# Central Queensland Coal Project

# Chapter 11 - Rehabilitation and Decommissioning

**Central Queensland Coal**

**CQC SEIS, Version 3**

**October 2020**

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## Terms and Abbreviations

| | |
|---|---|
| AEP | Annual Exceedance Probability |
| AMD | Acid and Metalliferous Drainage |
| ANZMEC | Australian and New Zealand Minerals and Energy Council |
| ARI | Annual Recurrence Interval |
| CHPP | Coal Handling and Preparation Plant |
| CQC | Central Queensland Coal Proprietary Limited |
| DES | Department of Environment and Science |
| EA | Environmental Authority |
| EIS | Environmental Impact Statement |
| EMS | Environmental Management System |
| EP Act | *Environmental Protection Act 1994* |
| EP Regulation | Environmental Protection Regulation 2019 |
| ERA | Environmentally Relevant Activity |
| ESCP | Erosion and Sediment Control Plan |
| ESP | Exchangeable Sodium Percentage |
| Financial Assurance Guideline | Guideline Financial assurance under the *Environmental Protection Act 1994* (DES 2019). |
| GBR | Great Barrier Reef |
| GBRMP | Great Barrier Reef Marine Park |
| ha | Hectare(s) |
| Km | Kilometre(s) |
| LiDAR | Light Detection and Ranging |
| LPSDP | Leading Practice Sustainable Development Program |
| m | Metre(s) |
| Mbcm | Million bank cubic metres |
| mm | Millimetres |
| MCA | Minerals Council of Australia |
| ML | Mining Lease |
| mm | millimetres |
| MWMP | Mineral Waste Management Plan |
| NAF | Non-Acid Forming |

| | |
|---|---|
| NRM | Natural Resource Management |
| pH | Potential for Hydrogen |
| PMF | Probable Maximum Flood |
| PRCP | Progressive Rehabilitation and Closure Plan |
| PRCP Guidelines | Guideline for Progressive Rehabilitation and Closure Plans 2019 |
| RL | Reduced Level |
| ROM | Run-of-Mine (coal) |
| SEIS | Supplementary Environmental Impact Statement |
| SEIS v3 | the current SEIS |
| SMD | saline mine drainage |
| TARP | Trigger, Action, Response Plan |
| TLF | Train Loadout Facility |
| The Project | The Central Queensland Coal Project |
| ToR | Terms of Reference |
| TSS | Total Suspended Solids |

# 11 Rehabilitation and Decommissioning

## 11.1 Introduction

This Chapter presents the rehabilitation and closure strategy for the Central Queensland Coal Project (the Project), including an assessment and description of soil management and rehabilitation methods, a description of the planned progressive rehabilitation and revegetation of areas across the mine site and rehabilitation monitoring and maintenance requirements.

This chapter has been rewritten for this Version 3 of the Supplementary Environmental Impact Statement (SEIS) to provide a consolidated chapter including previous information provided in the original Environmental Impact Statement (EIS) (October 2017), and subsequent SEIS documents (SEIS, May 2018 and SEIS v2, December 2018) together with recent work undertaken to support this version of the SEIS (SEIS v3). Furthermore, this chapter has been updated to include assessment of changes to the Project Footprint and updates to the legislative framework.

Appendix A13 includes the full details of all submissions received for the EIS and Version 1 of the SEIS. Matters raised in submissions regarding the EIS and SEIS v1 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
- the management of sodic and dispersive soils
- provision of clear completion criteria/indicators to ensure that the final landform achieves a non-polluting objective and
- provide provision of a commitment to achieve (and associated justification for) for the post-mining final land use.

In addition, the following comments were raised in submissions to SEIS v2:

- information on the final landforms, including maximum final heights and slopes, and how factors relevant to the final landform have been considered to minimise impacts and
- assessment of post closure flooding impacts and clarification of proposed diversions.

The submissions received relating to the SEIS version 2 are addressed in Chapter 3 of this SEIS (i.e. Version 3).

### 11.1.1 Rehabilitation Objectives and Performance Criteria

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

- safe to humans and wildlife
- non-polluting
- stable and
- able to sustain an agreed post-mining land use.

Whilst these former guideline documents have since been superseded, the latest Government guidance provided by the Better Mine Rehabilitation for Queensland Discussion Paper (Queensland Government FA IDC 2017), the Mined Land Rehabilitation Policy (EHP, DNRM and QT 2019) and the Guideline Progressive Rehabilitation and Closure Plans (PRC Plans) (PRCP Guidelines) (DES 2019a) continue to require mining proponents to deliver consistent general rehabilitation goals and post-mining outcomes.

Central Queensland Coal (CQC) will seek to achieve the following overarching rehabilitation and decommissioning goals to address the general rehabilitation goals as nominated in the Queensland Government's Guideline(s) by:

- providing final landforms with similar land use capabilities and / or suitability as those which existed prior to the disturbance, unless other beneficial land uses are pre-determined and agreed with key stakeholders throughout the mining operations (post-mining land owners, managers and relevant regulators)
- rehabilitation of disturbed land as soon as practicably available so that it presents a negligible safety or environmental risk in terms of stability
- providing land that is self-sustaining to agriculture and/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 post-mining land uses. These goals are consistent with the principles of Ecologically Sustainable Development (ESD) as required by the Queensland *Environmental Protection Act 1994* (EP Act).

#### 11.1.1.1 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.

**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 (including temporary rehabilitation activities) to minimise visual exposure
- rehabilitate areas of disturbance not required for active mining operations or no longer required for mining related operations
- apply soil (topsoil / subsoil) and other available growth mediums (such as suitable weathered (regolith) materials) to the final landform based on material characterisation and availability to achieve the intended post-mining land use
- conduct rehabilitation monitoring and management to ensure that rehabilitation progress is trending towards the relevant final landform completion criteria
- design, construct and stabilise all earthworks, drainage lines and disturbed areas to minimise erosion and sedimentation and

- control vermin, feral animals and noxious weeds.

**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 conditions. These long-term goals include:

- post-mining rehabilitated landform to be suitable for low intensity cattle grazing land-use, with surrounding land being retained for managed natural regeneration, with a small section in the southern section of Mamelon set aside wholly for grazing land-use
- preservation of downstream water quality for ecological and existing beneficial uses
- establishment of a low maintenance, geotechnically stable landform commensurate with low-intensity grazing land-use
- design and construct the final rehabilitated landform to integrate with the surrounding environment, with no final void to remain within the rehabilitated landform and
- monitoring rehabilitation success in terms of physical and biological parameters (i.e. as set out within the completion criteria/indicators described within Section 11.11).

As previously discussed, a proposed Progressive Rehabilitation and Closure Plan (PRCP) has not been prepared for inclusion within this SEIS given the stage in the Government approvals process. However, this SEIS includes the rehabilitation planning information relevant to inform the preparation of a PRCP prior to the commencement of operations. The PRCP will be prepared to outline the specific operational activities required to complete the rehabilitation and decommissioning of the Project. The PRCP will include monitoring and management of:

- wastewater collection and treatment systems
- groundwater quality and levels
- surface water quality and flows
- seepage rates
- erosion rates
- integrity and stability of the final landform slopes and associated drainage lines and
- health and resilience of vegetation cover.

### 11.1.2 Terms of Reference Addressed in this Chapter

Table 11-1 summarises the requirements from the ToR for the Project (4 August 2017) relevant to this Chapter, and where in this chapter they are addressed.

**Table 11-1: Tor cross-reference**

| Terms of Reference | Chapter Section |
|---|---|
| **8.2.1 Rehabilitation** | |
| • Conduct impact assessment in accordance with the EHP's EIS information guideline—Rehabilitation | Section 11.1.3.3 |
| • The EIS must provide information based on relevant guidelines (including the departmental 'Guideline: Rehabilitation requirements for mining resource activities11), current best practice approaches and legislative requirements about the strategies and methods for progressive and final rehabilitation of the | Section 11.1.3.3 |

| Terms of Reference | Chapter Section |
|---|---|
| environment disturbed by construction, operation, and decommissioning of the project. | |
| • The EIS must propose completion criteria and a rehabilitation strategy which addresses the following considerations: | Sections 11.1.1 and 11.11 |
| a. develop rehabilitation criteria for disturbed areas and post mining land uses across the mine as outlined in EHP Guideline: Rehabilitation requirements for mining projects | |
| b. specify spoil characteristics, soil analysis, soil separation for use on rehabilitation | Sections 11.2.4, 11.7, 11.9.4 and Chapter 5 - Land |
| c. explain any planned native vegetation rehabilitation areas and corridors | Section 11.9 particularly Section 11.9.5 |
| d. explain development and rehabilitation of improved pastures and grazing landforms | Sections 11.9.2, 11.9.3 and 11.11 (Table 11-6) |
| e. detail rehabilitation methods applied to disturbed areas, including map(s) to identify proposed rehabilitation types and methods in different areas | Sections 11.9 and 11.12 |
| f. describe landform design criteria including end of mine design | Sections 11.9.2 and 11.11 |
| 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 11.11 |
| h. identify success criteria for rehabilitation areas | Section 11.11 |
| i. detail how landform design will be consistent with the surrounding topography | Section 11.9.2 |
| 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 | Section 11.9.1 and Chapter 9 – Surface Water |
| k. detail how surrounding environmental values will be protected | Section 11.9 |
| l. describe rehabilitation indicators, projected progressive rehabilitation, and the monitoring program to be used | Sections 11.9, 11.9.1 and 11.12 |
| m. develop a contingency plan for rehabilitation maintenance or design. | To be prepared as part of the PRCP that will form part of the EA Condition |
| n. assess waste in terms of acid forming potential; describe risks and proposed management | Sections 11.7 and 11.8 and Chapter 8 – Waste Rock and Rejects |

| Terms of Reference | Chapter Section |
|---|---|
| o. provide rehabilitation goals, rehabilitation objectives, indicators of success and completion criteria for each mining domain for the agreed post mining land use | Sections 11.6 and 11.11 |
| p. details and commits to a progressive rehabilitation schedule for the life of mine which:<br>▪ minimise the amount of land disturbed at any one time<br>▪ minimise the residual loss of land and water bodies with ecological or productive value<br>▪ 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<br>▪ specifies the timing, criteria and definition for successfully achieving the progressive rehabilitation goals for all relevant domains | Sections 11.1.1, 11.9.1, 11.11 and 11.12.<br>Further detail to be provided in the PRCP |
| 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 | Sections 11.2, 11.7, 11.8, 11.9, 11.11 and 11.12 |
| 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 | Section 11.9.4 |
| 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 | Sections 11.9.1 and 11.9.2 |
| 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 | Sections 11.11 and 11.12 |
| 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 | Section 11.9 |
| 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 | Section 11.9 |

## 11.1.3 Relevant Legislation and Policy Instruments

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

### 11.1.3.1 Relevant Legislation

#### *11.1.3.1.1 Mineral and Energy Resources (Financial Provisioning) Bill 2018*

Since the release of the original 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 though a PRCP.

The new requirements for financial assurance and rehabilitation for resources activities commenced on 1 November 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. The PRCPs 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.

The Department of Environment and Science (DES) has prepared the PRCP Guidelines (DES 2019a) to assist with the preparation of PRCPs. This SEIS has been updated to provide background information and overarching rehabilitation goals, objectives and post-mining land uses for further detail within a PRCP in relation to the progressive rehabilitation and closure of the Project. CQC envisages that upon approval of the Project, it will prepare a detailed PRCP in accordance with the PRCP Guidelines for the review and approval of DES.

#### *11.1.3.1.2 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 assist the DES in preparing the draft Environmental Authority (EA) for the Project. Rehabilitation requirements will be further refined, planned for and implemented in detail through the PRCP approvals process upon the receipt of the relevant approval for the Project.

**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. In April 2019, DES completed a revision to the Guideline Financial assurance under the Environmental Protection Act 1994 (Financial Assurance Guideline) (DES 2019b). The Financial Assurance Guideline outlines the relevant legislative provisions, including 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.

**Progressive Rehabilitation and Closure Plan**

The previous requirement for a mining proponent to prepare a Plan of Operations and Rehabilitation Management Plan was replaced with the requirement to prepare a PRCP from 1 November 2019. The main purposes of a PRCP are to:

- require the EA proponent to plan for how and where activities will be carried out on land in a manner that maximises the progressive rehabilitation of the land to a stable condition and
- document the condition to which the EA proponent must rehabilitate the land to before the EA may be surrendered.

The PRCP comprises two components: the rehabilitation planning part and the PRCP schedule. The rehabilitation planning part generally includes (as detailed within the PRCP Guideline):

- general information about the site and operation
- information about community consultation
- analysis and justification of the post-mining land uses (and non-use management area, if an appropriate post-mining land use is not able to be achieved)
- justification of timeframes for land being available for rehabilitation (section 126D of the EP Act) and available for improvement (Schedule 6 Part 1 of the *Environmental Protection Regulation 2019* (EP Regulation)) and
- details of the rehabilitation methodologies and techniques that will be used to develop rehabilitation milestones and management milestones and supporting documentation.

The PRCP schedule is to consist of the following:

- rehabilitation and management milestones
- milestone criteria
- identification of post-mining land uses (or non-use management areas)
- when land becomes available for rehabilitation and available for improvement
- rehabilitation areas and improvement areas and
- milestone completion dates.

The progress of operations against the PRCP schedule are to be reviewed every three years by an independent, suitably qualified auditor (Section 285 of the EP Act). The audit report may provide recommendations for actions the holder should take to ensure milestones are achieved and conditions are complied with.

The audit report is to be provided to the administering authority within the required timeframe. Within 10 business days of receiving the audit report, the administering authority may request further information from the holder. The holder has a period of at least 20 business days to provide the requested additional information.

In considering the audit report, the administering authority may amend the PRCP schedule (Section 215 of the EP Act), take appropriate compliance action if a non-compliance is identified or take no further action. The PRCP schedule audit reports are to be made available on a public register.

**Final Rehabilitation Report and EA Surrender**

Upon completion of the Project, CQC will be required to submit an EA surrender application. As part of the surrender application, CQC 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).

#### 11.1.3.2 Policies

The Queensland Government released the Mined Land Rehabilitation Policy in late 2017 following a discussion paper and public consultation process. This policy requires all large mines in Queensland to develop a PCRP as described in the PRCP Guidelines and above sections which implement the policy.

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.

#### 11.1.3.3 Guidelines

The Commonwealth Government's Leading Practice Sustainable Development Program (LPSDP) for the mining industry issued a handbook series in 2006 which was subsequently 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.

The PRCP Guidelines released in November 2019 have replaced the former *EM1122, Rehabilitation Requirements for Mining Resource Activities* (EHP 2014) which were previously used to develop acceptable rehabilitation outcomes and strategies for this Project.

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

- avoid disturbance that will require rehabilitation

- reinstate 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
- reinstate the previous land use (e.g. grazing or cropping) and
- develop lower value land use.

In light of the baseline soil fertility and condition of soils across the Project area and consistent with the current and historical land uses, the Project is aiming to create a final landform which is suited to a low intensity cattle grazing post-mining land uses. The rehabilitated landform will also comprise patches of open woodland vegetation which will provide shade trees for cattle, whilst also facilitating the movement of mobile fauna across the rehabilitated landscape.

The rehabilitation goals described in the former guideline require that 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.

## 11.2 Description of Environmental Values

Under the new LPSDP'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 the PRCP. 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.

### 11.2.1 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 and Climate Change.

#### 11.2.1.1 Key Rehabilitation Considerations

The key rehabilitation considerations with reference to climate are:

- 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 and
- selection of species will include those that are most resilient to climate change.

### 11.2.2 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, regolith 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 11-2.

**Table 11-2: Key landscape processes**

| Process | Description | Relevance |
|---|---|---|
| Water and sediment movement process | The fluvial landscapes and the sediment that will be transported from the mountains into the valleys then deltas. | • Altering this process and movement of sediment within the landscape can significantly change the downstream landscape and<br>• Identify potential downstream impact areas if contamination released offsite. |
| Landscape evolution process | The topographically controlled redistribution of materials through gravitational force moving water and sediment downhill, landslides, soil creep. | • Controls over soil losses<br>• Topography and slope influence erosion and deposition (Chapin, Matson and Vitousek 2011)<br>• Physical pathway by which materials move between ecosystems and<br>• 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. | • Understanding the local weathering pressures and processes at the site<br>• Dissolution of saline content in rock and material overtime and<br>• Stability and integrity risks of reformed areas. |
| Chemical weathering | Process through reactions (dissolution, redox reactions, reaction with water, oxygen or carbonic dissolution). | • Mining rehabilitation with waste rock management to avoid acid mine drainage<br>• Soil salinity and toxicity<br>• Soil sodicity and erosion and<br>• 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 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 water and groundwater. The waste rock is 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 occur and will not pose ongoing risks to rehabilitation success.

Sodicity of waste rock and coal reject composite samples, in the form of Exchangeable Sodium Percentage (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. These matters have been identified to require careful management to ensure the success of the overall rehabilitation program.

