Appendix U

Mine development rehabilitation and landscape management strategy

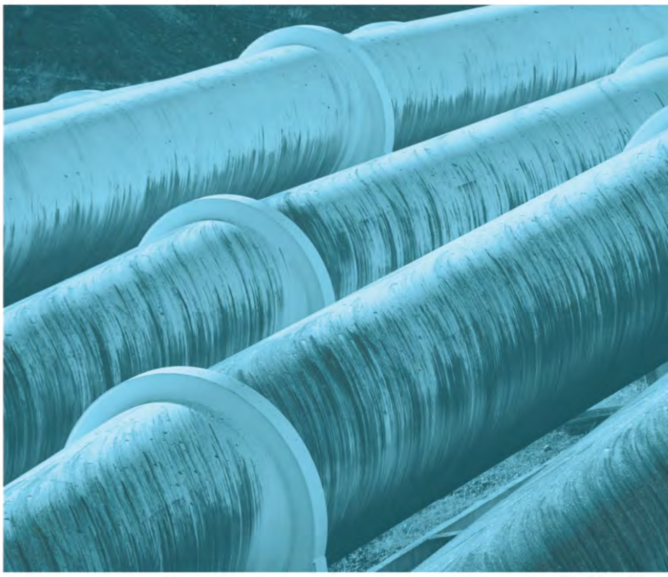
REGIS RESOURCES LTD


McPhillamys Gold Project

Rehabilitation and Landscape Management Strategy

Prepared for LFB Resources NL

July 2019

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McPhillamys Gold Project

Rehabilitation and Landscape Management Strategy

Report Number

RP1

Client

LFB Resources NL

Date

9 July 2019

Version

v2 Final

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9 July 2019

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9 July 2019

Executive Summary

This Rehabilitation and Landscape Management Strategy (the strategy) forms part of the Environmental Impact Statement to support a development application for the McPhillamys Gold Project; for which approval is sought under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979*.

The McPhillamys Gold Project comprises two key components; the mine site where the ore will be extracted, processed and distributed to the market (the mine development), and an associated water pipeline which will enable the supply of water from near Lithgow to the mine site (the pipeline development). This report presents a rehabilitation strategy for the mine development component of the McPhillamys Gold Project (herein referred to as the project). Rehabilitation of the pipeline development is addressed in the main report of the Environmental Impact Statement (EIS) (Volume 1, EMM 2019a).

The mine development is approximately 8 km north-east of Blayney, within the Blayney and Cabonne local government areas.

The overarching rehabilitation objective of the project is to restore the land as much as possible to its pre-mining land use at the end of its operational life; that is, primarily an agricultural land use comprising grazing on improved pasture while improving the biodiversity values of the area by re-establishing endemic open-woodland communities as part of the rehabilitation program.

There will be opportunities for progressive rehabilitation of all available disturbed areas as the mine is developed, including the pit amenity bund and waste rock emplacement. Wherever possible during operations, disturbed areas no longer required for mining activities will be progressively rehabilitated.

The project area has been divided into a series of primary and secondary domains, in accordance with *ESG3 Mining Operations Plan (MOP) Guidelines* (NSW Department of Trade and Investment – Division of Resources and Energy 2013). The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains identified across the project area are infrastructure areas, the tailings storage facility, water management areas, waste rock emplacement, soil stockpiles and the open cut void. A secondary domain (ie final land use) of pasture/grazing has been assigned to most of the primary domains, other than the waste rock emplacement, which have been assigned a secondary domain of biodiversity, and the final void which will remain a void (non-use management area).

Preliminary completion criteria have been developed for each of the domains as part of this strategy. Rehabilitation monitoring will be undertaken throughout the mine life and post-closure (until lease relinquishment) to assess progress towards meeting the criteria. Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to analogue site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

Closure of the mine will involve rehabilitation of the remaining unrehabilitated sections of the waste rock emplacement area, capping of the tailings storage facility, decommissioning and removal of infrastructure and services; soil testing of potentially contaminated areas such as ore stockpile areas and hydrocarbon storage areas; and remediation or removal of any contaminated soil if required. Soil will also be tested for erosion and agronomic aspects and ameliorated as required to suit the agreed post-mine land use. Reshaping will be undertaken where required to blend disturbed surfaces into surrounding topography, contour scarified, and stockpiled soil applied to promote establishment of species appropriate for the post-mine land use.

Post-mining, there will be some changes to the land and soil capability (LSC) class within the disturbance footprint of the project. After mining and upon completion of rehabilitation, there will be a 12ha decrease in LSC class 4 land, and a 411ha reduction of LSC class 5 land. The area of LSC class 6 land will increase by 336 ha the waste rock emplacement and mine infrastructure areas. There will also be an increase in LSC class 7 land (by 17ha) and an additional 71ha of LSC class 8 land, associated with the final void.

Final rehabilitation and project closure requirements will ultimately be developed as part of a detailed closure plan, which will be produced within five years of closure in consideration of input from key government agencies and relevant stakeholders at the time.

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1 Introduction

1.1 Overview

LFB Resources NL, a 100% owned subsidiary of Regis Resources Limited (herein referred to as Regis), is seeking development consent for the construction and operation of the McPhillamys Gold Project, a greenfield open cut gold mine and water supply pipeline in the Central West of New South Wales (NSW). The project application area is illustrated at a regional scale in Figure 1.1.

As shown in Figure 1.1, the McPhillamys Gold Project comprises two key components;

- the mine site where the ore will be extracted, processed and distributed to the market (the mine development); and
- an associated water pipeline which will enable the supply of water from near Lithgow to the mine site (the pipeline development).

This report presents a rehabilitation strategy for the mine development component of the McPhillamys Gold Project (herein referred to as the project). Rehabilitation of the pipeline development is addressed in the main report of the Environmental Impact Statement (EIS) (Volume 1, EMM 2019a).

The mine development is approximately 8km north-east of Blayney within the Blayney and Cabonne local government areas (LGAs). This locality has a long history of alluvial and hard rock mining, with exploration for gold and base metals occurring since the mid to late 19th century. The mine development project boundary (herein referred to as the project area) is illustrated in Figure 1.2 and covers the Mining Lease (ML) application area for the project as well as the parts of the project that do not require a ML.

This Rehabilitation and Landscape Management Strategy report forms part of the EIS for the McPhillamys Gold Project. It presents a detailed overview of the final land-use options and closure criteria for the proposed development. Opportunities to improve rehabilitation and environmental outcomes for areas to be disturbed within the project area have been identified and discussed. This strategy presents the overall rehabilitation philosophy, principles and objectives and describes the conceptual rehabilitations domains, long-term land use strategy, conceptual post-mining landform and final landform and revegetation concepts.

1.2 Project overview

A full project description is provided in Chapter 2 of the EIS (EMM 2019a). The key components of the project are as follows:

- Development and operation of an open cut gold mine, comprising approximately one to two years of construction, approximately 10 years of mining and processing and a closure period (including the final rehabilitation phase) of approximately three to four years, noting there may be some overlap of these phases. The total project life for which approval is sought is 15 years.
- Development and operation of a single circular open cut mine with a maximum diameter of approximately 1,050metres(m) and a final depth of approximately 460m, developed by conventional open cut mining methods encompassing drill, blast, load and haul operations. Up to 8.5Million tonnes per annum (Mtpa) of ore will be extracted during the project life.

- Construction and use of a conventional carbon-in-leach processing facility with an approximate processing rate of 7Mtpa to produce approximately 200,000 ounces, and up to 250,000 ounces, per annum of product gold. The processing facility will comprise a run-of-mine (ROM) pad and crushing, grinding, gravity, leaching, gold recovery, tailings thickening, cyanide destruction and tailings management circuits. Product gold will be taken off-site to customers via road transport.

- Placement of waste rock into a waste rock emplacement which will include encapsulation of material with the potential to produce a low pH leachate. The southern portion of the waste rock emplacement will be constructed and rehabilitated early in the project to act as an amenity bund.

- Construction and use of an engineered tailings storage facility to store tailings material.

- Construction and operation of associated mine infrastructure including:

  - administration buildings and bathhouse;

  - workshop and stores facilities, including associated plant parking, laydown and hardstand areas, vehicle washdown facilities, and fuel and lubricant storage;

  - internal road network;

  - explosives magazine and ammonium nitrate emulsion storage facilities;

  - topsoil, subsoil and capping stockpiles;

  - ancillary facilities, including fences, access roads, car parking areas and communications infrastructure; and

  - on-site laboratory.

- Establishment and use of a site access road and intersection with the Mid Western Highway.

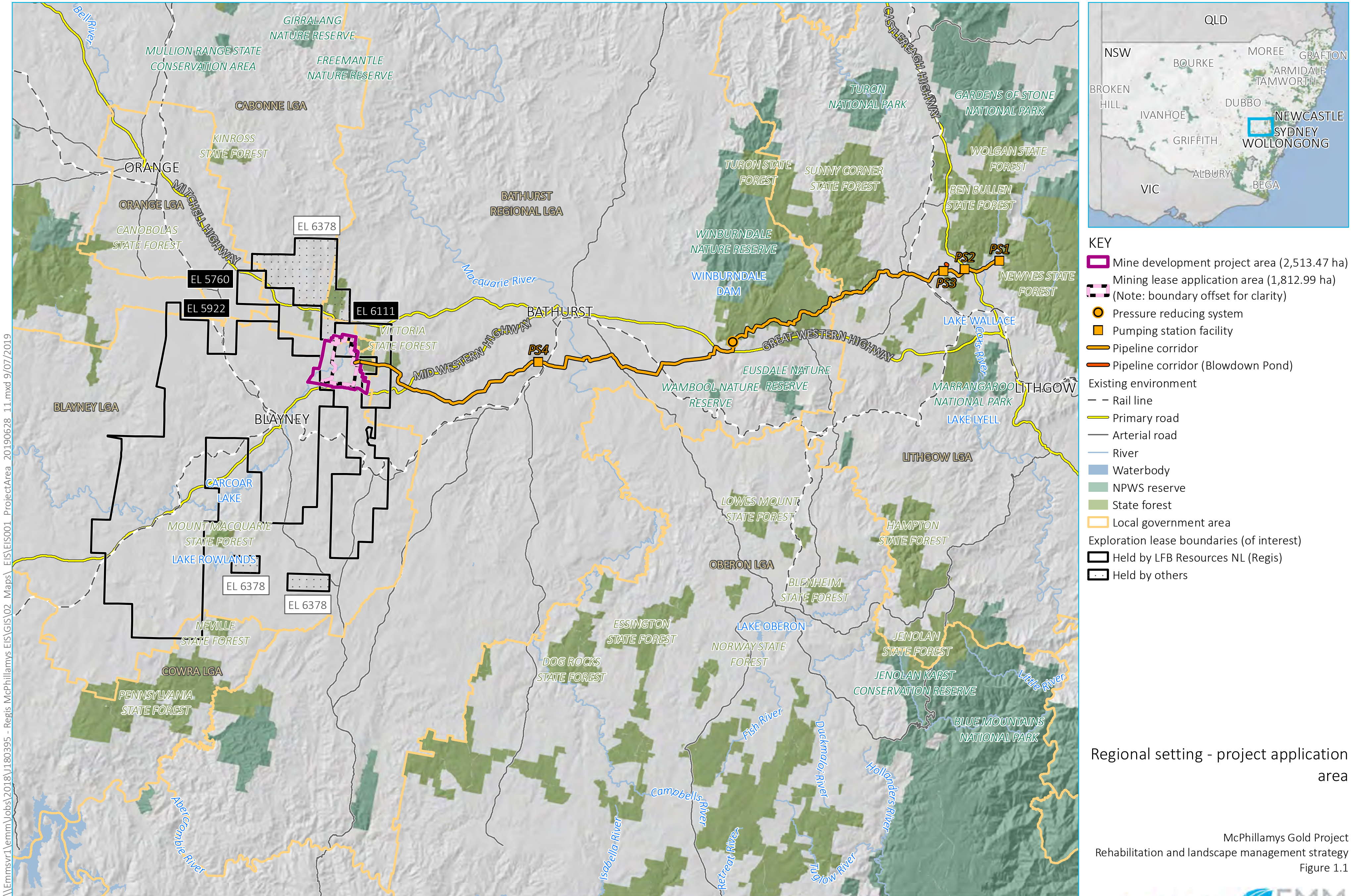
- Construction and operation of water management infrastructure, including water storages, clean water and process water diversions and sediment control infrastructure.

- A peak construction workforce of approximately 710 full-time equivalent (FTE) workers. During operations, an average workforce of around 260 FTE employees will be required, peaking at approximately 320 FTEs in around years four and five of the project.

- Construction and operation of a water supply pipeline approximately 90 km long from Centennial's Angus Place Colliery and Springvale Coal Services Operations (SCSO); and Energy Australia's Mount Piper Power Station, near Lithgow to the mine project area. The pipeline development will include approximately four pumping station facilities, a pressure reducing system and communication system. Approximately 13megalitres (ML) ML/day (up to a maximum of 15.6 ML/day) will be transferred for mining and processing operations.

- Installation and use of environmental management and monitoring equipment.

Progressive rehabilitation will occur throughout the mine life. At the end of mining, mine infrastructure will be decommissioned, and disturbed areas will be rehabilitated to integrate with natural landforms as far as practicable. Final land use of the project area will address relevant local government plans and strategies.



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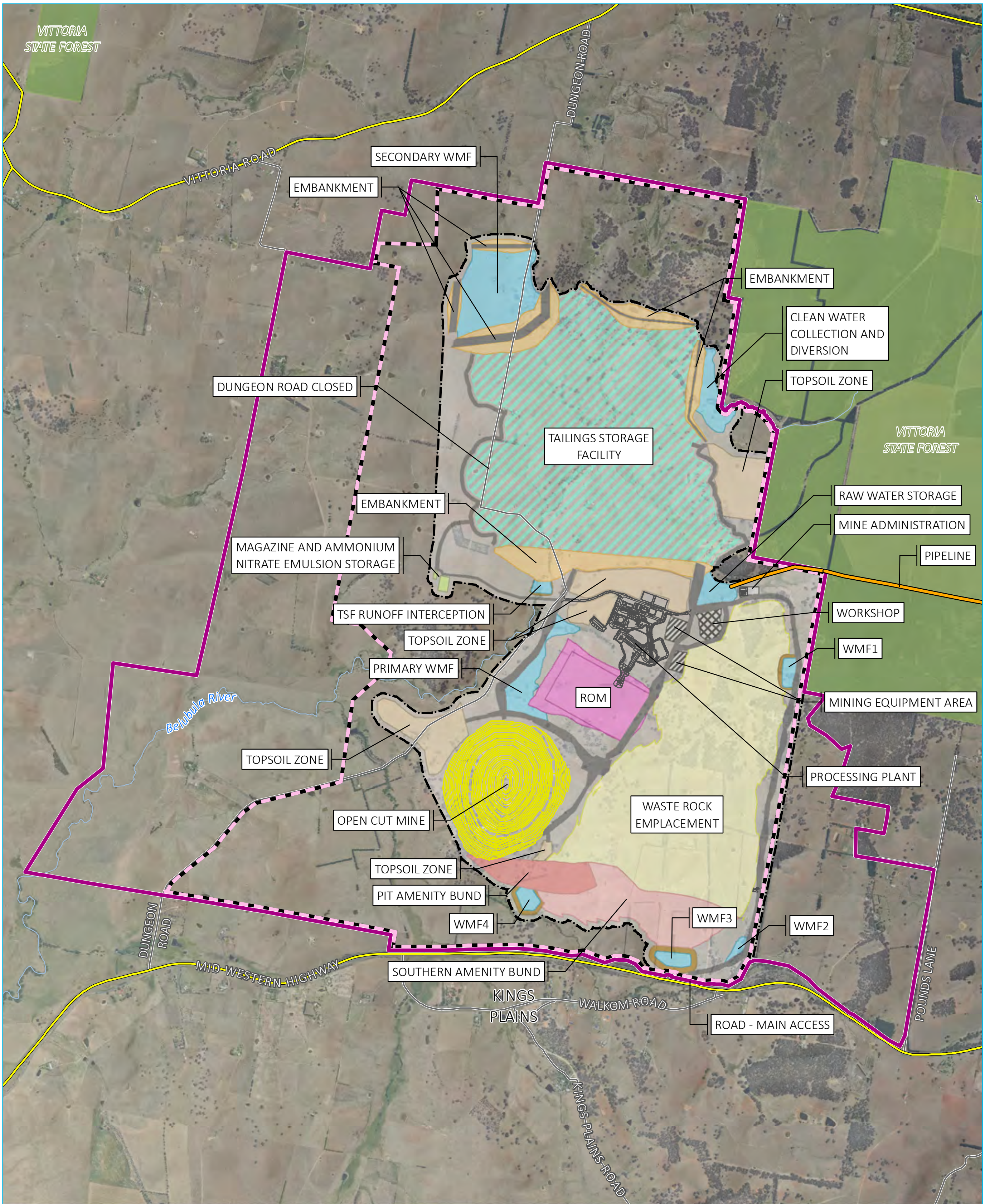
Source: EMM (2019); Regis Resources (2019); DPE (2018); DFSI (2017); GA (2011)

Regional setting - project application area

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 1.1



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Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DPE (2018); DFSI (2017); GA (2011)

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GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Project general arrangement
- Plant layout
- Road
- Water management facility (WMF)
- Sediment basin structure

Existing environment
- Main road
- Local road
- Belubula River
- State forest

Mine development general arrangement

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 1.2

1.3 Assessment requirements

This strategy has been prepared in accordance with requirements of the NSW Department of Planning and Environment (DPE). These were set out in DPE's Environmental Assessment Requirements (EARs) for the Project, issued on 24 July 2018 and revised on 19 December 2018. The EARs identify matters which must be addressed in the EIS and essentially form its terms of reference. Table 1.1 lists individual requirements relevant to this strategy and where they are addressed in this report.

Table 1.1 Rehabilitation related SEARs

Requirement	Section addressed
Key Issues: **Closure, Rehabilitation and Final Landform –** including a Rehabilitation and Landscape Management Strategy providing:	This document
a detailed overview of the final land-use and closure criteria for the development, including both the mine and site and raw water pipeline; and	Section 3.2.2, Chapter 4 and Chapter 6. The final land-use and completion criteria for the pipeline is presented in Chapter 35 of the EIS (EMM 2019).
identification and discussion of opportunities to improve rehabilitation and environmental outcomes for existing disturbed areas within the project site	The project is a greenfield development. Whilst the majority of the project area has been subjected to a long history of disturbance associated with agricultural land uses, the site is well vegetated. The areas within the project that will not be disturbed by the proposal will continue to be used for agricultural purposes other than existing areas of medium to high quality native open woodland and open forest that will be managed to enhance their biodiversity values . This use will include measures to improve the land to ensure a productive land use, as discussed in sections 4 and 5.

To inform the preparation of the EARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the EARs. Copies of the government agencies' advice to DPE were attached to the EARs.

The DPE Resources Regulator raised matters relevant to the rehabilitation of the mine. The matters raised are listed in Table 1.2 and have been taken into account in preparing this strategy, as indicated in the table.

