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Rehabilitation Strategy and BSAL Reinstatement Strategy

BYLONG COAL PROJECT
Environmental Impact Statement

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

Bylong Coal Project

Rehabilitation Strategy and BSAL Reinstatement Strategy

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Bylong Coal Project

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Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

TABLES

Table of Contents

FIGURES

APPENDICES

Abbreviations

Abbreviation	Term
A	Authorisation
ACMER	Australian Centre for Minerals Extension and Research
BOS	Biodiversity Offset Strategy
BSAL	biophysical strategic agricultural land
CHPP	Coal Handling and Preparation Plant
DITRIS	Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy
Draft Interim BSAL Protocol	*Interim protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land – V7*
DP&E	Department of Planning & Environment
DP&I	Department of Planning & Infrastructure
DPI-OASFS	Department of Primary Industries - Office of Agricultural Sustainability and Food Security
EIS	Environmental Impact Statement
EPA	Environmental Planning Agency
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation.	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
ESG Guideline	*ESG3: Mining Operations Plan (MOP) Guidelines*
Hansen Bailey	Hansen Bailey Pty Limited
KEPCO	KEPCO Bylong Australia Pty Ltd
Interim Protocol for BSAL Verification	*Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*
LFA	Landscape Function Analyses
LGA	Local Government Area
LSC	Land and Soil Classification
LSC Guideline	*Land and Soil Capability Assessment Scheme*
Mtpa	million tonnes per annum
MCM	million cubic metres
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
MWRC	Mid-Western Regional Council

Abbreviations

Abbreviation	Term
MOP	Mining Operations Plan
NATA	National Association of Testing Authorities
NSW	New South Wales
OEA	Overburden Emplacement Area
OEH	Office of Environment & Heritage
OAS&FS	Office of Agricultural Sustainability and Food Security
Project, the	Bylong Coal Project
Rehabilitation Strategy	*Rehabilitation and BSAL Reinstatement Strategy: Bylong Coal Project*
ROM	Run Of Mine
SAL	strategic agricultural land
SEARs	Secretary's Environmental Assessment Requirements
SLR	SLR Consulting Australia Pty Ltd
Soil Assessment	*Soil, Land Capability and Strategic Agricultural Land Assessment: Bylong Project*
SRLUP	Strategic Regional Land Use Plan
TARPs	Trigger Response Action Plans
TSC Act	*NSW Threatened Species Conservation Act 1995*
WAF	Workforce Accommodation Facility
WorleyParsons	WorleyParsons Services Pty Ltd

1 INTRODUCTION

Hansen Bailey Pty Limited (Hansen Bailey) engaged SLR on behalf of WorleyParsons Services Pty Ltd (WorleyParsons) to undertake a *Rehabilitation and BSAL Reinstatement Strategy* (Rehabilitation Strategy) for the Bylong Coal Project (the Project).

1.1 Project Background

In December 2010 KEPCO Bylong Australia Pty Ltd (KEPCO) acquired Authorisation (A) 287 and A342 (the Authorisations). Since this time, extensive exploration and mine planning work has been undertaken to determine the most socially responsible and economically viable mine plan to recover the known coal resources within the Authorisations.

In August 2014 KEPCO commissioned WorleyParsons to manage the Project exploration activities, mine feasibility study planning, environmental approvals and ongoing environmental monitoring for the Project.

The Project is wholly located within A287 and A342 which are located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA). The closest regional centre is Mudgee, located approximately 55 km south-west of the Project Boundary. The Project is approximately 230 km by rail from the Port of Newcastle.

Figure 1 illustrates the locality of the Project within New South Wales (NSW). **Figure 2** shows the regional locality of the Project in relation to the neighbouring town centres, mining authorities, major transport routes and reserves.

KEPCO is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the development and operation of the Project. The State Significant Development Application will be supported by an Environmental Impact Statement (EIS) which is being prepared by Hansen Bailey.

1.2 Project Description

The Project life is anticipated to be approximately 25 years, comprising a two year construction period and a 23 year operational period, with underground mining operations commencing in Year 7. Various rehabilitation and decommissioning activities will be undertaken during both the course of, and following the 25 years of the Project. It is noted that further mineable coal resources exist within both A287 and A342.

The Project is to be developed on land within the Project Boundary as illustrated on **Figure 3**. Key features of the Project are conceptually shown on **Figure 3** and include:

- The initial development of two open cut mining areas with associated Haul Roads and Overburden Emplacement Areas (OEAs), utilising a mining fleet of excavators and trucks and supporting ancillary equipment;
- The two open cut mining areas will be developed and operated 24 hours a day, 7 days a week over an approximate 10 year period and will ultimately provide for the storage of coal processing reject materials from the longer term underground mining activities;
- Construction and operation of administration, workshop, bathhouse, explosives magazine and other open cut mining related facilities;
- Construction and operation of an underground coal mine operating 24 hours a day, 7 days a week for a 20 year period, commencing mining in around year 7 of the Project;

- A combined maximum extraction rate of up to 6.5 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal;
- A workforce of up to approximately 800 during the initial construction phase and a peak of 470 full-time equivalent operations employees at full production;
- Underground mining operations utilising longwall mining techniques with primary access provided via drifts constructed adjacent to the rail loop and Coal Handling and Preparation Plant (CHPP);
- The construction and operation of facilities to support underground mining operations including personnel and materials access to the underground mining area, ventilation shafts, workshop, offices and employee amenities, fuel and gas management facilities;
- Construction and operation of a CHPP with a designed throughput of approximately 6 Mtpa of ROM coal, with capacity for peak fluctuations beyond this;
- The dewatering of fine reject materials through belt press filters within the CHPP and the co-disposal of dewatered fine and coarse reject materials within OEAs and final open cut voids (avoiding the need for a tailings dam);
- Construction and operation of a rail loop and associated rail load out facility and connection to the Sandy Hollow to Gulgong Railway Line to facilitate the transport of product coal;
- The construction and operation of surface and groundwater management and water reticulation infrastructure including diversion drains, dams (clean, dirty and raw water), pipelines and pumping stations;
- The installation of communications and electricity reticulation infrastructure;
- Construction and operation of a Workforce Accommodation Facility (WAF) and associated access road from the Bylong Valley Way;
- The upgrade of Upper Bylong Road and the construction and operation of a Mine Access Road to provide access to the site facilities;
- Relocation of sections of some existing public roads to enable alternate access routes for private landholders surrounding the Project; and
- Infilling of mining voids, progressive rehabilitation of disturbed areas, decommissioning of Project infrastructure and rehabilitation of the land progressively following mining operations.

1.3 Project Boundary

The Project Boundary covers an area of approximately 6,957.7 ha and is shown on **Figure 4**. Within the Project Boundary the various Project features cover an area of 2,874.7 ha. For rehabilitation planning purposes the features and have been categorised into eight major primary domains based on their unique operation and functional purpose (refer **Section 4**). **Figure 4** shows their spatial location.

1.4 Regulatory Requirements

1.4.1 Secretary's Environmental Assessment Requirements

This Rehabilitation Strategy has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the Project. **Table 1** provides a summary of the requirements under the SEARs that are relevant to this assessment and indicates where specific issues have been addressed in this document.

Table 1 Summary of Secretary's Environmental Assessment Requirements

Specific issues	Where addressed in this document
Secretary's Requirements	
Land – including:	
- an assessment of the likely impacts of the development on the soils and land capability of the site and surrounds, paying particular attention to any biophysical strategic agricultural land (BSAL), having regard to the Mining & Petroleum Gateway Panel's and Department of Primary Industries' requirements (see Attachments 2 & 3);	*Soil, Land Capability and Strategic Agricultural Land Assessment* (Soils Assessment)
OAS&FS	
Specifically include: - …detailed advice regarding rehabilitation, in particular the proposed rehabilitation of Biophysical Strategic Agricultural Land (BSAL), including the location of the activities, methodologies and time-frames for implementation.	Sections 4, 6, 7, 8, 9, 10, 11
DTIRIS-DRE	
The following are the key issues to be addressed in the EIS that are likely to have a bearing on rehabilitation and mine closure: - …An evaluation of current land capability class and associated condition. The EIS should characterise soils across the proposed area of surface disturbance and assess their value and identify opportunities and constraints for use in rehabilitation.	Soils Assessment
- Where an agricultural land use is proposed, the EIS should: - Demonstrate that the landscape will be returned to the Agricultural Suitability Class that existed before mining commenced or better; - Provide information on how soil would be developed in order to achieve the proposed stock capacity.	Sections 3.4, 8
- Post Mining Land Use - KEPCO must identify and assess post mining land use options and provide a statement of the preferred post mining land use outcome in the EIS. This should include a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives as well as the benefits of the post mining land to the surrounding environment, a subsequent landowner, the local community and the state of NSW.	Section 4
EPA	
Soils The EIS should include: - A description of the mitigation and management options that will be used to prevent, control, abate or minimise identified soil and land resource impacts associated with the project. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Sections 8, 11

1.4.2 Strategic Regional Land Use Policy

The NSW Strategic Regional Land Use Policy applies state-wide in areas where there is high value agricultural land and increasing activity in the coal and coal seam gas industries. The Project Boundary falls within the area covered under the Upper Hunter Region Strategic Regional Land Use Plan (SRLUP) which was released in September 2012.

A key component of the Upper Hunter Region SRLUP is the identification and mapping of Strategic Agricultural Land (SAL). One category of SAL is Biophysical Strategic Agricultural Land (BSAL), which is land containing "a rare combination of natural resources and is considered highly suitable for agriculture" (DP&I, 2012).

State Significant Development proposals related to mining that are likely to impact on areas of BSAL are subject to a the Gateway Process. The Gateway process has been implemented through an amendment to, inter alia, *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). The amendment was gazetted in October 2013. A further amendment to *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* was gazetted in February 2014 with revised mapping of SAL.

The EP&A Regulation (section 50A) requires that:

> *"..a development application for consent to a mining or petroleum development on certain identified land (including land shown on the Strategic Agricultural Land Map) must be accompanied by:*
>
> *(a) a gateway certificate, or*
>
> *(b) a site verification certificate that certifies that the land on which the proposed development is to be carried out is not biophysical strategic agricultural land.*

KEPCO identified that the Project will impact areas of BSAL and proceeded directly to the Gateway process that included details of the verification of BSAL within the application (SLR, 2013). The Gateway Panel issued a Conditional Gateway Certificate with conditions in April 2014.

Table 2 provides a summary of the requirements under the Conditional Gateway Certificate that are relevant to this assessment and indicates where specific issues have been addressed in this or affiliated Project documentation.

Table 2 Summary of Gateway Requirements

Specific issues	Where addressed
Mining Petroleum and Gateway Panel	
With regard to the removal and recreation of verified BSAL soils: 1. Undertake a risk assessment that identifies the hazards and proposes controls with respect to the movement of BSAL soils;	Section 12
2. Identify a final location for the verified BSAL soils within the Project Boundary area;	Section 6.3
3. Detail the methods proposed for the handling, storage and treatment of the verified BSAL soils;	Sections 8, 9
4. Propose alternate mitigation measures to be implemented in the event that the methodology selected results in the loss of verified BSAL soils post-implementation.	Section 10

1.4.3 Guidelines and Standards

This report has prepared generally in accordance with the requirements of the following relevant strategic land use planning and resource management plans and policies:

- Strategic Framework for Mine Closure (ANZMEC, 2000)
- ESG3: Mining Operations Plan (MOP) Guidelines ((Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DITRIS). Hereafter referred to as the ESG3 Guideline.
- Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land ((Office of Environment & Heritage (OEH) and Department of Primary Industries - Office of Agricultural Sustainability and Food Security (DPI-OASFS), 2013)). Hereafter referred to as the Interim Protocol.
- The Land and Soil Capability Assessment Scheme (OEH, 2012) was applied to provide rehabilitation success criteria for each post-mining Land and Soil capability (LSC) class of land. Hereafter referred to as the LSC Guideline.
- Department of Environment and Climate Change (2008) Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries. Applied to assist with erosion control measures.

1.5 Key Project Members

The key authors of this Rehabilitation Strategy and their relevant qualifications are detailed below.

Project Director	Rod Masters
	MSc, DipGeo, DipAppSc (Agric), CPSS III
	Executive
Project Manager	Adele Calandra
	BSc, MSc (Hons), CPSS II
	Snr Environmental Scientist

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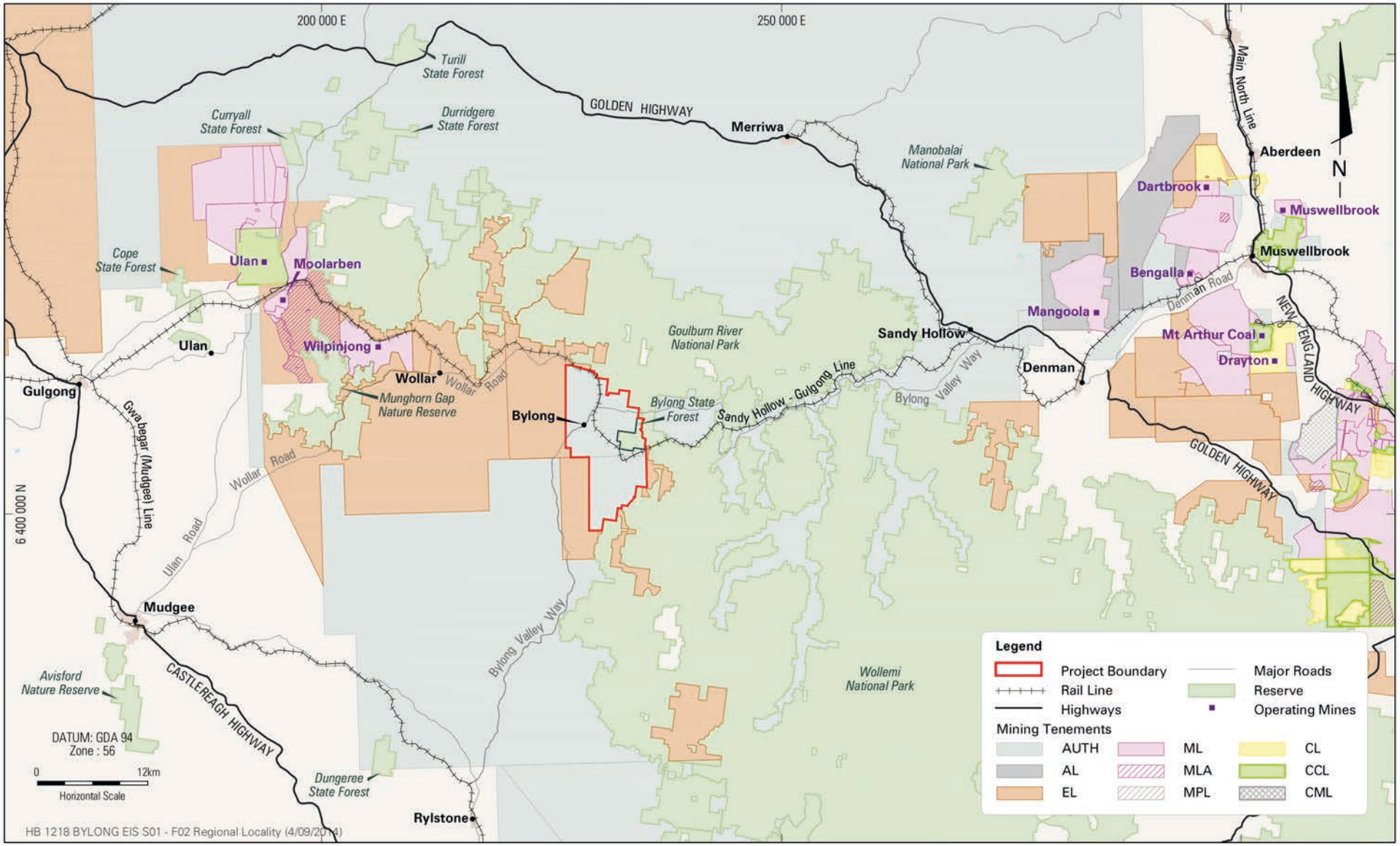
Locality Plan

FIGURE 1



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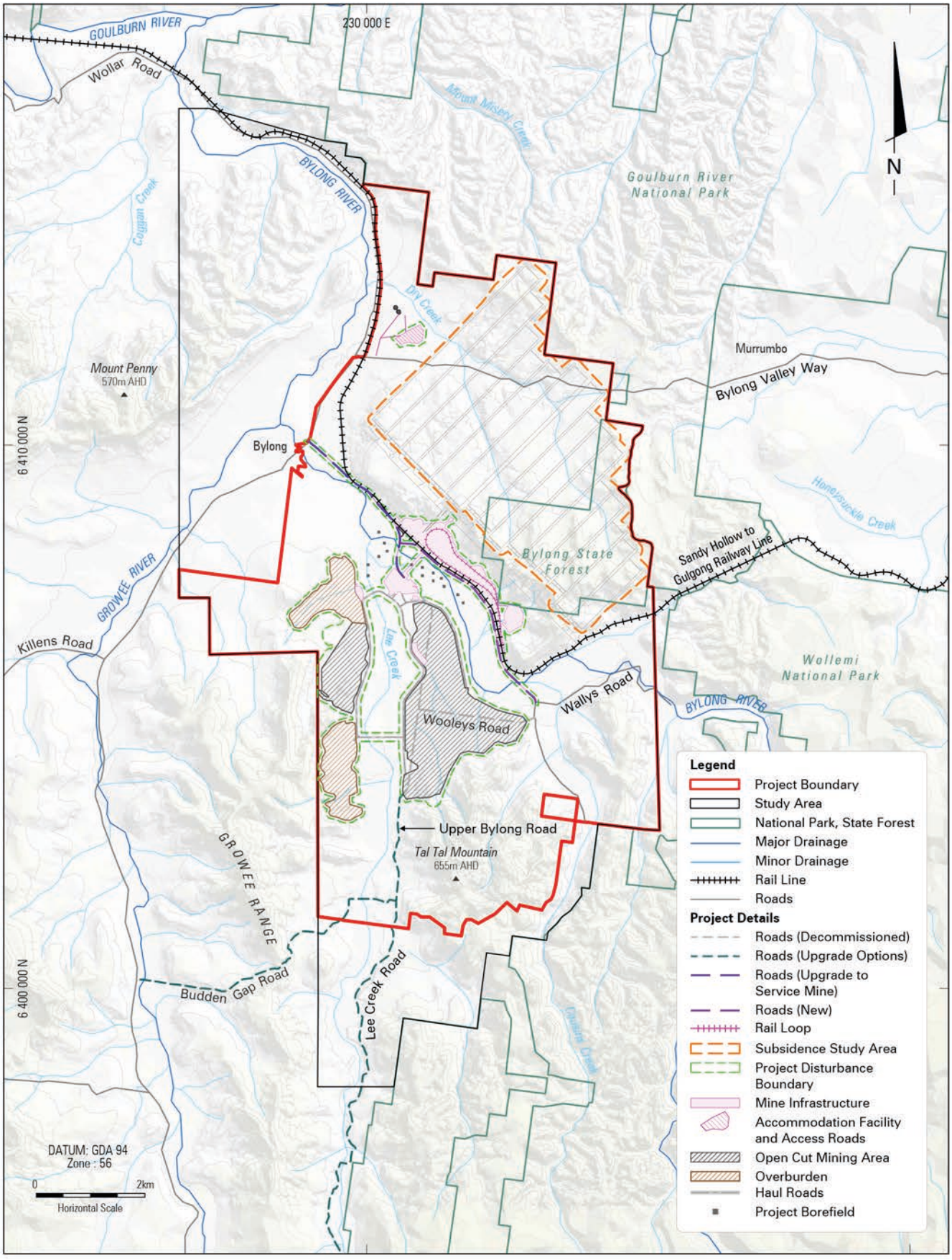
Regional Locality

FIGURE 2



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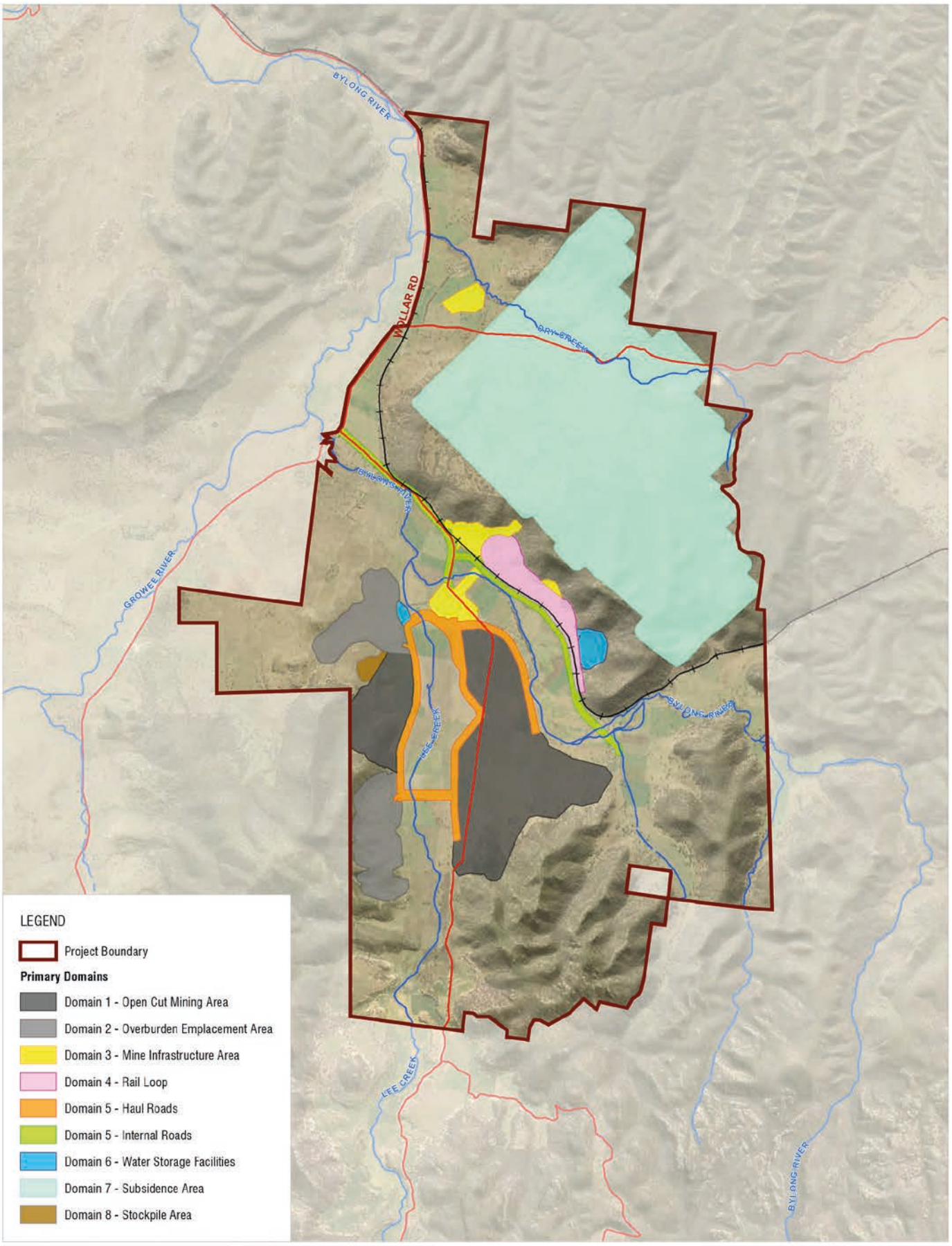
Conceptual Project Layout

FIGURE 3



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Hansen Bailey

Rehabilitation and BSAL Reinstatement Strategy

Primary Domains (Operational Domains)

FIGURE 4

2 REHABILITATION PLANNING PROCESS

Rehabilitation planning commences as part of mine project feasibility studies and continues through the entire mine life to lease relinquishment. It is only complete when mining disturbances have been fully rehabilitated to completion criteria and to a sustainable post mining land use. **Diagram 1** below shows the Rehabilitation Planning Process.

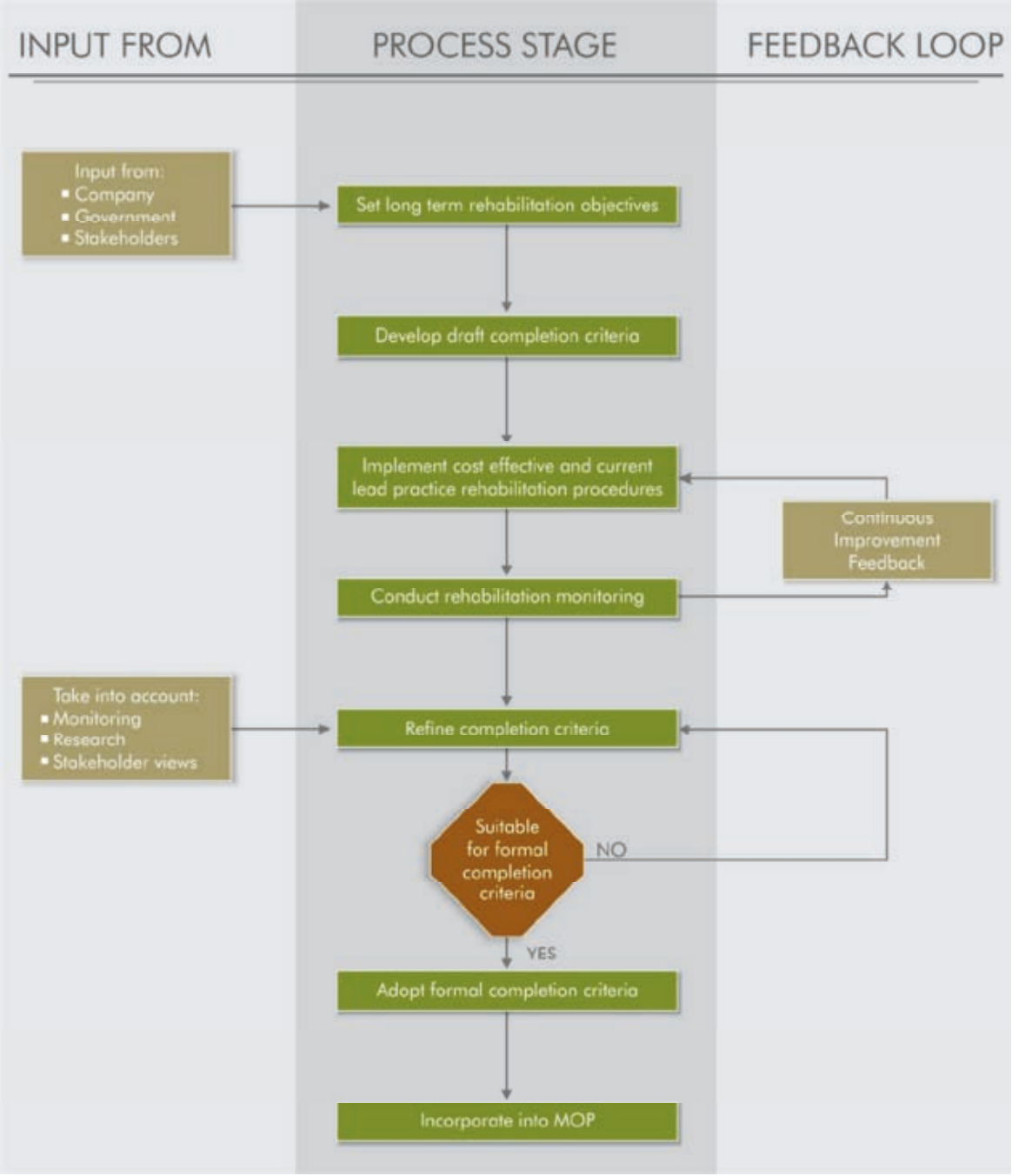


Diagram 1: Rehabilitation Planning Flowchart (Source: ESG Guideline)

The rehabilitation planning processes includes the following steps:

1. Nomination of the intended post mining land use, otherwise known as the land use goal (or goal of rehabilitation);

2. Establishment of rehabilitation objectives for the site that clearly describe the rehabilitation outcomes required to achieve the post mining land use;

3. Identification of mine domains and the more specific rehabilitation objectives that apply to each domain;

4. Identification of the applicable rehabilitation phases to achieve the desired rehabilitation objectives;

5. Identification of performance indicators that can be measured reliably over time using accepted scientific techniques and standards (i.e. Australian Standards) to "track" the progress towards completion/relinquishment criteria;

6. Establishment of the completion/relinquishment criteria for each domain which will quantitatively demonstrate rehabilitation success, i.e. when a phase of rehabilitation is complete, or, when total rehabilitation is complete; and

7. Establishment of an appropriate monitoring methodology, including Trigger Response Action Plans (TARPS), to track rehabilitation progress and facilitate continuous improvement

Mine rehabilitation is an ongoing program designed to restore the physical, chemical and biological environment disturbed by mining that is generally in keeping with the character and landscape of the area and to a state acceptable to stakeholders, including post-mining landholders.

The emphasis for management of rehabilitation is progressing into "*planning for closure*". Mine closure is a continuous series of activities that begins with pre-planning prior to a project's design and construction and resulting in the achievement of long-term site stability and the establishment of a self-sustaining final land use.

The concepts and standards underlying mine rehabilitation reflect stakeholder expectations and environmental imperatives. KEPCO accepts the concept and responsibility of mine site rehabilitation activities which will lead onto successful mine closure. This is demonstrated by means of the rehabilitation objectives and associated works program provided in the following sections.

3 REHABILITATION GOALS AND OBJECTIVES

3.1 Goal of Rehabilitation

The ultimate rehabilitation goal is to create stable, non-polluting post mining landforms that are cognisant of site constraints and allow the achievement of the agreed post mining land uses.

The concepts and standards underlying mine rehabilitation reflect stakeholder expectations and environmental imperatives. KEPCO accepts the concept and responsibility of mine site rehabilitation activities which will lead onto successful mine closure. This is demonstrated by means of the rehabilitation objectives and associated works program provided in this report.

The overarching post-mining land use goals (rehabilitation goal) include:

- Where practical, return the land to its pre-mining land capability and land use such that the post-mining landform is consistent with the character and landscape of the Bylong Valley;
- Limit impacts on BSAL and minimise the total quantity of BSAL foregone within the Project Boundary;
- Return land subject to temporary disturbance to pre-mining condition; and
- Return a similar quantity of good quality land, (including BSAL) for land directly and permanently impacted by mining related activities.

3.2 Rehabilitation Objectives

3.2.1 Overarching Objectives

The *Strategic Framework for Mine Closure* (ANZMEC, 2000) rehabilitation contains a series of rehabilitation criteria. These criteria state that rehabilitation outcomes are:

- Consistent with the environmental assessment which formed the basis of approval;
- Based on mine closure criteria and rehabilitation outcomes developed through mine planning and stakeholder consultation;
- Integrate rehabilitated native vegetation with undisturbed native vegetation to provide for larger areas and wildlife corridors;
- Suitable for an agreed subsequent land use that is, as far as possible, compatible with the surrounding land fabric and land use requirements;
- Should address limitations on the use of rehabilitated land;
- Sustainable in terms of that land use;
- Produce stable and permanent landforms, with soils, hydrology, and ecosystems with maintenance needs no greater than those of surrounding land (may include waste emplacements, voids, pits and water bodies providing that they are part of the accepted final outcome);
- Securely and safely contain waste substances that have the potential to affect land use or result in pollution;

- Do not present a hazard to persons, stock or native fauna;
- Address threatened species issues;
- Address heritage issues;
- Be clean and tidy, and free of rubbish, metal and derelict equipment/structures, except for heritage and other agreed features; and
- Be free from unacceptable air and water pollution, and other environmental effects outside the disturbed area.

3.2.2 Project Specific Objectives

All the rehabilitated land will form a stable landform with either a self-sustaining vegetation cover or of adequate stability conducive to agricultural activities.

Short-term rehabilitation objectives include:

- Reducing the extent of clearing and/or vegetation disturbance (consistent with operational requirements);
- Scheduling of operations, including overburden/ interburden emplacement shaping and revegetation;
- Timely rehabilitation of the disturbed areas no longer required for mining-related operations;
- Application of topdressing material (topsoil/subsoil) to the final landform based on soil availability and post-mining Land and Soil Capability classification targets;
- Stabilisation of all earthworks, drainage lines and disturbed areas in order to minimise erosion and sedimentation; and
- Control of vermin, feral animals and noxious weeds on KEPCO owned land, including the rehabilitation areas.

Overall medium and long-term mine rehabilitation objectives are to provide a landform that is safe, low maintenance and geotechnically stable that blends in with the surrounding topography.

Land use will provide for a mixture of rehabilitated native vegetation, pastoral land and cropping areas. Specific long-term objectives include:

- Re-establishment to cropping land, pastoral land or native vegetation in the areas disturbed by the mine;
- Limit direct impacts on BSAL and minimise the total quantity of BSAL that is degraded within the Project Boundary;
- Reinstate pre-mining land uses and LSC classes where Project impacts are temporary;
- Reinstate an equivalent amount of BSAL on the rehabilitated landform to mitigate the long-term impact of mining activities on good quality agricultural lands;
- Reinstate an equivalent amount of LSC Class 3 and 4 land on the rehabilitated landform to mitigate the long-term impact of mining activities on the better quality agricultural lands;

- Appropriately recover, store and re-handle suitable soil resources for future rehabilitation;
- Establish healthy and self-sustaining soil profiles and vegetation cover on rehabilitated lands to meet the nominated post-mining LSC class and land use commitments;
- Establish healthy and self-sustaining soil profiles and vegetation cover on lands to meet the nominated post-mining BSAL reinstatement commitments;
- Undertake progressive rehabilitation as soon as areas become available for practical rehabilitation;
- Monitoring of rehabilitation success in terms of physical, chemical and biological parameters;
- Conduct maintenance (e.g. weed control, follow-up fertiliser, reseeding, erosion repair etc.) until rehabilitation is sustainable;
- Monitor and manage rehabilitation areas to facilitate the process of achieving sign-off on pre-determined success criteria;
- Long-term conservation of remnant and degraded native vegetation and/or habitat corridors on the mine site;
- Development and implementation of a long-term and regionally integrated biodiversity offset strategy;
- Ensuring that the quality of run-off water from rehabilitation areas that is released from the site will not cause environmental harm; and
- Ensuring that the water quality of any residual water bodies is suitable for the nominated use and does not have the potential to cause environmental harm.

3.3 Consideration of Local and Regional Strategies

The Mid-Western Regional Local Environmental Plan (LEP) 2012 under the *Environmental Planning and Assessment Act 1979* has mapped the Project Area as Zone RU1 Primary Production. The objectives of this land use 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 maintain the visual amenity and landscape quality of Mid-Western Regional by preserving the area's open rural landscapes and environmental and cultural heritage values.
- To promote the unique rural character of Mid-Western Regional and facilitate a variety of tourist land uses.

The Project aims to reinstate disturbed land to land capable of primary production (pastoral land and cropping areas) with a post-mining landform consistent with the character and landscape of the Bylong Valley. These rehabilitation objectives align with the objectives of the Mid-Western Regional LEP Primary Production zoning of the Project Boundary.

The connectivity of the Project with regional land use strategies and project initiatives has been considered. There are a number of these landscape connectivity projects relevant to the Bylong district occurring at the national, state and local levels, in addition to volunteer and private initiatives. However, these primarily focus on environmental (rather than agricultural) connectivity conservation, with the Great Eastern Ranges initiative and Central Tablelands Local Land Service in particular having large and relevant native vegetation connectivity projects. At a more local scale, the MWRC has a roadside corridor management project aimed at improving habitat and remnant vegetation condition throughout the local area.

