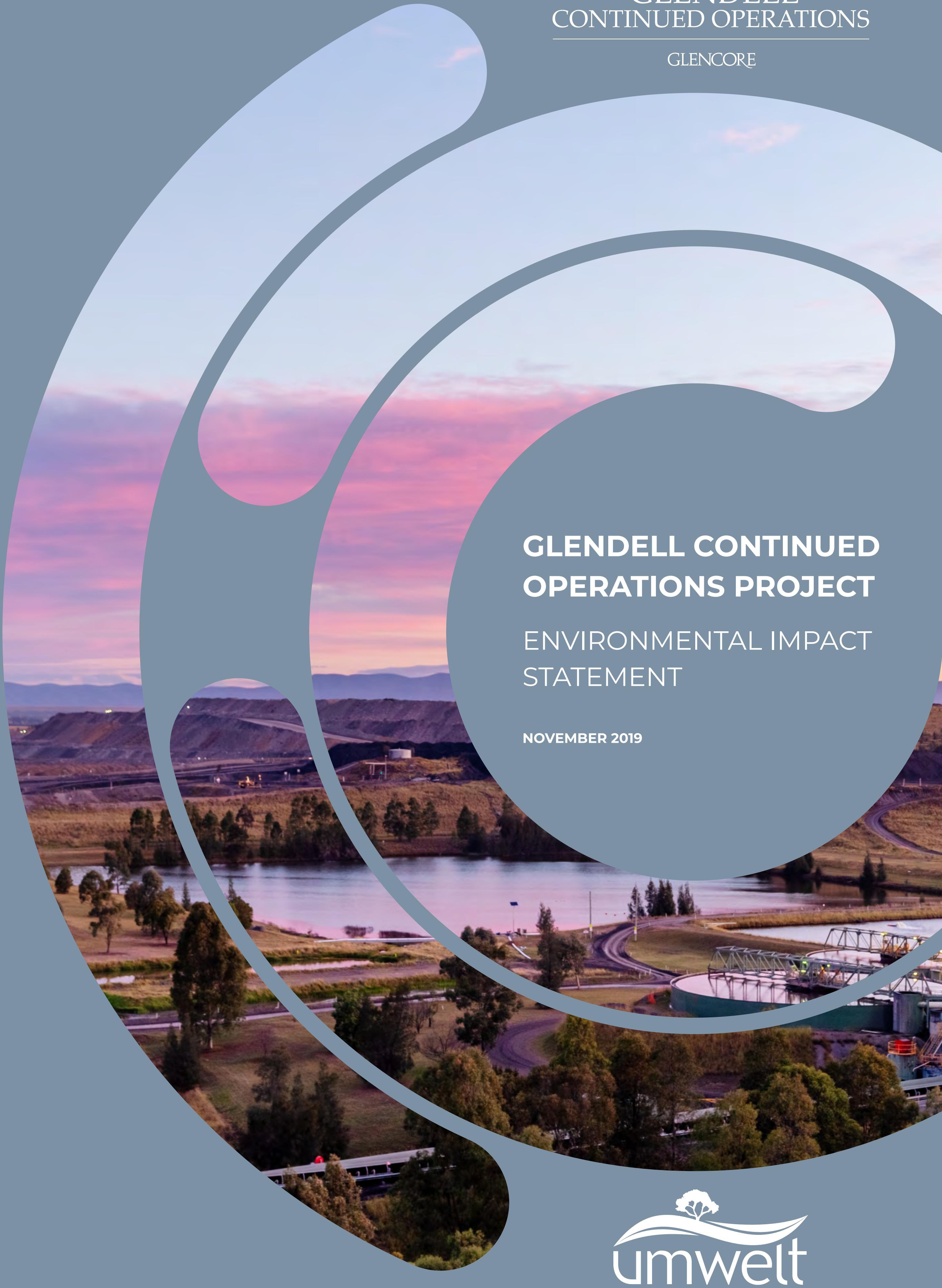
GLENDELL
CONTINUED OPERATIONS

GLENCORE



GLENDELL CONTINUED OPERATIONS PROJECT

ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 2019

umwelt
Environmental & Social Consultants

MAIN TEXT

GLENCORE

GLENDELL CONTINUED OPERATIONS PROJECT

Environmental Impact Statement

FINAL FOR SUBMISSION

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

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Report No.	4166/R08
Date:	November 2019

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V1 - Final	David Holmes	29 November 2019	Bret Jenkins	29 November 2019

EXECUTIVE SUMMARY

Executive Summary

Glendell Mine forms part of the Mount Owen Complex 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. The Mount Owen Complex is owned by subsidiaries of Glencore Coal Pty Limited (Glencore). The Mount Owen Complex open cut operations are located in the north-eastern part of the Upper Hunter Valley, which has been heavily dominated by coal mining and power station operations for decades. The majority of land immediately surrounding the Mount Owen Complex is mine owned, with the closest private residences located approximately 1.1 km to the south of the southern extent of the existing Glendell Mine in Camberwell.

Mining activities commenced at the Glendell Mine in 2008, with the current development consent (DA 80/952) (Glendell Consent) allowing for mining up to 4.5 million tonnes per annum (Mtpa) of coal through to June 2024. Glendell is one of 3 operating pits at the Mount Owen Complex, which also includes the Mount Owen (North Pit) and Ravensworth East (Bayswater North Pit) operations. Coal from all 3 operations is processed at the Mount Owen Coal Handling Preparation Plant (CHPP) and product coal is either transported to the Port of Newcastle via the Mount Owen Complex rail loop for export or railed to domestic customers.

The Glendell Continued Operations Project (the Project) would provide for the approval to continue open cut mining to the north of the existing Glendell Mine into a new mining area, providing access to approximately 135 million tonnes (Mt) of additional coal reserves. The Project would extend the life of mining operations at Glendell to approximately 2044, provide ongoing employment opportunities for the existing workforce and provide substantial revenue to the local, regional and state economies.

This Environmental Impact Statement (EIS) has been prepared to assess the environmental and social impacts of the Project and will accompany a State Significant Development (SSD) Application for the Project, and to also accompany an associated application to modify the existing Mount Owen Continued Operations Project development consent (SSD-5850) (Mount Owen Consent) for aspects of the Mount Owen operations that require modification as a result of the Project.

Project Overview

The Project comprises the following key components:

- continuation of open cut mining operations within a new mining area to the north of the existing Glendell Mine
- provide access to 135 Mt of additional coal reserves through to approximately 2044 using truck and excavator mining methods

- an increase to the existing approved maximum rate of mining from 4.5 Mtpa up to approximately 10 Mtpa of coal. This increase would coincide with a decrease in production rates at the other Mount Owen Complex pits to maintain the currently approved throughput at the CHPP
- disturbance of approximately 750 hectares (ha) of primarily cleared rural land outside of areas already approved for disturbance
- continued use of the existing Mount Owen Complex infrastructure for the life of the Project including hauling coal to the existing coal handling, processing and transportation facilities
- emplacement of overburden from the new mining area within the existing approved Glendell mine void to assist with creation of a final landform
- construction of a new Mine Infrastructure Area (MIA)
- realignment of a section of Hebden Road
- realignment of the lower section of Yorks Creek, an ephemeral tributary of Bowmans Creek
- relocation of Ravensworth Homestead
- construction of a water management system that will be integrated with the existing Mount Owen Complex water management system and wider Greater Ravensworth Area Water and Tailings Scheme (GRAWTS)
- a peak construction workforce of approximately 350 people and continued employment opportunities for the existing operational workforce at the Mount Owen Complex
- a single final void will remain at the northern end of the new mining area resulting in no additional void in the final landform, which is consistent with the current approved Glendell Mine
- establishment of a final landform that utilises natural landform design principles and provides connectivity to established offsets and areas of existing vegetation. Mount Owen Complex has been recognised as having industry leading rehabilitation practice and this approach will continue to be used for the Project.

The Project has been designed through a detailed social, economic and environmental risk-based approach that aims to maximise resource extraction efficiency and utilise the synergies provided through the use of existing mining infrastructure, whilst seeking to minimise impacts on the environment and surrounding community. As discussed in later sections of this EIS, the key learnings from the existing mining operations at the site; the stakeholder engagement program; the comprehensive social impact assessment; and the detailed environmental studies, have all been considered in refining the design of the Project. Numerous changes were made to the design of the Project throughout the impact assessment process in order to minimise environmental and social impacts.

Benefits of the Project

Mining within the existing approved mining area is scheduled to be completed around 2023 if the Project does not proceed. The Project will extend the operational life of Glendell Mine for approximately 20 years providing ongoing employment opportunities and other economic benefits at a local, regional and State level. The Project is proposed in an area of historic mining and is a brownfield continuation of the existing mining operation with the target mining area being one of the few remaining economically viable resources in the greater Ravensworth area. The benefits of the Project include:

- maximise efficient recovery of the State’s coal resources
- ongoing use of the existing Mount Owen Complex infrastructure and rail infrastructure

- ongoing employment opportunities for the existing Mount Owen Complex workforce
- provide an integrated final landform design across both the existing approved and proposed mining areas, with no additional void as a result of the Project relative to current approved operations
- use the same leading practice environmental management approach and controls as the existing operation
- brownfield continuation of the existing Glendell Mine located in an area of established mining operations
- moving away from the closest private residences in Camberwell and not impacting on any additional residences
- continued support of local community-based groups and initiatives
- ongoing contribution to the local, regional and State economies from a well established mining operation
- a net benefit to the Upper Hunter region of $446.7 million in net present value (NPV) terms
- a net benefit (both direct and indirect) of $1.15 billion to the State over the life of the Project in NPV terms
- provide a royalty revenue stream flowing to the State estimated to be $296.1 million over the life of the Project in NPV terms.

The Project represents a brownfield continuation of the existing Glendell Pit and fits within Glencore's commitment to cap its global coal production at 150 Mtpa of saleable product. The Project will occur at a time when production at Glencore's adjacent Liddell Coal Operations, and the Ravensworth East and Glendell Mines have ceased. The coal produced by the Project is 'replacement production' that will help to maintain Glencore's long term production profile.

Through the implementation of the Project, Glencore believes it can contribute substantial economic benefits at local, regional and State levels whilst minimising environmental impacts and continuing to coexist with the local community.

Broad Overview of Environmental, Social and Economic Outcomes

This EIS includes a detailed assessment of the potential environmental, social and economic outcomes of the Project and identifies the management, mitigation and offset measures that will be implemented. A summary of the key findings of the assessment is provided in **Table ES1**.

Table ES1 – Summary of the Key Environmental, Social and Economic Impact Assessment Findings

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Air Quality	• The Project will comply with the relevant applicable annual average and incremental 24-hour average air quality criteria at all private residences that do not currently have acquisition rights under existing development consents. • The Project will have similar air quality impacts to the existing approved Glendell Mine with Project specific impacts in Camberwell and the Middle Falbrook area declining as operations progress towards the north and away from these receiver areas. • Proactive and reactive dust control measures will continue to be implemented to minimise dust emissions over the life of the Project, including by adaptively managing the mining operations to minimise impacts in adverse conditions. • Comprehensive air quality management controls have been incorporated into the design of the Project to minimise the contribution of the Project to impacts on local and regional air quality.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Noise	• The design of the Project, incorporates a range of noise controls through equipment selection, mine scheduling and mine design to minimise noise impacts. • The detailed noise assessment has confirmed that the Project can manage the operations to remain within relevant noise criteria at all private residences. • Noise levels from the mine will be managed so that no exceedances of the relevant criteria occur at private residences in Camberwell. • Noise levels in Hebden from the Mount Owen Complex operations may increase as mining progresses to the north, however this will occur in the latter stages of the Project and impacts will remain well below relevant noise criteria. • No material changes to operational road traffic noise. • No increase in annual train movements or previously approved rail noise impacts. • No adverse cumulative noise impacts are predicted as a result of the Project. • Noise impacts will continue to be managed through the implementation of proactive noise management and monitoring measures that will be used to adaptively manage mining operations, as required, to minimise noise impacts.
Blasting	• Blasting activities will be managed so that relevant blast criteria are met at private residences and blast sensitive locations. • Intermittent road closures of Hebden Road will be required when blasting is within 500 m distance of Hebden Road, with up to 15 minutes delay for road users. • Where possible, blasts will be conducted at times that avoid school related traffic and planned road closure will be notified beforehand in order to minimise disruptions on local road users.
Water Resources	Surface Water • The Project requires the realignment of the lower section of Yorks Creek, an ephemeral tributary of Bowmans Creek, of which approximately 1.5 km section has previously been diverted. • The realigned Yorks Creek will join Bowmans Creek upstream of the current alignment. • The Yorks Creek Realignment has been designed to be geomorphically stable, with appropriate aquatic and riparian habitat, and to mitigate the potential impact of erosion on downstream water quality. • The Glendell Pit Extension has been set back at least 200 metres (m) from the high bank of Bowmans Creek to minimise potential impacts. • A comprehensive water management system has been designed for the Project to manage water in accordance with legislative requirements and relevant guidelines. • The water management system for the Project builds on the existing Mount Owen Complex system and the GRAWTS and maximises water recycling and reduces external water import. • No significant flooding impacts are expected due to the Project. • No discharges of mine affected water will occur as part of the Project. • No adverse effects on downstream water quality are expected due to the Project. • The minor changes to stream flows associated with catchment changes and groundwater impacts to baseflows are unlikely to be observable relative to natural variability. Groundwater • The Project will have no significant impact on any registered groundwater bores held by private landholders • The Project is not predicted to result in any significant groundwater impact relative to existing approved operations. • The long history of mining in the area has significantly modified the groundwater environment in the vicinity of the Project Area and the effects of historical and approved mining operations will further affect these systems over the life of the Project; these impacts are complex and vary both spatially and temporally.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• Detailed modelling of the groundwater system in the region has been undertaken to understand the impact of the Project in the context of impacts associated with historical and approved operations. • The only potential highly productive aquifer in the Project Area is Bowmans Creek alluvium; the Project's impacts on this aquifer system are not predicted to exceed the relevant minimum harm criteria defined in the Aquifer Interference Policy. • Predicted cumulative drawdown in Bowmans Creek alluvium is up to 2 m in isolated areas with much of this predicted drawdown due to existing approved and historical operations. The Project's contribution to cumulative impacts is limited to localised areas adjacent to the point of intersection of the Glendell Pit Extension with Yorks Creek and Swamp Creek alluvium. • The Project's (and cumulative) predicted impacts on the alluvial water table within Bowmans Creek are within the natural variability observed in historical monitoring. • Following the cessation of mining associated with the Project, cumulative impacts on the Bowmans Creek alluvium are predicted to decline as the regional water table level recovers. Water licensing • The Project's modelled take from alluvial groundwater systems is predicted to be small with only a minor increase to cumulative take predicted as a result of the Project. • Adequate water entitlements can be obtained to account for licensable take from water sources as a result of the Project at the time the take occurs.
Biodiversity	• Avoidance of impacts to key biodiversity values was a key driver for the Project design and the impacts were reduced through changes to the mine plan and infrastructure design. • The Project will impact approximately 540 ha of native grassland, woodland and forest vegetation. • Three threatened ecological communities occur within the Development Footprint, one of which is listed as threatened at the Commonwealth level; *Central Hunter Valley Eucalypt Forest and Woodland.* • The Project is not expected to result in any substantial indirect impacts on the terrestrial biodiversity values of surrounding lands during the construction or operational phases of the Project. • The impacted land will be rehabilitated with the conceptual final land use returning much of it to a combination of native vegetation and open grassland communities as would have historically occurred in the area. • All impacts to native vegetation and threatened species will be fully offset such that there is no-net loss of biodiversity values. • The predicted drawdown in Bowmans Creek alluvium from the Project poses negligible additional threat to terrestrial groundwater dependent ecosystems. • The Project is not predicted to have any significant impacts on aquatic or subterranean groundwater dependent ecosystems.
Aboriginal Heritage	• A comprehensive Aboriginal Cultural Heritage Assessment was completed in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holders for the Project. • The historical associations with early settlement, conflict, dispossession and survival are important, and the nature of the area as a surviving cultural landscape is of significance to numerous members of the Wonnarua people. • An archaeological survey identified 91 Aboriginal sites that would be impacted by the Project (36 isolated finds and 55 artefact scatters). Of these sites, the majority (77) were assessed as having low scientific significance, 9 having low-moderate scientific significance and 5 having moderate scientific significance. No sites have been assessed as having high scientific significance.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• Glencore has developed management and mitigation measures in consultation with the RAPs and Knowledge Holders involved in the assessment and these will be implemented in consultation with, and involving the participation of, the relevant Aboriginal community representatives.
Historic Heritage	• The Project requires the relocation of the Ravensworth Homestead Complex which, along with the associated archaeological resource, have been assessed as having State significant heritage values. • The Homestead is listed as an item of local heritage significance under the Singleton Local Environmental Plan 2013. • Extensive heritage studies have been undertaken to allow for a detailed understanding of the property and building group in terms of social history, historical land use and landscape, archaeology, architecture, structural and engineering assessments, land tenure and early interactions between Aboriginal people and colonial settlers. • Extensive community consultation has been undertaken regarding the Ravensworth Homestead relocation including the formation of the Ravensworth Homestead Advisory Committee, an independently chaired committee comprising members of the local community, to identify and investigate relocation options for the Homestead; interviews were also undertaken with local residents and other stakeholders expressing an interest in local heritage, and a broader community survey was conducted to understand the wider Singleton community perspective. • Following a review of 11 alternate relocation options, and 2 relocation methods, 2 reasonable and feasible relocation options are proposed for the Ravensworth Homestead: o Ravensworth Farm (Option 1) - involves the intact relocation of all buildings including moving selected trees and plants to the 'Ravensworth Farm' site located within the Project Area and on the original Bowman "10,000 acre" land grant (Ravensworth Estate Lands). The building will be used by Glencore as an administration and training facility during the life of the Project and, after mining, the Homestead could return to use as a farmstead with an attached landholding. This option will place the buildings on land with a similar landscape and outlook to the current Homestead site and will maximise the retention of building fabric and heritage values including the building complex layout. o Broke Village (Option 2) – this is a proposal by members of the Broke-Fordwich community and involves the dismantling all of the Homestead buildings and relocation to Broke where the buildings would be rebuilt and have multi-purpose usage forming the village square. This outcome will provide lower preservation of heritage values, however provide greater community benefits with a higher level of public accessibility. This option will require further secondary approvals for the Broke site, and the securing of land tenure should this option be approved as part of the Project approval. • A Statement of Significance for Ravensworth Estate and the Ravensworth Homestead Complex has been prepared and a Statement of Heritage Impact undertaken that assesses the impact of the Project on Ravensworth Estate and the Ravensworth Homestead Complex including the 2 relocation options. • The Statement of Heritage Impact concludes that the Project will have notable heritage impact on the Core Estate Lands and the setting of the Ravensworth Homestead Complex but that this would be mitigated by the proposal to relocate the homestead buildings and carry out comprehensive salvage archaeology. • The wider Singleton LGA community have identified Option 2 as their preferred outcome for relocation largely due to the associated community benefits including improved accessibility.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Rehabilitation and Final Landform	• The existing approach to final landform establishment and rehabilitation at the Mount Owen Complex, which includes the use of natural landform design principles and rehabilitation to native vegetation and open grassland communities will be applied to the Project. • The Rehabilitation and Mine Closure Strategy aims to minimise environmental impacts throughout the life of, as well as upon completion of the Project. • The Project will provide for a fully integrated rehabilitation program and final landform. • The final landform will generally be designed to direct runoff away from the final voids and into the natural environment, specifically Yorks Creek, Bowmans Creek, Swamp Creek and Bettys Creek catchments. • The Project does not result in any additional voids than currently approved under the existing Glendell Consent. • The final void will be a long-term hydraulic sink meaning it will not discharge to the environment; pit lake water quality within the final void is predicted to be similar to that of the existing approved final void and other approved final voids in the Hunter Valley. • The Mount Owen Complex, including the landform and infrastructure developed as part of the Project, provide significant opportunities for high value land uses following the cessation of mining and these will be considered as part of a detailed mine closure process.
Visual	• The Project is located within an area that has a long history of mining and electricity generation and the visual landscape of the area is heavily influenced by these activities. • The Project, including active overburden emplacement activities, will be visible from sections of Hebden Road, the New England Highway and Glennies Creek Road. • Visual impacts associated with views from public roads will be reduced over time through the implementation of progressive rehabilitation and the use of visual screening. • The increased height of overburden emplacement areas associated with the Project may result in increased visibility at some locations, all of which currently have visual impacts associated with existing operations at Glendell Mine and operations within the Mount Owen Complex or other nearby mining operations; the impacts associated with increased emplacement height are likely to be minimal given the distance from vantage points and the minor increase in height relative to viewing distance. • The use of natural landform design principles and increased variability in terrain height will reduce the flat-topped emplacement area design which was identified as being an issue for some stakeholders. • Direct views of the active pit areas from outside of the Project Area are limited and will largely be obscured by the existing topography and proposed vegetation screen planting.
Traffic and Transport	• The Project will require the realignment of a section of Hebden Road; the proposed realignment will have minimal impact on travel distances (approximately 1.2 km longer) and will provide an improved standard of road over the realigned section. • The new section of Hebden Road will be largely constructed ‘off-line’ to minimise disruption to existing road users and maintain the existing 80 km/hr standard. • The construction and operation phases of the Project will have a negligible impact on road safety conditions on the New England Highway and Hebden Road due to the minor increase in traffic volumes associated with the Project. • During construction, the Project is predicted to result in short term traffic increases. • The assessment has confirmed that all intersections that were modelled will continue to operate at acceptable levels of service. • The Project does not seek any increase to the current approved maximum annual production rate or employment levels of the Mount Owen Complex and as such, no operational traffic changes are anticipated above those that have been previously assessed and approved.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Land Use and Agriculture	• The Project Area has been utilised for agricultural purposes for over 180 years and much of the Additional Disturbance Area shows significant degradation of soil resources associated with past land uses. • The majority of the Additional Disturbance Area is currently managed for low intensity grazing production with only limited cropping of alluvial flats (predominately for pasture purposes) over the past 30 years. • Approximately 34 ha of the alluvial flats associated with Bowmans Creek have been verified as Biophysical Strategic Agricultural Land (BSAL) in accordance with the Interim Protocol (Verified BSAL); none of the Verified BSAL area is located within the Glendell Pit Extension. • The Verified BSAL has been mapped as being either Land and Soil Capability (LSC) Class 3 or Class 4 land which represents a lower level of land capability for BSAL; there is no LSC Class 1 or 2 land (better quality) within the Additional Disturbance Area. • BSAL areas not permanently impacted by either the Hebden Road realignment or areas where landform shaping is required for final landform development and/or drainage purposes. (approximately 21 ha), is proposed be rehabilitated to at least Land and Soil Capability Class 4. • Much of the surrounding land is mine owned significantly reducing the potential for impacts on private land uses. • The Project is not predicted to result in adverse impacts on surrounding private agricultural land and the mining operations are expected to continue to coexist with the surrounding agricultural land uses.
Greenhouse Gas	• The predicted greenhouse gas emissions associated with the Project have been quantified, including the scope 1, 2 and 3 emissions. The implications of the predicted emissions in the context of climate change policy have been assessed. • A range of energy and greenhouse gas management initiatives will be implemented as part of the Project to improve energy efficiency and reduce the greenhouse gas emissions of the on-site mining operations.
Waste and Hazards	• The existing waste management plan will be updated to incorporate the Project. The existing plan is based on the principles of avoid, re-use and recycle, with waste disposed of in accordance with legislative requirements where necessary. • The Project design has had regard to potential hazards associated with the Project.
Social	• An extensive consultation program was undertaken to identify community issues/views of the Project with a range of mechanisms including interviews with key stakeholders, information sessions, information sheets delivered across the LGA and a broader community survey of heritage aspects. • The social impacts of the Project have been minimised where possible through project design and the proposed management and enhancement approaches. • The broader Singleton community has appeared generally accepting of the Project due to the predicted positive economic benefits; however, there is a trend in increasing concern around cumulative impacts of mining in the Hunter region, primarily in regard to air quality, intergenerational equity and the prolonged nature of impacts. • The perceived social impacts are greatest for those living in closest proximity to the Project, or those who perceive they will be most directly impacted by the development. • The social impacts directly related to the relocation of the Ravensworth Homestead have been outlined and stakeholder feedback sought on the potential relocation options being considered. • A range of strategies will be implemented to seek to minimise social impacts and maximise benefits including community enhancement projects, and employment and training initiatives; these social impact mitigation measures have been specifically targeted to address the issues identified in the Social Impact Assessment and based on stakeholder feedback.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• The proposed approaches to manage community impacts have been developed through identification of technical and social/community risks as assessed through consultation, and analysis of complaints data and technical reports prepared by specialist consultants. • A Social Impact Management Plan for the Mount Owen Complex will be developed, that defines and guides the ongoing monitoring and management of social impacts. • The Project will provide ongoing employment opportunities for the existing workforce for an additional 21 years of mine life (approximately), providing significant ongoing benefits for the local and wider communities through employment, use of local services, community participation, local and regional expenditure, community investment and payment of royalties and taxes.
Economic	• The Project will provide significant ongoing economic benefits for the local and wider communities through employment, local and regional expenditure, community investment and payment of royalties and taxes. • A detailed economic analysis of the Project has been undertaken which includes consideration of the Project's economic benefits and costs associated with adverse impacts. • The economic assessment predicted that the Project would have substantial net benefits for the State and region under a range of sensitivity scenarios considered including reduced coal prices. • The cost benefit analysis (CBA) of the Project indicates that the overall net benefits of the Project to the State would be in the order of $1.15 billion in net present value (NPV) terms. • The Local Effects Analysis, which is a CBA of regional economic impacts indicates that the overall net benefits to the Lower Hunter Valley (excluding Maitland and Newcastle) would be in the order of $449 million in NPV terms. • The economy wide net benefits of the Project, were estimated through computable general equilibrium (CGE) modelling; Gross State Product is projected to increase by approximately $3 billion in NPV terms as a result of the Project.

Further details of the predicted environmental and social impacts of the Project are provided in the main text of this EIS and associated technical reports. This EIS includes commitments by Glencore to the implementation of comprehensive management, mitigation and offset measures to minimise and counterbalance the predicted impacts of the Project.

The Project is a logical brownfield continuation of Glendell Mine to the immediate north of the existing operation. The Glendell Pit Extension is located on mine owned land that is surrounded on three sides by current and historical mining operations. The majority of the Project Area has been cleared with only a few remnant areas of trees. Almost the entirety of the vegetation within the Project's Additional Disturbance Area is regrowth that has occurred over the past 30 years, including the riparian vegetation along Swamp Creek and Yorks Creek. Past and approved mining within and surrounding the Project Area has significantly modified the regional groundwater and surface water systems and will continue to do so into the future. There is substantial buffer distance between the Project and private residences, with nearest residence being approximately 3.5 km from the Glendell Pit Extension.

The detailed cost benefit analysis undertaken for the Project following relevant NSW Government guidelines has identified that the benefits of the Project will outweigh the costs, including consideration of environmental and social costs. The Project will provide significant net economic benefits, estimated to be in the order of $1.15 billion in current terms.

The Project has been assessed against the principles of ecologically sustainable development as required by the *Environmental Planning & Assessment Act 1979* (EP&A Act) and NSW *Environmental Planning and Assessment Regulation 2000*. This assessment has indicated that while the Project, like most large scale development, will have impacts, these impacts can be managed, mitigated and offset and the development will result in significant economic benefits. The assessment therefore concludes that the Project is consistent with the principles of ecologically sustainable development.

Acknowledgement

Glencore and Umwelt would like to acknowledge the Traditional Owners of the Project Area – the Wonnarua people – and pay respect to their cultural heritage, beliefs and continuing relationship with the land.

We would also like to acknowledge the post-contact experiences of Aboriginal people who have attachment to the Project Area and surrounds.

We pay respect to the Elders, both past and present, for they hold the memories, traditions, culture and hopes of Aboriginal people in the area.

We thank the Registered Aboriginal Parties, their families and elders for their engagement in this Project. Their willingness to participate in discussions during land visits and to contribute in a meaningful way during workshops is greatly appreciated.

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SECTION 1.0

Introduction

1.0 Introduction

The existing Glendell Mine forms part of the Mount Owen Complex 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 (refer to **Figure 1.1**). The Mount Owen Complex open cut operations are located in the north-eastern part of the Upper Hunter Valley which has been heavily dominated by coal mining and power station operations for many decades; rural and rural residential land are located to the north, north-east, east and south-east of the Mount Owen Complex (refer to **Figure 1.1**).

In addition to the Glendell Mine, the Mount Owen Complex comprises mining operations at Mount Owen Mine (North Pit) and Ravensworth East Mine (Bayswater North Pit). The Mount Owen Complex also includes a coal handling and preparation plant (CHPP) and coal handling and transport infrastructure (refer to **Figure 1.2**[1]).

The Mount Owen Complex is owned by subsidiaries of Glencore Coal Pty Limited (Glencore). Mt Owen Pty Limited operates the Bayswater North Pit, CHPP and Glendell mining operations at the Mount Owen Complex. Thiess Pty Ltd operates the North Pit pursuant to a contractual arrangement with Mt Owen Pty Limited.

The Mount Owen Complex is adjacent to the Integra Underground, Liddell Coal Operations and Ravensworth Operations, which are also owned and operated by subsidiaries of Glencore and its joint venture (JV) partners.

The Proponent is proposing to extend the life of operations at the Glendell Mine and optimise the use of infrastructure at the Mount Owen Complex by extending mining in the existing Glendell Pit to the north (the Project).

1.1 Project history and overview

The Glendell Mine currently operates under development consent DA 80/952 (Glendell Consent). The Glendell Consent regulates the mining of coal from the Glendell Pit and the rehabilitation of the mining area. The processing of coal mined from the Glendell Pit is regulated by development consent SSD-5850 (Mount Owen Consent) which also regulates mining at the Mount Owen Mine and Ravensworth East Mines, and associated activities. **Section 2.0** contains further details regarding the existing operations.

Glendell Mine has an approved production rate of up to 4.5 million tonnes per annum (Mtpa) of run of mine (ROM) coal. Mount Owen Mine (approved 10 Mtpa), Ravensworth East Mine (approved 4 Mtpa) and Glendell Mine ROM coal feed the Mount Owen CHPP and associated infrastructure. The Mount Owen CHPP has a total approved processing capacity of 17 Mtpa of ROM coal. Up to 2 Mtpa ROM coal and/or crushed gravel can also be transported via conveyor from the Mount Owen Complex to the Liddell Coal Operations and/or Ravensworth Coal Terminal. Coal is also approved to be transported to the Liddell and/or Bayswater Power Stations by conveyor. The Mount Owen Complex produces both semi soft coking coal and thermal coal. Coal is primarily transported via the Mount Owen Rail Loop to the Port of Newcastle for export.

Mining at Glendell is approved to the end of 2024 but is currently scheduled to be completed within the current approved area of Glendell Mine by the end of 2022. An application to modify the Glendell Consent has been lodged to extend the approved mining area in the Glendell Pit which would extend the mining of approved reserves to 2023.

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[1] The Mount Owen Consent Boundary shown in **Figure 1.2** includes the proposed changes to the boundary associated with the Narama Pipeline Modification. This is discussed further in Sections 2.1.4.2 and 2.2.1.

Mining approved under the Mount Owen Consent in the Bayswater North Pit will be completed in approximately 2023 and in North Pit in approximately 2037.

1.2 Surrounding community

The Mount Owen Complex is located in an area that was historically rural but has been increasingly dominated by coal mining related development dating from the 1950s. The Project Area is entirely surrounded by existing and historical mining operations. Camberwell is the closest residential area to the Project Area located approximately 1.1 km to the south of the southern extent of the existing Glendell Mine. The Ashton Coal Mine is located between the Glendell Mine and Camberwell.

A number of private properties (including residences) are located along Glennies Creek Road/Middle Falbrook Road in the Middle Falbrook area. All of the properties in Camberwell and several properties in the Middle Falbrook area have acquisition rights under various development consents for mining operations in the area.

The Bridgman area (refer to **Figure 1.1**) located to the east of the Mount Owen Complex, is a rural residential area, with generally smaller land holdings. To the north west of the Mount Owen Complex is the area of Hebden which comprises typically larger rural holdings. All residences in this area are located on Scrumlo Road and are located more than 3 km from the Mount Owen Complex. The Rix's Creek North and South operations are located between the Mount Owen Complex and Singleton Heights (refer to **Figure 1.1**). **Section 4.2** provides further information for the social context of the Project.

1.3 The Project

The Project is the extension of open cut mining operations at the current Glendell Mine, to extract the coal reserves in the mining authorities to the north (refer to **Figure 1.3**). This proposed extension would extract an additional 135 Mt, approximately, of ROM coal. This proposed extension of the Glendell Pit is referred to as the Glendell Pit Extension. The mining of the Glendell Pit Extension will involve the extraction of reserves down to and including the Hebden seam. Assuming approval in 2021, the Project would extend the life of mining operations at Glendell to approximately 2044 and provide ongoing employment opportunities. The Glendell Pit Extension mining area represents one of the last remaining un-mined and easily accessible resources in the greater Ravensworth area.

The Project represents a brownfield continuation of the existing Glendell Pit and fits within Glencore's commitment to cap its global coal production at 150 Mtpa of saleable product. The Project will occur at a time when production at Glencore's adjacent Liddell Coal Operations, and the Ravensworth East and Glendell Mines have ceased. The coal produced by the Project is 'replacement production' that will help to maintain Glencore's long term production profile.

As a continuation of the existing mining operations, the Project will utilise existing infrastructure at the Mount Owen Complex currently used for mining at Glendell. ROM coal sourced from the extended Glendell Mine will continue to be processed through the Mount Owen CHPP, including ongoing coal stockpiling and train loading at Mount Owen Complex for the life of the Project. This will extend the life of the CHPP for approximately an additional 8 years beyond that currently approved by the Mount Owen Consent (i.e. to 2045) and includes an allowance for the processing of coal mined in the latter stages of 2044 in the 2045 calendar year.

The Project will necessitate some changes to the location of existing Mount Owen Complex infrastructure and associated services which will also be sought through the modification of the Mount Owen Consent. The Project will also link with the Mount Owen Complex Water Management System (WMS). Through the linkage with the Mount Owen Complex WMS, the Project will be connected with Glencore's Greater Ravensworth Area Water and Tailings Scheme (GRAWTS) which enables the transfer of water between the mining operations linked to the GRAWTS. At present, the Mount Owen Complex, Integra Underground, Liddell Coal Operations and Ravensworth Coal Operations are all linked via this scheme. The GRAWTS also includes pipeline infrastructure which enables the transfer of tailings material between operations to enable tailings facilities to be managed more efficiently.

The Project will require the removal of the existing Glendell Mine Infrastructure Area (MIA) (including the administration, training and workforce deployment area, bathhouse facilities, carpark etc.) and the construction of a new MIA. In order to access the pit from the proposed MIA and allow for the maintenance of mobile mining fleet, a Heavy Vehicle Access Road is also required. The Project will necessitate the realignment of a section of Hebden Road, realignment of part of Yorks Creek and the relocation of Ravensworth Homestead. The key features of the Project are shown conceptually in **Figure 1.3**.

The extension of open cut mining to the north of the current Glendell Mine and associated infrastructure, plus the extended life of the Mount Owen CHPP and infrastructure, are collectively referred to as the Project throughout this EIS.

A detailed Project description is provided in **Section 3.0**.

1.3.1 Project objectives

Key objectives of the Project include:

- maximising the recovery of accessible reserves within relevant mining tenements
- optimising the use of existing infrastructure and equipment
- extending the economic life of the Glendell Mine and Mount Owen Complex infrastructure and providing ongoing employment opportunities for the existing workforce
- minimising overburden re-handle
- effectively co-existing with the local community, including Hebden, Camberwell and Middle Falbrook through avoiding additional impacts to residences
- minimising disturbance of higher value native vegetation and established mine site rehabilitation that is consistent with surrounding vegetation communities
- minimising impacts on Bowmans Creek and associated alluvium
- Minimising heritage impacts through the sensitive relocation of the Ravensworth Homestead Complex of historical buildings and archaeological salvage of Aboriginal heritage items
- establishing a final landform that is safe, stable, non-polluting and sympathetic with surrounding landforms and which provides for a range of sustainable post mining land use options.

These Project objectives have been developed having regard to the financial objectives of the Proponent and its shareholders whilst also having regard to the broader environmental, social and strategic context for the Project. The strategic and environmental context within which the Project will operate and the justification for the Project in terms of scale, location and timing are discussed in further detail in **Section 4.0**. The design of the Project has been developed with regard to the strategic, social and environmental context of the Project and the views of relevant stakeholders.

The reserves targeted by the Project are within existing mining authority areas identified as having potential for resource development. These reserves can be efficiently mined and cost effectively accessed through the removal of the existing Glendell MIA (currently located above mineable coal reserves) and the northern progression of the existing Glendell Pit. The location of the Project provides an opportunity to maximise the integration of the Project with surrounding mining operations in relation to the following:

- coal handling and processing
- beneficial water sharing and re-use
- efficient tailings emplacement
- rehabilitation and environmental management and monitoring systems.

Importantly, the Project will increase employment opportunities associated with the mining operations at the Mount Owen Complex relative to the alternative of ceasing mining at Glendell in approximately 2023 and North Pit (approximately 2037).

The Project also provides significant advantages in providing an integrated final landform design across both the existing approved and proposed mining areas. There will be no additional final void as a result of the Project relative to current approved operations.

1.3.2 Project alternatives

Glencore has completed detailed environmental and social constraints studies to inform the Preferred Mine Plan for the Project. As part of these studies, a range of different alternatives for mine design were considered and reviewed including mine disturbance areas, overburden emplacement areas, infrastructure design, fleet numbers, equipment type and location, and scheduling. The outcome of this iterative design and review process was the identification and selection of potential mining options and the requirement for associated infrastructure that would allow the Project to achieve its objectives (refer to **Section 1.3.1**).

Technical mining constraints considered in determining the mineable coal reserve include:

- location of past mine workings such as the former Liddell underground mine to the north and Ravensworth East open cut mine to the east of the target area (refer to **Section 2.1**)
- faulting and other geological structures in the area including the location of the Camberwell anticline and block fault zone
- variations in the thickness and depths of the different coal seams and differing thicknesses of overburden and interburden material in the area
- variability of the quality of the coal in the different seams.

In addition to the technical mining constraints identified above, the consideration of mine plan alternatives had regard to key environmental and social constraints, including:

- impacts on surface water and groundwater systems and water resources, such as Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and associated alluvial aquifers
- heritage impacts, particularly impacts in relation to Ravensworth Homestead and Aboriginal cultural heritage
- impacts on surrounding residents such as:
  - noise impacts
  - air quality impacts
  - visual impacts
- traffic impacts and additional travel distance associated with a realignment of a section of Hebden Road and temporary road closures due to blasting along Hebden Road
- potential cumulative amenity impacts (particularly air quality, noise and visual)
- impacts on agricultural land including assessment of any Biophysical Strategic Agricultural Land (BSAL)
- impacts on biodiversity values.

Other considerations in developing the Project mine plan include:

- requirement to realign part of Yorks Creek and a section of Hebden Road
- location of high voltage transmission lines and other utilities
- location of existing Glendell MIA
- access to adjacent existing operations
- capacity of Mount Owen CHPP and other existing infrastructure
- final landform design, final void configuration and post mining land use options.

The above factors were considered and evaluated in an iterative design and review process, to refine the sequence of mining required to enable the quality and quantity of coal extracted to be managed to meet market specifications and maximise production and operational efficiencies across the life of the Project while mitigating environmental and social impacts.

Project alternatives considered include:

- not undertaking the Project
- underground mining
- different open cut mine design layouts (both larger and smaller in extent to the Project)
- different mine infrastructure area options
- different Hebden Road and Yorks Creek Realignment options.

Details regarding the various conceptual design options and other alternatives considered during the iterative project design phase are discussed in detail in **Appendix 1**.

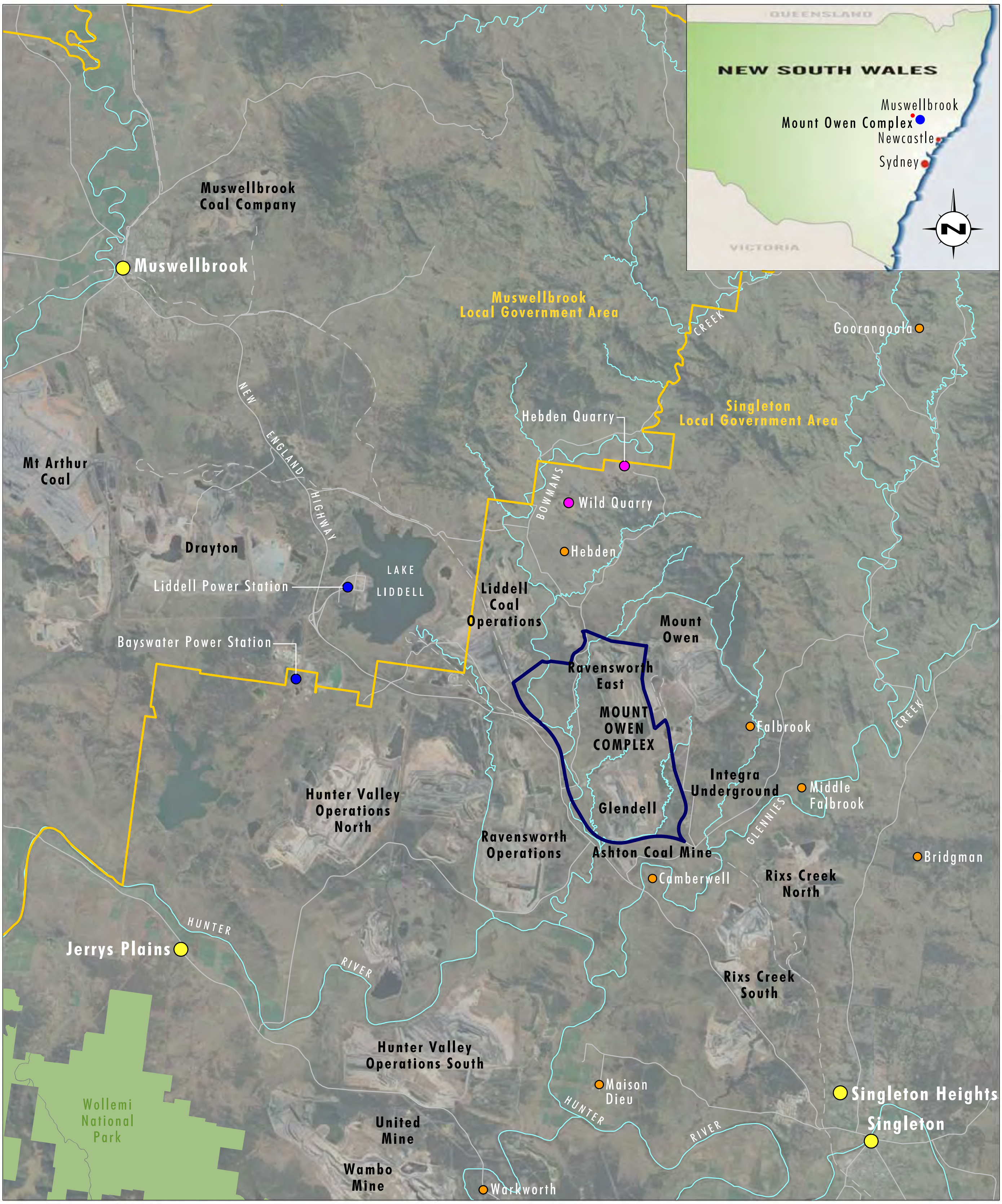

Image Source: Google Earth (2018)
Data Source: Glencore (2019), OEH (2018)

Legend

- Project Area
- Local Government Area Boundary
- National Park
- Road
- Railway
- Drainage Line
- Towns
- Village/Localities
- Power Stations
- Quarry

FIGURE 1.1

Project Locality

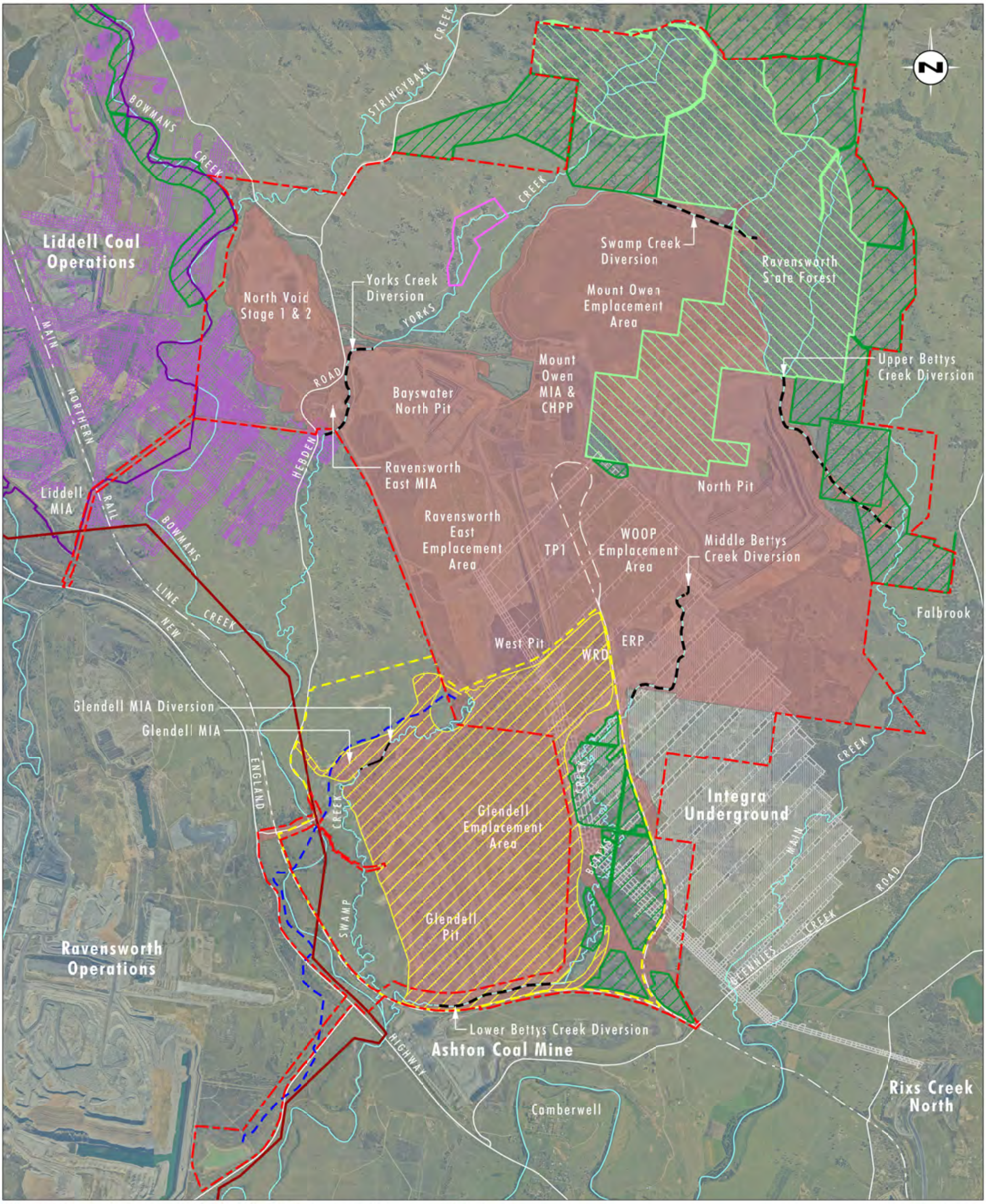

Image Source Glencore (Dec 2018), Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved.
* Mining Related Disturbance assumes Glendell MOD 4 is approved

Legend

- Glendell Consent Boundary (DA 80/952)
- Mount Owen Consent Boundary (SSD-5850)
- Liddell Consent Boundary (DA 305-11-01)
- Ravensworth Consent Boundary (09_0176)
- Mount Owen Complex Mining Related Disturbance*
- Approved Glendell Disturbance Area*
- Existing Creek Diversion
- Existing Narama Pipeline
- Approved Integra Underground Mining Area - Middle Liddell Seam Workings
- Integra Underground Workings Middle Liddell Seam as at October 2019
- Liddell Underground Workings
- Biodiversity Offset Area
- Yorks Creek Voluntary Conservation Area
- Ravensworth State Forest

FIGURE 1.2

Existing Glendell Mine and Other Approved Operations

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20191128 11.28

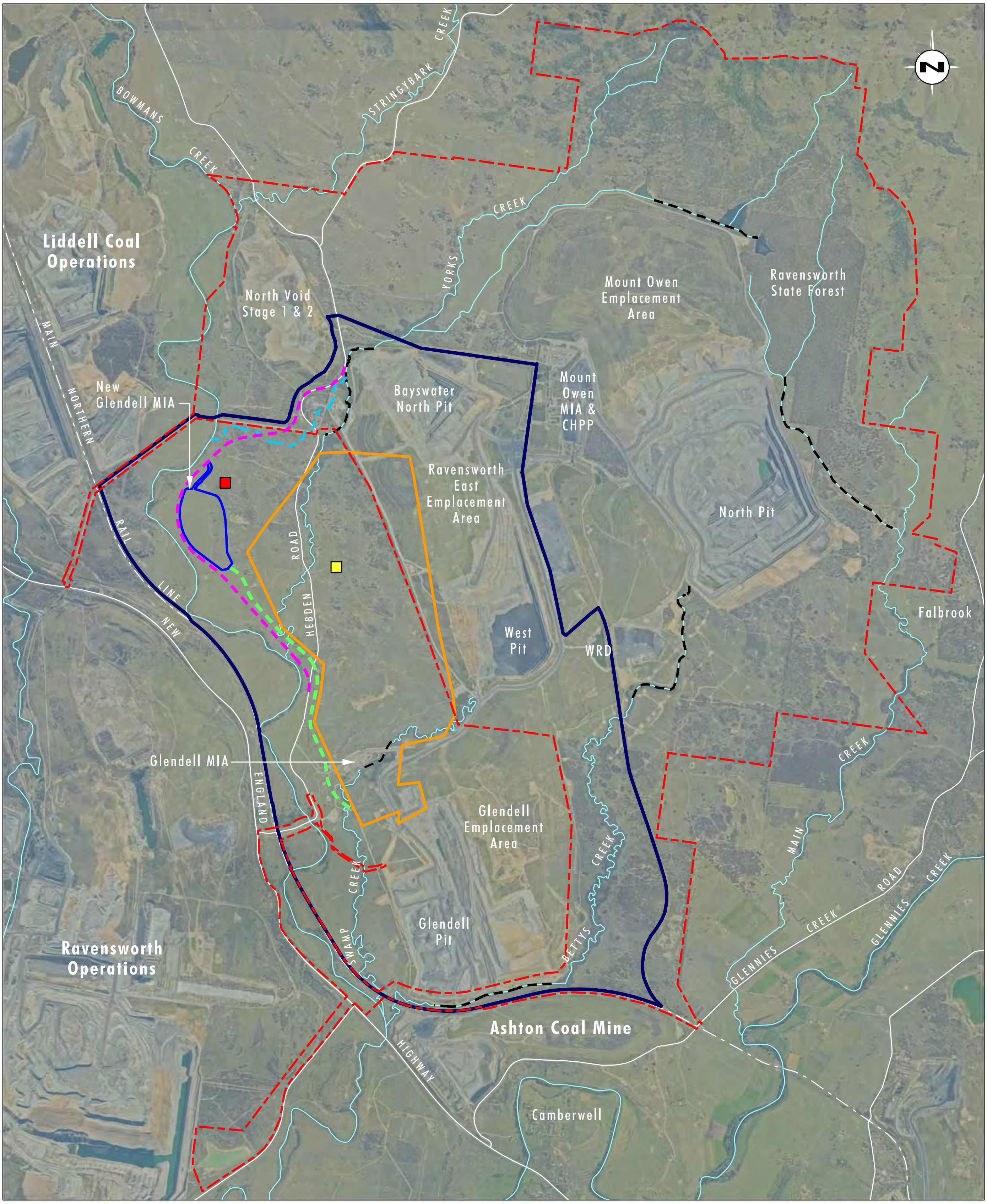


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Ravensworth Homestead

Project Features:
- New Glendell MIA
- Yorks Creek Realignment
- Hebden Road Realignment
- Heavy Vehicle Access Road
- Ravensworth Farm Relocation Option

FIGURE 1.3

Proposed Glendell Continued Operations Project

File Name (A4): R08/4166_137.dgn
20191128 11.25

1.4 Approval requirements and process

1.4.1 NSW approval requirements

The Project will require development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Being development for the purpose of coal mining, the Project is declared to be a State Significant Development (SSD) under the provisions of *State Environmental Planning Policy (State and Regional Development) 2011*. Approval for the Project is being sought for both a new development consent and a section 4.55(2) modification of the existing Mount Owen Consent.

The new consent (referred to in this EIS as the Glendell Continued Operations Consent (SSD9349)) will replace the existing Glendell Consent. The Glendell Continued Operations Consent would cover activities associated with the completion of mining in the existing Glendell Pit and proposed Glendell Pit Extension including the mining operations and ROM coal haulage to the Mount Owen CHPP, relocation of the Ravensworth Homestead, the Heavy Vehicle Access Road, construction of the new Glendell MIA and realignment of a section of Hebden Road and part of Yorks Creek. The existing Glendell Consent would subsequently be surrendered within a reasonable time following the commencement of the Glendell Continued Operations Consent.

The Project also requires modifications of the approved operations regulated under the existing Mount Owen Consent, in particular, the extended use of the Mount Owen CHPP and associated transport infrastructure, and the potential use of the Mount Owen MIA. The Project also includes the use of North Pit and Bayswater North Pit for water and/or tailings storage as part of the Mount Owen Complex WMS. The proposed modifications will result in a development which is substantially the same to the development originally approved under the Mount Owen Consent in 2016. The proposed modifications to the Mount Owen Consent include the ongoing processing of ROM coal from Glendell at the Mount Owen CHPP and ongoing use of associated infrastructure including the Mount Owen Rail Loop for coal transport. The changes to approved operations under the Mount Owen Consent are being sought as a modification of the Mount Owen Consent under section 4.55(2) of the EP&A Act. This modification is referred to in this EIS as the Mount Owen Consent Modification.

A separate modification of the Mount Owen Consent is currently being prepared for construction of a new pipeline from the Western Rail Dam (WRD, formerly known as TP2) at the Mount Owen Complex to Ravensworth Operations as part of the GRAWTS. The modification application is referred to in this EIS as the Narama Pipeline Modification.

The Project Area, the subject of the development application for the Glendell Continued Operations Consent is shown on **Figure 1.3** and a schedule of lands within the Project Area is included as **Appendix 2**. The boundary of the Mount Owen Consent Area is also shown on **Figure 1.3** and includes the proposed changes to the Mount Owen Consent Area associated with the Narama Pipeline Modification.. **Appendix 2** includes the schedule of lands for the Mount Owen Consent Area.

Further detail of the proposed Project is provided in **Section 3.0**. **Section 3.2** provides details of the development that is proposed to be approved by the Glendell Continued Operations Consent while **Section 3.3** contains details regarding the proposed modifications to the Mount Owen Consent required as part of the Project. **Section 5.0** includes further details regarding the respective approval/modification processes and other approvals required under NSW Legislation.

1.4.2 Commonwealth approval requirements

In addition to the approvals required for the Project under NSW legislation, consideration of the Project is required under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Project was declared to be a controlled action under the EPBC Act on 10 July 2019 in relation to its potential impacts on the following Matters of National Environmental Significance (MNES):

- listed threatened species and communities (sections 18 & 18A EPBC Act) and
- a water resource, in relation to coal seam gas development and large coal mining development (sections 240 and 24E EPBC Act).

This EIS also considers the impacts on the relevant MNES (refer to **Sections 0**, **7.6** and **Appendix 10**).

1.4.3 The Proponent

The applicant for the proposed Glendell Continued Operations Consent is Glendell Tenements Pty Ltd, a 100% owned subsidiary of Glencore.

The applicant for the section 4.55(2) modification of the Mount Owen Consent is Mt Owen Pty Limited, a 100% owned subsidiary of Glencore.

For the purposes of this EIS, the proponents are collectively referred to as Glencore.

1.5 Environmental assessment of the Project

This EIS has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Glencore in accordance with the requirements of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), including the Secretary's Environmental Assessment Requirements (SEARs) for the Project. The SEARS are discussed further below.

Details of the project team and the technical specialists responsible for preparation of assessments as part of this EIS are provided in **Appendix 3**.

1.5.1 Secretary's Environmental Assessment Requirements (SEARs)

This EIS has addressed the SEARs provided for the Project which were issued by Department of Planning, Industry and Environment (DPIE) on 7 June 2018 and reissued on 11 July 2018 and 12 August 2019.

The SEARs outline the specific requirement to include a detailed assessment of the potential impacts of the development in the local and regional community in accordance with the *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development* (DPE, 2017).

A checklist of the SEARs and where they have been addressed in the EIS is outlined in **Appendix 4**. The specific government agency requirements included as an attachment to the SEARs have been considered and addressed where relevant, throughout the EIS and the relevant specialist studies.

1.5.2 EIS structure

This EIS has been prepared in accordance with the EP&A Act and the EP&A Regulation. An overview of the structure of this EIS is provided below.

The **Executive Summary** provides a brief overview of the Project and the major outcomes of the EIS.

Section 1.0 introduces the Project, outlines the background, provides an overview of existing and approved operations at Mount Owen Complex and environmental context, provides a summary of the key Project details, provides a summary of the approval requirements and process, outlines the SEARs Requirements, alternatives considered and outlines the EIS project team and the EIS structure.

Section 2.0 contains a detailed description of currently approved operations at the Mount Owen Complex.

Section 3.0 contains a detailed description of the Project as proposed. **Appendix 5** contains a summary of the proposed mitigation and management measures that will be implemented as part of the Project.

Section 4.0 outlines the environmental and strategic context for the Project including the physical and social context, and planning and policy context.

Section 5.0 summarises the State and Commonwealth statutory context for the approval process and Project once operational

Section 6.0 describes the stakeholder consultation program and details the environment and community issues identified as part of this process for consideration in the EIS.

Section 7.0 contains a comprehensive analysis and assessment of the key environmental, social and economic issues relevant to the Project, including the Project specific and cumulative impacts.

Section 8.0 summarises the key conclusions arising from the detailed environmental assessment process.

Section 9.0 lists references cited in the EIS.

A list of Abbreviations and a Glossary of technical terms is provided in **Section 10.0** to assist with reading and understanding the EIS.

SECTION 2.0

Description of Approved Mining Operations at Mount Owen Complex

2.0 Description of approved mining operations at Mount Owen Complex

2.1 The Mount Owen Complex

Mining operations at what is now the Mount Owen Complex were commenced by the Hebden Mining Company at Ravensworth East Mine (previously known as Swamp Creek Mine) and date back to the early 1960s.

Ravensworth East Mine has been subject to various modifications including:

- integration with the Mount Owen Mine and Glendell Mine in 2008 to allow efficient processing and haulage of coal to the Mount Owen CHPP
- the emplacement of tailings within the Ravensworth East voids from the Mount Owen CHPP.

Mining in the Ravensworth East Mine is currently limited to the Bayswater North Pit and tailings emplacement in the West Pit void; and ancillary development associated with these activities are undertaken pursuant to the Mount Owen Consent.

Mining operations within the Mount Owen Mine (North Pit) commenced in 1993 under the management of Hunter Valley Coal Corporation Pty Limited (HVCC). The Mount Owen Consent, granted in 2016, brought the Mount Owen and Ravensworth East Mines under a single development consent with the former consents for these operations surrendered. Mining is approved in the North Pit to 2037. Mining in Bayswater North Pit is expected to be finished by approximately 2023. Glencore (formerly Xstrata) has owned the Mount Owen, Ravensworth East and Glendell Mines as the Mount Owen Complex since 2004.

The Glendell Consent was granted on 2 May 1983 permitting production of up to 3.6 Mtpa ROM coal from the Glendell Mine. A subsequent modification in 1997 enabled the transport and emplacement of overburden from Glendell Mine into southern voids of the Ravensworth East mine. A modification of the Glendell Consent approved in February 2008 allowed the integration of the Glendell Mine with the broader Mount Owen Complex. This modification removed the duplication of coal processing, handling and transport infrastructure and enabled integrated water and tailings management at the operations forming the Mount Owen Complex. Mining commenced pursuant to the Glendell Consent in 2008.

The Glendell Mine forms part of the broader Mount Owen Complex however the Glendell Consent is limited to the management of the mining operations in the Glendell Pit and associated rehabilitation. ROM coal extracted from the Glendell Pit is transported to the Mount Owen CHPP for processing and the integrated coal handling and processing facilities, product transport, tailings disposal and water management systems are all managed under the Mount Owen Consent.

The integration of water management and tailings disposal systems between the Mount Owen Complex and the other Glencore operated mines of Integra Underground, Liddell Coal Operations and Ravensworth Operations (refer to **Figure 1.2**) is also approved under the various development consents and project approvals for each operation. This integrated water and tailings management system is known as the GRAWTS and enables water and tailings to be transferred between sites to optimise water use and management at these operations and provide for more efficient management and emplacement of tailings from CHPPs. The Mount Owen Complex WMS and the water sharing aspect of the GRAWTS is described in further detail in **Section 2.1.4**. The tailings sharing aspects of the GRAWTS is described in further detail in **Section 2.1.3**.

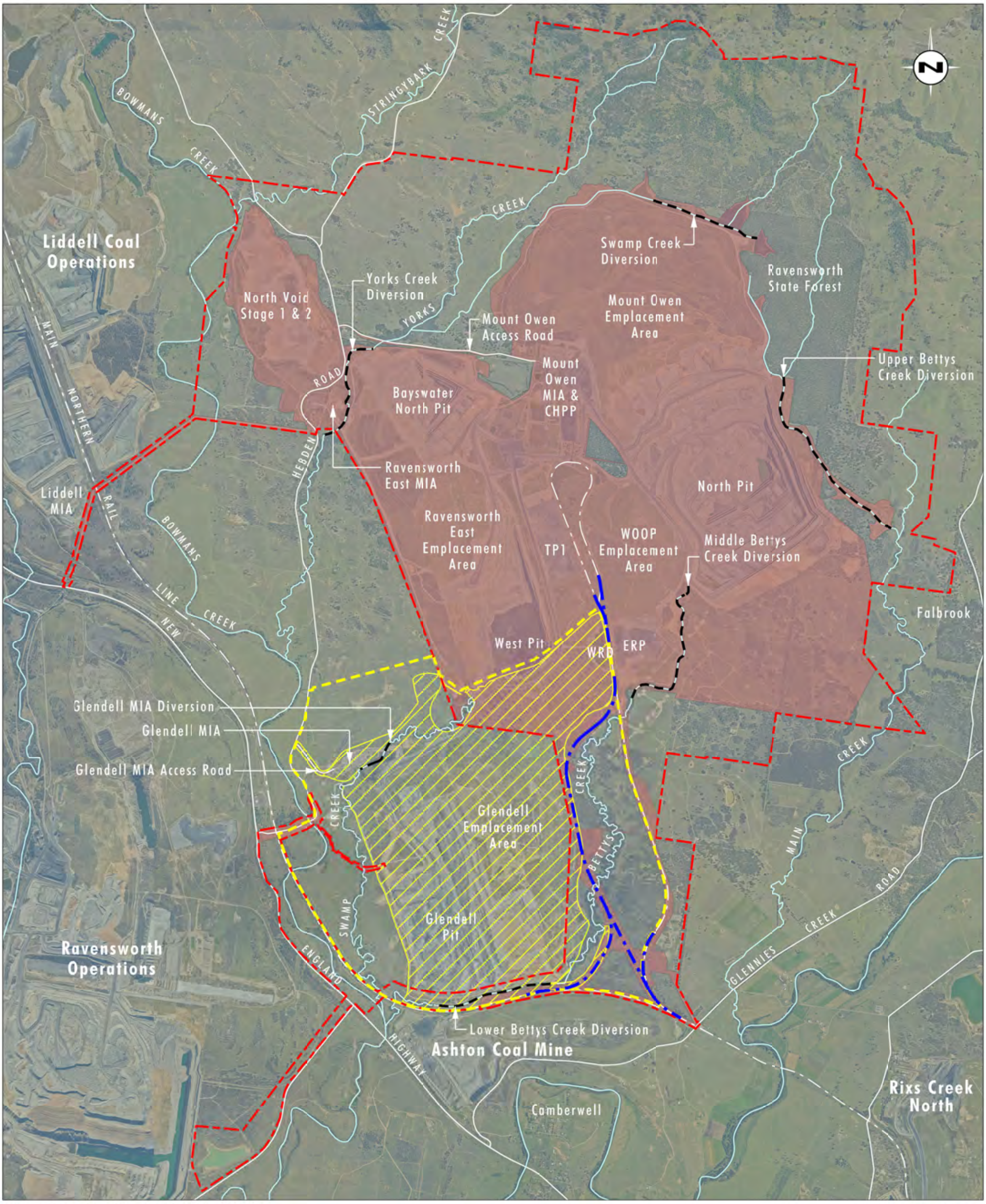


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved.
Approved Glendell Disturbance Area assumes Glendell MOD 4 is approved

Legend

- Glendell Consent Boundary (DA 80/952)
- Mount Owen Consent Boundary (SSD-5850)
- Approved Mount Owen Operational Area
- Approved Glendell Disturbance Area
- Existing Creek Diversion
- Approved Rail Upgrade Works

FIGURE 2.1

Mount Owen Complex Approved Operations

Mt Owen Pty Limited operates the Mount Owen CHPP and associated infrastructure, and the Ravensworth East Mine (Bayswater North Pit) and the Glendell Mine (Glendell Pit). Thiess Pty Ltd currently operates the North Pit within the Mount Owen Mine under a contractual agreement with Mt Owen Pty Limited.

2.1.1 Key operational aspects

Key operational aspects at the current Mount Owen Complex are provided in **Table 2.1**. Key features of the existing approved development are shown on **Figure 2.1**.

Table 2.1 Key Operational Aspects of Existing Approved Developments at Mount Owen Complex

Operational Aspect	Glendell Consent (DA 80/952)	Mount Owen Consent (SSD-5850)
Mining Area	Glendell Pit (also referred to as Barrett Pit)	North Pit Bayswater North Pit
Production Limits	Glendell Pit - up to 4.5 Mtpa ROM coal	North Pit - up to 10 Mtpa ROM coal Bayswater North Pit - up to 4 Mtpa ROM coal
Mining Method	Glendell Pit - open cut (truck and excavator)	North Pit – open cut (truck and excavator) Bayswater North Pit - open cut (truck and excavator)
Approved Mine Life	Glendell Pit - to 30 June 2024	North Pit – to 31 December 2037 Bayswater North Pit (approved to 31 December 2037 but mining scheduled to be completed by 2023)
Operating Hours	24 hours per day, 7 days per week	24 hrs per day, 7 days per week
Previously Mined Areas	N/A - Glendell Pit currently being mined	Eastern Rail Pit (ERP), Tailings Pit 1 (TP1), Western Rail Dam (WRD) (formerly known as TP2), RW Pit, North Void Stage 1 (NVS1), North Void Stage 2 (NVS2), West Pit.
Tailings Emplacement	N/A - Tailings generation and emplacement undertaken pursuant to the Mount Owen Consent	West Pit Bayswater North Pit and cells in North Pit also approved for tailings emplacement Former tailings disposal areas include: TP1, ERP, RW Pit, NVS1 and NVS2 Approved receipt of tailings from Ravensworth Operations and Liddell Coal Operations for emplacement at Mount Owen Complex tailings facilities pursuant to GRAWTS Approved disposal of tailings at other operations as part of the GRAWTS
Overburden Emplacement	In-pit emplacement in Glendell Pit and out-of-pit emplacement adjacent to Glendell Pit to approximately 160 mAHD	In-pit emplacement at Bayswater North Pit to approximately 160 mAHD, and North Pit to approximately 230 mAHD Out-of-pit emplacement at western out-of-pit (WOOP) emplacement area to approximately 190 mAHD, and parts of Ravensworth East emplacement area to approximately 160 mAHD Capping of former tailings facilities and West Pit
Approved final voids	Glendell Pit	Bayswater North Pit North Pit

Operational Aspect	Glendell Consent (DA 80/952)	Mount Owen Consent (SSD-5850)
Coal Processing	No coal processing at Glendell ROM coal transported to Mount Owen CHPP for processing	Mount Owen CHPP (up to 17 Mtpa) and transfer to Liddell CHPP (up to 2 Mtpa ROM)
Coal Transportation	Via the Mount Owen CHPP and approved Mount Owen Consent transport methods	Mount Owen Rail Loop Conveyor to Liddell Coal Operations, Ravensworth Coal Terminal, Bayswater Power Station and Liddell Power Station
Mine Infrastructure Area (MIA)	Glendell MIA	Mount Owen MIA and Ravensworth East MIA
Workforce	Approximately 300 full time equivalent (FTE) positions	Approximately 920 FTE positions
Creek Diversions	Bettys Creek diverted around southern extent of Glendell Pit Swamp Creek diverted adjacent to Glendell MIA (refer to **Figure 1.2**)	Upper reaches of Bettys Creek into Main Creek Upper reaches of Swamp Creek to Yorks Creek Bettys Creek diverted around ERP Yorks Creek diverted as part of former Swamp Creek Mine around current Ravensworth East MIA (refer to **Figure 1.2**)

2.1.2 Approved operational areas

Mining operations and related activities (including creek and road diversions) have been undertaken in the Mount Owen Complex area since the 1960s. Active mining operations continue at the Mount Owen Mine, Ravensworth East Mine and Glendell Mine. All three operations also include areas of previous disturbance that is in the process of being rehabilitated. The Mount Owen Consent includes obligations to rehabilitate all areas disturbed pursuant to operations approved under the former Ravensworth East and Mount Owen consents, including disturbance associated with the former Swamp Creek Mine. As part of the preparation of this EIS, a detailed review of all areas historically disturbed under these development consents was undertaken to understand the full extent of the areas where the rehabilitation requirements under the Mount Owen Consent apply. As many of the former consents did not include a delineation of approved disturbance areas, the location of areas actually disturbed from the range of historical and contemporary approved mining activities at the Mount Owen Complex was identified through aerial imagery. The extent of historical approved disturbance and areas approved for disturbance under the current Mount Owen Consent (referred to as the Approved Mount Owen Operational Area) is shown on **Figure 2.1**. The Mount Owen Consent Area also includes the areas associated with the proposed Narama Pipeline Modification, which is the subject of a separate modification (refer to **Section 2.1.4.2**). The extent of the Approved Glendell Disturbance Area under the Glendell Consent is also shown on **Figure 2.1** and assumes that Glendell Modification 4 is approved**.**

There is currently an overlap of approved disturbance areas under the Glendell Consent and Mount Owen Consent. There are also areas under each consent that are approved for disturbance but have not yet been disturbed. While rehabilitation has commenced in some areas of historical disturbance, ongoing disturbance in these areas may still be required for ongoing operations or further rehabilitation works, including ongoing drainage works, erosion controls, or vegetation management/replanting.

2.1.3 Coal handling and processing

ROM coal mined at the Glendell Pit, North Pit and Bayswater North Pit is processed at the Mount Owen CHPP. The Mount Owen CHPP is approved under the Mount Owen Consent to process up to 17 Mtpa ROM coal until 2037.

Where possible, to minimise re-handle and to improve operating efficiencies, coal is directly fed to the Mount Owen CHPP through trucks dumping directly into hoppers at the CHPP ROM stockpile areas without stockpiling. Where this is not possible, ROM coal is stockpiled prior to processing.

Coarse reject from the CHPP is hauled via trucks back into the active overburden emplacement areas.

Tailings (fine reject) material from the Mount Owen CHPP is pumped to West Pit. Tailings are also approved to be emplaced in the Bayswater North Pit and in cells in the North Pit and, subject to relevant approvals being granted, may be emplaced in Liddell Coal Operations voids as part of the GRAWTS. The tailings facilities at the Mount Owen Complex are also approved to receive tailings from Liddell Coal Operations and Ravensworth Operations CHPPs as part of the GRAWTS. The GRAWTS linkages are discussed further in **Section 2.1.4.2**. The ability to transfer tailings between operations and utilise different voids allows the emplacement of tailings materials in voids to be managed to avoid the need to construct and manage above ground tailings facilities. The ability to manage tailings within the GRAWTS also has rehabilitation benefits, both through the reduction of voids by filling them with tailings and through the ability to transfer tailings to other emplacement facilities to enable drying and consolidation prior to recommencing further emplacement or capping.

Product coal is transported from the Mount Owen Complex using the Mount Owen Rail Loop or to the Liddell and/or Bayswater Power stations by conveyor. Up to 2 Mtpa ROM coal and/or crushed gravel can also be transported by conveyor from the Mount Owen Complex to the Liddell Coal Operations and/or Ravensworth Coal Terminal. Export product coal is currently loaded onto trains using the Mount Owen Complex load out facility and rail loop (refer to **Figure 2.2**) and is transported to the Port of Newcastle via the Main Northern Rail Line. The Mount Owen Consent also approves the construction of additional rail loop connections to minimise impacts associated with subsidence from the Integra Underground operations and enable greater flexibility in coal train movements to and from the complex.

The Mount Owen Complex operates 7 days per week, 24 hours per day.

2.1.4 Water management system

The Glendell Mine WMS will continue to be managed as an integrated component of the Mount Owen Complex WMS. In addition, the Mount Owen Complex is an integral part of the GRAWTS which links it to the water management systems of Liddell Coal Operations, Ravensworth Operations and Integra Underground.

A schematic diagram of the GRAWTS linkages and key WMS infrastructure within the GRAWTS are shown in **Figure 2.3**.

