing. It also negates the need for storage structures and can provide for concurrent reclamation.

This process has considerable long-term economic, social and environmental benefits.

11.10.4 Waste Rock Management Plan

Waste rock and coarse and fine rejects generated during the extraction of the resource have the potential to impact upon the EVs if they are not appropriately managed. Management measures have been determined in response to these potential impacts and best reflect the requirements for land management throughout the construction, operation and rehabilitation phases of the Project.

The information contained in this section has been provided at a level of detail suitable for strategic planning. However, to make decisions about specific construction activities at the detailed planning phase, a higher intensity geochemical investigation will be undertaken due to the potential variation

in overburden and interburden geology within the proposed open cut mine areas. The information gathered from a higher intensity geochemical investigation will be used to inform the MWMP and continue throughout the life of the Project.

The MWMP will include, but not be limited to:

- Effective characterisation of the mining waste to predict, under the proposed placement and disposal strategy, the quality of run-off and seepage generated including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic inorganic substances;
- Mineral waste field and laboratory testing procedure for validation of the acid-forming and potential erodibility characterisations of each phase;
- Classifying waste rock zones (based on acid forming potential, salinity and sodicity), placement and use of waste rock materials and appropriate disposal of PAF waste or waste designated as not suitable for use on final surfaces (including potential PAF material identified during mining);
- Ex-situ waste rock stockpile design criteria, including preferred selective placement of each waste domain, stockpile heights, stockpile profiles, conceptual final landform design;
- Monitoring and management of erosion, groundwater and surface water (including run-off and seepage) at ex-situ waste landforms; and
- Progressive rehabilitation strategies, including a site wide hydro-geochemical model to assist with waste rock stockpile design, water management and closure planning.

11.11 Proposed Rehabilitation Strategy

EIS Section 11.9.1 stated the Post-Mining Completion Works Years 18 – 20 Program would include the rehabilitation of remaining voids. As there will no longer be any retained voids, an updated Post-Mining Completion Works Years 2036 – 2038 Program has been developed to reflect this.

As all voids will now be infilled, there is a change in the footprint of Waste Rock Stockpile 2 and Waste Rock Stockpile 1 (now Waste Rock Stockpile 1a and 1b). Consequently, the final landform discussion and figures at Section 11.11 have been updated to reflect these changes.

Modelling of the final rehabilitation landforms will be undertaken in developing the RMP or PRCP. This will include modelling potential risks of adverse impacts from any proposed retained water storages and retained levees or bunds. The RMP or PRCP will also consider potential for adverse impacts associated with flooding post mining operation, along with the long-term management of any AMD and / or saline drainage. The following sections provide an updated Progressive Rehabilitation Program which will be further developed in the RMP or PRCP.

11.11.1 Progressive Rehabilitation Program

Progressive rehabilitation will apply to the open cuts and waste rock stockpiles. The main features of the progressive rehabilitation process are:

- Constructing a stable land form for all disturbed areas;
- Topsoil spreading across available reshaped areas;
- Contour ripping immediately after topsoil placement to control erosion;
- Revegetation with an appropriate seed mix prior to the wet season; and
- Management of rainfall and runoff from the rehabilitated landform in sediment dams.

The proposed mine life is 20 years including the final rehabilitation and mine closure period. The indicative program for progressive rehabilitation is described below. Progressive rehabilitation will occur in accordance with the Plan of Operations, until the requirement to prepare a PRCP comes into force. The Plan of Operations will identify areas to be rehabilitated and refer to the RMP for specific rehabilitation details for each domain and desired post-rehabilitation land use. The proposed rehabilitation program is summarised below.

Construction - Infrastructure construction to commence in conjunction with mining the Box Cut. All works areas to be cleared and grubbed with disposal of vegetation. Topsoil to be stripped and separately stockpiled for future use. Primary sediment controls such as dams to be constructed in this phase.

Operational Years 2019 – 2037 – Waste rock stockpiles to be utilised initially during pit development for overburden and for coal rejects (filter press tailings – refer EIS Chapter 8 – Waste Rock and Rejects for further disposal details). Waste rock stockpiles will be reshaped and contoured, stabilised, topsoiled and seeded to minimise potential erosion. Reshaping and stabilisation of in-pit dumps will continue through operations. Progressive rehabilitation, including reshaping, topsoiling and seeding will be undertaken through the operational period.

Post-mining Completion Works Years 2037 – 2038 - All voids will be in-filled, shaped, topsoiled and seeded. Once voids are in-filled, remaining out of pit waste rock stockpiles will be rehabilitated. Mine infrastructure will be decommissioned and dismantled for removal from site with the individual locations rehabilitated accordingly. Dams and access roads will remain for future beneficial use or decommissioned. Rehabilitated areas will be monitored and if necessary, reworked to achieve the required completion criteria.

The aim of progressive rehabilitation is to minimise the amount of land disturbed at any one time. The indicative program for the progressive backfilling and rehabilitation of both open cut pits is shown as schematics in Figure 11-16 and Figure 11-17. The progressive rehabilitation and final landforms are shown in Figure 11-18 to Figure 11-22. These show rehabilitation at various stages, including ex-pit waste rock stockpiles and in-pit dumping where rehabilitation has been completed in 2021, 2027, 2036 and the final landform. The final landform of the rehabilitated pits and waste rock stockpiles lie outside the post mining 0.1% Average Exceedance Probability (AEP) flooding (Figure 11-23). Progressive rehabilitation will also include the rehabilitation of any areas disturbed during construction that are not required for ongoing operations.

The PRCP (or Plan of Operations) will include annual rehabilitation schedules and detailed rehabilitation design drawings. As the PRCP (or Plan of Operations) is updated, drawings showing rehabilitation progress, landform and proposed design contours, planned future rehabilitation schedules and operational budgets for rehabilitation activities will be included. Design drawings and contours will be developed using LiDAR data that has been captured for the site.

