APPENDIX 24

Rehabilitation and Mine Closure Strategy

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GLENCORE

GLENDELL CONTINUED OPERATIONS PROJECT

Rehabilitation and Mine Closure Strategy

FINAL

November 2019

GLENCORE

GLENDELL CONTINUED OPERATIONS PROJECT

Rehabilitation and Mine Closure Strategy

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Glencore Tenements Pty Ltd

Project Director:	Bret Jenkins
Project Manager:	David Holmes
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umwelt
Environmental & Social Consultants

Newcastle

75 York Street
Teralba NSW 2284

T| 1300 793 267
E| info@umwelt.com.au

www.umwelt.com.au

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	David Holmes	22/11/2019	David Holmes	22/11/2019

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1.0 Introduction

1.1 Background

Mt Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), owns three existing open cut operations in the Mount Owen Complex:

- Mount Owen Mine (North Pit)
- Ravensworth East Mine (Bayswater North Pit)
- Glendell Mine (Glendell Pit).

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

Operations at Mount Owen and Ravensworth East Mines are approved under development consent SSD-5850 (as modified) (Mount Owen Consent) and Glendell Mine is approved under development consent DA 80/952 (as modified) (Glendell Consent).

The Mount Owen Complex also includes areas previously disturbed as a result of past mining activities including the West Pit void which is currently receiving tailings from the Mount Owen coal handling and preparation plant (CHPP) and other operations forming part of the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Operations at the Mount Owen Complex include the integrated use of the Mount Owen CHPP, coal stockpiles and the rail load out facility. The disposal of tailings, and the operation of the Mount Owen CHPP, coal stockpiles and the rail load out facility are all approved under Mount Owen Consent.

Mount Owen (North Pit) has an approved production rate of 10 million tonnes per annum (Mtpa) of run of mine (ROM) coal. Ravensworth East and Glendell have approved production rates of 4 Mtpa and 4.5 Mtpa ROM coal respectively. ROM coal is fed to the Mount Owen CHPP and associated infrastructure, which has a current approved processing capacity of 17 Mtpa of ROM coal. Coal processed at the Mount Owen CHPP, 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.

Subject to mining conditions, Glencore expects that mining will be completed within the currently approved area of the North Pit, Bayswater North Pit and Glendell Pit by 2037, 2022 and 2023 respectively.

The Glendell Continued Operations Project (the Project) will extend the life of mining operations at Glendell via the proposed Glendell Pit Extension to approximately 2044 and also extend the operating period for the Mount Owen CHPP and associated infrastructure to approximately 2045. The Project will also alter the final landform and drainage patterns relative to the currently approved landform under the Mount Owen Consent and Glendell Consent.

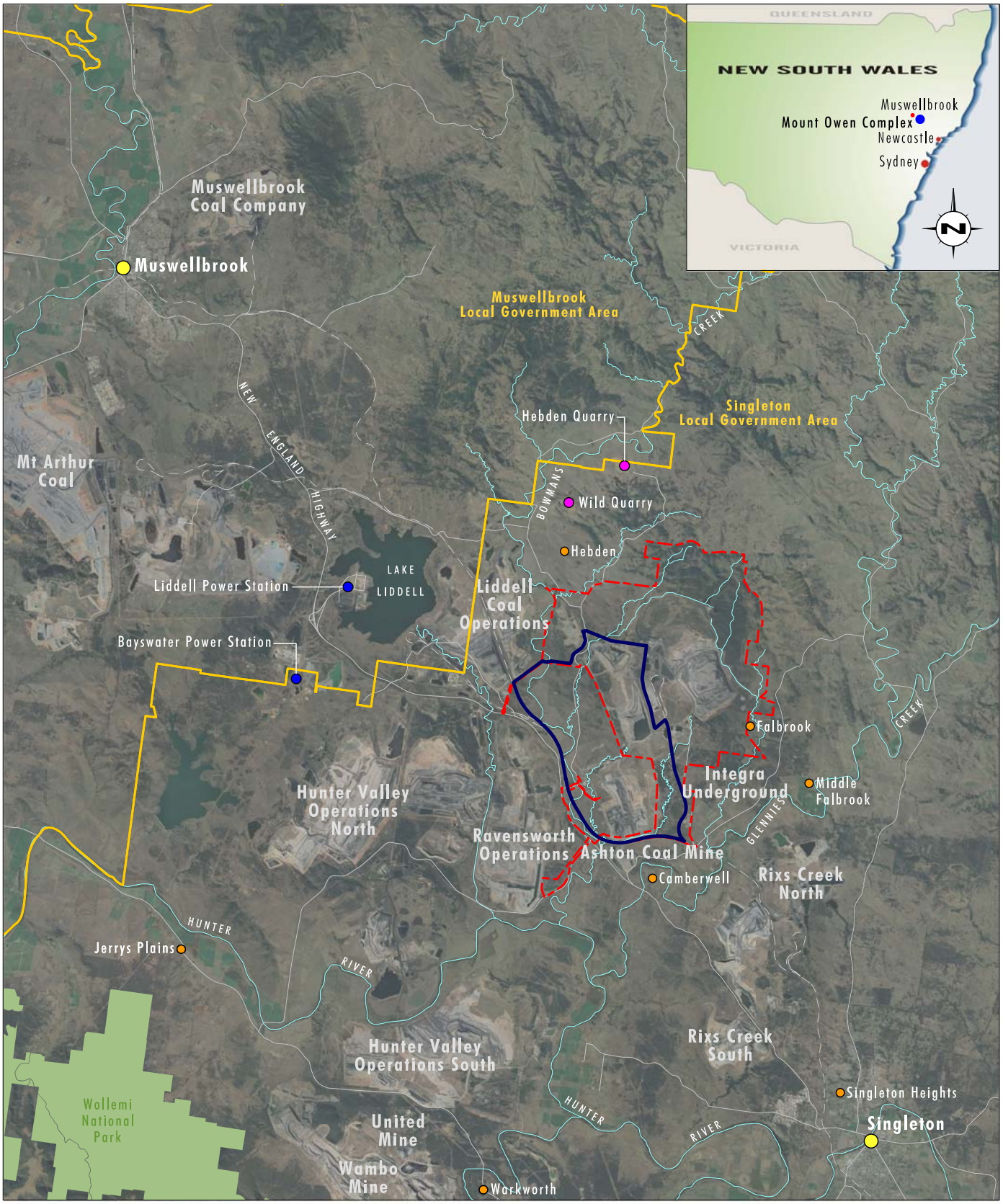

Image Source: Google Earth (2018)
Data Source: Glencore (2019), OEH (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is Approved

Legend

- Mount Owen Consent Boundary
- Project Area
- Local Government Area Boundary
- National Park
- Road
- Railway
- Drainage Line
- Towns
- Localities
- Power Stations
- Quarry

FIGURE 1.1

Project Locality

File Name (A4): R11/4166_153.dgn
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1.1 Purpose of rehabilitation and mine closure strategy

The following Rehabilitation and Mine Closure Strategy (the Strategy) has been prepared to detail the proposed approach to the rehabilitation and mine closure of the Project. The existing approved Rehabilitation Strategy (Glencore 2019), prepared in accordance with the Mount Owen Consent does not apply to those parts of the Mount Owen Complex regulated solely by the Glendell Consent. This proposed Rehabilitation Strategy preserves the approved aspects as they relate to the existing Mount Owen Complex, and provides additional measures proposed to apply to the rehabilitation and closure of the Complex as affected by the Glendell Continued Operations Project. The Strategy retains the existing design and management objectives approved for the Bayswater North Pit mining area, North Pit mining area and the existing creek diversions at the Mount Owen Complex, and also provides design and management objectives for the proposed Yorks Creek Realignment required by the Project.

This Strategy 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. The Strategy has been prepared having regard to strategic local and regional planning strategies.

1.2 Operations subject to the strategy

The key operational features at Mount Owen Complex, including those proposed by the Project are outlined in **Table 1.1**.

The key features of the Project and operations approved under the Mount Owen Consent (as modified by the Project) and the Glendell Consent are shown in **Figure 1.2**. The conceptual final land use(s) are discussed in **Section 3.0**.

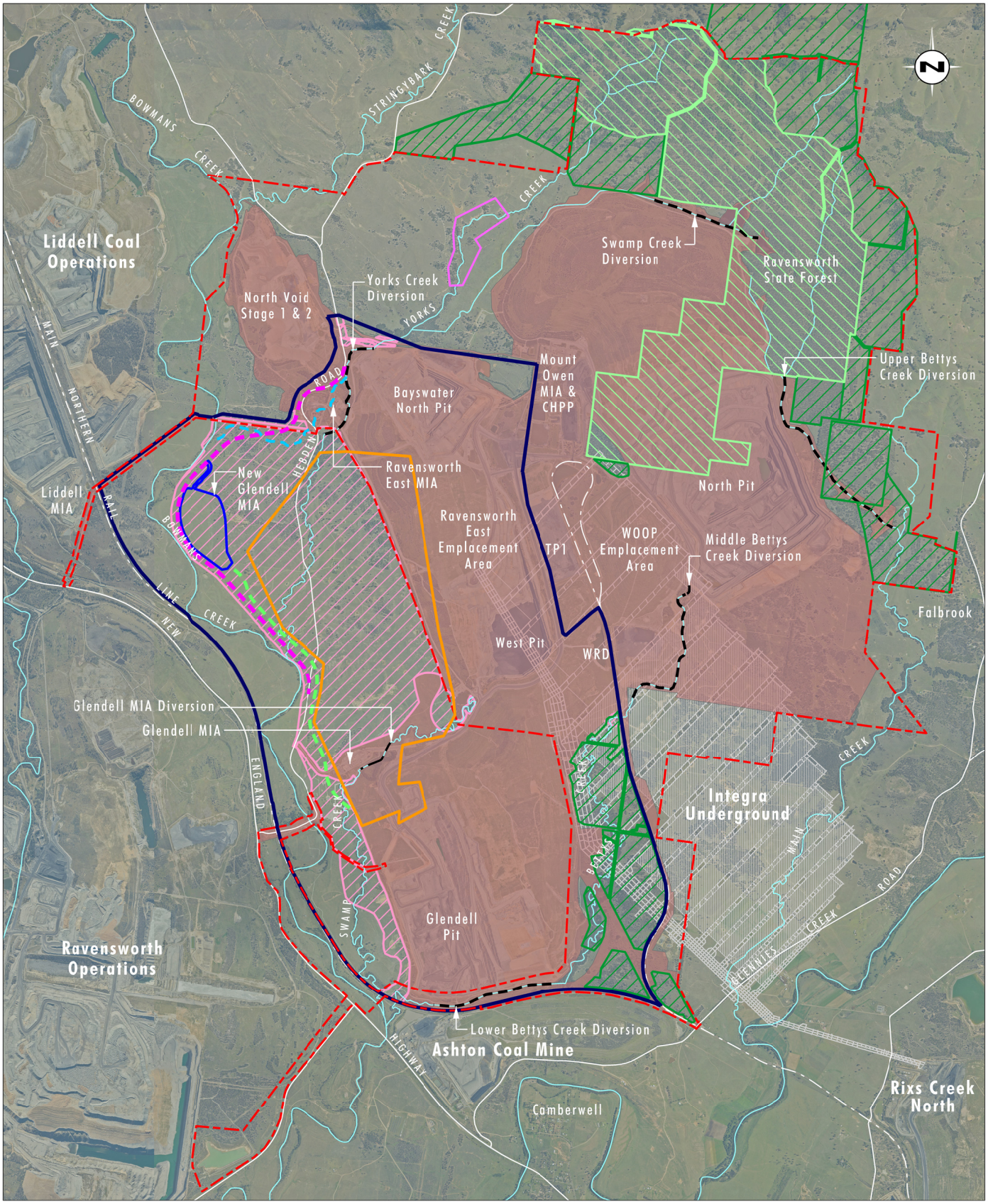

Image Source Glencore (Dec 2018), Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Additional Disturbance Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- New Glendell MIA
- Heavy Vehicle Access Road
- Yorks Creek Realignment
- Hebden Road Realignment
- Mount Owen Complex Mining Related Disturbance
- Existing Creek Diversion
- Approved Integra Underground Mining Area - Middle Liddell Seam Workings
- Integra Underground Workings Middle Liddell Seam as at Oct 2019
- Biodiversity Offset
- Yorks Creek Voluntary Conservation Area
- Ravensworth State Forest

FIGURE 1.2

Mount Owen Complex

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Table 1.1 Key features of Mount Owen Complex Operations

Key Feature	Mount Owen Consent (including proposed amendments as a result of the Project)	Glendell Continued Operations Consent (SSD 9349)
Mine Life	Mining operations to 31 December 2037 CHPP and associated infrastructure, to 31 December 2045* Rehabilitation activities ongoing until completed	Mining operations to 31 December 2044 Rehabilitation activities ongoing until completed
Limits on Extraction	North Pit – up to 10 Mtpa ROM Bayswater North Pit – up to 4 Mtpa ROM Mining depths down to approximately 380 m below ground level (North Pit)	Glendell Pit – up to 10 Mtpa ROM Mining depths down to and including the Hebden seam (approximately 240 m below ground level)
Mining Methods	Open cut - truck and excavator operations	Open cut - truck and excavator operations
Overburden Emplacement and Tailings Facilities	Emplacement of waste: • in-pit and out-of-pit at Mount Owen emplacement areas up to approximately 230 mAHD • at Ravensworth East emplacement areas up to approximately 185 mAHD • at WOOP emplacement area up to approximately 190 mAHD Co-disposal of rejects with waste at Mount Owen and Ravensworth East in-pit emplacement areas Tailings emplacement in voids approved for tailings disposal as part of the GRAWTS (which include West Pit and Bayswater North Pit and in-pit tailings cells in North Pit)	Emplacement of waste in-pit and on existing Glendell emplacement areas up to approximately 200 mAHD Out-of-pit emplacement and reshaping associated with Yorks Creek Realignment, and minor areas where in-pit emplacement areas are merged into existing topography Emplacement at Ravensworth East emplacement areas up to approximately 185 mAHD Co-disposal of rejects with waste at Glendell emplacement areas
Mount Owen CHPP, MIAs and other infrastructure	CHPP throughput of up to 17 Mtpa ROM (includes the processing of ROM coal from Glendell Pit Extension) Product and ROM stockpiles Water management infrastructure including water storages Rail loading facilities and rail loop Crushing plant Mine Infrastructure Area (MIA) at Ravensworth East and Mount Owen including office facilities, bath house, workshops and associated infrastructure	Construction and use of new Glendell MIA including office facilities, bath house, workshops and associated infrastructure[1] Utilisation of associated infrastructure and facilities approved under the Mount Owen Consent Water management infrastructure including water storages
Creek Diversions	Swamp Creek Diversion Upper Bettys Creek Diversion Middle Bettys Creek Diversion Lower Bettys Creek Diversion Yorks Creek Diversion (until decommissioned for Yorks Creek Realignment)	Glendell MIA Diversion (until mined through by Glendell Pit Extension) Yorks Creek Realignment

[1] The existing mine infrastructure area approved under the Glendell Consent will remain in use until the new Glendell MIA is commissioned. This facility will be removed prior to being mined through by the Glendell Pit Extension.

Key Feature	Mount Owen Consent (including proposed amendments as a result of the Project)	Glendell Continued Operations Consent (SSD 9349)
Final Voids	North Pit Bayswater North Pit	Glendell Pit
Active Uses of Final Voids Post Mining	North Pit and Bayswater North Pit approved for use as a mine water storage following the cessation of mining operations Tailings emplacement in Ravensworth East voids (including West Pit and Bayswater North Pit) and within in-pit tailings cells in North Pit Other uses to be considered as part of the detailed mine closure planning process	To be considered as part of detailed mine closure planning process

2.0 Strategic context for rehabilitation

2.1 Glencore Mine closure planning protocol

Glencore is committed to a proactive approach to rehabilitation and mine closure at the Mount Owen Complex. Glencore 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 Mine Closure Planning Protocol includes the scope of mine closure activities required at each phase of mining, with closure planning commencing at the conceptual and pre-feasibility mine design phases, continuing through the feasibility design and operational phases 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.

2.2 Alignment with strategic land use objectives

The strategic land use objectives for the area which have been considered as part of the Strategy are discussed below.

2.2.1 Singleton Local Environmental Plan (LEP)

This Strategy has been developed in consideration of the objectives of the Singleton LEP. The Mount Owen Complex is situated within areas classified as RU1 Primary Production and E2 Environmental Conservation (Ravensworth State Forest). The Project does not propose any additional disturbance to E2 zoned land.

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 Singleton LEP, provision has been included within the Strategy to maintain the rural landscape by re-establishing open grassland areas in flatter parts of the final landform (refer to **Section 3.0**). In addition, the existing approved Mount Owen Rehabilitation Strategy aims to return areas of Ravensworth State Forest to native vegetation 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 rehabilitation of this area is unaffected by the Project. The additional areas of native vegetation to be planted as part of rehabilitation, including those areas planted as part of the rehabilitation for the Project, will also expand the area of native 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.

Any amendments that may occur to the Singleton LEP during the life of operations at the Mount Owen Complex will be evaluated as part of ongoing revisions to the Strategy.

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 Land Use Strategy had a time frame of 25 years, to 2032. The closure of the Mount Owen Complex and the transition to alternative land uses is outside the planning horizon covered by the current Land Use Strategy. Nonetheless, the general principles remain broadly relevant to the land use planning for the Mount Owen Complex. The Land Use 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 in the Land Use Strategy 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).*

Infrastructure areas and facilities at Mount Owen Complex satisfy each of the above criteria.

The Land Use Strategy is currently under review by Council and will be replaced by the Strategic Local Planning Statement being developed by Singleton Council will also provide key strategic guidance on future land use options for the Project. It is envisaged that this Strategic Local Planning Statement will have greater focus on the transition of mine sites towards end land uses which provide alternative land use opportunities into the future. The Strategic Local Planning Statement will be considered in the development of the Mine Closure Plan for the Mount Owen Complex.

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).

This Strategy 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. While the Synoptic Plan was developed having regard to the approved and contemplated mining projects in the late 1990s, the broad principles outlined in the plan remain relevant to the rehabilitation and closure of the Mount Owen Complex. The conceptual final land use (refer to **Section 3.2**) includes native vegetation rehabilitation to establish and enhance habitat corridors to promote regional fauna movements across the Mount Owen Complex and surrounding region.

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 proposed as part of the conceptual find land uses 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 (SRLUP)

The *Upper Hunter Strategic Regional Land Use Plan* (DP&I 2012) (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 coal seam gas industry.

Amongst the various land use types, the Upper Hunter SRLUP 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.