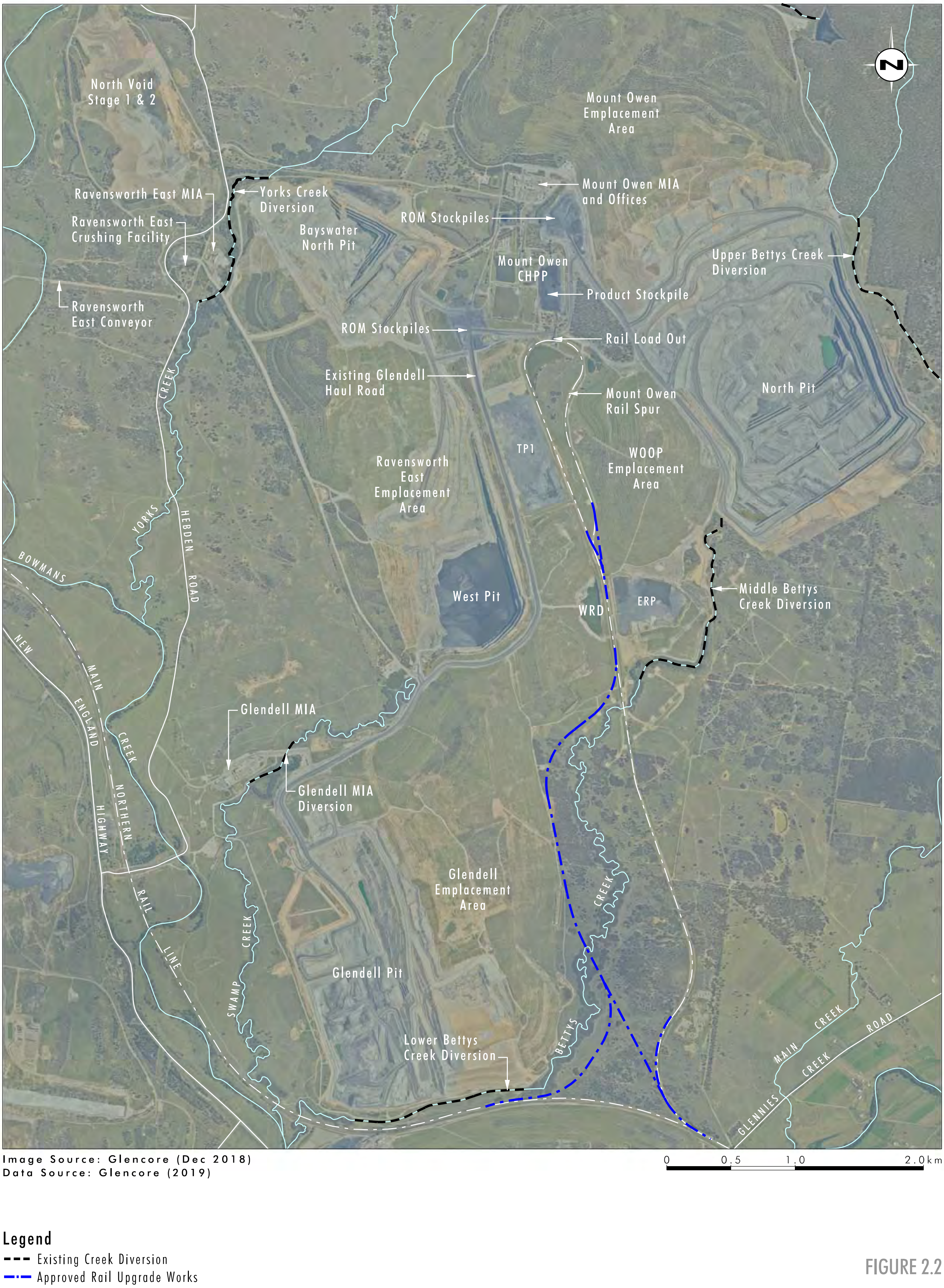
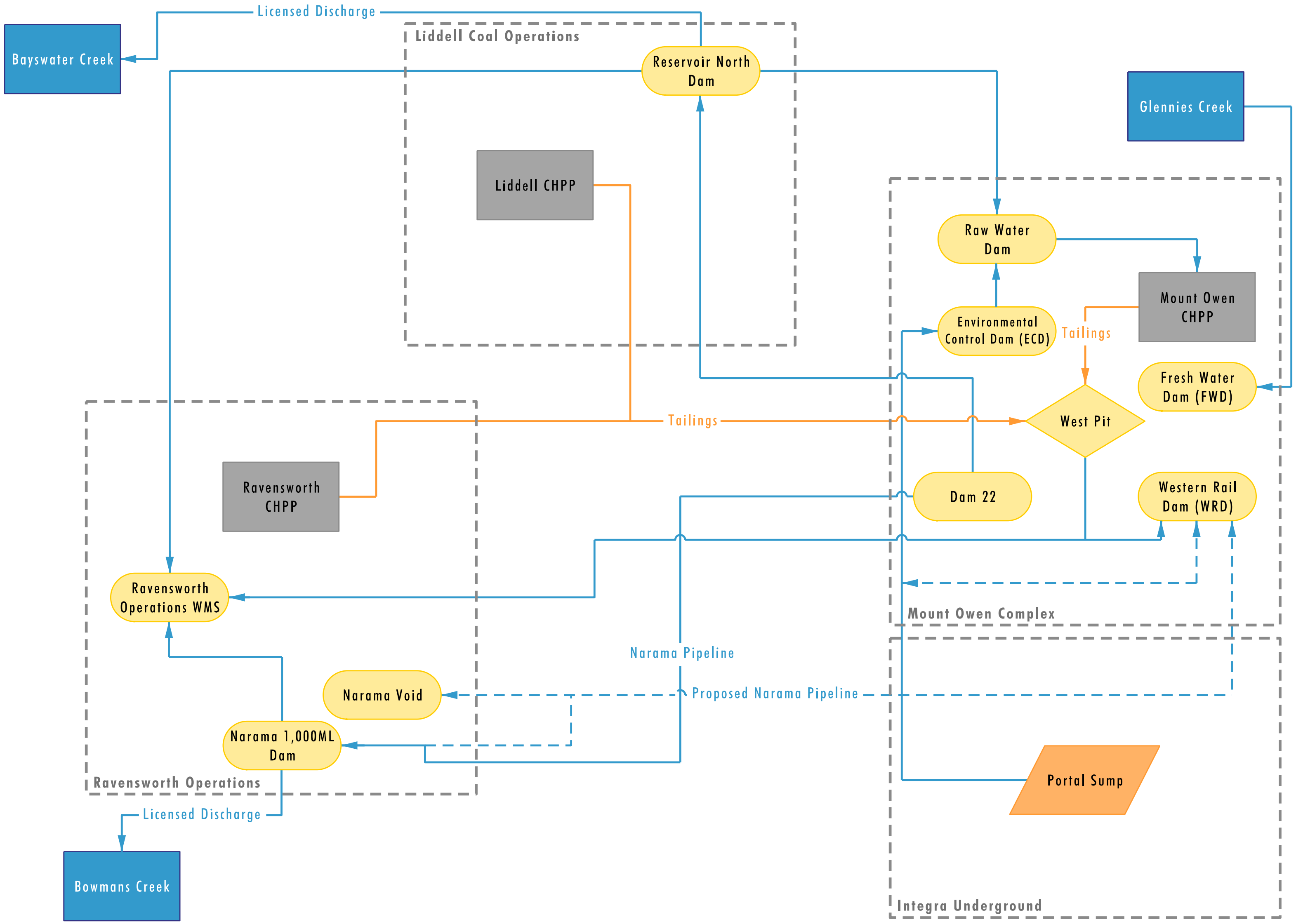


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)

FIGURE 2.2

Mount Owen Complex
Approved Coal Handling Facilities



Legend

- Proposed Narama Pipeline Modification Water Linkage
- Existing Water Linkage
- Tailings Transfer Linkage

Image Source: Glencore (2019)

FIGURE 2.3

Key Infrastructure and Linkages within the GRAWTS

File Name (A4): R08/4166_540.dgn
20191129 8.32

2.1.4.1 Mount Owen Complex WMS

Water management at the Mount Owen Complex considers three categories of water, each with different potential to cause environmental harm. The target design criteria for water storages holding the three categories of water are based on the management of pollution risk and are summarised in **Table 2.2**.

Table 2.2 Design Criteria for Components of Mount Owen Complex Water Management System

Water Category	Water Description	Target Storage Design Criteria
Clean	Runoff from undisturbed or rehabilitated areas and selected hard surface areas where coal and fuel/oil contamination risks are low. Raw water sourced under licence from Glennies Creek is also managed as clean water until use.	N/A – no pollution risk from discharge. Runoff from clean catchments is released, where feasible and practicable, to downstream environment.
Dirty	Runoff from disturbed areas and overburden emplacement areas (does not include water captured in mining pit areas, runoff from coal processing areas or workshops).	Managed in line with the Blue Book (*Managing Urban Stormwater: Soils and Construction Volumes 1* and *2E*). Designed with capacity to manage runoff from the 5 day, 95^{th} percentile rainfall event. Water captured in sediment dams is pumped to storage dams where it is used for operational purposes.
Mine	Runoff from active mining areas and areas exposed to coal, runoff from coal processing areas and workshops, groundwater recovered from mining areas, or water used in coal processing or from coal stockpile areas and water recovered from tailings.	Contained for events up to and including the 1% annual exceedance probability (AEP) 24-hour storm event.

Raw water obtained under licenses from Glennies Creek is used at the Mount Owen and Glendell MIAs. Mine water (including water pumped from the dirty water system sediment dams pursuant to Blue Book requirements) is used for operational purposes at Mount Owen Complex, including the CHPP and dust suppression.

Excess mine water at the Mount Owen Complex is managed under the GRAWTS with any necessary discharges occurring at the Ravensworth Operations and/or Liddell Coal Operations pursuant to licenses held for those operations.

The clean water management system at the Mount Owen Complex includes a number of existing creek diversions. These are discussed further in **Section 2.1.5**.

2.1.4.2 Greater Ravensworth Area Water and Tailings Scheme (GRAWTS)

The GRAWTS allows greater flexibility in water management for the Mount Owen Complex and other operations in the GRAWTS by allowing mine water to be transferred from sites with excess water to sites with storage capacity and/or higher usage demands or discharge opportunities. This flexibility assists in reducing the need to draw raw water from licenced external sources, including the Hunter River and Glennies Creek, and reduces the need to discharge water under the Hunter River Salinity Trading Scheme (HRSTS). The Mount Owen Complex does not have a licenced discharge point.

The key GRAWTS linkages between the Mount Owen Complex and other mines include (refer to **Figure 2.3**):

- linkage between Ravensworth Operations and the Mount Owen Complex for the transfer of tailings
- linkage between Liddell Coal Operations and the Mount Owen Complex for the transfer of tailings
- linkage between Liddell Coal Operations and the Mount Owen Complex for the transfer of mine water
- linkage between Integra Underground and the Mount Owen Complex for the transfer of mine water
- a linkage between Ravensworth Operations and the Mount Owen Complex for the transfer of mine water (referred to as the Narama Pipeline).

As described in **Section 1.4.1**, a separate modification of the Mount Owen Consent (Narama Pipeline Modification) is currently being prepared for the construction of a new GRAWTS pipeline from WRD at the Mount Owen Complex to Ravensworth Operations to augment (and ultimately replace) the existing Narama Pipeline, which will be mined through as part of the Glendell Pit Extension.

2.1.5 Historical and approved creek diversions

Approved mining operations at the Mount Owen Complex have involved the realignment and diversion of sections of Yorks Creek, Swamp Creek and Bettys Creek. These diversions are shown on **Figure 2.1**.

2.1.5.1 Yorks Creek

Yorks Creek is an ephemeral tributary of Bowmans Creek. An approximately 1.5 km section of Yorks Creek has previously been diverted around the Ravensworth East MIA as part of the former Swamp Creek Mine/Ravensworth East mining operations (in the late 1970s, early 1980s) (refer to **Figure 2.1**). **Plate 2.1** and **Plate 2.2** show sections of the existing Yorks Creek Diversion adjacent to the Ravensworth East MIA.

The catchment of Yorks Creek upstream of the Glendell Pit Extension has been significantly modified due to approved mining at Ravensworth East Mine and Mount Owen Mine. As these areas are rehabilitated, runoff will be progressively returned into the Yorks Creek catchment. This progressive increase in the size of the upper catchment will occur during the life of the Project.

Plate 2.1 Yorks Creek Diversion east of Ravensworth East MIA (January 2018)

© Umwelt, 2018

Plate 2.2 Yorks Creek Diversion adjacent to Ravensworth East MIA (January 2018)

© Umwelt, 2018

2.1.5.2 Swamp Creek

Swamp Creek is an ephemeral tributary of Bowmans Creek which has been significantly modified by approved mining projects. The remnant upper reaches of Swamp Creek are intercepted by dams located to the immediate north of the North Pit emplacement area with overflow from the dams diverted to the west into Yorks Creek (known as the Swamp Creek Diversion). The central areas of the former Swamp Creek catchment are located within the existing approved disturbance area for Mount Owen Mine and Ravensworth East Mine. This central section of former catchment of Swamp Creek is located entirely within the Approved Mount Owen Operational Area and Approved Glendell Disturbance Area and is managed as part of the Mount Owen Complex WMS.

The lower reaches of Swamp Creek include areas within the Approved Glendell Disturbance Area. A section of this lower reach of Swamp Creek has been diverted around the Glendell MIA (known as the Glendell MIA Diversion) (refer to **Figure 2.1**). Downstream of the Glendell MIA, the Swamp Creek floodplain merges with the Bowmans Creek floodplain.

Drainage from the central areas of the Mount Owen Complex (including the Mount Owen MIA, CHPP area and rehabilitated rail loop) which are currently contained within the Mount Owen Complex WMS are generally redirected towards Swamp Creek in the approved conceptual final landform (refer to **Section 2.1.6**).

2.1.5.3 Bettys Creek

Bettys Creek is another ephemeral tributary of Bowmans Creek which is located to the east and south of the current Glendell operations and has previously been diverted around the southern end of the Glendell Pit as approved under the Glendell Consent (known as the Lower Bettys Creek Diversion).

Plate 2.3 shows the Lower Bettys Creek Diversion. The remnant upper reaches of Bettys Creek catchment to the north of the Mount Owen Complex have previously been diverted towards Main Creek (known as the Upper Bettys Creek Diversion) as part of the approved Mount Owen operations (refer to **Figure 2.1**). A third diversion of Bettys Creek (known as the Middle Bettys Creek Diversion) occurs around the southern extent of the Eastern Rail Pit (ERP) (refer to **Figure 2.1**).

Parts of the Bettys Creek catchment are also located within the Approved Mount Owen Operational Area and are managed as part of the Mount Owen Complex WMS. The approved conceptual final landform retains the diversion of the upper catchment of Bettys Creek towards Main Creek, as well as all other creek diversions within the Mount Owen Complex.

Plate 2.3 Lower Bettys Creek Diversion (June 2018)

2.1.5.4 Main Creek

Main Creek is an ephemeral tributary of Glennies Creek, located to the east of the Mount Owen Complex. The approved diversion of Bettys Creek upper catchment areas into Main Creek has resulted in an increase in the catchment of Main Creek. The approved conceptual final landform for Mount Owen Mine also changes the catchment area of Main Creek.

The Glendell Mine does not directly impact on Main Creek.

2.1.6 Approved final landform and final land use

The approved conceptual final landform and revegetation strategy for the Mount Owen Complex is shown in **Figure 2.4**. There are three approved final voids at the Mount Owen Complex: the North Pit and Bayswater North Pit voids (both approved under the Mount Owen Consent) and the Glendell Pit void (approved under the Glendell Consent).

The conceptual final land use of the rehabilitated Mount Owen Complex is agriculture, forestry (within Ravensworth State Forest area) and native vegetation/conservation. These uses are all permissible without consent in these areas.

At least 2037 ha of disturbed land within the Mount Owen Consent Area 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 woodland 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 general locations of woodland and treed vegetation commitments under the Mount Owen Consent and Glendell Consent are shown in **Figure 2.4**, however the final location of woodland and treed vegetation will be delineated in the Mount Owen Complex Mining Operations Plan (MOP). The revegetation strategy for the approved Mount Owen Complex has been designed to improve regional habitat connectivity and provide linkages between offset areas (refer to **Section 2.1.7**) and Ravensworth State Forest.

The current extent of progressive rehabilitation (as of October 2018) at the Mount Owen Complex is shown on **Figure 2.5**. Some areas of this rehabilitation in the Mount Owen Consent Area, particularly in the Ravensworth East Mine were commenced prior to the grant of the Mount Owen Consent. To date, whilst no areas of rehabilitation at the Mount Owen Complex have met relevant completion criteria, monitoring of the Mount Owen North Pit rehabilitation indicates that it is strongly trending towards this criteria.

Under the current Mount Owen Consent and Glendell Consent, all mining infrastructure is to be removed (unless otherwise approved by the DPIE - Resources Regulator (Resources Regulator)) as part of the mine closure process. Opportunities to implement higher value end land uses (including uses which can maximise the use of existing infrastructure) in rehabilitated areas will be investigated as part of the mine closure planning process. Further approval may be required for these uses if not permissible without consent at the time of closure.

2.1.7 Offset areas

2.1.7.1 Biodiversity offset areas

Twelve biodiversity offset areas have been approved to offset the impacts of the Mount Owen Complex projects over the years. These are listed in **Table 2.3**.

The Mount Owen Complex offset areas located in close proximity to the Mount Owen Complex are shown in **Figure 2.4**. The Esparanga Offset is located west of the Project near the Manobalai Nature Reserve and the Mitchell Hills Offset is located to the north west of the Mount Owen Complex adjacent to other Glencore offset areas.

Table 2.3 Mount Owen Complex Biodiversity Offset Areas

Name	Area (ha)	Consent
Travelling Stock Reserve (TSR) Offset	25.1	Mount Owen Consent#
Southeast Offset	58.3	
Forest East Offset	110.9	
Southeast Corridor Offset	74.1	
Northeast Offset	83.6	
Northwest Offset	71.4	
Southern Remnant Offset	4.0	
Cross Creek Offset	367.0	Mount Owen Consent EPBC 2013/6978
Stringybark Creek Habitat Corridor Offset	97.5	
Esparanga Offset	303.0	
Mitchell Hills Offset	143.7	
Rehabilitation Woodland	518.0*	
Bettys Creek Habitat Management Area (HMA)	174.0	Glendell Consent
Total area	**1959.2**	

Originally required under DA 14-01-2004. Commitments were consolidated in the Mount Owen Consent following the surrender of DA 14-01-2004.

*The location of the 518 ha of Rehabilitation Woodland to contain ecological mine rehabilitation will be identified within 5 years of the commencement of development under the Mount Owen Consent.

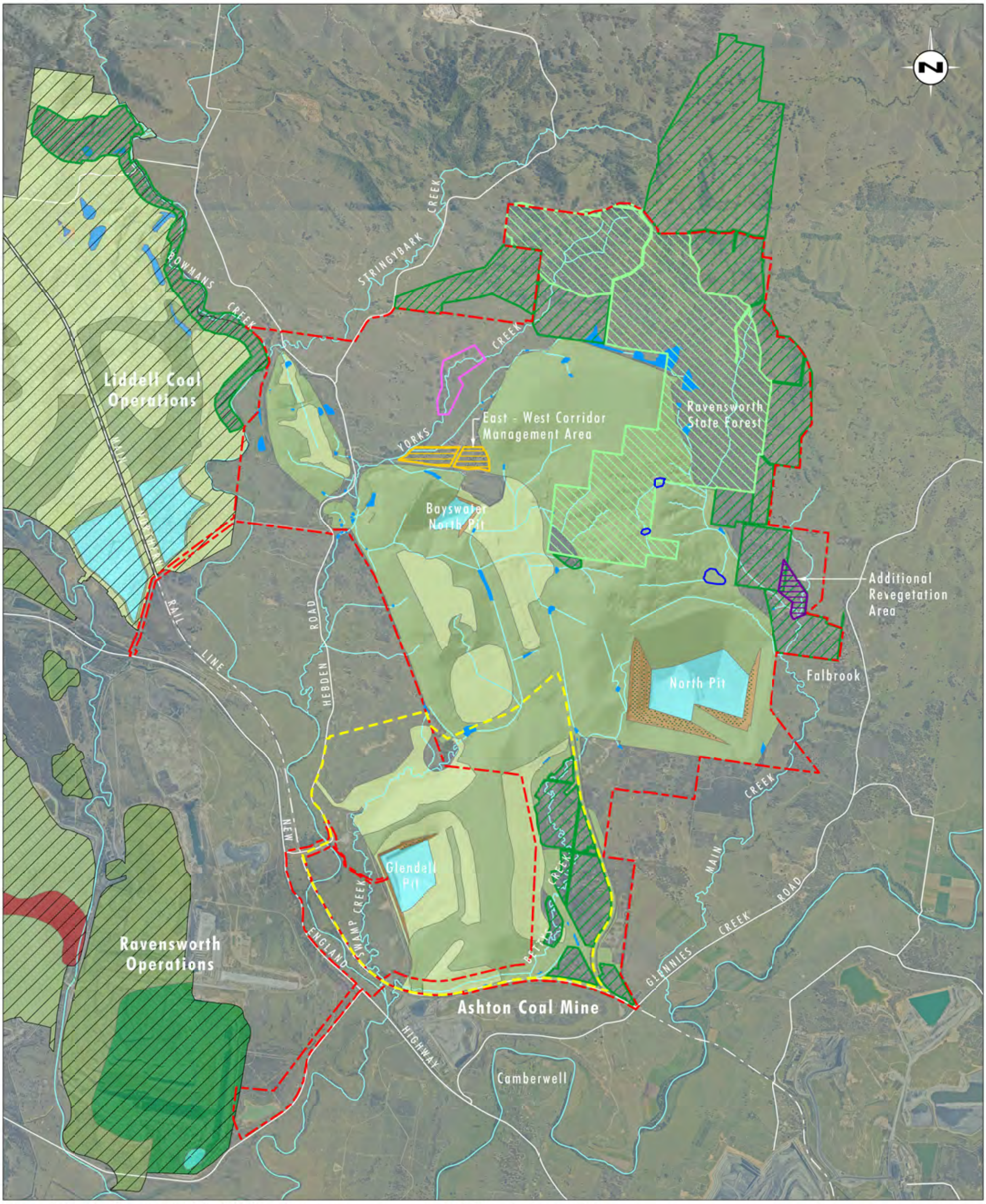


Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), Ravensworth Operation Vegetation: Umwelt (2010), Liddell Coal Operations Vegetation: Umwelt (2016)
Note: Equilibrium pit lake water level shown in void, Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 2.0 3.0 4.0km

Legend

- Glendell Consent Boundary
- Mount Owen Consent Boundary
- Native Vegetation
- Open Grassland (Potential grazing area with pockets of native vegetation)
- Grazing (Ravensworth Operations)
- Dryland Attenuation Basin
- Water Storage
- Pit Lake
- Vegetated Benches on Retained Highwall
- Retained Highwall
- Biodiversity Offset Area
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area
- East - West Corridor Management Area
- Additional Vegetation Area
- Associated with Other Operations

FIGURE 2.4

Mount Owen Complex Approved Conceptual Final Landform

File Name (A4): R08/4166_278.dgn
20191120 14.56

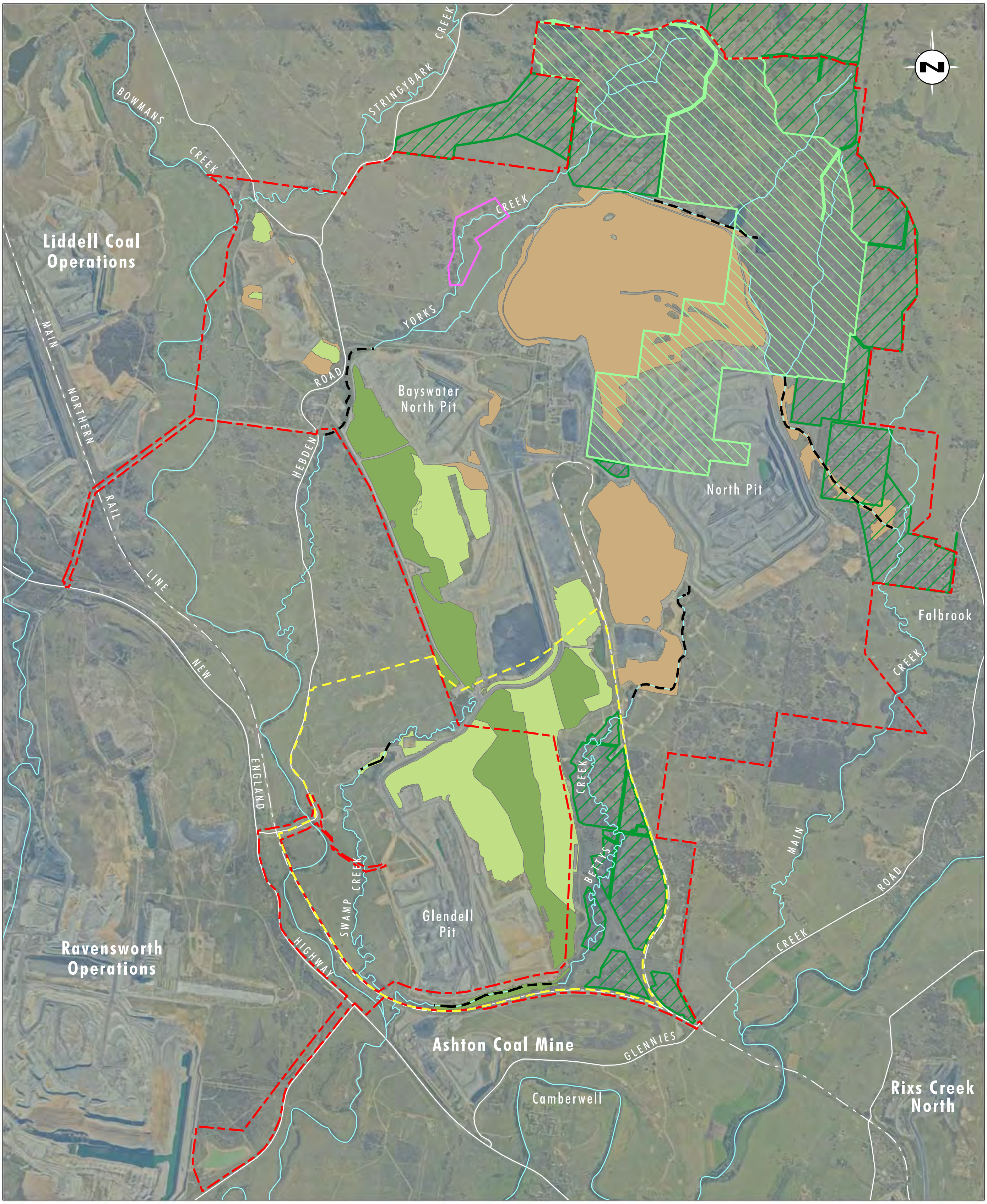


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), (2018/2019 MOP)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Glendell Consent Boundary
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Grassland Rehabilitation
- Native Woodland Rehabilitation
- Corridor - Shelter Belts
- Mount Owen Complex Biodiversity Offset Area
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area

FIGURE 2.5

Existing Rehabilitation at Mount Owen Complex (End 2018)

File Name (A4): R08/4166_601.dgn
20191128 11.13

These biodiversity offset areas were strategically selected due to their proximity to the Mount Owen Complex and their combined valuable corridor function within a fragmented and primarily agricultural landscape.

In addition to the existing biodiversity offset areas, the East-West Corridor Management Area (refer to **Figure 2.4**), has been implemented north of the Mount Owen access road. This area is maintained to retain the native vegetation and connectivity in an east to west direction between Ravensworth State Forest, rehabilitated areas in the northern area of the North Pit overburden emplacement area, and riparian vegetation along Yorks Creek and Bowmans Creek to the west toward Liddell Coal Operations. This area is not a formal offset but rather an area of active vegetation management to mitigate impacts associated with the Mount Owen Continued Operations Project on habitat connectivity until such times as rehabilitation areas are established and reinstate/enhance connectivity.

Biodiversity offset areas are managed in accordance with the Mount Owen Complex Biodiversity and Offset Management Plan.

2.1.7.2 Cultural heritage offset areas

The Yorks Creek Voluntary Conservation Area is located on Yorks Creek north of the Mount Owen access road (refer to **Figure 2.4**) and is conserved for Aboriginal cultural heritage purposes. Management strategies relating to Aboriginal cultural heritage sites and values are provided in the Mount Owen Complex Aboriginal Cultural Heritage Management Plan.

2.2 Existing approvals

2.2.1 Planning approvals

Table 2.4 summarises the status of development consents for the operations at the Mount Owen Complex.

Table 2.4 Mount Owen Complex Development Consents

Development Consent Reference	Title	Description	Approval Granted	Expiry (Mining operations)
Glendell Consent				
DA 80/952	Glendell Mine	Initial approval of Glendell Mine operations. Dragline and truck and excavator mining methods. Production Rate of 3.6 Mtpa.	02/05/1983	02/05/2013
DA 80/952 Modification No.1	Glendell Open Cut	Approval to use the Swamp Creek Mine South Void for overburden emplacement and extension of mining area.	1997	30/06/2013
DA 80/952 Modification No.2	Glendell Mine Operations	Modification of mining footprint and integration with Mount Owen Complex coal handling, processing and transport facilities. Increase in production rate to 4.5 Mtpa. Extended approved mining operations to 30 June 2024.	February 2008	30/06/2024

Development Consent Reference	Title	Description	Approval Granted	Expiry (Mining operations)
DA 80/952 Modification No.3	Powerline Relocation	Realignment of a 2.7 km section of an existing 132 kV Ausgrid powerline and associated activities.	01/12/2016	30/06/2024
DA 80/952 Modification No.4	Minor Extension	Minor extension to the Glendell Pit at Glendell Mine in order to access an additional 2.5 Mt ROM coal.	Application under assessment	30/06/2024
Mount Owen Consent				
SSD – 5850	Mount Owen Continued Operations Project	Consolidated planning approvals for Ravensworth East Mine and Mount Owen Mine under a single consent (and surrender of former consents for these operations). Approved extension of operations at Bayswater North Pit and North Pit. Life of mine at Mount Owen Complex extended. Continued integration with GRAWTS (initially approved under previous consents).	3/12/2016	31/12/2031
SSD – 5850 Modification No. 1	Integra to Mount Owen Complex Water Pipeline Modification	Modification to facilitate the construction of a water pipeline to convey mine water from Integra Underground Mine to the Mount Owen Complex.	15/09/2017	31/12/2031
SSD – 5850 Modification No. 2	Mount Owen Continued Operations – Modification 2	Modification of approved mining area at North Pit to enable access to an additional approximately 35 Mt of ROM coal from the North Pit and the extension of the approved Mount Owen Mine life by an additional 6 years.	06/09/2019	31 /12/2037
SSD – 5850 Modification	Narama Pipeline Modification	Modification to facilitate the construction of a pipeline from WRD to Ravensworth Operations (Narama Dam) as part of the GRAWTS	Application under preparation	TBC
Narama Pipeline Consent				
DA 506/2000 (Singleton Council)	Narama Pipeline Consent	Authorises construction and use of a water transfer pipeline between the Mount Owen Complex (Ravensworth East Mine) and Ravensworth Operations (Narama Mine).	22/12/2000	N/A

Ravensworth Operations, Liddell Coal Operations and Integra Underground consents all include provision for the integration of water and/or tailings management systems as part of the GRAWTS.

2.2.2 Environment Protection Licences

Table 2.5 identifies the Environment Protection Licences (EPLs) held under the *Protection of the Environment Operations Act 1997* (POEO Act) for the mining operations at the Mount Owen Complex. The Integra Underground EPL also includes surface areas that are within the Project Area.

Table 2.5 Environment Protection Licences

	Mount Owen Mine	Glendell Mine	Integra Underground
Licence	EPL 4460	EPL 12840	EPL 3390

None of the EPLs for the Mount Owen Complex have licensed discharge points. In addition, the Mount Owen Complex receives water from the Integra Underground Mine operated under EPL 3390. As noted in **Section 2.1.4**, excess water at the Mount Owen Complex is managed under the GRAWTS with any necessary discharges occurring at the Ravensworth Operations and/or Liddell Coal Operations pursuant to licenses held for those operations.

2.2.3 Mining Authorities

Table 2.6 details the mining authorities held in relation to the Mount Owen Complex and the Project Area. These authorities in the immediate area of the Glendell Pit Extension are shown on **Figure 2.6**.

Table 2.6 Mining Authorities within the Project Area and Mount Owen Complex

Reference	Authority Type	Expiry	Holder	Depth (m)
Mining leases				
CCL 708	Mining Lease	30/12/2023	Liddell Tenements Pty Limited	Varying
CCL 715	Mining Lease	Renewal pending	Mt Owen Pty Limited	Varying
CL 358	Mining Lease	27/03/2032	Glendell Tenements Pty Limited	Varying
CL 380	Mining Lease	23/09/2033	Ravensworth Operations Pty Limited	Surface to 15.24 m
CL 382	Mining Lease	11/11/2033	HV Coking Coal Pty Limited	Varying
CL 383	Mining Lease	12/11/2033	Mt Owen Pty Limited	Surface to unlimited
CL 580	Mining Lease	31/12/2023	Ravensworth Operations Pty Limited	Surface to 5 m
ML 1313	Mining Lease	13/10/2023	Liddell Tenements Pty Limited	Varying
ML 1348	Mining Lease	Renewal Pending	Glencore Newpac Pty Limited	Varying
ML 1349	Mining Lease	31/12/2023	Glencore Newpac Pty Limited	Varying
ML 1355	Mining Lease	26/07/2036	Mt Owen Pty Limited	Surface to unlimited
ML 1398	Mining Lease	10/02/2027	Resource Pacific Pty Limited	Surface to 15.24 m
ML 1410	Mining Lease	04/07/2020	Glendell Tenements Pty Limited	Surface to 106.68 m
ML 1415	Mining Lease	04/07/2020	Mt Owen Pty Limited	Varying

Reference	Authority Type	Expiry	Holder	Depth (m)
ML 1419	Mining Lease	12/11/2033	Mt Owen Pty Limited	Surface to 15.24 m
ML 1453	Mining Lease	04/07/2020	Mt Owen Pty Limited	Surface to 106.68 m
ML 1475	Mining Lease	23/11/2021	Mt Owen Pty Limited	Surface to 15.24 m
ML 1476	Mining Lease	23/11/2021	Glendell Tenements Pty Limited	Varying
ML 1477	Mining Lease	29/11/2021	Resource Pacific Pty Limited	Varying
ML 1484	Mining Lease	31/01/2024	AGL Macquarie Pty Limited; Resource Pacific Pty Limited	Varying
ML 1485	Mining Lease	17/08/2036	AGL Macquarie Pty Limited; Resource Pacific Pty Limited	Surface to 5 m
ML 1525	Mining Lease	17/11/2023	HV Coking Coal Pty Limited	Depth of 5 m below surface to 20 m
ML 1529	Mining Lease	11/11/2021	White Mining (NSW) Pty Limited	Depth of 20 m below surface to unlimited
ML 1533	Mining Lease	25/02/2024	White Mining (NSW) Pty Limited	Varying
ML 1552	Mining Lease	10/03/2025	Liddell Tenements Pty Limited	Depth of 15.24 m below surface to 900 m
ML 1561	Mining Lease	16/02/2026	Mt Owen Pty Limited	Surface to 15.24 m
ML 1597	Mining Lease	05/11/2028	Liddell Tenements Pty Limited	Surface to depth
ML 1608	Mining Lease	19/12/2028	Mt Owen Pty Limited	Surface to depth
ML 1623	Mining Lease	30/10/2029	White Mining (NSW) Pty Limited	Depth of 5 m below surface to 900 m
ML 1629	Mining Lease (Mining Purposes)	09/03/2030	Mt Owen Pty Limited	Surface to 15.24 m
ML 1668	Mining Lease	31/12/2023	Glencore Newpac Pty Limited	Depth of 106.68 m below surface to 900 m
ML 1673	Mining Lease	11/11/2033	Mt Owen Pty Limited	Varying
ML 1676	Mining Lease	04/01/2026	HV Coking Coal Pty Limited	Surface to 5 m
ML 1694	Mining Lease	22/10/2034	Mt Owen Pty Limited	Varying
ML 1786	Mining Lease	31/12/2031	HV Coking Coal Pty Limited	Varying
ML 1794	Mining Lease	31/12/2031	Mt Owen Pty Limited	Surface to 15.24 m
MPL 343	Mining Lease (Mining Purposes)	04/01/2026	Glendell Tenements Pty Limited	Surface to 5 m
Exploration Licences				
A 268	Exploration Licence	25/08/2022	Mt Owen Pty Limited	Varying

Reference	Authority Type	Expiry	Holder	Depth (m)
A 423	Exploration Licence	Renewal Pending	Mt Owen Pty Limited	Varying
A 429	Exploration Licence	Renewal Pending	Mt Owen Pty Limited	Surface to depth
EL 4918	Exploration Licence	Renewal Pending	White Mining (NSW) Pty Limited	Varying
ELA 5736	Exploration Licence	N/A	Glendell Tenements Pty Limited	Surface to 15.24 m
EL 5824	Exploration Licence	Renewal Pending	Mt Owen Pty Limited	Surface to 20 m
EL 6254	Exploration Licence	Renewal Pending	Mt Owen Pty Limited	Surface to depth
EL 6594	Exploration Licence	06/07/2020	Glendell Tenements Pty Limited	Surface to 15.24 m in Project Area
EL 8184	Exploration Licence	Renewal Pending	Glendell Tenements Pty Limited	Surface to 15.24 m and 20 m in Project Area

2.2.4 Environment Protection and Biodiversity Act 1999 (EPBC Act) Approval

The Glendell Consent was originally granted prior to the commencement of the EPBC Act and was therefore not subject to approval under that Act.

The original Ravensworth East development consents and Mount Owen Mine development consent were granted prior to the EPBC Act commencing and did not require further approval under that Act. The 2004 extension of mining operations at Mount Owen Mine was referred and determined not to be a controlled action under the EPBC Act (EPBC 2004/1369).

The Mount Owen Continued Operations Project was referred and was determined to be a controlled action under the EPBC Act. EPBC Act Approval 2013/6978 covers the changes to operations approved under the Mount Owen Consent.

The Mount Owen Continued Operations Modification 2 was referred (EPBC 2017/8083) however the modification was declared not to be a controlled action.

2.2.5 Environmental Management

All current operations at the Mount Owen Complex, including the Glendell Mine, are undertaken in accordance with approved Environmental Management Plans and Strategies as detailed below:

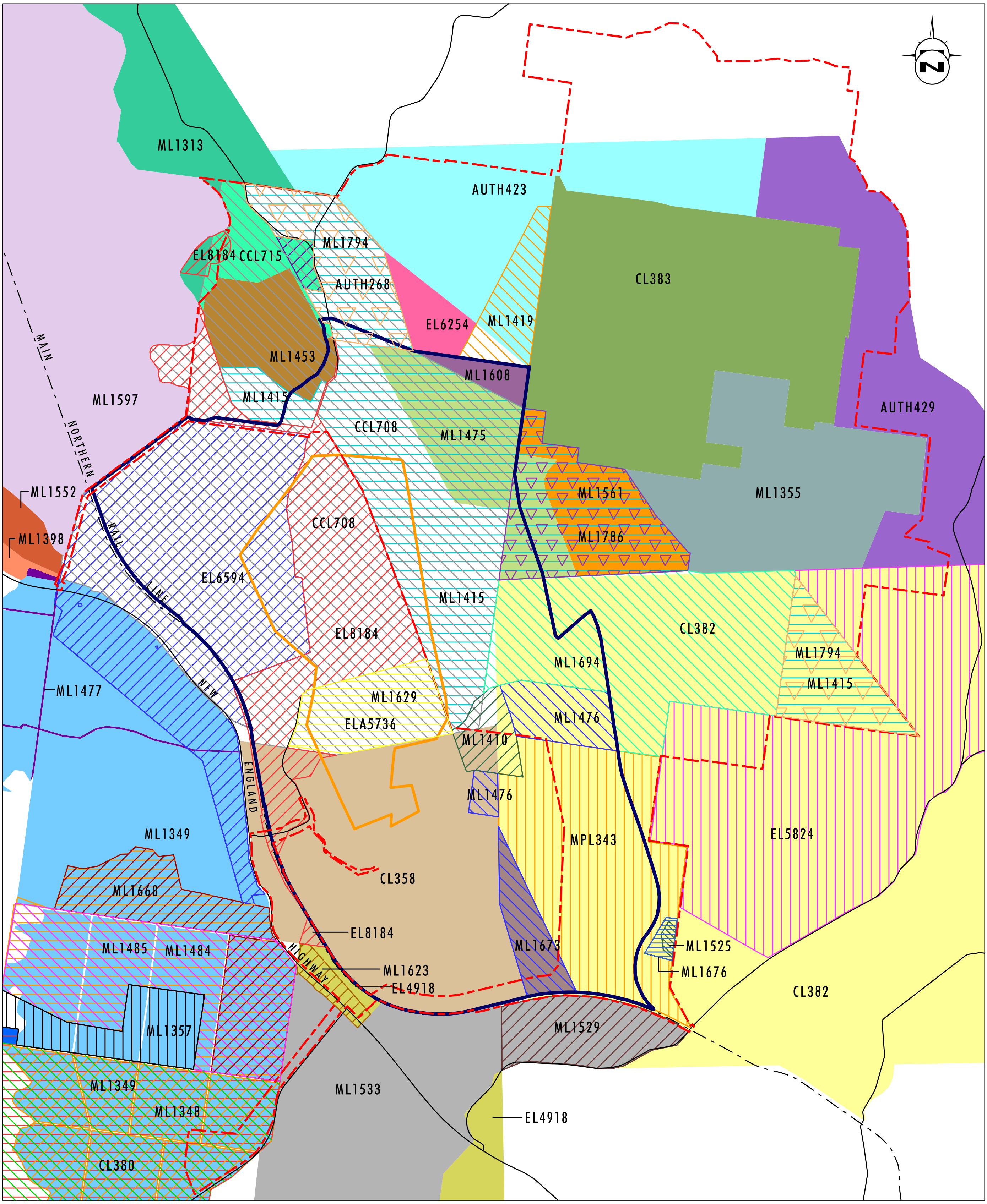
- Mining Operations Plan/Rehabilitation Management Plan (Glencore, 2019d)
- Air Quality and Greenhouse Gas Management Plan (Glencore, 2019b)
- Noise Management Plan (Glencore 2019e)
- Blast Management Plan (Glencore, 2018l)

- Water Management Plan (Glencore 2018k) (including water and salt balance, Erosion and Sediment Control Plan (Glencore, 2018g), Surface Water Management and Monitoring Plan (Glencore 2019g),Groundwater Management and Monitoring Plan (Glencore, 2019c), Surface and Groundwater Response Plan (Glencore, 2019f) and Creek Diversion Plan(2018d))
- Biodiversity and Offset Management Plan (Glencore, 2018f)
- Aboriginal Cultural Heritage Management Plan (Glencore, 2018e)
- Greenhouse Gas and Energy Efficiency Plan (Glendell Mine only) (Glencore, 2017b)
- Historic Heritage Management Plan (Glencore, 2018h)
- Pollution Incident Response Management Plan (Glencore, 2019a)

A Rehabilitation Strategy is also required under the Mount Owen Consent and was approved in May 2019. The Rehabilitation Strategy (Glencore, 2019h) only applies to the Mount Owen Consent.

The management plans include detailed environmental monitoring programs. Glencore continually monitors environmental performance and legislative compliance of the existing operations. Mining operations are managed through the existing Environmental Management System (EMS) to minimise impacts on the surrounding environment and community. The EMS provides for the monitoring and reporting of all key environmental aspects of the current operations.

Figure 2.7 shows the location of the monitoring network associated with the Mount Owen Complex. The current approved environmental management plans are available on the Mount Owen Complex website (www.mtowencomplex.com.au).



Data Source: Glencore (2019), Minview (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved.
At time of EIS finalisation, ELA5736 was pending

Legend

Project Area
Glendell Pit Extension
Mount Owen Consent Boundary
AUTH268
AUTH423
AUTH429
CCL708
CCL715
CL358
CL380
CL382
CL383
CL580
EL4918
EL5824
EL6254
EL6594
EL8184
ELA5736
ML1313
ML1348
ML1349
ML1355
ML1357
ML1398
ML1410
ML1415
ML1419
ML1453
ML1475
ML1476
ML1477
ML1484
ML1485
ML1525
ML1529
ML1533
ML1552
ML1561
ML1597
ML1608
ML1623
ML1668
ML1673
ML1676
ML1694
ML1786
ML1794
MPL343

FIGURE 2.6

Mining Authorities

File Name (A4): R08/4166_138.dgn
20191129 12.54

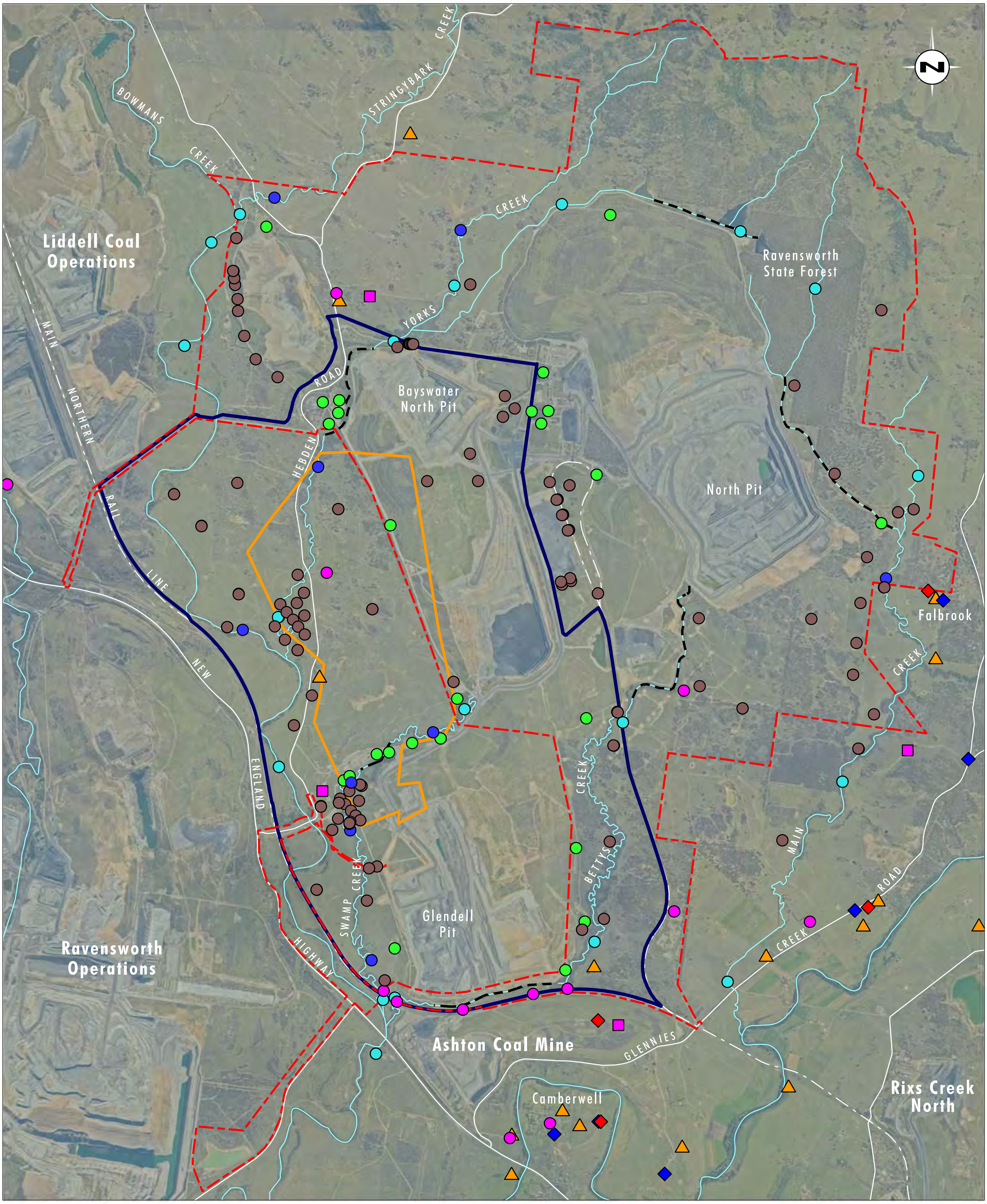


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Meteorological Station
- Air Quality Monitoring Location
- Blast Monitoring Location
- Attended Noise Monitoring Location
- Continuous Noise Monitoring Location
- Groundwater Monitoring Location
- Surface Water - Channel Stability and Stream Health
- Surface Water Onsite Storage
- Surface Water - Watercourse

FIGURE 2.7

Mount Owen Complex
Existing Monitoring Network

File Name (A4): R08/4166_279.dgn
20191114 12.42

SECTION 3.0

Project Description

3.0 Project Description

As discussed in **Section 1.0**, this EIS has been prepared to assess the environmental impacts of the Project. This EIS supports a new development consent for mining in the Glendell Pit Extension and associated infrastructure (the proposed Glendell Continued Operations Consent), and a modification of the Mount Owen Consent for the extended interactions with the proposed Glendell Pit Extension, collectively referred to as the Project.

Section 3.1 provides an overview of the overall Project including the proposed Glendell Pit Extension and proposed infrastructure requirements.

Section 3.2 details the components of the Project covered by the development application for the Glendell Continued Operations Consent.

Section 3.3 details the proposed modification to the Mount Owen Consent.

3.1 Project overview

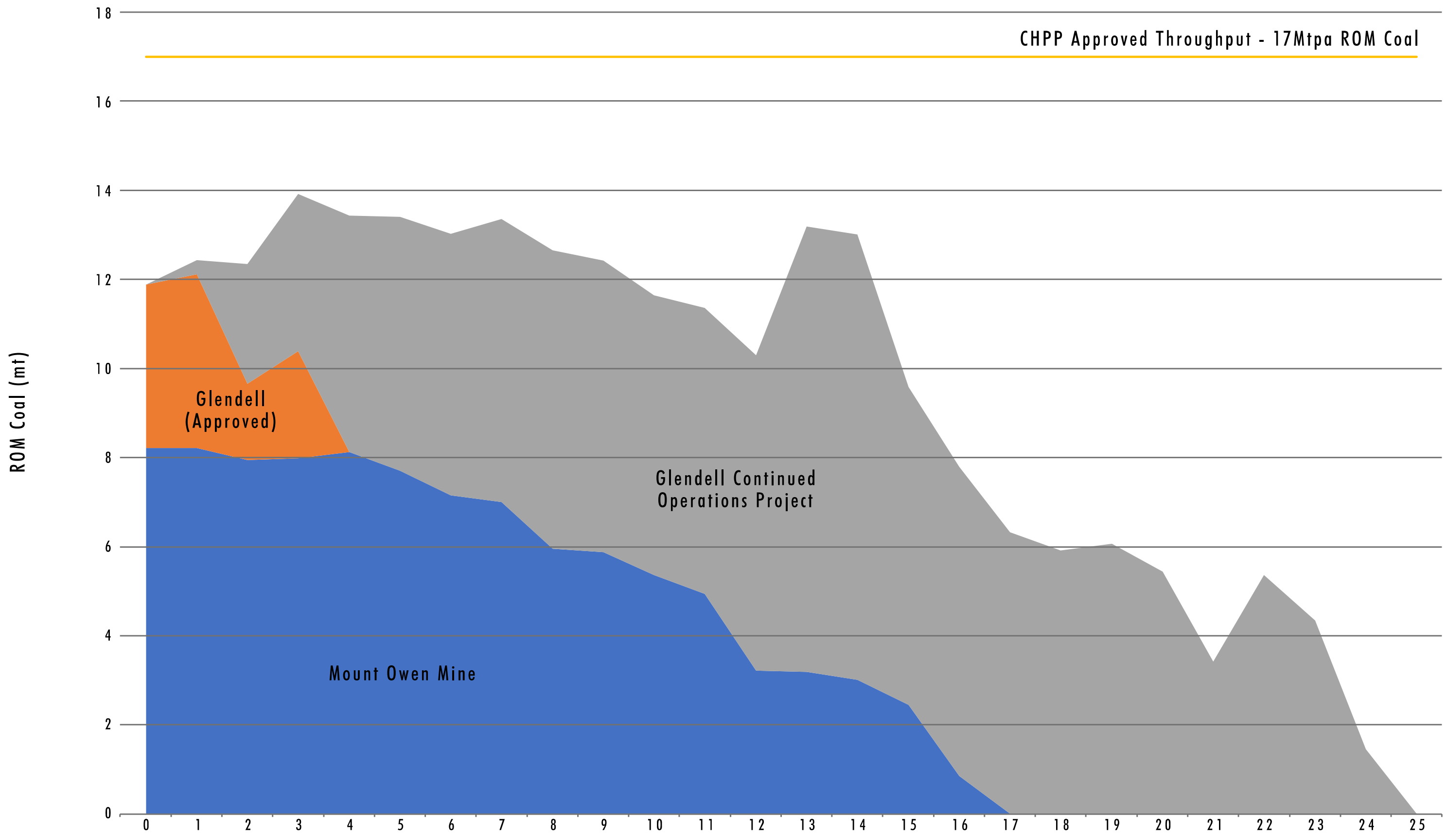
The Project proposes the extension of mining at the Glendell Mine to the north of the current Glendell Pit (Glendell Pit Extension). Mining operations will extend the existing open cut operations to the north with mining occurring down to and including the Hebden seam. Estimated additional ROM coal reserves in the Glendell Pit Extension are approximately 135 Mt. Mining operations will be undertaken using truck and excavator mining methods supported by ancillary equipment such as drills, dozers, front-end-loaders etc.

Mining operations for the Project will initially proceed at the current approved production rate (up to 4.5 Mtpa) with production increasing during the life of the operations as production at Mount Owen's Bayswater North Pit and North Pit decline and eventually cease. Proposed maximum annual production from the Glendell Pit Extension will be up to 10 Mtpa ROM coal. This increase in production is designed to optimise the operation of the Mount Owen CHPP over the life of mining at both Mount Owen Mine and Glendell Pit Extension. **Figure 3.1** shows the conceptual production schedule for the Mount Owen Complex over the life of the Project. This production schedule is subject to change based on market conditions.

ROM coal would be transported by truck from the Glendell Pit Extension to the Mount Owen CHPP for washing, consistent with current practice. The Project will not result in any increase to the currently approved 17 Mtpa ROM coal throughput at the Mount Owen CHPP; however the Project will extend the life of the Mount Owen CHPP and associated coal handling and transport system and other infrastructure by an additional approximately 8 years beyond that currently approved by the Mount Owen Consent.

The Project represents a brownfield continuation of the existing Glendell Pit and fits within Glencore's commitment to cap its global coal production at 150 Mtpa of saleable product. The Project will occur at a time when production at Glencore's adjacent Liddell Coal Operations, and the Ravensworth East and Glendell Mines have ceased. The coal produced by the Project is 'replacement production' that will help to maintain Glencore's long term production profile.

Overburden removed as part of the mining operations will generally be emplaced in-pit to the south of the mined area as mining progresses to the north. Overburden emplacement would also occur on existing Glendell and Mount Owen emplacement areas. The final emplaced landform will be developed using natural landform techniques and will be progressively rehabilitated over the life of the Project.



Legend

- Mount Owen Mine
- Glendell (Including MOD 4)
- Glendell Continued Operations Project

Image Source: Glencore (2019)

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20191128 11.30

FIGURE 3.1

Indicative Mount Owen Complex ROM Coal Production Schedule

As a result of mining progressing to the north, the Project will require the realignment of a section of Hebden Road, the relocation of the Ravensworth Homestead (including the collection of associated out-buildings) (refer to **Section 7.8**) and the realignment of part of Yorks Creek (refer to **Section 3.2.11.1**). The Glendell Pit Extension will also mine through the current Glendell MIA. The Project will therefore require the construction of a new MIA to the north west of the proposed Glendell Pit Extension and may also utilise the Mount Owen MIA. **Sections 3.2.7** to **3.2.16** provide further details regarding ancillary aspects of the Project.

The modified Mount Owen Consent would continue to regulate mining at the North Pit and Bayswater North Pit, in addition to the extended operations of the CHPP, Mount Owen MIA, load out facility and Mount Owen Rail Loop to approximately 2045 to enable the processing and transport of coal mined from the Glendell Pit Extension. All handling of coal from the Glendell Pit Extension, once emplaced on the Glendell ROM stockpile, would be managed under the modified Mount Owen Consent which would also continue to manage primary mine water storages, linkages within the GRAWTS and tailings emplacement facilities.

As outlined in **Section 1.4.1**, a separate modification of the Mount Owen Consent is currently being prepared for the construction of a new pipeline as part of the GRAWTS. The Narama Pipeline Modification includes an assessment of impacts associated with the construction of the pipeline, including an assessment of biodiversity impacts associated with disturbance outside of the existing approved disturbance areas (refer to **Section 2.1.2**). This EIS has been prepared on the basis of the Narama Pipeline Modification being approved.

The key Project features are shown conceptually in **Figure 1.3**.

3.1.1 Conceptual Project Stages

The conceptual mine plans (Years 1, 6, 13, 18) for the Project are outlined in **Figure 3.2** to **Figure 3.5**. Based on approval being granted in 2021, these stages align with the stages presented for the environmental assessment of the approved Mount Owen Continued Operations Modification 2 (Mount Owen Consent).

The conceptual mine years presented in **Figure 3.2** to **Figure 3.5** have been selected as they are considered to be representative of the key mining stages for the Project in terms of both project specific and cumulative impacts. The key Project stages are outlined in **Table 3.1**. It should be noted that these conceptual mine stages are indicative only and may be subject to change within the defined production parameters identified.

Table 3.1 Conceptual Project Stages Overview

Conceptual Project Stage	Aspect	Glendell Continued Operations Consent (SSD9349)	Mount Owen Consent (SSD-5850)
Years 1-5 **(Conceptual Mine Year 1)**	Mining related activities	Mining at Glendell extracts coal from both the existing approved mining area under the Glendell Consent and the Glendell Pit Extension. In-pit emplacement of overburden during this stage includes emplacement at the southern extent of the existing approved operations. Both mining and in-pit emplacement occurs in areas closest to private properties to the south and south east of Glendell.	No change to ongoing mining. Mining occurring in North Pit and Bayswater North Pit. Mining in North Pit at close to maximum approved production rate. Ongoing processing of ROM coal from Mount Owen Complex. Ongoing tailings disposal from Mount Owen CHPP and other GRAWTS operations in West Pit.

Conceptual Project Stage	Aspect	Glendell Continued Operations Consent (SSD9349)	Mount Owen Consent (SSD-5850)
	Construction activities	Construction of the new Glendell MIA, Hebden Road realignment, Heavy Vehicle Access Road and early works associated with Yorks Creek Realignment has commenced.	
	Ancillary Activities	Commence early works associated with relocation of Ravensworth Homestead, electricity and telecommunications infrastructure and WMS.	
	Decommissioning activities	Decommissioning of Glendell MIA.	Decommissioning of Ravensworth East MIA and associated coal handling infrastructure.
Years 6-12 **(Conceptual Mine Year 6)**	Mining related activities	Mining in the Glendell Pit Extension has progressed from the currently approved Glendell mining area in a northerly direction. Overburden emplacement will reach maximum height at approximately 200 mAHD and the production rate of mining has increased to approximately 6 Mtpa ROM coal.	Mining in Bayswater North Pit is complete, and Bayswater North Pit is available for water storage and/or tailings disposal. Mining in North Pit reaching the approved eastern extent of mining towards neighbouring landholders to the east. Ongoing processing of ROM coal from Mount Owen Complex. Ongoing tailings disposal from Mount Owen CHPP and other GRAWTS operations in West Pit.
	Construction activities	Yorks Creek Realignment is completed and commissioned.	
	Ancillary activities	Ravensworth Homestead relocation complete.	
Years 13-17 **(Conceptual Mine Year 13)**	Mining related activities	Mining has reached the proposed maximum production rate in Glendell Pit Extension (up to 10 Mtpa ROM coal), maximum workforce numbers and maximum equipment numbers and overburden emplacement high in the landform for the Project.	Mining in North Pit reaching the approved southern extent of mining and closest point of mining to neighbouring landholders to the south and south-east. In-pit emplacement of overburden only. Ongoing processing of ROM coal from Mount Owen Complex. Tailings disposal from Mount Owen CHPP and other GRAWTS operations being disposed in West Pit, Bayswater North Pit or other storages approved under GRAWTS. Bayswater North Pit available for water storage and/or tailings disposal.

Conceptual Project Stage	Aspect	Glendell Continued Operations Consent (SSD9349)	Mount Owen Consent (SSD-5850)
Years 18 - completion (Conceptual Mine Year 18)	Mining related activities	Represents the northernmost extent of the Glendell Pit Extension and closest point to private properties in the Hebden area. Production rates declining following the earlier peak.	Mining in the Mount Owen North Pit is planned to have been completed (2037, Year 17), with activities in the Mount Owen North Pit emplacement areas focussed on reshaping and rehabilitation. Ongoing processing of ROM coal from Glendell Pit Extension. Tailings disposal from Mount Owen CHPP and other GRAWTS operations being disposed in Bayswater North Pit, cells within the North Pit or other storages approved under GRAWTS. Bayswater North Pit and North Pit available for water storage and/or tailings disposal.

The conceptual mining stages outlined in **Table 3.1**, as they relate to the Glendell Continued Operations Consent and the modified Mount Owen Consent are discussed in further detail in **Sections 3.2** and **3.3** respectively.

The Mount Owen Complex conceptual final landform as modified is shown in **Figure 3.6** and is discussed further in **Sections 3.2.17** and **3.3.10**.

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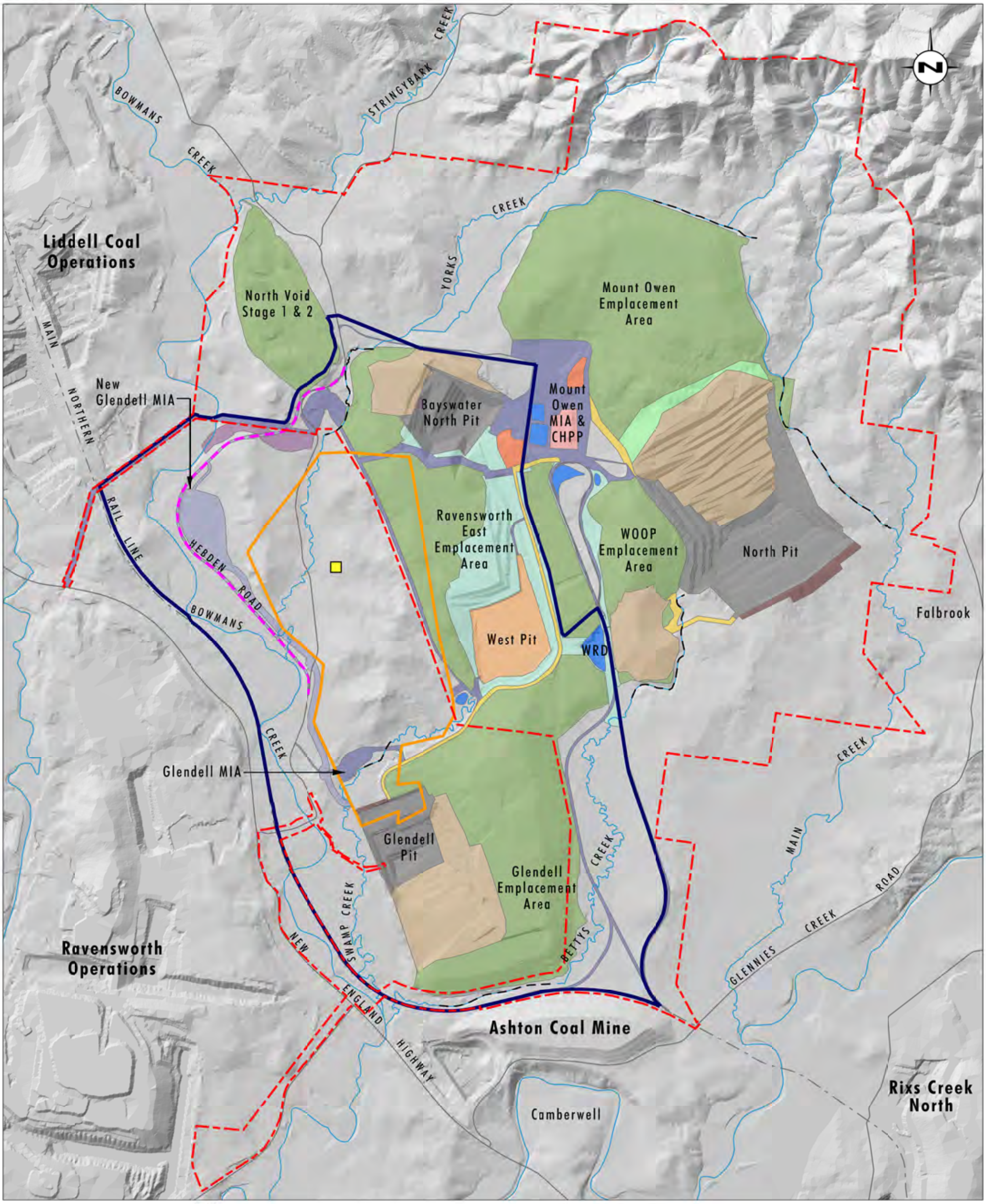

Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- 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 (Construction)
- Infrastructure/Internal Access
- Infrastructure (Construction)
- Haul Road
- Coal Stockpile ROM
- Coal Stockpile Product
- Tailings Emplacement Area
- Water Storage

FIGURE 3.2

Mount Owen Complex Conceptual Mine Plan - Year 1

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20191118 13.45

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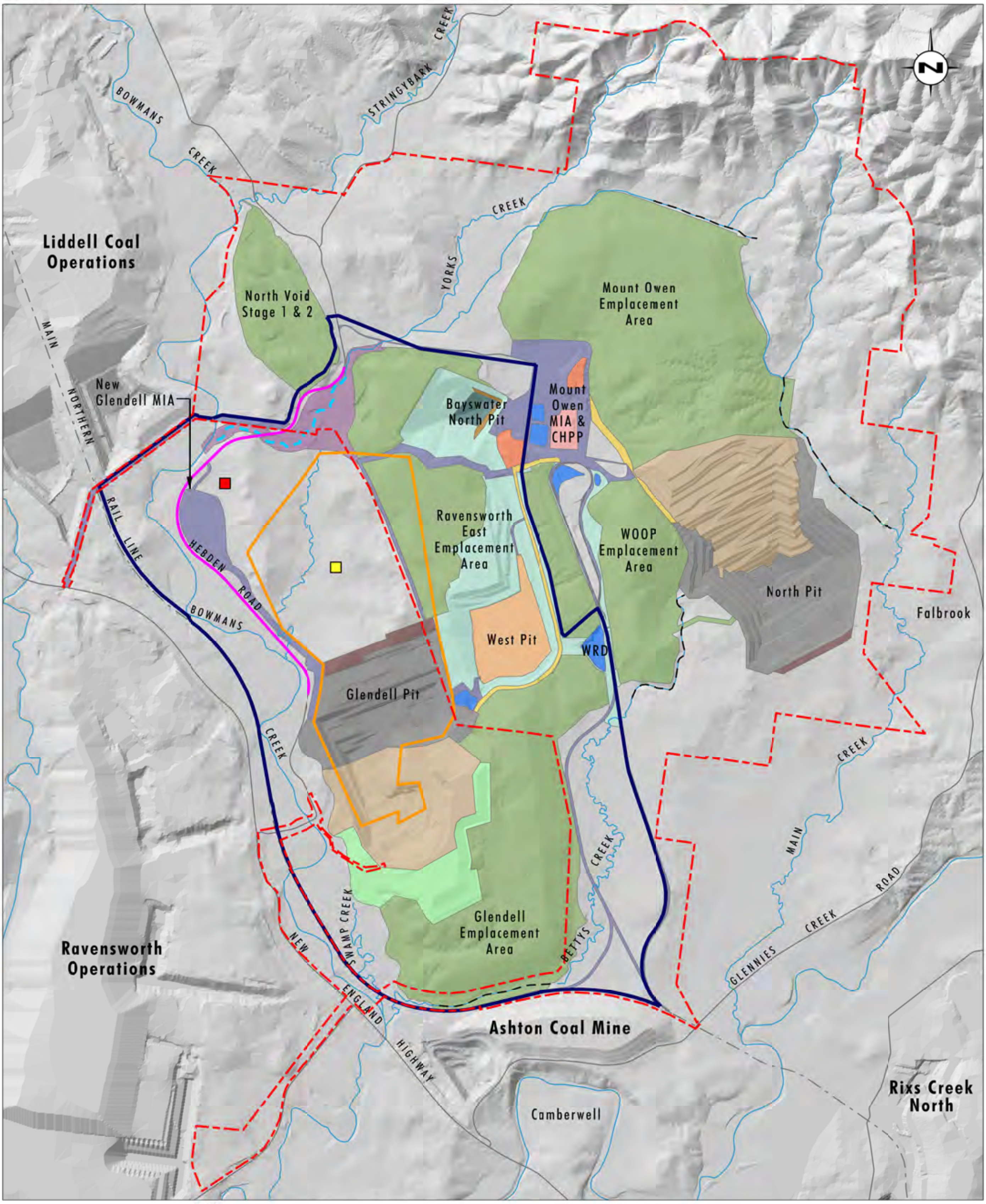

Data Source: Glencore (2019)

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- 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 Area
- Highwall

FIGURE 3.3

Mount Owen Complex Conceptual Mine Plan - Year 6

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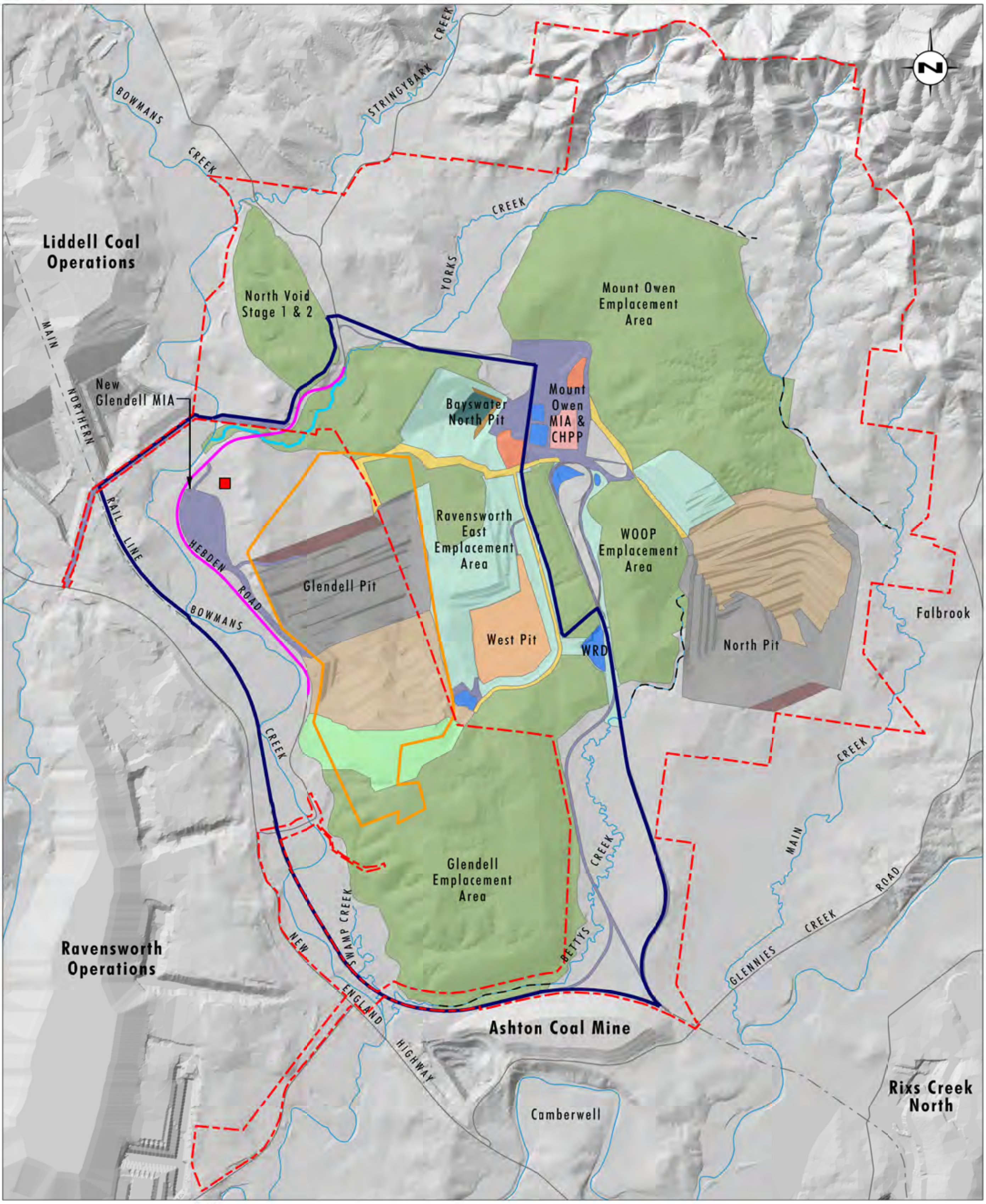
20191118 13.47



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

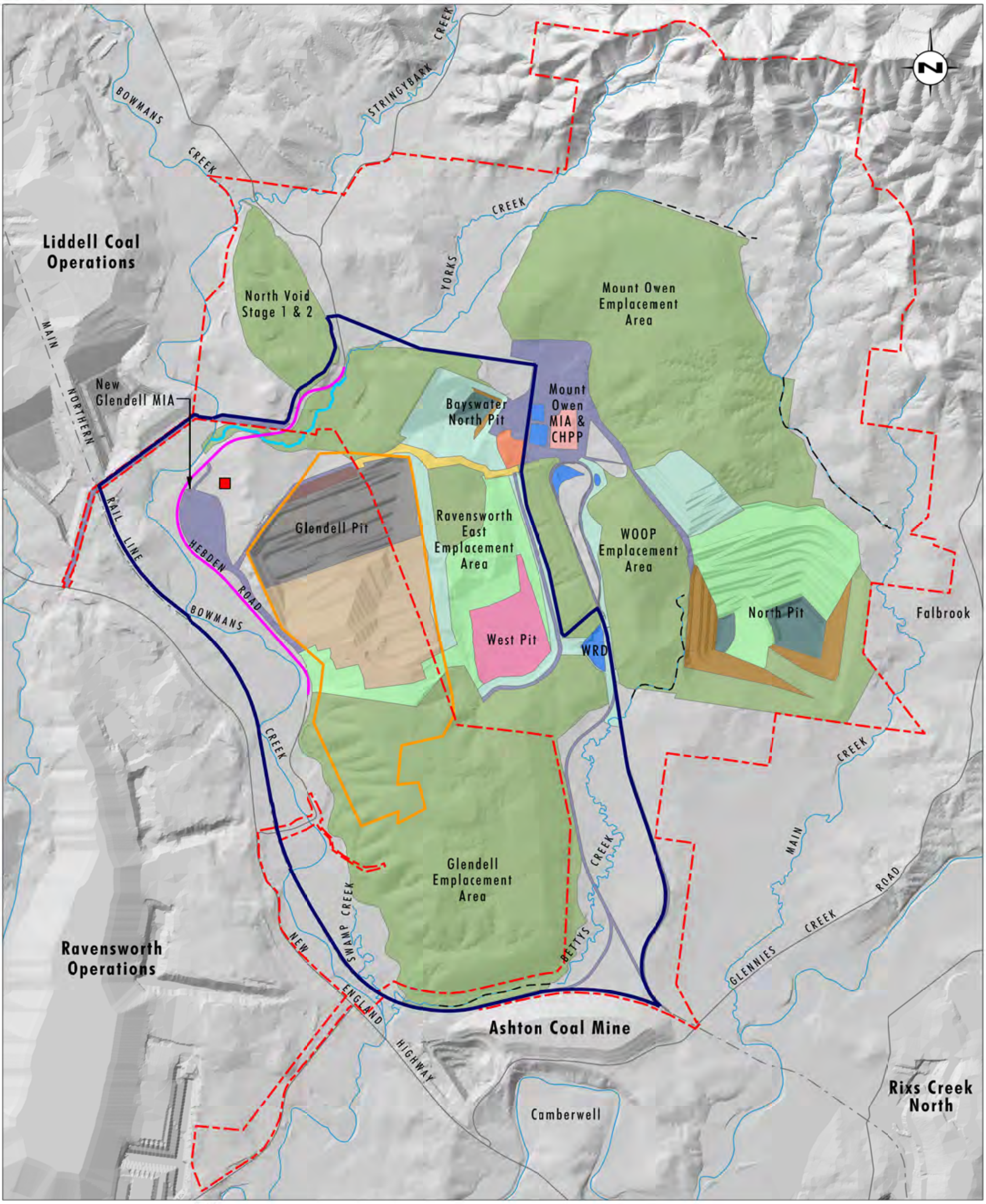
Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- 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 Area
- Highwall

FIGURE 3.4

Mount Owen Complex Conceptual Mine Plan - Year 13

File Name (A4): R08/4166_239.dgn
20191118 12.45



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
- Glendell Pit Extension
- Mount Owen Consent Boundary
- 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 Area
- Highwall
- Tailings Capping in Progress

FIGURE 3.5

Mount Owen Complex Conceptual Mine Plan - Year 18

File Name (A4): R08/4166_240.dgn
20191118 13.43

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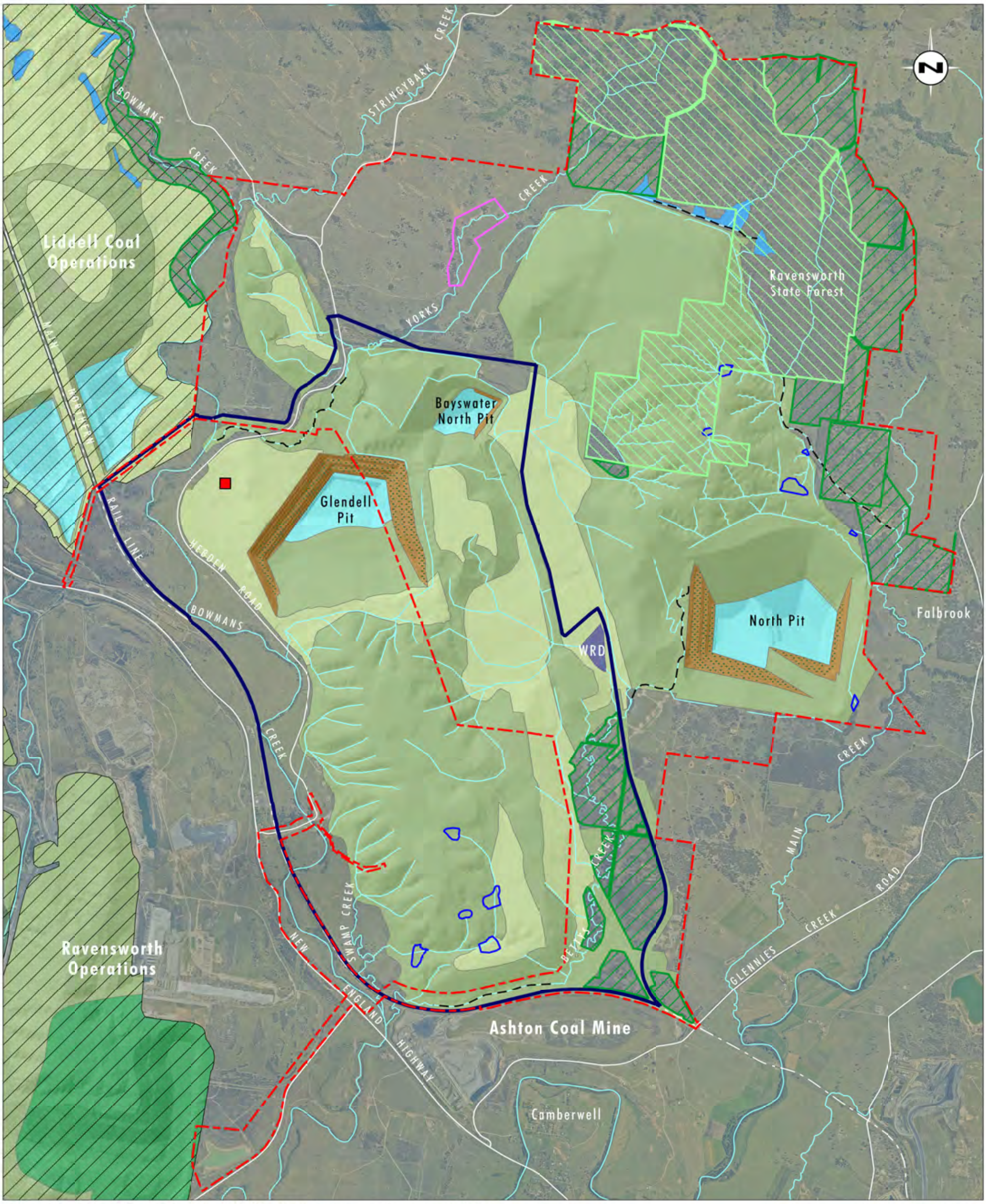

Image Source: Glencore (Dec 2018), Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

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

FIGURE 3.6

Mount Owen Complex Conceptual Final Landform

File Name (A4): R08/4166_242.dgn
20191128 16.21

3.1.2 Workforce

3.1.2.1 Operational Workforce

The Project will not result in any increase to the historical maximum operational workforce numbers for the Mount Owen Complex of 1,220 FTE, however there is an increase in the workforce associated with mining operations in the Glendell Mine as the production rates increase over the life of the Project. The Glendell workforce will increase from approximately 300 FTE up to approximately 690 FTE at maximum production. The increased workforce at the Glendell Mine coincides with the decrease in production and workforce numbers at Mount Owen North Pit which is planned to cease in 2037.