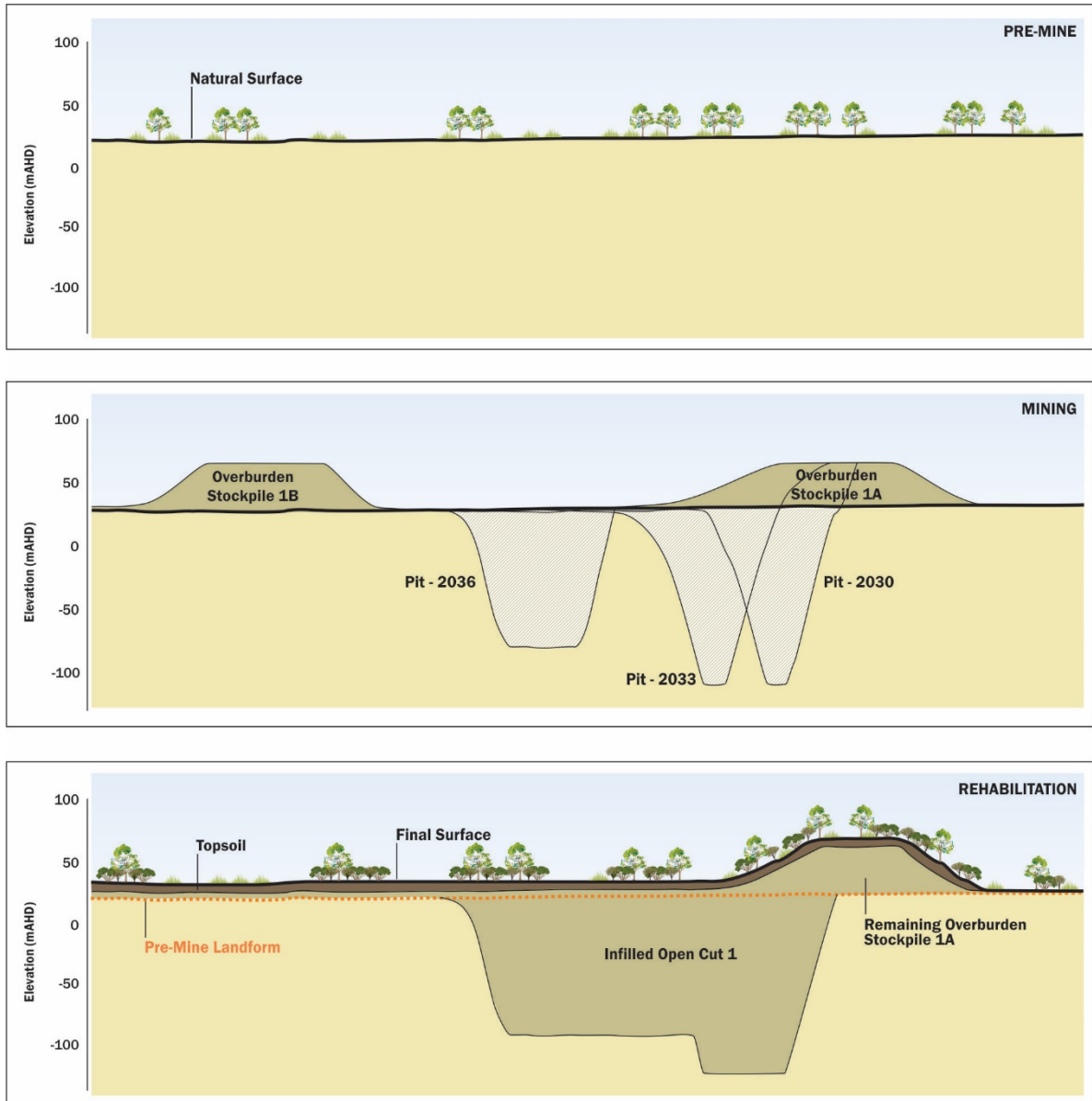


Figure 11-16 Indicative rehabilitation schematic Open Cut 1

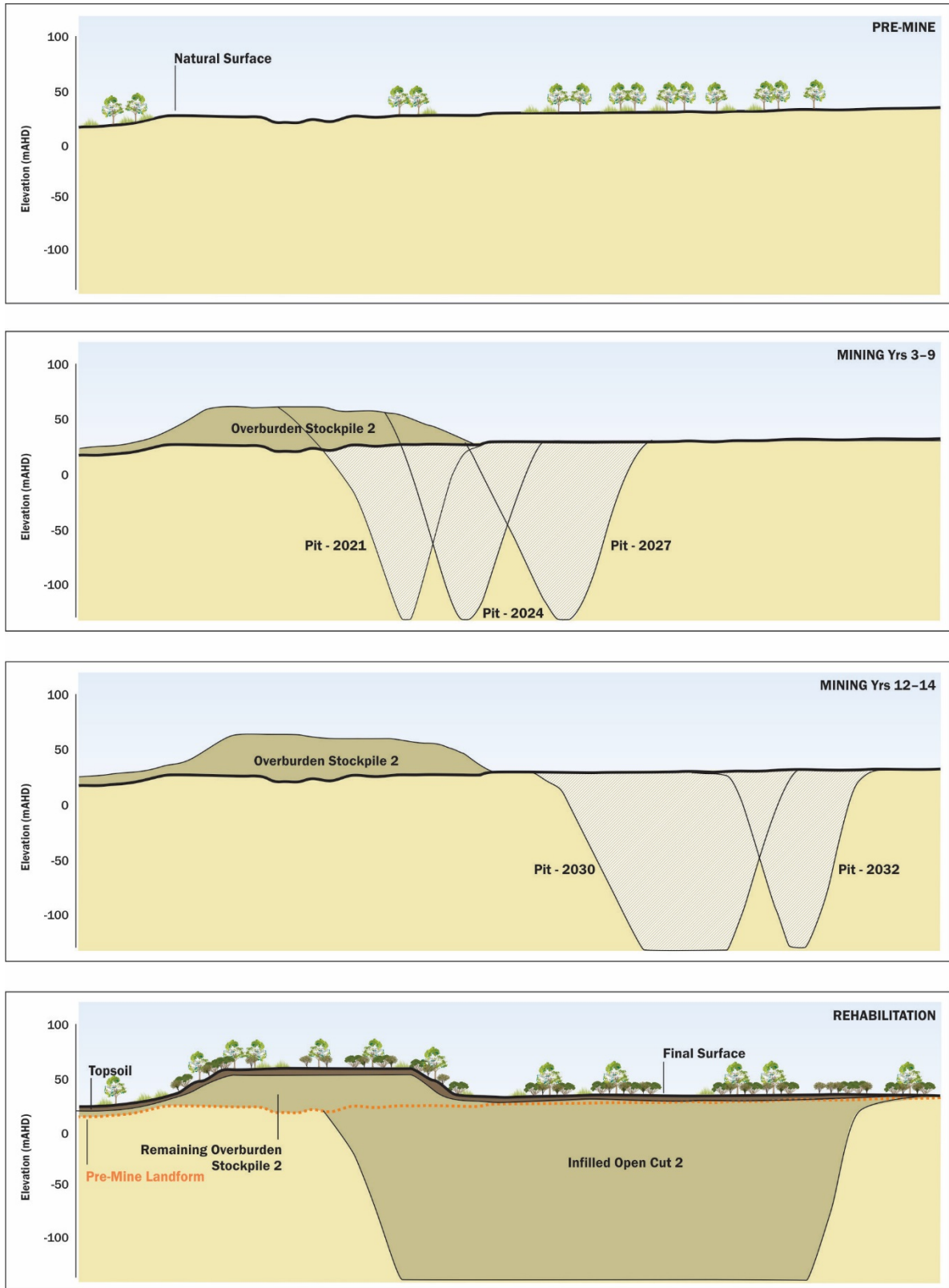
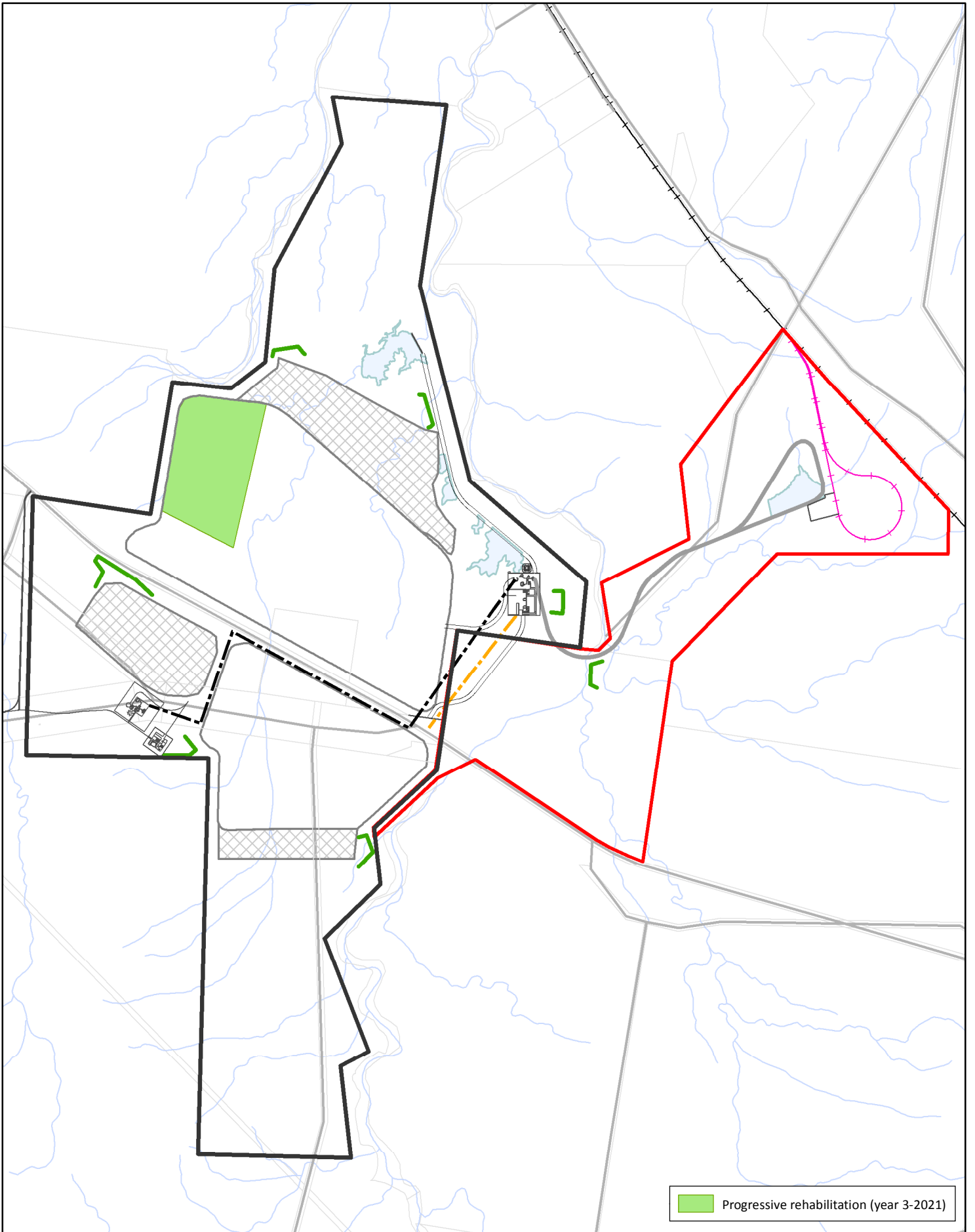


Figure 11-17 Indicative rehabilitation schematic Open Cut 2



Progressive rehabilitation (year 3-2021)

Figure 11-18
Progressive rehabilitation
(year 3–2021)

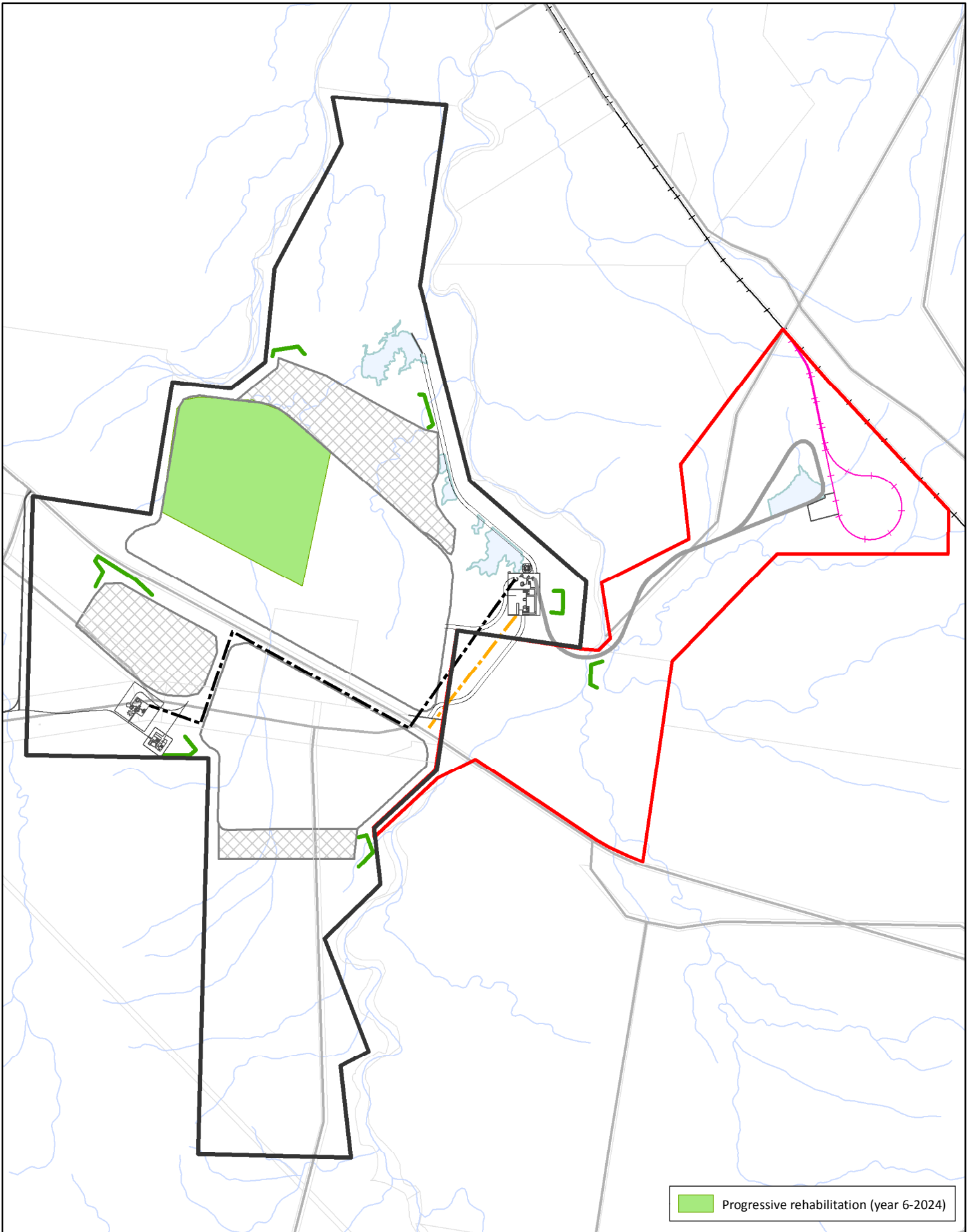


Scale @ A4 1:46,500
Date: 18/10/18
Drawn: Gayle B.

Legend

- | | | |
|-----------------------|----------------------|-------------------------|
| — Haul Road | — ML 80187 | — Main Road |
| — Mine infrastructure | — ML 700022 | — North Coast Rail Line |
| — Overland Conveyor | — Cadastral boundary | — Watercourse |
| — Power | — Open-cut Mine Pit | — Dam |
| — Rail Balloon Loop | — Waste Rock Area | |
| — Mine Access Road | — Environmental Dams | |


DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018



Progressive rehabilitation (year 6-2024)

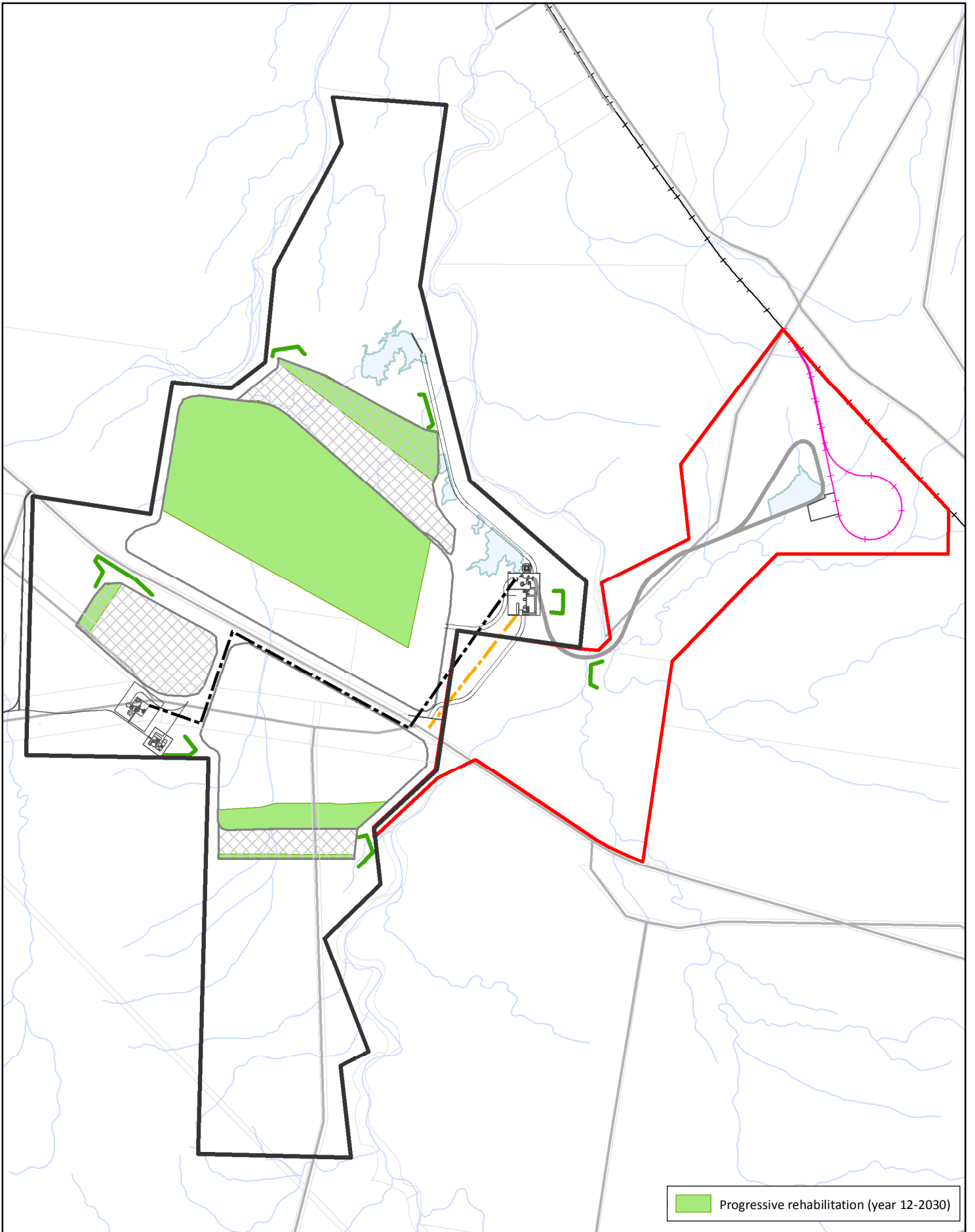
Figure 11-19
Progressive rehabilitation
(year 6–2024)




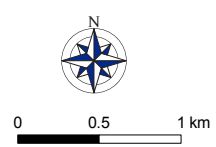

 Scale @ A4 1:46,500
 Date: 18/10/18
 Drawn: Gayle B.