Table 1.2 Agency project specific assessment recommendations

Requirement	Section addressed
Post-mining land use	Section 3.2.2 and Chapter 4
a) Identification and assessment of post-mining land use options;	
b) Identification and justification of the preferred post-mining land use outcome(s), including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives;	Section 3.2.2 and Chapter 4
c) Identification of how the rehabilitation of the project will relate to the rehabilitation strategies of neighbouring mines within the region, with a particular emphasis on the coordination of rehabilitation activities along common boundary areas;	Not applicable as there are no neighbouring mines. Cadia Valley Operations' mine site is 28km away.
Rehabilitation objectives and domains	Chapter 4 and Chapter 6
d) Inclusion of a set of project rehabilitation objectives and completion criteria that clearly define the outcomes required to achieve the post-mining land use for each domain. Completion criteria should be specific, measurable, achievable, realistic and time-bound. If necessary, objective criteria may be presented as ranges;	
Rehabilitation methodology	Chapter 4 and Chapter 5
e) Details regarding the rehabilitation methods for disturbed areas and expected time frames for each stage of the rehabilitation process.	
f) Mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key production milestone (i.e. ROM tonnes) of the mine layout sequence before being translated to indicative timeframes through the mine life. The mine plan should maximise opportunities for progressive rehabilitation;	Section1.2 and 4
Conceptual final landform design	Figure 4.6
g) Inclusion of a drawing at an appropriate scale identifying key attributes of the final landform, including final landform contours and the location of the proposed final land use(s)	
Monitoring and research	Sections 5.5.1 and 6.2
h) Outlining the monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria	
i) Details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices;	Section 3.2.7
j) Outlining any proposed rehabilitation research programs and trials, including their objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices;	Section 6.2.5
Post-closure maintenance	Section 5.5
k) Description of how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land use(s) in order to demonstrate progress toward meeting the rehabilitation objectives and completion criteria in a timely manner;	

Table 1.2 Agency project specific assessment recommendations

Requirement	Section addressed
Barriers or limitations to effective rehabilitation	
l) Identification and description of those aspects of the site or operations that may present barriers or limitations to effective rehabilitation, including:	
i) evaluation of the likely effectiveness of the proposed rehabilitation techniques against the rehabilitation objectives and completion criteria	Sections 5 and 6
ii) an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (e.g. acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden/interburden and reject material;	Sections 3.2.1, 4.3 and 4.4, *McPhillamys Gold Project Geochemical Characterisation* SRK Consulting 2018 and *Regis Resources Limited McPhillamys Gold Project Tailings Storage Facility Definitive Feasibility Study* ATC Williams 2019. Note given that this is not a coal mining proposal, spontaneous combustion is not a risk for this project.
iii) the process that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes;	Sections 3.2.1, 4.3 and 4.4, *McPhillamys Gold Project Geochemical Characterisation* SRK Consulting 2018 and *Regis Resources Limited McPhillamys Gold Project Tailings Storage Facility Definitive Feasibility Study* ATC Williams 2019.
iv) a life of mines tailings management strategy, which details measures to be implemented to avoid the exposure of tailings materials that may cause environmental risk, as well as promote geotechnical stability of the rehabilitated landform; and	Sections 3.2.1, 4.3 and 4.4 and *Regis Resources Limited McPhillamys Gold Project Tailings Storage Facility Definitive Feasibility Study* ATC Williams 2019.
v) existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how key geomorphological characteristics evident in stable landforms with the natural landscape can be adapted to the materials and other constraints associated with the site.	Section 4.3, figure 4.6
m) Where a void is proposed to remain as part of the final landform' include:	
i) A constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;	Section 4.2.3 (final void) and Section 4.2.1 (waste rock emplacement)
ii) A preliminary geotechnical assessment to identify the likely long term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and	Sections 3.2.1, 4.2.3 and 4.3.6.
iii) outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required to be implemented to minimise associated impacts to the environment and downstream water users.	Section 4.2.3

Table 1.2 Agency project specific assessment recommendations

Requirement	Section addressed
n) Where the mine includes underground workings:	
i) Determine (with reference to the groundwater assessment) the likelihood and associated impacts of groundwater accumulating and subsequently discharging (e.g. acid or neutral mine drainage) from underground workings post cessation of mining; and	Not applicable as there are no underground workings
ii) Consideration of the likely controls required to either prevent or mitigate against these risks as part of the closure plan for the site.	Not applicable as there are no underground workings
o) Consideration of the controls likely to be required to either prevent or mitigate against rehabilitation risks as part of the closure plan for the site;	Section 3.2
p) Where an ecological land use is proposed, demonstrate how the revegetation strategy (e.g. seed mix, habitat features, corridor width etc) has been developed in consideration of the target vegetation community(s);	Section 4.3.5
q) Where the intended use is agriculture, demonstrate that the landscape, vegetation and soil will be returned to a condition capable of supporting this; and	Section 3.2.2
r) Consider any relevant government policies	Section 1.4

1.4 Other legislation, guidelines and leading practice

1.4.1 Legislation and environmental planning instruments

i Mining Act 1992

The project will require a mining lease under the Mining Act prior to the commencement of mining operations, which will include rehabilitation and environmental performance conditions. The Mining Act defines rehabilitation as the 'treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment'.

A mining lease cannot be issued until development consent is granted. Section 4.42 of the EP&A Act mandates that a mining lease for an approved SSD project cannot be refused and its terms must be substantially consistent with the terms of development consent for the SSD. It is also anticipated that the new mining lease and development consent will require the preparation and approval of a Mining Operations Plan (MOP)[1].

The MOP includes objectives and criteria for rehabilitation, rehabilitation plans, risks to rehabilitation that need to be addressed, rehabilitation controls and methodologies, and monitoring programs. A MOP is not required at this stage for the project, as a Mining Lease is yet to be granted however, the requirements of the MOP guidelines (ESG3) have been addressed in this Rehabilitation and Landscape Management Strategy. Accordingly, rehabilitation of the project area will be carried out generally in accordance with this strategy.

[1] It is understood that the MOP will soon be called a Rehabilitation Management Plan

ii Protection of the Environment Operations Act 1997

The POEO Act establishes the State's environmental regulatory framework and includes licensing requirements for certain activities. The objectives of the POEO Act that relate to decommissioning and rehabilitation include *...to protect, restore and enhance the environment, to reduce risks to human health and prevent degradation of the environment*.

The POEO Act objectives have been used in the preparation of this strategy and are principally reflected in one of the overarching goals of the strategy; to minimise the risk of pollution occurring from the site during and following closure, decommissioning and rehabilitation.

iii Blayney Local Environmental Plan 2012

The *Blayney Local Environmental Plan 2010* has outlined objectives for each land use zone in the shire. The disturbance footprint of the project is within land zoned RU1 – Primary Production. The objectives for this zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To enable function centres, restaurants and appropriate forms of tourist and visitor accommodation to be developed in conjunction with agricultural uses.

Open cut mining is permitted in this zone with consent.

Table 1.3 demonstrates the project's alignment with the objectives of the Blayney Local Environmental Plan.

Table 1.3 Objectives of the RU1 Primary Production Zone (Blayney LEP)

Blayney LEP objectives	Project alignment with objectives
To encourage sustainable primary industry	Open cut mining is considered to be a primary industry and is a permissible land use in the RU1 zone. agricultural
To minimise conflict between land uses within this zone and land uses within adjoining zones.	As described in the EIS (EMM 2019) neighbouring land uses include agricultural, rural residential and forestry. The EIS outlines measures to both minimise impacts and address residual impacts on land uses within the locality.
To enable function centres, restaurants and appropriate forms of tourist and visitor accommodation to be developed in conjunction with agricultural uses.	Not applicable to this development.

1.4.2 Guidelines

This strategy has been prepared generally in accordance with the appropriate guidelines, policies and industry requirements, where appropriate. Guidelines and policies referenced are as follows:

- Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells (NSW Department of Industry, Skills and Regional Development - Division of Resources and Energy, March 2016);
- ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013 (NSW Department of Trade and Investment – Division of Resources and Energy, 2013);
- The Strategic Framework for Mine Closure (ANZMEC and MCA, 2000);
- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia, 2006); and
- Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia, 2006).

The relevance of each of the guidelines is discussed briefly in the following sections.

i Borehole Sealing Requirements on Land

The Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells (the drilling guideline) provides an overview of the process for rehabilitation of boreholes not licensed under the Water Management Act 2000.

In the event that any boreholes remain open at completion of the operational phase, Regis will rehabilitate any remaining boreholes, having regard to the borehole sealing requirements in the drilling guideline.

ii Mining Operations Plan Guidelines

The *ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013* (the MOP guidelines) (NSW Department of Trade and Investment – Division of Resources and Energy 2013) provide a process for managing and monitoring progression towards successful rehabilitation of a mine site. The guidelines provide content and formatting requirements for MOPs and Annual Reviews. The purpose of these documents is to '*ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable and satisfactory outcome.'* Specifically, the MOP must meet the content and format as set out in the MOP guidelines as well as:

- be consistent with any development consent requirements;
- be consistent with safety management plans;
- be based on objectives and outcomes developed with stakeholder involvement;
- provide sufficient detail, supported by scientific and engineering assessment and/or peer review where appropriate, to clearly demonstrate that the objectives and outcomes defined in the MOP will be met; and
- where necessary, contain an environmental assessment of any impacts associated with the implementation of the MOP, where the activities have not been previously assessed under the EP&A Act.

This strategy has been prepared to address the various requirements of the closure and rehabilitation aspects of the MOP guidelines. In particular, rehabilitation domains have been identified as per the guidelines, as well as objectives and completion criteria for these domains.

A MOP will be prepared and submitted to the DRG for approval following the grant of development consent for the project. An approved MOP must be in place prior to the commencement of any significant disturbance activities including mining operations, mining purposes and prospecting.

As noted in the MOP guidelines, a MOP is designed to fulfil the function of both a rehabilitation plan and a mine closure plan. It will document the long-term mine closure principles and outcomes whilst outlining the proposed rehabilitation activities (if any) during the MOP term (typically five years).

A MOP also forms the basis for the estimation of the security deposit imposed to ensure compliance with conditions of authorisation granted under the Mining Act. An estimate of rehabilitation costs will be prepared in accordance with the relevant guidelines and submitted in conjunction with the MOP, prior to commencing operations.

iii Strategic Framework for Mine Closure

The *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia, 2000) (SFMC) was developed to promote nationally consistent mine closure management. The SFMC provides guidelines for the development of a mine closure plan to make sure that all stages of mine closure are conducted appropriately, including stakeholder engagement, development of mine closure methodology, financial planning, and implementation of mine closure. The SFMC also describes the expected standards for mine closure and relinquishment of the mine to a responsible authority. Whilst the objectives generally relate to mine closure, there are key elements that are relevant to rehabilitation of the project, in particular the allocation of appropriate resources and the establishment of rehabilitation criteria, which have been included in this strategy.

The main objectives of the SFMC are:

- To enable all stakeholders to have their interests considered during the mine closure process;
- To ensure the process of closure occurs in an orderly, cost-effective and timely manner;
- To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
- To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
- To establish a set of indicators which will demonstrate the successful completion of the closure process; and
- To reach a point where the company has met agreed rehabilitation criteria to the satisfaction of the Responsible Authority.

iv Mine Rehabilitation - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MR Handbook) is to provide guidelines to promote 'leading practice' sustainable mine plan and rehabilitation design, considering environmental, economic, and social aspects to support on-going sustainability of a mining development. The MR Handbook recommends procedures and mitigation measures that should be considered during mine plan and rehabilitation design, including stakeholder consultation, material and handling, water balance, final landform design, soil (topsoil and subsoil) management, vegetation and fauna habitat re-establishment and rehabilitation, and agriculture / commercial forestry suitability. The MR Handbook also provides relevant mine development case studies supporting the recommended procedures and mitigation measures. Where relevant to the project, the above principals have been addressed in this strategy.

v Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MCC Handbook) is to provide guidelines to promote 'leading practice' sustainable mine closure and completion, minimising any long-term environmental, economic, and social impacts and resulting in a suitable final land form for an agreed land use. Specifically, the MCC Handbook provides that a progressive rehabilitation plan, which is a key principle of this strategy, should be developed for mine closure.

1.5 Adoption of leading practices

Regis is committed to adopting leading practices in the planning, construction, operation, closure and rehabilitation of the project. This includes leading practice measures to avoid, minimise and/or mitigate potential environmental and social impacts. In relation to rehabilitation the leading practices adopted are:

- Adoption of a waste rock emplacement design that has used erosion and landform evolution modelling to develop stable slope gradients and drainage patterns that avoids structural drainage features and incorporates microrelief to increase the visual amenity of the landform.
- The use of topsoil/rock matrices to provide critical shear protection in steeply sloping areas of the waste rock emplacement.
- Establishing a biodiversity post mining land-use on the waste rock emplacement that will help account for previous clearing for agricultural purposes and maximises the function and stability of the cover system.
- Scheduling the construction of the waste rock emplacement so that:
    - it will be progressively rehabilitated over the life of the mine;
    - rehabilitation of the southern face of the waste rock emplacement will be prioritised in the first few years of the project life (including construction of the landform to its final height and establishing a vegetative cover as quickly as possible) so that this southern face will act as an effective visual and noise bund throughout the rest of the mine life.
- Designing the layout of the project so that it avoids potential Biophysical Strategic Agricultural Land (BSAL) identified in the western portion of the project area.
- Establishing a Land and Soil Capability Class 4 on the capped surface of the tailings storage facility.

1.6 Purpose and scope of this strategy

The purpose of this report is to prepare a strategy that addresses applicable regulatory requirements, standards and guidelines for the rehabilitation and landscape management of the project.

This strategy has been prepared recognising that once conditions of consent are available for the project to proceed, a MOP will be prepared and submitted to the DRG for approval. The MOP will be generally consistent with the commitments relating to rehabilitation and closure outlined in this strategy.

The objectives of this strategy are:

- to describe the proposed post-mining land use;
- identify potential risks and impacts which will impact on rehabilitation, landscape management and success;
- to describe the methods for establishing stable post-mining landforms; and
- to set rehabilitation criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.

The rehabilitation concepts presented in this strategy should be regarded as provisional to allow for consideration of the outcomes from future rehabilitation trials and research, and other unforeseeable changes that may come about, for example via the mine closure consultation phase. Final rehabilitation and project closure requirements will ultimately be formulated in consultation with key government agencies and other relevant stakeholders.

2 Rehabilitation domains

2.1 Overview

The project area has been divided into a series of primary closure domains, with each domain having similar bio-physical characteristics. These domains have been assigned in accordance with the requirements of the Department of Trade and Investment's guideline ESG3: Mining Operations Plan (MOP) Guidelines (September 2013) (the MOP guidelines), so that they can be easily transferred into the MOP when it is prepared post-approval.

2.2 Primary domains

Primary domains (as defined in the MOP guidelines) are based on land management units within the project area, usually with a unique operational and functional purpose during operation and therefore have similar characteristics for managing environmental issues. The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains that have been identified for the project, in accordance with ESG3 are:

2. Infrastructure areas
3. Tailings storage facility
4. Water management areas
5. Waste rock emplacement
6. Soil stockpiles
7. Open cut void

The primary domains are illustrated in Figure 2.1, and the extent of disturbance per primary domain is presented in Table 2.1.

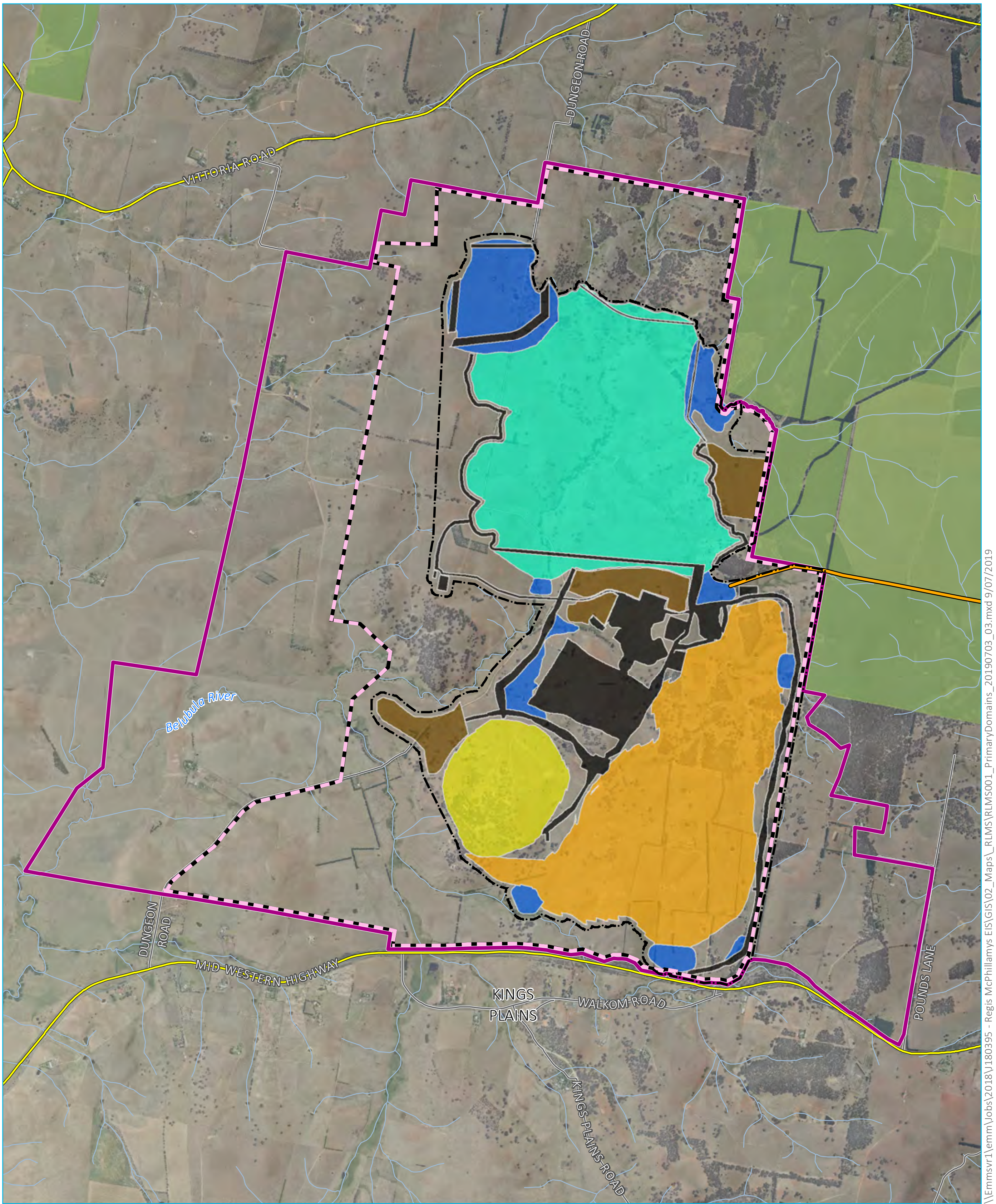
Table 2.1 Surface Infrastructure disturbance by primary domain

Primary domain	Project element	Area (ha)
1. Infrastructure areas	Ore handling and Processing Crushing circuit Processing Plant (Carbon in Leach) Water Treatment Plant Run of Mine (RoM) stockpiles General infrastructure access roads and haul roads offices, bathhouse, carpark, workshop, stores temporary construction facilities utilities (power line, water pipelines)	136.57
2. Tailings storage facility	Tailings storage facility (TSF)	293.45

Table 2.1 Surface Infrastructure disturbance by primary domain

Primary domain	Project element	Area (ha)
3. Water management areas	raw water dam	84.97
	primary water storage facility (process water dam)	
	TSF seepage interception water storage facility	
	Secondary water storage facility and sedimentation dams (WSF1 to WSF4)	
	TSF clean water diversion	
4. Waste rock emplacement	Waste rock emplacement including the pit amenity bund	270.12
5. Soil stockpiles	Subsoil stockpiles for capping and amelioration to growing media	55.39
	Topsoil stockpiles	
6. Open cut void	Void	70.51

An overview of the rehabilitation activities to be carried out in each primary domain is presented in the following section. The decommissioning of each project element is described in Chapter 4.3.



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment
- Main road
- Local road
- Watercourse/drainage line
- Vittoria State Forest

Primary domains
- 1. Infrastructure area
- 2. Tailings storage facility
- 3. Water management area
- 4. Waste rock emplacement
- 5. Soil stockpile
- 6. Open cut void

Primary domains

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 2.1

REGIS RESOURCES LTD
EMM creating opportunities

3 Environmental and socio-economic risk management

3.1 Overview

Identifying environmental, social and economic risks associated with rehabilitation and closure is essential for effective closure planning.

