APPENDIX 16

Draft Rehabilitation Strategy




MT OWEN
OPEN CUT

GLENCORE

Draft Rehabilitation Strategy Mount Owen Continued Operations Project – Modification 2

NOTE: This Draft Rehabilitation Strategy has been framed to address the Proposed Modification 2, if approved. The Draft may be subject to further update during the approval process, prior to submission for approval in accordance with schedule 3, condition 43 of SSD-5850.

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Review:	N/A
Owner:	Environment and Community Manager

Table of Contents

1 Introduction

1.1 Background

The Mount Owen Complex (MOC) is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres north-west of Singleton, 24 kilometres south-east of Muswellbrook and to the north of Camberwell village (refer to **Figure 1.1**).

The MOC includes the Mount Owen and Glendell open cut coal operations, which are currently owned and operated by Mount Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited. The Mount Owen open cut coal operations include the Mount Owen (North Pit) and Ravensworth East (Bayswater North Pit) operations approved under the Mount Owen Continued Operations Project Development Consent (SSD 5850) granted on 3 November 2016 and as modified. The Glendell open cut operations (Barrett Pit) operate under the Development Consent (DA 80/952). The Mount Owen Complex also includes areas previously disturbed as a result of past mining activities and includes the West Pit Void (formerly part of the Ravensworth East operations) which is currently receiving tailings from the Mount Owen coal handling and preparation plant (CHPP). The mining operations at the MOC include the integrated use of the Mount Owen CHPP, coal stockpiles and the rail load out facility.

Mount Owen (North Pit) has an approved production rate of 10 million tonnes per annum (Mtpa) of run of mine (ROM) coal, and blended with Ravensworth East (approved 4 Mtpa) and Glendell (approved 4.5 Mtpa) ROM coal, feed the Mount Owen CHPP and associated infrastructure, which has a current approved processing capacity of 17 Mtpa of ROM coal. Processed coal, both semi soft and thermal, is transported via the Main Northern Rail Line to the Port of Newcastle for export, or by conveyor for domestic use as required.

Mount Owen expects, subject to market conditions, that mining will be completed within the currently approved area of the North Pit and the Bayswater North Pit (BNP) by 2037 and 2022 respectively; and Barrett Pit by 2022.

1.2 Purpose of Rehabilitation Strategy

The following Rehabilitation Strategy was prepared to meet the Requirements of Condition 43 of the Mount Owen Continued Operations Development Consent (SSD – 5850) (Mt Owen Consent). The rehabilitation Strategy does not apply to any aspect of the ongoing operations at Glendell Mine. For the purposes of the Strategy document, the Project is described as those parts of the Mount Owen Complex regulated by the Mt Owen Consent and does not include operations regulated solely by the Glendell Consent.

The requirements of the Mt Owen Consent and where they have been addressed within this document are outlined in **Table 1.1**.

Table 1.1 SSD 5850 Rehabilitation Objectives and Rehabilitation Strategy Requirements

Mount Owen Mine (SSD 5850)	Condition	Section Addressed
Schedule 3, Condition 28	**Threatened Species** The Applicant must ensure that the Biodiversity Offset Strategy and the Rehabilitation Strategy for the development focus on the regeneration, enhancement and/or re-establishment of: (a) significant and/or threatened flora communities, including: • Central Hunter Grey Box — Ironbark Woodland EEC; and • Central Hunter Ironbark — Spotted Gum — Grey Box Forest EEC; and (b) habitat and/or foraging resources for other significant and/or threatened flora and fauna species, including: • Spotted-tailed Quoll; • Squirrel Glider; • Koala; • Swift Parrot; • Regent Honeyeater; • Green and Golden Bell Frog; • Brush-tailed Phascogale; • Eastern Bent-wing Bat; • East-coast Freetail Bat; • Southern Myotis; • Speckled Warbler; • Little Lorikeet; • Grey-crowned Babbler; • Diamond Firetail; and • Masked Owl.	**Section 5.1.1, 5.1.2** and **5.6**
Schedule 3, Condition 42	**Rehabilitation** **Rehabilitation Objectives** The Applicant must rehabilitate the site to the satisfaction of DRE. This rehabilitation must be generally consistent with the proposed rehabilitation activities described in the documents listed in condition 2(a) of Schedule 2 (and shown conceptually in the Rehabilitation Plans in Appendix 7), and comply with the objectives in Table 10 [of the Mt Owen Consent].	**Sections 3.1** and **3.2**

Mount Owen Mine (SSD 5850)	Condition	Section Addressed
Schedule 3, Condition 43	**Rehabilitation Strategy** The Applicant must prepare a Rehabilitation Strategy for the Mount Owen Complex to the satisfaction of the Secretary. This strategy must:	This Document
	(a) be prepared in consultation with DRG and Council, and be submitted to the Secretary for approval prior to the commencement of development under this consent, unless the Secretary agrees otherwise	**Section 2.3**
	(b) build upon the Rehabilitation Objectives in Table 10 and the Rehabilitation Plans shown in Appendix 7, including identification of opportunities for increasing the areas of woodland and habitat connectivity within the rehabilitated landscape;	**Section 3.1** and **3.2**
	(c) include details of the canopy, sub-canopy, understorey and ground strata species to be established in the rehabilitation areas, with a particular focus on ensuring the achievement of an appropriate level of diversity and mix of functional groups within each target community;	**Section 5.6** and **Appendix A**
	(d) identify opportunities for the incorporation of preferred feed trees, foraging resources and habitat for threatened fauna species identified in condition 28; and	**Section 5.6**
	(e) include an indicative schedule for the staged rehabilitation of the development.	**Section 5.6**

The purpose of this document is to outline the proposed mine closure and rehabilitation strategy for the Project, which has been developed in consideration of a number of factors including site opportunities and constraints, ecological and rural land use values and existing strategic land use objectives, including the integration of rehabilitation with the strategies developed for surrounding Glencore operations.

As part of the continuation of coal mining operations, the details regarding mine closure and rehabilitation will be documented within the Rehabilitation Management Plan for the Project.

1.3 Approved Operations

The key features of the Approved Operations as modified relevant to the Rehabilitation Strategy are outlined in **Table 1.2**. For a detailed description of the Approved Operations as modified, refer to Section 2 of the Statement of Environmental Effects for the Mount Owen Continued Operations Project - Modification 2.

Table 1.2 Key Features of the Approved Operations

Key Feature	Approved Operations
Mine Life	• Mining operations approved to 31 December 2037 • Rehabilitation Activities approved until completed.
Limits on Extraction	• North Pit – up to 10 Mtpa ROM. • Ravensworth East (Bayswater North Pit) – up to 4 Mtpa ROM. • Mining depths down to approximately 380 m (average 340m) (North Pit). • Total additional mineable coal tonnes of approximately 121 Mt ROM (comprising 74 Mt ROM Continued Operations Project, 35 Mt ROM Modification 2 from the North Pit), 12 Mt ROM (BNP).
Mining Methods	• Truck and Shovel Operations
Tailings Facilities	• Emplacement of waste in-pit and out-of-pit, up to a maximum approved height of 230m • Tailings emplacement in Ravensworth East Voids (including West Pit), within in-pit tailings cells in North Pit or the BNP void
Mount Owen CHPP, MIA and other infrastructure	• CHPP throughput of up to 17 Mtpa ROM (includes the processing of ROM coal from Glendell). • product stockpiles; • Water management infrastructure including water storages • Rail loading facilities • Rail loop • Crushing plant • Conveyor to Liddell for transfer of crushed rock material

The key features of the approved development are shown on **Figure 1.2**, and the approved disturbance footprint is shown in **Figure 1.3**

The Conceptual post mining land use design is shown on **Figure 1.4.**

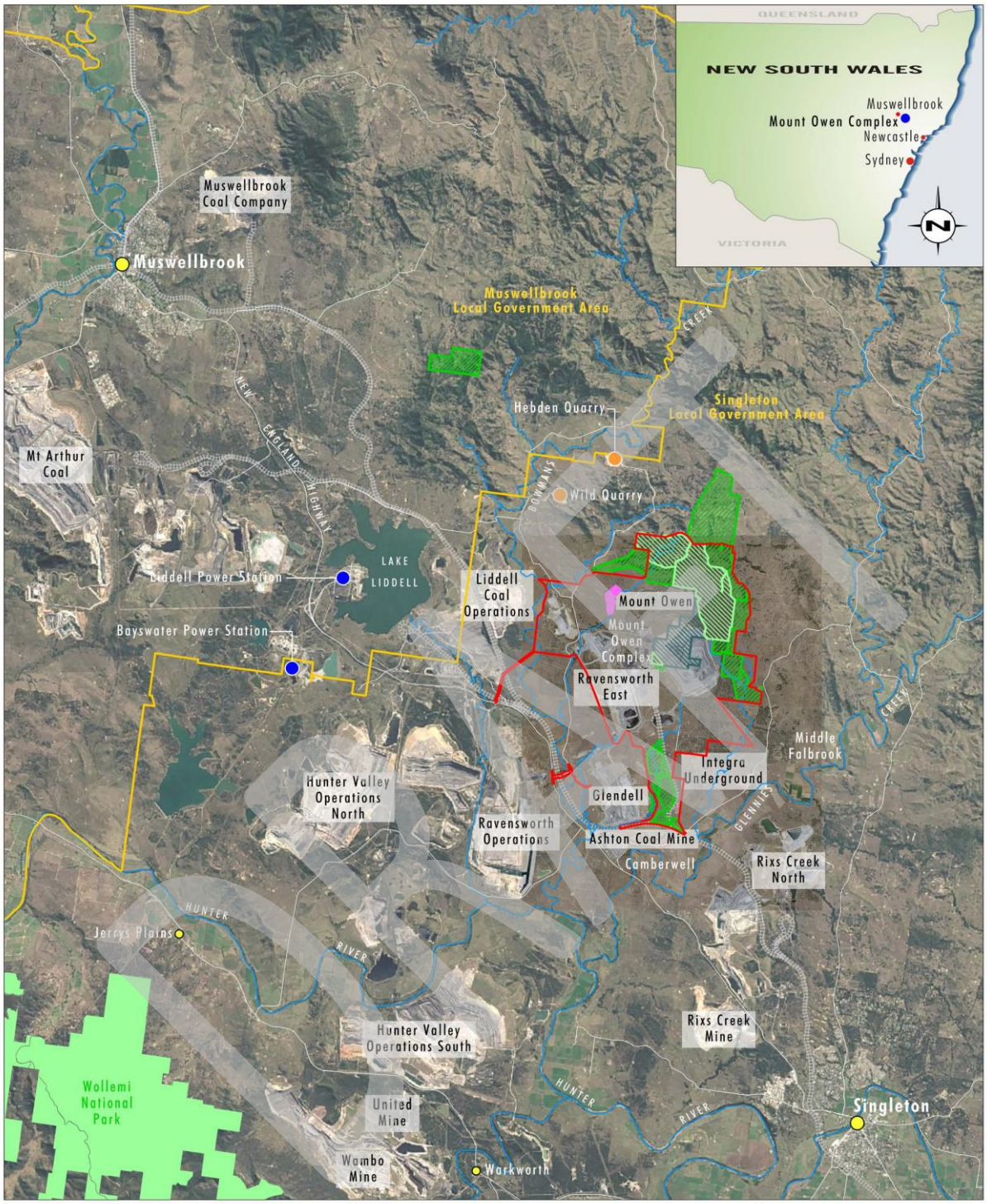

FIGURE 1.1

Upper Hunter Valley Context and Approved Mount Owen Operations

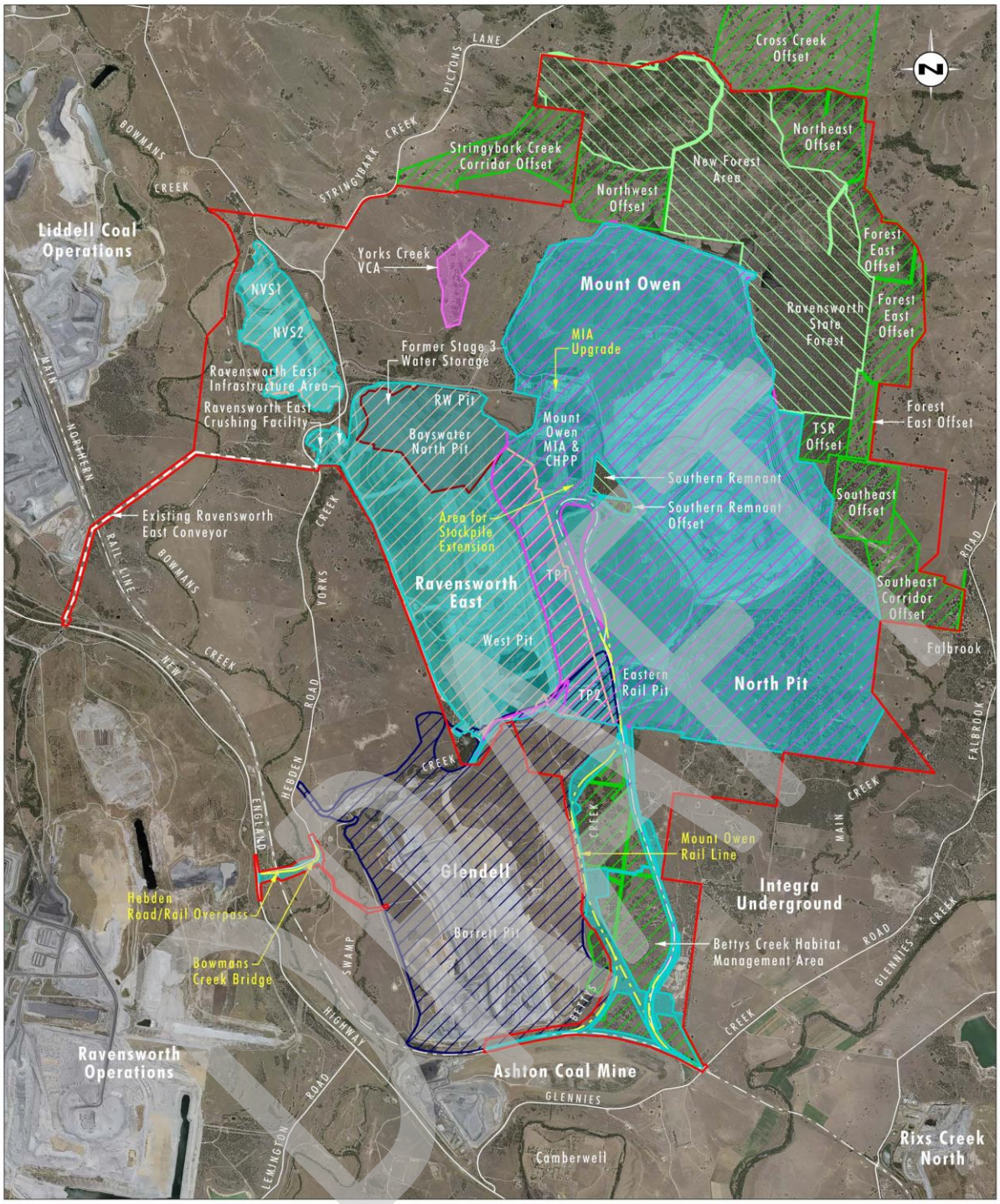

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

Legend

- SS5-5850 Consent Boundary
- Approved Rail Upgrade Works
- Approved Hebden Road Upgrade Works
- Approved Disturbance Area
- Yorks Creek VCA
- Bayswater North Pit
- Mount Owen Operational Area
- Glendell Operational Area
- Ravensworth East Operational Area
- Biodiversity Offset Area
- Ravensworth State Forest (Outside Operational Mining Area)