- Legend**
- | | | |
|-------------------------|----------------------|-------------------------|
| — Haul Road | — ML 80187 | — Main Road |
| — Mine infrastructure | — ML 700022 | — North Coast Rail Line |
| - - - Overland Conveyor | □ Cadastral boundary | — Watercourse |
| - - - Power | □ Open-cut Mine Pit | □ Dam |
| — Rail Balloon Loop | ▨ Waste Rock Area | |
| — Mine Access Road | — Environmental Dams | |

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



 Progressive rehabilitation (year 12-2030)



Scale @ A4 1:46,500
 Date: 18/10/18
 Drawn: Gayle B.

Legend

















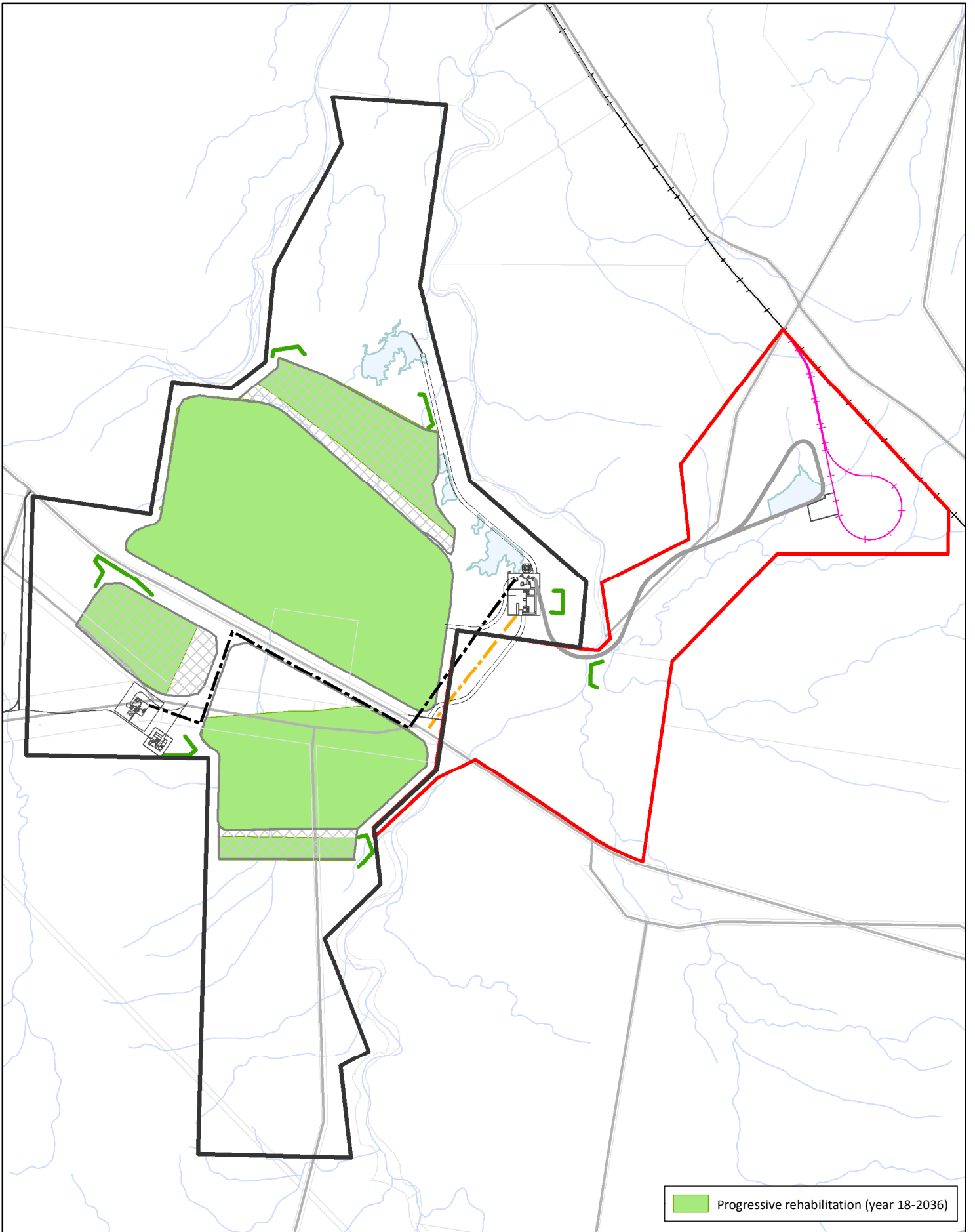
- | | | |
|---|--|---|
|  Haul Road |  ML 80187 |  Main Road |
|  Mine infrastructure |  ML 700022 |  North Coast Rail Line |
|  Overland Conveyor |  Cadastral boundary |  Watercourse |
|  Power |  Open-cut Mine Pit |  Dam |
|  Rail Balloon Loop |  Waste Rock Area | |
|  Mine Access Road |  Environmental Dams | |

Figure 11-20
 Progressive rehabilitation
 (year 12–2030)



DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018




















 Progressive rehabilitation (year 18-2036)

Figure 11-21
Progressive rehabilitation
(year 18–2036)



Scale @ A4 1:46,500
 Date: 18/10/18
 Drawn: Gayle B.

Legend

- | | | |
|---|--|---|
|  Haul Road |  ML 80187 |  Main Road |
|  Mine infrastructure |  ML 700022 |  North Coast Rail Line |
|  Overland Conveyor |  Cadastral boundary |  Watercourse |
|  Power |  Open-cut Mine Pit |  Dam |
|  Rail Balloon Loop |  Waste Rock Area | |
|  Mine Access Road |  Environmental Dams | |

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



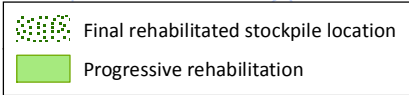
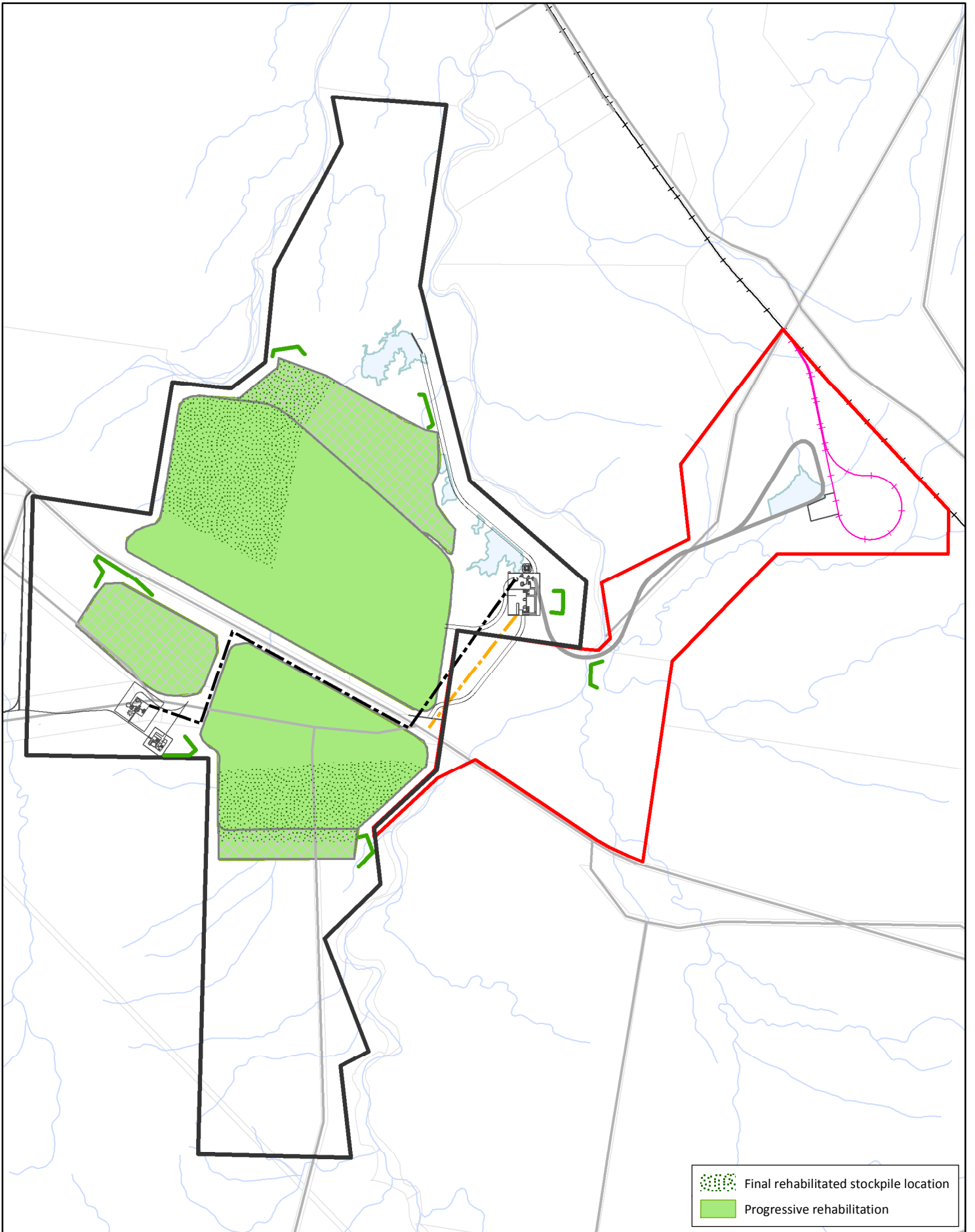
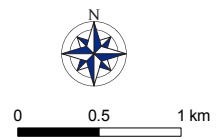


Figure 11-22
Progressive rehabilitation
(final landform)



Scale @ A4 1:46,500
Date: 31/10/18
Drawn: Gayle B.

Legend

- | | | |
|-----------------------|----------------------|-------------------------|
| — Haul Road | — ML 80187 | — Main Road |
| — Mine infrastructure | — ML 700022 | — North Coast Rail Line |
| — Overland Conveyor | — Cadastral boundary | — Watercourse |
| — Power | — Open-cut Mine Pit | — Dam |
| — Rail Balloon Loop | — Waste Rock Area | |
| — Mine Access Road | — Environmental Dams | |

DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018



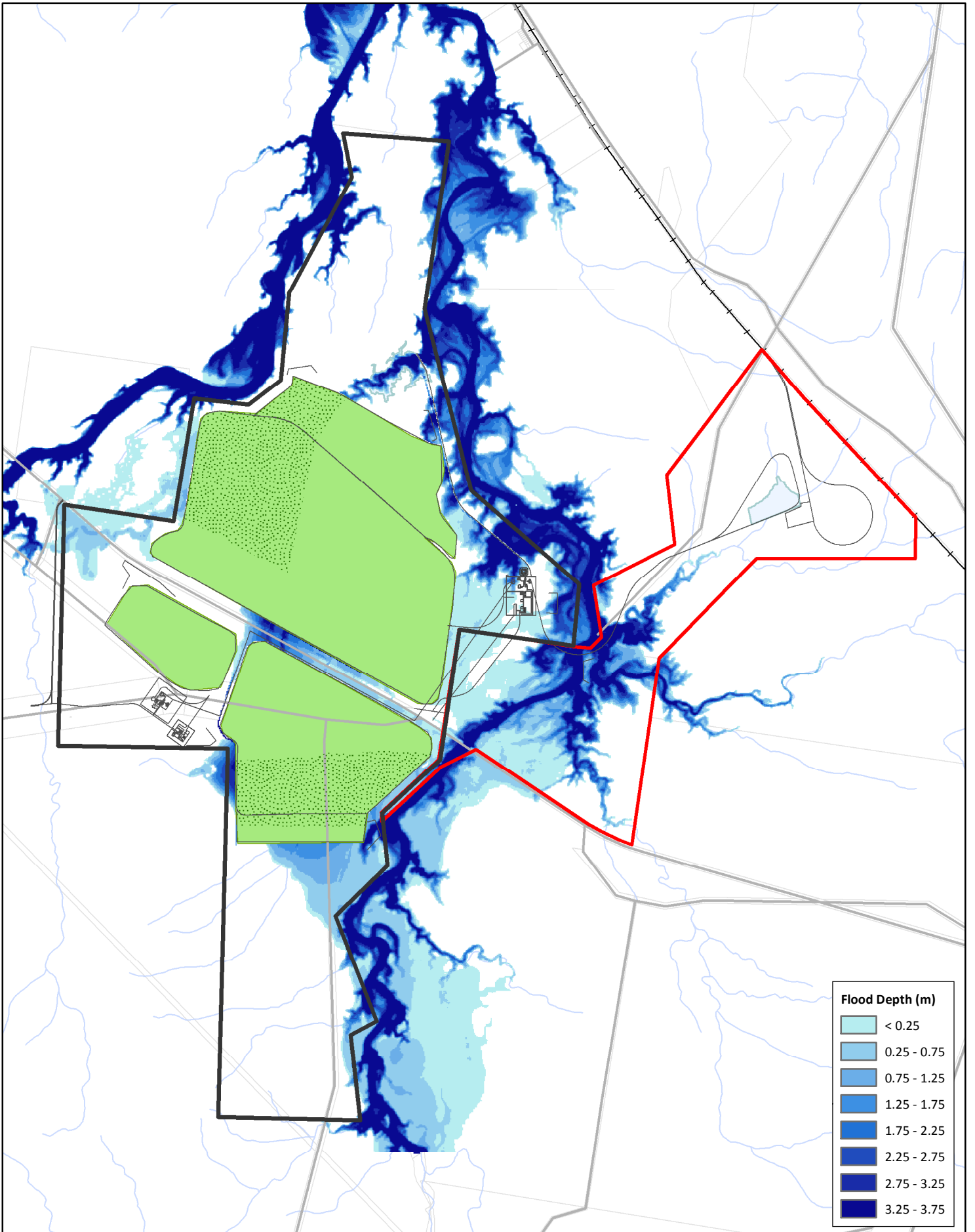













Figure 11-23
Flooding at 2038 final landform


 Scale @ A4 1:50,000
 Date: 14/11/18
 Drawn: Gayle B.