3.1.2.2 Construction Workforce

An additional workforce will be required for construction activities during the early stages of the Project. The construction workforce associated with the Project is estimated to peak at approximately 350 FTE positions in Years 1-2. The bulk of the construction activity will take place within the first approximately 5 years of the Project.

3.1.3 Project Disturbance Areas

The Project includes approximately 750 ha of additional disturbance outside existing approved disturbance areas (refer to **Section 2.1.2**). This area is referred to in this EIS as the Additional Disturbance Area which includes both the Glendell Additional Disturbance Area (discussed further in **Section 3.2.2**) and the Mount Owen Additional Operational Area (discussed further in **Section 3.3.9**). All other disturbance associated with the Project will be located within existing approved disturbance/operational areas under other consents (refer to **Section 2.1.2**).

The Approved Glendell Disturbance Area and Approved Mount Owen Operational Area currently overlap and will include overlap areas under the new consent boundaries. The overlap under the new consent boundary arrangement is due to the timing in which activities approved under each consent occur and an efficient allocation of rehabilitation obligations between the 2 consents will be developed. The rehabilitation of disturbance areas managed under the Glendell Continued Operations Consent and Mount Owen Consent are described in **Sections 3.2.17** and **3.3.10** respectively.

Proposed disturbance associated with the Project in areas that have been previously disturbed and are in the process of being revegetated. The rehabilitation in these areas that was commenced prior to March 2018 has been identified as being in various stages of development from newly planted to areas which have been established for more than 20 years. However, the rehabilitation in these areas has been monitored regularly, and has been assessed as not meeting final rehabilitation criteria and security obligations under the *Mining Act 1992* remain in place in relation to these areas (refer to **Section 2.1.6**).

The existing approved disturbance/operational areas associated with the Mount Owen Complex and the Additional Disturbance Area are shown in **Figure 3.7**. The relative disturbance/operational areas under each consent are defined further in **Section 3.3.2** (Glendell Project Disturbance Area) and **Section 3.3.9** (Mount Owen Operational Area).

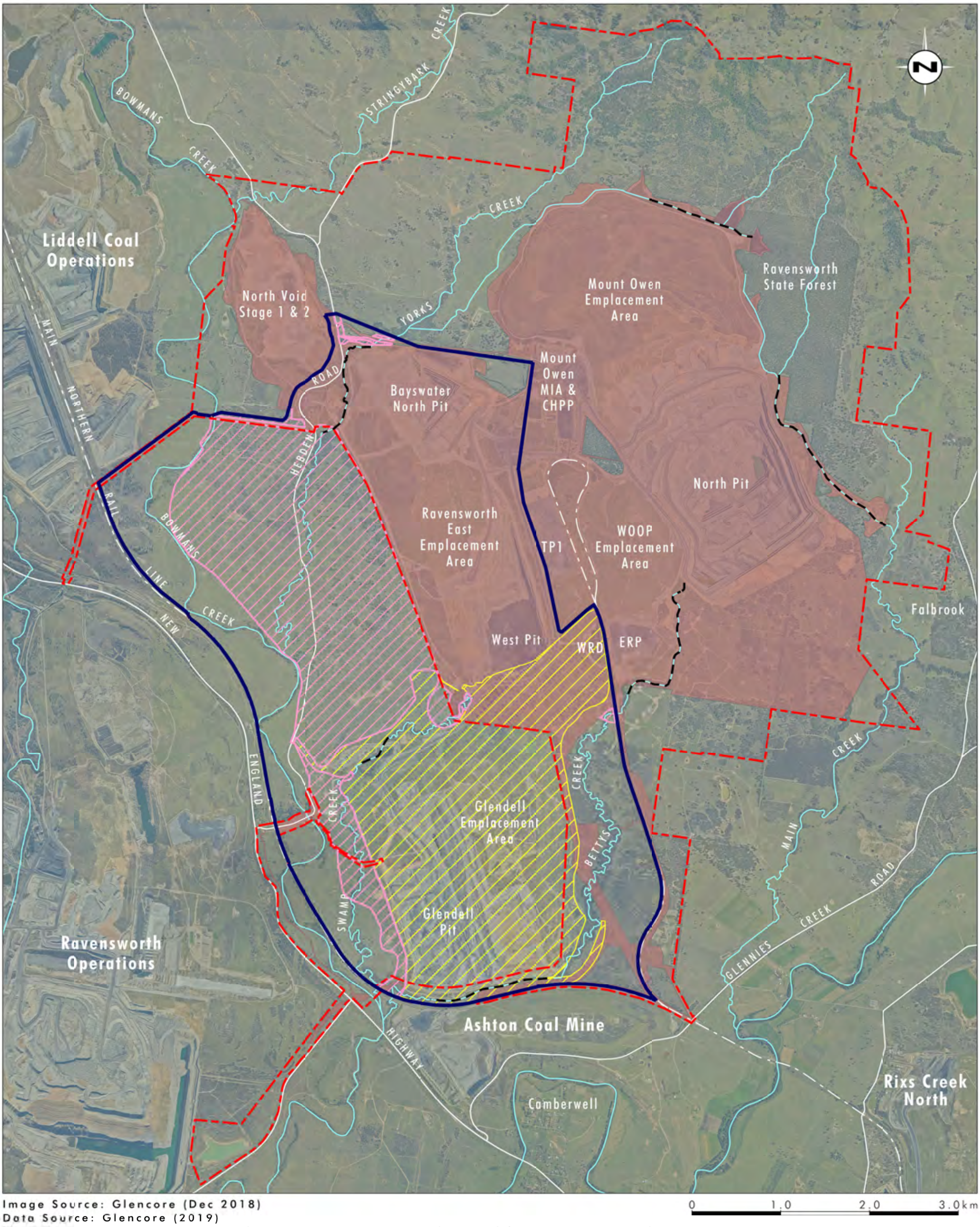

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved.
Approved Glendell Disturbance Area assumes Glendell MOD 4 is approved

Legend
- Project Area
- Mount Owen Consent Boundary
- Additional Disturbance Area
- Approved Glendell Disturbance Area
- Approved Mount Owen Operational Area
- Existing Creek Diversion

FIGURE 3.7

Project Disturbance/Operational Areas

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20191129 8.34

3.2 Glendell Continued Operations Consent

The development application covers the key project features associated with the mining of the Glendell Pit Extension and construction of the new Glendell MIA. It also includes the realignment of part of Yorks Creek and a section of Hebden Road and other infrastructure in the immediate vicinity of these project components. The proposed Glendell Continued Operations Consent will include the haulage of coal to the Mount Owen CHPP and the rehabilitation of areas directly affected by the mining and emplacement of overburden from mining at Glendell.

The Project also requires the relocation of the Ravensworth Homestead. There are 2 alternate relocation options proposed which are:

- 'Ravensworth Farm' (Option 1) being a local move using specialised building removal and transportation methods to move the buildings intact to the new location with a focus on retaining as much of the building fabric as possible. The buildings would be retained by Glencore and used as office/administration buildings until closure of the mining operations when they would be available to return to ongoing rural occupancy purposes or other use consistent with land use demands at the time.
- 'Broke Village' (Option 2), which is a proposal by members of the Broke-Fordwich community and involves dismantling the Homestead buildings and relocating them to Broke township to be rebuilt as the village square. Whilst this option would involve the retention of less intact building fabric, it proposes to provide ongoing community facilities along with improved public access.

Approval is sought as part of this State Significant Development (SSD) application to relocate the Ravensworth Homestead on the basis that relocation will be either locally to Ravensworth Farm (Option 1) or alternatively to Broke Village (Option 2). In the event that Ravensworth Farm (Option 1) is approved by the consent authority, then approval for this relocation option would be included as part of the Glendell Continued Operations Consent and would require no further statutory approvals. In the event that Broke Village (Option 2) is approved by the consent authority, land tenure is to be secured for the proposed location or an alternative location, and further secondary approvals for the reconstruction and use of the Homestead will be required to be obtained prior to relocation. In the event that the necessary secondary approvals cannot be obtained in a timely manner then the Homestead would be relocated to the Ravensworth Farm (Option 1). Further details on the Homestead relocation approval process is provided in **Section 5.2.1**.

An extensive body of work involving historical research, architectural and archaeological studies, alternative mine designs, recipient site identification and option analysis, and community consultation has been undertaken to reach the proposed 2 options. Further details on these aspects are provided in **Section 6.6** and **Section 7.8**.

The Project includes the following key components:

- continuation of mining of existing approved reserves in the Glendell Pit
- mining of the Glendell Pit Extension by open cut operations recovering approximately 135 Mt ROM coal down to and including the Hebden seam
- the continuation of haulage of coal to the Mount Owen ROM coal pads for processing at the Mount Owen CHPP
- relocation of the Ravensworth Homestead

- the demolition and removal of the existing Glendell MIA, and construction of the new Glendell MIA and Heavy Vehicle Access Road
- the realignment of part of Yorks Creek and a section of Hebden Road and other infrastructure
- the rehabilitation of areas directly affected by the mining and emplacement of overburden from mining at Glendell, the MIA, Heavy Vehicle Access Road and disturbed areas associated with ancillary works.

Further details of the key components of the Project are provided in **Table 3.2**.

Table 3.2 Key Project Features

Operational Aspect	Glendell Continued Operations Consent
Mining Area	Glendell Pit Extension and unmined areas of currently approved Glendell Pit.
Production Limits	Up to 10 Mtpa ROM coal.
Mining Method	Open cut (truck and excavator).
Approved Mine Life	Mining in Glendell Pit and Glendell Pit Extension - to 31 December 2044.
Overburden Emplacement	In-pit emplacement within Glendell emplacement area to approximately 200 mAHD. Emplacement at existing Ravensworth East emplacement area to approximately 185 mAHD. Out-of-pit emplacement associated with formation of Yorks Creek Realignment landform areas, and minor areas where in-pit emplacements are merged into existing topography. Use for various mining activities including capping of Mount Owen Complex tailings facilities, haul road construction, rehabilitation etc. Use in final landform shaping at Ravensworth East emplacement area. Use for construction of foundations for MIA, Heavy Vehicle Access Road and Hebden Road re-alignment.
Final voids	Glendell Pit void in the northern end of the Glendell Pit Extension. No increase in number of approved voids (one only).
Coal Processing	N/A – ROM coal continued to be transported to the Mount Owen CHPP and managed under the Mount Owen Consent.
Coal Transportation	Processing of coal and offsite transport managed under the Mount Owen Consent.
Mine Infrastructure Area (MIA)	Replacement Glendell MIA (with some plant and equipment also utilising the Mount Owen MIA) including associated infrastructure and services, heavy and light vehicle access roads etc. Use of existing Glendell MIA until decommissioned.
Workforce	Up to approximately 690 FTE positions at maximum production level.
Primary Mine Water Storages	Mine water transfer dams at Glendell. Mine water storages continue to be managed under Mount Owen Consent.
GRAWTS Linkages	Glendell WMS integrated with broader Mount Owen Complex WMS and GRAWTS.
Creek Diversions	Retention of existing Lower Bettys Creek Diversion to south of Glendell Pit. Existing Glendell MIA Diversion (until mined through by Glendell Pit Extension). Proposed Yorks Creek Realignment.

Operational Aspect	Glendell Continued Operations Consent
Road Realignment and Infrastructure	Hebden Road realignment. Ancillary infrastructure as required for mining operations. Telecommunications and electricity infrastructure impacted by Glendell Pit Extension or Hebden Road realignment to be re-routed. New infrastructure associated with the new Glendell MIA including powerlines and access road.
Rehabilitation	Progressive rehabilitation of mined areas with the use of temporary rehabilitation on disturbed surfaces such as exposed overburden emplacements that remain inactive for 12 months or more.
Demolition	Existing Glendell MIA and associated roads, infrastructure and services. Demolition of infrastructure on completion of mining operations (unless approved for other post mining land uses).
Ravensworth Homestead	Relocation of the Ravensworth Homestead.

Subject to approval of Glendell Continued Operations Consent under conditions satisfactory to the Proponent, the existing Glendell Consent would be surrendered within a reasonable time following commencement of the Project.

3.2.1 Conceptual mine plan

The Project will involve the extension of mining at Glendell Mine to the north of the current Glendell Pit (refer to **Figure 1.3**. Mining operations would extend the existing open cut operations to the north with mining down to and including the Hebden seam (Glendell Pit Extension). Estimated additional ROM coal reserves in the proposed mining area are approximately 135 Mt. Mining operations would initially proceed at the current approved production rate (up to 4.5 Mtpa) with production increasing during the life of the operations as production at Bayswater North Pit and North Pit decline and eventually cease. Maximum annual production from the Glendell Pit Extension would be up to 10 Mtpa ROM coal.

The target coal reserves for the Glendell Pit Extension are the Burnamwood, Bulga and Foybrook Formations, which are the lowermost coal bearing formations of the Wittingham Coal Measures. Seven seams with open cut potential exist from the Bayswater seam to the Hebden seam and range in depth to approximately 240 m below ground surface (refer to **Figure 3.8**).

Figure 3.8 shows the target stratigraphy within the Glendell Pit Extension. As with the existing Glendell Pit, the Glendell Pit Extension will mine along the Camberwell anticline with the floor of the pit being deeper on the eastern side of the pit. **Section 4.0** contains further details regarding the geology in the proposed mining area.

The target seams are stratigraphically identical to those mined in the existing Glendell Pit and neighbouring Bayswater North Pit and North Pit. Experience has shown that these seams generally exhibit a low propensity for spontaneous combustion.

The northern limit of the Glendell Pit Extension is defined by the Liddell underground workings and the block fault zone. The Glendell Pit Extension final wall is offset from the former Liddell underground workingsm.by a horizontal distance of more than 100 m. Figure 3.9 shows a cross section of the final Glendell Pit Extension highwall and its relationship to the Liddell underground workings.

Haul trucks will be used to transport ROM coal from the Glendell Pit Extension (and areas of the existing approved Glendell Pit not yet mined by the time of approval) to the Mount Owen CHPP for processing consistent with current practice.

Overburden removed as part of the proposed mining operations will generally be emplaced in-pit to the south of the mined area as mining progresses to the north. Overburden emplacement would also occur on existing Glendell emplacement areas and areas disturbed as part of the Ravensworth East operations. Overburden from the Glendell Pit and Glendell Pit Extension may also be used for ancillary purposes as discussed in **Section 3.2.3.2**.

The proposed progression of mining and the construction of project related infrastructure and associated works for each of the conceptual mine plan stages discussed in **Section 3.1.1** is provided below. Conceptual plans for each of these stages for the operations covered by the Glendell Continued Operations Consent are contained in **Appendix 6**. The key Project features are shown conceptually in **Figure 3.10**.

The conceptual mine plans (Years 1, 6, 13, 18) for the Project are outlined in **Figure 3.2** to **Figure 3.5**. Assuming the Project commences in 2021**,** these mine plan years align with the stages presented for the environmental assessment of the approved Mount Owen Continued Operations Modification 2 to ensure consistency with the recent modification of the Mount Owen Consent.

The progression of mining and rehabilitation activities depicted in the conceptual mine plans shown in **Figure 3.2** to **Figure 3.5**, and as described in this EIS, represent the most likely mine plans for the Project, however these conceptual plans are subject to change throughout the life of the Project due to a range of variables such as geological and geotechnical conditions, variations in coal quality and market conditions, and changes to mining equipment and available technology.

The conceptual mine stages presented in **Figure 3.2** to **Figure 3.5** have been selected as they are considered to represent indicative key features of the proposed mining progression for the Project in terms of both project specific and cumulative impacts as outlined below.

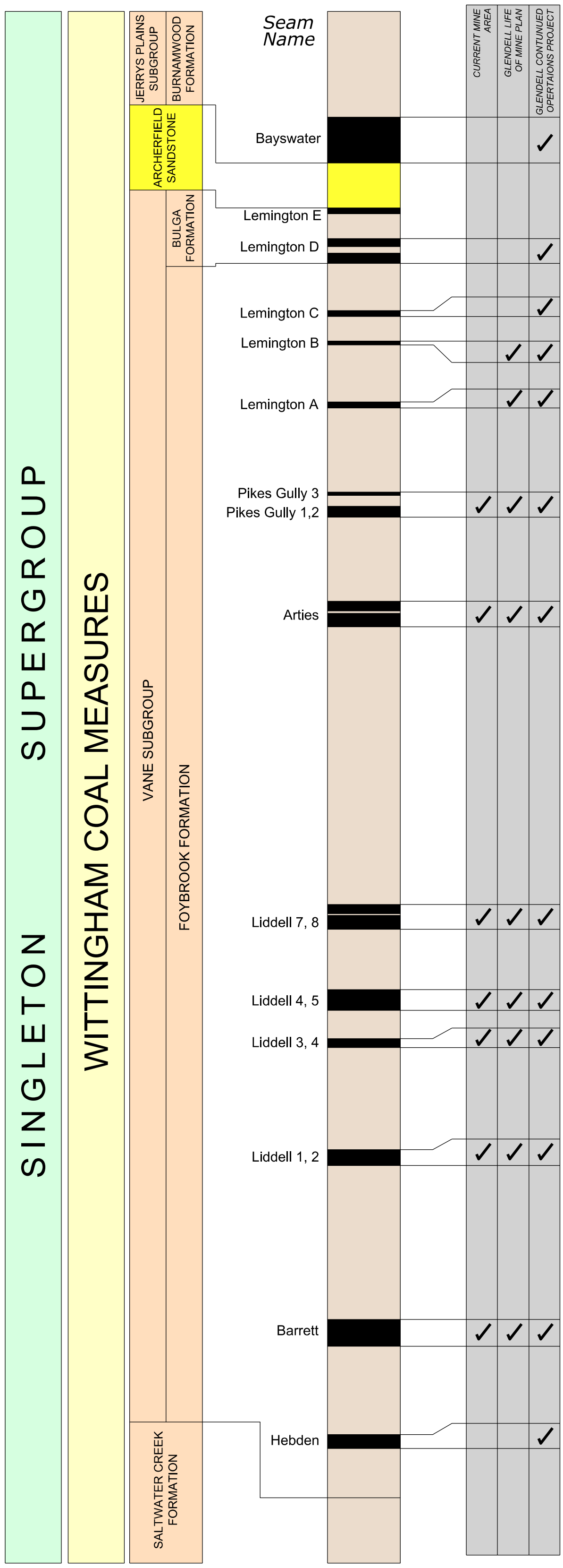
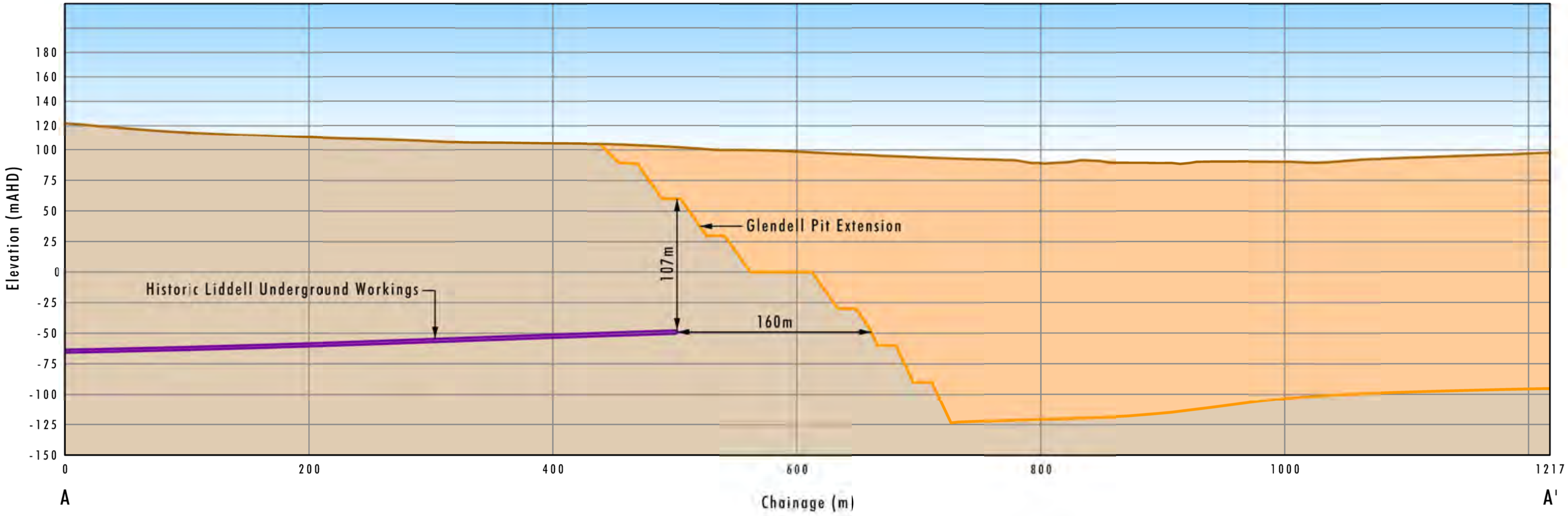


FIGURE 3.8

Target Stratigraphy

Image Source: Glencore (April 2018)



Legend

- Existing Landform
- Glendell Pit Extension
- Historic Liddell Underground Workings

Data Source: Glencore (2019)

FIGURE 3.9

Cross-section of the Glendell Pit Extension and Liddell Underground Workings

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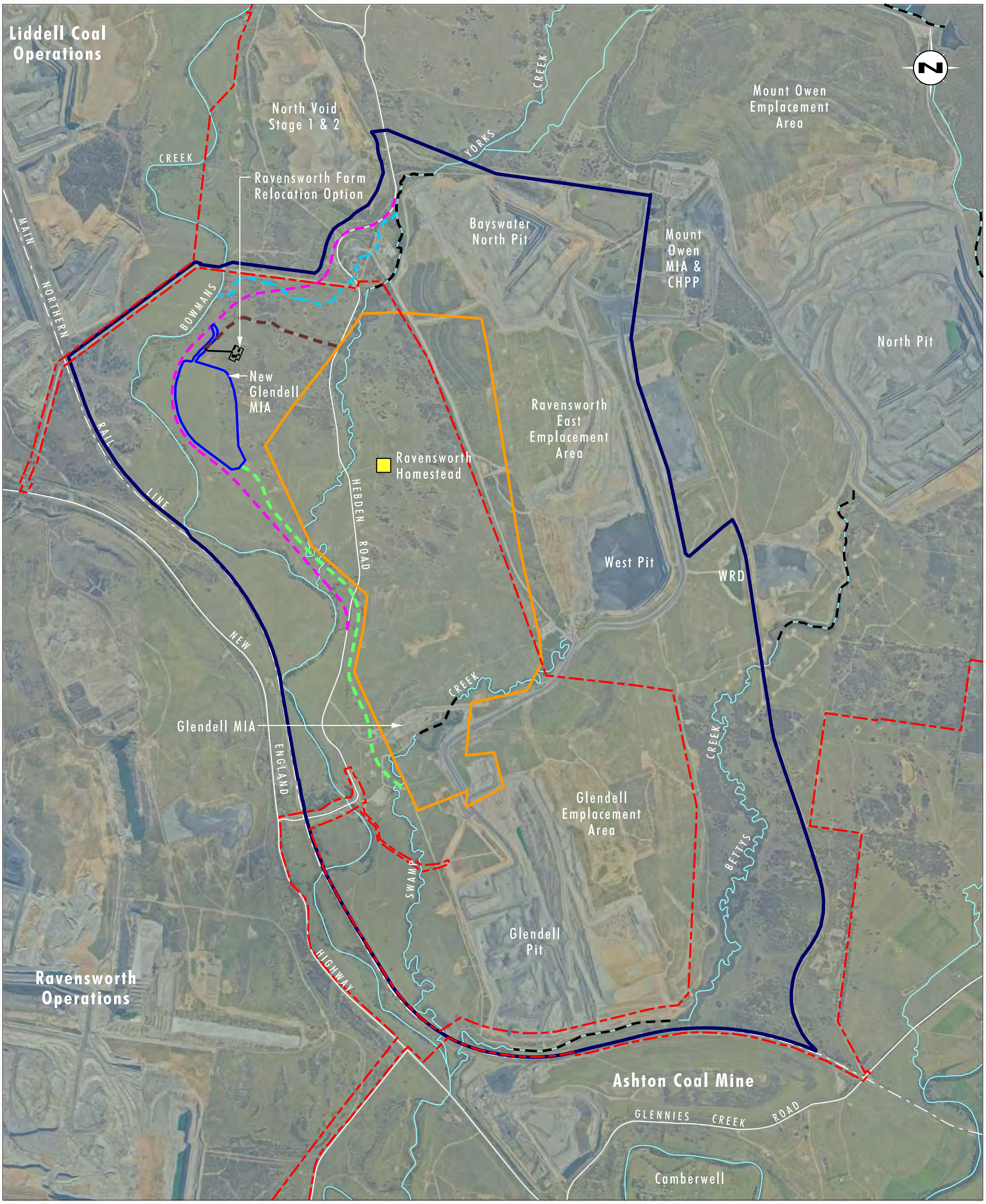

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Notes: Ravensworth Homestead to be relocated, Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Ravensworth Homestead
- Existing Creek Diversion
- Construction Access Road

Project Features:
- New Glendell MIA
- Heavy Vehicle Access Road
- Yorks Creek Realignment
- Hebden Road Realignment

FIGURE 3.10

Glendell Continued Operations Project
Key Project Features

File Name (A4): R08/4166_262.dgn
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Year 1 to Year 5

- General progression of mining in areas currently approved for mining under the Glendell Consent and adjoining areas to the north. Production rates and overburden movement are proposed to be similar to existing approved operations. Overburden is emplaced in-pit within the currently approved mining and emplacement area. Both mining and overburden emplacement during this stage is generally located in the southern area (refer to **Figure 3.2**).

- Haulage of coal from the Glendell Pit Extension and existing approved mining areas under the Glendell Consent to the CHPP will be generally along the current haulage alignment.

- Commencement of construction of Yorks Creek Realignment works.

- Construction and commissioning of Hebden Road realignment, new Glendell MIA and Heavy Vehicle Access Road.

- The existing Glendell MIA is to be dismantled upon commissioning of new infrastructure area, elements may be relocated to the new Glendell MIA for re-use.

- During this period the relocation of Ravensworth Homestead will be nearing completion. Prior to the commencement of relocation works, archaeological recording and salvage of the insitu archaeology will be undertaken.

Year 6 to Year 12

- During this phase of the Project, mining within the Glendell Pit Extension will continue to advance in a northerly direction with overburden emplacement within the Glendell Pit Extension progressively moving further away from sensitive receptors in Camberwell. As mining progresses, shaping of emplacement areas and rehabilitation within the existing Glendell Mine and Glendell Pit Extension will occur progressively (refer to **Figure 3.3**).

- Haulage of coal from the Glendell Pit Extension to the CHPP will be generally along the current haulage alignment.

- The Yorks Creek Realignment construction will be completed and the realignment will be commissioned within this period.

- Ravensworth Homestead will have been relocated to a new recipient site.

Year 13 to Year 17

- During this phase of the Project, mining within the Glendell Pit Extension has progressed further north (refer to **Figure 3.4**) and production rates approach maximum rates of 10 Mtpa ROM coal. Shaping of emplacement areas and rehabilitation progresses in a northerly direction behind the active emplacement activities within the Glendell Pit Extension with overburden emplacement generally to approximately 185 mAHD and selected areas to approximately 200 mAHD.

- Haulage of coal from the Glendell Pit Extension will generally be across the Ravensworth East emplacement area to reduce the haulage distance to the Mount Owen CHPP.

Year 18 to completion

- During this phase of the Project, mining is scheduled to have progressed to the northern limit of the Glendell Pit Extension (refer to **Figure 3.5**). Shaping of emplacement areas and rehabilitation within the Glendell Pit Extension has continued north.

- Haulage of coal will continue through the Ravensworth East emplacement area to the Mount Owen CHPP.

Figure 3.11 shows the indicative ROM coal production rates from the Glendell Pit Extension and volumes of overburden handled over the life of the Project. Changes in mining progression and market fluctuations may change the production profile within the overall limit of 10 Mtpa ROM coal.

The progression of mining and detailed mine design will be managed to meet relevant impact assessment criteria prescribed for the Project.

Further discussion on the progressive rehabilitation and details of the conceptual final landform are provided in **Section 3.2.17**.

3.2.2 Glendell Project Disturbance Area

Figure 3.12 shows the areas of proposed disturbance associated with the Project (Glendell Project Disturbance Area). The Glendell Project Disturbance Area is the area within which surface disturbance related activities regulated under the Glendell Continued Operations Consent will be undertaken and includes existing approved disturbance areas under the Glendell Consent (Approved Glendell Disturbance Area) (refer to **Section 2.1.2**) and all areas impacted by works covered by the proposed Glendell Continued Operations Consent including:

- Glendell Pit Extension and associated overburden emplacement
- new Glendell MIA
- Heavy Vehicle Access Road
- Hebden Road realignment and associated infrastructure realignments
- Yorks Creek Realignment and associated land forming works
- water management infrastructure
- and other ancillary infrastructure required for mining operations.

The Glendell Additional Disturbance Area (shown in **Figure 3.12**) represents those parts of the Additional Disturbance Area that would be disturbed as a result of activities regulated under the Glendell Continued Operations Consent. The areas of overlap with the Approved Mount Owen Operational Area (refer to **Section 3.3.9**) are also shown on **Figure 3.12**.

With the exception of the Hebden Road and public utility realignments (and Ravensworth Homestead if relocated to the Ravensworth Farm site within the Project Area), all areas of disturbance will be subject to mine rehabilitation obligations.

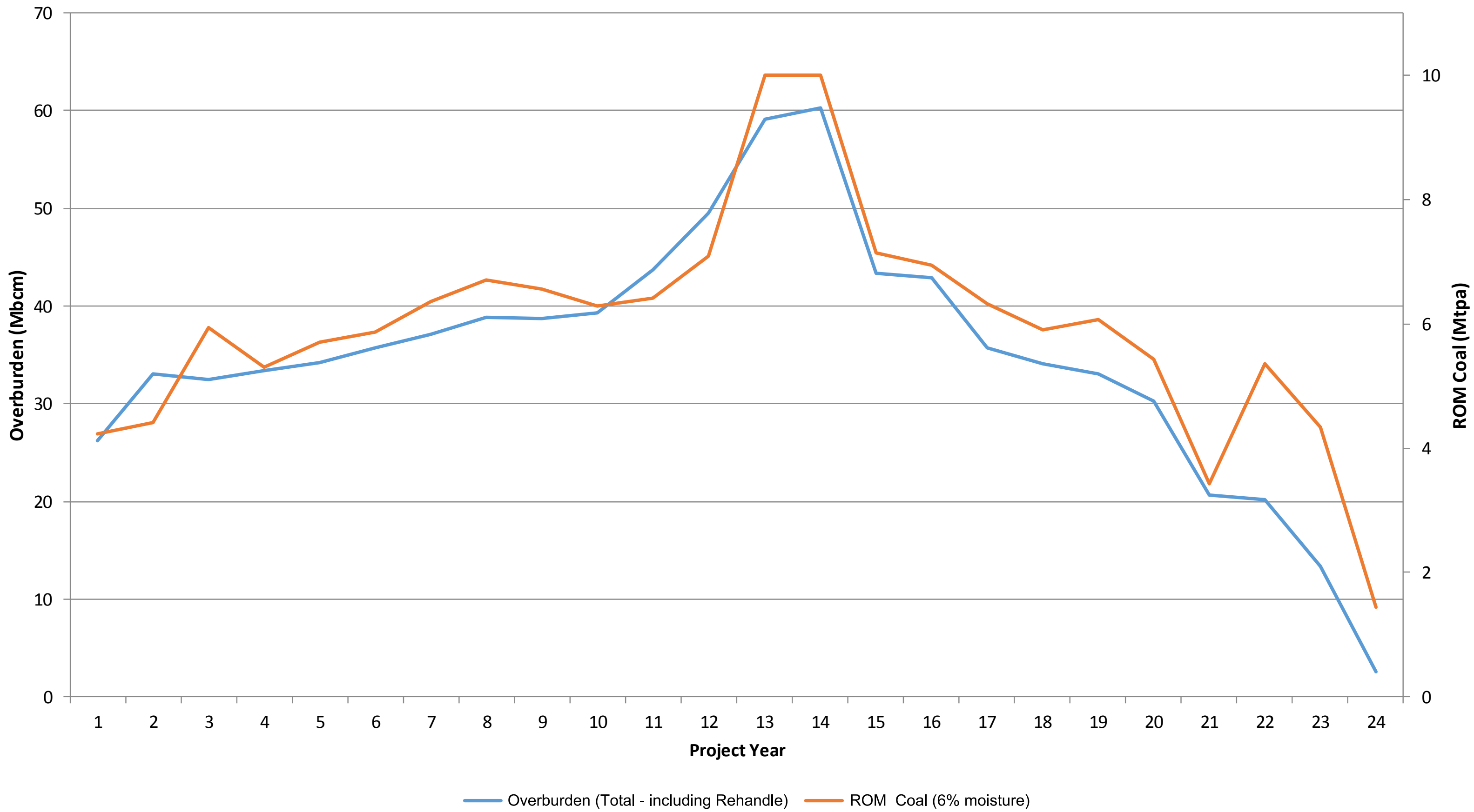

FIGURE 3.11

Indicative Project ROM Coal Production and Overburden Movement

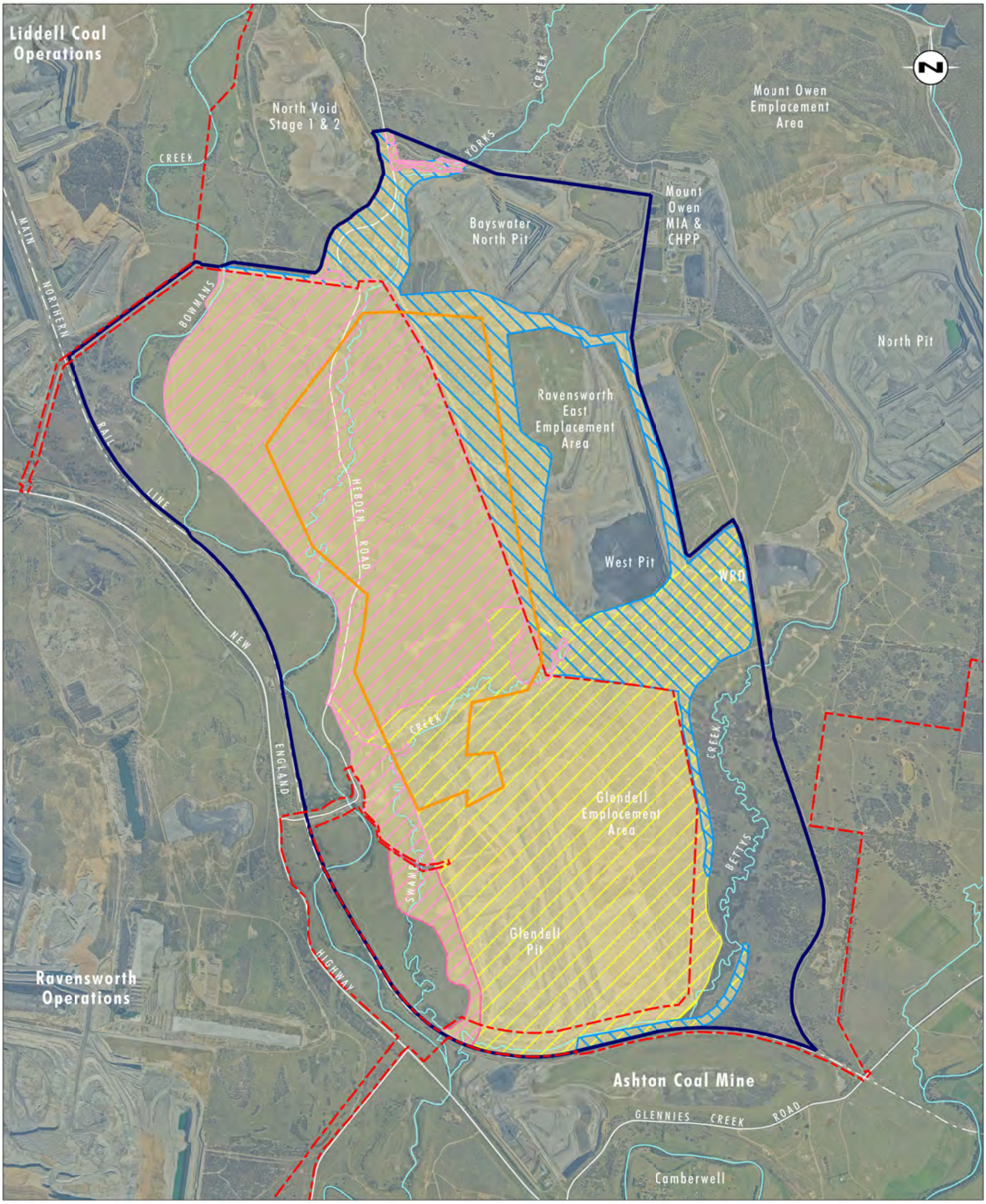

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 0.5 1.0 2.0km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Approved Glendell Disturbance Area
- Glendell Project Disturbance Area
- Glendell Additional Disturbance Area
- Overlap with Approved Mount Owen Operational Area

FIGURE 3.12

Glendell Project Disturbance Area

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3.2.3 Mining methods

3.2.3.1 Pre-strip operations

Pre-strip operations include the removal of vegetation and soil ahead of the active mining operation. Prior to any disturbance of the surface, clean water diversions and erosion and sediment control works will be established where required. This will ensure that surface water runoff is diverted around disturbed areas where practical, and not impacted by mining activities. Sediment control works will manage surface water runoff generated from direct rainfall entering the mining area resulting in dirty water being adequately treated and erosion minimised.

Following the removal of trees and other large vegetation, soil will be stripped and either placed in stockpiles or placed directly on reshaped overburden for rehabilitation purposes.

Further details of soil management and vegetation clearing processes are provided in **Section 7.9**.

3.2.3.2 Overburden management

The majority of overburden and interburden (referred to collectively as overburden) from mining operations associated with the Project will be emplaced in-pit behind the northward progressing mining operations. Overburden will be hauled from the pit to the emplacement location by haul truck. Overburden will also be emplaced on the existing Glendell Mine emplacement areas and in the areas disturbed as part of the Ravensworth East operations. Some out-of-pit emplacement will be required for final landform purposes and overburden from the Glendell Pit Extension may also be used for landform purposes associated with the construction of the Yorks Creek Realignment. Overburden may also be used for the capping of tailings emplacement areas at the Mount Owen Complex.

The conceptual sequence of the development of emplacement areas is shown in **Figure 3.2** to **Figure 3.5**.

Out-of-pit overburden emplacement at Glendell Mine (to the east of the existing approved Glendell Pit) is currently permitted to approximately 160 mAHD under the Glendell Consent; this limit also extends to the in-pit-emplacement area under the terms of the approved MOP for the Mount Owen Complex. To avoid additional disturbance associated with out-of-pit emplacement, the overburden emplacement areas in Ravensworth East and Glendell utilised for the Project will be generally developed to approximately 185 mAHD with selected areas emplaced to approximately 200 mAHD to provide for variations in topography to facilitate drainage and improve aesthetics. This emplacement strategy will reduce the need for additional disturbance which would be associated with separate new out-of-pit emplacement areas.

Overburden from the Project which meets appropriate engineering specifications may also be crushed and used for the construction of infrastructure associated with the Mount Owen Complex, including but not limited to the Hebden Road realignment, the Heavy Vehicle Access Road, the MIA and associated hardstand areas, GRAWTS infrastructure, access roads and haul roads throughout the life of the Project.

3.2.3.3 Coal removal

The exposed coal will be mined by hydraulic excavators and loaded into haul trucks for transport to the Mount Owen CHPP or to be fed directly into the Mount Owen CHPP via the existing ROM dump hoppers (refer to **Figure 2.2**).

During the early stages of the Project, the haul route to the Mount Owen CHPP is proposed to remain largely the same as is currently used for the Glendell Pit (refer to **Figure 3.2** and **Figure 3.3**).

During later stages, as the Glendell Pit extends further north, alternate ROM coal haulage routes may be established to reduce the haulage distance (refer to conceptual haul routes shown in **Figure 3.2**, **Figure 3.3**, **Figure 3.4** and **Figure 3.5**).

ROM coal haulage will operate 7 days per week, 24 hours per day.

Emplacement of ROM coal and handling of Glendell ROM coal once emplaced on the ROM stockpiles at the Mount Owen CHPP will be undertaken in accordance with the Mount Owen Consent (as modified - refer to **Section 3.3**).

3.2.3.4 Blasting

Blasting will be undertaken on a regular basis for both overburden removal and coal extraction. Blast practices for the Project will include:

- up to 2 mining related blasts per day
- an average of 8 mining related blasts per week (averaged over a 12 month period).

As with current Glendell operations, blasting will generally be restricted to between the hours of 9.00 am and 5.00 pm Monday to Saturday. Similar to the Mount Owen Consent, an allowance to undertake up to 12 blasts per year between the hours of 7.00 am and 9.00 am is also required to manage unexpected weather or operational conditions that preclude blasting within the standard period. No blasting will be conducted on Sundays or Public Holidays, except where approved by the Planning Secretary.

Temporary closures of Hebden Road will be required when blasting is within 500 m distance of Hebden Road. No blasts associated with the Project are proposed within 500 m of the New England Highway or Main Northern Rail Line. Depending on the timing of approval of the Project, some blasting associated with existing approved operations may still be required within 500 m of the Main Northern Rail Line. Existing management practices regarding any such blasts will be maintained as part of the Project.

As noted in **Section 3.2.14**, some construction activities (e.g. cuttings associated with the Hebden Road realignment and Yorks Creek Realignment works) may also require some blasting. Construction related blasts will be in addition to the mining related blasts. Some of these blasts may be within 500 m of Hebden Road however blasting associated with these works is unlikely to be located within 500 m of either the Main Northern Rail Line or the New England Highway.

Road closures on Hebden Road will typically be scheduled to occur outside of school bus hours along Hebden Road, except where required for emergency purposes.

3.2.3.5 Mining fleet

The typical mining fleet that will be used for the Project includes:

- excavators
- dozers (tracked or tyred)
- refuelling/service trucks
- drills
- crushers and screens
- light vehicles.
- haul trucks
- graders
- water trucks
- scrapers
- front end loaders

Technological advances in mining equipment, varying geotechnical properties of the material being mined, etc may require alterations to the composition of the fleet. The make-up of the mining fleet will vary from time to time throughout the life of the Project.

Consistent with existing operations, proactive and reactive mine management will be undertaken to manage noise and air quality impacts from the operations with operational decisions to relocate or temporarily stand down parts of the fleet to manage impacts where necessary.

3.2.4 Coal handling and product transportation

All ROM coal mined from the Glendell Pit Extension will be emplaced at ROM stockpiles for processing at the CHPP or directly fed into an existing ROM hopper. Once emplaced, the handling, processing and transport of the coal is managed under the Mount Owen Consent.

The majority of product coal from the Project will be sold into export markets. **Section 3.3.3** contains further details regarding the transport of coal regulated under the Mount Owen Consent.

3.2.5 Tailings and reject management

Coarse rejects from the Mount Owen CHPP may be co-disposed with overburden in the emplacement area developed as part of the mining of the Glendell Pit Extension.

The management of tailings associated with the operation of the Mount Owen CHPP will continue to be managed under the Mount Owen Consent. This is discussed further in **Section 3.3.4**.

3.2.6 Proposed infrastructure

3.2.6.1 Mine Infrastructure Area

The progression of mining to the north of the Glendell Pit will necessitate the demolition of the current Glendell MIA and the construction of a new MIA. The Project may also utilise the existing Mount Owen MIA. The decommissioning of the current Glendell MIA will likely occur in the early stages of the Project (approximately Years 2-3) meaning the new MIA (or use of temporary facilities) needs to be available prior to decommissioning. The construction and operation of a new MIA is proposed to the north west of the proposed Glendell Pit Extension, as shown in **Figure 3.10**.

The new MIA includes, but is not limited to the following key components:

- administration and workforce facilities to provide for management, operational, maintenance, environmental and technical workforce, including workforce dispatch and training, bath house, first aid and emergency response facilities
- workshops and maintenance facilities for maintaining the mobile mining fleet, and equipment/supplies storages
- vehicle wash-down areas, refuelling facilities, tyre handling and storage facilities, parking areas and hardstand areas for equipment
- fuel, lubricant and other chemical storage areas
- water management infrastructure for the collection of runoff, storage and supply of wash-down water, fire water storage and reticulation, and treatment and storage of water prior to use for dust suppression

- workforce, visitor and delivery access road and car parking areas
- electrical substation and distribution network
- potable water supply tanks
- sewerage treatment facilities
- helicopter pad
- associated services.

Some of these components will be transferred from the existing Glendell MIA for re-use at the new MIA.

The new MIA facilities may require the augmentation of existing ancillary services such as power, water supply and telecommunication facilities. Glencore will consult with relevant service providers where required during detailed design and construction of the proposed infrastructure facilities.

Sewerage and other wastes are managed on site with regular collection for off-site disposal via licensed contractors. Waste management is discussed further in **Section 7.14**.

Access to the new MIA by the workforce and visitors will be via the realigned section of Hebden Road (refer to **Figure 3.13**). Access to the new MIA from the Glendell Pit for mining equipment requiring servicing will be provided via a Heavy Vehicle Access Road (refer to **Figure 3.14**).

A range of temporary infrastructure will also be required for the construction period including construction site offices, car parking areas and hardstand/laydown areas.

3.2.6.2 Heavy Vehicle Access Road

The Heavy Vehicle Access Road is a road linking the new MIA to active areas of the Glendell Pit Extension (refer to **Figure 3.14**).

The road will be designed to provide an approximately 70 m wide road corridor that provides a light vehicle road corridor and a corridor for haul trucks and heavy vehicles to access the workshop and maintenance facilities at the new MIA. Two ancillary pad areas will be constructed along the Heavy Vehicle Access Road for undertaking some servicing operations closer to the working area and other works necessary to support the mining operations.

Figure 3.14 shows a conceptual alignment for the Heavy Vehicle Access Road.

The pads will include dedicated access roads from Hebden Road to enable direct access to the ancillary pad by personnel and supply trucks and vehicles.

Roadside bunds along the Heavy Vehicle Access Road and other visual screening techniques (including vegetation screens) may be utilised along sections of the western edge of the Heavy Vehicle Access Road to manage visual impacts associated with the Heavy Vehicle Access Road and the active mining areas. The management of visual impacts is discussed further in **Section 7.10**.

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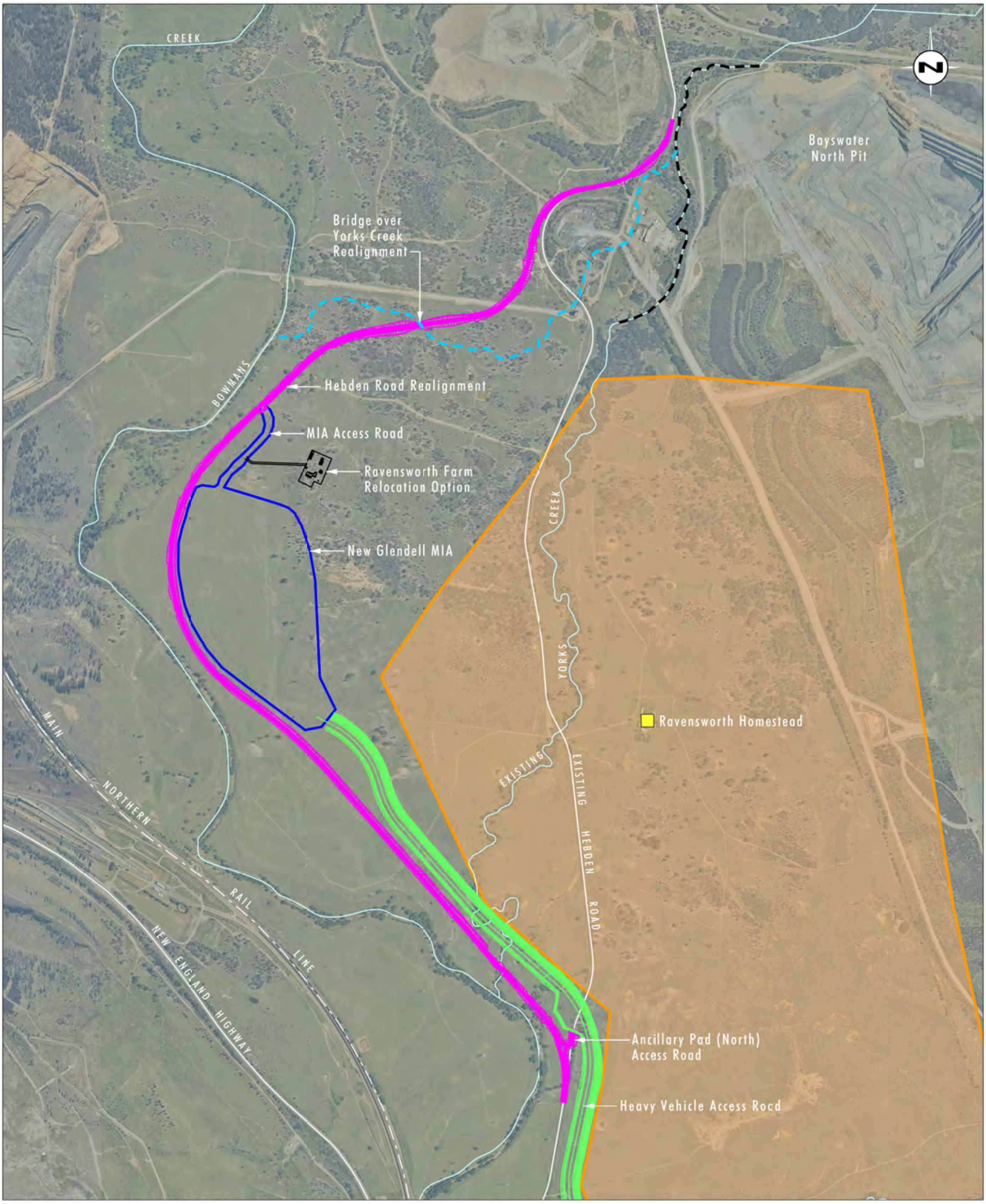

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Ravensworth Homestead to be relocated

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

FIGURE 3.13

Hebden Road Realignment and New Glendell MIA - Conceptual Alignment and Footprint

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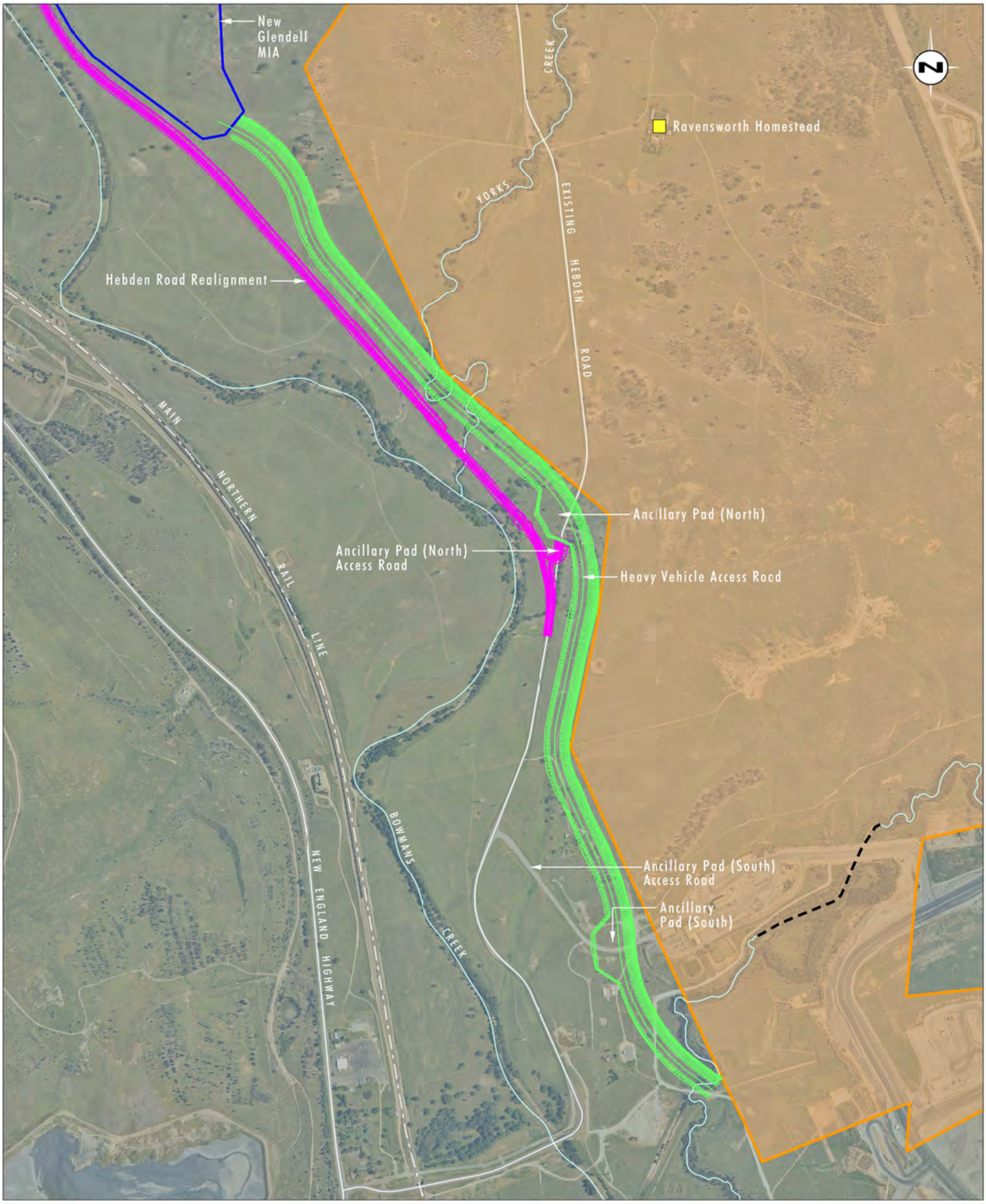

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Ravensworth Homestead to be relocated

Legend

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

FIGURE 3.14

Heavy Vehicle Access Road - Conceptual Design

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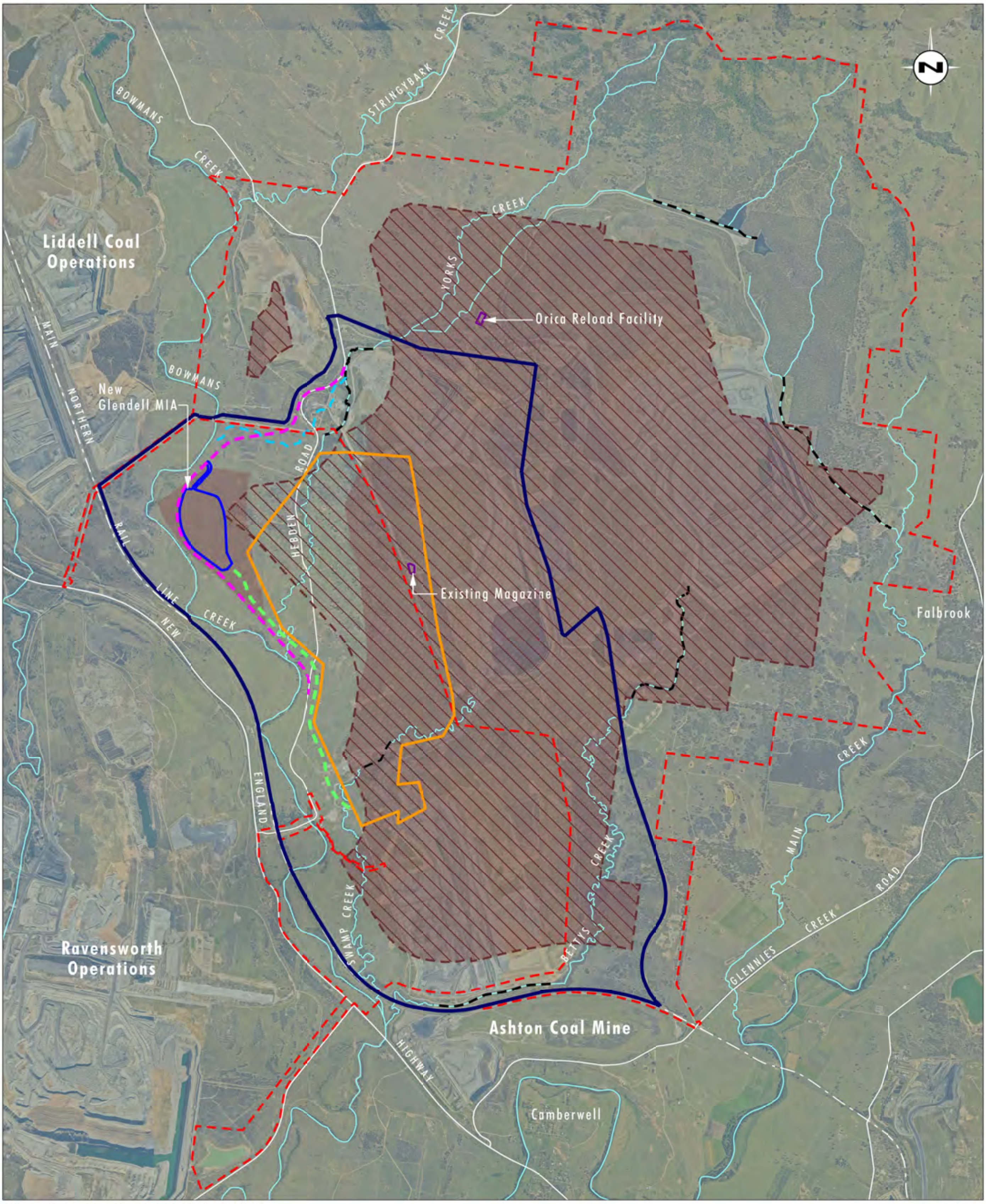

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- New Glendell MIA
- Yorks Creek Realignment
- Hebden Road Realignment
- Heavy Vehicle Access Road
- Area suitable for locating the magazine prior to Hebden Road Realignment
- Area suitable for locating the magazine following Hebden Road Realignment

FIGURE 3.15

Areas where Explosives Magazine can be located (550 m Offset)

File Name (A4): R08/4166_173.dgn
20191128 12.44

3.2.6.3 Magazine

The Glendell Pit Extension will require the relocation of the existing explosives magazine. The explosive magazines are used for the storage of detonation equipment only as the bulk explosives used for blasting are mixed from non-explosive substances during delivery down the drill holes prior to blasting.

The magazines are readily relocatable with minimal site establishment works. Due to the hazardous nature of the materials housed in the structures, comprehensive management controls including fencing and separation distances are required to minimise the risk of an explosion and manage related workplace and public safety risks.

A detailed hazard assessment has been undertaken (refer to **Section 7.14.2**) which has identified the minimum separation distances that the magazine must be located from publicly accessible areas or non-Glencore owned land. These separation distances depend on the nature and quantity of the material stored in the magazine. Based on the existing licensed storage capacity for each structure, this separation distance is 550 m for the magazine **Figure 3.15** represents the region within the Project Area where the structures may be located prior to the realignment of Hebden Road and the region within the Project Area where the structures (assuming the maximum proposed Project inventory of 60,000 kg at any one time) may be located once the Hebden Road realignment is completed and operational. As the Glendell Pit Extension develops, these structures will be relocated having regard to operational and workplace safety issues including the minimum separation distances calculated for the magazine.

3.2.6.4 Water Management System

The Glendell WMS is an integrated component of the Mount Owen Complex WMS and the GRAWTS (as described in **Section 2.1.4**) and is managed in accordance with the Mount Owen Complex Water Management Plan (Glencore, 2018k). Integration of the Mount Owen Complex WMS with the GRAWTS will continue to be managed under the Mount Owen Consent.

Drainage infrastructure will need to be constructed and installed to capture water from additional areas disturbed by the Project. This infrastructure will include clean water diversions, pipelines, pumps and sediment dams and dirty water diversion drains. The existing management principles for the Mount Owen Complex will apply to this infrastructure (refer to **Section 2.1.4**).

Water collected in the active pit area (either as groundwater inflows to the pit or rainwater runoff from active mining areas) will be treated as mine water (refer to **Section 2.1.4**). Run-off from the Heavy Vehicle Access Road and associated pads will also be managed as mine water. This water will be transferred to the mine water storages and will be managed under the Mount Owen Consent.

Water collected in sediment dams will be treated as dirty water and managed within the dirty water system (as per Blue Book design and management requirements) and includes the transfer of collected water from selected dams post rainfall into mine water storages to allow for the required settling volume to be provided in the sediment dam.

Water from the mine water management system will be used for coal processing in the CHPP and dust suppression purposes as well as other operational purposes at the Mount Owen Complex. Water reticulation systems will be installed as part of the Project and will include water truck fill points installed in locations to enable efficient use of water trucks for dust suppression.

A raw water pipeline will be constructed from the Mount Owen MIA to the new Glendell MIA to provide fresh water for plant wash down and some domestic uses.

The WMS for the Project is discussed in further detail in **Section 2.1.4**.

3.2.6.5 Ancillary activities and services

Mount Owen Complex is currently supported by a range of ancillary services such as potable water and sewerage facilities, electricity supply, internal communication, monitoring and access infrastructure.

The existing approved ancillary services will be utilised or modified if required to minimise the surface disturbance associated with constructing new infrastructure. Conceptual locations and disturbance footprints for the various surface infrastructure components have been determined based on mine requirements, topography and ecological and archaeological constraints and are located within existing disturbance/operational areas and/or the Additional Disturbance Area for the Project. Where surface infrastructure is required to be moved as a result of the detailed design process, it will be relocated to ensure that the impacts associated with the final design and location are not significantly greater or different than those associated with the concept locations. These relocations will generally follow the Hebden Road realignment.

The key ancillary services required for the Project include, for example:

- surface water management infrastructure including water treatment facilities, water fill points, pumps and associated infrastructure (refer to **Section 3.2.6.4**)
- internal power supply infrastructure servicing the new MIA and infrastructure associated with the mining of the Glendell Pit Extension – powerlines, substations, switch yards, etc.
- piped services – potable water supply, mine wastewater removal, process and fire water supply, etc.
- internal communications and monitoring services including communication towers, etc.
- internal access roads and other minor infrastructure within the existing approved and Additional Disturbance Area
- portable buildings as required.

All infrastructure associated with the new MIA will be located within the Additional Disturbance Area.

3.2.7 Hebden Road realignment

The current Hebden Road alignment is located within the proposed Glendell Pit Extension as shown on **Figure 3.13**. The Glendell Pit Extension will necessitate the realignment of a section of Hebden Road.

It is proposed that an approximately 5 km section at the southern end of Hebden Road will be realigned to the west around the Glendell Pit Extension and the new MIA in the location shown on **Figure 3.13**. This realignment would extend the trip distance for some road users travelling on Hebden Road by approximately 1.2 km. The realignment will also include a bridge crossing over the proposed Yorks Creek Realignment (refer to **Section 3.2.11.1**).

The road is proposed to be constructed to a design speed of 80 km per hour, consistent with current road conditions and will improve upon the safety standard of the existing road. The proposed Hebden Road realignment has been designed in accordance with the NSW Roads and Traffic Authority's (RTA, now RMS) *Road Design Guide* (1993), Singleton Council's Development Control Plan (2014) and relevant Austroads guidelines, and will see a significant improvement in standard of the carriageway. The construction of the Hebden Road realignment will include an intersection for the new MIA and intersections for ancillary pad areas on the Heavy Vehicle Access Road and at the existing Ravensworth East MIA (refer to **Section 3.2.6.2**).

In order to minimise disruptions to traffic, where possible, the realigned section of Hebden Road will be fully constructed prior to tie-in works and decommissioning of the existing section. This is anticipated to be completed by Year 2 of the Project.

Consultation has been undertaken with Singleton Council regarding the proposed realignment and its design so that it meets appropriate standards. Road users, in particular, the local residents, Hebden Quarry, Wild Quarry, and Hunter Valley Buses, in addition to RMS have been consulted on the proposed realignment.

3.2.8 Site access

Glendell Mine currently has a single primary site access off Hebden Road, approximately 2 km from the Hebden Road intersection with the New England Highway (refer to **Figure 1.2**).

The primary access for traffic associated with the mining of the Glendell Pit Extension will be via a new mine access road linking the new MIA and the proposed realigned Hebden Road (refer to **Figure 3.13**). As with existing operations, a number of minor access points off Hebden Road and realigned Hebden Road and associated hardstand areas will be developed for maintenance and other purposes. Access to the remote pads located adjacent to the Heavy Vehicle Access Road will be via the current Glendell MIA access road and a new intersection off Hebden Road (refer to **Figure 3.14**).

During the construction of the MIA and associated works in the early stages of the Project, an access track off the existing Hebden Road will also be constructed and utilised. This intersection and access road are shown conceptually on **Figure 3.10**.

Traffic associated with the utilisation of the Mount Owen MIA and CHPP associated with the Glendell Pit Extension will access the Mount Owen MIA and CHPP via the current Mount Owen access road off Hebden Road.

New intersections will be designed and constructed in accordance with relevant design standards. Further details on traffic impacts and intersection design are contained in **Section 7.11**.

3.2.9 Relocation of Ravensworth Homestead

The Ravensworth Homestead (refer to **Figure 3.16**) is a collection of buildings constructed c1832 and modified over time by subsequent owners. The Homestead is listed as an item of local heritage significance under the Singleton Local Environmental Plan 2013 (Singleton LEP). Ravensworth Homestead is owned and maintained by Glencore. The Glendell Pit Extension will mine through the location of the Ravensworth Homestead necessitating its relocation. Various mitigation and management options have been identified and considered for the Ravensworth Homestead including its partial or whole relocation (refer to **Sections 6.6** and **7.8**).

Since the submission of the Project's Preliminary Environmental Assessment, Glencore has identified and investigated a range of relocation options in close consultation with the Ravensworth Homestead Advisory Committee (RHAC) (refer to **Section 6.0**) and heritage consultants. A number of public calls were made in 2018 seeking ideas and submissions from the Singleton community on possible relocation options. Eight submissions were received from individuals, businesses, organisations and community groups. In parallel, Glencore also investigated a number of potential options on Glencore-owned land in the vicinity of the Homestead, as well as other potential site options in the township of Singleton and around Lake St Clair.

In total 11 options have been considered by the RHAC and Glencore with consideration of sustainability, commercial viability, ownership, physical attributes of recipient site (verisimilitude), ability to retain heritage fabric and accessibility. In addition, 2 alternate move methodologies have been investigated. Further details on the options assessed and investigations completed are provided in **Section 7.8**.

As a result of the investigations 2 relocation options have been identified, namely:

- Ravensworth Farm (Option 1):
  - This option (shown on **Figure 3.16**) involves relocation of the complex of buildings to a Glencore-owned site situated within the original Bowman '10,000 acre' land grant using a methodology that moves the buildings intact on a purpose built road using highly specialized equipment.
  - This option focuses on preserving the heritage values of the buildings and would see the buildings used by Glencore for administration purposes during mining.
  - At the completion of mining, the buildings would be sold with possible options including return of the facility to use as a private homestead with an attached landholding or an alternate use that suits future land use and interest in the area.
- Broke Village (Option 2):
  - This option is a proposal by members from the Broke-Fordwich community and involves relocation of the complex of buildings to McNamara Park (Crown land) in Broke where they would have multi-purpose usage (administration and exhibition space, café and restaurant, cellar door/wine tasting, market space and space for annual events) and form the village square.
  - The buildings would be dismantled 'stone by stone' and then rebuilt at the new location.
  - This option provides a greater emphasis on placing the buildings in a publicly accessible location where they can be adapted to suit the intended end use and fulfil a community need.
  - The facility would be transferred to a new entity comprising members of the Broke-Fordwich community with financial benefits generated by the facility used for funding local community initiatives.

Two relocation options are proposed for Ravensworth Homestead. As mentioned earlier, approval is sought as part of this SSD application to relocate the Homestead on the basis that relocation will be either locally to Ravensworth Farm or alternatively to Broke. Should Ravensworth Farm (Option 1) be approved by the consent authority then approval for this relocation option would be included as part of the SSD development consent. However, should Broke Village (Option 2) be approved by the consent authority then land tenure is to be secured and further secondary approvals will be required to be obtained. In the event that the necessary secondary approvals cannot be obtained in a timely manner (within 2 years of commencement of development under the SSD development consent) then the Homestead would be relocated to the Ravensworth Farm (Option 1). Further details on the approval process is provided in **Section 5.2.1.2**.