#### 11.2.2.1 Key Rehabilitation Considerations

The key rehabilitation considerations with reference to landscape and landform are:

- 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 leachate generation from waste rock because of physical and chemical weathering, through operational management by the selective handling and storage of certain materials back in-pit.
- Effective management of sodic waste materials back in-pit or within residual spoil areas where slope management and rehabilitation timeframes are key considerations.

### 11.2.3 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).

The Project is wholly contained within the Styx River Basin which discharges to the Great Barrier Reef Marine Park (GBRMP) (refer Figure 11-1), 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 11-1). These two small ephemeral creeks meet at a confluence

downstream of the Project area to form the Styx River. The boundary of the GBRMP is located approximately 10 km downstream of the ML area (General purpose zone), with the marine National Park zone 40 km downstream of the ML area.

The Fitzroy Basin Association Natural Resource Management (NRM) manages waters within the Styx Basin. It reports that the most significant risk to the entire Great Barrier Reef Marine Park is sediment (Waterhouse et al. 2015). On average, it is estimated that approximately 9.9 million tonnes (t) of sediment as total suspended solids (TSS) is delivered to the GBR lagoon, with approximately 1.8 million t per year from the Fitzroy region, amounting to 18% of the total sediment load that reaches the GBR (Bartley et al. 2017). The leading land use source of sediment is grazing land which accounts for 75% of the extra sediment entering the Great Barrier Reef Marine Park (Bartley et al. 2017). It is estimated that the Styx Basin contributes approximately 0.1 million t per year of TSS, equating to around 5% of the total Fitzroy region (Bartley et al. 2017).

Cattle grazing is the dominant land use of the area (80%) and around 14% of the Styx basin is comprised of wetlands. Many of the wetlands are estuarine systems (8.8%) with approximately 187 lacustrine / palustrine wetlands (DES 2017).

During peak flood events on the existing (pre-mining) site, these creek systems inundate portions of the proposed mining areas. Whilst flooding will be managed during operations (with appropriately designed flood levees and diversions), the final landform design will consider the effects of such events and facilitate the reinstatement of surface drainage lines through the rehabilitated mine landform back to Tooloombah and Deep Creeks. Further information on hydrology is found in Chapter 9 – Surface Water.

#### 11.2.3.1 Key rehabilitation considerations

The key rehabilitation considerations with reference to hydrology are:

- 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, once runoff and seepage are of a quality which is unlikely to adversely impact known environmental values. Once decommissioned, the landform will be rehabilitated to a stable, non-polluting, vegetated and self-sustaining condition.
- The water storage dams which are required for management of runoff water during mining activities will be removed at mine closure, once runoff and seepage are of a quality which is unlikely to adversely impact known environmental values. Once decommissioned, the landform will be rehabilitated to a stable, vegetated and self-sustaining condition.
- Final landform design to incorporate stable, vegetated and self-sustaining drainage lines to assist surface runoff to be conveyed towards the neighbouring creeks, generally consistent with the pre mining hydrology.
- Re-establish fish passage opportunities.

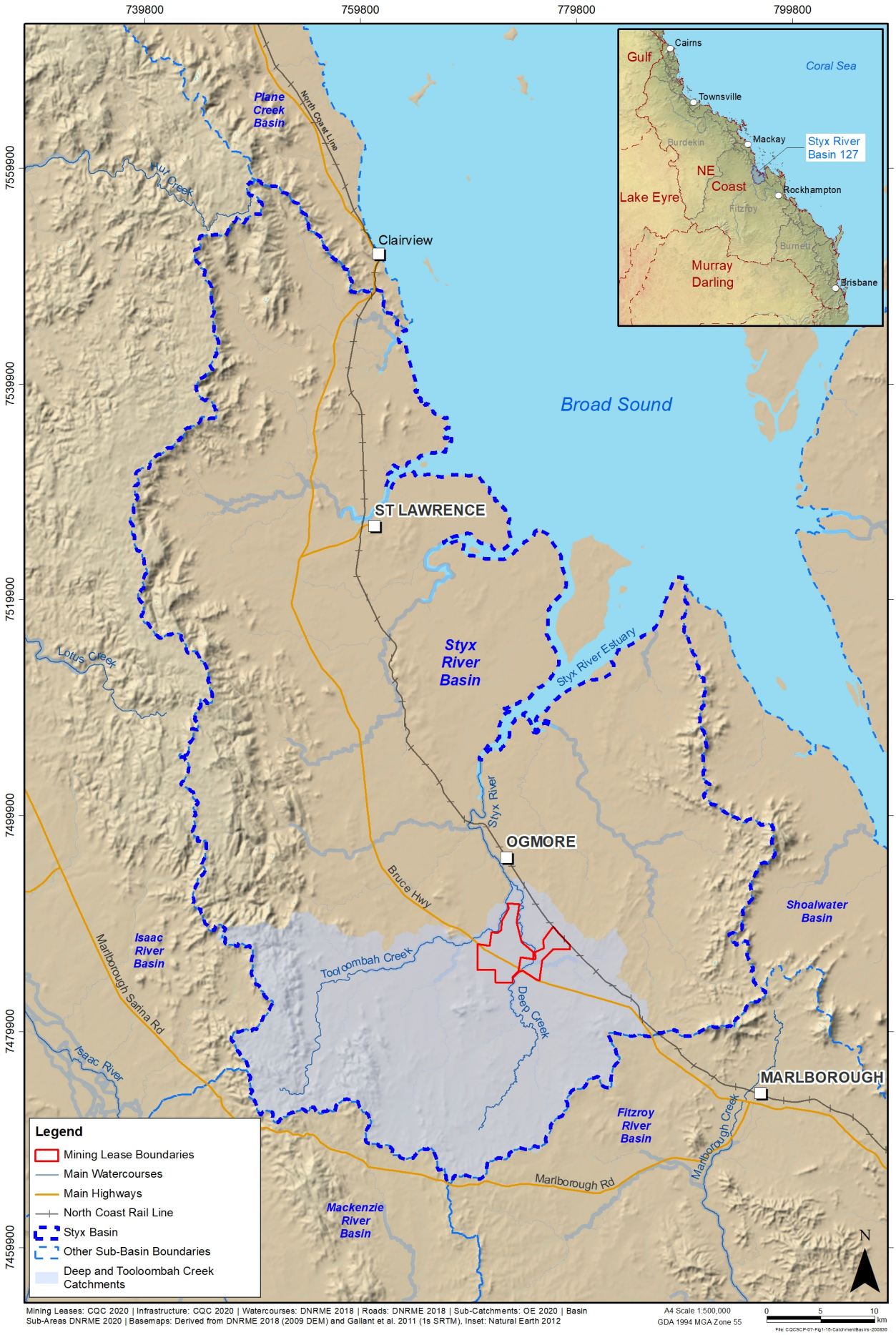



**Figure 11-1: Catchments and major waterways**

### 11.2.4 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 and 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 et al. 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, Kandosols and Rudosols. The soil properties and land capabilities are outlined in Chapter 5 – Land. Most soil types have few physical root limitations however, the clay sodic B horizon of the Sodosol was identified to restrict root growth. Within the CQC mine area, soil salinity is generally low except for some salt build up found in the B horizons (i.e. subsoils) of the Sodosols. The subsoils within the Sodosols and Vertosol soils within the Project mine area were also identified to be highly sodic and dispersive at depth and could be prone to erosion and soil structural decline, if not managed appropriately during disturbance. Sodic subsoils were identified by HESSE (Appendix 3a) to potentially be used as a primary growth medium, following the amendment with gypsum and fertiliser, and the addition of organic matter. This soil amelioration was recommended to be undertaken during the stripping and stockpiling process to ensure that these materials will be suitable for rehabilitation activities (see Appendix 3c). Other soil types within the Project mine area were identified to be non-sodic and all soils are suited to extensive dryland grazing of native

or improved pastures. The baseline soil fertility (particularly phosphorus) and organic carbon levels within the Project area is low to moderate and most are suitable for pasture production and beef cattle grazing.

HESSE (Appendix 3a) identified an extensive topsoil and subsoil resource within the Project mine area which if managed appropriately would be valuable in the rehabilitation of the mine site. Further to this, RGS Environmental (Appendix 3c) identified the potential for use of underlying weathered materials (i.e. regolith) as a further layer on mine rehabilitation, underlying the subsoil and topsoil.

#### 11.2.4.1 Key Rehabilitation Considerations

The key rehabilitation considerations with reference to geology, soils and root zone function are:

- loss of topsoil fertility and viability from storage of soil resources over extended time periods
- soil pH should be used as an indicator for the Kandosol soils generally in the vicinity of the rail loop, which have the potential to create aluminium toxicity if conditions become acidic and will require application of lime to these soils prior to use in rehabilitation
- the subsoils recovered from Vertosols and Sodosols have tendencies to pose secondary salinity problems, which will need to be addressed during the stripping and stockpiling of these materials to facilitate later use within the rehabilitation and
- sodic soils (i.e. subsoils from Vertosols and Sodosols) have the potential to be highly erodible if used untreated on slopes in high intensity rainfall areas and as such, will need to be addressed during the stripping and stockpiling of these materials to facilitate later use within the rehabilitation.

### 11.2.5 Management of Sodic or Dispersive Materials

Sodicity of waste rock and some coal reject composite samples, in the form of Exchangeable Sodium Percentage (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.

Sodic and dispersive materials will be identified, selectively handled and placed within the core of waste rock stockpiles (or returned to voids during mining) well below the final landform surfaces. Where sodic waste materials may be required for use as an additional growth media, prior treatment would likely be required. The most effective means to ameliorate against sodicity during rehabilitation works is to apply and incorporate gypsum, rock mulch 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 a stand alone approach. As such, the following additional management practices will be employed:

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

- Very High >15%

Other tests that can be used to determine sodicity are dispersion or the Emerson Aggregate Test

- Selectively bury high to very highly sodic spoil. Within the waste rock stockpiles, consideration will be given to ensuring such sodic materials will be emplaced in areas well below the final landform design levels.
- Ensure moderately sodic material is top dressed with topsoil and/or other suitable materials. Weathered rock materials (i.e. regolith materials) within the Project mining area have also been identified as a suitable primary and/or secondary growth media to assist in retaining soil moisture content within rehabilitation.
- Low and very low sodic material can be sown with pasture, 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).

The temporary waste rock stockpiles to be constructed during the initial years of mining operations may contain some areas of sodic materials on the surface. RGS Environmental (Appendix 3c) and Engeny (Appendix A15a) have identified that surface runoff from these temporary landforms may be managed by armouring the landform with competent and durable rock materials recovered from the mining areas.

### 11.2.6 Terrestrial Ecology

Vegetation communities within the Project mine area 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 (*E. crebra*). 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 Train Loadout Facility (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.

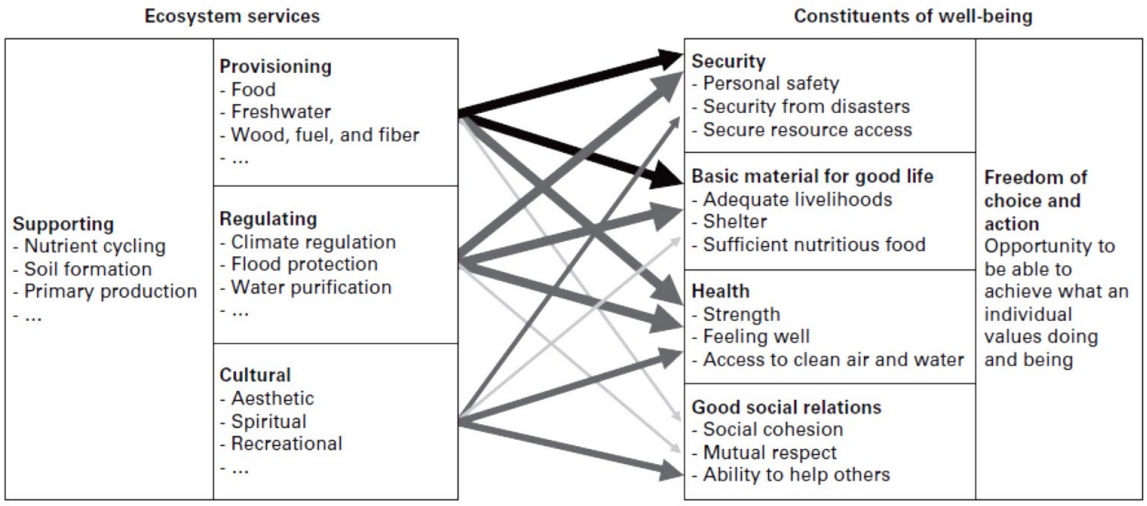
#### 11.2.6.1 Key Rehabilitation Considerations

The key rehabilitation considerations with reference to terrestrial ecology are:

- Restoration of the current vegetated areas surrounding the Project mine area, including the Mamelon property offset areas will assist in protecting the 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 of these species, vegetation restoration of areas outside the disturbance area and adjacent to creeks and drainage lines, potential food and habitat needs of these species is included.
- Framework species of existing Regional Ecosystems onsite to be used in seed mix and flora food and habitat species for keystones species.

## 11.3 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 11-2.




Source: Bouma and Beukering 2015

**Figure 11-2 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.

## 11.4 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.

CQC intends to manage its operations and conduct decommissioning and rehabilitation activities to ensure that the land disturbed is returned to land suitable for low intensity cattle grazing activities following the completion of mining operations. Land held by the applicant which neighbours the mining areas which will remain undisturbed throughout the proposed mining activities will be rehabilitated and managed to naturally regenerate 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.

## 11.5 Rehabilitation Framework

The Project will be decommissioned following the depletion of the target coal resource and final rehabilitation activities have been completed. The primary aim of rehabilitation will be to establish a landform with no final voids that is suitable to be used for low intensity grazing land uses.

To achieve the final landform objective of having a free draining landform with no final voids, rehabilitation activities during the initial years of mining operations will target the temporary stabilisation of the two main waste rock emplacement areas which are proposed to be developed to manage waste rock initially extracted from the open cut mining areas. Temporary rehabilitation of these waste rock emplacement areas will be required as a priority to stabilise the outer slopes and to manage erosion risk throughout the life of mining operations. These stored waste rock materials will (in part) be utilised to fill the final void areas at the completion of mining operations. At this time, the remaining materials within the emplacement areas will be reshaped and rehabilitated according to the final landform design.

Open cut mining will progressively backfill as it advances, with both ex and in-pit waste rock stockpile areas utilised. The resulting elevated landform will require reworking as described above in the later years of the Project, and mining operations are scheduled to advance beyond this initial waste rock footprint in approximately Year 12 (i.e. to areas beside the waste rock stockpiles to be reworked). At this time, progressive rehabilitation will continue following the completed mining operations (refer to the rehabilitation schedule in 11.9.1). 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 operations and associated rehabilitation activities are completed and plant and structures have been decommissioned.

The above Rehabilitation Framework will be further developed and will continue to evolve over time to reflect changing regulatory requirements, community values, and lessons learned onsite or at other mines.

A PRCP was not required as part of the Terms of Reference (ToR) for the Project dated 4 August 2017. However, in light of the recent commencement of the new financial provisions and rehabilitation requirements, this SEIS includes information which is typically required for inclusion within a PRCP. A formal PRCP will be developed at a later date based on the objectives and goals presented within this SEIS which seek to provide predetermined land uses for the different land units (domains) of the mine (see Section 11.11).

The PRCP will (based on the comprehensive assessments provided within this SEIS) 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 domain (see Section 11.11) will be further refined and developed within the PRCP prior to the commencement of mining operations. These success criteria will be used to demonstrate the success of final rehabilitation works. The rehabilitation works will be designed and completed 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.

## 11.6 Mine Domains

Rehabilitation goals and strategies for the Project have been described in previous EIS and SEIS volumes, and discrete elements to be rehabilitated within each domain were described. The previous SEISv2 proposed the rehabilitated mined landform would be returned for biodiversity conservation land-use. However, in light of regulatory submissions received on the previous SEISv2 and further reviews of the proposed final landform design, the following section provides an updated post-mining goal to return the rehabilitated mine landform to low intensity cattle grazing land-use.

Since the EIS was initially submitted, it has been confirmed that most of the Mamelon Property, including most of the ML, will be destocked. Cattle grazing will be progressively decreased within the mining leases during the operational period and at approximately year 10, no grazing is proposed within the entirety of the two leases. In addition, the adjacent offset area on Mamelon will be destocked and no grazing will occur within the offset areas, except on a periodic as-needed basis to manage fuel load and weeds. The total area to be destocked across the property is over 5,000 ha.

The following sections provide an updated description, based on changes to the mine design and the updated rehabilitated mine landform and land use.