Legend

 Final rehabilitated stockpile location	 Cadastral boundary
 Progressive rehabilitation	 Main Road
 ML 80187	 North Coast Rail Line
 ML 700022	 Watercourse
 Mine infrastructure	 Dam

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



11.11.2 Landforming

The cumulative volume of excavated waste from open cut activities is expected to include approximately 745 Million bank cubic metres (Mbcm) consisting of waste rock, subsoils and fines from the CHPPs. As operations commence, waste rock from the open cuts will initially be stored in the ex-pit waste rock stockpiles. As mining in the open cuts progress, the excavated waste rock will be backfilled in-pit as part of the progressive rehabilitation. As such it is not anticipated that extensive rehabilitation will be required of the waste rock stockpile areas over and above re-seeding. This will; however, be assessed as mining progresses. All dry filter press tailings have final disposal within the pit.

Expired pit areas will have the reject waste and overburden returned and will be profiled to the final desired landform specifications. Topsoil will be replaced on the profiled landform at an appropriate thickness.

Before the topsoil is spread, the profiled landform will be scarified parallel to the contour to a nominal depth of 50 to 100 millimetres (mm) to break up any hard setting surfaces and prevent lamination of the topsoil and profiled landform. Dependant of the quantities originally recovered, topsoil will be spread to a nominal depth of between 100 to 150 mm where possible.

Where required, contour banks will be progressively installed to minimise rill erosion and direct water off the profiled landform to either a stable surface or dedicated stabilised drainage paths or flumes constructed on the final landform. The heights and depths of these contour banks will be determined through ongoing landform design. At the finalisation of this process a pre-vegetation landform will have been constructed. Finalised landforms will initially be sown with either a cover crop or perennial native vegetation. Areas intended for ongoing nature conservation will be over sown with non-invasive perennial grasses as an interim measure until the area becomes available for inclusion in the ongoing revegetation program.

11.11.3 Erosion and Sediment Control

The erosion potential for all permanent and temporary landforms associated with the Project will be assessed and will focus on erosion and stability effects for all disturbed areas, including areas disturbed or exposed during decommissioning and rehabilitation. The methods to prevent or control erosion will have regard to the long-term stability of the land, preventing soil loss and preventing the degradation of waterways.

Erosion and sediment control measures (see Chapter 5 – Land) will be like those applied during construction and during operations and will be outlined in the Project's Erosion and Sediment Control Plan (ESCP). The ESCP will be developed by a suitably qualified person in accordance with relevant legislation and guidelines. This will relate to the whole Project area and identify the risk of erosion and sedimentation within each area of the Project based on the soil type present.

Runoff from rehabilitated areas will collect in contour drains and collection drains, from where it will be directed to sediment dams and settling ponds to remove suspended sediment prior to draining from site. These drains and ponds will be maintained to ensure their proper functioning.

11.11.4 Soil Management

Significant surface disturbance will occur as a result of mining activities and will require the stripping of topsoil for reuse in rehabilitation programs. Sufficient topsoils will be stripped, handled and stored to prevent excessive soil deterioration. Specific recommendations for topsoil stripping depths for typical soil descriptions are summarised in Table 11-13.

Table 11-13 Soil stripping depth guidance

Soil Type	Topsoil Stripping Recommendation ¹ (mm)
Rocky sands and sandy loams	100
Ironstone sands and sandy loams	50 – 100 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth
Shallow red-yellow earths	30
Deep red – yellow earths	300
Shallow red – grey Texture Contrast (TC) soils	250 - 400 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth Subsoil salt levels may be elevated
Deep red – grey TC soils	100 - 350 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth Potential for high to extreme salinity below 1 m depth
Deep yellow – grey TC soils	100 - 300 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth Potential for medium salt levels at depth
Alluvial red TC soils	300
Alluvial yellow – grey TC soils	100 - 300 Detailed field validation will be undertaken before areas are stripped to determine the appropriate depth Potential for medium salt levels at depth

1. The recommended stripping depth includes suitable material from the surface layer and the underlying subsurface (if present) or subsoil

An inventory of available soils will be maintained to ensure adequate materials are available for planned rehabilitation activities. General soil management will include the following measures.

Topsoil Stripping

- Prior to stripping, all vegetation would be progressively cleared to the minimum extent required for the impending future works;
- Supervisors and earthmoving plant operators will be trained to visually identify the topsoil layers to ensure that stripping operations are conducted in accordance with stripping plans and *in situ* soil conditions; and
- 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.

Stockpiling

- Material that has been stockpiled for reuse will be protected from excessive disturbance or traffic, and stockpiled away from drainage lines;
- Drainage will be constructed to manage or divert surface water flows around stockpiles and maintained to ensure proper functioning;
- Topsoil stockpiles will be formed in low mounds with a height up to three metres and subsoil stockpiles up to six metres. Long-term stockpiles (present for greater than six months) will be deep ripped and provided with a vegetative cover to maintain the soil heath, maintain biological activity and minimise erosion potential. Stockpiled material will be constructed with batters or gradients of 1:4 wherever possible;
- Appropriate sediment controls will be installed to prevent soil loss; and
- Weed and pests will be monitored and controlled as required.

Respreading

- Prior to re-spreading, weed growth will be scalped from the top of the stockpiles, if required, to minimise the transport of weeds into rehabilitated areas;
- Any stockpiles that have evidence of any weed growth will be treated prior to the use in rehabilitation;
- Movement and handling from stockpiles to be conducted to minimise structural degradation such as compaction;
- Selective placement of more erodible soils on flatter areas as opposed to steeper slopes to minimise erosion potential;
- Respreading of soil in even layers at a thickness appropriate for the intended final land use;
- Avoidance of soil lamination through contour ripping to encourage soil keying, water infiltration and minimise runoff;
- Reseeding and revegetation as soon possible after respreading to establish vegetation cover;
- Installation of slope drainage control to limit slope lengths and runoff velocities; and
- Installation of collection drains and catch dams to collect runoff and remove suspended sediment.

Topsoil and spoil material will be tested prior to being used for rehabilitation. The results from soil testing will determine if any ameliorates are required to be added to topsoil and spoil material to achieve sustainable rehabilitation. The use of soil ameliorants is designed to prevent surface crusting, increase moisture and organic content, and buffer surface temperatures to improve germination. Vegetation which has been stockpiled as a result of clearing activities will be mulched on site and this will also be incorporated into the rehabilitation activities.

11.11.5 Revegetation

Revegetation activities will typically commence at the completion of land forming, such as, reshaping, re-topsoiling and drainage works. The timing of these works will ideally be scheduled to enable a preferred seasonal sowing of pasture or tree seed. Where surfaces have been prepared, the nominated revegetation specification for tree, shrub and pasture species, will be sown using seed stock or planted depending on the species, slope gradients and final land use. Rehabilitation will utilise locally relevant tree and shrub species at a density and richness consistent with the desired post-mine landform. Plant selection for areas to be returned to a bushland landform will be based on the following criteria:

- The species will successfully establish on the available growth medium;
- The species will bind the soil; and
- The species diversity will result in a variety of structure and food and habitat resources.

Native flora used for rehabilitation will ideally be endemic and will be established through a combination of direct seeding or planting of tube stock from local propagules. Seed will be collected from site where possible and treated if necessary to ensure it is adapted to environmental conditions in the area. Tree and shrub establishment onsite will be dominated by the direct seeding method, currently being used at most coal mines in the Bowen Basin.

An initial tree and shrub mix that could be used for rehabilitation is provided in Table 11-14 and is based on the current suite of flora species found in the Project area. The final species mix will depend on the final agreed RMP and will be reviewed periodically depending on changes in best practice, technology and rehabilitation monitoring results.

Table 11-14 Tree and shrub species

Common name	Scientific name	Woodland	Grassland	Riparian zone
<i>Acacia bidwillii</i>	Corkwood Wattle	X		
<i>Acacia harpophylla</i>	Brigalow	X		
<i>Acacia holosericea</i>	Soap Bush	X		
<i>Acacia rhodoxylon</i>	Rosewood	X		
<i>Acacia salicina</i>	Sally Wattle	X		
<i>Acacia shirleyi</i>	Lancewood	X		
<i>Acalypha eremorum</i>	Soft Acalypha	X		
<i>Aeschynomene indica</i>	Budda Pea	X		
<i>Alloteropsis semialata</i>	Cockatoo Grass	X	X	X
<i>Alphitonia excelsa</i>	Red Ash	X		X
<i>Alstonia constricta</i>	Quinine Bush	X		X
<i>Aristida calycina</i>	Dark Wiregrass	X		
<i>Aristida inaequiglumis</i>	Feathertop Three-awn			X
<i>Artistida latifolia</i>	Feathertop Wiregrass	X		X
<i>Arundinella nepalensis</i>		X	X	X
<i>Atalaya hemiglauca</i>	Whitewood	X		X
<i>Bothriochloa decipiens</i>	Pitted Bluegrass	X	X	X
<i>Bothriochloa ewartiana</i>	Desert Bluegrass	X		
<i>Brachychiton populneus</i>	Kurrajong	X		X
<i>Breynia oblongifolia</i>	Coffee bush	X		X
<i>Bursaria spinosa</i>		X		X
<i>Carissa ovata</i>	Currant Bush	X		
<i>Chloris divaricata</i>	Slender Chloris	X	X	X
<i>Chrysopogon fallax</i>	Golden Beard Grass	X		
<i>Citrus glauca</i>	Desert Lime	X		X
<i>Corymbia dallachiana</i>	Dallachy's Gum	X		X
<i>Corymbia intermedia</i>	Pink Bloodwood	X		X
<i>Corymbia tessellaris</i>	Moreton Bay Ash	X		X
<i>Croton insularis</i>	Silver Croton			X
<i>Cupaniopsis anacardioides</i>	Tuckeroo			X
<i>Cymbopogon refractus</i>	Barbed Wire Grass	X	X	X
<i>Dactyloctenium radulans</i>	Button Grass	X		
<i>Dichanthium sericeum</i>	Queensland Blue Grass	X	X	X
<i>Diospyros geminata</i>		X		X
<i>Dodonaea lanceolata</i> var. <i>lanceolata</i>	Hopbush	X		
<i>Enchylaena tomentosa</i>	Ruby Saltbush	X		X
<i>Enteropogon acicularis</i>	Curly Windmill Grass	X	X	X
<i>Entolasia stricta</i>	Wiry Panic	X		X
<i>Erythroxylum</i> sp.		X		X
<i>Eucalyptus camaldulensis</i>	Red River Gum	X		X