Key risks during the rehabilitation and closure phases include:

- potential for long term acid rock drainage due to the geochemistry of the ore and waste rock;
- not achieving the agreed post mining LSC classes on rehabilitated lands and post mine land uses;
- erosion and sediment control;
- noise and dust;
- weeds;
- hydrocarbons, chemicals and wastes;
- bushfire; and
- socio-economic considerations.

3.2 Environmental risk

3.2.1 Geochemistry and geotechnical stability

Detailed characterisation of the McPhillamys ore body, waste rock and tailings has been undertaken to guide the design of the waste rock emplacement and the tailings storage facility. During operations potential acid forming (PAF) rock will be mined from the void as either ore or waste. Ore will be trucked to the ROM pad for temporary stockpiling prior to processing and waste PAF material will be trucked to the PAF cells primarily in the waste rock emplacement (WRE) for disposal. Tailings will be piped to the TSF for disposal.

The following sections describe how the potential for acid rock drainage (ARD) will be mitigated at the ROM pad, processing plant, WRE, TSF and the open cut.

i ROM

The ROM will be constructed primarily from compacted non-acid forming rock (NAF) waste rock but will also include a central PAF cell to encapsulate some of the early PAF waste rock generated from development of the open cut. The volume of the ROM pad will be approximately 4.6 million m^3 of which 2.0 million m^3 will be PAF waste rock.

Gold ore mined from the open cut will be stockpiled at the ROM pad for a short period of time before being loaded into the crushing, grinding and processing circuits to extract the gold. Any run-off from the ROM will be contained in the primary water management facility for re-use in processing.

At closure, any remaining ore not processed or spilled on the haul road will be trucked to the PAF cell in the WRE. The ROM construction materials will be selectively assessed for potential contamination issues against background criteria for:

- pH and electrical conductivity (EC)
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (such as aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination above threshold limits is found, then the contaminated materials will be excavated and taken to the PAF cell in the WRE so that ROM is appropriately remediated suitable for the agreed future land use prior to reshaping the outer batters and replacing the subsoil and topsoil that was stripped during construction.

ii Processing plant

The pad for the processing plant will be constructed from compacted NAF waste rock. The processing plant will be constructed on concrete foundations and will be bunded to contain spillages of process slurries and chemicals.

Any spillages of gold ore in the crushing circuit will be fed back into the circuit for processing. Spillages of process slurries will be cleaned up and disposed of in the TSF.

At closure, any spilled ore will be removed and trucked to the PAF cell in the WRE. Any spilled process slurries will be moved and disposed in the TSF. The construction pad will be selectively assessed for potential contamination issues against background criteria for:

- pH and EC;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (such as aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination above threshold limits is found, then the contaminated materials will be excavated and taken to the PAF cell in the WRE prior to reshaping the outer batters and replacing the subsoil and topsoil, so that processing plant areas can be appropriately remediated to a standard that is suitable for the agreed future land use.

iii Waste rock emplacement

The WRE at McPhillamys will include PAF cells that are encapsulated with a NAF waste rock base that has a 5m minimum thickness, and 5m to 7m of NAF material above, depending on its location within the WRE. The thickness of the capping over the PAF waste rock will provide sufficient water storage for the operation of a store and release cover system and allows for the potential rooting depth of the proposed open woodland to minimise the potential for root penetration into the PAF waste rock.

A cover for the WRE will be constructed in accordance with the climate criteria provided in Figure 6-9 of *Global Acid Rock Drainage Guide* INAP 2014 (INAP). This figure is reproduced in Figure 3.1. The cover may be a store and release cover, which is most effective in wet/dry climates with high potential evaporation equal to two to three times the rainfall (INAP, 2014), or a shedding style cap.

Figure 3.1 ARD Capping Options Matrix (INAP 2014)

Further detail on the WRE landform design is provided in section 4.3.1.

iv Tailings storage facility

The key risks with the TSF are:

- acidic and metalliferous seepage from the TSF;
- capillary rise of metals into the capping layer(s);
- inadequate geotechnical strength within the tailings to support the placement of the capping layers; and
- inadequate quantities of materials to cap the tailings.

The TSF is proposed to have a clay key and core in the wall that extends down into the competent rock under the wall to create an effective seal between the wall and substrate to minimise seepage. The floor of the TSF will also be appropriately treated to minimise the potential for seepage during operation and closure of the mine, such that the permeability of the floor will achieve a minimum of 3.3×10^{-10} m/s using site materials or 1×10^{-9} m/s using geotextile with bentonite clay encapsulated with geotextile. Multiple spigots will be located on the wall and on the eastern side of the TSF to form a tailings beach away from the wall and toward a dedicated decant structure on the western side of the TSF (Figure 3.2).

Tailings deposition will be planned to:

- cycle spigot operation to minimise the duration of tailings exposure to air to reduce the potential for oxidation and acid formation;
- facilitate desiccation at closure to provide a geotechnical competent surface for capping;
- direct supernatant water away from the primary wall and containment embankments;
- create as flat as possible tailings profile to maximise the effectiveness of the cap; and
- create a low gradient generally free drainage final surface profile that minimises ponding.

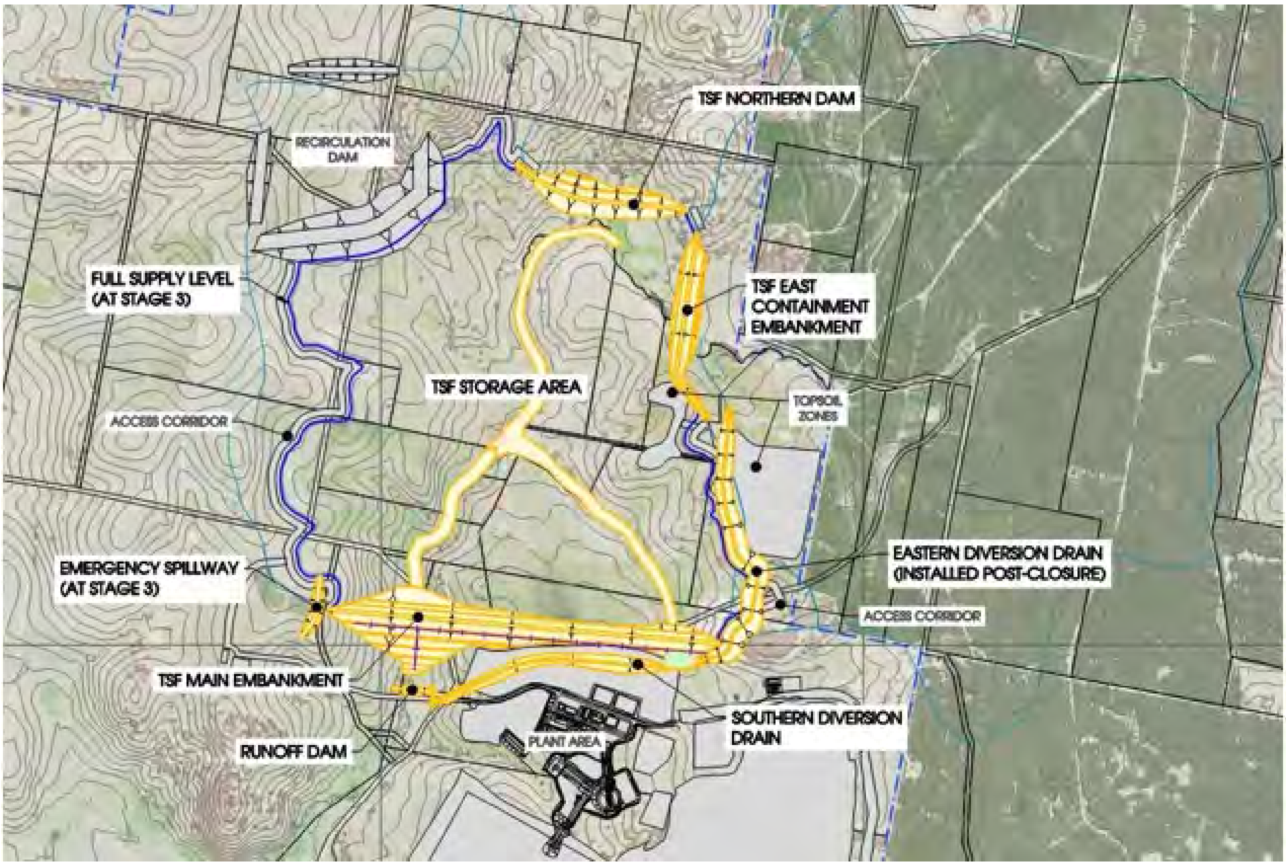


Figure 3.2 TSF arrangement

At closure, the TSF will be covered with a capillary break layer (which will also function as a trafficking layer) of NAF waste rock approximately 0.5m thick. The capillary break will minimise the potential for capillary rise of salts and heavy metals into the above capping layers and provides a bridging layer.

The capillary break will be covered with approximately 0.7m (minimum thickness) of a capping layer consisting of 0.6m of subsoil capped with 0.10m of topsoil. This arrangement is shown conceptually in Figure 3.3.

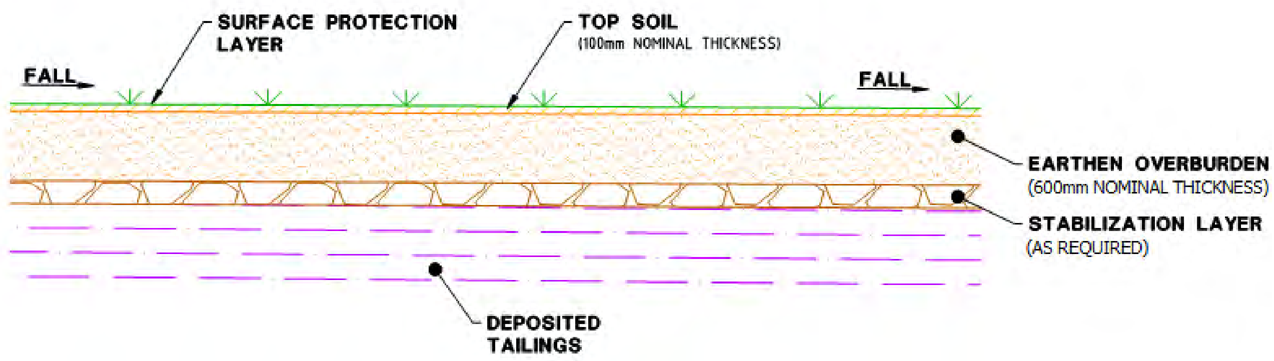


Figure 3.3 TSF capping arrangement

There may be periods of high rainfall where the volume of rain exceeds the infiltration rate and storage capacity of the cover. Therefore, the final surface of the TSF has been designed to drain runoff in these instances to the proposed clean water diversion on the south-east side of the TSF wall.

The TSF will be actively dewatered during operations and rehabilitation phase to the primary water management facility to minimise the volume of supernatant water stored on the TSF to facilitate desiccation of the tailings. Dewatering will continue until there is insufficient water to pump from the dam.

A seepage interception trench will also be constructed downstream of the TSF embankment cut-off key, which will direct any seepage into the seepage sump. Any collected water will be pumped to the primary water management facility. Seepage should decline as the tailings beach facilitates moving the phreatic line away from the TSF wall. Some seepage may be anticipated during the capping process as the weight of the capping and machinery operation preloads the tailings and expresses trapped pore water.

It is expected that capping of the TSF and establishment of an effective grass cover on the surface of the capped TSF will significantly minimise the potential for seepage from the TSF.

v Void

The final void will be approximately 460m deep with the void slope ranging from 40 to 45° in competent rock areas. Groundwater modelling demonstrates that the void will function as a groundwater sink. It shows that the final void will reach an equilibrium level approximately 9m below the spill level and will therefore never overtop. Water quality is likely to be acidic, with elevated metal levels and electrical conductivity. As the groundwater gradient is toward the void and the rate of evaporation will exceed groundwater and surface water inflows, it is highly improbable that there will be contaminated seepage from the void.

Geotechnical assessments have been undertaken to provide input for the project planning and design process. The ore body is located within a sequence of sheared Silurian metavolcanics and volcanoclastic rocks forming part of the Eastern Lachlan Fold Belt of NSW. The mineralised rock sequence has undergone well developed sericite-quartz-chlorite-clay-pyrite alteration with calcareous and argillic alteration associated with a major fault (Sherlock Fault) along the western margin of the mineralised zone. A dominant, NNW-SSE trending subvertical foliation pervades the rock mass. In addition, the sequence is inferred to include large scale cross cutting fault structures-oriented NE-SW and NW-SE.

Targeted drilling was undertaken to better define the full extent and western margin of the deeply altered, 'clay' zone associated with the Sherlock Fault. The additional drilling confirmed that the zone is limited to the south western wall of the proposed final pit and does not extend to the western or north western walls (SRK Consulting 2019 2019).

The depth of highly weathered material is typically about 20m across the proposed pit area. A variably weathered, transition zone extends to a further 40m to 60m depth. Within the south western corner of the pit is a zone of low strength, altered rock material extending to the full depth of the pit. Open pit design domains are further subdivided on the basis of pit wall orientation relative to the main structural (kinematic) constraints within the rock mass.

The majority of material to be mined comprises slightly weathered to fresh volcanoclastic rock with an unconfined compressive strength (UCS) strength range in the order of 70MPa to 130MPa. In general terms the rock mass on the eastern side of the open pit represents the higher strength range material while the mineralised and altered, central part of the pit represents the lower strength range of materials. The highly altered zone associated with the Sherlock fault system (within the south western part of the pit) comprises low to medium strength rock materials with UCS values in the range of 5MPa to 25MPa. Rock strength increases again to the west, away from the Sherlock Fault system, to form the western and north western walls of the pit.

Testing undertaken by Australian Centre for Geomechanics (ACG) indicates that the magnitude of pre-existing tectonic horizontal rock stress is twice that of the vertical stress condition and therefore not expected to significantly impact on pit wall stability at current design depths.

SRK Consulting has undertaken a range of design methodologies including empirical and kinematic analyses of slope design parameters accompanied by limit equilibrium and finite element analysis of large-scale slope configurations.

3.2.2 Land and Soil Capability

i Land and Soil Capability

The Land and Soil Capability (LSC) classes of the Project Area were assessed as part of the Land and Soil Capability Assessment undertaken for the project (Sustainable Soils Management 2019), in accordance with the *Land and Soil Capability Assessment Scheme – second* approximation (OEH 2012).

The LSC assessment classifies land into one of eight soil and land capability classes. These classes give an indication of what the land can be used for without causing land and soil degradation (Table 3.11).

Table 3.1 Land and soil capability classes (OEH 2012)

LSC Class	Description
Land capable of wide variety of uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	Extremely high capability land: Land has no limitations. No special land management practices required. Land capable of all rural uses and land management practices.
2	Very high capability land: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	High capability land. Land: Has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental limitations
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	Moderate land capability land: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	Moderate-low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations will need to be carefully managed to prevent long-term degradation.
Land capable of a limited set of land uses (grazing, forestry, nature conservation and some horticulture)	
6	Low capability land: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
Land generally Incapable of agriculture land use (selective forestry, nature conservation)	
7	Very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	Extremely low capability: Limitations are so severe that land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

The project area is predominantly LSC class 4 and class 5, which is consistent with the historic land-use of growing naturalised pasture to support grazing by cattle and sheep. Some class 6 land also occurs across the project area, with very small patches of class 3 and class 7.

Much of the project area has previously been cultivated; however, the strongly acidic nature of the soils and high aluminium levels constrains the range of crops that can be grown and limits their productivity. Intensive soil amelioration is required to sustain cropping and as such agricultural land-use has transitioned to grazing.

Pre and post mining LSC classes for the project area are shown in Figure 3.4 and 3.5.