### 11.6.1 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, namely:

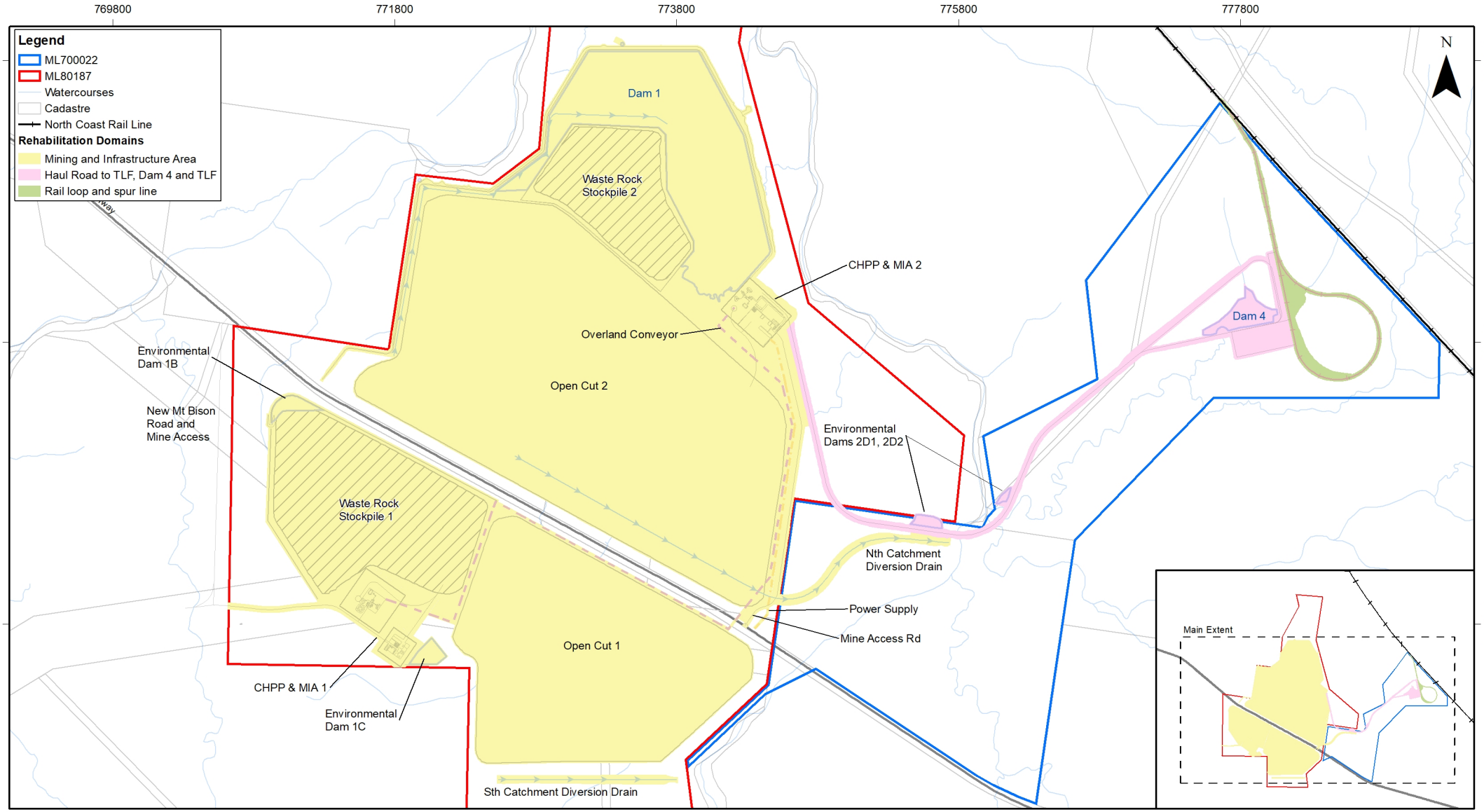
- Mining and Infrastructure Area
- Haul Road to TLF and Environmental Dams, Dam 4 and TLF and
- Rail loop and spur line.

The Mining and Infrastructure Area is further divided into sub-domains. The domains, sub-domains and surface areas are provided in Table 11-3 with each domain illustrated in Figure 11-3. Note that these represent the disturbance / clearing footprint, rather than the infrastructure area itself. As such, the areas provided are that of the infrastructure plus the associated clearing footprint, and so will differ from the areas that may be reported in other chapters, such as Chapter 1 – Introduction and Project Description.

**Table 11-3: Rehabilitation domains and surface area**

| Project Component | Approximate area (ha) |
|---|---|
| **Mine Domain: Mining and Infrastructure Area** | **1287.2** |
| Open Cut 1 | 255.7 |
| Open Cut 2 | 531.6 |
| Waste Rock Stockpile 1 | 152.6 |
| Waste Rock Stockpile 2 | 76 |
| Environmental Dams | 6.6 |
| Dam 1, Dam access road and Embankment / Levee | 157.8 |
| MIA & CHPP 1 and 2 | 39.5 |
| Catchment Diversion Drains | 18.6 |
| Mine access and internal roads – Open Cut 1 | 6.9 |
| Mine access and internal roads – Open Cut 2 | 9.2 |
| Power supply | 4.2 |
| Conveyor | 10.6 |
| Ancillary areas within mining and infrastructure area | 17.9 |
| **Mine Domain: Haul Road to TLF and Environmental Dams, Dam 4 and TLF** | 55.1 |
| **Mine Domain: Rail loop and spur line** | 17.9 |
| Total within Mining Lease | 1360.2 |

Strategies to achieve rehabilitation goals for each specific Project domain are provided in Table 11-4.




Sources: Infrastructure, ML Boundaries: CQC 2020 | Domain Zones: CQC 2020, derived by OE 2020
Basemap: ESRI World Street Map

A4 Scale 1:37,500 0 0.375 0.75 km
GDA 1994 MGA Zone 55
CQCSCP-07-Fig11-03-RehabilitationDomains-200623, 25 Aug 2020

**Figure 11-3: Rehabilitation domains**

**Table 11-4: Strategies to achieve rehabilitation goals based on individual domains**

| Domain and sub-domain | Goal | | | |
|---|---|---|---|---|
| | Safe | Non-polluting | Stable landform | Sustains agreed land use |
| **Mine** | | | | |
| Open cut pits (excluding areas covered by Waste Rock Stockpiles) | Backfill to original ground level (or higher to allow for settlement) to the extent possible (i.e. no final void to remain). | No residual water contained. | Settled, compacted and stabilised. | Return to condition consistent with pre-mining land use (i.e. low intensity cattle grazing). |
| 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 (i.e. generally less than 7 degrees) and designed to sustainably convey surface runoff. | |
| 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.<br>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. | |

| Domain and sub-domain | Goal | | | |
|---|---|---|---|---|
| | Safe | Non-polluting | Stable landform | Sustains agreed land use |
| **Haul Road** | | | | |
| Road, road furniture, drains, and cut and fill | Removal of all above ground infrastructure.<br>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 pre-mining land use (i.e. low intensity cattle grazing). |
| 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. | |
| **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 pre-mining land use (i.e. low intensity cattle grazing). |
| 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. | |

## 11.7 Geochemical Analysis of Mineral Waste Material

Chapter 8 – Waste Rock and Rejects provides a summary of the geochemical analysis and characterisation undertaken for the overburden, interburden and Coal Handling and Preparation Plant (CHPP) waste streams that have been undertaken for the Project. RGS Environmental (2020a) has prepared a technical assessment report (refer to Appendix 3b),which outlines the geochemical sampling and analysis work which have been completed for the approvals stage of the Project and has recommended a work program for refined sampling and analysis throughout the ongoing mining operations to inform management actions to be implemented.

The geochemical assessments have demonstrated that an overwhelming majority of the waste rock and potential coal reject materials have low sulfide content, excess Acid Neutralising Capacity and are classified as Non-Acid Forming (NAF) materials. Accordingly, these materials have a very low risk of acid generation and there is a high factor of safety with respect of potential acid generation from the mine.

Surface runoff and leachate from the waste rock and potential coal reject materials is expected to be alkaline and have a low level of salinity and low levels of dissolved solids. Further to this, given the alkaline nature of the waste rock and potential coal reject materials, dissolved metal/metalloid concentrations within the surface runoff and leachate from the bulk NAF Materials are expected to be low and are unlikely to lead to any significant risk to surface water and groundwater qualities.

NAF waste rock materials have been identified to be a potentially useful resource for rehabilitation activities. However, these materials have the potential to be sodic and may require treatment and appropriate management to minimise the potential for dispersion and erosion of the rehabilitated landforms.

## 11.8 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. As indicated above, the waste rock is expected to have a low capacity to generate acid and a low to 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 be generated, possibly with degraded 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 end uses such as for 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 ex-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.

Although the potential for acid and metalliferous drainage (AMD) or saline mine drainage (SMD) from the waste rock and potential coal reject is considered low, it has the potential for the following impacts may occur:

- changes to the salinity of groundwater within the water table (although much of the groundwater resource is already saline)
- changes to pH of groundwater and the mobilisation of dissolved metals and
- effects on stock watering and aquatic ecology dependent on shallow groundwater.

The salinity of rejects is expected to be low and the sodicity is variable. Surface salinity contents of exposed reject surfaces can increase by oxidisation, 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.

### 11.8.1 Waste Rock Stockpiles Design and Disposal Method

Two waste rock stockpiles will be developed during the initial years of operations to facilitate the early development of the two mining areas. These waste rock stockpiles will store waste rock materials which will ultimately be utilised to infill the mining areas at closure to ensure no final voids remain in the landscape.

The proposed mining and associated disturbance areas are generally constrained by mining lease boundaries and the two neighbouring local drainages - Deep Creek and Tooloombah Creek. The conceptual mine plan design for the Project entails temporary rehabilitation of the waste rock stockpiles to manage water runoff and erosion of these landforms during the ongoing mining operations. Final shaping and rehabilitation of the waste rock stockpiles according to the final landform design will be undertaken following the recovery and use of stored materials to fill the completed mining areas at closure to ensure no final void remains in the landscape.

The detailed design and management of waste rock materials 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 (including temporary rehabilitation where final rehabilitation is not able to be achieved) whilst also optimising for mine closure outcomes.

The management of waste rock materials will be integrated with the overall mine planning which will be described within the PRCP. Accordingly, any changes to the PRCP 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.

During the initial development of each open cut, waste rock will be hauled via a fleet of trucks to out-of-pit waste rock stockpiles. Topsoil and other suitable growth medium (such as subsoil and regolith materials) will be recovered and stockpiled for later use on mine rehabilitation from the surface footprints of the waste rock stockpiles. The waste rock stockpiles will be strategically developed, graded and compacted to ensure no internal pooling of water and to minimise the infiltration of water into the stockpiled materials. The stockpiles will be bunded around their perimeter to capture and divert any rainfall runoff from these stockpiled materials into the mine water management system.

As mining operations progress and sufficient working areas have been developed within the open cut, waste rock will be emplaced into the completed mining areas and facilitate progressive rehabilitation. Any surplus waste rock materials will continue to be temporarily emplaced within

the waste rock stockpiles and be available at closure to assist in filling the mining area to ensure no final void remains in the landscape.

The conceptual mine plan design has located the waste rock stockpile areas with consideration of 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 will be designed in a manner that avoids and minimises the potential for environmental harm through erosion whilst also facilitating the success of rehabilitation activities, including the establishment of suitable final landforms and vegetative cover. Some weathered rock and other waste rock materials with the potential to become dispersive (and accordingly be susceptible to erosion) will be selectively handled and emplaced at the base of waste rock stockpiles or emplaced deep within the mining areas and capped beneath suitable materials. Consideration will also be given to ensure this material is emplaced within areas which remain well below the proposed final landform design to avoid the need to rehandle this material at mine closure. These measures will ensure that the waste rock materials with the most potential to disperse (and result in erosion impacts) will be appropriately managed to ensure the success of the overall rehabilitation strategy.

Identifying and selectively utilising waste rock materials with low sodicity will be important for the final shaping and rehabilitation of the waste rock stockpiles at mine closure. Thus, materials characterised and validated as non-dispersive and non-sodic will be used for the outer slopes of waste rock stockpiles to limit the potential for dispersion and erosion, with identified sodic materials disposed of within the central (inner) zones (i.e. below the final landform design) of waste rock stockpiles. Surface run-off 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 two waste rock stockpiles according to the conceptual mine plan design are shown in Figure 11-4.

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 waste rock materials will initially be emplaced with slopes generally less than angle of repose for geotechnical stability and to facilitate temporary rehabilitation activities. The outer slopes of these temporary waste rock stockpiles will be armoured with competent and durable rock materials which is to be sourced from certain strata within the mining areas. The materials within these temporary waste rock stockpiles will be used to fill the final mining areas, following which remaining materials flattened and reshaped to the final landform design for rehabilitation.

With the implementation of the above described characterisation and management of waste rock materials, the waste rock stockpiles are not considered to pose significant management issues to the Project with respect to erosion.

Waste rock materials to be used in the construction of roads and hard-standing areas will be subjected to engineering and geotechnical testing to their suitability for this purpose. Any sodic and dispersive materials identified will be selectively handled and managed as described above.

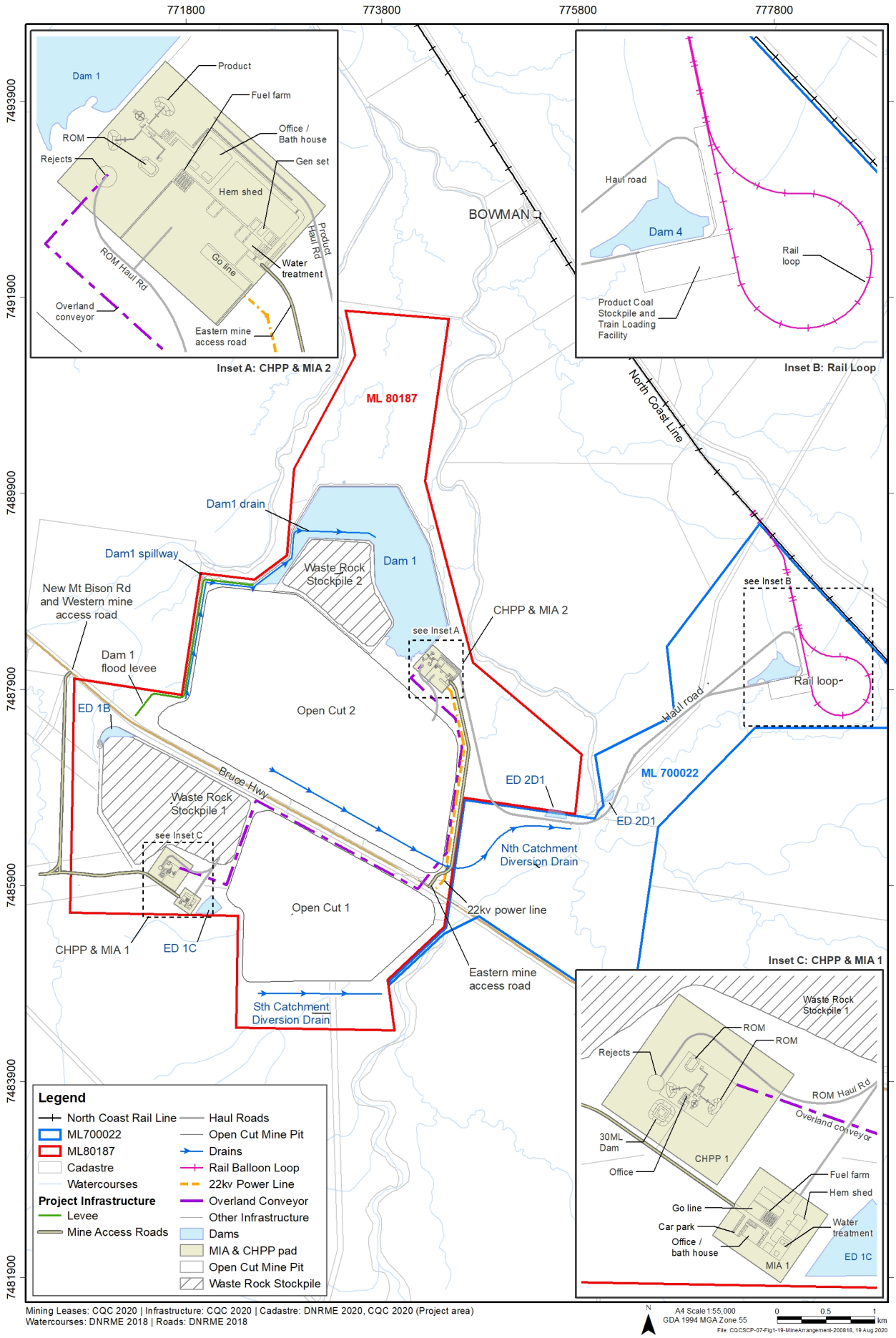



**Figure 11-4: Project layout**

### 11.8.2 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 former 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 at worst a very small proportion of overburden samples having potential to generate acidic drainage (the bulk material has been determined to be non-acid forming by RGS Environmental, refer Appendix A3b). Rejects management will:

- Produce stable coarse and filter pressed rejects suitable for co-disposal with overburden and burial.
- Minimise disturbance to the environment by strategically and heavily diluting all rejects with non-acid forming overburden materials in central locations and at the base of the waste rock stockpiles during the initial years of operation, prior to Steady State Mining. Further, all rejects will be strategically emplaced within the open cut mine void, after mining operations have reached Steady State.
- 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 waste rock stockpiles and in the open cut mine void. Further detail on the management of coarse and fine reject materials is presented within Chapter 8 – Waste Rock and Rejects.