Common name	Scientific name	Woodland	Grassland	Riparian zone
<i>Eucalyptus cambageana</i>	Dawson River Blackbutt	X		X
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	X		
<i>Eucalyptus exserta</i>	Messmate	X		
<i>Eucalyptus melanophloia</i>	Silver-leaved ironbark	X		X
<i>Eucalyptus moluccana</i>	Grey Box	X		X
<i>Eucalyptus populnea</i>	Poplar Box	X		
<i>Eucalyptus tereticornis</i>	Forest Red Gum	X		X
<i>Eucalyptus tessellaris</i>	Moreton Bay Ash	X		X
<i>Ficus coronata</i>	Sandpaper Figs			X
<i>Ficus opposita</i>	Sandpaper Figs			X
<i>Fimbristylis dichotoma</i>		X		X
<i>Fimbristylis ferruginea</i>	Rusty Sedge	X		X
<i>Gahnia aspera</i>	Rough Saw-sedge	X		X
<i>Grevillea striata</i>	Beefwood	X		X
<i>Heteropogon contortus</i>	Black Speargrass	X		X
<i>Hibiscus heterophyllus</i>	Native Rosella	X		
<i>Imperata cylindrica</i>	Cogon Grass	X	X	X
<i>Lomandra longifolia</i>	Spiny-head Mat-rush	X		X
<i>Lophostemon grandiflorus</i>	Northern Swamp Mahogany			X
<i>Melaleuca bracteata</i>	Black Tea-tree			X
<i>Melaleuca leucadendra</i>	Weeping Paperbark			X
<i>Melaleuca trichostachya</i>				X
<i>Melaleuca viminalis</i>	Weeping Bottlebrush			X
<i>Melaleuca viridiflora</i>	Broad-leaved Paperbark			X
<i>Melia azedarach</i>	Persian Lilac			X
<i>Myoporum montanum</i>	Waterbush	X		X
<i>Panicum decompositum</i>	Native Millet	X	X	
<i>Panicum queenslandicum</i>		X	X	X
<i>Paspalidium caespitosum</i>	Brigalow Grass	X		X
<i>Pennisetum cillare</i>	Buffel Grass	X		
<i>Petalostigma pubescens</i>	Quinine Bush	X		X
<i>Rhynchosia minima</i>		X	X	X
<i>Setaria surgens</i>	Annual Pigeon Grass	X		
<i>Sporobolus caroli</i>	Fairy Grass		X	X
<i>Stephania japonica</i>	Snake Vine			X
<i>Themeda triandra</i>	Kangaroo Grass	X	X	X

A combination of native and introduced pasture species will be used to ensure the establishment of a groundcover and reduce the likelihood of erosion. Legumes may also be selected to assist in the supply of bio-available nitrogen to the soil. If local species do not provide adequate cover it may be necessary to use a cover crop to protect the soil. Should this be required, the crop cover would be an infertile annual species that will die off after one year rather than reproduce and spread to surrounding areas. This approach will provide initial assistance for endemic species by increasing protection against wind and soil erosion. If the use of introduced grasses and / or legumes is deemed necessary for erosion control in the bushland areas, pasture seed and fertilizer will be applied at a lower rate than for pasture outcomes to reduce competition with tree seed and / or seedlings.

Some seed germination rates are dramatically improved if the seeds are treated prior to planting. A range of treatments are available and would be investigated as necessary to maximise revegetation success and cost effectiveness.

11.11.6 Undisturbed Land

Land not impacted by mining activities will be retained for natural regeneration and a small area on Mamelon, but outside of the ML, will be set aside for cattle grazing purposes. Land not impacted but made inaccessible by mining activities will be allowed to naturally regenerate free of grazing.

11.11.7 Mine Infrastructure Area

Following decommissioning, most infrastructure areas will be returned to the pre-mining landform or alternatively bench cuts will be removed and steep grades reduced, and the landform returned to a profile similar to current landforms in the region. Where beneficial use of an area can be gained, such as access tracks, roads, hardstand or TLF facility, the final landform use will be negotiated and accepted in writing with the underlying landholder and DES.

Building end use will be assessed at the time of Project closure, as alternative uses may be available. It is likely, however, that the main administration building, workshop, CHPP and fixed plant (conveyors and gantries, transfer points, thickener tank, coarse reject hopper, vehicle wash, etc.) will be dismantled or demolished and removed from the site. Where infrastructure is removed, the footprint area will be assessed and where required, reworked to facilitate the appropriate drainage of surface runoff from the site.

Where required, potentially hazardous locations will be decommissioned and or rehabilitated to an acceptable level to prevent negative environmental impacts. This may require sumps to be dewatered and the excess coal removed prior to the commencement of demolition. In addition, all items of equipment will be de-oiled, degassed, depressurised and isolated, and all hazardous materials removed from the site as per legislative requirements.

Appropriate surface water management structures (contour banks, drains and settlement ponds) will be constructed as required to minimise potential erosion of the decommissioned and rehabilitated area.

11.11.7.1 Roads and Hardstands

Where no beneficial long-term use can be provided to the final land use, road furniture and fittings will be removed from site for recycling or disposal. The roads, car parks and hardstand areas will be ripped, topsoiled and rehabilitated. Several of the internal and haul roads may be retained for use by future landowners. Several additional haul roads will also be temporarily retained following rehabilitation as access roads for rehabilitation monitoring purposes. Roads and hardstands to remain after mine closure will be determined in consultation with DES. For those roads to be left operational, either permanently or temporarily, erosion and sediment controls will be employed to prevent and minimise sediment entering waterways.

Most haul roads and access tracks across the Project area requiring decommissioning may be highly compacted and require a combination of rehabilitation techniques such as deep ripping, profiling, topsoiling and seeding. Contaminated, carbonaceous or unsuitable material will be removed from the haul roads and hardstand surfaces and disposed of to the low wall area and incorporated into the rehabilitation of those areas. Reshaping of roads and access tracks will be undertaken to reflect the surrounding landforms. Where not required for beneficial long-term use, creek crossings will be removed and the pre-existing drainage lines re-established. As required, drainage will be

constructed where necessary. Roadside markers (tyres and guideposts) and redundant signage will also be removed from within the area once mine closure activities within the pit area have been completed.

11.11.7.2 Train Loadout Facility

The infrastructure associated with the TLF, including the rail loop, rail spur, rails and sleepers, will be removed at the end of the Project life, unless approved for use by another party. Any contaminated areas will require onsite remediation or encapsulation onsite to prevent the release of contaminants.

11.11.8 Water Infrastructure

Where no beneficial long-term use can be provided to the final land use, water storage dams will be decommissioned and rehabilitated. If not retained as water storages, water storage dams will be rehabilitated and returned to land consistent with desired rehabilitation and conservation objectives. The rehabilitation process may require dewatering, removal of any sediments and embankments, and the re-establishment of original drainage paths. Rehabilitation techniques may include a combination of re-profiling, topsoiling and seeding. If water infrastructure is to be retained onsite, then this will occur following written agreement of the underlying landholder.

Rehabilitation may vary depending on the storage history during mine operations. Dams that have contained saline water may require additional remediation. This may require the membrane liner, if previously installed in the dam, to be removed. Any saline material inside the dam will be removed during rehabilitation and disposed of by appropriate methods, in accordance with the management of saline overburden material. Removal will either be through evaporation or, given the existing groundwater is already relatively saline, reinjection of the saline water. Alternatively, saline sediment will be capped using an inert clay layer and salt tolerant vegetation used to provide new plant cover. Dams collecting potentially contaminated runoff, for example from waste rock stockpiles, will be retained to control for any long-term pollution.

11.11.9 Open Pits (Voids)

This section is no longer relevant to the EIS as there will be no retained voids and Open Cut 4 no longer exists within the mine plan.

11.11.10 Waste Rock Stockpiles

Noting the changes to the footprint of Waste Rock Stockpile 1 and Waste Rock Stockpile 2 an updated rehabilitation program has been developed. The following sections provide an updated discussion regarding the rehabilitation of Waste Rock Stockpiles 1a and 1b, and Waste Rock Stockpile 2.

The waste rock stockpiles will be designed, constructed and operated to enable progressive rehabilitation during operations with the final landform objectives in mind. Thus, the waste rock stockpiles will be managed to prevent pollution, be stable, safe and support the final land use both during operations and in the longer term to ensure post-closure objectives will continue to meet regulatory requirements.

Optimisation of the mine plan has been undertaken such that there will be no retained voids. Consequently, the mineral waste volumes reporting to waste rock stockpiles and the final landform described in the EIS have been updated.

The location of the waste rock stockpiles has been determined considering the presence and location of sensitive environmental receptors, including Deep Creek and Tooloombah Creek and Endangered and Of Concern Regional Ecosystems. The selected locations have also been selected to maximise the use of already disturbed land to minimise the clearance of remnant vegetation.

It is estimated that 745 Mbcm will report to the three ex-pit waste rock stockpiles and two open cut pits. The updated waste schedule is discussed in detail in SEIS Chapter 3 – Description of the Project. The size of the final area occupied by Waste Rock Stockpile 2 (servicing Open Cut 2) and Waste Rock Stockpile 1a (servicing Open Cut 1) will be 74 ha and 17.24 ha respectively. There will be no retained ex-pit overburden material associated with Waste Rock Stockpile 1b as the total volume of material will be returned to the void in Open Cut 1.

Geotechnical, climate, surface water and groundwater monitoring throughout the construction and operation of the Project will be used to evaluate the condition of the waste rock stockpiles and quantify their environmental risks. This information will then be used to determine the requirements for rehabilitation and closure control measures.

The stability of the waste rock stockpiles will be assessed based on the nature of: foundation materials, fill materials, and capping materials. The assessment will consider short-term, long-term and extreme conditions and meet the requirements of the Assessment and Management of Acid Drainage guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME, 1995).

Surface water flows will be prevented by capping using a low permeability material (i.e. clay), compacted and graded to limit stability issues which primarily result from water ingress and assist with directional precipitation runoff. Grading would be 2% and grade away from the crest. Side slopes would be designed to have 5% slopes. Contour grooving, channel linings, surface armour and drop structures on slopes will prevent long watercourse runs and minimise slope erosion. Certification will be obtained by Central Queensland Coal that slopes are stable in the long term and erosion rates are no greater than at comparable reference sites. To assist with rehabilitation soils with low sodic values will be stockpiled separately and used in the final stages of waste rock stockpile rehabilitation.

All dams receiving runoff from the waste rock stockpiles will be remediated at the completion of mining as part of final mine closure activities. Water quality within each dam will be assessed against the relevant water quality guidelines in place at the time of closure. Where water quality characteristics allow, water from the dams will be used as part of final rehabilitation and closure activities. Where water quality characteristics prevent re-use, the water will be treated to a quality suitable for use as part of final remediation and closure.

It is not expected that any water from the dams will be released to either Deep or Tooloombah Creek during the final rehabilitation period as water will be required for the rehabilitation activities. Should there be a reason for a release during final rehabilitation and closure activities the water quality will be assessed and released in accordance with the EA release triggers values in place at the time. Where water quality does not comply with release trigger values it will be treated to a compliant water quality and then released in accordance with the relevant EA conditions.

The waste rock stockpiles will necessarily result in a higher landform than that which existed before mining, although given the landform is already hilly it will not be out of character with the surroundings. Indeed, slopes of >5% are found within the existing mine area. Topsoil will be re-spread according to required depths and vegetation sown to establish cover comparable to reference sites. Soil characteristics will be measured *in situ* to confirm levels of surface roughness, aggregate stability and surface conditions as defined in the Australian Soil and Land Survey

Handbook. If there is an issue of saline or sodic materials then gypsum will be obtained from a certified supplier and added to the land, or into the waste rock stockpiles during operations.

Vegetation cover will be provided to not only assist with erosion control but to provide for the natural regeneration of native vegetation. Vegetation completion criteria will be measured based on achieving at least 70% cover as required by Eyre *et al.*, 2015.

11.11.11 Pest and Weed Management

Weed species have the potential to negatively impact rehabilitation activities and have a major impact on both native vegetation and grazing. Fifty-three introduced weed species of which ten are classified as Restricted Matters under the *Biosecurity Act 2014* (Biosecurity Act) and five declared as weeds of national significance were recorded within or surrounding the Project area (see Chapter 5 – Land, Chapter 14 – Terrestrial Ecology and Chapter 17 – Biosecurity for full details). Weed management will be a critical component of mine rehabilitation and will be conducted in conjunction with broader council and community weed management strategies where practical.

Weed control will be undertaken in a manner that minimises soil disturbance. Declared weeds will be controlled in accordance with the Biosecurity Act. A Land Use Management Plan will be developed and will incorporate a combination of control measures including:

- Herbicide spraying or scalping of weeds off soil stockpiles;
- Washdown and cleaning of high risk equipment prior to entering the site; and
- Monitoring and control of existing weed populations over the mine life.

11.11.12 Contaminated Land

Pursuant to the EP Act, an activity that will, or has the potential to, release contaminants into the environment and which may cause environmental harm is defined as an Environmentally Relevant Activity (ERA). In accordance with the *Environmental Protection Regulation 2008* (EP Regulation) (Schedule 6, Item 5), the development will be a site-specific EA mining project for the mining of black coal. The activities associated with the Project will require a number of ERAs (as prescribed in Schedule 2, EP Regulation). The EA is an integrated authority that allows for the carrying out of multiple ERAs that are part of a project, as such all ERAs must be listed and described in the EIS for inclusion in the EA. The EA is expected to provide approval conditions for each of the required ERAs.