As outlined in **Section 3.0**, the indicative post mining land use for the Mount Owen Complex will primarily involve the establishment of native vegetation communities consistent with surrounding vegetation in the post-mining landform with areas of open 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, including the promotion of wildlife corridors and conservation areas. The establishment of vegetation corridors identified in the conceptual final land use plan for the Mount Owen Complex (refer to **Section 3.2.1**) facilitates regional linkages throughout the broader area whilst not precluding opportunities for other post-mining land uses.

The construction of the Glendell MIA, Heavy Vehicle Access Road and the realignment of Hebden Road for the Project will impact on a small area (approximately 34 ha) of Land and Soils Classification (OEH 2012) Class 3 and 4 land which has been verified as Biophysical Strategic Agricultural Land (BSAL) (refer to **Figure 2.1**). These infrastructure features will either be permanent (Hebden Road) or in place for more than 20 years (Glendell MIA and Heavy Vehicle Access Road). The use of stripped BSAL soils and the rehabilitation of this area is discussed further in **Sections 3.2.2**, **5.3** and **5.4**. Approximately 21 ha of verified BSAL will be rehabilitated to a minimum of Land and Soil Capability Class 4. While this aspect of the Strategy will not result in the reinstatement of BSAL, it will improve the quality of the growing medium in the areas of the final landform identified for agricultural uses. The loss of up to 13 ha (less than 0.01% of total mapped BSAL within the Upper Hunter) of verified BSAL will have a negligible impact on overall agricultural productivity in the Hunter Valley with the land in question only having been occasionally cultivated for improved pasture purposes in the past 30 years.

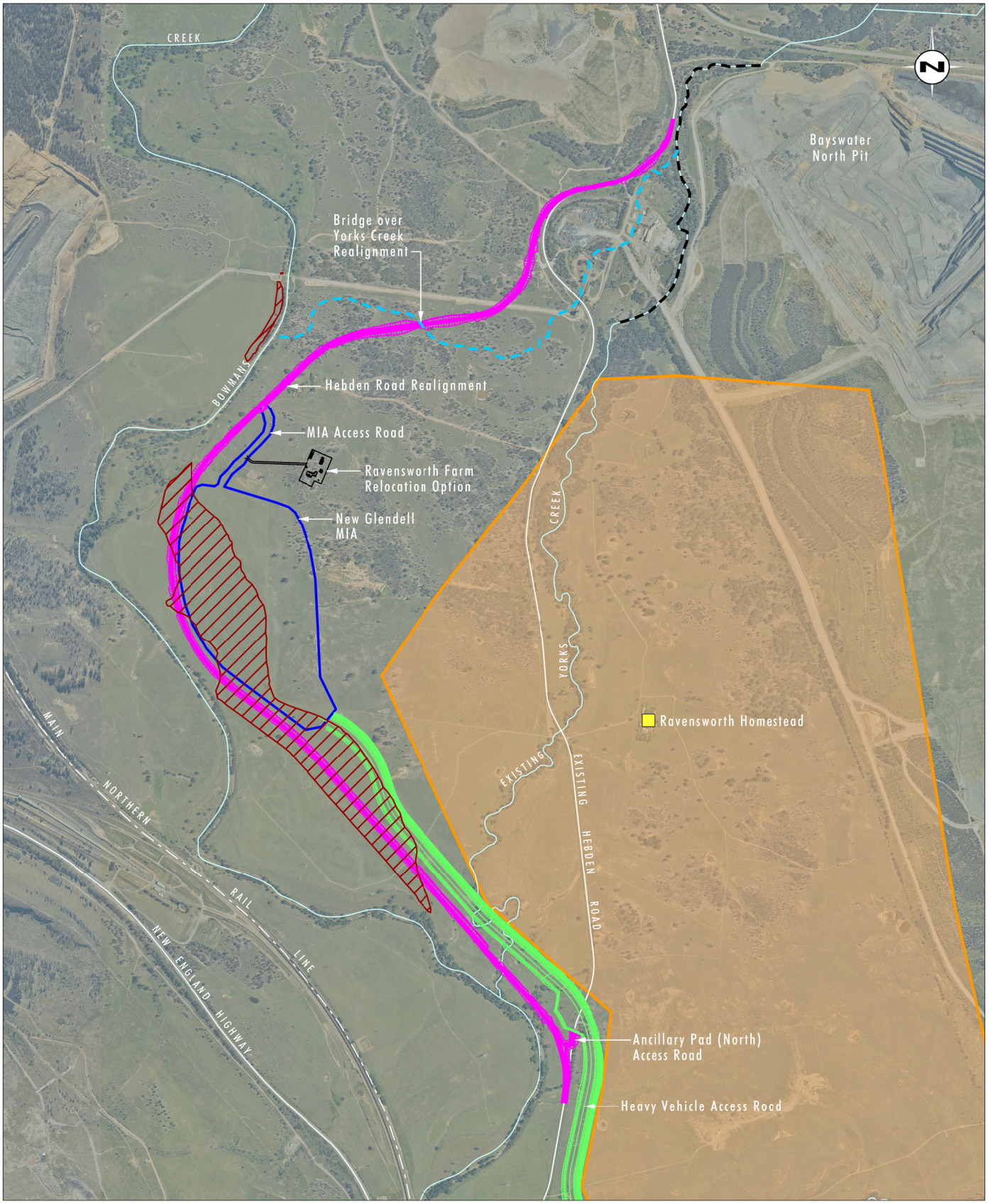

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Ravensworth Homestead to be relocated

0 0.25 0.5 1.0km

Legend

- Glendell Pit Extension
- Ravensworth Homestead
- Existing Creek Diversion
- New Glendell MIA
- Yorks Creek Realignment
- Hebden Road Realignment
- Heavy Vehicle Access Road
- Verified BSAL

FIGURE 2.1

BSAL Impacted by the Project

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2.2.5 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (NSW Government 2016) (Regional Plan) is the NSW Government's strategic long term plan for guiding land use planning decisions for the Hunter Region until 2036. The Regional Plan sets out four regionally focused goals for the Hunter Region, being:

- the leading regional economy in Australia
- a biodiversity-rich natural environment
- thriving communities
- greater housing choice and jobs

The Regional Plan aims to strengthen the region's economic resilience, protect its well established economic and employment bases and build on its existing strengths to foster greater market and industry diversification. In particular, the intent of the Regional Plan is to transform the productivity of the Upper Hunter, plan for greater land use compatibility, protect and connect natural areas and sustain water quality and security. This Strategy aligns to the following 'directions' in the Regional Plan:

- Direction 5 transform the productivity of the Upper Hunter specifically to identify the land and infrastructure requirements to develop the Hunter's coal and alternative energy resources
- Direction 11 is aimed at managing the ongoing use of natural resources and notes 'the combination of undeveloped coal resources in the Hunter and Newcastle coalfields and the export capability of the Port of Newcastle provide significant opportunities for growth'
- Direction 13 is based on managing the compatibility of land uses in particular identifying and protecting important agricultural land, including intensive agricultural clusters
- Direction 14 is aimed at protecting and connecting natural areas, including developing a holistic approach across both public and private lands that will protect and manage natural ecosystems and ensure connectivity between habitats
- Direction 15 notes the importance of monitoring and managing the impacts of existing land uses, and in the future those associated with growth will be essential to protect the quality and security of the region's water supplies

Directions 5 and 11 are relevant as they relate to the economic benefits of the Project through development of economic coal resources. Direction 13 is related to how this Strategy aligns with the Upper Hunter SRLUP which is discussed in **Section 2.2.5**.

Direction 14 is addressed through the proposed revegetation of the site to predominately native vegetation communities which recreates and enhances local and regional habitat connectivity (refer also to **Section 2.2.4** and **Figure 3.8**).

Direction 15 is addressed through the range of management, mitigation and monitoring measures committed to for the Project and those discussed in **Section 6.0**. The investigation of alternative, higher economic value and employment generating industries for the site post mining as part of the mine closure planning processes (refer to **Sections 1.1** and **2.1**) is also consistent with Direction 15.

2.2.6 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. This Strategy has been developed in consideration of the six key objectives as identified by the strategic 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 procss	**Section 2.3**
To ensure the process of closure occurs in an orderly, cost-effective and timely manner	**Sections 2.1** and **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 **6.0**
To reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority	**Section 3.0** and **6.0**

2.3 Stakeholder consultation

2.3.1 Development of rehabilitation strategy

As part of past approval processes at the Mount Owen Complex, Mount Owen have sought stakeholder feedback on mine closure and rehabilitation aspects through various forums including meetings with regulatory authorities, community groups and surrounding landowners. 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, Umwelt 2018a, Umwelt 2018b).

Glencore has also consulted with regulatory authorities, community groups and surrounding landowners during the development of the Project with similar views expressed to that received in relation to the Mount Owen Consent approval processes.

Consultation was undertaken with the NSW Department of Planning (now DPIE), the NSW Resources Regulator and Singleton Council during the original development of the Rehabilitation Strategy for the Mount Owen Consent. As a result of the consultation undertaken during the initial approval of the Rehabilitation Strategy, agency and Singleton Council stakeholders were consulted on a number of iterations of the document with changes made to incorporate the feedback received during this process. Additional consultation was undertaken with agency and Singleton Council stakeholders during the assessment process for the Mount Owen Continued Operations Modification 2.

Consultation will occur with the DPIE, NSW Resources Regulator and Singleton Council during the development of the Project and throughout the assessment process regarding the proposed final landform options and rehabilitation strategy.

Consultation on the various iterations of the Strategy included the identification and discussion of a range of different closure options. These included agricultural use, conservation for biodiversity and the potential suitability of the site in the future for other higher value land uses.

2.3.2 Development of mine closure plan

One of the key focus areas for ongoing dialogue with stakeholders will be the mine closure and rehabilitation planning and implementation process.

As discussed in **Section 3.3**, the existence of infrastructure associated with the current and proposed mining operations (e.g. road access, power, water and rail access) provide opportunities for other uses of the post mining landform including opportunities for industrial and other higher value/higher employment generating uses. The views of stakeholders will be considered in the investigation of alternative land use options for the Mount Owen Complex as a part of the mine closure planning process. 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 RMP/MOP for the Mount Owen Complex
- development of the Mine Closure Plan
- submission of annual reviews and conducting associated meetings with government agencies to seek feedback in relation to the progress with rehabilitation activities
- Community Consultative Committee (CCC) meetings
- community meetings and information days
- community newsletters, and
- one-on-one meetings with stakeholders.

3.0 Conceptual post mining landform and land use

3.1 Conceptual final landform

Terrain Development

Key design considerations associated with the overburden emplacement areas at the Mount Owen Complex are outlined below:

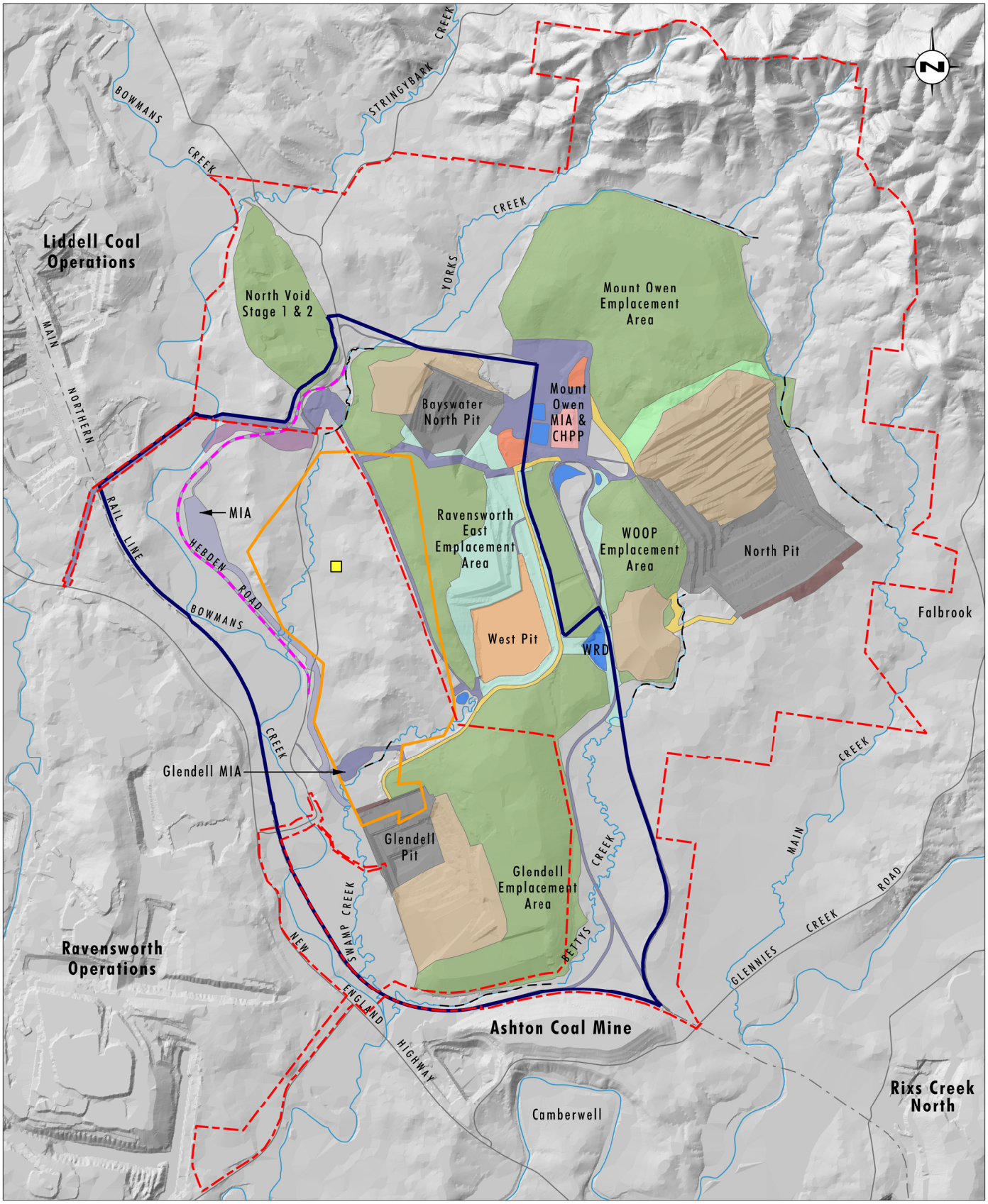
- The conceptual final landform of emplacement areas outside of the voids will predominantly consist of an undulating landform generally reflecting the dominant features of the existing environment.
- Final landform slopes for Ravensworth East, North Pit and Glendell Pit emplacement areas will be generally battered to an average of 10^{o} in order to minimise erosion risk. Natural landform design features will be incorporated into areas of the overburden emplacement areas developed. These natural landform design features are aimed at achieving consistency with surrounding natural landforms and may result in localised sections of slopes exceeding 18^{o}. However, it is anticipated that steeper profiles will typically 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. Maximum heights of emplacement areas are:
    - Mount Owen emplacement area – to approximately 230 mAHD
    - WOOP emplacement area – to approximately 190 mAHD
    - Ravensworth East emplacement area – to approximately 185 mAHD , and
    - Glendell emplacement area – to approximately 200 mAHD.

Specific details of natural landform design features in the rehabilitated landform will be provided in the RMP/MOP prepared and updated through the life of the Project.

As mining progresses, emplacement areas which are no longer required for active emplacement are shaped and rehabilitated; this is known as progressive rehabilitation. **Figure 3.1** to **Figure 3.4** show the progressive landform development and rehabilitation of mining areas at the Mount Owen Complex over the life of the Project.

Figure 3.5 shows the conceptual final landform for the Mount Owen Complex.

Consistent with the rehabilitation objectives (refer to **Section 4.0**), natural landform features will be developed in the final landform above natural ground level. Typical cross-sections of the final landform design are shown in **Figure 3.6** and **Figure 3.7**.



Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is Approved

0 1.0 2.0 3.0km

Legend

- Mount Owen Consent Boundary
- Project Area
- Glendell Pit Extension
- Existing Creek Diversion
- Hebden Road Realignment (Construction)
- Ravensworth Homestead
- Active Pit/Working Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Temporary Rehabilitation
- Rehabilitation
- Creek Realignment Establishment
- Infrastructure/Internal Access
- Infrastructure (Construction)
- Haul Road
- Coal Stockpile ROM
- Coal Stockpile Product
- Tailings Emplacement Area
- Water Storage

FIGURE 3.1

Mount Owen Complex Conceptual Mine Plan circa 2021

File Name (A4): R11/4166_311.dgn
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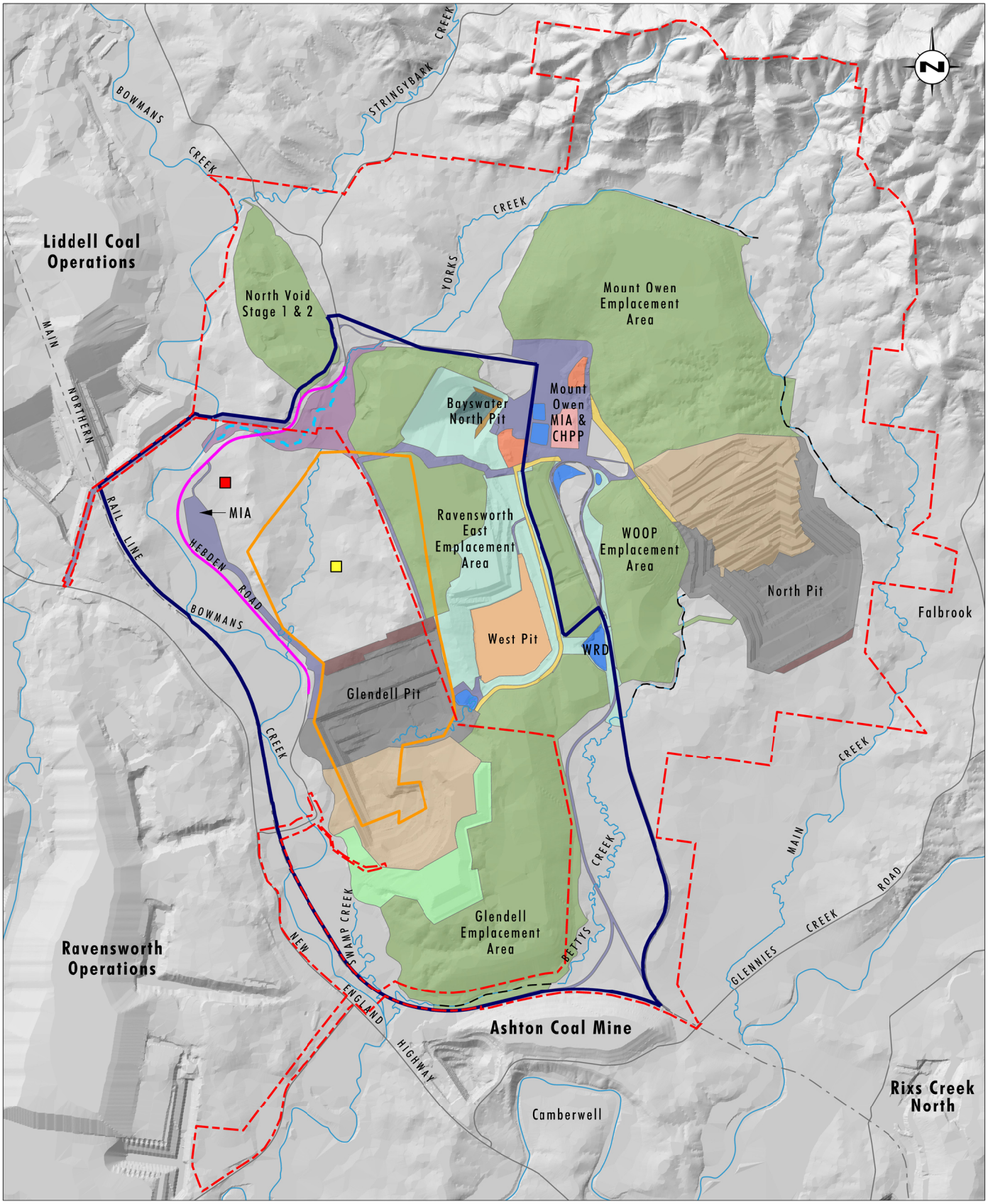


Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is Approved

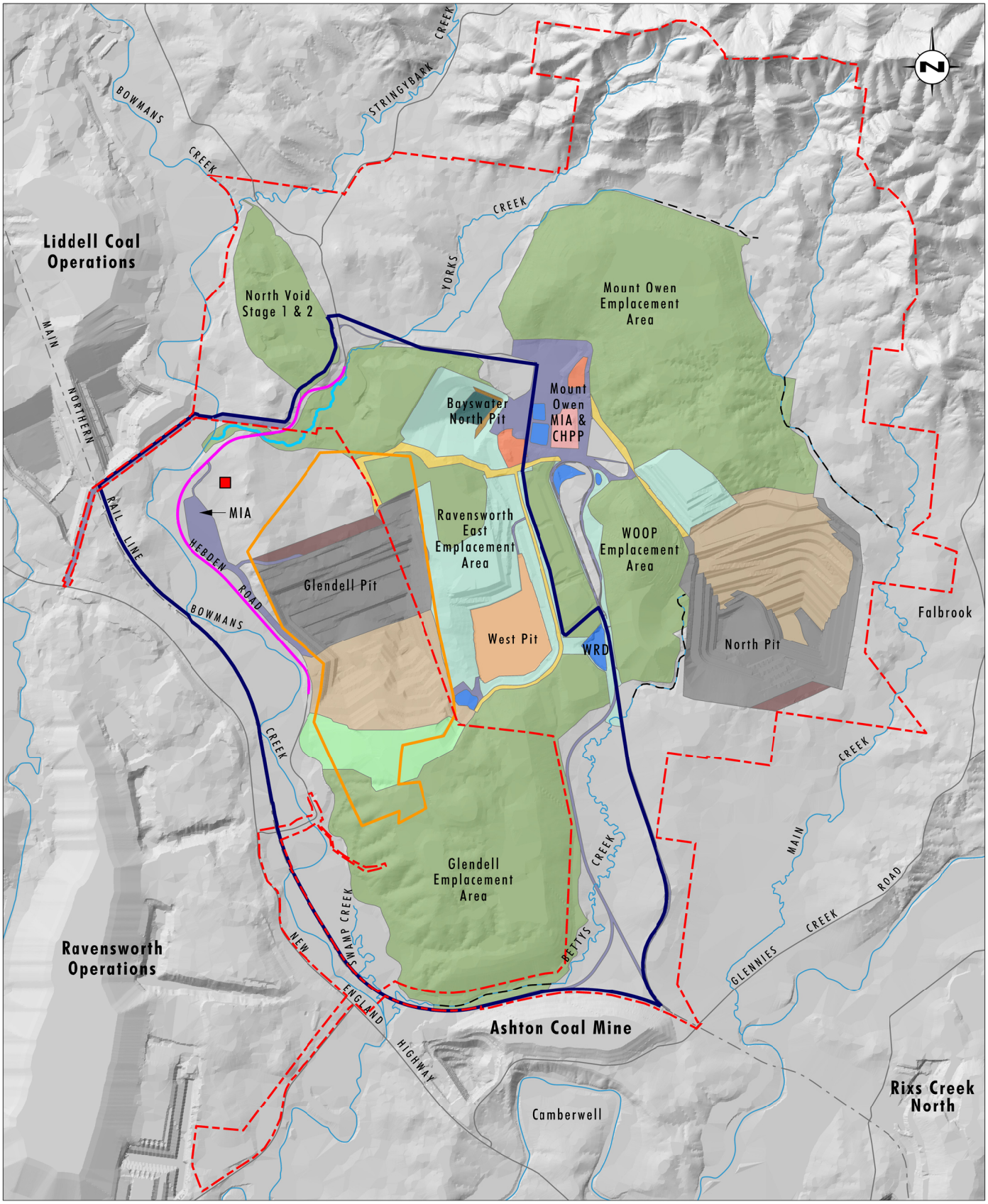
Legend

- Mount Owen Consent Boundary
- Project Area
- Glendell Pit Extension
- Existing Creek Diversion
- Yorks Creek Realignment (Establishment)
- Hebden Road Realignment
- Ravensworth Homestead
- Ravensworth Farm Relocation Option
- Active Pit/Working Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Temporary Rehabilitation
- Rehabilitation
- Creek Realignment Establishment
- Infrastructure/Internal Access
- Haul Road
- Coal Stockpile ROM
- Coal Stockpile Product
- Tailings Emplacement Area
- Water Storage
- Water Storage/Tailings Emplacement
- Highwall

FIGURE 3.2

Mount Owen Complex Conceptual Mine Plan circa 2026

File Name (A4): R11/4166_159.dgn
20191009 15.15



Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is Approved

0 1.0 2.0 3.0km

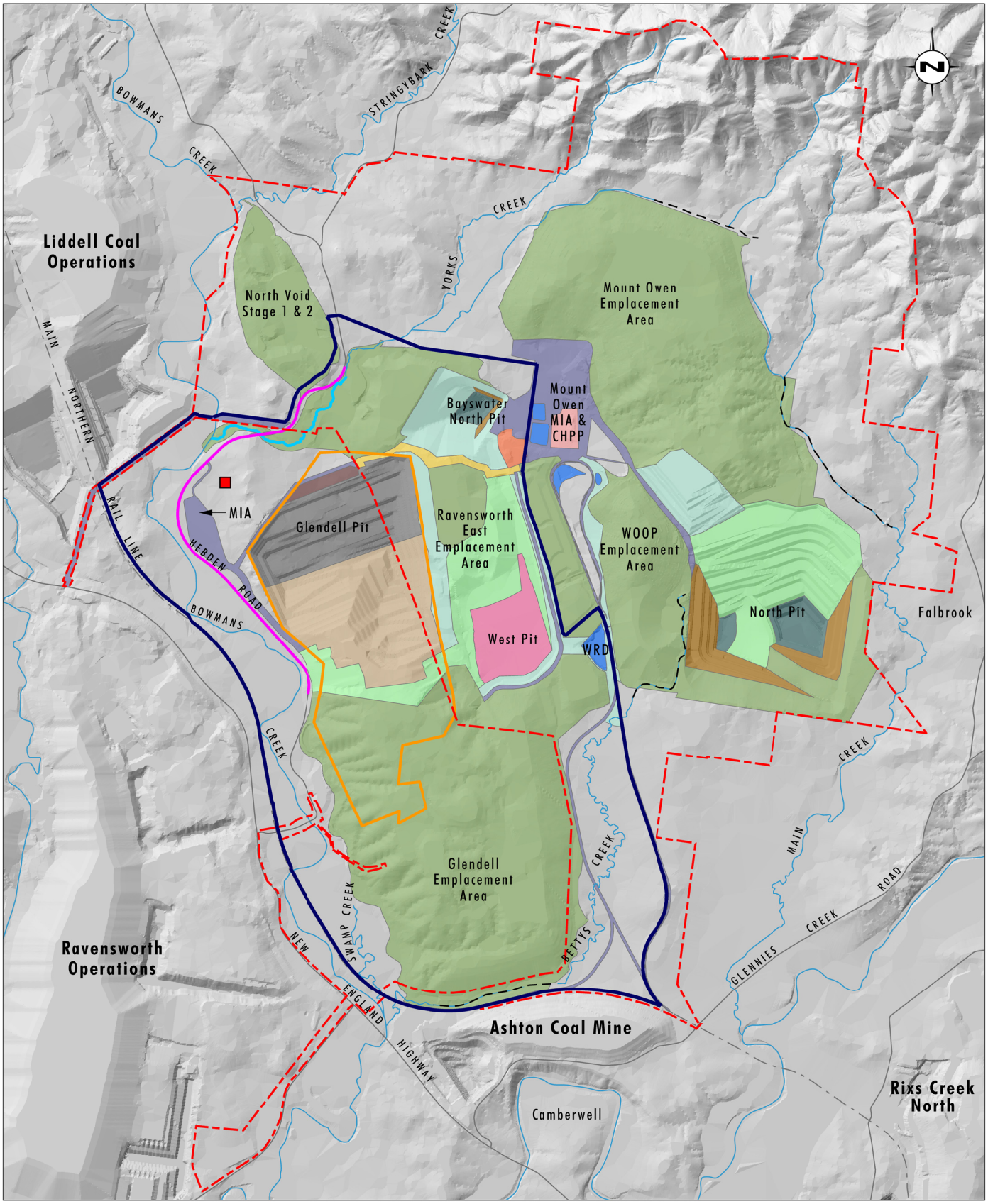
Legend

- Mount Owen Consent Boundary
- Project Area
- Glendell Pit Extension
- Existing Creek Diversion
- Yorks Creek Realignment (Commissioned)
- Hebden Road Realignment
- Ravensworth Farm Relocation Option
- Active Pit/Working Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Temporary Rehabilitation
- Rehabilitation
- Infrastructure/Internal Access
- Haul Road
- Coal Stockpile ROM
- Coal Stockpile Product
- Tailings Emplacement Area
- Water Storage
- Water Storage/Tailings Emplacement
- Highwall

FIGURE 3.3

Mount Owen Complex Conceptual Mine Plan circa 2033

File Name (A4): R11/4166_160.dgn
20191009 15.17



Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is Approved

Legend

- Mount Owen Consent Boundary
- Project Area
- Glendell Pit Extension
- Existing Creek Diversion
- Yorks Creek Realignment (Commissioned)
- Hebden Road Realignment
- Ravensworth Farm Relocation Option
- Active Pit/Working Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Temporary Rehabilitation
- Rehabilitation
- Infrastructure/Internal Access
- Haul Road
- Coal Stockpile ROM
- Coal Stockpile Product
- Water Storage
- Water Storage/Tailings Emplacement
- Highwall
- Tailings Capping in Progress

FIGURE 3.4

Mount Owen Complex Conceptual Mine Plan circa 2038

File Name (A4): R11/4166_161.dgn
20191009 15.18

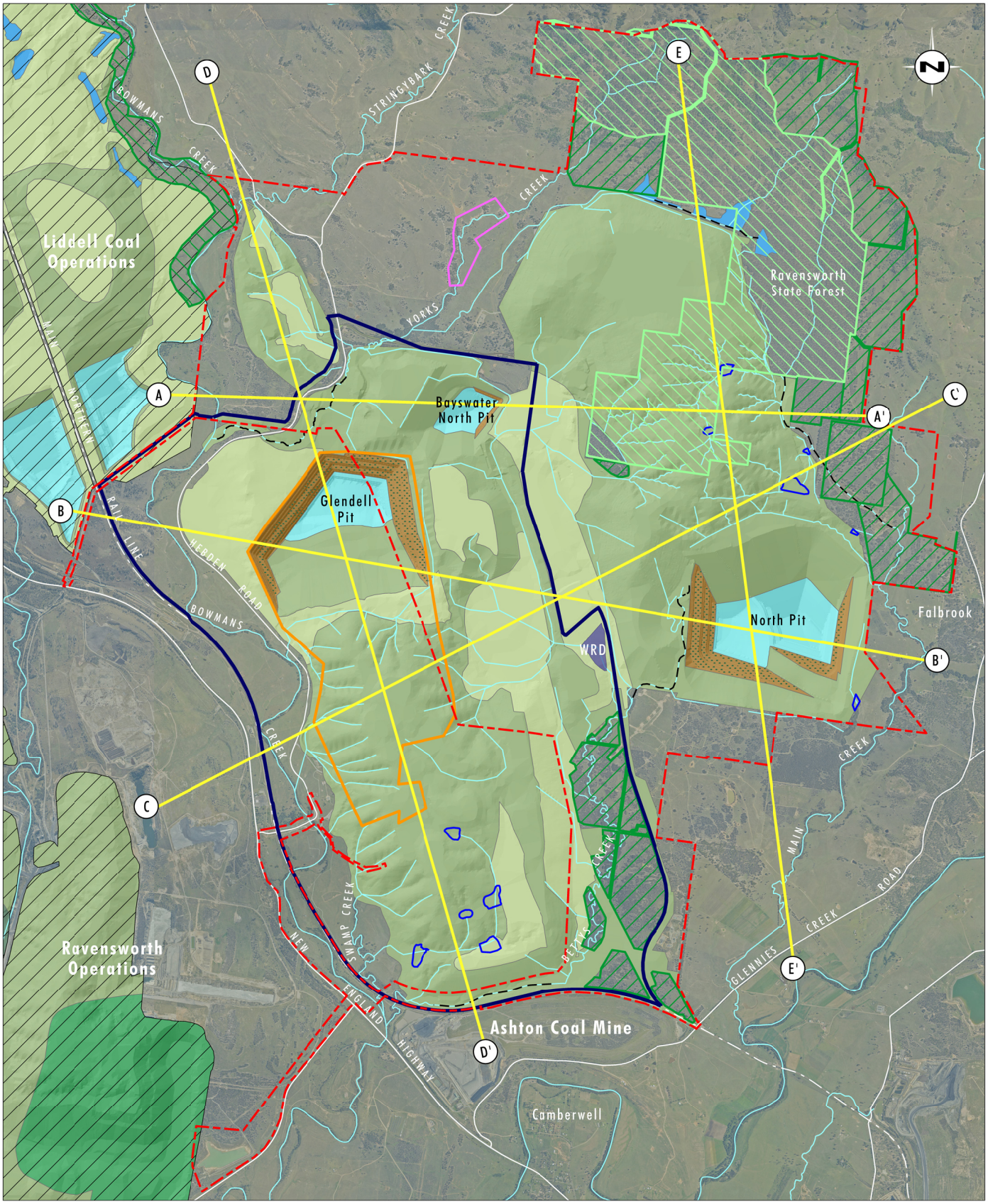


Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), GHD (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved.
Dams may be retained in Final Landform

0 1.0 2.0 3.0km

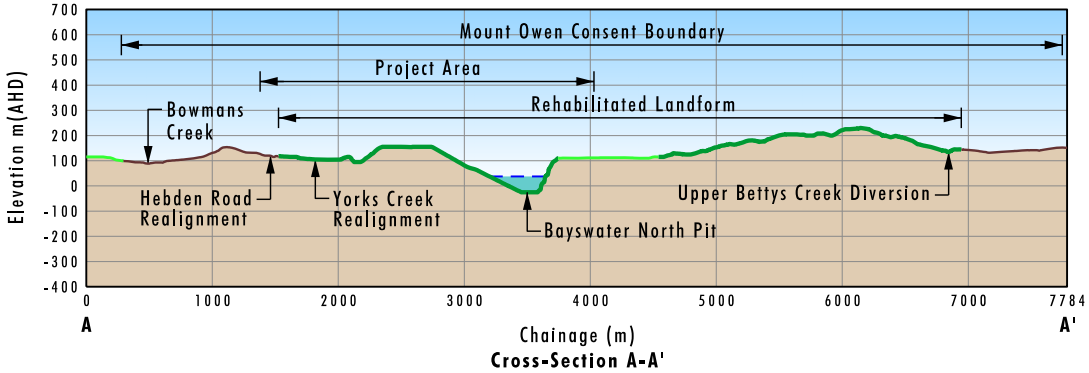
Legend

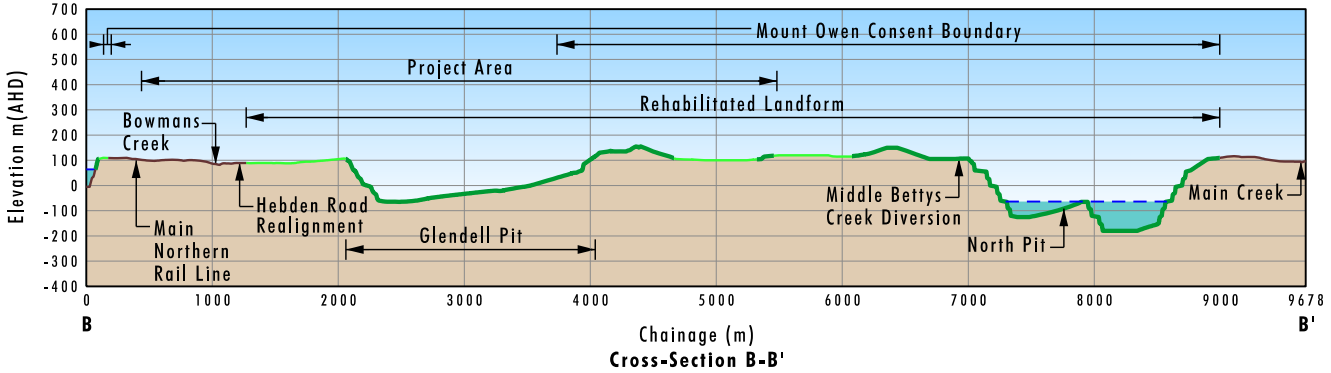
- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Creek Diversion/Realignment
- Native Vegetation
- Open Grassland (Potential grazing areas with pockets of native vegetation)
- Grazing (Ravensworth Operations)
- Vegetated Benches on Retained Highwall
- Retained Highwall
- Water Storage
- Retention Basin
- Pit Lake
- Dryland Attenuation Basin
- Mount Owen Complex Biodiversity Offset Area
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area
- Liddell Coal Operations Biodiversity Offset Area
- Associated with Other Operations
- Transect Location