File Name (A4): R15/3810_126.dgn
20180702 15.59

FIGURE 1.2

Approved Operations Overview

umwelt

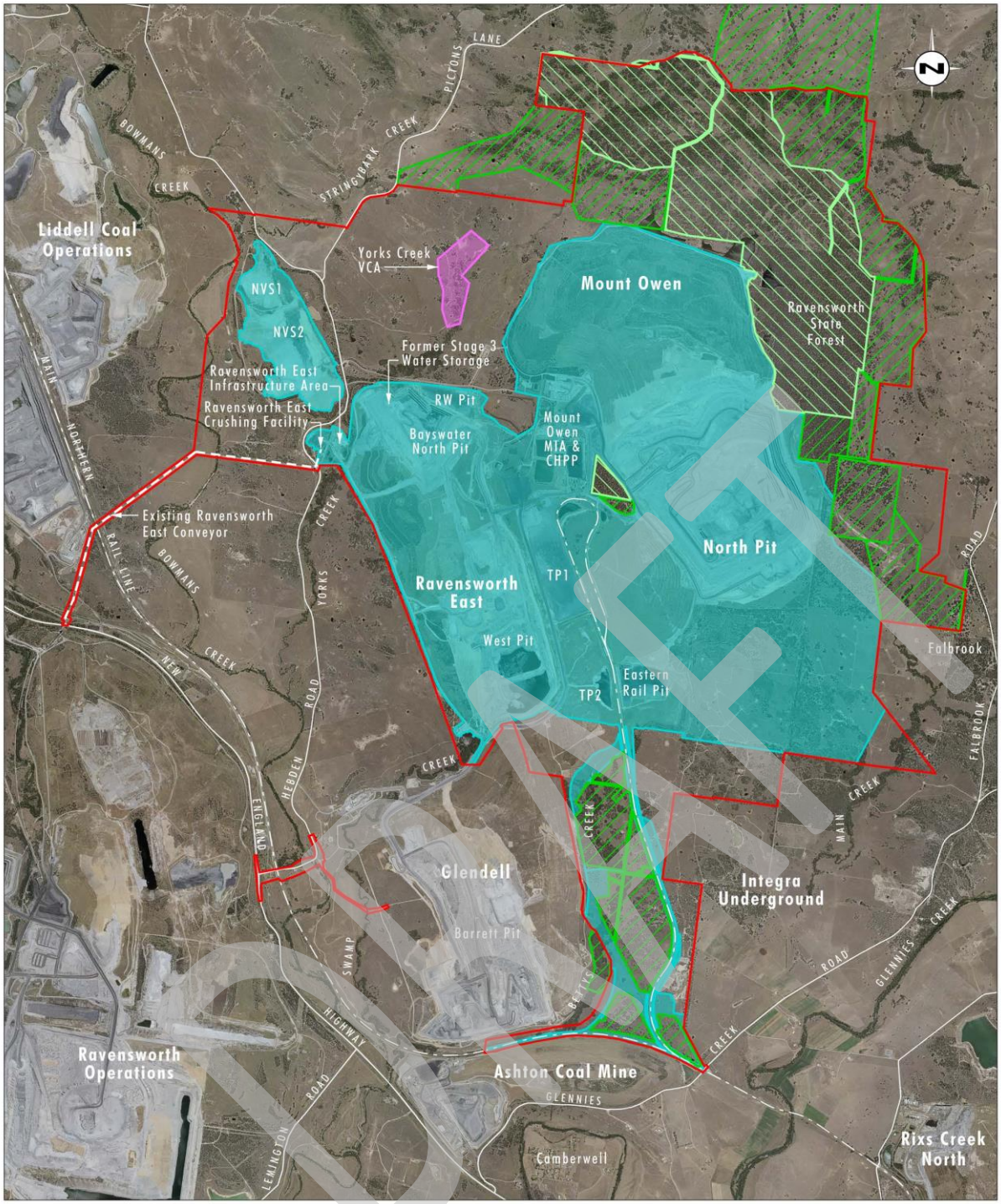

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend
- SSD-5850 Consent Boundary
- Approved Disturbance Area
- Biodiversity Offset Area
- Ravensworth State Forest (Area Outside Approved Disturbance)
- Yorks Creek VCA

FIGURE 1.3

Approved Mount Owen Disturbance Footprint

File Name (A4): R15/3810_127.dgn
20180702 15.45

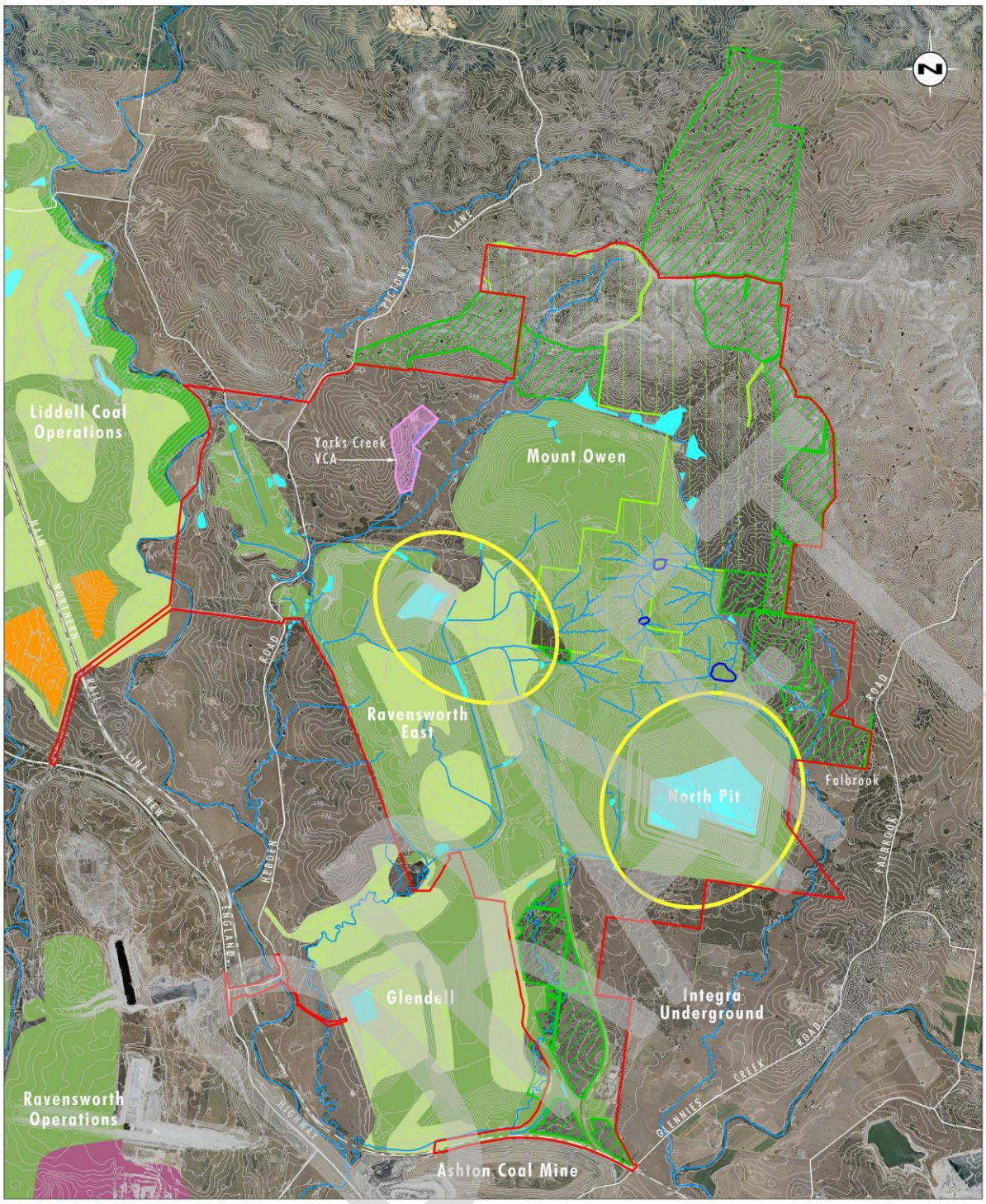


FIGURE 1.4

Conceptual Post Mining Land Use Design

1.4 Existing Rehabilitation Processes and Performance

Several forms of ecological rehabilitation and restoration have been undertaken to date at the Mount Owen Complex, comprising:

- mine rehabilitation on spoil material;
- revegetation (active management) of pasture grasslands outside of the mine disturbance areas through plantings; and
- passive regeneration of grasslands outside of the mine disturbance areas where adequate canopy seed sources are located nearby.

Previous and current mine rehabilitation practices on mine spoil has involved direct seeding with canopy species. Forest topsoil and woody mulch from areas cleared by mining has been used on a large portion of the rehabilitation, and this has provided a valuable seed source for the rehabilitation. In the absence of forest topsoil, pasture topsoil has been used as a replacement and planted with tube stock.

A range of fauna impact mitigation and management measures have been implemented. These measures have included the installation of nest boxes to compensate for the loss of hollow-bearing trees as a result of approved mining operations; and the construction of green and golden bell frog habitat in two frog conservation zones within Biodiversity Offset Areas and also within mine rehabilitation.

The rehabilitation strategy at the Mount Owen Complex has benefited from extensive research undertaken in partnership with the Centre for Sustainable Ecosystem Restoration (CSER) at the University of Newcastle. An initial goal of the Mount Owen Mine research program was to re-establish sustainable nutrient acquisition and cycling using natural root-microbe associations. This soon expanded to include research into the use of available bulk materials and amelioration techniques for mine rehabilitation when forest topsoil would eventually run out. Since commencement, the research has included over 40 experiments and investigations established to date. Mount Owen is now listed as a 'Highly Commended' site on the Global Restoration Network of the Society for Ecosystem Restoration, International. Mount Owen has also participated in several Australian Coal Association Research Program (ACARP) projects on mine site rehabilitation. Mount Owen has also undertaken, in collaboration with the University of Newcastle, the Ravensworth State Forest Vegetation Complex Research Program which has as its objective, the development of effective methods to establish dry sclerophyll and other native forest communities on rehabilitated overburden emplacement areas.

Assessments of ecological outcomes of mine rehabilitation, regeneration and revegetation at the North Pit (Umwelt 2014a) has indicated that rehabilitation areas sampled are trending very strongly towards the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC. In addition, other key findings included:

- natural recruitment of canopy species is present across the rehabilitation areas;
- rehabilitation communities provide known habitat for a range of threatened fauna species including small terrestrial mammals, birds and micro-bats;
- a wide range of common fauna species have been recorded utilising mine rehabilitation areas within the Mount Owen Complex including:
    - common brushtail possum (*Trichosurus vulpecula*);
    - Australian magpie (*Cracticus tibicen*);
    - eastern rosella (*Platycercus eximius*);
    - welcome swallow (*Hirundo neoxena*);
    - superb fairy wren (*Malurus cyaneus*);
    - olive-backed oriole (*Oriolus sagittatus*);
    - brown-headed honeyeater (*Melithreptus brevirostris*); and
    - yellow-faced honeyeater (*Lichenostomus chrysops*) and yellow-rumped thornbill (*Acanthiza chrysorrhoa*).

- a range of threatened species listed under the *Biodiversity Conservation Act 2017* and/or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are also known to utilise this habitat including:
    - spotted-tailed quoll (*Dasyurus maculatus*);
    - New Holland mouse (*Pseudomys novaehollandiae*);
    - eastern bentwing-bat (*Miniopterus schreibersii oceanensis*);
    - east coast freetail-bat (*Mormopterus norfolkensis*);
    - speckled warbler (*Chthonicola sagittata*); and
    - grey-crowned babbler (*Pomatostomus temporalis temporalis*).
- areas of derived native grassland in biodiversity offset areas that have been revegetated with canopy species provide high quality fauna habitat (including several threatened fauna species); and
- rehabilitation communities provide appropriate levels of species diversity for the age of vegetation and the majority of target species and groups of fauna species are repeatedly achieving benchmark species diversity values

However, the assessment report (Umwelt 2014b) also outlines that ongoing management of these sites is required to continue to improve their condition and function and to ensure long term self-sustainability.

The rehabilitation strategy as presented in this document has been designed to build off the success of these existing techniques and based on the learnings derived from previous monitoring and research, be adaptive to include new measures aimed at continual improvement.

2 Context for Rehabilitation

2.1 Glencore Coal Mine Closure Planning Process

Glencore has implemented a proactive approach to rehabilitation and mine closure by developing a range of standards that are to be implemented across its business units which includes the Mount Owen Complex. These standards require that planning for closure is an integrated part of the life of mine planning process. Specific guidance is provided for developing, implementing and reviewing mine closure plans taking into consideration economic, social and environmental factors so that each of Glencore's operations meet statutory requirements and achieves a sustainable post-closure land use.

The Glencore Closure Standard includes the scope of mine closure activities required at each phase of mining, with closure planning commencing at the exploration phase, continuing through the operational phase and eventually to government sign-off of rehabilitation and successful mining lease relinquishment. The level of detail required in a closure plan increases as the operation proceeds towards the planned closure date. Specifically, the standard requires that when a mine is within five years of the planned closure date that a detailed closure planning process is to be initiated. The process involved:

- Confirmation of final land use options;
- Identification of any closure issues and appropriate solutions;
- Budgeting for specific closure costs; and
- Development of a Final Closure Plan

The latter plan will be developed and submitted to the relevant regulatory authorities at a minimum of 2 years prior to the cessation of mining operations.

The existing Conceptual Closure Plan will be revised as part of the implementation of the Approved Operations. As such, this plan will be updated in consideration of the commitments outlined within the EIS (Umwelt 2014a) and the Response to the PAC Review Report (Umwelt 2016) and will include details regarding final land use objectives and closure criteria, rehabilitation and final void management strategies.

2.2 Alignment with Strategic Land Use Objectives

The strategic land use objectives for the area, which have been considered as part of the concept closure planning process for the Approved Operations, include those within the Singleton Local Environment Plan (LEP) 2013, NSW Resources Regulator Synoptic Plan and the Strategic Regional Land Use Plan for the Upper Hunter (Upper Hunter SRLUP) (Department of Planning and Infrastructure (DP&I) 2012). This document has also been developed to fulfil the key principles of the Strategic Framework for Mine Closure. Discussion of the alignment of the rehabilitation strategy for the Approved Operations with these strategies is outlined below.

2.2.1 Singleton Local Environmental Plans

The rehabilitation and closure strategy has been developed in consideration of the objectives of the Singleton LEP. Amendments that may occur to the LEP will be evaluated as part of ongoing revisions to the Project's mine closure plan. The Project Area is situated within an area classified as RU1 Primary Production. The objectives of RU1 zone are outlined below:

- 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; and
- to minimise conflict between land uses within this zone and land uses within adjoining zones.

In consideration of the LEP 2013, provision has been included within the rehabilitation strategy to maintain the rural landscape by re-establishing grassland areas (refer to **Section 3.0**). In addition, the Rehabilitation Strategy aims to return areas of Ravensworth State Forest to woodland communities resembling those which existed pre-mining, which provides opportunities for conservation and forestry industries similar to what the State Forest would previously have provided. The additional areas of woodland to be planted as part of rehabilitation will also expand the area of woodland vegetation potentially available for forestry use, should this be warranted as a primary industry into the future.

The infrastructure available to the post mining landform and the availability of water lend the site to potential use for intensive plant agricultures (permissible without consent) and some intensive livestock uses and potentially aquaculture (both permitted with consent). These and other potential post-mining land uses will be investigated as part of the detailed mine closure planning process.

2.2.2 Singleton Land Use Strategy

The Singleton Land Use Strategy was developed in 2008 and outlines key land use policies and principles for the Singleton local government area (LGA), and provides the planning context for the preparation of local environmental plan provisions. The Strategy had a time frame of 25 years, to 2032. The end land use for the Mount Owen Complex is therefore at the tail end of the planning horizon covered by the current Land Use Strategy. The Singleton Land Use Strategy was developed during the early stages of the mining investment boom. The Strategy specifically addresses Coal Mining lands and buffers:

Coal mining is probably the most significant land use and economic activity affecting the future of the LGA. In Singleton, coal production and employment is reaching its expected peak, and is likely to be stable or increase for the next 10 – 15 years and then progressively decline as easily accessible coal resources are depleted. ... Mining has a range of environmental and social impacts which need to be taken into account in future land use planning.