### 11.8.3 Mineral Waste Management Plan

Waste rock and coarse and fine rejects generated during the extraction of the coal resource will be managed as outlined within the Mineral Waste Management Plan (MWMP) which will be prepared for the Project. Further details on the MWMP are further discussed within Chapter 8 – Waste Rock and Rejects.

## 11.9 Proposed Rehabilitation Strategy

Originally, the 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 19 - 24 Program was developed to reflect those changes. This SEIS has resulted in further refinements to the proposed mine plan and resulting rehabilitation strategy which is described within the following sections.

All mining voids associated with the Project are now proposed to be infilled. This rehabilitation goal will be achieved at mine closure by utilising materials stored within the waste rock stockpiles to fill the remaining mining void areas back to near natural ground levels.

The following sections provide an updated Progressive Rehabilitation Program which will be further developed in the PRCP.

### 11.9.1 Progressive Rehabilitation Program

Progressive rehabilitation activities will be undertaken to all open cut mining areas and waste rock stockpiles as areas become practicably available for rehabilitation. Where open cut mining areas or waste rock stockpiles remain inactive for a considerable period of time, temporary rehabilitation activities will be undertaken to assist in landform stability. The main features of the progressive rehabilitation process are:

- constructing stable landforms for all disturbed areas
- topsoil spreading across available reshaped areas which meet the final landform design
- 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 24 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 PRCP to be prepared for the Project. The PRCP will identify areas to be rehabilitated and provide specific rehabilitation details for each domain and desired post-rehabilitation land use.

**Construction -** Will commence in the year prior to mining. All work areas (including footprints of the advancing mining operations and waste rock stockpiles) will be cleared and grubbed with disposal of vegetation. Topsoil (and other suitable soil materials) will be stripped and separately stockpiled for future use on mine rehabilitation. Primary sediment controls such as dams and drainage diversions will also be constructed in this phase.

**Operational Years 1 to 19 –** Waste rock stockpiles to be utilised initially during Box Cut and pit development for overburden and for coal reject materials (including coarse and fine reject materials – refer Chapter 8 – Waste Rock and Rejects for further disposal details). Waste rock stockpiles will initially be constructed and temporarily rehabilitated during the operational years to ensure landform stability. It is noted these waste rock stockpiles will provide the materials required during the years of the post-mining completion works to establish the final landform design which contains no final void within the landscape. It is scheduled that the western most portion (~8.5ha) of Waste Rock Stockpile 2 will be able to be shaped and permanently rehabilitated to the final landform design by approximately Project Year 4.

Reshaping and stabilisation of in-pit dumps will continue throughout the operational years. Progressive rehabilitation, including reshaping, topsoiling and seeding will be undertaken on these in-pit dumps through the operational period as areas become practicably available.

**Post-mining Completion Works Years 19 to 24 –** As indicated above, all voids will be in-filled, shaped, topsoiled and seeded using materials which are stored within the temporarily rehabilitated waste rock stockpiles. Once voids are in-filled, remaining waste rock stockpiles will be reshaped and contoured, stabilised, topsoiled and seeded. Mine infrastructure will be decommissioned and dismantled for removal from site with the individual locations rehabilitated accordingly. Dams and access roads will be decommissioned and rehabilitated (unless an alternate future beneficial use is identified and approved by the regulator at the time). Rehabilitated areas will be monitored and if necessary, reworked to achieve the required completion criteria.

The primary 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 the waste rock emplacements and the two open cut pits is shown as schematics in Figure 11-6 and Figure 11-7:, based on the cross sections shown in Figure 11-5. The progressive rehabilitation of the temporary and final landform designs are shown in Figure 11-8 to Figure 11-12. These figures illustrate the progression of mining operations and associated rehabilitation at various stages. The figures illustrate the development of waste rock stockpiles and in-pit dumping where temporary and final rehabilitation has been completed in Project Years 4, 6, 12, 18 and the final landform.

The final waste rock stockpiles (after reshaping) are located outside the main channel flood extent of Tooloombah and Deep creeks for the 0.1% Annual Exceedance Probability (AEP) flooding (refer Chapter 9 – Surface Water). The northern overburden emplacement will cross the alignment of the existing drainage path that drains the proposed mining area. As such, the backfilled mining pit will include realigned drainage paths to drain local runoff, as well as any flow breakouts from Deep Creek, to Tooloombah and Deep Creeks. The Indicative alignments for the realigned drainage paths are shown in Figure 11-13. Shallow flood depths extend over parts of the backfilled pits for the 0.1% AEP event (and to a lesser extent the 1% AEP event).

Progressive rehabilitation will also include the rehabilitation of any areas disturbed during construction that are not required for ongoing operations.

The PRCP will include annual rehabilitation schedules and detailed rehabilitation design drawings. As the PRCP 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.