The Project has the potential to involve two ERAs applicable to the construction and operational stages. These ERAs are:

- ERA 8 (1)(a) Chemical Storage (see Chapter 21 – Hazard and Risk); and
- ERA 31 (1) Mineral Processing (see Chapter 3 – Description of the Project).

As such, soil will be assessed for contamination at the following potential locations:

- Mine infrastructure area (fuel and chemical storages, belt filter press processing area); and
- Soil profile under the ex-pit waste storage area after material is returned to in-pit.

A risk assessment of these activities suggested that potential impacts can be remediated with current common contaminated land practices. In addition, these potential impacts were assessed as having relatively low residual risk following the adoption of mitigation measures. The handling of hazardous materials and dangerous goods and the associated waste management strategies are

discussed in separate chapters. Mitigation or control strategies will be included in either the construction or operational Environmental Management Plan.

Onsite records will be maintained regarding any activities or incidents that have the potential to result in land contamination. An inventory will also be maintained that contains information on storage locations, personnel training and disposal procedures for all chemicals, fuel and other potential contaminants used onsite.

Finances will be set aside to rehabilitate the land in the unlikely event of land contamination. Contaminated land, should it result from the Project activities, will be rehabilitated as per the regulatory conditions and by best practices at the time of mine closure to ensure the land is suitable for its final land use. Measures to minimise the risk of spills or spread of any contamination during decommissioning and rehabilitation will be implemented including, for example: identification of risk areas, appropriate investigation of contamination risk, isolation and removal or rehabilitation of land.

11.11.12.1 Development of Specific Management Plans

The development and statutory approval of all management plans discussed above will take place ahead of any construction or operation works onsite, as appropriate, and in consultation with DES. These plans will outline in detail how management, rehabilitation and mitigation measures will be implemented across the site. If an accelerated closure process is required, for example because of environmental, safety, economic or other external pressures, these plans will be adaptable to account for such a scenario.

11.12 Qualitative Risk Assessment

The deficiency to achieve rehabilitation goals may have the potential to cause, or may result in, adverse environmental impacts. The identification of impacts that could eventuate is critical to the selection of appropriate rehabilitation objectives or corrective action. During the detail design of the Project, prior to construction, the level of risk associated of not achieving rehabilitation goals will be determined using a Hazard Identification Matrix. This matrix will assess the likelihood and consequences to define a risk ranking.

The objectives of the risk assessment are to:

- Identify activities or outcomes that have the potential to adversely affect the local environment;
- Qualitatively evaluate and categorise each risk item;
- Assess whether risk issues can be managed by environmental protection measures; and
- Qualitatively evaluate residual risk with implementation of measures.

For each rehabilitation goal within the risk register there is a stated:

- Goal, objectives and performance criteria;
- Risk analysis negative impact occurring;
- Control measures to be implemented to meet management objectives / goals and performance; and
- Risk analysis of residual risk following the implementation of control measures.

Review and refinement of residual risk can be assessed and determined during the monitoring and implementation of the rehabilitation.

In line with the State government framework the rehabilitation process will use monitoring, targeted research and completion criteria to demonstrate ultimate success is shown in Figure 11-24. Within each rehabilitation stage, specific indicators will be monitored to determine and demonstrate the site has satisfied the completion criteria agreed between Central Queensland Coal and the administering authority.

Rehabilitation indicators are used to monitor the trending of ecological process towards the rehabilitation objectives, allowing early identification of issues requiring intervention and remedial actions. Indicators are used to demonstrate measurable effectiveness of the completion criteria to comply with community and regulatory expectations. The proposed completion criteria are approved and conditioned within the EA for the mine and provide the assessment benchmark for surrendering the EA and discharging the financial assurance (EHP 2014). The rehabilitation indicators and completion criteria have been developed in line with the legislative framework, standards and relevant industry codes of practice.

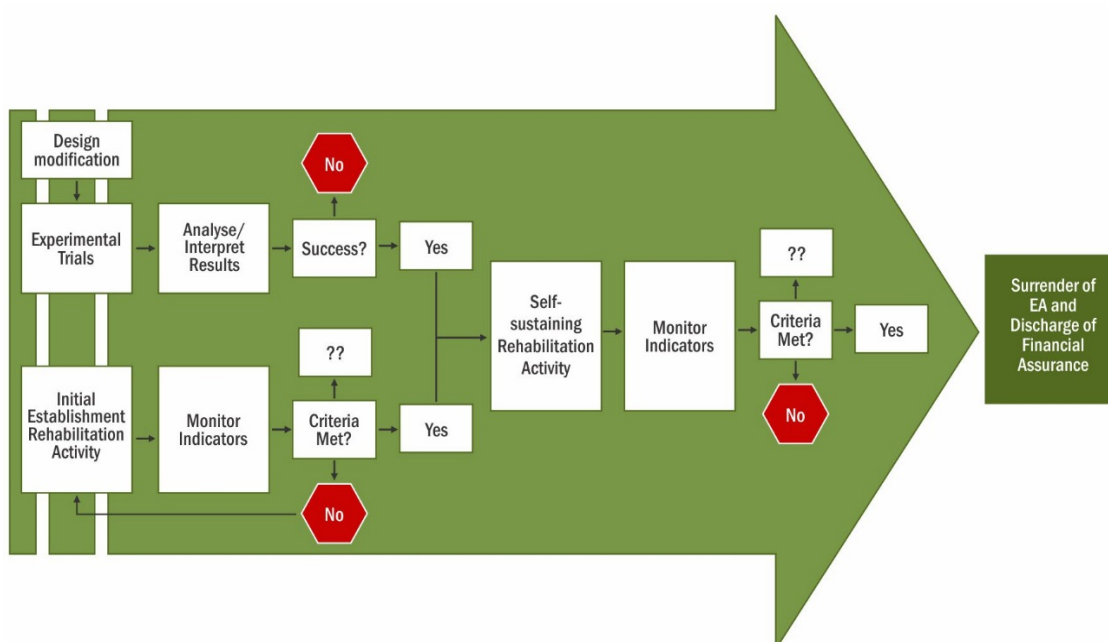


Figure 11-24 Process of determining rehabilitation progress and success

Monitoring and reviewing of the implementation of the rehabilitation strategies as discussed previously during mine operations may provide more precise or improved indicators, enhanced completion criteria or more cost effective or alternative rehabilitation techniques. If rehabilitation goals are anticipated to be changed, the relevant performance indicator and completion criteria may also require amendment. Proposed or anticipated changes to rehabilitation goals, performance indicators for a domain need to acknowledge the requirements as stated in the EA. Departures from the EA will require liaison with the regulatory authority for comment or approval.

Rehabilitation implementation and performance indicators will be required to be progressively monitored to collate adequate data and information towards the assessment of the risks, either positive or negative, towards archiving the completion criteria. Potential negative risks can be investigated, and corrective or preventative actions developed to ensure environmental harm is minimised.

Overarching performance indicators and completion criteria have been proposed in Table 11-14. The sub-criteria will be developed based on the monitoring of progressive rehabilitation and the completion criteria reviewed every three to five years. The completion criteria will be deemed as having been met when the post mining land use is self-sustaining. That is, where vital ecosystem process and functions are in place supporting a diverse, adaptable, resistant and resilient vegetation and fauna community. Indicators have been chosen based on scientific principles, practical measurement, value of data obtained and their cost effectiveness.

BioCondition assessments in accordance with the BioCondition Assessment Manual (Queensland Herbarium 2015) will be undertaken prior to disturbance to provide an ecosystem baseline. The baseline BioCondition assessment will enable site comparison of ecosystem structure and function including vegetation composition, substrate characteristics, nutrient cycles, animal – plant interactions, ecosystem exchanges and habitat needs. Completion criteria will be regularly reviewed for continual improvement to reflect improved knowledge and work practices in collaboration with key stakeholders.

11.13 Post-mining Indicators and Completion Criteria

Since the release of the EIS Central Queensland Coal has committed to not retaining voids. Central Queensland Coal has also committed to destocking the majority of the Mamelon Property to enable natural regeneration of the non-mining areas such as the riparian zones of Deep Creek and Tooloombah Creek. The destocking is to also enable land management activities to be consistent with desired biodiversity management outcomes that will be developed through the Projects offset planning. The following is an updated discussion relating to post-mining indicators and completion criteria.

The attainment of post mining rehabilitation goals through the nomination of strict performance indicators or completion criteria during mine planning or development may not be entirely beneficial. Monitoring and reviewing of the implementation of the rehabilitation strategies as discussed previously during mine operations may provide more precise or improved indicators, enhanced completion criteria or more cost effective or alternative rehabilitation techniques.

Overarching performance indicators and completion criteria have been updated from those in the EIS and are presented in Table 11-15. The sub-criteria will be developed based on the monitoring of progressive rehabilitation and the completion criteria reviewed every three to five years. The completion criteria will be deemed as having been met when the post mining land use is self-sustaining. That is, where vital ecosystem process and functions are in place supporting a diverse, adaptable, resistant and resilient vegetation and fauna community. Indicators have been chosen based on scientific principles, practical measurement, value of data obtained and their cost effectiveness.

If rehabilitation goals are anticipated to be changed, the relevant performance indicator and completion criteria may also require amendment. Proposed or anticipated changes to rehabilitation goals, performance indicators for a domain need to acknowledge the requirements as stated in the EA. Departures from the EA will require liaison with the regulatory authority for comment or approval.

Rehabilitation implementation and performance indicators will be required to be progressively monitored to collate adequate data and information towards the assessment of the risks, either positive or negative, towards archiving the completion criteria. Potential negative risks can be investigated, and corrective or preventative actions developed to ensure environmental harm is minimised.

Table 11-15 Decommissioning and rehabilitation objectives and completion criteria by domain