Identified initiatives and relevant planning instruments include:

- Great Eastern Ranges Initiative (Anon, 2015): Bylong is located just to the west of the ranges, abutting the Wollemi National Park, and close to the Goulburn River National Park and several State Forests;
- Central Tablelands Local Land Services – Catchment Action Plan (Anon, 2013): This is a multi – catchment management plan including creeks and rivers found within the immediate vicinity of Bylong;
- NSW Upper Hunter Strategic Regional Land Use Plan (NSW DP&I, 2012): Recommendations extend to the Bylong and Mudgee mining districts;
- NSW Mining Operations Plan Guidelines (i.e. ESG Guidelines): Emphasises integration of post mining landforms with local environment and catchment management plans;
- Mid-Western Regional Council – Roadside Corridor Management Project (Applied Ecology, 2010): This project is conducted across the MWRC LGA, including Bylong; and
- Watershed Landcare – the local Landcare initiative covering Mudgee, Bylong, Gulgong and surrounds (Anon, 2009).

Given the initiatives are largely environmental rather than agricultural they are not directly related to the Project's rehabilitation objectives which seek to re-instate the pre-mining landscape (as is practical). However, should KEPCO wish to integrate its own land management initiatives and rehabilitated post mining landforms into other landscape connectivity activities, there should be ample opportunity to do so at multiple scales. This should be supported by funding existing initiatives and supporting research, partnering with existing groups or integrating company land into relevant schemes.

3.4 Evidence of Successful Reinstatement of Good Quality Agricultural Land

KEPCO proposes to reinstate land classified as BSAL that will be permanently impacted upon on the rehabilitated landform within the Project Boundary. A number of recent examples of mine rehabilitation (as described below) demonstrate that this proposal is achievable.

The Alluvial Lands Project at the Rio Tinto owned Hunter Valley Operations (Nelson and Stewart, 2007) provided evidence that rehabilitation of mined land to the former Rural Land Capability Class I and II land is achievable and that this land can facilitate agricultural production. The operations required selective handling and reinstatement of 630,000 m³ of subsoil to a depth of 1 m, along with 252,000 m³ of topsoil to 0.4 m depth. The entire process followed particular rigour with tolerance for the final land surface set to be within 0.5 m of the pre-mining surface.

A Lucerne Hay productivity yield of *"at least equivalent to the average crop productivity yields for the Upper Hunter Region for three consecutive years"* was required. Regular inspections and meetings with officers from NSW DPI's Environmental Sustainability Branch and the NSW DPI's regional agronomist demonstrated Rio Tinto's compliance with yield, quality and monitoring requirements for the reinstatement to Class I and II land capabilities. As such the project achieved the conditioned target land capability class characteristics for agricultural production and was endorsed by the NSW Government at the time.

The Alluvial Lands Project is considered to be a good example of successful reinstatement of arable land after mining, particularly in comparison to that proposed for the Project (i.e. rehabilitating back to LSC Class 3 and 4 lands).

The recent example of soil profile reconstruction and rehabilitation of high value agricultural land has been demonstrated at Bengalla Mine in Muswellbrook, NSW. Bengalla Mine has recently gained approval for the restoration of Rural Land Capability Class III land. Bengalla has established an area of approximately 5.7 ha of an existing OEA to Land Capability Class III Rural Land Capability where slopes are less than 3% and Black Vertosol soils have been applied as topsoil (BMC, 2013). This area was sown with pasture in late 2012 and will be monitored as part of the annual rehabilitation audit with results presented in an Annual Review. Given the early stages of the program, no further information has been made available regarding the long term sustainability of land capability characteristics and agricultural productivity.

In the Midwestern United States, a reclamation research program was initiated at the Universities of Illinois and Kentucky to investigate the best reclamation strategies to reinstate prime agricultural farmland after mining activities. Darmody et al. (2002) compiled research which has shown that surface mining can be a short term land use which can be followed by productive higher agricultural uses, if rehabilitation is undertaken correctly. Achieving a higher mine land productivity is possible if rehabilitation plans are designed to minimise compaction, if good quality soil materials are used, and if high management levels (herbicides, fertility, adapted crop varieties) and practices are followed.

This is supported by anecdotal evidence provided by Peabody Energy (Peabody Energy, 2011) indicating that use of best practice reclamation strategies based on soil management and crop management practices has resulted in the establishment of mine rehabilitated land capable of sustaining cropping. The use of best practice reclamation strategies has resulted in the successful bond release in a number of mines including Sugar Ridge Mine (100% bond release), Farmersburg (70% bond release), Cedar Creek Mine (99% bond release) and others.

Given the available topsoil and subsoil resource and recent evidence afforded by other parties, SLR is confident that land within the Project Boundary can be successfully returned to BSAL provided that appropriate rehabilitation planning (as detailed in this report) is carried out.

4 REHABILITATION DOMAINS

In accordance with the ESG Guideline, a domain is defined as a land management unit within a mine site. There are two main domain types, primary domains, also known as operational domains, and secondary domains, also known as post-mining land use domains.

In general, the process of identifying domains can be broken into three steps:

- Identify mining domains according to the way an area of land is managed in a mining context;
- Identify primary (operational) mining domains. These can be defined as land management units within the mine site, usually with unique operational and functional purpose and therefore similar geophysical characteristics; and
- Identify secondary (post mining land use) domains. These are defined as land management units characterised by a similar post mining land use objective.

Domains are usually determined in consideration of the specific requirements of the mining location and local environment.

When allocating a primary domain to a parcel of land, an assessment is required in terms of:

- The purpose of the parcel of land;
- The activities taking place e.g. earthmoving, storage of water, handling of a raw product; and
- The risks associated with the area e.g. storage of hazardous material, management of vegetation etc.

Once areas of overlap are defined the domain can be allocated.

The allocation of secondary domains relates to the final land use. When allocating a secondary domain to a parcel of land, an assessment is required in terms of:

- Residual risk;
- The ongoing land use post mining e.g. what activities will take place on the site in 10 years' time; and
- The maintenance activities required. In the case of a Rehabilitation-based domain this may be weed control whereas a domain for a Final Void would be in context of public safety and water quality.

4.1 Primary Domains (Operational Domains)

Project features that will impact the land have been categorised into a series of primary domains. Within the Project Boundary the various Project features cover an area of approximately 2,875 ha and have been categorised into eight major primary domains (**Table 3**; **Figure 4**).

Table 3 Project Domains

Primary Domain		Description	Area (ha)
1	Open Cut Mining Area	- Western Open Cut - Eastern Open Cut	532.7
2	Overburden Emplacement Area (OEA)	- South-western OEA - North-western OEA	225.0
3	Mine Infrastructure Area	- Employee & materials drift - Overland Conveyor - ROM coal pad - Main access - Administration buildings - Accommodation village	85.0
4	Rail Loop	- Rail Loop, associated rail load out and CHPP	88.3
5	Roads	- Haul Roads - Internal Roads	191.8
6	Water Storage Facilities	- Raw water storage - Dirty water storage	26.5
7	Subsidence Study Area	- Angle of draw for the Underground Extraction Area within the Study Area boundary	1,714.3
8	Stockpile Area	- Land nominated for storage and management of stripped soil	11.1
Total			**2,874.7**

4.2 Decommissioning Strategy of Primary Domains

The Project seeks to minimise risks to agricultural resources and minimise long-term impacts. The Project's decommissioning strategy for each primary domain is described below in **Table 4**. This strategy will drive post-mining land use goals (i.e. development of secondary domains).

Table 4 Preliminary Rehabilitation Objectives by Primary Domain

Primary Domain		Rehabilitation Objectives
1	Open Cut Mining Area	Shape overburden to provide a stable landform consistent with the surrounding environment and proposed post-mining land use. Any carbonaceous material emplaced within the Open Cut Mining Areas will be capped with suitable inert material.
		Void remaining within the Eastern Open Cut Mining Area at the completion of open cut mining operations will be progressively backfilled with coarse and fine reject materials for the remaining term of underground mining operations. Following completion of mining operations, the area will be capped and rehabilitated as per the conceptual final landform.
2	OEA	Shape OEAs to provide a stable landform consistent with the surrounding environment and landscape and to facilitate the proposed post-mining land use.
3	Mine Infrastructure Area	Remove all aboveground infrastructure and seal and recover underground mining infrastructure. Regrade embankments and cuttings where required and reshape landform to be similar to pre-mining landform. Drift to be rehabilitated by emplacement of a concentre plug with topdressing material for rehabilitation.
4	Rail Loop	Rail Loop to remain at closure. Carbonaceous material associated with the CHPP, located within the rail loop, to be removed with CHPP infrastructure decommissioned and the land topsoiled.

Primary Domain		Rehabilitation Objectives
5	Roads:	
	Haul Roads	Haul roads will have road base materials removed. Roads will be re-shaped to blend with the surrounding landform and revegetated with appropriate species.
	Internal Roads	Internal roads will be left insitu as they form part of the road network.
6	Water Storage Facilities	
	Raw water storage dam	Dams will be drained and de-silted with dam walls re-shaped to blend in with the surrounding landscape.
	Mine water dam	
7	Subsidence Study Area	Monitor erosion, ponding and surface cracking during operations and post closure.
8	Stockpile Area	Stockpiles will be removed and rehabilitated.

4.3 Secondary Domains (Post-mining Land use Goals)

The Project seeks to return the land back to the pre-mining land use where practical. The Project's post-mining land use for each primary domain is described below in (**Table 5**).

Table 5 Post-Mining Goals

Primary Domain	Post-mining Goal
Indirect and Temporary Impact	
Subsidence Study Area	Return to: - Pre-mining land use - Pre-mining LSC Class Pre-mining soil and landscape characteristics
Direct and Temporary Impact	
Mine Infrastructure Area Haul Roads Stockpile Area	Return to: - Pre-mining Land use - Pre-mining LSC Class Pre-mining soil and landscape characteristics
Direct and Permanent Impact	
Open Cut Mining Area OEA	Return to: - Pre-mining land use Reinstate - Equivalent quantity of LSC Class 4 land Soil and landscape characteristics to be commensurate with LSC Class 4 hazard criteria - Equivalent quantity of LSC Class 3 land Soil and landscape characteristics to be commensurate with LSC Class 3 hazard criteria Establish: - Equivalent quantity of BSAL located on land with a target LSC of Class 3 within Project Boundary to offset the direct impacts on BSAL - Soil and landscape characteristics to be commensurate with the BSAL criteria and where appropriate the LSC Class 3 hazard criteria

Primary Domain	Post-mining Goal
Internal Roads Rail Loop	Retain infrastructure: - Pre-mining land use changed from agricultural to transport (road and rail) infrastructure - Pre-mining LSC changed to an agricultural classification of Urban (U)

Based on the identified post-mining goals (refer **Table 5**), there are five different types of secondary domains (**Table 6**; **Figure 5**).

Table 6 Secondary Domains

Primary Domains (Operational)		Secondary Domains (Post-mining land use)
1	Open Cut Mining Area	A – Grazing, B – Cropping, C - Woodland
2	Overburden Emplacement Area (OEA)	A – Grazing, B – Cropping, C – Woodland
3	Mine Infrastructure Area	D – Pre-mining land use
4	Rail Loop	E – Infrastructure
5	Roads	D, E
6	Water Storage Facilities	D
7	Subsidence Study Area	D
8	Stockpile Area	D

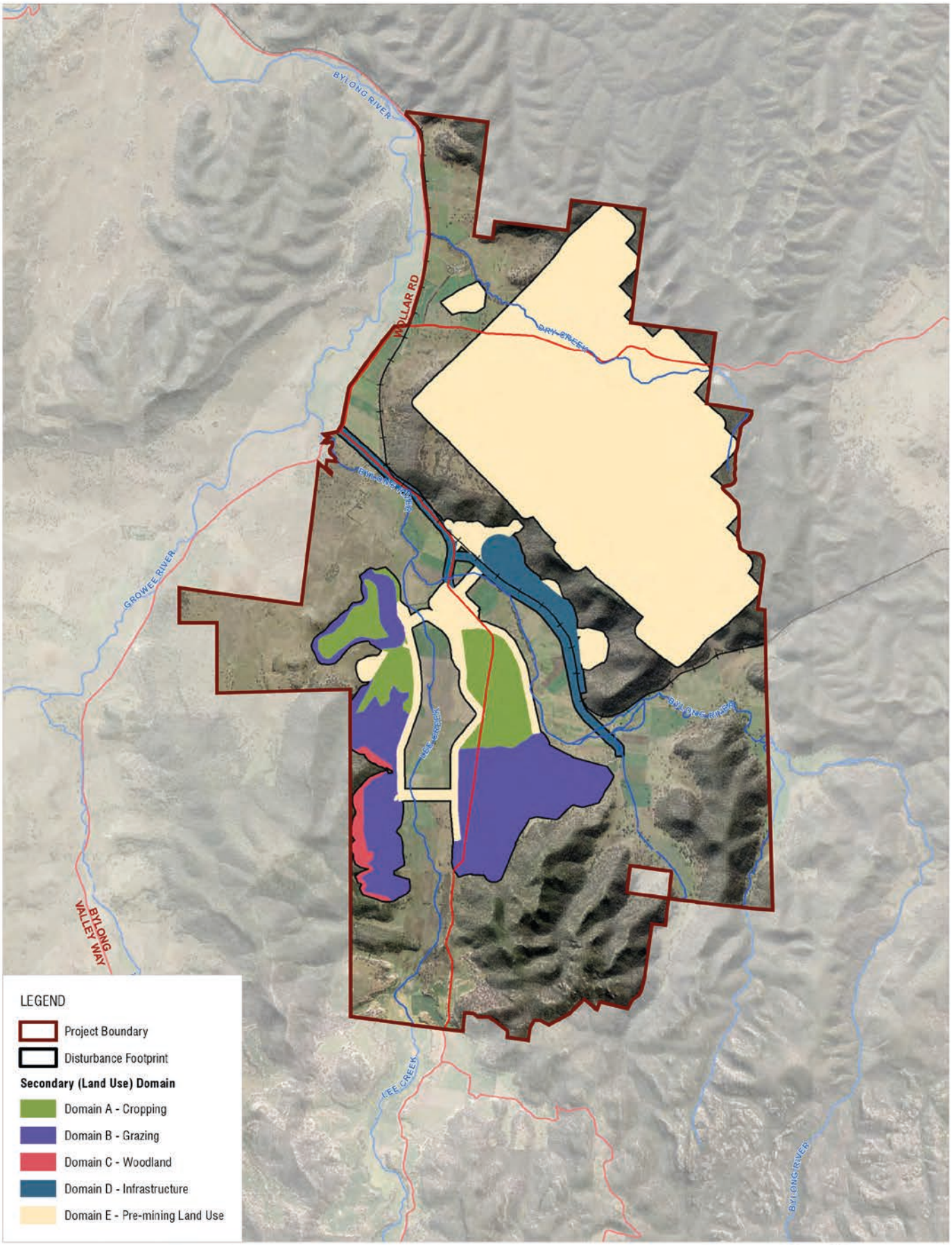
4.4 Integration of Post-mining Rural Land Use and Surrounding Environment

The Project's long-term rehabilitation objective is to provide a stable rehabilitated landform with either a self-sustaining vegetation cover or of adequate stability conducive to agricultural activities. Specific landscape objectives seek to return the rehabilitated land to its pre-mining land use or similar, where practical, and to enhance biodiversity values where possible.

Secondary land use domains (refer **Section 4.3**) were identified based on a number of factors, one of which is proximity to existing land uses and their integration with the surrounding environment. Domain A, cropping land, has been located as proximal to existing cropping and/or potential cropping land as was practicable to maximise integration opportunities. Domain B, grazing, has been located adjacent to cropping land on the slightly elevated slopes and Domain C, Woodland, has been strategically placed to blend in with the mountainous terrain on the western side of the OEA.

The Project's Land Management Plan will ensure the best agricultural use of adjacent non-mine lands to maximise this integration and to provide opportunities for private farmers to use these through long-term leases.

The region's land use strategies have been considered (refer **Section 3.3**) and the proposed land uses are compatible with these strategies. The Project aims to reinstate disturbed land to land capable of primary production (pastoral land and cropping areas) with a post-mining landform consistent with the character and landscape of the Bylong Valley. These rehabilitation objectives align with the objectives of the Mid-Western Regional LEP Primary Production zoning of the Project Boundary.



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Rehabilitation and BSAL Reinstatement Strategy

Secondary Domains (Land Use Domains)

FIGURE 5

5 SUMMARY OF PROJECT IMPACTS ON EACH PRIMARY DOMAIN

This section should be read in conjunction with the *Bylong Coal Project Soils, Land Capability and Strategic Agricultural Land Assessment* (Soils Assessment) (SLR, 2015), which provides further detail on the Project impacts to existing soil resources.

5.1 Impact Types

Three impact types have been identified for each primary domain on agricultural resources after consideration of the Project's decommissioning strategy and post-mining goal commitments. The three impact types are:

- Indirect and temporary: defined as impacts that do not directly disturb the land's surface and are temporary;
- Direct and temporary: defined as impacts which directly disturb the land's surface, however, are short-term by nature with the area to be rehabilitated to pre-mining status; and
- Direct and permanent: defined as impacts which will directly disturb the land's surface and the area will not be rehabilitated to pre-mining status.

5.2 Project Impact by Primary Domain

The impact category for each of the eight major primary domains is provided in **Table 7. Figure 6** shows the distribution of impact types across the Project disturbance footprint.

Table 7 Project Impact Category by Primary Domain

Project Domain		Impact Category
1	Open Cut Mining Area	Direct and permanent
2	OEAs	Direct and permanent
3	Mine Infrastructure Area	Direct and temporary
4	Rail Loop	Direct and permanent
5a	Roads: Haul	Direct and temporary
5b	Roads: Internal	Direct and permanent
6	Water Storage Facilities: raw water and mine water dams	Direct and temporary
7	Subsidence Study Area	Indirect and temporary
8	Stockpile Area	Direct and temporary

The amount of land in each impact category is summarised in **Table 8** and the key findings are:

- Indirect and temporary impacts cover 1,714.3 ha and comprise 59.6% of the Project disturbance footprint. This area is entirely covered by the Subsidence Study Area;
- Direct and temporary impacts cover 240.9 ha and comprise 8.4% of the Project disturbance footprint. This area is largely covered by the Haul Roads, Mine Infrastructure Area, Stockpile Area and Water Storage Facilities; and
- Direct and permanent impacts cover 919.5 ha and comprise 32.0% of the Project disturbance footprint. This area is impacted upon by the Internal Roads, Rail Loop, Open Cut Mining Area and the OEAs.

Table 8 Impact Category: Project Disturbance Footprint

Impact Category by Project Domain	Area (ha)	Percentage (%)
Indirect and Temporary Impacts	**1,714.3**	**59.6**
Subsidence Study Area	1,714.3	59.6
Direct and Temporary Impacts	**240.9**	**8.4**
Haul Roads	118.3	4.1
Mine Infrastructure Area	85.0	3.0
Stockpile Area	11.1	0.4
Water Storage Facilities	26.5	0.9
Direct and Permanent Impacts	**919.5**	**32.0**
Internal Roads	73.5	2.6
Open Cut Mining Area	532.7	18.5
Overburden Emplacement Area	225.0	7.8
Rail Loop	88.3	3.1
Total	**2,874.7**	**100.0**

5.3 Project Impact on Agricultural Land (by LSC Class)

The Soils Assessment determined that there are five LSC Classes) within the Project disturbance footprint. The dominant land capability category within the footprint is low capability land (LSC Classes 6 and 7 followed by moderate capability land (LSC Classes 4 and 5) and then high capability land (LSC Class 3).

Class 3 lands are capable of high intensity land uses and are suitable for a range of agricultural uses including high-impact land uses such as cropping with cultivation. Class 4 land is moderately capable land suitable for some rotational cropping and good quality grazing. Class 5 land is moderate-low capable land that is largely restricted to grazing, some horticulture and forestry. Classes 6 and 7 are low to very low capability land suited to light grazing.

Based on the previously defined impact categories, the type of LSC within each primary domain has been quantified (SLR, 2015). **Table 9** provides a summary and the key findings are:

- Indirect and temporary impacts are largely associated with low capability land (Class 6) followed by high capability land (Class 3) with the remainder covered by very low capability land;
- Direct and temporary impacts are largely associated with moderate capability land (Classes 4 and 5); and
- Direct and permanent impacts are mainly associated with moderate capability land (Classes 4 and 5), followed by high (Class 3) and low capability (Class 6) land distributions.

Table 9 Impact Category: LSC Class within Project Disturbance Footprint

LSC	ha	%
Direct and Permanent Impacts	**919.5**	**32.0**
Class 3	141.9	4.9
Class 4	194.7	6.6
Class 5	440.9	15.3
Class 6	127.8	4.7
Class 7	14.2	0.5
Direct and Temporary Impacts	**240.9**	**8.4**
Class 3	37.0	1.3
Class 4	76.9	2.7
Class 5	85.6	3.0
Class 6	40.0	1.4
Class 7	1.4	<0.1
Indirect and Temporary Impacts	**1,714.3**	**59.6**
Class 3	509.2	17.7
Class 4	146.5	5.1
Class 5	0.9	<0.1
Class 6	862.0	30.0
Class 7	195.7	6.8
Total	**2,874.7**	**100.0**

5.4 Project Impact on BSAL

There is 440.8 ha of verified BSAL within the Project disturbance footprint (SLR, 2015). The amount of BSAL in each impact category is summarised below:

- 39.0% (171.8 ha) of the verified BSAL within the Project disturbance footprint will be indirectly and temporarily impacted by the Subsidence Study Area;
- 14.2% (62.7 ha) of the verified BSAL within the Project disturbance footprint will be directly; however, temporarily impacted by the development of Haul Roads, Mine Infrastructure, Stockpile Areas and Water Storage Facilities; and
- 46.8% (206.3 ha) of the verified BSAL within the Project disturbance footprint will be directly and permanently impacted by Internal Roads, Open Cut Mining Areas and OEAs.

There are no impacts on verified BSAL resulting from the Rail Loop.

5.5 Pre and Post-mining Impact Assessment Discussion

The amount of land in each LSC Class in the Project Boundary (pre and post-mining) is summarised in **Table 10** and the key findings are:

- The predicted permanent reduction in LSC Class 5 and 6 lands within the Project Boundary will be offset by the reinstatement of a greater area of LSC Class 3 and LSC Class 4 lands;
- There is a minor increase in the area of LSC Class 7;

- A total of 161.8 ha of infrastructure including Internal Roads and the Rail Loop will remain post-mining and therefore is not designated a LSC Class; and

- Overall, the spatial distribution of LSC classes will change; however, the quality of LSC will improve overall due to the increase in LSC Class 3 and 4 lands.

Table 10 Pre- and Post-mining LSC Class

LSC	Pre-mining		Post-mining		Difference	
Class	ha	%	ha	%	ha	%
3	1,957.0	27.9	2,042.1	29.3	85.1	1.4
4	818.1	11.8	888.2	12.9	70.1	1.1
5	884.9	12.8	676.2	9.5	-208.7	-3.3
6	1,680.7	24.3	1564	22.6	-116.7	-1.7
7	1,617.0	23.2	1,625.4	23.4	8.4	0.2
Non-Rehabilitated Infrastructure						
Urban	Nil	Nil	161.8	2.3	161.8	2.3
Total	**6,957.7**	**100.0**	**6,957.7**	**100.0**	**-**	**-**

5.5.1 Indirect and Temporary Impacts

WRM Water & Environment Pty modelled the impact of direct rainfall on the Subsidence Study Area with regards to ponding effects across the landscape. The modelling found that "*there is only very minor ponding in overland flow areas. This is due to the steep slopes in the Dry Creek catchment and indicates that the catchment is generally free-draining with the exception of farm dams and small water bodies located throughout the catchment area*".

Therefore it is predicted that land indirectly and temporarily impacted by the Subsidence Study Area will experience localised short-term changes in soil and landscape characteristics by means of surface cracking and localised topographical depressions. Minor surface cracking may facilitate erosion whereas depressions may result in ponding and the development of an anaerobic environment, which, depending on the period of ponding, affect chemical characteristics (e.g. soil pH) and physical characteristics (e.g. drainage). Where such issues may occur surface remediation will be investigated to ensure BSAL and its soil and landscape characteristics are not significantly impacted from its pre-mining condition.

5.5.2 Direct and Temporary Impacts

Land directly impacted temporarily by Mine Infrastructure and Haul Roads will experience a short-term change in soil and landscape characteristics as a result of the removal of topsoil, subsoil compaction from the operation of Project components, and from the re-grading of localised slopes to engineer stable Project components.

Post-mining, or during the operational phase as is appropriate, the impacted land will be rehabilitated to pre-mining condition, which includes all key soil and landscape characteristics. This will be undertaken through the (i) careful stockpiling and management of soil resources during the operational period to maintain soil integrity, (ii) re-grading of slopes commensurate with pre-mining condition, and (iii) execution of an approved BSAL Reinstatement Plan to ensure that key soil and landscape characteristics specific to the soil unit are reinstated. In this regard, BSAL soil and landscape characteristics will not be significantly impacted in the long-term as a result of the Project's operations.

5.5.3 Direct and Permanent Impacts

Land directly and permanently impacted by the Open Cut Mining Areas, OEAs, Internal Roads and Rail Loop will experience a long-term change in soil and landscape characteristics. The rehabilitated land will change as a result of the complete removal of the soil profile and underlying rock strata during coal extraction activities and the emplacement of overburden material.

Impacts on the better class of agricultural resources (i.e. LSC Classes 3 and 4) will be mitigated and offset through reinstatement of an equivalent amount of impacted LSC Class 3 and 4 lands on the rehabilitated landform.

Impacts on BSAL will be mitigated and offset through reinstatement of an equivalent amount of impacted BSAL on the rehabilitated landform. This will occur on land being rehabilitated to meet the LSC Class 3 capability.

5.5.4 Reinstated LSC Classes and BSAL

LSC Class 4 Development

Land to be rehabilitated to LSC Class 4 will contain a different mix of soil and landscape characteristics to the pre-mining landform. Rehabilitation works will reshape the land to have characteristics commensurate with the target LSC of Class 4 as appropriate. This includes grading slopes to no greater than 10%, backfilling and capping the final void and returning the land to a state suitable for moderate impact land uses. The rehabilitated landform will be suitable for grazing with some cultivation and is expected to have no significant micro-relief, moderate soil fertility, a minimum effective rooting of 0.5 m, better than poor internal soil drainage and suitable pH and salinity characteristics. As a conservative estimate, it is expected that the rehabilitated land will experience a reduction in relative soil fertility from moderately high to moderate. Further details on success criteria for key soil and landscape characteristics are contained in **Section 6**.

LSC Class 3/BSAL Reinstatement

Land to be rehabilitated to LSC Class 3/BSAL will contain a different mix of soil and landscape characteristics to the pre-mining landform. It is proposed that the same quantity, or greater, of BSAL and LSC Class 3 land that is to be permanently impacted upon is reinstated on the rehabilitated landform within the Project Boundary. The reinstated BSAL will initially be required to meet all the BSAL soil and landscape criteria followed by consideration of LSC Class 3 criteria. The developed landform will be suitable for cropping enterprises with some cultivation and is expected to have no significant micro-relief, moderately high soil fertility, a minimum effective rooting of 0.75 m, better than poor internal soil drainage and satisfactory pH and salinity characteristics to facilitate LSC Class 3 agricultural enterprises. Further details on success criteria for key soil and landscape characteristics are contained in **Section 6**.

5.5.5 Reinstated Land Uses

Within the Project disturbance footprint, all land within areas to be temporarily disturbed, whether indirectly or directly, will be returned to their pre-mining land use (refer **Section 4.3**).

Of the 919.5 ha to be directly and permanently disturbed, land associated with Internal Roads and the Rail Loop will not be returned to a pre-mining land use and will remain as non-rehabilitated infrastructure.

For the remaining land (757.7 ha), land suitable for cropping will be established on rehabilitated LSC Class 3 land and will cover around 227.0 ha. Grazing land will be established on land associated with LSC Classes 4 and 5, covering 497.1 ha. Woodland will be used for the remaining land which is LSC Class 6 and 7 due to their association with moderately steep to steeply inclined land (**Figure 7**). **Table 11** summarises the post-mining land uses for Primary Domains 1 & 2.

Table 11 Post-mining Land Use for Permanently Disturbed Domains

Land Use	Associated LSC Class	Post-mining	
		ha	%
Rehabilitated Land			
Cropping	Class 3	227.0	24.8
Grazing	Class 4 and 5	497.1	54.0
Woodland	Class 6 and 7	33.6	3.6
Subtotal		757.7	82.4
Non-Rehabilitated Infrastructure			
Urban	N/A	161.8	17.6
Total		**919.5**	**100.0**

5.5.6 Reinstated Land Uses within Mapped Equine CIC

Mapped equine CIC is located within the land being directly and permanently impacted upon by the Project (specifically Domains 1 and 2) (Scott Barnett & Associates, 2015). This area of Equine CIC (pre-mining) is associated with LSC classes 3 through to 7, inclusive. The dominant pre-mining LSC classes are the grazing LSC Classes 4 and 5.

The Project's Rehabilitation Strategy commits to returning the land to LSC Classes within the same pre-mining range (i.e. classes 3 through to 7, inclusive). The dominant post-mining LSC Classes are 3 and 5, which would be suitable for equine land uses post mining. On this basis there is no impediment for future landholders should they wish to implement Equine CIC related activities on the rehabilitated landform.

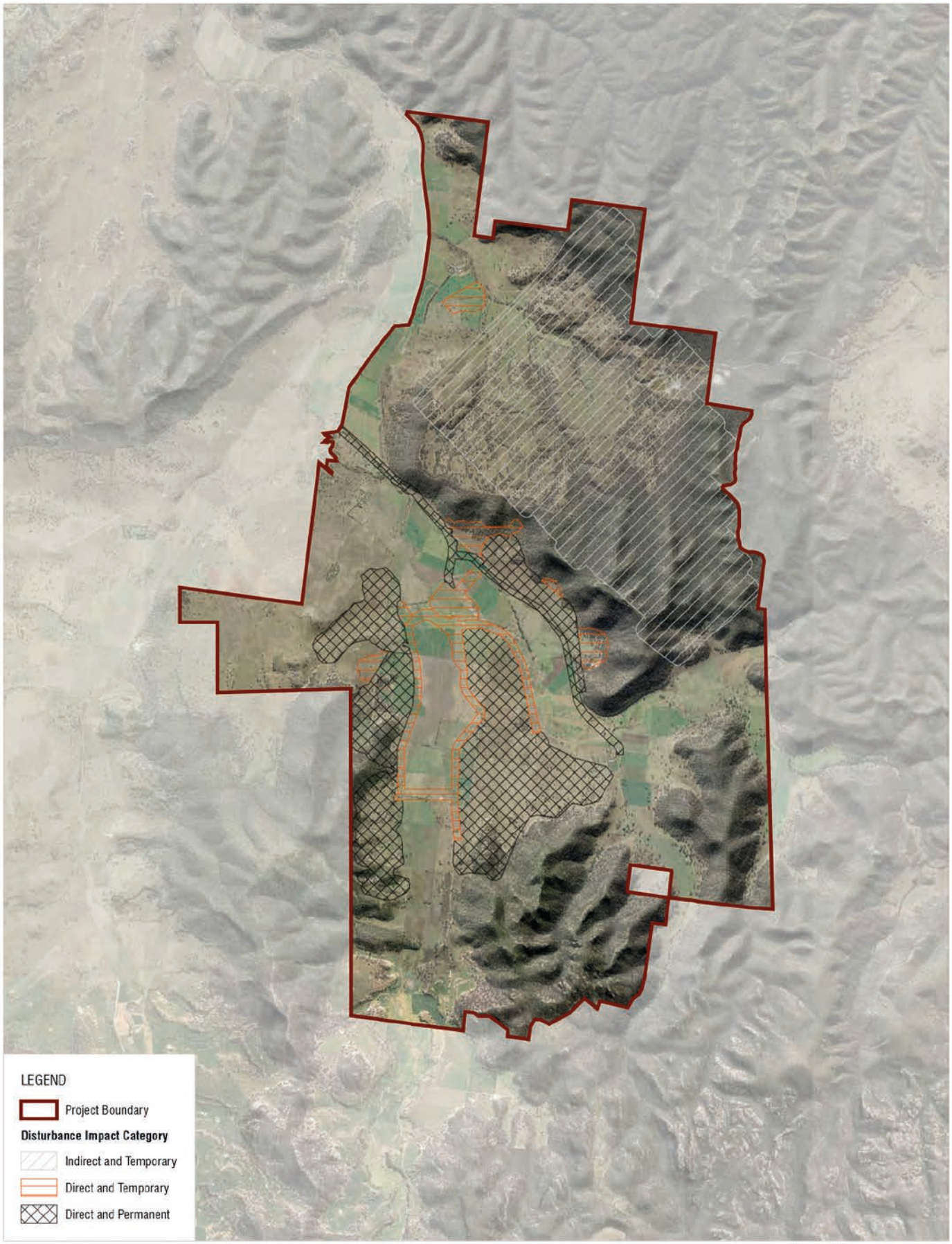
5.6 Project Impact on Biodiversity Values

The Project will directly impact vegetation and associated habitat through the removal of vegetation associated with mining activities, particularly mining activities in Primary Domains 1 & 2 and the development of mine infrastructure (Domain 3). Indirect Impacts on ecological values will also occur throughout the Project Boundary through a range of indirect impacts, including subsidence, fragmentation, edge effects, alteration to wildlife corridors, alteration to hydrological regimes and changes to weed occurrence and feral animal abundance.

Biodiversity values considered by Cumberland Ecology (2015) for the impact assessment include native flora and fauna species collectively, and threatened species and ecological communities protected under the *NSW Threatened Species Conservation Act 1995* (TSC Act) and *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Two TECs have been identified as occurring within the area to be directly and indirectly impacted upon and these are:

- Hunter Valley Footslopes Slaty Gum Woodland; and
- Box Gum Woodland and Derived Native Grassland.

Mitigation and compensation of this impact has been assessed by Cumberland Ecology (2015) through the development of a Biodiversity Offset Strategy (BOS). The BOS provides for upfront compensation of the Project's impacts on biodiversity values and includes onsite and offsite offset areas. These on-site areas are not related to the rehabilitated landform and therefore will nor form any further part of the discussion within the Rehabilitation Strategy.