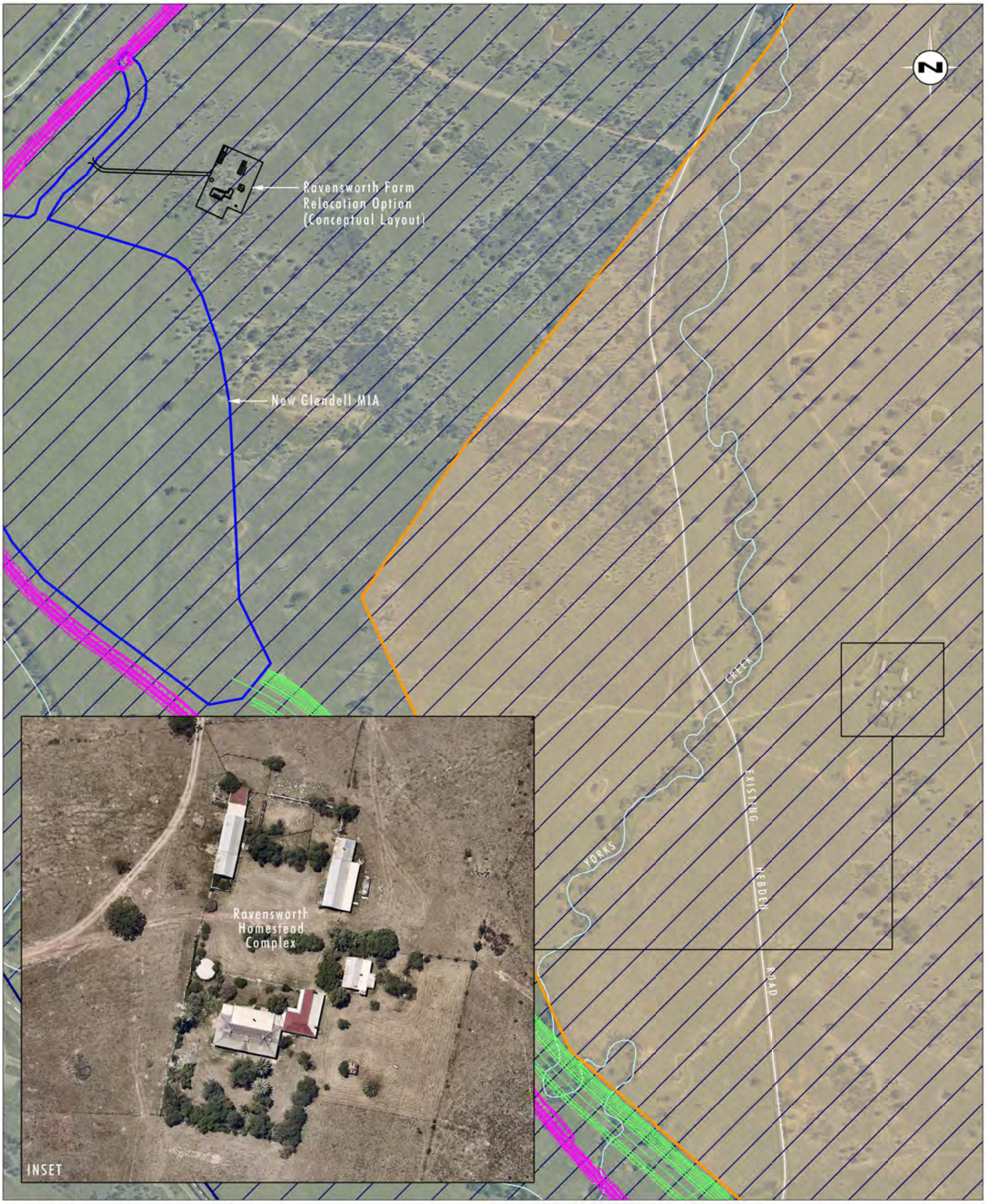

Image Source: Glencore (Jul 2018)
Data Source: Glencore (2019)

0 20 50 100m Inset
0 100 250 500m

Legend
- Project Area
- Glendell Pit Extension
- New Glendell MIA
- Hebden Road Realignment
- Heavy Vehicle Access Road

FIGURE 3.16

Ravensworth Homestead and Ravensworth Farm Relocation Option

File Name (A4): R08/4166_136.dgn
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3.2.10 Electricity and Telecommunications Infrastructure

The establishment of operations within the Additional Disturbance Area will require the relocation, construction and decommissioning of several sections of existing electricity and telecommunications infrastructure. These relocations are shown on **Figure 3.17** and will be undertaken by the Proponent in consultation with the relevant infrastructure owners.

Existing 11 kV transmission lines running through the Additional Disturbance Area provide power to private users in the Hebden area, the existing Telstra Tower location, the Glendell Mine, Ravensworth East MIA and Mount Owen Mine. Some of these lines will need to be relocated and Ausgrid has been, and will continue to be, consulted as the Project progresses in this regard.

The relocation of these lines will take place during the construction phase and where possible will occur prior to decommissioning of the existing line for continuity of supply to other users. Private users in the Hebden area will be notified prior to any works on this infrastructure that may disrupt supply for short periods of time during construction.

Some existing telecommunications and associated infrastructure is also located within the Additional Disturbance Area and will require disconnection, relocation or protection during construction works as part of the Project. These services are predominantly owned by Telstra. The relocated alignment will largely follow the alignment of the realigned Hebden Road.

Discussions have been undertaken with the owners and operators of this infrastructure regarding the design requirements for the infrastructure being relocated and the timing of relocation. The relocated infrastructure will be commissioned in a manner that causes the least practicable disruption to end users and the infrastructure operators. The Proponent will continue to engage with the owners and operators of this infrastructure during the detailed design and construction process to minimise the risk of service disruptions.

Design works have commenced for the relocation of the existing Telstra Tower that is currently situated within the Glendell Pit Extension. The tower will be relocated by Telstra onto Glencore-owned land under a lease arrangement. The relocation of the Telstra Tower is occurring independently of the Project and does not form part of the Project.

3.2.11 Creek interactions

3.2.11.1 Yorks Creek

The progression of the Glendell Pit Extension to the north will necessitate the realignment of the lower portion of Yorks Creek, an ephemeral tributary of Bowmans Creek that currently runs in a roughly north-south alignment though the Project Area. Earthworks upstream of the Glendell Pit Extension will also be required to manage the risk of flood waters entering the pit. The portion of Yorks Creek that requires realignment includes the approximately 1.5 km section that has previously been diverted (refer to **Section 2.1.5.1**) as part of Ravensworth East Mine operations (when it was formerly Swamp Creek Mine).

The proposed realignment will commence north of the existing Ravensworth East MIA (and south of the Mount Owen access road) and progress in a south-westerly direction where it will enter Bowmans Creek. The realignment will require land forming works in the area east of the proposed Hebden Road realignment. A cutting through the ridge west of the Hebden Road realignment will also be required with the Hebden Road realignment crossing in the vicinity of this cutting. The realigned creek will re-enter Bowmans Creek approximately 4 km upstream of the existing confluence.

umwelt

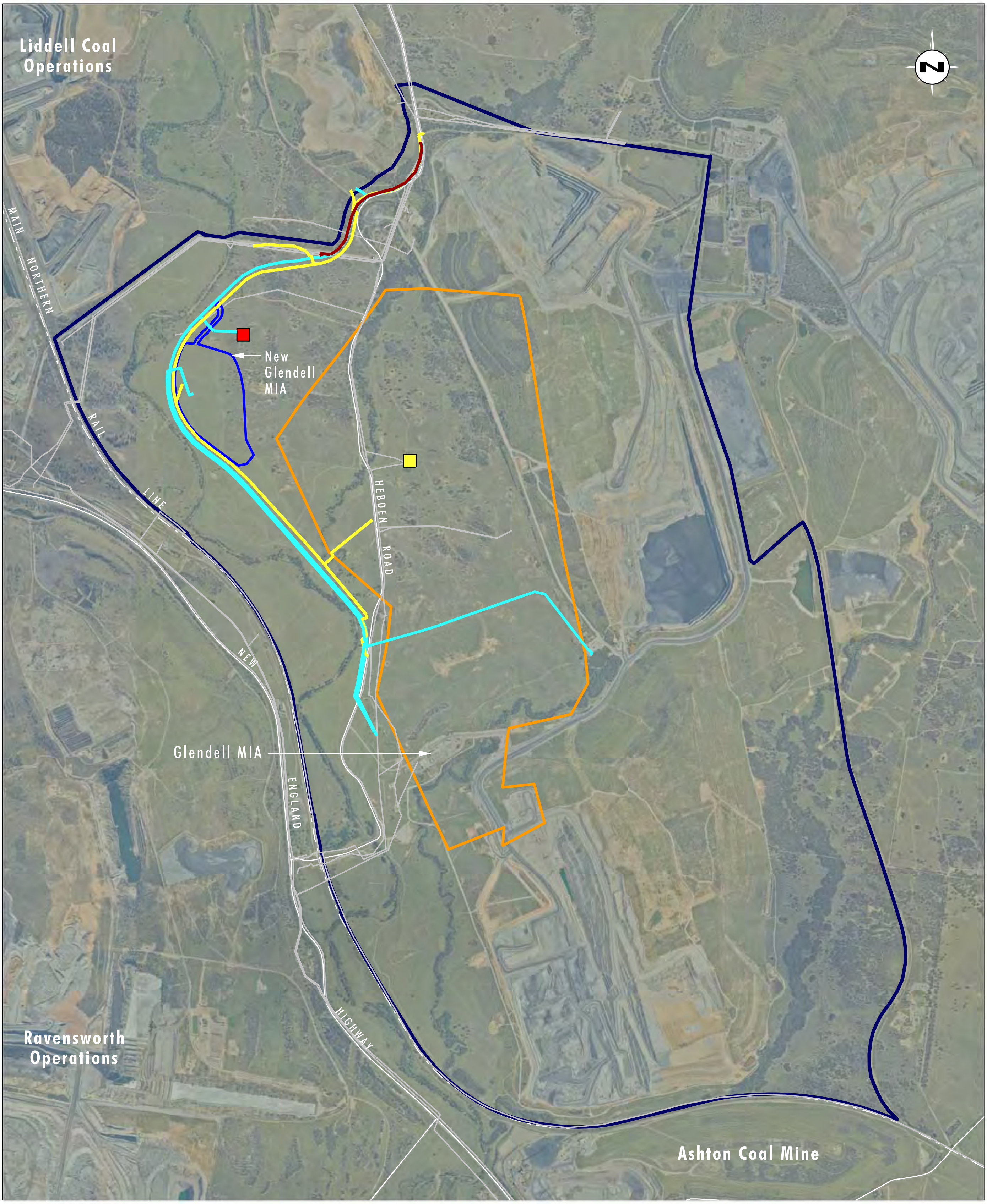

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Ravensworth Homestead to be relocated

Legend

- Project Area
- Glendell Pit Extension
- New Glendell MIA
- Ravensworth Homestead
- Ravensworth Farm Relocation Option
- Existing Powerline/Communications
- Proposed Relocated 11kV Powerline
- Proposed Relocated 33kV Powerline
- Proposed Relocated Communications

FIGURE 3.17

Electricity and Telecommunications Infrastructure Relocation

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A conceptual detailed design for the realignment is shown in **Figure 3.18.** During construction, a combination of constructed channels and pipelines will be used to convey wet weather flows from the upper reaches of Yorks Creek to the sections of Yorks Creek downstream of the realignment works. Detention basins and dams, in combination with high flow bypass structures will be constructed in the upstream sections of the realignment to manage high flow events during construction. A Yorks Creek Realignment Plan will be developed to inform the construction and commissioning works for the Yorks Creek Realignment.

This realignment is proposed to be permanent and its design will have regard to a wide range of environmental factors. Conceptual detailed design plans for the Yorks Creek Realignment are shown in **Appendix 7**.

The realignment is required to be in place and appropriately stabilised to manage downstream risks associated with elevated turbidity during the commissioning process before the existing creek alignment is intercepted by the Glendell Pit Extension. Aspects of the realignment construction (primarily the development of the cutting for the lower reach) may occur as part of the Hebden Road realignment works.

The Glendell Continued Operations Consent will regulate the development of the Yorks Creek Realignment Plan and construction, commissioning and the ongoing management and rehabilitation/riparian revegetation works of the Yorks Creek Realignment. The Rehabilitation Strategy developed for the Mount Owen Complex (common to both consents) will identify objectives and rehabilitation criteria for the Yorks Creek Realignment.

Further discussion of the Yorks Creek Realignment design considerations and processes is included in **Appendix 18**. Design objectives for the Yorks Creek Realignment and rehabilitation of riparian areas is discussed further in **Section 7.5**.

3.2.11.2 Swamp Creek

The Project will mine through a section of Swamp Creek located immediately north of Glendell Pit. The lower reaches of Swamp Creek to the west of Glendell Pit and Glendell Project Disturbance Area will not be directly impacted by the Project. These lower reaches will be indirectly affected through reduced catchment area during the life of the mine. Water from the rehabilitated slopes of the south-western part of the final landform of the Project will be directed towards the lower reaches of Swamp Creek.

The terrain developed by the in-pit emplacement of overburden as part of the mining of the Project will preclude the former upstream areas of the Swamp Creek catchment within the Mount Owen Complex WMS from being returned to the downstream Swamp Creek catchment. This will result in the Swamp Creek catchment area being smaller than the pre-mining extent of Swamp Creek and the currently approved conceptual final landform catchment for Swamp Creek but similar in size to the existing Swamp Creek catchment. Areas of the former Swamp Creek catchment within the existing mining disturbance area will generally be diverted towards Bettys Creek as part of final landform drainage. This change to the final landform will be managed under the Mount Owen Consent and is discussed further in **Section 3.3.10**.

3.2.12 Hours of operation

Mining at the Glendell Pit (including the Glendell Pit Extension) and operations at the Glendell MIA will continue to be undertaken 24 hours per day, 7 days per week for the life of the Project.

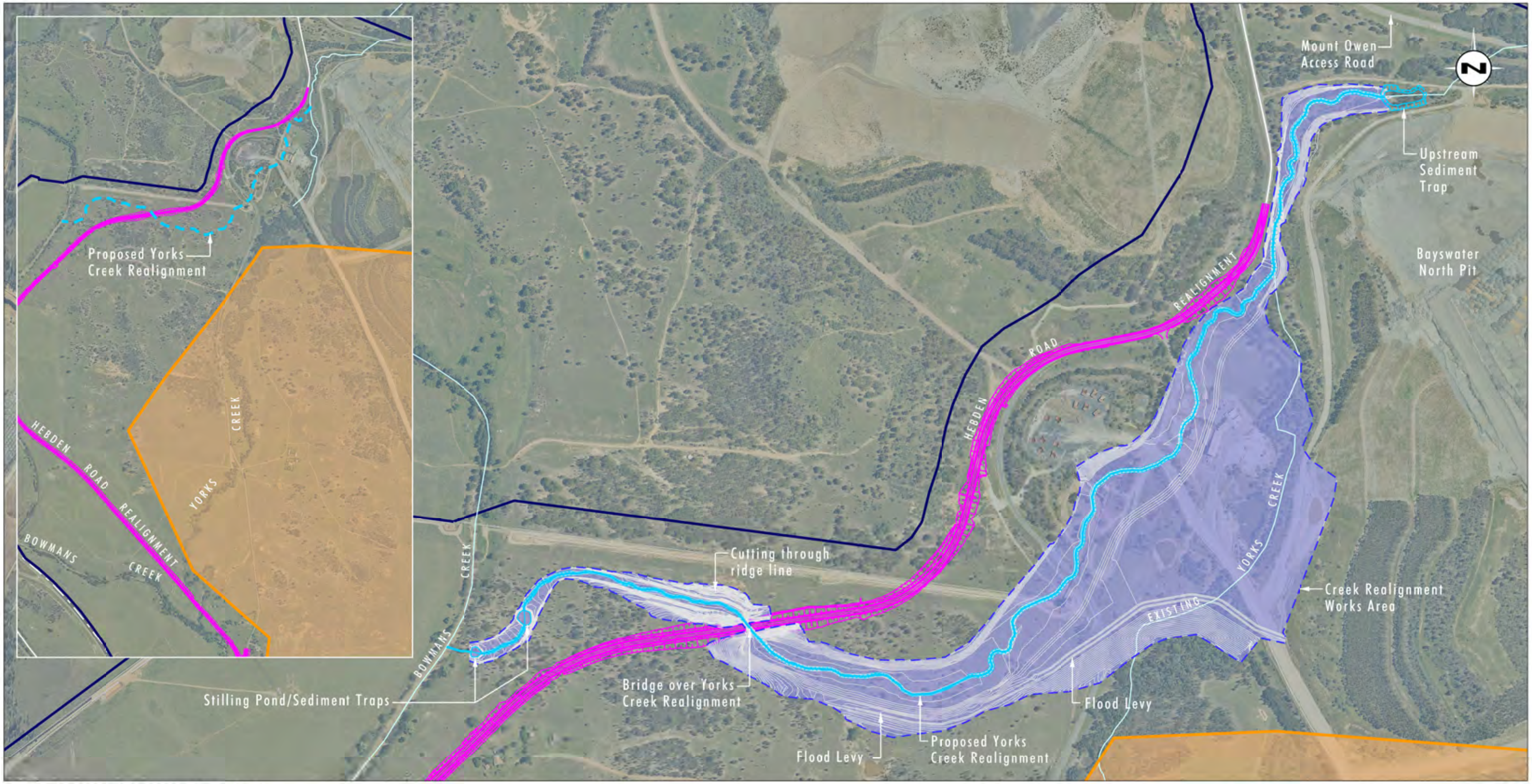

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)

Legend
- Project Area
- Glendell Pit Extension
- Hebden Road Realignment
- Yorks Creek Realignment
- Creek Realignment Works Area

FIGURE 3.18

Yorks Creek Realignment - Conceptual Detailed Design

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3.2.13 Operational workforce

During the life of the Project, Glendell operational workforce numbers will progressively increase from approximately 300 FTE up to a maximum of approximately 690 FTE positions when production rates are higher. The increasing workforce at Glendell coincides with a reduced complex workforce as operations at Bayswater North Pit and North Pit decline.

Following the cessation of mining, mine closure and rehabilitation activities will require a reduced ongoing workforce.

3.2.14 Construction

3.2.14.1 Construction activities and schedule

The Project has been designed to maximise the use of existing and currently approved infrastructure, however, as outlined in the previous sections, the Project will involve a number of significant construction activities including a new MIA and the realignment of a section of Hebden Road and realignment of part of Yorks Creek.

Construction activities will require the development of temporary construction facilities such as offices and construction workforce deployment, training and parking facilities. To facilitate an efficient construction program it may be necessary to prepare construction facilities in several locations. These temporary facilities will be constructed within the Additional Disturbance Area, with appropriate water and erosion controls in place.

As discussed in **Section 3.2.8** a dedicated primary access road will be constructed off Hebden Road to the primary construction area. Additional access points to construction areas off Hebden Road may also be required, including at the points of connectivity with the realigned section.

All construction related activities, including internal access roads, will be located within the Additional Disturbance Area and existing approved disturbance areas (refer to **Section 3.2.2**). The indicative timing of construction activities is set out in **Table 3.3**.

Table 3.3 Indicative Construction Schedule

Feature	Indicative Construction Period
Temporary Construction Facilities	Year 1 to Year 2
New MIA	Year 1 to Year 2
Heavy Vehicle Access Road	Year 1 to Year 2
Hebden Road Realignment	Year 1 to Year 2
Yorks Creek Realignment	Prior to Year 7 – some aspects constructed as part of Hebden Road realignment
Power and Communications	Year 1 to Year 3
Water Management System and Ancillary Infrastructure to support mining operations	Year 1 to Year 3 and ongoing as mining progresses
Demolition of Glendell MIA	Year 2
Relocation of Ravensworth Homestead	Year 1 to Year 6

Construction activities in some areas may include blasting for cuttings (Hebden Road and Yorks Creek Realignment). Crushing of overburden and blasted material from cuttings and areas within the Glendell Pit Extension and other approved mining areas at the Mount Owen Complex identified as having suitable material may also be required for road and MIA construction fill. Surplus excavated material not required will be disposed of as overburden. Soil stripped from construction areas will be used for rehabilitation purposes where required.

If suitable, material extracted from the cuttings associated with the realignment works for the Hebden Road realignment and Yorks Creek Realignment may be used for the construction of the Hebden Road realignment, MIA foundations, and Heavy Vehicle Access Road. Alternatively, suitable construction material may be imported from off-site, or extracted from approved Mount Owen Complex mining areas, including within the Glendell Pit Extension.

Overburden extracted from the Glendell Mine and/or Mount Owen Mine may also be used as road base or pavement material using the existing in-pit crushing equipment.

3.2.14.2 Construction hours

Construction activities will generally be undertaken within standard construction hours (7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm Saturday) however may occur 24 hours a day. Work activities that occur outside of the nominated construction hours will be managed to minimise impacts to the community. It is also noted that some works such as the installation of power utilities may need to be undertaken at specific times to minimise disruptions to users.

Blasting associated with construction activities will only be undertaken 9.00 am to 5.00 pm, Monday to Friday and 9.00 am to 1.00 pm Saturday. Blasting activities with potential to impact traffic using Hebden Road will be carried out in periods to avoid school bus movements. Operational blast criteria will apply to construction blasting.

3.2.14.3 Construction workforce

The construction workforce on site at any one time will vary depending on the timing of the various construction components of the Project. The construction workforce is estimated to peak at up to approximately 350 FTE positions in Years 1-2. This includes the construction of the Heavy Vehicle Access Road, new MIA, and the Hebden Road realignment. The bulk of the construction activity will take place within the first approximately 5 years of the Project, as outlined in **Section 3.2.14**.

It is expected that some short term increases in traffic associated with key infrastructure construction periods will occur. Further details on the management of traffic impacts in relation to construction activities associated with the Project is provided in **Section 7.11**.

3.2.15 Demolition

There are a number of former residences and farm structures located within the Additional Disturbance Area that will be removed as part of the Project. The demolition of these structure will be undertaken in accordance with *Australian Standard AS 2601 – 2001 The Demolition of Structures*, or its latest version.

The Project will also require the demolition of infrastructure associated with the existing Glendell MIA. The removal of this infrastructure is approved under the Glendell Consent. Consistent with the requirements of the Glendell Consent, the demolition of the Glendell MIA will be undertaken in accordance with *Australian Standard AS 2601 – 2001 The Demolition of Structures*, or its latest version (as applicable).

3.2.16 Ongoing exploration activities

Exploration activities will continue to be undertaken throughout the life of the Project including drilling within the mining authorities to obtain further information regarding the reserves to be mined as well as geological, hydrogeological and geotechnical information relevant to the mining and construction activities that will be undertaken. Additional drill holes to install groundwater and gas monitoring bores may also be required.

Construction, sealing and abandonment of boreholes will be in accordance with relevant standards and guidelines published by the DRG and in force at the time.

Surface disturbance associated with exploration and groundwater monitoring activities will be minimised with drilling undertaken on existing disturbed areas where practicable. All exploration and groundwater monitoring boreholes will be undertaken in accordance with relevant requirements and standards under the *Mining Act 1912* and *Water Management Act 2000*.

3.2.17 Final landform and rehabilitation

Progressive rehabilitation has been undertaken throughout the life of Glendell, Ravensworth East and Mount Owen Mines. Rehabilitation works have included extensive flora and fauna monitoring and research projects in order to develop rehabilitation techniques and ensure the development and success of the rehabilitation programs in place. Consistent with existing approved operations under each of the Glendell Consent and Mount Owen Consents, disturbed areas will be rehabilitated as soon as practicable throughout the life of mining at the Mount Owen Complex.

The rehabilitation of the areas within the Glendell Project Disturbance Area will include the shaping and revegetation of disturbed areas for a combination of native vegetation and open grassland areas with a pit lake associated with the Glendell Pit Extension final void.

Figure 3.6 shows the conceptual final landform and revegetation strategy for the Mount Owen Complex upon final rehabilitation of the site. The proposed rehabilitation has been designed to integrate with the currently approved rehabilitation and final land use of other Glencore mines within the greater Ravensworth area. The conceptual final land use plan for the Project has been developed to minimise potential constraints on alternative land uses that may be identified during the detailed mine closure planning process. The following sections outline the general rehabilitation commitments that will be applied to areas disturbed by the Project. Further detail regarding mine rehabilitation and the closure strategy for the Project is provided in **Section 7.9**.

3.2.17.1 Progressive rehabilitation and landform development

Progressive rehabilitation will consist of the shaping of overburden emplacement areas to create a suitable final landform. The rehabilitation works will include optimisation of ongoing overburden emplacement and final landform shaping to achieve an undulating landform with adequate surface drainage which is in keeping with the surrounding landscape. Soil will then be spread over the shaped overburden emplacement areas and revegetation works will commence. Monitoring of the success of the revegetation works will continue throughout the life of the mining operations and the closure process.

Temporary rehabilitation measures, such as seeding with a cover crop, will also be implemented as required in areas that will not form part of active mining operations for more than a 12 month period of time for erosion and sediment control and dust control purposes. Areas of existing vegetation in rehabilitation areas identified as being impacted by the Project will be maintained but not actively managed for rehabilitation outcomes pending disturbance associated with the Project.

The design of the final landform is to be developed progressively as part of the detailed mine planning process and is included in the staged rehabilitation plans contained in the MOP/Rehabilitation Management Plan. The progressive inclusion of natural landform design elements in the landform as part of the detailed mine planning process is necessary to improve the efficiency of overburden handling and to improve the stability of the final landform by providing suitable surface drainage as part of the final landform design.

The Glendell Continued Operations Consent will include some areas already rehabilitated under the existing Glendell Consent; these areas have typically not been developed using natural landform shaping practices. Those areas of established landform that are not re-disturbed as part of the Project will be maintained in accordance with the approved final landform and MOP authorised at the time of establishment. The rehabilitation of the final landform covered by the Glendell Continued Operations Consent is shown in **Appendix 6**.

3.2.17.2 Final void

The Glendell Consent approved conceptual final landform incorporates a single void in the northern end of the Glendell Pit (refer to **Figure 2.4**). The Project will result in a single void in the north of the proposed Glendell Pit Extension with the existing approved Glendell Pit entirely backfilled. The Project will not result in any additional voids at the Glendell Mine when compared to current approved operations. Highwalls will be retained in the final void with the final highwalls designed to be safe and stable having regard to geotechnical investigations undertaken as part of the mine closure planning process. The low wall slopes will be battered to between 10 and 18 degrees and vegetated. The overall catchment area of the Glendell Pit Extension final void is slightly less than that of the currently approved final void. The final void design will have regard to potential land uses which can make use of the opportunities presented by final voids.

A pit lake will develop in the final void over time following the cessation of mining. The pit lake shown in **Figure 3.6** represents the maximum predicted pit lake extent when equilibrium steady state is reached. Details regarding the final void lake water quality are provided in **Section 7.5**, and processes for the management of the final void are provided in **Section 7.9**.

3.2.18 Subdivision

Once realigned, the land associated with Hebden Road will be transferred to Singleton Council with the existing alignment of Hebden Road consolidated with Glencore owned titles following formal closure of this section of road. This may require a subdivision and consolidation of current allotments. This subdivision will be undertaken as part of the Project.

3.3 Mount Owen Consent Modification

Table 3.4 summarises the proposed modifications to the Mount Owen Consent as a result of the Project and contains an updated summary of the key aspects of the development covered by the Mount Owen Consent following the proposed modification.

Table 3.4 Mount Owen Consent Modification – Summary of Key Aspects

Operational Aspect	Development (as approved by Modification 2)	Proposed Modifications due to the Project
Mining Area	North Pit. Bayswater North Pit.	No change.
Production Limits	North Pit – up to 10 Mtpa ROM coal. Bayswater North Pit – up to 4 Mtpa ROM coal.	No change.

Operational Aspect	Development (as approved by Modification 2)	Proposed Modifications due to the Project
Mining Method	North Pit – open cut (truck and excavator). Bayswater North Pit – open cut (truck and excavator).	No change.
Approved Mine Life	North Pit – to 31 December 2037. Bayswater North Pit – to approximately 2023. CHPP, MIA, load out facility and rail loop to 2037.	No change to mining. Extended duration of use of CHPP, MIA, load out facility and rail loop to 2045.
Tailings Emplacement	Ability to transfer tailings to other operations approved for receipt and transfer of tailings as part of the GRAWTS. Tailings emplacement in West Pit, Bayswater North Pit and cells within North Pit.	Extended duration of approved emplacement to 2045.
Overburden Emplacement	In-pit emplacement (Bayswater North Pit and North Pit). Out-of-pit emplacement at western out-of-pit (WOOP) emplacement area, and parts of Ravensworth East emplacement area. Use for mining purposes such as capping of former tailings facilities and West Pit, haul roads etc. Emplacement to approximately 185 mAHD at Ravensworth East emplacement area. Emplacement to approximately 190 mAHD at WOOP emplacement area. Emplacement to approximately 230 mAHD at Mount Owen emplacement area.	Extension of time for completion of final landform reshaping in North Pit and Bayswater North Pit voids. Ongoing use of Bayswater North Pit and North Pit for emplacement of coarse rejects.
Approved Final Voids	Bayswater North Pit. North Pit.	No change.
Coal Processing	Processing coal from Mount Owen Complex mines at Mount Owen CHPP (up to 17 Mtpa) approved to end of 2037.	No change to capacity. Extended duration of use of CHPP and associated coal handling facilities to end of 2045.
Coal Transportation	Mount Owen load out facility and rail loop approved to end of 2037. Transportation of coal via rail or conveyor to the Bayswater and/or Liddell Power Stations. Transport of up to 2 Mtpa ROM coal and/or crushed gravel to Liddell Coal Operations and the Ravensworth Coal Terminal coal via conveyor.	Extended duration of use of existing coal transport systems to end of 2045. Removal of Ravensworth East conveyor and associated infrastructure to enable construction of Yorks Creek Realignment. Continued coal transport to Liddell and/or Bayswater Power Stations, Liddell Coal Operations and the Ravensworth Coal Terminal coal via rail rather than conveyor, once conveyor is removed.
Mine Infrastructure Area (MIA)	Mount Owen MIA and Ravensworth East MIA.	Extended duration of use of Mount Owen MIA.

Operational Aspect	Development (as approved by Modification 2)	Proposed Modifications due to the Project
Workforce	Up to approximately 920 FTE positions during mining operations.	No change during mining period. Extended duration of CHPP and coal handling related workforce from 2037 to 2045.
Primary Mine Water Storages	Use of Bayswater North Pit and North Pit as water and/or tailings storages following cessation of mining activities.	Extended duration of use.
GRAWTS Linkages	Water pipeline linkages to Integra Underground. Water and tailings pipeline linkages to Liddell Coal Operations and Ravensworth Operations. Use of WRD as a GRAWTS linkage[1].	Extended duration of use of GRAWTS linkages. Realignment of GRAWTS linkage and access track to Liddell Coal Operations to accommodate Yorks Creek Realignment.
Creek Diversions	Upper reaches of Bettys Creek into Main Creek. Upper reaches of Swamp Creek into Yorks Creek. Diversion of section of Bettys Creek to the south of WOOP emplacement area.	Existing Yorks Creek Diversion replaced by the Yorks Creek Realignment as part of the Project. Yorks Creek Diversion area to be managed under Glendell Continued Operations Consent following commissioning of Yorks Creek Realignment.
Road Realignments and Infrastructure	Road overpass over the Main Northern Rail Line on Hebden Road Dual land bridge over Bowmans Creek on Hebden Road Additional rail line and northern turn-out west of the existing Mount Owen rail line (yet to be constructed)	No change.
Rehabilitation	Ongoing progressive rehabilitation of disturbed areas when no longer required for active operations with the use of temporary rehabilitation on disturbed surfaces such as exposed overburden emplacements that remain inactive for 12 months or more. Reinstatement of former Swamp Creek catchment into remnant of Swamp Creek.	Delay of final landform shaping at North Pit and Bayswater North Pit and delayed decommissioning of infrastructure associated with continued use for the Project. Changes in final landform catchments. Parts of former Swamp Creek catchment reports to Bettys Creek in final landform. Use of WRD as a retention basin in the final landform to manage flows associated with the changed landform. Maintenance of existing areas of rehabilitation pending disturbance as part of Glendell Pit Extension and associated overburden emplacement.
Demolition	Demolition of infrastructure (including MIAs) on completion of mining operations (unless approved for other post mining land uses). Decommissioning and removal of redundant mine-owned infrastructure.	Extended duration of use of some infrastructure delaying demolition.

1 Subject to Narama Pipeline Modification

The following sections describe the proposed changes to the development approved under the Mount Owen Consent.

3.3.1 Conceptual mine plan

The Project will not result in any changes to the approved mining in Bayswater North Pit or North Pit at Mount Owen.

The Project will result in some changes to the timing of final reshaping and rehabilitation activities in the final voids at the Bayswater North Pit and North Pit. These changes are associated with the extended life of operations from the processing of the additional coal from the Glendell Pit Extension as part of the Project.

Figure 3.2 to **Figure 3.5** show the conceptual development of operations at Mount Owen Complex over the life of the Project. Conceptual plans for each of these stages for the operations to be covered by the modified Mount Owen Consent are contained in **Appendix 6**.

There is no proposed change to mining fleet numbers or production rates under the Mount Owen Consent as a result of the Project.

3.3.2 Mount Owen CHPP and Associated Infrastructure

ROM coal from the Mount Owen Continued Operations (Bayswater North Pit and North Pit) will continue to be processed at the Mount Owen CHPP and will continue to be loaded onto trains using the Mount Owen Complex rail loading and transportation infrastructure.

ROM coal from the Glendell Mine (Glendell Pit and Glendell Pit Extension) will be handled and processed at the Mount Owen CHPP and associated stockpile areas and crushing facilities.

The operation of the Mount Owen CHPP and associated facilities is currently approved to 2037 at an operating capacity of up to 17 Mtpa ROM coal in any calendar year.

The modification to the Mount Owen Consent will extend the approved operating period of the Mount Owen CHPP and associated infrastructure to the end of 2045 (assuming approval in 2021). This modification will maintain the current operating capacity of the Mount Owen CHPP and associated facilities for the duration of the mining in the Glendell Pit Extension and the additional year of operation post 2044 is to enable the processing of ROM coal mined in the final year of operations under the Glendell Continued Operations Consent.

The increased annual production from the Glendell Pit Extension may require ROM stockpile upgrades. The increased stockpile area can be accommodated entirely within the Approved Mount Owen Operational Area.

3.3.2.1 Decommissioning of Ravensworth East Conveyor and associated infrastructure

The Ravensworth East conveyor currently provides for continuity of production at the Mount Owen Complex in the event of full operational capacity at the Mount Owen CHPP being unavailable. The conveyor also provides a link to the supply to the Liddell and Bayswater Power Stations. Under the current approvals, total ROM coal (and/or crushed rock) movements via the Ravensworth East conveyor are limited to 2 Mtpa.

The construction of the Hebden Road realignment and Yorks Creek Realignment will directly impact on the Ravensworth East conveyor, Ravensworth East ROM stockpile area, crushing facilities and associated infrastructure. The Ravensworth East conveyor will be decommissioned to accommodate the Yorks Creek Realignment works with further dismantling to occur over the life of the Project. These works will be undertaken within the Mount Owen Consent Area.

3.3.3 Product transportation

The currently approved annual operating capacity of the Mount Owen train loading facility is not proposed to be increased and has approval to process up to 17 Mtpa of ROM coal. The Project will extend the current approved life of the Mount Owen Rail Loop and rail loading facilities to approximately 2045.

Once trains are loaded, they travel southwards on the Mount Owen rail spur to the Main Northern Rail Line. The rail loading facility will continue to operate 24 hours per day, 7 days per week for the life of the Project. Rail infrastructure may also be used during the decommissioning process for the conveyance of plant and materials to and from the site.

The approved Mount Owen Rail Loop infrastructure enables ROM and product coal from Mount Owen Mine to be transported to the Liddell and Bayswater Power Stations. This rail linkage would also enable ROM coal to be transported to the Liddell Coal Operations and the Ravensworth Coal Terminal coal processing facilities for beneficiation should the Mount Owen CHPP be unavailable. The currently approved ability to transfer up to 2 Mtpa of coal (ROM or product) to these operations via rail rather than conveyor would be maintained.

3.3.4 Coarse Rejects and tailings management

Coarse rejects from the Mount Owen CHPP are currently approved to be disposed through co-disposal with overburden at the Mount Owen and Ravensworth East overburden emplacement areas.

Tailings emplacement within the Mount Owen Complex is undertaken within disused mining areas in accordance with the tailings management strategy. In addition to past tailings facilities, tailings are currently approved to be disposed in West Pit, Bayswater North Pit and constructed cells within North Pit. Tailings are also approved to be transferred to operations within the GRAWTS for disposal (subject to relevant approvals for the transport to and receipt of tailings from those facilities being in place).

ROM coal from the Project will be processed through the existing Mount Owen CHPP. The Project will produce approximately 21 Mm^3 of coarse rejects and 30 Mm^3 of additional tailings throughout the mine life. The Project will not result in any substantial change to the overall coarse rejects and tailings strategy for the Mount Owen Complex. The following sections detail the changes proposed to the currently approved tailings strategy as a result of the extended life of the Mount Owen CHPP and additional ROM coal processed.

3.3.4.1 Coarse rejects

Coarse reject from the processing of Glendell Pit Extension (and approved Glendell Pit) ROM coal will continue to be emplaced within in-pit emplacement areas at the Mount Owen Complex. Coarse rejects from the CHPP may also be used for the capping of tailings facilities where appropriate. Consistent with current operations, coarse rejects will be hauled by truck from the Mount Owen CHPP to emplacement areas.

As outlined in **Section 7.9**, the geochemical properties of coarse reject material associated with the processing of coal from the Project are similar to reject material associated with current operations. Current material handling and emplacement practices will be applied to coarse reject material associated with the Project and are not predicted to represent any change of environmental management risk.

3.3.4.2 Tailings management

Consistent with the current Mount Owen Consent approved tailings management methods, tailings will continue to be emplaced within existing voids within the Mount Owen Complex under the GRAWTS. Given the extension of operating life of the Mount Owen CHPP required for processing ROM coal from the Glendell Pit Extension, the emplacement of tailings from the Mount Owen CHPP will continue until processing of coal from the Glendell Pit Extension is completed in approximately 2045.

Based on current approvals for operations within the GRAWTS, there is sufficient void capacity available to store tailings associated with all approved operations plus the Project. **Figure 3.19** shows available tailings storage capacity within the GRAWTS and projected tailings generation over the life of the Project.

Consistent with the current strategy, tailings will be initially emplaced in West Pit. Tailings will then be emplaced at either Liddell Coal Operations, the Bayswater North Pit void, or in cells in the North Pit void if required.

To facilitate the consolidation and drying of emplaced tailings facilities, the rates of tailings deposition in the various facilities may be adjusted with tailings being emplaced in 2 or more facilities at any one time to assist in settlement and rehabilitation of the facilities.

Decant water from each tailings storage will be collected and managed as mine water and be distributed throughout the GRAWTS for further use in coal processing and dust suppression.

In accordance with the current approvals, tailings emplacement areas at the Mount Owen Complex will be capped with overburden to achieve a stable final landform and allow the area to be rehabilitated in accordance with the proposed mine plans and Rehabilitation and Mine Closure Strategy (refer to **Section 7.9**).

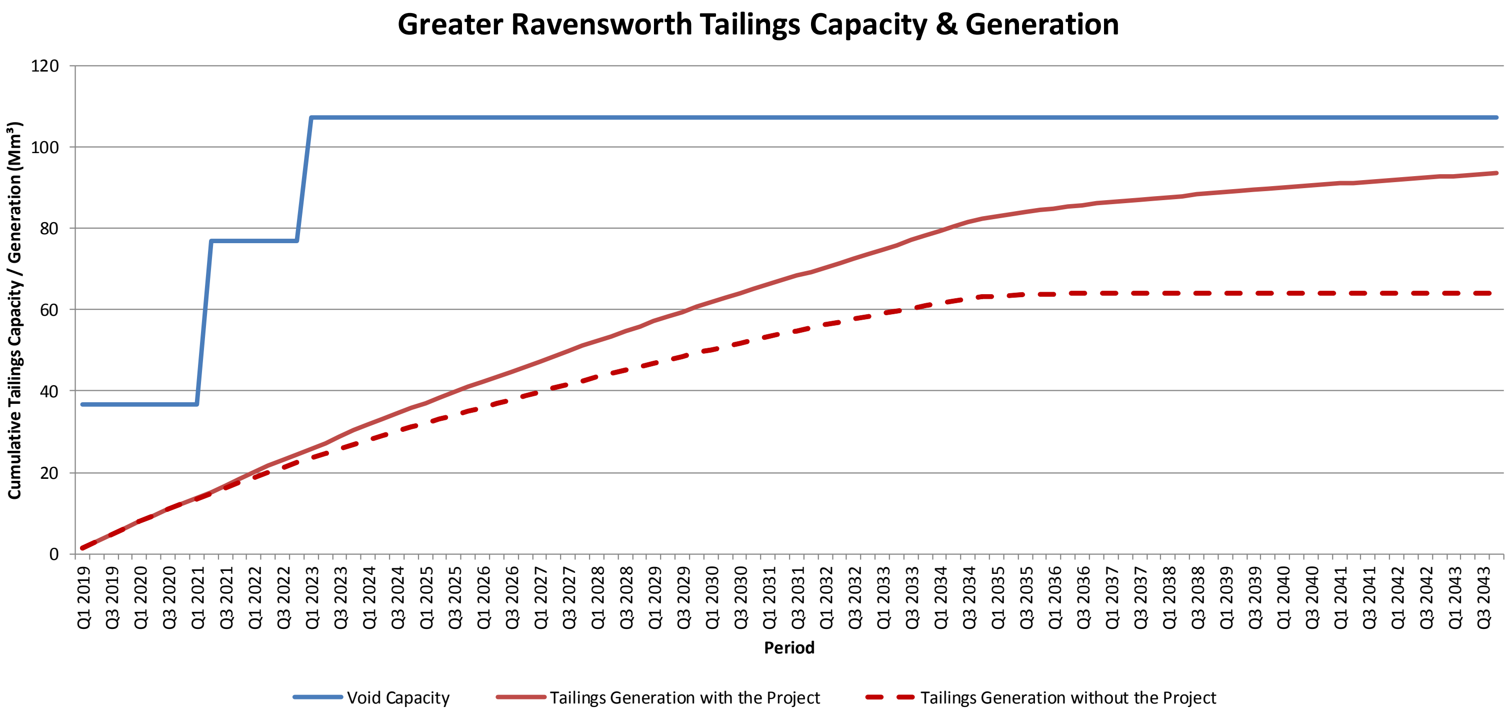

FIGURE 3.19

GRAWTS Tailings Capacity and Generation over the Life of the Project

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3.3.5 Mount Owen infrastructure upgrades/changes

3.3.5.1 General infrastructure upgrades and realignments

The realignment of a section of Hebden Road and part of Yorks Creek required for the Glendell Pit Extension may require the relocation (or temporary realignment) of existing services and infrastructure associated with the Mount Owen Complex including:

- telecommunications
- powerlines
- pipelines
- internal access roads and associated water management structures such as culverts and drains
- other ancillary infrastructure where required.

The Yorks Creek Realignment may also require changes to culverts under the Mount Owen access road.

The current electricity and telecommunications infrastructure servicing the Mount Owen MIA/CHPP are proposed to be re-routed around the Glendell Pit Extension and proposed infrastructure works.

All relocation and upgrade works will be located within the Mount Owen Operational Area, the Mount Owen Additional Disturbance Area or the Glendell Project Disturbance Area (refer to **Sections 3.2.2** and **3.3.9**).

3.3.5.2 Decommissioning and demolition of Ravensworth East MIA

The Yorks Creek Realignment works will require the demolition of the Ravensworth East MIA. These decommissioning and demolition works will be undertaken in accordance with the existing commitments under the Mount Owen Consent and mining leases associated with the Ravensworth East Mine.

3.3.5.3 Mount Owen Complex Water Management System

The Mount Owen Complex WMS and interactions with the GRAWTS will continue to be managed in accordance with the Mount Owen Complex Water Management Plan. The main changes required to the Mount Owen Consent as a result of the Project are:

- realignment of parts of the Liddell Coal Operations GRAWTS linkages in areas affected by the Yorks Creek Realignment and Hebden Road realignment
- use of WRD as a mine water storage and transfer point for GRAWTS as well as a transfer point for aspects of the WMS covered by the Glendell Continued Operations Consent
- internal changes to the Mount Owen Complex WMS, including works to divert any overflow from mine water dams located at the Mount Owen CHPP/MIA into Bayswater North Pit
- extended duration of GRAWTS interactions to the end of the Project (subject to approvals at other sites linked to the GRAWTS)
- enlargement of WRD for water management and as a retention basin in the final landform.

The Narama Pipeline Modification will also result in changes to the Mount Owen Complex WMS, however this is subject to a separate modification of the Mount Owen Consent. Changes in landform associated with the Project will also necessitate changes to the sediment dam layout in some areas.

Full details of the changes to the Mount Owen Complex WMS associated with the Project and its ongoing interaction with the GRAWTS over the life of the Project are discussed in detail in **Section 7.5** and will be incorporated into a revised Mount Owen Complex Water Management Plan should the Project be approved.

3.3.6 Hours of operation

Approved activities under the Mount Owen Consent will continue to be undertaken 24 hours per day, 7 days per week for the life of the Project.

3.3.7 Creek interactions

3.3.7.1 Yorks Creek

As discussed in **Section 3.2.11.1**, the Project includes the realignment of a section of Yorks Creek, including a previously diverted section of Yorks Creek (Yorks Creek Diversion) regulated under the Mount Owen Consent. The construction and operation of the Yorks Creek Realignment will be managed under the Glendell Continued Operations Consent (refer to **Section 3.2.11.1**). The maintenance and rehabilitation of the existing Yorks Creek Diversion within the Mount Owen Consent Area will continue to be managed under the Mount Owen Consent until construction of the Yorks Creek Realignment.

3.3.7.2 Swamp Creek

The terrain developed by the in-pit emplacement of overburden as part of the mining of the Project will result in a reduction to the Swamp Creek catchment relative to that currently contemplated for the final landform in the existing Mount Owen Consent. The Project will result in areas of Swamp Creek catchment within the existing mining disturbance area being diverted towards Bettys Creek as part of final landform drainage rather than the existing lower reach of Swamp Creek.

The catchment in the area of the former Swamp Creek catchment to the east of the Bayswater North Pit and the west of the Mount Owen MIA may be directed towards Yorks Creek as part of the final landform. These works may require the construction of drainage lines in this area with the point of connection to Yorks Creek being constructed as part of the decommissioning of the Mount Owen access road. These works, if required, will be located entirely within the Approved Mount Owen Operational Area (refer to **Section 3.3.9**). This is discussed further in **Section 7.5**.

3.3.7.3 Bettys Creek

As discussed above, the Project will result in the redirection of part of the former Swamp Creek catchment towards Bettys Creek as part of the conceptual final landform design (refer to **Figure 3.6**). The WRD will operate as a retention basin in the final landform to manage the larger catchment flowing into Bettys Creek and to minimise potential erosion at the new confluence associated with the increased catchment. Earthworks may be required to connect the final landform drainage and Bettys Creek which may also include armouring. These changes to the water management system are discussed in further detail in **Section 7.5**.

Additional earthworks will be required as rehabilitation progresses enabling rehabilitated areas to transition to clean catchments and flow towards Bettys Creek; this will include earthworks associated with the decommissioning of WRD as a mine water storage and its use as a retention basin. The Additional Mount Owen Operational Area (refer to **Section 3.3.9**) includes an allowance for additional disturbance associated with these final landform drainage works. Part of this potential disturbance is located within the Bettys Creek Habitat Management Area. The impacts to vegetation within this area will be fully offset. These impacts are discussed further in **Section 7.6**.

This increase in the Bettys Creek catchment would occur progressively as areas of the former Swamp Creek catchment are rehabilitated such that run-off is of suitable water quality. The overall size of the Bettys Creek catchment in the final landform will be similar to the pre-mining catchment area.

The Rehabilitation and Mine Closure Strategy for the Mount Owen Complex (refer to **Section 7.9**) will include rehabilitation objectives and criteria associated with the final landform drainage and connections to the existing downstream drainage system.

3.3.8 Mount Owen operational workforce

During the life of the Project, workforce demands associated with each operation within the Mount Owen Complex will change however overall workforce numbers at the Mount Owen Complex are proposed to be up to approximately 1,220 FTE. Workforce associated with operations under the Mount Owen Consent will be up to approximately 920 FTE.

Following the completion of mining of coal under the Mount Owen Consent, employment opportunities will continue through the operation of the CHPP and coal transport system to process ROM coal from the Glendell Pit Extension, and through associated ancillary functions such as overburden reshaping and rehabilitation, water and tailings management, land management, etc.

3.3.9 Mount Owen Operational Area

Aspects of the Project covered by the Mount Owen Consent include areas of disturbance outside the existing approved operational/disturbance areas for the Mount Owen Complex. This additional disturbance is associated with:

- realignment of parts of the Liddell Coal Operations GRAWTS linkage
- realignment and upgrades to Mount Owen infrastructure affected by the realignments of a section of Hebden Road and part of Yorks Creek
- additional earthworks associated with final landform drainage changes
- WMS infrastructure changes associated with landform changes.

Figure 3.20 shows the Mount Owen Additional Operational Area and overall Mount Owen Operational Area under the modified Mount Owen Consent.

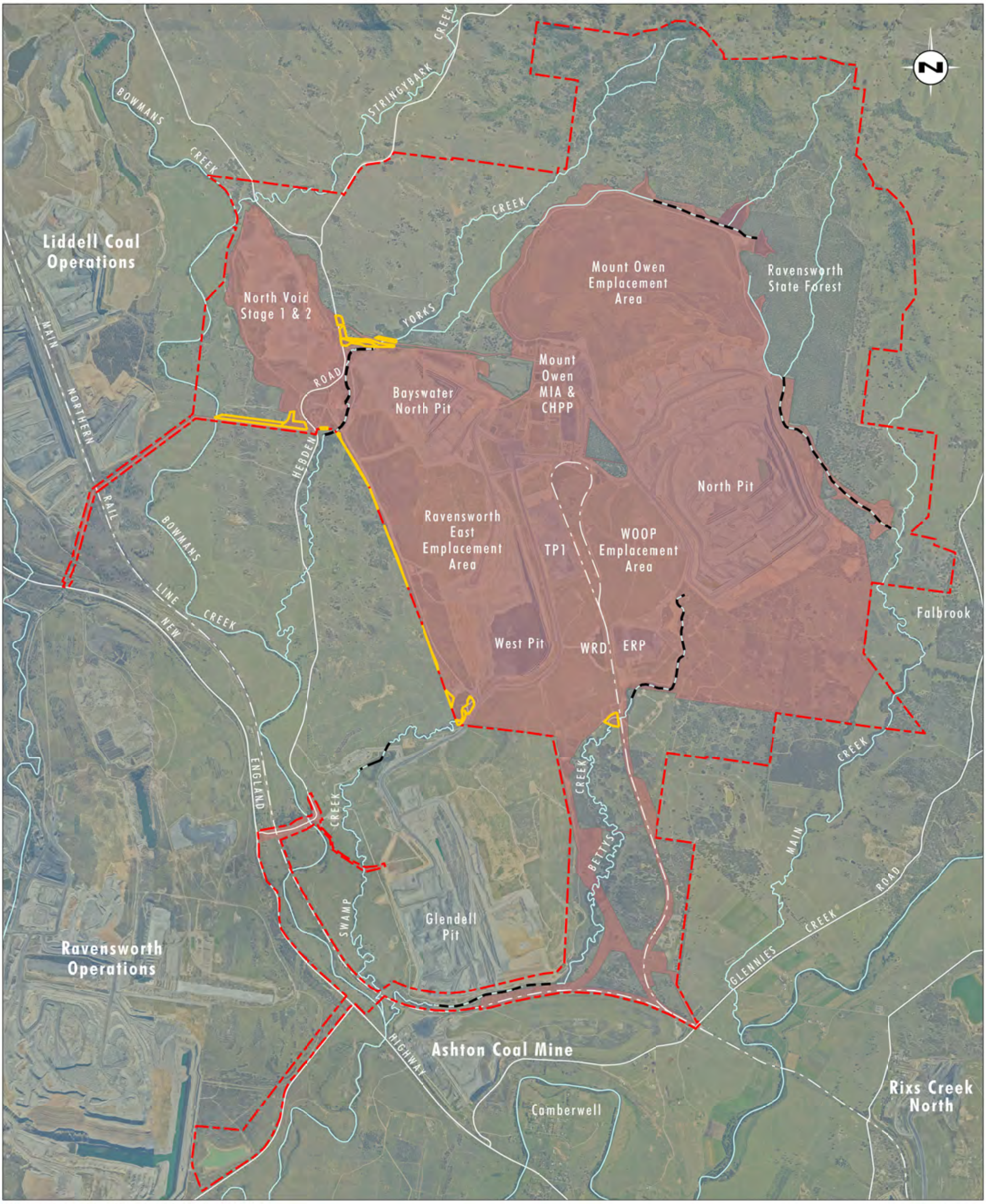


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km
1:60 000

Legend

- Mount Owen Consent Boundary
- Mount Owen Operational Area
- Mount Owen Additional Operational Area
- Existing Creek Diversion

FIGURE 3.20

Mount Owen Operational Area

3.3.10 Final landform and rehabilitation

While the general rehabilitation principles for the Mount Owen Consent will remain unchanged as a result of the Project, the Project will involve the following changes to the currently approved Rehabilitation Strategy:

- changes to the conceptual final landform associated with the redirection of the former Swamp Creek catchment towards Bettys Creek
- minor changes to the revegetation layout relative to the existing approved operations
- delay in final rehabilitation of Bayswater North Pit
- delay of some land forming activities and final rehabilitation in North Pit by approximately 8 years due to use of North Pit void as a mine water storage and/or for tailings deposition and coarse reject emplacement
- delay in decommissioning and demolition of the Mount Owen CHPP, MIA and Rail Loop and GRAWTS infrastructure by approximately 8 years due to continued use for the Project
- changes to the conceptual final landform and final landform drainage associated with the mining of the Glendell Pit Extension and associated in-pit overburden emplacement

Areas of the Mount Owen Complex landform where land shaping works are delayed due to the Project will be vegetated to reduce air quality, erosion and visual impacts until final landform shaping works are undertaken. These activities will be managed through the MOP/RMP process.

The Project will not result in any change to the number of final voids in the final landform or the size of the North Pit void. The Project may result in a reduced depth of the Bayswater North Pit final void due to the additional tailings generated by the Project relative to existing approved operations.

The revised conceptual final landform for the Project is shown in **Figure 3.6**. Further detail regarding mine rehabilitation and the closure strategy for the Project (including the impacts associated with the delay in final rehabilitation of North Pit and Bayswater North Pit voids and Mount Owen Complex infrastructure) is provided in **Section 7.9**.

SECTION 4.0

Strategic Context

4.0 Strategic Context

The Project is located within an area that presents both opportunities and constraints for the mining of coal. These can be broadly grouped into physical (which include both the natural and built environment and existing and past land uses), social setting (including proximity to other properties and cumulative impacts associated with environmental impacts from mining and other activities) and strategic policy and legislative context. Some of these issues operate as technical constraints to mining while others present environmental or social impact risks that have been considered in mine design.

For coal mining projects in NSW, key strategic policy considerations include:

- strategic land use and regional planning policy
- water resource protection policy
- air quality protection goals
- greenhouse gas, energy and climate change policy

This section provides an overview of the strategic constraints and opportunities relating to the Project. Water resource protection policy, air quality policy and climate change related policies are discussed in more detail in **Section 7.0** of this EIS.

4.1 Market Context

Glencore provides the following summary of current and future market for energy coal.

Glencore is a major producer of coal in the global market and coal from the Mount Owen Complex, which includes coal produced from the Glendell Mine, is a key component of Glencore's production profile. The Project will produce both thermal coal and semi-soft coking coal, typically of low ash and high energy content. Coal produced from Glendell may be blended with coal from other operations to meet market specifications and for this reason production from Glendell (and the Project) cannot be viewed in isolation in market terms but rather should be viewed as part of a broader portfolio of coal production. In addition, the coal produced from the Project is required to maintain supply into existing markets and does not represent an increase in production from Glencore's total NSW mining operations.

Coal remains one of the cheapest forms of energy and, while some countries are moving away from coal generated power production, industrialisation and urbanisation of developing economies, particularly in Asia, will continue to drive growth in global energy, electricity, steel and cement.

The South-East Asian economy is expected to triple in size and its energy needs are expected to grow by almost two thirds by 2040 (IEA World Energy Outlook 2018). Coal is expected to continue to be a key input to industrial processes as a competitive, safe, secure and reliable baseload source of energy for this time horizon.

This is supported by the policy commitments made in the Paris Agreement, the platform for the world to transition to a low-carbon economy in response to the risks posed by climate change, and by relevant subsequent analysis of coal demand, particularly in Asia.

In 2018 global seaborne thermal coal demand grew by more than 60 Mt (6.5%) from 2017, dominated by the Pacific and sub-continent markets, rising 8.8%. Indian and Chinese thermal electricity demand growth was 4.9% and 6.0% respectively, supporting demand growth for imported thermal coal. In Asia-Pacific markets, excluding China and India, import demand was buoyed by 9 gigawatts (GW) of newly commissioned coal fired power stations to meet demand for low cost base load electricity. More than 50 GW of new coal fired generation capacity is currently under construction in the region. While Australian export coal supply increased 6% from 2017 to 2018, with few new projects under development, supply growth going forward is expected to be limited meaning that demand for high energy coal, similar to what will be produced by the Project, is likely to be strong.

4.2 Physical Context

The physical setting of the Project Area and surrounds are described in **Section 7.0**. The key aspects of the physical setting which are directly relevant to the siting of the Project are:

- geological context
- hydrological environment and
- ecological values.

These aspects are discussed further in the following sections.

4.2.1 Geological Context

As a resources project, the geological characteristics of the target resource are a key factor in the siting and design of the Project.

The coal seams and overburden layers within the Project Area are well known due to experience gained in mining this geology at the Mount Owen Complex and within the greater Ravensworth area, and through an extensive exploration program that has occurred since 2010. The Project coal resources are located within a region with geological features including faults, folds, and dykes traversing the area. The exploration program has confirmed that the seams within the Project Area are consistent with those within the existing approved Glendell mining area with some local variations in quality, thickness, depth and interval separation.

Figure 4.1 shows the location of the main geological structures which impact on mining methods and mine design. **Figure 4.2** shows a cross section of the strata through the central area of the proposed Glendell Pit Extension.

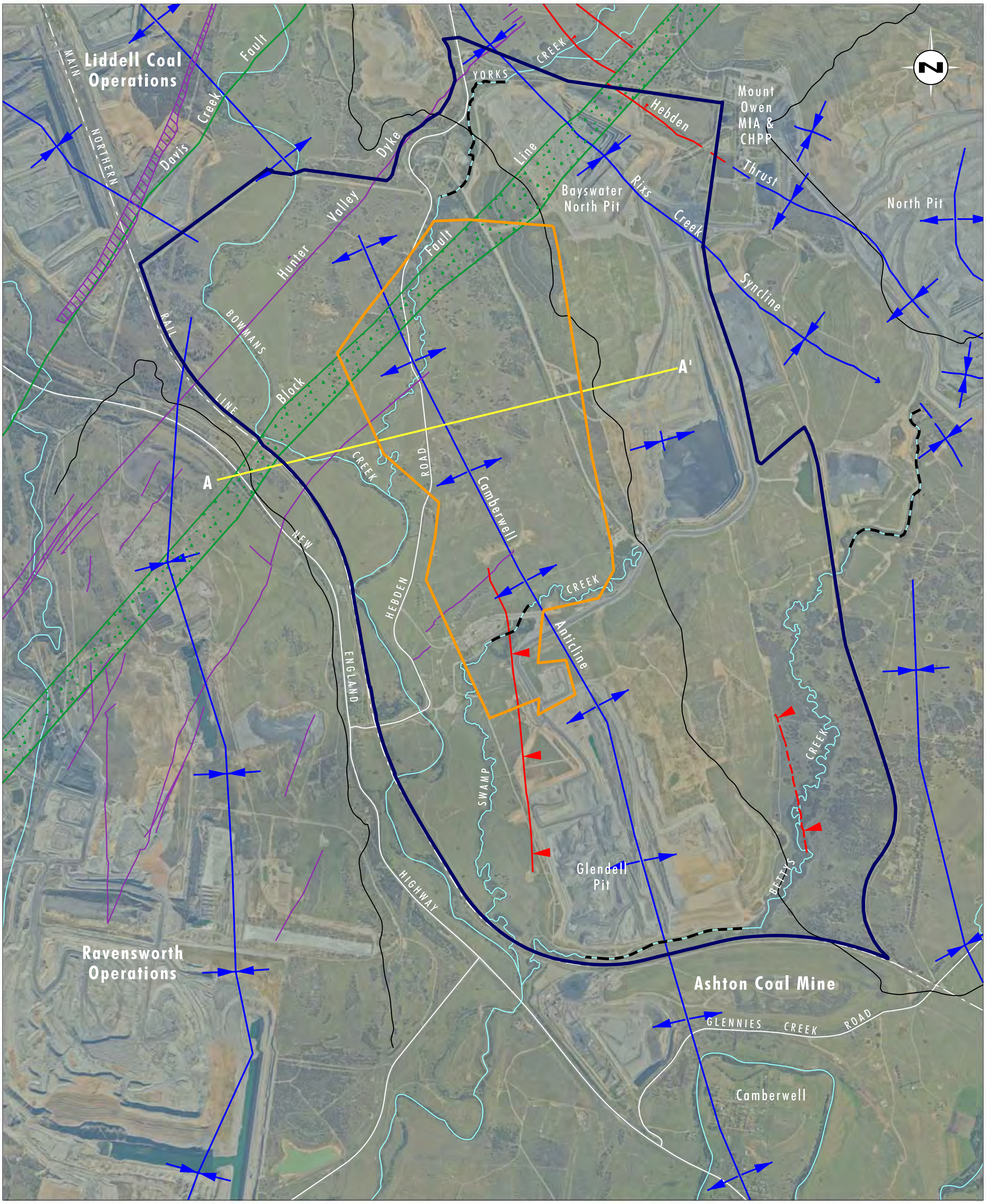


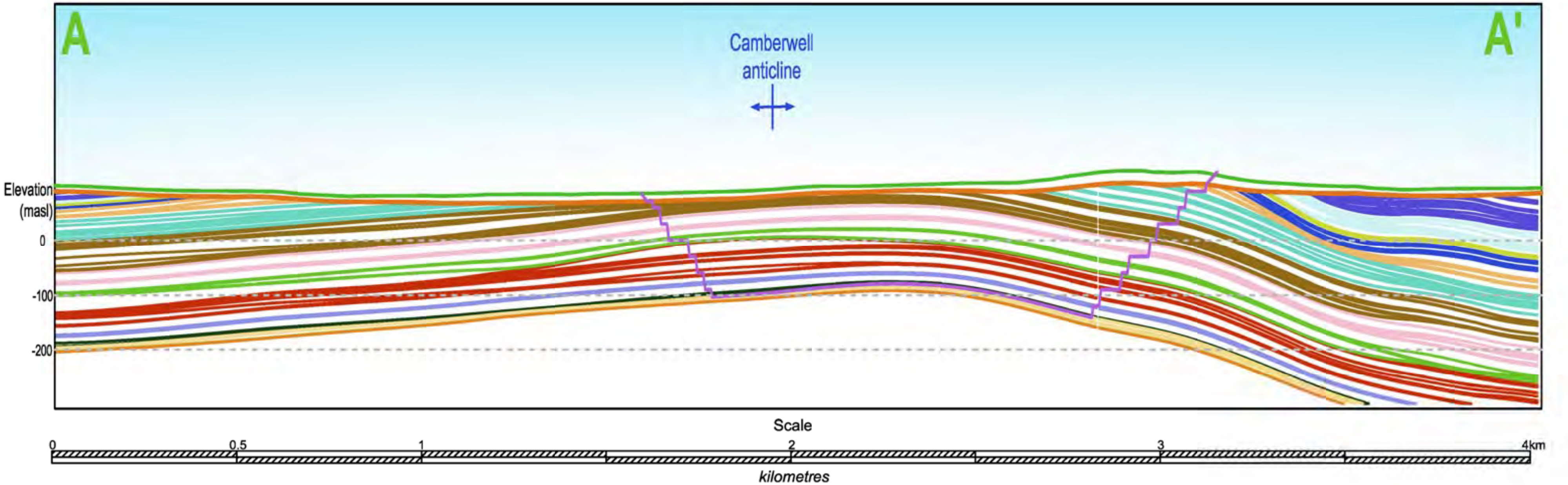
Image Source: Glencore (Dec 2019)
Data Source: Glencore (2019)

Legend

- Project Area
- Glendell Pit Extension
- Existing Creek Diversion
- Geological Cross Section (Refer to Figure 4.2)
- Block Fault Zone
- Dyke, Significant Thickness
- Dyke
- Reverse Fault
- Normal Fault
- Syncline
- Anticline
- Monocline
- Subcrop Bayswater Seam

FIGURE 4.1

Geological Structures



Note: Refer to Figure 4.1 for location of section

Legend

- Surface
- Base of Weathering
- Anticline hinge
- Pit Shell

Seams Legend

- Ravensworth
- Ravensworth
- Lemington E
- Lemington D
- Lemington C
- Lemington B
- Lemington A
- Pikes Gully
- Arties
- Liddell
- Barrett
- Upper Hunter
- Hebden
- Lower Hebden

Data Source: Glencore (2019)

FIGURE 4.2

Geological Cross Sections of Glendell Pit Extension Showing Camberwell Anticline

Three key regional geological features which influence the mine design are:

- Camberwell anticline, which is centrally located within the Project Area, trending north-south with strata gently dipping (<20 degrees) to the east and west away from the fold axis, which plunges gently to the north.
- Hunter Valley block fault zone
- Hunter Valley dyke.

Appendix 1 includes a comprehensive discussion of the constraints on mining posed by these structures and their consideration in the mine design.

4.2.2 Topography

The topography of an area is relevant to mining projects in that the removal of coal and overburden will alter the terrain. This can have an impact on the hydrology of an area (i.e. change the direction of stream flows) and also change how an area looks. Terrain can also have a significant impact on the management of noise impacts and can have localised effects on air quality impacts through changes in wind patterns. The terrain surrounding the Project Area is heavily influenced by active and historic mining operations and this terrain will continue to evolve throughout the life of the Project as a consequence of existing approved development at other operations.

4.2.2.1 Existing Landscape and Topography

The Project Area is situated centrally on the floor of the Hunter Valley (Central Lowlands) and occurs within the wider Hunter River catchment which covers approximately 22,000 km^2 of land bordered by the Liverpool Ranges, the Great Dividing Range, the Mount Royal Range and the Barrington Tops. The Project Area is situated approximately 87 km from the coast and 150 km from the western extremity of the Hunter River catchment at the Great Dividing Range.

The Project Area is typical of the Central Lowlands of the Hunter Valley, which are characterised by undulating to low rolling hills formed on weak sedimentary rocks with low local relief (Kovac and Lawrie 1991). The topography of the Project Area is characterised by an undulating and hilly landscape extending to lower areas associated with the creek lines that traverse the Project Area. Elevations range between 70 mAHD in the south and 400 mAHD in the northern extent of the Mount Owen Complex, north of Mount Owen Mine. Approximately 18 km to the south of the Project Area are the dissected sandstone plateaus of Wollemi and Yengo National Parks, while approximately 30 km to the north, the foothills of the Barrington Tops and Mount Royal Range adjoin the Hunter Valley floor, which is bounded by the Hunter thrust system (Peake 2006). To the east and west of the Project Area extend the highly eroded Permian lowlands of the floor of the Hunter Valley.

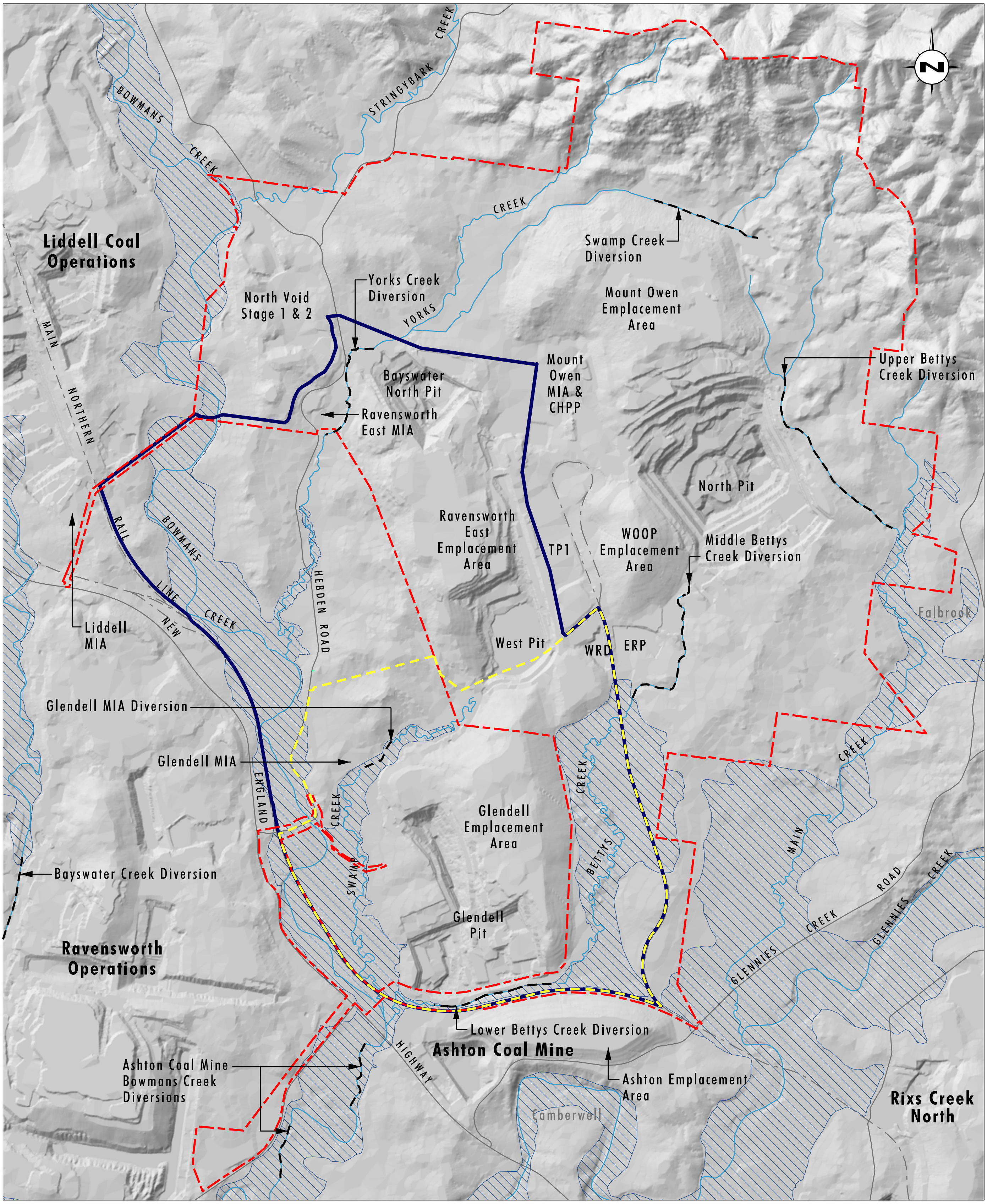
Emplacement areas at the Mount Owen Complex are approved to approximately 230 mAHD. The Glendell Pit Extension will affect land with elevations of between approximately 70 mAHD and 130 mAHD (excluding areas of the Glendell and Ravensworth East emplacement areas impacted by the Glendell Pit Extension).

The Ashton Coal Mine emplacement area is located between the current Glendell mining area and Camberwell to the south. This emplacement area rises to approximately 135 mAHD and precludes direct views of the current Glendell operations from Camberwell. This emplacement area also assists to mitigate noise impacts from Glendell and Mount Owen at some properties in the Camberwell area. Tree growth as part of the rehabilitation of this emplacement area will further add to the visual screening provided by this topographical feature.

There is an extensive alluvial floodplain associated with Bowmans Creek. The Yorks, Swamp and Bettys Creek systems all have alluvial areas directly connected to the Bowmans Creek alluvium. Areas associated with the alluvial plains of Bowmans Creek, Yorks Creek, Swamp Creek and Bettys Creek are generally flat to gently sloping. The Bettys Creek alluvium would have historically been connected to the Bowmans Creek alluvium however the diversion of Bettys Creek around the south of the Glendell Mine has effectively removed the alluvial connection in this area.

Extensive field investigations and desktop studies have been undertaken as part of the Groundwater Impact Assessment to confirm the extent and thickness of the Bowmans Creek (and its tributaries Swamp and Yorks Creek) alluvium in proximity to the Project (refer to **Appendix 16**). This work supplements early studies to define the extent of the Bettys Creek alluvium and Main Creek alluvium in proximity to the Mount Owen North Pit (AGE 2017). The extent and depth of mapped alluvium is discussed further in **Section 7.5**.

The current topography, creek lines and alluvial extent surrounding the Project Area is shown in **Figure 4.3**.



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

Legend

- Project Area
- Glendell Consent Boundary
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Mapped Alluvium (AGE 2019)
- Drainage Line

FIGURE 4.3

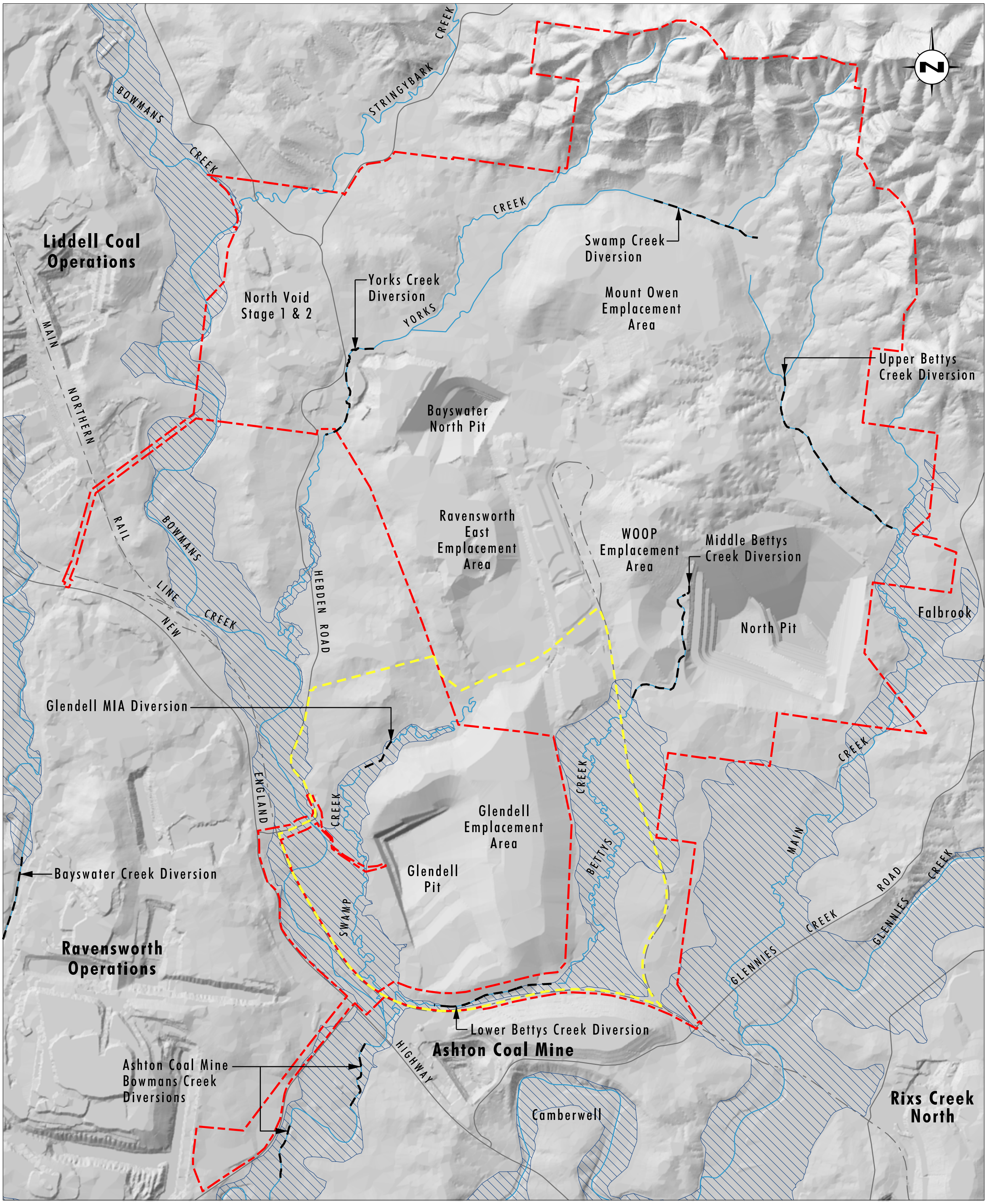
Topography and Drainage (Existing Conditions)

4.2.2.2 Future approved topography

At the Mount Owen Complex, mining operations in the Bayswater North Pit are approved to extend to the east with in-pit emplacement behind the active mining area and on the Ravensworth East emplacement area. Mining in North Pit will progress to the south with in-pit emplacement behind the active mining area on the Mount Owen emplacement area and out-of-pit emplacement at the WOOP emplacement area and over areas of the Eastern Rail Pit (ERP) former tailings storage facility. West Pit will be used as a tailings storage facility as part of the GRAWTS until filled when it will be capped and the Ravensworth East emplacement area shaped to ensure this area is free draining. The approved conceptual final landform for the Mount Owen Complex has the area between the Ravensworth East and the WOOP emplacement areas and part of the Mount Owen emplacement area draining towards Swamp Creek. The voids (North Void Stage 1 and 2) in the northern parts of the former Ravensworth East mining area (west of Hebden Road) have been used for tailings emplacement and are in the process of being capped and rehabilitated as free draining landforms.