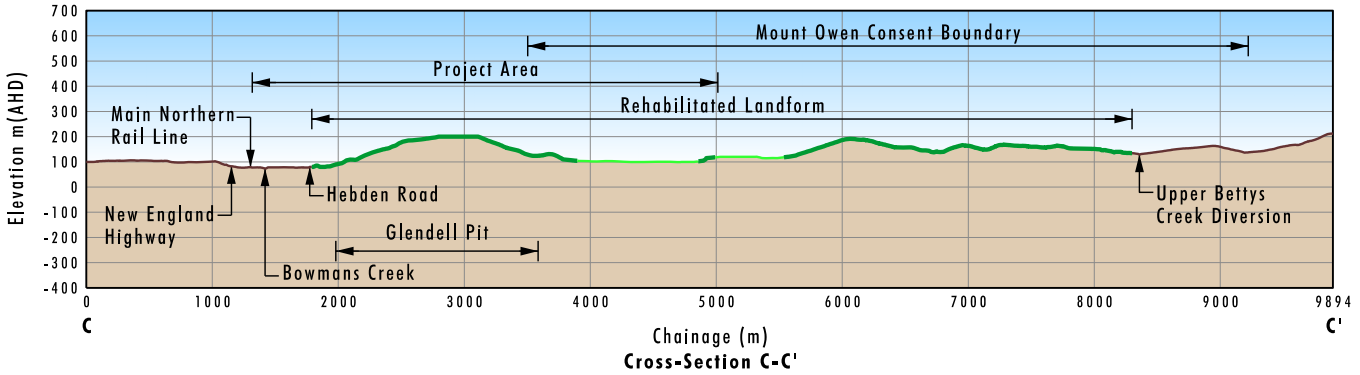
FIGURE 3.5

Mount Owen Complex Conceptual Mine Plan - Final Landform

File Name (A4): R11/4166_158.dgn
20191128 16.36





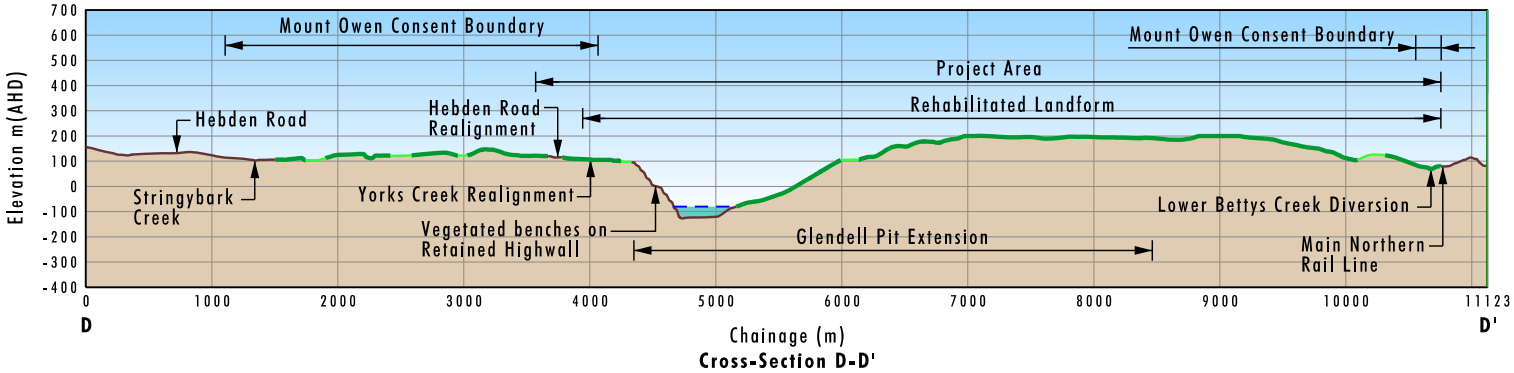


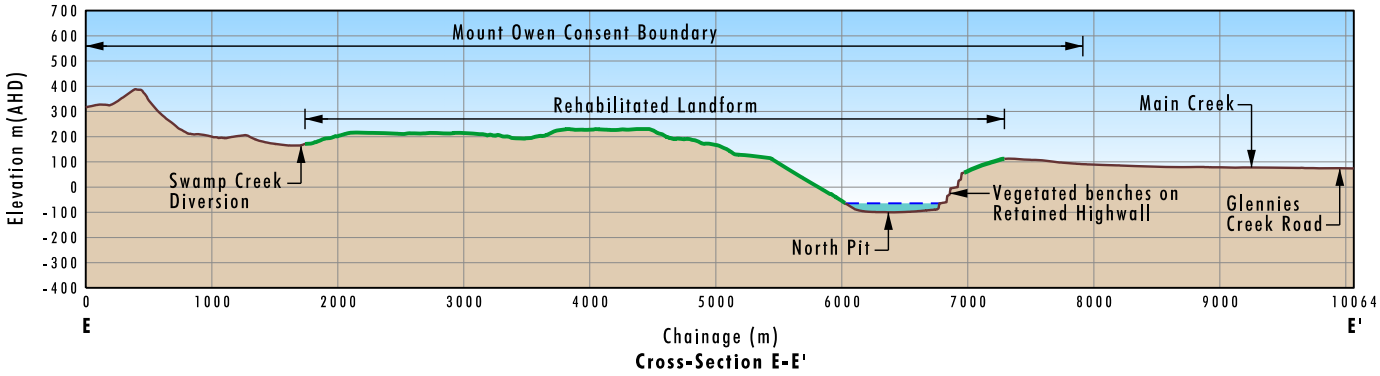
Legend

- Landform Surface
- Modelled Maximum Water Storage Level
- Water Storage
- Rehabilitated Final Landform Surface Native Woodland
- Rehabilitated Final Landform Surface Open Grassland (Potential Grazing Areas with pockets of woodland vegetation)

FIGURE 3.6

Conceptual Final Landform Cross Sections





0 0.5 1.0 1.5km
Vertical Scale 1:30 000

0 1.0 2.0 3.0km
Horizonal Scale 1:60 000

Legend

- Landform Surface
- Modelled Maximum Water Storage Level
- Water Storage
- Rehabilitated Final Landform Surface Native Woodland
- Rehabilitated Final Landform Surface Open Grassland (Potential Grazing Areas with pockets of woodland vegetation)

FIGURE 3.7

Conceptual Final Landform Cross Sections

3.1.1 Void Areas

Three voids are approved for incorporation into the conceptual final landform following cessation of mining at Mount Owen Complex:

- North Pit
- Bayswater North Pit, and
- Glendell Pit.

The final void associated with the former TP2 pit (now known as the Western Rail Dam (WRD)) will be used as a GRAWTS transfer point for the life of the Project and, upon decommissioning, be utilised as a retention dam in the final landform to control flows into the lower Bettys Creek catchment.

The Project does not propose any changes to the approved landform or uses of the North Pit or the Bayswater North Pit but may utilise these voids for water and/or tailings storage into the future, beyond previously planned cessation of mining at those locations.

The Glendell Pit Extension will result in the Glendell Pit final void being located further to the north of the approved void location under the Glendell Consent. Highwalls will remain in the Glendell Pit Extension void, consistent with the previously approved final void under the Glendell Consent. The Glendell Pit Extension final void highwalls will be located around the western, northern and eastern sides of the void. The retention of highwalls on three sides reduces the overall catchment area of the void.

Pit lakes will form in the final voids following the cessation of mining. The final voids have been designed to ensure that they will be hydraulic sinks such that the pit lakes and level of saturation within the spoil do not result in discharge to downstream catchments.

A groundwater assessment (AGE 2019) of the final landform (at closure) indicates that the voids will not discharge to local alluvial aquifers or through the regolith. The final voids are predicted to be a source of water to the hard rock aquifers in strata sub-cropping below the water level of the pit lakes. The predicted equilibrium water levels within the North Pit final void and Bayswater North Pit final void are approximately -65 mAHD and 10 mAHD respectively (Engeny 2018, Umwelt 2016). The Glendell Pit Extension final void is expected to reach an equilibrium water level of approximately -60 mAHD after approximately 450 years (GHD 2019). Modelled salinity levels in North Pit and the Glendell Pit will rise slowly with predicted salinity levels (measured as Total Dissolved Solids (TDS)) of between 5,000 mg/L and 6,000 mg/L after 400-450 years post closure (Engeny 2018, GHD 2019). The Bayswater North Pit is likely to have significant fluctuations in salinity during the early stages of the recovery however long term salinity levels are expected to be between 500 and 1,000 mg/L after 200 years post closure (Umwelt 2016). pH levels in all pit lakes are expected to be neutral due to the abundant buffering capacity present in overburden material contained in in-pit spoils (EGi 2013, 2017 and 2019).

Highwalls will be maintained in each of these voids, minimising catchment areas associated with the final voids. Highwall benches and battered low walls will be revegetated to contain flora species assemblages characteristic of vegetation communities consistent with those in the surrounding landform however growing medium depth on benches may limit the ability to successfully grow trees in these areas.

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

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

3.1.2 Final landform drainage

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 landforms planned as part of the operations regulated under the Mount Owen Consent since the approval of that consent have been designed to incorporate natural drainage landform principles to increase topographic variation and reduce the need for engineered drainage structures. Natural landform principles were not required under the previous approvals applicable to the Mount Owen and Ravensworth Mines and areas of the final landform established under those consents and revegetated are not required to be redisturbed to include natural landform design principles. Under the existing Glendell Consent natural landform principles are not required to be implemented and areas of the final landform not redisturbed by the Project will be retained.

The use of natural landform design principles 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.

The conceptual final landform design for new areas of landform at the Mount Owen Complex established during the life of the Project, (exclusive of final void drainage) has been designed to maximise surface water drainage into the natural environment.

Specific details of natural landform design features in the rehabilitated landform and final landform catchments will be provided in the RMP/MOP prepared and updated through the life of the Project.

The final landform will generally be designed to direct runoff away from the final voids and into the natural environment, specifically Main Creek, Yorks Creek, Swamp Creek and Bettys Creek catchments. This will return catchment flows to Yorks Creek and Main Creek and re-instate some of the natural flows to the lower reaches of Swamp Creek and Bettys Creek. Former parts of the Swamp Creek catchment will be diverted to the Bettys Creek catchment via WRD which will be converted to a retention basin to assist in the management of flood flows.

3.1.3 Creek diversions

The Mount Owen Complex Water Management System includes as an objective, the diversion of clean water catchments around disturbed areas. The following existing creek diversions are approved at the Mount Owen Complex to divert flows around operational areas:

- Upper Bettys Creek Diversion
- Middle Bettys Creek Diversion
- Lower Bettys Creek Diversion
- Swamp Creek Diversion (into Yorks Creek north of Mount Owen Mine)
- Glendell MIA Diversion (Lower Swamp Creek Diversion) [2]
- Yorks Creek Diversion (Ravensworth East MIA Diversion) [3]

The locations of these diversions are shown in **Figure 1.2**.

3.2 Conceptual final land use

The primary objectives for the site are that the post mining landform is safe, stable and non-polluting. Ideally, the conceptual land use(s) must also be sustainable.

At the time of approval, the indicative conceptual land use identified is also one which is identified as being permissible without consent under the current environmental planning instruments applicable to the site under the EP&A Act. Any alternative land uses will require development consent under the EP&A Act and the environmental assessment undertaken as part of that approval process will consider the impacts of those uses relative to the proposed conceptual land use.

The indicative conceptual final land uses currently identified for the Mount Owen Complex under the existing Mount Owen Consent and Glendell Consent are a combination of native vegetation and open grassland (potential grazing areas with pockets of native vegetation) with pit lakes in North Pit, Bayswater North Pit and Glendell Pit voids. This combination of land uses will be carried through to the conceptual final landform for the Project. The proposed conceptual post mining land uses for the Mount Owen Complex are shown in **Figure 3.8** and includes conceptual locations of native vegetation and open grassland.

3.2.1 Native vegetation areas

The conceptual post mining land use for the Mount Owen Complex will primarily involve the establishment of native vegetation areas consistent with surrounding vegetation communities and selected areas of open grassland for agriculture.

The primary objective is to create a native vegetation corridor network that promotes fauna movements between the vegetated areas within the landscape.

[2] To be removed by the Project

[3] To be replaced by Yorks Creek Realignment proposed as part of the Project

The habitat corridors created are shown in **Figure 3.8**. These corridors will be developed throughout the life of operations at the Mount Owen Complex through progressive rehabilitation of emplacement areas (refer to **Section 3.1.1**). These corridors link to existing remnant vegetated areas of Ravensworth State Forest as well as the significant areas of native vegetation being planted and regenerated in offset areas associated with Mount Owen Complex and offset lands for other mining projects in the area (e.g. Liddell Coal Operations offsets to the north west).

The areas not specifically targeted for native vegetation rehabilitation in the conceptual land use strategy are outlined below.

BSAL Areas

As discussed in **Section 2.2.4**, approximately 34 ha of verified BSAL could be impacted by the Project. The BSAL areas not impacted by either the permanent Hebden Road realignment or areas where landform shaping is required for final landform development and/or drainage purposes (approximately 21 ha) will be rehabilitated to at least Land and Soil Capability Class 4 land. This classification is broadly consistent with the current Land and Soil Capability classification of the affected land.

3.2.2 Open grassland areas

Portions of the Approved Disturbance Area, including the tops of overburden dump areas associated with Ravensworth East, as well as capped tailings storage facilities (refer to **Section 5.7**) will be also 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, 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. Pockets of native vegetation may be established in these grassland areas as shelter belts to support grazing activities.

The combination of terrain and soil constraints in the rehabilitated final landform will generally restrict open grassland areas to Land and Soil Capability Class 6 or better. This outcome is broadly consistent with the existing pre-mining Land and Soil Capability classification of the areas.

3.3 Alternative land use considerations

In consideration of the proposed operational life of Mount Owen Complex extending to approximately 2045, 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. These uses including the potential options to utilise voids for either water storage areas or tailings emplacement from other mines and the Mount Owen CHPP could potentially be used for the processing of coal from other operations. The Mount Owen Complex and surrounding area has a number of attributes that provide significant opportunities for future high value employment generating land uses following the cessation of mining. These attributes include:

- installed electricity infrastructure and close proximity to high voltage transmission network
- installed rail infrastructure
- installed road access with existing capacity to handle large workforce numbers
- established water storages (including pit lakes in voids)
- separation distance from residences (i.e. buffer land for potential amenity impacts)

- proximity to Singleton and Muswellbrook
- proximity to port infrastructure at the Port of Newcastle and direct rail access to port
- existing infrastructure areas located on flat terrain, and
- the ability to emplace overburden in a manner which facilitates alternative land uses.

The predicted pit lake water salinity levels and the assessment of geochemical characteristics of spoil inflow water quality (EGi 2013, 2017 and 2019) indicates that the water in the final void pit lakes (refer to **Section 3.1.2**) is suitable for a wide range of alternative land uses. Due to the depths of the voids in the Glendell Pit and North Pit and their proximity to high voltage electricity transmission network infrastructure, there is a potential opportunity for these voids to be used as pumped hydroelectricity water storages with overburden emplacement areas utilised for upper water storage areas.

The use of the Mount Owen Complex for high value, employment generating uses has a range of social and economic benefits for the region and State. In particular, the availability of alternate employment opportunities to offset reductions associated with the eventual decline in employment from mining as resources in the region become depleted and/or the demand for coal declines will reduce social and economic impacts on the local and regional economy.

However, due to the proposed life of mining operations at the Mount Owen Complex (Glendell Pit mined to approximately 2044 and North Pit mined to approximately 2037) it is not possible to accurately identify the ultimate or even preferred end land use for the site which can make use of these opportunities. Under the current Mount Owen Consent, alternative land uses must be considered as part of the mine closure planning process with a Mine Closure Plan to be developed at least 5 years prior to planned closure (currently 2032 under the Mount Owen Consent). The mine closure planning process includes extensive consultation with key stakeholders such as Local and State Government and local businesses and landholders and is discussed further in **Section 2.1**.

Alternative uses for voids identified as part of the mine closing planning process may result in changes to proposed void treatments (refer to **Section 3.1.2** and **Section 5.6**). Groundwater and pit lake recovery modelling will be undertaken as part of the mine closure process. This modelling will update groundwater modelling predictions and evaluate the long term pit lake hydrochemistry and water levels post closure; this modelling will also be used to inform potential alternative land uses that may be suitable for the site.

If alternative land uses are identified, further approvals may be required to implement these changes. Areas surrounding the final voids have been prioritised as open grassland areas to minimise the area of rehabilitated native vegetation that would need to be removed if alternative land uses are pursued as part of the final closure process.

Preliminary rehabilitation objectives and completion criteria for the conceptual post mining landform are discussed in detail in **Section 4.0** of this Strategy. While this Strategy has been developed in consideration of alternative land uses being pursued in the future, the rehabilitation strategy detailed in **Section 5.0** and proposed monitoring program in **Section 6.0** has been developed around the land uses and conceptual final landform identified in the **Figure 3.8**.