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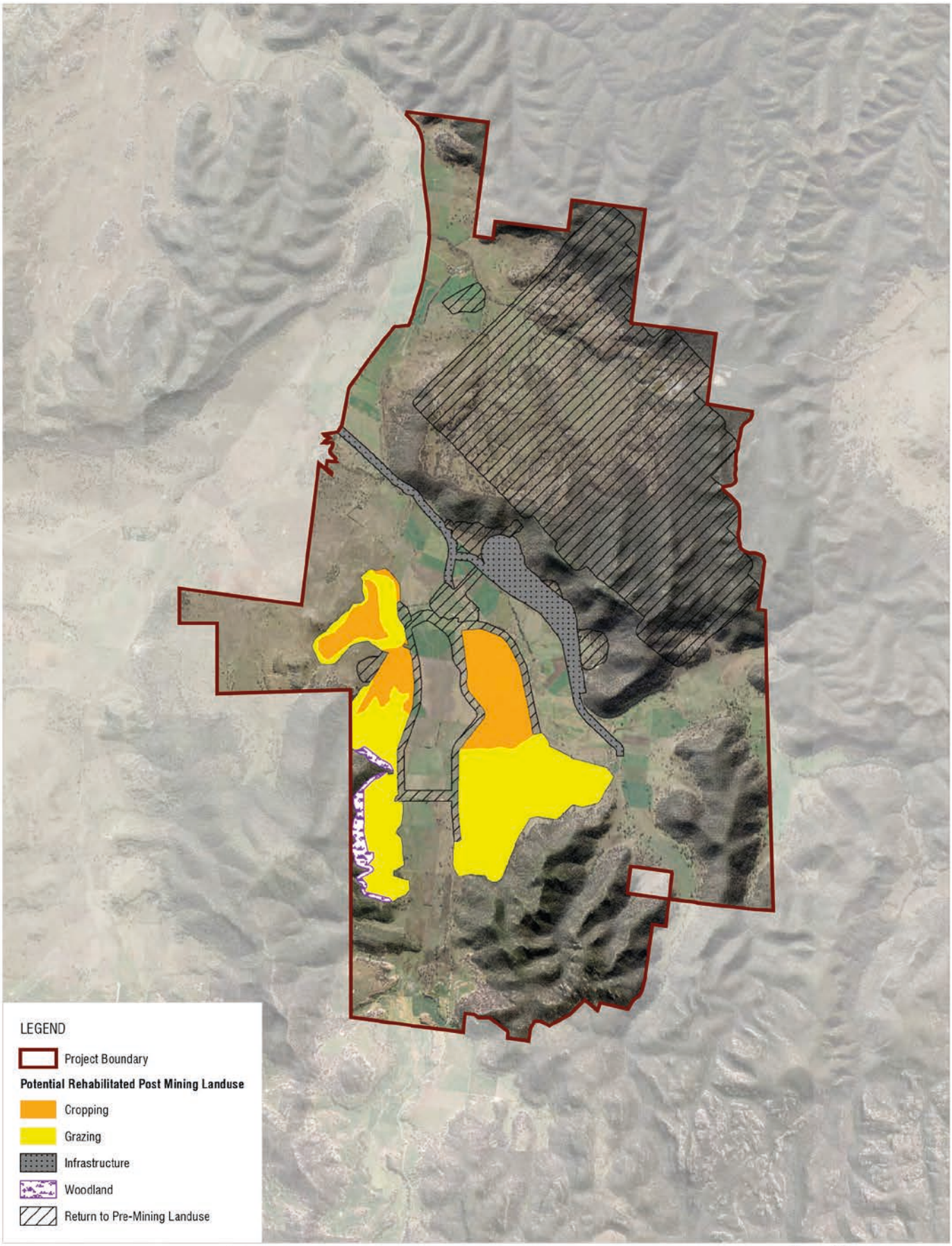
Rehabilitation and BSAL Reinstatement Strategy

Disturbance Impact Category

FIGURE 6



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Rehabilitation and BSAL Reinstatement Strategy

Post-mining Land Use

FIGURE 7

6 CONCEPTUAL FINAL LANDFORM AND PROGRESSIVE REHABILITATION SCHEDULE

6.1 Conceptual Final Landform Shape of Primary Domains

6.1.1 Overview

Landform design and planning takes into account three main components:

- Landform stability;
- Erosion minimisation; and
- Landform compatibility with the surrounding environment.

Rehabilitation has been designed to achieve a stable final landform compatible with the surrounding environment. Pells Sullivan Meynink (2014) conducted a geotechnical study to determine stable slope design criteria for the pit excavation slopes, OEA and in pit slopes. All finished slopes are designed to a safe, geotechnical maximum angle. This will involve shaping the completed OEAs, where practical, to achieve slopes of 18% or less. Where slopes exceed 18%, additional drainage and revegetation works will be carried out to aid groundcover establishment and enhance erosion and sediment control.

The final landform will incorporate contour-graded banks installed during the rehabilitation process. The spacing and ultimate dimensions of these banks will be a function of the final slope and catchment area. On the slopes exceeding 18%, linear contour bank spacing will generally range between 50 and 80 m.

Ongoing mine planning will limit the total area of disturbance at any one time, considering both clearance in advance of operations and rehabilitation of areas disturbed. This will reduce the potential for wind-blown dust, visual impact and sediment-laden run-off. Any treed vegetation along the toe of rehabilitation areas will not be cleared unless an unacceptable safety or erosion risk remains.

The final landform will contain no voids with the two open cut mining areas to be backfilled to surface level in accordance with the final landform design. The void associated with the Western Open Cut will be backfilled with overburden at the completion of open cut mining operations. The void associated with the Eastern Open Cut will remain as an open void for the storage of coarse and fine reject materials for the longer term underground mining operations. This void will be filled over the life of the Project and will be capped and rehabilitated at the end of the mine life, so that no final void remains. The void will be capped with overburden material from the South-Western OEA and/or the OEAs within the Eastern Open Cut.

Figure 8 shows the slopes of the conceptual final landform for all primary domains.

6.1.2 Primary Domains 4 & 5

It is proposed that all upgraded and realigned roads (part of Domain 5), as well as the rail loop (Domain 4) will be retained at closure. This landform will therefore differ from its pre-mining shape within these Domains.

6.1.3 Primary Domains 3, 6, 7 and 8

All land covered by main infrastructure components will be returned to the pre-mining landform and will be capable of supporting pre-mining land uses.

6.1.4 Primary Domains 1 & 2

The land to be directly and permanently disturbed by the open cut mining areas and OEAs will be backfilled with overburden and reshaped in accordance with the landform design (**Figure 8**). Reshaping will ensure that final slopes are generally 18% or less, excluding some slopes around the margin where the landform integrates into the surrounding mountainous terrain. This landform will differ from its pre-mining state.

The reshaped South-Western OEA will be an elevated landform largely composed of moderately inclined land with some steeper slopes on the western perimeter where it abuts the existing rugged topography. The maximum design height for the landform of the South-Western OEA will be the same as the pre-mining landform. The re-shaped North-Western OEA is largely comprised of flat to gently inclined land with some moderately inclined slopes on the perimeter. The maximum design height for the elevated landform will be approximately 3 m lower than the pre-mining landform.

The Western Open Cut will contain an elevated landform largely composed of moderately inclined land in the south and flat to gently inclined land in the north. The maximum design height for the elevated landform will be approximately 8 m lower than the pre-mining landform. The re-shaped Eastern Open Cut will be an elevated landform largely composed of gently inclined land with some fringing steeper slopes where it abuts the existing rugged topography in the south. The maximum design height for the elevated landform will be approximately 28 m lower than the pre-mining landform.

6.2 Conceptual Final Landform Visual

As discussed in **Section 6.1**, rehabilitation has been designed to achieve a stable final landform compatible with the surrounding environment. **Plates 1** to **4** visually compare the pre-mining and post-mining landform with respect to primary and secondary domains.

Plates 1 and **2** show the show the footprint from a northerly aspect through Bylong Valley. Land that is being directly and permanently impacted upon is labelled and shown in colour in **Plate 2**. All other land is being returned to its pre-mining land capability and land use. As can be seen from these plates the final land uses blend into the surrounding environment.

Plates 3 and **4** show the show the footprint from a south-easterly aspect through Bylong Valley.

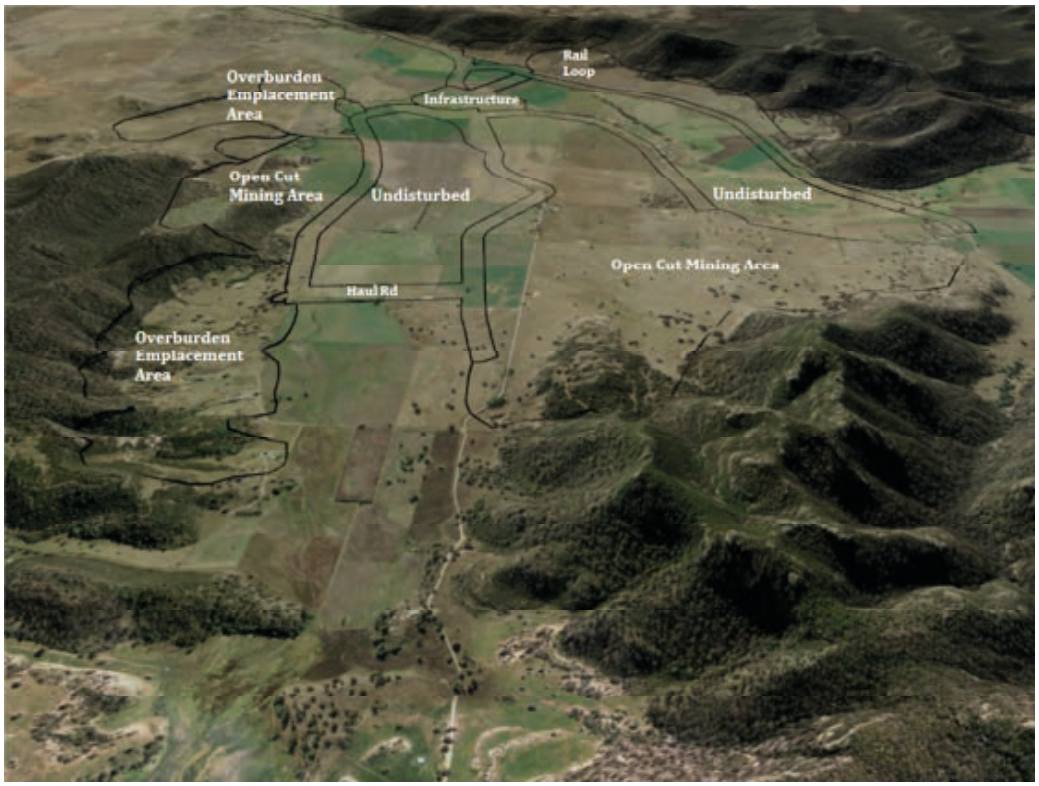


Plate 1: Pre-mining landscape with Project components: northerly aspect through Bylong Valley

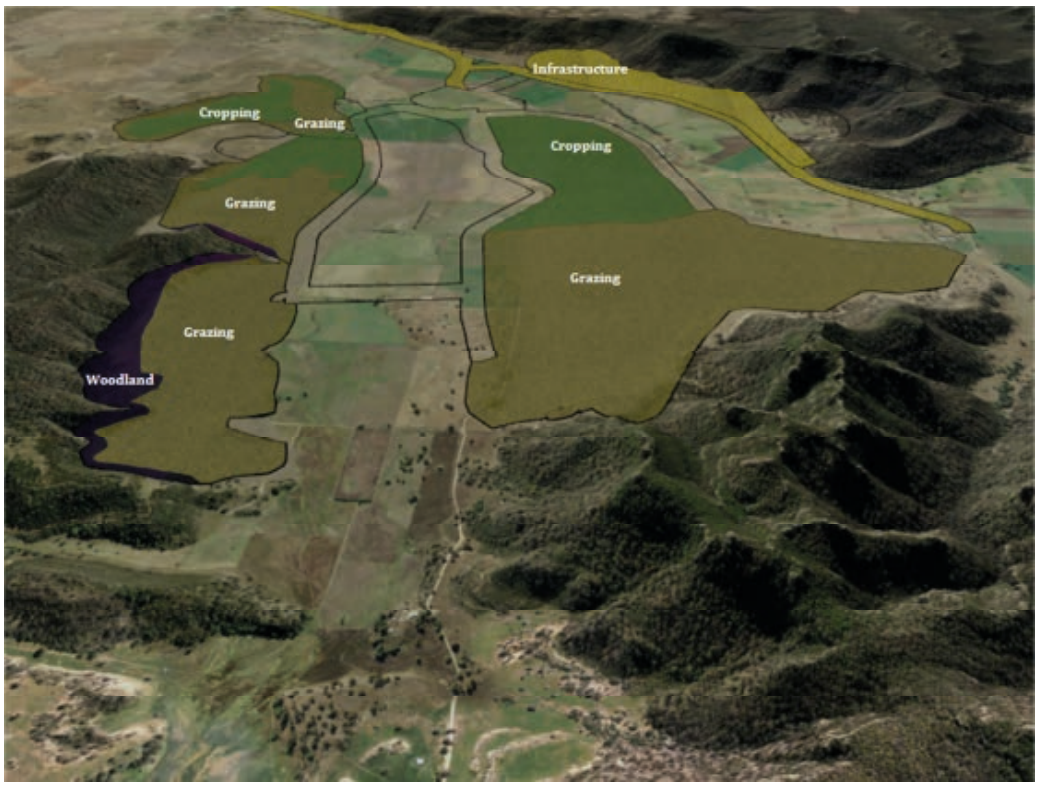


Plate 2: Post-mining landscape with post-mining land use: northerly aspect through Bylong Valley

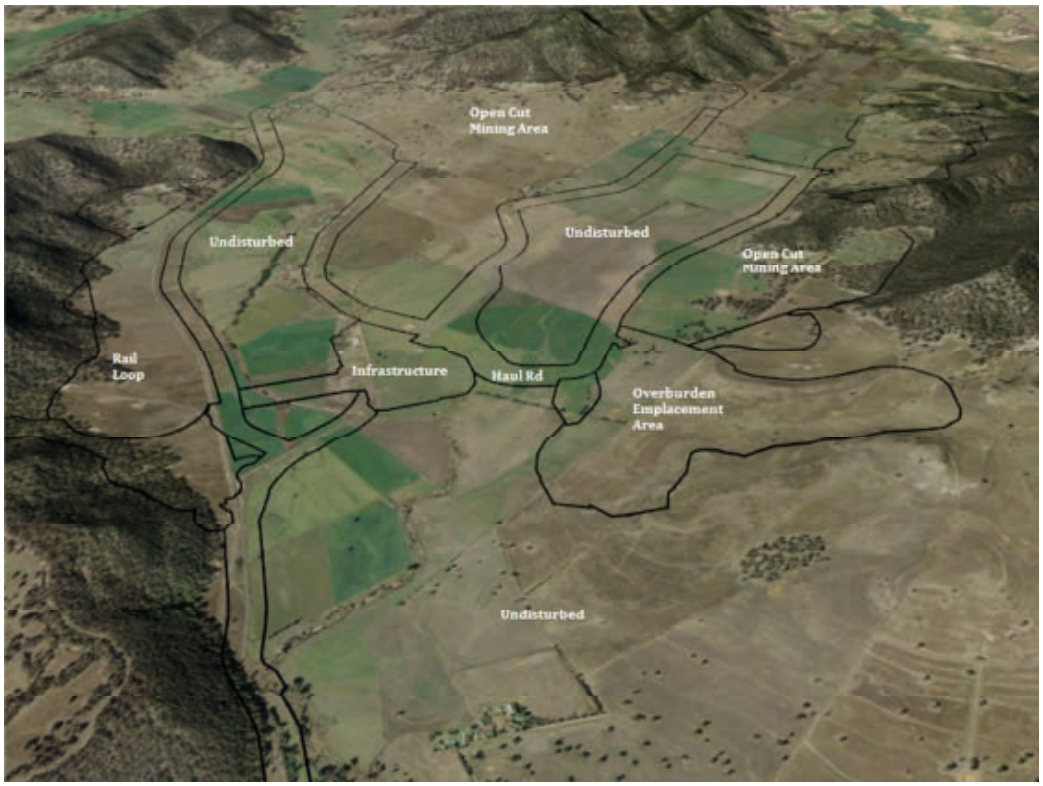


Plate 3: Pre-mining landscape with Project components: south-easterly aspect through Bylong Valley

Plate 2: Post-mining landscape with post-mining land: south-easterly aspect through Bylong Valley

6.3 Location of BSAL

As discussed in **Section 5.4**, the Project will directly and permanently disturb a total of 206.3 ha of the verified BSAL within the Project disturbance footprint. The Project is committed to reinstating all BSAL land that will be directly and permanently disturbed.

To meet the following Gateway certificate requirement as outlined in **Table 2**:

"Identify a final location for the verified BSAL soils within the Project Boundary area"

SLR undertook an assessment to identify the most suitable locations for BSAL reinstatement activities within the Project Boundary (**Appendix A**). The assessment used a two-option, four stage methodology to identify constraints (hazards) for the re-instatement of BSAL within the Project Boundary, in accordance the Interim Protocol.

Option 1 was designed to identify land within the Project Boundary that will not be disturbed and is capable of being improved to meet BSAL status through implementation of land improvement strategies. This consisted of three stages:

- Stage 1 identified any automatic exclusion zones for BSAL based on slope, presence of BSAL, the proposed operation footprint and state forest. The remaining soil types will be identified as potential BSAL re-instatement areas.

- Stage 2 assessed the remaining soil types for constraints to rehabilitation such as chemical and physical constraints. The remaining soil types will be identified as Recommended BSAL Re-instatement Areas.

- Stage 3 assessed the impact of other considerations including non-mine infrastructure, land ownership and risk to flooding.

Option 2 was designed to identify land within the post-mining rehabilitated landform that was capable of being improved to meet BSAL. This final assessment stage (Stage 4) assessed the areas of land that will be disturbed and rehabilitated by the Project as potential BSAL re-instatement areas. These rules were that the land be greater than 20 ha, less than 10% slope and preferably contiguous to verified BSAL.

The assessment concluded that there is no land suitable for BSAL instatement within the Project Boundary and external to the Projects disturbance footprint. However, there is a suitable quantity of land available for BSAL reinstatement within the rehabilitated landform.

- **Figure 9** shows the location of the proposed BSAL reinstatement on the rehabilitated landform. This correlated with the post-mining LSC Class 3 land.

6.4 Progressive Rehabilitation Schedule

The Project disturbance footprint will be progressively rehabilitated, excluding the Rail Loop and Internal roads which will remain as urban infrastructure post-mining.

The Project features that will directly and permanently disturb the landscape are associated with Primary Domains 1 (Open Cut Mining) and 2 (OEAs). These domains will be developed in the first eight to nine years of the Project (following construction). Underground mining operations will then occur for the remainder of the Project life. The final Project year or 'closure period' is Project Year 25.

The Project will adopt a progressive approach to the rehabilitation of disturbed areas within the Project disturbance footprint. Therefore rehabilitation of Domains 1 and 2 will largely occur in the first eight

years with the residual void associated with the Eastern Mining Area backfilled over time using reject materials from the underground mining operation.

The progressive rehabilitation schedule provided in this section is for Primary Domains 1 and 2.

6.4.1 Primary Domains 1 & 2

It is proposed that disturbed areas be reshaped within one year of overburden placement and then rehabilitated to the target LSC classes, with BSAL reinstatement a priority where practical. This will ensure that areas where mining or overburden placement is completed are promptly shaped, topsoiled and vegetated to provide a stable landform. The progressive formation of the post-mining landform and the establishment of a vegetative cover will reduce the amount of disturbed land at any one time and also reduce the visibility of mine-related activities from surrounding properties and roads.

The progressive site rehabilitation schedule for the life of the mine is listed in **Table 12** and described below.

Figure 10 to **Figure 14** illustrate the progressive rehabilitation of the site for Project Years 3, 5, 7, 9 and closure (final year).

Table 12 Progressive Rehabilitation: Primary Domain 1 & 2

Rehabilitation Period	Land and Soil Capability	BSAL	Land Use	Area	
Year	Class	BSAL / Non-BSAL	Type	ha	%
0-3	3	BSAL	Cropping	Nil	Nil
	4	Non-BSAL	Grazing	Nil	Nil
	5			7.6	0.8
	6		Woodland	Nil	Nil
	7			Nil	Nil
			Subtotal	**7.6**	**0.8**
3-5	3	BSAL	Cropping	32.5	3.5
	4	Non-BSAL	Grazing	Nil	Nil
	5			23.2	2.5
	6		Woodland	Nil	Nil
	7			Nil	Nil
			Subtotal	**55.7**	**6.0**
5-7	3	BSAL	Cropping	98.8	10.8
	4	Non-BSAL	Grazing	29.2	3.2
	5			88.4	9.5
	6		Woodland	7.7	0.8
	7			0.3	<0.1
			Subtotal	**224.4**	**24.3**
7-9	3	BSAL	Cropping	47.4	5.2
	4	Non-BSAL	Grazing	12.6	1.4
	5			27.9	3.0
	6		Woodland	3.3	0.4
	7			18.1	2.0
			Subtotal	**109.3**	**12.0**

Rehabilitation Period	Land and Soil Capability	BSAL	Land Use	Area	
Year	Class	BSAL / Non-BSAL	Type	ha	%
9-Final	3	BSAL	Cropping	47.9	5.3
	4	Non-BSAL	Grazing	223.0	24.3
	5			85.7	9.3
	6		Woodland	Nil	Nil
	7			4.1	0.4
Subtotal				**360.7**	**39.3**
Non-rehabilitated Land	Urban Infrastructure			161.8	17.6
Total				**919.5**	**100.0**

In total, 757.7 ha will be rehabilitated and 161.8 ha will be left as urban infrastructure. The following is a brief description of the annual rehabilitation sequencing for each Project period:

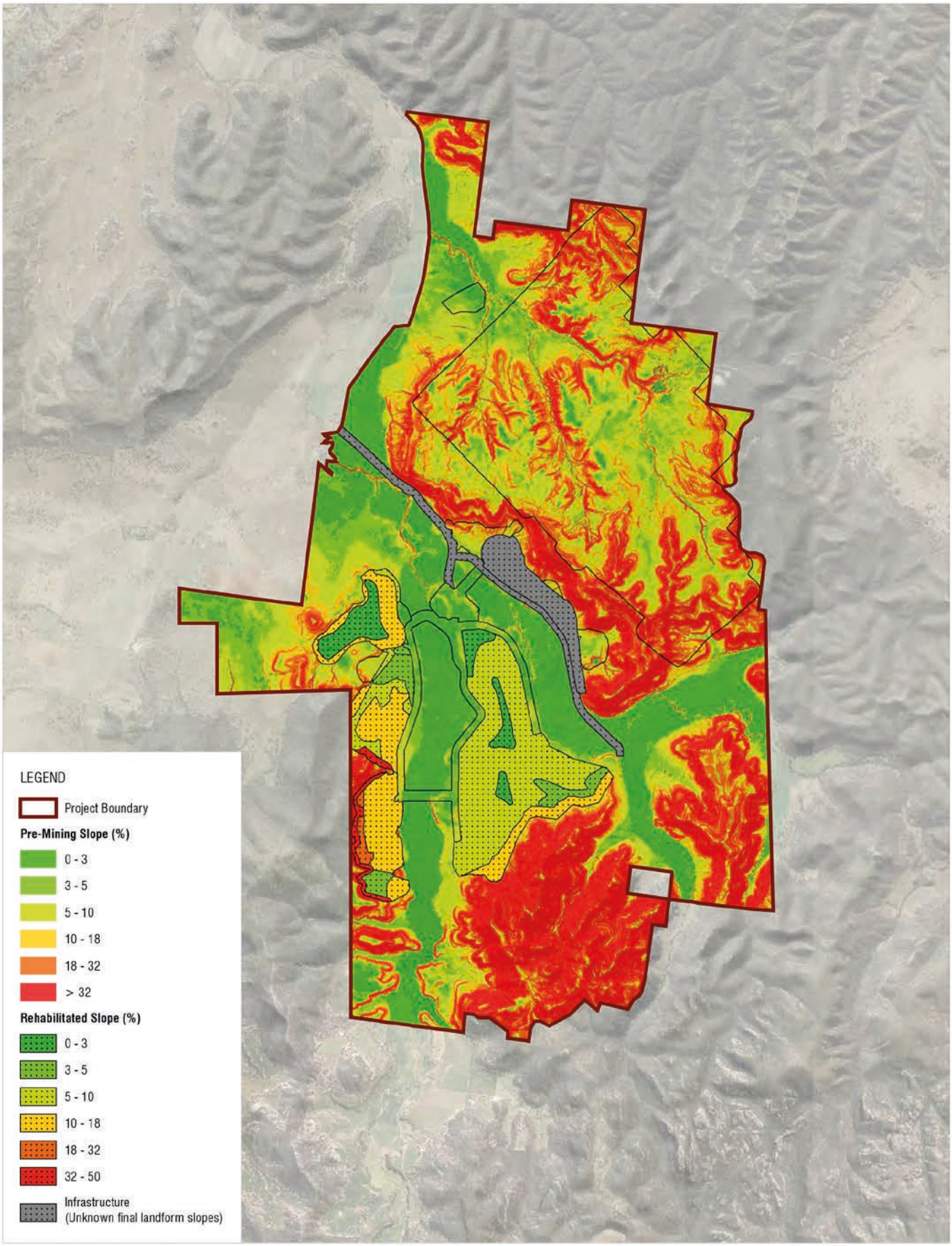
Period: Years 0-3 Rehabilitation of 7.6ha of land and does not include any BSAL / LSC Class 3.

Period: Years 3-5 Rehabilitation of 55.7 ha of land and includes 32.5 ha of BSAL / LSC Class 3.

Period: Years 5-7 Rehabilitation of 224.4 ha of land and includes 98.8 ha of BSAL / LSC Class 3.

Period: Years 7-9 Rehabilitation of 109.3 ha of land and includes 47.4 ha of BSAL / LSC Class 3.

Period: Year 9-Final Rehabilitation of 360.7 ha of land and includes 47.9 ha of BSAL / LSC Class 3.



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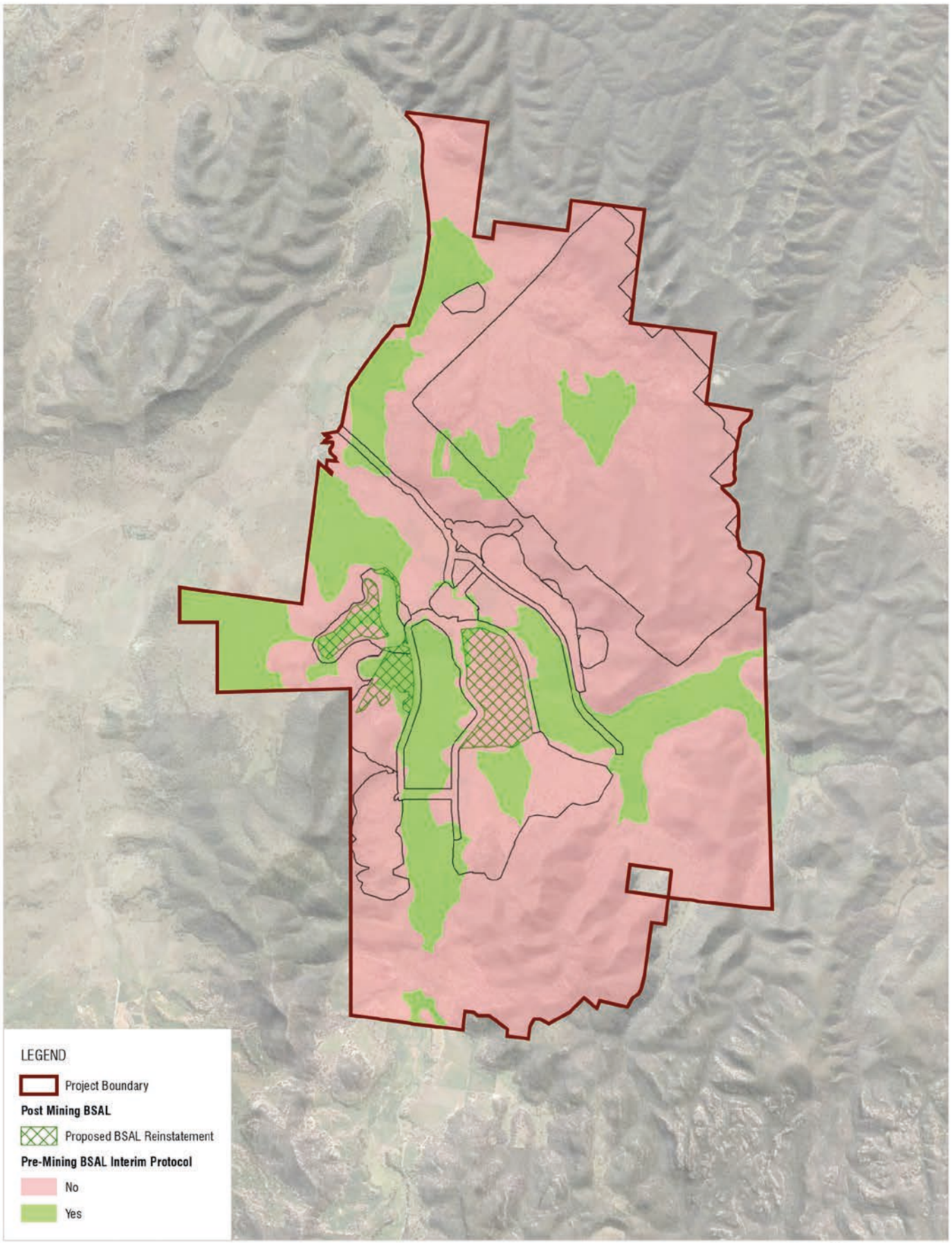
Rehabilitation and BSAL Reinstatement Strategy

Post-mining Slope Classes

FIGURE 8



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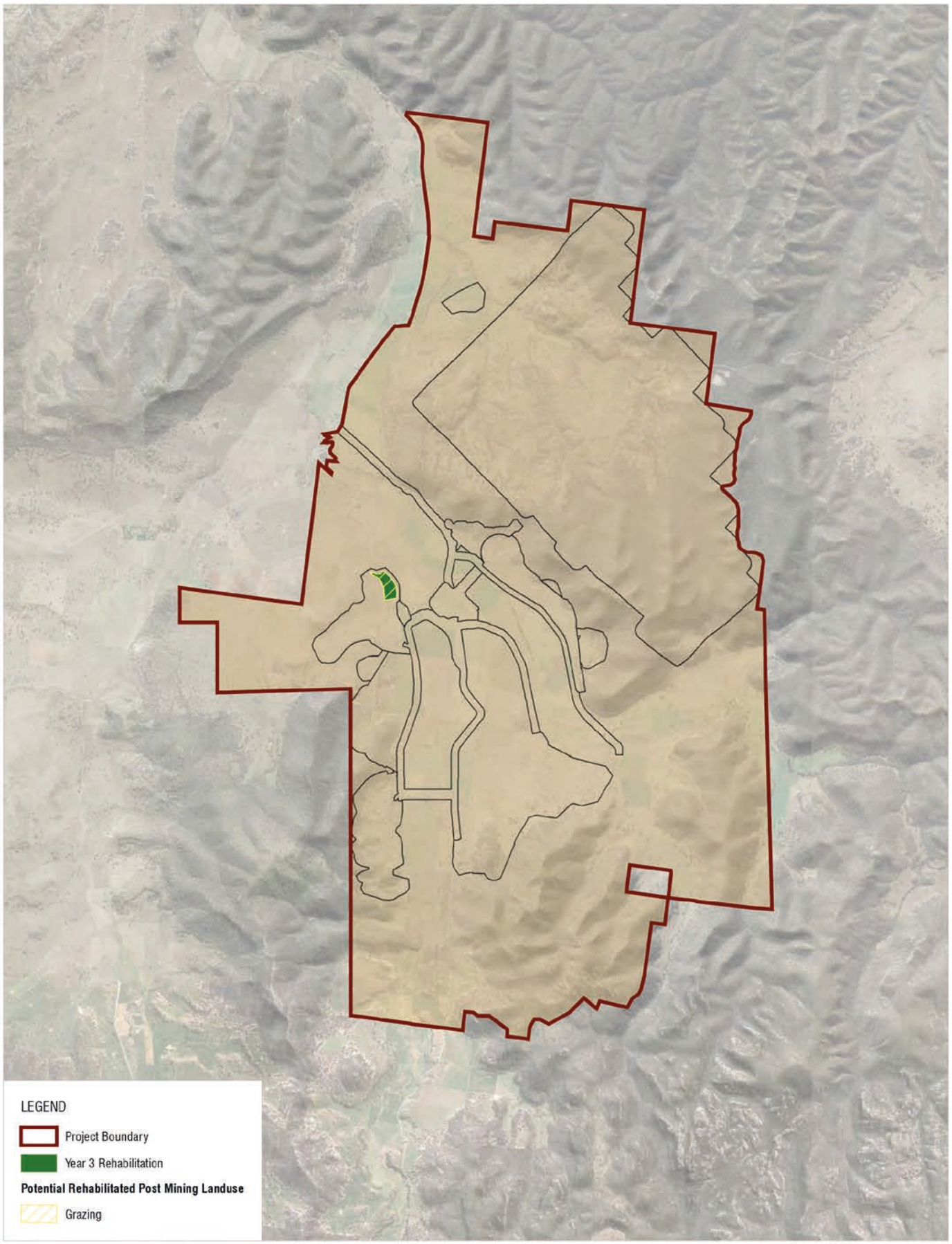
Rehabilitation and BSAL Reinstatement Strategy

BSAL (Post-Mining)

FIGURE 9



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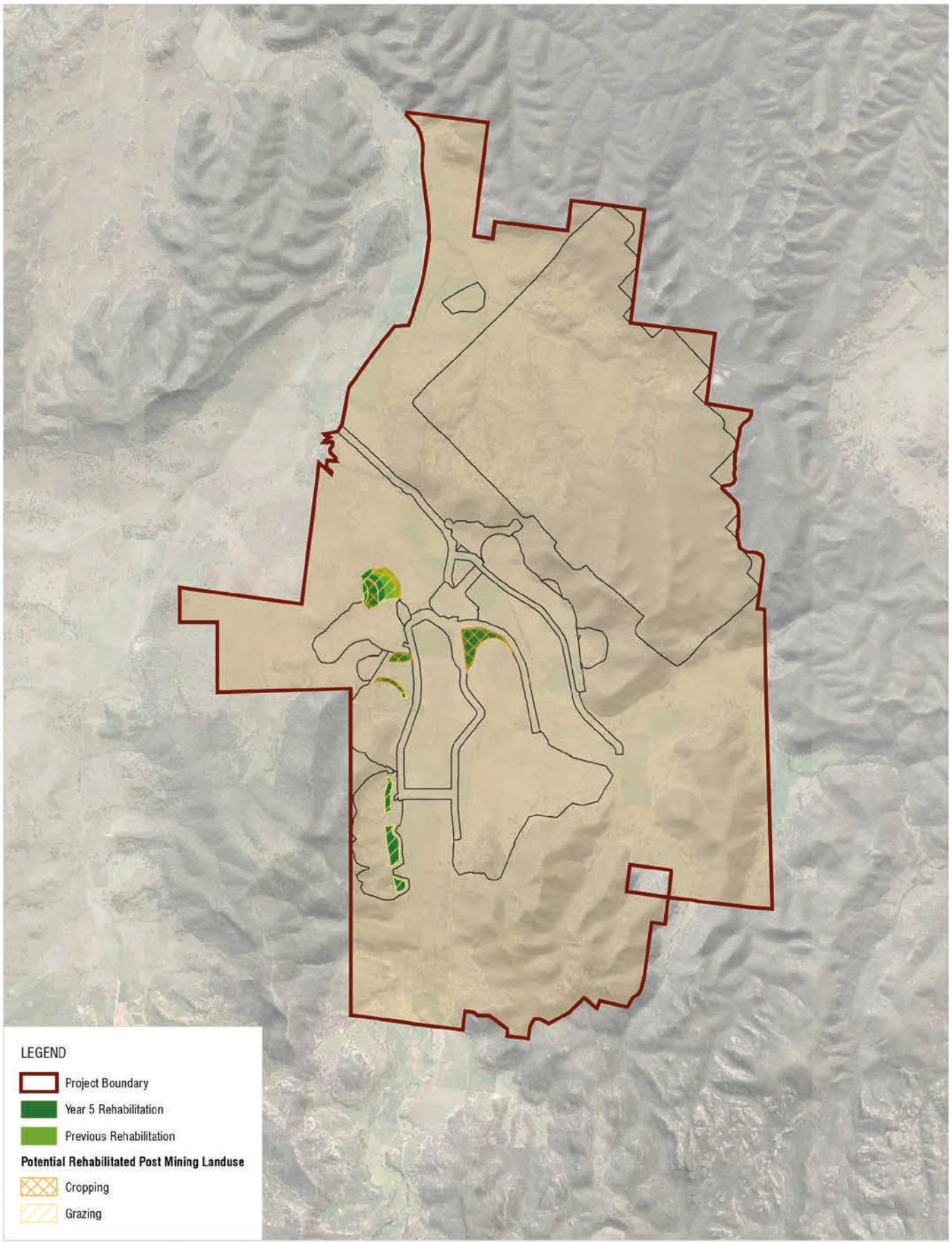
Rehabilitation and BSAL Reinstatement Strategy