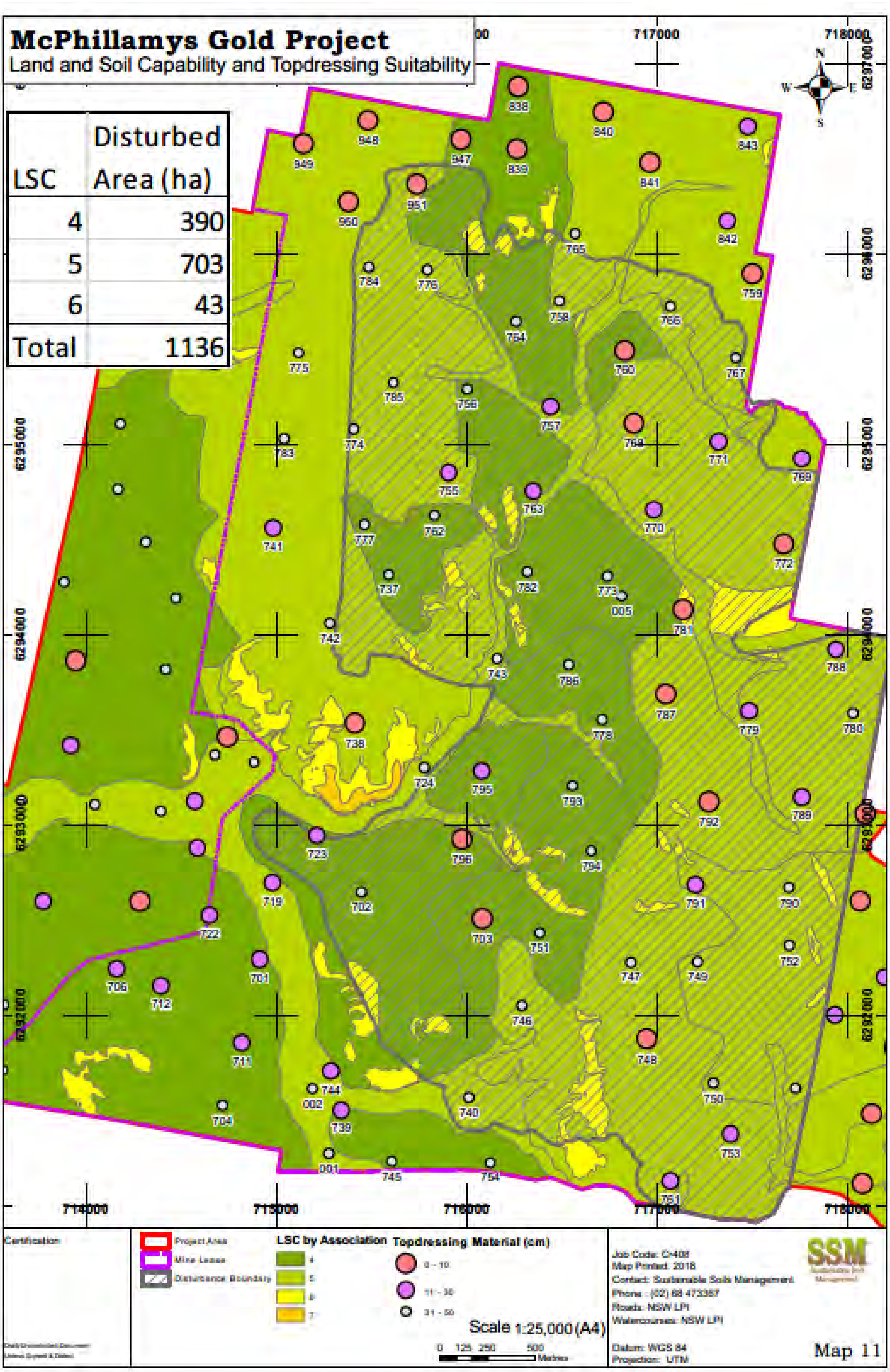


Figure 3.4 Pre mining land and soil capability classes

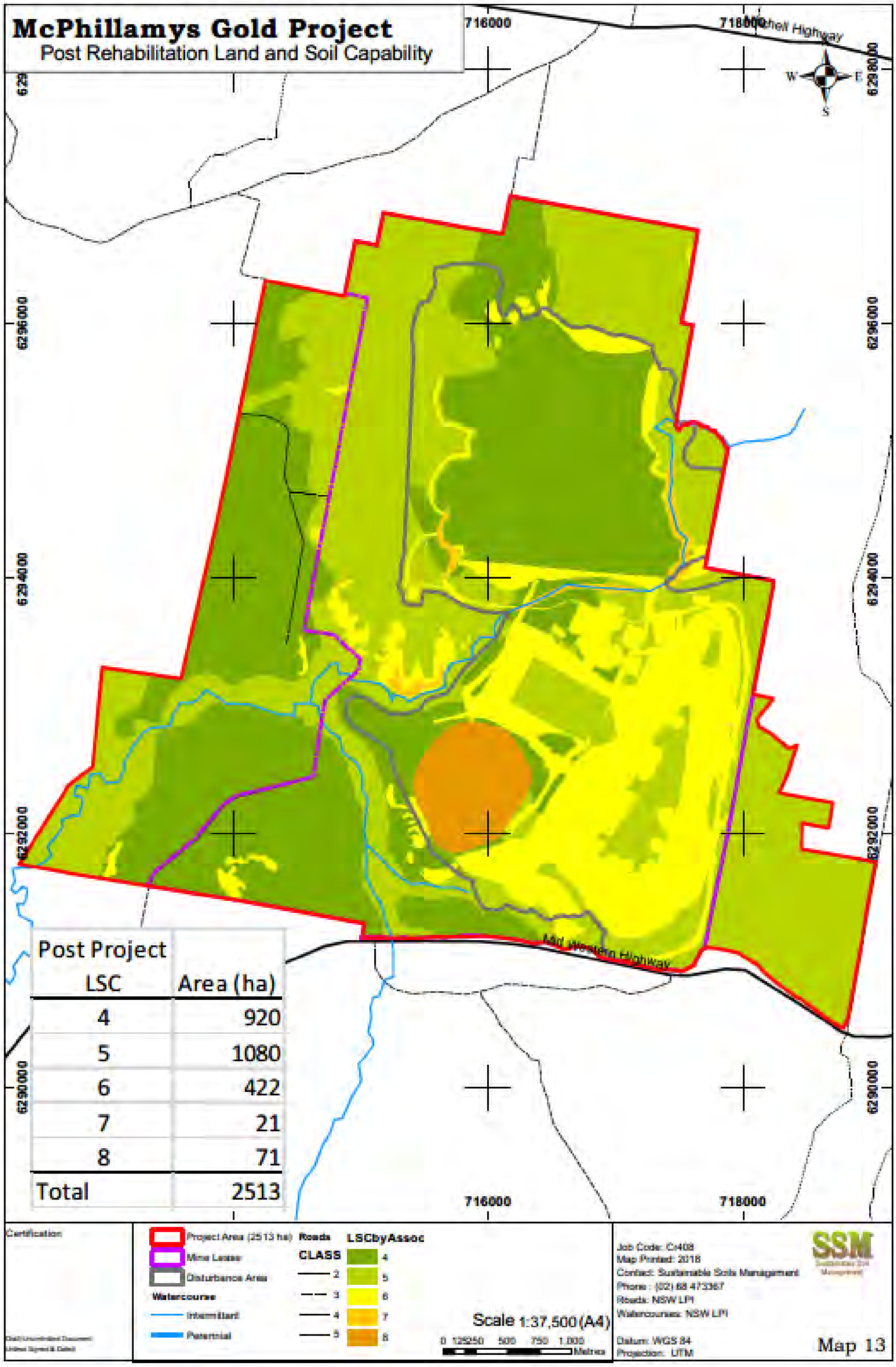


Figure 3.5 Post mining land and soil capability classes

Rehabilitation works to be undertaken during the closure phase will replace sufficient soil in some areas (eg the TSF) to achieve LSC 4 Class; however due to limitations associated with protection of the tailings cap and propensity of project soil for waterlogging, cultivation should not be undertaken.

Site soils will be ameliorated (with what? And at what rate) during the stripping phase to address the soil acidity and aluminium toxicity and therefore are likely to produce more productive pastures than currently exists.

There will be some loss of LSC Class 4 and LSC Class 5 land in the footprint of the WRE, and loss of LSC Class 4 and LSC Class 6 land due to the final void.

Sufficient topsoil and subsoil will be stripped during mine establishment and mining operations for respreading during the closure phase to ensure the post-mining LSC's are achieved.

The change in areas of each LSC class over the life of the mine is shown in Table 3.22 and Figure 3.5.

Table 3.2 Change in LSC class areas over the life of the project

LSC Class	Capability	Pre-mining area (ha)	Post-mining area (ha)	Change (ha)
Land with a wide range of uses (cropping, grazing, horticulture, nature conservation)				
1	Extremely high	0	0	
2	Very high	0	0	
3	High	0	0	
Land with a variety of uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)				
4	Moderate	932	920	-12
5	Moderate-low	1491	1080	-411
Land with a limited range of uses (grazing, forestry and nature conservation				
6	Low	86	422	+336
Land generally unable to support agriculture (selective forestry and nature conservation)				
7	Very low	4	21	17
8	Extremely low	0	71	71

ii Soils

a Soil Associations

Soil associations were mapped across the project area by Sustainable Soils Management (2019) (Figure 3.6).

Soil Association boundaries were fine-tuned using digital soil maps of clay content and exchangeable aluminium percentage of the 30 to 60 cm layer. created using regression kriging (Malone, 2013) with covariates from the Digital Elevation Model used to map slope across the Project Area.

The depositional parts of the landscape have been mapped as the **Alluvium** Association.

The remaining 7 soil associations are subdivisions of the Vittoria-Blayney soil landscape mapped by Kovac *et al.*, (1989). Soil on the hills was divided first on the basis of underlying geology. Soil on the Blayney Volcanics are mapped as the **Manganic West** Association because 17 of the 20 profiles described in the association had a manganic B horizon.

Soil associations mapped on metamorphic rocks of the Anson Formation are grouped on the basis of soil properties. These are:

- **Red Soil** Association, which has red subsoil, and was also strongly acidic, well-structured and well drained;
- **Manganic East** Association, which has impeded drainage indicated by 17 of 18 profiles with having a manganic layer in the B horizon, and was generally located on mid-slopes on Anson Formation parent material;
- **Upland East** Association, which is east of the Belubula River and is strongly leached, indicated by strongly acidic profiles;
- **Aluminic variant of Upland East** Association near the boundary of the Anson and Cunningham Formations, and has subsoil that is more acidic, and has elevated proportions of exchangeable aluminium and magnesium
- **Upland Centre** Association, which is in more elevated land than the Manganic East association, and is west of the Belubula River;
- **Discharge** Association which is represented by one pit, near an area of scalded soil, and had chemistry that was so different to the 112 remaining sites that it was mapped separately.

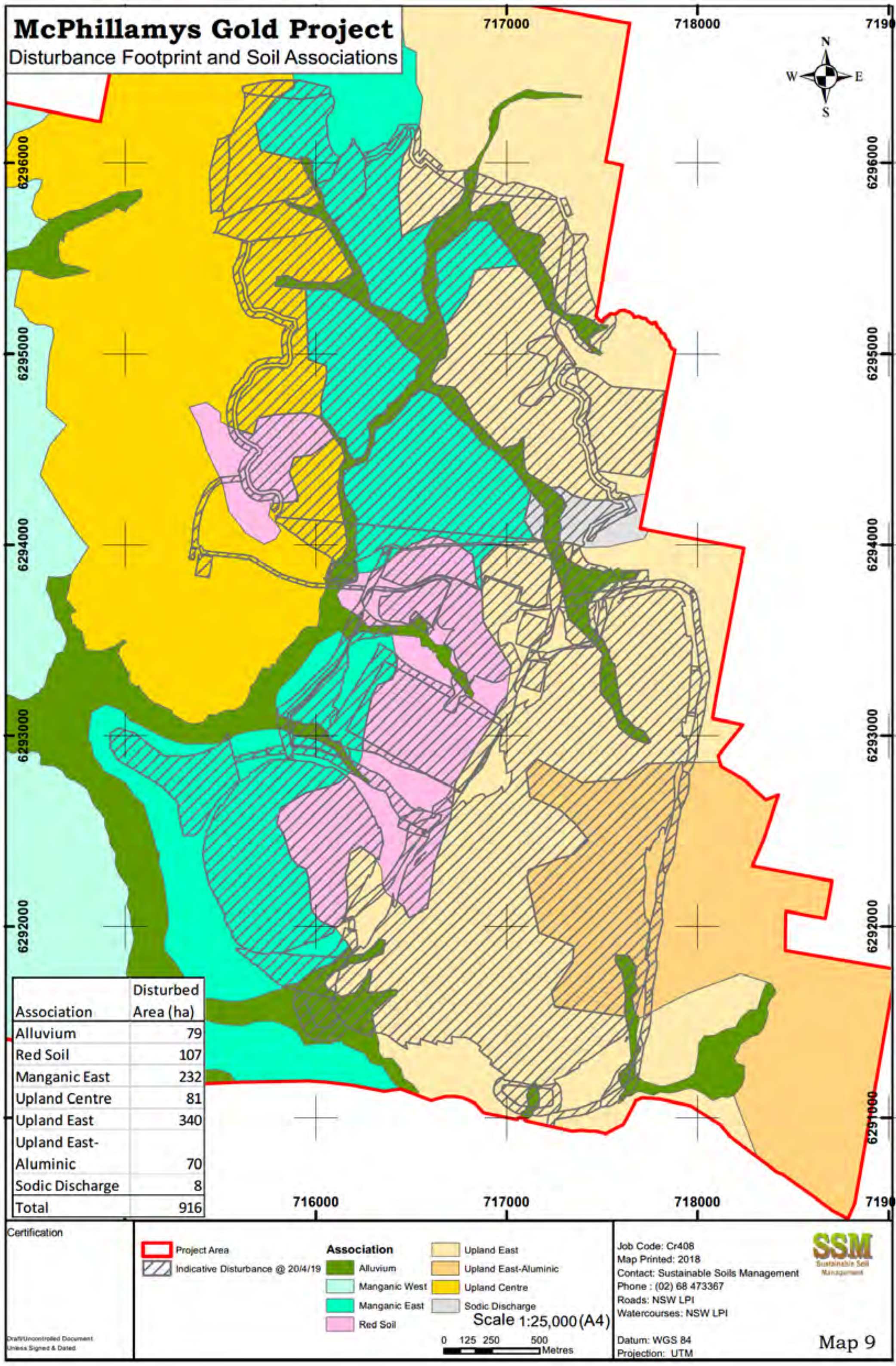


Figure 3.6 Project soil associations

b Soil Physical and Chemical Limitations

Soil across the project area generally has strongly acidic topsoil over slightly acidic subsoil. The cation exchange capacity is very low in the topsoil and low in the subsoil. Both these properties render the soil susceptible to acidity.

Calcium makes up a smaller proportion of cations than desired, while both magnesium and aluminium make up a larger proportion of cations desired for agricultural purposes. The soil nutrient levels of phosphorous, sulphur, potassium, molybdenum and zinc are present at suboptimal levels for grazing while copper was adequate. Aluminium, manganese and perhaps iron are present at levels that may be high enough to restrict plant growth.

Exchangeable sodium percentages generally increase with depth.

Most of the profiles showed evidence of prolonged periods of waterlogging in the form of either a bleached A2 horizon, manganic layers, or mottled subsoil. These properties are consistent with the low fertility.

Despite these indicators of poor subsoil drainage and low soil fertility, the land in the project area seems to be reasonably productive under its current grazing land use. This is likely to be due to a combination of relatively high rainfall, and good drainage of the surface soil. This drainage is facilitated by the common vertical macropores in the form of worm holes to a depth of 0.5m or more.

The soil limitations are easily addressed via amelioration which will be undertaken during the stripping and rehabilitation phases. This is addressed in more detail in section 5.1.

c Erosion and sediment control

Erosion potential of a soil is determined by its physical and chemical properties. Sustainable Soils Management (2019) assessed soil erodibility against the nomograph provided in *Managing Urban Stormwater – Soils and Construction Volume 1* Landcom 2004 (Landcom 2004) using measured and estimated K factors. However, this nomograph only considers the physical characteristics of the soil and does not consider the electo-chemical stability of the soil. Table 3.3 provides a soil erodibility ranking for K factor from Rosewell (1993).

Table 3.3 Rosewell (1993) Soil Erosion Ranking

K factor (t ha h $ha^{-1}MJ^{-1}mm^{-1}$)	Erosion Potential
<0.02	Low
>0.02 to <0.04	Moderate
>0.04	High

K factors for site topsoil were determined by Sustainable Soil Management (2019). These are provided in Table 3.4 below:

Table 3.4 K factors for Project Soil Associations

Soil Association	Alluvium	Manganic East	Manganic West	Red Soil	Sodic Discharge	Upland Centre	Upland East
K factor	0.05	0.07	0.06	0.05	0.06 *	0.07	0.05

A soil K factor was unable to be determined for the Sodic Discharge Soil Association however Loch et al (1998) recommends a minimum value of 0.06 be adopted for sodic soils.

Applying the soil erosion ranking in Table 3.4 to the site derived K factors indicates that the project soil has a high erosion risk.

Soils where the dominant cations are sodium or magnesium tend to be dispersive when wet. The potential for the soil to disperse is reduced as soil salinity increases and the relationship between the two is the Electrochemical Stability Index (ESI).

A ranking of clay dispersion hazard from IECA 2015 is provided in Table 3.5 below:

Table 3.5 Clay Dispersion Hazard Ranking IECA 2015

Dispersion Hazard Rating	Emmerson Class Number	ESP	Ca:Mg ratio	ESI ($EC_{1:5}$ in dS/m)/ESP	Clay content (%)	Cation : Clay ratio
Low	4 - 8	<6%	> 0.5	> 0.1	< 10%	<0.2
Moderate	3	6 to 15%	0.5	< 0.05	10 – 30%	>0.2
High	1 - 2	>15%	< 0.5	< 0.05	> 30%	>0.2

The clay dispersion hazard for the soils in the project area ranges from low to high. Generally, the clay dispersion hazard increases with depth due to either increasing sodium percentage or increasing magnesium percentage.

The soil erosion risk will be mitigated by:

- chemically treating dispersive and magnesic soils such that Ca: Mg ratio is >0.5 and exchangeable sodium percentage is less than 4%;
- selectively handling and placing the more erodible soils such that they are covered by less erodible soils; and
- blending non-cohesive (sandy) soils with soils with a higher non-dispersive clay content.

Erosion hazard for the project area has been determined using the procedure described in section 4.4.1 of Landcom 2004. The first step in the hazard assessment is a simple process using Figure 4.6 from Landcom 2004 (reproduced as Figure 3.6) that considers slope of the land and the Rainfall Erosivity or R factor.

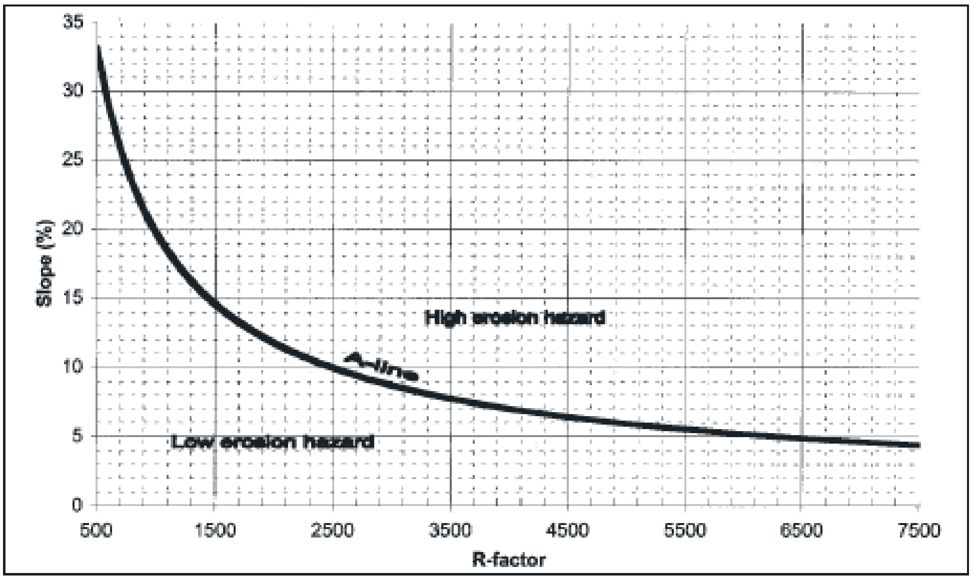


Figure 3.7 Assessment of potential erosion hazard (Figure 4.6 Landcom 2004)

For the project, the slope gradient of planned disturbed areas ranges from less than 1% for mine infrastructure areas to 50% on the inner embankment of the TSF. The R factor is 1,365 (Appendix A2 Landcom 2004). Applying these numbers to the erosion hazard nomograph results in an erosion hazard from low to high. A high erosion hazard requires further detailed assessment in accordance with section 4.4.2 of Landcom 2004 to determine soil loss classes (Table 3.6). Soil loss classes are described in Table 3.7 and are based on a nominal 80m slope length. The Revised Universal Soil Loss Equation (RUSLE) is used to predict the soil loss to determine the soil loss classes. RUSLE calculates the annual average erosion in tons per hectare from rill and interrill (sheet) erosion. It does not consider gully or tunnel erosion and does not calculate peak erosion.

The soils on site that have the greatest erosion potential are dispersive soils with an exchangeable sodium percentage of >4%. These are found in subsoils within the footprint of the open cut mine and with the Sodic Discharge Soil Landscape Association.

The landforms within the final landforms with the greatest erosion hazard are the WRE, the pit amenity bund and the TSF inner wall, due to slope lengths and gradients. Slope gradients on the WRE can range from as 1% on the top to 24% on the slopes. Using site specific K factors of 0.05 and 0.07, and a nominal slope length of 80m, calculated soil loss ranges from 17t/ha/y to 1181t/ha/y which equates to an erosion hazard ranging from very low to very high.

Table 3.6 Soil Loss Classes *(*adapted from Table 4.2 Landcom 2004)

Soil Loss Class	Calculated Soil Loss (t/ha/y)	Erosion Hazard
1	0 to 150	Very low
2	151 to 225	low
3	226 to 350	Low-moderate
4	351 to 500	moderate
5	501 to 750	high
6	751 to 1500	Very high
7	>1500	Extremely high

Erosion and landform evolution modelling for the WRE undertaken by Landloch (2019) (Appendix 1) demonstrates that because of the relatively low R factor, the erosion hazard can be mitigated on the WRE emplacement by using topsoil and rock matrices in areas of steep slopes and concentrated flows with effective vegetation cover. Landloch considers that annual average erosion rates of less than 2t/ha/y and a peak erosion rate of less than 5t/ha/y, can be achieved on the WRE essentially reducing the erosion hazard to very low.

Type D/F sediment basins (in accordance with Landcom 2004 (the Blue Book)) will be constructed downstream of all major disturbed areas to trap any eroded sediments. Water collected in the sediment basins will be pumped to the primary water storage facility for re-use on site. The sediment basins will remain in place until 70% soil surface cover has been achieved and/or Total Suspended Solids (TSS) levels in runoff are less than 50mg/L.

3.2.3 Dust and Noise

Air quality and noise management plans will be implemented during operations and will be updated to include the rehabilitation phase of the project prior to rehabilitation activities commencing. These management plans will be designed to achieve compliance with licence limits during decommissioning and rehabilitation activities.