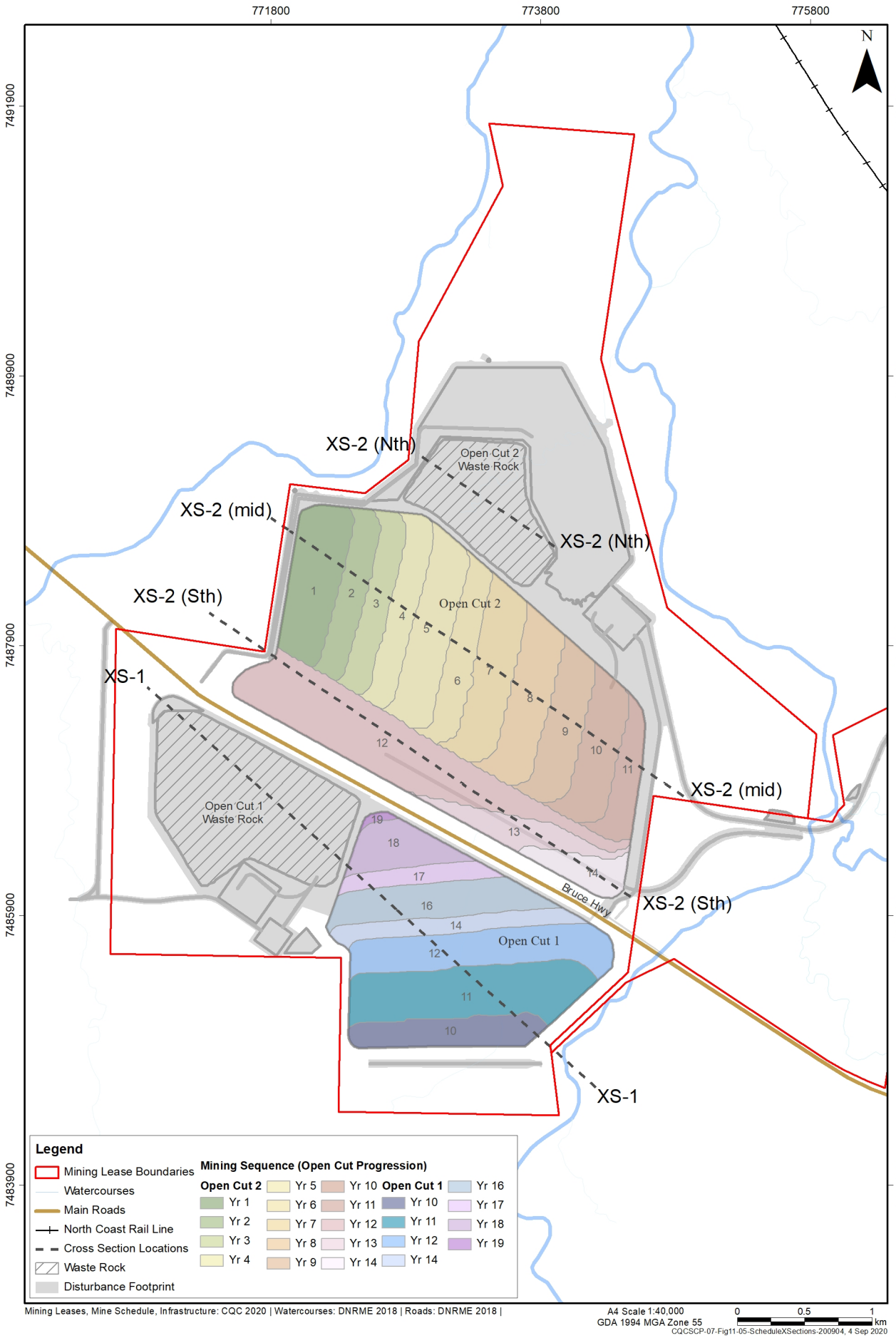



**Figure 11-5: Mining schedule and location of conceptual cross sections**

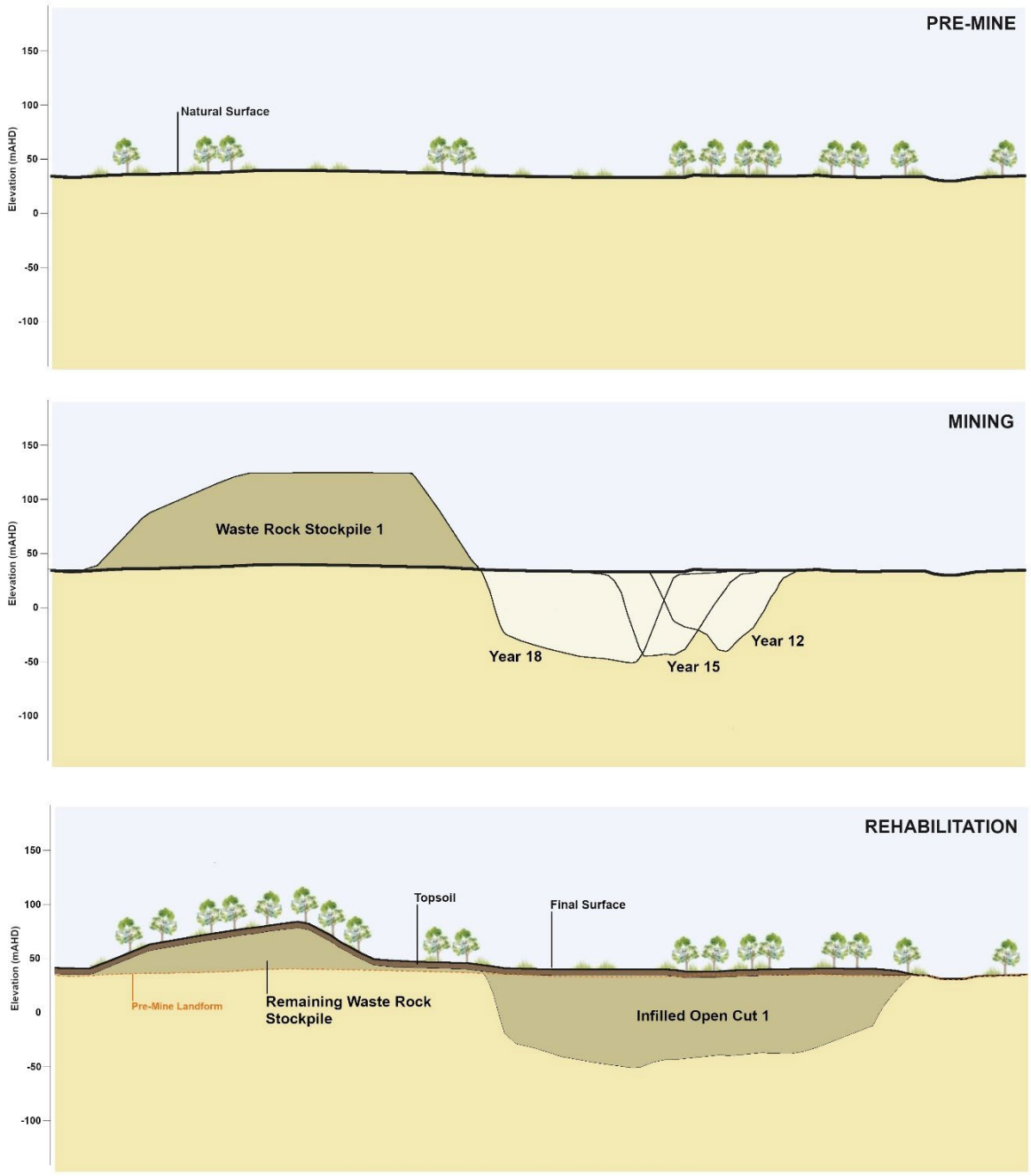



**Figure 11-6: Indicative rehabilitation schematic Open Cut 1 (XS-1)**

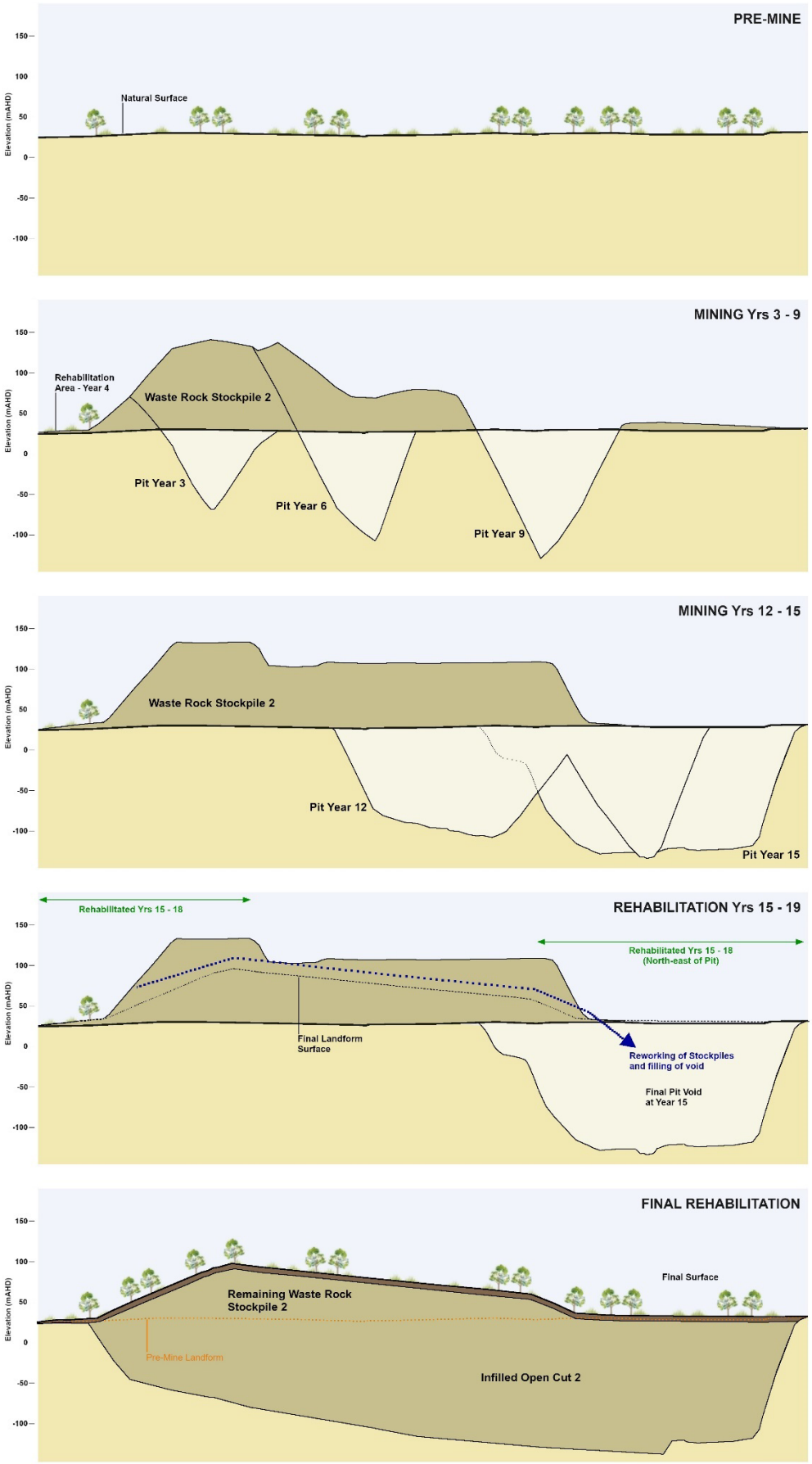



**Figure 11-7: Indicative rehabilitation schematic Open Cut 2 (XS2 – combination of N, Mid, S)**

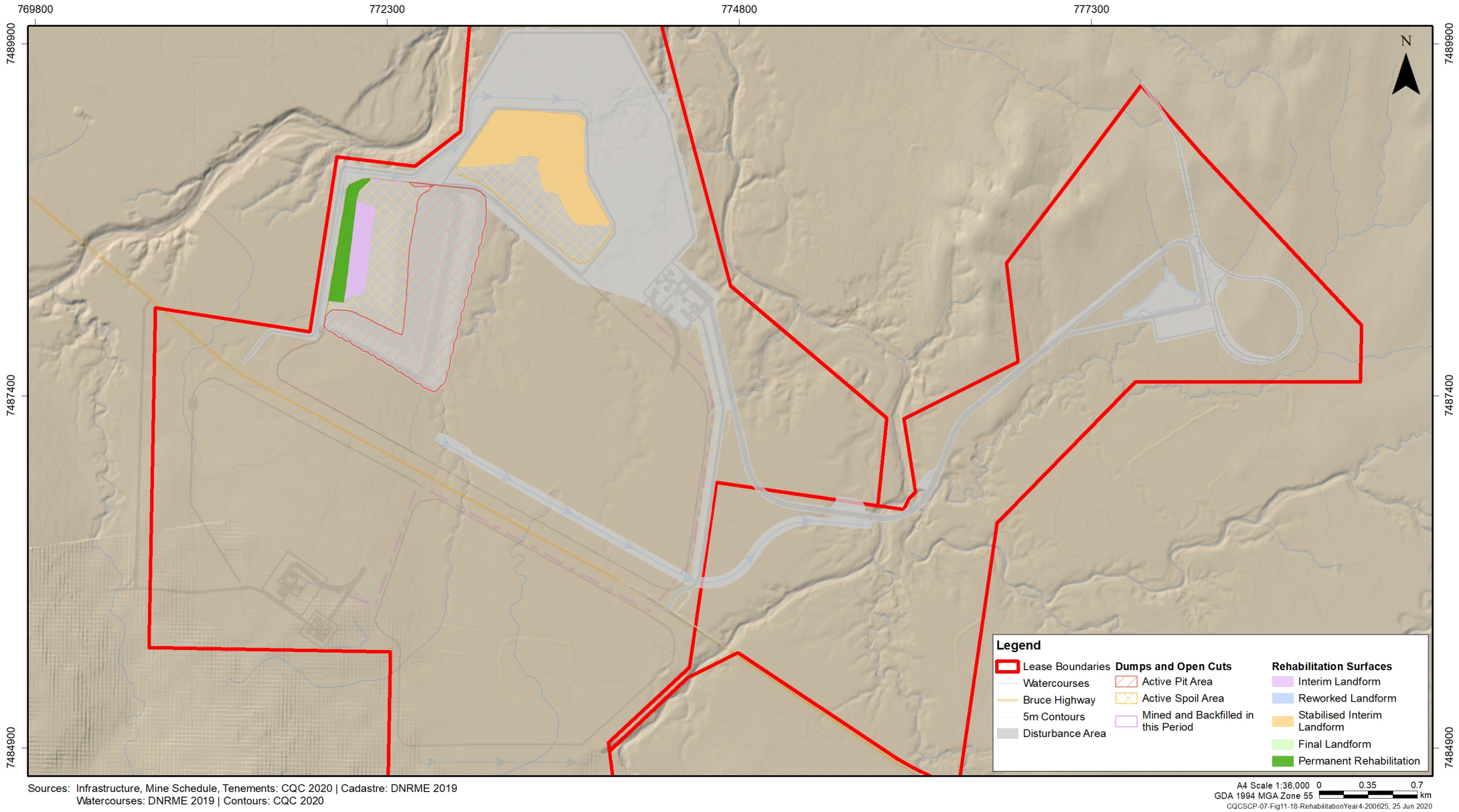



**Figure 11-8: Progressive rehabilitation Project Year 4 (2024)**

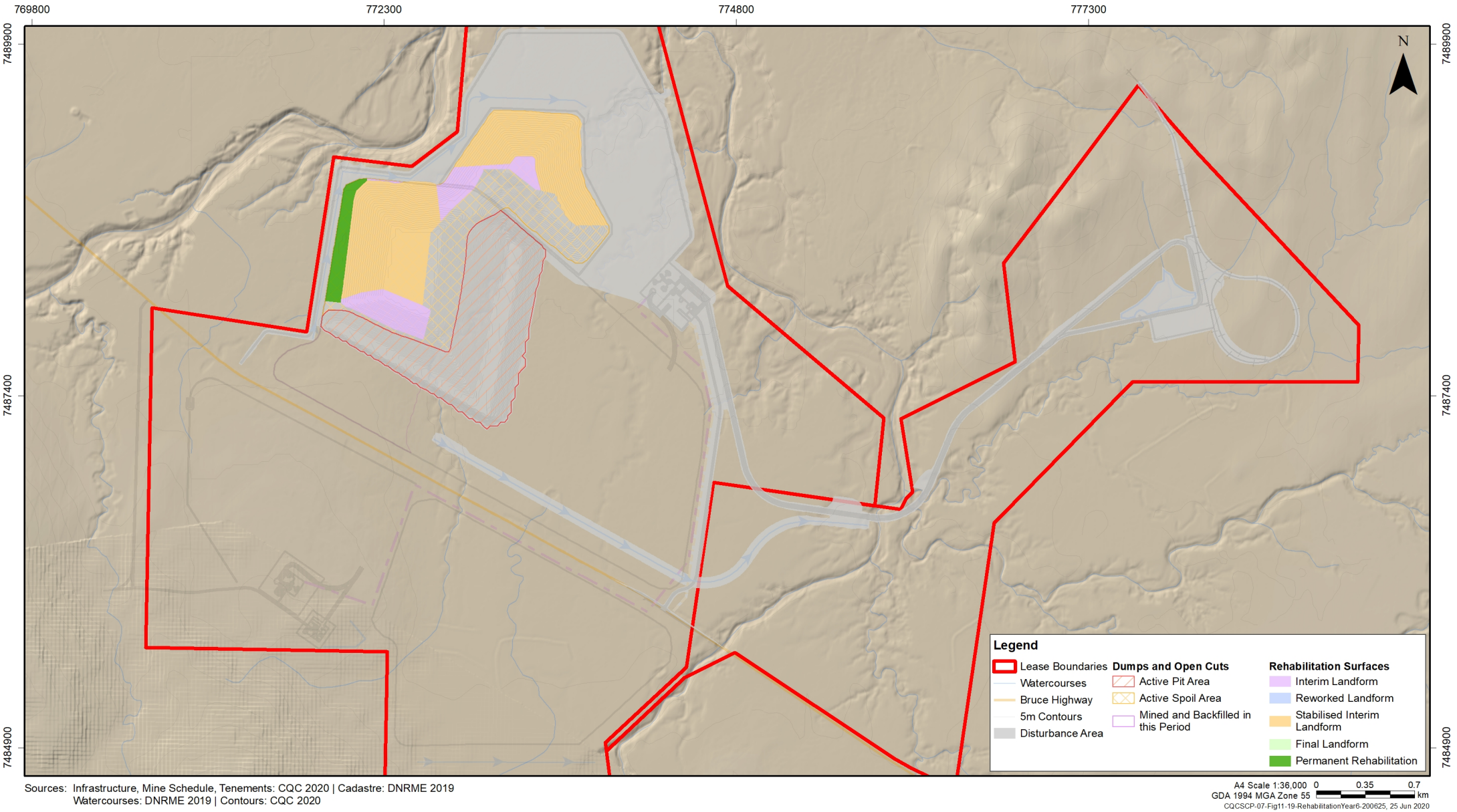



**Figure 11-9: Progressive rehabilitation Project Year 6 (2026)**

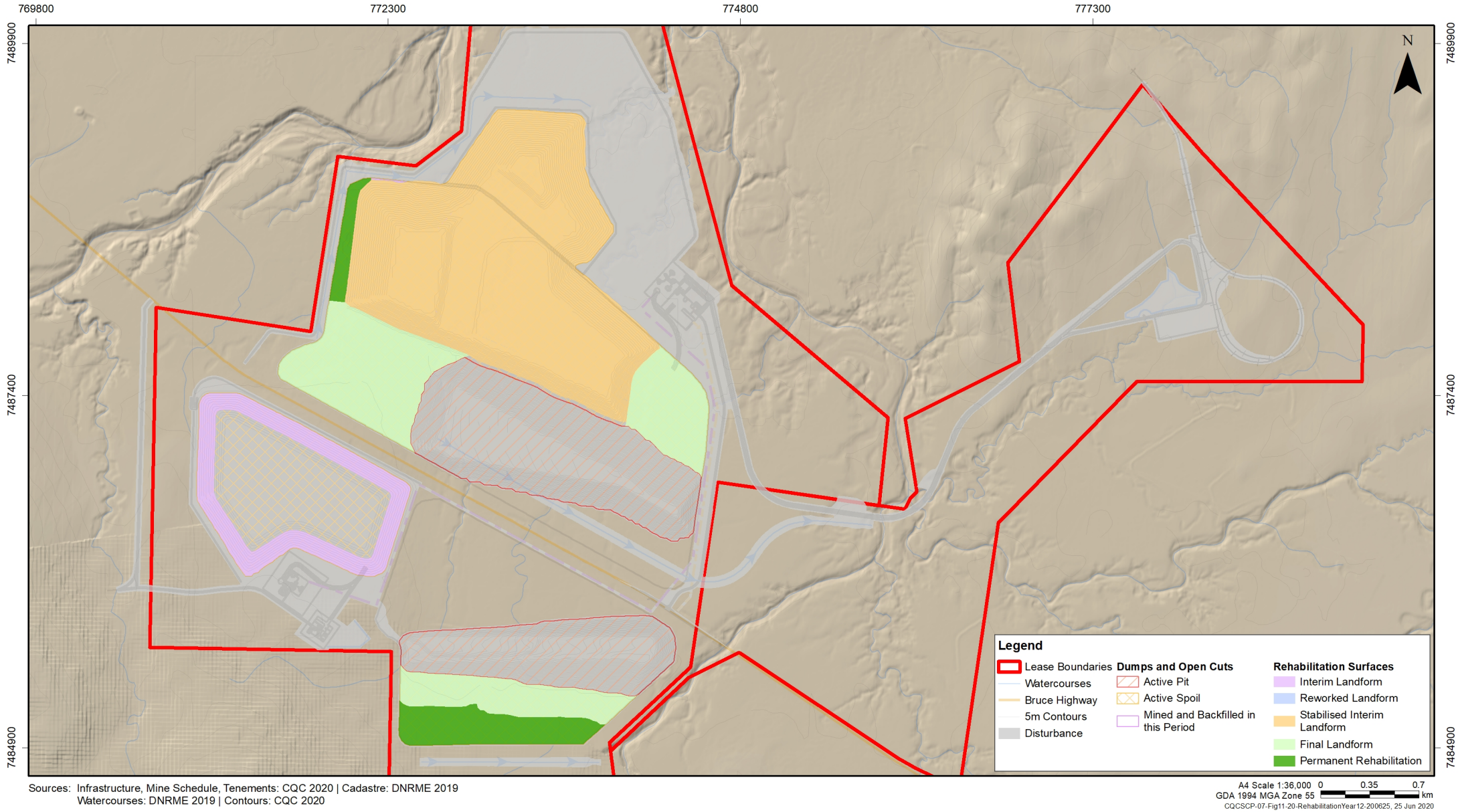



**Figure 11-10: Progressive rehabilitation Project Year 12 (2032)**

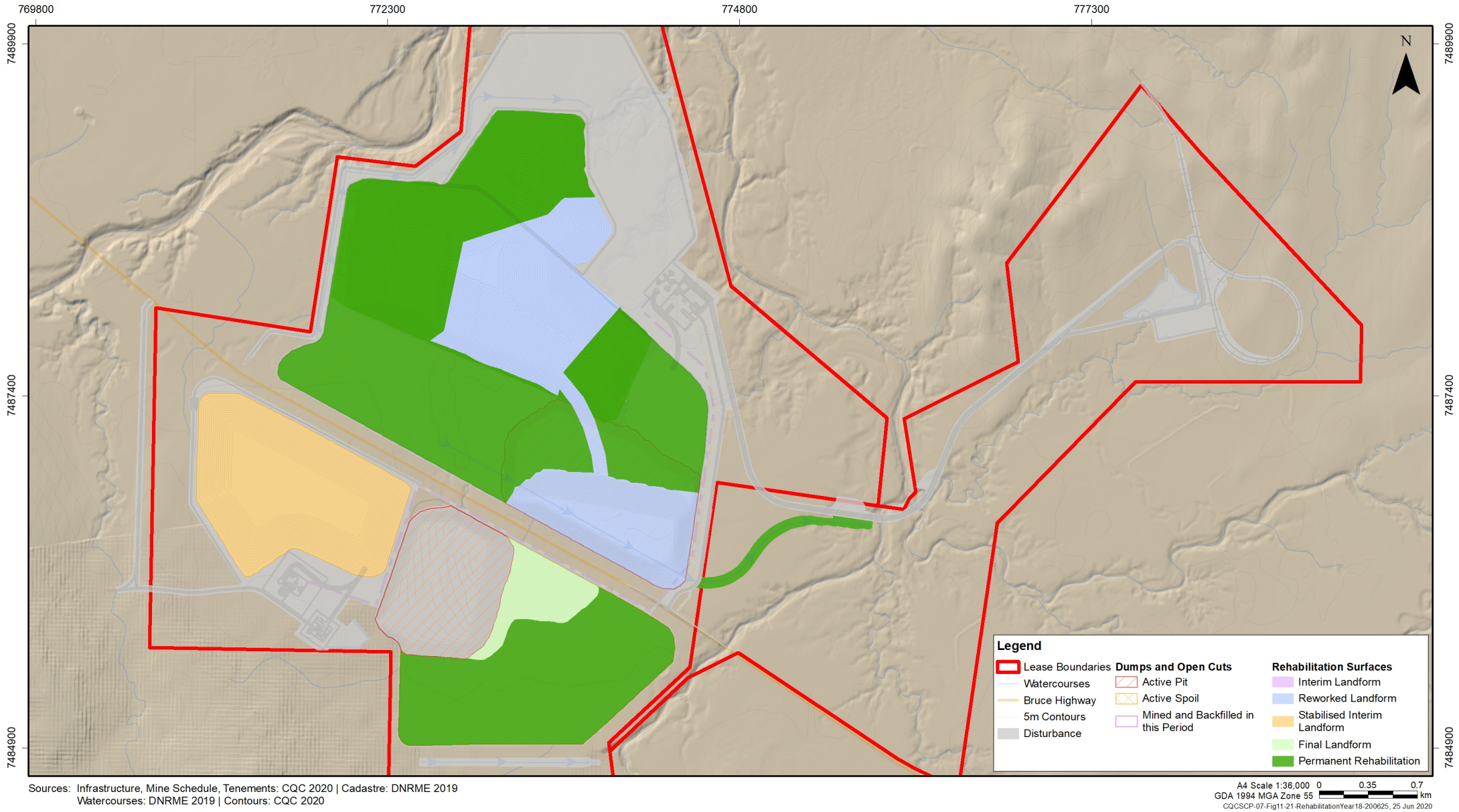



**Figure 11-11: Progressive rehabilitation Project Year 18 (2038)**

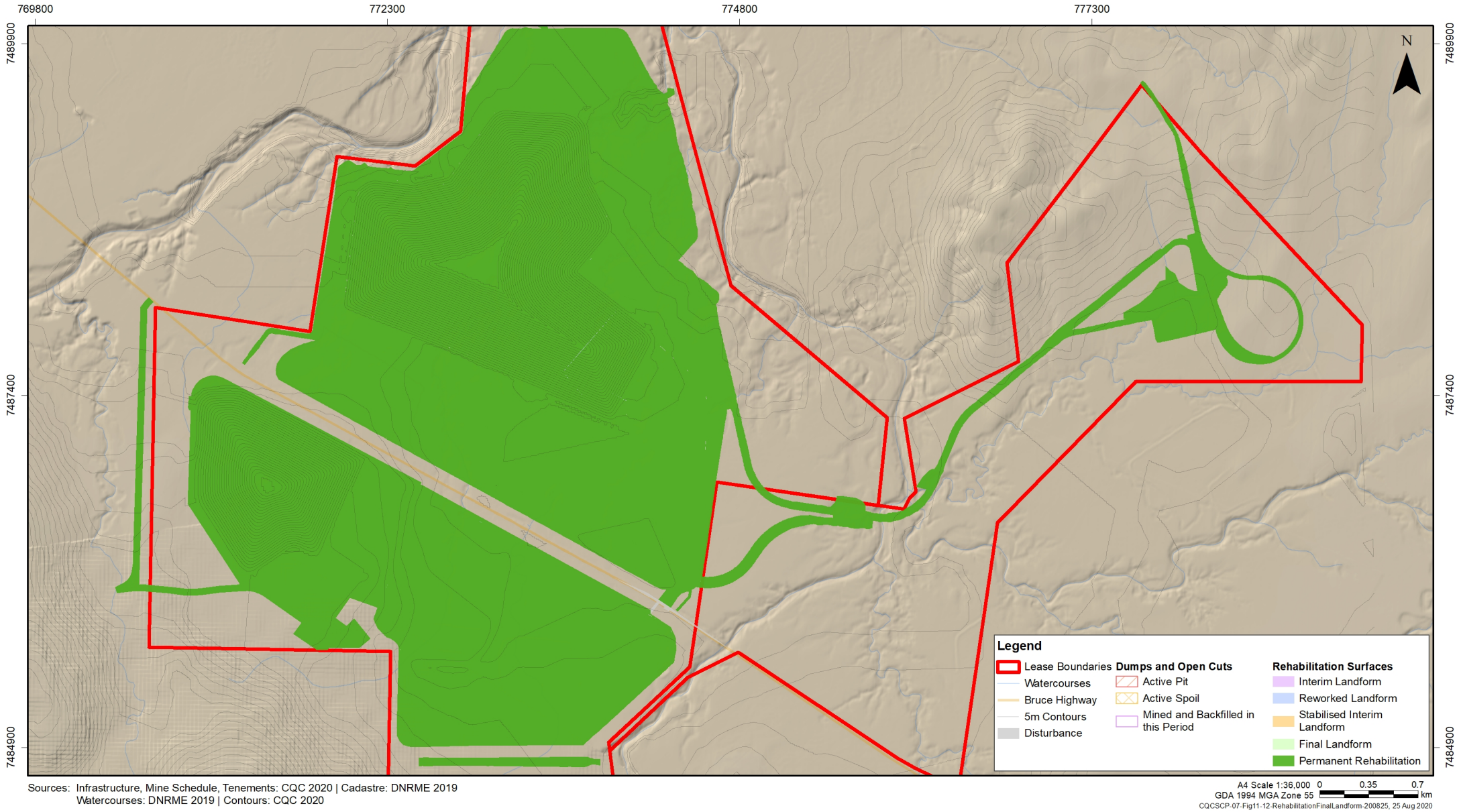



**Figure 11-12: Progressive rehabilitation (final landform at 2044)**

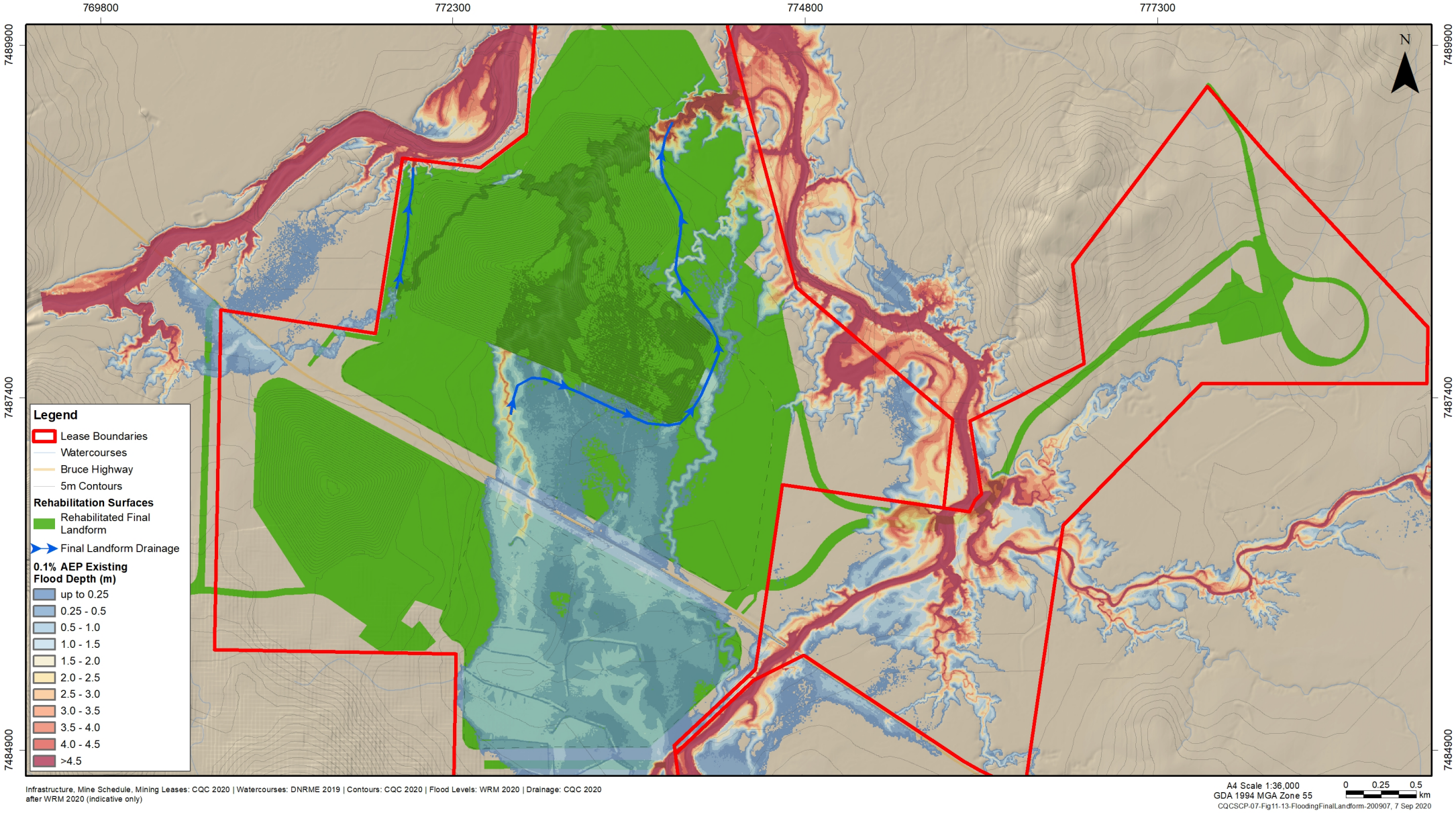



**Figure 11-13: Flooding at final landform**

### 11.9.2 Landforming

The cumulative volume of excavated waste from open cut activities is expected to include approximately 740 Million bank cubic metres (Mbcm) consisting of waste rock, subsoils (i.e. those subsoils which are not suitable for mine rehabilitation) and coarse and fine (i.e. dry filter press tailings) reject materials from the CHPPs. Approximately 140 Mbcm of waste rock materials to be stored within the waste rock stockpiles during operations will ultimately be used for the final backfilling of the mining area to ensure that no final voids remain at closure.

Prior to construction commencing, a detailed geo-environmental block model of the mining domain will be developed, using the existing CQC geological block model, the soil profile data (refer Chapter 5 – Land) and the 3D hydrogeological model prepared for the numerical groundwater model (refer Chapter 10 – Groundwater), infilled with additional drilling where required. From this landform design will be undertaken alongside a detailed landform haulage schedule to ensure material is excavated, hauled and dumped with the overall end in mind (i.e. a safe, stable, and non-polluting final landform).

Waste materials generated during the mining operations will be emplaced within either the waste rock stockpiles (particularly during the initial development of the open cut pits) or backfilled within the completed mining areas.

The waste rock stockpiles to be developed during the initial open cut activities will be temporarily rehabilitated (including the installation of appropriate water management structures) to assist with the management of erosion. At the completion of mining operations, materials temporarily stored within these waste rock stockpiles will be used to fill the completed mining areas. At this time, the remaining materials within the waste rock stockpiles will be reshaped, topsoiled and rehabilitated to achieve the final landform design.

Reject materials (including both coarse reject and fine dry filter press tailings) generated during the processing of ROM coal will be transported and co-disposed with waste rock materials within the waste rock stockpiles and within the pit. These materials will be disposed in locations well below the elevation of the final landform design.

Waste rock materials which are identified to contain high levels of sodicity (or other geochemical constraints) will be selectively handled and disposed deep within the mining area or within the core of the waste rock stockpiles (i.e. in locations which are well below the final landform design). Certain materials utilised on the outer slopes of the waste rock stockpiles may need to be treated to reduce levels of sodicity (such as with the addition of gypsum or waste rock mulch) which in turn will improve water infiltration, facilitate the establishment a suitable cover vegetation and minimise erosion and sedimentation issues. The treatment of sodic materials with gypsum will be undertaken during both temporary and final rehabilitation activities associated with the Project.

Expired pit areas which have been backfilled with waste rock and reject materials will be progressively profiled to the final desired landform specifications. The profiled landform will be scarified parallel to the contour to a nominal depth of 50 to 100 mm to break up any hard setting surfaces and prevent lamination of the topsoil (and other growth mediums) and profiled landform.

The Soil and Land Suitability Assessment (refer Appendix 3a) completed for the Project has estimated that approximately 1.4 Million cubic metres of suitable topsoil materials (primary growth media) and approximately 6.3 Million cubic metres of subsoil materials (secondary growth

media) will be available for use in final rehabilitation activities (assuming 10% soil loss) and allowing for stripping of soil across the entire potential disturbance footprint. Further analysis (refer Chapter 5 - Land) apportioning stripping requirements by different disturbance types indicates around 80% of this would need to be stripped, the remainder being utility areas and the like where surface cover could be retained and soil stripping would not be required.

Consistent with the mine plan which proposes to recover materials from the temporarily rehabilitated waste rock stockpiles to infill the mining areas, temporary rehabilitation activities will not utilise the valuable topsoil and subsoil resources which will be retained in stockpiles for use in final rehabilitation activities.

For final rehabilitation activities subsoils (and other secondary growth media) will then be spread across the scarified profiled landform at a nominal depth of around 500 mm. Topsoil (and other suitable primary growth mediums) will then be spread over the subsoil to a nominal depth of 100 mm. Fertiliser and/or hay mulch will also be applied, as necessary. Native trees and shrubs may also be planted in selected areas of the final rehabilitated landform to establish shade trees for grazing stock and to improve the amenity of the completed landform. Consistent with recommendations by RGS Environmental (Appendix 3c), weathered rock (or regolith material) will be used to facilitate stability and the retainment of soil moisture of the final rehabilitated surface. These materials will primarily be utilised on the sloping sections of the waste rock stockpile areas and be initially emplaced to a depth of around 2.4 m.

Contour banks and other water management features will be progressively installed as the profiled landform is developed to minimise slope lengths and to direct water runoff to either a stable land 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 and will be continually monitored and maintained to ensure they remain appropriate. Once the rehabilitated landforms have established suitable vegetative cover and are demonstrating the qualities of a stabile landform, the contour banks and other water management features will be progressively removed and rehabilitated in accordance with advice from a suitably qualified geotechnical specialist.

The completed final landform will be sown with a fast growing cover crop, pasture or suitable perennial native vegetation consistent with meeting the final objectives for achieving a low intensity cattle grazing final land use.