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
Mine - Open Pits	Safe to humans and wildlife	<ul style="list-style-type: none"> ▪ No retained voids; ▪ Adequacy and predicted long term performance of safety barriers; and ▪ No hazardous materials and structurally sound with limited slopes. 	<ul style="list-style-type: none"> ▪ Groundwater level and quality; ▪ Surface water quality; and ▪ Slopes are erosively and geotechnically stable. 	<ul style="list-style-type: none"> ▪ Certification by an appropriately qualified person in the Rehabilitation Report that slopes are safe and exhibit characteristics for long term stability; ▪ Downstream surface water quality is not significantly different from baseline prior to mining and no risk of environmental impacts downstream; ▪ Groundwater level and quality is not statistically different from baseline prior to mining; and ▪ No final void.
	Non polluting	<ul style="list-style-type: none"> ▪ Moderate quality but no connectivity; and ▪ Low risk of groundwater contamination or overflow but monitoring and management in place. 	<ul style="list-style-type: none"> ▪ Water Quality parameters - Salinity; ▪ Soil chemical analysis; ▪ Dust deposition and particulate matter; and ▪ Groundwater levels and quality. 	<ul style="list-style-type: none"> ▪ Results of contaminated land survey indicate no contamination; ▪ No degradation of water quality or significant increase in salinity over the EA required post-mining monitoring period; ▪ Dust and particulate matter indicates compliance with the EA; and ▪ Groundwater levels to remain similar to background variations.
	Stable	<ul style="list-style-type: none"> ▪ Long term geotechnical and erosive stability. 	<ul style="list-style-type: none"> ▪ As nominated by geotechnical engineer. 	<ul style="list-style-type: none"> ▪ No final void; ▪ Installation of contour or graded drains to manage erosion; ▪ Back-filled pits to be assessed as geotechnically stable by suitable qualified geotechnical engineer; and ▪ Sub-soil placed on overburden.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	Able to sustain an agreed post mining land use	<ul style="list-style-type: none"> ▪ Natural vegetation and habitat. 	<ul style="list-style-type: none"> ▪ Percentage pasture cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; and ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm ▪ Topsoil spread at agreed depths parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes; ▪ Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites; ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Native tree and species includes species identified in Table 12-4 of the SEIS; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.
Waste rock stockpiles	Safe to humans and wildlife	<ul style="list-style-type: none"> ▪ Structurally safe with no hazardous materials; and ▪ Site is safe now and for foreseeable future. 	<ul style="list-style-type: none"> ▪ Safety assessment of landform; and ▪ Appropriate decommissioning. 	<ul style="list-style-type: none"> ▪ Certification by an appropriately qualified person in the Rehabilitation Report that slopes are safe and exhibit characteristics for long term stability; and ▪ A risk assessment has been completed and risk mitigation measures have been implemented, as appropriate.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	Non polluting	<ul style="list-style-type: none"> ▪ Mine affected water contained on site; and ▪ No mine drainage outside of waste rock stockpiles. 	<ul style="list-style-type: none"> ▪ Downstream surface water quality; ▪ Groundwater quality; ▪ Final land form water storages are contained onsite with no over flows to external surface waters; ▪ All diversions to meet approved design criteria; and ▪ All structures not required for post-mining land use decommissioned. 	<ul style="list-style-type: none"> ▪ Results of contaminated land survey indicate no contamination; ▪ No degradation of water quality or significant increase in salinity over the EA required post mining monitoring period; ▪ Dust and particulate matter indicates compliance with the EA; and ▪ Groundwater quality to remain similar to background variations.
	Stable	Landform design achieves appropriate erosion rates.	<ul style="list-style-type: none"> ▪ Engineered structures to control water flow and reduce soil loss; ▪ Dimensions and frequency of erosion rills and gullies; and ▪ Vegetation cover sufficient to minimise erosion. 	<ul style="list-style-type: none"> ▪ Side slopes are no more than 14 to 16 Degrees; ▪ Crest grades away at no more than 2 %; ▪ Evidence that required contour banks, channel linings, surface armour, drop structures and other measures are in place and functioning; ▪ Certification that erosion activities are not greater than at comparable reference site; ▪ Dimension and occurrence of rills and gullies are no greater than at comparable reference site; and ▪ Evidence that vegetation type and density are of species suitable to the site and for erosion minimisation.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	Able to sustain an agreed post-mining land use	<ul style="list-style-type: none"> ▪ Natural vegetation and habitat. 	<ul style="list-style-type: none"> ▪ Percentage vegetation cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm ▪ Topsoil spread at agreed depths parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes. ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Established vegetative cover on slopes and outside bund to at least 70 % cover; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.
Mine infrastructure	Safe to humans and wildlife	Area safe for human and native species usage.	<ul style="list-style-type: none"> ▪ Presence/absence of infrastructure and wastes. 	<ul style="list-style-type: none"> ▪ All infrastructure removed unless agreed in writing with the landholder and submitted to the administering authority; ▪ Bench cuts removed; ▪ Steep grades reduced; and ▪ Similar surrounding landform profile.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	Non-polluting	No residual pollutants that could mobilise in environment.	<ul style="list-style-type: none"> ▪ Soil sample result – hydrocarbon and metal levels. 	<ul style="list-style-type: none"> ▪ Post contamination assessment complete on areas where notifiable activities occurred, and recommendations of assessment implemented; and ▪ Runoff and seepage will be good quality water that is unlikely to affect known environmental values.
	Stable	No erosion and sediment loss above surrounding area.	<ul style="list-style-type: none"> ▪ Water turbidity in watercourses; ▪ Sediment loss - visual inspection; ▪ Presence of scouring or erosion; and ▪ Percentage vegetative ground cover. 	<ul style="list-style-type: none"> ▪ Stable site with adequate cover and permanent drainage with no erosion issues.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	<p>Able to sustain an agreed post mining land use</p>	<ul style="list-style-type: none"> ▪ Minimal weed infestation and outbreaks. 	<ul style="list-style-type: none"> ▪ Percentage vegetation cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; and ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm ▪ Topsoil spread at agreed depth parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes. ▪ Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites; ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Established vegetative cover on slopes and outside bund to at least 70 % cover; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
Water infrastructure (dams and drains)	Safe to humans and wildlife	Structurally safe with no hazardous materials and safe for the foreseeable future.	<ul style="list-style-type: none"> ▪ Safety assessment of landform; and ▪ Appropriate decommissioning and rehabilitation. 	<ul style="list-style-type: none"> ▪ A risk assessment has been completed and risk mitigation measures have been implemented, as appropriate; and ▪ Landform design certified as meeting design requirements of rehabilitation.
	Non polluting	Mine affected water is contained on site or released according to EA conditions.	<ul style="list-style-type: none"> ▪ Downstream surface water quality; ▪ Groundwater quality; ▪ Final land form water storages are contained onsite with no over flows to external surface waters; ▪ All diversions to meet approved design criteria; and ▪ All structures not required for post-mining land use decommissioned. 	<ul style="list-style-type: none"> ▪ Results of contaminated land survey indicate no contamination or recommendations of survey report have been implemented successfully; ▪ No degradation of water quality or significant increase in salinity over the EA required post mining monitoring period; ▪ Dust and particulate matter indicates compliance with the EA; and ▪ Groundwater levels to remain similar to background variations
	Stable	Landform design achieves appropriate erosion rates.	<ul style="list-style-type: none"> ▪ Engineered structures to control water flow; ▪ Appropriate rates of soil loss; ▪ Dimensions and frequency of erosion rills and gullies; and ▪ Vegetation cover sufficient to minimise erosion. 	<ul style="list-style-type: none"> ▪ Evidence that required contour banks, channel linings, surface armour, drop structures and other measures are in place and functioning; ▪ Certification that erosion activities are not greater than at comparable reference site; ▪ Dimension and occurrence of rills and gullies are no greater than at comparable reference site; and ▪ Evidence that vegetation type and density are of species suitable to the site and for erosion minimisation.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	Able to sustain an agreed post mining land use	To rehabilitate and return area to nature conservation usage.	<ul style="list-style-type: none"> ▪ Pasture cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm ▪ Topsoil spread at agreed depth parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes. ▪ Certification by a suitably qualified person that the density and presence of key species and pasture cover is the same as at reference sites; ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Established vegetative cover on slopes and outside bund to at least 70 % cover; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
Haul Road Corridor All areas (road furniture, haul road, drainage, cut and fill areas)	Safe to humans and wildlife	No objects remaining which could cause injury.	<ul style="list-style-type: none"> ▪ Presence/absence of infrastructure and wastes. 	<ul style="list-style-type: none"> ▪ All road furniture removed unless agreed in writing with the landholder and submitted to the administering authority; ▪ Bench cuts removed; ▪ Steep grades reduced; and ▪ Similar surrounding landform profile.
	Non polluting	No residual pollutants that could mobilise in environment.	<ul style="list-style-type: none"> ▪ Soil sample result – salinity, hydrocarbon and metal levels. 	<ul style="list-style-type: none"> ▪ Runoff and seepage will be good quality water that is unlikely to affect known environmental values.
	Stable	No erosion and sediment loss above surrounding area.	<ul style="list-style-type: none"> ▪ Water turbidity in watercourses; ▪ Sediment loss - visual inspection; ▪ Presence of scouring or erosion; and ▪ Percentage vegetative ground cover. 	<ul style="list-style-type: none"> ▪ Stable site with adequate cover and permanent drainage with no erosion issues.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	<p>Able to sustain an agreed post mining land use</p>	<ul style="list-style-type: none"> ▪ Revegetation and reconnection of wildlife corridor in previously RE areas. 	<ul style="list-style-type: none"> ▪ Vegetation percentage cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; and ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm ▪ Topsoil spread at agreed depths parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes. ▪ Certification by a suitably qualified person that the density and presence of key species and pasture cover is the same as at reference sites; ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Established vegetative cover on slopes and outside bund to at least 70 % cover; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Potential fish passage areas are appropriately re-established; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
TLF All areas (Environmental dams, rail loop, train loader and conveyer, stockpiles)	Safe to humans and wildlife	Soil sample result – salinity, hydrocarbon and metal levels.	<ul style="list-style-type: none"> ▪ Soil sample result – salinity, hydrocarbon and metal levels. 	<ul style="list-style-type: none"> ▪ All infrastructure removed unless agreed in writing with the landholder and submitted to the administering authority; and ▪ Land re-profiled, ripped and pasture cover established.
	Non polluting	No residual pollutants that could mobilise in environment.	<ul style="list-style-type: none"> ▪ Soil sample result – salinity, hydrocarbon and metal levels. 	<ul style="list-style-type: none"> ▪ Post contamination assessment complete on areas where notifiable activities occurred; and ▪ Runoff and seepage will be good quality water that is unlikely to affect known environmental values.
	Stable	Removal and rehabilitation of environmental dam and stable ground cover reduce erosion from surface water runoff.	<ul style="list-style-type: none"> ▪ Water turbidity in watercourses; ▪ Sediment loss - visual inspection; ▪ Presence of scouring or erosion; and ▪ Percentage vegetative ground cover. 	<ul style="list-style-type: none"> ▪ Stable site with adequate cover and permanent drainage with no erosion issues.

Domain and Sub-domain	Rehabilitation goal	Rehabilitation objectives	Indicators	Completion criteria
	<p>Able to sustain an agreed post mining land use</p>	<ul style="list-style-type: none"> ▪ Natural vegetation and habitat. 	<ul style="list-style-type: none"> ▪ Vegetation percentage cover per square meter; ▪ Soil characteristics; ▪ Presence and density of key plants species; ▪ Structure of vegetation; and ▪ Weed and pest species presence, abundance and type; ▪ Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus); ▪ Biological: fish diversity, benthic algal growth; ▪ Habitat indicators: width, continuity, extent of shading and species composition; ▪ Native species; and ▪ Weed and pest abundance. 	<ul style="list-style-type: none"> ▪ Restored landform ripped to nominal depth of 50-100 mm; ▪ Topsoil spread at agreed depths parallel to ripped contours; ▪ Topsoil replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate; ▪ No active areas of rill or gully erosion and drainage follows appropriate drainage paths; ▪ Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes; ▪ Certification by a suitably qualified person that the density and presence of key species and pasture cover is the same as at reference sites; ▪ Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site); ▪ Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook; ▪ Battered slopes with at least 70 % vegetative cover; ▪ Established vegetative cover on slopes and outside bund to at least 70 % cover; ▪ Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded; ▪ Potential fish passage areas are appropriately re-established; ▪ Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites; and ▪ Evidence that weed and pest species management is occurring where appropriate.

11.14 Rehabilitation Monitoring and Measurement

Monitoring will be carried out to ensure Central Queensland Coal obtains a representative dataset to enable progressive certification of rehabilitation under Chapter 5A of the EP Act. The responsibility for all environmental monitoring and management will be undertaken by Central Queensland Coal's Environment Manager. Attainment of the site's rehabilitation performance and completion criteria will be the responsibility of Central Queensland Coal.

The scope of environmental work will be based on the Project's Environmental Management System (EMS) and the plans and procedures that the EMS provides for, including rehabilitation measures. Key management plans which will provide for comparative reference monitoring sites (against which the results of the Project will be compared), monitoring methods and reporting that relate to rehabilitation are:

- Rehabilitation Management Plan or Progressive Rehabilitation and Closure Plan;
- Erosion and Sediment Control Plan;
- Receiving Environment Monitoring Plan;
- Water Management Plan; and
- Land Use Management Plan.

Rehabilitation monitoring will comprise permanent monitoring locations at which visual and photographic surveys, transects / quadrats, ecosystem function analysis and remote sensing will be applied to determine change. It will specify the location of monitoring sites on disturbed areas and reference sites undisturbed by mining, as well monitoring frequency, tools, personnel and reporting protocols.

Rehabilitation monitoring will also include recording the history of rehabilitation activities in any one area so that the performance of a rehabilitation practice can be related to its results. This would include, for example, ground preparation measures, topsoil source, handling and respreading rates, seeding source and application, and meteorological information such as rainfall, temperature and wind speed.

The ongoing monitoring of the management measures and assessment of attainment of performance indicators will possibly identify departures from the intended goals. Progressive risk assessments will be undertaken towards the degree of the achievement of the rehabilitation goal and long-term sustainability of the rehabilitation and will consider the probability of causing environmental harm. Corrective or preventative actions can be identified and developed to achieve the stated goals. Alternatively, if a corrective action cannot be defined or developed, alternative goals can be established.

Conversely, where monitoring provides evidence of the attainment of the intended goals or negligible potential for potential environmental harm, the monitoring may become unnecessary. Any reduced monitoring will be required to be negotiated and approved by the regulatory authority prior to implementation.

Monitoring during the development of the final landform will incorporate the use of LiDAR imagery which will assist with the identification of elevation changes as a result of erosion and/or settlement. Where identified rehabilitation of the affected area will be carried out.

11.15 Contingency Planning

The rehabilitation success would be determined as a part of the rehabilitation monitoring program. If the monitoring program indicates that rehabilitation progress is poor, or if re-profiled areas become unstable, action would be taken to ensure rehabilitation success as measured by the monitoring program.

The measures used to ensure rehabilitation success would depend on the issue. For areas where site stability is an issue, these would be repaired or regraded with appropriate scale equipment and stabilised with additional surface stabilisation materials. These may include use of biodegradable organic matting in problem areas.

Wherever possible maintenance works will be undertaken within the same planting season. Once reasons for poor site stability success have been determined, and rectified, for example reinstatement or realignment of drainage control, repaired areas will be seeded.

Areas may also be revegetated either by reseeding or by planting nursery seedlings, or treated to manage weeds, if monitoring programs indicate that revegetation progress is poor. The need to undertake additional rehabilitation works will be assessed based on:

- If the area has less than 60% damage or failed germination, seeding or planting of seedlings should be repeated using half the rates originally used; and
- If the area has more than 60% failed germination, the revegetation process should be repeated from scratch, including ground preparation if required.