Staged Rehabilitation Years 0-3

FIGURE 10



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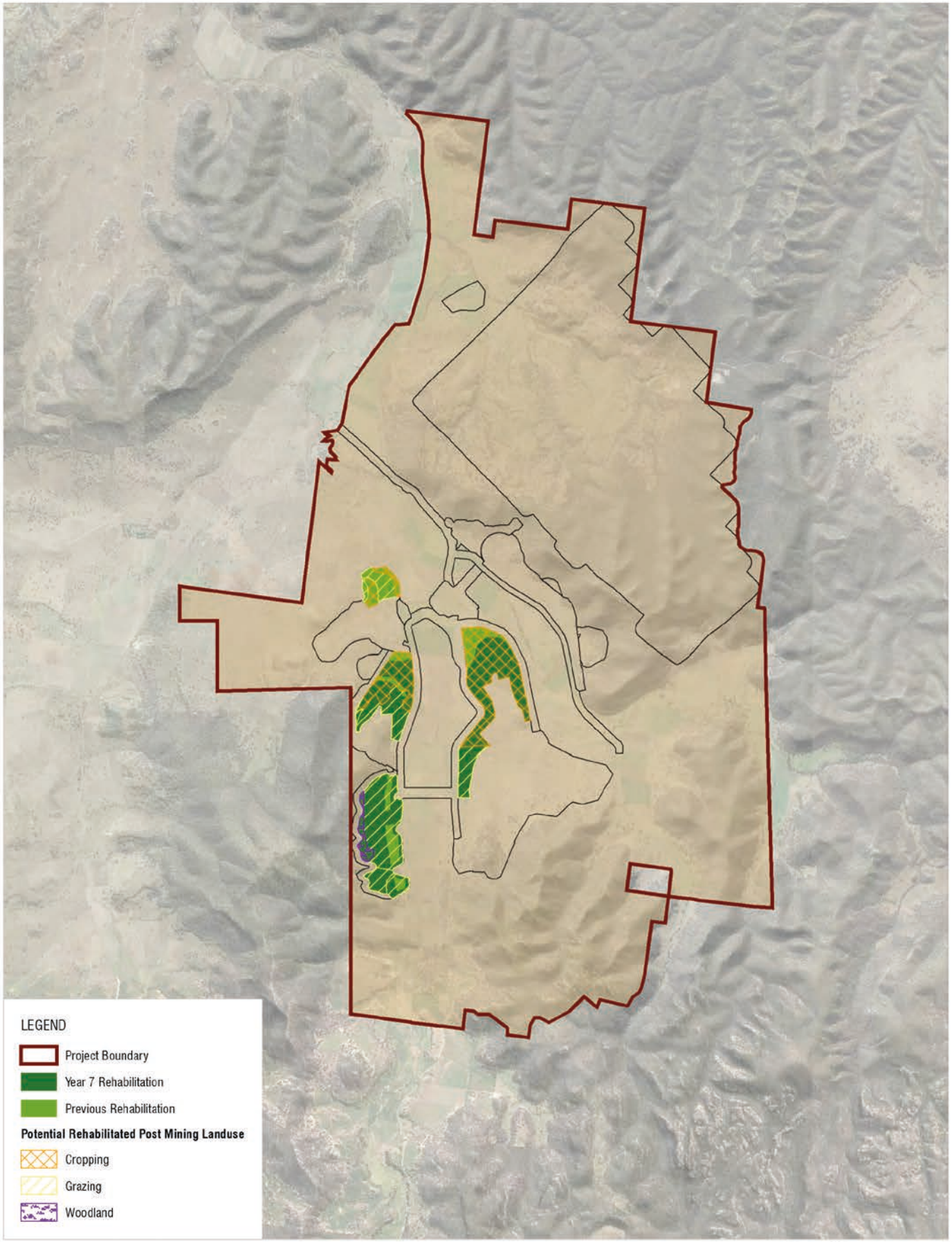
Rehabilitation and BSAL Reinstatement Strategy

Staged Rehabilitation Years 3-5

FIGURE 11



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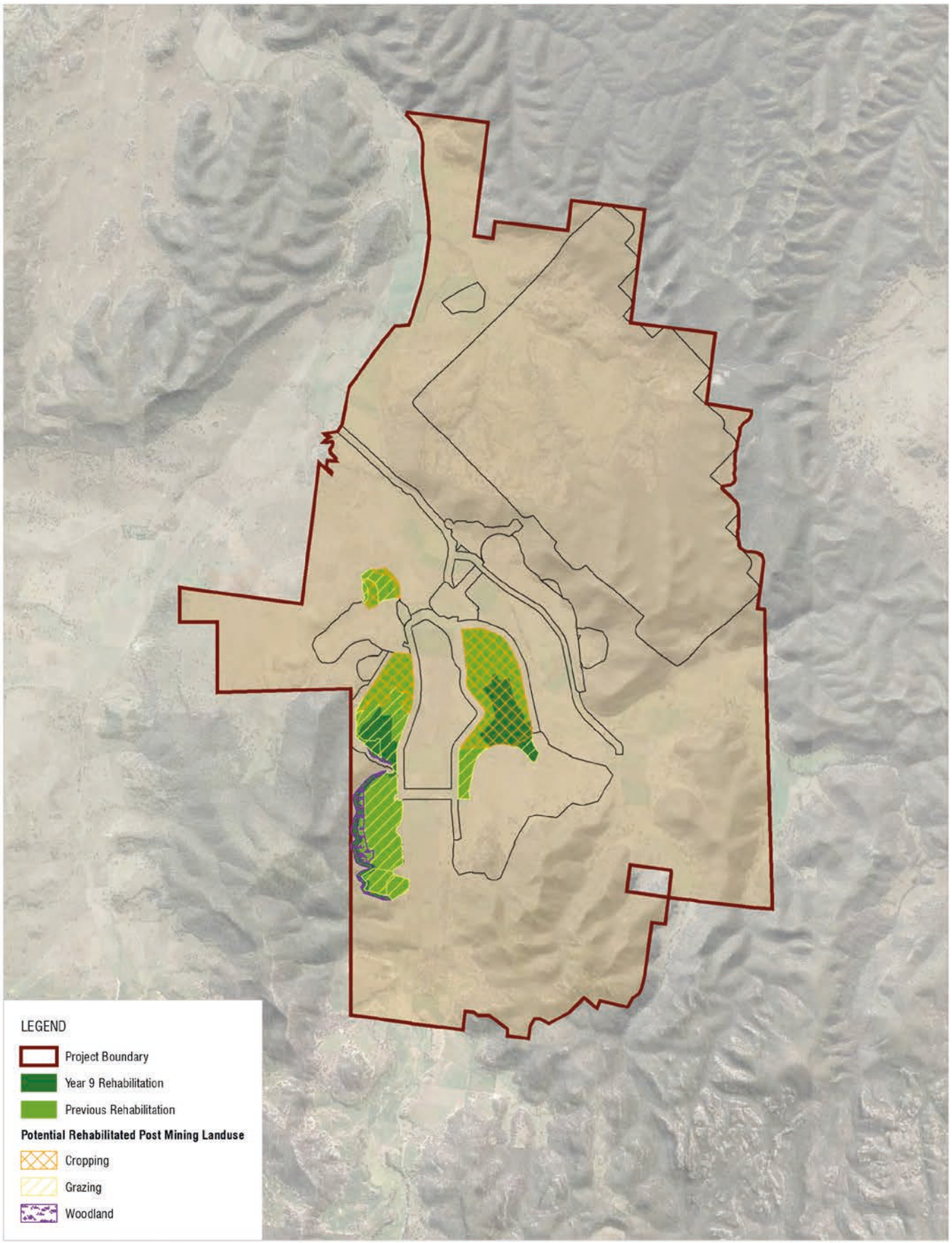
Rehabilitation and BSAL Reinstatement Strategy

Staged Rehabilitation Years 5-7

FIGURE 12



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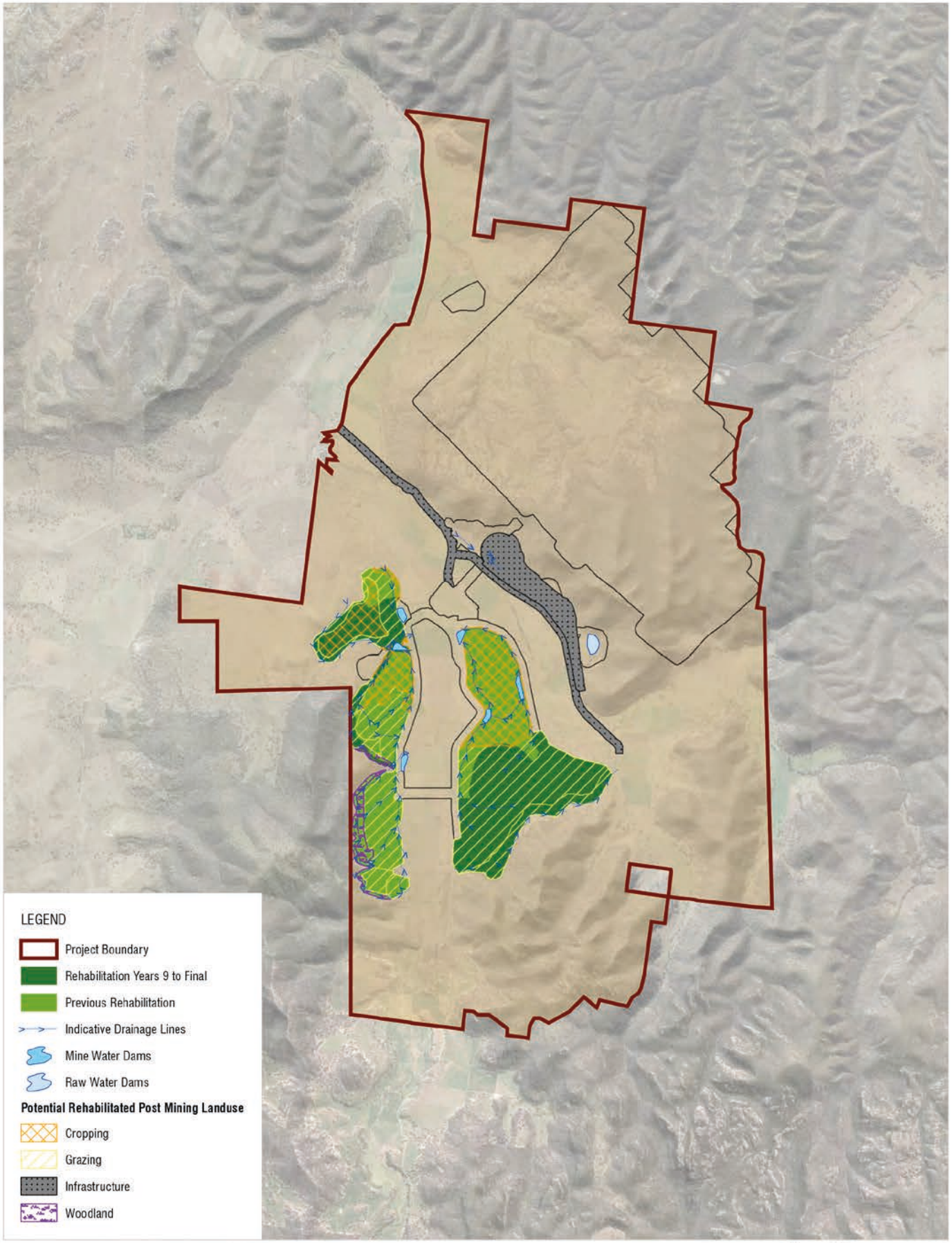
Rehabilitation and BSAL Reinstatement Strategy

Staged Rehabilitation Years 7-9

FIGURE 13



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Rehabilitation and BSAL Reinstatement Strategy

Staged Rehabilitation Final

FIGURE 14

7 REHABILITATION COMPLETION CRITERIA

7.1 Overview

The completion criteria (often referred to as 'success criteria') are performance objectives or standards against which rehabilitation success (i.e. achieving a sustainable system for the proposed post-mine land use) is measured. Demonstrating that completion criteria are being met or on track to being met (as indicated by monitoring results) will show that the rehabilitated landscape is ready to be relinquished from the mine's financial assurance and handed back to stakeholders in a productive and sustainable condition.

Criteria that define rehabilitation success at mine closure are provided for each post-mining land use element. Indicators will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. This will be based on results of further research and ongoing monitoring of the progressive rehabilitation areas. The success criteria and performance indictors will be reviewed every three to five years with stakeholder participation to ensure the nominated success criteria remain realistic and achievable.

Rehabilitation indicators and performance criteria go hand in hand insofar as:

- Performance indicator is an attribute of the biophysical environment (e.g. pH, slope, topsoil depth, biomass) that can be used to approximate the progression of a biophysical process. It can be measured and audited to demonstrate (and track) the progress of an aspect of rehabilitation towards a desired completion/relinquishment criterion, i.e. defined end point. The indicator may be aligned to an established protocol and used to evaluate changes in a system.

  These indictors will also provide the basis of the Trigger Response Action Plans (TARPs) to monitor rehabilitation success and the feed into the continual improvement process.

- Completion/Relinquishment criteria are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. These are the standards that are to be met by successful rehabilitation. They will generally be in the form of a numerical value that can be verified by measurement of the indicators selected for the rehabilitation objectives. They may include an element based on time.

In this document, completion criteria are presented with performance indicators to be developed in conjunction with the Project's Mining Operations Plan (MOP).

7.2 Completion Criteria

The Project has committed to rehabilitating land to LSC Classes 3, 4, 5, 6 and 7 on the landform that is to be directly and permanently disturbed. In addition, within these areas, the LSC Class 3 will be rehabilitated to meet BSAL criteria. The appropriate closure criteria have therefore been taken directly from the LSC Guideline and the Interim Protocol as these guidelines provide prescriptive criteria to measure rehabilitation success against. Performance indicators and TARPs will be developed in conjunction with the MOP.

7.2.1 LSC Class 3 and BSAL Closure Criteria (Cropping Land Use)

LSC Class 3 land includes flat to sloping land that is capable of sustaining cultivation on a rotational basis. This land should be capable of a supporting a range of crops including cereals, oilseeds and pulse. Productivity will vary with soil fertility.

BSAL is land that, in addition to water supply requirements, meets the BSAL criteria of the Interim Protocol. Inherent soil fertility for BSAL can vary from moderate to high fertility. BSAL criteria are not correlated with a LSC Class criteria, however, it is reasonable to assume that land suited to high

intensity land uses (i.e. LSC Classes 1, 2 and 3) could be potential BSAL and land suited to lesser intensity agricultural enterprises (e.g. grazing) is unlikely to be BSAL.

Preliminary success criteria for the development of LSC Class 3 and BSAL land is provided in **Table 13**. The refinement of these criteria will be developed in conjunction with the BSAL Reinstatement Plan and MOP whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria.

Measurement of rehabilitation effectiveness for post mining LSC Class 3 land will also include cropping targets that are based on equivalent LSC Class 3 land from within and/or proximal to the Project Boundary. Other criteria will be developed as appropriate.

Table 13 LSC Class 3 and BSAL Closure Criteria

Criteria	Relevance to Interim Protocol & LSC Guideline	BSAL	LSC Class 3 criteria
Slope	BSAL Criteria 1 LSC Hazard 1	Slope less than 10%	Slope < 10% **or** < 3% if slope is > 500 m in length
Rock outcrop	BSAL Criteria 2 LSC Hazard 7	Rock outcrop less than 30%	Rock outcrop less than 30%
Surface Rockiness	BSAL Criteria 3	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter	Not applicable
Gilgai	BSAL Criteria 4	Less than 50% of the area has gilgai depression that are deeper than 500 mm	Not applicable
Slope, relative soil fertility class and rock outcrop	BSAL Criteria 5, 6, 7 LSC Hazard 1	Moderate fertility **and** <5% slope **and** nil rock outcrop **OR**	Not applicable
		Moderately high or high fertility **and** <5% slope **and** <30% rock outcrop **OR**	
		Moderately high or high fertility **and** 5-10% slope **and** <30% rock outcrop	
Physical Barrier	BSAL Criteria 8 LSC Hazard 7	Effective rooting depth to a physical barrier (i.e. bedrock, gravel layer) is greater than or equal to 750 mm	Soil depth is >75 cm
Soil Drainage	BSAL Criteria 9 LSC Hazard 6	Soil drainage is better than poor	Imperfectly drained soil (waterlogging is 1-8 weeks duration)
pH	BSAL Criteria 10 LSC Hazard 4	pH within range of 5.0 to 8.9 within upper 600mm of soil profile	Moderate or higher surface soil buffering capacity **and** pH >5.5 **or** low surface soil buffering capacity **and** pH 6.7-8.0

Criteria	Relevance to Interim Protocol & LSC Guideline	BSAL	LSC Class 3 criteria
Soil Salinity	BSAL Criteria 11 LSC Hazard 5	ECe less than or equal to 4 dS/m **or** if gypsum is present, chlorides less than 800 mg/kg within upper 600mm of soil profile	low salt store **OR** low discharge potential **and** moderate salt store
Chemical Barrier	BSAL Criteria 12	Effective rooting depth to a chemical barrier is greater than or equal to 750 mm Chemical barrier includes: • pH <5.0 **or** >8.9; • ECe > 4 dS/m **or** if gypsum is present, chlorides > 800 mg/kg • ESP >15% • Ca:Mg ratio <0.1	Not applicable
Wind Erosion	LSC Hazard 2	N/A	Selected site to be a site that has low exposure to wind
Soil Structure Decline	LSC Hazard 3	N/A	Surface soil texture a sandy loam **OR** fine sandy loam with <60% silt and very fine sand **and** <5% ESP (hazard 3) **OR** normal loam/clay loam **OR** friable/ferric or weakly self-mulching clay**.**
Mass Movement	LSC Hazard 8	N/A	No mass movement

7.2.2 LSC Class 4 Closure Criteria (Grazing Land Use)

LSC Class 4 land includes land that is generally used for grazing and is suitable for pasture improvement. Class 4 land can be cultivated occasionally for sowing of pastures and crops, however; it has cropping limitations due to chemical and/or physical factors.

Preliminary success criteria for the development of LSC Class 4 land will be based on the LSC Guideline. The LSC Class 4 hazard criteria are provided in **Table 14** The refinement of these criteria will be developed in conjunction with the MOP whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria. Measurement of rehabilitation effectiveness for post mining LSC Class 4 land will also include grazing targets that are based on equivalent LSC Class 4 land from within and surrounding the Project Boundary. Other criteria will be developed as appropriate.

Table 14 LSC Class 4 Closure Criteria

Criteria	Relevance to LSC Guideline	LSC Class 4
Water Erosion	LSC Hazard 1	Slope < 20%
Wind Erosion	LSC Hazard 2	Surface texture with no more than moderate erodibility where in a highly exposure position.
Soil Structure Decline	LSC Hazard 3	Surface soil texture with <8% ESP
Soil Acidification	LSC Hazard 4	Moderate or higher surface soil buffering capacity **and** pH >4.7 **or** low surface soil buffering capacity **and** pH 5.5-8.0
Salinity	LSC Hazard 5	moderate salt store
Waterlogging	LSC Hazard 6	Imperfectly drained soil (waterlogging is 8-12 weeks duration every 2-3 years)
Soil Depth (rock outcrop)	LSC Hazard 7	<30% rock outcrop **and** soil depth >50cm **or** 30-50% rock outcrop **and** soil depth >100cm
Mass Movement	LSC Hazard 8	No mass movement
Vegetation	N/A	Land is useable as a functioning agricultural system as per the Class 4 LSC parameters with yield similar or exceeding known yield of local Class 4 agricultural enterprises.
Soil fauna	N/A	Representation of a range of soil species such as earthworms, springtails and fungi relative to the control site

7.2.3 LSC Class 5 Closure Criteria (Grazing Land Use)

LSC Class 5 land has severe limitations for high impact land management uses such as cropping. This land is therefore generally more suitable to grazing.

Preliminary success criteria for the development of LSC Class 5 land will be based on the LSC Guideline. The LSC Class 5 hazard criteria are provided in **Table 15**. The refinement of these criteria will be developed in conjunction with the MOP whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria. Measurement of rehabilitation effectiveness for post mining LSC Class 5 land will also include grazing targets that are based on equivalent LSC Class 5 land from within and surrounding the Project Boundary. Other criteria will be developed as appropriate.

Table 15 LSC Class 5 Closure Criteria

Criteria	Relevance to LSC Guideline	LSC Class 5
Water Erosion	LSC Hazard 1	Slope < 20%
Wind Erosion	LSC Hazard 2	N/A – due to average rainfall and low wind erosive power
Soil Structure Decline	LSC Hazard 3	Surface soil texture with <15% ESP
Soil Acidification	LSC Hazard 4	Low or higher surface soil buffering capacity **if** pH <4.7. All other soil surface pH is suitable.
Salinity	LSC Hazard 5	moderate salt store
Waterlogging	LSC Hazard 6	Imperfectly drained soil (waterlogging is 8-12 weeks duration every year)
Soil Depth (rock outcrop)	LSC Hazard 7	<30% rock outcrop **and** soil depth >50cm

Criteria	Relevance to LSC Guideline	LSC Class 5
		or 30-50% rock outcrop **and** soil depth >75cm
Mass Movement	LSC Hazard 8	No mass movement

7.2.4 LSC Class 6 Closure Criteria (Woodland Land Use)

LSC Class 6 land has very severe limitations for a wide range of land management uses. This land is therefore generally only suited to grazing. Given the location of the LSC Class 6 post-mining land, its nominated land use is woodland. However, the key LSC capability criteria will still apply.

Preliminary success criteria for the development of LSC Class 6 land will be based on the LSC Guideline. The LSC Class 6 hazard criteria are provided in **Table 16**. The refinement of these criteria will be developed in conjunction with the MOP whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria. Measurement of rehabilitation effectiveness for post mining LSC Class 6 land will also include target woodland community criteria. Other criteria will be developed as appropriate.

Table 16 LSC Class 6 Closure Criteria

Criteria	Relevance to LSC Guideline	LSC Class 6
Water Erosion	LSC Hazard 1	Slope < 33%
Wind Erosion	LSC Hazard 2	N/A – due to average rainfall and low wind erosive power.
Soil Structure Decline	LSC Hazard 3	Surface soil texture with <15% ESP
Soil Acidification	LSC Hazard 4	N/A
Salinity	LSC Hazard 5	moderate to high salt store
Waterlogging	LSC Hazard 6	Poorly drained soil (waterlogging is >12 weeks duration per year but not almost permanently)
Soil Depth (rock outcrop)	LSC Hazard 7	<50% rock outcrop **and** soil depth >25cm **or** 50-70% rock outcrop **and** soil depth >50 cm
Mass Movement	LSC Hazard 8	No mass movement

7.2.5 LSC Class 7 Closure Criteria (Woodland Land Use)

LSC Class 7 land has extremely severe limitations for a wide range of land management uses. This land is therefore unsuitable for any type of grazing or cropping due to the severity of the limitations. Given the location of the LSC Class 7 post-mining land, its nominated land use is woodland.

Preliminary success criteria for the development of LSC Class 7 land will be based on the LSC Guideline. The LSC Class 7 hazard criteria are provided in **Table 17**. The refinement of these criteria will be developed in conjunction with the MOP whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria (refer **Section 10.1.1**). Measurement of rehabilitation effectiveness for post mining LSC Class 7 land will also include target woodland community criteria. Other criteria will be developed as appropriate.

Table 17 LSC Class 7 Closure Criteria

Criteria	Relevance to LSC Guideline	LSC Class 7
Water Erosion	LSC Hazard 1	Slope < 50%
Wind Erosion	LSC Hazard 2	N/A – due to average rainfall and low wind erosive power
Soil Structure Decline	LSC Hazard 3	N/A
Soil Acidification	LSC Hazard 4	N/A
Salinity	LSC Hazard 5	N/A
Waterlogging	LSC Hazard 6	Poorly drained soil (waterlogging is >12 weeks duration per year but not almost permanently)
Soil Depth (rock outcrop)	LSC Hazard 7	<70% rock outcrop **and** soil depth of maximum 25 cm
Mass Movement	LSC Hazard 8	No mass movement

8 REHABILITATION IMPLEMENTATION

8.1 Key Rehabilitation Phases

On cessation of all mining activities and reject emplacement activities, the land disturbed by the Project (**Section 4**) will be fully rehabilitated to create a stable and self-sustaining landform for the nominated end land uses of agricultural activities (cropping and grazing) and woodland in accordance with the standard and objectives outlined in **Section 3**. Achievement of the agreed post mining land use will be achieved through a series of conceptual rehabilitation phases described in **Table 18** below.

Table 18 Rehabilitation Phases

Phase		Description
1	Decommissioning	The process of removing hardstands, plant, equipment, buildings and other structures and all contaminated and hazardous materials.
2	Landform Establishment	The process of shaping unformed rock or other sub-stratum material into a desired land surface profile including final landform drainage features. This phase includes substrate material characterisation, hazardous material encapsulation and earthworks to achieve safe and stable slopes with the desired gradients and landscape characteristics.
3	Growth Medium Development	The process of establishing and enhancing the physical structure, chemical properties and biological properties of a soil stratum suitable for plant growth. This includes placing and spreading soil and applying ameliorants.
4	Ecosystem Establishment	The process of seeding, planting and transplanting plant species. Incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities, and habitat establishment.
5	Ecosystem Development	The process of applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post mining land use outcome. Incorporates features including species reproduction, nutrient recycling and community structure.
6	Rehabilitation Complete/Relinquishment	Completion criteria for rehabilitation are met and the land is determined to be suitable to be relinquished from the future Mining Lease.

Methodologies for each phase of rehabilitation are documented in the sections below. Rehabilitation implementation must be interwoven with other strategies such as weed management, water management and erosion control strategies to create competitive conditions unsuitable for weed establishment in both the short and long term.

8.2 Decommissioning Phase

A decommissioning and demolition strategy will form an integral part of the detailed closure planning for the Project. KEPCO will engage suitably qualified and experienced demolition experts to undertake an assessment of all structures to be decommissioned and demolished. The demolition strategy will be prepared in accordance with Australian Standard *AS2601-2001: The Demolition of Structures* (or its latest version) to determine the appropriate demolition techniques, equipment required, and the optimal decommissioning sequencing.

Prior to the demolition of any structures, a hazardous material assessment will be undertaken to determine whether there are any hazardous materials present, including asbestos. Where hazardous materials are identified, they will be assessed and quantified to enable appropriate safety measures to be implemented during removal by a licensed contractor. All hazardous material removed from the buildings will be recorded and disposed of at an approved waste management facility.

8.2.1 Primary Domains 1 & 2

There will be no significant infrastructure located within Primary Domains 1 and 2 that will require decommissioning. Landform shaping work will be undertaken in accordance with the Landform establishment Phase.

8.2.2 Primary Domain 3

Site Services

All services, including power, water, data and telephone, that are not required for demolition activities will be safely isolated, disconnected and terminated. Generally all underground services will be made safe and left buried in-situ. Overhead power lines, which are not proposed for ongoing use, will be removed and the materials, including poles and wire, recovered for potential re-sale or recycling where practicable.

Where also practicable, pipelines and cables will be capped and remain in-situ. This is due to the risk of disturbing the re-established vegetation by excavation and removal. The location of pipelines that are to remain in-situ will be recorded in an abandoned services register and signs will be erected where appropriate.

Equipment and Buildings

All demountable/transportable buildings and the coal handling areas (stockpiling, screening, etc.) will be removed from the Project Boundary. Any permanent buildings, including the workshops will then be demolished, with the component materials being recycled or re-sold.

All sumps will be de-watered and de-silted prior to the commencement of demolition. In addition, all items of equipment will be de-oiled, degassed, depressurised and isolated, and all hazardous materials will be removed. All recoverable scrap steel will be sold and/or recycled. Prior to disposal, all wastes will be assessed and classified in accordance with the relevant regulatory requirements.

Any materials not recycled or re-sold will be disposed of in a suitable location either on-site or off-site at a licenced waste management facility. Opportunities for the sale and/or re-use of assets and recycling of scrap steel will be maximised where possible. Material assessed as “not hazardous or contaminated” by a suitably qualified person can be crushed and disposed of within the Project Boundary if a suitable location is identified.

Concrete footings and pads will be broken up to at least 0.5 m below the surface and removed. Options for the re-use of this material (for example, crushed and used for road and track stabilisation) will be investigated as the mine approaches closure. If re-use or recycling opportunities are not available or viable, all “non-contaminated” waste material will be disposed of in a suitable location on-site or off-site at an approved waste management facility.

Roads, Tracks and Hardstand Areas

Access roads, tracks, car parks and hardstand areas that are not required to be maintained for future use will be scalped to remove stabilised and compacted material. The inert waste will be disposed of in a suitable location on-site or off-site at an approved waste management facility. Material assessed as “not hazardous or contaminated” by a suitably qualified person can be crushed and disposed of within associated portal entries or placed as fill into the shafts.

Minor reshaping work may be undertaken to ensure surface level consistency with the surrounding areas and rehabilitated.

Pipes

All above ground pipes shall be removed and disposed of appropriately. Opportunities for the sale and/or re-use of assets and recycling of materials will be maximised to the extent practicable. Generally all underground services will be made safe and left buried in-situ. The location of pipelines that are to remain in-situ will be recorded in an abandoned services register.

8.2.3 Primary Domain 4

The Rail Loop will be retained at closure and largely not subject to decommission activities.

8.2.4 Primary Domain 5

The upgraded internal roads will be retained at closure and largely not subject to decommission activities.

The haul roads will be scalped to remove stabilised and compacted material with all fill and road base material removed. The inert waste will be disposed of in a suitable location on-site or off-site at an approved waste management facility. Material assessed as “not hazardous or contaminated” by a suitably qualified person can be crushed and disposed of within associated portal entries or placed as fill into the shafts.

Reshaping work will be undertaken to ensure surface level consistency with the surrounding areas and rehabilitated.

8.2.5 Primary Domain 6

All dams and water storages will be removed unless they are required for on-going water management, for example to prevent erosion. Where appropriate the location of water management infrastructure that is to remain in-situ will be recorded in an abandoned services register and signs will be erected where appropriate.

The dams will be decommissioned as follows:

- Draining the water from the dam;
- Removal or reshaping of the dam embank to be consistent with the surrounding landform;
- Sampling and analytical testing of the sediment within the dam, and appropriate treatment or disposal of the sediment based on the analytical results;
- Backfilling of the dam and reshaping to a landform similar to that of the surrounding undisturbed areas;
- Topsoiling and/or amelioration the disturbed area if required; and
- Revegetating with species that are commensurate with the surrounding vegetation and previous land use.

Opportunities for utilising dams by surrounding land owners will be investigated as part of the consultation process during detailed closure planning. If a use for the dams is identified, which has been agreed in writing with the future landowner and/or the relevant regulator, these may be left on-site following the removal of any residual produce water and sediment (if assessed and determined not to be suitable for the proposed use).

8.2.6 Primary Domain 7

Infrastructure located within Domain 7 that may require decommissioning includes power lines and transformers, access tracks and minor disturbance associated with exploration drilling or environmental monitoring. Site services and access tracks located in Domain 7 will be rehabilitated as described for Domain 3. Exploration drilling holes will be rehabilitated in accordance with regulatory requirements.

8.2.7 Primary Domain 8

There will be no significant infrastructure located within the Stockpile Area domain that will require decommissioning.

Excavation activities of remnant carbonaceous materials and minor reshaping work will be undertaken to ensure surface level consistency with the surrounding areas before rehabilitation.

8.3 Landform Establishment Phase

8.3.1 Primary Domains 1 & 2

Landform establishment activities in Domain 1 (Open Cut Mining area) and 2 (OEAs) are associated with:

- Progressive earthworks to shape backfilled areas of the open cut pits and overburden areas that have reached the final design height;
- Construction of drainage structures; and
- Substrate preparation including surface spoil characterisation and amelioration where required.

When the mining area has been progressed sufficiently, fine and coarse rejects will be transported from the Project's CHPP to the open cut mining areas and co-disposed with overburden. Once completed, these areas will be capped as appropriate and rehabilitated to integrate with the natural landform. The North-Western OEA during the early mining years will also be subject to the co-disposal of fine and coarse rejects with overburden. Once the open cut mining areas have progressed sufficiently the OEAs will no longer be used to store reject material. These areas will be capped as appropriate and rehabilitated to integrate with the natural landform.

Overburden and interburden handling will be managed to identify and selectively handle suitable material to construct the surface layers of the backfill. Key characteristics of suitable surface layer materials are:

- Non-acid forming;
- Non-sodic to low sodicity materials; and
- Non-carbonaceous material.

All carbonaceous material, potentially acid forming material (PAF) and highly dispersive or highly sodic materials will be buried at depth in the backfill. Non-sodic and low sodicity material will be selectively handled for use to construct the outer layers of the backfill. Surface layers of the backfill may require additional amelioration such as the addition of coarse gypsum to minimise erosion.

Landform establishment will predominantly be undertaken progressively during operations following emplacement of overburden and interburden (refer **Section 6)**. Domain 1 will be reshaped to a free

draining landform that integrates with the surrounding landform. The conceptual final landform for the Project is shown in **Figure 8** and described in **Section 6**.

The main objective of reshaping is to produce slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. Integrated with this is a drainage pattern that is capable of conveying run-off from the newly created catchments whilst minimising the risk of erosion and sedimentation. Final slope gradient should not exceed 18%, or approximately 10 degrees.

The most significant means of controlling surface water run-off on disturbed areas is to construct contour furrows or contour banks at intervals down the slope. The effect of these is to divide a long slope into a series of short slopes with the catchment area commencing at each bank or furrow. This prevents run-off from reaching a depth of flow or velocity that would cause erosion. As the slope angle increases, the banks or furrows must be spaced closer together until a point is reached where they are no longer effective.

Contour ripping across the grade is by far the most common form of structural erosion control on mine sites as it simultaneously provides some measure of erosion protection and cultivates the surface in readiness for sowing. Graded banks are essentially a much larger version of contour furrows, with a proportionately greater capacity to store run-off and/or drain it to some chosen discharge point. The banks are constructed away from the true contour, at a designed gradient (0.5% to 1%) so that they drain water from one part of a slope to another; for example, towards a watercourse or a sediment control dam.

Eventually, run-off that has been intercepted and diverted must be disposed of down slope. The use of engineered waterways using erosion blankets, ground-cover vegetation and/or rip rap is recommended to safely dispose of run-off downslope.

8.3.2 Primary Domains 3, 5, & 8

There are no landform establishment activities proposed for internal roads (part of Domain 5) as these will be retained at closure.

The primary objective of landform establishment within the Mine Infrastructure Areas (Domain 3), Haul Roads (part of Domain 5) and Stockpiles (Domain 8) will be to return this land to its pre-mining land use, which includes a similar landform shape. To achieve this, stabilisation of batters, road verges, drains, banks, and cleared areas will be undertaken with disturbed areas within this domain will be re-profiled to establish geotechnically stable and self-draining areas.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control. These measures may include the use of sediment fences for non-channelised flow over disturbed areas, sand bags, rip rap, or any combination of those materials.

8.3.3 Primary Domain 4

There are no landform establishment activities proposed for the Rail Loop (Domain 4) as it will be retained at closure.

8.3.4 Primary Domain 6

The primary objective of landform establishment within the Water Storage Domain (Domain 6) is to return this land to its pre-mining land use, which includes a similar landform shape. Water storages, including sediment dams and clean water dams, will progressively be rehabilitated when no longer required. Dams will be drained, sediments removed for disposal in emplacement areas, and the area re-graded to form a free draining landform. All water management structures will be retained and maintained until the catchment is stable following rehabilitation.

Additional temporary control measures will be utilised to minimise erosion and sedimentation including sediment fences, sand bags, rip rap, or any combination of those materials. Erosion control structures will be installed in accordance with the Erosion and Sediment Control Plan.

8.3.5 Primary Domain 7

Land indirectly impacted by subsidence related effects within the Subsidence Study Area will experience localised short-term changes in soil and landscape characteristics and will require some surface remediation works. The post-mining landform will be free-draining and therefore minimal ponding is expected (MSEC, 2015, WRM, 2015).

Temporary control measures will be utilised to minimise erosion and sedimentation including sediment fences, sand bags, rip rap, or any combination of those materials. Erosion control structures will be installed in accordance with the Erosion and Sediment Control Plan.

8.4 Growth Media Development Phase

8.4.1 Soil Resources

Prior to the commencement of mining, a Soil Resource Management Plan will be developed and documented in the approved MOP. The Soil Resource Management Plan will include detailed protocols for soil stripping and handling. The Project's Soil Assessment identifies suitable soil resources for salvaging and recommended stripping depths. A summary is provided here.