The Land Use Strategy does not specifically target the development of employment generating industries to mitigate the effect of mines reaching the end of production, however it does provide the following Strategic Action for coal mining lands and buffers:

> *Support a strategic review by the NSW Government of future coal mining proposals within the Upper Hunter Region, including rehabilitation, infrastructure and land use options, and an update of the … Synoptic Plan* [refer to **Section 2.2.3]** *for rehabilitation of mined landscapes.*

The Singleton LEP (see **Section 2.2.1**) also contains a broad range of uses permissible with and without consent that are potentially suitable for post mining landforms. The Land Use Strategy specifically identifies former coal mines as potential sites for adaptive reuse, particularly where they:

> *[H]ave existing infrastructure (e.g. water allocation and supply), wastewater treatment, roads, rail access, electricity, etc.) and are separated from urban areas. Limited by current rural zoning.*

The following broad location criteria are identified for any new industrial areas:

- *Located within or adjacent to an existing urban area (or within reasonable proximity to Singleton or Branxton) on relatively flat land which is not visually prominent.*
- *Proximity to major transport facilities such as major roads and with railway access.*
- *No direct access for individual industrial developments to the New England or Golden Highway, but otherwise convenient, suitable standard access.*
- *Must have direct connection to water and sewer, provision for adequate electricity. Require water allocation and reticulated water supply and sewer for all new industrial lots.*
- *Availability, or possible extension, of essential infrastructure such as water, sewer, electricity, sealed road access.*
- *Must support an industrial land hierarchy, with industrial service land located close to town, and large lot industrial/mining related development separated from town.*
- *Located so as to not have any adverse environmental impacts (e.g. visual impacts).*
- *All large new areas for heavy industrial to be serviced by rail access.*
- *Not subject to development constraints such as flooding, bushfire hazard, or biodiversity issues.*
- *Access to industrial areas should avoid traversing residential areas and areas are to be accessible by public transport (if available).*

The areas within and surrounding the current Mount Owen Complex MIA and CHPP area satisfy each of the above criteria.

The Land Use Strategy is currently under review by Council and it is envisaged that this strategy will have greater focus on the transition of mine sites towards end land uses which provide alternative land use opportunities into the future.

2.2.3 Synoptic Plan

The *Synoptic Plan: Integrated landscapes for coal mining rehabilitation in the Hunter Valley of NSW* (Department of Mineral Resources, 1999) (the Synoptic Plan) aims to provide a basis for the development of a long term integrated strategy for the rehabilitation of mines sites. The rehabilitation of mined areas at Ravensworth East and Mount Owen Mines is specifically identified in the Synoptic Plan as part of a broad north-south / east west corridor linkage (refer to Figure 39 in the Synoptic Plan).

The rehabilitation strategy for the Approved Operations has been developed to meet the intent of the Synoptic Plan and considers the potential regional outcomes for visual amenity, biodiversity and sustainable post closure use. The conceptual final land use (refer to **Figure 1.4**) includes woodland rehabilitation to establish and enhance native vegetation corridors to promote regional fauna movements across the Mount Owen Complex and surrounding region.

These corridors link to existing remnant vegetated areas of Ravensworth State Forest as well as the significant areas of woodland area being planted and regenerated in offset areas associated with Mount Owen Complex approvals and offsets lands for other mining projects in the area (e.g. Liddell Coal Operations offsets to the north west). The linkages are also focussed on enhancing biodiversity connectivity between major creek systems (in particular Glennies Creek and Bowmans Creek) and addressing 'missing gaps' in the local and regional biodiversity corridors. The biodiversity corridors established will be suitable for a range of threatened fauna species including but not limited to the spotted-tailed quoll (*Dasyurus maculatus*). The development and enhancement of habitat corridors is consistent with the intent of the broader regional corridor system outlined within the Synoptic Plan.

2.2.4 Upper Hunter Strategic Regional Land Use Plan (DP&I 2012) and Upper Hunter Strategic Assessment

The Upper Hunter SRLUP has been developed to provide a strategic framework for delivering the necessary context for government investment priorities, servicing strategies and local environmental plan making for the Upper Hunter Valley. The stated objective of the Upper Hunter SRLUP is to balance the strong economic growth in Regional NSW with the protection of valuable agricultural land and the sustainable management of natural resources. In particular, the Upper Hunter SRLUP identifies the importance of minimising the land use conflicts arising from the rapid growth of coal mining activities and the recent emergence of the coal seam gas industry.

Amongst the various land use types, the Strategy outlines the importance of the protection of biodiversity through strategic land use planning. It recognises that post mining rehabilitation has the potential to contribute to biodiversity conservation in the longer term and that the location and design of rehabilitation can be used to maximise its landscape value in the future. Importantly, the plan outlines that effective planning will be required to design a post-mining landscape that will allow a number of different land uses including conservation.

Other than the Synoptic Plan, there is limited strategic planning to guide the development of rehabilitation to improve biodiversity outcomes in the Hunter Valley. Notwithstanding, as outlined in **Sections 2.2.3, and 3**, the establishment of vegetation corridors identified in the Final Land Use for the Mount Owen Complex (refer to **Figure 1.4**) facilitates regional linkages with the biodiversity values of the broader area whilst not precluding opportunities for other post-mining land uses. As outlined in **Section 3**, the indicative post mining land use for the Project Area will primarily involve the establishment of Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the post-mining landform with areas of grassland on flatter areas considered more suited to sustainable grazing and agriculture practices. The ecological value of successful post-mining rehabilitation areas will contribute to the overall biodiversity offset strategy for the Project.

2.2.5 Strategic Framework for Mine Closure

The Strategic Framework for Mine Closure (ANZMEC & MCA 2000) has evolved as a cooperative development between the Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Australian Minerals Industry represented by the Minerals Council of Australia (MCA) that provides a framework of issues to be considered as part of a mine closure plan. The strategy for mine closure as outlined in this document has been developed in consideration of the six key objectives as identified by this framework document. Each of these objectives is outlined in **Table 2.1**, along with the relevant section of this document where they are addressed.

Table 2.1 Key Objectives from the Strategic Framework for Mine Closure

Key Objectives	Relevant Section of Document
To enable all stakeholders to have their interests considered during the mine closure process.	**Section 2.3**
To ensure the process of closure occurs in an orderly, cost-effective and timely manner.	**Sections 5.0**
To ensure that the cost of closure is adequately represented in company accounts and that the community is not left with a liability.	**Section 6.0** and security required under Mining Leases which is based on assessed rehabilitation liability associated with approved MOP
To ensure there is clear accountability and adequate resources for the implementation of the closure plan.	**Section 6.0**
To establish a set of indicators which will demonstrate the successful completion of the closure process.	**Section 3.0** and **Section 6.0**
To reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.	**Sections 3.0** and **6.0**

2.3 Stakeholder Consultation

One of the key focus areas for ongoing dialogue with stakeholders will be progress with the mine closure and rehabilitation planning and implementation process. As part of the approval process, Mt Owen sought stakeholder feedback on the mine closure and rehabilitation aspects of the Approved Operations through various forums including meetings with regulatory authorities, community groups and surrounding landowners.

Consultation was undertaken with DP&E, the NSW Resources Regulator and Singleton Council during the development of this Rehabilitation Strategy, these agencies and a number of iterations were made to incorporate the feedback received during this process.

Additional consultation was undertaken with the NSW Resources Regulator, DP&E and Singleton Council during the assessment process for the Mount Owen Continued Operations Project Modification 2 regarding the proposed final landform options and Rehabilitation Strategy. Comments received during this consultation process were also addressed by further amendments to this Rehabilitation Strategy.

Meetings undertaken during consultation for the Approved Operations included the identification and discussion of a range of different closure options. These included agricultural use, conservation for biodiversity and a number of other more specific land uses. The existence of infrastructure associated with the current mining operations (e.g. road access, power, water and rail access) would also provide opportunities for other uses of the post mining landform including opportunities for industrial uses. In a general sense, there was a view that the landform returned should be 'natural looking' and should, as closely as possible, retain the original landform that existed prior to mining through effective rehabilitation practice (Coakes Consulting / Umwelt 2014).

Key processes to enable all stakeholders to have their interests considered during the mine closure process will include but not necessarily be limited to the following:

- ongoing review and update of the Rehabilitation Management Plan/ MOP for Mount Owen,;
- submission of annual reviews and conducting associated meetings with government regulators to seek feedback in relation to the progress with rehabilitation activities;
- Mount Owen Complex Community Consultative Committee (CCC);
- Community meetings and information days;
- Community newsletters; and
- One-on-one meetings with stakeholders.

3 Indicative Post Mining Land Use

The indicative post mining land use for the Project Area (refer to Figure 3.1) will primarily involve the establishment of woodland areas, specifically a vegetation community consistent with the Central Hunter Ironbark – Spotted Gum – Grey Box Forest and selected areas of grassland for agriculture. The North Pit and Bayswater North Pits will include pit lakes which will recover over time. The Rehabilitation Strategy will also include the establishment of other communities in appropriate parts of the terrain such as Hunter Lowland Red Gum Forest and wet variants of Central Hunter Ironbark-Spotted Gum-Grey Box Forest. The primary objective is to create a native vegetation corridor network that promotes fauna movements between the Mount Owen Complex, Ravensworth Operations, Liddell Coal Operations, Lake Liddell and the Ravensworth Operations Hillcrest Offset Areas, as well as throughout the region.

There is no Biophysical Strategic Agricultural Land (BSAL) land in the Approved Disturbance Area due to soil fertility constraints. The combination of terrain and soil constraints in the rehabilitated final landform will restrict Land and Soil Capabilities (LSC) to LSC Classes 6 to 8, other than minor flatter areas, which will be rehabilitated to LSC Class 4 or 5 land.

Portions of the Approved Disturbance Area, including the tops of overburden dump areas associated with Ravensworth East, as well as capped tailings dams (refer to **Figure 1.4**) will be revegetated with open grassland with pockets of native vegetation. Depending on outcomes of final land use analysis to be completed as part of the detailed closure planning process five years from closure, it is the intent that these areas could be used for sustainable agricultural purposes such as grazing. As such, revegetation may involve the use of both native and suitable exotic pasture species for the establishment of grasslands in these areas. In this instance, pockets of native vegetation may be established as shelter belts to support grazing activities.

Two voids are currently planned for incorporation into the final landform following cessation of mining: one within the North Pit and one in the Bayswater North Pit. Where necessary, the high walls surrounding these voids will be battered back to improve stability. This will result in a slight increase in overall void footprint, but also provide opportunity for selective woodland plantings (refer to **Section 5.4.1**).

The conceptual final land use strategy for the Project is shown in **Figure 1.4**. As discussed in **Section 5.4**, micro-relief features will be implemented in the parts of the final landform developed as part of the new approval that is for all rehabilitation completed from 6 February 2017. The landform in existing areas already top dressed with topsoil and revegetated will not be revisited.

In consideration of the proposed operational life of the Approved Operations to 2037, the potential for other sustainable and economically productive post-closure land uses will be investigated in light of the local and regional land use strategies that may have further evolved towards the end of the mine life including the potential options to utilise voids for either water storage areas or tailings emplacement from other mines. Other options may include potential industrial uses, particularly in consideration of the availability of the rail line as well as the suitability of infrastructure associated with the workshop, office complex and other surface facilities including lay down storage areas, stockpiles and water management structures. The areas with most potential for these alternative land uses is shown in **Figure 1.4**. The investigation of post mining land uses and opportunities to maximise the value of existing infrastructure on the site will be undertaken as part of the detailed mine closure process and in consultation with relevant stakeholders.

Rehabilitation activities will be undertaken progressively throughout the life of mine to allow maximum opportunities for the development of vegetation prior to mine closure. Areas with greatest potential for alternative land uses will be the areas rehabilitated latest however it is noted that these areas will remain operational until the end of the mine life.

3.1 Rehabilitation Objectives

The proposed rehabilitation strategy for the Approved Operations (refer to **Figure 1.4**) has been developed in consideration of a number of factors including site opportunities (i.e. proximity to remnant native vegetation areas) and constraints (i.e. slope, substrate quality etc.), ecological and rural land use values and existing strategic land use objectives. These objectives are consistent with condition 42 of the current development consent and set out in **Table 3.1** below:

Table 3.1 Rehabilitation Objectives

Feature	Objective
Mine site (as a whole)	• Safe, stable and non-polluting • Final landforms (including final voids) designed to incorporate micro-relief and integrate with surrounding natural landforms[#] • Constructed landforms maximise surface water drainage to the natural environment (excluding final void catchments) • Minimise long term groundwater seepage zones • Minimise visual impact of final landforms as far as is reasonable and feasible • Final landforms designed in consideration of water licensing requirements, as calculated through consultation with DPI Water
Final voids	• Designed as to ensure sufficient freeboard at all times to minimise the risk of discharge to surface waters • Minimise to the greatest extent practicable: o the size and depth of final voids o the drainage catchment of final voids o any high wall instability risk and o the risk of flood interaction for all flood events up to and o including the Probable Maximum Flood
Rehabilitation areas and other vegetated land	• Restore at least 2,163 ha of self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area, as shown conceptually in **Figure 1.4** including at least 518 hectares of woodland which conforms to the Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC • Establish areas of self-sustaining: o riparian habitat, within any diverted and/or re-established creek lines and retained water features o potential habitat for threatened flora and fauna species and o wildlife corridors, as far as is reasonable and feasible, and as shown conceptually in **Figure 3.1**
Agricultural land	• Rehabilitate grassland areas identified in **Figure 1.4** as being potential grazing areas to support sustainable grazing activities
Creek restoration works	• Engineered to be hydraulically and geomorphologically stable • Incorporate erosion control measures based on vegetation and engineering revetments • Incorporate structures for aquatic habitat • Revegetate with suitable native species
Surface infrastructure	• To be decommissioned and removed, unless DRE agrees otherwise
Community	• Ensure public safety • Minimise adverse socio-economic effects associated with mine closure

The rehabilitation objectives apply to the entire site, including all landforms constructed under either this consent or previous consents. However, they do not require any additional earthmoving works to be undertaken for landforms that have been approved and constructed under previous consents.

Further detail in regards to the rehabilitation criteria and specific rehabilitation methodology related to the establishment of these areas as outlined above are included in **Sections 3.2** and **5.0** respectively.

3.2 Rehabilitation Completion Criteria

Completion criteria are objective target levels or values assigned to a variety of indicators (i.e. slope, species diversity, groundcover etc.) which can be measured against to demonstrate progress and the ultimate success of rehabilitation. As such, they provide a defined end point, at which point in time rehabilitation can be deemed successful.

The rehabilitation completion criteria for the Approved Operations are outlined in **Table 3.2**. The criteria have been developed considering specific issues for the Approved Operations and objectives, Glencore's standards and the outcomes of the 2005 ACARP study entitled 'Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley'.

Further details regarding rehabilitation processes are contained in **Section 5.0**. Detailed management activities and processes undertaken throughout the Project to achieve these criteria will be set out in the Mining Operation Plan/Rehabilitation Management Plan.

These criteria will be reviewed and revised throughout the life of the mine considering:

- the results of rehabilitation monitoring programs;
- any relevant research trials; and
- consideration of stakeholder feedback.

The completion criteria will be finalised as part of the detailed mine closure planning process and presented in the Final Closure Plan for approval by the relevant government agencies.

The achievement of the completion criteria (and progression towards completion criteria) will be monitored and reported within the annual reports submitted to relevant government agencies.