Three final voids are currently approved at the Mount Owen Complex in the North Pit, Bayswater North Pit and the currently approved Glendell Pit. Pit lakes are modelled to develop in each of these mining voids following the cessation of mining, each operating as a long-term groundwater ‘sink’.

The approved conceptual final landform for the Mount Owen Complex and likely topography surrounding the Project Area is shown in **Figure 4.4**.



Data Source: Glencore (2019)

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Glendell Consent Boundary
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Mapped Alluvium (AGE 2019)
- Drainage Line

FIGURE 4.4

Future Approved Topography (Conceptual Final Landform)

File Name (A4): R08/4166_520.dgn
20191128 13.07

4.2.3 Hydrology and Hydrogeology

4.2.3.1 Hydrology

The Project Area is located within the Bowmans Creek catchment. Bowmans Creek is a tributary of the Hunter River. Mining in the proposed Glendell Pit Extension is primarily within 2 sub-catchments of Bowmans Creek, namely Yorks Creek and Swamp Creek. Mining associated with existing approved operations at Glendell is also located within the Bettys Creek sub-catchment of Bowmans Creek.

Bowmans Creek and Glennies Creek are the two most significant creeks surrounding the Project Area. Bowmans Creek is a semi-permanent creek with flow rates heavily influenced by rainfall. Bowmans Creek includes pools (refer to **Plate 4.1**) including some which have maintained water throughout the most recent drought. Bowmans Creek also contains long sections of creek bed lined with cobbles (refer to **Plate 4.2**). Glennies Creek is located downstream of Lake St Clair and is a regulated creek system meaning it has almost permanent flow. The Glennies Creek catchment is not directly affected by the Project.

Yorks Creek (refer to **Plates 4.3** and **4.4**), Swamp Creek and Bettys Creek are all ephemeral systems which only flow after heavy rainfall events. These creeks have few pools.

Previous mining operations have significantly modified local catchments through the capture of runoff from disturbed areas and diversion of upslope runoff around the mining operations (refer to **Section 7.5**). The upper sections of the former Swamp Creek Catchment are upstream of the Mount Owen Complex. These remnant tributaries to Swamp Creek have been diverted around the Mount Owen Complex to the west via a series of dams. Following large rainfall events, these dams overflow towards Yorks Creek. These dams are the only permanent water in the Yorks Creek catchment. The existing diversions of Yorks, Swamp and Bettys Creek are discussed in further detail in **Section 2.1.5**. Bowmans Creek has also been diverted downstream of the Project Area as part of the approved Ashton Coal Mine.

Surface water runoff from the disturbed areas of the Bowmans Creek catchment in and around the Project Area are currently managed by the water management systems for the relevant mining operations. As a result, the catchment area of Bowmans Creek in the vicinity and downstream of the Project Area is smaller than the pre-mining environment. The progressive release of rehabilitated areas to the Bowmans Creek catchment will increase flows in local tributaries and Bowmans Creek itself throughout the life of the Project.

The key drainage lines in the vicinity of the Project are shown in **Figure 4.3**.

Plate 4.1 Pool in Bowmans Creek upstream from confluence with Yorks Creek (January 2018)

Plate 4.2 Bowmans Creek upstream from proposed Yorks Creek Realignment confluence (October 2017)

Plate 4.3 Yorks Creek downstream from Hebden Road crossing (September 2019)

Plate 4.4 Yorks Creek upstream from Hebden Road crossing (September 2019)

4.2.3.2 Hydrogeology

The 2 main hydrogeological features occurring within and surrounding the Project Area are:

- Quaternary alluvium
- Permian sediments – which can be divided into:
  - thin and variably permeable weathered rock (regolith)
  - non-coal interburden that forms aquitards (a body of rock that retards but does not completely stop the flow of water)
  - low to moderately permeable coal seams that act as the most transmissive strata within the Permian strata.

The alluvium along Bowmans Creek (refer to **Figure 4.4**) forms a thin aquifer system in the Project Area and adjacent to the Glendell Pit Extension. The Bowmans Creek alluvium is commonly less than 10 m in thickness with the most permeable part of the sequence being the 'bed load' sand and gravels that readily transmit groundwater.

Geological maps show alluvial sediments occur along Bettys Creek, Swamp Creek and Yorks Creek. Field investigations indicate the alluvium occurring along these tributaries is thin, clayey and contains saline groundwater. The Bowmans Creek alluvium is the only geological strata in the Project Area that has the potential to sometimes meet the NSW government criteria to be classified as a 'highly productive' groundwater source, which requires Total Dissolved Solids (TDS) concentrations less than 1,500 mg/L and contain water supply works that can yield water at a rate greater than 5 L/s. All other formations are classified as 'less productive' including the areas of alluvial sediments occurring along Yorks Creek and Swamp Creek within the Glendell Pit Extension.

The Permian coal measures form less productive groundwater systems, with the coal seams being the most permeable lithology within the Permian sequences. The Project is situated along the hinge of an anticline structure with the sequence of coal seams dipping from the hinge axis towards the east and west where adjacent mining operations extract coal via open cut and underground methods. The Permian strata is also not considered to form a highly productive aquifer because of generally poor water quality and low yields that preclude any beneficial use. TDS concentrations in the Permian strata are generally in the range of 500 mg/L to 15,000 mg/L.

Permian sediments outcrop in the Glendell Pit Extension and are recharged via rainfall infiltrating through the soil cover and weathered Permian profile. Groundwater flows from areas of high head (pressure plus elevation) to low head via the most permeable and transmissive pathways. In the absence of mining activities the main discharge mechanism for groundwater within the Permian strata is typically through slow upward flow to low lying alluvium along creeks, particularly Bowmans Creek. However, groundwater monitoring from the Project Area and surrounds shows that approved mining activities have depressurised the Permian groundwater systems and reduced the piezometric surface below the base of the alluvium. This means the main discharge zone for groundwater within the Permian interburden and coal seams, which was formerly to the alluvium and adjacent regolith, is now to surrounding mining operations, either operating or completed. Unlike the Permian strata, drawdown within the Bowmans Creek alluvium is not readily evident within available monitoring datasets outside of variability associated with climatic conditions.

The monitoring data indicates a high degree of variability within the groundwater system in relation to salinity, which is the key constraint to groundwater use. Groundwater with the lowest levels of salinity occurs within the Glennies Creek alluvium, which is likely attributed to the releases from the upstream dam regulating flow. Records of Bowmans creek alluvium indicate typically fresh to brackish groundwater, dependent on the location and duration following rainfall and flows in the ephemeral system, indicating that some areas of Bowmans Creek alluvium can be considered 'highly productive' based on salinity and in other areas it is categorised as 'less productive' according to
the NSW government criteria.

Samples of groundwater from Bettys Creek, Swamp Creek, and Yorks Creek, all of which are tributaries of Bowmans Creek, record widely varying salinity from fresh to highly saline waters. However, available data indicates high salinity, low transmissivity and low saturated thickness within Bettys Creek, Swamp Creek and Yorks Creek alluvium, indicating these systems are classified as a 'less productive' groundwater source.

The generally variable nature of salinity within the smaller tributaries of Bowmans Creek indicates relatively slow movement of groundwater, with low permeability areas hindering the recharge and flushing of salts from the sediments. The occurrence of the salinity is due to evapo-concentration of rainfall recharge and flow of saline groundwater from the underlying Permian strata into the base of the alluvium where the regional water table is above the base of alluvium or has been in the past.

With the exception of parts of the Bowmans Creek and Glennies Creek alluvium, water quality monitoring indicates the alluvium and Permian groundwater systems are generally not suitable for potable or irrigation uses due to salinity. The concentration of some metals also exceeds the ANZECC (2000) guidelines for freshwater aquatic ecosystems, however this is typical in groundwater systems where trace elements can be naturally concentrated above guideline values for aquatic ecosystems that would rely on fresh water. The results also indicate that groundwater from some areas within the alluvium and Permian systems could yield groundwater with salinity levels that could be used for stock water supply according to the ANZECC (2000) guidelines, however these areas are not consistent throughout the groundwater systems.

4.2.4 Climate

The climate in the region is temperate and is characterised by hot summers with regular thunderstorms and mild dry winters.

Temperature data has been obtained from the Bureau of Meteorology (BoM) maintained Singleton STP station for the period 2002 to 2019, and rainfall and evaporation data has been obtained from the Scientific Information for Land Owners (SILO) database of historical climate records for Australia (DSITI 2015) for the period 1900 to 2018. A summary of the mean climate statistics for the Mount Owen Complex (rainfall and evaporation) and Singleton (temperature) is shown in **Table 4.1**.

Table 4.1 Mean Climate Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (°C) (Singleton STP station (BOM 2002 – 2019))													
Mean Maximum	32.1	30.7	28.3	24.9	21.6	18.1	18.0	20.0	23.5	26.3	28.8	30.3	25.2
Mean Minimum	17.9	17.5	15.2	11.3	6.9	6.0	4.3	4.3	7.2	10.4	13.9	16.1	10.9

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (SILO 1900 – 2018)													
Mean rainfall (mm)	78.1	74.8	65.9	53.2	44.3	52.1	43.1	37.3	41.3	50.9	60.9	69.1	671.0
Mean evaporation (mm)	204.5	161.4	142.9	103.6	72.5	55.2	63.9	89.4	119.6	156.1	177.0	210.0	1556.2
Evaporation minus rainfall	126.4	86.6	77.1	50.4	28.2	3.1	20.8	52.1	78.3	105.2	116.2	140.9	885.1

The climate of the central parts of the Hunter region is variable year on year and decade to decade. Inter-decadal variability is associated with the Southern Oscillation Index (La Niña-like and El Niño-like periods). Examples of extended periods within the Hunter region affected by these inter-decadal variations include a La Niña-like period from 1948 to 1976 (a period of heavier rainfall and higher flood frequency) and an El Niño-like period from 1977 to 2007 (a period of more frequent drought). Extended drought periods affect production on both floodplain lands and on hilly country. Climate variability at a seasonal level also has a significant impact on agricultural production. This particularly includes seasons with below average rainfall or temperatures that can impact on the growth of pastures both in the affected season and into following seasons. The Hunter Valley is currently subject to drought conditions. **Figure 4.5** shows the Combined Drought Indicator (CDI) data for the Liddell Parish (in which the Project Area is located) for the period June 2013 to October 2019. As can be seen, the drought indexes used in the CDI all remain well below long term averages with current index levels some of the lowest in the period covered by the CDI.

Figure 4.6 shows the annual wind patterns for each year from 2012 to 2018. It can be seen from these wind-roses that the most common winds in the area are from the south-southeast, southeast and northwest and north-northwest. The prevailing winds are from the northwest direction during the winter months, and then predominantly from the southeast during the summer months. Generally, wind speed is greatest from late winter through spring with lighter winds occurring in autumn. This pattern of winds is common for many parts of the Hunter Valley and reflects the northwest-southeast alignment of the valley. As can be seen from **Figure 4.6**, the wind patterns do not vary significantly from year to year.

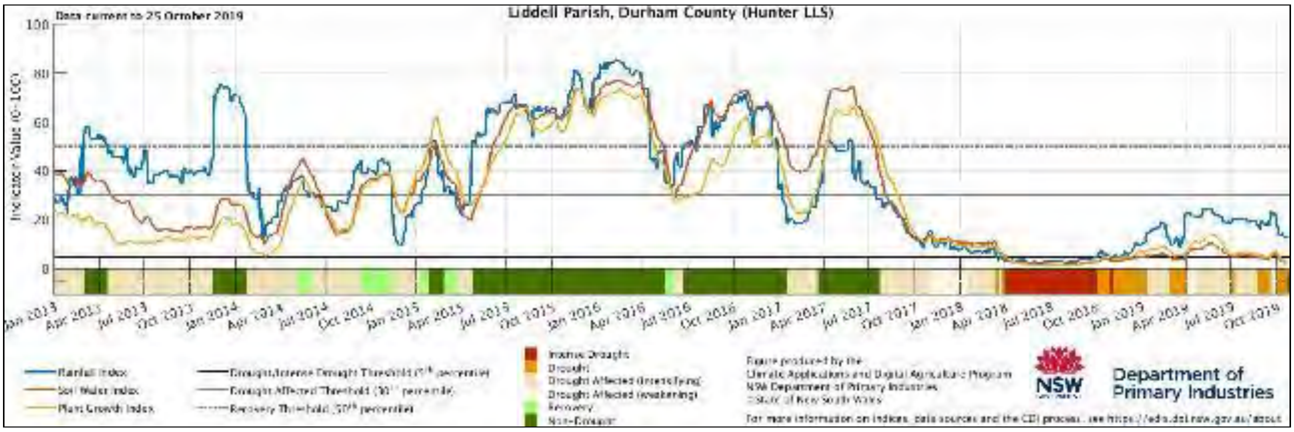


Figure 4.5 Combined Drought Index (Liddell Parish) January 2013 – October 2019

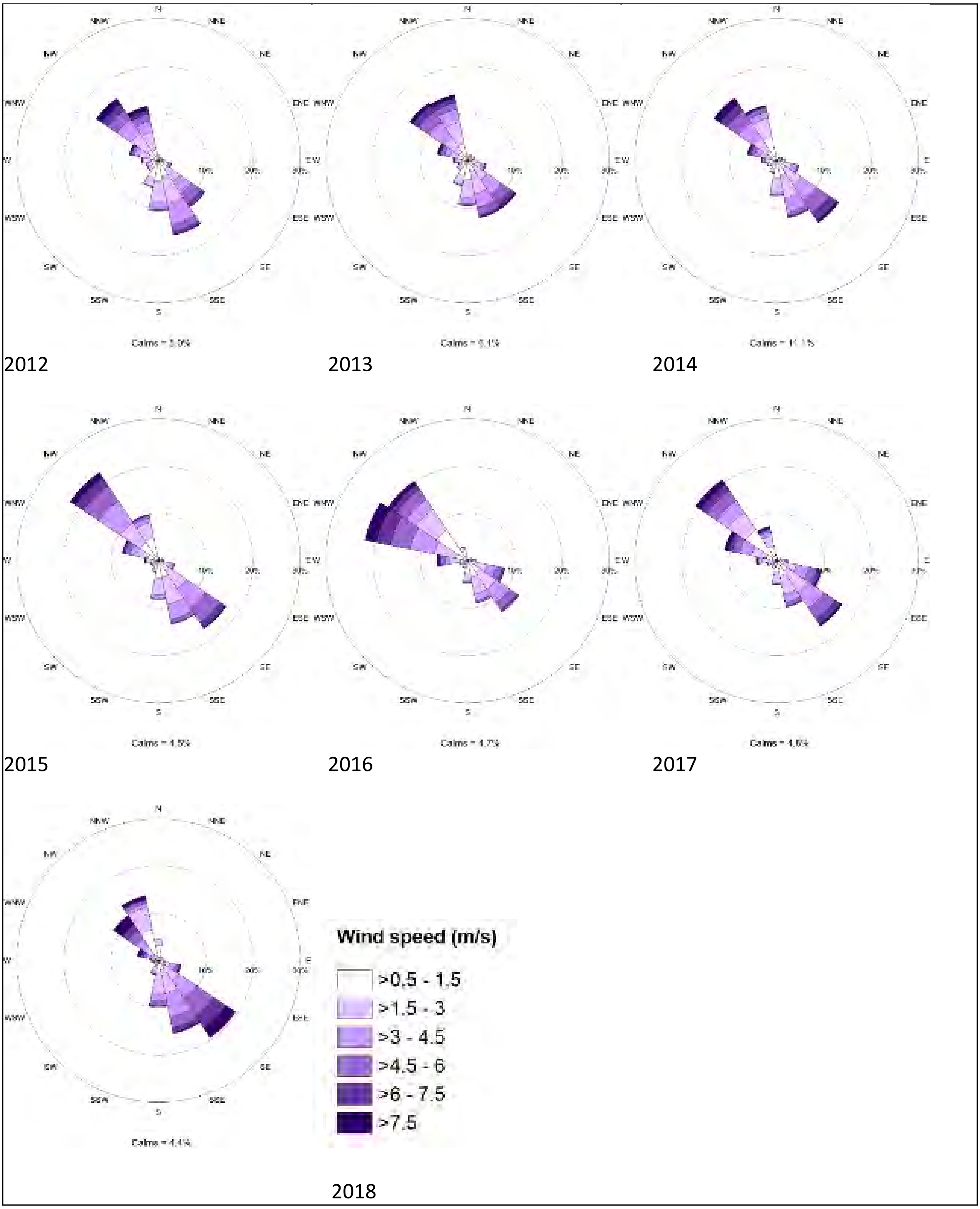


Figure 4.6 Windroses (Glendell Meteorological Station) 2012 – 2018

4.2.5 Soil Landscapes and Land and Soil Capability

Extensive soil investigations have been carried out in the Additional Disturbance Area as part of the Project (refer to **Appendix 27**).

The soil survey identified six soil orders within the Additional Disturbance Area, namely:

- Sodosol (620 ha, 82%)
- Tenosol (58 ha, 8%)
- Chromosol (18 ha, 2%)
- Dermosol (11 ha, 1%)
- Rudosol (7 ha, <1%)
- Kandosol (6 ha, <1%)

Sodosols are the main soil type within the Project Area and contain significant physical and chemical constraints for agricultural use. Due to the long history of grazing in the area and the extensive clearing of slopes, these sodosols are heavily eroded with most no longer containing an A Horizon. The soils mapped within the Additional Disturbance Area are shown in **Figure 4.7**.

Regional mapping undertaken by Kovac & Lawrie (1991) has mapped the majority of the Project Locality as the Bayswater, Hunter and the Liddell soil landscapes. The majority of the Project Area and Additional Disturbance Area is mapped as the Bayswater soil landscape with the western extent containing the Hunter soil landscape. There is only a small area of the Liddell soil landscape in the Project Area on the western side of Bowmans Creek and this area will not be directly impacted by the Project.

Regional mapping of Land and Soil Capability (LSC) (Office of Environment and Heritage (OEH) 2017) identifies the Bayswater and Liddell soil landscapes as being Class 6 and Class 5 respectively. The regional LSC mapping is shown in **Figure 4.8**. Areas associated with the Bowmans Creek, Glennies Creek and Hunter River floodplains are mapped by Kovac & Lawrie (1991) as the Hunter soil landscape, which has been mapped as LSC Class 3. More detailed LSC mapping of the Additional Disturbance Area has been undertaken as part of the Agricultural Impact Statement (AIS) (refer to **Appendix 27**) and is discussed in **Section 7.12**.

Open cut mining at the Mount Owen Complex and other mining operations in the surrounding areas has largely been limited to the lower LSC Class 5 and Class 6 land. Higher land capability land (LSC Class 2, 3 and 4 land) is primarily limited to the alluvial flats along creeks.

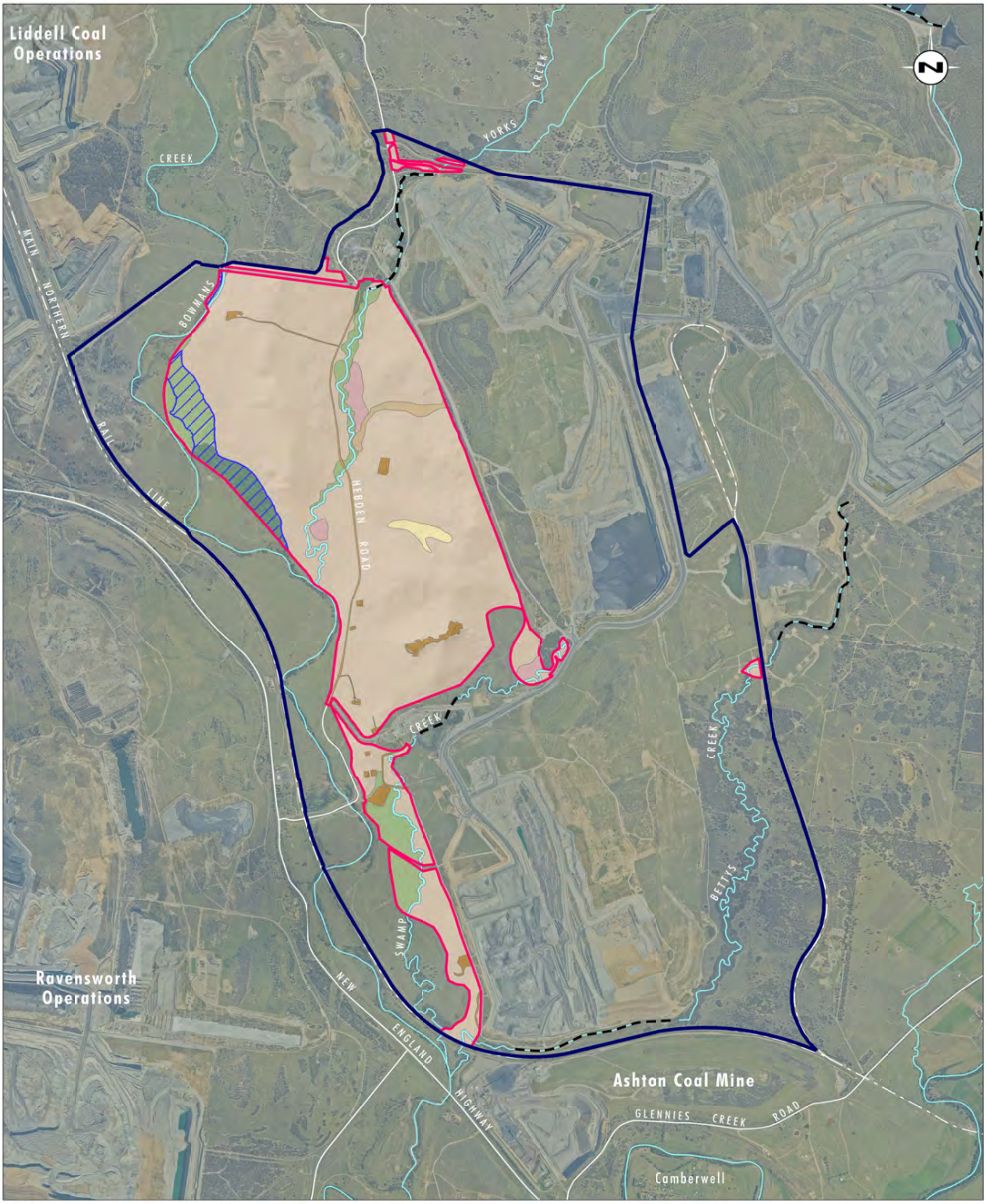


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

Legend

- Project Area
- Additional Disturbance Area
- Existing Creek Diversion
- Verified BSAL
- Creek
- Disturbed

Soils:

- Chromosol
- Tenosol
- Rudosol
- Sodosol
- Kandosol
- Dermosol

FIGURE 4.7

Soil Mapping in the Additional Disturbance Area

umwelt

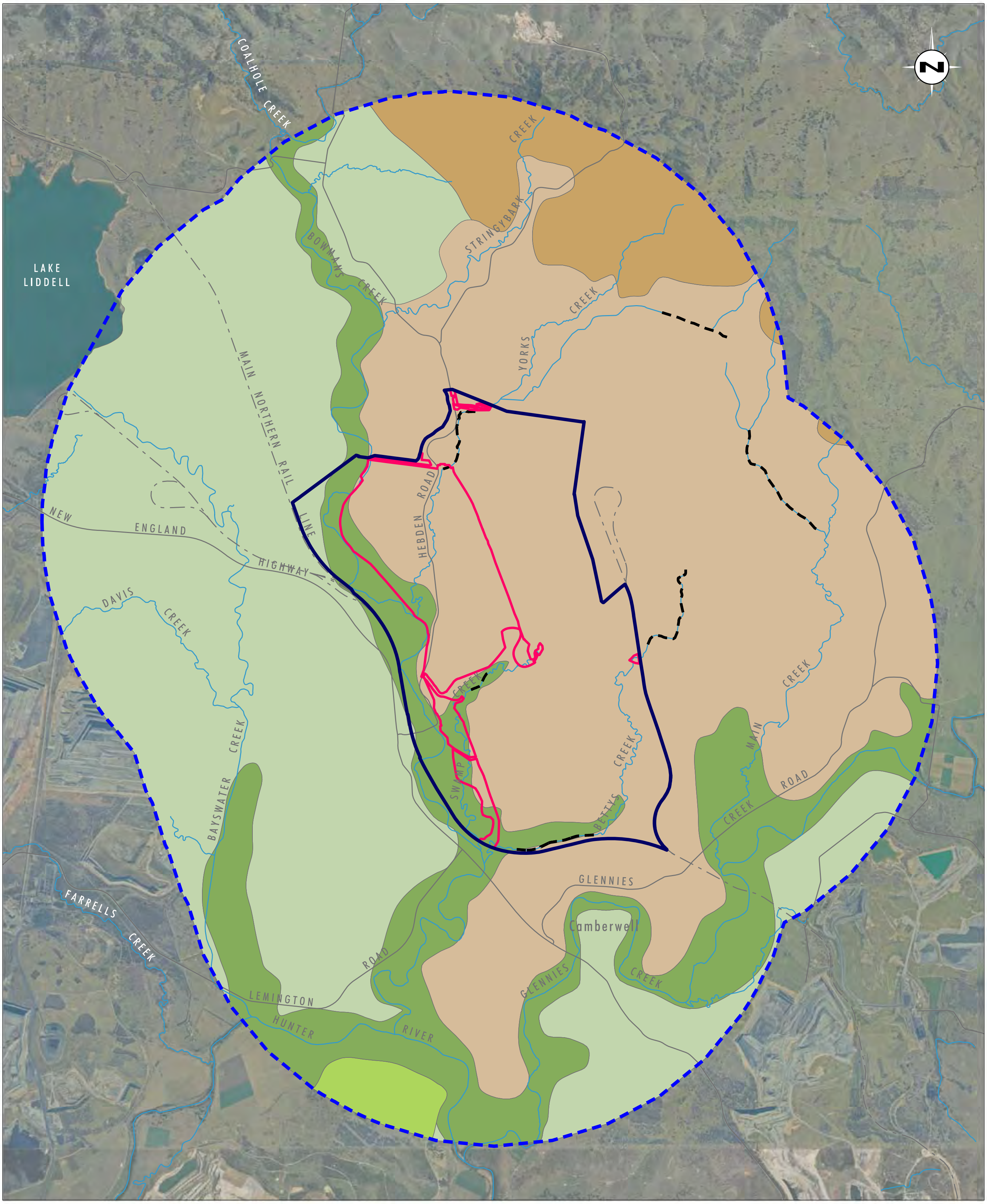


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), OEH (2017)

Legend

Project Area
Project Locality
Additional Disturbance Area
Existing Creek Diversion
Soil and Land Capability (OEH 2019):
Class 3
Class 4
Class 5
Class 6
Class 7

FIGURE 4.8

Land and Soil Capability Classes in the Project Locality (Pre Mining)

File Name (A4): R08/4166_563.dgn
20191129 8.39

4.2.6 Ecological Values

The central Hunter Valley has been largely cleared of native vegetation, primarily for agriculture and other land uses, including mining and urban development. Similar land use patterns occur in the vicinity of the Mount Owen Complex, which is surrounded by agricultural land and coal mining operations, with scattered patches of native vegetation, the most significant of which is Ravensworth State Forest. Ravensworth State Forest and adjoining areas represent a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley. Ravensworth State Forest is located approximately 1 km to the east of the Project Area (refer to **Figure 1.2**).

The Project Area occurs in the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and the Hunter subregion. The Hunter Valley is considered to be of great ecological significance given that it represents the only major break in the Great Dividing Range (linking coastal and inland areas of NSW), and includes an overlap between tropical and temperate climate zones (McVicar T.R *et al.* 2015).

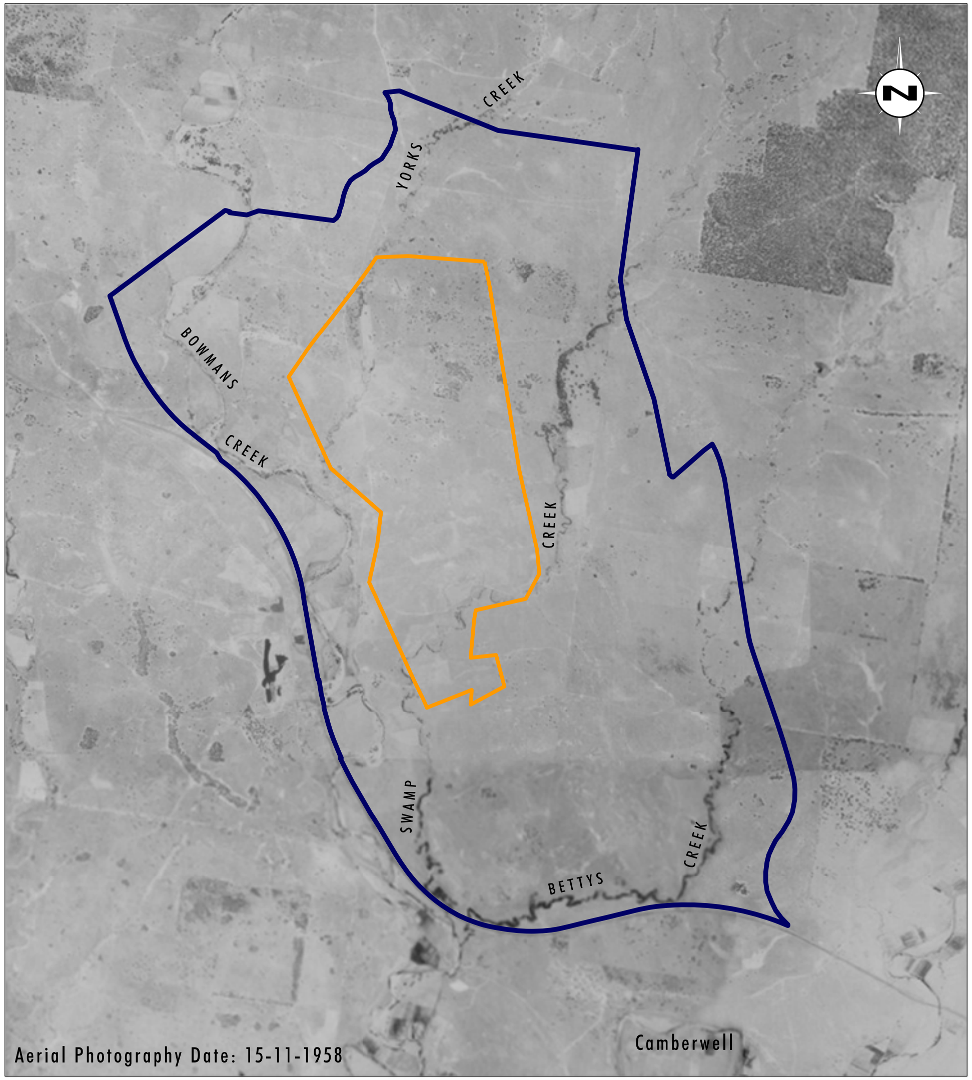
The central location of the vegetation in Ravensworth State Forest and the surrounds is important for its functionality as a fauna refuge and 'stepping stone' in a highly fragmented landscape. Remnant vegetation in the area includes Ravensworth State Forest, and the existing Mount Owen Complex biodiversity offset areas, and other native woodland and forest vegetation that are connected to these conservation areas. These remnants provide an important link in the generally north/south movement of highly mobile species, from other sizeable remnants in the north-west, to large remnants to the south-east and south-west of the Project Area.

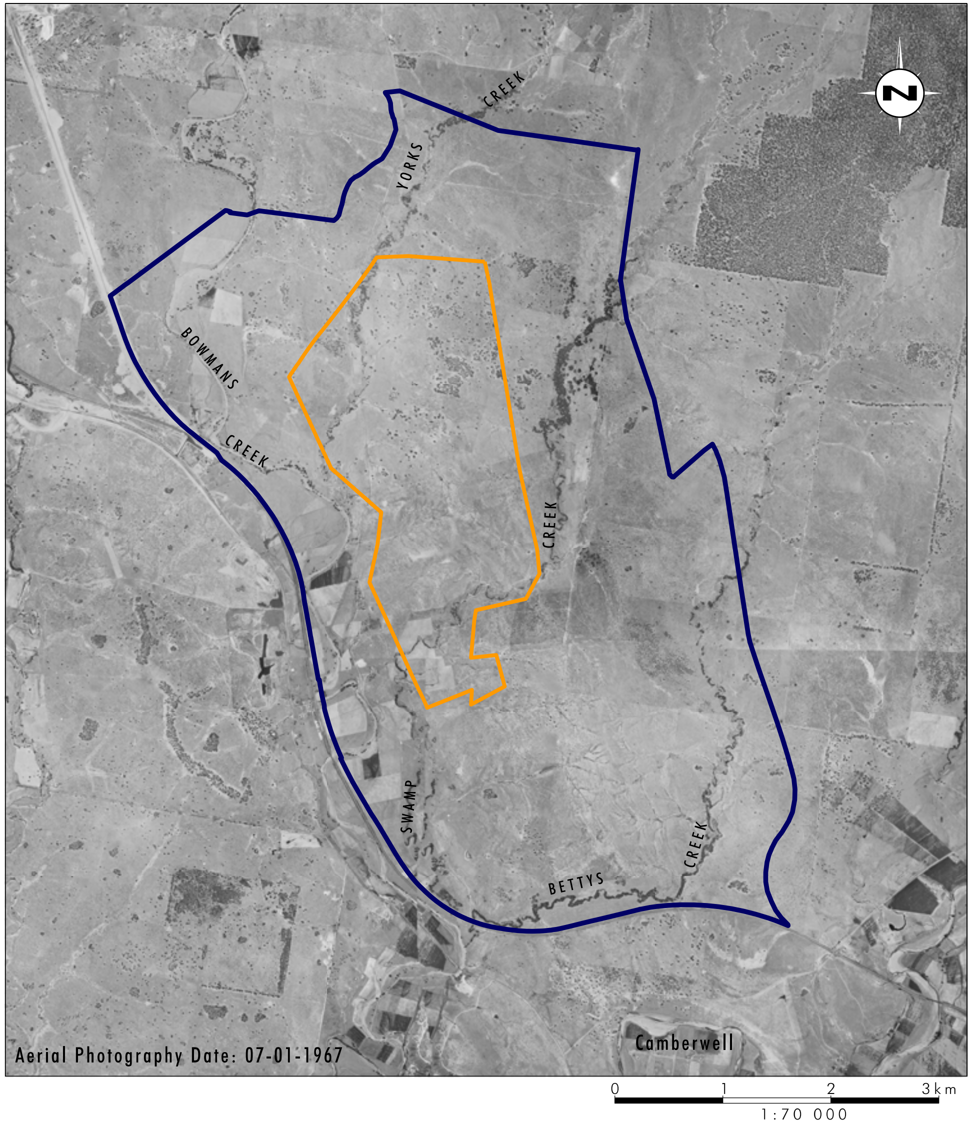
The Project Area itself has been extensively cleared and grazed since the late 1820s. Extensive evidence of cropping can be seen on the alluvial flats associated with Bowmans Creek, Swamp Creek and parts of Yorks Creek. Large areas were contoured in the 1960s and 1970s to mitigate erosion risks associated with past clearing and agricultural activities. The majority of the existing vegetation within and surrounding the Mount Owen Complex exists as a result of extensive re-growth over the past 30 years. **Figure 4.9** and **Figure 4.10** show aerial photography of the Project Area from 1958, 1967, 1983 and 2002**.** As can be seen from this sequence of aerial imagery, the Project Area was largely devoid of any wooded vegetation save for some areas within what is now the Approved Mount Owen Operational Area and Approved Glendell Disturbance Area. The extant woodland in the Additional Disturbance Area is majority 'regrowth' vegetation, that is, it has been previously cleared and its present extent is based entirely on natural regeneration or on targeted planting of canopy species.

Plate 4.5 is taken from the top of the ridgeline to the north of the current Glendell Mine looking north across the Additional Disturbance Area. The contouring from the late 1960s and 1970s remains evident, as do areas of erosion which likely predate the contouring. As can be seen from **Plate 4.5**, little woodland/forest vegetation remains in the southern part of the Additional Disturbance Area. The vegetated areas immediately behind the mobile phone tower are the partly rehabilitated slopes in the Ravensworth East emplacement area; woodland/forest vegetation within the Additional Disturbance Area is also visible in the left edge of the Plate.

The current vegetation communities within the Additional Disturbance Area are shown in **Figure 4.11**.

Plate 4.5 Cleared Grazing Land in Southern Part of Additional Disturbance Area (April 2019)





Legend

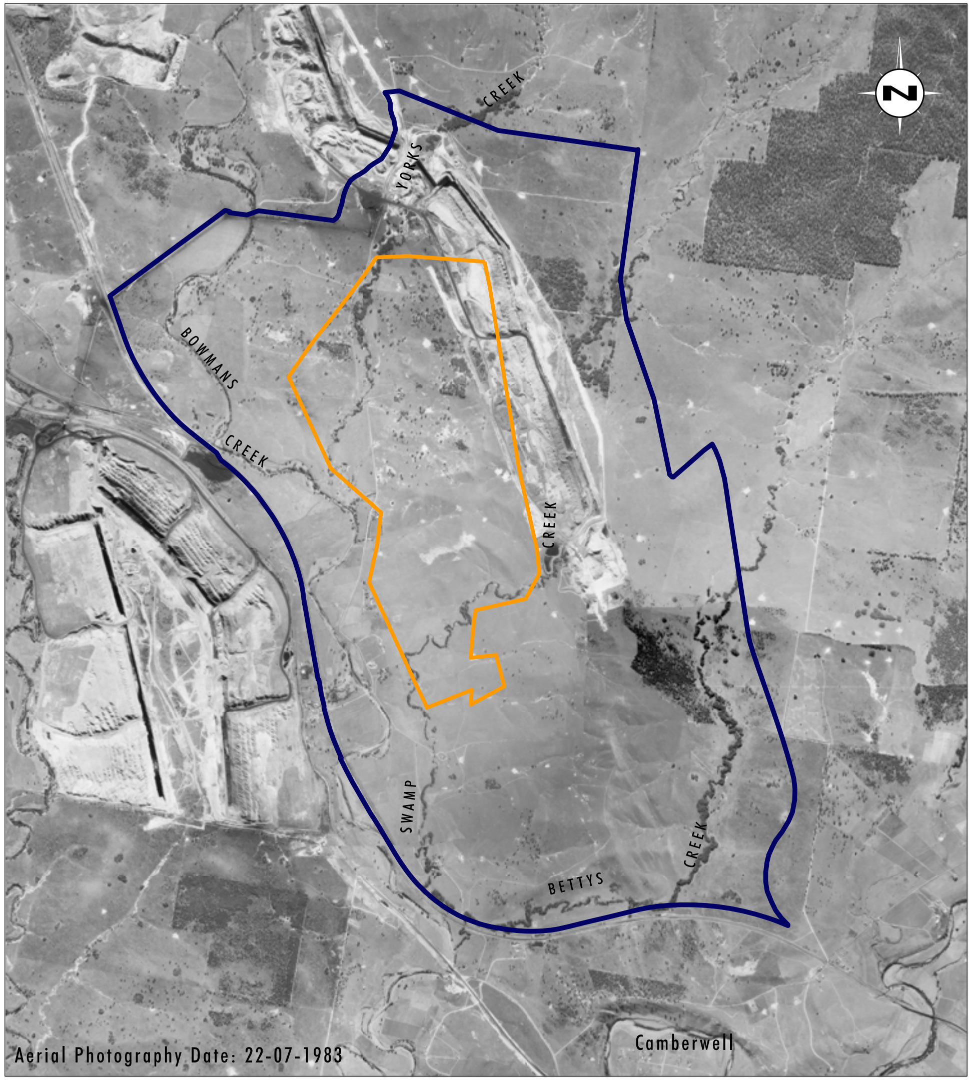
- Project Area
- Glendell Pit Extension

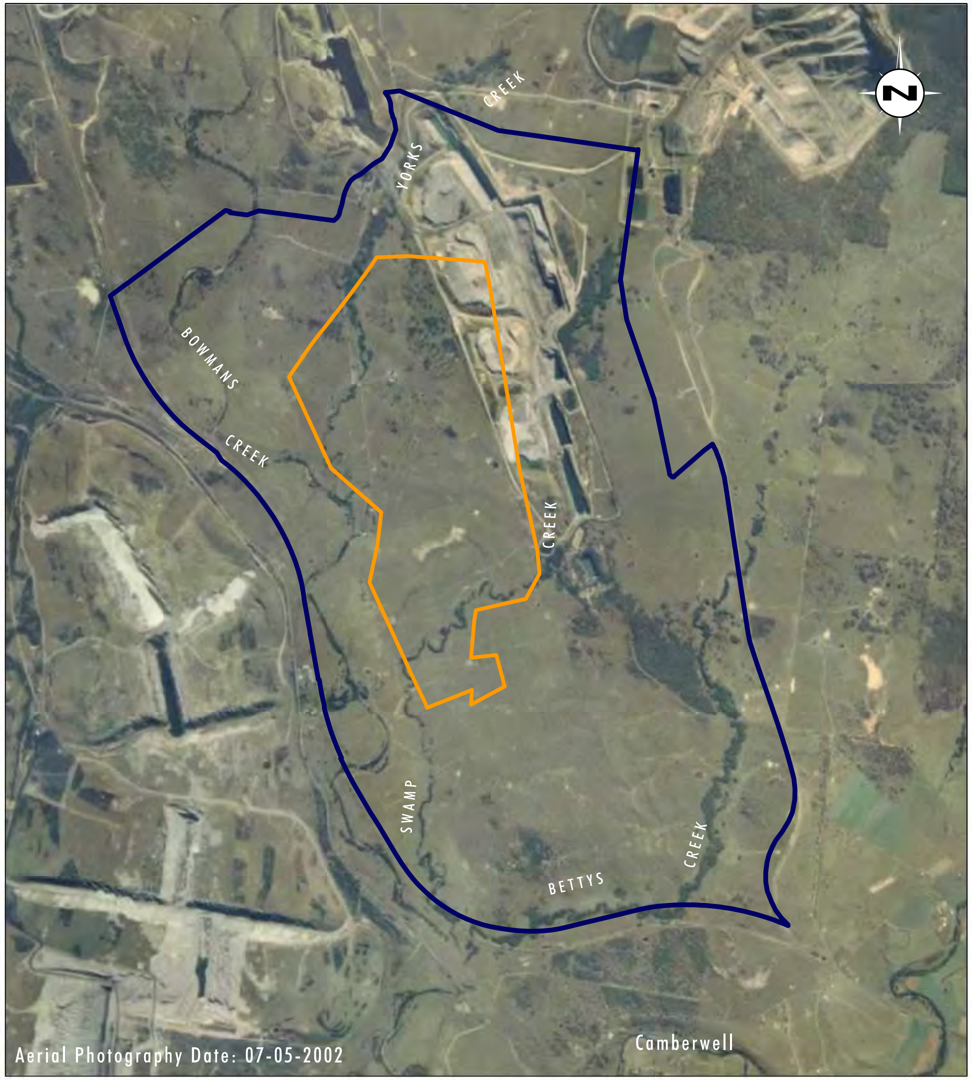
Image Source: Land and Property Information (received 2013)
Data Source: Glencore (2019)

FIGURE 4.9

Historical Aerial Photography of the Project Area (1958 and 1967)

File Name (A4): R08/4166_536.dgn
20191115 9.18





0 1 2 3 km
1:70 000

Legend

- Project Area
- Glendell Pit Extension

Image Source: Land and Property Information (received 2013)
Data Source: Glencore (2019)

FIGURE 4.10

Historical Aerial Photography of the Project Area (1983 and 2002)

File Name (A4): R08/4166_537.dgn
20191115 9.21

umwelt

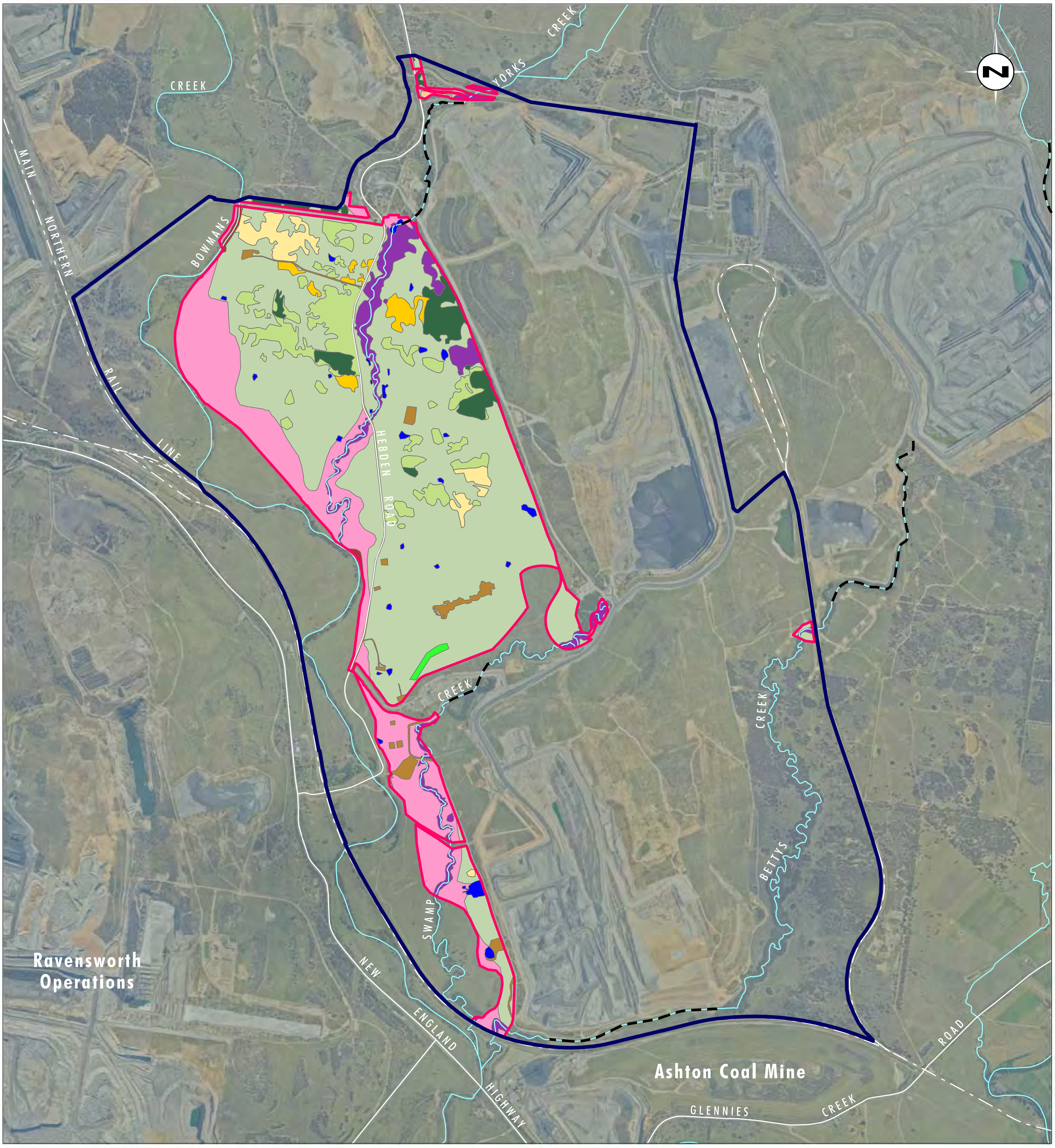


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

0 0.5 1.0 2.0km

Legend

- Project Area
- Additional Disturbance Area
- Existing Creek Diversion
- 485 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley - Moderate to Good Condition
- 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter - Moderate to Good Condition
- 1603 - Plantation
- 1603 - Regeneration
- 1603 - Derived Native Grassland
- 1604 - Narrow-Leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central And Lower Hunter - Plantation
- 1604 - Woody Rehab
- 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Moderate to Good Condition
- 1692 - Regeneration
- 1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good Condition
- Exotic Grassland
- Dam
- Disturbed Land

FIGURE 4.11

Vegetation Communities in the Additional Disturbance Area

File Name (A4): R08/4166_515.dgn
20191115 9.23

4.3 Social Context

As discussed in **Section 1.2**, there are a number of rural localities within proximity to the Project Area including Hebden to the north, Goorangoola to the north-east, Falbrook, Middle Falbrook and Glennies Creek to the east and south-east, and Camberwell to the south. Other rural residential land holdings are present within the surrounding area. These are predominantly located to the south-east of the Project Area. Residence locations in proximity to the Mount Owen Complex are shown in **Figure 4.15**.

4.3.1 Community Profile

Table 4.2 summarises the key features of the communities residing in the State Suburbs (SSC) surrounding the Project as per the 2016 census (ABS 2016). This data is compared to the Singleton and Muswellbrook LGAs, Upper Hunter State Electoral District (SED) and NSW, where relevant, with further analysis in **Section 7.16.**

Table 4.2 Summary of Key Human Capital Indicators

Indicator	Camberwell SSC	Falbrook SSC	Glennies Creek SSC	Hebden SSC	Middle Falbrook SSC	Ravensworth SSC	Singleton LGA	Muswellbrook LGA	Upper Hunter SED	NSW
Population	78	32	35	41	96	7	22,989	16,080	75,531	7,480,231
% Indigenous	20	0	11	0	9	0	6	8	7	3
% Males	50	56	46	49	49	43	51	51	50	49
Median Age (years)	37	32	48	39	36	25	36	35	40	38
Proportion born overseas (%)	4	0	9	9	3	0	9	9	8	30
Year 12 or Equivalent Education (%)	24	33	24	29	31	0	39	34	37	59
Equivalent Post-Secondary Education[2] (%)	29	0	17	38	54	0	45	38	41	49
Bachelor Degree Level (%)	0	0	33	16	10	-	14	11	14	26

Source: ABS community profiles – 2016

Population numbers (at the Statistical Area 1 (SA1) level) in the Camberwell SSC have declined by 13% between 2011 and 2016, compared to an increase of 1% in Singleton LGA and a 4% increase in the Upper Hunter SED.

Of the SSC surrounding the Project, the proportion of indigenous population is largest within the SSCs of Camberwell, Glennies Creek and Middle Falbrook, with these communities all above the proportions within the Upper Hunter SED and NSW.

[2] Includes Cert III & IV, Diploma and Bachelor. Community Profile Census data (GCP). Cert Level I & II are excluded as both the Socio-Economic Indexes for Areas (SEIFA) Index and Census define these levels as being equivalent to Years 11 and 12.

4.3.2 Historical use of the land and surrounds

4.3.2.1 Pre-European Settlement

The Project Area is located within the traditional country of the Wonnarua people, whose history extends from the present day back many thousands of years. The Project Area is also within the modern day Native Title registered claim area of the Plains Clans of the Wonnarua People, and is also within the Wanaruah Local Aboriginal Land Council (WLALC) boundary.

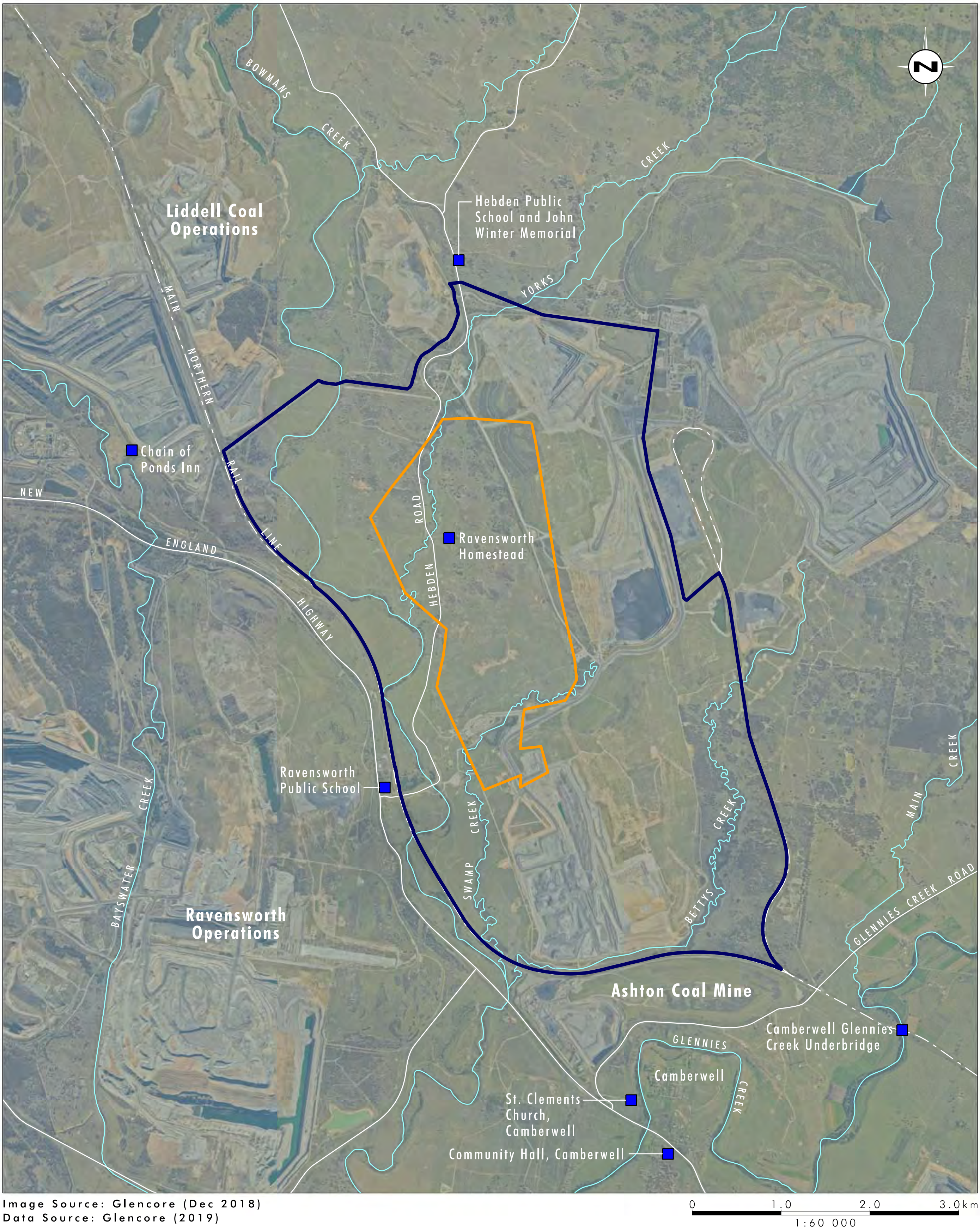
The Project Area has undergone considerable modification since European settlement. Traditional Aboriginal lifeways and customs began to disappear in the early days of contact with Europeans and had largely disappeared before the turn of the 20th Century. Much of the natural landscape surrounding the Project Area no longer exists in any cohesive manner, as the long history of agriculture and mining in the area has irreversibly altered the landscape. Combining the historical disconnection of people from place with the extensive landscape modification since settlement means that the Project Area has a relatively low cultural significance when compared to other places within the wider region. This is also consistent with the archaeological assessment, which has determined that the majority of the archaeological sites within the Additional Disturbance Area are of low scientific significance. A scarred tree and an engraving site have been identified outside of the Additional Disturbance Area along Bowmans Creek. (refer to **Section 7.7**).

4.3.2.2 Post-European Settlement

The Upper Hunter Valley was opened up to free settlers in the 1820s. The Project Area is located almost entirely within the original land grant to Dr James Bowman of 10,000 acres (approximately 4,050 ha). The initial land grant to James Bowman was made in 1824 and was one of the first freehold land grants in the area. The Ravensworth Homestead is located within the area of the proposed Glendell Pit Extension (refer to **Figure 3.16**). Ravensworth Homestead was constructed c1832 and forms part of a broader complex of buildings.

Ravensworth Homestead is listed as an item of local heritage significance in the Singleton LEP. While not listed as an item of State heritage significance, the Heritage Impact Assessment undertaken for the Project has identified that the Ravensworth Homestead has heritage and archaeological values that are of State significance, and the broader Estate is a place that has significant heritage values. The Ravensworth Homestead and the history of the site post settlement is discussed in further detail in **Section 7.8** and **Appendix 23a**.

There are number of other locally listed and non-listed heritage items located in the vicinity of the Project Area which are shown in **Figure 4.12** and also discussed in further detail in **Section 7.8**. Blast and vibration impact criteria are contained in the Glendell Consent and Mount Owen Consent for a number of these heritage items.



Legend
- Project Area
- Glendell Pit Extension
- Historical/Heritage Item

FIGURE 4.12

Location of Historic Heritage Sites in the Vicinity of the Project

File Name (A4): R08/4166_599.dgn
20191119 13.19

4.3.3 Public and Private Infrastructure

There is a range of public and private infrastructure located within and surrounding the Project Area that has been considered as part of the Mine Design process.

4.3.3.1 Roads

The New England Highway, part of the National Road Network, runs in a general north-south alignment to the west of the Project Area. Hebden Road, a local road vested in Singleton Council, runs through the Project Area. Hebden Road joins the New England Highway near the former Ravensworth School west of the existing Glendell Mine. Hebden Road runs in a general north-south alignment through the Project Area before turning west where it again re-joins the New England Highway on the northern side of Lake Liddell. Significant upgrades to Hebden Road were undertaken as part of the Mount Owen Continued Operations Project which included improved dual lane bridge over Bowmans Creek and the construction of an overpass over the Main Northern Rail Line to replace the former level crossing. **Figure 4.13** shows the main roads in the vicinity of the Project.

Hebden Road is the only means of accessing the Mount Owen, Ravensworth East and Glendell Mines. Hebden Road is also the only means of access for residents in the Hebden area and vehicles accessing the Hebden Quarry and Wild Quarry. All heavy vehicles accessing Wild Quarry (near the intersection of Hebden Road and Scrumlo Road) and Hebden Quarry (Pictons Lane) are required to use the southern intersection with the New England Highway due to current road restrictions. The southern section of Hebden Road to Scrumlo Road, including Pictons Lane, is an approved B-Double route. Private residences in the Hebden area are all located on Scrumlo Road, off Hebden Road. Traffic coming from Singleton typically enter Hebden Road from the southern intersection with the New England Highway while light traffic travelling to and from Muswellbrook typically use the northern intersection.

4.3.3.2 Rail Infrastructure

The Main Northern Rail Line is a duplicated rail line running adjacent to the southern and western boundary of the Project Area. The Main Northern Rail Line crosses Bowmans Creek just to the south of the newly constructed Hebden Road overpass. To the west of the Project Area, branch lines travel to the west to access Liddell Coal Operations, Ravensworth Operations and Hunter Valley Operations train load-out facilities.

A spur line off the Main Northern Rail Line services the Mount Owen CHPP and is located on the eastern boundary of the Project Area (the Mount Owen Rail Loop). The Mount Owen Rail Loop is the primary means of transporting coal from the Mount Owen Complex to market. At present all product coal from the Mount Owen Complex is approved to be transported to the Port of Newcastle however up to 2 Mtpa of ROM coal is approved to be transported to the Liddell and Bayswater Power Stations.

The Mount Owen Continued Operations Project approved under the Mount Owen Consent includes provision to realign parts of the Mount Owen Rail Loop. These approved (but not constructed) works also include a new northern rail line turn-out on the Main Northern Rail Line enabling trains to travel to the north from the Mount Owen Rail Loop.

Figure 4.13 shows the alignment of existing and approved rail infrastructure area in the vicinity of the Project.

4.3.3.3 Electricity Infrastructure

There is a range of electricity infrastructure located within and adjacent to the Project Area including:

- 330 kV transmission lines
- 132 kV transmission lines
- 66 kV transmission lines
- 33 kV transmission lines
- 11 kV transmission lines and
- Substations.

The 11 kV and 33kV transmission lines running through the Additional Disturbance Area provide power to private users in the Hebden area, the existing Telstra Tower (refer to **Section 4.3.3.4**), and the Mount Owen Complex operations.

The 330 kV and 132 kV transmissions lines run to the west of the Additional Disturbance Area and will not be directly impacted by the Project.

The location of the electricity infrastructure in the vicinity of the Project is shown in **Figure 4.14**.

4.3.3.4 Telecommunications Infrastructure

Telecommunications infrastructure is located within the Project Area and generally follows the alignment of roads. These services are predominantly owned by Telstra.

A mobile phone tower is currently located in the Project Area to the north of the Glendell Mine (refer to **Plate 4.5**). The tower is operated by Telstra and is located on Glencore owned land subject to lease arrangements. The lease has recently been extended and a new location for the tower, also on Glencore owned land, is currently being negotiated. A potential location for the relocated tower is identified in **Figure 4.14**. The relocation of the tower will be undertaken independently of the Project and does not form part of the Project.

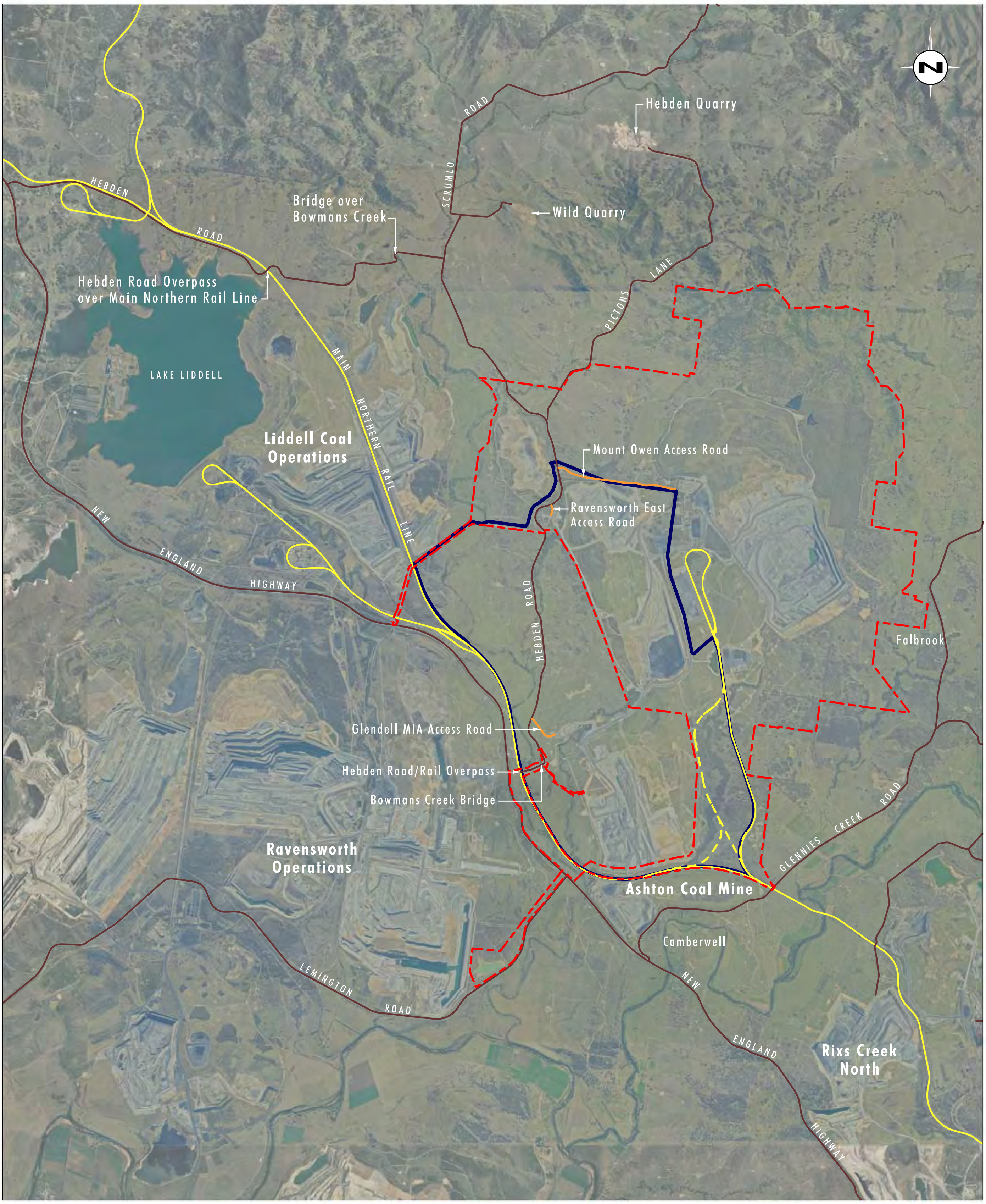


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Mount Owen Consent Boundary
- Road
- Railway
- Approved Rail Upgrade Works
- Access Road

FIGURE 4.13

Road and Rail Infrastructure

File Name (A4): R08/4166_521.dgn
20191129 12.42

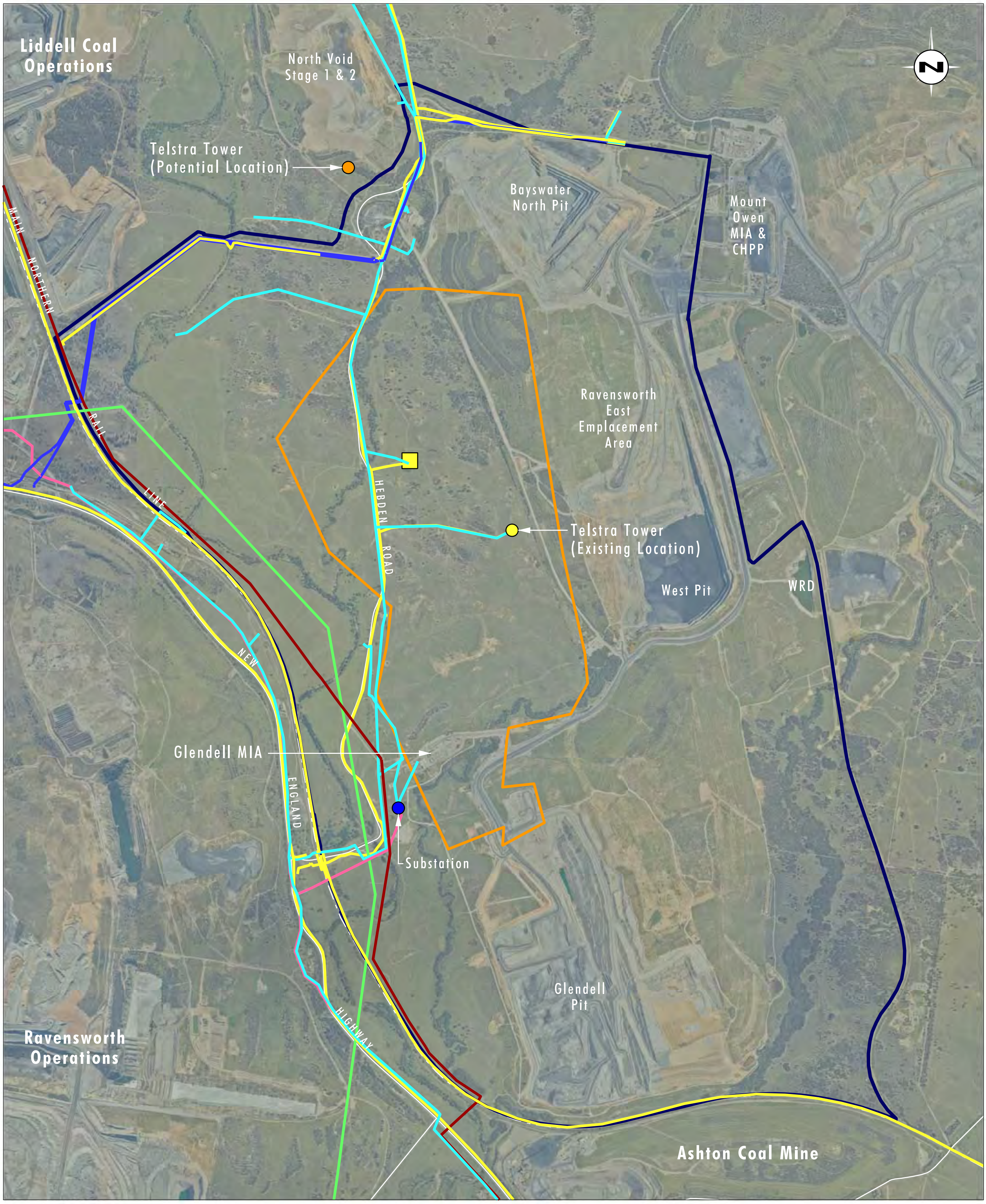


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Ravensworth Homestead to be relocated

0 0.5 1.0 2.0km
1:40 000

Legend

- Project Area
- Glendell Pit Extension
- Ravensworth Homestead
- 132kV Powerline
- 330kV Powerline
- 66kV Powerline
- 33kV Powerline
- 11kV Powerline
- Communications

FIGURE 4.14

Existing Electricity and Telecommunications Infrastructure

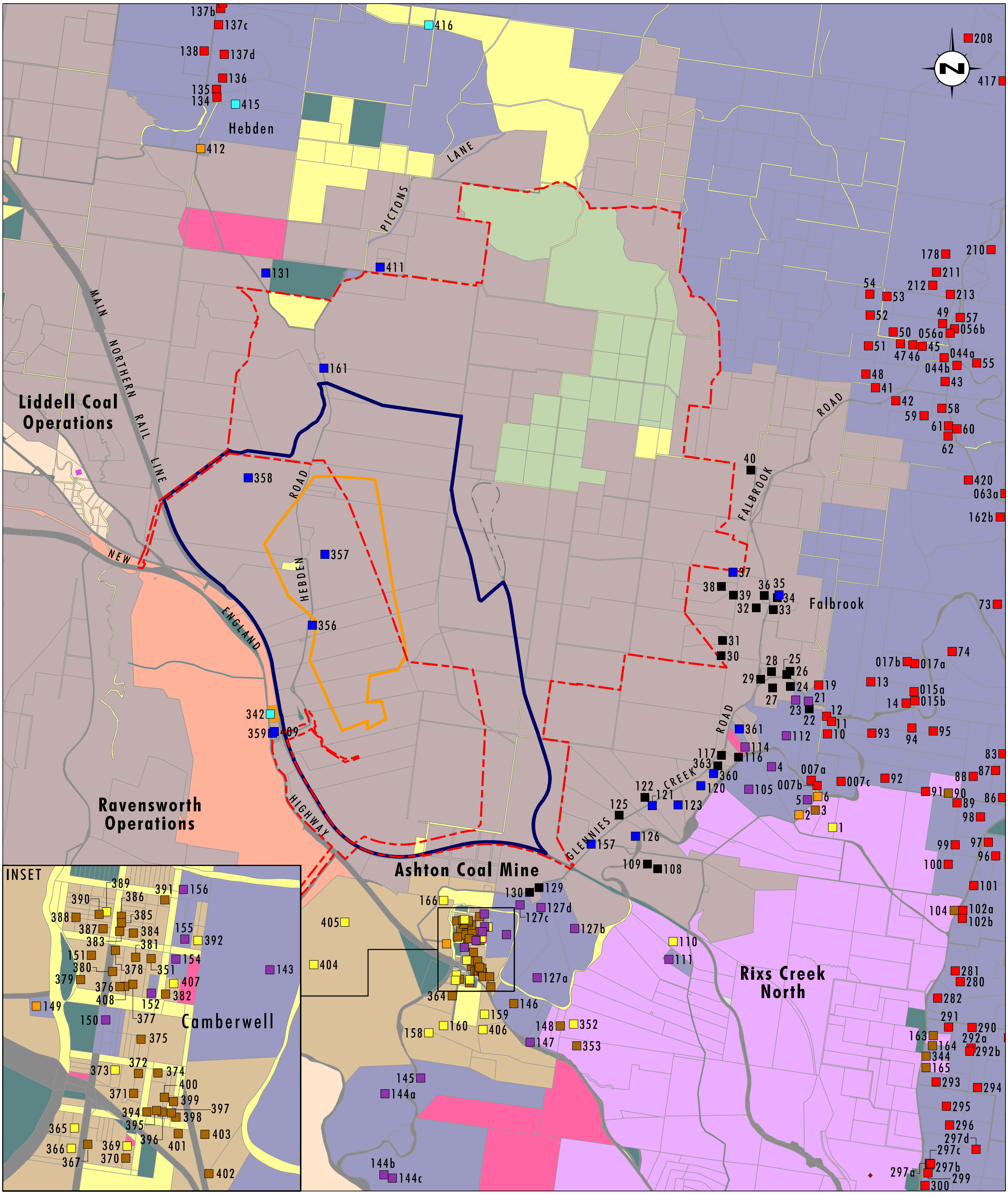
File Name (A4): R08/4166_528.dgn
20191129 8.40

4.3.4 Land Ownership

The land within the Project Area is owned by Glencore or associated entities with the exception of some Crown parcels and roads, the road reserve for Hebden Road for which Singleton Council is the Road Authority, and a small lot associated with a disused substation near the Ravensworth East MIA which is owned by Ausgrid. A small parcel of Crown land is located within the proposed Glendell Pit Extension. A claim under the *Aboriginal Land Rights Act 1983* has been lodged over this parcel of Crown land.

The Schedule of Lands proposed under the Glendell Continued Operations Consent and the Mount Owen Consent Modification are provided in **Appendix 2**.

As outlined in **Section 1.2**, land in the area surrounding the Project Area is largely owned by the operators of the coal mines in the area. A number of properties to the south and east of the Project Area have acquisition and/or mitigation rights under existing consents. These rights have been granted due to the exceedance of relevant noise and air quality criteria associated with the existing and approved coal mining operations. **Table 4.3** summarises the private properties in the vicinity of the Project Area that have acquisition and/or mitigation rights under existing development consents. Land ownership in the area is shown in **Figure 4.15**. **Figure 4.15** also identifies the properties that have acquisition rights under existing development consents. As can be seen from **Table 4.3** and **Figure 4.15**, all residences to the south and south east of the Project Area in the Camberwell area have acquisition rights under one or more development consents.