The main anticipated source of dust during rehabilitation operations include:

- light and heavy vehicles travelling on unsealed roads and tracks;
- exposed tailings in the TSF;
- soil dumping during capping and topsoil activities; and
- land shaping.

Dust management to be used during rehabilitation and closure may include:

- sheeting roads with gravel;
- application of trafficable soil stabilising polymers to roads and tracks;
- watering areas of dust generation;
- reducing the speed of light and heavy vehicles;
- not undertaking works on exposed locations during windy conditions; and
- progressive stabilisation and rehabilitation of disturbed areas.

The main sources of noise during the rehabilitation and closure phases include:

- demolition works;
- hauling and placement of capping materials and topsoil;
- reshaping works;
- construction of the void safety bund.

Noise control during rehabilitation and closure may include:

- undertaking demolition and rehabilitation works in daylight hours only;
- reducing heavy vehicle speeds;
- maintenance of guarding and silencers on vehicles and machinery; and
- modifying work operations when climatic conditions may increase noise impacts (wind direction, temperature inversion).

3.2.4 Weeds

The presence of weed species has the potential to have an impact on revegetation outcomes. Additionally, weed species within the surrounding land has the potential to impact on the success of rehabilitated areas. Weed management will therefore be a critical component of rehabilitation activities.

Weeds will be managed through a series of control measures, including:

- if machinery to be used for rehabilitation is brought to the site from another site, and if there is a risk of weed seeds having been transported on the machinery, it will be hosed down in an approved wash down area before entry to the project area;
- herbicide spraying or scalping weeds from soil stockpiles prior to re-spreading;
- rehabilitation inspections to identify potential weed infestations; and
- identifying and spraying existing weed populations together with ongoing weed spraying over the life of the project.

Weed control programs will be implemented according to industry best management practice for the weed species present, if required.

3.2.5 Hydrocarbons, chemicals and wastes

Despite designs that prevent or contain spills, there is a low residual risk that land within the surface infrastructure area could be contaminated during de-commissioning (eg from hydrocarbon spills, storage of fuel and chemicals, refuelling activities, sewage, etc).

To manage any potential contamination sources, waste management practices in accordance with the site Environmental Management System will continue to be implemented during rehabilitation. For example:

- hydrocarbons will be stored in self bunded tanks or bunded areas designed in accordance with Australian Standard 1940;
- waste products that are removed from the project will be appropriately disposed of at licensed facilities; and
- sewage generated post-decommissioning will be minimal (ie after the on-site sewerage treatment facility is removed). Any such waste (eg portable toilets) will be transported off site for appropriate disposal at a licensed facility by a licensed waste contractor.

There is a low risk that hydrocarbon spills may also occur during soil spreading associated with rehabilitation (eg a burst hydraulic hose), but the impact would be isolated and spill-clean-up procedures would mitigate any potential impacts.

3.2.6 Bushfire

To prevent or manage bushfire risks, the site bushfire management plan will continue to be implemented. A hot work permit system will be used during rehabilitation works which will take into account the risk factors for bush fires. Machinery working on site will have spark arrestors fitted to their exhaust systems.

3.2.7 Contingency measures

A detailed rehabilitation risk assessment will be undertaken as part of the MOP development. A Trigger Action Response Plan (TARP) will be developed based on the key outcomes from the risk assessment. The TARP will identify key risks or threats to rehabilitation success at the McPhillamys mine and will detail the risk treatment measures or contingency measures that will be undertaken to mitigate the identified risks.

The triggers identified in the TARP will be reviewed and updated (if necessary) following implementation of the rehabilitation monitoring programme and/or evaluation of the rehabilitation monitoring programme results in the Annual Review.

Anticipated contingency measures that will be implemented where rehabilitation monitoring results identify a requirement for maintenance or remedial works include:

- repair of erosion (ie regrading of eroded areas);
- repair of drainage structures and de-silting of sediment control structures;
- supplementary seeding or planting;
- application of fertiliser;
- application of gypsum or lime to control pH and improve soil structure;
- bushfire management activities; and
- implementation of weed and pest control measures.

The effectiveness of the remedial works will be monitored, and the results reported in the Annual Review and used to inform and refine the rehabilitation programme.

3.3 Socio-economic impacts

Community consultation has been, and will continue to be, key to project planning and understanding the project's potential impacts on the local community. Relevant stakeholders will be engaged in the rehabilitation and closure planning and implementation process, including in the development of a detailed closure plan as the project progresses towards completion. The closure plan will address socio-economic impacts at closure, post-mining land use and rehabilitation objectives.

4 Land use options following closure

Land uses on properties surrounding the project area primarily comprise agricultural uses, forestry, rural residential and transport infrastructure (Mid-Western Highway). Consideration of final land use options have taken into account the current land uses in and surrounding the project area, infrastructure to be developed by the project, and the proximity of the project to existing agricultural land uses, the town of Blayney, residences and general local infrastructure. The rehabilitation approach for the project is to reinstate the previous land-use as much as possible while enhancing biodiversity values lost due to past agricultural clearing.

As described in Section 3.2.2, the project area is currently predominantly LSC classes 4 and 5, which is consistent with the historic land-use of growing naturalised pasture to support grazing by cattle and sheep.

The required depth of topsoil and subsoil will be stripped during mine establishment and mining operations for respreading during the closure phase to ensure the post-mining agricultural land use can be achieved.

Regis proposes an open woodland and open forest for the WRE to:

- enhance the biodiversity and visual amenity of the project area;
- protect the integrity of the WRE PAF cell from the erosion risks associated with poorly managed grazing practices; and
- enhance the function of the store and release cover by establishing trees that maximise evapotranspiration of water stored in the soil.

There are some infrastructure areas associated with the project that may be able to provide an alternate beneficial post mining land use, such as:

- the mine infrastructure areas that may be used for industrial purposes;
- a workshop that may be suitable for storage of agricultural machinery;
- the open cut void which may be used as a bioreactor to generate electricity from putrescible wastes, similar to the old Woodlawn Mine near Lake George.

Such alternate options will be considered, along with any other identified options by Regis during operation of the mine as part of detailed closure planning, and in consultation with relevant stakeholders, including the Department of Planning and Environment and Blayney Council.

Proposed post mining land uses for each domain are summarised in Table 4.1 below.

Table 4.1 McPhillamys mine proposed post mining land uses

Domain Number	Primary Domain (Operational)	Description	Pre-mining LSC classes	Post-mining LSC classes	Reasons
1	Infrastructure Areas	Administration office and amenities, carparking, processing plant, process and maintenance buildings, workshop, stores, ROM pad, ore stockpiles, haul roads and access roads, powerlines and water pipelines	4, 5, 6	6	Infrastructure areas will have concrete foundations and slabs removed, any contamination remediated, the surface recontoured to form stable gradients and will be topsoiled. The presence of hardstand materials at depth will restrict the potential for cultivation however grazing will be able to be sustained at pre-mining levels.
2	Tailings storage facility	Tailings dam	4, 5	5	The capped tailings dam will be capable of sustaining grazing due to the depth of soil and slope of the final landform. Cultivation and forestry will not be possible due to the risk of penetrating the clay cap over the tailings
3	Water management areas	Clean water collection and diversion, primary water facility/dam, secondary water management facility/dam, water management facilities 1, 2, 3 and 4, raw water storage dam.	4, 5, 6	4,5,6	No change other than the clean water diversion that will be a geomorphologically stable watercourse with riparian vegetation.
4	Soil stockpiles	Topsoil stockpiles, subsoil stockpiles	4, 5, 6	4, 5, 6	No change
5	Waste rock emplacement	Waste rock, Out of pit disposal area	4,5, 6	6, 7	The batters of the waste rock emplacement will be unsuitable for grazing due to the slope. Whilst the top of the waste rock emplacement will have sufficient depth of soil to sustain grazing; in order to protect the encapsulated PAF material, to maximise the effectiveness of the store/release cover and to enhance biodiversity, the waste rock emplacement will be planted with Yellow Box - Blakely's Red Gum grassy woodland and Broad leaved Peppermint-Brittle Gum – Red Stringybark dry open forest. As such grazing would need to be limited to well managed occasional crash grazing.
6	Final void	Final void	4, 6	8	Other than the benches, the slopes in the final void limit any productive agricultural post-mine land-use. The final void will be bunded and fenced to prevent the entry of people and stock as it will be a non-managed area.

4.1 Rehabilitation objectives

This rehabilitation strategy has been developed in consideration of several factors including opportunities (such as proximity to remnant native vegetation areas) and constraints (such as slope and soil quality), ecological and rural land use values and existing strategic land use objectives. The rehabilitation objectives for the project are set out in Table 4.2.

Table 4.2 Rehabilitation Objectives

Aspect	Objective
Mine site (as a whole)	• Safe, stable and non-polluting • Landforms designed to incorporate micro-relief and integrate with surrounding natural landforms • Constructed landforms that maximise surface water drainage to the natural environment (excluding final void catchments) • Minimise visual impact of final landforms as far as is reasonable and feasible
Void	• Minimise water inflows at all times to prevent risk of discharge to surface waters • Minimise to the greatest extent practicable the safety risk to humans, stock and fauna
Rehabilitation areas	• Safe, stable and non-polluting • Establish self-sustaining native open woodland ecosystems characteristic of vegetation communities found in the project area (ie pre-mining) on the WRE
Agricultural land	• Reinstate targeted land and soil capability classes as per EIS • Rehabilitate grassland areas so that they can support sustainable grazing activities
Clean water diversion channel(s)	• Engineered to be hydraulically and geomorphologically stable • Incorporate erosion control measures based on natural channel design principles • Revegetate with suitable native species and establish areas of self-sustaining riparian habitat
Surface infrastructure	• To be decommissioned and removed, unless agreed otherwise as part of the detailed closure planning process
Community	• Ensure public safety • Minimise adverse socio-economic effects associated with mine closure

Further details of specific rehabilitation methodology and rehabilitation criteria related to the establishment of these areas as outlined above are included in the following sections.

4.2 Conceptual post-mining landform design

4.2.1 Waste rock emplacement

Erosion and landform evolution modelling have been undertaken to ensure the WRE is stable in the long-term.

The modelling undertaken by Landloch (2019) demonstrated that the traditional benched design WRE is visually inconsistent with existing landforms due to the presence of linear drainage features and sharp corners and is unlikely to be stable in the long-term due to:

- potential for benches overtopping during greater than design run-off events;

- potential for benches overtopping due to sediment accumulation as a result of upstream erosion and diversion of flow over the batter;
- tunnels forming in dispersive or non-cohesive materials;
- tunnels and gullies forming either under or adjacent to rock drop structures.

A ‘Geofluv™´WRE design was considered but determined to be inappropriate due to:

- gully erosion risk and subsequent risk to the encapsulated PAF material due to a design that maximises the concentration of flow; and
- insufficient space within the project area to build such a landform given the relatively flat gradients necessary to achieve critical shear stress values below levels capable of being withstood by site soils and waste materials in the concentrated flow paths.

The adopted design is based primarily on the ability of the site soil and waste materials to withstand the critical shear stress from overland flows. The design includes:

- linear gradient of 14 degrees.
- minimisation of flow concentration and therefore the erosion potential of run-off.
- smooth corners consistent with pre-existing and surrounding landforms.
- incorporation of ridge lines and minor drainage lines within the WRE slope profile.
- incorporation of micro-relief and topographical features on the top of the WRE.
- use of topsoil, vegetation and rock matrices where necessary to provide necessary erosion protection on slopes and flow paths.

Figure 4.1 shows the proposed WRE final landform. Further refinement of the design will be undertaken following detailed flume testing and rainfall simulation testing of site soils and waste materials during development of the Mine Operation Plan.

The WRE design has been refined using the Water Erosion Prediction Program (WEPP), SIBERIA and the Revised Universal Soil Loss Equation (RUSLE). WEPP is a 2-dimensional batter slope erosion model used to develop stable batter shapes. WEPP is used to refine stable batter surfaces and is parameterised using the laboratory-based assessment of erodibility.

SIBERIA is a sophisticated, 3-dimensional topographic evolution model that simulates runoff, erosion and deposition. It predicts the long-term evolution of channels and slopes within a landform and is used to map and quantify the rate of gully development. This provides a method for predicting how long the PAF cell would be protected from erosion within the WRE.

The 2-dimensional batter slopes derived from WEPP are then used to develop a final 3-D landform shape that will then be input to the SIBERIA model (parameterised from WEPP output) to assess issues of flow concentration and interactions with the surrounding landscape.

Construction of the WRE will commence from the south and south-east and will generally move in an upward and northerly direction (Figures 4.3 to 4.7). This will include development of the floor of the PAF cell and the downslope containment bunds so that PAF waste rock is contained during mining operations. The southern end of the WRE will be constructed as a priority in the first few years of the project to create a landform that provides both a visual and noise amenity bund.

Sediment dams will be installed to collect any surface run-off and seepage from the WRE until it is substantially revegetated.

At closure, the bulk of the PAF cells will have been enclosed with a small area remaining open to receive PAF materials from closure operations. Once all PAF materials have been placed in the PAF cells, it will be encapsulated and remaining unrehabilitated areas shaped and revegetated.

The WRE will be constructed to achieve a final height across the landform of approximately 1065RL. As described above, micro-relief has been incorporated into this final design to facilitate a natural looking landform as much as practicable. These micro-relief features will be up to 1075RL in places across the top of the landform.

It is also noted that a second, smaller WRE was originally proposed within the south-western part of the project area. As part of the design optimisation process, this second WRE was removed from the project for two reasons:

1. to reduce noise, air and visual impacts on the western side of Kings Plains that could result from a WRE in this location; and

2. to avoid the potential for impacts on Biophysical Strategic Agricultural Land that was identified in the area. The avoidance of a second WRE means that this productive land will not be unnecessarily sterilised.

4.2.2 Tailings storage facility

Geotechnical analysis has been undertaken to confirm the general suitability of the proposed TSF embankment. As a result, the TSF embankment has been designed with the following design features:

- external batter slope of 14°;
- internal batter slope of 26°;
- crest width of 15 m; and
- Height of 49 m.

The TSF will be operated such that tailings beaching will aim to achieve the final slope design to the maximum extent possible. This is undertaken to reduce the need to reshape tailings which can be challenging due to the bearing strength of the tailings.

The tailings will be overlain by a 0.5m capillary break layer of NAF waste rock and then 0.7m soil cover consisting of 0.6m of subsoil capped with 0.1m of topsoil (refer to Figure 3.4). The proposed final TSF landform will grade gently toward the proposed clean water diversion to the south-east of the TSF embankment.

Minor reshaping works may be required, and it may be necessary to install shallow grass lined drains to facilitate free draining on the landform to the permanent creek diversion to the east of the TSF.

4.2.3 Final void

The final void will be approximately 460m deep. In the competent rock areas, the void will have side slopes of 40 to 45°.

The void has been designed with the steepest possible geotechnically stable sides to economically access the ore body and minimise the generation of waste rock. There is no opportunity to progressively backfill the void due to the single pit configuration, and any backfilling would prevent access to the orebody at depth. Reclaiming the waste rock to backfill the void after mining has been completed would both prolong the duration of visual, noise and air quality impacts on sensitive receivers by a number of years and would render the project financially unviable.

Notwithstanding, the blasting and movement of rock results in swelling of the rock, meaning that even if the pit could be backfilled, only a portion of the waste rock material would fit back into the pit and a WRE would always be required.

For these reasons, backfilling of the void is not considered financially viable nor reasonable and feasible and would exclude the full extent of the resource being mined.

Minimal modification to the final void landform is anticipated during the rehabilitation phase, other than reshaping upper batters of the void where soil and weathered rock is present and the construction of a safety bund and security fence.

Addition detail on the final void is provided in section 4.3.6.

4.2.4 Other re-shaped areas

Other areas that require reshaping, such as the outer batters of the ROM and mine infrastructure areas, will be reshaped to 14° unless the natural slope is steeper. Reshaping works will aim to maintain sheet flow conditions to minimise the soil erosion potential.

4.3 Rehabilitation by domain

4.3.1 Secondary domains

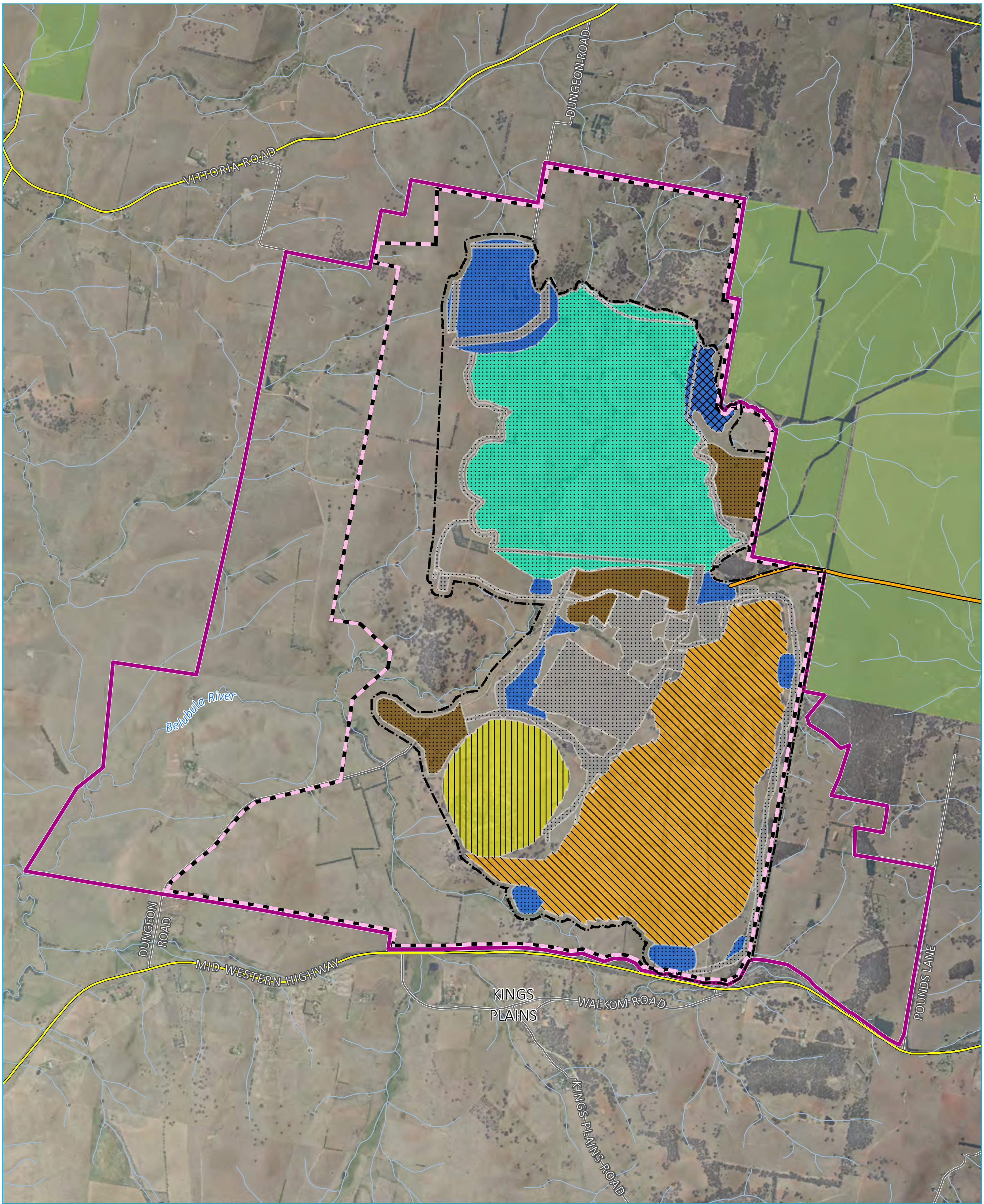
Primary and secondary domains for rehabilitation planning have been developed for the project in accordance with the requirements of ESG3. As described in Section 2.2, the primary domains are defined based on land management units within the project area with unique operational and functional purposes.