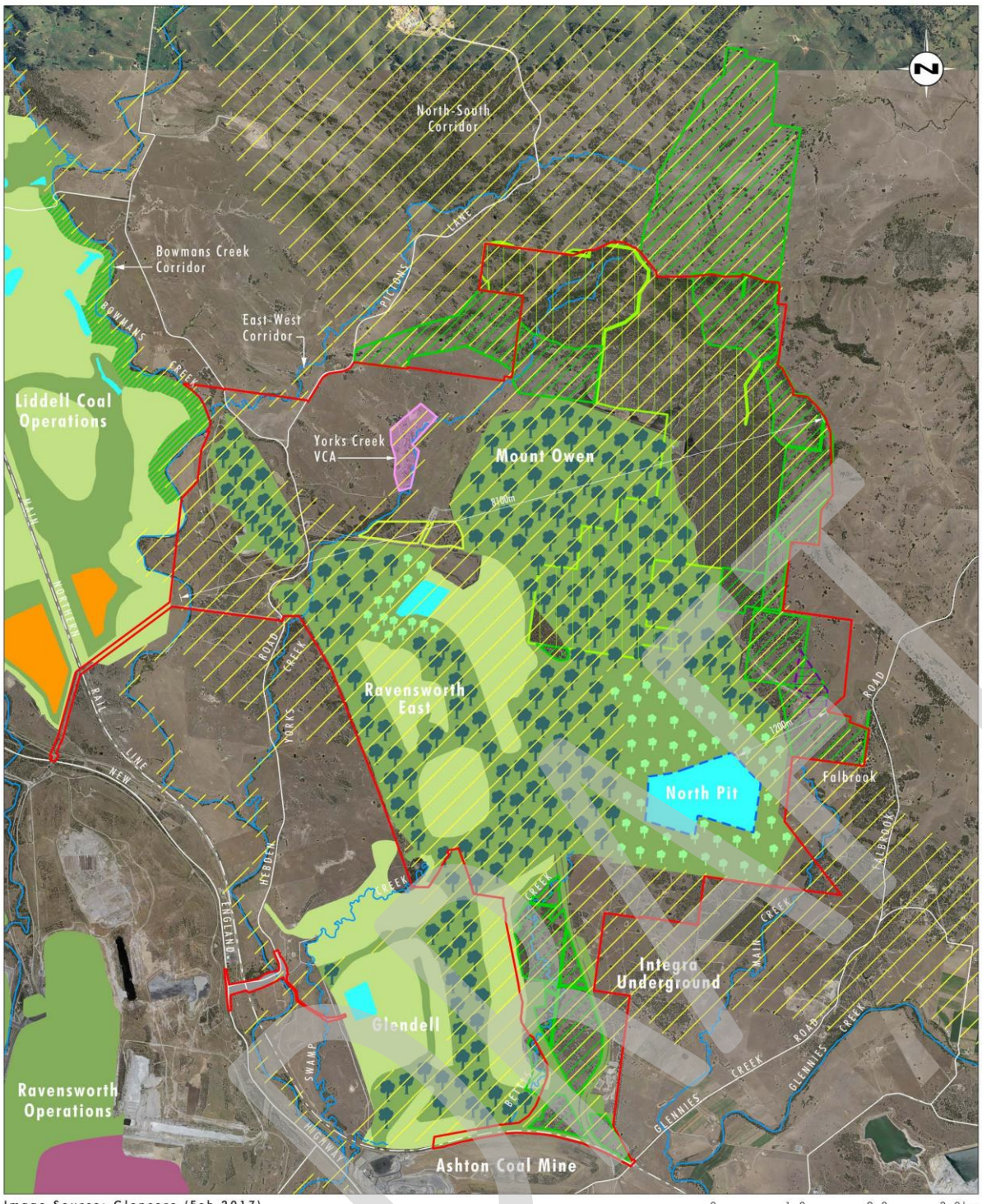


FIGURE 3.1

Conceptual Habitat Connectivity and Conceptual Final Landform Area 10 Year Post Closure

Table 3.2 – Preliminary Closure and Rehabilitation Criteria

Aspect	Objective	Preliminary Closure Criteria
Decommissioning	All infrastructure that is not to be utilised as part of the future intended land use are removed to make the site safe and free of hazardous materials.	• All surface infrastructure which does not have a potential future use associated with the post mining land use will be removed, unless such removal has a greater environmental impact than rehabilitating the area with the infrastructure remaining in place. • Services: removal of all services (power, water, communications), which don't have potential future uses. • Mount Owen CHPP and associated infrastructure: removal of the CHPP and all associated conveyors and structures. • Rail provisioning facility, train loading system and loop: removal of all infrastructure, rail provisioning facility, train loading system and loop, including ballast material, should a suitable alternate future use for the rail infrastructure not be identified. • Office and Workshop: demolition and removal of all offices and workshop related facilities including refuelling facilities. • Pumps, pipes and power: removal of water management infrastructure. Where underground pipelines are to remain *in situ*, the location of the infrastructure has been marked on the final landform plan and a suitable caveat developed to provide that they are readily identifiable for future land holders. • Lay down areas: removal of all plant and equipment.
	All infrastructure that is to remain as part of the future land use is made safe through the use of fencing and /or bunding.	• Potential hazards (i.e. electrical, mechanical etc.) have been effectively isolated. • The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use. • Appropriate security measures have been implemented to minimise the potential for unauthorised access during the period that the site is transitioned to the intended final land use.
	There is no residual soil contamination on site that is incompatible with intended land use or that poses a threat of environmental harm.	• Contamination will be appropriately remediated if required, so that appropriate guidelines for land use are met. • Where practical, exposed carbonaceous material will be removed and co-disposed within the overburden emplacement areas or suitably capped *in situ*.

Aspect	Objective	Preliminary Closure Criteria
Landform Establishment	Landform suitable for final land use and compatible with surrounding landscape as sustainable native ecosystem.	• Rehabilitated slopes (excluding retained sections of the highwall and the low wall within the final void) are generally an average of 10 degrees. However, to allow for the creation of local relief in topography on the top of overburden dumps as well as the creation of alternative stable slope designs (i.e. if concave profiles are utilised), slope angles may exceed this criteria. • Low wall batter within the final void to an average slope not exceeding 18 degrees. • Retained highwalls to be assessed as being geotechnical stable by a suitably qualified person. • Local micro-relief of the final landform is designed and constructed to be geomorphically stable (within the context of a dynamic naturally evolving landscape) and visually consistent with the surrounding area. • No significant erosion is present that would constitute a safety hazard or compromise the capability of supporting the end land use. • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff. • Rehabilitated areas are designed to be free draining (for areas not forming part of the catchment areas of final voids) • Landform is designed to have regard to minimising long term groundwater seepage zones. • Surface layer is free of any hazardous materials. • Final voids are designed to have sufficient freeboard to avoid spills to the environment • Final void design to consider minimising size, depth, drainage catchments and flooding risks having regard to proposed final land use and water quality, and demand requirements. • Final Voids are designed to avoid potential for flood ingress up to and including the Probably Maximum Flood • Final voids are designed with consideration to providing sufficient freeboard and minimising size, depth, drainage catchments and flooding risks. • Final voids and associated highwall has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose a safety risk; • Access to final Bayswater North Pit Final Void is restricted through the construction of an appropriate barrier to prevent human and animal access; • Tailings and reject emplacement areas will be capped and reshaped and be free draining. • Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and does not pose a threat to downstream water quality. • Any creek restoration works have been engineered to be hydraulically and geomorphically stable, incorporating suitable natural and engineered structures to aid erosion control and provide aquatic habitat. • The final landform reestablishment design has regard to potential habitat resources suitable for significant and/or threatened species (refer to Section 5.6.1). • Sufficient water licences are held to account for net take from water systems covered by licensing requirements.

Aspect	Objective	Preliminary Closure Criteria
Growing Media Development	Growing media is capable of supporting sustainable vegetation growth.	• The rehabilitation surface is a suitable growing medium (as evidenced by vegetation establishment). • Soil pH to be in the range of analogue sites. • Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer).
Ecosystem Establishment	Revegetation is sustainable for the long term and only requires maintenance that is consistent with the intended final land use.	• Revegetation areas contain flora species assemblages characteristic of the desired native vegetation communities. • Second generation trees are present or likely to be, based on monitoring in comparable older rehabilitation sites (i.e. evidence of fruiting of native species observed). • More than 75 per cent of trees (non-pioneer species) are healthy and growing as indicated by the long term monitoring program. • There is no significant weed infestation such that weeds do not compromise a significant proportion of species in any stratum. • Appropriate bushfire hazard controls have been implemented on the advice from the NSW Rural Fire Service.
Ecosystem Development	Revegetation areas will provide habitat value in the future.	• Rehabilitated areas provide a range of vegetation structural habitats (e.g. eucalypts, shrubs, ground cover, developing litter layer, etc.) to encourage use by native fauna species.

4 Scope of Mine Closure Decommissioning Works

At the end of the proposed operational life, with the exception of that which is required for the final land use, Mount Owen proposes to decommission all on site infrastructure and associated facilities not required for any post-mining land uses as part of the mine closure process. Closure monitoring and maintenance works would continue after mine closure activities are complete until it can be demonstrated that the relevant completion criteria have been met (refer to **Section 3.2**).

A detailed mine closure plan will be developed for the Project at least two years prior to mine closure date. Development of the mine closure plan, will include consultation with a range of stakeholders including:

- Local Council;
- DP&E;
- NSW Resources Regulator;
- other relevant government agencies; and
- local community.

This plan will specifically address the major aspects of decommissioning and rehabilitation and define the future rehabilitation care and maintenance requirements developed to achieve these criteria.

A summary of the general decommissioning activities that will be undertaken as part of the closure and decommissioning is outlined in **Table 4.1**.

Table 4.1 General Approach to Decommissioning Activities

Mine Closure Aspect	General Approach
Site Services	Where not required for approved future land uses, The following activities will occur: • Electricity services to any remaining infrastructure will be removed prior to the commencement of building demolition works. • Telecommunications, water supply and other services will also be disconnected and removed where practical. • Where services are buried (i.e. pipelines, cables etc.) and their retrieval may lead to further disturbance, the infrastructure may be left in situ provided that they don't pose constraints to the post mining land use. In this situation, the location of the services will be surveyed and marked on the site plan and a suitable caveat developed to provide that they are readily identifiable for future land holders.

Mine Closure Aspect	General Approach
Buildings and Fixed Plant	• All buildings, fixed plant and other infrastructure which are not required as part of the post-closure land use will be demolished and removed. Where appropriate the materials recovered during demolition will be sold for re-use or recycled. • Concrete footings and pads along with other potential inert building waste will be broken up and buried with overburden in the pit area or used in rehabilitation where appropriate. • Where it does not pose a constraint to the proposed final land use, structures such as footings, underground water pipelines and disconnected power cables may be left in situ. This may include where it is not practical to retrieve the structures or where their removal may lead to environmental damage. These remaining structures will be surveyed and recorded on a plan.
Rail loop and rail siding (if not required as part of the final land use)	• The management of the rail loop and rail siding at closure will be dependent upon the outcomes of the final land use analysis. • In the event that the rail infrastructure is not required as part of the final land use, the rail lines will be deconstructed and removed. This will involve the removal of all railway sleepers and ballast material, which depending on their condition may be reused or disposed of in accordance with the appropriate waste guidelines. • The rail siding and loop will be reshaped and revegetated as part of rehabilitation activities. • Spillages of potential carbonaceous or contaminated material will be managed as per below.
Removal of Carbonaceous/ Contaminated Material	• Excess coal material remaining at closure will be scraped up and either reprocessed or disposed of within the tailings/coarse reject emplacement areas. • Any remaining carbonaceous material (e.g. coal reject) on the base of the coal stockpile area will be either capped with inert material in accordance with relevant guidelines or scraped up and removed to the tailings/coarse reject emplacement area. • Where there is potential that contamination may have occurred as a result of operational activities (e.g. re-fuelling areas, workshops, etc.), investigations will be undertaken to determine the presence and extent of any contamination. Where identified, contaminated material will be bioremediated on site or managed in accordance with the appropriate waste guidelines.
Equipment Storage Areas	• Any redundant plant or equipment will either be sold for reuse, recycled (i.e. scrap metal) or disposed of at an appropriate landfill facility. • Storage areas will be assessed for potential contamination (e.g. hydrocarbons) and remediation undertaken as required.
Hardstand Areas, Roadways and Car Parks	• Hardstand areas, roadways and car parks will be removed with the waste material (e.g. bitumen, concrete) being placed and capped in the tailings/overburden emplacement areas or incorporated into the final voids.

Mine Closure Aspect	General Approach
Hazardous Materials Management	• All remaining hydrocarbons such as diesel and lubricants and other hazardous materials will be either utilised or disposed of via an authorised waste contractor. • The storage tanks will be removed and depending on their condition either sold or disposed of at an authorised facility.
Dangerous Goods	• It is envisaged that the majority of dangerous goods remaining on-site will include gas bottles and cleaning agents, which will be utilised during decommissioning activities or disposed of off-site in accordance with the regulatory arrangements applicable at the time.
Water Management Infrastructure (e.g. Main Water Storage Dam)	• Depending on the chosen final land use, issues that will be addressed as part of the post-mining water management system will likely include: ○ the removal of the oily water treatment system following the demolition of the workshop and associated facilities; ○ removal of excess sediment (i.e. saline sediment) from the surface dams for future use by the subsequent land owner or alternatively filling or removing the dams if they are no longer required; ○ re-shaping dams (where required) in accordance with their intended use. This may involve re-sizing, facilitating stock access (if required) or reshaping to enhance habitat functionality for specific fauna species; ○ where dams are to be retained, design drainage structures to capture runoff from sufficient catchment area so that the dam can be utilised for its intended use; and ○ the installation of appropriate sediment and erosion control measures. • Sediment material extracted from surface dams will be analysed to determine the potential for contamination and, if present, will be appropriately disposed.
Final Void Management	• High and Low walls of final voids rehabilitated as per geotechnical recommendations to provide wall stability; • Drainage structures constructed to divert water away from final voids; • Drainage structures constructed as required within final void areas to prevent instability from erosion; • Rehabilitation of high and low walls as defined in the final void management plan; • Monitoring of groundwater impacts and water quality within the final void during the care and maintenance phase of the project; • Option to utilise remaining voids as a future water storage or tailings storage facility for future use in the Greater Ravensworth Area based on future approvals

5 Rehabilitation Strategy

Rehabilitation will be undertaken progressively in accordance with the Rehabilitation Management Plan/MOP. The MOP will be developed in accordance with this rehabilitation strategy and will include the detailed measures and schedules for all rehabilitation activities. The ongoing review and refinement of rehabilitation completion criteria (refer to **Section 3**) will be undertaken as part of the MOP process and the monitoring of rehabilitation performance against the completion criteria will be reported in the Annual Review.

Details of the rehabilitation strategy are provided in the sections below.

5.1 Management of Biological Resources for Utilisation in Rehabilitation

5.1.1 Seed Collection and Propagation

Native revegetation activities in rehabilitation areas will preferentially use local provenance seed for direct seeding or tubestock propagation. Mount Owen has developed a seed collection program to maximise the amount of viable seed of local provenance for use in rehabilitation and revegetation activities. The program includes:

- a seed calendar that contains information relating to fruiting and seed collection times for key native species;
- data on seed collection including species, collection location and date of collection;
- seed assessment of native vegetation within the pit shell in order to allow for seed collection prior to or immediately following clearing;
- required volumes of seed to be collected in order to enable adequate supply of native seed for reuse; and
- the utilisation of record sheets and a GIS database to track collection, storage and utilisation of the seed resource.

The seed collection program adopts innovations to industry best practice techniques, where relevant.

Where adverse seasonal conditions (i.e. drought) affect the availability of local provenance seed, supplementation with non-local provenance seed may be required. Alternatively, revegetation works may be delayed until sufficient stocks of local provenance species are available.

5.1.2 Salvage of Tree Hollows, Stags and Timber

The salvage of hollow bearing trees, hollow logs, fallen timber and boulders will continue to be undertaken, where practical, during the clearing process. The relocation of such habitat resources into post-mining rehabilitation areas and offset and conservation areas (where deemed to be appropriate) is aimed at increasing habitat complexity in these areas, in order to make them more habitable for native species, particularly key threatened species.

5.1.3 Soil Characterisation and Topsoil Management

As outlined in the Agricultural Impact Statement (Umwelt 2014c) for the Approved Operations, soil survey and soil testing (including soil structure, texture, pH, sodicity, cation exchange capacity and soil fertility) was conducted in the proposed disturbance area, to verify the soil types present and the actual LSC classes of the Project Area. Based on this analysis, the proposed disturbance area contains LSC Classes 4 to 7 which represent moderate through to very low capability land.

In general there will be the opportunity for reuse of soil and subsoil for rehabilitation purposes, however, subject to further characterisation it is expected that ongoing specialist management practices as outlined further below will be required to overcome constraints. Overall it is expected that

there will be a topsoil deficit for the Approved Operations and a detailed topsoil balance will be included in the MOP to determine the quantity of other alternative substitutes (e.g. organic material) that may need to be imported on site if direct planting into overburden is not considered to be feasible. The outcomes of this process will be detailed within the Rehabilitation Management Plan/MOP for the Mount Owen Mine.