8.4.1.1 Quality and Quantity Available for Rehabilitation

Rehabilitation of disturbed mining land requires adequate soil resources be available for rehabilitation works. The Soils Assessment provides an assessment of suitability of relevant soils for re-use as a topsoil resource (primary growth media) or subsoil resource (secondary growth media). The assessment specifically targeted the suitability each soil layer within each soil type for re-use as:

- Primary and Secondary growth media for LSC Class 3 and BSAL reinstatement; or
- Primary and Secondary growth media for LSC Class 4, 5, 6 and 7 reinstatement.

Based on this information the estimated total volume of soil available from areas to be disturbed is approximately 7.42 million cubic metres (MCM) and of this 5.51 MCM is available from land to be directly and permanently impacted upon. The total volume breakdowns of available soil for primary and secondary media use are as follows:

- Primary media capable for BSAL reinstatement: 0.96 MCM;
- Primary media capable for LSC Class 4 (also used for Class 5) reinstatement: 1.03 MCM;
- Primary media capable for LSC Class 6 and 7 reinstatement: 0.25 MCM;
- Secondary media for all LSC Classes 3, 4 and 5: 4.07 MCM (including 0.79 MCM that required amelioration); and
- Secondary media for all LSC Classes 6 and 7: 1.11 MCM.

8.4.1.2 Soil Volume Required

The target soil replacement depths to meet the rehabilitation goals and meet closure criterion, as per the Soils Assessment, are as follows:

- LSC Class 3 and BSAL landform will have a minimum of 0.6 m subsoil overlain by 0.25 m of topsoil (total profile depth 0.85 m);
- LSC Class 4 landform will have a minimum of 0.4 m subsoil (secondary media) overlain by 0.2 m of topsoil (total profile depth 0.6);
- LSC Class 5 land will have a minimum of 0.4 m subsoil (secondary media) overlain by 0.1 m of topsoil (total profile depth 0.5 m);
- LSC Class 6 land will have a minimum of 0.2 m subsoil (secondary media) overlain by 0.1 m of topsoil (total profile depth 0.3 m); and
- LSC Class 7 land will have 0.1 m of topsoil (total profile depth 0.1 m).

The volume of soil required for rehabilitation per LSC Class has been calculated on this basis. **Table 19** details the soil volume requirements per LSC Class (source: Soils Assessment).

Table 19 Soil Volume Requirements for the Permanently Impacted Landform

LSC	Area	Soil Volume Required (MCM)		
Class	ha	Topsoil (Primary)	Subsoil (Secondary)	Total
3 / BSAL	227.0	0.57	1.36	1.93
4	264.8	0.53	1.06	1.59
5	232.3	0.23	0.93	1.16
6	11.0	0.01	0.02	0.03
7	22.6	0.02	0.00	0.02
Total	**757.7**	**1.36**	**3.37**	**4.73**

8.4.1.3 Soil Volume Mass Soil Balance

For land that will be permanently impacted upon and is to be rehabilitated, the Soils Assessment determined that the Project has sufficient soil volumes available for conservation and re-use to achieve the post-mining LSC classes.

There is a total of 5.51 MCM of soil available for conservation across the growth media categories from land to be directly and permanently impacted. This exceeds the 4.73 MCM required for rehabilitation (refer **Table 19**).

The Project has sufficient soil for reinstatement of all LSC Classes including LSC Class 3/BSAL. To achieve this, a strategy has been provided to ensure that the appropriate soil resources are used in the correct post-mining land use Domain. **Table 20** summarises the strategy to use the different soil medias.

Table 20 Soil Volume Summary

Growth Media Class	Placement Media Summary		
	Sufficient Primary media	Sufficient Secondary Media	Comment
Topsoil (Primary LSC 3/BSAL)	✓	✓	Sufficient supply using soil resources suitable for LSC Class 3/BSAL instatement Surplus of 0.04 MCM
Topsoil (Primary LSC 4 and 5)	✓	✓	Sufficient supply using soil resources suitable for LSC Classes 4 & *5*. Surplus of 0.04 MCM
Topsoil (Primary LSC 6 and 7)	✓	✓	Sufficient supply using soil resources suitable for LSC Classes 6 & 7. Surplus of 0.21 MCM
Subsoil (Secondary LSC 3 and 4)	✓	✓	Sufficient supply using soil resources suitable for LSC Class 3/BSAL instatement Surplus of 0.56 MCM
Subsoil (Secondary LSC 5, 6 and 7)	✓	✓	Sufficient supply using soil resources suitable for LSC Class 5, 6 and 7 *in conjunction* with surplus LSC Class 3 and 4 soil resources

8.4.2 Soil Replacement Protocol

The soil replacement depths are summarised in **Table 21** below. All rehabilitated land, excluding Class 7, will include a layer of subsoil between the overburden material and the topsoil. This will improve the water-holding capacity of the rehabilitated landform and reinstate a more natural soil profile. The subsoil layer will be spread on an even but roughened surface that has been ripped on the contour to break any compacted and/or smooth surfaces. Ripping will also assist the keying of subsoil into the overburden, which will in turn assist in the prevention of land slip, assist vegetation penetrate deep into the soil profile, encourage water infiltration and percolation, and minimise erosion. Additionally the ripping of the overburden material will form another subsoil layer over time providing an even deeper soil profile over time.

Table 21 Soil Placement Depth

Land Use	Class	Topsoil (m)	Subsoil (m)	Ripped Overburden (m)	Total depth (m)
Cropping	3	0.25	0.6	0.3	1.15
Grazing	4	0.2	0.4	0.3	0.9
Grazing	5	0.1	0.4	0.3	0.8
Woodland	6	0.1	0.2	0.3	0.6
Woodland	7	0.1	Nil	0.3	0.4

Plate 5 visually shows the soil replacement protocol.

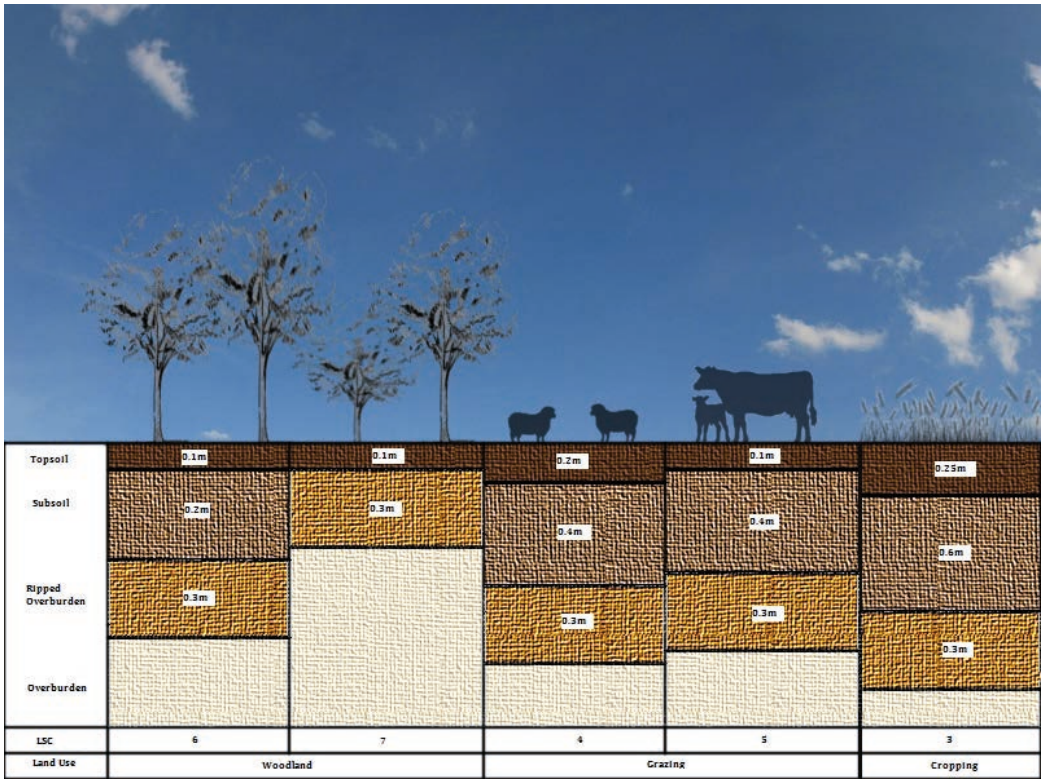

Plate 5: Soil replacement

8.4.3 Soil Respreading and Seedbed Preparation

Sampling and analysis of topsoil resources, whether stockpiled or in-situ, is recommended prior to respreading. This will assist in ensuring high quality material is available and for estimating required rates of fertiliser, or ameliorant (i.e. gypsum or lime) application, or level of blending with other soils.

Prior to re-spreading stockpiled topsoil onto reshaped overburden (particularly onto designated native vegetation areas), an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.

Thorough seedbed preparation should be undertaken to ensure optimum establishment and growth of vegetation. All topsoiled areas should be contour ripped (after topsoil spreading) to create a “key” between the soil and the spoil. Ripping should be undertaken on the contour and the tynes lifted for approximately 2 m every 200 m to reduce the potential for channelised erosion. Best results will be obtained by ripping when soil is moist and when undertaken immediately prior to sowing. The respread topsoil surface should be scarified prior to, or during seeding, to reduce run-off and increase infiltration. This can be undertaken by contour tilling with a fine-tyned plough or disc harrow.

For the LSC Class 3/BSAL land the process of re-establishing soil profile will include the following steps:

- Final shaping of overburden is scheduled to allow re-vegetation during autumn, the optimum time for sowing. The surface of the overburden will be left rough to maximise infiltration of rain and to minimise surface erosions;

- Soil will be placed by truck and spread by dozers to the required thickness or directly placed by scrapers where conditions allow. To establish the subsoil profile, soils will be placed, shaped and left roughened prior to topsoil spreading. Travel lanes will be set out on the areas being rehabilitated to LSC Class 3 and BSAL standards to reduce the potential for soil compaction during placing;

- Prior to sowing, soils will be cultivated along the contour using a tyned plough drawn by a bulldozer. On the LSC Class 3 and BSAL areas a specially adapted ripper will be used to provide deep cultivation and to alleviate any compaction of the soil profile that may have occurred during placement;

- Surface cultivation will be undertaken using a tyned plough such as an “Agro Plough” for seed bed preparation; and

- Pastures or lucerne crops will be sown and fertilisers will be applied.

8.4.4 Surface Water Management Structures

The construction of sediment control dams is recommended for the purpose of capturing sediment laden run-off prior to off-site release. Sediment control dams are responsible for improving water quality throughout the mine site and, through the provision of semi-permanent water storages, enhance the ecological diversity of the area.

The following points should be considered when selecting sites for sediment control dams:

- Each dam should be located so that run-off may easily be directed to it, without the need for extensive channel excavation or for excessive channel gradient. Channels must be able to discharge into the dam without risk of erosion. Similarly, spillways must be designed and located so as to safely convey the maximum anticipated discharge;

- The material from which the dam is constructed must be stable. Dispersive clays will require treatment with gypsum to prevent failure of the wall by tunnel erosion. Failure by tunnelling is most likely in dams which store a considerable depth of water above ground level, or whose water level fluctuates widely. Dams should always be well sealed, as leakage may lead to instability, as well as allowing less control over the storage and release of water; and

- The number and capacity of dams should be related to the total area of catchment and the anticipated volume of run-off. The most damaging rains, in terms of erosion and sediment problems are localised, high intensity storms.

8.5 Ecosystem Establishment Phase

There are three secondary post-mining land use domains that require ecosystem establishment, Secondary Domain A – Grazing land, Secondary Domain B – Cropping land and Secondary Domain C – Woodland. Note that Secondary Domain D is the return of land to pre-mining land use which may be a combination of the three aforementioned secondary domains.

A revegetation strategy will be developed for the Project and documented in the MOP to meet the post-mining land-use objectives. Revegetation activities will be scheduled to occur promptly following the completion of topsoil spreading and drainage works to assist maintain effective erosion and weed controls. Where possible, the timing of seeding will coincide with the preferred pasture and tree seasonal sowing periods in autumn or spring.

A key component in meeting rehabilitation goals is the design of targeted vegetation specifications for each post-mining land use. Elements of this strategy include identifying suitable species, method of establishment (sowing/tube stock planting), sowing/planting rates and other requirements needed to establish the desired community and allow it to evolve towards the desired outcome.

8.5.1 Secondary Domain A: Grazing Land

The total area to be restored to grazing land within the primary domains directly and permanently impacted upon (i.e. Domains 1 & 2) is 497.1 ha. Other land within domains that are directly and temporarily being impacted upon may require some amelioration works to assist with the re-establishment of this ecosystem.

Species Selection

The landscape for a grazing land use is essentially grassland with scattered mosaics of trees. Therefore the long-term grassland species will be selected to be conducive with cattle grazing requirements. For this domain, legumes may be selected to assist in the supply of bio-available nitrogen to the soil. The mosaic of trees will be selected to complement proximal woodland land uses. Appropriate long-term species selection will be undertaken in consultation with local farmers and will complement the Project's Land Management Plan that provides an overall agricultural strategy for non-mine affected lands that are owned and managed by KEPCO.

Seed Sowing

All secondary domains will be initially sown using a light pasture mix, in conjunction with native seed, which will initially provide quick cover and stabilisation of bare areas (a short term objective). Examples of short lived species which provide short term erosion control include oats for Japanese millet (depending on season). Other slower establishing species such as couch, native grass species and rye will provide medium to long term cover once the initial cover crop species 'hays off'. Further information is provided below:

- *Light* Pasture*/Cover Crop* - A light pasture mix will be incorporated into the above mix. The purpose of inclusion is to ensure early soil stability and erosion control prior to the establishment of native species. This mix has been designed to be functional but not competitive and will include:
    - Japanese Millet or Oats (depending on season) - 5 kg/ha
    - Perennial Rye - 2 kg/ha
    - Couch - 2 kg/ha

- *Bulking Agent* - Because of the potentially high weed content fertiliser will not be applied with the seed mix. Instead Kitty Litter, an inert bulking agent, will be mixed with seed at 62.5 kg/ha (equivalent in volume to 100 kg/ha of fertiliser) to assist in the even spreading of seed.

- *Seasonal Considerations* – If a top-dressed area becomes available out of season (see earlier comments) the area will be initially sown with a temporary cover crop of oats or Japanese millet (depending on season) at 30 kg/ha. Once the cover crop matures, and the correct season comes around, the cover crop will be deep ripped and sowing/planting of the target vegetation type will be undertaken.

- *General Application* - the above apply to all the post-mining land use domains and have not been repeated.

Revegetation Scheduling

All initial ground cover sowing activities will be undertaken immediately after the landform establishment phase.

8.5.2 Secondary Domain B: Cropping/BSAL Land

The total area to be restored to cropping land within the primary domains directly and permanently impacted upon (i.e. Domains 1 & 2) is 227 ha. Other land within domains that are directly and temporarily being impacted upon may require some amelioration works to assist with the re-establishment of this ecosystem.

Species Selection

The landscape for a cropping land use is essentially similar to a grassland scenario with the absence of the mosaics of trees. Therefore the long-term grassland species will be selected to be conducive with cattle grazing requirements as this will allow this land to be selectively grazed and/or selectively cropped.

Appropriate cropping sequences will be undertaken in consultation with local farmers and will complement the Project's Land Management Plan that provides an overall agricultural strategy for non-mine affected lands that are owned and managed by KEPCO.

Seed Sowing

Initial seed sowing activities are as described for Secondary Domain A.

Revegetation Scheduling

All initial ground cover sowing activities will be undertaken immediately after the landform establishment phase.

8.5.3 Secondary Domain C: Woodland

The total area to be restored to woodland within the primary domains directly and permanently impacted upon (i.e. Primary Domains 1 & 2) is 33.6 ha. Other land within domains that are directly and temporarily being impacted upon may require some amelioration works to assist with the re-establishment of this ecosystem.

Species Selection

Species selection for Domain C will incorporate species representative of analogue sites to create woodland corridors that will link with remnant vegetation and rehabilitation areas at adjacent operations.

Proposed species should replace lost habitat and create habitat and corridors for native fauna and complement the Project's Biodiversity Offset Strategy. Targeted woodland communities may include:

- Hunter Valley Footslopes Slaty Gum Woodland; and
- Box Gum Woodland and Derived Native Grassland.

Seed Sowing

Initial seed sowing activities are as described for Secondary Domain A.

Direct seeding of native woodland species will be the main revegetation technique employed. Where not suitable (some species are unsuitable for direct seeding) tube stock will be propagated and planted with preference applied to locally-collected seed, wherever possible. Seed will be collected in advance of mining through a carefully designed seed collection program by appropriately licenced personnel. As a result, a combination of both planted tube stock and direct seeding will be used to achieve suitable species composition in most communities. Based on the need to control weeds and maximise ecological values it is proposed to create tree/shrub stands which will close canopy between 3 and 5 years. Once mining commences ongoing trials and research will refine strategy parameters.

Native tree and shrub species will begin to dominate over time and will meet longer term ecosystem objectives. This will be a dynamic system, with a sequential and evolving vegetation structure. As an example, many shrub species grow quickly then seed and die after 5 to 10 years. This process allows time for slower establishing and longer-lived forest tree species to emerge.

In terms of meeting ecological objectives the cover crop and other native grasses will provide seed for many bird species, and the presence of large numbers of parrots and other seed eating native birds are often noted at this stage. As the understorey matures it will provide shelter and nesting sites for bird species and reptiles and the numbers of these species in rehabilitated areas often increase rapidly at this stage. Once longer lived trees emerge further ecological advantages accrue for birds, reptiles and marsupials such as kangaroos and koalas.

The revegetation strategy proposed in this report attempts to maximise all the above objectives in both the short, medium and long terms. In this context, a denser forest structure, rather than an open woodland structure, will provide greater ecological benefits to a greater range of species. For this and other reasons described later, a moderate density native tree/shrub cover over time has been targeted in the specifications described later in the report.

Revegetation Scheduling

As lead times are often substantial in preparing for revegetation projects significant and focussed forward planning is needed to achieve success. As an example, forward planning for securing the Project's native seed requirement should be undertaken by KEPCO. This is a result of some of the common species in the Bylong area having irregular flowering and seed set patterns. This can affect the availability of seed, which is rarely available on demand. Consequently, revegetation scheduling will commence well before the commencement of mining and will include identification of a suitable seed contractor and engagement of this person/company to assess and commence seed collection on KEPCO holdings and in the surrounding region. In conjunction, commercial suppliers will be contacted to assess general seed availability over time. The objective will be to rapidly build an extensive seed supply network that will assist in meeting the projected needs over the life-of-mine.

As tube stock will also be needed to achieve suitable vegetation community composition, engagement of a local nursery will be undertaken prior to mining in order to produce projected numbers of suitable species. Local provenance seed when available will be supplied to the nursery to propagate tube stock, together with a schedule for mine requirements over the following two years. This schedule will be updated regularly and will be closely linked to the MOP. As mentioned, a schedule will also be developed to co-ordinate seed collection in conjunction with clearing.

Prior to clearing of treed areas, it is proposed to engage local fencing and/or saw mill contractors to harvest any viable timber prior to clearing. Remnant timber will either be mulched or stockpiled as coarse timber during the clearing process. Again forward scheduling of all these operations will be undertaken well in advance of operations.

In summary, advanced scheduling of a range of rehabilitation related operations will be undertaken to ensure the best possible rehabilitation outcome.

8.5.3.1 Limiting Factors

The discussion on revegetation scheduling has highlighted the need for forward planning to overcome potential supply limitations. Other potential factors (limitations) also have the potential to affect desired outcomes. The most important of these are listed below together with actions proposed to overcome each.

- Seed Shortfall/Limited Availability

  The implementation of an extensive advanced seed collection program in the Bylong area will ensure that as much local provenance seed as practical will be available for direct seeding and tubestock propagation. Where locally collected seed is not sufficient to meet demand relevant seed will be purchased from commercial suppliers.

- *Tubestock versus Direct Seeding*

  The proposed strategy acknowledges that some species do not lend themselves to direct seeding. Where this occurs relevant species will be propagated in a local nursery and planted as tubestock.

- *Timing*

  Revegetation operations must be undertaken in the correct season. Direct seeding will be undertaken in the months October to February (inclusive). Tubestock planting will occur in the period April to June (inclusive) depending on rainfall. Where rehabilitated areas become available out of season a temporary cover crop will be sown to stabilise the site until the primary vegetation cover is establishment. A spreadsheet will be developed to ensure that adequate advanced planning for the supply of both seed and tube stock is achieved. All works will be scheduled in coordination with the current MOP at that time.

- *Weeds and Native Grasses*

  Based on past experience at other mine sites, it is assumed that there will be an initial emergence of annual weeds following topsoil placement, deep-ripping and seeding. The extent of this emergence is unknown at that this time. Despite this uncertainty a worst case weed scenario has been planned for. The control of weeds will be achieved through:

  - Targeted spraying of problematic weeds;
  - Topsoil management involving weed control strategies;

- Competitive effect of sown/planted native tree and shrub species on weeds. The control of weeds through this mechanism increases as trees mature and as canopy closure occurs. More rapid closure of the tree canopy will be achieved through the establishment of sufficient numbers of native tree/shrubs to shade out weeds as canopy closure occurs over time. Experience has shown that native tree/shrub densities will decline over time and as the stand matures. At that time, experience has shown that the population of many weeds decline and native grasses (if they are present in topsoil prior to mining) tend to re-emerge and establish.

- Stock Damage - All areas identified for native vegetation establishment will have stock permanently excluded until it can be demonstrated that the vegetation cover is stable and self-sustaining and that grazing will not impact upon its health and function. For some areas fencing will be required in perpetuity.

- Drought - Drought has the potential to kill vegetation and the potential impact of drought on established vegetation will be addressed through a range of biological and soil management factors as described below.

8.5.4 Drought – Enhancing Water Harvesting and Soil Water Availability

Drought is a regular and ongoing feature of the Australian environment. The Mid-Western region and, specifically, the Bylong Valley are not immune to reasonably regular drought periods. Vegetated areas of most mines will experience drought at some stage. Drought, like other potentially limiting factors, must be managed in order to ensure that rehabilitation, and particularly revegetation strategies are not jeopardised. A number of drought proofing strategies have been built into both the general rehabilitation strategy and also the more specific revegetation strategies. These include:

- *Landform Design*

  The majority of slopes will be equal to or less than 18%. As a result of lower slopes subsoil water drainage will be reduced and soil water levels will remain higher for longer periods (compared to steep slopes).

- *Reinstatement of Soil Profiles*

  There is sufficient good quality topsoil in areas proposed for disturbance. In addition, some subsoils are of suitable quality and will be placed to create a stratified surface layer containing both topsoil and subsoil. This will effectively create a deep layer in which plant roots can grow before they enter the underlying overburden. This relatively thick topsoil/subsoil layer will enhance soil water availability to plants.

- *Topsoil Quality*

  The quality of stripped topsoil is high and most topsoils have relatively high soil organic content together with favourable particle size composition (a favourable percentage of silt and clay). The high silt/clay component of the sub soil layer will enhance soil water retention in the deeper root zone and will help to offset drought effects.

  Both factors will contribute to enhanced soil water retention and availability to plants.

- *Use of Felled Timber Debris*

  Felled timber will be either mulched (30%) or spread as coarse logs and other timber debris (70%). This ratio may be adjusted as mining progresses. Mulched timber will be spread onto steeper slopes and incorporated through cultivation. The subsequent enhanced organic content of soils will enhance soil water retention. Coarse timber will be spread parallel to the contour and will reduce the velocity and volume of surface water movement through enhanced soil infiltration.

Timber debris will also reduce the area of surface soil exposure thus reducing evaporation through shading of the soil surface.

- *Cover Crop*

  The use of Japanese millet or oats as a cover crop will further enhance soil organic content as it 'hays-off' - thus increasing soil water retention. The overall vegetation strategy has been designed to progressively enhance soil organic content and hence enhance soil water (and nutrient availability) to plants over time.

- *Site Preparation – Deep Ripping*

  Deep ripping parallel to the contour will greatly enhance rainfall infiltration and, in turn, soil water availability. Proposed ripping to 400-500 mm depth will enhance the volume of water stored in the root zone of plants.

- *Species Selection*

  Only locally occurring drought tolerant native tree, shrub and grass species will be used in the long term revegetation strategy for woodland and grazing objectives. These species are all adapted to recurring drought. Long-term species selection for cropping land will be dependent upon the Land Management Plan.

- *Direct Tree Seeding*

  Direct seeding will constitute the main revegetation strategy. Because seeds germinate in situ direct seeded seedlings will active innate stress responses, and hence adapt much more quickly to soil water stress compared to planted tube stock. Young direct seeded seedlings have been observed to survive 4 to 5 months over summer under drought conditions.

- *Tube Stock*

  Tube stock will be planted in the cooler months of April to June (inclusive) when transpiration and water stress on nursery grown plants is reduced. This will allow plants to develop strong supporting root systems before the onset of hotter and (often) drier spring and summer conditions. In addition, a water absorbing gel (Terraform) will be placed around the root ball of each plant at the time of planting. Once wet, this material swells and acts as a mini-reservoir thus extending the benefits of any rain or watering. In addition and when required, tube stock will be artificially watered until they establish a self-supporting root system. A wetting agent will also be added at watering to further enhance soil water availability to plants.

8.6 Ecosystem Development Phase

The Ecosystem Development phase of rehabilitation is characterised as the period of time required to demonstrate that an ecosystem is on a sustainable trajectory towards the desired post mining land use. Key activities in the Ecosystem Development phase include rehabilitation monitoring, rehabilitation maintenance and adaptive management.

8.6.1 Rehabilitation Maintenance

Effective rehabilitation requires an ongoing monitoring and maintenance program throughout and beyond the operational life of the mine. Areas being rehabilitated will be regularly inspected and assessed against the rehabilitation objectives outlined in **Section 3**.

Maintenance activities will be initiated if rehabilitation efforts do not meet the relevant success criteria. These may include reseeding and, where necessary, applying additional topsoil and/or applying specialised treatments (such as composted mulch) to areas with insufficient vegetation establishment. Tree guards will be placed around tube stock if grazing by native animals is found to be excessive.

If drainage controls are found to be inadequate or are compromised by grazing stock or wildlife they will be repaired and/or temporary fences installed to exclude animals. Should areas of excessive erosion or sedimentation be identified, remedial works – such as the importation of additional fill, subsoil or topsoil material or the redesigning of water management structures to address erosion – will be implemented.

No time limit has been placed on post-mining rehabilitation maintenance. Rather, maintenance will continue until such time as the completion criteria are met, although it is generally accepted that is will be at least five years beyond closure.

Maintenance at rehabilitated areas will include, but not be limited to:

- Weeds and pest animal control as described in **Section 8.7**;
- Minor earthworks to remediate any significant erosion features, including contour banks and diversion channels as described in **Section 8.8**;
- Infill planting and/or seeding to meet vegetation community requirements; and
- Maintaining erosion and sediment controls as described in **Section 8.9**.

Rehabilitation monitoring and adaptive management are discussed in **Sections 10** and **11** respectively.

8.7 Weed Management

The presence of weed species has the potential to have a major impact on the success of revegetation and regeneration outcomes. In addition to this, weed species in the surrounding area have the potential to significantly impact on the biodiversity value of rehabilitated areas. Weed management will be a critical component of mine rehabilitation and landscaping activities. KEPCO will take the necessary precautions to prevent the excessive occurrence of weeds within the rehabilitated areas.

The following weed management measures will be implemented during soil stripping and rehabilitation works:

- The Bylong induction program will be used to promote awareness of weed management measures;
- Specific training in weed identification and eradication measures will be provided to relevant site personnel and contractors;
- Contracted equipment involved with all forms of ground disturbance will be hosed down in an approved wash-down area before entry to site;
- When necessary, spraying herbicide or removing the top layer (‘scalping’), including weeds, of topsoil stockpiles will take place prior to respreading. Weed control will be improved by constructing topsoil dumps with very shallow slopes so that the surface, weed infested layer can be easily scalped off and disposed of prior to recovery of the underlying, clean material;
- Rehabilitation inspections will be carried out to identify potential weed infestations;

- Details of all weed management and eradication programs and follow-up inspections will be entered into the site's environmental management database;

- Existing weed populations on site will be identified and sprayed, together with ongoing weed spraying over the life of the mine;

- Vegetation and topsoil stripped from the weed risk areas with known infestations will be stripped and stockpiled separately. These stockpiles will be marked and recorded in the site's environmental management database;

- Topsoil stripped from weed risk areas with known infestations will either be buried (if treatment is not practicable) or treated (several times if necessary). The decision to bury or treat topsoil from weed risk areas will involve an assessment of the volume of material involved, the dormancy of the particular weed species, the likely number of treatments required, the likely success in eradicating the weed species from the stripped soil and whether the treatment will significantly affect the viability of native seeds and / or the fertility of the soil; and

- Soils from weed risk areas that are used in the rehabilitation program will be closely monitored after rehabilitation and any residual weeds that germinate will be treated as appropriate.

Weed control will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DTIRIS) and OEH. Records of weed infestations will be maintained and control programs implemented according to best management practice for the weed species concerned.

8.8 Water Management in Rehabilitation Areas

Where practicable, water management structures (such as contour banks and drains) will be constructed with longitudinal gradients that permit the transfer of water at non-erosive velocities (e.g. 1:100 (V:H)). Consequently, specialised rehabilitation treatments will generally not be required. Similarly, rock-lined drop structures constructed on the slopes of the emplacements and final void will be retained and allowed to revegetate naturally.

The planting of trees and other vegetation around the various water management structures will enhance the filtration ability of these structures and surrounding areas and minimise the potential for erosion, as well as encouraging their use by native fauna. In the event that unacceptable levels of erosion are observed, specific fast-growing species and/or specialised treatments such as bitumen/jute meshing or rock lining are recommended.

8.9 Erosion and Sediment Control

8.9.1 Principle Objectives

A detailed Water Management Plan will be implemented prior to the commencement of construction works. The principle objectives of the Erosion and Sediment Control section of the Water Management Plan, specifically for rehabilitation areas will be to:

- Minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;

- Segregate contact water (surface run-off from disturbed catchments; e.g., active areas of disturbance, stockpiles and rehabilitated areas until stabilised), from clean water (surface run-off from catchments that are undisturbed or relatively undisturbed by project-related activities and rehabilitated catchments) and maximise the retention time of contact water so that any discharge from the Disturbance Area meets the relevant water quality limits;

- Prevent water from being discharged from the disturbance area but, should water be displaced from the site, enable sufficient settlement/treatment time prior to discharge so that suspended sediment within the water meets the objectives;

- Manage surface flows upstream of any surface disturbance so that rehabilitation activities are not affected by excessive run-off water;

- Prevent erosion of ephemeral watercourses or gully's that occur on the site;

- Establish sustainable long-term surface water management features following rehabilitation of the site, including implementation of an effective revegetation and maintenance program; and

- Monitor the effectiveness of surface water and sediment controls in order to meet all relevant surface water quality criteria.

8.9.2 Principle Design Aspects

The primary design aspect of the Project is the prevention of clean water in ephemeral drainage channels gullies entering the active disturbance footprint. This will be achieved through the use of diversionary structures such as drains, berms and banks, as well as the containment of contact water in sediment control structures within the active areas of the project to eliminate uncontrolled run-off. Effective erosion and sediment control will require appropriate activities to be carried out over the life of the Project including during construction, mine operations and rehabilitation and mine closure.

8.9.3 Planning and Design Strategies

The effectiveness of erosion and sediment controls for rehabilitated areas will be optimised through effective planning and design. Suitable strategies will include:

- Designing and operating drainage systems for the life of the Project so that they do not cause erosion;

- Designing the final Project geometry to create a landform that allows free drainage of surface run-off while minimising erosion (this includes designing an appropriate drainage system that avoids erosion); and

- Re-using water as part of the overall water management strategy for the site.

9 REHABILITATION MANAGEMENT AND RECORDS

The Project will temporarily and/or permanently impact 2,874.7 ha of land. In accordance with the rehabilitation objectives, land will be returned to either its pre-mining state and land use or an alternate state which is commensurate with surrounding land uses.

Rehabilitation will be undertaken in accordance with a detailed MOP as well as a BSAL Reinstatement Plan upon grant of Development Consent. The following information provides a basis for the development of the both these plans.

9.1 Stakeholder Consultation

KEPCO will consult with DTIRIS, DP&E and OEH regarding input into the development of the MOP and BSAL Reinstatement Plan.

9.2 Management

9.2.1 General

Soil stripping, stockpiling, inventory systems and survey reconciliations used during the stripping and stockpiling process will be under the control of the Environmental Manager (or delegate). Field monitoring will be controlled by appropriately trained personnel.

A regular review of activities will be undertaken by an appropriately experienced soils expert. The soils expert and the review intervals may be altered to suit the progress of activities.

Management of soils whilst in stockpile, their recovery, placement for reinstatement, effectiveness trials and monitoring of rehabilitation effectiveness will be managed by the Environmental Manager (or delegate) who in-turn will be advised by experts where necessary.

9.2.2 Training

All management and supervisory personnel involved in stripping and stockpiling of soil resources will undertake, as a minimum, a one day training program in recognition of the Project areas of BSAL and the procedures put in place for its management. This will be the same or similar to the program undertaken by supervisors prior to the commencement of construction activities on the site. Training manuals and aids will be supplied during these courses and will be used for reference during the stripping operation. Appropriately experienced soil experts will be engaged to carry out such training.

9.2.3 Inductions and Toolbox Talks

All persons involved in the soil stripping, stockpiling, recovery and reinstatement of Land Capability Classes, particularly BSAL, will attend an induction session, prior to commencing work. This session will deal with soil issues and management and will generally include:

- Value of BSAL soils;
- Value of non-BSAL soils and their contribution to post-mining land use goals;
- Stockpile control and signage;
- Rules when working on stockpiles;
- Basic soils and land use information;
- Rules when stripping soils; and

- Soil profile reinstatement procedures.

Information regarding the soils management operation will be covered and reinforced at regular toolbox meetings.

9.2.4 Role of Experienced Soils Consultant

The soil consultant will be actively involved in the implementation of the Rehabilitation and BSAL instatement Plan.

Specific tasks will include, but not limited to, the following:

- Carrying out regular inspections and attend meetings as required during the stripping process;
- Organising review of activities against the Rehabilitation and BSAL Reinstatement Plan;
- Providing advice regarding testing and testing procedures that need to be implemented;
- Providing testing equipment and procedures as necessary;
- Assessment of the suitability of laboratories to carry out testing services;
- Provide advice on earthmoving equipment to be used;
- Provide advice on earthmoving procedures to be used;
- Provide advice on soil stripping and stockpiling conditions;
- Review and advise on inventory and reconciliation records; and
- Supervision, monitoring and assessment of field trials and analogue sites.

9.2.5 Soils Plan

The Soils Assessment has assessed the soil suitability of each soil type present in the land to be disturbed. The assessment identified which soil types can specifically be used for which post-mining LSC Class reinstatement. This information has been prepared using information collected at a scale of 1:25,000 for areas of high impact disturbance.

These plans will also form part of the MOP and will include:

- Soil mapping units with legend;
- Topsoil thickness;
- Subsoil thickness; and
- Pre-mining LSC classification.

Such plans will be used as a guide for topsoil and subsoil stripping depths and boundaries and for removal of unsuitable layers. These plans are based on limited information and on site decisions will be made as removal progresses by trained supervisors and as advised by the soil consultant.

Soil unit and LSC classification boundaries as assessed by the Soils Assessment will be used initially to indicate the class and type of topsoil being stripped. This in turn will govern its stockpile location.

Location of these boundaries will be pegged in the field prior to topsoil stripping commencing and in the case of the land to be permanently impacted upon. Boundaries will be fine-tuned by the excavation of extra soil inspection pits. Any major change to such boundaries will be recorded.