### 11.9.3 Erosion and Sediment Control

The permanent and temporary landforms to be developed with waste rock materials mined by the Project has the potential to be subject to erosion and landform instability issues, if not appropriately designed and managed.

Erosion and sediment control measures for these mine landforms will be similar to those applied during construction and during operations (see Chapter 5 – Land) and will be outlined in the Project's Erosion and Sediment Control Plan (ESCP). A draft ESCP has been developed, and is included as Appendix 15a of this SEIS, which will be updated prior to works beginning on-site (by a suitably qualified person in accordance with relevant legislation and guidelines). The ESCP 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.

As previously mentioned, the outer slopes of the waste rock stockpiles will be stabilised, and where required armoured with durable and competent rock materials. Further fast growing cover crops will also seek to be established. This is proposed to minimise the potential for the generation of dust and/or wind erosion and to minimise the potential for significant erosion over the term of open cut operations.

The final rehabilitation activities on the waste rock stockpile areas will entail shaping the waste rock down to the final landform design, covering with topsoil (and/or other suitable growth media) and revegetating with a fast growing cover crop, pasture or suitable perennial native vegetation. The rehabilitation will then be subject to ongoing monitoring and review to demonstrate the landform is stable and free from any material erosion concerns. The area on the western portion of Waste Rock Stockpile 2, which is proposed to be subject to final rehabilitation activities in Project Year 4, will be subject to landform stability monitoring and testing throughout the progressive mining operations. Any knowledge gathered from this testing will be used to refine the final landform design and associated rehabilitation activities for the Project. Areas of flat and sloped final landform will be tested, with specific soil amelioration and rehabilitation trials utilising sodic and saline soils that will be required for later rehabilitation. Further to this, as this rehabilitated landform is stabilised, low intensity cattle grazing trials will be conducted to establish the resilience of the pasture and landforms following grazing pressures. This will also facilitate in demonstrating the potential chances of success in relation to the post mining land uses.

Surface water runoff from both temporary and permanent rehabilitation areas will be collected 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 throughout the life of the mine. Once monitoring results indicate suitable vegetative cover has been achieved and the landform is stable and free of significant erosion, sediment dams will be progressively decommissioned to enable runoff from the rehabilitated landforms to be released to the neighbouring environment.

### 11.9.4 Soil Management

The Project will disturb approximately 1,360 hectares of land during the course of mining operations. Suitable topsoil and subsoil resources will initially be stripped from these disturbance areas for ultimate reuse in the Project's progressive rehabilitation activities. Topsoil and subsoil materials will be stripped, handled and stored to prevent excessive soil deterioration. Specific recommendations for stripping depths for typical growth media across the Project area as identified within the recent Soil and Land Suitability Assessment (Appendix 3a) are summarised in Table 11-5.

**Table 11-5: Growth media stripping depth guidance**

| Soil Map Unit/Soil Type | Topsoil Stripping Recommendation (mm) | Subsoil Stripping Recommendation (mm) |
|---|---|---|
| **Alluvial Soils - Rudosols:** Gravelly sandy alluvial soils<br>Units 2 and 3 | 0.3 | 1.0 |

| Soil Map Unit/Soil Type | Topsoil Stripping Recommendation (mm) | Subsoil Stripping Recommendation (mm) |
|---|---|---|
| **Earthy Soils – Kandosols**: Gravelly red and brown earths, sandy to loamy over clay loam<br>Unit 1 | 0.3 | 0.6 |
| **Sodic Texture contrast Soils – Sodosols:** Gravelly grey and brown texture, contrast soil clay loam over highly sodic cracking clay subsoil<br>Unit 5 | 0.1 | 0.5 |
| **Cracking Clay Soils – Vertosols:** Non-gravelly grey and brown cracking clays with highly sodic subsoils<br>Unit 4 | 0.3 | 0.5 |

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.

#### *11.9.4.1.1 Equipment Selection for Stripping and Handling of Materials*

- Equipment for stripping, stockpiling and reinstatement of topsoils and subsoils will be selected to minimise compaction and to avoid breakdown of the soil structure.
- Different practices may be implemented for the stripping, stockpiling and reinstatement of the fragile sandier soils and the stiffer and more robust loam and clay soils. Final equipment selection will be based on ongoing research, conditions experienced during stripping and equipment availability.

#### *11.9.4.1.2 Topsoil Stripping*

- Prior to stripping, all vegetation will be progressively cleared to the minimum extent required for the impending future works.
- Further soil surveys will be completed by a Certified Professional Soil Scientist prior to stripping to ensure soil materials are adequately categorised, soil handling practices and stripping depths are accurately identified, expected quantities of materials are recorded and any specific soil ameliorations/treatments are identified (such as addition of fertilisers, gypsum, etc) for the planned storage in stockpiles for later reuse on rehabilitation areas.
- To supplement the above soil surveys, supervisors and earthmoving plant operators will be appropriately trained to visually identify the soil layers to ensure that stripping operations are conducted in accordance with the stripping plans and *in situ* soil conditions.
- Care will be taken to ensure soil moisture conditions are appropriate for stripping and stockpiling, for example the moisture content of the soil material is not too dry or too wet.

#### *11.9.4.1.3 Stockpiling*

- Details of each soil stockpile will be recorded and maintained within a soil inventory to facilitate the planning for rehabilitation to achieve the desired rehabilitation outcomes. This inventory may include details such as the *in situ* soil type and qualities, original location of recovered materials, any soil treatments recommended by the qualified soil scientist and

details of application (such as fertilisers and/or gypsum applied to the stockpiled soil materials), quantity of materials stored, and preferred locations for the ultimate use on the mine rehabilitation areas.

- Soil stockpiles will be protected from excessive disturbance or traffic and located well 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 (i.e. those which are 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. Depending upon the in-situ soil characteristics, some soil stockpiles may require ongoing monitoring and management to ensure the long-term maintenance of soil health.
- 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 impacts to the neighbouring environment.
- Weed and pests will be monitored and controlled as required.