The final contingency strategy and plan will be developed and described in detail in the RMP or PRCP.

11.16 Relinquishment

An objective of rehabilitation is to facilitate relinquishment of the mining lease and EA and release Central Queensland Coal from ongoing liability for the land. The relinquishment of the mining lease and surrender of the EA requires the appropriate application forms to be completed and adequate information to be provided within a final rehabilitation report. The rehabilitation report prepared for this will be based on the results of Central Queensland Coal's rehabilitation monitoring and will include evidence that the rehabilitation meets the completion criteria.

The attainment of completion criteria is an important component of the certification process and will be comprehensively discussed within the rehabilitation report. The rehabilitation report will provide definitive information on the assessment of performance indicators and the overall success of the rehabilitation for the duration of the rehabilitation. The rehabilitation report will include interpretation or discussion by appropriately qualified people, relevant to the scope of the rehabilitation and an overall statement of compliance with the stated performance criteria. Rehabilitation must be to the satisfaction of the administering agencies and at a state where there will be no residual risk before any financial assurance held against the Project will be released.

11.17 Temporary Closure (Care and Maintenance) and Sudden or Unplanned Closure

Temporary closure (or care and maintenance) occurs when operations temporarily cease due to economic or operational constraints. Temporary closure is normally planned and would entail the immediate preparation and implementation of a Care and Maintenance Program, considering the potential for future operations of the site. The Care and Maintenance Program would contain key mine components that need continuous monitoring, including maintenance of ongoing environmental and social programs.

Sudden or unplanned closure occurs when mining and / or processing suddenly cease due to financial constraints (or similar economic imperatives) or if the operation is instructed to close due to nonconformance/s with regulatory requirements.

Conceptually, it is proposed that the predominant final post-mining land use for the site will generally include returning the site to native vegetation made up of predominantly endemic species (comprising trees, shrubs and grasses), interspersed with cover crop where dictated by erosion and sediment control requirements. The following general site requirements would need to be completed under a care and maintenance program or if sudden unplanned closure occurred:

- Notify the workers and contractors and notify the appropriate local and government authorities;
- Prepare Care and Maintenance Program or review and update the MCP or PRCP in the case of an unplanned closure;
- Designate a contact person(s) for authorised access to the site and project management of care and maintenance activities or rehabilitation and closure in the case of an unplanned closure;
- Prepare and leave mechanical, hydraulic and electrical systems in a “no-load” condition, as well as ensuring they are effectively isolated;
- Drain all pipelines;
- Remove all petroleum, chemicals and explosive products from the site;
- Where required in the case of an unplanned closure, demolish buildings / infrastructure, if buildings were to remain then seal, secure and/or lock buildings;
- Remove all mobile equipment from the site;
- Construct fences / barriers as required to restrict access to the site of specific areas within the site;
- Establish a program for roadway maintenance to ensure access to the site is maintained;
- Continue regular inspections;
- Establish a schedule for the environmental and rehabilitation monitoring during care and maintenance or following closure;
- Assign an appropriately qualified person to review and report all monitoring data collected; and
- Prepare a Trigger, Action, Response Plan (TARP) based on a risk assessment that considers the possible impacts on the surrounding environment(s).

11.18 Resources for Rehabilitation and Closure

A number of key resources will be required throughout the mine closure process, and adequate planning will be required mine moves into the mine closure planning phase to ensure these resources requirements are accounted for and met.

The key resources required for final rehabilitation and mine closure include the following:

Mine Manager - required to provide the necessary resources to the Environment Manager or Closure Project Manager to assist with rehabilitation and closure activities.

Environment and Community Manager and / or Closure Project Manager - required to ensure all environmental commitments are met throughout the closure process, including the continuation of environmental monitoring and the setup of post closure environmental monitoring systems, and to continue communication with stakeholders throughout the process. The Environment Manager and / or Closure Project Manager will be responsible for preparing, managing and implementing the rehabilitation and closure activities.

External consultants and contractors - required throughout the rehabilitation and closure process to assist in execution of the rehabilitation and closure activities. These may include, hydrogeological, geotechnical, flora and fauna consultants. Demolition and earthmoving contractors will be required.

Surveyors - to ensure all rehabilitation and closure activities are documented and the appropriate final landform plans are produced.

11.19 Conclusion

Specific rehabilitation and decommissioning measures to avoid or minimise any impacts will be identified in the EA and ultimately the Plan of Operations and the MCP that will be finalised prior to the commencement of mine closure activities. Should guidelines be issued regarding the preparation of a PRCP, this will be completed in place of a Plan of Operations and MCP.

It may be the case that the best beneficial use of some of the supporting infrastructure is to leave the infrastructure in place to support the region. This will be discussed with the relevant authorities and landholders prior to formalising the decommissioning strategy. If the preferred outcome is to leave some of the infrastructure components *in situ* as operating infrastructure, Central Queensland Coal will facilitate the transfer of operating licences and obligations to the relevant parties.

Rehabilitation will occur progressively throughout the life of the Project to create a low maintenance, geotechnically stable landform commensurate with the agreed final land use.

11.20 Commitments

In relation to rehabilitation, Central Queensland Coal's updated commitments are provided in Table 11-16.

Table 11-16 Commitments – rehabilitation and decommissioning

Commitment
A PRCP will be prepared once guidance has been formalised by the Queensland Government. The PRCP will address the seven factors for successful remediation of mine sites with dispersive soils as identified by Dale et al., 2018.
A RMP will be developed based on objectives and goals that seek to provide predetermined land uses for the different land units of the mine. Note if PRCP guidelines are issued, the PRCP will be prepared in place of a RMP.
A MCP will be prepared outlining the specific operational activities required to complete the rehabilitation and decommissioning of the Project. Note if PRCP guidelines are issued, the PRCP will be prepared in place of a RMP.
Implementation of a Project ESCP, developed by a suitably qualified person in accordance with relevant legislation and guidelines.
Rehabilitation to be non-polluting and consistent with the environmental values as per the Environmental Protection (Water) Policy 2009.
Provide landforms with the same or similar land use capabilities and / or suitability prior to the disturbance, unless other beneficial land uses are pre-determined and agreed with key stakeholders (post-mining land owners, managers and relevant regulators).
Rehabilitate disturbed land so that it presents a negligible safety or environmental risk in terms of stability.
Provide land that is self-sustaining to agriculture or ecosystem processes where maintenance requirements are negligible and consistent with an agreed post-mining land use.
Maintain the water quality, leaving waterways and aquifers with water quality and quantity acceptable for existing and future users within or surrounding the site.
Continuation and / or restoration of biodiversity and ecological integrity of areas affected by mining within the mining lease.
Preservation of downstream water quality for ecological and existing beneficial uses.
The Project Land Use Management Plan will outline weed control measures in accordance with the Biosecurity Act.
Onsite records will be maintained regarding any activities or incidents that have the potential to result in land contamination. An inventory will also be maintained that contains information on storage locations, personnel training and disposal procedures for all chemicals, fuel and other potential contaminants used on site.
Establishment of a low maintenance, geotechnically stable landform commensurate with natural regeneration, nature conservation land uses.
Shape the created landforms to the extent practical to appear as a natural extension with the surrounding landforms.
Provide habitat for fauna and corridors for fauna movement within the final landform and waterways.
Monitor rehabilitation success in terms of physical, chemical and biological parameters.

11.21 ToR Cross-reference Table

Table 11-17 ToR Cross reference

Terms of Reference	Section of the EIS
8.2.1 Rehabilitation	
Conduct impact assessment in accordance with the EHP's <i>EIS information guideline—Rehabilitation</i> .	Section 11.2.3
The EIS must provide information based on relevant guidelines (including the departmental 'Guideline: Rehabilitation requirements for mining resource activities ¹), current best practice approaches and legislative requirements about the strategies and methods for progressive and final rehabilitation of the environment disturbed by construction, operation, and decommissioning of the project.	Section 11.2.3
The EIS must propose completion criteria and a rehabilitation strategy which addresses the following considerations: <ul style="list-style-type: none"> a) develop rehabilitation criteria for disturbed areas and post mining land uses across the mine as outlined in <i>EHP Guideline: Rehabilitation requirements for mining projects (EM1122) (EHP 2014)</i> 	Section 11.7

¹ <https://www.ehp.qld.gov.au/land/mining/guidelines.html>

Terms of Reference	Section of the EIS
b) specify spoil characteristics, soil analysis, soil separation for use on rehabilitation	Section 11.11.4 and Chapter 5 - Land
c) explain any planned native vegetation rehabilitation areas and corridors	Section 11.11.5
d) explain development and rehabilitation of improved pastures and grazing landforms	Sections 11.11.5 and 11.11.6
e) detail rehabilitation methods applied to disturbed areas, including map(s) to identify proposed rehabilitation types and methods in different areas	Sections 11.11 and 11.14
f) describe landform design criteria including end of mine design	Section 11.11.2
g) where suitable remnant vegetation sites are available, identify an appropriate number for the development of rehabilitation success criteria and comparison with progressive rehabilitation at the mine.	Section 11.13
h) identify success criteria for rehabilitation areas	Section 11.13
i) detail how landform design will be consistent with the surrounding topography	Section 11.11.2
j) include detailed flood modelling for two year Average Recurrence Interval (ARI), 50 year ARI (i.e. 1 in 50), 100 year ARI (i.e. 1 in 100), 1,000 year ARI (i.e. 1 in 1,000) and the Probable Maximum Flood (PMF). Maps must illustrate the final landform and where mined areas and uncompacted overburden would lie in relation to all of these flood levels up to and including the PMF. Maps must illustrate the final landform and where mined areas and uncompacted overburden would lie in relation to all of these flood levels up to and including the PMF	Section 11.11.1 and Chapter 9 – Surface Water
k) detail how surrounding environmental values will be protected	Section 11.11
l) describe rehabilitation indicators, projected progressive rehabilitation, and the monitoring program to be used	Sections 11.11, 11.11.1 and 11.14
m) develop a contingency plan for rehabilitation maintenance or design.	To be prepared as part of the RMP that will form part of the EA Condition
n) assess waste in terms of acid forming potential; describe risks and proposed management	Sections 11.9.1 and 11.10 and Chapter 8 – Waste Rock and Rejects
o) provide rehabilitation goals, rehabilitation objectives, indicators of success and completion criteria for each mining domain for the agreed post mining land use	Sections 11.7 and 11.11

Terms of Reference	Section of the EIS
<p>p) details and commits to a progressive rehabilitation schedule for the life of mine which:</p> <ul style="list-style-type: none"> • minimise the amount of land disturbed at any one time • minimise the residual loss of land and water bodies with ecological or productive value • quantifies the milestones that would be met during the progressive rehabilitation of the project site including a table that specifies goals, timing and minimum quantities of the progressive rehabilitation to be achieved for each mining domain at different stages over the life of the mine • specifies the timing, criteria and definition for successfully achieving the progressive rehabilitation goals for all relevant domains 	<p>Sections 11.11.1 and 11.14</p>
<p>q) include rehabilitation methods, topsoil requirements for rehabilitation, the proposed cover designs for encapsulation of waste material, including performance and completion criteria, geotechnical, geochemical and hydrological studies that support their design and proposed rehabilitation monitoring program</p>	<p>Sections 11.11 and 11.14</p>
<p>r) provide detailed description of the topsoil resources on site and how topsoil storage will be quantitatively and qualitatively managed (stripped, salvaged and stockpiled) for the life of the project to prevent topsoil loss from any disturbance areas and to ensure successful progressive revegetation and rehabilitation</p>	<p>Section 11.11.4</p>
<p>s) describe and illustrate the proposed final landforms including landform type, slope, regional ecosystem, retained voids, drainage design, and post mining land or infrastructure use agreed with background landholders. Maps of the proposed final topography should have contours at suitable intervals, and show waste dumps, and any dams that would not be removed and rehabilitated</p>	<p>Section 11.11 and 11.13</p>
<p>t) describe rehabilitation completion criteria that would be used to measure progress and completion in relation to the final land uses and wildlife habitat areas. Describe how the achievement of the objectives would be monitored, audited and reported, and how corrective actions would be managed</p>	<p>Sections 11.13 and 11.14</p>
<p>u) include the staged design of the voids over the life of mine, including the estimated timing that works will commence and be completed, post mining land use, topography, geotechnical rehabilitation stability, post-mining hydrological interactions</p>	<p>Section 11.11</p>
<p>v) Notwithstanding that management techniques may improve over the life of the project, and legislative requirements may change, the EIS must give confidence that all potential high-impact elements of the project (e.g. spoil dumps, voids, tailings and water management dams, creek diversions or crossings, borrow pits) are capable of being managed and rehabilitated to achieve acceptable land suitability, to be safe, stable, non-polluting and self-sustaining, and to prevent upstream and downstream surface and groundwater contamination</p>	<p>Section 11.11</p>