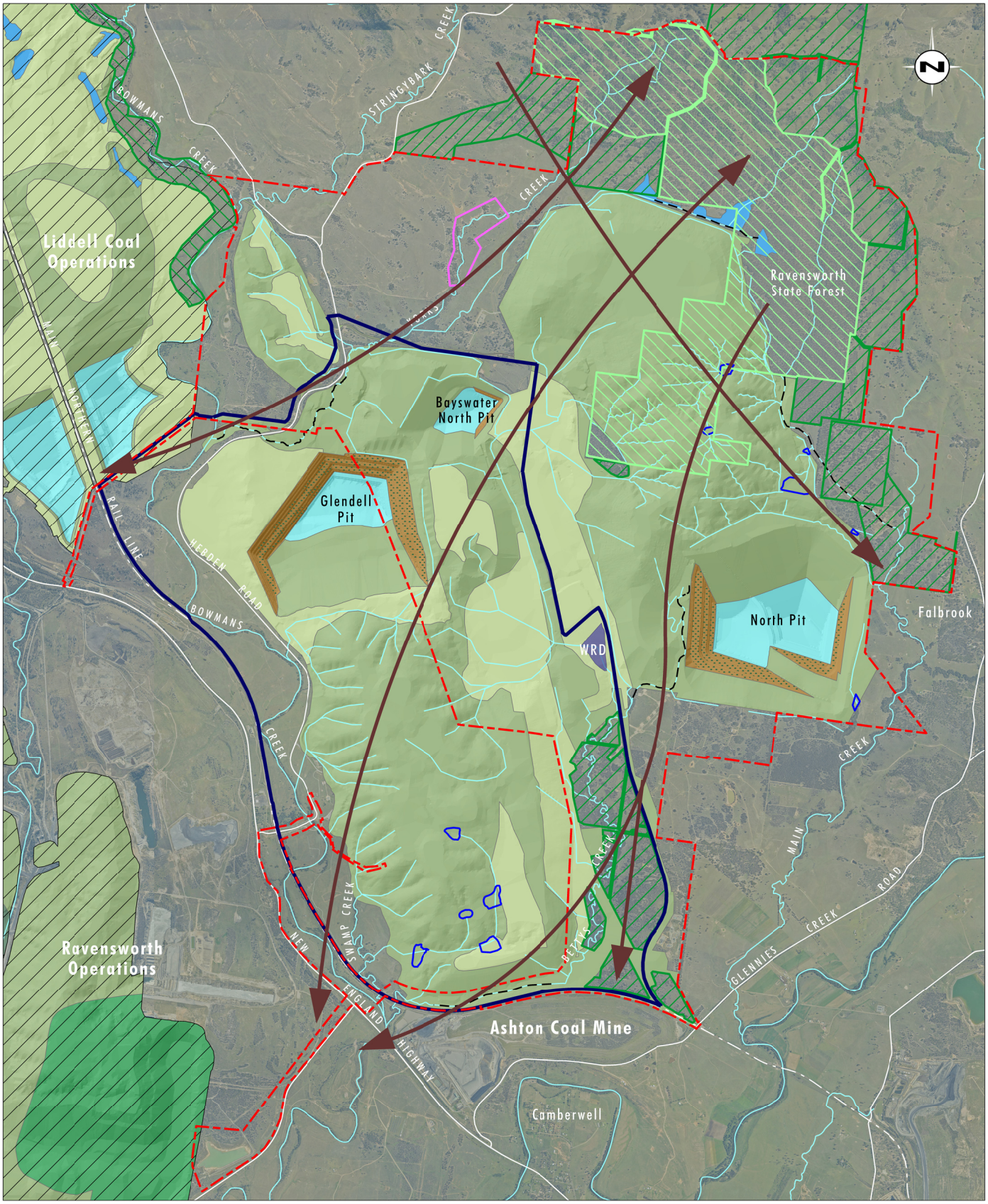


Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), GHD (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Mount Owen Consent Boundary
- Creek Diversion/Realignment
- Habitat Corridor
- Native Vegetation
- Open Grassland (Potential grazing areas with pockets of native vegetation)
- Grazing (Ravensworth Operations)
- Vegetated Benches on Retained Highwall
- Retained Highwall
- Water Storage
- Retention Basin
- Pit Lake
- Dryland Attenuation Basin
- Mount Owen Complex Biodiversity Offset Area
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area
- Liddell Coal Operations Biodiversity Offset Area
- Associated with Other Operations

FIGURE 3.8

Conceptual Regional Habitat Linkages through the Conceptual Final Landform

File Name (A4): R11/4166_157.dgn
20191128 16.33

4.0 Rehabilitation objectives and completion criteria

4.1 Rehabilitation risk and opportunities assessment

Mine rehabilitation presents both risks and opportunities. The MOP/RMP considers the potential rehabilitation risks and opportunities associated with the activities undertaken at the Mount Owen Complex. A detailed consideration of these risks is contained in the MOP/RMP developed for the Mount Owen Complex.

The rehabilitation objectives, preliminary completion criteria and broad rehabilitation strategy has been developed having regard to these risks.

Opportunities regarding rehabilitation are primarily associated with end land use options. These are discussed in **Section 3.3** and will be considered in more detail as part of the detailed mine closure planning process.

4.2 Rehabilitation objectives

The proposed conceptual post mining land use design for Mount Owen Complex (refer to **Figure 3.8**) 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.

The overall objectives of the proposed post-mining land use design of Mount Owen Complex include:

- development of a safe, stable and non-polluting landform
- development of regional native corridors that promote fauna movements between Mount Owen Complex, Ravensworth Operations, Liddell Coal Operations, Lake Liddell, Hillcrest Offset Area and Bowmans Creek
- maintain and provide additional suitable habitat for a range of threatened fauna species including the spotted-tailed quoll (*Dasyurus maculatus*)
- provide opportunities for future agricultural activities such as sustainable grazing in appropriates parts of the terrain
- improve the visual amenity of the area, and
- not preclude other potential post mining land use should they be determined to be viable and preferable as part of the detailed mine closure planning process that will commence at least five years prior to the planned cessation of mining.

These objectives are consistent with the rehabilitation objectives provided in Table 10 of the Mount Owen Consent. Table 10 of the Mount Owen Consent and conceptual rehabilitation objectives for the Project are represented below in **Table 4.1**.

Table 4.1 Mount Owen Consent rehabilitation objectives and conceptual rehabilitation objectives for the Project

Feature	Objective	Mount Owen Consent	Glendell Continued Operations Consent
Mine site (as a whole)	• Safe, stable and non-polluting	✓	✓
	• Final landforms 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 DPIE Water	✓	✓
Final voids	• Designed as long-term groundwater sinks to prevent the release of saline water into the surrounding environment, unless further mine planning and final landform design processes identify a more suitable outcome for the 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: ○ highwall slopes (excluding slopes below the post-mining standing water level) ○ the size and depth of final voids ○ the drainage catchment of final voids ○ any high wall instability risk and ○ the risk of flood interaction for all flood events up to and including the Probable Maximum Flood	✓	✓
	• Vegetate upper benches with a mixture of native species of varied heights	✓	✓
Rehabilitation areas and other vegetated land	• Restore at least 2,037 ha of self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area, as shown conceptually in **Figure 3.8**	✓	

Feature	Objective	Mount Owen Consent	Glendell Continued Operations Consent

	• Establish areas of self-sustaining:
	  ○ riparian habitat, within any diverted and/or re-established creek lines and retained water courses
	  ○ potential habitat for threatened flora and fauna species and
	  ○ wildlife corridors, as far as is reasonable and feasible, and as shown conceptually in **Figure 3.8**
		✓	✓

Agricultural land	• Rehabilitate grassland areas identified in **Figure 3.8** 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 Resources Regulator agrees otherwise	✓	✓
Water Quality	• Water retained on the site is fit for the intended post-mining land use/s	✓	✓
	• Water discharged from the site is suitable for receiving waters and is capable of supporting existing aquatic ecology and riparian vegetation	✓	✓
Community	• Ensure public safety	✓	✓
	• Minimise adverse socio-economic effects associated with mine closure	✓	✓

[#] The rehabilitation objectives do not require any additional earthmoving works to be undertaken for landforms that have been approved and constructed under previous consents. Microrelief features are not required to be incorporated into final void areas below natural ground level.

Further detail in regards to the specific rehabilitation methodology related to the establishment of these areas as outlined above are included in **Sections 3.0** and **5.0**. Rehabilitation objectives for creek diversions, including the Yorks Creek Realignment is provided in **Section 5.1**.

4.3 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 preliminary rehabilitation completion criteria for the Mount Owen Complex are contained in **Appendix A**. The preliminary criteria have been developed considering specific issues and objectives for the Mount Owen Complex 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*'.

These criteria will be reviewed and revised throughout the life of the mine through the MOP/RMP processes, and will consider:

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

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 MOP/RMP. The rehabilitation criteria identified in the MOP/RMP and detailed Mine Closure Plan is set for specific management domains based on proposed and approved final land uses.

The completion criteria will be finalised as part of the detailed mine closure planning process and presented in the Mine 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. Proposed rehabilitation monitoring is detailed in **Section 5.0**.

5.0 Rehabilitation strategy

The following sections identify high level rehabilitation principles relevant to the key rehabilitation risks and opportunities for the Project.

Rehabilitation will be undertaken progressively in accordance with the RMP/MOP. The RMP/MOP will be developed in accordance with this 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 3.0**) 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.

Consistent with NSW Resources Regulator policy, the RMP/MOP will identify rehabilitation domains for the site. This includes specific management and rehabilitation objectives for each domain area at different stages of the development.

Details of the rehabilitation principles to be considered in the RMP/MOP are provided in the sections below.

5.1 Creek diversions and final landform drainage

5.1.1 Existing creek diversions

With the exception of the Yorks Creek and Swamp Creek Diversion, all existing diversions (refer to **Section 3.1.3**) have been designed, constructed and managed with four guiding principles, including:

- engineered to be hydraulically and geomorphologically stable up to the relevant design storm event
- incorporate erosion control measures based on vegetation and engineering revetments
- incorporate structures for aquatic habitat
- revegetate with suitable native species

These principles are designed to ensure the long-term stability, sustainability and functionality of the diversion. The design criteria for existing diversions are to:

- produce stable channel, which is unlikely to undergo significant geomorphic change over time
- reduce the need for ongoing maintenance where possible
- ensure sufficient capacity to convey the estimated peak flow from the 1% AEP storm event, and
- where practical, incorporate persistent pools to assist in sustaining aquatic habitats.

The key design details for the existing Mount Owen Complex diversions are given in **Table 5.1**. Refer to the associated detailed design reports for further information.

Table 5.1 Key diversion design details

Diversion	Length (km)	Typical Cross Section		Longitudinal Slope		In-stream structures	Design Report
		Shape	Base Width (m)				
Upper Bettys Creek Diversion	~2	Trapezoidal	6-8	1(V):3(H)	0.25%	Four rocklined drop structures	Parsons Brinckerhoff 2007
Middle Bettys Creek Diversion	2.5	Trapezoidal	6	1(V):3(H) - 1(V):5(H)	0.58 to 0.94%	Three rockramp drop structures	EarthTech 2006
Lower Bettys Creek Diversion	1.4	Trapezoidal with benches	10	1(V):3(H)	0.44%	Nil	URS 2012
Glendell MIA Diversion	0.5	Trapezoidal	3	1(V):3(H)	0.5%	Culverts beneath haul road and rock-lined stilling basin at outlet	Parsons Brinckerhoff 2008

The existing Yorks Creek Diversion does not have any set detailed design criteria or objectives. This diversion was constructed in the late 1970s/early 1980s to facilitate mining of parts of the former Swamp Creek Mine (Ravensworth East). The existing Yorks Creek Diversion is geomorphologically stable. This diversion will be replaced by the Yorks Creek Realignment developed as part of the Project. The design objectives for the Yorks Creek Realignment are discussed below.

The Project does not impact on the existing Swamp Creek, Upper/Middle/Lower Bettys Creek Diversions. However the proposed landform changes associated with the Project will result in additional catchment reporting to the Lower Bettys Creek Diversion. The management and monitoring of existing diversions is set out in the Mount Owen Complex Creek Diversion Plan.

5.1.2 Yorks Creek realignment

The lower section of Yorks Creek requires realignment as part of the Project. The proposed conceptual realignment is shown in **Figure 3.8**.

The upper section of the Yorks Creek Realignment overlaps with the existing Yorks Creek Diversion adjacent to the Ravensworth East MIA. The proposed realignment will require the removal of the Ravensworth East MIA infrastructure and filling of sections of the existing Yorks Creek Diversion and extant creek to recreate a flood plain in this area.

A levee will be constructed at the southern end of the constructed flood plain to prevent inundation of the Glendell Pit Extension to the 0.1% annual exceedance probability flood event. Relatively minor changes to the final landform would be required to avoid any overtopping from a probable maximum flood (PMF) event in Bowmans Creek and this will be considered as part of the detailed mine closure planning process. The realignment will require a cutting through the ridgeline to the west of the current alignment where the creek will re-enter Bowmans Creek, approximately 4 km upstream from the current confluence. The channel of the realigned creek through the upper floodplain section will be constructed through fill material while the lower sections will be constructed into sedimentary bedrock material.

A set of design objectives have been established for the realignment. The objectives were based on a philosophy of maintaining environmental values, incorporating natural geomorphological forms and processes typical of the existing Yorks Creek or alternative regional reference reaches, achieving an acceptable degree of physical stability, minimising risks to downstream riverine environments and cost effectiveness. The design objectives include:

- minimise the risk of excessive erosion of the bed and bank in the realignment.
- maintain hydrological integrity of the flood and low flows from the upper reaches of Yorks Creek to Bowmans Creek.
- maintain sediment transport from the upper reaches of Yorks Creek to Bowmans Creek.
- provide habitat in the riparian zone for vegetation, aquatic invertebrates, fish, reptiles and mammals typical of the existing ephemeral system.

The Mount Owen Complex Creek Diversion Plan will be updated to include the final design details for the Yorks Creek Realignment.

5.1.3 Final landform drainage

The catchment areas developed as part of the detailed final landform design will have regard to licensing requirements under the *Water Management Act 2000*.

The following rehabilitation strategies will be applied to the development of final landform drainage:

- 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.
- drainage lines and constructed confluence points with natural drainage lines in the downstream landscape will have regard to the following principles:
    - ACARP hydraulic guidelines
    - the morphologic and hydraulic characteristics of existing creek lines surrounding the locality, and
    - designs and treatments of existing creek diversions surrounding the locality.

Confluence points of constructed drainage lines and existing drainage lines/creeks will have regard to changes in catchment size and the potential for the increased flow volumes to affect the geomorphic stability at the point of confluence and downstream.

Revegetation strategies for constructed drainage lines in the landscape will have regard to the proposed final land use and vegetation in analogous drainage lines in the surrounding landscape.

Where sediment dams are removed or altered as part of the return of rehabilitated catchment areas as clean catchment, the need for temporary sediment control measures to manage potential turbidity risks associated with disturbance from the removal/alteration of the sediment dam will be considered.

5.2 Decommissioning works

At the end of the proposed operational life Glencore 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 4.3).

As identified in **Section 2.1**, Glencore will develop a detailed Mine Closure Plan for the Project at least five years prior to the cessation of the Project and include consultation with a range of stakeholders including:

- Singleton Council
- DPIE
- NSW Resources Regulator
- other relevant government agencies, and
- local community.

The Mine Closure Plan will specifically address the major aspects of infrastructure decommissioning and rehabilitation and define the future rehabilitation care and maintenance requirements developed to achieve these criteria.

Detailed completion criteria will be developed for all infrastructure decommissioning based on the final land use identified for that area.

5.3 Rehabilitation of BSAL areas

Approximately 34 ha of verified BSAL will be disturbed as a result of the Project. Approximately 13 ha of this BSAL has been mapped as Land and Soil Capability Class 3 with the remaining 21 ha mapped as Class 4.

The construction of the proposed MIA, Heavy Vehicle Access Road and the realignment of Hebden Road proposed as part of the Project will either be permanent (Hebden Road) or are in place long term (>20 years) (MIA and Heavy Vehicle Access Road). The BSAL areas not impacted by either the Hebden Road realignment or areas where landform shaping is required for final landform development and/or drainage purposes will be rehabilitated to at least Land and Soil Capability Class 4 land (approximately 21 ha).

Topsoils from the BSAL areas directly impacted by the Project will be stripped prior to the construction of infrastructure. The need to also strip subsoils will be dependent on the nature of the activity proposed in the area of impact. The area between the Hebden Road realignment and the Heavy Vehicle Access Road which will contain a vegetated area to screen views of the Heavy vehicle Access Road and adjacent mining operations; will require minimal soil disturbance. Areas to be permanently impacted by the Hebden Road realignment will have both topsoils and subsoils stripped.

Some material stripped for the Heavy Vehicle Access Road and MIA can be used for bunding on the Hebden Roadside of the infrastructure. The use of the material as bunding also provides an effective means of stockpiling some of this topsoil material for the life of the Project. Excess stripped topsoil beyond available stockpile area capacity at the MIA will be relocated for use in ongoing mine rehabilitation at the Mount Owen Complex.

The reinstatement of the BSAL areas as Land and Soil Capability Class 4 land will be achieved through a combination of:

- during construction, soil stripping required for the Heavy Vehicle Access Road and MIA will have regard to maintaining as much soil material in-situ as practicable,
- some soil stripped from the BSAL area will be stockpiled or used for nearby roadside bunds and will be actively vegetated and managed to assist with maintaining soil characteristics throughout life of the Project,
- higher quality soil material (chromosols, dermosols and tenosols) obtained from areas along Yorks Creek stripped during the latter stages of the Glendell Pit Extension will be stockpiled for potential reinstatement in the areas to be rehabilitated to Class 4 if required, or otherwise used on mine rehabilitation areas,
- the amelioration of other soil resources obtained from on-site, and
- the use of imported soil resources if required.

Other than where the soil can be used as a vegetated bund, the long-term stockpiling of BSAL material for reinstatement following closure is not considered to be practical for a range of reasons, including:

- the additional area of disturbance associated with the stockpiling and management of the material would be considerable, and
- given the long period of stockpiling, there is a high likelihood that degradation of the soil chemical, physical and biodiversity values would occur such that significant amelioration and treatment would be required prior to reinstatement.

Soils from verified BSAL areas removed for construction purposes that cannot be used for vegetated bunding on the Heavy Vehicle Access Road and MIA will be preferentially used in the rehabilitation of areas of the Mount Owen Complex identified in the final landform for open grasslands, where practicable. This aspect of the Strategy will improve the quality of the growing medium in the areas of the final landform identified for potential grazing uses. This practice will reduce both the soil stockpile requirements and the need to rehandle the higher value soils, both of which have potential to degrade soil qualities and can result in the loss of soil material.

5.4 Management of biological resources for utilisation in rehabilitation

5.4.1 Seed collection and propagation

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

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.

5.4.2 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, including key threatened species.

5.4.3 Soil characterisation and topsoil management

Soil survey and testing (including soil structure, texture, pH, sodicity, cation exchange capacity and soil fertility) has been undertaken in support previous approvals at the Mount Owen Complex (Umwelt 2014, Umwelt 2018) and the EIS for the Project (Umwelt 2019b), to verify the soil types present and the actual Land and Soil Capability classes.

The majority of soils within the Additional Disturbance Area required for the Project are sodosols which have structural and chemical limitations. The chemical and physical properties of the subsoils associated with the sodosols and kandosols present within the Mount Owen Complex limit their ability to be used in the rehabilitation. 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 operations at Mount Owen Complex. A detailed topsoil (and subsoil) balance will be included in the RMP/MOP to determine the quantity of alternative growth mediums (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 RMP/MOP for the Mount Owen Complex.

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

- Material characterisation will be undertaken at an appropriate scale, prior to pre-stripping activities or the re-handling of long-term soil 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, soil identified as appropriate for use as a growing medium will be transferred directly from stripping location to areas that have been reshaped for rehabilitation, eliminating the need for storage and re-handling.
- Soil from verified BSAL areas that are not used for bunding will be preferentially used in the rehabilitation of areas of the Mount Owen Complex identified for open grasslands, where practicable.
- Where the stockpiling of soil is necessary due to the unavailability of shaped areas for direct-return, stockpiles should be generally less than 3 m high to retain biological activity within the soil.
- Stockpiles to be kept longer than 3 months should be sown with a suitable cover crop to minimise soil erosion and the invasion of weed species.