#### *11.9.4.1.4 Respreading*

- any stockpiles that have evidence of any weed growth will be treated prior to the use in rehabilitation
- any remaining weed growth will be scalped from the top of the stockpiles, if required, to minimise the transport of weeds into rehabilitated areas
- movement and handling of soil materials from stockpiles will preferably be conducted using equipment as described within Section 11.9.4.1.1 to minimise structural degradation of these materials (i.e. 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 controls to limit slope lengths and runoff velocities and
- installation of collection drains and catch dams to collect runoff from rehabilitated landforms and remove suspended sediment.

Stockpiled topsoil and subsoil materials will be tested prior to being used for rehabilitation. The results from soil testing will determine if any further ameliorates are required to be added to soil materials to achieve the desired sustainable rehabilitation outcomes. 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.

### 11.9.5 Revegetation

Revegetation activities will follow the completion of land forming activities, such as reshaping of waste rock, spreading of soil materials and construction of drainage works. The timing of these works will ideally be scheduled to enable a preferred seasonal sowing of pasture seed. Where surfaces have been prepared, the nominated revegetation specification for pasture species will be sown using seed stock. Once the groundcover vegetation is suitably developed, native trees and shrubs will be planted in selected areas of the rehabilitated landform to assist in the development of shade trees and to improve the blend the rehabilitated landform with the surrounding landscape.

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.

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.

### 11.9.6 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.

### 11.9.7 Mine Infrastructure Area

Following decommissioning of mine infrastructure, any bench cuts will be removed and steep grades reduced to establish a final landform which is generally consistent with the neighbouring 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 reshaped to facilitate the appropriate drainage of surface runoff from the site and to blend with the neighbouring topography.

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 de-watered 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. Once the final rehabilitated areas have been stabilised, these surface water management structures will be removed.

**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 the site. The roads, car parks and hardstand areas will be ripped, topsoiled and rehabilitated. Several of the internal roads 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 to be removed from within the area once mine closure activities within the pit area have been completed.

**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.

### 11.9.8 Water Infrastructure

Where no beneficial long-term use can be provided to the final land use, water storage dams will be decommissioned and rehabilitated. 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.

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 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 runoff from the waste rock stockpiles during operations will be decommissioned and rehabilitated following the stabilisation of the final rehabilitated landform and confirmation that runoff meets the desired water quality outcomes.

### 11.9.9 Fish Passage

There is potential for obstructions to fish passage to occur as a result of the Project. Both Deep Creek and Tooloombah Creek are mapped as major risk waterways for barriers to fish passage. A number of smaller waterways are present within the Project Site and are mapped as low to moderate risk. Only one small section of waterway is mapped as high risk within the Project Site.

The haul road will cross Deep and Barrack Creek. Deep Creek is likely to be used for fish passage when flows occur. Barrack Creek is largely an ephemeral waterbody with highly intermittent flows. These works will be undertaken in accordance with the DAF guidelines - Accepted development requirements for operational work that is constructing or raising waterway barrier works. With appropriate crossing design, including culverts, no barriers to fish passage are anticipated at these crossing points.

Two highly degraded and ephemeral unnamed tributaries of Deep Creek will be permanently removed through the establishment of Dam 1 and the mine pits, resulting in the permanent loss of aquatic habitat and riparian vegetation. Their disturbance will reduce the potential for fish passage across 8.35 km of floodplain on the Project Site. Note that the impact to waterway fish passage is proposed to be subject to environmental offsets as described in Chapter 15 – Aquatic and Marine Ecology.

Following mine closure, rehabilitation works will include drainage around the final elevated landforms on the site, which will enable fish passage where required (refer to Section 11.9.1)

### 11.9.10 Open Pits (Voids)

The Project no longer proposes to retain open cut pits (or voids) in the final landform at the time of mine closure. The waste rock and overburden materials which are temporarily stored within the ‘in pit’ and ‘out of pit’ waste rock stockpiles will be available to backfill the completed open cut pits to the final landform design.

The Project mine plan, including initial development of the waste rock stockpiles has been specifically designed to minimise surface disturbance whilst facilitating the temporary storage of material required for final rehabilitation activities. Strategic mine planning activities will continue to be undertaken throughout the mine life to maximise opportunity for progressive rehabilitation. As part of these mine planning activities, further optimisation will occur in relation to the activities required at the completion of mining operations to backfill and rehabilitate the final voids.

### 11.9.11 Waste Rock Stockpiles

As explained above, the mine plan has been optimised to specifically ensure that no voids will be retained within the landform at mine closure. Consequently, waste rock materials and mining schedules have been updated from those originally reported within the EIS. The Project mine plan now entails the establishment of two waste rock stockpiles: Waste Rock Stockpile 1, which services Open Cut 1 and Waste Rock Stockpile 2, which services Open Cut 2.

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 the floodplain area. The locations for each waste rock stockpile have also been selected to maximise the use of already disturbed land to minimise the clearance of remnant vegetation, as much as is practicable whilst considering the stability and safety of the stockpiles.

Given these surface footprint constraints, the waste rock stockpiles are currently designed to maximise the temporary storage of waste rock extracted from the initial open cut operations. The construction of these waste rock stockpiles will generally be initially constructed with outer slopes of up to 1 in 3 (approximately 18 degrees) which will be shaped and temporarily rehabilitated. The exception is an area on the western side of waste rock stockpile 2, which will be shaped and rehabilitated to the final landform design in Project Year 4. This rehabilitated area will be subject to ongoing landform stability monitoring and testing from which the final landform design will be refined and updated accordingly.

Waste Rock Stockpile 1 will initially be developed up to RL 150 m and be reformed to a maximum final landform height of RL 100 m upon the completion of closure operations. Waste Rock Stockpile 2 will initially be developed up to a maximum landform height of RL 170 m and will be reformed to a landform height of approximately RL 100 m at mine closure.

At the completion of mining operations, materials stored within these waste rock stockpiles will be extracted and used for backfilling the completed open cut pits. Remaining waste rock materials will be reprofiled, topsoiled and rehabilitated to the final landform design.

Temporary rehabilitation of the waste rock stockpiles will aim to stabilise the waste rock materials stored within the temporary landform whilst assisting with the management of water runoff to avoid pollution to neighbouring waterways. The final landform design will be refined throughout the mine life to ensure that the landform established will be stable, safe and support the intended final land use (i.e. low intensity cattle grazing) for the Project area.

It is estimated that approximately 740 Mbcm will report to the two ex-pit waste rock stockpiles and two open cut pits throughout the mine life. The updated waste schedule is discussed in detail in Chapter 8 – Waste Rock and Rejects. The size of the final area occupied by Waste Rock Stockpile 2 (servicing Open Cut 2) and Waste Rock Stockpile 1 (servicing Open Cut 1) will be 287 ha (including over-pit areas totalling 211 ha) and 134 ha respectively.

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 refine the current understanding of their environmental risks. This information will then be used to determine any refinements required in preparation for final rehabilitation and closure.

The stability of the waste rock stockpiles will be monitored and reassessed based on the nature of: foundation materials, fill materials, and capping materials. The reassessments will consider short-term, long-term and extreme conditions and be implemented in accordance with 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).

Deep infiltration of surface water flows into the final rehabilitated waste rock stockpiles will be minimised by compacting surface waste rock materials and if required capping using a low permeability material (i.e. clay) which is recovered from the mining area.

Final landform slopes will be shaped down to have slopes less than 7 degrees. Contour grooving, channel linings, surface armour and drop structures will be constructed on the outer slopes to prevent long watercourse runs and minimise slope erosion. Certification will be obtained to demonstrate that slopes are stable in the long-term and erosion rates are no greater than at comparable reference sites. To assist with achieving this rehabilitation objective, soil materials

with low sodic values (either naturally or after treatment) 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, when rehabilitated areas have been stabilised. 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 final landform waste rock stockpiles will necessarily result in a higher landform than that which existed before mining. However, it should be noted that the neighbouring landforms (particularly those to the south of the ML) are already hilly and the waste rock stockpiles will generally be consistent with the surroundings.

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.

Vegetation cover will be provided to not only assist with erosion control but to provide for the regeneration of pasture land, suited to low intensity cattle grazing operations. Vegetation completion criteria will be measured based on achieving at least 70% cover as required by Eyre et al. (2015).

### 11.9.12 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. 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. Further details on the type of weeds present on the Project site, and their control and management is discussed in Chapter 17 – Biosecurity).

Weed control will be undertaken in a manner that minimises soil disturbance. Declared weeds will be controlled in accordance with the Queensland *Biosecurity Act 2014*. A Draft Land Use Management Plan has been developed as part of the Environmental Management Plan (Appendix 12). This incorporates 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.

## 11.9.13 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 EP Regulation, the development will be a site-specific Environmental Authority (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 of the 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. 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 (see Chapters 21 – Hazard and Risk, and 7 – Waste Management, respectively). 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.

### 11.9.13.1 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.

## 11.10 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 detailed design of the Project, prior to construction, the level of risk associated with 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 Queensland government's rehabilitation and PRCP Policy framework, the rehabilitation process will use monitoring, targeted research and completion criteria to demonstrate ultimate success is shown in Figure 11-14. Within each rehabilitation stage, specific indicators will be monitored to determine and demonstrate the site has satisfied the completion criteria agreed between CQC 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 (DES, 2019b). The rehabilitation indicators and completion criteria have been developed in line with the legislative framework, standards and relevant industry codes of practice.

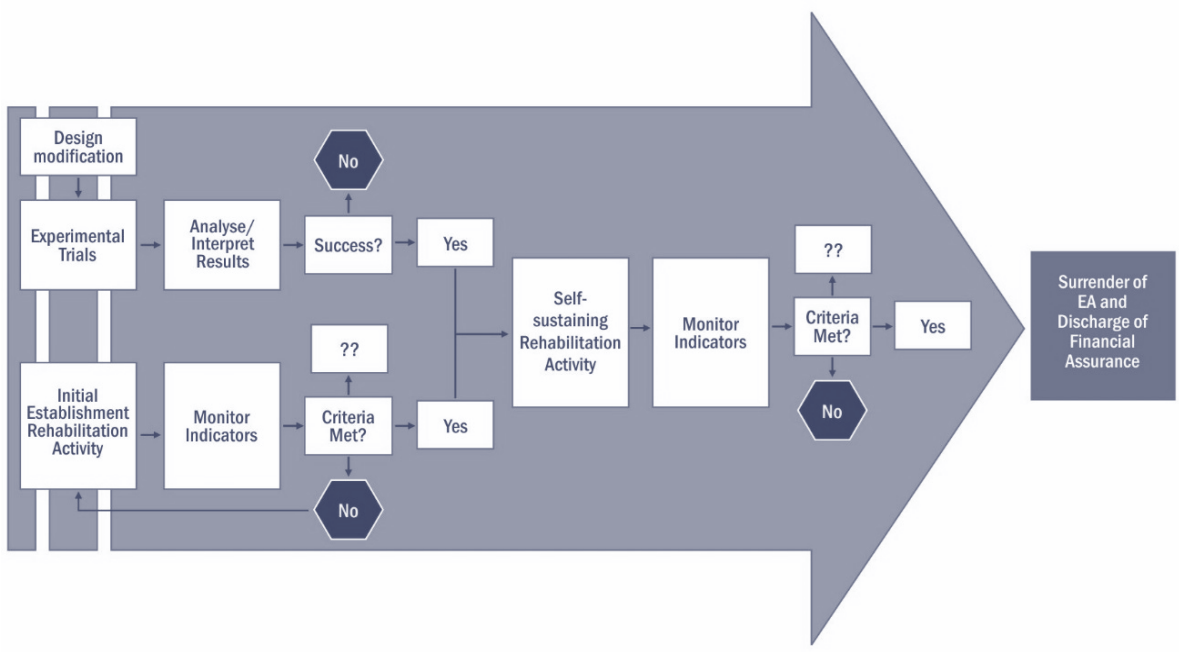



**Figure 11-14: Process of determining rehabilitation progress and success**

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 and 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 11-6. 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 (Eyre et al. 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.

## 11.11 Post-mining Indicators and Completion Criteria

Since the release of the EIS, CQC has committed to no final voids remaining in the landscape at mine closure. CQC has also committed to destocking the majority of the Mamelon Property. Cattle grazing will be progressively decreased within the mining leases during the operational period and at approximately year 10, no grazing is proposed within the entirety of the two leases. In addition, the adjacent offset area on Mamelon will be destocked and no grazing will occur within the offset areas, except on a periodic as-needed basis to manage fuel load and weeds. The total area to be destocked across the property is over 5,000 ha. 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 review of the implementation of rehabilitation strategies during mining 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 previous EIS and SEISs and are presented in Table 11-6. The criteria have been updated to reflect the intended post-mining land uses for each site domain and to include further detail to address regulatory comments. These performance criteria will be used as the basis for preparing the PRCP and will be further refined and developed based on the monitoring and testing of progressive rehabilitation completed throughout the life of the Project. The performance indicators and the completion criteria will be reviewed as part of the PRCP process 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 suitable for the low intensity cattle grazing post-mining land use. 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 11-6: Decommissioning and rehabilitation objectives, indicators and completion criteria by domain**