9.2.6 Inventory Reconciliation

Actual depths and position of topsoil and subsoil removed will be picked up by surveys (for active faces only) and recorded. These records will be updated on a regular basis. Such records will be used to reconcile actual soils stripped with soil quantities estimated from the original plans by the Soils Assessment.

Reconciliation shall be updated on a regular basis. Any subsoils stripped below 2.5 m will also be surveyed at regular intervals and included in records. Reported quantities shall be calculated based on these surveys. Estimates are to be based on scraper and or truck counts and corrected based on survey.

9.3 Soil Handling and Stockpile Management

9.3.1 Equipment and Access

Equipment for stripping, stockpiling and reinstatement of topsoils and subsoils will be selected to minimise compaction and to avoid breakdown of the soil structure.

Different practices may be implemented for the stripping of the fragile sandier soils and the stiffer and more robust loamy soils. Final equipment selection will be based on ongoing research and conditions experienced during stripping.

Equipment and procedures that are successfully used during the stripping process will also be used in the recovery of stockpiles for reinstatement purpose. If necessary equipment and procedures used, based on experienced gained during stripping will be amended to minimise compaction and soil structure damage during recovery of stockpiles for reinstatement purposes.

Equipment will be selected with the aim of minimising ground pressures where soil structure and moisture conditions indicate this may be a problem.

The stripping program will be designed to minimise the number of times the equipment travels over soil materials. To accomplish this, the following will be implemented:

- For haulage, access roads will be first constructed into defined stripping areas from which topsoil will be removed in advance;
- Heavy vehicles will only travel on these approved access roads to and from defined soils stripping areas;
- Sequencing of stripping operations will be set out to prevent machines running over soils materials;
- Stripping operations will be set out and controlled on a defined area basis;
- Light vehicles will access areas only as approved by the Project's Environmental Manager; and
- Thick (> 0.1m) unsuitable layers between topsoil and subsoil will be considered as adequate for travelling on during stripping operations.

9.3.2 Soil Stripping Handling Procedures

The following management and mitigation strategies are recommended for implementation during mining, in order to reduce the potential for degradation within the Study Area and adjoining lands. These recommendations are based on the assessment of the existing site conditions and experience with the management of mining surface impacts at sites throughout NSW and Central Queensland and apply to both topsoil and subsoil stripping:

- Strip soil to the depths stated in the Soils Assessment, subject to further field investigations during stripping;
- Soil should preferably be stripped in a slightly moist condition. Material should not be stripped in either an excessively dry or wet condition;
- Place stripped material directly onto area to be rehabilitated and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling;
- Grade or push soil into windrows with graders or dozers for later collection by open bowl scrapers, or for loading into rear dump trucks by front-end loaders. This will minimise compression effects of the heavy equipment that is often necessary for economical transport of soil material. These techniques are examples of preferential less aggressive soil handling systems;
- Soil transported by dump trucks may be placed directly into storage. Soil transported by scrapers is best pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil;
- The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- As a general rule, maintain a maximum stockpile height of 3 m for subsoil (or 2 m for topsoils). Clay soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils;
- If long-term stockpiling is planned (i.e. greater than 12 months), seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds (e.g. oats) should be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil;
- An inventory of available soil resources should be maintained to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities;
- Subsoil and topdressing materials will be spread to depths dependent on target land capability and as stated in **Table 21**; and
- Where possible, suitable subsoil/topsoil should be re-spread directly onto reshaped areas. Topsoil should be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.

9.3.3 Stockpiling and Stripping Guidelines

Stripping operations will not be undertaken during excessive dry periods to prevent pulverisation of the natural soil aggregates. Similarly, stripping during wet periods will not be undertaken to prevent damage through compaction. Stripping of soils will be undertaken during daylight hours.

Stripping will occur well ahead of mining to avoid interference and to ensure complete recovery of soils. It will involve up to four faces – topsoil, the unsuitable layer, subsoils to 2.5 m depth and subsoils below 2.5 m depth. The fourth face will depend on the in-field identification of the > 2.5 m subsoils.

Stripping should occur at a moisture content between the air day and plastic limit such that deformation is minimised without pulverisation occurring. The theoretically desirable moisture range for stripping for each texture group on BSAL is:

- Loamy sands and clayey sands 9 - 11%
- Sandy clay loams, clay loams, sandy clays 12 - 14%
- Silty clays, light clays 20 - 22%

It is probable that stripping outside the desired range will be necessary, in which case the stripping procedure or amelioration will be reassessed. Placement at wetter then above may necessitate deep ripping once the profile has been dried to below the plastic limit. Stripping should not occur at wetter than the plastic limit except where the normal moisture regime is above this level. Modifications to the stripping procedure may be required should this occur.

If severe wheel compaction is likely, the dumping will best be undertaken by following set tracks and subsequent ripping those tracks rather than compacting the whole dump surface.

Topsoils and subsoil stockpiles will be established with a coarse seedbed to enhance moisture retention.

Stockpiles will immediately be sown by seeder (where practical) with a permanent cover crop such as Lucerne, and if seasoned conditions warrant, a temporary cover crop such as oats with an under-sowing of a permanent species.

To ensure that finished stockpiles are not built beyond the recommended heights the following method shall be used:

- Prior to stockpiling commencing, the prepared receiving areas will be accurately surveyed and plans prepared;
- Survey stations will be set up to allow levels to be taken on the stockpile areas; and
- Pegs will be offset around stockpile areas indicating remaining fill required (and cut if necessary).

9.3.4 Stockpile Management

9.3.4.1 Stockpile Location and Configurations

As discussed in **Section 9.2**, the assessment identified which soil types can specifically be used for which post-mining LSC Class reinstatement. This assessment further identified specifically which soil layers (soil horizons) can be used for each LSC reinstated class in conjunction will soil layers that should be discarded or acquire amelioration.

For the temporary and directly impacted land where each individual soil unit will be rehabilitated, topsoil for each soil unit will be stored separately. Topsoil from LSC Class 3 and Class 4 lands will be stored in separate stockpiles. Subsoil down to 2.5 m below the surface will be stored separately to subsoil recovered below 2.5 m below the surface.

For the permanently and directly impacted land each soil layer will be stored in the relevant stockpile for either reinstatement of LSC Class 3, 4, 5, 6 or 7 lands.

Maximum stockpile heights are to be as follows:

- All topsoils 2.0 m (max)
- Subsoils < 2.5m to 3.0 m (max)

Stockpiles will not be disturbed until required for rehabilitation, for weed and erosion control or for seeding and fertilising purposes.

9.3.4.2 Control of Stockpile Placement

During stripping and stockpiling operations, active stockpiles or active sections of stockpiles will be clearly signposted as opened or closed.

The supervisor in charge of stripping and stockpiling operations will notify machine operators of the stockpile locations for that day and will regularly check to ensure that material is taken to the correct stockpile location. Operators will immediately be notified of any changed to activities regarding stripping and dumping by the supervisor in charge of operations.

Regular checks and audits will be carried out in the regard by the Environmental Manager (or delegate).

Temporary signs will be erected indicating the stockpile number, its soil type and soil class. These signs will be at least 500 mm x 600 mm in size with lettering that is clearly able to be seen from 20 m away by an approaching operator. Signs with arrows will also be used to indicate the correct position of stockpiles.

9.3.4.3 Signage

On completion of a stockpile or section of stockpile, it will be shown as being closed off by signage or the use of pegs and barriers.

Completed stockpiles will be clearly posted with reflective signs of at least 500 mm x 600 mm size with reflective white lettering on a green reflective background. Such signs will be securely erected at both ends of completed stockpiles.

Signs will contain the following information:

- Soil type (topsoil/subsoil/soil type);
- Soil class (3, 4, etc.);
- Date stripped;
- Volume; and
- Stockpile number.

Information on the signs will be correlated to inventories and plans kept during the soils stripping operation.

9.3.4.4 Erosion Control and Drainage

The stockpile areas will have contour drains built around its perimeter to divert water away from it. This water will be drained into existing mine sedimentation dams. Stockpiles will be located in areas remote from the floodplain or flow lines.

Soil will not be stockpiled on any surface with a grade in excess of 15%. Measures will be taken on soil stockpiles to prevent scouring and erosion due to rainfall run-off. This may require the battering down of stockpile edges. Stockpiles will be arranged in the stockpile area to run near parallel to natural contours as far as practical. This will minimise scouring from rain events. Free draining gaps will be left between stockpiles to prevent pooling of water.

A combination of straw bales and silt fences will be placed in draining paths as determined on site to capture silt from run-off. Run-off from within the stockpile area will be directed into drainage sumps or sedimentation dams. Stockpiles will be seeded as quickly as possible after placement to minimise scouring from rainfall.

9.3.4.5 Dust Control

Dust control during stripping and stockpiling operations by earthmoving plant will be undertaken using mobile water carts. Water cart capacity will be such as to regularly water active roads and active face areas.

Dust will be controlled on completed stockpiles by the establishment of pasture cover.

9.3.4.6 Seeding

Completed topsoil and subsoil stockpiles will be sown and pasture established as prevailing weather conditions permit.

The seed mixture will include fast-growing, short-lived species and perennial grasses and legumes. Example pasture mixes for cool and warm seasons are presented in **Table 22**. The pasture mix will be sown simultaneously with an appropriate fertiliser; for example, 250 kg/ha di-ammonium phosphate. Following establishment of these areas, it is anticipated that rotational cropping of pasture and suitable crops will be undertaken. All legumes (clovers and lucerne) will be inoculated with appropriate rhizobia and lime pelleted.

Table 22 Example Pasture Species Seed Mix

Pasture Species	Rate (kg/ha)
Autumn Sowing	
Oats	10
Cocksfoot	3
Perennial Ryegrass	6
Phalaris	3
Subterranean Clover	4
Red Clover	2
Spring Sowing	
Japanese Millet	10
Phalaris	5
Paspalum	5
White Clover	2
Lucerne	3

9.3.4.7 Weed Control

Prior to stripping and placement of soils, inspections will be carried out to identify if any weed control measures are required to be implemented.

9.3.4.8 Stockpile Inspections

Regular inspections of the stockpile areas will be undertaken, particularly after significant rainfall events. The following features will be checked:

- Integrity of sediment control;
- Effectiveness of drainage;
- Integrity of erosion control measures;
- Grass growth; and
- Weed infestation.

Remedial measures will be undertaken as necessary. Revegetation and weed control will be carried out as assessed at the time in consultation with the soils consultant. Internal stockpile conditions will be assessed by moisture movement and limited inspection pits.

9.4 Soil Testing

9.4.1 In-situ Test Pits

Prior to commencement of stripping topsoil and subsoils, small test pits will be excavated using a backhoe or small excavator to accurately determine sol profiles and soil type boundaries. These pits will:

- Be supervised by a suitably trained person;
- Positioned to give advance indication of stripping depths for changes in profile;

- Be accurately logged by a suitably trained person;
- Be excavated to a depth of 2.5 m below the surface; and
- Materials won from these trenches will be discretely stockpiled as topsoil, unsuitable and subsoils.

Test pits will also be used to determine in-situ densities and moisture contents according to standards and methods as specified by a soils consultant.

9.4.2 Test Pits in Stockpiles

Test pits will be excavated through topsoil and subsoil stockpiles during the stripping operation to ensure that critical densities are not being exceeded, that soil structure is not being destroyed and to indicate the necessity for deep ripping. Monitoring will also be undertaken on soil benches during the construction of the stockpile.

Extra test pits will be excavated during the life of the soil stockpiles to determine the "health" of the soils within these stockpiles.

9.4.3 Test Pits in Reinstated Land and Soil Capability Class 3 and 4

Test pits will be excavated as part of the assessment procedure as recommended by a soils consultant in reinstated LSC Class 3 and 4 lands. Dry densities and infiltration will also be monitored. Accepted procedures, as recommended by an appropriately experienced soils consultant, will be utilised for all testing.

9.5 Records and Reporting

9.5.1 Reconciliation

Reconciliation will be carried out as indicated in **Section 9.3** during the stripping and placement process. A typical reconciliation record is attached in **Appendix B**. Reconciliation surveys shall be completed regularly.

9.5.2 Reports

A quarterly report will be prepared by the Environmental Manager and will include:

- Cumulative stripped quantities;
- Updated reconciliation records;
- Indicated status of stockpiles and soil face positions;
- Seeding and reseeding details; and
- Weed control measures.

A summary of the detail from the quarterly monitoring reports will be provided within the Annual Review.

9.5.3 Inventory

An inventory recording system shall be kept for each soil type and soil class on a stockpile basis. This shall be updated on a regular basis and shall be used as a means of tracking soils movements from

stripped areas to stockpile locations and for reconciliation purposes. The inventory system will enable cross referencing with soil face plans and soil stockpiles positions. Typical inventory records are as attached as **Appendix C.**

9.5.4 Stockpile Height Monitoring

Measures to control and monitor stockpile heights are described in **Section 9.3**. Plans based on field surveys will be completed on a monthly basis detailing stockpile heights and stockpile RLs.

9.5.5 Reviews

The soil consultant will inspect the site on an as required basis as agreed with KEPCO. The results of these inspections will be recorded in writing.

9.5.6 Seeding and Weed Control

Records will be kept and updated on a quarterly basis showing the status of stockpile seeding. This record will also detail seeding and fertilised mixes and rates applied. Ongoing assessment of vegetation cover present will be undertaken. Weed control measures and applications will also be indicated.

10 REHABILITATION MONITORING PROGRAM AND RESEARCH TRIALS

The Project will undertake a rehabilitation monitoring program in accordance with best practice standards. The objectives of the program will be to:

- Assess the long term stability and functioning of re-established ecosystems on mine affected land;
- Assess rehabilitation performance against the closure criteria; and
- Facilitate continuous improvement in rehabilitation practices.

In order to verify rehabilitation procedures and outcomes the monitoring program is required to assess rehabilitation progress towards meeting the completion criteria using appropriate indicators.

A rehabilitation monitoring program will be implemented to describe the processes and activities required to determine the biophysical state of a domain. It should describe a standardised and repeatable approach to the measurement of certain biophysical attributes and processes that can be compared against the completion criteria for the site and domains. The program should be designed to ensure collection and storage of data is undertaken in a robust and statistically valid manner.

To facilitate continuous improvement, rehabilitation is an iterative process which allows activities to be defined and improved upon throughout the life of the mine. Monitoring of rehabilitation successes and failures will enable lessons learnt in early years of rehabilitation to be applied in subsequent and later years. It will also ensure that continuous improvement in the site's performance in terms of landscape and land use is achieved.

The monitoring program will be continued within rehabilitated as well as non-mined areas until it can be demonstrated that rehabilitation has satisfied the closure criteria. Information from this monitoring program will also be used to refine closure criteria (refer **Section 7**) as required.

10.1 Selection of Monitoring Program

Monitoring is the gathering, analysis and interpretation of information for the assessment of performance. The parameters chosen for monitoring, and the frequency for monitoring, will depend on the specific site circumstances.

A key reference for the design of the Project's monitoring program is Nichols (2005). The Australian Centre for Minerals Extension and Research (ACMER) funded the Nichols report in order to develop an agreed, workable process for addressing relevant issues relating to mine closure and associated completion criteria following coal mining in the Hunter Valley of NSW. The findings were synthesised into a set of principles that can be used in designing monitoring programs across all mine sites. Although the Nichols report targeted the restoration of native vegetation, the principles are applicable to all mining operations and have been applied to this project.

The aim of the selected program is to establish clearly defined, repeatable and consistent methodologies for monitoring changes in various aspects of ecosystem function, succession and long-term sustainability. This program is to include:

- Selection of a range of suitable reference sites that reflect the desired final land use, biodiversity targets, historical disturbances and local community expectations;
- Establishment of a range of relevant reference sites to compare and track the progress and inherent ecosystem function of rehabilitation areas; and
- Undertaking a monitoring program that provides simple but informative and reliable information that indicates positive recovery trends or rapid detection of rehabilitation failure.

10.1.1 Reference Sites

The use of reference sites to set the benchmark for rehabilitation is an appropriate way to track rehabilitation outcomes. Selecting suitable reference sites is essential as it will ultimately set the benchmark for rehabilitation targets and the criteria to be met for completion. Fundamental to this selection is consideration of the post-mining land use as this will dictate the vegetation community that is to be established and the type of management regime that it will be subjected to.

Reference sites are to provide:

- Series of revegetation benchmarks (i.e. from sites with a history of disturbance to relatively undisturbed sites in the local context);
- Record of changes in community structure and function under different management regimes or disturbance events (eg. final land use may be a grazed pasture or woodland area therefore criteria also should reflect this planned disturbance event); and
- Picture of what is typical about the vegetation communities in the local area.

10.1.2 Key Monitoring Methodology Steps

The monitoring methodology to be adopted will be a standard and simple procedure that can be easily replicated over any revegetation area and importantly results in a system that essentially compares 'apples with apples'.

The key aspects to be incorporated into the monitoring methodology are:

- Data obtained from the reference sites will provide a range of values from replicated examples of similar vegetation communities;
- Rehabilitation areas will be compared to reference sites that best represent the final land use vegetation community and management conditions they will be subjected to;
- In recognition of the dynamic nature of ecosystems, rehabilitation sites will be monitored simultaneously to the reference sites over time to account for changes in seasonal variations, climatic conditions, management practices and unexpected disturbance events; and
- Selected performance indicators (completion performance indicators) will be expected to equal that or exceed values obtained from the reference site under the same set of conditions or demonstrate a positive trend towards target values.

The monitoring methodology for the Project proposes to use a combination of:

- Landscape Function Analyses (LFA), which includes an erosion assessment;
- Intrusive soil analyses; and
- Floristics assessment.

Permanent transects and photo-points are to be established to record changes in these attributes over time. All monitoring sites will have appropriate replicates to ensure data collection is statistically robust.

10.1.3 LFA

LFA is a field-based monitoring procedure that assesses the rehabilitated landform from a landscape perspective. The procedure assessed the fate of vital resources such as water, topsoil and organic matter, and identifies both potential accelerated losses and processes that retain those resources. The quality and fate of the resources are compared over time against the relevant reference sites, completion criteria and performance indicators.

LFA was developed by CSIRO scientists Tongway and Hindley (2004) and has been used and tested widely and successfully in the mining industry across the globe. It has been designed for repeated use so that the development, or degradation, of a site can be assessed over time.

The monitoring procedure uses a linear transect positioned vertically down the slope. Transect length ranges from 50-100 m in length depending on the complexity/uniformity of the environment (**Diagram 2**). The assessment uses rapidly assessed, simple visual indicators, to determine how well a landscape functions as a biophysical system and the site assessment is comprised of two major data collection components along the transect:

- Landscape Organisation - measurement of the arrangement of these units along transect(s); and
- Soil Surface Assessment - the measurement of soil surface indicators for each unit to produce three information indices.

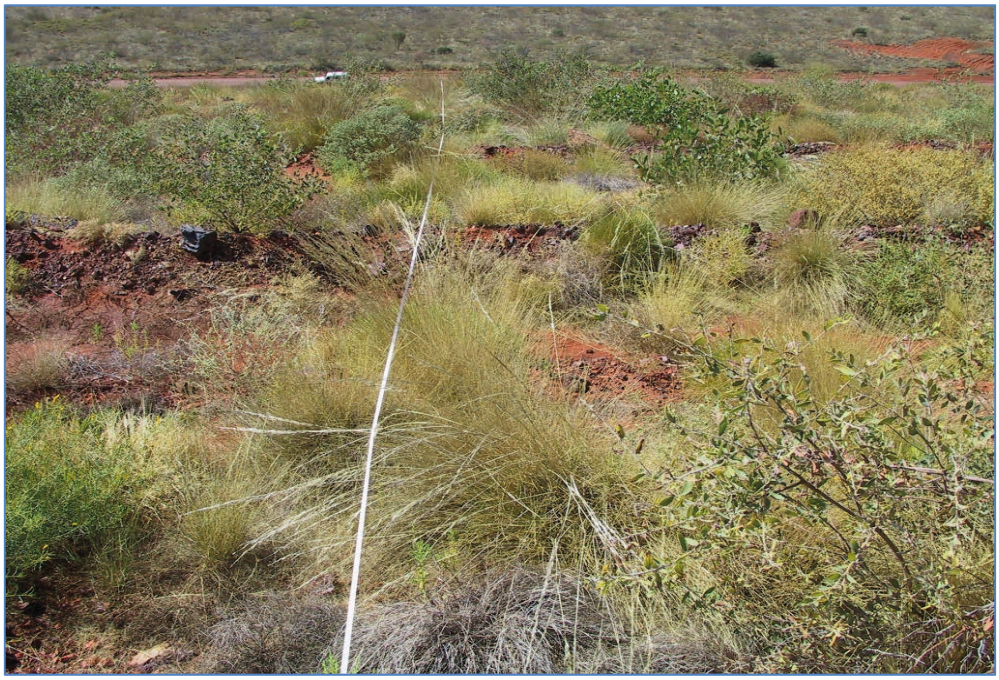

Diagram 2: Example LFA Transect (Tongway &Hindley, 2004)

The interpretation framework of the LFA provides three numeric values (indices): soil stability, infiltration of water and the cycling of nutrients. Indices are compared with appropriately selected reference sites, representing the most and the least disturbed examples of the landscape type being evaluated. Indices are incorporated into a value for the whole landscape and the application of this value is used to generate comparative graphs between rehabilitation sites of different age and a response curve which relates landscape condition to changes in landscape condition over time

(**Diagram 3**). This enables the user to examine the "trajectory" of the ecosystem being monitored and to use this information to decide if the site is converging on a "target" functional state, or needs further work to ensure ultimate success.

Diagram 3: Example: Stability Index versus Analogue (reference site) (Tongway & Hindley, 2004)

Erosion Assessment

Erosion data is to be collected from a 50 m cross-section along the centre of each LFA transect. Data to be collected includes:

- Type of erosion;
- Length and width of each site of erosion;
- Erosion depth; and
- Stability of the erosion.

This information was be used to estimate the scale and current activity of erosion at each monitoring site. In addition, information on soil surface stability from the LFA field slake test can be used to assist erosion predictions.

10.1.4 Intrusive Soil Analyses

Soil samples will be collected and analysed for physical and chemical parameters relevant to the secondary domain's performance indicators and completion criteria. Information will be compared with appropriately selected reference sites.

Samples will be collected from within a monitoring quadrat that is located proximal to the LFA transect. Soil samples will be collected using standard soil sampling techniques from appropriate soil horizons using a core sampler or backhoe. Key soil physical characteristics will be assessed as related to each secondary domain's completion criteria and may include characteristics as described below in **Table 23**.

Table 23 Key Soil Profile Description Parameters

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field colour	Permeability, susceptibility to dispersion/erosion
Field texture grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary distinctness and shape	Erosional/dispositional status, textural grade
Consistence force	Structural stability, dispersion, ped formation
Structure pedality grade	Soil structure, root penetration, permeability, aeration
Structure ped and size	Soil structure, root penetration, permeability, aeration
Stones – amount and size	Water holding capacity, weathering status, erosional/depositional character
Roots – amount and size	Effective rooting depth, vegetative sustainability
Ants, termites, worms etc.	Biological mixing depth

Key soil chemical parametres will be assessed as related to each secondary domain's completion criteria and may include parametres as described below in **Table 24**. Soil samples are to be sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis

Table 24 Key Laboratory Assessed Soil Chemical Parameters

Laboratory Suite	Sampling Frequency	Laboratory Analysis
All land uses	Every major soil horizon	• Electrical conductivity • pH • Chloride exchangeable cations & total cation exchange capacity • Colour • Particle size analysis • Emerson Aggregate Test
Agricultural topsoil suite	Surface soils horizon only (generally a topsoil sample depth of 0–0.1 m)	• Micronutrients • Sulphur • Total nitrogen • Total phosphorous • Total potassium • Organic carbon
Agricultural subsoil suite	Every major soil horizon	• PAWC • Available (reactive) phosphorus • Available Potassium • Sulphur

10.1.5 Floristics Survey

The floristics survey should aim to monitor changes in particular plants and groups of plants through the various successional phases and should document and/or identify critical changes or management actions required.

The survey should include quantitative data that measures changes in:

- Floristic diversity including species area curves and growth forms;
- Ground cover diversity and abundance;
- Vegetation structure and habitat characteristics;
- Understorey density and growth (including established shrubs, direct seeding, tubestock plantings and tree regeneration);
- Overstorey characteristics including tree density, health and survival; and
- If relevant, other habitat attributes such as the presence of hollows, mistletoe and the production of flowers and seed.

Some simple and rapid procedures for making these assessments were developed by CSIRO scientists (Gibbons 2002, Gibbons et al 2008) to assess habitat quality across a range of vegetation types in the southern NSW Murray-Darling Basin and later developed the Biometric Model (now known as the BioBanking model).

The BioBanking monitoring methodology is a standard and simple procedure that can be easily replicated over any vegetation community or revegetation area. It is the accepted methodology by OEH to assess the biodiversity value of land for determining the biodiversity value of the land with regards to biodiversity offsets.

BioBanking is a field-based monitoring procedure that uses a fixed transect to collect relevant floristics and habitat structure information. The standard transect is a 20 x 50 m plot. Used in conjunction with the LFA transect, it is recommended that the BioBanking transect be positioned across the slope such that the base line forms the basis for the LFA transect which must face down slope. The vegetation monitoring occurs along the 50 m transect situated at the 10 m interval that runs perpendicular to the LFA transect.

Full detail of this procedure is available within *Framework for Biodiversity Assessment* (OEH, 2014).

10.1.6 Permanent Monitoring Point

Transects, where possible, will be established as permanent transect position. GPS readings will be taken to ensure quadrats can be relocated over time and photo points are to be established at various marker pegs along the transect/quadrat.

10.2 Monitoring Methodology for Secondary Domains

In accordance with the key monitoring methodology steps (refer **Section 10.1.2**), the monitoring program for all secondary domains will consist of:

- LFA which includes an erosion assessment;
- Intrusive soil analyses; and
- Floristics assessment.

Further details on the monitoring methodology for each secondary domain, as considered relevant at this EIS stage, are provided in the following sub-sections. Details are considered preliminary with input from future rehabilitation trials and scientific organisations required prior to the completion of the monitoring protocol and inclusion in the Projects MOP.

10.2.1 Secondary Domain A – Grazing Land

To assess the success of the post-mining landform for use as grazing land the following measures/criteria are recommended to be included in the monitoring program:

- A vigorous perennial grass and annual legume pasture, comprising approximately 80% perennial grass and 20% annual legume;
- Obtain a year round pasture groundcover of greater than 70%;
- Broadleaf weeds to comprise less than 10% of the pasture sward (such as Paterson's curse, purple top, catheads, farmers friend, turnip weed and wireweed, which have previously been identified in the Agricultural Productivity Audits (SLR, 2014));
- Grass weeds to comprise less than 10% of the pasture sward (such as silver grass, liverseed grass, black grass and barley grass, which have previously been identified in the Agricultural Productivity Audits (SLR, 2014));
- Dry matter yields to be within 10% of the reference site, given similar pasture species composition and density. Dry matter production is proposed to be used as a measure rather than stocking rate as stocking rates (and DSE) are much more variable depending upon season and more difficult to quantify;
- Soil element completion target measures will be developed using a combination of the ideal range for soil elements and those measured at the reference site/s, where there is a vigorous perennial grass and annual clover based pasture currently established. Soil nutrient levels are to meet the minimum rehabilitation targets shown in **Table 25** and where relevant the success criteria for LSC Class 4 and /or 5 lands;
- Established monitoring sites should be monitored twice a year (Autumn and Spring) for the first three years after establishment and then annually thereafter; and
- Annual walkthrough of all rehabilitated areas will be undertaken to assess the general progress of completed rehabilitation and to identify areas where corrective action is necessary. This assessment will have very simple objectives relating to native vegetation, weeds, surface rock, surface water management and erosion control structures. This walkthrough assessment will identify any problems such as failure of a contour drain, localized slope erosion, failed vegetation areas and will provide an action list leading to the correction of the problem.

Table 25 Grazing Land Soil Nutrient Level Rehabilitation Targets (Example)

Soil Element	Nutrient Measure & Test	Reference Site Soil Test	Ideal Soil Element Range	Completion Target Measure
pH	1:5 CaCl2		Between 5.2 – 8.0	Between
Potassium	% of Total CEC		Greater than 2%	Greater than
Sodium	% of Total CEC		Less than 3%	Less than
Aluminium	% of Total CEC		Less than 5%	Less than
Sulphur	mg/kg KCl 40 S		Greater than 8	Greater than
Phosphorus	mg/kg Bray-1		Greater than 15	Greater than
Nitrogen	mg/kg Water Extract		Greater than 10	Greater than
Zinc	mg/kg DTPA		Greater than 1	Greater than
Calcium	Calcium to Magnesium Ratio		Greater than 3	Greater than

10.2.2 Secondary Domain B – Cropping/BSAL Land

To assess the success of the post-mining landform for use as cropping land the following measures/criteria are recommended to be includes in the monitoring program:

- Crop production yields to be within 10% of the reference site, given similar cropping species composition and density;
- Reference sites will be selected prior to the commencement of the initial rehabilitation campaign. Sites will be sourced from the adjacent KEPCO owned farming land which will be operated as a production farming enterprise;
- Soil element completion target measures will be developed using a combination of the ideal range for soil elements and those measured at the reference site/s. Soil nutrient levels are to meet the minimum rehabilitation targets and the success criteria for LSC Class 3 lands;
- Established monitoring sites should be monitored twice a year for the first three years after establishment and then annually thereafter; and
- Annual walkthrough of all rehabilitated areas will be undertaken to assess the general progress of completed rehabilitation and to identify areas where corrective action is necessary. This assessment will have very simple objectives relating to native vegetation, weeds, surface rock, surface water management and erosion control structures. This walkthrough assessment will identify any problems such as failure of a contour drain, localised slope erosion, failed vegetation areas and will provide an action list leading to the correction of the problem.

10.2.3 Secondary Domain C - Woodland Areas

To assess the success of the post-mining landform for use as woodland the following measures/criteria are recommended to be includes in the monitoring program:

- Reference sites will be selected prior to the commencement of the initial rehabilitation campaign. Sites will be sourced from the land identified in the Biodiversity Offsets Strategy.
- Soil element completion target measures will be developed using a combination of the ideal range for soil elements and those measured at the reference site/s. Soil nutrient levels are to meet the minimum rehabilitation targets and the success criteria for LSC Classes 6 or 7 lands as appropriate.

- Annual walkthrough of all rehabilitated areas will be undertaken to assess the general progress of completed rehabilitation and to identify areas where corrective action is necessary. This assessment will have very simple objectives relating to native vegetation, weeds, surface rock, surface water management and erosion control structures. This walkthrough assessment will identify any problems such as failure of a contour drain, localised slope erosion, failed vegetation areas and will provide an action list leading to the correction of the problem.

- Established monitoring sites should be monitored annually.

10.3 Research and Trials

While this Rehabilitation Strategy provides considerable detail on the proposed revegetation strategy further trials and ongoing research will be necessary to fine tune the revegetation strategy.

10.3.1 Secondary Domain A - Grazing Land

It is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

10.3.2 Secondary Domain B - Cropping Land

It is proposed that a trial plot for BSAL/LSC Class 3 land is established within or proximal to the Project Boundary. The trial plot should be A 50 m x 100 m trial plot simulating LSC Class 3 land will be constructed within the Project Boundary.

The plot will be used to assess the acceptability of the proposed soil profile depth for use in the LSC Class 3 land to carry out trials to assess yields and to establish the effect of handling techniques and deep ripping.

10.3.3 Secondary Domain C - Woodland

The following issues will be examined in trials and ongoing research as soon as the first recontoured and topsoiled areas become available for revegetation.

- *Extent of Weeds* - Extent of weed emergence on the different respread topsoil types across the mine is currently unknown. The purpose of this trial will be to both assess the nature and level of weed emergence as well is their effect on native species and to develop strategies which will reduce the competitive effects of weeds on sown/planted native species.

- *Germination and Establishment of Native Seed* - There has been no history of mine site revegetation in the Bylong area. In particular, many of the *understorey* species have complex dormancy mechanisms which need to be overcome before wide spread use of this seed is possible. Trials on different topsoil materials will examine the germination and suitability of different species both singularly and in combination with other species in direct seeding programs.

- *Species Proportions and Densities* - Various ratios of sown and planted seedlings will be tested in order to assess the optimum ratios for each community.

- *Re-emergence of Native Grasses* - The emergence and persistence of native grasses (occurring naturally in topsoil) will be examined over time as well as their success when artificially sown. This will provide guidance as to the extent to which native grasses will need to be incorporated into the original sowing mix.

- *Fertiliser Alternatives and Soil Amelioration* - The extent of weed reinvasion will determine whether fertiliser alternatives (such as kitty litter) will be needed to reduce weed competition. At this time, it is not proposed to use fertiliser when direct seeding native species due to likely enhancement of weed competition. Similarly, the benefits of different soil ameliorants such as gypsum and mulched timber will also be examined for their potential to enhance preferred community establishment and stability.

- *Mulching of Felled Timber* – At this point in time it is proposed to mulch approximately 30% of standing timber and incorporate and blend the mulch with topsoil in the topsoil stripping process. However, it is also planned to investigate the option of separately collecting, stockpiling and composting mulch prior to respreading onto top-dressed rehabilitation areas. There are benefits in both methods. The ratio of timber mulched, compared to that left and reused as coarse timber, will also be examined.

11 INTERVENTION AND ADAPTIVE MANAGEMENT

Where rehabilitation monitoring indicates that rehabilitation outcomes are not trending toward the nominated completion criteria, KEPCO will instigate early intervention and adaptive management to minimise the potential for rehabilitation failure.

Intervention and adaptive management tools such as Trigger Action Response Plans (TARPs) can be used to clearly identify the levels at which management response to unexpected events, such as a flood or drought or poor rehabilitation performance, is required. The overall advantage of developing a TARP is that it provides a summary of the considered and planned early responses if monitoring indicates that a trend towards unacceptable levels of risk is occurring. Accurate identification of trigger levels provide for early responses to emerging risks to rehabilitation. As with monitoring indicators against completion criteria, monitoring against trigger levels is also required.

Identification of threats to rehabilitation and the subsequent intervention is discussed in the sections below.

11.1 Threats to Rehabilitation

Where rehabilitation performance is not trending to the nominated completion criteria, this may indicate that there is a threat to long term rehabilitation success. Threats to rehabilitation may include events such as periods of drought, bushfire events, flooding, or pressures from weeds and/or feral animals.

Table 26 provides examples of key threats to rehabilitation. Where rehabilitation monitoring indicates that there is a significant threat to rehabilitation KEPCO will undertake adaptive management in accordance with the developed TARPs.

Table 26 Key Threats to Rehabilitation

Threat	Cause/s
Bushfire	Seasonal influences (temperature, rainfall) Increased fuel loads Proximity to State Forest and National Parks
Stability of the final landform	Geochemical characteristics of final landform substrate Inadequate final void design Steep slopes Inadequate vegetative cover
Flooding related geotechnical instability or erosion events	Major storm events
Rehabilitation / revegetation failure	Extreme or prolonged drought Soil nutrient deficiencies or chemical imbalances Weed invasion or predation by vertebrate pests

11.2 Trigger Action Response Plans

The following TARPs for rehabilitation are preliminary and have been developed to identify when required management actions are required in the event that rehabilitation outcomes/trends are not achieved in an acceptable timeframe. These TARPs have been based on the proposed rehabilitation completion criteria (refer **Section 7**). KEPCO will further develop the TARPs in consultation with stakeholders and experts in relevant fields (rehabilitation professionals, ecological consultants, subsidence engineers etc.).

TARPs will be regularly reviewed by the Environmental Manager with advice from the Project's Agriculture manager sought as appropriate. Where necessary, rehabilitation procedures will be amended accordingly with the aim of continually improving rehabilitation standards. KEPCO will notify the DTIRIS and other relevant stakeholders of any incident resulting in major impacts to rehabilitation.

TARPs for each LSC Class are provided below and will be reviewed and revised as Development Consent conditions change or new threats to rehabilitation are identified.