The secondary domains are the post-mining land-use domains and are characterised by similar post-mining land-uses. These domains form the basis of performance criteria used for measuring rehabilitation and closure success.

The primary domains are identified numerically, and the secondary domains are identified alphabetically. The primary and secondary domains for the project area are shown on Figure 4.2 and summarised in Table 4.3.

Table 4.3 Primary and Secondary Domains

Code	Primary Domain (Operational)	Mine Areas included	Code	Secondary Domains (Post Mining Land Use)
1	Mine Infrastructure Areas	Process Plant (CIL), Water treatment plant, Facilities, STP, ROM, Haul Roads and Access Roads, power lines and water pipelines	D	Rehabilitation Pasture –Land and Soil Capability Class 6
2	Tailings storage facility	Tailings Storage Facility	D	Rehabilitation Pasture –Land and Soil Capability Class 4
3	Water management areas	Raw Water Dam, Primary WSF (process water dam), TSF Seepage Interception WSF, Secondary WSF and sediment dams (WSF1 to WSF4), TSF clean water diversion	D, B	Rehabilitation Pasture – Land and Soil Capability Class 5 Riparian vegetation
4	Waste rock emplacement	Waste, Out of pit disposal area, pit amenity bund	E	Yellow Box - Blakely's Red Gum grassy woodland and Broad-leaved Peppermint-Brittle Gum – Red Stringybark dry open forest.
5	Soil stockpiles	Topsoil stockpiles, subsoil stockpiles	D	Rehabilitation Pasture – Land and Soil Capability Class 4 and 5
6	Open cut void	Final void	I	Final Void



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment

- Main road
- Local road
- Watercourse/drainage line
- Vittoria State Forest

Primary domains

- 1. Infrastructure area
- 2. Tailings storage facility
- 3. Water management area
- 4. Waste rock emplacement
- 5. Soil stockpile
- 6. Open cut void

Secondary domains

- B - Riparian vegetation
- D - Pastures
- E - Open woodland and open forest
- I - Final void

Primary and secondary domains

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 4.2

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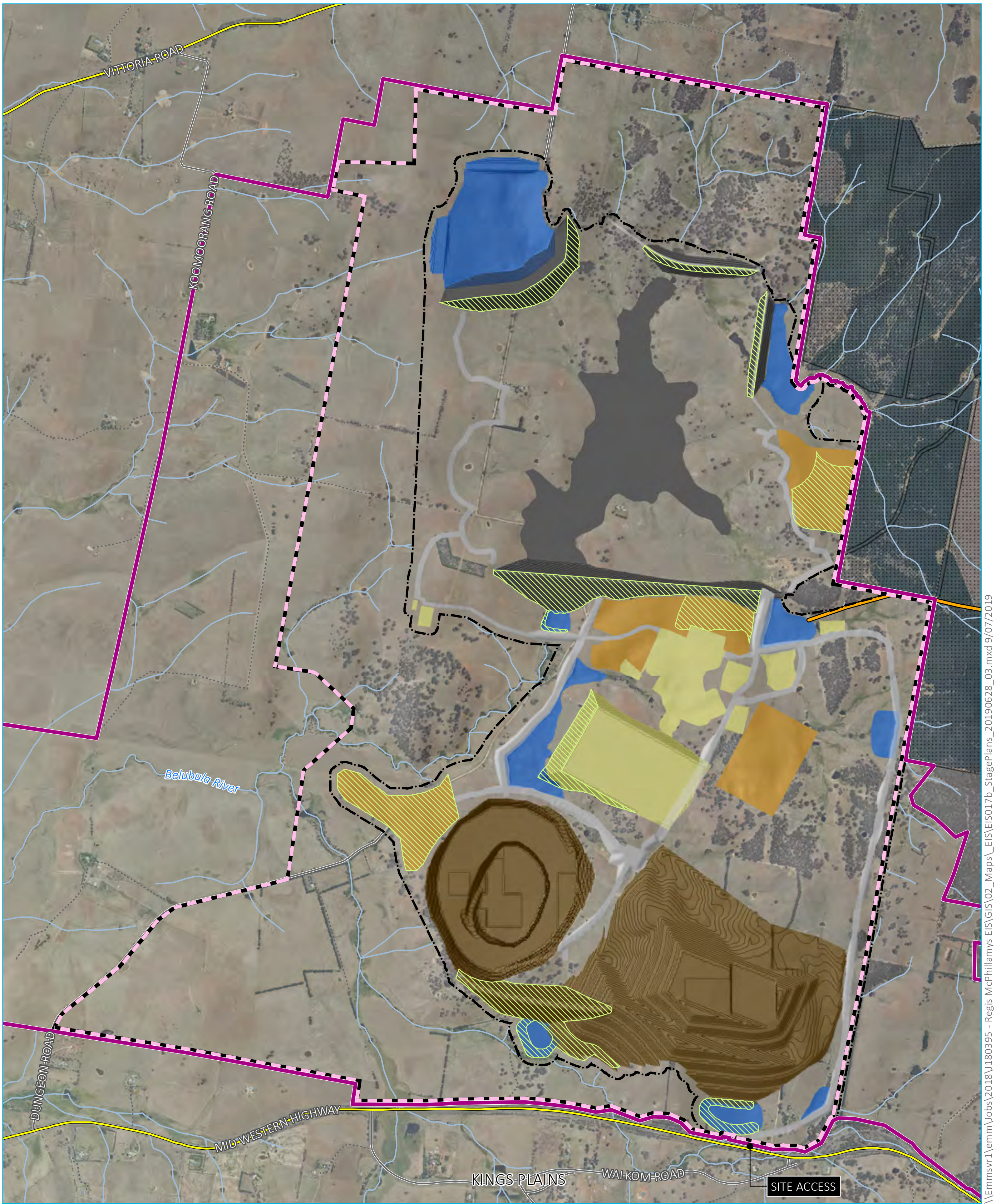
EMM creating opportunities

The opportunity for progressive rehabilitation is limited to the WRE and TSF embankment outer batter. Temporary revegetation of the pit amenity bund, water storage facility embankments, the ROM outer embankments, some road fill batters and soil stockpiles will be undertaken where possible.

The bulk of progressive rehabilitation will be undertaken on the WRE on the south-eastern, southern and south-western slopes to provide erosion protection and visual amenity (Figures 4.3 to 4.6).

Further progressive rehabilitation of the WRE will be able to be undertaken as construction of the WRE emplacement moves in a northerly direction. Further detail is provided in section 4.4.5.



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine plan contour (2.5 m)

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Completed works

- Mine infrastructure area
- Mining operations (open cut & waste rock emplacement)
- Road
- Tailings storage facility
- Topsoil zone
- Water management area

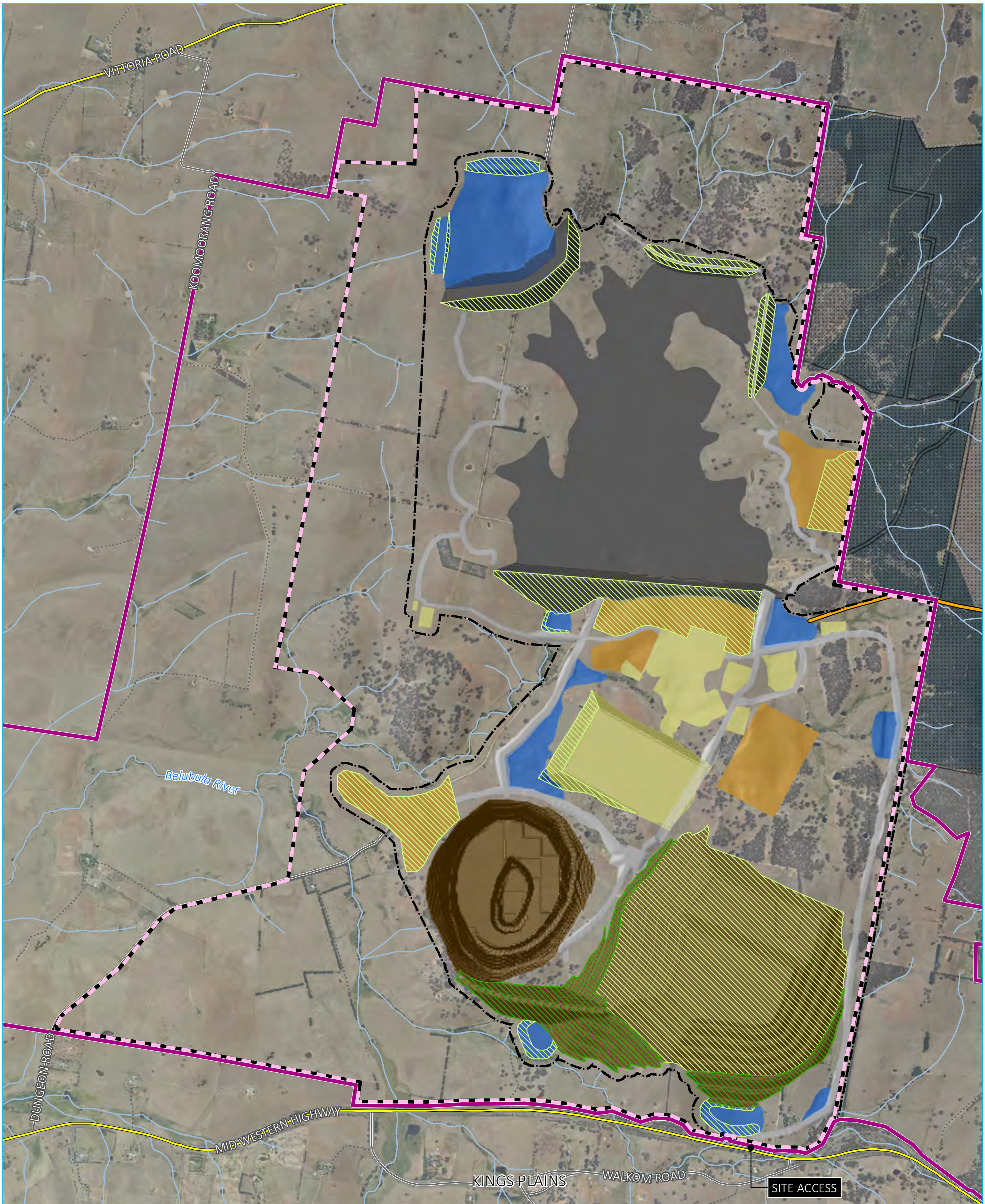
Mine rehabilitation

- 70% cover - hydromulched/grass

Mine development general arrangement - Year 2

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 4.3

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); ;DFSI (2017); GA (2011)

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KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine plan contour (2.5 m)

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Completed works

- Mine infrastructure area
- Mining operations (open cut & waste rock emplacement)
- Road
- Tailings storage facility
- Topsoil zone
- Water management area

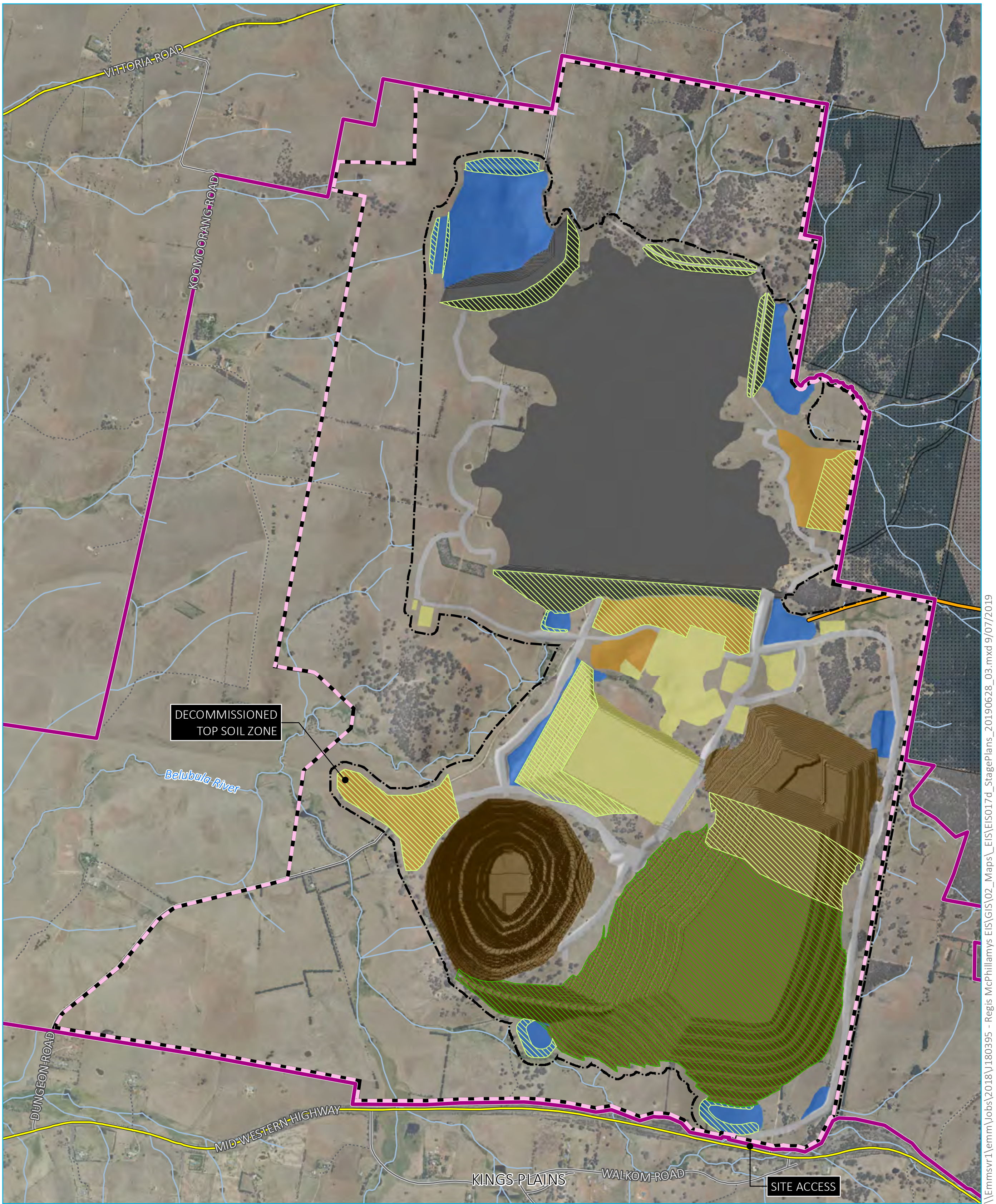
Mine rehabilitation

- 70% cover - hydromulched/grass
- Early stages of open woodland establishment

Mine development general arrangement - Year 4

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 4.4

REGIS RESOURCES LTD
EMM creating opportunities



Source: *EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)*

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine plan contour (2.5 m)

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Completed works

- Mine infrastructure area
- Mining operations (open cut & waste rock emplacement)
- Road
- Tailings storage facility
- Topsoil zone
- Water management area

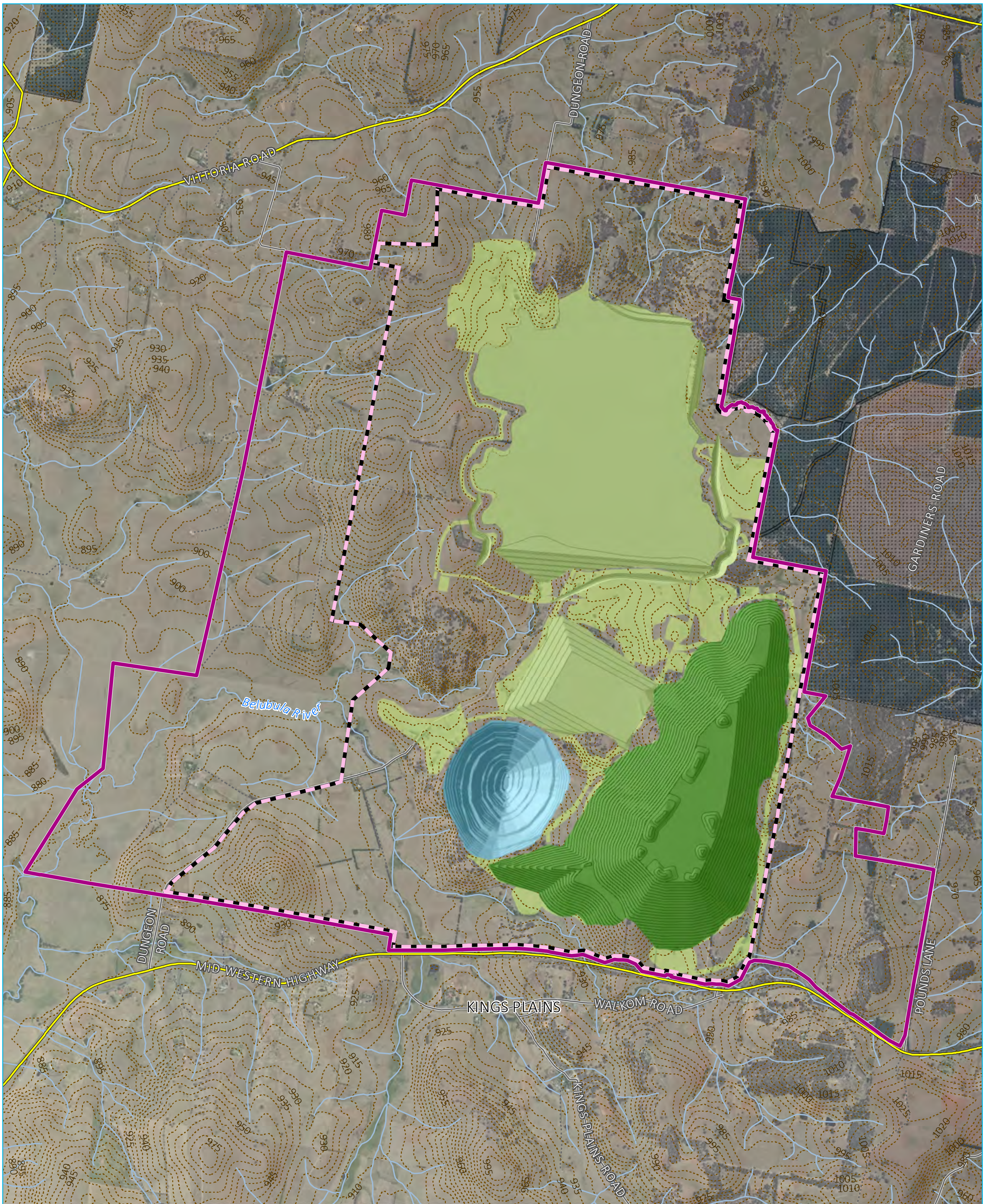
Mine rehabilitation

- 70% cover - hydromulched/grass
- Early stages of open woodland establishment

Mine development general arrangement - Year 8

McPhillamys Gold Project
Rehabilitation and landscape management strategy
Figure 4.5

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Existing contour (5 m)
- Vittoria State Forest

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Mine plan contour (2.5 m)

Conceptual final landform elements

- Rehabilitated area (grazing)
- Rehabilitated area (open woodland)
- Void

Conceptual final landform

McPhillamys Gold Project

Rehabilitation and landscape management strategy

Figure 4.6

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EMM creating opportunities

4.3.2 Domain 1 mine infrastructure areas

The majority of mine infrastructure areas (MIAs) will have relatively flat gradients other than their outer batters e.g. the ROM. It is possible that some MIAs may be retained e.g. hardstands and workshop buildings post mining for beneficial re-use for agricultural activities subject to appropriate approval(s); however, for MIA areas to be rehabilitated, the outer batters will be re-shaped to achieve a slope gradient of 14° or flatter.