Data Source: Glencore (2019), Department of Finance Services & Innovation (2019)

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- AGL Macquarie
- Ashton Coal
- Bloomfield Collieries
- Crown Land
- Daracon
- Ausgrid
- Glencore
- Government Authority
- Hunter Valley Operations
- Private
- State Forest
- Private Vacant Land (Acquisition Rights)
- Telstra
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant

FIGURE 4.15

Land Ownership

File Name (A4): R08/4166_298.dgn
20191128 13.33

Table 4.3 Summary of Private Properties with Acquisition and Mitigation Rights

Property ID	Associated Lots in Landholding	Mount Owen Consent SSD-5850	Glendell Consent DA 80/952	Ashton SEOC MP 08_0182	Ravensworth Surface Operations DA 09_0176	Rixs Creek North 08_0102	Rixs Creek South Continuation SSD-6300	Integra Underground 08_0101	Ashton Underground DA309-11-2001
Camberwell residences									
143	3//1088108	A[2], M	M	B, M		M	A[7]		
144a	70//1107703 1//162412			A, M	A, M				A
144b, 144c	75//1124347 1//121623			A, M			A[5]		
145	2//111313 3//1111313			A, M		A	A[5]		A
147	30/1018512			A, M		A	M		A
150	1//248748 2/9/758214 3/9/758214 4/9/758214 5/9/758214 6/9/758214 7/9/758214 8/9/758214 9/9/758214	A[2], M		A, M			A[5]		
152	1/8/758214 2/8/758214	A[2], M	M	B		M	A[4]		
154	105/855187	A[2], M	M	A, M			A[5]		
155	102//852484	A[2], M	M	A, M		M	A[6]		

Property ID	Associated Lots in Landholding	Mount Owen Consent SSD-5850	Glendell Consent DA 80/952	Ashton SEOC MP 08_0182	Ravensworth Surface Operations DA 09_0176	Rixs Creek North 08_0102	Rixs Creek South Continuation SSD-6300	Integra Underground 08_0101	Ashton Underground DA309-11-2001
156	103/852484 104//852484	A[2], M		A, M			A[6]		
Other residences (Refer to Figure 4.15 for locations)									
4	1//600327	A, M				M			
5	2//600327					M		A	
007b	65//752499					M			
10	64//752499					M			
12	2//810452					M			
13	1//79387	M							
19	510//1033291	M							
21	560//1104561	A, M							
23	2//626880	A, M							
93	4//1065800	M							
105	79//1161577	A[3], M				A		A, M	
111	8//246434		M			A	M		
112	8//851867	A, M				M			
114	5//851867	A, M							
127a	1//741653		A, M	B		A	M		
127b	1//745211		A, M	B		A	M	M	
127c	10//1169092				*	A			*
127d	11//1169092	*	*	*	*	A			*

Property ID	Associated Lots in Landholding	Mount Owen Consent SSD-5850	Glendell Consent DA 80/952	Ashton SEOC MP 08_0182	Ravensworth Surface Operations DA 09_0176	Rixs Creek North 08_0102	Rixs Creek South Continuation SSD-6300	Integra Underground 08_0101	Ashton Underground DA309-11-2001
133	31/6842 2//1175728	A[1], M							
Privately owned vacant land									
3//1111313				A		A	A[5]		
1//121623				A			A[5]		
1//1136411				A		A	A[5]		
2//804005							A		
1//1137660							A		
52//252692							A		
53//252692							A		
54//252692							A		
4//1166047		A[2]		B			A[4, 8]		
5//1166047		A[2]		B			A[4]		
175//1002770		A[2]		B					
106//855187		A[2]		B			A[6]		
4//851867		A,M							

Notes: A = acquisition on request | B = Ashton SEOC acquisition noise trigger | M – Mitigation rights

[1] - As per Mount Owen Consent, the Applicant is only required to acquire 31//6842 and 2//1175728 within property 133

[2] - As per Mount Owen Consent, the Applicant is only required to acquire the identified land if acquisition is not reasonably achievable under the development consents for the Ashton SEOC Project (MP 08_0182), the Glendell Open Cut Coal Mine (DA 80/952), Ravensworth Operations Project (MP 09_0176), Rix's Creek South Continuation of Mining Project (SSD 6300) or the Rix's Creek North Open Cut Project (MP 08_0102).

[3] – As per Mount Owen Consent, the Applicant is only required to acquire property 105, if its acquisition is not reasonably achievable under the approval for the Rix's Creek North open cut mine.

[4] – As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine.

[5] – As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine or Ashton SEOC.

[6] – As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine, Ashton SEOC or Glendell Mine.

[7] - As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine or Glendell Mine.

[8] – Lot identified incorrectly on Rix's Creek South Consent as Lot 44 DP 1166047

* Dwelling constructed after project approval granted

4.3.5 Land Use

The land use within the Project Area and surrounds is dominated by mining operations (refer to **Figure 1.2**). Glencore operates the Mount Owen Complex, Integra Underground operations to the south-east, Liddell Coal Operations to the north-west and Ravensworth Surface Operations to the south-west. Ashton Coal Mine is located to the south of the Project Area while Rix's Creek North is located to the south-east of the Project Area (refer to **Figure 1.2**). The extent of historically mined areas and approved mining areas in the vicinity of the Project are shown in **Figure 4.16**.

Other land uses within the surrounding area include grazing and rural residential holdings and the Hebden Quarry and Wild Quarry to the north of the Project Area. The Bayswater and Liddell Power Stations are located to the northwest of the Project Area. **Figure 4.17** shows the land uses in the area around the Project Area.

With a variety of landscapes and climates, the Upper Hunter region supports a diverse range of agricultural industries. Similarly, Singleton and Muswellbrook LGAs have a long history of agricultural land use, particularly in regard to cropping and grazing. Cropping within the Project Area and immediate surrounds has historically been largely limited to the flatter alluvial terraces associated with Bowmans Creek. There has been limited cropping of alluvial terraces in recent years other than localised areas used for improved pastures for grazing. Areas away from alluvial terraces have largely been used for grazing.

Where not used for mining related activities, land owned by Glencore and its subsidiaries within and surrounding the Project Area is utilised for cattle grazing and rural residential leases (subject to environmental conditions). The cattle grazing operations are currently managed and operated by Colinta Holdings Pty Limited (Colinta), a Glencore subsidiary. Typical areas of native grassland grazing areas within the Additional Disturbance Area are shown in **Plates 4.5**, **4.6** and **4.7**.

Plate 4.6 Grazing land to the southeast of Ravensworth Homestead (April 2019)

Plate 4.7 Grazing Land to the south of Ravensworth Homestead with regrowth (April 2019)

Plate 4.8 Native Grassland grazing land in northern part of Additional Disturbance Area with Bulloak Regrowth (September 2019)

Plate 4.9 shows the alluvial flats to the east of Bowmans Creek which have a long history of cropping and grazing. This photo is taken facing east towards the northern part of the Additional Disturbance Area. The partly rehabilitated Ravensworth East emplacement area is visible in the background (right). The eroded hillside in the centre left of the photo is located within the Additional Disturbance Area and is to the east of the proposed MIA and Heavy Vehicle Access Road.

Plate 4.9 Bowmans Creek Alluvial Floodplain looking towards the Additional Disturbance Area (June 2018)

The Additional Disturbance Area is currently used for low intensity grazing and buffer land for the current Mount Owen Complex operations. The western and southwestern parts of the Additional Disturbance Area have historically been cropped intermittently but are now primarily used for grazing.

The Ravensworth State Forest is located in the north-eastern corner of the Mount Owen Complex. Surrounding these State Forest areas is the existing Mount Owen Complex biodiversity offset areas (refer to **Figure 4.17**). Adjoining the State Forest to the south is a Travelling Stock Reserve (TSR89694) managed by the NSW Local Land Services (LLS). There are no direct impacts on Ravensworth State Forest or the Travelling Stock Reserve (TSR) as part of the Project. Other than some minor disturbance associated with final landform drainage works in the Bettys Creek Habitat Management Area, the Project will not have any direct impacts on any existing offset areas.

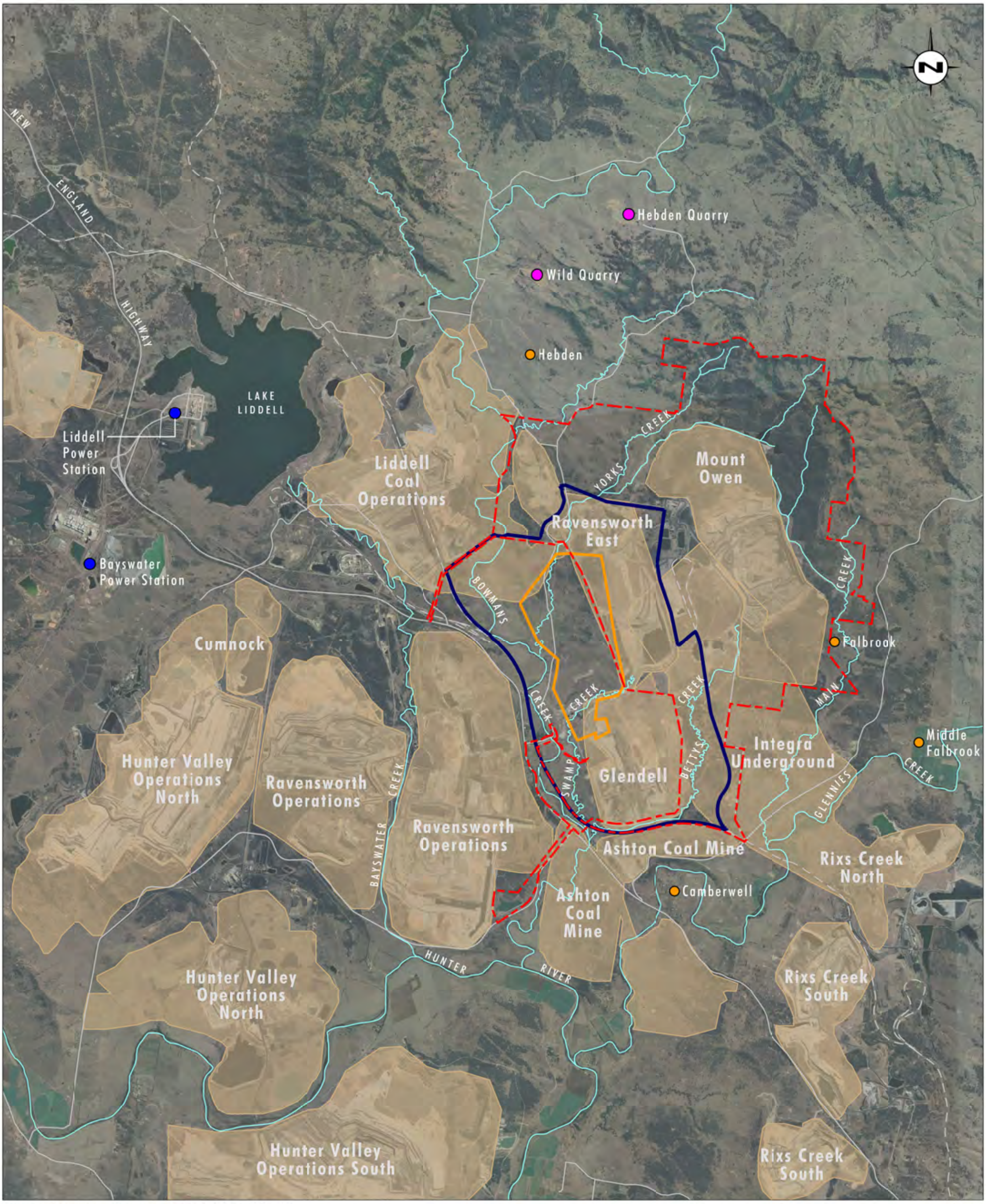


Image Source: Google Earth (Sep 2018)
Data Source: Glencore (2019), AGE (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend
- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing/Approved Mining Operations

FIGURE 4.16

Historical and Approved Mining Operations in the Area

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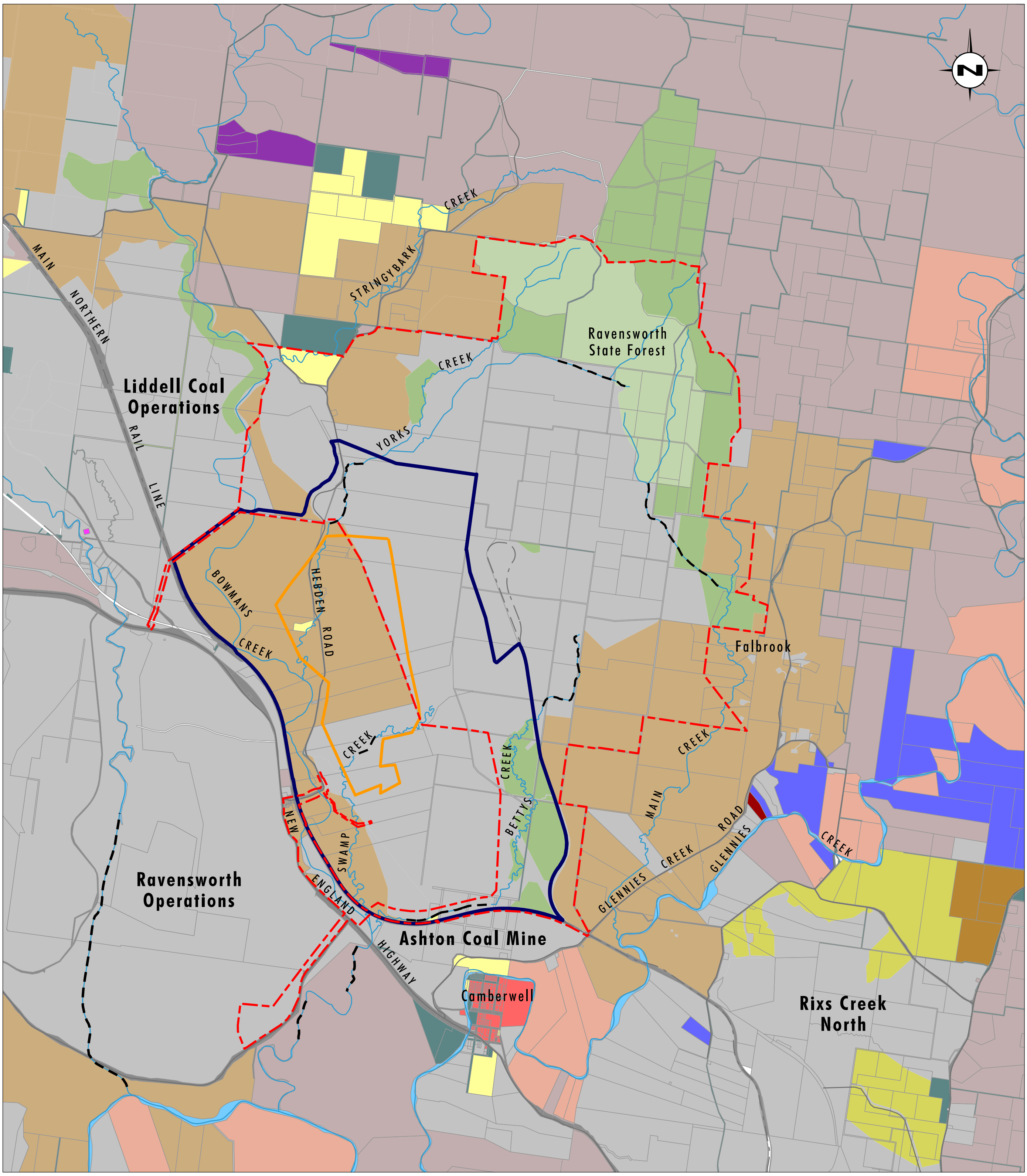

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion

Land Use:

- Ausgrid
- Colinta Grazing Land
- Crown Land
- Government Authority Land
- Grazing - Native Pastures. Some Improved Pastures
- Infrastructure
- Rixs Creek North Biodiversity Offset Area
- Mining Operations (Including Leased Buffer Land)
- Mixed Grazing and Irrigation/Cropping/Improved Pasture
- Biodiversity Offset Areas/Conservation Areas
- Quarry/Industrial
- Regenerating Forest
- Rural Residential
- State Forest
- Vacant
- Residential - Small Holdings
- Water

FIGURE 4.17

Surrounding Land Use

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20191118 16.16

4.4 Planning and Policy Context

There are a range of Government plans and policies that apply to the use of land in the Hunter Valley and mining in general. These are discussed briefly below in relation to their application to mining in the Project Area.

4.4.1 Mining Act – Mining Authorities

The entire Project Area is subject to mining authorities (mining leases, exploration licences and assessment leases) for coal. These mining authorities require the holders of the leases to actively investigate the mineral bearing qualities of the area and, in the case of mining leases, maximise the extraction of resource within the lease areas. Many of these mining leases and exploration licences have been in force over the area for several decades. The existence of these mining authorities over the land and the obligations to actively investigate the mineral bearing values of the area are strong evidence of NSW Government support for coal mining in this area.

It is a result of exploration activities undertaken pursuant to these licences that the Proponent identified a mineable resource and has developed a mine plan which optimises the extraction of this resource whilst having regard to physical and social constraints.

4.4.2 NSW State, Regional and Local Planning Policies

4.4.2.1 Integrated Mining Policy

The DPIE has developed the Integrated Mining Policy to improve the assessment of mining projects. The DPIE Integrated Mining Policy Website summarise the NSW Government's general policy towards mining projects (DPIE, 2019):

- The government is committed to a balanced approach to mining regulation, which supports increasing investment in regional NSW, while managing potential impacts on the environment, local communities and existing businesses.

and:

- The Integrated Mining Policy improves transparency, consistency and accountability for assessment decisions by helping guide proponents to develop applications and compliance reports that better communicate key issues that are of interest to government and the community.

This EIS has been prepared having regard to the DPIE guidance documents prepared under the Integrated Mining Policy relevant to the assessment process.

4.4.2.2 Hunter Regional Plan 2036

The Hunter Regional Plan 2036 is the NSW Government's strategic long-term plan for guiding land use planning decisions for the Hunter Region until 2036. The Hunter 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 Hunter 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 Hunter 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. The Project aligns to the following 'directions' in the Hunter 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 to 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 the Project aligns with the Upper Hunter Strategic Regional Land Use Policy (SRLUP) which is discussed in **Section 4.4.4**. Direction 14 requires consideration of the Project's potential environmental impacts. These are discussed in detail in **Section 7.0** of this EIS. Direction 15 is addressed through the range of management, mitigation and monitoring measures committed to for the Project as discussed throughout **Section 7.0** and as summarised in **Appendix 8**.

4.4.2.3 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 has a time frame of 25 years, to 2032. 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 includes 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 for rehabilitation of mined landscapes.*

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 the Mount Owen Complex satisfy most of the above criteria.

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

4.4.3 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).

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 Project.

4.4.4 Upper Hunter Strategic Regional Land Use Plan 2012

The key strategic policy guiding the assessment of mining development in the Upper Hunter Valley region of NSW is the NSW Government's Upper Hunter SRLUP. The Upper Hunter SRLUP was approved in September 2012 and applies to the Project Area. 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 emergence of the coal seam gas industry. The Upper Hunter SRLUP requires all development and modification applications for mining development that is SSD (including this Project), and where mining is proposed outside existing mining lease boundaries which would potentially impact on agricultural resources or industries, to be accompanied by an Agricultural Impact Statement (refer to **Appendix 27**).

Key to the implementation of the Upper Hunter SRLUP is the assessment of impacts from mining and coal seam gas development on land identified as being strategic agricultural land. There are 2 types of strategic agricultural land identified in the Upper Hunter SRLUP, BSAL and, critical industry clusters (CICs). BSAL is land that has soil, topography and access to water which make it ideally suited to agricultural production. CICs are areas in which established specialist agricultural industries are located or have the potential to be located and their continued success as an industry is related to the critical mass of the industry present in these areas.

The Upper Hunter SRLUP includes mapping of BSAL and CICs in the Upper Hunter Valley. There are no CICs within 10 km of the Project Area. The Upper Hunter SRLUP mapping of BSAL is based on OEH LSC mapping (refer to **Figure 4.8**) (OEH, 2017), proximity to reliable water and soil fertility. The Upper Hunter SRLUP mapping limits BSAL to moderate to high fertility soils of LSC Classes 1, 2 and 3 which are land identified as having low to moderate limitations for high-impact land uses. Class 3 land is only identified in the Upper Hunter SRLUP mapping where it aligns with the regionally mapped high fertility soils.

The site verification process prescribed under the Mining SEPP requires the Secretary of DPIE, when considering a Site Verification Certificate, to *have regard to* the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Land (NSW Government, 2013) (Interim Protocol). This process only applies to land where a new mining lease is required to carry out the Project. Verification is not required where existing mining leases are held for the Project.

A Site Verification Report accompanied the Gateway Application for the Project (Umwelt, 2019). The Site Verification Report was prepared having regard to the Interim Protocol and applies only to parts of the Project Area that will be newly disturbed by the Project and where new mining leases may be required for the activities proposed (Verification Area). Based on the assessment in accordance with the Interim Protocol, there is approximately 34 ha of BSAL within the Additional Disturbance Area (refer to **Figure 4.7**); this area is referred to in this EIS as Verified BSAL.

Plate 4.10 shows the areas of Verified BSAL where the proposed MIA will be located.

Plate 4.10 Looking south across proposed site for MIA
© Umwelt, 2019

The Interim Protocol does not apply the OEH LSC process, but rather provides a different set of criteria. Detailed LSC classification of the land has also been carried out as per the OEH Land and Soil Classification Guidelines (OEH 2012a) for the Agricultural Impact Assessment for the Project in accordance with Agricultural Impact Assessment Guidelines (refer to **Appendix 27** and **Section 7.12**). This assessment has identified that just 13 ha of the Additional Disturbance Area is LSC Class 3 land with all of this being within the Verified BSAL area assessed using the Interim Protocol. The remaining 21 ha of the Verified BSAL assessed in accordance with the Interim Protocol has been assessed as being LSC Class 4 land.

LSC Class 4 land is identified as being moderate capability land which has moderate to high limitations to high impact land uses. The soils within the LCS Class 3 and Class 4 land in the Verified BSAL area is identified as being either tenosols or chromosols that have moderately high fertility. Based on the LSC classification and soil fertility, these soils, while technically meeting the criteria for BSAL when assessed in accordance with the Interim Protocol, are considered to be lower value land relative to the types of land that can be assessed as being BSAL. All other areas within the Verification Area have been assessed as LSC Class 5, 6 and 8 land.

The areas of the Additional Disturbance Area located outside of the Verification Area have not been assessed under the Interim Protocol but have been assessed in accordance with the LSC process. This assessment has identified that there are small areas of LCS Class 4 land (approximately 29 ha in total) located in the south of the Additional Disturbance Area outside the Verification Area adjacent to Swamp Creek with the remainder being LSC Class 5, 6 and 8 land. The implications of this for agricultural productivity are discussed further in **Appendix 27** and **Section 7.12**.

The Upper Hunter SRLUP also identifies key planning challenges and policy responses to other social, economic and environmental issues in the Upper Hunter Valley which are of relevance to the Project including:

- infrastructure

- economic development and employment
- housing and settlement
- community health and amenity (including air quality, noise, visual amenity and water quality)
- natural environment (including the identification of targeted conservation areas and habitat corridors)
- cultural heritage.

4.4.5 Environmental Planning Instruments

4.4.5.1 Singleton Local Environment Plan 2013

The Project Area is located wholly within the Singleton LGA. The Singleton Local Environmental Plan 2013 (Singleton LEP) regulates the permissibility of local development within the Singleton LGA. The key features of the Project (refer to **Section 3.1**) are all located on land zoned RU1 – Primary Production under the Singleton LEP.

The objectives of the RU1 zone are outlined below.

a) To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.

b) To encourage diversity in primary industry enterprises and systems appropriate for the area.

c) To minimise the fragmentation and alienation of resource land, and

d) To minimise conflict between land uses within this zone and land uses within adjoining zones.

Open cut mining is permissible with development consent in the RU1 zone. Agriculture is also permissible in the RU1 zone. The land zoning of the area around the Project Area is shown in **Figure 4.18**, and is discussed further in **Section 5.2.1.**

4.4.5.2 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP)

The Mining SEPP regulates the permissibility and assessment requirements for mining, petroleum production and extractive industries and related development. As noted in **Section 4.4**, the Mining SEPP contains provisions related to the consideration of the impacts from proposed mining projects on agricultural impacts. The Mining SEPP also includes mandatory requirements to consider a range of environmental impacts as well as land use conflict issues.

Clause 7 of the Mining SEPP provides that mining may be carried out, with development consent, on land where development for the purposes of agriculture or industry may be carried out. As noted in **Section 4.4.5.1** 'agriculture' is also permissible in the RU1 Zone. While there is no direct conflict between permissibility under the Mining SEPP and the Singleton LEP, the operation of Part 3 of the EP&A Act and clause 5 of the Mining SEPP provides that State Environmental Planning Policies prevail over LEPs to the extent of any inconsistency.

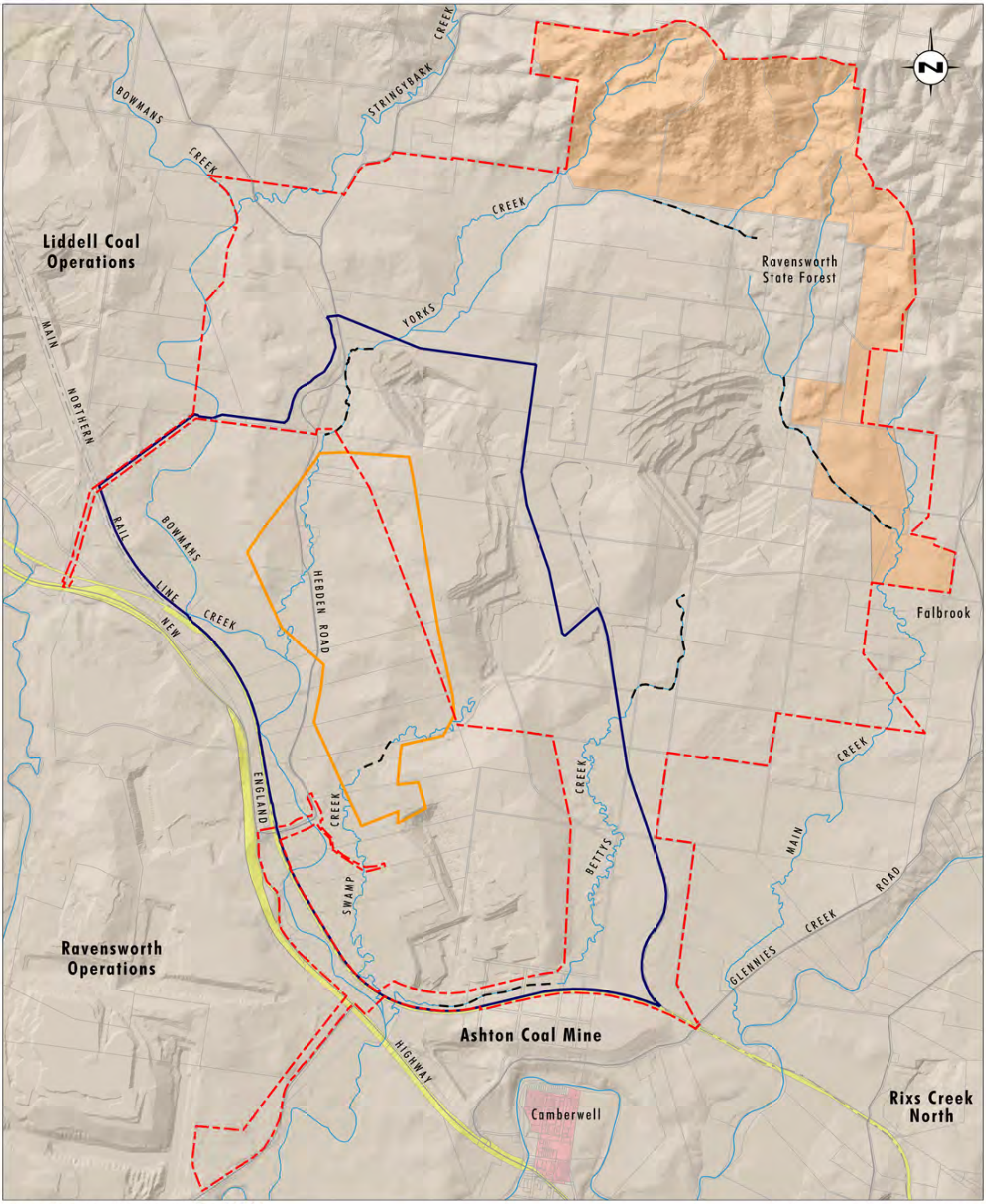

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Singleton LEP (2013)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- SP2 - Infrastructure

Zoning:

- E2 - Environmental Conservation
- R5 - Large Lot Residential
- RU1 - Primary Production

FIGURE 4.18

Land Zoning under the Singleton LEP

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SECTION 5.0

Statutory Context

5.0 Statutory Context

5.1 Statutory context

This section discusses the application of the various State and Commonwealth environment and planning legislation and policies that are relevant to the Project. The primary approvals required for the Project under NSW and Commonwealth legislation are:

- granting of a new development consent for the Glendell Continued Operations Project under Part 4, Division 4.7 (SSD) of the EP&A Act
- modification of the Mount Owen Consent under section 4.55(2) of the EP&A Act
- approval under the EPBC Act.

This EIS has been prepared to meet the specific assessment requirements prescribed under the EP&A Act. These requirements are discussed further in **Section 5.2**. The NSW assessment path under Part 4, Division 4.7 of the EP&A Act has been declared to be an accredited assessment process for the Project under the EPBC Act. These specific assessment requirements under the EPBC Act are discussed further in **Section 5.4.1**.

The application of other NSW planning, land use and environmental legislation relevant to the Project is discussed in **Section 5.2.2**. The operation of other Commonwealth legislation relevant to the Project is discussed in **Section 5.4**.

Appendix 8 contains further consideration of specific statutory considerations and where they are addressed in the EIS.

5.2 Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act is the primary legislation governing environmental planning and assessment for NSW. The EP&A Act prescribes a number of approval and assessment pathways for new and modified developments. These pathways are determined by environmental planning instruments such as local environmental plans and State Environmental Planning Policies.

5.2.1 Approval pathway

5.2.1.1 Requirement for development consent

As identified in **Section 4.4.5**, mining is permissible with consent in the areas directly impacted by the Project. The effect of this zoning is that development consent is required under Part 4 of the EP&A Act.

Development consent authorising specific development can be obtained through either a modification of an existing development consent and/or through a new development consent. Modifications to development consents are regulated under section 4.55 of the EP&A Act and the ability to modify a consent is subject to the modified development being substantially the same development as originally approved. In the present case, the proposed extension to mining in the Glendell Pit contemplated by the Project is not considered to be substantially the same development as the development approved under the Glendell Consent or the Mount Owen Consent. The aspects of the Project which interact with the approved operations at Mount Owen is however considered to be substantially the same as the development currently approved under the Mount Owen Consent. Accordingly, the proposed approval pathway under the EP&A Act for the Project is a new development application for the Glendell Continued Operations Project described in **Section 3.2** and a modification of the Mount Owen Consent as set out in **Section 3.3**.

This EIS supports both an application for a new development consent to cover the development described in **Section 3.2** as well as the section 4.55(2) modification application to the Mount Owen Consent.

5.2.1.2 Ravensworth Homestead relocation options

The Project necessitates the relocation of the Ravensworth Homestead Complex. As discussed in **Section 3.2.9**, 2 alternate options are proposed for the relocation of Ravensworth Homestead and are:

- 'Ravensworth Farm' (Option 1) – involves the intact relocation of the complex buildings to a new recipient site 'Ravensworth Farm' located within the Project Area and within the original Bowman '10,000 acre' land grant. This land is owned by Glencore and the buildings would be adapted for use as administration/office facilities by Glencore.

- 'Broke Village' (Option 2) – this is a proposal developed by members from the Broke-Fordwich community that proposes to dismantle and rebuild the buildings at McNamara Park in Broke where they would become the village square. The buildings are proposed for multi-purpose usage and the facility would provide local employment opportunities, communal interaction and encourage enterprise growth.

Approval is sought as part of this SSD application to relocate the Homestead on the basis that relocation will be either locally to Ravensworth Farm or alternatively to Broke Village. In the event that Ravensworth Farm (Option 1) is approved by the consent authority, then approval for this relocation option would be included as part of the SSD development consent and would require no further statutory approvals as all necessary environmental assessments for this option have been completed as part of the current SSD application.

In the event that Broke Village (Option 2) is approved by the consent authority then it needs to be recognised that land tenure is to be secured for the proposed location or an alternative location, and further secondary approvals for the reconstruction and use of the Homestead in this location will be required to be obtained. Based on the proposed mining schedule for the Project, all requisite statutory approvals for Option 2 are required to be obtained by the end of Year 2 of the Project. If the requisite approvals cannot be obtained within 2 years of commencement of development under the SSD development consent (Broke Approval Date) then the Homestead will be relocated to the Ravensworth Farm. The relocation and use of the Homestead at the Ravensworth Farm is therefore part of the development being assessed under the SSD development application to cover the event that the Broke option is not available and fully approved by the Broke Approval Date. This approval pathway is summarised in **Figure 5.1**.

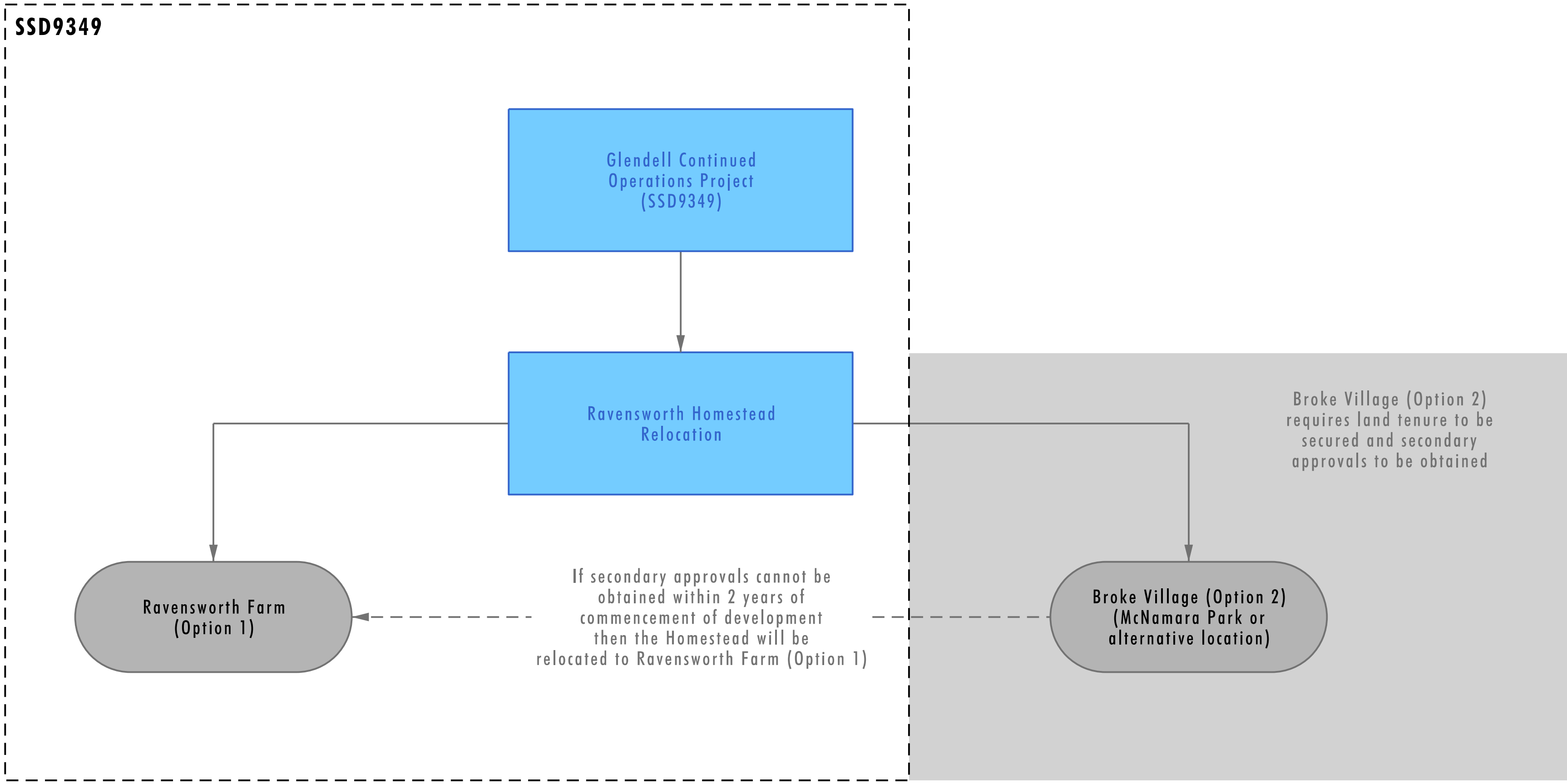

FIGURE 5.1

Ravensworth Homestead Relocation Approvals Process

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5.2.1.3 Coverage of different consents

In general, the new development consent will cover the mining of the remaining reserves approved in the Glendell Pit and the proposed mining of the Glendell Pit Extension and the transport of coal by haul road to the Mount Owen CHPP. The new development consent will also cover the demolition of the existing Glendell MIA, construction of the new Glendell MIA, the realignment of parts of Hebden Road and Yorks Creek and the rehabilitation of areas disturbed by these components of the Project.

The modified Mount Owen Consent will continue to cover the mining of the Bayswater North Pit and North Pit, operations at the Mount Owen CHPP and MIA (including the ROM stockpiles), the transport of coal from the complex (including the conveyor to Liddell Coal Operations), and the linkages to the GRAWTS infrastructure (including primary water storages and tailings management at Mount Owen).

The Mount Owen Consent will continue to regulate rehabilitation of areas disturbed by current and past operations at the Mount Owen Mine and Ravensworth East Mine. The Glendell Continued Operations Consent will regulate rehabilitation of areas disturbed by the Glendell Pit Extension, Heavy Vehicle Access Road, Yorks Creek Realignment and the Glendell MIA. The Glendell Continued Operations Consent will also manage the ongoing rehabilitation commitments associated with the areas disturbed under the current Glendell Consent. A common Rehabilitation Strategy will be prepared to cover the entire Mount Owen Complex to provide for the integration of rehabilitation commitments and activities.

The Project components to be regulated under each of the consents are set out in **Table 5.1** below:

Table 5.1 Regulation of Project Components under Glendell and Mount Owen Consents

Project Component	Glendell Continued Operations Consent	Modified Mount Owen Consent	Comments
Mining in Glendell Pit Extension	Yes	No	Refer to **Section 3.2**
Mining in North Pit and Bayswater North Pit	No	Yes	No change to existing approved mining operations
Glendell ROM Haul Roads	Yes	No	The haulage of coal between the Glendell Pit Extension and the Mount Owen ROM pads will be regulated under the Glendell Continued Operations Consent and are considered in noise and air quality impact assessments for the Glendell Continued Operations Consent. The management of water runoff and the rehabilitation of the haul roads within the Mount Owen Consent Area will be managed under the Mount Owen Consent.
ROM stockpiles at CHPP	No	Yes	Refer to **Section 3.3**
Mount Owen CHPP and throughput	No	Yes	Refer to **Section 3.3**
Mount Owen MIA	No	Yes	Refer to **Section 3.3**

Project Component	Glendell Continued Operations Consent	Modified Mount Owen Consent	Comments
Rehabilitation of tailings facilities, Bayswater North Pit, Mount Owen CHPP and MIA and North Pit	No	Yes	Refer to **Section 3.3**
Rehabilitation of disturbance associated with the Glendell Pit EExtension, Glendell MIA and current Glendell mine and associated ancillary infrastructure	Yes	No	Refer to **Section 3.2.1**
Heavy Vehicle Access Road	Yes	No	Refer to **Section 3.2**
Transport of coal from Mount Owen Complex	No	Yes	Refer to **Section 3.2.4 and Section 3.3**
Linkages of GRAWTS infrastructure	No	Yes	Refer to **Section 3.2.6**
Yorks Creek Realignment	Yes	No	Refer to **Sections 3.2.10** and **3.2.17** Design and construction of the realignment will be managed under the Glendell Continued Operations Consent. The Rehabilitation and Mine Closure Strategy for the Mount Owen Complex (refer to **Section 7.9.4**) will be common to both consents.
Hebden Road Realignment	Yes	No	Refer to **Section 3.2.7**
Demolition of Glendell MIA	Yes	No	Refer to **Section 3.2.6.5**
Relocation of Ravensworth Homestead and associated mitigation and management measures	Yes – Ravensworth Farm (Option 1) only as all necessary environmental assessments for this option have been completed as part of the SSD application. Broke Village (Option 2) would require land tenure to be secured and the requisite secondary approvals.	No	Refer to **Section 7.8**

5.2.1.4 Designation as State Significant Development (SSD)

Clause 8(1)(b) and clause 5(1)(a) of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) prescribe that development for the purposes of 'coal mining' is SSD. Division 4.7 of the EP&A Act regulates the granting of development consent for SSD.

5.2.1.5 Consent Authority

Under section 4.5 of the EP&A Act, the consent authority for development applications for SSD is the Minister for Planning and Public Spaces unless otherwise prescribed by an environmental planning instrument. Clause 8A of the SSD SEPP prescribes the Independent Planning Commission (IPC) as the consent authority in the following circumstances:

> *(a) development in respect of which the council of the area in which the development is to be carried out has duly made a submission by way of objection under the mandatory requirements for community participation in Schedule 1 to the Act,*
>
> *(b) development in respect of which at least 25 persons (other than a council) have duly made submissions by way of objection under the mandatory requirements for community participation in Schedule 1 to the Act,*
>
> *(c) development the subject of a development application made by a person who has disclosed a reportable political donation under section 10.4 to the Act in connection with the development application.*

The above circumstances also define the consent authority for the purposes of modification applications.

At the time of submission of the development application, Glencore (refer to **Section 1.4.3**) had not made a reportable political donation as described in clause 8A(1)(c). Accordingly, the determination of the consent authority for the Project will be dependent on the number and nature of objections received following the public exhibition of the application and EIS.

5.2.1.6 Preconditions to lodgement of the applications and/or determination of the applications

Gateway Certificate

Under clause 50A of the *Environmental Planning and Assessment Regulation 2000* (EP&A Reg), a development application that relates to 'mining or petroleum development' (within the meaning of Part 4AA of Mining SEPP) on land shown on the Strategic Agricultural Land Map (or any other land that is the subject of a site verification certificate) must be accompanied by a current gateway certificate or a site verification certificate verifying that the land on which the proposed development is to be carried out is not BSAL. Given the Project includes a proposal for mining outside the areas of the current mining leases for the Glendell Mine, the development is 'mining or petroleum development'.

As discussed in **Section 4.4.4**, the Project will impact on an area of verified BSAL. A Conditional Gateway Certificate for the Project was obtained on 24 July 2019 in relation to the Project and is attached as **Appendix 4**. This EIS has been prepared to address the recommendations in the Conditional Gateway Certificate.

Clause 119A of the EP&A Regulation applies to modification applications under section 4.55 for 'mining or petroleum development' in the same way that clause 50A applies to development applications for 'mining or petroleum development'. The modification to the Mount Owen Consent does not include any 'mining or petroleum development' within the meaning of Part 4AA of the Mining SEPP and, therefore, clause 119A of the EP&A Regulation does not apply to the modification application.

Mining authority over relevant land

Under section 380AA of the *Mining Act 1992*, an application for development consent, or for the modification of a development consent, to mine for coal cannot be made or determined unless (at the time it is made or determined) the applicant is the holder of an authority that is in force in respect of coal in relation to the land where mining for coal is proposed to be carried out, or the applicant has the written consent of the holder of such an authority to make the application.

The proposed mining of the Glendell Pit Extension and the existing approved Glendell mining area that will be covered by the proposed Glendell Continued Operations Consent is located within authorities in force with respect to coal (refer to **Figure 2.6**). The authorities are:

- CCL708 (held by Liddell Tenements Pty Ltd)
- CL358 (held by Glendell Tenements Pty Ltd)
- ML1415 (held by Mt Owen Pty Ltd)
- EL8184 (held by Glendell Tenements Pty Ltd)
- EL6594 (held by Glendell Tenements Pty Ltd)

At the time of finalisation of the EIS, ELA5736 had been lodged by Glendell Tenements Pty Ltd over the area covered by ML1629 (a mining lease authorising mining purposes only) but not yet determined. ELA5736 applies to Group 9 minerals (coal). Due to the operation of section 380AA of the Mining Act, the development application for the Project can only be lodged once ELA5736 is granted.

Appendix 9 contains letters from Mt Owen Pty Ltd and Liddell Tenements Pty Ltd consenting to the lodgement of the development application for the Glendell Continued Operations Project by Glendell Tenements Pty Ltd in relation to the land subject to CCL708 and ML1415 which is affected by the Glendell Pit Extension.

The modification application in relation to the Mount Owen Consent does not relate to the extraction of coal and does not affect the approved mining areas under that consent. Accordingly, section 380AA of the *Mining Act 1992* does not apply to lodgement or determination of the application to modify the Mount Owen Consent.

Landowner consent

As SSD for 'mining', the development application and modification application are both 'public notification development' as defined in clause 49 of the EP&A Regulation[3]. As public notification development, the consent of the owners of the land affected by the applications is not required in the present circumstances provided an advertisement is published in the newspaper within 14 days after the applications are made[4].

Application to be accompanied by an EIS

As SSD, section 4.12(8) of the EP&A Act requires the development application for the Glendell Continued Operations Project to be accompanied by an EIS. This EIS has been prepared on behalf of the Glendell Tenements Pty Ltd to support the development application for the Glendell Continued Operations Project. **Section 5.2.1.8** and **Appendix 8** contains further information regarding the requirements that the EIS must address.

[3] Neither application relates to land within a State Conservation Area reserved under the *National Parkes and Wildlife Act 1974*.

[4] Under clause 49, the consent of the Local Aboriginal Land Council (LALC) is required in relation to any applications for public notification development affecting land owned by the LALC. There is no land owned by a LALC within the Project Area or Mount Owen Consent Area.

The EIS also supports the proposed modification of the Mount Owen Consent.

5.2.1.7 Pre-conditions to the exercising of power to grant development consent

The following considers the preconditions to the exercising of power to the grant of development consent relevant or potentially relevant to the Project.

Permissibility

The consent cannot approve the carrying out of a SSD that would be wholly prohibited under an environmental planning instrument.

As discussed in **Section 4.4.5.1** the Project is located wholly within land zoned RU1 – Primary Production under the Singleton LEP (refer to **Figure 4.18**). Open cut mining is permissible with development consent in the RU1 zone. Additionally, clause 7 of the Mining SEPP provides that mining may be carried out, with development consent, on land where development for the purposes of agriculture or industry may be carried out. Agriculture is also permissible in the RU1 zone. Accordingly, the zoning of the land does not preclude the consent authority from granting development consent to the Project.

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44)

SEPP 44 prevents a Council from granting development consent for proposals on land identified as core koala habitat without preparation of a plan of management. Singleton LGA is listed in Schedule 1 of SEPP 44 and therefore the SEPP applies to the Project.

An extensive biodiversity assessment (refer to **Section 7.6**) has been completed for the Project and includes a koala habitat assessment. The Project Area is not considered to be core koala habitat and a koala plan of management is not required.

SEPP No 55 – Remediation of Land (SEPP 55)

SEPP 55 aims to provide a state-wide planning approach to the remediation of contaminated land and to reduce the risk of harm to human health and the environment by consideration of contaminated land as part of the planning process. Under SEPP 55, a consent authority must not consent to the carrying out of development on land unless it has considered any potential contamination issues.

A search of the EPA's NSW Contaminated Lands Public Record Register was undertaken on 31 July 2019. There are no contaminated sites currently recorded within the Project Area, however activities carried out at Mount Owen Complex have the potential to cause contamination if not properly managed. The management of contamination risks is discussed further in **Section 7.14**. Any contamination of the land will not affect the suitability of the site for operating as a mine.

5.2.1.8 Mandatory matters for consideration

As SSD, the Project is subject to the general assessment requirements under Part 4 of the EP&A Act as amended by the requirements under Part 4 Division 4 4.7 of that Act. The requirements are discussed below.

Section 1.3 Relevant Objects of the EP&A Act

The consideration of whether or not to approve a development application or modification application must have regard to the objects of the EP&A Act to the extent they are relevant. The objects of the EP&A Act are set out in section 1.3 of the EP&A Act and are reproduced below:

- to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources

- to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment
- to promote the orderly and economic use and development of land
- to promote the delivery and maintenance of affordable housing
- to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats
- to promote sustainable management of built and cultural heritage (including Aboriginal cultural heritage)
- to promote good design and amenity of the built environment
- to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants
- to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State
- to provide increased opportunity for community participation in environmental planning and assessment.

Appendix 8 includes consideration of the objects of the EP&A Act to the extent they are relevant to the Project.

Section 4.15 Matters for Consideration

Under Part 4, the consent authority, in this case the Minister or the IPC must have regard to the matters set out in section 4.15 of the EP&A Act. Subsection 4.15(1) of the EP&A Act requires the consent authority to take into consideration the following matters insofar as they are relevant to the development application:

- the provisions of:
  - any environmental planning instrument, and
  - any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Planning Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved
  - any development control plan
  - any voluntary planning agreement that has been entered into or any draft planning agreement that a developer has offered to enter into
  - the regulations (to the extent that they prescribe additional matters for consideration)
  - that apply to the land to which the development application relates,
- the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,
- the suitability of the site for the development,
- any submissions made in accordance with this Act or the regulations,
- the public interest.

Subsection 4.15(2) contains specific provisions related to the consideration of non-discretionary development standards. Clause 92 of the EP&A Regulation includes a number of additional considerations required under section 4.15(1).

The section 4.15 matters for consideration by the consent authority and where they have been addressed in this EIS are provided in **Appendix 8**. **Sections 7.0** and **8.0** specifically address the likely impacts of the Project and the suitability of the site for the development. **Section 8.0** includes a consideration of the public interest having regard to the results of the impact assessments undertaken for the EIS and the views of stakeholders captured during the engagement processes undertaken during the preparation of the EIS (refer to **Section 6.0**). The consent authority will also be required to have regard to submissions made during the public exhibition period of the EIS.

EIS Requirements

A development application for SSD is to be accompanied by an EIS prepared in accordance with Schedule 2 of the EP&A Regulation. The requirements of Schedule 2 of the EP&A Regulation and where they are addressed in this EIS are also set out in **Appendix 8**.

The EIS has also addressed the SEARs provided for the Project issuedon 7 June 2018 (as amended on 11 July 2018 and 12 August 2019). A copy of the SEARs and checklist of where they have been addressed in the EIS is contained in **Appendix 4**.

Biodiversity Conservation Act requirements

Section 1.7 of the EP&A Act provides that the operation of the EP&A Act is subject to the requirements of Part 7 of the *Biodiversity Conservation Act 2016* (BC Act). Section 7.9 of the BC Act requires that:

- an application for development consent for SSD is to be accompanied by a biodiversity development assessment report (BDAR) unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values, and
- an EIS that accompanies any such application is to include the biodiversity assessment required by the environmental assessment requirements of the Planning Agency Head under the EP&A Act.

Section 7.14 of the BC Act requires the consent authority to take into consideration under that Act the likely impact of the proposed development on biodiversity values as assessed in the biodiversity development assessment report. Section 7.14 also enables the consent authority to grant a development consent subject to the requirement to retire biodiversity credits in accordance with the biodiversity offsets scheme established under the BC Act, however the consent authority also has discretion to consider other mitigation or management options.

A BDAR for the Project, prepared in accordance with the Biodiversity Assessment Method established under the BC Act is included in **Appendix 20**. **Section 7.6** contains a summary of the findings from the BDAR and an assessment of other biodiversity matters identified for consideration by the SEARs.

Fisheries Management Act requirements

Section 1.7 of the EP&A Act provides that the operation of the EP&A Act is subject to the requirements of Part 7A of the Fisheries Management Act 1994 (FM Act). Part 7A, Division 12 of the FM Act contains specific assessment requirements for certain applications under the EP&A Act. These requirements do not extend to SSD applications. Nonetheless, **Section 7.6** includes an assessment of potential impacts on aquatic biodiversity which has had regard to the assessment requirements under sections 220ZZ and 220ZZA of the FM Act.

5.2.2 Other State legislation

The Project will be subject to a number of separate regulatory approval processes, if approved. As an existing operation, a number of these additional approvals are already held, however they will require modification to cover the Project. There are several additional approvals that are also required for the Project.

Due to the Project being SSD, the assessment and approval process for a number of these approvals is aligned with the development application assessment process under Part 4 of the EP&A Act.

5.2.2.1 Approvals legislation to be applied consistently

Section 4.42 of the EP&A Act requires that a number of approvals, if required for a SSD, cannot be refused if a development consent is granted and must be substantially consistent with the terms of any development consent granted for the development. Insofar as these approvals apply to the Project, they are discussed in **Table 5.2** below.

Table 5.2 Approvals that cannot be refused and are to be applied consistently with development consent

Act	Approval	Authority
Coal Mine Subsidence Compensation Act 2017 (CMSC Act)	An approval under section 22 for development within a mine subsidence district. Approval is required for the Hebden Road realignment works and Glendell MIA. The relocation of Ravensworth Homestead, if approved as a mitigation and management measure associated with its removal, may also require approval under section 22 depending on its selected relocation site.	Subsidence Advisory NSW
Mining Act 1992 (Mining Act)	New mining leases are required as part of the Project. This new mining lease(s) will cover the surface areas over the existing CCL 708 and a small area of CL 358 which are currently subject to exploration licences.	Resources Regulator
Protection of the Environment Operations Act 1997 (POEO Act)	Regulates pollution to the environment. Coal mining and coal works are scheduled activities which require licensing. The existing EPL for Glendell (No. 12840) will require a variation to cover changes associated with the Project. The existing EPL for Mount Owen and Ravensworth East (No. 4460) will also require variation to address the changes associated with the Project.	NSW Environment Protection Authority (EPA)
Roads Act 1993 (Roads Act) section 138	A consent is required under section 138 to work on or above a road or to connect a road to a classified road. Consents under section 138 will be required for: • the road works associated with the realignment of the Hebden Road • the connection of access roads off the realigned section of Hebden Road to the new MIA and ancillary pad • the connection of the construction access road to the existing alignment of Hebden Road • construction works associated with the Yorks Creek Realignment under Hebden Road. A consent may also be required under section 138 for ongoing maintenance works on the Yorks Creek Realignment under the bridge where the realigned Hebden Road will cross the realigned creek.	Singleton Council

Under the POEO Act, an EPL is also required for the receival and/or processing of waste. The transfer of tailings between operations for disposal in coal mine voids as part of the GRAWTS is subject to *The coal washery rejects (coal mine void) exemption 2014* Resource Recovery Exemption and *The coal washery rejects (coal mine void) order 2014* Resources Recovery Order issued under clauses 91, 92 and 93 of the *Protection of the Environment Operations (Waste) Regulation 2014*. An EPL is not required for the receipt of coal washery rejects in 'coal mine voids' provided the requirements of the exemption and order are satisfied by both the 'generator' of the tailings waste material and 'consumer'. Disposal of tailings in West Pit currently meets the requirements of these orders. All necessary preconditions to the disposal of tailings in any of the other mining voids approved for the receipt of tailings under the GRAWTS will be obtained prior to disposal in the voids.

The various matters regulated by each of the above approvals are assessed in **Section 7.0**.

5.2.2.2 Approvals Legislation that does not apply

Section 4.41 of the EP&A Act removes the requirement for a number of approvals for approved SSD projects; these approvals are discussed further in **Table 5.3**. While these approvals are not required, the matters of consideration relevant to these approvals is considered as part of the development application assessment process.

Table 5.3 Authorisations which do not apply

Act	Approval	Relevant Project Aspect
Fisheries Management Act 1994 (FM Act)	A permit under section 201 (dredging or reclamation work), section 205 (harming marine vegetation) or section 219 (blocking of fish passage).	The works associated with the Yorks Creek Realignment and the mining through of Swamp Creek and Yorks Creek. Impacts associated with these works are assessed in **Sections 0** and **7.6**
Heritage Act 1977 (Heritage Act)	An approval under Part 4 (effect on interim heritage orders and listing on State Heritage Register), or an excavation permit under section 139 (disturbance or excavation of relic) and Division 8 of Part 6 of the Heritage Act.	The removal of Ravensworth Homestead from its current location and other impacts on heritage items. Impacts and proposed mitigation measures for heritage items are provided in **Section 7.8**
National Parks and Wildlife Act 1974 (NPW Act)	An Aboriginal heritage impact permit under section 90 (Aboriginal Heritage Impact Permit).	Surface disturbing works associated with the Project will impact on a number of Aboriginal sites. Impacts on Aboriginal sites and proposed mitigation measures are considered in **Section 7.7**.
Rural Fires Act 1997	A bushfire safety authority under section 100B (bushfire safety authority).	Aspects of the Project will be undertaken in bushfire prone land as mapped in the Singleton Council Bushfire Prone Land Map (Singleton Council 2013). Refer to **Section 7.14.2** for assessment and proposed mitigation measures.
Water Management Act 2000 (WM Act)	A water use approval under section 89. A water management work approval under section 90. An activity approval (other than an aquifer interference approval) under section 91.	The Project's impacts on water resources are considered in **Section 7.5**.

The various matters regulated by each of the above approvals are assessed in **Section 7.0**.

5.3 Other relevant State approvals

A summary of other relevant environmental and planning approvals that may be required for the Project that are not otherwise subject to sections 4.41 and 4.42 of the EP&A Act are identified and discussed in **Table 5.4**.

Table 5.4 Other State approvals that may be required for the Project

Planning Provision	Comments	Approval Required?
Crown Lands Management Act 2016	The *Crown Lands Management Act 2016* (CLM Act) provides for the administration and management of Crown land in NSW. Crown land may not be occupied, used, sold, leased, licensed, dedicated, reserved or otherwise dealt with unless authorised by the CLM Act. The Minister may grant a 'relevant interest' such as a lease, licence or permit, over Crown land for the purpose of any infrastructure, activity or other purpose that the Minister thinks fit. As part of meeting these requirements, additional steps may need to be taken by the proponent if the land is determined to have environmental, social or cultural value (including Aboriginal heritage value). There is a small parcel of Crown land located within the Glendell Pit Extension.	Yes
Dams Safety Act 2015	The *Dams Safety Act 2015* requires that Dam Safety NSW ensure that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community. Dams Safety NSW may, by order published in the Gazette, declare a dam or proposed dam to be a declared dam for the purposes of this Act. There are several prescribed dams at the Mount Owen Complex associated with tailings storage. **Sections 0** and **7.14** consider the Project's potential to impact on these facilities. Any dams required to be constructed as part of the Project will be subject to assessment in accordance with the Dam Safety NSW requirements to determine if any of these dams will be declared dams. It is unlikely that any dams constructed or altered as part of the Project will require licensing under the Dams Safety Act.	No
Explosives Act 2003	A licence is required for the storage of explosives on site. This Act is administered by SafeWork NSW. The relevant licences are in place for the possession and storage of explosives at Glendell Mine. The locations of the magazine(s) used to store explosives at Glendell may be revised as part of, and during the Project and this would likely require amendments to the existing licences. This is discussed in further detail in **Section 7.15.1**.	Yes
Environmentally Hazardous Chemicals Act 1985	Under the *Environmentally Hazardous Chemicals Act 1985* a licence is required for any storage, transport or use of prescribed chemicals. Should such a licence be required under this Act during the life of the Project, Glencore or the relevant contractor will obtain a licence prior to the storage, transport or use of prescribed chemicals.	If required
Local Government Act 1993	Approval under section 68 is required to operate a system of sewerage management at the new MIA.	Singleton Council

Planning Provision	Comments	Approval Required?
Water Management Act 2000	All water extractions (take) from water sources (surface and groundwater) regulated by a Water Sharing Plan (WSP) will require licensing under the WM Act where they are in addition to extractions permitted under harvestable rights or other exemptions from licensing. The licensing requirements for the Project are discussed in **Section 7.5**.	Yes

Singleton Council will also need to close the existing alignment of Hebden Road following the commissioning of the new alignment. The process for road closure is regulated by Part 4 of the Roads Act.

Glencore has undertaken consultation with the Singleton Council regarding the Hebden Road realignment design and the closure of the bypassed sections. As part of the road closure process, Glencore will arrange the survey and subdivision of the new road realignment and the transfer of this land to Singleton Council. It is expected that the land transfer process would involve a land swap in relation to the bypassed section of road.

5.4 Commonwealth legislation

The EPBC Act is the primary environmental and planning regulatory instrument relevant to the Project at a Commonwealth level. The operation of the EPBC Act and its application to the Project is discussed in **Section 5.4.1**.

5.4.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on a Commonwealth Matter of National Environmental Significance (MNES).

Existing EPBC Act approvals and previous referrals submitted for the approved operations at the Mount Owen Complex are outlined in **Section 2.2.4**.

Approval under Part 9 of the EPBC Act is required for actions that may result in a significant impact on MNES. The aspects of the Project that are not already approved under the Mount Owen Consent, Glendell Consent or Narama Pipeline Consent (the Referred Project) were referred to the Commonwealth Minister for the Environment on 10 April 2019 (EPBC Act referral 2019/8409). The Referred Project was declared to be a controlled action under the EPBC Act on 10 July 2019 in relation to its potential impacts on the following MNES:

- listed threatened species and communities (sections 18 & 18A EPBC Act) and
- a water resource, in relation to coal seam gas development and large coal mining development (sections 240 & 24E EPBC Act)

A copy of the determination of the Referred Project as a Controlled Action is provided in **Appendix 4**. Attachment 4 of the SEARs includes 'general assessment requirements' for the assessment of potential impacts on the MNES likely or potentially significantly impacted by the Referred Project. These requirements, and where they are addressed in the EIS, are set out in **Appendix 8**.

Appendix 10 contains an assessment of the Referred Project's potential impacts on water resources and an assessment of biodiversity issues relating to MNES, with a summary of these assessment findings included in **Section 7.5** and **Section 7.6** respectively.

5.4.2 Native Title

The Project includes development on a relatively small parcel of land that is Crown land. Native Title has been extinguished on all areas of Crown land that will require a mining lease under the Mining Act or other approval. The provisions of the *Native Title Act 1993* therefore have no application to the Project.

5.4.3 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

On 7 November 2018 a written application seeking declarations under sections 9 and 10 of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIHP Act) to protect and preserve an area described as the 'Ravensworth Estate Homestead Complex and Surrounds' on the basis of its Aboriginal significance was submitted by Mr David Shoebridge MLC on behalf of representatives of the Plains Clans of the Wonnarua People. Section 9 of the ATSIHP Act provides emergency protection to sites of Aboriginal significance considered under immediate threat of injury or desecration, whilst section 10 of the ATSIHP Act provides long term preservation and protection to sites of Aboriginal significance.

Assessment of the declaration under section 9 of the ATSIHP Act followed DoEE internal processes with Glencore providing further details on the works the subject of the application at DoEEs request on 27 August 2019.

Under section 10 of the ATSIHP Act, the Minister for the Environment (Australia) appointed a Reporter to review the application. On 14 June 2019 (and updated on 22 July 2019), public notices were published in the Australian Government Gazette inviting interested persons to make representations in relation to the application and representations were submitted on 21 August 2019.

On 6 September 2019, the applicant withdrew the application prior to a determination being made under either section of the ATSIHP Act.

SECTION 6.0

Stakeholder Consultation and Identification of Environmental and Community Issues

6.0 Stakeholder consultation and identification of environmental and community issues

Mining operations at the Glendell Mine were approved in 1983 and were integrated with the Mount Owen Complex in 2008. As part of the approval process and throughout the operational period of the Mount Owen Complex over this time, the community have been actively engaged through a range of different mechanisms. Their input, key concerns and issues have been considered and addressed through operational changes, implementation of targeted mitigation strategies and during the planning, design and approval phases of recent projects at the Mount Owen Complex. Most recently, this has included the Mount Owen Continued Operations Project and subsequent modifications, Glendell Mine modifications, and the proposed Project.

The long period of active mining and extensive community engagement associated with the Mount Owen Complex over time has resulted in the local community generally having a good understanding of mining and its associated impacts and acknowledgement of the management practices adopted by Glencore to minimise disruption and to keep the community well-informed. Further, the Project Area is in a location that is surrounded by existing mining operations (refer to **Figure 1.2**), where residences have active or previous mining located between their properties and the proposed Glendell Pit Extension.

The key community issues that have been raised historically through previous engagement on projects include concerns regarding air quality, noise impacts, blasting, cultural heritage, visual amenity, traffic and transport, biodiversity, final voids and rehabilitation.

Over the years of operation at Mount Owen Complex, and recent years of planning for the Project, Glencore has worked to put in place a range of strategies, management and mitigation measures to address these key issues. These considerations are fundamental to the overall design of the mine with mine planning considering air quality, noise, visual, biodiversity, water and other impacts as key design parameters in seeking to minimise the impact of the mine on the environment and community.

Ongoing implementation of mitigation measures is also a key component of existing operations. These measures work in partnership with the mine planning process to minimise impacts. Existing and ongoing community engagement at the Mount Owen Complex is discussed further in **Section 6.3**.

6.1 Project engagement approach

Engagement has been an integral part of the Project and a comprehensive stakeholder engagement program has been implemented. This strategy considers the International Association of Public Participation (IAP2) engagement spectrum in selecting engagement mechanisms to involve key stakeholders and the community in project planning and assessment. The strategy articulates the level of participation afforded to community members by mechanism e.g. inform, consult, involve, collaborate and empower.

Given that the Mount Owen Complex is a well-established operation, and relationships with the community have been developed over time, the engagement approach adopted for the current assessment also builds on existing relationships and activities. The aims of the engagement program for the Project were to:

- adopt a proactive approach to engagement with the community

- be open and transparent in dealings with the community
- provide meaningful and relevant information on the Project
- utilise a range of existing and additional engagement methods so that all stakeholders have an opportunity to participate
- identify community issues and opportunities in relation to the Project to proactively inform project planning and assessment
- provide opportunities for stakeholder input throughout the assessment process, including input on proposed management measures to reduce negative and enhance positive Project impacts.

While certain engagement mechanisms have been undertaken jointly with Glencore; further independent engagement has also been undertaken by members of the Umwelt team, to ensure independence and impartiality in the development of the Social Impact Assessment (SIA) for the Project.

The engagement program commenced early during the planning phases of the Project and has continued throughout the Project design and assessment phases as outlined in **Table 6.1**. The outcomes of the program have provided Glencore with valuable input from key stakeholders and local residents with regard to the impacts of current operations, as well as identifying any perceived impacts associated with the Project. Key stakeholders include near neighbours, community members, Aboriginal stakeholders and individuals and groups with an interest in heritage. Further details on the engagement methods undertaken and stakeholders consulted across the assessment phases are outlined in the following sections, with a summary of the issues raised by stakeholders included in **Section 7.16**

In summary, the engagement program has involved a range of mechanisms, implemented to facilitate engagement and participation of differing stakeholders at the varying phases of the environmental assessment program; both central to the SIA for the Project and the broader environmental assessment program. Outputs of this engagement has been used to inform different aspects of the Project's environmental assessment process, which includes the SIA. The SIA is included as **Appendix 11** and is discussed further in **Section 7.16**.

Table 6.1 Summary of Social Assessment Phases and Stakeholder Engagement

Assessment Method	Description
Phase 1 – Program Planning	Review of previous SIA studies and development of a tailored Stakeholder Engagement Strategy for the Project. This strategy was informed by previous consultation activities, including the engagement and analysis undertaken for the previous SIAs completed for the Mount Owen Complex and the Preliminary Social Impact and Opportunities Assessment for the Project's Preliminary Environmental Assessment (PEA) (Umwelt 2018).
Phase 2 - Community Profiling	Assessment and analysis of census data and other relevant social and community indicators to develop a detailed social profile of the communities of interest. Documentation of social and economic linkages/associations between the Glendell Mine and communities within the region through analysis of workforce and supplier data and community investment data analysis.
Phase 3 – Scoping of Issues and Opportunities	Review and analysis of historical stakeholder consultation outcomes and complaints data for Glendell Mine to obtain an understanding of perceived issues and opportunities. Primary data collection through stakeholder interviews, and local landholder gatherings, to understand historical, existing and emerging issues and opportunities within the community, followed by ranking of perceived issues and opportunities relative to their frequency. Provision of a Community Information Sheets outlining the Project (No.1) and the Homestead relocation investigations and process (No. 2).

Assessment Method	Description
Phase 4 – Assessment of Impacts and Opportunities	Prediction of unmitigated and mitigated social risks/impacts associated with the Project through review of relevant social and environmental consequence and likelihood ratings. Further round of personal and telephone interviews with near neighbours of the Project to further identify perceived issues and opportunities relating to the Project, in light of the outcomes of the technical assessments. Local landholder Information Sessions at Hebden and Middle Falbrook areas to allow input from near neighbours and 3 advertised Information Sessions in Singleton and Broke to seek feedback from the broader community on the impacts and opportunities relating to the Project. Targeted briefings with stakeholder groups to provide feedback on the outcomes of key assessment studies. Provision of a dedicated Community Information Sheet (No.3) summarising the key outcomes of the assessment studies and proposed mitigations and enhancements.
Phase 5 – Prediction of Impact and Strategy Development	Categorisation of impacts by social impact category and theme, followed by identification and development of appropriate strategies to address predicted Project impacts. Minimisation of high and moderate social impacts through commitment to relevant management strategies and enhancement of positive impacts associated with the Project.

6.2 Stakeholder groups

A comprehensive stakeholder identification process was undertaken at the commencement of the Project planning phase and a broad range of stakeholder groups have been consulted throughout the planning and assessment phases of the Project (refer to **Figure 6.2.1**). As Burdge (2004) outlines, stakeholders may be affected groups or individuals that:

- live nearby the mine/project
- have an interest in the proposed action or change
- use or value a resource
- are interested in its use
- may be forced to relocate residence as a result of the project.

Figure 6.2.1 Stakeholder Groups Consulted

6.3 Existing company engagement

The Mount Owen Complex has an ongoing community engagement program which involves a range of information provision and engagement mechanisms that include:

- meetings, briefings and telephone liaison
- community consultative committee (CCC) meetings
- newsletters and fact sheets
- a community complaints line
- company website.

The objectives of the broader stakeholder engagement strategy for the Mount Owen Complex are to build and maintain effective relationships with stakeholders, engage with near neighbours and communities, invest in local communities, meet the requirements of the Glencore Community and Stakeholder Engagement Standard and assist to maintain the company's 'social licence to operate'.

Glencore has established relationships with the local community and other stakeholders and has implemented a program for ongoing engagement regarding its existing mining operations. As shown in **Table 6.2**, the program has included regular consultation with both individuals and groups from the local community, via a range of mechanisms including:

- personal meetings with individuals and/or groups (as required/requested), including meetings in response to specific complaints

- regular meetings (at least 2 meetings per year) with the Mount Owen Complex and Integra Underground CCC. The CCC is made up of community representatives, Singleton Council representative, Mount Owen representatives, Integra representatives, Thiess representatives, State government agency representative/s
- newsletters (2 per year) to update the community on the existing operations and Mount Owen Complex initiatives, which is incorporated into the Greater Ravensworth Newsletter
- stakeholder meetings and briefings e.g. community groups, local and state government
- a community complaints line and maintenance of an ongoing complaints register to record all community complaints, investigations and outcomes
- ongoing email and telephone correspondence with stakeholders
- a company website.

Through implementation of this program, Glencore has developed a good understanding of key community issues in relation to their mining activities, to be considered in planning for the Project.

Outputs of the previous consultation activities have therefore been used to inform planning and the development of the specific stakeholder and community engagement program for the Project. **Table 6.2** provides a concise summary of all stakeholder engagement currently undertaken at the Mount Owen Complex.

Table 6.2 Mount Owen Complex Stakeholder Engagement Initiatives

Consultation Target	Engagement Method/Strategy	Description	IAP2 Spectrum Goal/ Objective
Personal/ Property Specific	Personal Meetings	Meetings with stakeholders at their residence (or common meeting area), providing personalised opportunities for engagement and provision of detailed information specific to private landholders.	Consult Involve
	Letter Box Drops	Information delivered by the Mount Owen Complex so that specific information reaches intended recipients.	Inform
	Contact Phone Numbers	All stakeholders provided with a direct line to project team members for any queries or information requests.	Consult
Personal/ Property Specific cont.	Newsletter	A biannual newsletter (the Greater Ravensworth Newsletter) has been delivered to key stakeholders and is also made available on the company website, outlining project planning updates community investment initiatives, rehabilitation and land management activities.	Inform
	Mount Owen Complex Website	Website material updated regularly providing information pertaining to the Mount Owen Complex operations, including project updates, community investment, environmental management and monitoring results, newsletters, fact sheets and contact information.	Inform

Consultation Target	Engagement Method/Strategy	Description	IAP2 Spectrum Goal/ Objective
	Consultation Database	Consultation database used to capture issues and consultation interactions between the Mount Owen Complex personnel and stakeholders.	Consult
	Aboriginal Cultural Heritage Working Group	Aboriginal Cultural Heritage Working Group meetings held bi-annually involving indigenous stakeholders and an annual open day which all Registered Aboriginal Parties are invited to.	Collaborate
Broader Community	Glencore Perception Survey	Community survey undertaken every 3 years in neighbouring and regional communities proximal to Glencore's operations in NSW and QLD, with the purpose of providing Glencore with a greater understanding of stakeholder issues and needs relating to company activities, past and present; and to assist in driving business improvement in the areas of environmental performance, stakeholder engagement and community development. Latest survey undertaken in July and August 2018.	Involve
	Community Consultative Committee	The CCC provides a means for open discussion between Mount Owen Complex representatives, the community, Singleton Council and other stakeholders. The CCC meet twice yearly to review ongoing mining operations, discuss community concerns and work together towards equally beneficial outcomes for the local community and the company.	Collaborate
	Blasting Notification Register	Registered stakeholders are sent notifications of impending blasts. Stakeholders are required to call Mount Owen Complex directly to be added to the register.	Inform
	Community Response Line	24 hour freecall line with professional answering service is in place for community enquiries or complaints relating to the Mount Owen Complex.	Inform
	Blasting Hotline	Blasting Hotline provides access to a recorded message communicating upcoming blasts, updated daily when blasting occurs.	
	Site Tours	Glencore participates in the Upper Hunter Mining Dialogue's School Mine Tours Program which offers free tours to all schools in the Singleton-Muswellbrook educational catchment.	Involve

Consultation Target	Engagement Method/Strategy	Description	IAP2 Spectrum Goal/ Objective
Community Development Program	Community Development Program Initiatives	Glencore supports a range of initiatives at a local community level. Such initiatives in 2019 included: • Mt Pleasant School - Education Support Program, School Enhancement, and school based program with environmental/ biodiversity values • Singleton Public School capacity building fundraising event • Hebden Community Hall solar panel installation • Rural Fire Service support • Police Citizens Youth Club support • Wildlife Aid support • Life Line support • Samaritans Singleton Christmas lunch • Fundraising event for Maitland Community Preschool • Sponsorship for Team McInerney's participation in the Cancer Council's Annual Relay for Life Fundraiser • Singleton Annual Rugby League Charity Game for the Westpac Rescue Helicopter Service • Soft Cogs Charity Bike Ride for Multiple Sclerosis Australia	Collaborate
Specific Engagement relating to Environmental Management	Mitigation Measures	Consultation with landowners afforded mitigation rights, for example: • Property inspections to establish baseline conditions • Water tank cleaning • Air quality and/or noise measures e.g. double glazing, air filters, air conditioning, insulation etc.	Involve

6.3.1 Glencore perception survey

As noted above, Glencore undertakes a community perception survey, every 3 years, across the mining regions in which it operates, in NSW and Queensland. Telephone interviews/surveys and online surveys are undertaken with near neighbours and key stakeholders; with random telephone surveys also undertaken within the localities in which Glencore is based, to identify and track community attitudes and perceptions in relation to their operations. The most recent of these surveys was undertaken by Umwelt in July to August 2018, to build upon previous surveys implemented since 2010.