- Soil will be stripped using appropriate equipment (e.g. dozer or scraper) to the appropriate depths identified in the Agricultural Impact Assessments (Umwelt 2014c, Umwelt 2019b) or in accordance with the outcomes of further investigations undertaken as required. Indicative stripping depths for the different soil types identified within the Mount Owen Complex are provided in Table 5.2; these stripping depths may fluctuate due to further site specific constraints identified during the soil stripping process.
- Soil will be assessed and managed so that it can be appropriately re-applied in areas to be rehabilitated.
- Soil obtained from currently wooded areas should, where practicable, be preferentially applied to areas where similar vegetation communities are proposed in the final landform to maximise the seed bank values in the soil. This material can be mixed with mulched vegetation from the clearing activities.
- Higher quality soils stripped during the latter stages of the Project may be stockpiled for use in the rehabilitation of previously verified BSAL areas; this may necessitate longer stockpiling periods that may ordinarily be considered and active management of biological processes in these stockpiles should be considered. Additional soil material may need to be imported or other soils ameliorated to enable the Land and Soil Capability of these areas to be returned to Class 4 or better.
- Soil stockpiles should be located away from traffic areas and at an appropriate distance from watercourses and appropriate sediment controls should be installed around stockpiles.
- Weed growth will be monitored and subsequently controlled if necessary.
- Stockpiles should be appropriately identified to minimise the potential for inadvertent use or disturbance.

Table 5.2 Indicative soil stripping depth for the Project

Soil Type	Stripping Depth (mm)	
	Topsoil	Subsoil
Dermosol	100	Up to 300
Chromosol	150	Up to 500
Tenosol	150	Up to 750
Sodosol	150	Not suitable for rehabilitation
Kandosol	150	Not suitable for rehabilitation
Rudosol	150	Up to 500

5.5 Overburden and interburden handling

5.5.1 Management of potential geochemical constraints to rehabilitation

Environmental Geochemistry International Pty Ltd (EGi) have carried out three assessments (EGi 2013, EGi 2018 and EGi 2019) to assess the geochemical characteristics of coal, overburden, coarse rejects and tailings. In particular, the assessments looked at the potential for:

- acid rock drainage (ARD)
- salinity and elemental solubility (neutral mine drainage (NMD)), and
- sodicity.

The assessments identified potential geochemical issues and provided recommendations for materials management and follow up test work to ensure rehabilitation criteria can be met.

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 occasional thin zones (0.2-0.3 metres) containing elevated sulphur identified close to coal seams, dilution and mixing during mining should be sufficient to mitigate any ARD generation.

The final pit floor materials at the North Pit and Bayswater North Pit are likely to be NAF with possible portions of low capacity potential acid forming (PAF-LC) materials. The Glendell Pit Extension will involve mining to the base of the Hebden seam, with a stepped pit floor, consisting of two seams, Barrett 1 seam and the Hebden seam. Both seams are identified as being NAF and are unlikely to require any special management.

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.

The capping of tailings dams will need to have regard to the management of tailings derived from coal seams containing pyritic material where this is deposited near the top of tailings facilities; this is discussed further in **Section 5.6**.

5.5.2 Summary of ongoing management of 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 m 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.

5.5.3 Spontaneous combustion management

Based on the history of mining operations at Mount Owen Complex, it is considered that there is a low propensity for spontaneous combustion to occur within coal reject and overburden emplacement areas on site. Small areas of spontaneous combustion have been identified in emplacement areas developed by dragline operations in the former Ravensworth East mining area; no instances of spontaneous combustion has been observed in relation to more recent mining at the Mount Owen Complex using excavator/shovel mining techniques and is not anticipated from proposed future mining activities using these mining methods. However, the issue of spontaneous combustion and the potential liability for mine closure will continue to be evaluated and managed (if required).

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 storage facilities
- 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.

5.6 Natural landform establishment

Natural landform design in rehabilitation is the development of variability in the terrain and drainage lines similar to those in the surrounding natural landform; these design practices also reduce the need for graded drainage channels across slopes by developing drainage patterns and slopes in the landform having regard to rainfall patterns and soil chemical and physical constraints.

The use of natural landform design features will also be utilised to create terrain variability such that constructed landforms are consistent with the surrounding natural landform; the terrain variability also reduces the visual impact associated with mining.

Glencore has had significant success with the use of natural landform design in the rehabilitation undertaken at the Mount Owen Complex and other Hunter Valley operations including Mangoola Coal Mine, Ravensworth Operations and Liddell Coal Operations. The existing Rehabilitation Strategy requires that natural landform design techniques are applied to new areas of landform (outside final voids) developed under the Mount Owen Consent. Under the existing Rehabilitation Strategy, existing parts of the landform developed under previous consents where growing medium has already been spread and/or revegetation commenced will not be developed using natural landform techniques as this would further delay the rehabilitation of these areas. These commitments will also carry through to the areas of the former Glendell Consent and areas impacted by the Project with landforms developed as part of the Project (outside of the Glendell Pit Extension final void) reshaped using natural landform techniques however existing areas of landform developed as part of the existing operations will not be reshaped.

The landform design and shaping processes employed at the Mount Owen Complex will draw on experience from other operations utilising similar techniques.

5.7 Final voids

The proposed final landform at Mount Owen Complex will result in three final voids, one in the southern area of the North Pit, one in the former Bayswater North Pit and one in the northern section of the Glendell Pit Extension (refer to **Section 3.1**).

5.7.1 General final void rehabilitation considerations

5.7.1.1 Highwall management

As a general principal, highwalls retained in the final landform will be long term stable. This will require consideration of the geotechnical stability of the highwalls.

Analysis was undertaken by engineering consultants Pells Sullivan Meynink (PSM) (PSM 2017) and URS (URS 2017) to assess the geotechnical stability of the conceptual final void highwalls in North Pit and Bayswater North Pit respectively. Further geotechnical analysis was undertaken by PSM (PSM 2019) to assess the stability of the Glendell Pit Extension design. These studies are based of the current understanding of the geology and geotechnical conditions in the areas surrounding the voids. In the case of the Glendell Pit Extension, the studies also considered the geotechnical issues associated with the former Liddell underground workings. The conceptual mine design for mining areas at the Mount Owen Complex are based on the results of these geotechnical studies. The results of these geotechnical studies and their implications for the mine design are outlined below.

Further geotechnical studies will be undertaken as mining progresses towards the maximum extent of the relevant mining areas; these geotechnical studies will be used to inform any highwall treatments that may be required as mining progresses and the consideration of alternative land use options for final voids as part of the mine closure planning process.

5.7.1.2 North pit geotechnical assessment

The PSM (2017) assessment of the North Pit pit walls found that in regards to the stability of the pit walls, the geotechnical risk is low and that an acceptable stability criteria was achieved for all pit walls under design static scenarios. Other key findings of the assessment included the following:

- 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
- 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.

5.7.1.3 Bayswater north pit geotechnical assessment

The URS (2018 study of the Bayswater North Pit highwalls identified specific design parameters to improve the FoS and control the risks for the stability of the northern highwall. 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.

5.7.1.4 Glendell pit geotechnical assessment

A geotechnical assessment of the Glendell Pit Extension design, by PSM (2019), has identified no significant highwall stability risks for the northern and eastern highwalls of the final void, and that a FoS of greater or equal to 1.2 is achievable.

The western highwall occurs within the Block Fault Zone, a regional "horst and graben" type structure comprising a series of alternating raised and lowered blocks across the fault zone. The Block Fault Zone has been intersected in several mining operations, including in the Bayswater North Pit and at Ravensworth Operations. Geotechnical drilling and testing was undertaken at the proposed western highwall location, and analysis of this data, in conjunction with hydrological considerations and data from previous Block Fault Zone interactions, was undertaken by PSM to inform the western highwall slope design. The analysis indicates that a FoS of 1.5 is achievable for the western highwall through the implementation of an appropriate slope design that will result in a safe and stable final void.

A final void will remain at the northern extent of the Glendell Pit Extension with the southern low wall battered to slopes of up to approximately 18°. A highwall will be maintained around the western, northern and eastern edges of the final void with the overburden emplacement to the east of the final void battered to between approximately 14 ° and 18 °.

5.7.1.5 Rehabilitation of highwall areas

If no alternative land uses area identified, the conceptual final land use plan for the Mount Owen Complex includes the revegetation of highwall benches with native vegetation and the use of highwall landform treatments to reduce the linearity/angularity of the highwalls in the final landform.

Vehicle and machinery access to the battered internal void areas will be required until appropriately stabilised. In some areas, 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/angularity 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 (Department of Mineral Resources 1999) (refer to **Section 2.2.3**). Figures 20 to 22, 28 and 29 from the Synoptic Plan are extracted below in **Figure 5.1** and **Figure 5.2**, illustrating the variability in terrain that can be developed through selective blasting and battering of sections of retained highwalls.

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 overall drainage design for final voids, and in particular low walls, will have regard to erosion control. The need for ongoing post-mining maintenance of drainage structures will be assessed and appropriate measures will be included within the Mine Closure Plan.

Groundwater and pit lake recovery modelling will be undertaken as part of the mine closure process. This modelling will update groundwater modelling predictions and evaluate the long term pit lake hydrochemistry and water levels post closure; this modelling will also be used to inform potential alternative land uses that may be suitable for the site.

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

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

Highwall bench prior to rehabilitation

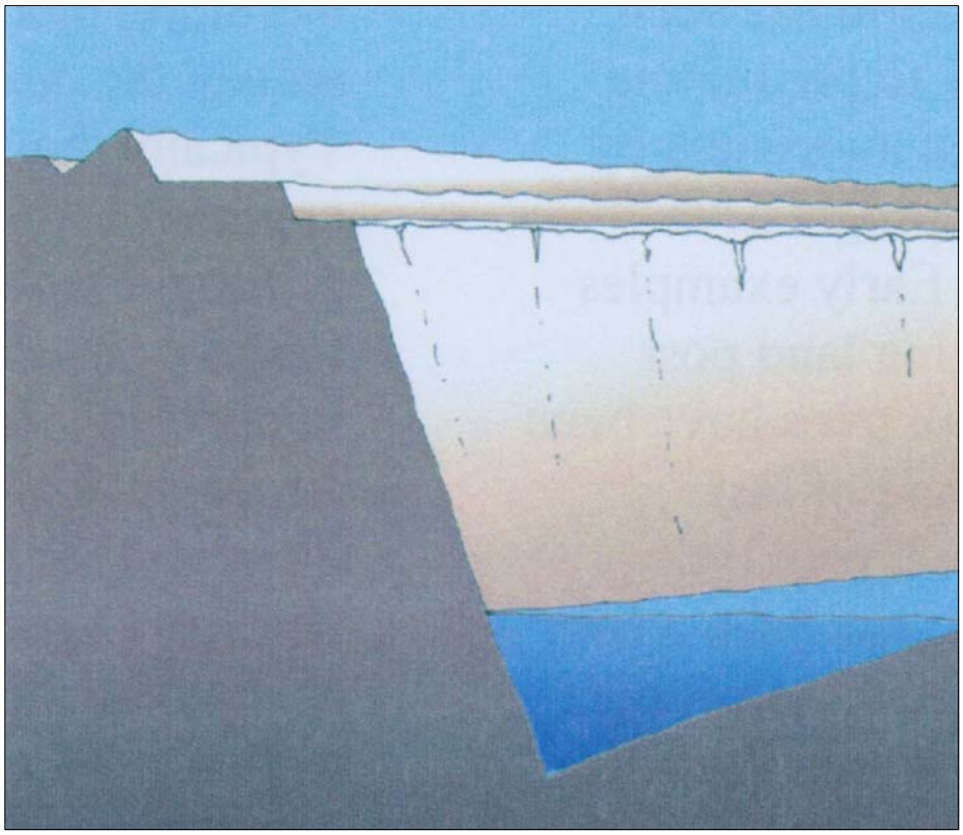
Blasting of highwall bench/crest

Partially filled void from onsite drainage

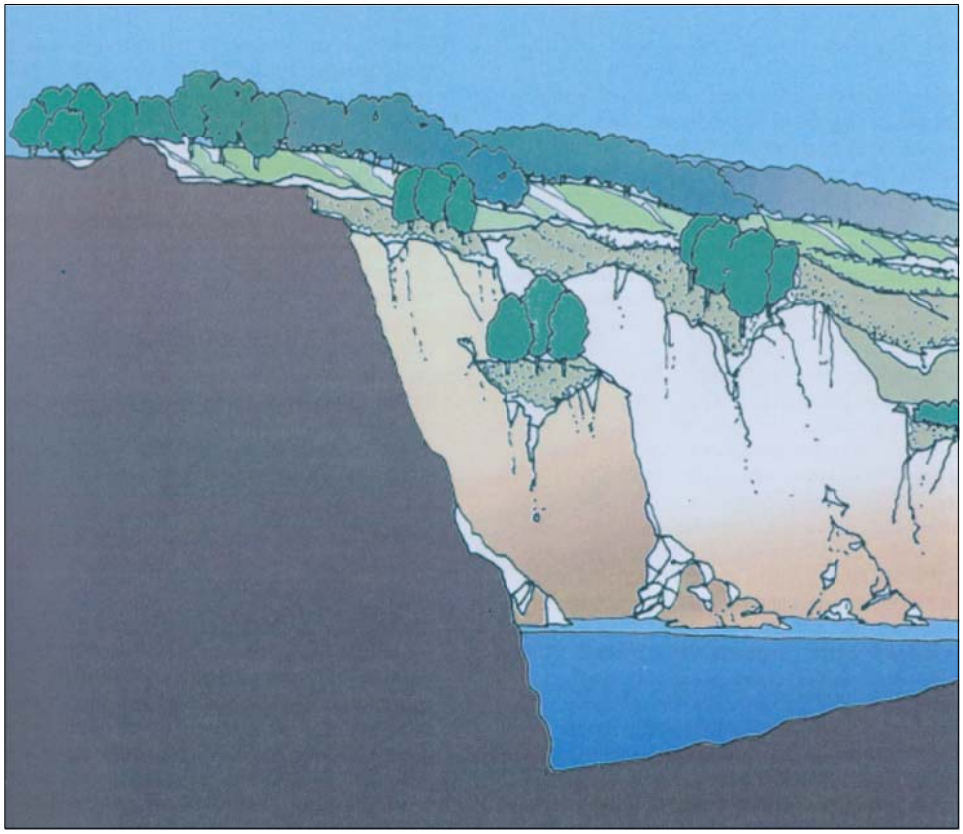
FIGURE 5.1

Example of Highwall Treatments Demonstrated in the Synoptic Plan

Image Source: Andrews, Neil (1999)



Before



Highwall rehabilitation blasting

FIGURE 5.2

Examples of Highwall Rehabilitation Blasting Treatment Demonstrated in the Synoptic Plan

Image Source: Andrews, Neil (1999)

5.7.1.6 Void design process

In consideration of the above for all remaining voids, the key design features and processes associated with the final voids, to minimise public safety and long-term stability issues are set out below. The design features for the North Pit and Bayswater North Pit voids are the same as currently identified in the approved Rehabilitation Strategy under the Mount Owen Consent. Should these voids be used for tailings emplacement, the design features will need to be reviewed.

The general rehabilitation principles to be applied to the final voids are set out below:

- 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.
- The detailed design of the drainage on the low wall and highwalls in the final landform will be defined in the RMP/MOP 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 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 native vegetation generally consistent with the remainder of the rehabilitated landform. Internal void slopes will be progressively topsoiled and/or vegetated as the final landform slopes are established (i.e. rehabilitation will commence as the final landform slopes are established).
- Spontaneous combustion and external ignition risks (e.g. bushfires) will be considered in the design of highwalls.

5.8 Coarse reject and tailings storage facility decommissioning

5.8.1 Tailings storage facility decommissioning

The tailings storage facilities will be filled and shaped to the final landform for that domain as identified in the RMP/MOP 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.

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 and management of the tailings storage facilities. The utilisation of other voids in the GRAWTS also enables the rate of tailings deposition to be managed to improve the drying and settling of tailings facilities. The aim of the GRAWTS and dewatering strategy will be to progressively dewater the tailings storage facilities 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 storage facilities will be managed to enable finalisation of capping and rehabilitation following the cessation of active mining.

Analysis undertaken by EGi (2013, 2018 and 2019) to assess the ARD potential of materials handled at the Mount Owen Complex identified that the vast majority of tailings represented by the samples collected are expected to be NAF with excess ANC and are not expected to require special handling. However, as the tailings are not mixed with neutralising materials, spigotting can result in preferential deposition and concentration of pyritic materials, potentially resulting in PAF zones. Where these PAF zones occur close to the surface, the capping design will need to have regard to this.

A detailed capping design will be completed for tailings storage facilities as part of final rehabilitation design that has regard to the properties of the consolidated tailings and capping materials. The detailed capping design will be contained in the RMP/MOP.

5.8.2 Coarse rejects

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 5.5.1**, analysis was undertaken by EGi to assess the geochemical constraints and identify potential measures required for materials management and follow-up test work required. This analysis identified that the vast majority of 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 with overburden 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 ARD indicated by testing to date, with particular focus on rejects from the Pikes Gully, Liddell and Hebden seam groups.

5.9 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 Mount Owen Complex 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 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.

Biosolids and other organic matter- rich substrate materials/supplements will be used where these are considered to provide benefits for rehabilitation outcomes. The use of biosolids will be subject to appropriate approvals being obtained and quality criteria being satisfied.

Stripped soils containing potential seed bank material consistent with target revegetation communities will be prioritised, where practicable, for use in areas where similar vegetation are proposed in the final landform.

5.10 Revegetation program

5.10.1 Existing rehabilitation processes and performance

Relevant to the end land uses and conceptual final landform identified in **Section 3.2** and **3.3**, several forms of ecological rehabilitation and restoration have been undertaken to date in former mining disturbance areas 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.

At least 2,037 ha of disturbed land within the existing Mount Owen Consent Boundary is to be returned to native woodland ecosystems characteristic of vegetation communities found in the local area. Under the Mount Owen Consent, 518 ha of this rehabilitation is to be set aside for long term conservation as an offset measure for the approved operations. The Glendell Consent requires at least 250 ha of treed vegetation in the rehabilitated landform. The revegetation strategy for the approved Mount Owen Complex has generally been designed to improve regional habitat connectivity and provide linkages between offset areas and Ravensworth State Forest.