Mount Owen has existing topsoil stockpile management procedures to maintain the quality of topsoil for subsequent use in rehabilitation. These procedures will continue to be implemented for the Approved Operations. Materials management and monitoring techniques to be adopted in this strategy are outlined below:

- Material characterisation of topsoil and subsoil will be undertaken at an appropriate scale across the proposed disturbance area, prior to pre-stripping activities or the re-handling of long term topsoil stockpiles. Representative samples will be taken to characterise the nature of the soil material (e.g. sodicity, acid-generating potential, etc.) to determine the potential limitations to rehabilitation and sustainable plant growth. The results will be used to determine specific ameliorant techniques that may be applied to the soil material in order to overcome potential limitations and enhance vegetation establishment.
- Wherever practicable, topsoil is to be transferred directly from stripping location to areas that have been reshaped for rehabilitation, eliminating the need for storage and re-handling.
- Where the stockpiling of topsoil is necessary due to the unavailability of shaped areas for direct-return, stockpiles will be generally less than 3 metres high to retain biological activity within the topsoil.
- Stockpiles to be kept longer than 3 months will be sown with a suitable cover crop to minimise soil erosion and the invasion of weed species.
- Topsoil and subsoil stripping activities are to be restricted during adverse weather conditions to minimise the potential for dust generation.
- When stripping topsoil and subsoil a water cart is available to minimise dust emissions during stripping activities.
- Topsoil and subsoil will be stripped using appropriate equipment (e.g. dozer or scraper) to the appropriate depths identified in the Agricultural Impact Assessment (Umwelt 2014c) for the Project or in accordance with the outcomes of further investigations undertaken as required.
- Topsoil and subsoil layers will be assessed and managed so that they can be appropriately re-applied in areas to be rehabilitated.
- Topsoil stockpiles are to be located away from traffic areas and at an appropriate distance from watercourses.
- Appropriate sediment controls will be installed around topsoil stockpiles.
- Where required, machinery used to handle and transport topsoil shall be washed down prior to and at the completion of works to minimise the transfer of weeds.
- Weed growth will be monitored and subsequently controlled if necessary.
- Prior to re-spreading, any weed growth will be scalped from the top of the stockpiles to minimise the transport of weeds into rehabilitated areas.
- Stockpiles will be appropriately identified to minimise the potential for inadvertent use or disturbance.

5.2 Overburden and Interburden Handling

5.2.1 Management of Potential Geochemical Constraints to Rehabilitation

Environmental Geochemistry International Pty Ltd (EGI) carried out assessments in 2013 and 2018 into the potential for

- acid rock drainage (ARD);
- salinity and elemental solubility (neutral mine drainage (NMD); and
- sodicity potential

to identify any geochemical issues and provide recommendations for materials management and follow up test work.

Analysis showed that the majority of the overburden/interburden materials represented by the samples tested are likely to be non-acid forming (NAF), with a significant excess of acid neutralising capacity and low leachable salinity. Whilst there was the occasional thin zone (0.2 metres) of elevated Sulfur (S) identified close to coal seams, dilution and mixing during mining should be sufficient to mitigate any ARD generation. The final pit floor materials will comprise mainly of the Bayswater Seam and as such, the study outlines that the pit floor and margins of the pits are likely to be NAF with possible portions of low capacity potential acid forming (PAF-LC) materials.

In addition to the above, water extracts from NAF overburden/interburden indicated that neutral mine drainage was unlikely to contain significant metal/metalloid concentrations and that results indicated that there was no potential for alkaline drainage.

Furthermore, EGI outlined that weathered Permian materials (that is, sandstone) represented by the samples tested are likely to be sodic and dispersive. It was also found that finer grained fresh Permian materials may also be partly sodic. As such, this material may be subject to surface crusting and high erosion rates if they are incorporated into the surface of the final rehabilitated landform.

Additional analysis indicates that mixing PAF overburden/interburden and NAF Sandstone will provide sufficient buffering and delay acid production. This would suggest that the blended material would be suitable for use in rehabilitation.

5.2.2 Summary of Ongoing Management of Mine Materials

In consideration of the above results, the strategies for mine materials management to address potential geochemical constraints for rehabilitation will be undertaken as outlined below.

Periodic sampling and testing of mine water will be continued as part of the water quality testing program to check for ARD generation. A sampling program will be continued to assess the potential for sodic/dispersive materials and be used to maintain management measures to achieve successful rehabilitation.

Where strongly sodic and dispersive material has been identified within the strata profile, the mine materials management process will avoid the placement of this material where it has the potential to affect the quality of final rehabilitation (e.g. within 3 metres of the surface of the final landform).

The handling of non-sodic material, as identified through sampling and testing of the strata profile, will be preferentially selected over sodic material for placement at the surface of the final landform. Where this material cannot be practically or efficiently accessed for selective handling during the mining process, specific amelioration requirements (i.e. gypsum, lime etc.) may be required where sodic material is used in the plant growing horizon, exposed on dump surfaces or used in engineering structures.

In the event that PAF material is to be used for rehabilitation purposes, it will be mixed with suitable NAF material to provide for sufficient buffering to allow for rehabilitation establishment and prevent generation of acid runoff.

5.2.3 Spontaneous Combustion Management

Based on the history of mining operations at Mount Owen Mine, it is considered that there is a low propensity for spontaneous combustion to occur within coal reject and overburden emplacement areas on site. However, the issue of spontaneous combustion and the potential liability for mine closure will continue to be evaluated and managed (if required) as part of the Approved Operations.

Material that is potentially prone to spontaneous combustion will be placed at a suitable depth to minimise any potential interference to rehabilitation establishment as well as minimise the potential for spontaneous combustion or ignition of carbonaceous material in the event of bushfire occurring within the revegetated landscape. General practices designed to minimise oxygen exposure pathways to potentially prone material will include the following:

- the capping of tailings emplacement areas;
- coarse reject material will be co-disposed with overburden material and incorporated at a suitable depth into the final landform; and
- spontaneous combustion prone overburden/interburden material that is identified through the routine sampling program will be selectively handled and buried at depth to prevent exposure of this material.

5.3 Coarse Reject and Tailings Dam Decommissioning

5.3.1 Tailings Dam Decommissioning

The tailings emplacement areas will be filled and shaped to the conceptual final landform plan and subsequently capped. The primary objective of the capping design will be to minimise the potential for exposure of potentially environmentally sensitive tailings material in the rehabilitated landform and prevent the occurrence of spontaneous combustion. Following capping, these areas will be revegetated in accordance with the revegetation processes as outlined in **Sections 5.6**.

To promote the geotechnical stability of these areas and avoid the potential sterilisation of land in the post-mining landform, dewatering strategies will be incorporated into the design of the tailings dam. The aim of the strategy will be to progressively dewater the tailings dams and promote the consolidation of material throughout the tailings profile. Water extracted from the process will be re-utilised for on-site purposes such as the processing of coal or for dust suppression. Dewatering of the tailings dam will be managed to enable finalisation of capping and rehabilitation following the cessation of active mining.

5.3.2 Coarse Reject

Coarse reject material will be co-disposed with overburden material and incorporated into the final landform. The coarse reject material will be placed at a suitable depth within the final landform to minimise any potential interference to rehabilitation establishment as well as minimise the potential for spontaneous combustion or ignition of carbonaceous material in the event of bushfire occurring within the revegetated landscape.

As outlined in **Section 5.2.1**, analysis was undertaken by EGI to assess the geochemical constraints and identify potential measures required for materials management and follow-up test work required. As part of the scope of the EGI study included the sampling and testing of coal reject samples from the current Mount Owen CHPP. The results of the samples tested were reported by EGI to be mainly NAF, but may include potentially acid forming (PAF) and PAF-LC portions.

Analysis undertaken by EGI (2013 and 2018) to assess the ARD potential identified that the vast majority of fine and coarse rejects represented by the samples collected are expected to be NAF with excess ANC and are not expected to require special handling. Dilution and mixing during mining is expected to be sufficient to mitigate ARD from any occasional thin zones of pyrite that may be present.

Regular review with sampling and testing of washery wastes will be carried out during operations to confirm the low salinity and low risk of neutral mine drainage and ARD indicated by testing to date, with particular focus on rejects from the Pikes Gully, Liddell and Hebden Seam Groups.

Periodic sampling and testing of mine water will be continued as part of the water quality testing program to identify the potential for ARD generation, assess the performance of management strategies, and determine and/or refine non acid forming/potentially acid forming blending ratios and limestone treatment requirements (if required).

5.4 Final Landform Design

The conceptual final landform, as shown in **Figure 5.1**, has been designed to maintain consistency with the local area and will predominantly consist of an undulating landform generally reflecting the dominant features of the existing environment. Consistent with the rehabilitation objectives (refer to **Section 3.0**), micro-relief features will be developed in all parts of the final landform above natural ground level developed under SSD-5850[1] other than the final void internal slopes. Typical cross-sections of the final landform design are shown in **Figure 5.2**. Key features of the final landform are discussed below.

[1] Parts of the final landform already developed under previous consents do not require the incorporation of microrelief features.

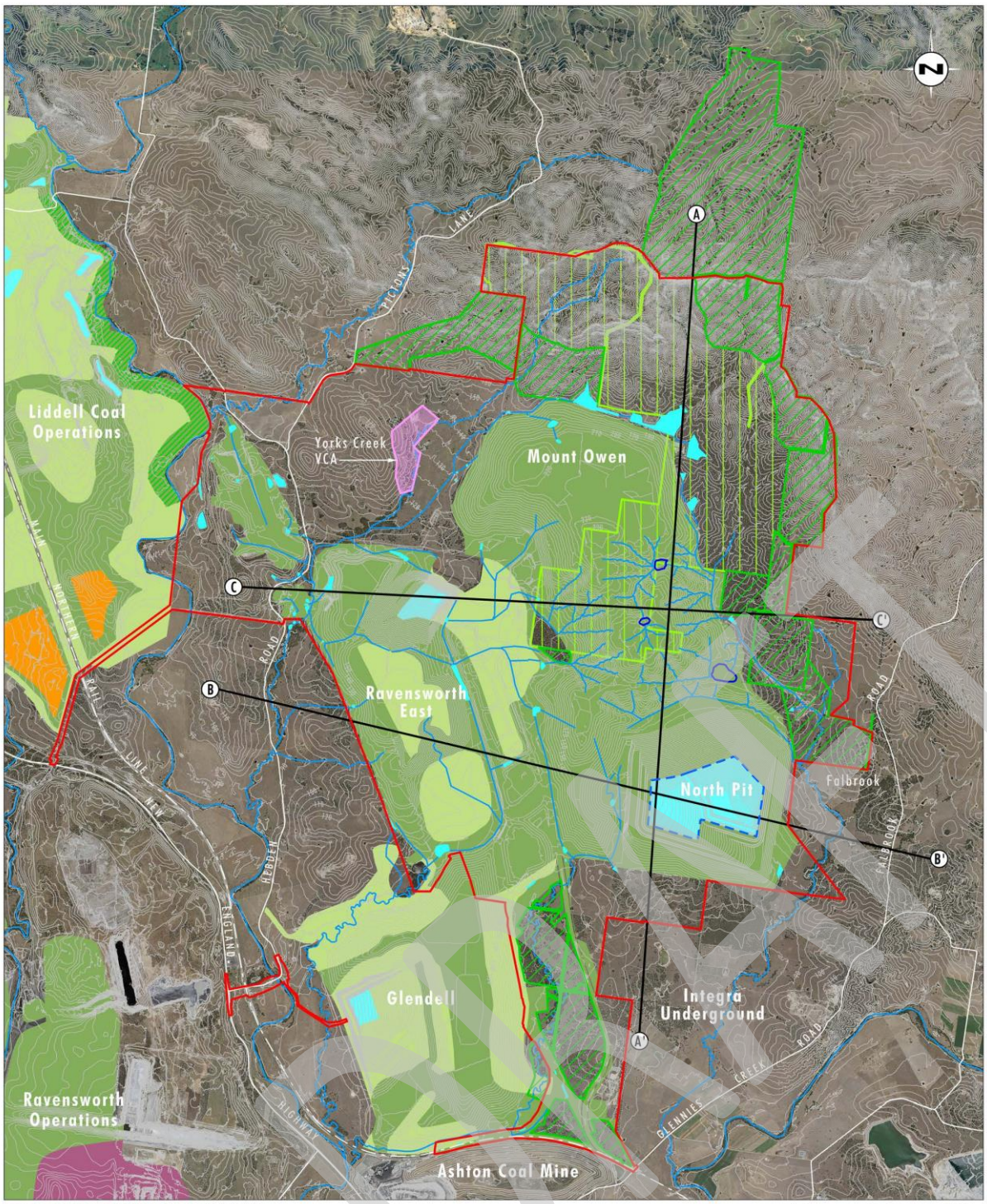


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018), Ravensworth Operation Vegetation: Umwelt (2010), Liddell Coal Operations Vegetation: Umwelt (2016)
Note: Contour Interval 5m(AHD)

0 1.0 2.0 3.0km
1:65 000

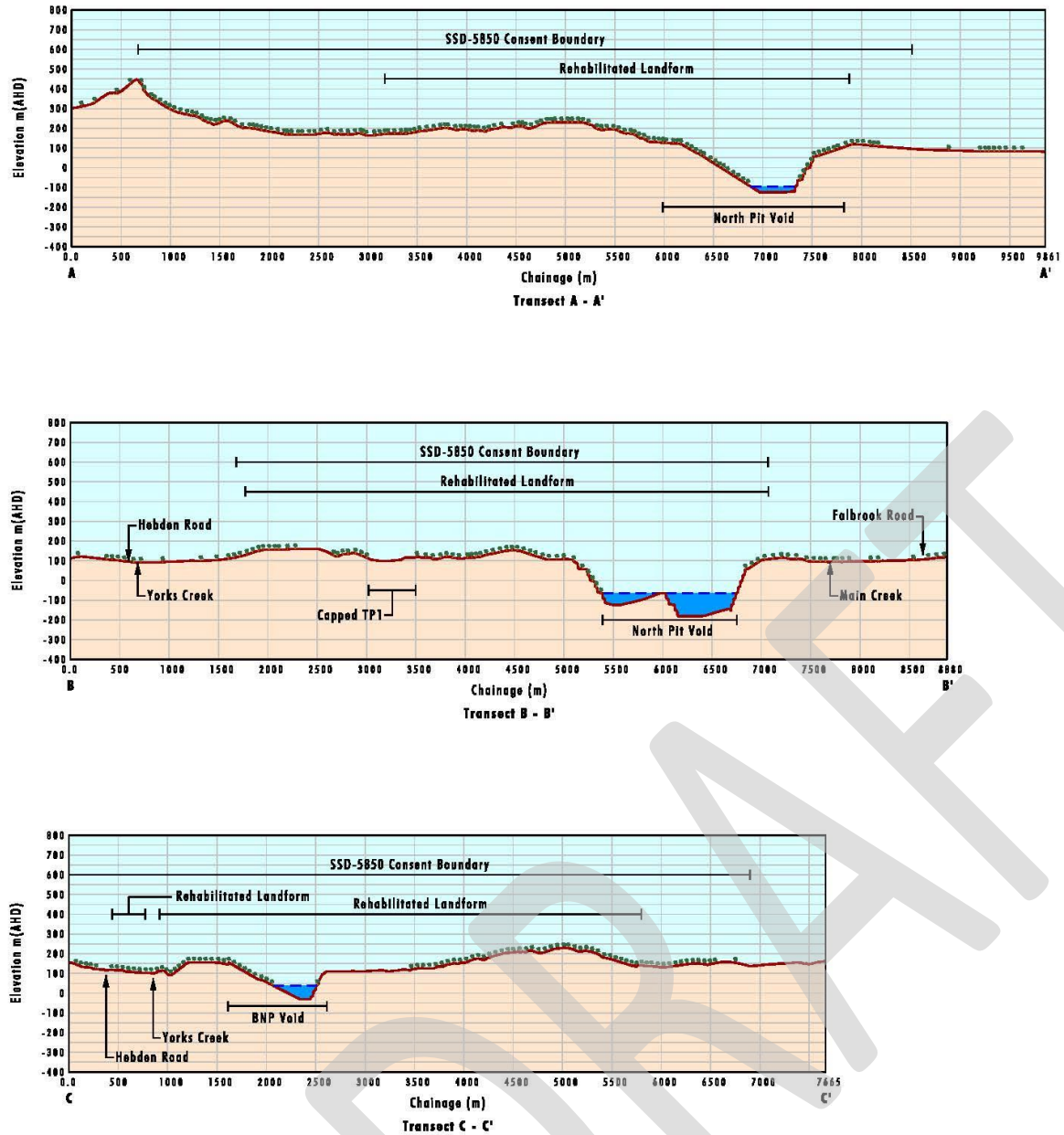
Legend

- SSD-5850 Consent Boundary
- Yorks Creek VCA
- Water Storage
- Native Woodland
- Open Grassland (Potential grazing areas) with pockets of Native Vegetation
- Grassland for Stabilisation (Liddell Coal Operations)
- Grazing (Ravensworth Operations)
- Ravensworth State Forest
- Biodiversity Offset Area
- Drainage Line
- Maximum Water Storage Level
- Dryland Attenuation Basin
- Section Line

FIGURE 5.1

Conceptual Final Landform

File Name (A4): R15/3810_130.dgn
20180702 15.50



Legend

- Final Landform Surface
- Modelled Maximum Water Storage Water Level
- Water Storage
- Woodland/Native Vegetation

Note: Vertical Exaggeration 2:1

0 1.0 2.0 3.0km
Horizontal Scale 1:60 000

0 0.5 1.0 1.5km
Vertical Scale 1:30 000

File Name (A4): R15/3810_131.dgn
20180702 15.51

FIGURE 5.2

Conceptual Final Landform Transects A-A', B-B' and C-C'

5.4.1 Final Voids and Highwall

The proposed final landform will result in two final voids, one in the southern area of the North Pit, and one in the former Bayswater North Pit in the north of the Ravensworth East Mine. On completion of mining in the North Pit, the Bayswater North Pit void will be decommissioned as an operational water storage with batter angles flattened and high-walls stabilised. The North Pit void high-walls will also be stabilised following the cessation of mining. If the BNP is required for tailings emplacement, the BNP void would be partially filled prior to final capping and rehabilitation.