Several roads and tracks may be retained for use by future landowners' and post-mine closure and rehabilitation. Agreement for ongoing use and management of roads will be sought with landholders or third parties. Some roads may also be temporarily retained following rehabilitation as access roads for rehabilitation monitoring purposes. This will be determined in consultation with stakeholders and the councils.

Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants.

Significant reshaping of haul road batters is not anticipated.

Most roads across in the project area will be highly compacted. Rehabilitation, where required, will accordingly require deep ripping, profiling, application of topsoil and seeding. Drainage will be constructed where necessary. Roads which are selected to remain at the project site post-mine closure may require sediment containment measures to minimise sediment entering waterways.

Power poles associated with the mine power supply will generally not require the excavation of pads for installation of footings, therefore will not require reshaping when they are removed.

The main water supply line from Centennial and Energy Australia will be constructed in an excavated trench, which will follow existing land contours and will not require reshaping works.

The tailings pipeline will consist of a HDPE pipe located within a containment bund. The containment bund will be reshaped such that the pre-mining contours are re-established.

The clean water catchment to the north-east of the TSF will be diverted around disturbed areas via a pipe through the plant area during mining operations. At closure, this will be removed, and a permanent diversion channel established that will be designed in accordance with natural channel design principles.

Domain 1 areas are expected to support a grazing post mine land use.

4.3.3 Domain 2 tailings storage facility

It is planned to progressively rehabilitate the outer TSF embankment batter as operations allow. This will be completed once the TSF embankment has reached maximum height.

Subsoil will be stripped from within the TSF and used to construct temporary water storage facilities upstream of the TSF (Figure 3.3). Topsoil will be stripped and stockpiled for respreading.

During mining and processing operations tailings deposition will be managed to:

- cycle spigots to minimise the duration of tailings exposure to air to reduce the potential for oxidation and acid formation and;
- facilitate desiccation to provide a geotechnical competent surface for capping, whilst also ensuring effective management of dust;

- direct supernatant water away from the primary wall and containment embankments;
- create as flat as possible tailings profile to maximise the effectiveness of the proposed cap; and
- create a low gradient generally free drainage final surface profile that minimises ponding.

A 0.5m thick capillary break layer will be placed on the TSF, followed by a capping layer over the capillary break layer. It will consist of approximately 0.6 m of subsoil and 0.1m of topsoil. Prior to placing the topsoil, the cap will be allowed to settle and if necessary, additional subsoil placed to achieve the final landform design, followed by topsoil placement and revegetation with pasture species by either drill or broadcast seeding.

4.3.4 Domain 3 Water management areas

Other than the TSF clean water diversion embankment, all water management facilities (WMFs) will be rehabilitated. The rehabilitation process will entail dewatering, removal of any embankments, revegetation and monitoring. Rehabilitation will vary depending on the storage history. WMFs that contained saline water or other contaminants such as the Primary WMF (used for process water) and the TSF Runoff Interception WMF, may require remediation. These dams will be dewatered once site discharge water criteria has been achieved and any contaminated sediment excavated and taken to the TSF or offsite to an appropriately licensed facility.

WMFs that have been used as sediment basins such as WMF1 through to WMF4 may require treatment with suitable coagulants and/or flocculants, dewatering and backfilling once the accumulated sediment has been allowed to desiccate.

WMFs that have been used for water storage such as the Raw Water Storage and Secondary WMF will be dewatered and excavations backfilled. Part of the Secondary WMF wall material will be used in the capping of the TSF.

Slope gradients will generally be in accordance with those that existed pre-mining. WMFs will be rehabilitated to a grazing post mine land use.

A clean water diversion drain will be constructed on the eastern side of the TSF. It will consist of an embankment at the north-eastern end of the TSF and a channel around the south-eastern end of the TSF. The clean water will be piped underneath the MIA during mining operations. This will be removed, and an open channel constructed during the rehabilitation phase (Figure 3.3).

The diversion channel will be constructed to mimic natural geomorphological features and will be seeded with cover crop and riparian species.

It is also noted that there is the potential for some water management areas associated with the pipeline development to remain in place, in the event that a use for this water supply from Lithgow is identified post-mining. This would be considered as part of the detailed closure planning phase. Retaining this water supply could have some for regional benefits relating to water security, subject to appropriate approvals at the time.

4.3.5 Domain 4 Soil stockpiles

Subsoil and topsoil will be stripped for capping and rehabilitation purposes. Soil stockpiles will be located on relatively flat areas that will not require modification and seeded with a cover crop. It is anticipated that all soil will be removed from the stockpiles during the rehabilitation phase of the project and pasture will be reestablished at soil stockpile locations.

4.3.6 Domain 5 Waste rock emplacement

Domain 5 also includes the pit amenity bund, which will be one of the first landforms to be constructed and rehabilitated so as to provide an effective noise and visual bund to viewpoints south of the project area.

Emplacement of waste rock will commence at the southern end of the WRE to construct the south-western, southern and south-eastern outer slopes so that progressive rehabilitation of the slopes can be undertaken as early as possible to minimise the noise and visual amenity related impacts of the landform (see Figures 4.3 to 4.6). Construction of the WRE (and progressive rehabilitation) will then proceed generally in a northerly direction.

It will be necessary to maintain benches and windrows on the outer sections of the WRE in the active emplacement areas to minimise spillage of waste rock to the lower slopes that are being progressively rehabilitated. Some reshaping will be required to infill the benches and achieve the design slope gradient. Bulk reshaping is not anticipated.

Some areas of the WRE and pit amenity bund such as steeper slopes and concentrated flow areas will require the use of topsoil and rock matrices to withstand the critical shear of overland and concentrated flows.

The WRE will be rehabilitated with open woodland and open forest species for a biodiversity post mine land use. This will include the Yellow Box-Blakely's Red Gum grassy woodlands, South Eastern Highlands Bioregion and Broad-leaved Peppermint – Brittle Gum – Red Stringybark dry open forest of the South Eastern Highland Bioregion. Introduced and native grasses will also be used to provide short- and long-term erosion protection and visual amenity.

Species used in rehabilitation works will be dependent on seed availability but are expected to include the species described in Table 4.4. The species list will be refined during the development of the MOP.

Table 4.4 Structural dominant rehabilitation species

Community	Broad-leaved Peppermint - Brittle Gum - Red Stringybark dry open forest on the South Eastern Highlands Bioregion	Mountain Gum - Manna Gum open forest of the South Eastern Highlands Bioregion	Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion
Understory species	Purplish Wallaby Grass *Rytidosperma tenuius*	Purplish Wallaby Grass *Rytidosperma tenuius*	Purplish Wallaby Grass *Rytidosperma tenuius*
	Short Wallaby Grass *Rytidosperma carphoides*	Short Wallaby Grass *Rytidosperma carphoides*	Short Wallaby Grass *Rytidosperma carphoides*
	Snow Grass *Poa sieberiana*	Snow Grass *Poa sieberiana*	Snow Grass *Poa sieberiana*
	Kangaroo Grass *Themeda trainer*.	Kangaroo Grass *Themeda triandra*.	Common Wheatgrass *Anthosachne scaber*
	Weeping Grass *Microlaena stipoides*.	Weeping Grass *Microlaena stipoides*.	Weeping Grass *Microlaena stipoides*.
	Red-anthered Wallaby Grass *Rytidosperma pallidum*	Slender Knot Weed *Persicaria decipiens*	
	Common Wheatgrass *Anthosachne scaber*		
Mid-story species	Hoary Guinea Flower *Hibbertia obtusifolia*	Silver Wattle *Acacia dealbata subsp. dealbata*	Silver Wattle *Acacia dealbata subsp. dealbata*
		White Dogwood *Ozothamnus diosmifolius*	

Table 4.4 Structural dominant rehabilitation species

Community	Broad-leaved Peppermint - Brittle Gum - Red Stringybark dry open forest on the South Eastern Highlands Bioregion	Mountain Gum - Manna Gum open forest of the South Eastern Highlands Bioregion	Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion
Overstory species	Broad-leaved Peppermint *Eucalyptus dives*	Manna Gum *Eucalyptus viminalis*	Yellow Box *Eucalyptus melliodora*
	Long-leaved box *Eucalyptus goniocalyx*		Apple Box *Eucalyptus bridgesiana*
	Brittle Gum *Eucalyptus mannifera*		
	Yellow Box *Eucalyptus melliodora*		
	Apple Box (*Eucalyptus bridgesiana*		

Due to the erosion risk associated with the slopes of the WRE and visual bund, seed will be sowed using a hydro-seeder followed by the application of a straw-based hydro-mulch and hydro-colloid binder to protect the seed and soil from compact and erosion by rainfall and erosion from overland flow. The hydro-mulch will include soil mycorrhiza and bacteria species additives to maximise germination rates of native plants, increase plant rooting depths and improve drought tolerance.

Cover crops will be used with all seeding activities to provide erosion protection and minimise the potential for weed invasion.

Seed predation by meat ants is common and it may be necessary to include pesticides with the seed application.

It may also be necessary to inoculate open woodland rehabilitation areas with small quantities of fresh topsoil from adjacent open-woodland areas from within the project areas to ensure necessary mycorrhizal fungi are present within the soil biology.

Seeding of the WRE will focus on establishing the structural dominant components of the woodland and open forest communities with additional seeding and/or tube stock planting undertaken if required.

The pit amenity bund will initially be seeded with introduced grass species to provide erosion protection and to improve visual amenity. The pit amenity bund will ultimately be regraded and seeded with open woodland and open forest species similar to the WRE.

Bush rock and tree debris will be retained from land clearing and stripping activities for placement on the WRE to provide erosion protection and habitat enhancement for small invertebrates and reptiles. These materials will be preferentially placed on the WRE slopes. Cleared timber will be placed on the slopes on the contour and track rolled to ensure intimate soil contact and to minimise the concentration of flow under the timber.

4.3.7 Domain 6 Open Cut

Rehabilitation of the void is expected to include removal of any mining infrastructure, laying back the soil batters at the top of the void, and the construction of a safety bund and fence.

The upper benches where soil is present will be battered back to a gradient that topsoil can be placed on (< 27°) and any dispersive soils treated with gypsum. The benches will then be topsoiled and seeded with grass species.

The safety bund will be constructed approximately 2m high with 27° batters and a 30° offset from the void edge. The bund will be topsoil and seeded with cover crops and open woodland species. A barbed wire fence will be constructed in front of the bund to prevent stock access.

5 Rehabilitation methods for closure

5.1 Soil management

Topsoil and subsoil stripping plans will be developed for each area prior to soil disturbance. As part of this process, a Land Disturbance Permit system will be implemented for operations personnel, to ensure that clearing activities are managed appropriately.

Soils within the project area are generally acidic, with elevated aluminium levels and acceptable organic carbon levels. Sodium and magnesium levels typically increase with depth. Soil stripping and stockpiling will involve disturbance and mixing of soil, reduction in soil stability and fertility can be expected. Rehabilitated areas will be (initially) completely bare of vegetation, subject to increased rates of runoff and (if sloping) risk of erosion. Therefore, amelioration of the soils to ensure stability and to redress any fertility decline is likely be required.

Gravelly and/or sandy soils will be suitable for reuse in rehabilitation areas that will not have an agricultural land use following amelioration, such as the WRE. High stone content topsoil is suitable for reuse for non-agricultural purposes and is particularly valuable for use in areas where higher overland flow velocities can be anticipated such as the outer batters of the WRE.

High clay subsoils will be selectively stripped and stockpiled for clay capping of PAF materials in the TSF and WRE.

5.1.1 Soil testing

Prior to stripping, topsoil and subsoil will be sampled to:

- identify the soil resource prior to stripping;
- assist with the preparation of a soil balance or inventory to assist with rehabilitation planning;
- determine if the soil requires amelioration.

Soil sampling will determine if the soil requires amelioration to ensure the soils physical and chemical characteristics are within ranges necessary to address any erosion or revegetation constraints posed by the soils.

Soil exchangeable sodium levels and potential for clay dispersion will be assessed, with data on exchangeable cations used to calculate gypsum requirements (if any) to reduce Exchangeable Sodium Percentage to <4% (presence of dispersive clays will drastically increase erosion risk, and also reduce vegetation establishment and growth.)

Removal of vegetation will effectively reduce nutrient stores. Some elements such as Nitrogen will be eventually replaced by growth of leguminous species, but elements (generally Phosphorus) that are in extremely low levels may well become limiting to both pastures and native woodland rehabilitation.

Soil sampling prior to stripping is essential to determine whether the soils require amelioration, and to provide guidance on maximum depths of stripping (for situations where topsoil may be in short supply). As well, the sampling data will provide useful baseline information on the ranges of specific soil properties.

The soil parameters to be measured are listed in Table 5.1.

Table 5.1 Physical and chemical soil testing parameters

Parameter	Method
Organic carbon	Walkley and Black
pH	1:5 suspension, water
Effective cation exchange capacity and exchangeable cations	
Electrical conductivity	1:5 suspension, water
Total Nitrogen	Kjeldahl
Total Phosphorous	Nitric/Perchloric
Available Phosphorous	Colwell
Available Potassium	Colwell
Labile Sulfur	KCl extraction

Additional assessment of topsoil for the presence of weeds will be undertaken as part of soil sampling.

Soil sampling will be undertaken at a sampling frequency of one sample per 0.8 - 4 hectares (1:10,000 scale) and will include an assessment of topsoil depth and analysis of soil characteristics as detailed in Table 4.4. A soil stripping and placement plan will be incorporated into the Land Disturbance Permit for each stripping event.

5.1.2 Clearing and grubbing

During the clearing and grubbing process the following will be undertaken to minimise subsoil contamination of the topsoil:

- grub out stumps and roots ≥100mm in diameter to a depth of 0.5m; and
- minimise mixing of topsoil and subsoil during grubbing.

5.1.3 Soil amelioration

Soil testing as discussed previously will be undertaken to determine amelioration requirements and rates.

Some ameliorants may be mixed in with the topsoil and subsoil as part of the stripping operation, irrespective if the topsoil or subsoil is to be placed in storage or directly applied to a rehabilitation area.

Application of ameliorants as part of the soil stripping process can be more cost effective and allows additional time for certain ameliorants to react and modify the soil to assist in the maintenance of soil conditions suitable for plant development.

Mine soils are typically ameliorated with agricultural gypsum to treat dispersion, and improve the structure, water holding capacity and agricultural lime to increase pH to improve nitrogen and phosphorous availability and reduce aluminium toxicity.

Fertilisers will be applied following respreading to compensate for nutrients lost from the soil in stockpiles during storage.

Topsoil stockpiles will require amelioration and/or good mixing of the anaerobic and aerobic layers when returned to rehabilitated areas.

5.1.4 Topsoil stripping

A soil stripping and placement plan will be developed for each area that is to be stripped as part of the Land Disturbance Permit process. All staff and contractors will be required to obtain the relevant permit prior to clearing activities. The responsible environmental personnel will advise on permits required and authorise permits prior to commencement of works.

The depth of soil material suitable for recovery and re-use as a topsoil in rehabilitation will be determined using available information from SSM 2019. This report identifies that topsoil is available across the project area for stripping to a depth of 0.1m. SSM 2019 estimate that 1,243,000m^3 of topsoil and 3,412,000 m^3 of subsoil is available for stripping within the disturbance footprint and 872,000 m^3 of topsoil and 2,664,000 m^3 of subsoil is required for rehabilitation purposes. This is shown in Table 5.2.

Table 5.2 Topsoil and subsoil volume estimates

Infrastructure type	Topsoil available		Subsoil available		Topsoil required		Subsoil required	
	Depth (m)	Volume (m^3)	Depth (m)	Volume (m^3)	Depth (m)	Volume (m^3)	Depth (m)	Volume (m^3)
Mine void	0.15	106,000	0.50	353,000		-		-
Waste Rock Emplacement, Amenity Bunds and Run of Mine pad - top surface	0.15	107,000	0.45	321,000	0.115	82,000	0.50	357,000
Waste Rock Emplacement, Amenity Bunds and Run of Mine pad - batters	0.15	402,000	0.45	1,207,000	0.115	308,000	0.25	670,000
Tailings Storage Facility- top surface	0.15	416,000	0.45	1,247,000	0.115	319,000	0.50	1,386,000
Tailings Storage Facility- embankments	0.15	44,000	0.45	131,000	0.115	34,000	0.25	73,000
Topsoil stockpiles	0	-	0	-		-		-
Water storage embankments	0.15	34,000	0	-	0.115	26,000		-
Water storages	0	-	0	-		-		-
Processing Plant and associated infrastructure and laydown yards	0.15	41,000	0	-	0.115	31,000	0.20	54,000
Roads	0.15	67,000	0.15	67,000	0.115	52,000	0.20	90,000
Diversion Drain	0.15	26,000	0.50	86,000	0.115	20,000	0.20	34,000
Clear trees		0		-		-		-
Total		1,243,000		3,412,000			872,000	2,664,000

Stripping operations will be supervised to ensure they are conducted in accordance with the stripping plan and in situ soil conditions. This will ensure that all suitable soil resources are salvaged, and that the quality of the stripped soil is not reduced through contamination with unsuitable soils.

The process of soil stripping will also involve the continual evaluation of soil throughout the depths of the profile as areas and layers are exposed. Management of soils and stripping depths during this process is dynamic and generally require soil observations to be made on site on the day topsoil stripping is occurring. This enhances decision making and operational modifications can be adopted to best utilise the soil resources available.

The following process for stripping topsoil will be followed:

- the area to be stripped of topsoil will be clearly demarcated and surveyed;
- topsoil will not be stripped during excessively wet or dry conditions;
- as part of the planning process, sufficient area for stockpiling will have been identified and these areas will be accessible;
- as part of the planning process, temporary drainage, sediment control and structures to prevent erosion will be developed for area if required;
- grading or pushing soil into windrows with graders or dozers will be undertaken for later collection by open bowl scrapers or loading into rear emplacement trucks by front-end loaders; and
- a record will be kept of the nature and quantities of salvaged bush rocks, timber etc to ensure that the salvage of these items is maximised, in accordance with protocols outlined in the Rehabilitation Management Plan.

5.1.5 Topsoil stockpiling

A topsoil plan will be incorporated into the Rehabilitation Management Plan, to identify where the stripped topsoil will be placed, based on its suitability for reuse and the soil balance. Suitability will be determined following soil testing. Topsoil stockpile locations, volumes and date of soil stripping will be recorded as part of the Rehabilitation Management Plan.

The following process for soil stockpiling will be followed:

- where possible, topsoil stockpiles will be located away from drainage lines. Drainage will be diverted around stockpiles to prevent erosion;
- sediment controls will be installed downstream from stockpiles to prevent contamination of clean water;
- stockpiles will be limited to a maximum height of 2m;
- more erodible materials will be placed on flatter areas to minimise the potential for erosion;
- the surface of soil stockpiles shall be contour scarified in order to promote infiltration and minimise erosion until vegetation is established; and
- stockpiles will be seeded with cover crops to protect the stockpile from raindrop splash erosion, aerate the soil to reduce anaerobic conditions, enhance organic carbon levels and suppress weeds.

5.1.6 Subsoil characterisation

Where sufficient data of subsoil characteristics is not available from baseline testing, characterisation of subsoil for erosion (primarily dispersion or excessive magnesium levels), agronomic (pH, EC, CEC, OC, metals) and capping parameters will be undertaken. Sampling will determine if the subsoil and spoil is suitable for reuse or if it requires selective handling and placement.

Dispersive subsoil will be treated with gypsum to reduce the exchangeable sodium percentage to less than or equal to 4% (≤ 2% if the subsoil is magnesic) during stripping if it is to be placed within 1m of the soil surface. Untreated dispersive subsoils will be capped with at least 1m of non-dispersive material.

Acidic subsoil will be treated with agricultural lime to increase pH levels if they are to be placed within 1 m of the soil surface or for the TSF cover.