The survey affords the tracking of a number of key indicators relating to the company's social and environmental performance and provides evaluation of the approach's operations have adopted in relation to stakeholder engagement and consultation. In the most recent survey, a sample of 51 near neighbours and opinion leaders (community groups, local business, Indigenous groups, State and local government representatives) were surveyed with 196 individual community members residing in the Singleton LGA also randomly sampled.

Although not conducted specifically as a part of the engagement program for the Project, the survey has identified community perceptions of Glencore operations in the wider Singleton LGA (and the Hunter Valley more broadly) and has involved near neighbours and key stakeholders relevant to the Mount Owen Complex operations. A summary of outcomes of the survey relevant to the current assessment is provided at **Section 7.16** with further details provided in **Appendix 11**.

6.4 Project engagement - social impact assessment

As has been noted earlier in this section, specific engagement with key stakeholders has been undertaken to inform both the SIA and EIS programs for the Project (refer to **Section 7.16** and **Appendix 11**). SIA is an approach to predicting and assessing the likely consequences of a proposed action in social terms and developing options and opportunities to improve social outcomes. Best practice SIA is participatory and involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense, to provide a complete picture of potential impacts, their context and meaning. Given the established nature of the operation in the community, the engagement for the SIA has built upon, where relevant, existing engagement approaches at Mount Owen Complex, to identify the social impacts relating to the Project.

The generally agreed international principles relating to SIA (Vanclay, 2003) and DPE's Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DPE, 2017) (the SIA Guideline) identify social impacts as the matters affecting, directly or indirectly:

- people's way of life, that is: how they live, work, play and interact with one another on a day to day basis
- the community, that is: its cohesion, stability, character, services and facilities
- access to and use of infrastructure, services and facilities, whether provided by local, State, or Commonwealth governments, or by for-profit or not-for-profit organisations or volunteer groups
- their culture, that is: their shared beliefs, customs, values and language or dialect
- their health and wellbeing: health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity
- their surroundings, such as: the quality of the air and water people use, the availability and quality of the food they eat, the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources
- their personal and property rights, particularly whether people are economically affected or experience personal disadvantage which may include a violation of their civil liberties
- their political and decision-making system, such as the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose
- their fears and aspirations, that is: their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

Table 6.3 provides a concise summary of the stakeholders consulted as part of the SIA including key stakeholders and the wider Singleton LGA community used for each stakeholder group.

Table 6.3 Participants in the SIA Community Engagement Program – Rounds 1 and 2

Stakeholder	Description	Number of participants (Round 1)	Number of participants (Round 2)
Key Stakeholders			
Near neighbours	Landholders including residents and businesses in proximity to the current mining operation including the localities of Camberwell, Middle Falbrook, Falbrook, Glennies Creek and Hebden	37 structured interviews (including 5 local businesses)	37 structured interviews 26 attendees across 2 local community information sessions in Hedben and Middle Falbrook
Aboriginal stakeholders	Aboriginal community service providers. Participants included: • Plains Clan of the Wonnarua People (PCWP) • Ungooroo Aboriginal Corporation • Wanaruah Local Aboriginal Land Council (WLALC) • Wonnarua Nation Aboriginal Corporation (WNAC)	4 structured interviews	18 structured interviews
Community and heritage stakeholders and group representatives	Including community groups and individuals associated with the area with a specific interest in heritage aspects of the Project, emergency services and service providers. Participants included: • Members of the Ravensworth Homestead Advisory Committee (RHAC) • Individuals with a specific interest in heritage • Singleton Historical Society and Museum • Singleton Heritage Advisory Committee • Past owners of the Ravensworth Homestead • Emergency services, local bus company and local halls (Hebden Hall and Mount Olive)	13 structured interviews Focus group with 6 members of the RHAC	12 structured interviews

Stakeholder	Description	Number of participants (Round 1)	Number of participants (Round 2)
Wider Singleton LGA Community			
Wider community	Singleton LGA residential and business community.	7 members of the Singleton Business Chamber	Random sample of residents in the Singleton LGA contacted via a random telephone survey ((n=251 from the Singleton Local Government Area and n=22 from the Broke & surrounds community, with a total of n=273). 34 attendees across the 3 wider community information sessions (CIS) held at the Singleton Youth Venue on 18 and 21 September (n=2 attendees), and Broke Hall on 19 September (n=32 attendees).
Workforce and Suppliers	Glendell workforce and those who supply services to the Glendell Mine.	NA	132 suppliers completed a structured survey. Existing workforce data was provided by the Glendell Mine.
Total		**67**	**532**

6.5 Project engagement – Environmental impact assessment

In addition to the engagement as part of the SIA, further engagement has been undertaken with stakeholders including Registered Aboriginal Parties and Knowledge Holders, government agencies and service providers, to inform the broader environmental assessment program. A summary of engagement with these stakeholders is provided in the subsections below.

6.5.1 Aboriginal community engagement

A comprehensive engagement process was undertaken with the Aboriginal community regarding the Project in accordance with:

- the National Parks and Wildlife Act 1974 (NPW Act)
- the National Parks and Wildlife Regulation 2009 (NPW Regulation)
- relevant OEH guidelines (including the Department of Environment and Conservation (DEC, now BCD) 2005 Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment
- Department of Environment, Climate Change and Water (DECCW, now OEH) Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010
- the principles of The Burra Charter (Australia ICOMOS 1999)

Throughout the course of the Project, consultation for the purposes of assessing cultural heritage aspects was undertaken with 32 Registered Aboriginal parties (RAPs) who registered an interest in the Project. Further discussion regarding the consultation process with the RAPs for the Project is included in **Section 7.7** and **Appendix 22**.

As noted in **Table 6.3** engagement with Aboriginal stakeholders and service providers was also undertaken as part of the SIA for the Project and outcomes are included in **Section 7.16** and **Appendix 11**. There were 16 Indigenous stakeholders engaged as a part of the SIA program including representatives from the Wanaruah Local Aboriginal Land Council and other service providers.

6.5.2 Agency/authority consultation

Throughout the Project, there has been ongoing consultation with both local and State government representatives that has included:

- government agency briefings outlining Project details, design and strategies to reduce impacts
- meetings with relevant agencies to discuss the assessment approach, assessment outcomes, approach to management, mitigation and offset measures and to address issues specific to the respective agency.

Further details regarding agency consultation are provided in the sections below.

6.5.2.1 Singleton Council

Glencore has met with a range of representatives from Singleton Council including relevant staff and the elected councillors. Briefings have included coverage of the following topics:

- Project overview, key impact areas and mitigation strategy
- relocation of Ravensworth Homestead

- Voluntary Planning Agreement (VPA)
- roads and traffic with specific discussion on the proposed realignment of Hebden Road
- Yorks Creek Realignment.

A summary of these meetings is provided in **Table 6.4**.

Table 6.4 Consultation with Singleton Council

Date	Engagement Mechanism	Purpose
28 June 2017	Meeting	Meeting to introduce the Project and discuss proposed approach to development of a relocation strategy for Ravensworth Homestead.
18 December 2017	Meeting	Introduction of the Project to Singleton Mayor and Councillors including discussion of the Ravensworth Homestead Advisory Committee formed by Glencore.
10 April 2018	Meeting	Meeting to provide updates on the refinements made to the Project and advise of PEA lodgement planned for April 2018.
7 February 2019	Meeting/Site Visit	Site visit to Homestead and Project Area and meeting to provide an overview of the Project and summary of heritage studies being completed for the Project.
26 February 2019	Meeting	Meeting to discuss proposal to realign a portion of Hebden Road as part of the Project.
13 August 2019	Meeting	Initial discussion on Project VPA.
23 August 2019	Presentation	Presentation to Singleton Heritage Advisory Committee on the outcomes of heritage studies regarding the Ravensworth Homestead.

6.5.2.2 State and Commonwealth government agencies

A summary of the government agency consultation undertaken to date is included in **Table 6.5**. Consultation with State and Commonwealth government agencies has been undertaken through various mechanisms throughout the assessment process to keep agencies informed of progress and outcomes of the Project.

Table 6.5 Consultation with Agencies and Authorities

Stakeholder	Consultation
State Government Agencies/Authorities	
DPIE (formerly DPE)	14 November 2017 – Meeting (Sydney) – Project introduction 4 December 2017 – Site visit 14 March 2018 – Meeting (Sydney) – Project update, including SIA scoping discussion 5 July 2018 – Site visit 10 January 2019 – Meeting (Sydney) – Project update 27 May 2019 – Meeting (Sydney) – Project update

Stakeholder	Consultation
Heritage Branch of the Department of Premier and Cabinet (formerly OEH Heritage Branch)	14 March 2018 – Meeting (Parramatta) – Project introduction 26 September 2018 – Meeting (Parramatta) – Discussion on Historic Archaeology Research Design 7 February 2019 – Site visit by Heritage Branch
Heritage Council	5 December 2018 – Meeting (Sydney) – Project introduction and overview of heritage investigations undertaken to date 28 August 2019 – Meeting (Sydney) – Outcomes of assessment and proposed relocation options
Biodiversity and Conservation Division (BCD) within DPIE (formerly OEH)	20 December 2018 – Meeting (Newcastle) – Project introduction and overview of biodiversity fieldwork completed to date 24 January 2019 – Meeting (Newcastle) – Discussion Category 1-exempt land mapping and Project biodiversity assessment methodology
Environment Protection Authority	Offer of Project briefing
Division of Resources and Geoscience (DRG) and Resources Regulator within DPIE	24 Oct 2018 – Meeting (Maitland) – Project and tenement update 15 November 2019 – Meeting (Maitland) – Project update and discussion on final landform
Water Group within DPIE (formerly Crown Lands Water Division)	24 May 2018 – Meeting (Sydney) – Project introduction, discussion on approach to water resources assessment and water licences 8 August 2018 – Site visit
Forestry Corporation of NSW	17 May 2018 – Meeting (Wauchope) – Project introduction
Department of Primary Industries – Forestry, Agriculture and Fisheries branches	Offer of Project Briefing
Crown Lands Group within DPIE	Offer of Project Briefing
Roads and Maritime Services (RMS)	10 October 2019 – Meeting – Project overview and discussion on outcomes of assessments with regard to RMS assets
Rural Fire Services	Offer of Project Briefing
Dams Safety Committee	Offer of Project Briefing
Singleton Local Land Services	Offer of Project Briefing
Hunter New England Population Health	Offer of Project Briefing
Subsidence Advisory NSW	Offer of Project Briefing
Transport for NSW	Offer of Project Briefing
Commonwealth Government Agencies	
Department of the Environment and Energy	8 December 2017 – Meeting (Canberra) – Project introduction 23 Oct 2018 – Meeting (Canberra) – Project update 24 June 2019 – Site visit

6.5.3 Infrastructure/service provider consultation

Service providers that have infrastructure located within the Project Area, or who may provide services for the Project, have been consulted by Glencore during the project design and environmental assessment process. Consultation has been undertaken with these service providers so that relevant design or management issues could be identified and addressed through Project design.

Service providers consulted include Ausgrid and Telstra as well as Australian Rail Track Corporation Ltd (ARTC) and the Hunter Valley Coal Chain Coordinator with regard to the continued operation of the rail loadout facility and transport of coal to the Port of Newcastle. Further consultation will be required with these asset owners and managers as part of the detailed engineering design and implementation phases of the Project.

6.6 Ravensworth Homestead engagement

As outlined in **Section 3.2.9**, the Project proposes the relocation of Ravensworth Homestead.

Glencore has undertaken an extensive process to identify and assess relocation options with the relocation philosophy and the process adopted for selecting the preferred Ravensworth Homestead relocation options involving the Ravensworth Homestead Advisory Committee (RHAC).

The engagement strategy has involved the following key components:

- establishment of the RHAC to assist in the investigation and assessment of relocation options of the Homestead
- identification of key considerations and issues, including key values associated with the Homestead, through involvement of the RHAC, assistance of technical specialists and community consultation
- media release seeking ideas, from the broader Singleton community, for options for relocation sites or ideas for proposed end use
- consultation with stakeholders who made a submission for the relocation of the Homestead to further investigate the feasibility of these options
- involvement of the RHAC in assessing each of the proposed options for relocation, including consideration of stakeholder submissions and alignment of each option with key considerations developed through the group process e.g. retention of heritage fabric, geographic placement, access, community benefit
- involvement of the RHAC in assessing the proposed Homestead relocation sites based on their key considerations
- discussions with stakeholders, with an interest in heritage issues, and the wider Singleton community regarding the proposed relocation options.

The involvement of the RHAC, and consultation with stakeholders with an interest in heritage issues and the wider Singleton community, has been an integral part of the process of identifying and assessing potential Homestead relocation options. This involvement is represented in **Figure 6.6.1** which illustrates the extensive process Glencore, with the assistance of the RHAC and specialist heritage consultants, and involvement of the Singleton community, has undertaken to identify viable options for the relocation of the Ravensworth Homestead.

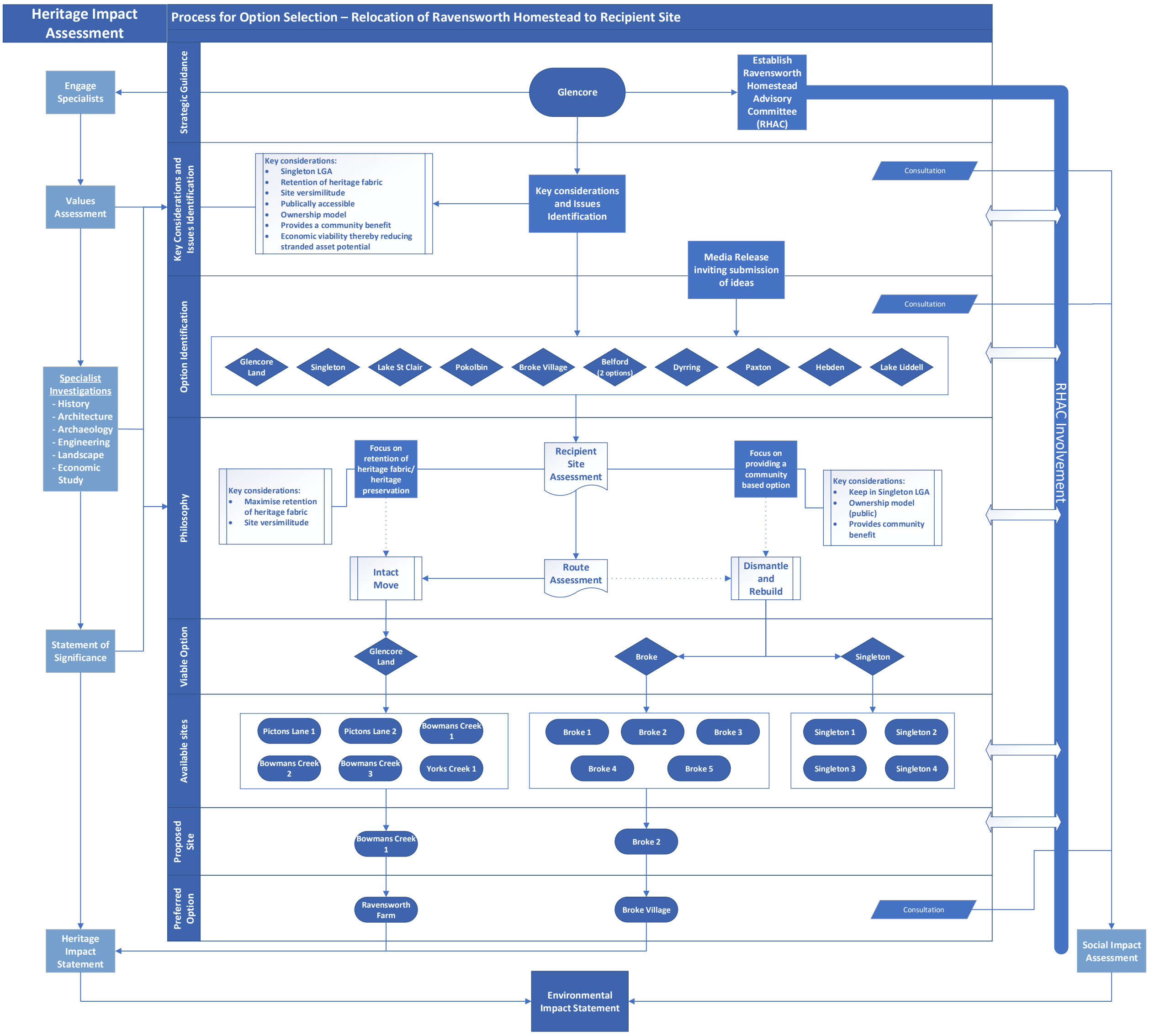


Figure 6.6.1 Process for Selection of Preferred Ravensworth Homestead Relocation Options

6.6.1 Ravensworth Homestead Advisory Committee

In the early planning phases of the Project, Glencore identified the potential for the Ravensworth Homestead to be considered as having significant heritage values, notwithstanding being listed as an item of local heritage significance under the Singleton LEP. Due to its significance, the need for a robust process of analysis to understand appropriate methods of relocation and final end-use, whilst considering the heritage values of the Homestead, was required.

Glencore established the RHAC in October to November 2017, as part of the stakeholder engagement and consultation strategy for the Project. The intent of the committee was to assist with the identification and consideration of relocation options for the Ravensworth Homestead Complex to preserve its heritage value, whilst also providing an end use that was economically viable and which afforded ongoing public access.

The RHAC was facilitated by an independent chair and comprises representatives from the local community, and Singleton's business and heritage sectors. The RHAC membership consisted of:

- Mrs Lindy Hyam, Independent Chair

- Ms Susan Gilroy, President of Singleton Business Chamber
- Dr Cameron Archer, former Principal of Tocal College,
- Mrs Jenny Marshall, former owner of Ravensworth Homestead
- Mr Geoff Marshall, former owner of Ravensworth Homestead
- Mrs Peggy Moore, President of Singleton Historical Society and Museum Inc
- Mr Graeme Cheetham, resident of Middle Falbrook
- Mr David Williams, former resident of Hebden

Singleton Council, the Singleton (Council) Heritage Advisory Committee, and Arts Upper Hunter were also approached seeking representation on the committee, however these organisations declined to nominate a representative.

As discussed in **Section 6.6**, the RHAC was involved in all phases and met on a regular basis to bring ideas to the table for consideration, with involvement of the RHAC members, Glencore Project team members; Shane Scott and Bradly Snedden. Dr Sheridan Coakes, Social Practice Lead, Umwelt has also attended several meetings to ensure integration with the broader SIA program. Other stakeholders were also invited to present at the committee meetings, as relevant, to facilitate information sharing. These meetings are summarised in **Table 6.6** below.

Table 6.6 Summary of RHAC meetings

Meeting No.	Date	Key Agenda Items
RHAC Meeting #1	7 December 2017	Overview of Project, purpose of the RHAC, brief history and site inspection of the Homestead, values mapping and issue identification.
RHAC Meeting #2	17 January 2018	Presentation by Scott Franks of the Plains Clan of the Wonnarua People. Presentation by Tim Duddy, Chair of Historic Houses Association of Australia. Issue identification, next steps in engagement process.
RHAC Meeting #3	31 January 2018	RHAC inspection of Tocal, outcomes of committee members values identification process, site selection options, engagement and briefing process.
RHAC Meeting #4	15 February 2018	Inspection of potential recipient sites, option assessment criteria and identification, process review and review of engagement process.
RHAC Meeting #5	15 March 2018	Update on values mapping, committee members feedback on submissions and site visits and studies being undertaken, option assessment criteria, process review and review of engagement process.
RHAC Meeting #6	24 April 2018	Update on engagement/consultation and heritage studies including building move feasibility assessment, route study and commercial modelling.
RHAC Meeting #7	22 June 2018	Inspection of recipient sites, update on engagement and reports and any committee members feedback on site visits.

Meeting No.	Date	Key Agenda Items
RHAC Meeting #8	16 August 2018	Update on engagement/consultation and heritage studies including route assessment, architectural recording of buildings, historical investigations and completion of commercial modelling.
RHAC Meeting #9	3 October 2018	Inspection of potential recipient sites in Broke Village, update on engagement and heritage studies including outcomes of route study and breaking of buildings to facilitate move further afield, presented preliminary outcomes of heritage consultant significance assessment – architectural, short-listing of options.
RHAC Meeting #10	1 November 2018	Update on engagement and heritage studies including progress of archaeological investigation and further detailed route study by building mover, heritage consultant feedback provided on potential recipient sites.
RHAC Meeting #11	18 December 2018	Presentation by heritage consultant on recipient sites, presentation by Glencore on route study, update on engagement and reports and any committee members feedback on site visits, heritage studies update, short-listed options.
RHAC Meeting #12	2 June 2018	Update on engagement and heritage studies including historical research, significance assessment and archaeology investigations, relocation studies and heritage studies update, outcomes of Glencore option review.
RHAC Meeting #13	3 July 2019	Update on engagement and heritage studies including historical research, significance assessment and archaeology investigations. Presented outcomes of assessment involving relocation of Main House to Singleton Showground – RHAC agreed not to pursue option further given presence of other heritage and minimal land availability. RHAC endorsed both Ravensworth Farm and Broke Village relocation options.
RHAC Meeting #14	27 November 2019	Final review of proposed relocation options against RHAC key considerations and committee Terms of Reference Present outcomes of Project consultation Committee close

Further detail on the RHAC and its involvement in the assessment process is provided in **Section 7.8**.

6.6.2 Heritage Branch of the Department of Premier and Cabinet and NSW Heritage Council

Glencore have consulted with the Heritage Branch of the Department of Premier and Cabinet (formerly OEH Heritage Division) and the NSW Heritage Council throughout the Project assessment process in regard to the Ravensworth Homestead Complex. A summary of this consultation is provided in **Table 6.5**.

6.7 Stakeholder issues

As described in **Section 6.5.2,** consultation has also been undertaken with local, State and Commonwealth government agencies so that relevant environmental, social and economic issues could be identified and assessed as part of the EIS process. This consultation builds on the input, to the SEARs, provided by these agencies. The key issues raised during this consultation are summarised in **Table 6.7**.

6.7.1 Agency/authority issues

Table 6.7 Key Issues

Stakeholder	Key Topics/Issues Raised
Local and State Government Agencies	
Singleton Council	• Input provided to the SEARs • Relocation of Ravensworth Homestead • Realignment of Yorks Creek • Hebden Road realignment • Temporary closures of Hebden Road due to blasting • Singleton Council involvement in Safety In Design workshops similar to completed for overpass for the recent Mount Owen Continued Operations Project
DPIE (formerly DPE)	• Assessment requirements and approvals process for the Project • Social impacts • Final landform considerations
Biodiversity and Conservation Division (BCD) within DPIE (formerly OEH)	• Input provided to the SEARs • Ravensworth Homestead • Biodiversity assessment requirements and approach
Environment Protection Authority	• Input provided to the SEARs; no additional issues raised
Division of Resources and Geoscience (DRG) and Resources Regulator within DPIE	• Input provided to the SEARs; no additional issues raised
Department of Primary Industries - DPI Water	• Input provided to the SEARs; no additional issues raised
Department of Primary Industries - NSW Forestry	• Input provided to the SEARs; no additional issues raised
Department of Primary Industries - Fisheries	• Input provided to the SEARs; no additional issues raised
Water Group within DPIE (formerly Crown Lands Water Division)	• Input provided to the SEARs; no additional issues raised
Resources Regulator within DPIE	• Input provided to the SEARs; no additional issues raised
NSW Roads and Maritime Services	• Input provided to the SEARs; no additional issues raised
NSW Rural Fire Services	• Input provided to the SEARs; no additional issues raised

Stakeholder	Key Topics/Issues Raised
NSW Dams Safety Committee	• Input provided to the SEARs; no additional issues raised
Hunter New England Population Health	• Input provided to the SEARs; no additional issues raised
Subsidence Advisory NSW	• Input provided to the SEARs; no additional issues raised
Transport for NSW	• Input provided to the SEARs; no additional issues raised
Commonwealth Government Agencies	
Department of the Environment and Energy (including advice from the IESC)	• Input provided to the SEARs • Various biodiversity and water matters related to the assessment of the referral of the Project under the EPBC Act • Assessment of impacts on MNES

6.7.2 Community issues

As outlined in **Table 6.3** and the sections above, as part of the SIA program for the Project, a diverse number of stakeholders have been identified and involved in the assessment program.

Two rounds of direct engagement with near neighbours and the wider Singleton LGA community were held as part of the SIA process. During this engagement, a range of perceived impacts, both positive and negative, have been identified relating to existing Mount Owen Complex operations and the Project. To ensure consistency in the social data collected, engagement activities were guided by structured interview guides and engagement mechanisms that addressed a range of topics relating to: engagement approach, community values and needs, project issues and opportunities, management and enhancement strategies, including potential investment opportunities.

Community issues raised by stakeholders and the wider Singleton LGA community identified during consultation are summarised in **Section 7.16** with a more detailed analysis of the issues provided in the SIA included as **Appendix 11**.

SECTION 7.0

Environmental Assessment

7.0 Environmental Assessment

7.1 Identification of key environmental and community issues

The identification of the key environmental and community issues for the EIS for the Project is based on consideration of:

- The environmental and planning context for the locality (refer to **Sections 4.0** and **5.0**)
- Outcomes of the stakeholder engagement process and learnings from over 20 years of history of operations at the Mount Owen Complex (**Section 6.0**)
- The SEARs for the Project (refer to **Appendix 4**)
- Baseline studies completed as part of the preparation of the EIS (**Sections 7.2** to **7.17**).

The extensive stakeholder engagement and social impact assessment processes undertaken for the Project (refer to **Section 6.0**, **Section 7.16** and **Appendix 11**) identified the issues which stakeholders consider to be the key issues for the Project that require assessment as part of the EIS. The highest-ranking stakeholder issues (based on a number of responses) and where they are addressed in this EIS are:

- social amenity including air quality (**Section 7.2**) and noise (refer to **Section 7.3**)
- sense of community and culture including the relocation of Ravensworth Homestead (refer to **Sections 7.8** and **7.16**)
- economic contribution including employment and partnership (refer to **Section 7.17**)
- traffic (refer to **Section 7.11**)
- water access and use (refer to **Section 7.5**)
- rehabilitation and future land use (refer to **Section 7.9**)

Further details of the issues raised by stakeholders are outlined in **Section 7.16** and **Appendix 11**.

7.1.1 Environmental risk analysis

The Preliminary Environmental Assessment (PEA) completed for the Project in May 2018 included an environmental risk analysis to identify the key issues that required detailed assessment as part of this EIS (refer to **Appendix 11**). The preliminary environmental risk analysis was undertaken in accordance with the Glencore Risk Management Standard, which is consistent with the principles outlined in Australian Standard AS/NZS ISO 31000:2009 Risk Management (Standards Australia 2009).

The method used for the environmental risk analysis included:

- establishing the context for the risk analysis process
- identifying environmental and community aspects and potential risks
- analysing risks
- evaluating risks to determine the key issues requiring further assessment.

The environmental risk analysis identified numerous issues that required further assessment as part of the EIS. Following the Glencore matrix, risks are rated as high, medium or low. The highest risks identified for the Project prior to the technical studies being undertaken were:

- air quality – specifically the potential for increased dust emissions resulting in degraded air quality and potential health impacts and impacts on amenity, including cumulative impacts (refer to **Section 7.2**)
- noise – specifically the potential for degradation of noise amenity (refer to **Section 7.3**)
- surface water – specifically the potential impact to surface water quantity and quality (refer to **Section 7.5**)
- ecology – specifically the potential for impact to flora and vegetation communities including threatened species and Threatened Ecological Communities (TECs), Endangered Ecological Communities (EECs) and Endangered Populations (refer to **Section 7.9**)
- Aboriginal cultural heritage and archaeology – specifically the potential impact to Aboriginal sites (refer to **Section 7.7**)
- historic heritage/built heritage – specifically the predicted impacts to historical heritage features from the Project (refer to **Section 7.8**)
- visual amenity – specifically the potential of the aesthetics of mining operations and surface facilities (refer to **Section 7.10**)

The PEA which included the environmental risk analysis was provided to DPIE to assist with issuing the SEARs for the Project. The PEA was also provided to other relevant government agencies with whom DPIE consulted regarding the SEARs. A checklist of the issues raised in the SEARs and where these are addressed in the EIS, is provided in **Appendix 4**.

To ensure a comprehensive assessment of potential impacts on water resources, a risk assessment was developed with expert input from Glencore, Umwelt, AGE and GHD. This risk assessment was refined over the duration of the assessment as additional information became available on both the receiving environment and the Project itself. The approach to the risk assessment was guided by the impact pathway approach used by the Independent Expert Scientific Committee (IESC) for regional assessments. This risk assessment is included with the Assessment of Commonwealth Matters in **Appendix 10** and includes the final analysis of risk having regard to the outcomes of the assessments and proposed mitigation measures.

A detailed assessment of each of the environmental and community aspects identified in the environmental risk analysis as requiring further assessment for the Project is provided throughout the remainder of **Section 7.0**.

This section provides a detailed assessment of each of the key environmental and community aspects identified in the stakeholder engagement program and SEARs. It also identifies reasonable and feasible management and mitigation measures to minimise environmental impacts.

7.2 Air quality

As discussed in **Section 6.7.2**, air quality impacts, in particular cumulative impacts from mining operations in the area, were identified by the local community as one of the key issues of concern in relation to the Project. This is consistent with the community feedback received during the preparation of other recent project assessments at the Mount Owen Complex and for other recent approvals for mining projects in the area. The potential amenity and health impacts associated with dust from coal mines and other activities in the Hunter Valley is also a key issue for the broader community.

Coal mines in the Hunter Valley have been working in close consultation with the EPA over the past decade to improve air quality management at their existing mining operations. These actions have included the implementation of Pollution Reduction Plans related to dust management at all operating coal mines which included a review of operations against what is considered 'best practice' management measures. All coal mines in the Hunter Valley are required to implement all reasonable and feasible management measures to mitigate air quality impacts from mining operations.

The approved mining operations at the Mount Owen Complex operate pursuant to an Air Quality and Greenhouse Gas Management Plan (AQGHGMP) (Glencore, 2019b), which has been approved by the DPIE, and covers the open cut mining operations, coal handing and transport systems. The AQGHGMP includes a range of management practices including proactive and reactive management of operations in response to both predicted meteorological conditions and measured air quality levels in the surrounding environment. The Blast Management Plan (Glencore, 2018l) implemented at the Mount Owen Complex also includes measures to manage potential air quality impacts associated with blasting including the management of blast fume risk. Compliance with these management plans is a requirement of the approved Glendell and Mount Owen Consents and the associated EPLs.

The SEARs for the Project require a detailed assessment of potential construction and operational air quality impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2016) (Approved Methods), and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10}. The land surrounding the Glendell Mine is dominated by active mining operations. Accordingly, the Air Quality Impact Assessment (AQIA) for the Project includes an assessment of cumulative impacts from the Project as well as other mining operations in the vicinity, combined with other non-mining sources all of which are likely to influence the quality of the air surrounding the Project Area. The SEARs require the assessment to have regard to the Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018) (VLMAP), which provides guidance for consent authorities in conditioning SSD projects that are predicted to cause or contribute to exceedances of air quality criteria.

The AQIA for the Project has been undertaken by Jacobs Pty Limited (Jacobs) in accordance with the SEARs and the Approved Methods, refer to **Appendix 13**. The AQIA has also been peer reviewed by Environmental Resources Management (ERM), the peer review report is included as Appendix D in the AQIA (refer to **Appendix 13**).

The potential air quality issues for the Project were identified as:

- dust from general mining activities
- fume from blasting; and
- emissions of substances from machinery exhausts.

The assessment was based on the use of an air dispersion model, CALPUFF, to predict concentrations of substances emitted to the air due to the proposed mining activities. Model predictions have been compared with relevant air quality criteria in order to assess the effect that the Project may have on the existing air quality environment. The model used for the assessment has been calibrated against monitored air quality data recorded in the area to provide increased confidence in the model predictions. The assessment of greenhouse gas emissions was undertaken separately and is provided in **Section 7.13**.

The main objectives of the AQIA were to:

- identify potential air quality issues
- quantify existing and potential air quality impacts; and

- identify suitable air quality management measures, as appropriate, to minimise impacts.

The AQIA also includes an updated assessment of potential impacts associated with the Mount Owen Complex due to the need to extend the running life of the CHPP beyond that permitted under the current Mount Owen Consent, which is required for the processing of coal from the Project. These impacts have been considered as part of the cumulative impact assessment.

There are a number of private residential properties and vacant land parcels to the south and south east of Glendell Mine that are subject to acquisition rights as a result of existing air quality and noise impacts associated with the various mining operations located in the vicinity. Impacts from the Project are expected to be highest in these areas during the early years of the Project when operations at the Glendell Mine are located closest to Camberwell and cumulative impacts from other approved and currently proposed operations are predicted to be at their highest. Construction activities will also occur concurrently with mining operations during the early years of the Project; the AQIA includes an assessment of the cumulative effects of these activities. The proposed increase in production associated with the Project coincides with the progression of mining in the Glendell Pit Extension away from the sensitive receptors in Camberwell. The AQIA has therefore included an assessment of the Project as production increases as well as at maximum production. An assessment of predicted impacts at the Project's northern extent has also been modelled to assess potential worst-case impacts on the Hebden area to the north of the Project Area.

A summary of the key findings of the AQIA is provided in this section and the full report is provided in **Appendix 13**.

7.2.1 Air quality assessment criteria

Typically, air quality is quantified by the concentrations of air pollutants in the ambient air. Some level of air pollution in the environment is inevitable as a consequence of a range of human and natural processes however regulatory processes and policies have been developed to minimise the adverse effects of air pollution on people and the broader environment. The relevant criteria are drawn from the national standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environmental Protection Measures (NEPM). An amendment to the NEPM in 2016 has set the reporting standards for annual average and maximum 24-hour $PM_{2.5}$ particles to 8 µg/m^3 and 25 µg/m^3 respectively and the annual average standard for PM_{10} particles has reduced from 30 µg/m^3 to 25 µg/m^3. These policies include the development of assessment criteria based on levels of impact that have been assessed by NSW and Commonwealth agencies as being acceptable in order to achieve air quality objectives that aim to protect both human health and community amenity.

There are various classifications of air-borne particulate matter and, relevant to the Project, the EPA has developed assessment criteria for:

- total suspended particulates (TSP), to protect against nuisance amenity impacts
- particulate matter less than 10 µm in diameter (PM_{10}), to protect against health impacts
- particulate matter less than 2.5 µm in diameter ($PM_{2.5}$), to protect against health impacts
- nitrous oxides, to protect against health impacts, and
- deposited dust, to protect against nuisance amenity impacts.

Air quality impacts from the Project have been assessed against the air quality assessment criteria set by the Approved Methods which are consistent with the NEPM. These criteria are outlined in **Table 7.1** and apply to existing and potentially sensitive receptors. The Approved Methods defines a sensitive receptor as "a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area". This has also been interpreted as places of near continuous occupation (e.g. with likely daily occupation).

Table 7.1 Approved Methods Air Quality Assessment Criteria (EPA, 2016)

Substance	Averaging Time	EPA Criterion	Source
PM_{10}	24-hour	50 µg/m^3	EPA (2016)/Department of Environment (DoE) (2016)
	Annual	25 µg/m^3	EPA (2016)/DoE (2016)
$PM_{2.5}$	24-hour	25 µg/m^3	EPA (2016)/DoE (2016)
	Annual	8 µg/m^3	EPA (2016)/DoE (2016)
TSP	Annual	90 µg/m^3	EPA (2016)/NHMRC (1996)
Deposited Dust	Annual (maximum increase)	2 g/m^2/month	EPA (2016)/NERDDC (1998)
	Annual (maximum total)	4 g/m^2/month	EPA (2016)/NERDDC (1998)
NO_2	1-hour	246 µg/m^3	EPA (2016)/NEPC (1998)
	Annual	62 µg/m^3	EPA (2016)/NEPC (1998)

Note: Annual PM_{10} and $PM_{2.5}$ criteria are also non-discretionary development standards for mining under section 12AB of Mining SEPP and provides that the consent authority cannot impose more onerous standards in any approval in relation to the matters covered by the development standard.

Some of the EPA air quality assessment criteria set out in **Table 7.1** relate to the total concentration of air pollutants in the air (that is, cumulative) and not just the contribution from project-specific sources. As such consideration of background levels needs to be made when applying these criteria to assess impacts.

The VLAMP (refer to **Table 7.2**) sets out the NSW Government's policy regarding relevant development consent conditions for State significant mining developments where air quality impacts exceed specific criteria at privately owned sensitive receptors. Where relevant criteria in the VLAMP is exceeded at privately owned sensitive receptors, the policy is that development consents are conditioned to give affected property owners a right to request management measures to be implemented at their property to mitigate the impacts. These property owners may also have the right to voluntarily request the proponent of the development to acquire their property in the terms set out in the development consent. The right to request acquisition of land also extends to circumstances where more than 25% of a private landholding (including vacant land where a dwelling could be built under existing planning controls) is also predicted to be subject to impacts above the relevant criteria. The rights to acquisition under the VLAMP extend to contiguous properties within the landholding.

Table 7.2 VLAMP Mitigation and Acquisition Criteria for Particulate Matter (NSW Government, 2018)

Substance	Averaging Time	VLAMP Criterion	Impact Type
$PM_{2.5}$	Annual[1,3]	8 µg/m^3	Human Health
	24-hour[2,4]	25 µg/m^3	Human Health
PM_{10}	Annual[1,3]	25 µg/m^3	Human Health
	24-hour[2,4]	50 µg/m^3	Human Health
TSP	Annual[1,3]	90 µg/m^3	Amenity
Deposited Dust	Annual[2,4]	2 g/m^2/month	Amenity
	Annual[2,3]	4 g/m^2/month	Amenity

Notes:
1 Mitigation Criteria - Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).
2 Mitigation Criteria - Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.
3 Acquisition Criteria - Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).
4 Acquisition Criteria - Incremental impact (i.e. increase in concentrations due to the development alone), with up to 5 allowable exceedances of the criteria over the life of the development.

As discussed in **Section 4.3.4** there are a number of private properties located to the south and south east of the Project Area that have existing acquisition rights under various development consents due to either predicted or actual air quality impacts. Some of these properties have rights under multiple development consents including the approved Glendell and/or Mount Owen Consents (refer to **Table 4.3**). The AQIA includes an assessment of the Project's predicted impacts on the identified private properties that have acquisition rights under those existing development consents.

7.2.2 Existing Air Quality Environment

The Mount Owen Complex air quality network currently includes 20 air quality monitors including dust deposition gauges, TSP and PM_{10} high volume air samplers (HVAS) and continuous and PM_{10} monitoring units (TEOMs and EBAMs) refer to **Figure 7.2.1**. Nitrogen dioxide (NO_2) is monitored in Singleton by DPIE.

The AQIA included a detailed review of the existing air quality data (2012-2018) from the Mount Owen Complex air quality monitoring network and the DPIE monitoring locations within the vicinity of the Mount Owen Complex (in Camberwell and Singleton). The detailed review of all existing air quality data is provided in the AQIA (refer to **Appendix 13**). The following conclusions have been made from the review of local meteorological and ambient air quality monitoring data:

- Wind patterns in the vicinity of the Glendell Mine are similar to other parts of the central Hunter Valley, with the prevailing winds being from either the northwest or southeast.
- There are seasonal variations in particulate matter concentrations, with PM_{10} levels higher in spring and $PM_{2.5}$ levels higher in winter.
- There are daily variations in particulate matter concentrations, with levels typically highest in the morning and evening. This may be explained by calm wind conditions resulting in poorer dispersion conditions during the morning and evening where dust emissions disperse more slowly and allow higher concentrations to exist for extended periods of time. Also, this may be influenced by increased anthropogenic (human) activity at these times, for example the use of wood heaters.

- In 2018 particle levels increased across the State due to dust from the widespread, intense drought and smoke from bushfires and hazard reduction burning (OEH 2019). In terms of PM_{10} concentrations, most monitoring sites in the vicinity of the Mount Owen Complex have experienced at least one day above the EPA's 24-hour average criterion (50 $\mu g/m^3$) in the past 7 years.

- The EPA's annual average PM_{10} criterion (25 $\mu g/m^3$) has been exceeded at 3 monitoring locations, namely the Mount Owen Complex monitoring location SX13-D4 in Camberwell (2018) and SX10-G2 in Middle Fallbrook (2018), and the DPIE monitoring location in Camberwell (2012, 2013, 2017 and 2018). The DPIE Camberwell monitor is located closer to the New England Highway and other mining operations which may contribute to the higher levels recorded at this monitor relative to the Mount Owen Complex monitor.

- The 2017 and 2018 air quality conditions were influenced by the drought conditions (OEH 2019). In comparing the meteorological data for the same timeframe for the greater Hunter Valley area and NSW (BoM 2019), these drought conditions are evident with monitors that are largely unaffected by mining operations in NSW also showing elevated PM_{10} levels in these years.

- Measured TSP and NO_2 concentrations are below the relevant EPA criteria.

- Deposited dust levels have exceeded EPA criteria at 2 monitoring locations, but not in the last 2 years.

- The 2 closest $PM_{2.5}$ monitoring stations, Camberwell and Singleton, have measured $PM_{2.5}$ concentrations which are close to or have exceeded the relevant EPA criteria. A study by the OEH (OEH, 2013b) found that wood smoke from domestic heating was one of the main factors that influenced $PM_{2.5}$ concentrations, especially during winter.

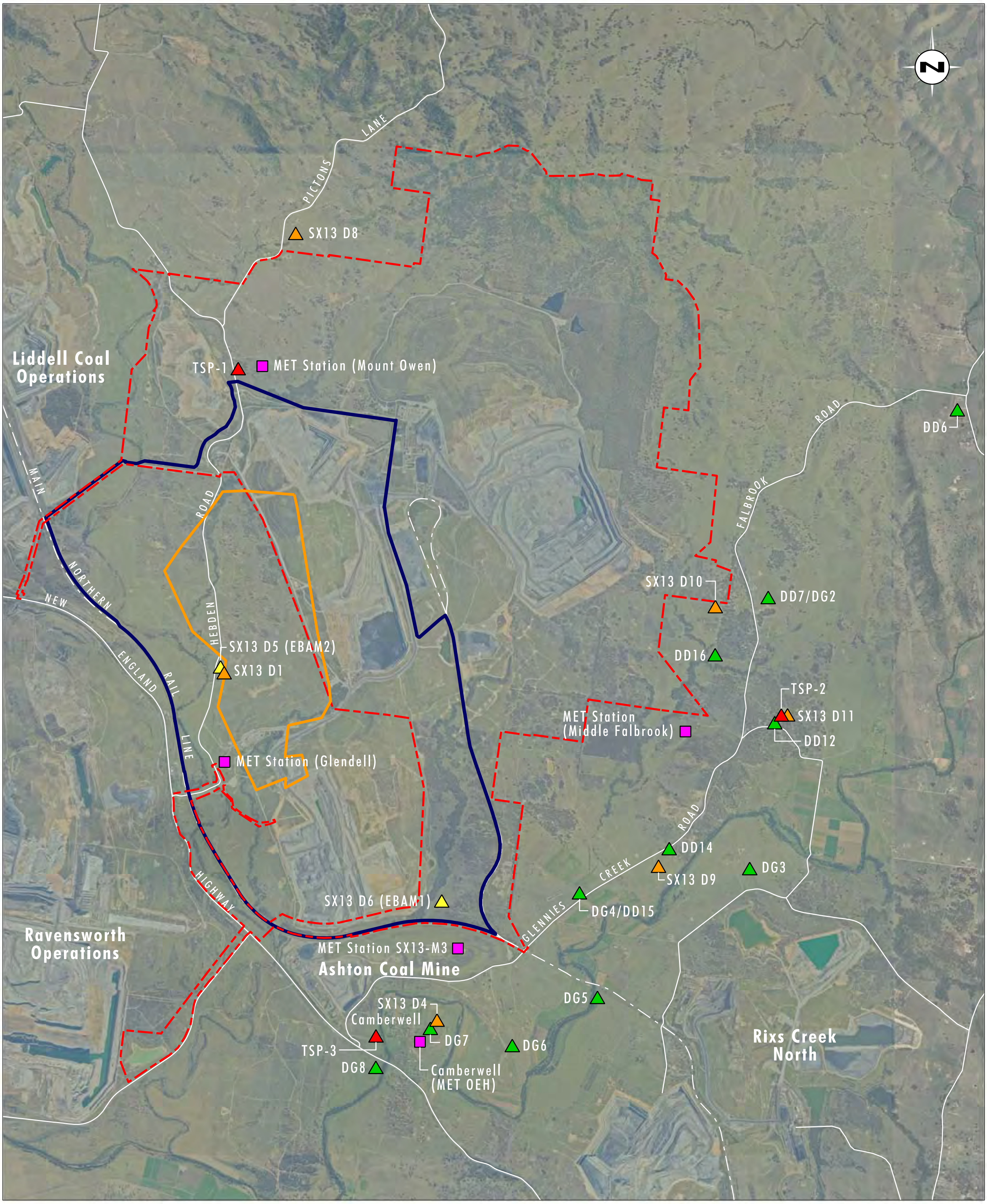


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Depositional Dust Monitoring Location
- PM_{10} Monitoring Location
- TSP Monitoring Location
- EBAM
- Meteorological Station

FIGURE 7.2.1

Existing Mount Owen Complex Air Quality Monitoring Network

File Name (A4): R08/4166_318.dgn
20191202 10.12

7.2.3 Assessment Methodology

The AQIA includes an assessment of potential impacts associated with the activities to be approved under the proposed Glendell Continued Operations Consent in accordance with the Approved Methods as well as an updated assessment of predicted impacts from the operations covered by the Mount Owen Consent relative to the existing approved Mount Owen operations. The impacts from other coal mining operations in the area have also been modelled to understand the cumulative air quality impacts in areas where the Project is a key contributor to emissions.

The AQIA has been subject to independent peer review, by ERM which included a review of model settings, calibration, assumptions and inputs. The AQIA takes account of all comments and suggested edits raised during the peer review and the peer review report has been included as an Appendix D of the AQIA, refer to **Appendix 13**. Full details of the model set up and methodology, including the peer review process are set out in **Appendix 13**.

7.2.3.1 Model Selection

The AQIA followed the Approved Methods, which specifies how assessments based on the use of air dispersion models should be undertaken. The computer-based dispersion model known as CALPUFF was used to predict the potential air quality impacts of the Project, including cumulative impacts. The dispersion modelling accounted for meteorological conditions, land use and terrain information and used dust emission estimates to predict the potential off-site air quality impacts.

7.2.3.2 Meteorological data used

Meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The key meteorological requirements of air dispersion models are, typically, hourly records of wind speed, wind direction, temperature, and atmospheric stability. For air quality assessments, a minimum one year of hourly data is usually required, which means that almost all possible meteorological conditions, including seasonal variations, are considered in the model simulations.

The data from the following meteorological stations were considered for use in the meteorological data analysis (refer to **Figure 7.2.1**):

- Glendell, operated by Glencore
- Mount Owen, operated by the Glencore
- Camberwell, operated by the DPIE

Meteorological data from the past seven years (2012 to 2018) was obtained and analysed in order to identify a representative year for modelling. Hourly records of temperature, wind speed and wind direction were obtained, among other parameters. The procedure for identifying a representative meteorological year involved selecting a meteorological monitoring station and comparing wind patterns for each calendar year. While any of the 3 meteorological stations could have been chosen for identifying a representative year, the Glendell meteorological station was chosen as this station is located closest to the centre of the model domain.

Further detail regarding the meteorological data review is provided in the AQIA, refer to **Appendix 13**.

In terms of wind speed and wind direction, none of the years reviewed appeared to be significantly different to the other years and were considered representative for the purposes of modelling. However, the use of 2017 and 2018 meteorological data was discounted as both years represent extremely low rainfall years (lowest 10-15 %ile) and the typical background levels in these years provide difficulties in accurately calibrating the model. For this assessment the 2014 calendar year was selected as the meteorological modelling year based on:

- high data capture rate (meeting the EPA's requirement for a 90% complete dataset)
- similar wind patterns to other years
- rainfall being slightly below the long-term average, and as a conservative approach the preference was for a slightly drier than average year and
- air quality conditions which showed similarities to other years which were not adversely influenced by bushfire activity or extreme conditions.

The use of the 2014 meteorological data also aligns with meteorological data used for other recent air quality impact assessments associated with the Mount Owen Complex (see for example, Jacobs [2016] and Jacobs [2018]) and enables the direct comparison of the results from this assessment with the modelled impacts from previous assessments. The 2014 meteorological data was also applied to the noise modelling undertaken for the Project, refer to **Section 7.3**.

7.2.3.3 Sensitive Private Receptors

The AQIA assessed all locations but with a focus on private sensitive receptors. A sensitive receptor is defined by the EPA as "*a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area"* and has been interpreted as places of near continuous occupation (e.g. with likely daily occupation). Two private non-residential receivers have been excluded from consideration as private sensitive receptors for the purposes of the assessment:

- Receiver ID342, owned by Daracon Mining Pty Limited, is an industrial workplace located adjacent to the New England Highway to the West of the Project Area; and
- Receiver ID2, The Glennies Creek Hall, which is a community based facility located on private land which is only occupied periodically for short periods.

7.2.4 Emissions to Air

The most significant emission to air from open cut coal mines, including the Project, will be dust (particulate matter) due to material (coal and overburden) handling, material transport, wind erosion, and blasting. Stockpiling and handling of washed coal has also been considered in the assessment however these activities typically represent only a small component of overall emissions due to the increased moisture content following coal processing.

7.2.4.1 Emissions from the Project

Total dust emissions have been estimated by analysing the material handling schedule, equipment schedule and the proposed conceptual mine plans and identifying the location and intensity of dust generating activities. The existing emissions predictions for the recently approved Mount Owen Continued Operations Modification 2 have also been included to reflect the changes to coal handled at the Mount Owen CHPP.

The emissions from different activities have been calculated using emission factors developed both locally and by the US EPA. The emission factors used for this assessment have been drawn largely from the following sources:

- Emission Estimation Technique Manual for Mining (NPI, 2012), and
- AP 42 (US EPA, 1985 and updates).

Dust emission inventories have been developed for each of the modelled scenarios, namely:

- Existing conditions. Monitoring and operational data from 2014 were used, in combination with the intensity and scheduling of operations approved and occurring at that time, for model performance evaluations and calibration.
- Project Years 1, 6, 13 and 18. These years have been selected as they represent a range of proposed future conditions including a scenario at which the Project would be operating at maximum production and during times when mining operations are comparatively closer to sensitive receptors.

The “existing” scenario, and use of meteorological data from 2014, has been developed to evaluate the performance of the model. The selection of Project Years 1, 6, 13 and 18 was based on a review of proposed production levels, material handling quantities, haul distances, and location of activities for each year in the proposed mine life. Year 1 was selected based on it representing mining at its closest point to Camberwell. Year 6 represents higher production rates than existing operations and overburden emplacement occurring at maximum elevation. Both Year 1 and 6 cover the periods with highest predicted cumulative impacts due to the operation of other contributing mining operations in the vicinity of the Project Area as well as the completion of construction activities associated with the Project. Year 13 is representative of the operation of the Project at maximum production levels, which is at a time when production at the Mount Owen North Pit has declined and production at some other surrounding mining operations has ceased (refer to **Table 7.3**). Year 18 reflects mining operations close to the most northern extent of the Glendell Pit Extension and closest to sensitive receptors in the Hebden area. While operations progress slightly further to the north in later years, production levels decline from Year 18 and this stage is therefore considered to represent worst case operational conditions associated with mining in the northern end of the proposed Glendell Pit Extension.

It is noted that the modelling includes the use of proactive air quality management measures such as engineering controls (mine plan design) and source specific controls (water spraying of haul roads) however does not include reactive management measures that will be undertaken on site in the event that either adverse weather conditions are predicted, or if elevated dust levels are identified through observations or monitoring, which can occur during adverse weather conditions. The reactive management measures that are implemented on site in order to maintain compliance with relevant air quality criteria will lead to lower emissions to air than for the unconstrained activities modelled. Consequently, the modelling predictions represent conservative estimates, and it follows that the predicted impacts of the Project presented in the AQIA will also be conservative.

7.2.4.2 Cumulative Impact Assumptions

As discussed in **Section 4.3.5**, the land use surrounding the Glendell Mine is dominated by mining operations. In addition, the model includes predictions of contributions from the existing mining operations within the vicinity of Glendell Mine and approved but not currently operating mining operations (Ashton South East Open Cut (SEOC)). The operations modelled include Mount Owen (North Pit and Bayswater North Pit), Ashton Coal Mine, Ashton SEOC, HVO (part of operations located within model domain), Integra Underground, Liddell Coal Operations, Ravensworth Operations, Rix’s Creek South and Rix’s Creek North. For the cumulative assessment, all operations other than those at the Mount Owen Complex have been conservatively modelled as operating at maximum approved productions rates for their entire approved operating period. Operations at the Mount Owen Complex are modelled at the proposed production rates as described in **Section 3.3**. **Table 7.3** summarises the operating assumptions applied to the cumulative assessment.

Table 7.3 Mining Operations included in Cumulative Impact Assessment

Operation	Notes/References	ROM coal production (Mtpa)				
		2014	Year 1 (2021)[1]	Year 6 (2026)[1]	Year 13 (2033)[1]	Year 18 (2038)[1]
Glendell	As per Project References: Mount Owen (2015), Consent(s): DA 80/952	4.4	4.2	5.9	10.0	5.9
Ashton (including SEOC)	Underground and current open cut approved to 2024. SEOC approved but not currently operating. SEOC consent lapses in 2020 if not commenced. Mining only approved for 12 years from commencement (i.e. ends 2032). Reference(s): Ashton (2015), PAE Holmes (2009), Consent(s): MP 08_0182, DA 309-11-2001-i	2.8	8.6 (cap for SEOC and underground)	8.6 (cap for SEOC and underground)	3.6 (underground only)	-
HVO North and South[2]	HVO North: Approved until July 2025. HVO South coal processed to 2030. HVO South: Approved until 2030, assume 16 Mtpa transferred to HVO North CHPP for washing. Reference(s): Rio Tinto (2015), Todoroski (2017), Consent(s): DA 450-10-2003, 06_0261	18	HVO North: 22 (production), processing up to 26. HVO South: 20	HVO North: 16 processing only. HVO South: 20	-	-
Integra Underground	Operation in care and maintenance (that is, no mining) from Apr 2014 to Feb 2017. Approved to 2035. Reference(s): Vale (2015), Consent(s): 08_0101	0.8	4.5	4.5	4.5	-
Liddell Coal Operations	2023 is the last planned mining year. Reference(s): Liddell Coal (2015), Consent(s): DA 305-11-01	6.7	8	-	-	-
Mount Owen	As per Mount Owen Continued Operations Modification 2. Approved to 2037. Reference(s): Mt Owen (2015), Jacobs (2018), Consent(s): SSD-5850	10	9.9	7.2	3.2	0[3]
Ravensworth Operations	Open cut approved to 2039 at up to 16 Mtpa. Complex approved to process 21 Mtpa. Underground approved to 2024 but not currently operating or proposed to operate. Reference(s): Ravensworth (2015), Consent(s): 09_0176	10.9	16	16	16	16

Operation	Notes/References	ROM coal production (Mtpa)				
		2014	Year 1 (2021)[1]	Year 6 (2026)[1]	Year 13 (2033)[1]	Year 18 (2038)[1]
Rix's Creek South	At the time of the assessment approved to 2020. Modelling assumed that the Rix's Creek South Continuation Project approved. Reference(s): Rix's Creek (2015), Todoroski (2015), Consent(s): DA 49/94, SSD 6300	2.8	4.5	4.5	4.5	4.5
Rix's Creek North	Operation in care and maintenance (that is, no mining) in 2014. Recommenced operations in 2016. Approved to 2035. Reference(s): Vale (2015), Consent(s): 08_0102	0	6 (1.5 North and 4.5 West)	6 (1.5 North and 4.5 West)	6 (1.5 North and 4.5 West)	-

[1] Calendar years are indicative only and are to provide guidance for the duration of other mining operations relative to the Project. [2] The component of HVO which is in the model domain. [3] CHPP operation only

It is noted that the approved Ashton SEOC has been included in the future modelling scenarios despite it not being operational at the time of completing the assessment. However, the existing Ashton SEOC development consent enables mining to occur during the life of the Project and has the potential to contribute significantly to air quality impacts in the surrounding area, therefore the Ashton SEOC has been included. The Ashton SEOC along with the Rix's Creek South Continuation Project (approved October 2019) will contribute substantial concentrations of dust to a number of sensitive receptor areas including Camberwell and Middle Falbrook.

The majority of the land within Camberwell is now owned by various mining operations, with the remaining private residences and vacant land having voluntary acquisition rights as a result of predicted air quality and noise impacts associated with the various mining operations located in the vicinity of Glendell Mine. Additionally, there are a number of properties in the Middle Falbrook area to the east of Glendell Mine that also have voluntary acquisition rights under various development consents.

7.2.5 Air quality impact assessment results

This section provides an overview of the findings of the AQIA as assessed against relevant EPA assessment criteria. Assessment against the relevant criteria under the VLAMP is provided in **Section 7.2.6**.

Air quality contours for predicted worst case annual average PM_{10}, $PM_{2.5}$, TSP and dust deposition concentrations for all years modelled and the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ (composite of all modelled years) are provided in this section, further detail is provided in **Appendix 13**.

The modelling indicates that the Project will have similar air quality impacts to the existing approved Glendell Mine operations with impacts in Camberwell and the Middle Falbrook area declining as operations progress towards the north away from these areas.

7.2.5.1 Particulate matter (PM_{10})

The Project is not predicted to result in any exceedance of the applicable annual average and maximum 24-hour average PM_{10} criteria at any private (non mine-owned) sensitive receptors, that do not currently have acquisition rights under existing development consents (refer to **Table 4.3**). **Figure 7.2.2** provides a composite contour for the predicted maximum 24-hour average PM_{10} concentrations for all modelled years.

The only predicted exceedance of the maximum 24-hour average PM_{10} (Project only) criteria of 50 µg/m^3 is the Daracon facility (ID 342) which is not considered to be a private sensitive receptor. This exceedance is modelled as occurring in Year 6 modelling year with only 3 predicted exceedances in the year. Predicted exceedances of cumulative annual average PM_{10} criterion are predicted in all modelling years at this location.

As shown in **Figure 7.2.3**, some private sensitive receptors with existing acquisition rights located to the south and south east of the Project Area are predicted to exceed the annual average PM_{10} criterion due to a combination of background dust levels, impacts from the Project and contributions from other sources e.g. other mining operations. As can be seen in **Figure 7.2.3**, cumulative impacts in these areas are predicted to decline over the life of the Project as mining operations progress to the north in the Glendell Pit Extension and production at other contributing mining operations either declines or ceases.

Modelling results indicate that most areas of the model domain will experience at least one day each year when maximum 24-hour average PM_{10} concentrations exceed the criterion (50 µg/m^3) when considering the cumulative impact (due to the contributions of the Project and other sources). The analysis of existing air quality conditions (refer to **Section 7.2.2**) indicates that this region as well as other parts of NSW such as Newcastle have historically experienced one or more days above the criterion each year, therefore the model results indicate that air quality conditions are unlikely to change in terms of maximum PM_{10} concentrations as a result of the Project.

It is anticipated that maximum 24-hour average PM_{10} concentrations will continue to be variable from day-to-day, due to existing conditions and sources as well as extreme weather events, and the mining operation will need to continue to be managed in a way which minimises the contribution to off-site PM_{10} concentrations. The implementation of air quality management measures currently implemented at Glendell Mine (as outlined in the AQGHGMP) is determined using a combination of visual monitoring, meteorological monitoring and ambient air quality monitoring. Real time dust monitors record directional dust sources and are set up to trigger an alarm, advising mining personnel that air quality at the monitor is approaching the relevant air quality criteria. When alarms are triggered, reactive controls are implemented including relocating, modifying or ceasing operations as necessary to maintain compliance with relevant air quality criteria.

As previously discussed, the cumulative modelling results are based on the inclusion of all approved and proposed mining operations including those that are not currently operating as well as assumed maximum production rates for all operations. It should therefore be noted that the predictions at key sensitive receptors for future operational scenarios represent a conservative estimate of impacts.

7.2.5.2 Particulate matter ($PM_{2.5}$)

The Project is not predicted to result in any exceedance of the applicable annual average and maximum 24-hour average $PM_{2.5}$ criteria at any private sensitive receptors (being dwellings or other buildings regularly occupied on a daily basis) that do not currently have acquisition rights under existing development consents. **Figure 7.2.4** provides a composite contour for the predicted maximum 24-hour average $PM_{2.5}$ for all modelled years. As shown in **Figure 7.2.5**, some private receptors with existing acquisition rights located to the south and southeast of the Project Area are predicted to exceed the cumulative annual average $PM_{2.5}$ criterion due to a combination of background dust levels, impacts from the Project and contributions from other sources, e.g. other mining operations. Consistent with predicted PM_{10} levels, cumulative impacts in these areas are predicted to decline over the life of the Project as mining operations at Glendell Mine progress to the north and production at other contributing mining operations either declines or ceases (refer to **Figure 7.2.3**).

No private sensitive receptors are predicted to experience exceedances of the maximum 24-hour average (Project only) $PM_{2.5}$ criterion (25 µg/m^3) (refer to **Figure 7.2.4**).

A predicted exceedance of the 24-hour $PM_{2.5}$ cumulative criterion at the Daracon facility (ID 342) is anticipated to occur in the Year 6 and Year 13 modelling years. Predicted exceedances of the cumulative annual average $PM_{2.5}$ criteria are predicted in the Year 1, 6 and 13 modelling years at this location. As noted in **Section 7.2.3.3,** this facility is not considered to be a private sensitive receptor.

7.2.5.3 Particulate matter (TSP)

No private sensitive receptors (being dwellings or other buildings regularly occupied on a daily basis) that do not currently have acquisition rights under existing development consents are predicted to experience exceedances of the annual average TSP criterion (90 µg/m^3) at any stage of the Project. The cumulative annual average TSP predictions for all modelled stages of the Project are shown in **Figure 7.2.6**.

7.2.5.4 Deposited dust

No private sensitive receptors (being dwellings or other buildings regularly occupied on a daily basis) that do not currently have acquisition rights under existing development consents are predicted to experience exceedances of the annual average dust deposition criterion at any stage of the Project. The cumulative annual average dust deposition predictions for all modelled stages of the Project are shown in **Figure 7.2.7**.

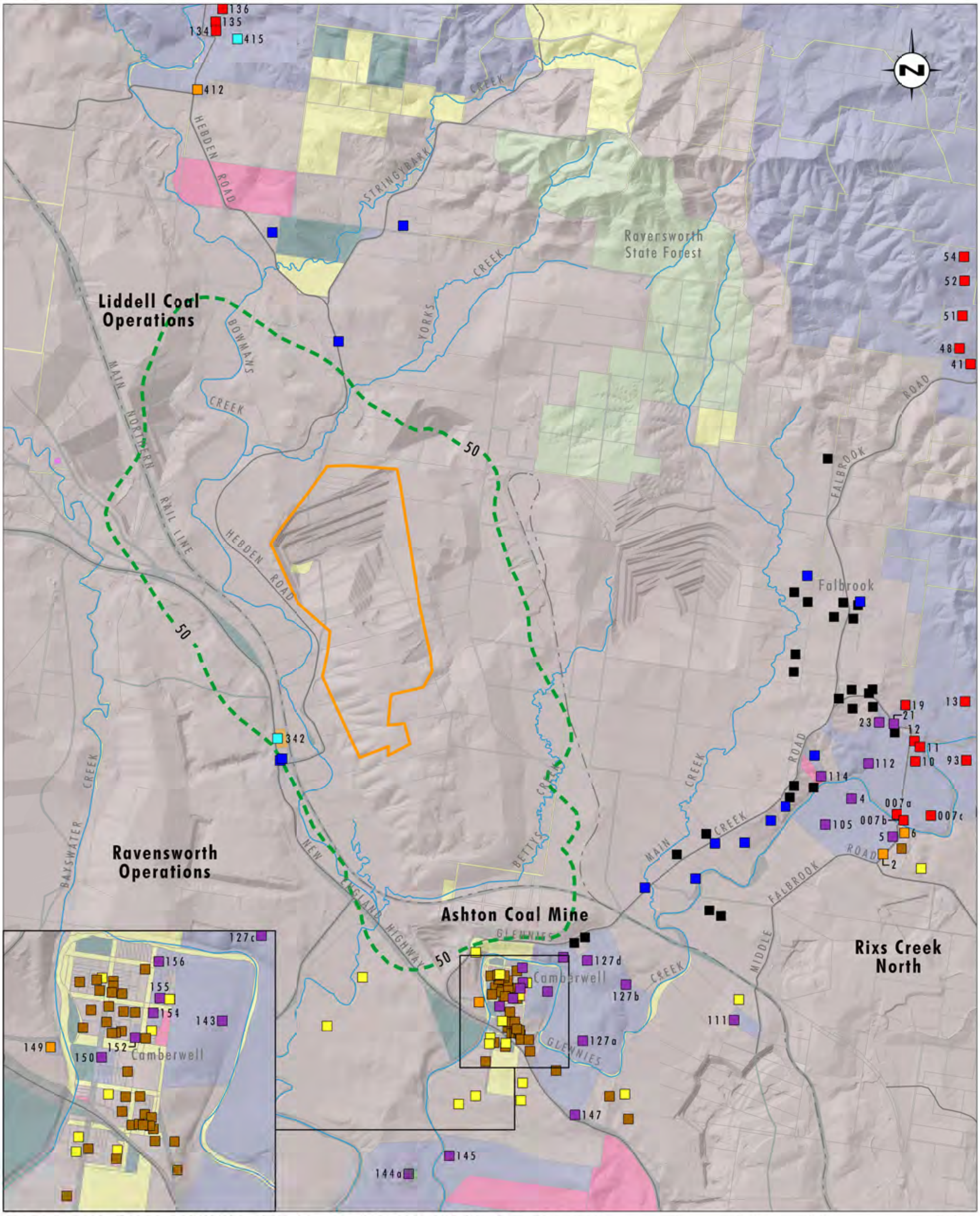


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)
Note: Year 18 landform used on Figure

Legend

- Glendell Pit Extension
- Maximum 24-hour Average PM_{10} (50μg/m^3)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Daracon
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.2

Predicted Maximum 24-hour Average PM_{10} Concentrations (Project only) - Composite of All Modelled Years

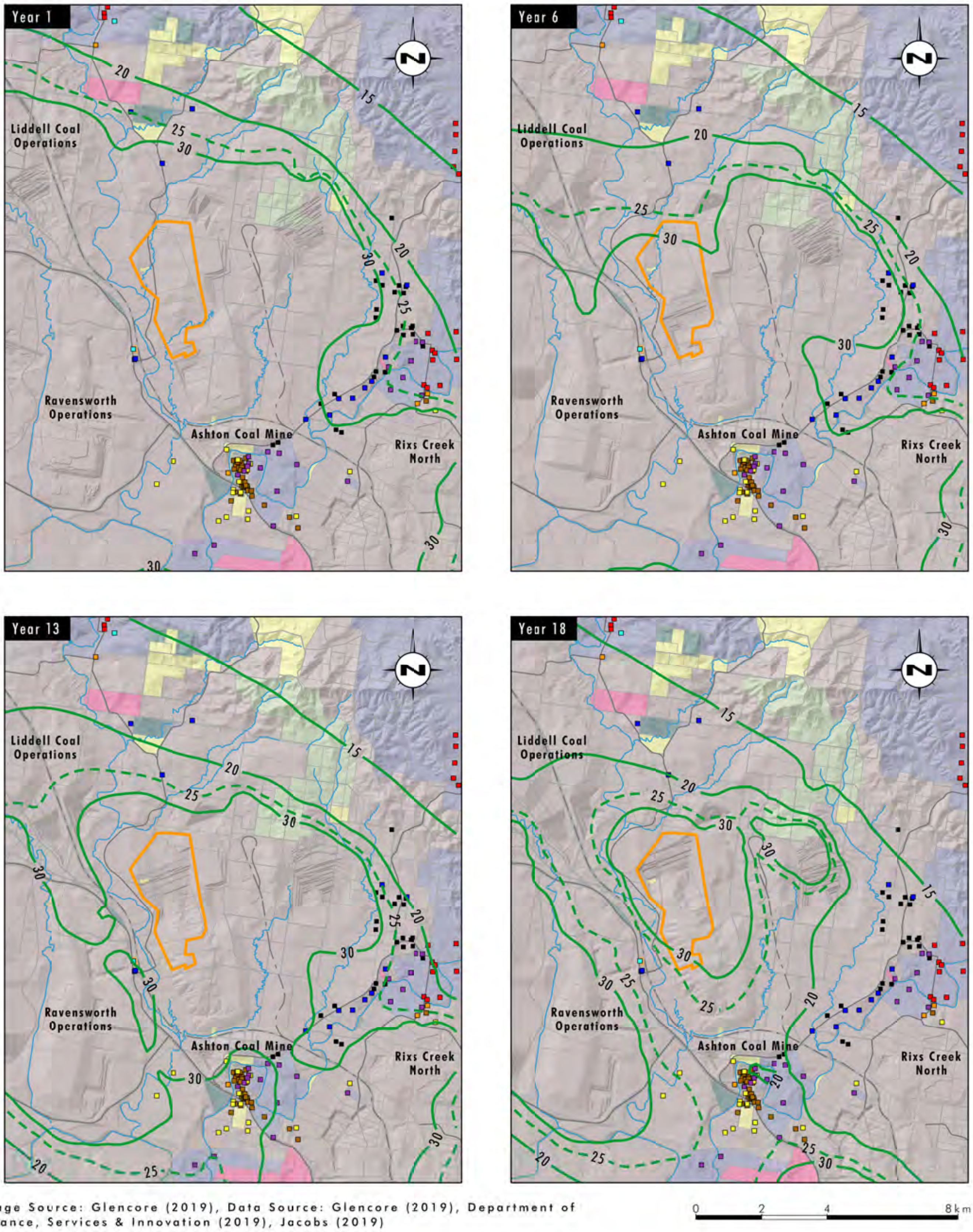


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)

Legend

- Glendell Pit Extension
- Predicted Cumulative Annual Average PM_{10} ($\mu g/m^3$)
- Predicted Cumulative Annual Average PM_{10} ($25\mu g/m^3$)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Daracon
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.3

Predicted Annual Average PM_{10} Concentrations (Cumulative)

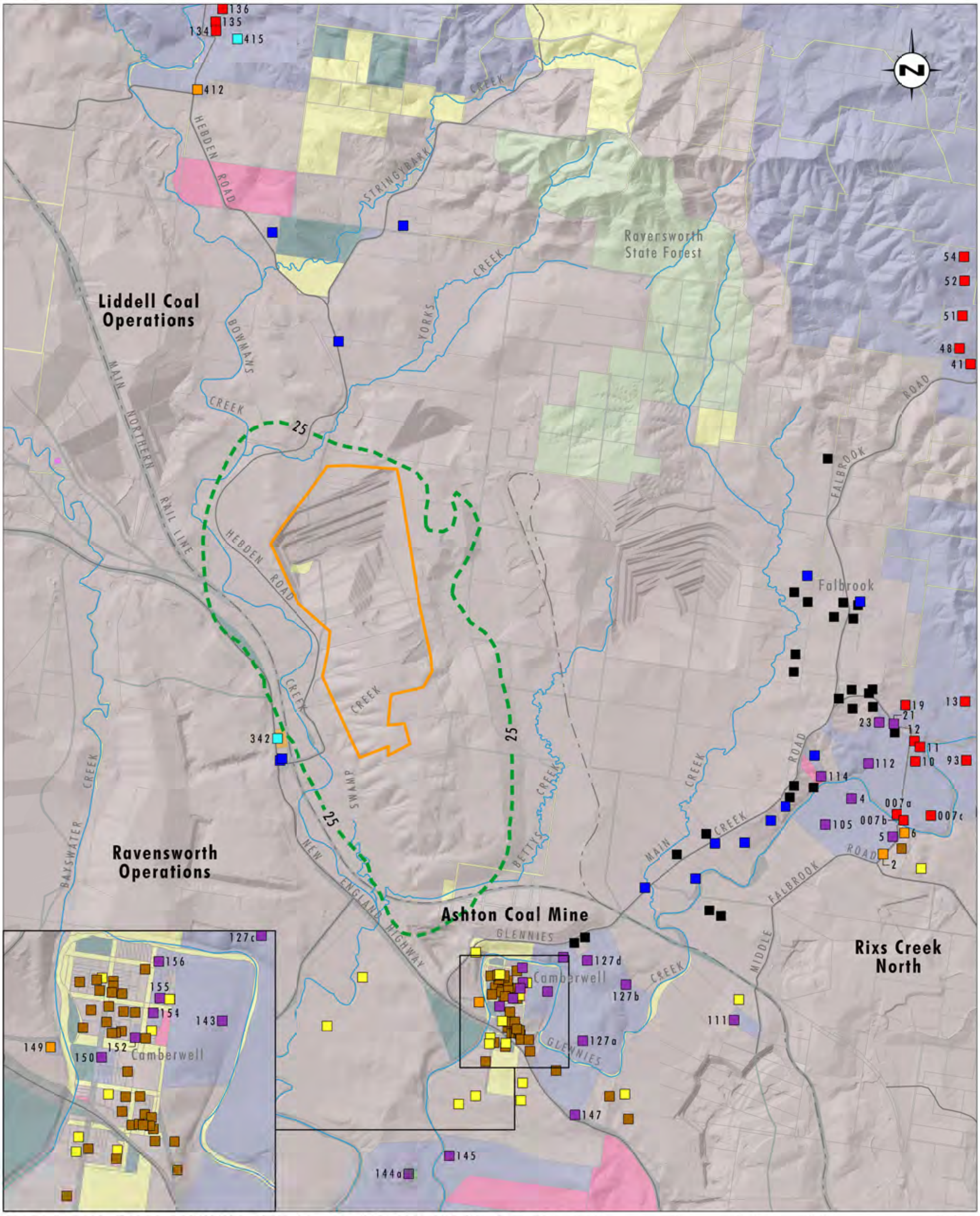


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)
Note: Year 18 landform used on Figure

0 1.0 2.0 4.0km

Legend

- Glendell Pit Extension
- Predicted Maximum 24-hour Average $PM_{2.5}$ (25$\mu g/m^3$)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Daracon
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.4

Predicted Maximum 24-hour Average $PM_{2.5}$ Concentrations (Project only) - Composite of All Modelled Years