Analysis was undertaken by engineering consultants Pells Sullivan Meynink Consult Pty Limited (PSM, 2017) and URS (URS, 2017) to assess the Life-of-Mine (LOM) geotechnical stability of the high walls in North Pit and BNP respectively.

5.4.1.1 North Pit Geotechnical Assessment

In summary, the assessment found that in regards to the stability of the pit walls, the geotechnical risk is low and that the acceptable stability criteria determined a Factor-of-Safety (FoS) greater or equal to 1.2 was achieved for all pit walls under design static scenarios. Other key findings of the assessment included the following:

- the stability of the eastern low wall is likely to improve with time as the void is filled with ground and surface water. However, drainage on the low wall (emplaced and shaped overburden) may not be effective in the longer term without maintenance, this is largely due to the length of slopes;
- a safe perimeter of the pit crest of the east wall could be achieved;
- in regards to the western and southern highwalls, it was assessed that a safe and stable pit wall and safe perimeter of the pit crest could be achieved, subject to the walls performing satisfactorily during the period of mining. In the event that failure was initiated, it was assessed that it was more likely to be in the southern portion where subsidence impacted rock mass is present. However, if such failure was to occur it was considered that it would be slow and more likely to be in the form of excessive deformation rather than global instability; and
- in regards to the western and southern highwalls, it was also assessed that some improvement in stability is expected as the void is filled with ground and surface water over time.

5.4.1.2 BNP Geotechnical Assessment

To improve the FoS and control the risks for the stability of the Northern Highwall some specific design parameters will be included for the BNP. This includes greater standoff, larger catch benches and geotechnical monitoring.

Similar management practices have also been recommended for the Eastern Highwall due to the presence of a number of fractures and bedding associated with the geology of this highwall.

The Southern Highwall did not have any specific management recommendations regarding stability, however recommendations have been made to continue to monitor this area during excavation to identify potentially unsafe structures.

Groundwater studies have indicated that water storage in the former Stage 3 dam be drained to prevent water over topping or building up behind the highwall.

5.4.1.3 Void Design Process

In consideration of the above for all remaining voids, the key design features and processes associated with the final void, to minimise public safety as and long term stability issues include:

North Pit Void

- The upper sections of the southern highwall in the North Pit Void will be battered to 15° (refer to **Figures 5.1** and **5.2**).
- Lower sections of the southern highwall and eastern and western highwalls will comprise of a series of benches of varying widths that will be constructed progressively as mining operations progress in the lower seams. The stability of the highwall will be assessed on an ongoing basis and appropriate stabilisation measures will be installed (where required) progressively.

- A trench and /or safety berm will be established along the top of the retained section of the highwalls and the top of the battered section of the southern highwall. The bunds will be designed to divert surface water runoff and restrict inadvertent access to the highwall.
- Internal slopes within the North Pit final void will be battered to an average of 18°.
- Drainage on battered slopes will be managed to divert run-off towards the highwalls and the south eastern pit floor where it will be allowed to cascade/ drain towards the pit floor with minimal erosion risk. Drop structures may be used in places where geotechnical considerations indicate the drop structures will be long-term stable.
- Low wall slopes will be established in stages. Battering and the establishment of areas of the lowwall forming the final landform will occur as the stages are progressively established. Drainage across battered slopes will also be established progressively.
- The detailed design of the drainage on the low wall and highwalls in the final landform will be defined in the MOP/RMP developed for the mine closure process. The development of the detailed drainage design for the final landform will have regard to erosion modelling and geotechnical assessments to confirm long term stability of the low wall.
- Geotechnical assessments of the highwalls and highwall benches will be undertaken and armouring/ highwall shaping undertaken where necessary to ensure long term stability.
- The highwall benches and battered slopes will be seeded with a suitable species mix having regard to potential soil depth limitations. Access roads along the highwalls may be retained for maintenance purposes
- Battered slopes will be revegetated to woodland generally consistent with the remainder of the rehabilitated landform. Internal void slopes will be progressively topsoiled and vegetated as the final landform slopes are established (i.e. rehabilitation will commence as the final landform slopes are established). Aerial foot access seeding/ will be used for initial and infill seeding where operational or slope restrictions limit.
- Spontaneous combustion and external ignition risks (e.g. bushfires) will be considered in the design of highwalls. Treatments such as 'shotcrete' can be used to reduce areas of coal seam exposed to the air where risks are considered to be material.

Bayswater North Pit Void

- Retained sections of highwalls (northern and eastern sections of the Bayswater North Pit void – (refer to **Figure 5.1** and **5.2**) will comprise of a series of benches of varying widths that will be constructed progressively as mining operations progress in the lower seams. The stability of the highwall will be assessed on an ongoing basis and appropriate stabilisation measures will be installed (where required) progressively.
- A trench and /or safety berm will be established along the top of the retained section of the highwalls. The bunds will be designed to divert surface water runoff and restrict inadvertent access to the highwall.
- Overburden batter angles will be flattened to approximately 18° (refer to **Figures 5.1** and **5.2**).
- Drainage on battered slopes will be managed to divert run-off towards the highwalls and the south eastern pit floor where it will be allowed to cascade/ drain towards the pit floor with minimal erosion risk. Drop structures may be used in places where geotechnical considerations indicate the drop structures will be long-term stable.
- The detailed design of the drainage on the low wall and highwalls in the final landform will be defined in the MOP/RMP developed for the mine closure process. The development of the detailed drainage design for the final landform will have regard to erosion modelling and geotechnical assessments to confirm long term stability of the low wall.
- Geotechnical assessments of the highwall will be undertaken and armouring/ highwall shaping undertaken where necessary to ensure long term stability.
- The highwall benches will be seeded with a suitable species mix having regard to potential soil depth limitations. Access roads along the highwalls may be retained for maintenance purposes.

- Low wall slopes will be established in stages. Battering and the establishment of areas of the lowwall forming the final landform will occur as the stages are progressively established. Drainage across battered slopes will also be established progressively.
- Battered slopes will be revegetated to woodland generally consistent with the remainder of the rehabilitated landform. Internal void slopes will be progressively topsoiled and vegetated as the final landform slopes are established (i.e. rehabilitation will commence as the final landform slopes are established). Aerial foot access seeding/ will be used for initial and infill seeding where operational or slope restrictions limit
- Spontaneous combustion and external ignition risks (e.g. bushfires) will be considered in the design of highwalls. Treatments such as 'shotcrete' can be used to reduce areas of coal seam exposed to the air where risks are considered to be material.

Vehicle and machinery access to the battered internal void areas will be required until appropriately stabilised. This access will be predominately via highwall benches, meaning there are limited opportunities to implement highwall landform treatments until the low wall areas have reached a level of revegetation appropriate to provide long term stability. Once this level of rehabilitation has been achieved, selective blasting/ battering of parts of the highwalls can occur to increase terrain variability and reduce linearity in the landform. Talus slopes developed through these methods are also able to be revegetated which will further improve the visual amenity of the retained highwalls. An example of these treatments is demonstrated in the *Synoptic Plan* (refer to **Section 2.2.3**). Figures 20 to 22, 28 and 29 from the Synoptic Plan are extracted below in **Figure 5.3 and 5.4,** illustrating the variability in terrain that can be developed through selective blasting and battering of sections of retained highwall**.**

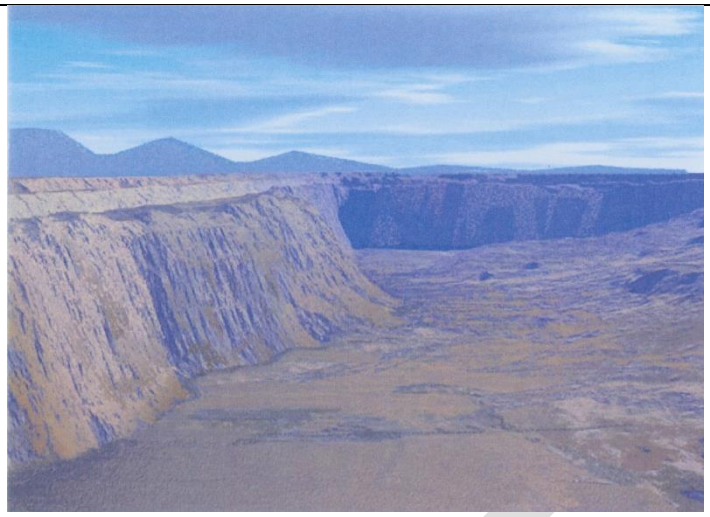
A surface drainage network will be established across overburden emplacement areas to divert the bulk of surface water away from the final voids so as to maximise replenishment of the local catchment areas. The need for ongoing post-mining maintenance of drainage structures will be assessed and appropriate measures will be included within the Final Closure Plan.

A groundwater assessment of the final landform (at closure) indicates that the voids will not discharge to local alluvial aquifers. The final void is predicted to be a source of water to the hard rock aquifer.

Updated groundwater modelling will be undertaken as part of the mine closure process to assist in refining the final landform. Modelling will commence at least 5 years from cessation of mining. This modelling will update groundwater modelling predictions and evaluate the long term pit lake hydrochemistry and water levels post closure.

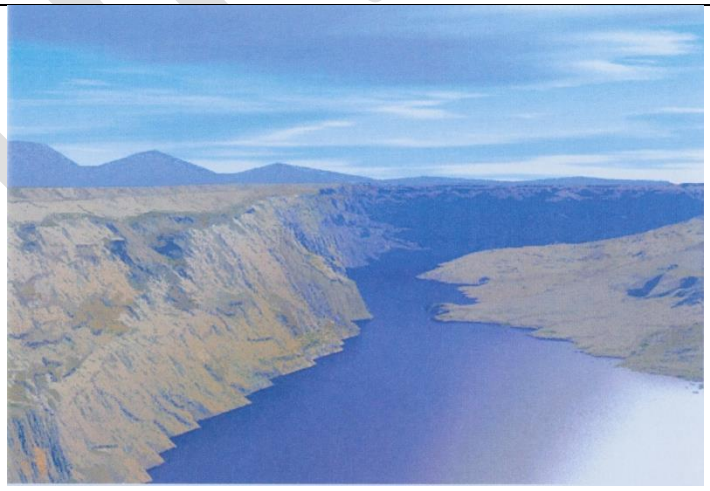
A Final Void Management Plan will be included in the Final Closure Plan. As outlined in **Section 2.1**, the Final Closure Plan will be submitted to the appropriate regulatory agencies for approval two years prior to cessation of mining.

The above considerations will be reviewed in light of any alternative final land uses considered for the Approved Operations, particularly where the alternative land uses include the active use of the voids.



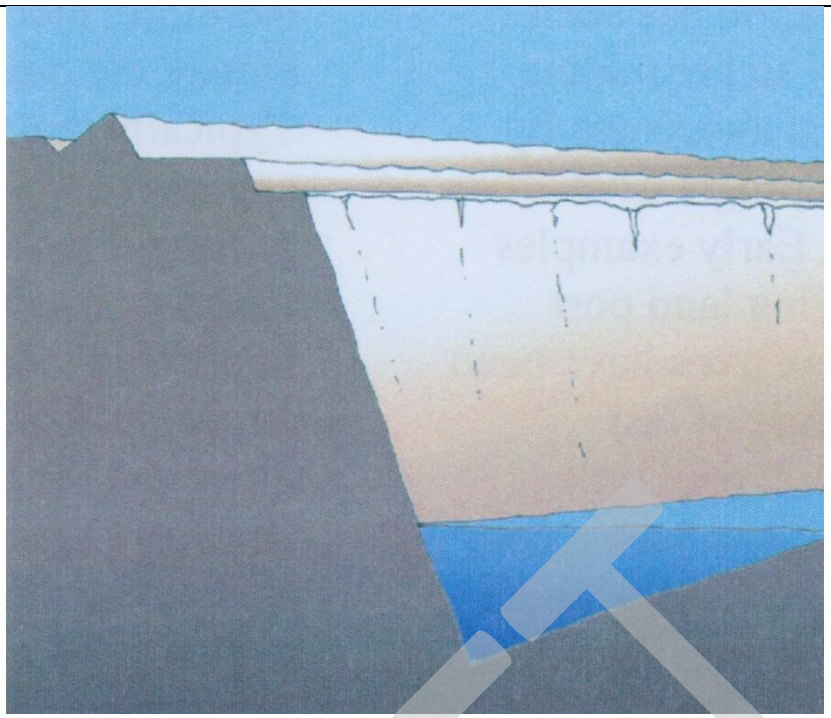
Highwall Bench Prior to Rehabilitation (Figure 20 in the Synoptic Plan)

Blasting of Highwall Bench/Crest (Figure 21 in the Synoptic Plan)

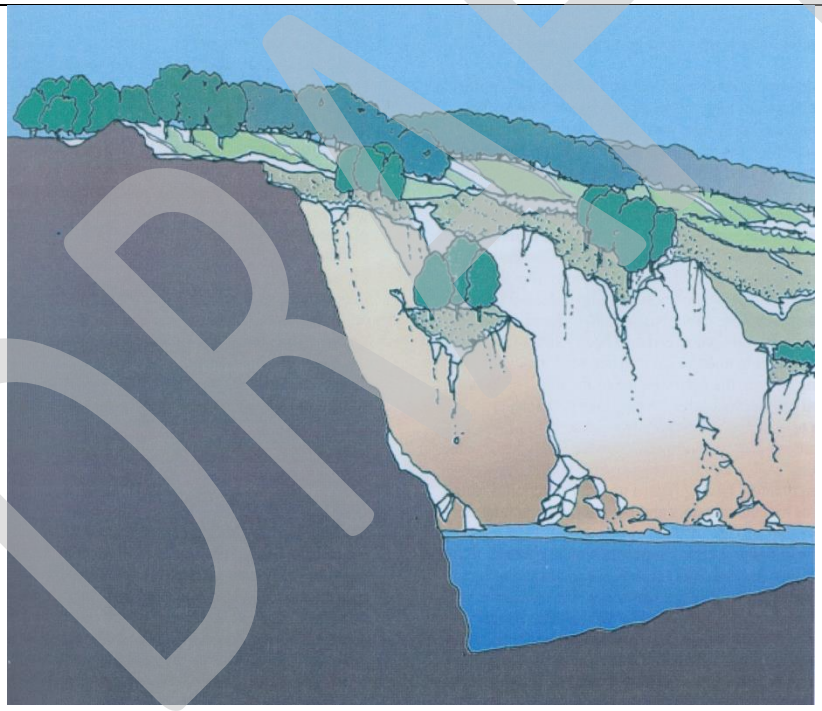


Partially Filled Void From Onsite Drainage (Figure 22 in the Synoptic Plan)