If encountered, unsuitable saline subsoil will be buried within the WRE.

a Soil Respreading

Prior to re-spreading of stockpiled topsoil, an assessment of weed infestation will be undertaken to determine if individual stockpiles require burial due to their unsuitability as a result of weed infestation.

The following will be considered during soil respreading:

- topsoil requirements for rehabilitation areas will be balanced against stored stockpile inventories, proposed post mine land-use and proposed stripping volumes;
- during the removal of soils from the stockpiles, care will be taken to minimise structural degradation of the soils; and
- material will be spread in even layers at an appropriate thickness to meet the rehabilitation goals of the area being rehabilitated. Further detail on rehabilitation methods will be included in the MOP.

b Monitoring

The soil management process will be monitored through each step to ensure that the health of the soil is maintained, and the rehabilitation and biodiversity objectives can be achieved.

The Rehabilitation Management Plan will detail the testing, witness and hold points requirements for each step of the soil management process.

5.2 Establishment of vegetation

Vegetation species for rehabilitation purposes is anticipated to consist of:

- cover crop species for short term erosion protection and weed suppression;
- introduced pasture species for stabilisation of the WSF and TSF embankments, long-term soil stockpile protection and rehabilitation for grazing purposes;
- species that comprise the vegetation communities currently present within the project area: Broad-leaved Peppermint-Brittle Gum – Red Stringybark dry open forest, Yellow Box -Blakely's Red Gum grassy woodland and Mountain Gum-Manna Gum open forest species for the Pit Amenity Bund and WRE; and
- riparian species for the clean water diversions.

Seed for cover crop and pasture species will be obtained from commercial suppliers. Collection of native seed has commenced on site and will continue. Given the limited availability of open woodland on site for seed collection and the significant reductions in seed viability that can occur when seed is stored, purchase of additional seed from commercial suppliers is anticipated.

Seed will be stored in a humidity controlled and vermin free environment to maximise its viability.

A number of sowing methods will be employed at the mine. These may include:

- hand seeding;
- drill seeding;
- broadcast seeding; and
- hydroseeding.

Hand seeding is likely to be used on small areas or where machinery access is difficult such as topsoil and subsoil stockpiles.

Drill seeding is likely be used for the establishment of cover crop and pasture species of flatter areas up to approximately 14°. Drill seeding is generally inappropriate for the native species due to the potential to bury the seed too deep in the soil as they should be buried no more than two to three times their diameter in the soil.

Broadcast seeding is likely to be used to sow natives on the top of the WRE where gradients are flatter. This will be followed by harrowing using pasture harrows to lightly cover the seed with soil to ensure intimate soil contact.

On the slopes of the WRE native seed will be sowed using a hydro-seeder followed by the application of a straw-based hydro-mulch and hydro-colloid binder to protect the seed and soil from compact and erosion by rainfall and erosion from overland flow.

Cover crops will be used with all seeding activities to provide erosion protection and minimise the potential for weed invasion.

It may also be necessary to inoculate open woodland rehabilitation areas with small quantities of fresh topsoil from adjacent open-woodland and open forest areas from within the project area to ensure necessary mycorrhizal fungi are present within the soil biology.

5.3 Fauna and habitat enhancement measures

Bush rock and tree debris will be retained from land clearing and stripping activities for placement on the WRE to provide erosion protection and habitat enhancement for small invertebrates and reptiles.

Cleared timber may also be placed on the slopes on the contour and track rolled to ensure intimate soil contact and to minimize the concentration of flow under the timber.

5.4 Erosion and sediment control

An assessment of soil erosion hazard was undertaken for the project in accordance with the requirements of Landcom 2004. This is described in section 3.2.2 and ranges from very low to very high. The key erosion risks for the project are:

- highly erodible dispersible and/or non-cohesive subsoils;
- steep and long slopes on the WRE and pit amenity bund; and
- duration of exposed soils.

The majority of the disturbed areas within the project will report to WMFs that will function as Type D/F sediment basins such that any eroded sediments will be contained (up to and including the design storm event). Contained turbid water will be re-used on site.

The WMFs will be maintained on site until 70% soil surface cover has been achieved on the rehabilitated surfaces and/or runoff meets the nominated water quality criteria.

Dispersive and non-cohesive soils will be managed in accordance with the methodologies described in section 5.1 that includes the blending of non-cohesive sandy subsoil with high clay subsoil and gypsum treatment of dispersive subsoils.

The WRE slope design has been modelled using WEPP and SIBERIA to determine stable slope designs and slope treatments to withstand the critical shear from overland and concentrated flows. As such, the WRE design includes the use of topsoil and rock matrices in high risk areas where the slope is steeper, or flow is concentrated. It is anticipated the topsoil and rock matrices will also be utilised on the pit amenity bund.

The WRE design considers the erosivity of site rainfall (relatively low), site soils (high) and the erosion protection that can be provided by effective revegetation of the WRE slopes. Landloch (2019) considers that annual average erosion rates of less than 2t/ha/y and a peak erosion rate of less than 5t/ha/y, can be achieved on the WRE essentially reducing the erosion hazard to very low.

Revegetation techniques as described in section 5.2 will be varied to suit the erosion hazard of areas undergoing rehabilitation. For example, drill seeding is appropriate for the surface of the TSF as the slope gradients are very low and significant erosion of the exposed soil awaiting grass germination is unlikely to occur, whereas it is unsuitable for the WRE slopes as the erosion risk is very high and the costs associated with replacing the lost topsoil and seed would be very high.

Regis will therefore aim to progressively rehabilitated disturbed areas as quickly as possible to minimise the risk of erosion and re-work. Planned progressive rehabilitation is shown in Figures 4.3 to 4.5.

A surface water management plan will be prepared for the project that will include an overarching erosion and sediment control plan. Progressive erosion and sediment control plans will then be prepared for discrete areas of disturbance as required.

5.5 Post-closure maintenance

5.5.1 Rehabilitation monitoring

Rehabilitation monitoring will be undertaken using analogue sites and Landscape Function Analysis (LFA) to assess rehabilitation progress and success. An annual rehabilitation report will be prepared, and a summary of this report will be included in the Annual Review.

Data obtained from the analogue sites will provide a range of values from replicated examples of similar vegetation communities. Rehabilitation areas are compared to reference sites that best represent the final land use, vegetation community and management conditions they will be subjected to.

This approach allows the recognition of the dynamic nature of ecosystems therefore rehabilitation sites will be monitored simultaneously to the reference sites over time to account for changes in:

1. seasonal variations
2. climatic conditions
3. management practices; and
4. unexpected disturbance events such bushfire.

In order to demonstrate rehabilitate success or succession toward rehabilitation success, specific indicators will be expected to equal or exceed values obtained from the reference site under the same set of conditions or demonstrate a positive trend towards target values.

With the exceptions of Domain 5, 6 and 7, all the other domains will have a grazing post mining land use. Regis will include grazing productivity parameters in the rehabilitation monitoring program.

Rehabilitation monitoring will inform areas requiring maintenance and identify and address deviations from the expected outcomes. Rehabilitated areas will be assessed against performance indicators (refer Section 6) and regularly (at least on an annual basis) inspected for the following aspects:

- evidence of any erosion or sedimentation;
- success of initial establishment cover;
- natural regeneration of improved pasture;
- weed infestation (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);
- integrity of graded banks, diversion drains, waterways and sediment control structures; and
- general stability of the rehabilitation areas.

Where rehabilitation criteria have not been met, maintenance works will be undertaken. This may include the following:

- re-seeding and, where necessary, re-soiling and/or the application of specialised treatments;
- use of materials such as composted mulch to areas with poor vegetation establishment;
- replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife; and
- de-silting or repair of sediment control structures.

5.5.2 Weed management

The presence of weed species has the potential to have a major impact on revegetation outcomes. Additionally, any significant weed species within the surrounding land has the potential to impact on the success of the rehabilitated areas. Weed management will be an important component of rehabilitation activities.

The spread of declared noxious weeds (and other invasive weeds that could impact revegetation success and/or plants that are undesirable to grazing stock) will be managed across the project area through a series of control measures, including:

- herbicide spraying or scalping weeds;
- post-mining use of rehabilitated areas as a working farm, with associated management practices; and
- rehabilitation inspections to identify potential weed infestations.

5.5.3 Access

Access tracks may be required to facilitate the revegetation and ongoing maintenance of the project. These tracks will be kept to a practical minimum and will be designated prior to the completion of the project.

5.5.4 Public safety

Controls will be implemented to minimise the potential for impacts on public safety, and may include maintenance of fencing and warning signs around areas that have the potential to cause harm and are that are accessible to the public including bunding and fencing of the void as described in section 4.4.6.

5.5.5 Rehabilitation resources

Environmental personnel will implement specific management requirements arising from this strategy.

Earth moving operations will be performed by machinery operators with experience and skill in the operation of the relevant machinery (scrapers, bulldozers, loaders, excavators etc). Project supervisors will be responsible for compliance with the requirements of this strategy and its future revisions.

The Mine Manager will be responsible for achieving the rehabilitation criteria.

A rehabilitation management plan will be developed to provide a structured and documented process for managing and improving rehabilitation activities at the mine. The plan will serve as a process map for interdepartmental administration of rehabilitation activities within the mine planning and implementation process.

The rehabilitation management plan will have two focus areas:

- The integration of rehabilitation activates between the various departments within the mines organisational structure through all stages of the rehabilitation process with an emphasis on joint planning between technical services and environmental departments. To achieve this, the manual will separate the rehabilitation process into different phases and outlines responsibilities at each stage with hold and witness points.

- The second focus is on establishing effective and robust monitoring methods with clear guidelines on the process to be followed to achieve mine rehabilitation objectives, and a means to record the process followed and results obtained.

6 Performance indicators and completion criteria

6.1 Rehabilitation criteria and reporting

Rehabilitation completion criteria will be used as the basis for assessing when rehabilitation of the project is complete. Indicators will be measured against the criteria, and are set for the six phases of rehabilitation, consistent with ESG3 as follows:

- Phase 1 – Decommissioning (ie removal of equipment and infrastructure);
- Phase 2 – Landform Establishment (ie land shaping);
- Phase 3 – Growth Medium Development (ie soil physical and chemical properties);
- Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment);
- Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is supporting post-mining land use); and
- Phase 6 – Land Relinquishment.

Interim rehabilitation criteria for the project have been developed with the current knowledge of rehabilitation practices and success in similar project environments. These are based largely on experience on mine sites elsewhere in New South Wales. They consist of a set of objectives; rehabilitation criteria and evidence that criteria have been met using Landscape Function Analysis (LFA) and agricultural productivity measures or the like.

Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or reference site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

The rehabilitation criteria need to demonstrate that the rehabilitation objective has been achieved. Consequently, interim rehabilitation criteria are presented in Tables 6.1, 6.2 and 6.3 that address the following outcomes:

- restoration of a safe and stable landform that is non-polluting; and
- reinstate soil profiles and function and create landforms that are compatible with surrounding topography; and reestablishment of landforms that permit grazing, improved pasture and biodiversity outcomes.

Table 6.1 provides rehabilitation criteria applicable to both grazing and biodiversity post mine land uses. Table 6.2 provides rehabilitation criteria applicable to grazing only and Table 6.3 provides rehabilitation criteria application to biodiversity only.

Reporting on rehabilitation activities, monitoring and progress towards achieving agreed rehabilitation criteria will occur via an annual environmental management report.

Table 6.1 Common rehabilitation performance indicators and completion criteria

Stage of Development	Aspect or Component	Completion Criteria	Performance Indicators
Landform establishment and stability	Landform slope, gradient	Landform suitable for final land use and generally compatible with surrounding topography	Slope angles consistent with design
	Landform function	Landform is functional and indicative of a landscape on a trajectory towards a self-sustaining ecosystem	LFA Stability; LFA Infiltration; LFA Nutrient Cycling; and LFA Landscape Organisation
	Active erosion	Areas of active erosion are limited	Number of rills/gullies; cross-sectional area of rills/gullies; presence/absence of sheet erosion; presence/absence of tunnel erosion
Growth medium development	Soil chemical and physical properties and amelioration	Soil properties are suitable for the establishment and maintenance of selected vegetation species	pH; Electrical Conductivity; Organic Matter; Phosphorus; Nitrate; Cation Exchange Capacity; and Exchangeable Sodium Percentage, Mg and Al
		Soil contaminant levels are suitable for post mine land use	TPH, metals, chemicals

Table 6.2 Grazing rehabilitation performance indicators and completion criteria

Stage of Development	Aspect or Component	Completion Criteria	Performance Indicators
Pasture establishment	Pastures established equivalent to analogue pastures sites	Pastures contains a diversity of species comparable to analogue pastures	Native and introduced pasture species richness;
		Number of weeds species and surface area cover ≤ analogue site	Diversity and percentage cover of weed species
Pasture development	Protective ground cover	Ground layer contains protective ground cover and structure comparable to that of the local pasture analogue	Litter cover; foliage cover; annual plants; cryptogam cover; rock; log; bare ground; perennial plant cover (0.5m); total ground cover
	Ground cover diversity	Pasture contains a diversity of species per square metre comparable to that of the local remnant vegetation	Native understorey abundance; exotic understorey abundance
		Number of weeds species and surface area cover ≤ analogue site	Diversity and percentage cover of weed species
Pasture stability	Pasture health	Pasture condition is comparable to that of analogue pastures	Live plants, healthy plants, pest infestation
	Pasture productivity	Pasture productivity equivalent to analogue pastures	Carrying capacity DSE/ha Crude protein % Digestibility % Green/dry matter content

Table 6.3 Biodiversity rehabilitation performance indicators and completion criteria

Stage of Development	Aspect or Component	Completion Criteria	Performance Indicators
Ecosystem establishment	Vegetation diversity	Vegetation contains a diversity of species comparable to that of the local remnant vegetation	Diversity of shrubs and juvenile trees; total species richness; native species richness; exotic species richness
	Vegetation density	Vegetation contains a density of species comparable to that of the local remnant vegetation	Density of shrubs and juvenile trees
	Ecosystem composition	The vegetation is comprised by a range of growth forms comparable to that of the local remnant vegetation	Trees; shrubs; sub-shrubs; herbs; grasses; reeds; ferns; aquatic
Ecosystem development and habitat complexity	Protective ground cover	Ground layer contains protective ground cover and structure comparable to that of the biodiversity analogue	Litter cover; foliage cover; annual plants; cryptogam cover; rock; log; bare ground; perennial plant cover (0.5m); total ground cover
	Ground cover diversity	Vegetation contains a diversity of species per square metre comparable to that of the local remnant vegetation	Native understorey abundance; exotic understorey abundance
		Native ground cover abundance is comparable to that of the local remnant vegetation	Percent ground cover provided by native vegetation
	Ecosystem growth and natural recruitment	The vegetation is maturing and/or natural recruitment is occurring at rates similar to those of the local remnant vegetation	Shrubs and juvenile trees 0-0.5 m in height; Shrubs and juvenile trees 0.5-1 m in height; Shrubs and juvenile trees 1-1.5 m in height; Shrubs and juvenile trees 1.5-2 m in height; Shrubs and juvenile trees >2.0 m in height
Ecosystem stability	Ecosystem structure	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation	Foliage cover 0.5-2 m; foliage cover 2-4 m; foliage cover 4-6 m; foliage cover >6 m
	Tree diversity	Vegetation contains a diversity of maturing tree and shrub species comparable to that of the local remnant vegetation	Tree diversity
	Tree density	Vegetation contains a density of maturing tree and shrub species comparable to that of the local remnant vegetation	Tree density; average diameter at breast height
	Ecosystem health	The vegetation is in a condition comparable to that of the local remnant vegetation	Live trees; healthy trees; medium health; advanced dieback; dead trees; mistletoe; flowers/fruit (trees)

6.2 Rehabilitation monitoring and research

6.2.1 Monitoring methodology

As proposed rehabilitation works require the establishment of pastures, woodland and riparian areas, the rehabilitation monitoring methodology adopted needs to be sufficiently flexible and capable of providing meaningful information of rehabilitation trajectories and when intervention is required.

A combination of LFA and agricultural productivity analysis is an appropriate and generally accepted rehabilitation monitoring methodology for demonstrating the success of rehabilitation works and providing meaningful guidance where intervention is required. However, the specific monitoring methods applied will be determined in the rehabilitation management plan and will be flexible in consideration of advancing technologies and changes to industry best practice.

6.2.2 Frequency of monitoring

It is expected that formal rehabilitation monitoring will be undertaken annually during operations and for five years following mine closure. At this time, a review of the monitoring frequency will be undertaken based on the performance of the revegetation and an appropriate monitoring frequency determined. The frequency will be determined by a suitably qualified person(s) and in consultation with the relevant regulatory authorities.

Informal monitoring of rehabilitation by mine environmental personnel will also be undertaken.

6.2.3 Analogue sites

Representative analogue sites will be established for grazing areas, as well as the key open-woodland, open forest communities and a relevant riparian community. These will be identified in the Rehabilitation Management Plan.

6.2.4 Rehabilitation monitoring

Permanent transacts and quadrats will be established for rehabilitation monitoring in analogue and rehabilitation areas over time. These will include permanent photo monitoring points.

The monitoring results will be used to assess whether rehabilitation areas are on a trajectory towards a self-sustaining landscape.

Soil samples will be taken using a core sampler within a monitoring quadrat at each rehabilitation monitoring site and soil samples will be sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. Soil samples are analysed for the following parameters: pH, electrical conductivity, available calcium, magnesium, potassium, ammonia, sulphur, organic matter, exchangeable sodium, calcium, magnesium, potassium, hydrogen, aluminium, cation exchange capacity, available and extractable phosphorus, micronutrients (zinc, manganese, iron, copper, boron) and total carbon and nitrogen. Exchangeable sodium percentages are also calculated to determine sodicity and soil dispersion.

For the native woodland and riparian rehabilitation, various biodiversity components will be assessed to monitor the successional phases/changes of plant development and to identify the requirements for ameliorative measures and guide adaptive management.

Rapid ecological assessment techniques will be used to provides quantitative data that measures changes in:

- floristic diversity including species area curves and growth forms (using full floristic sampling);
- ground cover diversity and abundance;

- vegetation structure and habitat characteristics (including ground cover, cryptogams, logs, rocks, litter, projected foliage cover at various height increments);
- understorey density and growth (including established shrubs, direct seeding and tubestock plantings and tree regeneration);
- overstorey characteristics including tree density, health and survival; and
- other habitat attributes such as the presence of hollows, mistletoe and the production of buds, flowers and fruit. Permanent transects and photo-points (as described below) have been established to record changes in these attributes over time.

As large portions of the site will be returned to a grazing post mine land use, rehabilitation monitoring will also include indicators of grazing productivity such as:

- Stock carrying capacity;
- Pasture crude protein levels;
- Digestibility; and
- Dry matter content.

6.2.5 Research and continual improvement

Knowledge of appropriate rehabilitation practices required to achieve the rehabilitation objectives is continually growing. Regis have engaged with industry specialists in the development of rehabilitation landform designs and techniques through the EIS development process and will consult with various experts as required during the operational, rehabilitation and closure phases of the project to address any rehabilitation and closure knowledge gaps.

The use of rock and soil matrices to provide erosion on steep slopes and concentrated flows in lieu of structural erosion controls such as channel banks and drop structures is common on mines site in Qld and WA but not common in NSW.

The key challenge with this technique is to find a practical method for mixing the rock and soil in the optimum ratio to provide a binary mixture. Three techniques are commonly used to mix the two components (R Loch, pers.com):

- Placing the rock later, then spreading topsoil over the rock and ripping the two layers to achieve proper mixing.
- Placing rock and topsoil separately at the top of the slope, then dozing them down together to mix.
- Physically mixing prior to placement.

Regis will trial these techniques and determine which one is the most practical and cost effective while achieving the required performance outcome.

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