Table 27 TARP – LSC Class 3/BSAL land (Cropping land use)

Key Element	Trigger/ Response	Condition Green	Condition Amber	Condition Red
Slope gradient	Trigger	Reinstated land has slopes that are generally <10%.	Reinstated land has slopes that have slopes >10% but <12%.	Reinstated land has slopes that are >12%.
	Response	No response required. Continue monitoring program.	Undertake regrading of the area so that reinstated land is <10%.	Undertake a review of the landform design, including survey if required. Undertake regrading of the area.
Soil depth	Trigger	Secondary media (subsoil) > 0.6m overlain by > 0.25m topsoil.	Secondary media (subsoil) is < 0.6m but > 0.5m, overlain by < 0.25m but > 0.2m topsoil.	Secondary media (subsoil) is < 0.5m, overlain by < 0.2m.
	Response	No response required. Continue monitoring program.	Apply an additional 100mm of subsoil to the area and / or an additional 50mm of topsoil to attain the required depth thresholds.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional soil to the area to attain the minimum depth thresholds.
Surface rock	Trigger	Surface rock (<60mm diameter) <20%.	Surface rock (<60mm diameter) >20% but <25%.	Surface rock (<60mm diameter) >25%.
	Response	No response required. Continue monitoring program.	Rock rake the area and remove surplus rock to achieve <20% rock (<60mm diameter) threshold.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing. Rock rake the area and remove surplus rock to achieve <20% rock (<60mm diameter) threshold.
Rooting depth	Trigger	Effective rooting depth to a physical barrier (i.e. bedrock, gravel layer) is >750mm	Effective rooting depth to a physical barrier is <750mm but >650mm.	Effective rooting depth to a physical barrier is <650mm.
	Response	No response required. Continue monitoring program.	Apply an additional 100mm of topsoil to the area to attain the minimum effective rooting depth threshold of 750mm.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional topsoil to the area to attain the minimum effective rooting depth threshold of 750mm.

Key Element	Trigger/ Response	Condition Green	Condition Amber	Condition Red
Soil drainage	Trigger	Soil drainage is better than poor.	Reinstated land exhibiting minor drainage issues but does not threaten to cause crop failure.	Reinstated land exhibiting poor drainage, causing crop failure.
	Response	No response required. Continue monitoring program.	A suitably trained person to inspect the site. Investigate opportunities to address issues. Rectify as appropriate.	Undertake a review of the drainage design and provide recommendations to appropriately rectify the area and do so as soon as practicable.
pH	Trigger	Soil pH within upper 600mm <8.9 but >5.0	Soil pH within upper 600mm is slightly >8.9 or <5.0	Soil pH within upper 600mm is >9.3 or <4.7
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.
Soil salinity	Trigger	ECe is <4 dS/m or if gypsum is present, chlorides less than 800 mg/kg within upper 600mm of soil profile	ECe is > 4.5 dS/m or if gypsum is present, chlorides >900 mg/kg within upper 600mm of soil profile	ECe is > 5 dS/m or if gypsum is present, chlorides >1,000 mg/kg within upper 600mm of soil profile
	Response	No response required. Continue monitoring program.	Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.	Undertake a review of the reinstatement process, including topsoil sourcing. Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.

Key Element	Trigger/ Response	Condition Green	Condition Amber	Condition Red
Sodicity	Trigger	Exchangeable Na% (ESP) in topsoil <15%	ESP in topsoil >15% but <17%	ESP in topsoil >17%
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15%.	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15%.
Agricultural productivity	Trigger	Land is useable as a functioning agricultural system as per the Class 3 LSC parameters with yield similar or exceeding known yield of local Class 3 agricultural enterprises.	Land is useable as a functioning agricultural system as per the Class 3 LSC parameters with yield <10% reduction of known yield of local Class 3 agricultural enterprises.	Land is useable as a functioning agricultural system as per the Class 3 LSC parameters with yield >10% reduction of known yield of local Class 3 agricultural enterprises.
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for production improvements so that it is similar or exceeding known production of local Class 3 agricultural enterprises.	Engage a consultant to recommend appropriate measures to improve production so that it is similar or exceeding known production of local Class 3 agricultural enterprises. All recommendations shall be implemented.

Table 28 TARP – LSC Class 4 (Grazing land use)

Key Element	Trigger/ Response	Condition Green	Condition Amber	Condition Red
Slope gradient	Trigger	Rehabilitated land has slopes that are generally <20%.	Rehabilitated land has slopes that have slopes >20% but <25%.	Rehabilitated land has slopes that are >25%.
	Response	No response required. Continue monitoring program.	Undertake regrading of the area so that rehabilitated land is <20%.	Undertake a review of the landform design, including survey if required. Undertake regrading of the area.
Soil depth	Trigger	Secondary media (subsoil) > 0.4m overlain by > 0.2m topsoil.	Secondary media (subsoil) is < 0.4m but > 0.3m, overlain by < 0.2m but > 0.1m topsoil.	Secondary media (subsoil) is < 0.3m, overlain by < 0.1m.
	Response	No response required. Continue monitoring program.	Apply an additional 100mm of subsoil to the area and / or an additional 100mm of topsoil to attain the required depth thresholds.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional soil to the area to attain the minimum depth thresholds.
Surface rock	Trigger	Surface rock <40%.	Surface rock >40% but <50%.	Surface rock >50%.
	Response	No response required. Continue monitoring program.	Rock rake the area and remove surplus rock to achieve <40% rock threshold.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing. Rock rake the area and remove surplus rock to achieve <40% rock threshold.
Soil drainage	Trigger	Soil drainage is better than poor.	Reinstated land exhibiting minor drainage issues but does not threaten to cause pasture failure.	Reinstated land exhibiting poor drainage, causing pasture failure.
	Response	No response required. Continue monitoring program.	A suitably trained person to inspect the site. Investigate opportunities to address issues. Rectify as appropriate.	Undertake a review of the drainage design and provide recommendations to appropriately rectify the area and do so as soon as practicable.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
pH	Trigger	Topsoil pH <8.0 but >4.7	Topsoil pH is slightly >8.0 or <4.7	Topsoil pH is >8.5 or <4.5
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.
Soil salinity	Trigger	Topsoil ECe is <4 dS/m	Topsoil ECe is > 4.5 dS/m	Topsoil ECe is > 5 dS/m
	Response	No response required. Continue monitoring program.	Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.	Undertake a review of the reinstatement process, including topsoil sourcing. Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.
Sodicity	Trigger	Exchangeable Na% (ESP) in topsoil < 8% (adjusted according to texture).	ESP in topsoil >8% but <12% (adjusted according to texture).	ESP in topsoil >12% (adjusted according to texture).

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <8% (adjusted according to texture).	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <8% (adjusted according to texture).
Ground cover	Trigger	Five years following revegetation, a minimum of 70% total ground cover (vegetation, leaf litter, mulch) is present within rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) of between 50-70% in rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) is <50% within rehabilitated areas.
	Response	No response required. Continue monitoring program.	Review procedures where required to increase vegetation cover.	A suitably trained person to inspect the site. Investigate use of appropriate management options to remediate. Remediate as appropriate.
Weed presence	Trigger	Twelve months following revegetation, no significant weed infestations present.	Twelve months following revegetation, >10% but <25% cover of undesirable species present.	Twelve months following revegetation, >25% cover of undesirable species present.
	Response	No response required. Continue monitoring program.	Engage weed management contractor to remove introduced species from the site.	Engage weed management contractor to remove introduced species from the site as soon as practicable. Investigate management measures to assist native plant establishment including use of ameliorants and implement as appropriate.
Species composition	Trigger	Five years following revegetation to grassland, species composition consists of grasses and legumes appropriate to the district and recognised as suitable for beef cattle grazing and consistent with target species.	Five years following revegetation to grassland, <75% of grasses and legumes in the area are consistent with target species.	Five years following revegetation to grassland, species composition comprises <50% consistency with target species.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
	Response	No response required. Continue monitoring program.	Investigate additional weeding and re-seeding where required and ensure seed mix utilised is consistent with desired species composition.	An inspection of the site will be undertaken by a suitably trained person. Investigate remedial options to achieve required species composition.
Agricultural productivity	Trigger	Land is useable as a functioning agricultural system as per the Class 4 LSC parameters with production similar or exceeding known production of local Class 4 agricultural enterprises.	Land is useable as a functioning agricultural system as per the Class 4 LSC parameters with production <10% reduction of known production of local Class 4 agricultural enterprises.	Land is useable as a functioning agricultural system as per the Class 4 LSC parameters with production >10% reduction of known production of local Class 4 agricultural enterprises.
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for production improvements so that it is similar or exceeding known production of local Class 4 agricultural enterprises.	Engage a consultant to recommend appropriate measures to improve production so that it is similar or exceeding known production of local Class 4 agricultural enterprises. All recommendations shall be implemented.
Damage to Rehabilitation	Trigger	Fuel loads are assessed and managed as required (including maintaining fire-breaks) and there is firefighting access across rehabilitation areas and water resources available for fighting fires.	Monitoring indicates fuel loads have not been managed and fire breaks have not been maintained. In the event of a fire, this would result in firefighters not being able to access the site or water resources.	A fire on site damages rehabilitated areas.
	Response	No response required. Continue monitoring program.	Reduce fuel loads and ensure access tracks are cleared. Inspect water sources are and ensure sufficient water is available.	Review and update (if required) the Bushfire Management Plan to ensure monitoring and maintenance is completed for fuel loads, access tracks, and water bodies.

Table 29 TARP – LSC Class 5 (Grazing land use)

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Slope gradient	Trigger	Rehabilitated land has slopes that are generally <20%.	Rehabilitated land has slopes that have slopes >20% but <25%.	Rehabilitated land has slopes that are >25%.
	Response	No response required. Continue monitoring program.	Undertake regrading of the area so that rehabilitated land is <20%.	Undertake a review of the landform design, including survey if required. Undertake regrading of the area.
Soil depth	Trigger	Secondary media (subsoil) > 0.4m overlain by > 0.1m topsoil.	Secondary media (subsoil) is < 0.4m but > 0.3m, overlain by < 0.1m but > 0.05m topsoil.	Secondary media (subsoil) is < 0.3m, overlain by < 0.05m.
	Response	No response required. Continue monitoring program.	Apply an additional 100mm of subsoil to the area and / or an additional 50mm of topsoil to attain the required depth thresholds.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional soil to the area to attain the minimum depth thresholds.
Surface rock	Trigger	Surface rock <40%.	Surface rock >40% but <50%.	Surface rock >50%.
	Response	No response required. Continue monitoring program.	Rock rake the area and remove surplus rock to achieve <40% rock threshold.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing. Rock rake the area and remove surplus rock to achieve <40% rock threshold.
Soil drainage	Trigger	Soil drainage is better than poor.	Reinstated land exhibiting minor drainage issues but does not threaten to cause pasture failure.	Reinstated land exhibiting poor drainage, causing pasture failure.
	Response	No response required. Continue monitoring program.	A suitably trained person to inspect the site. Investigate opportunities to address issues. Rectify as appropriate.	Undertake a review of the drainage design and provide recommendations to appropriately rectify the area and do so as soon as practicable.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
pH	Trigger	Topsoil pH <8.0 but >4.7	Topsoil pH is slightly >8.0 or <4.7	Topsoil pH is >8.5 or <4.5
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to increase pH (e.g. lime addition) or reduce pH (high sulphur fertiliser) to within pH threshold limits.
Soil salinity	Trigger	Topsoil ECe is <4 dS/m	Topsoil ECe is > 4.5 dS/m	Topsoil ECe is > 5 dS/m
	Response	No response required. Continue monitoring program.	Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.	Undertake a review of the reinstatement process, including topsoil sourcing. Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.
Sodicity	Trigger	Exchangeable Na% (ESP) in topsoil < 15% (adjusted according to texture).	ESP in topsoil >15% but <17% (adjusted according to texture).	ESP in topsoil >17% (adjusted according to texture).

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15% (adjusted according to texture).	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15% (adjusted according to texture).
Ground cover	Trigger	Five years following revegetation, a minimum of 70% total ground cover (vegetation, leaf litter, mulch) is present within rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) of between 50-70% in rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) is <50% within rehabilitated areas.
	Response	No response required. Continue monitoring program.	Review procedures where required to increase vegetation cover.	A suitably trained person to inspect the site. Investigate use of appropriate management options to remediate. Remediate as appropriate.
Weed presence	Trigger	Twelve months following revegetation, no significant weed infestations present.	Twelve months following revegetation, >10% but <25% cover of undesirable species present.	Twelve months following revegetation, >25% cover of undesirable species present.
	Response	No response required. Continue monitoring program.	Engage weed management contractor to remove introduced species from the site.	Engage weed management contractor to remove introduced species from the site as soon as practicable. Investigate management measures to assist native plant establishment including use of ameliorants and implement as appropriate.
Species composition	Trigger	Five years following revegetation to grassland, species composition consists of grasses and legumes appropriate to the district and recognised as suitable for beef cattle grazing and consistent with target species.	Five years following revegetation to grassland, <75% of grasses and legumes in the area are consistent with target species.	Five years following revegetation to grassland, species composition comprises <50% consistency with target species.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
	Response	No response required. Continue monitoring program.	Investigate additional weeding and re-seeding where required and ensure seed mix utilised is consistent with desired species composition.	An inspection of the site will be undertaken by a suitably trained person. Investigate remedial options to achieve required species composition.
Damage to Rehabilitation	Trigger	Fuel loads are assessed and managed as required (including maintaining fire-breaks) and there is firefighting access across rehabilitation areas and water resources available for fighting fires.	Monitoring indicates fuel loads have not been managed and fire breaks have not been maintained. In the event of a fire, this would result in firefighters not being able to access the site or water resources.	A fire on site damages rehabilitated areas.
	Response	No response required. Continue monitoring program.	Reduce fuel loads and ensure access tracks are cleared. Inspect water sources are and ensure sufficient water is available.	Review and update (if required) the Bushfire Management Plan to ensure monitoring and maintenance is completed for fuel loads, access tracks, and water bodies.

Table 30 TARP – LSC Class 6 (Woodland land use)

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Slope gradient	Trigger	Rehabilitated land has slopes that are generally <33%.	Rehabilitated land has slopes that have slopes >33% but <40%.	Rehabilitated land has slopes that are >40%.
	Response	No response required. Continue monitoring program.	Undertake regrading of the area so that rehabilitated land is <33%.	Undertake a review of the landform design, including survey if required. Undertake regrading of the area.
Soil depth	Trigger	Secondary media (subsoil) > 0.2m overlain by > 0.1m topsoil.	Secondary media (subsoil) is < 0.2m but > 0.1m, overlain by < 0.1m but > 0.05m topsoil.	Secondary media (subsoil) is < 0.1m, overlain by < 0.05m.
	Response	No response required. Continue monitoring program.	Apply an additional 100mm of subsoil to the area and / or an additional 50mm of topsoil to attain the required depth thresholds.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional soil to the area to attain the minimum depth thresholds.
Surface rock	Trigger	Surface rock <40%.	Surface rock >50% but <70%.	Surface rock >70%.
	Response	No response required. Continue monitoring program.	Rock rake the area and remove surplus rock to achieve <50% rock threshold.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing. Rock rake the area and remove surplus rock to achieve <50% rock threshold.
Soil drainage	Trigger	Soil drainage is better than poor.	Reinstated land exhibiting minor drainage issues but does not threaten to cause pasture failure.	Reinstated land exhibiting poor drainage, causing pasture failure.
	Response	No response required. Continue monitoring program.	A suitably trained person to inspect the site. Investigate opportunities to address issues. Rectify as appropriate.	Undertake a review of the drainage design and provide recommendations to appropriately rectify the area and do so as soon as practicable.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Soil salinity	Trigger	Topsoil ECe is <4 dS/m	Topsoil ECe is > 4.5 dS/m	Topsoil ECe is > 5 dS/m
	Response	No response required. Continue monitoring program.	Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.	Undertake a review of the reinstatement process, including topsoil sourcing. Engage a consultant to recommend appropriate measures to reduce soil EC (e.g. deep ripping to encourage salt leaching). Undertake consultant recommendations where possible and viable.
Sodicity	Trigger	Exchangeable Na% (ESP) in topsoil < 15% (adjusted according to texture).	ESP in topsoil >15% but <17% (adjusted according to texture).	ESP in topsoil >17% (adjusted according to texture).
	Response	No response required. Continue monitoring program.	Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15% (adjusted according to texture).	Undertake a review of the reinstatement process, including topsoil sourcing. Undertake analytical soil testing and results evaluation. Where appropriate implement recommendations for amelioration to reduce sodicity (e.g. gypsum addition) so that ESP <15% (adjusted according to texture).
Ground cover	Trigger	Five years following, a minimum of 70% total ground cover (vegetation, leaf litter, mulch) is present within rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) of between 50-70% in rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) is <50% within rehabilitated areas.
	Response	No response required. Continue monitoring program.	Review procedures where required to increase vegetation cover.	A suitably trained person to inspect the site. Investigate use of appropriate management options to remediate. Remediate as appropriate.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Weed presence	Trigger	Twelve months following revegetation, no significant weed infestations present.	Twelve months following revegetation, >10% but <25% cover of undesirable species present.	Twelve months following revegetation, >25% cover of undesirable species present.
	Response	No response required. Continue monitoring program.	Engage weed management contractor to remove introduced species from the site.	Engage weed management contractor to remove introduced species from the site as soon as practicable. Investigate management measures to assist native plant establishment including use of ameliorants and implement as appropriate.
Species composition	Trigger	Five years following revegetation to grassland, species composition consists of grasses and legumes appropriate to the district and recognised as suitable for beef cattle grazing and consistent with target species.	Five years following revegetation to grassland, <75% of grasses and legumes in the area are consistent with target species.	Five years following revegetation to grassland, species composition comprises <50% consistency with target species.
	Response	No response required. Continue monitoring program.	Investigate additional weeding and re-seeding where required and ensure seed mix utilised is consistent with desired species composition.	An inspection of the site will be undertaken by a suitably trained person. Investigate remedial options to achieve required species composition.
Damage to Rehabilitation	Trigger	Fuel loads are assessed and managed as required (including maintaining fire-breaks) and there is firefighting access across rehabilitation areas and water resources available for fighting fires.	Monitoring indicates fuel loads have not been managed and fire breaks have not been maintained. In the event of a fire, this would result in firefighters not being able to access the site or water resources.	A fire on site damages rehabilitated areas.
	Response	No response required. Continue monitoring program.	Reduce fuel loads and ensure access tracks are cleared. Inspect water sources are and ensure sufficient water is available.	Review and update (if required) the Bushfire Management Plan to ensure monitoring and maintenance is completed for fuel loads, access tracks, and water bodies.

Table 31 TARP – LSC Class 7 (Woodland land use)

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Slope gradient	Trigger	Rehabilitated land has slopes that are generally <50%.	Rehabilitated land has slopes that have slopes >50% but <60%.	Rehabilitated land has slopes that are >60%.
	Response	No response required. Continue monitoring program.	Undertake regrading of the area so that rehabilitated land is <50%.	Undertake a review of the landform design, including survey if required. Undertake regrading of the area.
Soil depth	Trigger	Topsoil depth > 0.1m topsoil.	Topsoil depth < 0.1m but > 0.05m.	Topsoil depth < 0.05m.
	Response	No response required. Continue monitoring program.	Apply an additional 50mm of topsoil to attain the required depth thresholds.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing and placement. Apply additional soil to the area to attain the minimum depth thresholds.
Surface rock	Trigger	Surface rock <70%.	Surface rock >70% but <80%.	Surface rock >80%.
	Response	No response required. Continue monitoring program.	Rock rake the area and remove surplus rock to achieve <70% rock threshold.	Undertake a review of the reinstatement process, including topsoil and subsoil sourcing. Rock rake the area and remove surplus rock to achieve <70% rock threshold.
Soil drainage	Trigger	Soil drainage is better than poor.	Reinstated land exhibiting minor drainage issues but does not threaten to cause vegetation failure.	Reinstated land exhibiting poor drainage, causing vegetation failure.
	Response	No response required. Continue monitoring program.	A suitably trained person to inspect the site. Investigate opportunities to address issues. Rectify as appropriate.	Undertake a review of the drainage design and provide recommendations to appropriately rectify the area and do so as soon as practicable.

Key Element	Trigger Response	Condition Green	Condition Amber	Condition Red
Ground cover	Trigger	Five years following, a minimum of 70% total ground cover (vegetation, leaf litter, mulch) is present within rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) of between 50-70% in rehabilitated areas.	Five years following revegetation, total ground cover (vegetation, leaf litter, mulch) is <50% within rehabilitated areas.
	Response	No response required. Continue monitoring program.	Review procedures where required to increase vegetation cover.	A suitably trained person to inspect the site. Investigate use of appropriate management options to remediate. Remediate as appropriate.
Weed presence	Trigger	Twelve months following revegetation, no significant weed infestations present.	Twelve months following revegetation, >10% but <25% cover of undesirable species present.	Twelve months following revegetation, >25% cover of undesirable species present.
	Response	No response required. Continue monitoring program.	Engage weed management contractor to remove introduced species from the site.	Engage weed management contractor to remove introduced species from the site as soon as practicable. Investigate management measures to assist native plant establishment including use of ameliorants and implement as appropriate.
Damage to Rehabilitation	Trigger	Fuel loads are assessed and managed as required (including maintaining fire-breaks) and there is firefighting access across rehabilitation areas and water resources available for fighting fires.	Monitoring indicates fuel loads have not been managed and fire breaks have not been maintained. In the event of a fire, this would result in firefighters not being able to access the site or water resources.	A fire on site damages rehabilitated areas.
	Response	No response required. Continue monitoring program.	Reduce fuel loads and ensure access tracks are cleared. Inspect water sources are and ensure sufficient water is available.	Review and update (if required) the Bushfire Management Plan to ensure monitoring and maintenance is completed for fuel loads, access tracks, and water bodies.

12 BSAL REINSTATEMENT SUMMARY

This section summarises the issues and tasks completed to address the BSAL reinstatement requirements within the Project Boundary.

12.1 Risks to BSAL Reinstatement

In accordance with the ESD Guideline, risk can be defined as the 'chance of something happening that will have an impact on objectives'. Risks to the successful reinstatement have been considered with regards to identifying site specific issues or constraints that require specific management to ensure that the BSAL rehabilitation objectives can be met. The risks identified will to some extent guide the environmental management strategies employed over the life of the mine.

The main risks identified for BSAL reinstatement works are:

- Insufficient land appropriate for BSAL reinstatement works within Project Boundary;
- Insufficient soil resources to undertake BSAL re-instatement works;
- Loss or damage of soil resources through inappropriate soil handling procedures;
- BSAL reinstatement failure; and
- Few Australian precedents on successful reinstatement of cropping land.

12.2 Summary of Risk Minimisation Measures

The risk minimisation measures identified to address the identified risks are summarised in **Table 32** below.

Table 32 Key Risk to BSAL Reinstatement Works

Risk	Avoided/ mitigated/ compensated	Details	Where addressed in this document
Permanent loss of BSAL	Yes	BSAL avoided where possible. Commitment to reinstate equivalent quantity of BSAL that is proposed to be directly and permanently impacted upon	**Section 3.2.2**
Insufficient land appropriate for BSAL reinstatement works within Project Boundary	Yes	Appropriate location for BSAL reinstatement identified on the final rehabilitated landform	**Section 6.3**
Insufficient soil resources to undertake BSAL re-instatement works	Yes	Sufficient soil resources are available for BSAL re-instatement works	**Section 8.4.1**
Loss of soil resources through inappropriate soil handling procedures	Yes	Soil handling and stockpile management protocols have been identified.	**Section 9.3**
BSAL reinstatement failure	Yes	BSAL rehabilitation monitoring program has been developed to ensure that progress is	**Section 10**

Risk	Avoided/ mitigated/ compensated	Details	Where addressed in this document
		monitored and continuous improvement occurs based on BSAL reinstatement success and failures.	
Insufficient peer reviewed literature on successful reinstatement of BSAL	Yes	BSAL rehabilitation monitoring program includes BSAL reinstatement trials that will run in conjunction with research instructions.	**Section 10**

12.3 Conclusion

The successful establishment of BSAL is dependent upon the execution of a detailed BSAL reinstatement plan which outlines specific soil handling and replacement techniques and strict rehabilitation monitoring protocols. Should the monitoring trends indicate that the BSAL establishment trajectory is unfavourable TARPs will implemented (Section 11.2) to address this situation and ensure that the proposed rehabilitation objectives are met.

13 FINAL VOID MANAGEMENT PLAN AND CO-DISPOSAL OF REJECTS

Open-cut mining commonly leaves an open pit (final void) at the end of operations. However, for this Project, there will be no final void left at closure. This outcome results from:

- The void associated with the Western Open Cut areas will be completed backfilled in the early years of the Project primarily using overburden from the Western Open Cut and Eastern Open Cut Mining Areas.

- The void associated with the Eastern Open Cut void will be backfilled using dewatered fine and coarse reject materials from the underground mining operations which continues after the open cut operations are completed.

To ensure voids are completely backfilled appropriately with and without the co-disposal of overburden the following actions area required:

- Ensure that all carbonaceous material, potentially acid forming material (PAF) and highly dispersive or highly sodic materials are buried at depth in the backfill. Non-sodic and low sodicity material will be selectively handled for use to construct the outer layers of the backfill. Surface layers of the backfill may require additional amelioration such as the addition of coarse gypsum to minimise erosion.

- Overburden/interburden and rejects will be handled to identify and selectively handle suitable material to construct the surface layers of the backfill. Capping of the subsurface, prior to topsoiling activities, with suitable materials to be applied as deemed appropriate by the materials characterisation assessment.

- The landform will be re-shaped in accordance with the final landform design to ensure that it is safe, stable and free-draining.

- The landform will be rehabilitated in accordance with the rehabilitation strategy to ensure that the post-mining land use is achieved.

- Groundwater monitoring during operations will provide valuable data for final void design, the final void configuration and depths. This information will be detailed in the mine closure plan that will be prepared in Year 15, five years before closure.

14 REHABILITATION STRATEGY REVIEW AND REPORTING

14.1 Rehabilitation Strategy Review

This Rehabilitation Strategy has been developed as a dynamic document. While it has initially been prepared for the Project's EIS, it will be continually reviewed and updated throughout the life of the Project. Five years prior to mine closure, a more detailed mine closure plan will be prepared (refer Section **14.3**). Throughout the life of the Project, the key triggers for a review of this strategy will include, but not be limited to:

- Issue of the Development Consent (i.e. amendments to reflect any additional requirements that might be included in the conditions of approval);
- Changes in legislation or policy that applies to the operation; and
- Progressive review throughout the life of the Project (in particular, if there are significant changes to the Project for which this Rehabilitation Strategy has been prepared).

14.2 Rehabilitation Strategy Reporting

Should the Project be approved, an Annual Review is required to be submitted to relevant government agencies and made publically available on the KEPCO website which reports on the following information relating to rehabilitation:

- An overview of rehabilitation undertaken each year;
- Results of annual rehabilitation inspections;
- Outcomes of the annual ecological monitoring; and
- Progress against the projected rehabilitation in the approved MOP.

14.3 Mine Closure Plan

Five years prior to mine closure, a detailed mine closure plan will be prepared. This will include but not be limited to:

- Define the objectives and criteria for mine closure;
- Investigate options for the future use of the site;
- Investigate ways to minimise the adverse socio-economic effects associated with the mine closure, including reduction in local employment levels;
- Describe how the performance of these measures would be monitored over time;
- Describe how stakeholders have been/will be engaged to enable all stakeholders to have their interests considered during the mine closure process;
- Describe the planning process to ensure the process of closure occurs in an orderly, cost effective and timely manner;
- Describe how closure will be implemented to ensure that there is clear accountability, and adequate resources, for the implementation of the closure plan;

- Detail the standards that will used as a set of indicators to demonstrate the successful completion of the closure process; and

- Show how relinquishment will be met to reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.

15 CONCLUSION

The Project is a State Significant Development that has been through the Policy's Gateway process and has addressed Clause 17H(4a) of the Mining SEPP. This Rehabilitation Strategy and BSAL Reinstatement Strategy has been prepared to support the EIS for the Project following on from the Preliminary BSAL Rehabilitation Strategy prepared as part of the Gateway Application.

The key findings of the strategy are summarised below:

- The Project footprint is 2,874.7 ha and there are approximately 206.3 ha of verified BSAL mapped in the Project disturbance footprint that will be permanently impacted upon.
- The Project has been designed such that potentially direct and permanent activities will avoid BSAL that is hydrologically linked and soil unit impacts are largely associated with the Bald Hill and Growee soil units.
- The land proposed to be directly and permanently impacted upon is high capability agricultural land, LSC Class 3 (23.8%), and moderate quality grazing land, Class 5 (24.6%).
- Temporary impacts will be effectively handled through surface remediation works and rehabilitation works with the impacted land returned to pre-mining condition that is capable of sustaining current land uses.
- Direct and permanent impacts on BSAL will be mitigated through the establishment of a similar quantity of BSAL. There will be no reduction in the quantity of BSAL.
- Direct and permanent impacts on the better quality classes of agricultural land (i.e. LSC Classes 3 and 4) will be mitigated through the reinstatement of an equivalent amount of this land on the rehabilitated landform.
- Overall, there will a spatial change in the distribution of LSC classes with a marginal increase in LSC Class 3 and a marginal decrease in LSC Class 5 within the Project Boundary.
- Upon grant of Development Consent and prior to commencement of construction activities, KEPCO will prepare a BSAL Reinstatement Plan in consultation with relevant government authorities. The proposed scope of the plan includes stakeholder consultation, success criteria, stockpile management, procedures for stripping, stockpiling, recovery and reinstatement, records and reporting management and monitoring of the effectiveness of reinstatement methods on BSAL..
- Rehabilitation trials will be conducted in conjunction with relevant government and scientific organisations to support the successful reinstate of BSAL.
- A small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Natural Sequence Farming (or Soil Hydrology Management) that has been pioneer in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

- Project impacts on BSAL are not considered to be significant as most impacts will be avoided, mitigated or offset in accordance with the detailed BSAL Reinstatement Plan prepared prior to disturbance.
- Rehabilitation activities will be conducted in accordance with an approved set of completion criteria, indictors and TARPs to track the progress of rehabilitated lands.

16 REFERENCES

Anon, 2009, Watershed Landcare, viewed 6 February 2015 http://www.watershedlandcare.com.au

Anon, 2015, The Greater Eastern Ranges Initiative, viewed 6 February 2015 < http://www.greateasternranges.org.au/>).

Anon, 2013, Central Tablelands Local Land Services – Transitional Catchment Action Plan, December 2013).

ANZMEC (2000) *Strategic Framework for Mine Closure.* Australian and New Zealand Energy Minerals Council and Minerals Council of Australia.

Applied Ecology, 2010, Roadside Vegetation Assessment Report, Mid-Western Regional Council.

Bengalla Mining Company (BMC) (2013). *Annual Environmental Management Report 2012*.

Cumberland Ecology (2015) *Biodiversity Offsets Report: Bylong Coal Project.*

Darmody, R., Dunker, R. and Barnhisel, R. (2002). *Reclamation of Prime Agricultural Lands After Coal Surface Mining: The Midwestern Experience*, Published by ASMR, Lexington KY.

DTIRIS (2013) *ESG3: Mining Operations Plan (MOP) Guidelines*

DP&I (2012) Strategic Regional Land Use Policy.

MSEC (2015) Subsidence Predictions and Impact Assessments for Natural and Built Features in Support of the Gateway Application – Bylong Coal Project.

Nelson & Stewart (2007) *Alluvial Lands Reinstatement Project. Hunter Valley Operations Final Report.*

Nichols O.G. (2005) *Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on Coal Mines in the Hunter Valley.* ACARP Project No. C13048 Australian Centre for Minerals Extension and Research PO Box 883, Kenmore QLD 4069.

NSW DP&I 2012, Upper Hunter Strategic Regional Land Use Plan, September 2012.

NSW DRE 2013, ESG3: Mining Operations Plan (MOP) Guidelines, September 2013.

OEH and DPI-OAS&FS (2013) *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*.

OEH (2014) *Framework for Biodiversity Assessment*.

Pells Sullivan Meynink (2014) Bylong Coal Project, Feasibility Geotechnical Study: Open Pit and Waste Dump Design.

Scott Barnett & Associates (2015) Agricultural Impact Statement*: Bylong Coal Project.*

SLR Consulting Pty Ltd (2013) *Soils Assessment and Site Verification of the Bylong Project Boundary.*

SLR Consulting Pty Ltd (2014) *Agricultural Productivity Audits: Bylong Project.*

SLR Consulting Pty Ltd (2015) *Soil, Land Capability and Strategic Agricultural Land Assessment: Bylong Coal Project.*

Tongway D.J. and Hindley N.L. (2004). *Landscape Function Analysis: Methods for monitoring and assessing landscapes, with special reference to minesites and rangelands*. CSIRO Sustainable Ecosystems, Canberra. www.cse.csiro.au/research/efa/index.htm.

WRM Water & Environment Pty Ltd (2015) *Surface Water Impact Assessment: Bylong Coal Project.*

Appendix A

Report Number 630.11072

BSAL Constraints Report: Bylong Project:

BSAL Rehabilitation Constraints Report

Report Number 630.11072

25 April 2015

Hansen Bailey Pty Limited
6/127-129 John Street
Singleton NSW 2330

Version: Revision 0

Hansen Bailey Pty Limited
Bylong Rehabilitation Strategy
BSAL Rehabilitation Constraints Report

Report Number 630.11072
25 April 2015
Revision 0

Bylong Rehabilitation Strategy

BSAL Rehabilitation Constraints Report

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Bylong Rehabilitation Strategy
BSAL Rehabilitation Constraints Report

Report Number 630.11072
25 April 2015
Revision 0

Table of Contents

Hansen Bailey Pty Limited
Bylong Rehabilitation Strategy
BSAL Rehabilitation Constraints Report

Report Number 630.11072
25 April 2015
Revision 0

Table of Contents

TABLES

FIGURES

1 INTRODUCTION

SLR Consulting (SLR) has prepared a BSAL Re-Instatement Constraints Report for the Bylong Project (the Project).

SLR has previously completed the *Soils Assessment and Site Verification* (SLR, 2013a), and a *Preliminary BSAL Rehabilitation Strategy* (SLR 2013b) for the Project to accompany the Project's Gateway application.

The Project's Conditional Gateway Certificate requirements were issued in April 2014, the purpose of this Constraints Report is to address the following requirement of the Conditional Gateway Certificate and support the Project Environmental Assessment:

- Identify a final location for the verified BSAL soils within the Project Boundary area.

1.1 Project Background

The Project disturbance footprint is 2,874.7 ha and there are approximately 440.8 ha of verified BSAL. A total of 206.3 ha of the verified BSAL within the Project disturbance footprint will be directly and permanently impacted by Internal Roads, Rail Loop, Open Cut Mining Areas and OEAs. The Project is committed to reinstating all BSAL land that will be directly and permanently disturbed.

2 METHODOLOGY

SLR has developed a two-option, four stage methodology to identify constraints (hazards) for the re-instatement of BSAL within the Project Boundary, in accordance with *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH and DPI-OAS&FS, 2013; hereafter referred to as the Interim Protocol).

Option 1: BSAL Re-instatement on Undisturbed Land

Option 1 is designed to identify land within the Project Boundary that will not be disturbed and is capable of being improved to meet BSAL status. This consists of three stages:

- Stage 1 will identify any automatic exclusion zones for BSAL based on slope, presence of BSAL, the proposed operation footprint and state forest. The remaining soil types will be identified as potential BSAL re-instatement areas.
- Stage 2 will assess the remaining soil types for constraints to rehabilitation such as chemical and physical constraints. The remaining soil types will be identified as Recommended BSAL Re-instatement Areas.
- Stage 3 will assess the impact of other considerations including non-mine infrastructure, land ownership and risk to flooding.

Option 2: BSAL Re-instatement within the Project Disturbance Footprint

Stage 4 will assess the areas of land that will be disturbed and rehabilitated by the Project as potential BSAL re-instatement areas. These lands will be greater than 20 ha, less than 10% slope and preferably contiguous to verified BSAL.