Figure 5.3 Example of highwall treatments demonstrated in the Synoptic Plan © (Andrews, Neil 1999)



Before



After

Figure 5.4 Highwall Rehabilitation Blasting (Figures 28-29 in the Synoptic Plan)
© (Andrews, Neil 1999)

5.4.2 Overburden Emplacement Areas

Key design considerations associated with the overburden emplacement areas are outlined below:

- Final landform slopes for BNP and North Pit will be generally battered to an average of 10° in order to minimise erosion risk. Natural landform design features (micro-relief) will be incorporated into areas of the overburden emplacement areas developed as part of the final landform during the life of the Mt Owen Consent. These micro-relief features are aimed at achieving consistency with surrounding natural landforms and may result in sections of slopes exceeding 10°. However, it is anticipated that steeper profiles will be located within the upper portions of catchment areas where the volume of surface water runoff will be at a minimum.
- Overburden emplacement areas will include variation in vertical relief in order to prevent extended ponding of surface water as well as create a profile that is commensurate with the natural local topography.
- The final landform will generally be designed to direct runoff away from the final voids and into the Main Creek, Yorks Creek, Bettys Creek and Swamp Creek catchments. This will return catchment flows to Yorks Creek and Main Creek and re-instate some of the natural flows to Bettys Creek and Swamp Creek. Catchments of each of these creeks developed as part of the detailed final landform design will have regard to licensing requirements under the *Water Management Act 2000* with a general objective of ensuring that the rehabilitated final landform achieves no net take of water in the area of Glennies Creek (Main Creek) catchment in the long term relative to the pre-mining environment.
- Drainage structures will be designed to minimise scouring associated with anticipated runoff. Where practicable, drainage lines will be designed to be commensurate with surrounding natural landforms.
- Drainage lines in the final landform catchment may include dryland attenuation areas to manage flow velocities during high rainfall events.

The proposal for a natural landform design approach offers an alternative to the conventional engineered profile design and involves using the key geomorphological characteristics evident in stable landforms within the natural landscape and adapting them to the materials and constraints of the site. Amongst the key principles of the approach include:

- the drainage density of the landform, being the number of drainage lines relative to the overall area, and reflecting the dendritic nature of the drainage;
- steeper slopes located close to the watershed where flows are smallest, with gradients that are typically initially convex in profile becoming concave and flattening out moving downstream;
- drainage lines that have both a channel component and a floodplain, providing stability during frequent and more extreme events; and
- the avoidance of knick points or transitions from sub-critical to super-critical flows other than where located in high erosion resistant material or where gentle transitions are constructed emulating natural transitions that maintain a balance between the scour risk and sediment load.

Specific details of micro-relief design in the rehabilitated landform will be provided in the MOP/Rehabilitation Management Plans prepared and updated through the life of the Project.

5.5 Substrate Preparation

Surface preparation activities for rehabilitated areas will commence as soon as practicable following the completion of mining activities. The general surface preparation activities to be undertaken within the Project Area include:

- prior to the commencement of rehabilitation of the shaped overburden surface, representative samples will be taken to characterise the nature of the spoil material (e.g. sodicity, acid-generating potential, etc.) to determine the potential limitations to rehabilitation and sustainable plant growth. Results from this process will be used to determine specific amelioration techniques (e.g. addition of gypsum, lime, organic matter etc.) that may be required for spoil to overcome potential limitations for landform stability, vegetation establishment and growth;

- soil ameliorants will be applied where appropriate;
- in areas to be returned for future agricultural use, measures such as additional soil amelioration works or further application of topsoil (or suitable alternative) may be required;
- suitable erosion control measures will be implemented to minimise soil loss from areas undergoing rehabilitation;
- where appropriate and practical, structures such as tree hollows, logs and other woody debris will be incorporated into the final landform to augment the habitat value of the proposed vegetated corridors; and
- the installation of appropriate habitat structures (e.g. ponds) will be undertaken where practical.

5.6 Revegetation Program

Rehabilitation of post-mining areas will be completed as soon as practicable after shaped areas become available. The indicative sequence for progressive rehabilitation and final landform design is shown in **Figure 5.1** and **Figures 5.5** to **5.7**. Whilst it is intended to maximise opportunities for progressive rehabilitation and reduce the disturbance footprint, potential deviations from the indicative schedule may occur due to:

- changes or delays in the mining schedule; and
- postponement of rehabilitation activities to avoid seeding and planting in conditions, which may lead to poor quality rehabilitation or failure.

Where rehabilitation is delayed due to the above scenarios, overburden areas will be shaped to final landform as close as reasonably practicable behind the active mining operation and suitable cover crops applied on exposed areas to minimise dust generation and erosion.

Temporary revegetation will also be undertaken on unshaped overburden dumps and other disturbed areas that are planned to be inactive for one to two years. Temporary revegetation of these areas will improve both visual amenity and the control of dust emissions. Temporary vegetation will typically be fast growing grass species however in some areas, other species, including pioneer species, may be utilised for improved visual amenity.

Revegetation techniques will be continually developed and refined over the life of the Project through a continual process of research, trialling, monitoring and improvement. Current revegetation techniques for the establishment of both native woodland and agricultural areas are discussed below.

The rehabilitation strategy involves the establishment of native vegetation corridors to promote regional fauna movements across the landscape (refer to **Figure 3.1**). In addition, areas of grassland with pockets of native vegetation will also be established for potential future agricultural activities such as grazing (refer to **Section 5.6.2**).

Subject to approved alternative final use requirements, final void slope areas which will eventually be below the high water mark of the pit lake will be revegetated where practical as outlined in the detailed mine closure planning documentation. An appropriate seed mix will be determined to assist in providing stability for the rehabilitation areas.

Subject to ultimate final land use constraints, areas identified for grazing will (refer to Section 3.1) l also be considered for additional woodland development. The reduction in any areas of potential grazing land or areas potentially suitable for alternative, post-mining, land uses (refer to Section 3.0) will have regard to any potential socio-economic impacts.

5.6.1 Native Woodland Establishment

Rehabilitated woodland areas will be created to contain flora species assemblages characteristic of the dominant vegetation communities impacted by the Project. Revegetation of the post-mining landscape, including native woodland areas will focus on establishing vegetation that is consistent with the Central Hunter Ironbark – Spotted Gum - Grey Box Forest vegetation community with smaller areas of other communities found in the local area (including the Central Hunter Grey Box — Ironbark Woodland) planted in appropriate parts of the terrain. At least 518 hectares of the woodland established in the final landform will be required to meet the listing criteria for the Central Hunter Ironbark – Spotted Gum - Grey Box Forest EEC and species.

A list of the key species to be utilised in the revegetation mix for target vegetation communities is contained in **Appendix A**. This species list is based on the listing criteria for the Central Hunter Ironbark – Spotted Gum Grey Box Forest. Actual species planted will also include a focus on habitat and/or foraging resources for other significant and/or threatened flora and fauna species, including:

- Spotted-tailed Quoll;
- Squirrel Glider;
- Koala;
- Swift Parrot;
- Regent Honeyeater;
- Green and Golden Bell Frog;
- Brush-tailed Phascogale;
- Eastern Bent-wing Bat;
- East-coast Freetail Bat;
- Southern Myotis;
- Speckled Warbler;
- Little Lorikeet;
- Grey-crowned Babbler;
- Diamond Firetail; and
- Masked Owl.

Eucalyptus moluccana (grey-box), *Eucalyptus blakelyi* (Blakely's red gum), and *Eucalyptus crebra* (Narrow-leaved Ironbark) are examples of selectively planted native species that will address the listing criteria for the Central Hunter Ironbark – Spotted Gum Grey Box Forest, while also providing suitable habitat and foraging resources for a number of the species listed above.

Due to seasonal variability, it is not realistic, no appropriate for the direct seeding mix or tube stock composition to include all of the species in the target woodland community. Initial seed mixes used will have regard to natural succession processes (refer to **Figure 5.8**) with the focus on establishing grasses and pioneer species during the establishment phases. The seed mix will contain species found in latter successional phases however further seeding and infill planting of these latter successional phase species will occur as pioneer species naturally begin to thin out. The species composition for revegetation should be selected from the species listed however nurse species may be used during the early succession phases to assist in the early establishment of vegetation. Natural establishment of some species through fauna and other vectors can also be expected in areas close to remnant woodland and previously established woodland areas.