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| Mine - Open Pits | Safe to humans and wildlife | • No retained voids with open pits filled to final landform design and<br>• No hazardous materials and structurally sound with limited slopes. | • Carbonaceous, Potentially Acid Forming and/or highly sodic materials that have not been ameliorated are not emplaced on final landform surface<br>• Groundwater level and quality<br>• Surface water quality and<br>• Final landform slopes are less than 7 degrees and erosively and geotechnically stable. | • No final void(s), with landform established to the agreed final landform design<br>• Certification by an appropriately qualified person in the Rehabilitation Report that slopes are safe and exhibit characteristics for long-term stability<br>• Downstream surface water quality is of a quality which is unlikely to adversely impact known environmental values and<br>• Groundwater level and quality is in line with modelling predictions. |
| | Non polluting | • Surface water runoff results in no significant influence on neighbouring water quality<br>• Minimal sediment generation from wind/water erosion and<br>• No groundwater contamination to occur from backfilled open cut pits. | • Surface water and groundwater quality parameters – Salinity, pH, cations/anions, metals and metalloids<br>• Soil chemical analysis<br>• Vegetation cover<br>• Dust deposition and particulate matter and<br>• Groundwater levels and quality. | • Results of contaminated land surveys indicate no contamination, or the recommendations of any survey reports have been implemented successfully<br>• No degradation of water quality or significant increase in salinity over the EA required post-mining monitoring period<br>• Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values<br>• Dust and particulate matter levels indicate compliance with the EA and<br>• Groundwater levels are consistent with post-mining modelling predictions. |
| | Stable | • Long-term geotechnical and erosive stability. | • Final landform slopes are less than 7 degrees and erosively and geotechnically stable, as | • No final voids<br>• Installation of contour or graded drains to manage surface water runoff and minimise erosion |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | monitored and determined by geotechnical engineer. | • Back-filled pits are to be constructed with final landform slopes of less than 7 degrees and assessed as geotechnically stable by suitable qualified geotechnical engineer and<br>• Sub-soil and topsoil materials placed on overburden prior to rehabilitation. |
| | Able to sustain an agreed post-mining land use | • Low-intensity cattle grazing with pockets of tree vegetation. | • Percentage pasture cover per square meter<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation<br>• Weed and pest species presence, abundance and type<br>• Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus)) and<br>• Resilience of pasture vegetation following initial grazing pressures. | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depths parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths<br>• Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes<br>• Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites and is consistent with the intended post-mining land use (i.e. low intensity cattle grazing)<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• 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<br>• Battered slopes with at least 70 % vegetative cover<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | | • Evidence that weed and pest species management is occurring where appropriate<br>• Pasture resilience (following grazing pressure) has been determined to be consistent with neighbouring reference sites by a suitably qualified person and<br>• Cattle grazing trials completed on rehabilitated landform demonstrate consistent agricultural productivity values to neighbouring reference sites as determined by a suitably qualified person. |
| Waste rock stockpiles | Safe to humans and wildlife | • Structurally safe with no hazardous materials and<br>• Site is safe now and for foreseeable future. | • Carbonaceous, Potentially Acid Forming and/or highly sodic materials that have not been ameliorated are not emplaced on final landform surface<br>• Safety assessment of landform<br>• Final landform slopes are less than 7 degrees and erosively and geotechnically stable and<br>• Appropriate decommissioning. | • Certification by an appropriately qualified person in the Rehabilitation Report that slopes are safe and exhibit characteristics for long-term stability and<br>• A risk assessment has been completed and risk mitigation measures have been implemented, as appropriate. |
| | Non polluting | • Mine affected water is contained on site<br>• No mine drainage outside of waste rock stockpiles (during operations) | • Downstream surface water quality<br>• Groundwater quality<br>• All catchment diversions to meet approved design criteria and | • Results of contaminated land surveys indicate no contamination, or the recommendations of any survey reports have been implemented successfully<br>• No degradation of water quality or significant increase in salinity over the EA required post-mining monitoring period |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | • Surface water runoff results in no significant influence on neighbouring water quality and<br>• Minimal sediment generation from wind/water erosion. | • All water management structures not required for post-mining land use decommissioned. | • Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values<br>• Dust and particulate matter indicates compliance with the EA and<br>• Groundwater quality to remain similar to background variations. |
| | Stable | • Landform design achieves appropriate erosion rates. | • Final landform slopes are less than 7 degrees and erosively and geotechnically stable, as monitored and determined by geotechnical engineer.<br>• Engineered structures to control water flow and reduce soil loss<br>• Dimensions and frequency of erosion rills and gullies and<br>• Vegetation cover sufficient to minimise erosion. | • Side slopes are no more than 7 Degrees<br>• Crest grades away at no more than 2%<br>• Evidence that required contour banks, channel linings, surface armour, drop structures and other measures are in place and functioning<br>• Certification by a suitably qualified person that erosion activities are not greater than at comparable reference site<br>• Dimension and occurrence of rills and gullies (as recorded by a suitably qualified person) are no greater than at comparable reference site and<br>• Evidence that vegetation type and density are of species suitable to the site and for erosion minimisation. |
| | Able to sustain an agreed post-mining land use | • Low-intensity cattle grazing with pockets of tree vegetation. | • Percentage vegetation cover per square metre<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation<br>• Weed and pest species presence, abundance and type | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depths parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | • Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus)) and<br>• Resilience of pasture vegetation following initial grazing pressures. | • Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes<br>• Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites and is consistent with the intended post-mining land use (i.e. low intensity cattle grazing)<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• 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<br>• Battered slopes with at least 70 % vegetative cover<br>• Established vegetative cover on slopes to at least 70 % cover<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites<br>• Evidence that weed and pest species management is occurring where appropriate<br>• Pasture resilience (following grazing pressure) has been determined to be consistent with neighbouring reference sites by a suitably qualified person and<br>• Cattle grazing trials completed on rehabilitated landform demonstrate consistent agricultural productivity values to neighbouring reference sites as determined by a suitably qualified person. |
| Mine infrastructure | Safe to humans and wildlife | • Area safe for human and native species usage. | • Presence/absence of infrastructure and wastes. | • All infrastructure removed unless agreed in writing with the landholder and submitted to the administering authority<br>• Bench cuts removed |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | | • Steep grades reduced and<br>• Similar surrounding landform profile. |
| | Non-polluting | • No residual pollutants that could mobilise in environment. | • Soil sample result – salinity, hydrocarbon and metal levels. | • Post contamination assessment complete on areas where notifiable activities occurred, and recommendations of assessment implemented and<br>• Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values. |
| | Stable | • No erosion and sediment loss above surrounding area. | • Water turbidity in watercourses<br>• Sediment loss - visual inspection<br>• Presence of scouring or erosion, sediment plumes and<br>• Percentage vegetative ground cover. | • Stable site with adequate cover and permanent drainage with no erosion issues. |
| | Able to sustain an agreed post-mining land use | • Low-intensity cattle grazing with pockets of tree vegetation. | • Percentage vegetation cover per square metre<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation<br>• Weed and pest species presence, abundance and type<br>• Ecosystem functioning indicators: water level and quality (dissolved oxygen, | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depth parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths<br>• Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes.<br>• Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | pH, temperature, salinity and nutrients (nitrogen and phosphorus)<br>• Resilience of pasture vegetation following initial grazing pressures. | reference sites and is consistent with the intended post-mining land use (i.e. low intensity cattle grazing)<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• 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<br>• Battered slopes with at least 70 % vegetative cover<br>• Established vegetative cover on slopes and outside bund to at least 70 % cover<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites<br>• Evidence that weed and pest species management is occurring where appropriate<br>• Pasture resilience (following grazing pressure) has been determined to be consistent with neighbouring reference sites by a suitably qualified person and<br>• Cattle grazing trials completed on rehabilitated landform demonstrate consistent agricultural productivity values to neighbouring reference sites as determined by a suitably qualified person. |
| Water infrastructure (dams and drains) | Safe to humans and wildlife | • All dam structures to be decommissioned (unless alternate post-mining land use identified and approved) | • Safety assessment of landform and<br>• Appropriate decommissioning and rehabilitation. | • All infrastructure removed unless agreed in writing with the landholder and submitted to the administering authority<br>• Similar surrounding landform profile<br>• A risk assessment has been completed and risk mitigation measures have been implemented, as appropriate and |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | • Contaminated sediments and/or materials to be disposed below final landform surface and capped / contained<br>• Landform shaped and rehabilitated to ensure no ponding or scouring potential<br>• Structurally safe with no hazardous materials and safe for the foreseeable future. | | • Landform design certified as meeting design requirements of rehabilitation. |
| | Non polluting | • Mine affected water is contained on site<br>• No mine drainage outside waste rock stockpiles (during operations)<br>• Surface water runoff results in no significant influence on neighbouring water quality and<br>• Minimal sediment generation from wind/water erosion. | • Downstream surface water quality<br>• Groundwater quality<br>• All catchment diversions to meet approved design criteria and<br>• All water management structures not required for post-mining land use decommissioned. | • Results of contaminated land survey indicate no contamination or recommendations of survey report have been implemented successfully<br>• No degradation of water quality or significant increase in salinity over the EA required post-mining monitoring period<br>• Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values<br>• Dust and particulate matter indicates compliance with the EA and<br>• Groundwater levels to remain similar to background variations. |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | Stable | • Landform design achieves appropriate erosion rates. | • Engineered structures to control water flow<br>• Appropriate rates of soil loss<br>• Dimensions and frequency of erosion rills and gullies and<br>• Vegetation cover sufficient to minimise erosion. | • Evidence that required contour banks, channel linings, surface armour, drop structures and other measures are in place and functioning<br>• Certification by a suitably qualified person that erosion activities are not greater than at comparable reference site<br>• Dimension and occurrence of rills and gullies (as recorded by a suitably qualified person) are no greater than at comparable reference site and<br>• Evidence that vegetation type and density are of species suitable to the site and for erosion minimisation. |
| | Able to sustain an agreed post-mining land use | • Low-intensity cattle grazing with pockets of tree vegetation. | • Pasture cover per square metre<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation<br>• Weed and pest species presence, abundance and type<br>• Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus) and<br>• Resilience of pasture vegetation following initial grazing pressures. | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depth parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths<br>• Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes<br>• Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites and is consistent with the intended post-mining land use (i.e. low intensity cattle grazing)<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• Soil characteristics have been determined by a suitably qualified person as having acceptable levels of surface roughness, |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | | infiltration capacity, aggregate stability and surface condition as defined in the Australian Soil and Land Survey Handbook<br>• Battered slopes with at least 70 % vegetative cover<br>• Established vegetative cover on slopes and outside bund to at least 70 % cover<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites<br>• Evidence that weed and pest species management is occurring where appropriate<br>• Pasture resilience (following grazing pressure) has been determined to be consistent with neighbouring reference sites by a suitably qualified person and<br>• Cattle grazing trials completed on rehabilitated landform demonstrate consistent agricultural productivity values to neighbouring reference sites as determined by a suitably qualified person. |
| Haul Road Corridor<br>All areas (road furniture, haul road, drainage, cut and fill areas) | Safe to humans and wildlife | • No objects remaining which could cause injury. | • Presence/absence of infrastructure and wastes. | • All road furniture removed unless agreed in writing with the landholder and submitted to the administering authority<br>• Bench cuts removed<br>• Steep grades reduced and<br>• Similar surrounding landform profile. |
| | Non polluting | • No residual pollutants that could mobilise in the environment. | • Soil sample result – salinity, hydrocarbon and metal levels. | • Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values. |
| | Stable | • No erosion and sediment loss above surrounding area. | • Water turbidity in watercourses<br>• Sediment loss - visual inspection | • Stable site with adequate cover and permanent drainage with no erosion issues. |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | • Presence of scouring or erosion and<br>• Percentage vegetative ground cover. | |
| | Able to sustain an agreed post-mining land use | • Low-intensity cattle grazing with pockets of tree vegetation. | • Percentage vegetation cover per square meter<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation and<br>• Weed and pest species presence, abundance and type<br>• Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus)<br>• Biological: fish diversity and<br>• Resilience of pasture vegetation following initial grazing pressures. | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depths parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths<br>• Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes<br>• Certification by a suitably qualified person that the density and presence of key species and vegetation cover is the same as at reference sites and is consistent with the intended post-mining land use (i.e. low intensity cattle grazing)<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• 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<br>• Battered slopes with at least 70 % vegetative cover<br>• Established vegetative cover on slopes and outside bund to at least 70 % cover |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | | • Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded<br>• Potential fish passage areas are appropriately established<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites and<br>• Evidence that weed and pest species management is occurring where appropriate<br>• Pasture resilience (following grazing pressure) has been determined to be consistent with neighbouring reference sites by a suitably qualified person<br>• Cattle grazing trials completed on rehabilitated landform demonstrate consistent agricultural productivity values to neighbouring reference sites as determined by a suitably qualified person. |
| TLF<br>All areas (Environmental dams, rail loop, train loader and conveyer, stockpiles) | Safe to humans and wildlife | • Area safe for human and native species usage. | • Presence/absence of infrastructure and wastes. | • All infrastructure removed unless agreed in writing with the landholder and submitted to the administering authority<br>• Bench cuts removed<br>• Steep grades reduced and<br>• Similar surrounding landform profile. |
| | Non polluting | • No residual pollutants that could mobilise in environment. | • Soil sample result – salinity, hydrocarbon and metal levels. | • Post contamination assessment complete on areas where notifiable activities occurred, and recommendations of assessment implemented and<br>• Runoff and seepage from rehabilitated landform will be of a quality which is unlikely to adversely impact known environmental values. |
| | Stable | • Removal and rehabilitation of environmental dam | • Water turbidity in watercourses | • Stable site with adequate cover and permanent drainage with no erosion issues. |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | and stable ground cover reduce erosion from surface water runoff. | • Sediment loss - visual inspection<br>• Presence of scouring or erosion and<br>• Percentage vegetative ground cover. | |
| | Able to sustain an agreed post-mining land use | • Natural vegetation and habitat. | • Vegetation percentage cover per square metre<br>• Soil characteristics<br>• Presence and density of key plants species<br>• Structure of vegetation and<br>• Weed and pest species presence, abundance and type<br>• Ecosystem functioning indicators: water level and quality (dissolved oxygen, pH, temperature, salinity and nutrients (nitrogen and phosphorus)<br>• Biological: fish diversity<br>• Habitat indicators: width, continuity, extent of shading and species composition<br>• Native species and<br>• Weed and pest abundance. | • Restored landform ripped to nominal depth of 50-100 mm<br>• Topsoil and subsoils spread at agreed depths parallel to ripped contours<br>• Topsoil and subsoils replaced according to pre-mining mapped soil units with selective placement of more erodible soils on flatter areas, as appropriate<br>• No active areas of rill or gully erosion and drainage follows appropriate drainage paths<br>• Sown cover crop of perennial native vegetation or pasture mixes including short- and long-lived grasses and legumes<br>• Certification by a suitably qualified person that the density and presence of key species and pasture cover is the same as at reference sites<br>• Area is certified as self-sustaining and has many of the attributes of the final landscape, including maintenance requirements (compared to surrounding analogue site)<br>• 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<br>• Battered slopes with at least 70 % vegetative cover<br>• Established vegetative cover on slopes and outside bund to at least 70 % cover |

| Domain and Sub-domain | Rehabilitation goal | Rehabilitation objectives | Indicators | Completion (and Success) criteria |
|---|---|---|---|---|
| | | | | • Native fauna identified in EIS baseline studies and at reference sites prior to mining are present or indicators of these species are recorded<br>• Potential fish passage areas are appropriately established<br>• Certification of no weed and pest species abundance identified in rehabilitation areas are no greater than at reference sites and<br>• Evidence that weed and pest species management is occurring where appropriate. |

## 11.12 Rehabilitation Monitoring and Measurement

Monitoring will be carried out to ensure CQC 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 CQC's Environment Manager. Attainment of the site's rehabilitation performance and completion criteria will be the responsibility of CQC.

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:

- Progressive Rehabilitation and Closure Plan (PRCP)
- 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/subsoil/other growth media 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 areas will be carried out.

## 11.13 Contingency Planning

The rehabilitation success will 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 will 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 will 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 revegetated.

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 PRCP.

## 11.14 Relinquishment

An objective of the mine rehabilitation and ongoing monitoring and maintenance of the rehabilitation areas is to facilitate the ultimate relinquishment of the mining lease and EA upon achievement of the agreed completion criteria. 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 CQC'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 indictors and the overall success of the rehabilitation in respect of achievement of the completion criteria for the duration of the rehabilitation program. 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 and completion 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.

## 11.15 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 non-conformance/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 a low intensity grazing land use with suitable pastures and native vegetation as 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, the appropriate local and government authorities and other stakeholders
- prepare Care and Maintenance Program, or review and update the 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 and
- 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).

## 11.16 Resources for Rehabilitation and Closure

A number of key resources will be required throughout the mine closure process. Adequate planning will therefore be required as the mine moves into the mine closure planning phase to ensure these resource 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 and Community Manager and / 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 closure process. The Environment and Community 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, agricultural consultants. Demolition and earthmoving contractors may also be required.

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

## 11.17 Conclusion

As part of this SEIS v3, additional detailed mine scheduling, rehabilitation planning and final landform assessment and design work has been undertaken, in particular development of final landforms to support a post mining low intensity cattle grazing landuse. Previously, final elevated landforms were located within the floodplain in both the north and south final landform areas, however with the re-design, the southern final elevated landform was moved out of the floodplain and the northern area adjusted to minimise floodplain coverage, improving post closure landform stability and reducing flood impacts. Updated mine schedule and design drawings including cross sections have been provided.

The decommissioning and rehabilitation objectives, indicators and completion criteria have been updated to better support the proposed post mining low intensity grazing landuse. This has been based on the revised landform design, updated rehabilitation scheduling and works on geochemistry, soils, and the updated rehabilitation strategy. Flood modelling was revised for the Project, and an assessment of post mining flood impacts undertaken (see Appendix A5b), with the post closure drainage over the site specified, subject to detailed design. Post closure, it is proposed to remove all catchment diversion drains and dams, fill all voids, flatten slopes to a maximum 7 degree overall grade and rehabilitate and stabilise all previously disturbed areas to achieve a post mining land use that is stable, vegetated and self-sustaining and supports the intended final land use. Rehabilitation works on drainage lines and creeks will maintain fish passage opportunities.

The strategy presented in this Chapter to be incorporated into the EA and the PRCP will be finalised and require approval prior to the commencement of mining operations. Specific rehabilitation and decommissioning measures to avoid or minimise any impacts will be identified and the PRCP will be

reviewed and updated during the mining life. The PRCP will be continuously updated during operations to ensure closure matters are appropriately addressed prior to the commencement of mine closure activities.

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, CQC will facilitate the transfer of operating licences and obligations to the relevant parties.

Overall, rehabilitation will occur progressively throughout the life of the Project, including the development of trial rehabilitation areas early in the mine life to ensure long term rehabilitation activities will be successful. The final landform stability assessment conducted as part of this new body of work has identified the detailed assessment and design work to be undertaken prior to mining commencing which CQC has committed to, including development of a geo-environmental block model and detailed landform haulage schedule. It provides a detailed assessment and pathway for forward works to ensure that final landforms are low maintenance and geotechnically stable commensurate with the agreed final land use. Overall, the work undertaken to support this revised chapter indicates that there should be no impediment to achieving a final landform that is safe, stable, and non-polluting.

## 11.18 Commitments

In relation to rehabilitation, CQC's updated commitments are provided in Table 11-7.

**Table 11-7: Commitments – Rehabilitation and Decommissioning**

| Commitments |
|---|
| A PRCP will be prepared for the Project to the satisfaction of DES prior to the commencement of mining operations. The PRCP will be prepared in accordance with the *Guideline Progressive Rehabilitation and Closure Plans (PRC Plans)* (PRCP Guideline) (DES 2019a). The PRCP will be prepared using the background information, the overarching goals and objectives and post-mining land uses as presented within this Chapter 11 of this SEIS. The PRCP will also address the seven factors for successful remediation of mine sites with dispersive soils as identified by Dale et al. (2018). The PRCP will also outline specific operational activities required to complete the rehabilitation and decommissioning of the Project. |
| To ensure safe, stable and low maintenance final landforms, CQC will develop a detailed geo-environmental block model and detailed landform haulage schedule to optimise the construction and rehabilitation sequence. |
| The Draft Project ESCP will be updated prior to construction commencing by a suitably qualified person and implemented in accordance with relevant legislation and guidelines. |
| Achieve the completion (and success) criteria for all rehabilitation domains as outlined within Table 11-6. |
| The Project Land Use Management Plan will outline weed control measures in accordance with the Queensland *Biosecurity Act 2014*. |
| 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. |
| Shape the created landforms, to the extent practical, to integrate with the surrounding landforms. |
| Monitor rehabilitation success in terms of physical, chemical and biological parameters. |