In addition to the above, Glencore has experience at other mining operations in the Hunter Valley with ecological and agricultural land reestablishment and natural landform rehabilitation practices. This experience, together with shared experiences and research from other mining operations in Australia and overseas, has been used in the development of this Strategy. This Strategy has been designed to build off the success of existing techniques and learnings derived from previous monitoring and research activities and to remain adaptive to include new measures and research outcomes aimed at continual improvement. This Strategy also extends the use of these rehabilitation practices to the areas impacted by the Project.

Ongoing and future research at the Mount Owen Complex and other operations will continue to be used to inform the rehabilitation processes at the Mount Owen Complex with updates to this Strategy being undertaken as necessary. The following sections briefly outline the key rehabilitation processes used to inform the Strategy.

5.10.1.1 Native vegetation areas

Previous and current mine rehabilitation practices on mine spoil targeted at being rehabilitated to native vegetation communities have involved direct seeding with canopy species. Forest topsoil and woody mulch from areas cleared by mining in the North Pit has been used on a large portion of existing rehabilitation and has also provided a valuable seed source.

In the absence of forest topsoil, pasture topsoil has been used as a replacement and planted with tubestock. Tubestock and direct and aerial seeding have been used in the Mount Owen Complex rehabilitation areas.

A range of fauna impact mitigation and management measures have been implemented at Mount Owen Complex. These measures include habitat augmentation practices, such as the installation of nest boxes and rock/boulder features to compensate for the loss of hollow-bearing trees and other habitat features as a result of approved mining operations. Two green and golden bell frog habitat conservation zones have also been constructed at the Mount Owen Complex, including within biodiversity offset areas and within mine rehabilitation areas.

The overall strategy for rehabilitation 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. The research has included over 40 experiments and investigations. Mount Owen is now listed as a 'Highly Commended' site on the Global Restoration Network of the Society for Ecosystem Restoration, International.

Glencore has also participated in several Australian Coal Association Research Program (ACARP) projects on mine site rehabilitation in collaboration with the University of Newcastle. This includes 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*)
- 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.

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.

5.10.1.2 Open grassland areas

The rehabilitation of disturbed areas to open grassland communities has primarily been limited to the eastern slopes of the Glendell emplacement area. This rehabilitation is generally progressing well and is easier to establish and maintain then native vegetation areas. During the extended drought over the 2017 to present period, these open grassland areas haven proven to be resilient to the drier conditions. As these areas are currently located in close proximity to active mining operations, they have not yet been grazed.

Grazing trials undertaken on rehabilitation at other mining operations in the Hunter Valley using similar rehabilitation techniques have demonstrated that the successful recreation of grazing areas in rehabilitated areas is possible (Griffiths & Rose 2018).

5.10.2 Vegetation establishment

Rehabilitation of post-mining areas will be completed as soon as practicable after shaped areas become available. The indicative sequence for progressive rehabilitation is shown in **Figure 3.1** to **Figure 3.4.** 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
- 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 more than 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 vegetation and open grassland are discussed below.

The rehabilitation strategy involves the establishment of native vegetation corridors to promote regional fauna movements across the landscape (refer to **Figure 3.8**). 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 3.2.1** and **3.3**).

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. The inundation of this vegetation as pit lake levels rise will assist in creating a diversity of aquatic habitat within the pit lakes. Based on the modelled recovery times, many of the trees within these areas will be large and very mature prior to inundation.

Subject to ultimate final land use constraints, areas identified for open grassland (refer to **Section 3.2**) will also be considered for additional native vegetation 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.

5.10.2.1 Native vegetation

Rehabilitated native vegetation areas will be created to contain flora species assemblages characteristic of the dominant vegetation communities impacted at the Mount Owen Complex. Revegetation of the post-mining landscape, including native vegetation areas will primarily focus on establishing vegetation that is consistent with the Central Hunter Ironbark – Spotted Gum – Grey Box Forest vegetation and the Central Hunter Grey Box – Ironbark Woodland however other vegetation communities also found in the local area will be targeted in appropriate locations including riparian areas (refer to **Section 5.10.2.2**)

The aim of having species consistent with these vegetation communities is to ensure endemic species are placed on the rehabilitation areas consistent with that found in the surrounding landform and being developed as part of other mine sites proposed final land use objectives. This ensures rehabilitation is complementary of the proposed rehabilitation at the adjacent Glencore operated Ravensworth Operations and Liddell Coal Operations while enhancing regional habitat connectivity.

At least 2,037 ha of self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area, must be established as per the Mount Owen Consent. 518 ha of this rehabilitation established as per the Mount Owen Consent must meet the EEC listing for the Central Hunter Ironbark – Spotted Gum - Grey Box Forest EEC and is to be permanently conserved as part of the biodiversity offset commitments under the Mount Owen Consent.

5.10.2.2 Riparian vegetation

Glencore intends to establish areas of self-sustaining riparian habitat within any diverted and/or re-established creek lines and retained water features. Riparian vegetation works will involve the revegetation with native species whilst incorporating structures for aquatic habitat such as persistent pools and woody debris.

The establishment of riparian vegetation will be in line with final landform drainage, achieve long term geomorphic stability and minimise erosion. Revegetation of the post-mining landscape, including riparian areas will focus on establishing vegetation that is consistent with the endemic vegetation community type within each local drainage system.

5.10.2.3 Revegetation species and seed collection

A list of the key species contained in the target vegetation communities is contained in **Appendix B**. This species list is based on seed availability for species comprising the Central Hunter Ironbark – Spotted Gum Grey Box Forest as previously utilised at Mount Owen Complex. The species list used for other communities is based on planting lists used at other operations in the Hunter Valley.

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), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Corymbia maculata* (Spotted Gum) are examples of selectively planted native species that will address the listing criteria for the Central Hunter Ironbark – Spotted Gum Grey Box Forest and the Central Hunter Grey Box – Ironbark Woodland , while also providing suitable habitat and foraging resources for a number of the species listed above including the Koala, Swift Parrot and Regent Honeyeater. The establishment of functioning vegetation communities (and in the case of the Green and Golden Frog – dams and grassland areas) will provide appropriate foraging habitat (as well as other habitat values) for the above (and other) native species.

Due to seasonal variability, it is not realistic, nor appropriate for the direct seeding mix or tube stock composition to include all of the species in the target vegetation community. Initial seed mixes used will have regard to natural succession processes (refer to **Figure 5.3**) with the focus on establishing grasses and pioneer species during the establishment phases. The seed mix should 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 target community species 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 native vegetation and previously established native vegetation areas.

Revegetation will involve the use of local provenance seed that will either be utilised for direct or aerial seeding or for the propagation of tubestock for planting. Vegetation propagation may also be used for some species where appropriate. 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.

Infill planting and latter successional phase species establishment will use a combination of direct and aerial seeding and the planting of tubestock.

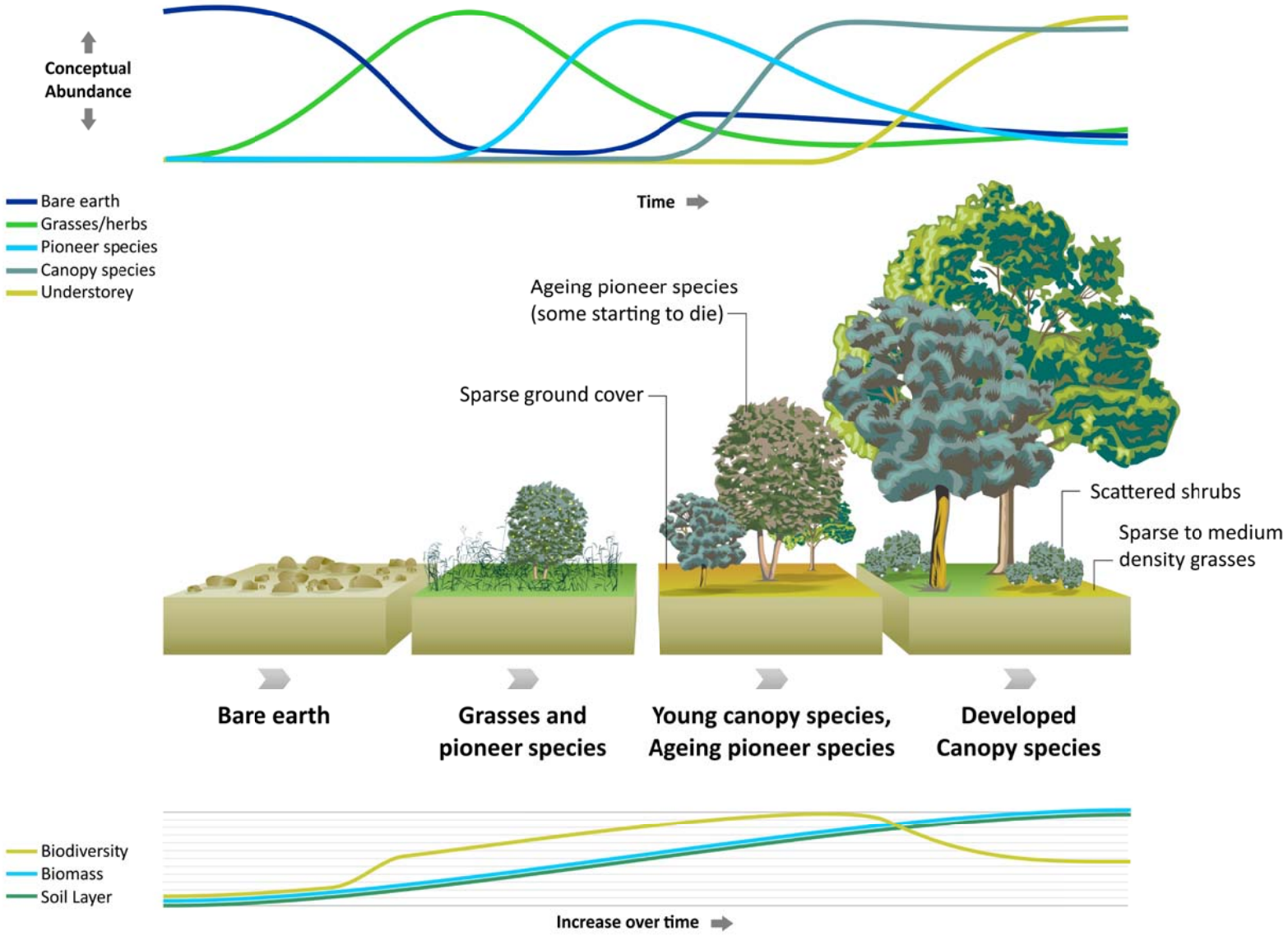


FIGURE 5.3

Succession Processes in Native Vegetation Communities

5.10.3 Establishment of agricultural areas

The establishment of native vegetation corridor areas does not preclude the ability to re-establish land for agricultural purposes. As shown in **Figure 3.8**, the conceptual post mining land use design includes the establishment of areas for potential future sustainable agricultural purposes such as grazing in the flatter portions of mine rehabilitation. 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.

The revegetation and establishment of grazing areas will be consistent with local agricultural practices. Revegetation will likely 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.

To promote agricultural activity as a post mining landscape, as described in **Section 2.2.4**, soils recovered from verified BSAL areas will be utilised in rehabilitation for open grassland, where practicable. Areas of open grassland where grazing has been identified as a potential find land use will be rehabilitated to a minimum of Land and Soil Capability Class 6. Areas of grassland rehabilitation at Glendell will have a nominal Land and Soil Capability Class 6. Approximately 21 ha of verified BSAL will be rehabilitated to a minimum of Land and Soil Capability Class 4.

5.11 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 ensure 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
- 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 Mount Owen Complex has satisfied the completion 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.

5.12 Proposed rehabilitation sign-off process

Based on the outcomes of the rehabilitation monitoring programs and in consultation with the relevant government agencies, the Proponent will 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.

Where ongoing monitoring indicates a high degree of confidence that revegetated areas are meeting certain benchmarks and will continue to transition towards fully functioning communities (based on experience at other areas of rehabilitation at the Mount Owen Complex and/or appropriate analogous sites in the Hunter Valley that have been assessed as being appropriately rehabilitated), rehabilitation sign-off criteria may be revised to enable sign-off at an earlier stage in the succession process.

Any such application of revised criteria would be based on the monitoring of early successional phases and evidence to provide a high degree of confidence that appropriate ecosystem function processes were occurring in the areas to be signed-off.

6.0 Proposed rehabilitation monitoring

Rehabilitation monitoring will be undertaken in accordance with Glencore standards and associated reporting requirements. 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 completion 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 completion criteria or there is a high degree of confidence that the vegetation in the rehabilitated area is on a successional pathway that will achieve completion 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.

6.1 Active mining records

During active mining operations, records of mining activities and processes that may impact upon the rehabilitation and closure of the site will be maintained. 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, 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.

6.2 Rehabilitation methodology

Details of each rehabilitation campaign will be recorded so that they are available for later interpretation of rehabilitation monitoring results with the aim of continually improving rehabilitation standards. The key parameters to be recorded include:

- 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).

6.3 Rehabilitation inspections

At the completion of each rehabilitation campaign, an initial establishment inspection will be conducted within six 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/MOP 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 Mount Owen Complex to 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 5.10**) and will be reviewed and revised as conditions at Mount Owen Complex change or new threats are identified.

6.4 Monitoring rehabilitation performances against objectives and completion 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 completion criteria having regard to expected successional processes. Information from this monitoring program will also be used to refine completion criteria as required.

To ensure these design principles for creek diversions are adhered to, the monitoring and management program will be designed to identify any water quality, ecological, hydrological or geomorphological deficiencies during the construction, establishment, and development and relinquishment phases of the diversion. Where the success of the program has been impacted by other factors such as the physical and chemical constraints of the site soils, the continued stability and establishment of vegetation for the diversions will be ensured through the ongoing creek diversion monitoring program in which any remediation requirements will be identified and implemented.

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. > three years). The exact scope of the long-term rehabilitation monitoring program and creek diversion monitoring will be refined through the RMP/MOP and Creek Diversion Plan, respectively.

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 completion criteria.

For areas to be returned to agricultural use, a rehabilitation monitoring program will be developed to assess performance against appropriate objectives and criteria. This criteria includes comparisons with analogue sites such as ground cover is in the range of analogue sites at Year 10, presence of weeds and management required to maintain vegetation health (such as fertiliser) is similar. Other criteria include no significant erosion present, at least 75% of species a suitable for grazing, grazing areas assessed to have a Land and Soil Capability of Class 6 or better and pasture production is comparable to similarly managed analogue site yields within five years. 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 RMP/MOP.

7.0 Accountabilities and implementation of the strategy

Specific responsibilities and appropriate resources for the implementation of the Strategy will be detailed within the RMP/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.

8.0 References

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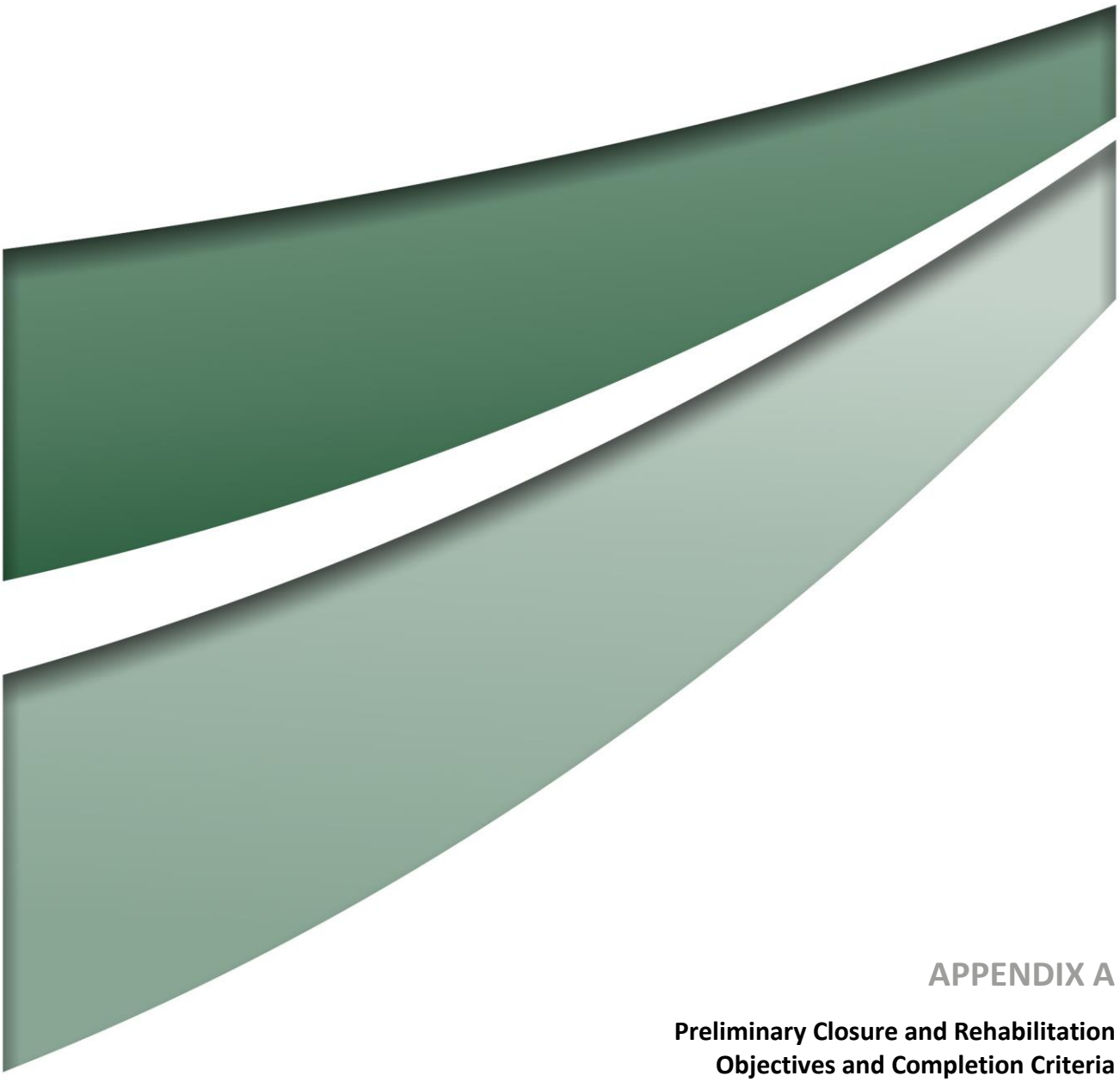


APPENDIX A

Preliminary Closure and Rehabilitation Objectives and Completion Criteria

Table A Preliminary Closure and Rehabilitation Objectives and Completion Criteria

Aspect	Objective	Preliminary Completion 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 has been removed, unless such removal has a greater environmental impact than rehabilitating the area with the infrastructure remaining in place. • All demolition work has been carried out in accordance with AS2601-2001: The Demolition of Structures or its latest version. • Services: all services are disconnected, and infrastructure removed (or marked on plans where left in-situ by agreement with the Resources Regulator and/or landholder). • Mount Owen CHPP and associated infrastructure: removal of the CHPP, footings and all associated conveyors and structures (unless required for future approved uses). • Rail provisioning facility, train loading system and rail loop: removal of all infrastructure, rail provisioning facility, train loading system and rail loop, including ballast material, should a suitable alternate future use for the rail infrastructure not be identified. • Offices and workshops: demolition and removal of all offices and workshop related facilities including refuelling facilities. • All pumps and associated water management infrastructure which does not have a potential future use associated with the post mining land use has been removed, unless such removal has a greater environmental impact than rehabilitating the area with the infrastructure remaining in place. All tailings infrastructure (pipelines, pumps and related infrastructure) has been decommissioned and removed. • Sediments accumulated in mine water and sediment dams is removed from the dam floor and emplaced or capped in-situ as documented by records. This material will be buried under a minimum of 2 m on inert overburden material. • Lay down areas: All plant and equipment has been removed. • All groundwater monitoring bores not required for long term monitoring have been decommissioned, and sealed in accordance with EDG01 – Borehole Sealing Requirements on Land. • All drill holes (and excavations that remain abandoned from previous mining or exploration), have been backfilled and, in the case of boreholes, sealed in accordance with EDG01 – Borehole Sealing Requirements on Land.