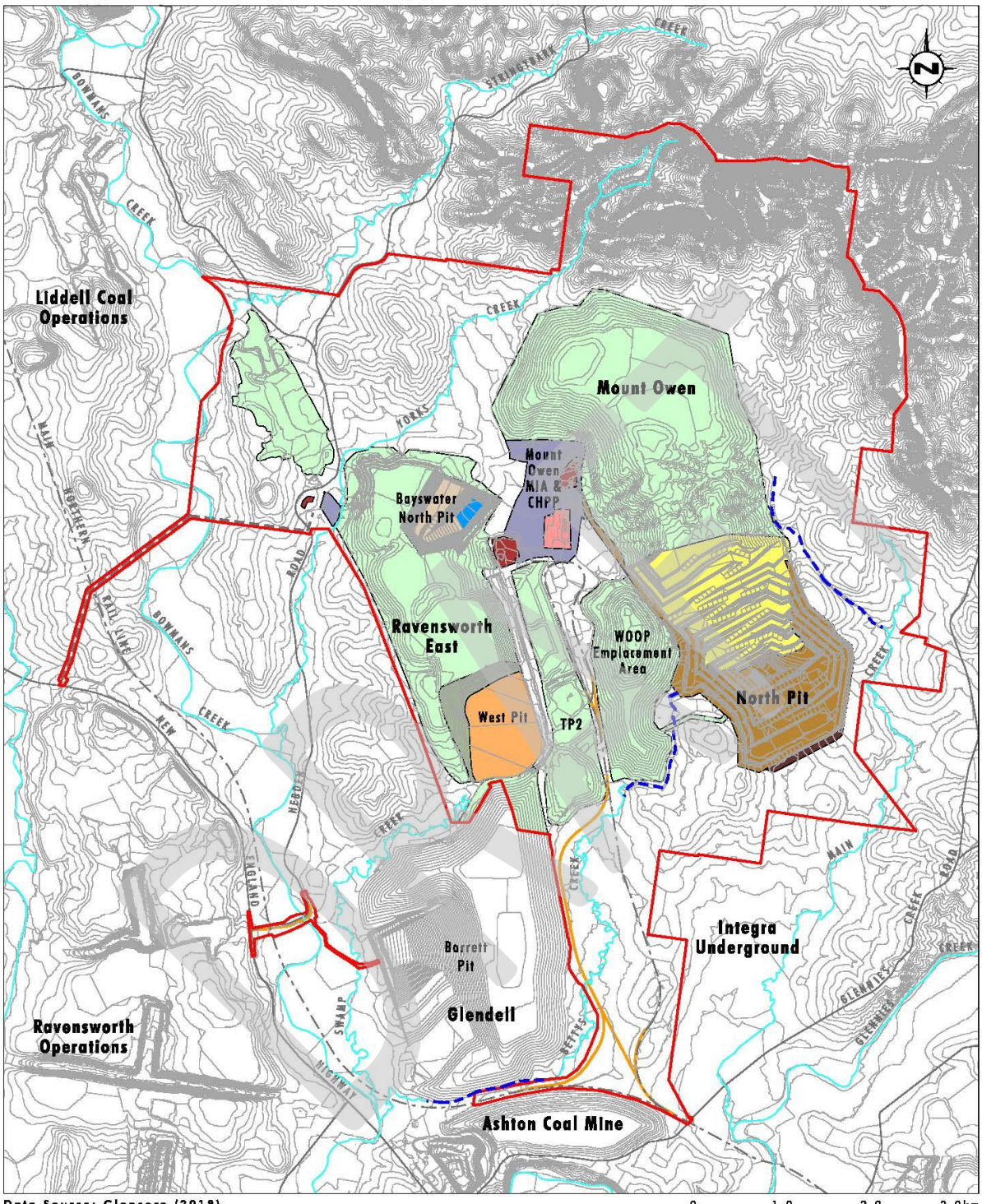


FIGURE 5.6

Year 8 Mine Plan

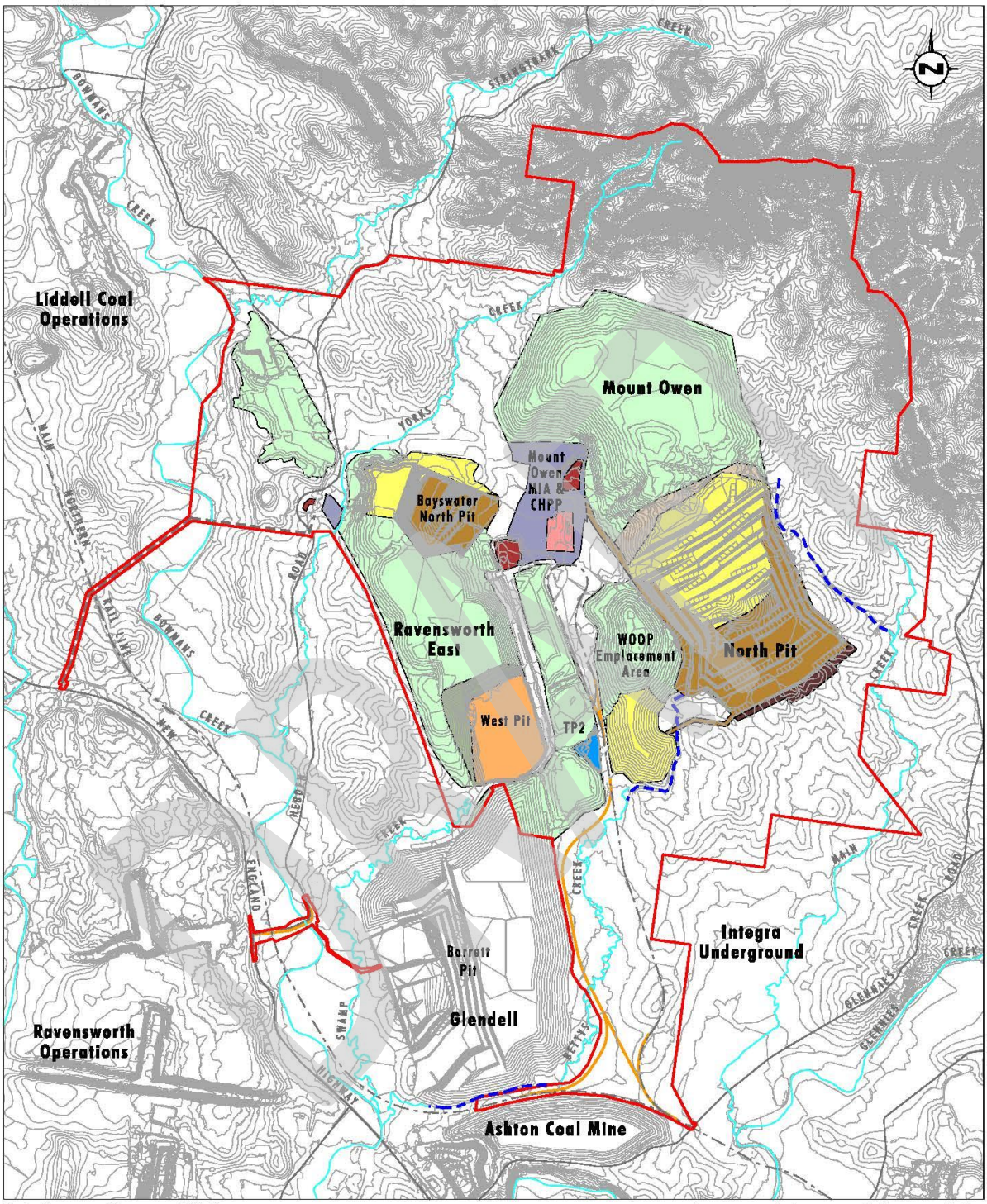
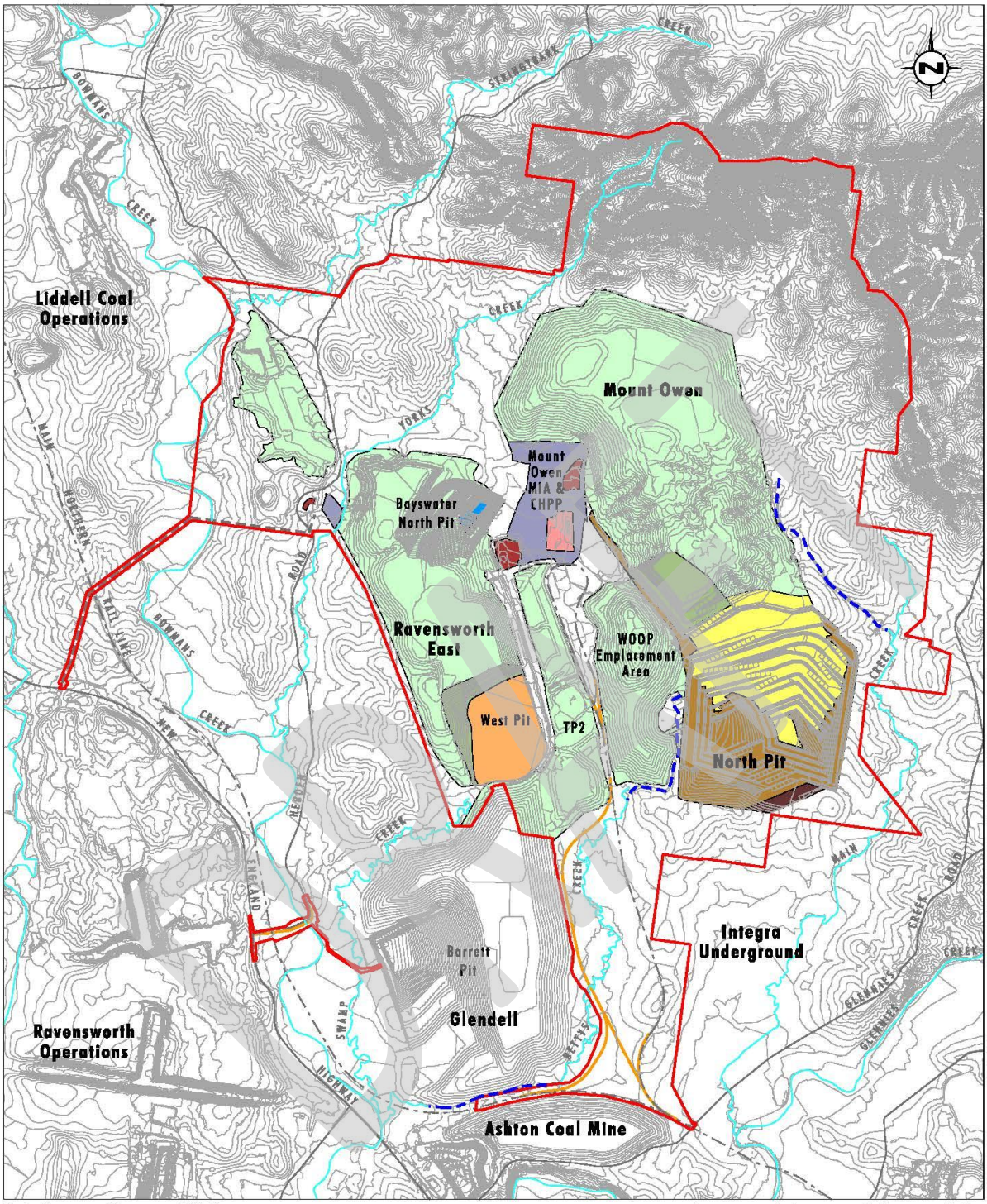


FIGURE 5.5

Year 2 Mine Plan

umwelt



Data Source: Glencore (2018)
Note: Contour Interval 5m

0 1.0 2.0 3.0km
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Legend

- SSD-5850 Consent Boundary
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Tailings Emplacement
- Topsoil Removal Strip
- Water Storage Area

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FIGURE 5.7

Year 15 Mine Plan

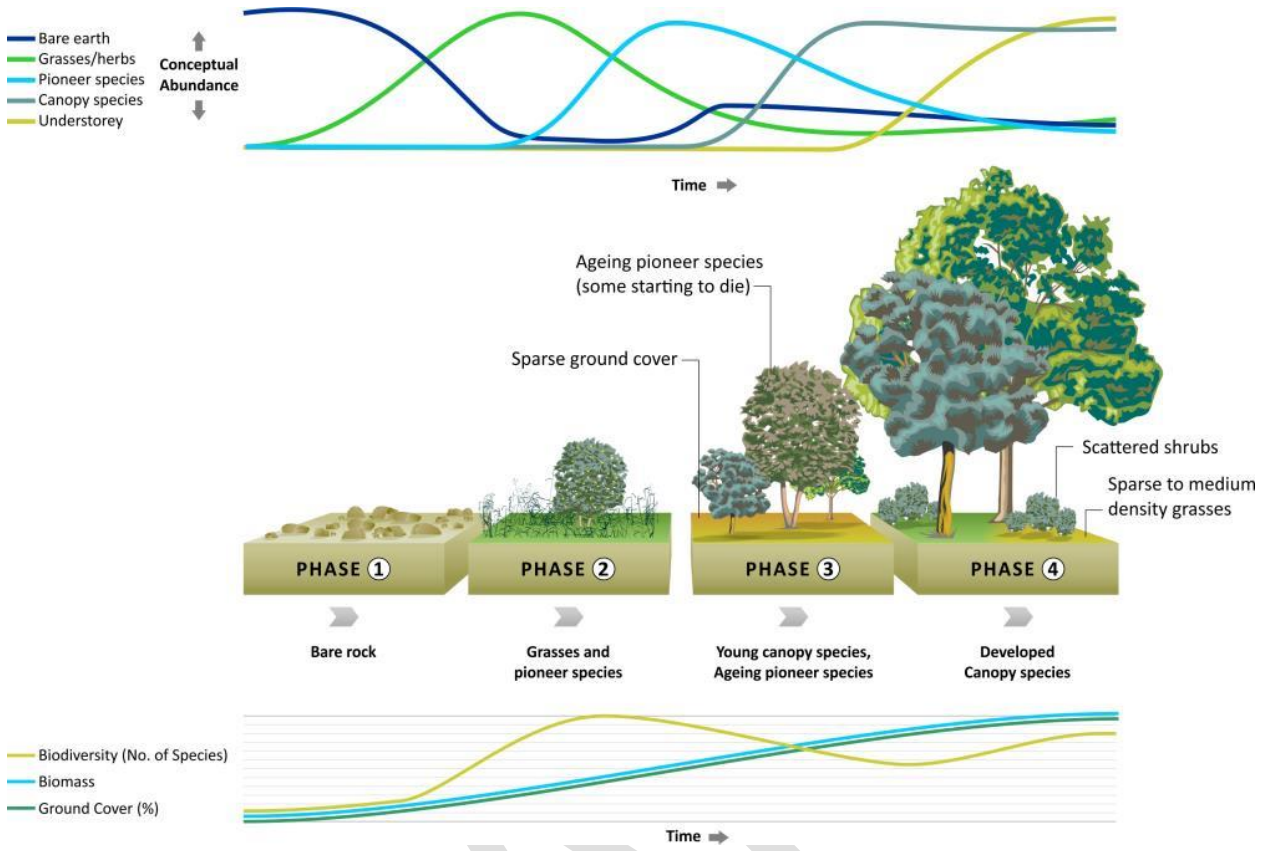

Figure 5.8 Succession Processes in Woodland Communities

A seed collection and handling program aimed at maximising the viability and diversity of local seed in the revegetation mix will be implemented as part of the rehabilitation program. As a priority, revegetation will involve the use of local provenance seed that will either be utilised for direct seeding or for the propagation of tubestock for planting. However, where adverse seasonal conditions (i.e. drought) or other factors may affect the availability of local provenance seed, supplementation with non-local provenance seed may be required.

Revegetation will primarily involve aerial or direct seeding of native species along with a suitable cover crop or other organic material (e.g. mulch, brush matting or organic growth medium etc.) as required to prevent soil loss and add biomass to the profile. A range of other techniques including the planting of tubestock may also be utilised where appropriate over isolated areas associated with steep slopes. Infill planting and latter successional phase species establishment will use a combination of direct and aerial seeding and the planting of tubestock.

5.6.2 Establishment of Sustainable Agricultural Areas

The establishment of native vegetation corridor areas does not preclude the ability to re-establish land for sustainable agricultural purposes. As shown in **Figure 1.4**, the Conceptual Post mining land uses includes the establishment of areas in the flatter portion of mine rehabilitation areas for potential future sustainable agricultural purposes such as grazing. However, the ultimate extent and location of these areas will be subject to further detailed closure planning prior to the cessation of mining. Revegetation may involve the use of both native and suitable exotic pasture species for the establishment of grasslands in these areas with pockets of native vegetation, which may ultimately be utilised as shelter for livestock. Some of the key considerations for the development of these areas will be the suitability of soil, proximity to roads, avoidance of steep areas and access to water resources for stock.

In regards to the establishment of grazing areas, revegetation techniques will be consistent with local agricultural practices and are likely to involve sowing with grasses and legumes appropriate to the district and recognised as suitable for grazing. A similar mix may also be used in areas with steeper slopes to prevent scouring and subsequent soil loss.

5.7 Revegetation Care and Maintenance

Based on the outcomes of the rehabilitation monitoring program as outlined in **Section 6.0**, a care and maintenance program will be implemented to facilitate that rehabilitation is sustainable for the long term. The scope of this program will include as a minimum the following:

- weed and feral animal control of rehabilitation;
- erosion and drainage control works;
- re-seeding/planting of rehabilitation areas that may have failed (e.g. lack of germination, high plant mortality rate etc.) or require the establishment of later phase successional species;
- maintenance fertilising; and
- repair of fence lines, access tracks and other general related land management activities.

It is envisaged that this program will be continued as required until it can be demonstrated that the rehabilitation of the Project Area has satisfied the closure criteria.

Where areas have been identified as being capable of being returned to sustainable agricultural use, it will be the intention to manage these areas in accordance with their intended use as soon as practical after rehabilitation has become established. For example, following the incorporation of infrastructure such as farm dams and fencing into the rehabilitated landform, cattle grazing at low stocking rates may be introduced intermittently until the soil profile and species diversity has developed sufficiently to support more intensive sustainable grazing.

5.8 Proposed Rehabilitation Sign-Off Process

Based on the outcomes of the rehabilitation monitoring programs and in consultation with the relevant government agencies, Mount Owen intend to seek progressive sign-off of rehabilitated areas once the agreed closure and rehabilitation criteria have been satisfied. The aim will be to achieve consensus on the quality of rehabilitation required as a benchmark for sign-off; this may result in earlier sign-off for subsequent phases of rehabilitation as there is increased confidence that revegetated areas will continue to transition towards fully functioning communities based on experience at other sites and the results of monitoring in early successional phases.

Proposed Rehabilitation Monitoring

Mount Owen will continue to undertake a rehabilitation monitoring program in accordance with Glencore 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.

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 or is there is a high degree of confidence that the vegetation in the rehabilitated area is on a successional pathway that will achieve closure criteria. Information from the monitoring program will also be used to refine closure and sign-off criteria as required. Further details on the proposed rehabilitation monitoring are outlined below

5.1 Active Mining Records

During active mining operations, Mount Owen will maintain active records as to mining activities and processes that may impact upon the rehabilitation and closure of the site. These records will provide the basis for developing rehabilitation strategies and interpretation of later rehabilitation monitoring outcomes. The types of records to be maintained include, but are not necessarily limited to the following:

- detailed rehabilitation procedures;
- register of contaminated sites including bioremediation areas;
- records of production wastes and other waste streams and where they are located, including where adverse overburden material layers are buried;
- environmental monitoring records, including surface and groundwater quality and results of past remediation programs;
- a register of topsoil and or soil substitute stockpiles (e.g. biosolids), which includes information such as the date in which they were formed and maintenance works undertaken (e.g. weed control, planting with native legumes to maintain microbes etc.); and
- environmental incident records.

5.2 Rehabilitation Methodology Records

Mount Owen will record the details of each rehabilitation campaign so that they are available for later interpretation of rehabilitation monitoring results with the aim of continually improving rehabilitation standards. Amongst the key monitoring parameters to be included in the program relate to the following:

- landform design details;
- drainage design details;
- substrate characterisation;
- site preparation techniques (e.g. topsoil and source, time of sowing, soil ameliorants used etc.);
- revegetation methodologies (e.g. rate and type of fertiliser, cover crop and rate, seed viability including watering and weed management);
- weather conditions;
- photographic records; and
- initial follow-up care and maintenance works (including watering and weed management).

5.3 Rehabilitation Inspections

At the completion of each rehabilitation campaign, an initial establishment inspection will be conducted within 6 months to determine whether issues have occurred or are emerging that have the potential to delay revegetation establishment. Issues may include erosion that has occurred due to storm events, failure of drainage structures and a lack of germination or establishment of vegetation. This process aims to identify potential issues early in order to minimise the extent of areas affected as well as develop mitigation strategies in a timely and cost effective manner.

Inspections of rehabilitated areas will be undertaken over the life of the Project to assess a range of criteria. Inspections will include assessment of

- soil conditions;
- erosion;
- drainage and sediment control structures;
- runoff water quality;
- germination rates;
- species abundance and diversity
- plant health; and
- weed infestation.

The inspection frequency will be refined within the RMP and have regard to the natural succession pathways of the communities being established. A Rehabilitation Trigger Action Response Plan (TARP) will also be implemented at MOC and ensure rehabilitation standards are maintained and continuously improved. This TARP will have regard to successional processes expected in the communities being re-established and will supplement the rehabilitation care and maintenance program (refer to **Section 5.7**) and will be reviewed and revised as conditions at Mt Owen change or new threats are identified.

5.4 Monitoring Rehabilitation Performances against Objectives and Criteria

To complement the annual inspections, a rehabilitation monitoring program will be continued. The objective of this monitoring program is to evaluate the progress of rehabilitation towards fulfilling long term land use objectives. The monitoring program will also include non-mined areas for reference (analogue) sites. The monitoring results will provide the basis to measure the success of the rehabilitation against the closure criteria having regard to expected successional processes. Information from this monitoring program will also be used to refine closure criteria as required.

The monitoring program for areas being rehabilitated back to native ecosystems may not commence until revegetation has demonstrated satisfactory growth, which may take a number of years (i.e. >3 years). The exact scope of the long term rehabilitation monitoring program will be refined through the Rehabilitation Management Plan/MOP. Broadly, the long term rehabilitation monitoring program will include vegetation monitoring, habitat assessment and fauna monitoring. Whilst the program will be designed to be comparable between monitoring periods, the program will also be flexible to enable the incorporation of a range of industry accepted techniques that will enable sites to be tracked against meeting the closure criteria.

For areas to be returned to agricultural use, a rehabilitation monitoring program will be developed to assess performance against appropriate objectives and criteria. Such rehabilitation monitoring programs may include surveys to assess the quality and health of soils and pasture species. The exact scope of the rehabilitation monitoring program for agricultural land will be refined through the Rehabilitation Management Plan/MOP.

6 Accountabilities and Implementation of the Strategy

Specific responsibilities and appropriate resources for the implementation of the mine closure and rehabilitation strategy for the Project will be detailed within the MOP. The allocation of responsibilities will be designed to promote the integration of rehabilitation and mine closure within the day to day mine planning process.

7 References

Reference	Title
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Umwelt (Australia) Pty Limited 2016.	Response to PAC Review Report, March 2016