2.1 Target BSAL and LSC Success Criteria

The BSAL criteria and LSC Class 3 hazard criteria are provided in **Table 1**. These have been developed based on *The land and soil capability assessment scheme - second approximation* (OEH, 2012; hereafter referred to as the LSC Guideline) and the Interim Protocol.

The refinement of the combination of the BSAL criteria with relevant LSC Class 3 criteria will be further developed in conjunction with the BSAL Re-instatement Plan whereby reference sites will be selected and analysed for relevant site specific parameters for each success criteria.

Table 1 BSAL and LSC Class 3 Success Criteria

Criteria	BSAL Criteria	LSC Class 3 Criteria	Rehabilitation Criteria
Slope	Slope less than 10%	Slope < 10% **or** < 3% if slope is > 500 m in length	Slope less than 10%
Rock outcrop	Rock outcrop less than 30%	Rock outcrop less than 30%	Rock outcrop less than 30%
Surface Rockiness	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter	N/A	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter
Gilgai	Less than 50% of the area has gilgai depression that are deeper than 500 mm	N/A	Less than 50% of the area has gilgai depression that are deeper than 500 mm
Slope, relative soil fertility class and rock outcrop	Moderate fertility **and** <5% slope **and** nil rock outcrop **OR**	N/A	Nil rock outcrop **and** Fertility criteria (to be developed in BSAL re-instatement Plan)
	Moderately high or high fertility **and** <5% slope **and** <30% rock outcrop **OR**		
	Moderately high or high fertility **and** 5-10% slope **and** <30% rock outcrop		
Physical Barrier	Effective rooting depth to a physical barrier (i.e. bedrock, gravel layer) is greater than or equal to 750 mm	Soil depth is >75 cm	Effective rooting depth to a physical barrier (i.e. bedrock, gravel layer) is greater than or equal to 750 mm
Soil Drainage	Soil drainage is better than poor	Imperfectly drained soil (waterlogging is 1-8 weeks duration)	Soil drainage is better than poor (i.e imperfect drainage)
pH	pH within range of 5.0 to 8.9 within upper 600mm of soil profile	Moderate or higher surface soil buffering capacity **and** pH >5.5 **or** low surface soil buffering capacity **and** pH 6.7-8.0	pH 5.5-8.9 and Loam or greater surface soil texture **or** pH 6.7-8.9 and Fine Sandy Loam or greater surface soil texture
Soil Salinity	ECe less than or equal to 4 dSm/m **or** if gypsum is present, chlorides less than 800 mg/kg within upper 600mm of soil profile	low salt store **OR** low discharge potential **and** moderate salt store	ECe less than or equal to 4 dSm/m **or** if gypsum is present, chlorides less than 800 mg/kg within upper 600mm of soil profile **And** Low discharge potential

Criteria	BSAL Criteria	LSC Class 3 Criteria	Rehabilitation Criteria
Chemical Barrier	Effective rooting depth to a chemical barrier is greater than or equal to 750 mm Chemical barrier includes: • pH <5.0 **or** >8.9; • ECe > 4 dSm/m **or** if gypsum is present, chlorides > 800 mg/kg • ESP >15% • Ca:Mg ratio <0.1	Not applicable	Effective rooting depth to a chemical barrier is greater than or equal to 750 mm Chemical barrier includes: • pH <5.0 **or** >8.9; • ECe > 4 dSm/m **or** if gypsum is present, chlorides > 800 mg/kg • ESP >15% • Ca:Mg ratio <0.1
Wind Erosion	N/A	Selected site to be a site that has low exposure to wind	Selected site to be a site that has low exposure to wind
Soil Structure Decline	N/A	Surface soil texture a sandy loam **OR** fine sandy loam with <60% silt and very fine sand **and** <5% ESP (hazard 3) **OR** normal loam/clay loam **OR** friable/ferric or weakly self-mulching clay**.**	Surface soil texture a sandy loam **OR** fine sandy loam with <60% silt and very fine sand **and** <5% ESP (hazard 3) **OR** normal loam/clay loam **OR** friable/ferric or weakly self-mulching clay**.**
Mass Movement	N/A	No mass movement	No mass movement

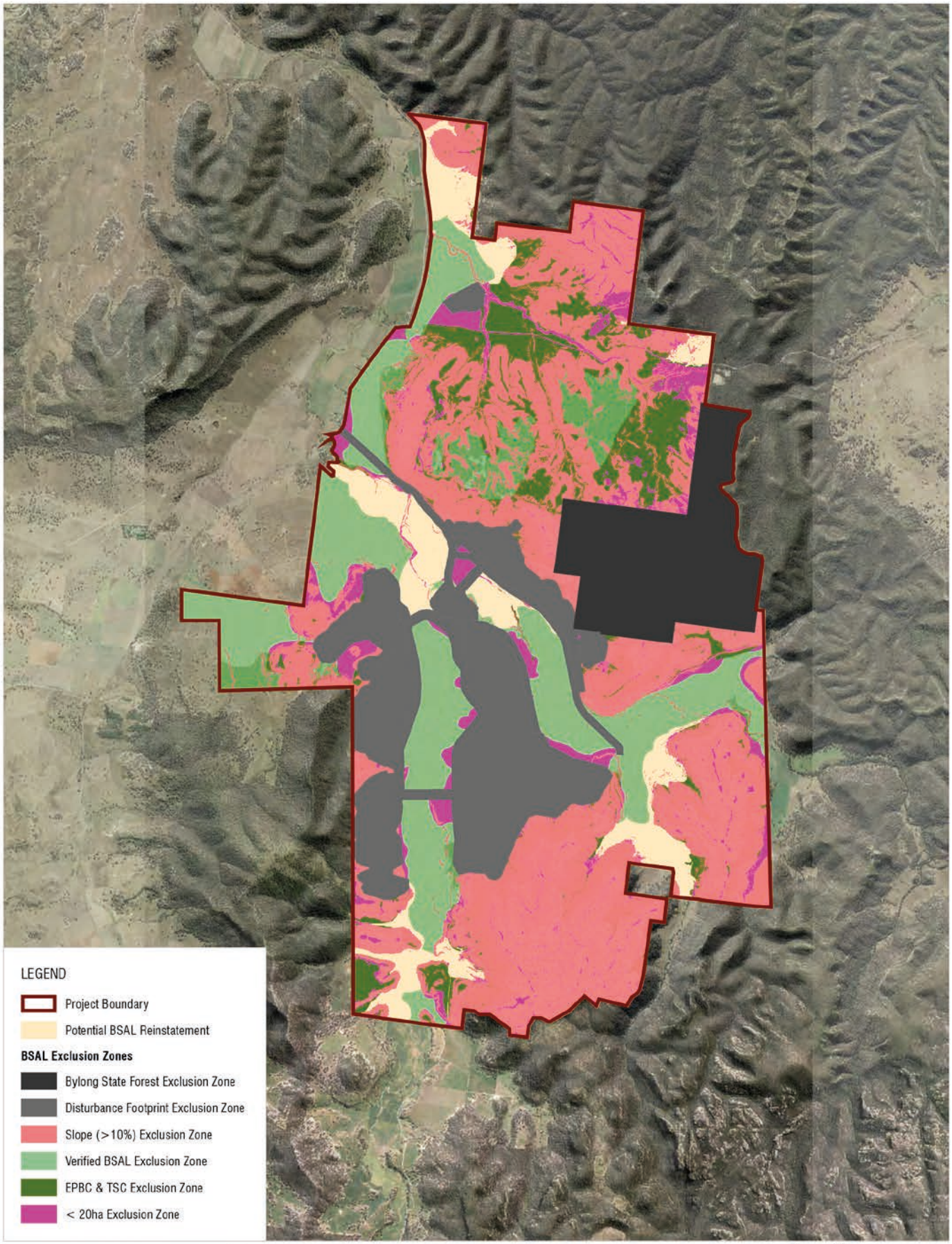
3 OPTION 1: BSAL RE-INSTATEMENT ON UNDISTURBED LAND

3.1 Stage 1: Exclusion Zones

A number of areas of land within the Project Boundary are excluded as potential sites of BSAL re-instatement (**Figure 1**) based on a number of criteria including:

- State Forest: Bylong State Forest is excluded from all potential disturbances.
- Disturbance footprint: Any land that will be disturbed at any stage during operations.
- Slope: In line with the Interim Protocol, all slopes greater than 10% are excluded from selection for re-instatement of BSAL land.
- Presence of threatened ecological communities and species in accordance with the *Threatened Species Conservation Act 1995 (TSC Act)* and *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.
- BSAL: All land verified as BSAL (SLR, 2013).
- Less than 20 ha: Remaining parcels of land that do not meet the minimum area size of 20 ha as per the Interim Protocol.

The remaining land that has not been excluded as potential areas for BSAL re-instatement has been grouped in Potential BSAL Re-instatement Areas (**Figure 2**; **Table 2**). A total 7 areas have been identified totalling approximately 462.2 ha.



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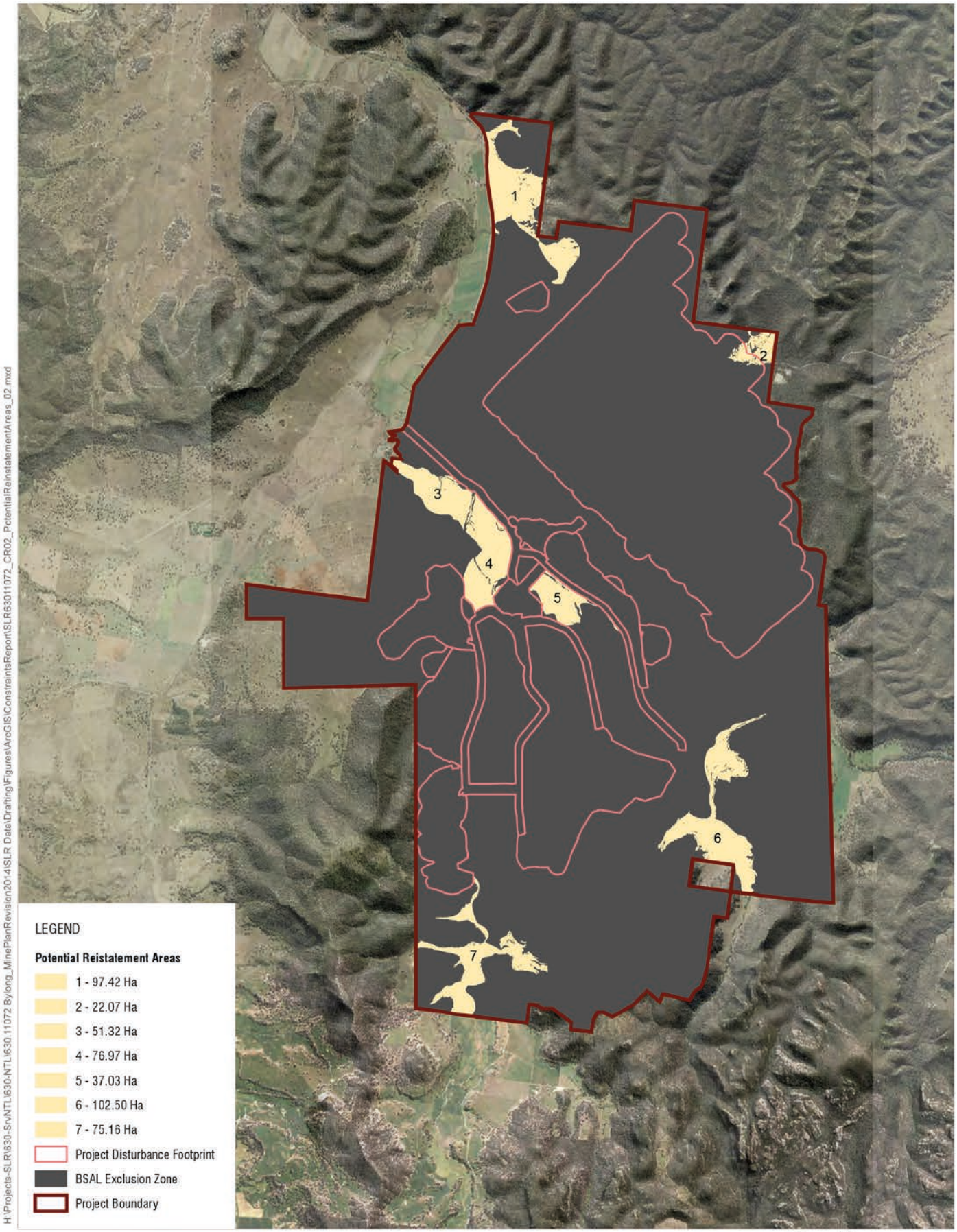
BSAL Constraints Report

BSAL Exclusion Zones

FIGURE 1



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BSAL Constraints Report

Potential BSAL Reinstatement Areas

FIGURE 2

Table 2 Potential BSAL Re-instatement Areas

Potential BSAL Re-instatement Area	Area (Ha)
1	97.4
2	21.8
3	51.3
4	77.0
5	37.0
6	102.5
7	75.2

3.2 Stage 2: Soil Constraints Analysis

3.2.1 Methodology

Each soil type within these Potential BSAL Re-instatement Areas (**Figure 3**) has been assessed based on their soil constraints using the success criteria outlined in **Table 1**, and includes:

- Soil Depth;
- pH Balance;
- Salinity; and
- Inherent fertility.

Depending on their soil constraints within each Potential BSAL Re-instatement Area, a 'BSAL Re-instatement Suitability' ranking of Nil, Low, Moderate or High has been assigned (**Table 4**).

Soil Depth

According to the Interim Protocol, BSAL is limited by a physical barrier when the soil depth is less than 0.75 m. This soil constraint represents the most likely site for BSAL re-instatement due to the lack of chemical constraints which would require amelioration during rehabilitation.

Any soil with at least 0.5 m soil depth would be considered an appropriate area for BSAL re-instatement. Shallower soil would be considered less suitable due to the increased volume of soil required for rehabilitation.

pH Balance

According to the Interim Protocol, BSAL is limited by the chemical barrier of pH when the soil pH is outside the range of 5.0 – 8.9 within 0.6 m of the soil surface.

The three main factors affecting soil pH are: parent material, precipitation and vegetation. Whilst soil types can be ameliorated for acidic pH balance using materials such as lime and gypsum, the re-instatement of BSAL on soils with pH limitations would only represent a viable option if no other land is identified. Soil types with highly alkaline soils are extremely difficult to ameliorate to a lower pH balance.

Salinity

According to the Interim Protocol, BSAL is limited by the chemical barrier of salinity when the ECe is greater than 4 dS/m within 0.6 m of the soil surface.

Whilst various management techniques have been suggested to improve salinity, there is no evidence that saline soils can be improved via rehabilitation. SLR considers that all soil types that are currently limited by soil salinity to be unsuitable sites for re-instatement of BSAL.

Inherent Fertility

The majority of land that failed BSAL criteria due to the presence of soil with moderately low inherent fertility are classified as Sodosols. According to the Interim Protocol, inherent fertility is based on the ASC classification of each soil type and all Sodosols are considered to have moderately low inherent fertility.

Sodosols characteristically have limited effective rooting depth (and therefore fertility) caused by high exchangeable sodium percentage (ESP) within the soil profile. Sodosols do not represent a suitable option for BSAL re-instatement due the issues arising from high sodium levels relative to the other exchangeable cations. The imbalance of cations results in poor soil structure which can result in poor seedling germination and plant growth.

Soil Drainage

Soil types with poor drainage have severely reduced crop and pasture productivity and root growth is inhibited due to poor aeration. These soil types with poor and imperfect drainage are usually associated with low-lying landscape positions, drainage restrictions or impediments and do not represent a suitable option for BSAL re-instatement due the permanent nature of soil profile drainage issues.

3.2.2 Soil Constraints Assessment

The soil types within each of the seven Potential BSAL Re-instatement Areas and the soil type's major and minor soil constraints are summarised in **Table 4**. According to their soil constraints the suitability of each soil type, and therefore the Potential BSAL Re-instatement Area, has been assessed for BSAL re-instatement suitability.

Following review of the exclusion zones and soil constraints for the Bylong Project, SLR has identified two areas of 'low' suitability for BSAL re-instatement areas (**Table 3**). The key findings are:

- There are no areas considered to be 'highly or moderately suitable' for BSAL re-instatement.
- Within Potential BSAL Re-instatement Areas 3 & 4, only one soil type, B03 – Eutrophic Black Dermosol, has been identified as displaying low BSAL re-instatement suitability. Soil Type B03 is constrained only by its pH balance, with a pH greater than 8.9 at a depth of 0.45 m and below. This soil will only require chemical amelioration for its pH balance in order to address its BSAL suitability.
- The remaining Potential BSAL Re-instatement Areas are considered unsuitable for BSAL re-instatement. Some soil types were deemed to be suitable, however, they failed to meet the minimum 20 ha BSAL requirements.

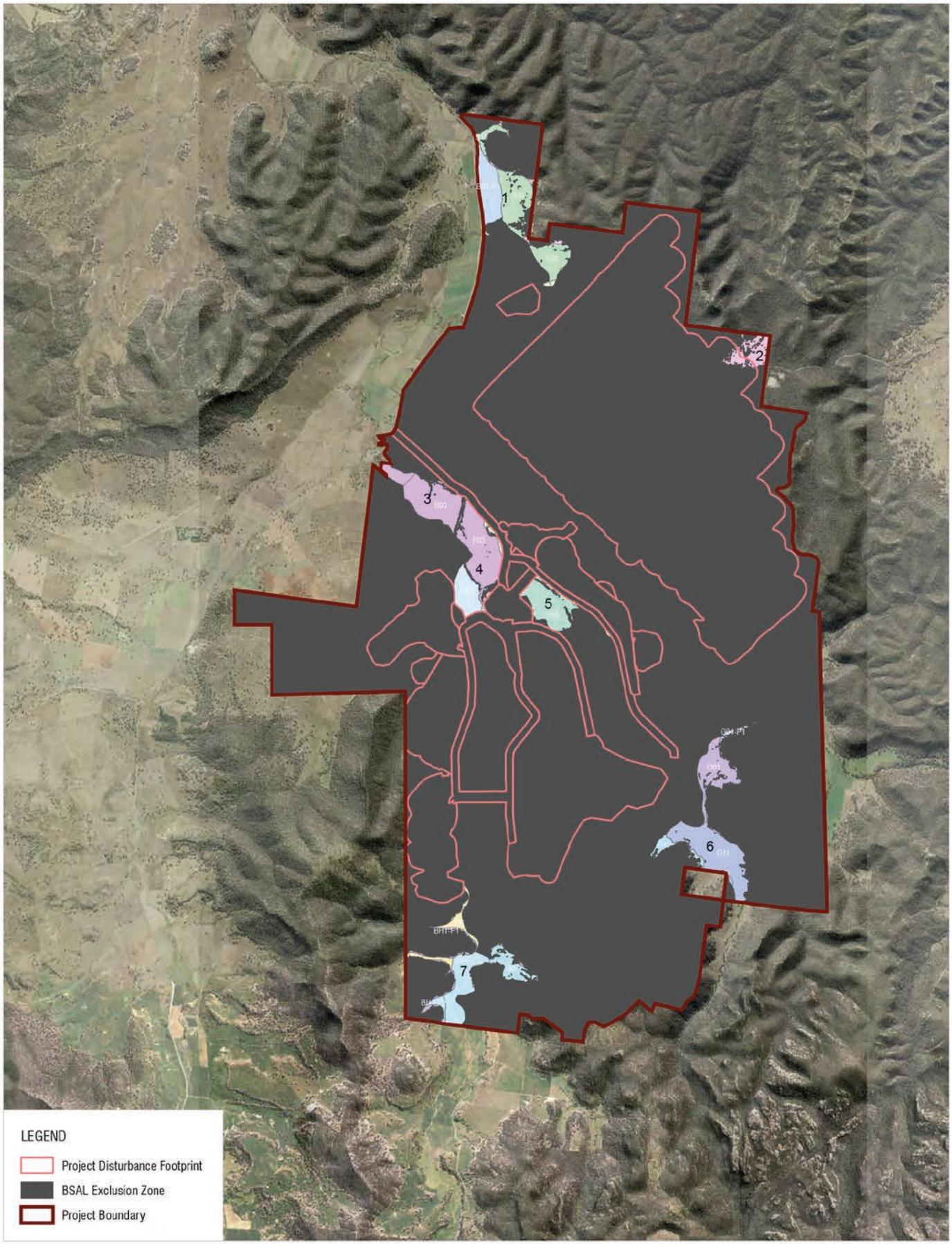
Table 3 Potential BSAL Re-instatement Areas after Soils Constraints Assessment

Potential BSAL Re-instatement Area	Soil Type(s)	ASC Soil Classification	Area (Ha)
Low BSAL Re-instatement Suitability			
3	B03	Eutrophic Black Dermosol (alkaline)	51.3
4	B03	Eutrophic Black Dermosol (alkaline)	50.4
		Total	**101.7**

Table 4 Potential BSAL Re-instatement Area Soil Constraints and Suitability

Potential BSAL Re-instatement Area	Soil Type	Area (ha)	Major Soil Constraint(s)	Minor Soil Constraint(s)	BSAL Re-instatement Suitability	Potential BSAL Re-instatement
1	B03-Phase 1	30.5	Salinity (ECe >0.4 dS/m at 0.6 m)	Heavy clay subsoil	Nil	No: G17-Phase 1 is less than 20 ha
	BH2-Phase 2	0.2	Rock fragments (>20% rock, >60 mm)	Shallow soil depth	Nil	
	BJ3	60.0	Moderately low inherent fertility (Subnatric Yellow Sodosol)	Imperfect drainage	Nil	
	BJ3-Phase 1	3.4	Moderately low inherent fertility (Subnatric Yellow Sodosol)	Soil depth at 0.55 m; Imperfect drainage	Nil	
	G17-Phase 1	1.3	None	Soil depth at 0.65 m	High	
	L01-Phase 1	2.0	Salinity (associated with L1)	Apedal to weak structure throughout profile; Shallow soil depth; Sodicity (associated with L1)	Nil	
2	BJ1	21.3	Salinity (ECe >0.4 dS/m at 0.6 m)	Imperfect drainage	Nil	No
	L01-Phase 1	0.5	Salinity (associated with L1)	Apedal to weak structure throughout profile; Shallow soil depth; Sodicity (associated with L1)	Nil	
3	B03	51.3	pH balance (pH >8.9 at 0.45 m)	None	Low	Yes
4	B03	50.4	pH balance (pH >8.9 at 0.45 m)	None	Low	Yes: Not including G14 as it is not contiguous to B03.
	B05	0.6	Moderately low inherent fertility (Brown-Orthic Tenosol)	Apedal to weak structure throughout majority of profile	Nil	
	B12	21.3	Moderately low inherent fertility (Rudosol)	Apedal to weak structure throughout majority of profile	Nil	
	G03	1.8	Low inherent fertility (Rudosol)	Apedal structure throughout profile; Soil depth at 0.55 m	Nil	
	G14	0.6	None	Poor drainage	High	
	SH1	2.3	Moderately low inherent fertility (Subnatric Red Sodosol); Salinity (ECe >0.4 dS/m at 0.6 m)	None	Nil	

5	B05	35.1	Moderately low inherent fertility (Brown-Orthic Tenosol)	Apedal to weak structure throughout majority of profile	Nil	No
	SH1	1.9	Moderately low inherent fertility (Subnatric Red Sodosol); Salinity (ECe >0.4 dS/m at 0.6 m)	None	Nil	
6	G04-P1	7.1	pH balance (pH >8.9 at 0.5 m)	Soil depth at 0.65 m	Low	No: G10 is less than 20 ha
	G10	7.7	None (verified BSAL that is less than 20 ha)	None	High	
	G11	56.8	Moderately low inherent fertility (Stratic Rudosol)	Apedal to weak structure throughout profile; Strongly to moderately acidic profile; Soil depth at 0.60 m	Nil	
	O01	30.9	Moderately low inherent fertility (Mesonatric Brown Sodosol)	pH balance (pH >8.9 at 0.35 m); Poor drainage	Nil	
7	B06-Phase 1	32.2	Salinity	None	Nil	No: G06 is less than 20 ha
	BH1-Phase 1	4.6	Rock fragments (70% rock, >2 mm)	Soil depth at 0.55 m	Nil	
	BH1-Phase 2	4.1	pH balance (pH >8.9 at 0.5 m)	None	Low	
	G01	1.5	Sodicity (ESP >6% at 0.6 m)	None	Nil	
	G03	2.7	Low inherent fertility (Rudosol)	Apedal structure throughout profile; Soil depth at 0.55 m	Nil	
	G04	16.7	pH balance (pH <5.0 at soil surface)	Soil depth at 0.6 m	Nil	
	G04-Phase 1	<0.1	pH balance (pH >8.9 at 0.5 m)	Soil depth at 0.65 m	Low	
	G06	12.0	None	Soil depth at 0.75 m	High	
	L01-Phase 1	0.9	Salinity (associated with L1)	Apedal to weak structure throughout profile; Shallow soil depth; Sodicity (associated with L1)	Nil	
	OL02-Phase 1	0.5	Low inherent fertility (Rudosol)	Apedal to weak structure throughout profile; Shallow soil depth	Nil	



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BSAL Constraints Report

Potential BSAL Reinstatement Areas by Soil Type

FIGURE 3

3.3 Stage 3: Other Considerations

A number of other factors must also be considered when assessing BSAL re-instatement, including:

- Risk of flooding;
- Current LSC Mapping;
- Non-mine infrastructure;
- Land ownership;
- Survey scale confidence;
- Re-instated BSAL lot size; and
- Access and locality within Project Boundary

3.3.1 Risk to Flooding

Any land that is within the likely area of flooding during a 1 in 100 year rainfall event is considered to have a high risk to flooding. The vast majority of Potential BSAL Re-instatement Areas 3 and 4 both fall within land considered to have a high risk to flooding.

3.3.2 Current Land and Soil Classification Mapping

The direct and permanent impacts on BSAL will be mitigated through the offset of BSAL, land reinstated as BSAL must also meet the Land and Soil Capability Class 3 criteria.

Both Areas 3 and 4 are mapped as LSC Class 3 and therefore already meet LSC Class 3 commitment.

3.3.3 Non-mine Infrastructure

Within the Project Boundary existing non-mine infrastructure including, buildings, roads and railway lines also present as a consideration for the re-instatement of BSAL. There are number of residential and agricultural building located within Area 3, with the building covering a single parcel of land covering approximately 3 ha, however this will not impact the suitability of the remaining 48.3 ha within Potential BSAL Re-instatement Area 3.

3.3.4 Land Ownership

The current land ownership of the Recommended BSAL Re-instatement Areas is also an important consideration for the re-instatement of BSAL. Currently KEPCO Bylong Australia Pty Limited owns all recommended areas.

3.3.5 Survey Scale Confidence

The survey scale within the Project Boundary varies according to the presence of mapped BSAL and the proposed disturbance footprint. Within the soil type boundaries recommended for BSAL re-instatement no survey sites fall within Area 3 (refer **Table 5**), and only two check sites fall within Area 4. Therefore these areas are considered to have low confidence in the current soil mapping, indicating that there is a high risk that further soil constraints may be identified in these Areas with additional soil sampling.

Table 5 Recommended BSAL Re-instatement Areas: Survey Scale Confidence

Recommended BSAL Re-instatement Area	Soil Type(s)	Detailed Sites	Check Sites	Survey Scale Confidence
Low BSAL Re-instatement Suitability				
3	B03	0	0	Low
4	B03	0	2	Low

3.3.6 Access and Locality within Project Boundary

The access and locality of the Recommended BSAL Re-instatement Areas is also an important consideration in terms of practicality and feasibility of BSAL re-instatement. All areas are considered to be a reasonable distance to access roads and tracks.

3.4 Option 1 Summary

In summary, a total of 101.7 ha of land, across two areas, have been identified within the Project boundary as Potential BSAL Re-instatement Areas that were not constrained by their soil properties. These two areas are significantly restricted by other considerations including a high risk to flooding during a 1 in 100 year rain event and low survey scale confidence.

Therefore all land that was determined to be a Potential BSAL Re-instatement Area is considered to be unsuitable for BSAL re-instatement.

4 OPTION 2: BSAL RE-INSTATEMENT WITHIN THE PROJECT DISTURBANCE FOOTPRINT

As discussed in **Section 3**, there is no suitable land within the non-disturbed areas for BSAL re-instatement, therefore land within the Project disturbance footprint is being assessed for BSAL re-instatement. This option has been assessed within *Soil, Land Capability and Strategic Agricultural Land Assessment* (SLR, 2015).

Key inclusion criteria for Potential BSAL Re-instatement Areas within the Project disturbance footprint include:

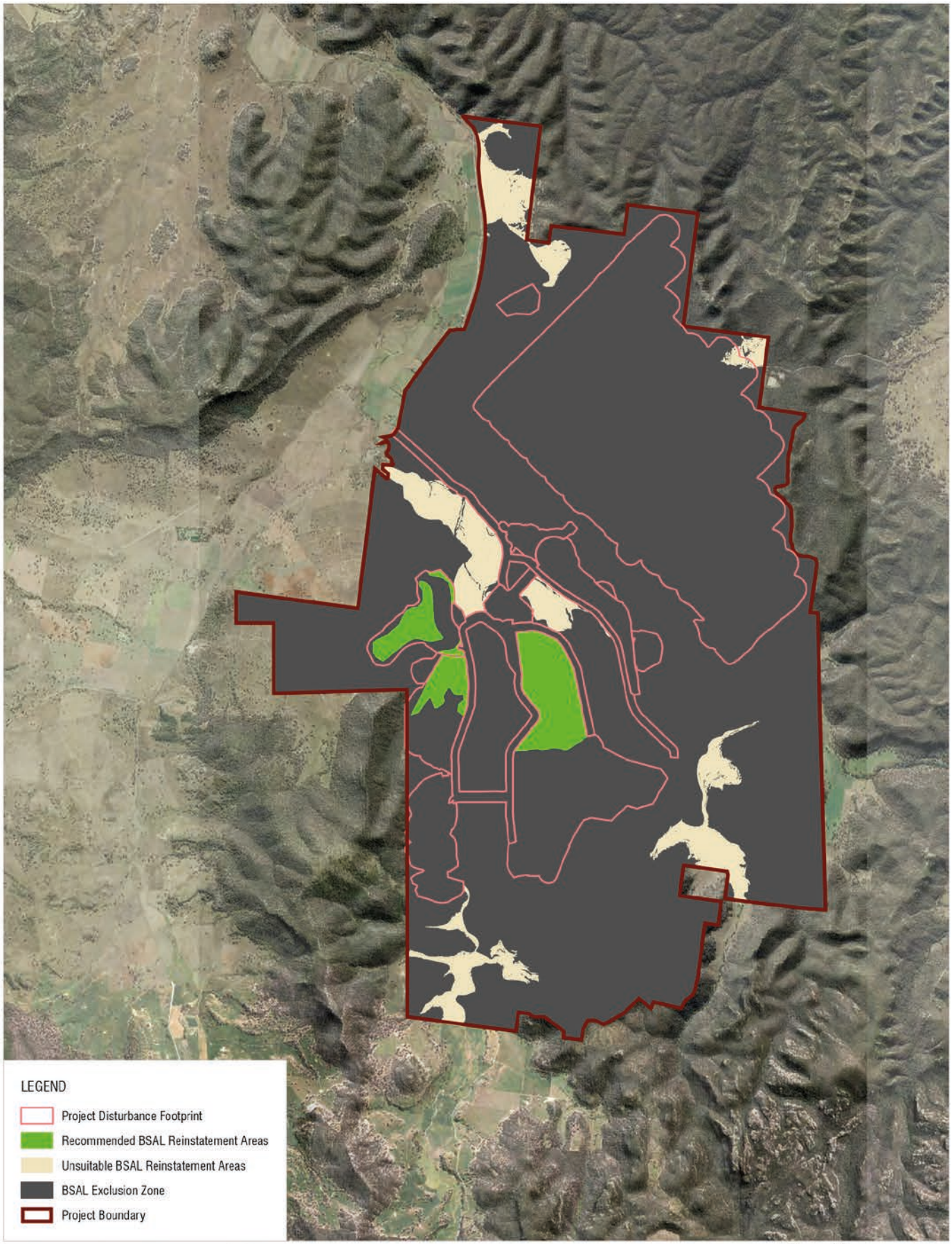
- Slope: In line with the Interim Protocol, all slopes less than 10% on the final rehabilitated landform are suitable from selection for re-instatement of BSAL. BSAL will be reinstated on land which also meets LSC Class 3 criteria with slopes preferably less than 3%, but may be reinstated on land up to 10% slope.
- Greater than 20 ha: The landform must meet the minimum area size of 20 ha.
- Temporary Disturbance: Land that will not be subject to temporary disturbance.
- Infrastructure: Land that will not be retained at closure as ongoing infrastructure (ie rail loop, internal roads).

Preferred inclusion criteria for Potential BSAL Re-instatement Areas within the Project disturbance footprint include:

- Contiguous land: Area is contiguous or nearby to undisturbed verified BSAL.
- Access: Location is considered practical and feasible for agricultural production, i.e. not adjacent to voids.

4.1 Option 2 Summary

Following a review of the conceptual final landform (as detailed in the *Soil, Land Capability and Strategic Agricultural Land Assessment* (SLR, 2015)), it has been determined that a total 227.0 ha of land is considered highly suitable for BSAL re-instatement as it meets the key inclusion criteria for BSAL re-instatement within the Project disturbance footprint and where possible the preferred inclusion criteria (as listed in **Section 4.0**). The area of land also exceeds the 206.3 ha of BSAL that will be disturbed by the Project (**Figure 4**), and therefore Option 2 is recommended for the re-instatement of BSAL.



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Projection:	GDA 1994 MGA Zone 56

Hansen Bailey

BSAL Constraints Report

Recommended BSAL Reinstatement Areas

FIGURE 4

5 CONCLUSION

Through a combination of exclusion criteria and soils constraints analysis, a total of two areas were identified as the most suitable land within the Project boundary (excluding the Project disturbance footprint) for re-instatement of BSAL. Once other considerations were taken into account, including risk to flooding, these two areas of land totalling 101.7 ha, were deemed to be unsuitable for BSAL re-instatement.

Subsequently land within the Project disturbance footprint was assessed for BSAL re-instatement suitability. A total 227.0 ha of land was assessed as highly suitable for BSAL re-instatement as it met all the key inclusion criteria required including (but not limited to) slope and minimum lot size criteria. Therefore it is recommended that the BSAL re-instatement occur on land within the Project disturbance footprint and not within other undisturbed land within the Project Boundary.

6 REFERENCES

DPI-OAS&FS (2013) *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*

OEH (2012) *The land and soil capability assessment scheme - second approximation*

SLR (2013a) *Soils Assessment and Site Verification*

SLR (2013b) *Preliminary BSAL Rehabilitation Strategy*

SLR (2015) *Soil, Land Capability and Strategic Agricultural Land Assessment*

Appendix B
Report Number 630.11072

Reconciliation of Soil Stripping and Stockpiling Operations

Soil Type: **Topsoil**

Soil Class: **LSC Class 3**

Table B1

Date		Estimated Volumes m^3		Surveyed	Difference	
Week Ending (Face Pickup)	Reporting Month Date	By Scraper or Truck (1)	From SLR Soil Thickness Plans (2)	Volumes (m^3) (3)	[3-1] m^3	[3-2] m^3

Appendix C
Report Number 630.11072

Topsoil and Subsoil Inventory

Soil Type: **Topsoil**

Soil Class: **LSC Class 3**

Stockpile No.: No. 1

Stockpile Coordinates

Table C1

Date of Removal	Source Location		Method of Removal	Load Description	Load Volume (m^3)
	Description	Approximate Location			

Table C2: TOPSOIL AND SUBSOIL INVENTORY SUMMARY

Stockpile No.	Height	Volume m^3	Date of Seeding	Date of Removal	Reuse Location
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					