Aspect	Objective	Preliminary Completion Criteria
	All infrastructure that is to remain as part of the future land use is made safe.	• Potential hazards (i.e. electrical, mechanical etc.) have been effectively isolated. • Where underground pipelines or other services 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. • 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 or requires ongoing remediation.	• Hazardous materials have been identified and removed from site including hydrocarbons, chemicals, explosive products, asbestos containing materials (ACMs), lead paints, synthetic mineral fibres (SMFs) and polychlorinated biphenyls (PCBs) (verified by Certificates of disposal) • A contamination assessment for infrastructure exposed to contaminants including the CHPP, workshops and rail loader has been undertaken prior to demolition. • 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. • Monitoring records verify that there is no evidence of active spontaneous combustion. • Net acid generating materials has been capped by a minimum of 5 m of inert material. • Surface layer is free of any hazardous materials.
Final Landform	Landform suitable for final land use and compatible with surrounding landscape as sustainable native ecosystems.	• Rehabilitated slopes (excluding retained sections of the highwall and the low wall within the final void) are generally an average of up to 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 or waterway designs (i.e. if concave profiles are utilised or steeper slopes associated with watercourse/streamflow development and management are required), slope angles may exceed this criteria to achieve an appropriate landform design. • Low walls are graded (where required) to less than 18 degrees unless otherwise agreed with the Resources Regulator. • 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.

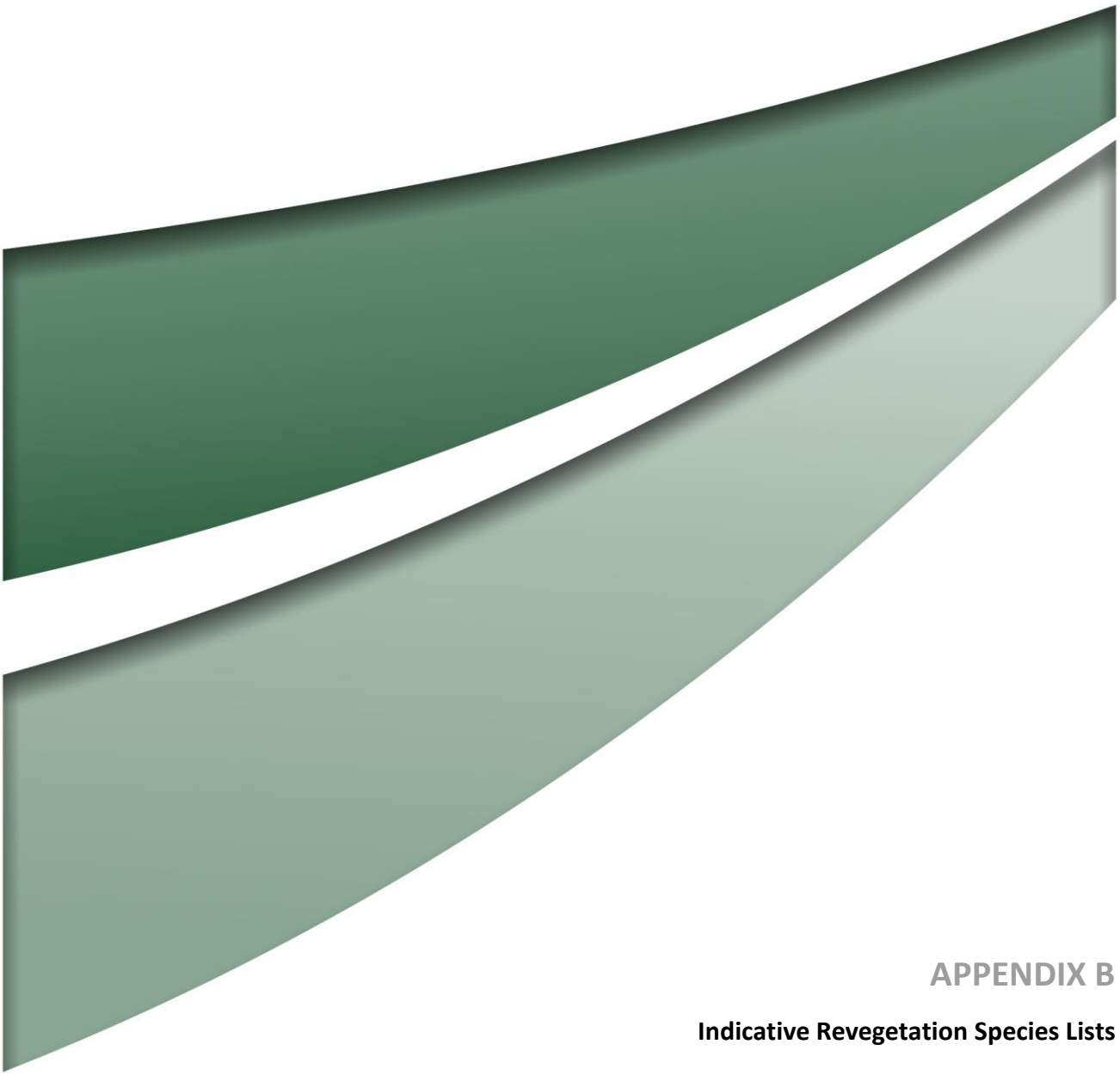
Aspect	Objective	Preliminary Completion Criteria

		• Landform survey verifies constructed landform is generally in accordance with the approved landform design including approximate approved heights of:
		  ○ WOOP emplacement area: 190 mAHD
		  ○ Glendell emplacement area: 200 mAHD
		  ○ Ravensworth East emplacement area: 185 mAHD
		  ○ Mount Owen emplacement area: 230 mAHD
		• There is no evidence of slumping or uncontrolled erosion that would cause a safety issue or compromise the land capability.
		• Monitoring verifies there are no gully or tunnel erosion features, or rill erosion >200 mm deep.
		• Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping (beyond design specification), active gully heads, tunnel erosion, bank erosion 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 seepage into weathered zones.
		• Tailings storage facilities have been capped in accordance with an approved detailed capping design.
		• Capped tailings storage facilities are confirmed by survey to be free draining following the expected settlement period.
		• Where practicable, exposed carbonaceous material have been removed and co-disposed within the overburden emplacement areas or suitably capped in situ.
		• 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.
		• The final landform design has regard to potential habitat resources suitable for significant and/or threatened species.
		• Sufficient water licences are held to account for net take from water systems covered by licensing requirements or can be obtained prior to modelled take occurring.

Aspect	Objective	Preliminary Completion Criteria
Highwalls	Highwalls are safe and stable and do not represent a risk to the long term future potential uses of the final void or final landform	• Retained highwalls to be designed to achieve long-term geotechnical stability by a suitably qualified person. • Designs of retained highwalls are to consider stabilising design features such as intermediate benches and batter angles specific to the long-term stability of interburden materials present in the highwall. • Retained highwalls are to include appropriate safety features such as a safety berm and/or security fence constructed at the void crest that provides an adequate long-term engineered barrier for vehicles and livestock. • Surface drainage is to be directed away from the top of the retained highwall, unless the highwall is designed to convey surface water into the void.
Sustainable Native Vegetation	Landform suitable for final land use and compatible with surrounding landscape as sustainable native vegetation ecosystem	• Rehabilitation monitoring verifies the following: ○ more than 75% of trees are healthy and growing as indicated by rehabilitation monitoring. ○ species diversity for each stratum (canopy, mid storey and ground cover) is comparable to analogue sites. ○ second generation tree seedlings are present or likely to be, based on monitoring in comparable older rehabilitation sites. ○ Habitat features such as woody debris and water bodies are incorporated into native rehabilitation areas comparable with analogue sites. ○ Weed species and density are comparable to analogue sites. • Native vegetation areas are compatible with adjacent rehabilitation areas and in line with the objectives of the Synoptic Plan (Department of Mineral Resources 1999).
Sustainable Agriculture	Landform suitable for final land use and compatible with surrounding landscape as sustainable agriculture ecosystem	• Areas identified for open grassland land use are assessed to have a Land and Soil Capability Class of 6 or better. • Areas of verified BSAL (refer to Project EIS) identified for grazing land use are assessed to have a Land and Soil Capability Class of 4 or better. • Pasture production is trending comparable to similarly managed analogue sites. • Rehabilitation monitoring has verified succession through second-generation pasture plants and/or vegetative propagation (e.g. runners) of established perennial species. • No significant erosion is present that poses a safety hazard. • At least 75% of species monitored consist of grasses and legumes appropriate to sustainable agricultural practices in the local area. • Weed species and density are comparable to analogue sites.

Aspect	Objective	Preliminary Completion Criteria
Final Void	Designed as long-term groundwater sinks to prevent the release of saline water into the surrounding environment, unless further mine planning and final landform design processes identify a more suitable outcome for the final voids Minimise to the greatest extent practicable: • Highwall slopes (excluding slopes below the post-mining standing water level) • size and depth of final voids • the drainage catchment of final voids • any high wall instability risk, and • the risk of flood interaction for all flood events up to and including the Probable Maximum Flood	• Final voids are developed and rehabilitated in accordance with the detailed Mine Closure Plan. • 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. • Modelling of final void design indicates projected water quality and pit lakes are consistent with EIS predictions (refer to Section 5.4.1) and /or appropriate for approved final land uses. • Final voids are designed to avoid potential for flood ingress up to and including the 1 in 1000 year ARI events.. • Retained highwalls and internal final void batter slopes have been assessed by a suitably qualified person to validate that they are stable and do not pose a safety risk. • Final void upper benches vegetated with a mixture of native species of varied heights.
Constructed Water Courses and Creek Diversions	Constructed water courses are hydraulically and geomorphologically stable and incorporate structures for aquatic habitat.	• Constructed water courses include suitable natural and engineered structures to aid erosion control and provide aquatic habitat appropriate for the creek line and its location in the terrain. • Creek diversions are assessed to be 'stable' as defined by the CSIRO Ephemeral Stream Assessment. • Creek diversions are constructed in accordance with the relevant approved detailed designs and are performing consistent with design specifications. • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping (beyond design specifications), active gully heads, tunnel erosion, bank failure or significant scouring as a result of runoff.

Aspect	Objective	Preliminary Completion 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). • 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.	• Within the Mount Owen Consent Boundary, restore at least 2,037 ha of self-sustaining native woodland ecosystems characteristic of vegetation communities found in the local area, including at least 518 ha of woodland which conforms to the Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC. • 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% 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 native vegetation areas provide a range of vegetation structural habitats (e.g. trees, shrubs, ground cover, developing litter layer, etc.) to encourage use by native fauna species.
Socio-economic Impacts and Public Safety	Minimise Socio-economic impacts	• Mine Closure Plan has been implemented. • A public safety risk assessment has be completed with all identified actions implemented and closed out. • Hazardous materials have been identified and removed from site including hydrocarbons, chemicals, explosive products, asbestos containing materials (ACMs), lead paints, synthetic mineral fibres (SMFs) and polychlorinated biphenyls (PCBs) (verified by Certificates of disposal). • Final landform design and final land use has had regard to regional and local strategic planning objectives and considers potential socio-economic impacts associated with closure including options for minimising socio-economic impacts associated with closure.



APPENDIX B

Indicative Revegetation Species Lists

Table B.1 Indicative Species List for Central Hunter Ironbark – Spotted Gum – Grey Box Forest

Scientific Name	Common Name	Plant Form
Eucalyptus blakelyi	Blakely's red gum	Tree
Eucalyptus crebra	Narrow-leaved iron bark	Tree
Eucalyptus moluccana	Grey box	Tree
Corymbia maculata	Spotted gum	Tree
Cassinia quinquefaria	Sifton bush	Shrub
Olearia elliptica	Sticky daisy bush	Shrub
Ozothamnus diosmifolius	White dogwood	Shrub
Daviesia ulicifolia	Gorse bitter pea	Shrub
Pultenaea spinosa	Spiny bush-pea	Shrub
Acacia falcata	Sickle wattle	Shrub
Acacia parvipinnula	Silver-stemmed wattle	Shrub
Sida corrugata/subspicata	Sida	Shrub
Bursaria spinosa subsp. spinosa	Blackthorn	Shrub
Dodonaea viscosa	Sticky hop-bush	Shrub
Hardenbergia violacea	False sarsaparilla	Climber
Calotis cuneifolia	Purple burr-daisy	Ground cover
Chrysocephalum apiculatum/semipapposum	Yellow buttons	Ground cover
Vernonia cinerea	-	Ground cover
Vittadinia cervicularis/cuneata/sulcata	Fuzzweed	Ground cover
Wahlenbergia communis/gracilis	Bluebell	Ground cover
Einadia hastata/nutans	Saltbush	Ground cover
Dichondra repens	Kidney weed	Ground cover
Lepidosperma laterale	Variable saw- sedge	Ground cover
Desmodium varians	Slender tick-trefoil	Ground cover
Hardenbergia violacea	False sarsaparilla	Ground cover
Lomandra filiformis subsp. filiformis	Wattle matt-rush	Ground cover
Lomandra multiflora subsp. multiflora	Many-flowered mat-rush	Ground cover
Eremopmop hila debilis	Amulla	Ground cover
Dianella caerulea var. caerulea	Blue-flax-lily	Ground cover
Aristida ramosa/vagans	Wiregrass	Ground cover
Austrostipa scabra var. scabra	Speargrass	Ground cover
Austrodanthonia fulva/richardsonii	Wallaby grass	Ground cover
Bothriochloa decipiens/macra	Redgrass	Ground cover
Chloris ventricosa/truncata	Chloris	Ground cover
Cymbopogon refractus	Barbed wire grass	Ground cover
Cynodon dactylon	Common couch	Ground cover
Dichanthium sericeum	Queensland bluegrass	Ground cover

Scientific Name	Common Name	Plant Form
Digitaria diffusa	Open summer- Grass	Ground cover
Echinopogon caespitosus	Bushy hedgehog- grass	Ground cover
Entolasia stricta	Wiry panic	Ground cover
Eragrostis brownii/leptostachya	Lovegrass	Ground cover
Sporobolus creber	Slender rats tail grass	Ground cover
Themeda australis	Kangaroo grass	Ground cover

The seeding list is a combination of species from this list that are known to germinate successfully from seed. Not all species listed are a part of the seeding list.

Table B.2 Indicative Species List for Central Hunter Grey Box – Ironbark Woodland Ironbark – Spotted Gum – Grey Box Forest

Species	Common Name	Type
Angophora floribunda	Rough-barked apple	Tree
Brachychiton populneus	Kurrajong	Tree
Corymbia maculata	Spotted gum	Tree
Eucalyptus blakelyi	Blakely's red gum	Tree
Eucalyptus crebra	Narrow-leaved ironbark	Tree
Eucalyptus moluccana	Grey box	Tree
Eucalyptus tereticornis	Forest red gum	Tree
Acacia implexa	Hickory wattle	Low tree
Acacia salicina	Sally wattle	Low tree
Allocasuarina littoralis	Black she-oak	Low tree
Allocasuarina luehmannii	Bulloak	Low tree
Acacia amblygona	Fan wattle	Shrub
Acacia decora	Western silver wattle	Shrub
Acacia decurrens	Green wattle	Shrub
Acacia falcata	Sickle wattle	Shrub
Acacia paradoxa	Kangaroo thorn	Shrub
Bursaria spinosa	Blackthorn	Shrub
Dodonaea viscosa	Sticky hop-bush	Shrub
Hardenbergia violacea	False sarsaparilla	Ground cover/climber
Bothriochloa decipiens	Red grass	Ground cover
Chloris ventricosa	Windmill grass	Ground cover
Eremophila debilis	Amulla	Ground cover
Lomandra filiformis or multiflora	Many-flowered mat rush	Ground cover
Microlaena stipoides	Weeping grass	Ground cover

The seeding list is a combination of species from this list that are known to germinate successfully from seed. Not all species listed are a part of the seeding list.

Table B.3 Indicative Riparian Vegetation Seeding List

Species		Type
Angophora floribunda	Rough-barked apple	Tree
Casuarina glauca	Swamp oak	Tree
Eucalyptus tereticornis	Forest red gum	Tree
Acacia implexa	Hickory wattle	low tree
Acacia parvipinnula	Silver-stemmed wattle	Shrub
Acacia salicina	Cooba	Shrub
Breynia oblongifolia	Coffee bush	Shrub
Austrostipa verticillata	Slender bamboo grass	Ground cover
Centella asiatica		Ground cover
Cynodon dactylon	Common couch	Ground cover
Dichondra repens	Kidney weed	Ground cover
Juncus continuus/filicaulis/usitatus		Ground cover
Microlaena stipoides	Weeping grass	Ground cover
Oplismenus aemulus	Australian basket grass	Ground cover
Pratia purpurascens	Whiteroot	Ground cover

The seeding list is a combination of species from this list that are known to germinate successfully from seed. Not all species listed are a part of the seeding list

umwelt
Environmental & Social Consultants

Newcastle
75 York Street
Teralba NSW 2284

Perth
First Floor
12 Prowse Street
West Perth WA 6005
PO Box 783
West Perth WA 6872

Canberra
2/99 Northbourne Avenue
Turner ACT 2612
PO Box 6135
O'Connor ACT 2602

Sydney
50 York Street
Sydney NSW 2000

Brisbane
Level 13
500 Queen Street
Brisbane QLD 4000

Orange
Office 1
3 Hampden Street
Orange NSW 2800

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au