File Name (A4): R08/4166_336.dgn
20191129 8.47

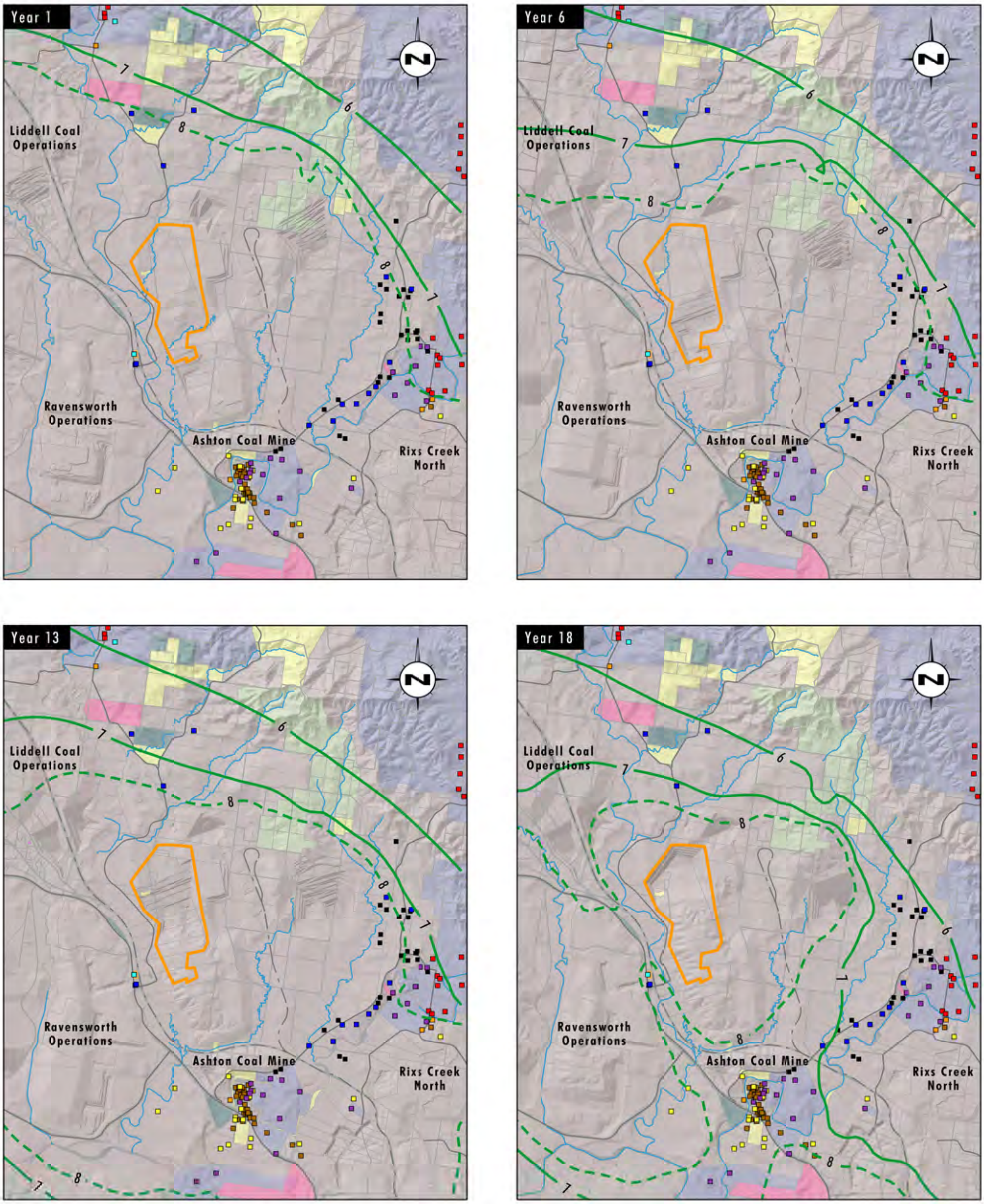


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)

0 2 4 8km

Legend

- Glendell Pit Extension
- Predicted Cumulative Annual Average $PM_{2.5}$ ($\mu g/m^3$)
- Predicted Cumulative Annual Average $PM_{2.5}$ ($8\mu g/m^3$)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.5

Predicted Annual Average $PM_{2.5}$ Concentrations (Cumulative)

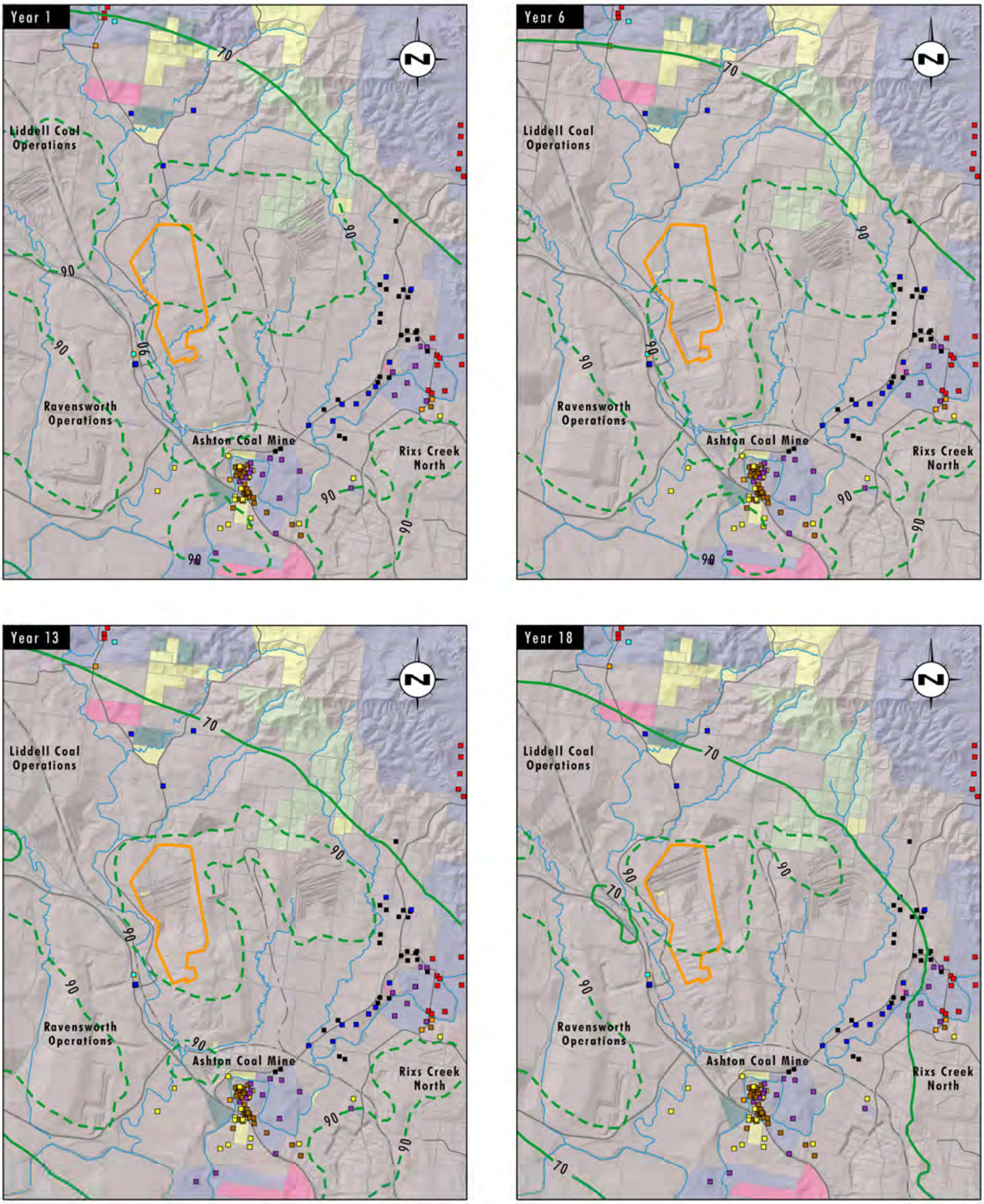


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)

0 2 4 8km

Legend

- Glendell Pit Extension
- Predicted Cumulative Annual Average TSP ($\mu g/m^3$)
- Predicted Cumulative Annual Average TSP ($90\mu g/m^3$)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.6

Predicted Annual Average TSP Concentrations (Cumulative)

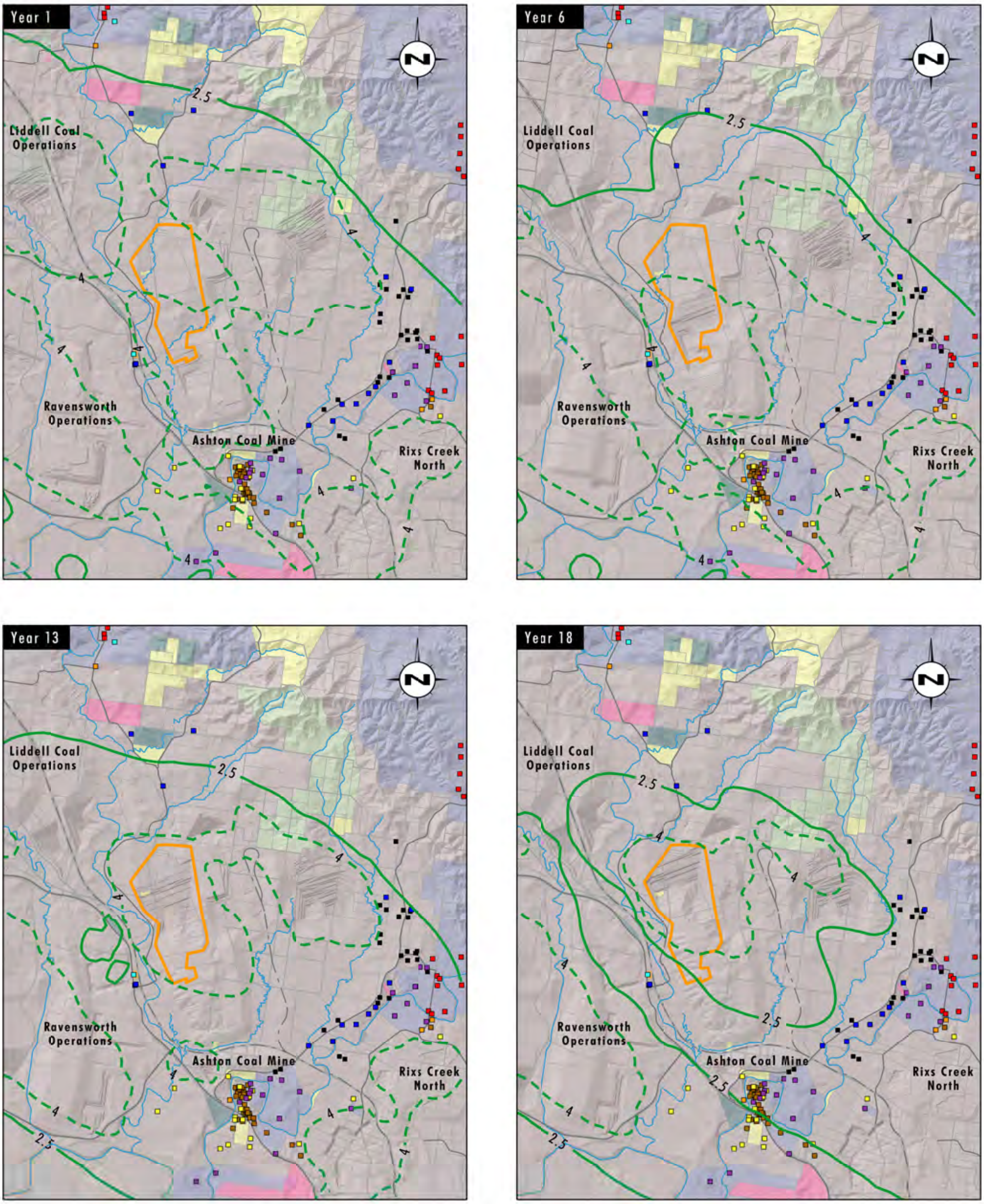


Image Source: Glencore (2019), Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Jacobs (2019)

0 2 4 8km

Legend

- Glendell Pit Extension
- Predicted Cumulative Annual Average Dust Deposition ($g/m^2/month$)
- Predicted Cumulative Annual Average Dust Deposition ($4g/m^2/month$)
- Private
- Private Vacant Land (Acquisition Rights)
- Mine Owned
- State Forest
- Crown Land
- Government Authority
- Ausgrid
- Telstra
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)

FIGURE 7.2.7

Predicted Annual Average Dust Deposition (Cumulative)

7.2.5.5 Post blast fume (NO_2)

Blasting activities have the potential to result in fume and particulate matter emissions. Particulate matter emissions from blasting are included in the dispersion modelling results. Post-blast fume can be produced during adverse blast conditions and comprise of oxides of nitrogen (NOx) including nitric oxide (NO) and nitrogen dioxide (NO_2), which forms a visible orange/brown plume. NO_2 has been linked to adverse health effects and much of the NO emitted into the atmosphere in blast fume is oxidised to NO_2.

The CALPUFF dispersion model has been used to quantify potential NO_2 concentrations due to blasting associated with the Project and the detailed methodology is included in the AQIA (refer to **Appendix 13**).

The modelling results show that, under worst-case meteorological conditions with a rated level 3 fume (visible orange gas), the maximum 1-hour average NO_2 concentrations will not exceed the assessment criterion of 246 µg/m^3 at any off-site sensitive receptor locations.

It is noted that blast fume does not occur on every blast as it relates to the incomplete oxidation of the explosives used and therefore typically only occurs periodically, at Glendell Mine specifically there has only been 2 level 3 fume occurrences since 2015. The Mount Owen Complex Blast Management Plan (Glencore, 2018l) includes a pre-blasting procedure which covers fume management and will continue to be implemented as part of the Project. The procedure includes key fume management actions, such as defining the potential risk zone based upon weather patterns and obtaining permission to fire based on an assessment of real-time weather conditions. In addition to general fume management practices, Glencore continues to work closely with its explosive suppliers to minimise the potential for post-blast fume.

Based on the dispersion modelling (with predominantly worst-case assumptions applied) and proposed implementation of site-specific pre-blast procedures it has therefore been concluded that the Project will not lead to any adverse air quality impacts with respect to post blast fume.

7.2.5.6 Diesel exhaust emissions

The most significant emissions from diesel exhausts are products of combustion including carbon monoxide (CO), oxides of nitrogen (NOx) and particulate matter (PM_{10} and $PM_{2.5}$). NOx (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) have been assessed as part of the AQIA. DPIE monitoring data indicates that CO concentrations have not exceeded relevant air quality criteria at rural or urban monitoring stations in NSW, indicating that this substance represents a much lower air quality risk and therefore has not been included in the assessment.

Particulate Matter (PM10 and PM2.5)

The estimated PM_{10} and $PM_{2.5}$ emissions due only to diesel plant and equipment exhausts are provided in **Table 7.4**. Emission factors for “Industrial off-road vehicles and equipment” from the EPA’s 2008 Air Emissions Inventory (EPA 2012) were used. The emission factors relate to diesel exhaust and evaporative emissions.

Table 7.4 Estimate of PM $_{10}$ and $PM_{2.5}$ emissions from diesel engines

Parameter	Year 1	Year 6	Year 13	Year 18
Estimated fuel used (kL) (source: Glencore)	31,851	43,459	72,080	41,791
PM_{10} calculations				
Diesel exhaust emission factor (kg/kL)	2.84	2.84	2.84	2.84
Diesel exhaust emissions - all equipment (kg/y)	90,459	123,425	204,710	118,688

Parameter	Year 1	Year 6	Year 13	Year 18
$PM_{2.5}$ calculations				
Diesel exhaust emission factor (kg/kL)	2.75	2.75	2.75	2.75
Diesel exhaust emissions - all equipment (kg/y)	87,745	119,722	198,568	115,127

Glencore has considered the practicalities of exhaust after-treatment technologies for in service non-road diesel engines in relation to the existing Glendell Mine operations and the Project. Consideration has been given to the emission reductions, capital costs, maintenance costs and operational costs. The proposed mitigation measures to manage diesel combustion emissions aim to address the equipment maintenance and engine replacement strategies from the "NSW Coal Mining Benchmarking Study: Best practice measures for reducing non-road diesel exhaust emissions" (EPA 2014).

The proposed continued emission control measures include:

- servicing all machinery in accordance with maintenance contracts and adopting original equipment manufacturer recommendations for maintenance
- targeting the maintenance to ensure, as far as reasonably practical, equipment remains fit for purpose over its whole life cycle, and
- defining failure modes, effects and criticality which helps to minimise potential equipment failure.

Nitrogen Dioxide (NO_2)

The AQIA includes an estimation of emissions of NOx from diesel exhaust from fuel consumption data and the emission factor from the EPA's Air Emissions Inventory for 2008 (EPA 2012). Emissions from diesel exhausts associated with off-road vehicles and equipment are not predicted to result in any adverse air quality impacts.

For Year 13 (potential worst case year) modelling indicates that at the nearest private sensitive receptors the predicted maximum 1-hour average NO_2 concentrations are in the order of 50 µg/m^3. With the addition of assumed background levels (74 µg/m^3), the results demonstrate compliance with the EPA's 246 µg/m^3 criterion (refer to **Appendix 13**) at all private sensitive receptors.

The modelling indicates the predicted annual average NO_2 concentrations (which assumes that 70% of the NOx is NO_2) at the nearest private sensitive receptors are in the order of 10 µg/m^3 or less. With the addition of conservative background levels (16 µg/m^3) the results comply with the EPA's 62 µg/m^3 criterion (refer to **Appendix 13** for further detail).

7.2.5.7 Construction work

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with the site construction works. Specifically, these works will primarily include the demolition of the existing Glendell MIA and construction of a new MIA, realignment of a section of Hebden Road and associated electricity and communication infrastructure, realignment of part of Yorks Creek, relocation of Ravensworth Homestead, and other ancillary infrastructure works such as the construction of a Heavy Vehicle Access Road. The total amount of dust generated would depend on the quantities of material handled, silt and moisture content of the soil, the types of operations being carried out, exposed areas, frequency of water spraying and speed of machinery. The detailed approach to the construction of the Project will depend on decisions that will be made by Glencore in conjunction with the contractor(s) and changes to the construction methods and sequences that are expected to take place during the construction phase.

Given the uncertainties related to weather conditions, methods, sequences and material handling quantities for construction activities, the modelling undertaken in relation to the proposed mining operations has not explicitly included contributions from construction related activities. However, an assessment of the potential cumulative effects between construction activities and Year 1 mining operations of the Project has been undertaken based on preliminary estimates of equipment inventories and material handling quantities as well as assumptions on how the construction activities may occur. The modelling inventories and construction assumptions are presented in **Appendix 13**.

A conservative approach was taken for all assumptions applied to the modelling with the resulting construction emission estimates representing maximum upper limits. The results indicate that construction emissions have the potential to increase annual operational emissions in Year 1 by a maximum of 10% for TSP, 13% for PM_{10} and 13% for $PM_{2.5}$. The modelling results indicate that, with the conservative assumptions for emission estimation, the contribution of maximum emissions from the proposed concurrent construction and mining operations will not change air quality outcomes for all private sensitive receptors, refer to **Appendix 13** for further detail.

Appropriate air quality management measures will be implemented during the construction phase of the Project including the use of water carts, the defining of trafficked areas, the imposition of site vehicle speed limits and constraints on work under extreme unfavourable weather conditions, such as dry wind conditions. The existing monitoring network would also continue to monitor dust levels during the construction phase to assess compliance with relevant EPA criteria.

7.2.6 Assessment against VLAMP

The relevant VLAMP criteria are set out in **Table 7.2**. The criteria apply to actual private sensitive receptor locations as well as potential sensitive receptor locations through an assessment of predicted impacts on private landholdings.

The VLAMP criteria are based on project only contributions to impacts as well as cumulative impacts. Where the VLAMP criteria is based on cumulative impacts, all private sensitive receptors have been assessed however consideration in **Table 7.5** has only been given to impacts on residences and landholdings located between the Mount Owen Complex and surrounding mining operations. Properties located further away than these other mining operations are considered to be primarily impacted by activities at those closer mining operations. The contribution from the Mount Owen Complex (including Glendell Mine) to cumulative impacts at these locations is not considered to be significantly material to justify the proposed Glendell Continued Operations Consent providing these properties with either voluntary mitigation or acquisition rights.

7.2.6.1 Mine owned residences

The modelling results indicate that there will be mine owned properties affected by air quality levels that exceed relevant impact assessment criteria at some point during the life of the Project. A number of these mine owned properties are tenanted. Existing tenants of Glencore owned dwellings are alerted to mining related activities and possible impacts, including air quality, as part of the tenancy application process to help inform their decision to occupy the residence. In addition, tenants are provided with a copy of the NSW Health Unit's 'Mine Dust and You' fact sheet prior to entering into a tenancy agreement. At any time during tenancy, tenants can make a written request to Glencore if they believe that mining related impacts are unacceptable, with the option of terminating their tenancy without penalty if Glencore cannot resolve the issue with the tenants. This process is consistent with the requirements set out in the VLAMP.

7.2.6.2 Predicted impacts at private residences

Project only impacts

As discussed in **Section 7.2.5** the predicted impacts from the Project alone for maximum 24-hour average PM_{10} and $PM_{2.5}$ are not predicted to exceed the relevant VLAMP criteria at any private residences.

The Project is similarly not anticipated to exceed the annual average depositional dust VLAMP criteria at any private residences.

There is one private infrastructure receptor, the Daracon facility, where the Project alone contribution to maximum 24-hour average PM_{10} concentrations is predicted to exceed the 50 µg/m^3 VLAMP criterion. This is anticipated to occur in the Year 6 modelling year with only 3 days where impacts are predicted to be above the criteria. It is considered that this predicted exceedance would not be unreasonably deleterious to worker health at this facility given that:

- The site is a laydown area with office and maintenance facilities with the potential to produce dust emissions and elevated levels of particulate matter and Daracon implements health and safety measures on site to manage exposure to dust;
- Workers are generally not present on site for extended periods of time (less than 24 hours on which the criteria is based).

Glencore will continue to manage the mining operations in a way which minimises the contribution to off-site PM_{10} levels.

Cumulative Impacts

As discussed in **Section 7.2.5**, the Project is not predicted to result in any exceedance of the applicable annual average PM_{10} or $PM_{2.5}$ criteria at any private residences that do not currently have acquisition rights under existing development consents. **Table 7.6** contains a list of private residences with acquisition rights (noise and/or air quality) under existing development consents which the AQIA has identified as likely to experience an exceedance of the VLAMP voluntary mitigation and acquisition annual average PM_{10} (25 µg/m^3) and $PM_{2.5}$ (8 µg/m^3) criteria during the life of the Project.

Table 7.5 Private residences with predicted exceedance of VLAMP mitigation and acquisition criteria

ID	Impact Type	Associated lots in landholding	Project Contribution				Existing mitigation and/or acquisition rights[7]
			Yr 1	Yr 6	Yr 13	Yr 18	
114	PM_{10}	5//851867	-	1.2	-	-	Mount Owen Consent
127a	PM_{10}	1//741653	2.4	2.2	1.9	-	Glendell Consent Rix's Creek North (08_0102) Rix's Creek South (SSD 6300)[M] Ashton SEOC (noise trigger) (08_0182)
	$PM_{2.5}$		0.8	0.8	0.7	-	
127b	PM_{10}	1//745211	5.0	4.5	3.2	-	Glendell Consent Rix's Creek North (08_0102) Ashton SEOC (noise trigger) (08_0182) Rix's Creek South (SSD 6300)[M] Integra Underground[M]
	$PM_{2.5}$		1.4	1.4	1.1	-	
127c[6]	PM_{10}	10//1169092	7.7	6.1	4.1	-	Rix's Creek North (08_0102)
	$PM_{2.5}$		2.2	1.9	1.5	-	

ID	Impact Type	Associated lots in landholding	Project Contribution				Existing mitigation and/or acquisition rights[7]
			Yr 1	Yr 6	Yr 13	Yr 18	
127d[6]	PM_{10}	11//1169092	7.2	5.9	4.1	-	Rix's Creek North (08_0102)
	$PM_{2.5}$		2.0	1.8	1.4	-	
143	PM_{10}	3//1088108	3.8	3.3	2.6	-	Ashton SEOC (noise trigger) 08_0182 Rix's Creek South (SSD 6300)[5] Mount Owen Consent[1] Glendell Consent [M]
	$PM_{2.5}$		1.1	1.1	1.0	-	
147	PM_{10}	30//1018512	1.3	1.2	1.2	-	Ashton SEOC (08_0182) Rix's Creek North (08_0102) Rix's Creek South (SSD 6300)[M] Ashton Underground (DA309-11-2001)
	$PM_{2.5}$		0.4	0.5	0.5	-	
150	PM_{10}	1//248748 2/9/758214 3/9/758214 4/9/758214 5/9/758214 6/9/758214 7/9/758214 8/9/758214 9/9/758214	2.9	2.8	2.4	-	Ashton SEOC (08_0182) Rix's Creek South (SSD 6300)[3] Mount Owen Consent[1]
	$PM_{2.5}$		0.9	1.0	0.9	-	
152	PM_{10}	1/8/758214 2/8/758214	3.4	3.1	2.6	-	Ashton SEOC (noise trigger) (08_0182) Rix's Creek South (SSD 6300)[2] Mount Owen Consent[1] Glendell Consent [M] Rix's Creek North (08_0102) [M]
	$PM_{2.5}$		1.1	1.1	1.0	-	
154	PM_{10}	105//855187	3.8	3.5	2.8	-	Ashton SEOC (08_0182) Rix's Creek South (SSD 6300)[3] Mount Owen Consent[1] Glendell Consent[M]
	$PM_{2.5}$		1.2	1.2	1.1	-	
155	PM_{10}	102//852484	4.1	3.7	2.9	-	Ashton SEOC (08_0182) Rix's Creek South (SSD 6300)[4] Mount Owen Consent[1] Glendell Consent[M] Rix's Creek North (08_0102)[M]
	$PM_{2.5}$		1.2	1.2	1.1	-	
156	PM_{10}	103//852484 104//852484	5.0	4.3	3.2	-	Ashton SEOC (08_0182) Rix's Creek South (SSD 6300)[4] Mount Owen Consent[1]
	$PM_{2.5}$		1.5	1.4	1.2	-	

Notes:

[1] As per Mount Owen Consent, the Applicant is only required to acquire the identified land if acquisition is not reasonably achievable under the development consents for the Ashton SEOC Project (MP 08_0182), the Glendell Open Cut Coal Mine (DA 80/952), Ravensworth Operations Project (MP 09_0176), Rix's Creek South Continuation of Mining Project (SSD 6300) or the Rix's Creek North Open Cut Project (MP 08_0102).

[2] As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine.

[3] As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine or Ashton SEOC.

[4] As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine, Ashton SEOC or Glendell Mine.

[5] As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine or Glendell Mine.
[6] Dwelling constructed following approval of Glendell Mine (DA80/952). Lots have acquisition rights due to being contiguous landholding to 127a and 127b.
[7] Current acquisition/mitigation status under Glendell and Mount Owen Consents will continue to apply should the Project be approved.
VLAMP criterion not exceeded in this modelled year.
M - Mitigation only

Annual average TSP and dust deposition criteria are not predicted to exceed VLAMP criteria at any private residences.

7.2.6.3 Land holding assessment

An assessment of privately-owned land where at least 25% of the lot is likely to experience an exceedance of relevant VLAMP criteria was also undertaken.

Table 7.6 contains a summary of the assessment of private land (including vacant land) where exceedances of VLAMP criteria are predicted but which do not have predicted exceedances at a residence located on that land. Private vacant land lots currently subject to acquisition under existing development consents are shown in **Figure 7.2.8**.

Table 7.6 Summary of VLAMP Land Lot Assessment

Lot	ID	Impact Type	% of land affected				Existing mitigation and acquisition rights[2]
			Yr 1	Yr 6	Yr 13	Yr 18	
1//600327	4[1]	PM_{10}	26	18	13	0	Mount Owen (SSD-5850) Rix's Creek North (08_0102)[M]
		$PM_{2.5}$	84	67	45	0	
4//851867	115	PM_{10}	100	100	77	0	Mount Owen (SSD-5850)
		$PM_{2.5}$	100	100	100	0	
8//851867	112[1]	PM_{10}	11	28	1.5	0	Mount Owen (SSD-5850) Rix's Creek North (08_0102)[M]
		$PM_{2.5}$	37	44	18	0	
4//1166047	NA	PM_{10}	100	100	100	0	Ashton SEOC (noise trigger) (08_0182) Rix's Creek South (SSD 6300)[4] Mount Owen (SSD-5850)[3]
		$PM_{2.5}$	100	100	100	0	
5//1166047	NA	PM_{10}	100	100	100	0	Ashton SEOC (noise trigger) (08_0182) Rix's Creek South (SSD 6300)[4] Mount Owen (SSD-5850)[3]
		$PM_{2.5}$	100	100	100	0	
175//1002770	NA	PM_{10}	100	100	100	0	Ashton SEOC (noise trigger) (08_0182) Mount Owen (SSD-5850)[3]
		$PM_{2.5}$	100	100	100	0	
106//855187	NA	PM_{10}	100	100	100	0	Ashton SEOC (noise trigger) (08_0182) Rix's Creek South (SSD 6300)[5] Mount Owen (SSD-5850)[3]
		$PM_{2.5}$	100	100	100	0	

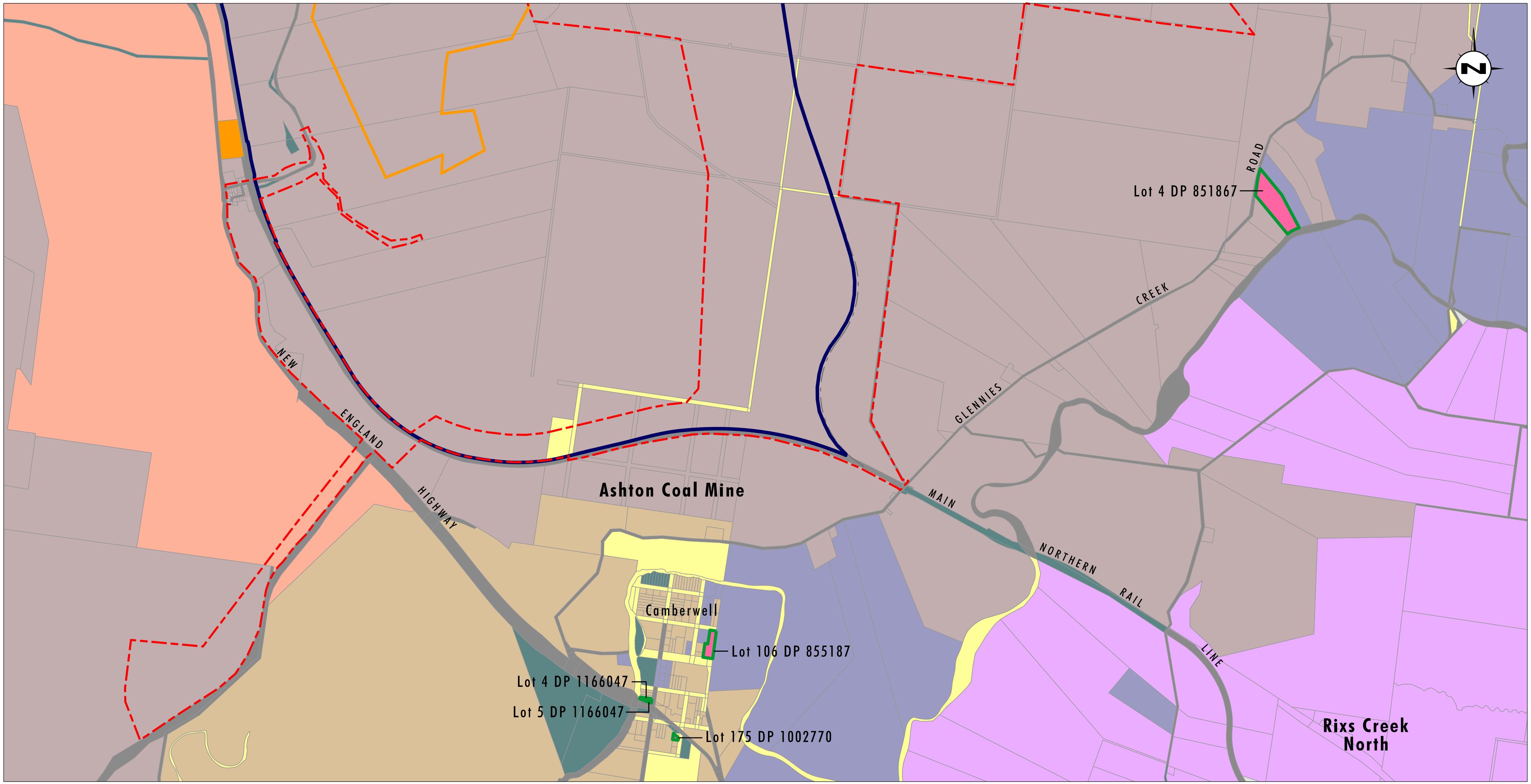
Notes:
[1] Predicted cumulative annual average PM2.5 impacts at the dwelling in Years 1, 6 and 13 are at criteria.
[2] Current acquisition/mitigation status under Glendell and Mount Owen Consents will continue to apply should the Project be approved.
[3] As per Mount Owen Consent, the Applicant is only required to acquire the identified land if acquisition is not reasonably achievable under the development consents for the Ashton SEOC Project (MP 08_0182), the Glendell Open Cut Coal Mine (DA 80/952), Ravensworth Operations Project (MP 09_0176), Rix's Creek South Continuation of Mining Project (SSD 6300) or the Rix's Creek North Open Cut Project (MP 08_0102).

[4] As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine.5 - As per the Rix's Creek South Consent, the Applicant is only required to acquire these properties if acquisition is not reasonably achievable under the approval for Rix's Creek North Mine, Ashton SEOC or Glendell Mine.

Lot 11//1100029 is privately owned land however contains the Glennies Creek Hall used by the local community and has been assessed as being community infrastructure (ID 2). The lot does not form part of a contiguous landholding and is approximately 0.2 ha, which does not meet the minimum lot size requirement in the RU1 – Primary Production zone under the Singleton LEP (>40ha). As a dwelling could not be built on this land under existing planning controls and it does not form part of a larger contiguous landholding, the lot does not trigger either mitigation or acquisition rights under the VLAMP. It is also noted that this building is only used periodically and for relatively short periods (several hours). The application of the annual average PM_{10} and $PM_{2.5}$ criteria to this land is not considered appropriate as a trigger for mitigation or acquisition rights given the intermittent use of the land.

No additional properties (i.e. properties that do not already have acquisition rights under existing development consents) are identified as having acquisition rights due to predicted impacts on at least 25% of the property as a result of the Project.

Annual average TSP and dust deposition criteria are not exceeded at any residences or privately owned land.



Data Source: Glencore (2019), Department of Finance Services & Innovation (2019)

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- VLAMP Assessment - Vacant Property
- AGL Macquarie
- Ashton Coal
- Bloomfield Collieries
- Crown Land
- Daracon
- Glencore
- Government Authority
- Private
- Private Vacant Land (Acquisition Rights)
- Telstra

FIGURE 7.2.8

Cumulative PM_{10} and $PM_{2.5}$ VLAMP Assessment - Vacant Land

File Name (A4): R08/4166_470.dgn
20191128 14.16

7.2.7 Air quality management and monitoring

Mining operations will continue to be managed in accordance with the existing Mount Owen Complex AQGHGMP, which will be reviewed and updated as part of the implementation of the Project.

The AQIA provides a comparison of the continued dust management measures proposed for the Project against the measures outlined in the "NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining" (Donnelly et al, 2011), refer to **Appendix 13**. This comparison indicates that the proposed air quality management measures are consistent with best practice mitigation measures.

Glencore is committed to effectively managing the air quality impacts associated with the Project and will implement a range of air quality management measures for the key dust generating activities. These measures are currently implemented as part of the existing Mount Owen Complex AQGHGMP and will continue to be implemented and continually reviewed and improved, where feasible, as part of the Project.

The key management measures that will continue to be implemented and that have been incorporated into the air quality modelling for the Project include:

- minimising the area of disturbed land at any one time, in line with the approved Mining Operations Plan
- continued implementation of timely progressive rehabilitation and the use of temporary rehabilitation and stabilisation measures on disturbed land.
- adopting controls for haul road dust emissions
- review of meteorological conditions prior to blasting
- consideration of meteorological conditions in planning the loading and unloading of overburden and minimising fall distance during loading and unloading of overburden
- applying water and using dust curtains when drilling overburden for the purposes of blasting
- utilising water sprays and water carts on ROM coal stockpile areas
- maintaining the existing covered conveyors and belt cleaning
- maintaining and servicing machinery, exhaust systems and plant equipment in accordance with contemporary maintenance practices
- using dust cameras to monitor dust
- continued implementation of the Trigger Action Response Plan (TARP) process and investigating dust levels when the TARP process is enacted to identify likely sources of dust from any complaints or potential compliance issues.

In addition to the measures listed above both proactive and reactive dust control strategies informed by real-time air quality and meteorological monitoring systems will continue to be implemented at Glendell Mine.

Proactive air quality management includes the discussion and planning of activities in advance of potentially adverse conditions. Specifically, the proactive air quality management approach includes:

- a system that provides environmental personnel with a daily forecast of expected air quality conditions in the vicinity of the operation

- discussion of the dust forecast at daily operational meetings
- modifying the planned mining activities, as appropriate, to minimise or avoid the potential dust impacts.

Reactive air quality management will continue to assess the need to modify the activities in response to the following triggers:

- visual conditions, such as excessive visible dust
- meteorological conditions, such as dry, strong wind conditions
- ambient air quality conditions (that is, elevated short-term PM_{10} concentrations).

A review of the existing air quality monitoring locations will be undertaken prior to the commencement of the Project to ensure that the monitoring network provides adequate coverage of the Project Area. Any changes to the monitoring network will also be included in the revised AQGHGMP.

7.3 Noise

As discussed in **Section 6.7.2**, noise is a key issue for the local community, particularly for the residents in Camberwell in relation to the current operations at Glendell. Noise generated at Glendell Mine is actively managed through the implementation of a performance-based, adaptive management approach that has focussed on implementing appropriate operational controls and management strategies to proactively manage potential noise impacts. This noise management includes the design and operation of mining activities, the implementation of a range of operational controls and also implementation of mitigation measures at surrounding receivers.

This approach to management of noise impacts is a proven and effective tool for minimising noise impacts from mining operations and has formed the basis for the detailed design process for the Project and the identification of reasonable and feasible noise mitigation measures required for the Project.

The noise environment surrounding the Project Area has undergone a range of changes since the existing Glendell Mine approval, in relation to both land ownership and also the commencement of a number of surrounding mining operations. The original noise impact assessment (NIA) undertaken to support the approved operations which determined the current criteria applied under the Glendell Consent was subject to the *NSW EPA Industrial Noise Policy, 2000* (INP) which no longer applies. Accordingly, the NIA undertaken to support the Project, has been undertaken in accordance with the *Noise Policy for Industry, 2017* (NPfI), and includes a comprehensive assessment of the existing noise environment, relevant receivers and identification of applicable project noise trigger levels.

Consistent with the approach to noise mitigation and management as part of approved operations, Glendell Mine has committed to the ongoing implementation of noise control measures to minimise noise emissions and to meet the relevant noise criteria at surrounding private receivers as part of the ongoing operations proposed for the Project.

Throughout the development of the conceptual mine plans, a range of iterative noise modelling processes have been undertaken, designed to identify noise controls that can be implemented as part of the Project. This process was undertaken to inform the operational constraints applicable to the Project that may be required for each mine plan stage to meet relevant noise criteria. This process included revisions to the mine plan progression including:

- optimisation of pit geometry and overburden emplacement sequencing to enable placement of mining equipment lower in the dump and in-pit (thus more shielded locations) during adverse meteorological conditions

- redesign of overburden haulage routes from the pit to the emplacement areas to maximise shielding from the pit crest and surrounding topography to limit noise emissions
- detailed review of production planning and mine sequencing to enable the incorporation of required operational controls (such as slow-down in mine progression, provision of shielded dump areas and, where required, selective mining equipment shutdowns) during periods of adverse meteorological conditions
- detailed review of mine plan sequencing and slowing the ramp-up of production during the earlier years to reduce noise impacts
- The inclusion of bunds in strategic locations along some haul roads, and where practicable, locating these along the south-eastern side of the ramps, shielding trucks and equipment on exposed sections of the ramps
- Location and orientation of proposed haul roads such that they are not aligned with the prevailing source to receiver winds where practicable

In addition to the mine design controls above, Glencore is committed to the continued implementation of reasonable and feasible controls over the life of the Project during adverse meteorological conditions in order to manage noise impacts. These controls largely relate to operational measures that are implemented in response to the real-time noise monitoring system surrounding the Mount Owen Complex. The implementation of these controls is consistent with the approved operations however the frequency and intensity of the use of the controls will change as a result of the Project. These controls have been factored into the noise model for the Project in order to demonstrate the proposed mining operation can meet the project noise trigger levels.

The SEARs for the Project require a detailed assessment of the likely construction, operational and offsite transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Noise Policy for Industry and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy

A detailed Noise Impact Assessment (NIA) has been undertaken by Umwelt to assess the potential noise impacts associated with the Project in accordance with the SEARs, the NPfI, the *Interim Construction Noise Guideline* (EPA 2009) (ICNG), the *NSW Road Noise Policy* (DECCW 2011) (RNP) and the *Rail Infrastructure Noise Guideline* (EPA 2013) (RING). The NIA has been subject to independent peer review, by Wilkinson Murray, including a review of the assumptions, modelling approach, results and conclusion. The peer review report forms Appendix A of the NIA. A summary of the key findings of the NIA is provided in this section and the full report is provided in **Appendix 14**.

7.3.1 Existing noise criteria

As discussed in **Section 2.2**, the Glendell Mine currently operates under the Glendell Consent and the processing of coal mined from the Glendell Pit is regulated by the Mount Owen Consent. The following sections provide an overview of the relevant current noise criteria applicable to each development consent.

Glendell Consent

The Glendell Consent regulates the mining of coal from the Glendell Pit and the rehabilitation of the Glendell mining area. The Glendell Consent (as modified) contains comprehensive environmental performance conditions, including noise considerations. Relevant noise criteria are reproduced below.

NOISE

Noise Impact Assessment Criteria

2. The Applicant must ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 2 at any residence on privately-owned land, or on more than 25% of any privately-owned land.

Table 2: Noise impact assessment criteria dB(A)Land Number/Receiver	*Day/Evening/Night LAeq(15 min)*	*Night LA1(1 min)*
Camberwell Village A		
30 – Ninness, 33 – Peachey, 37c – Richards, 53 – Yates	*42*	*45*
11 – Chisholm, 22b – Turner, 35 – Pugh	*41*	*45*
Other privately-owned land in Camberwell Village A	*40*	*45*
Camberwell Village B		
20 – Foord, 21a & 21b – Merchant, 38 – Roberton, 47 & 50 – Vollebregt & Clarke	*42*	*45*
6 – Bennett, 24 – Lopes	*40*	*45*
4 – Standing, 40 – Smiles	*39*	*45*
32 – Green, 44 – Stapleton	*38*	*45*
Other privately-owned land in Camberwell Village B	*37*	*45*
Camberwell Village C		
27 – McInerney	*40*	*45*
31 – Olofsson	*38*	*45*
Other privately-owned land in Camberwell Village C	*35*	*45*
Other privately-owned land		
37a & 37b – Richard, 83 – Westcott, 110 – Hall	*38*	*45*
34 – Poulton, 87 – Fairfull	*37*	*45*
9 – Burgess, 18 – Hall, 45 & 46 – Tisdel l	*36*	*45*
All other privately-owned land	*35*	*45*
Camberwell Hall and St Clements Church	*40*	*-*

However, if the Applicant has a written negotiated noise agreement with any landowner of the land listed in Table 2, and a copy of this agreement has been forwarded to the Department and EPA, then the Applicant may exceed the noise limits in Table 2 in accordance with the negotiated noise agreement.

Notes:

- *The land numbers and receiver references are as described in the EA (Mod 2),and shown on the figures in Appendix 4.*
- *Lands titled 30 - Ninness, 33 - Peachey, 37c - Richards, 53 - Yates, 11 - Chisholm, 35 - Pugh, 20 - Foord, 21a & 21b - Merchant, 38 - Roberton, 6 - Bennett, 24 - Lopes, 4 - Standing, 40 - Smiles, 32 - Green and 44 - Stapleton have been acquired and are now mine-owned.*
- *Noise generated by the development is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy (as may be updated from time-to-time).*

Since the Glendell Consent was approved a number of private properties identified in the consent have been acquired; these properties have been highlighted in grey in the extract from the Glendell Consent above (Table 2 of the Glendell Consent). It should also be noted that the current Glendell Consent incorrectly identifies two properties as having been acquired (37c Richards, 24 Lopes), these properties are still privately owned. The identification numbers assigned to the private properties in the Glendell Consent differ to that used in the Mount Owen Consent. As the Glendell and Mount Owen operations operate as a complex, the numbering of receivers in this assessment has aligned with the identification numbers used in the Mount Owen Consent. **Table 7.7** provides a reconciliation of the relevant identification numbers in the Glendell Consent with the identification numbers used in the Mount Owen Consent and the NIA for the Project.

Table 7.7 Reconciliation of Glendell Consent and Assessment Identification Numbers

Glendell Consent	Mount Owen Consent/Noise Impact Assessment
9	147
22b	150
24	154
27	143
31	155
37a and 37b	127a and 127b
37c	127c
47 and 50	152
110	111

Mount Owen Consent

The Mount Owen Consent regulates the processing and transportation of coal sourced from both the Glendell Pit, as well as coal sourced from approved mining areas under the Mount Owen Consent. The Mount Owen Consent regulates mining at the North Pit and Bayswater North Pit, and associated activities. Relevant noise criteria from the Mount Owen Consent are provided below:

Noise Criteria

5. The Applicant must ensure that the noise generated by the development (including rail movements along the Mount Owen Rail Loop, but excluding the construction works specified in condition 3), does not exceed the criteria in Table 3 at any residence on privately-owned land.

Table 3: Noise criteria dB(A)

Residence	*Day/Evening/Night LAeq(15 min)*	*Night LA1(1 min)*
41, 48	*36 / 35 / 35*	*45*
91	*37 / 37 / 36*	*45*
14, 92	*37 / 37 / 37*	*45*
10, 11	*37 / 37 / 37*	*46*
13	*38 / 38 / 38*	*45*
12, 94, 95, 112	*38 / 38 / 38*	*46*
111	*39 / 39 / 36*	*45*
19	*39 / 39 / 39*	*45*
93	*40 / 40 / 40*	*46*
21, 22, 23	*41 / 41 / 41*	*45*
122	*42 / 42 / 42*	*50*
All other residences Area 4 – South	*37 / 37 / 36*	*46*
All other residences Area 4 – North and all other residences Area 5	*37 / 37 / 35*	*45*
All other residences Area 6	*40 / 40 / 40*	*50*
All other residences Area 7	*40 / 40 / 38*	*48*
All other residences Area 8 – East	*39 / 39 / 35*	*45*
All other residences Area 8 – West	*44 / 44 / 42*	*52*
All other residences Area 9	*48 / 48 / 43*	*53*
Other privately-owned residences	*35 / 35 / 35*	*45*

Note: The location of the land referred to in Table 3 is shown on the figure in Appendix 3.

Noise generated by the development is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy (as may be updated from time-to-time). Appendix 4 sets out the meteorological conditions under which these criteria apply, and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has an agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

The receivers in the region surrounding the Mount Owen Complex were grouped into receiver areas that have similar representative background noise levels. The grouping utilised for the NIA for the Project are consistent with the receiver areas used for the Mount Owen Continued Operations Modification 2 NIA (Umwelt, 2018b). These areas have been defined giving consideration to topographical features that may enhance or attenuate the transmission of noise and the relative location of other noise sources (such as industrial, rail and road traffic). The defined receiver areas and the location of the relevant receivers are shown in **Figure 7.3.1**.

7.3.2 Assessment methodology

The NPfI documents the procedures to be used to assess the noise from industrial noise sources scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act). The first step in the application of the NPfI involves determining the *project noise trigger levels* for the development. These are the benchmark levels above which noise management measures are required to be considered. The aim of the *project intrusiveness noise level* is to protect against significant changes in noise levels, while the aim of the *project amenity noise level* is to protect against cumulative noise impacts from industry thereby protecting the amenity for particular land uses. The NPfI notes that setting the project noise trigger level at the most stringent of the project intrusiveness or project amenity noise levels ensures that intrusive noise is limited, and the amenity of the land use is protected.

The project intrusiveness noise levels are based on the measurement of the existing background noise levels. The project amenity noise levels are determined based on the acceptable amenity noise level for the respective land use.

The underlying *ambient noise level* is referred to as the background noise level and is represented by the $L_{A90,15minute}$ descriptor. The intrusiveness of an industrial noise source is generally considered acceptable if the predicted $L_{Aeq,15minute}$ from the noise source does not exceed the background noise level by more than 5 dB when measured in the absence of the source. The background noise level, or *rating background level* (RBL), is determined in accordance with Fact Sheet A of the NPfI and is the median value of the *assessment background levels* (ABL) determined for the monitoring period. For new developments, the background noise levels are measured without the subject development operating. However, if the premises have been operating for greater than 10 years and are operating in accordance with noise limits and applying best practice, the development can be considered part of the acoustic environment. The existing Glendell Mine satisfies these requirements. A detailed assessment of the existing background noise levels is presented in Appendix B of the NIA, refer to **Appendix 14**.

7.3.2.1 Project intrusiveness noise levels

The RBLs for the Project have been derived from attended background noise monitoring undertaken specifically as part of the Project and multiple continuous noise monitoring units in the vicinity of the Mount Owen Complex. In addition to the continuous noise monitoring units that make up the Mount Owen monitoring network, data from SX46 (Ravensworth Operations) and SX37 (Liddell Coal Operations) was also utilised. The RBLs from these units may include existing noise from Glendell and other mines as it is not possible to obtain background levels in this area without the presence of these existing operations. Additionally, in accordance with the NPfI, these sources have been present for a significant period (more than 10 years) and are considered a normal part of the acoustic environment.

Data from the 2014 calendar year was filtered for appropriate meteorological conditions as per the procedures outlined in the NPfI Fact Sheet B to determine the RBLs. The derived project intrusiveness noise levels based on the RBLs are shown in **Table 7.8**.

Table 7.8 Derived Project Intrusiveness Noise Levels, LAeq (15 minute) dB(A)

Unit/Receiver Area	Rating Background Level			Project Intrusiveness Noise Level		
	Day [1]	Evening [1]	Night [1]	Day [1]	Evening [1]	Night [1]
SX1/Area 4 North and South, Area 7	35 (28) [2]	30	30	40	35	35
SX12/Area 8 East and West, Area 9	35 (32) [2]	36	35	40	40 (41) [4]	40
SX37[6]/Area 11	35 (25) [2]	30 (29) [5]	30 (29) [5]	40	35	35
SX46[7]/Area 10	35 (30) [2]	33	32	40	38	37

Note:

[1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10pm to commencement of day period.
[2] Where the Day ABL is less than 35 dB(A) then RBL is set at 35 dB(A).
[3] Night project intrusiveness noise level should be no higher than evening, as per Section 2.3 of the NPfI.
[4] Evening project intrusiveness noise level should be no higher than day, as per Section 2.3 of the NPfI.
[5] Where the evening or night ABLs are less than 30 dB(A) then RBL is set at 30 dB(A).
[6] Liddell Coal Operations Noise Monitor.
[7] Ravensworth Operations Noise Monitor.

7.3.2.2 Project amenity noise levels

The $L_{Aeq, period}$ project amenity noise levels at receivers are defined as the acceptable amenity noise levels taken from NPfI Table 2.2 minus 5 dB. The NPfI represents the existing ambient noise level by the $L_{Aeq, period}$ descriptor where the period is the day, evening and/or night during which the proposed development will operate. The acceptable amenity noise levels at a specific location depend on the type of receiver and land use of each receiver location. Receiver/land use categories relevant to the assessment include rural residential, school, place of worship, commercial and industrial premises, and community buildings. In order to derive the project noise trigger levels, the period-based project amenity noise levels are converted to equivalent 15-minute levels ($L_{Aeq, 15minute}$) by the addition of 3 dB.

The project amenity noise levels for all receivers surrounding the Project Area are shown in **Table 7.9**.

Table 7.9 Project Amenity Noise Levels

Receiver/land use category	Time of day [1]	Recommended amenity noise level LAeq(period) dB(A) [2]	Project amenity noise level LAeq(period) dB(A)	Project amenity noise level LAeq(15 minute) dB(A)
Rural residential	Day	50	45	48
	Evening	45	40	43
	Night	40	35	38
School classroom - internal	Noisiest 1-hour period when in use	35 (internal) 45 (external)	30 (internal) 40 (external)	30 (internal) 40 (external)
Place of worship	When in use	40 (internal) 50 (external)	35 (internal) 45 (external)	35 (internal) 45 (external)

Receiver/land use category	Time of day [1]	Recommended amenity noise level LAeq(period) dB(A) [2]	Project amenity noise level LAeq(period) dB(A)	Project amenity noise level LAeq(15 minute) dB(A)
Commercial premises	When in use	65	60	60
Industrial premises	When in use	70	65	65
Community buildings - active recreation area	When in use	55	50	50

Note:

1 Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of day period.

2 NPfI, Table 2.2, (NPfI, 2017).

7.3.2.3 Project noise trigger levels

The project noise trigger level provides a benchmark or objective for assessing a proposal or site and is not intended for use as a mandatory requirement (NPfI 2017). The project noise trigger level, if exceeded, indicates a potential noise impact on the community and so triggers a management response e.g. further investigation of mitigation measures.

As discussed in **Section 7.3.2**, the project noise trigger level is the lower or most stringent value of the project intrusiveness noise level and the project amenity noise level. As discussed in **Section 7.3.1**, receivers in the region surrounding the Project Area are grouped into receiver areas that have similar representative background noise levels, refer to **Figure 7.3.1**. Where background monitoring data is not available, i.e. in Areas 1, 2 and 5, the minimum acceptable RBL has been adopted. Project noise trigger levels for the residential receivers within the defined receiver areas are shown in **Table 7.10** and the non-residential receivers shown in **Table 7.11**.

Table 7.10 Project Noise Trigger Levels for Residential Receivers, $L_{Aeq,15minute}$ dB(A)

Receiver Area	Period [1]	Intrusiveness	Amenity	Project Noise Trigger Level
Area 1	Day	40	48 [2]	40
	Evening	35	43 [2]	35
	Night	35	38 [2]	35
Area 2	Day	40	48 [2]	40
	Evening	35	43 [2]	35
	Night	35	38 [2]	35
Area 3 [5]	No project noise trigger level applies – Area 3 contains privately owned land however there are no privately-owned residences			
Area 4 – North Area 4 – South (Based off SX1)	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35
Area 5	Day	40	48 [2]	40
	Evening	35	43 [2]	35
	Night	35	38 [2]	35
Area 6	No project noise trigger level applies - no privately-owned land in Area 6			
Area 7 (Based off SX1)	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35
Area 8 – West	Day	40	48	40
	Evening	40	43	40

Receiver Area	Period [1]	Intrusiveness	Amenity	Project Noise Trigger Level
Area 8 – East (Based off SX12)	Night	40	38	38
Area 9 (Based off SX12)	Day	40	48	40
	Evening	40	43	40
	Night	40	38	38
Area 10 (Based off SX46) [4]	Day	40	48	40
	Evening	38	43	38
	Night	37	38	37
Area 11 (Based off SX37) [3]	Day	40	48	40
	Evening	35	43	35
	Night	35	38	35

Notes:

[1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of day period.

[2] Based on minimum assessable RBL and recommended amenity noise level.

[3] SX37 is a Liddell Coal Operations Noise Monitor.

[4] SX46 is a Ravensworth Operations Noise Monitor.

[5] Area 3 contains privately owned land only – no residential receivers – subject to assessment under the VLAMP only.

The project noise trigger levels for each individual residential receiver is provided in the NIA, refer to **Appendix 14**.

Table 7.11 Project Noise Trigger Levels for Non-Residential Receivers, LAeq,15minute dB(A)

Receiver Area/ID	Period	Amenity	Project Noise Trigger Level
Area 2 / 350 Mount Pleasant School [1]	Day	40	40
	Evening	40	40
	Night	40	40
Area 7 / 2 Glennies Creek Community Hall [1]	Day	50	55
	Evening	50	55
	Night	50	55
Area 7 / 6 Rural Fire Service Depot [1]	Day	50	55
	Evening	50	55
	Night	50	55
Area 9 / 149 St Clements Church [1, 2]	Day	45	45
	Evening	45	45
	Night	45	45
Area 9 / 342 Daracon Site [1]	Day	65	65
	Evening	65	65
	Night	65	65
Area 11 / 412 Hebden Community Hall [1]	Day	50	55
	Evening	50	55
	Night	50	55
Area 11 / 415 Wild Quarry [1]	Day	65	65
	Evening	65	65
	Night	65	65

Notes:

[1] As per the NPfI, applicable project noise trigger levels for school classrooms, places or worship, commercial and industrial premises, and community buildings apply only when they are in use.

[2] St Clements Church is a deconsecrated church, criteria only applies when in use.

7.3.2.4 Maximum noise level event (sleep disturbance) criteria

The sleep disturbance noise goal for each defined receiver area is provided in **Table 7.12,** individual receiver criteria for each receiver are provided in the NIA, refer to **Appendix 14**.

Table 7.12 Sleep Disturbance Noise Goal for Residential Receivers, $L_{Aeq,15minute}$ and L_{AFmax} dB(A)

Receiver Area	Sleep Disturbance Noise Goal			
	LAeq,15minute		LAFmax	
	RBL +5	Max 40 or RBL + 5	RBL + 15	Max 52 or RBL + 15
Area 1	40	40	50	52
Area 2	40	40	50	52
Area 3	No sleep disturbance noise goal applies – Area 3 contains privately owned land however there are no privately-owned residences			
Area 4 North	40	40	50	52
Area 4 South	40	40	50	52
Area 5	40	40	50	52
Area 6	No privately-owned land in Area 6 so no sleep disturbance noise goal applies			
Area 7	40	40	50	52
Area 8 West	45	45	55	55
Area 8 East	45	45	55	55
Area 9	45	45	55	55
Area 10	42	42	52	52
Area 11	40	40	50	52
All other residential receivers	40	40	50	52

7.3.2.5 Cumulative noise criteria

The NPfI notes that "where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required". The NIA has taken this into consideration when assessing cumulative noise. Based on the project noise trigger levels the most stringent project amenity noise level that could be used as a screening noise level for the cumulative industrial noise assessment would be an $L_{Aeq,15minute}$ of 38 dB(A). Where the suggested screening noise level for the cumulative industrial noise assessment cannot be met a cumulative noise assessment is required.

7.3.2.6 Construction noise criteria

As described in **Section 3.2.14**, the Project will require construction activities associated with the proposed MIA, partial Yorks Creek Realignment, Heavy Vehicle Access Road, partial Hebden Road realignment and the Ravensworth Homestead relocation. The EPA recognises that construction activities could potentially generate higher noise levels than those of an industrial operation. The ICNG provides noise management criteria for construction activities. The criteria are intended to guide the need for, and the selection of, feasible and reasonable work practices to minimise construction noise impacts.

The ICNG notes that a residential receiver is 'noise affected' if the $L_{Aeq,15minute}$ construction noise level exceeds the RBL by more than 10 dB during recommended standard hours. Outside recommended standard hours a residential area is 'noise affected' if the $L_{Aeq,15minute}$ construction noise level exceeds the RBL by more than 5 dB. For commercial and industrial areas, the ICNG notes that the $L_{Aeq,15minute}$ construction noise management levels are 70 dB(A) and 75 dB(A) respectively.

7.3.2.7 Road traffic noise criteria

While there will be minor changes in traffic volumes on Hebden Road as a result of the Project, the impact on the road traffic noise at the nearest privately-owned residence (approximately 4.5 km from the southern end of Hebden Road) will not be discernible. As a result, the NIA does not include an assessment of road traffic noise for Hebden Road due to changes in traffic volume due to the on-going operations as part of the Project. There will be an increase in traffic volumes associated with the construction phase of the Project peaking in approximately Year 1-2 of the Project. The only location where residential receivers could be impacted by this increase in traffic is in Camberwell at the receivers located in proximity to the New England Highway. An assessment of the potential change in road traffic noise from the New England Highway within Camberwell has been undertaken.

Table 7.13 outlines the road traffic noise criteria for the Project along the New England Highway in accordance with the RNP.

Table 7.13 Road Noise Criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria dB(A)	
		Day (7.00 am – 10.00 pm)	Night (10.00 pm – 7.00 am)
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq, 15 hour 60 (external)	L_{Aeq}, 9 hour 55 (external)

Source: NSW Road Noise Policy (DECCW, 2011)

Section 3.4 of the RNP notes that when assessing noise impacts and the effectiveness of feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

7.3.2.8 Rail noise

The Project will include the extension of the operating life of Mount Owen CHPP and associated coal handling infrastructure to 2045. The current CHPP throughput of 17 Mtpa ROM coal and export coal transportation via rail will not change due to the Project. As a result, the NIA does not include an assessment of the rail traffic noise as there will be no increase in rail traffic volumes due to the Project.

7.3.3 Noise prediction

The noise modelling was undertaken using the proprietary software ENM. The software utilises terrain data, source and receptor locations and heights, source sound power levels and input meteorological conditions to predict noise levels. The software accounts for ground effects, geometric spreading, air absorption, acoustic shielding and meteorological enhancement in its predictions.

The noise modelling inputs for the Project consider proposed mining operations for Year 1, Year 6, Year 13 and Year 18 of the Project. As the Glendell Pit Extension progresses further to the north, production is scheduled to increase along with the required mining fleet. The increase in fleet associated with mining in the Glendell Pit Extension will correspond with a reduction in fleet numbers in other mining areas at the Mount Owen Complex.

The indicative equipment schedules for the mine stages modelled are provided in the NIA, refer to **Appendix 14**. The actual fleet composition may vary over the life of the Project, however the modelled equipment is considered to be indicative of operations in each modelled stage. The dynamic sound power levels utilised for the modelling were sourced, where possible, from sound power level equipment noise monitoring at Glendell Mine, Mount Owen Mine and Liddell Coal Operations. Where representative dynamic sound power level data was not available for the equipment at these operations supplementary data was used from other Glencore mining operations (Mangoola Open Cut and Bulga Coal). The preferred sound power levels (i.e. not the alternate numbers) are consistent with the sound power levels used in the modelling for operational management purposes at the existing Glendell Mine.

The sound power levels should be considered as indicative of the level of control required to facilitate good management of the Project, not mandatory limits. Consistent with existing operations, proactive and reactive mine management will be undertaken to manage noise impacts with operational decisions, such as to relocate or switch-off parts of the fleet, used in conjunction with the ongoing management of machine sound power levels.

7.3.3.1 Meteorological conditions

Certain meteorological conditions may increase noise levels by focusing soundwave propagation paths at a single point. Such refraction of sound waves will occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient i.e. wind velocities increasing with height above ground level) with wind direction from the source to the receiver.

The NPfI approach to account for noise-enhancing weather conditions is to state the meteorological conditions under which the project noise trigger levels and limits will apply, rather than stipulating the noise modelling parameters that must be used. NPfI Fact Sheet D requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The likely noise enhancing meteorological conditions (in accordance with NPfI Fact Sheet D) which may affect the Project include:

- calm neutral conditions
- 3 m/s wind from the south-east (a vectored wind condition that can occur greater than 30% of the time during the evening and night time)
- 3 m/s wind from the north-west (a vectored wind condition that can occur up to 30% of the time during the day time)
- F Class stability, modelled as a 3°C/100 m inversion with 2 m/s drainage flow from the north west (the vectored wind condition can occur greater than 30% of the time during inversion conditions during winter night times (6.00 pm to 7.00 am).

Consistent with the AQIA the meteorological data from the 2014 calendar year was applied to the NIA. Further detail regarding the meteorological conditions is provided in the NIA, refer to **Appendix 14**.

7.3.3.2 Probabilistic modelling parameters

The probabilistic noise modelling approach allows the impact of the temporal variations in the meteorological conditions on the propagation of sound from the source to the receiver to be considered. The probabilistic modelling approach includes the iterative implementation of the noise control strategies to determine the percentage of the time each strategy, such as machine rerouting or shut down, needs to be implemented.

It is important to note that the aim of the probabilistic approach is not to simply model a preferred operational alternative, but rather to enable consideration of operational alternatives that are available to allow the Project to continue to operate during a range of meteorological conditions and achieve the approved noise criteria at each receiver location. The operational implications of these alternatives were considered in the assessment of the applicable reasonable and feasible operational scenarios.

The probabilistic noise model uses a detailed set of meteorological conditions that are representative of the meteorological conditions that would be expected during the life of the mine. The modelling approach involves analysing the local meteorological conditions to determine the percentage of occurrence of inversions and wind effects in the region for each respective season and time period. The predictive noise model is then run for each set of meteorological conditions described by the wind speed interval, wind direction interval and temperature gradients representing A to G class stability conditions for each source-receiver transmission path. The proportion of time each of these combinations applies is then combined with the resulting predicted sound pressure level to determine the noise level at the receiver location.

The results of the noise modelling for the Project based on the probabilistic method are presented as noise levels that are only predicted to be exceeded 10% of the time. The results of the probabilistic modelling approach are used to inform the Project on the likely levels of control required during noise-enhancing meteorological conditions to proactively and reactively manage the noise impacts based on operational decisions such as relocating or switching-off parts of the fleet. This approach to managing the noise impacts is consistent with approved noise management practices undertaken at the existing Glendell Mine.

The results of the noise modelling for the Project based on noise-enhancing meteorological conditions are presented as noise contours representing 35, 38, 40 and 43 dB(A) for the meteorological conditions identified in **Section 7.3.4.1**. These specific contour levels have been selected in order to demonstrate the various/variable noise criteria relevant to each receiver area can be achieved i.e. the 35 dBA contour level describes the relevant predicted noise into the Hebden area for the night period, while 38 dBA contour level describes the relevant predicted noise into Camberwell for the night period. The noise contours are described as follows:

- 35 dB(A) the minimum project intrusiveness noise levels $L_{Aeq,15minute}$ for the evening and night periods
- 38 dB(A) the minimum project amenity noise levels $L_{Aeq,15minute}$ for the night period
- 40 dB(A) the minimum project intrusiveness noise levels $L_{Aeq,15minute}$ for the day periods
- 43 dB(A) the minimum project amenity noise levels $L_{Aeq,15minute}$ for the evening period

The results of the assessment of predicted noise levels under noise-enhancing meteorological conditions are presented in **Section 7.3.4**. The assessment of noise-enhancing meteorological conditions has been completed in accordance with the requirements of NPfI Fact Sheet D.

7.3.4 Modelling results

7.3.4.1 Operational noise modelling results – Glendell noise-enhancing meteorological conditions

Table 7.14 and **Table 7.15** provide a summary of the compliance of the Project for all receiver areas against the project noise trigger levels discussed in **Section 7.3.2.3**. The results for each individual receiver (including residential and non-residential) are provided in the NIA, refer to **Appendix 14**.

The predicted operational noise levels for Year 1, 6, 13 and 18 of the Project under likely noise enhancing meteorological conditions with operational management controls in place are presented as composite noise contours (all modelled meteorological scenarios) in **Figure 7.3.2** to **Figure 7.3.5**. The contours for each individual meteorological scenario for each modelled year are presented in the NIA, refer to **Appendix 14**.

As previously discussed, reasonable and feasible mine design controls and effective noise management measures were incorporated into the model to demonstrate that compliance with the project noise trigger levels can be achieved under noise-enhancing meteorological conditions. It should be noted that the maximum level of noise management control required to meet the project noise trigger level at each receiver is only required under certain noise enhancing meteorological conditions. The scenarios modelled reflect operations with reasonable and feasible mitigation measures applied during the modelled prevailing meteorological condition, in order to demonstrate that the operation can comply with the project noise trigger levels. The actual mine layout will fluctuate on a daily basis as mining progresses to the north and overburden is emplaced in-pit to the south. The actual operational controls implemented at any given time will depend on the position of mining related activities, the fleet make-up and the actual meteorological conditions at the time of operations. Consistent with currently approved operational management practices, operations will be managed in real time to ensure that the noise criteria applicable to the operations are being met.

Table 7.14 Compliance with Noise Criteria for Modelled Operational Scenarios (Residential Receivers)

Receiver Area	Period	Project Noise Trigger Level	Year 1	Year 6	Year 13	Year 18
Area 1	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 2	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 3	Contains privately owned vacant land only - no privately-owned residences					
Area 4 - North	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 4 - South	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 5	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 6	No privately-owned land					
Area 7	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
Area 8 West	Day	40	All receivers less than 40 dB(A)			
	Evening	40	All receivers less than 40 dB(A)			
	Night	38	All receivers less than 38 dB(A)			

Receiver Area	Period	Project Noise Trigger Level	Year 1	Year 6	Year 13	Year 18
Area 8 East	Day	40	All receivers less than 40 dB(A)			
	Evening	40	All receivers less than 40 dB(A)			
	Night	40	All receivers less than 40 dB(A)			
Area 9	Day	40	All receivers less than 40 dB(A)			
	Evening	40	All receivers less than 40 dB(A)			
	Night	38	All receivers less than 38 dB(A)			
Area 10	Day	40	All receivers less than 40 dB(A)			
	Evening	38	All receivers less than 38 dB(A)			
	Night	37	All receivers less than 37 dB(A)			
Area 11	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			
All Other Private Residences	Day	40	All receivers less than 40 dB(A)			
	Evening	35	All receivers less than 35 dB(A)			
	Night	35	All receivers less than 35 dB(A)			

Table 7.15 Compliance with Noise Criteria for Modelled Operational Scenarios (Non-residential Receivers)

Receiver Area / ID	Period	Project Noise Trigger Level	Year 1	Year 6	Year 13	Year 18
Area 2 / 350 Mount Pleasant School [1]	Day	40	Less than 0 dB(A) – all modelled years			
	Evening	40	Less than 0 dB(A) – all modelled years			
	Night	40	Less than 0 dB(A) – all modelled years			
Area 7 / 2 Glennies Creek Community Hall [1]	Day	55	Less than 55 dB(A) – all modelled years			
	Evening	55	Less than 55 dB(A) – all modelled years			
	Night	55	Less than 55 dB(A) – all modelled years			
Area 7 / 6 Rural Fire Service Depot [1]	Day	55	Less than 55 dB(A) – all modelled years			
	Evening	55	Less than 55 dB(A) – all modelled years			
	Night	55	Less than 55 dB(A) – all modelled years			
Area 9 / 149 St Clements Church [1,2]	Day	45	Less than 45 dB(A) – all modelled years			
	Evening	45	Less than 45 dB(A) – all modelled years			
	Night	45	Less than 45 dB(A) – all modelled years			
Area 9 / 342 Daracon Site [1]	Day	65	Less than 65 dB(A) – all modelled years			
	Evening	65	Less than 65 dB(A) – all modelled years			
	Night	65	Less than 65 dB(A) – all modelled years			
Area 11 / 412 Hebden Community Hall [1]	Day	55	Less than 55 dB(A) – all modelled years			
	Evening	55	Less than 55 dB(A) – all modelled years			
	Night	55	Less than 55 dB(A) – all modelled years			
Area 11 / 415 Wild Quarry [1]	Day	65	Less than 65 dB(A) – all modelled years			
	Evening	65	Less than 65 dB(A) – all modelled years			
	Night	65	Less than 65 dB(A) – all modelled years			

Note:

[1] As per the NPfI, applicable project noise trigger levels for school classrooms, places or worship, commercial and industrial premises, and community buildings apply only when they are in use.

[2] St Clements Church is a deconsecrated church, criteria only applies when in use.

No receivers exceed the project noise trigger level as a result of the Project.

Probabilistic Modelling Results

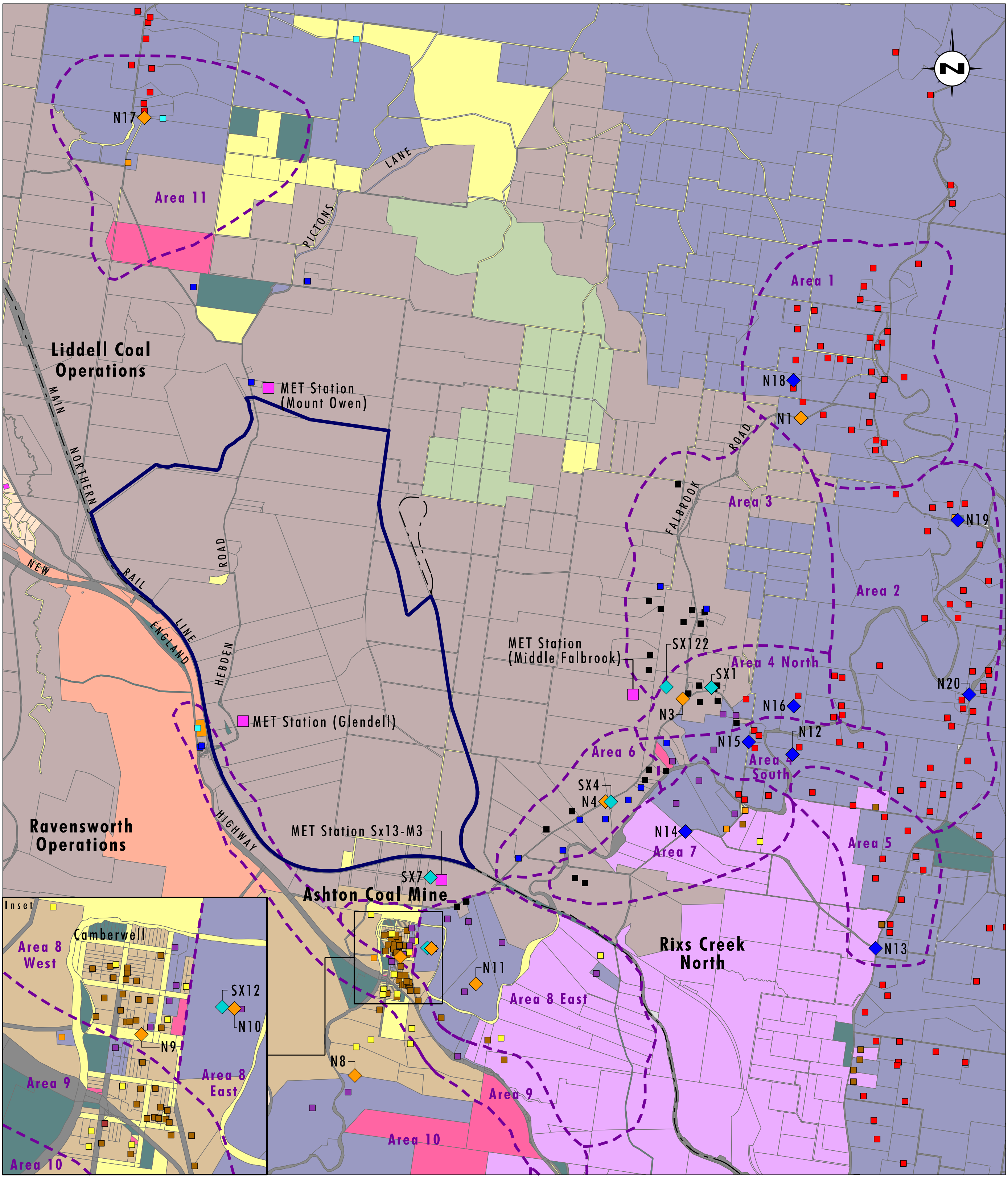
As previously discussed, the probabilistic modelling approach was used to help design the operating parameters of the Project during the full range of standard, noise-enhancing and very noise enhancing meteorological conditions. This includes conditions that are not identified by NPfI Fact Sheet D but could occur over the life of the Project. Importantly, the probabilistic modelling approach includes meteorological conditions that would be outside the range of conditions required to be considered by the NPfI but are highly noise-enhancing conditions. While such conditions are excluded by the NPfI, there is an expectation that the noise controls that would be implemented under the worst-case conditions identified by the NPfI would also be in place during these periods.

The results of the probabilistic modelling are presented in the NIA, refer to **Appendix 14** and summarised in **Table 7.16** as the percentage of time noise control measures may need to be implemented in order to achieve the project noise trigger levels within each of the defined receiver areas, refer to **Figure 7.3.1.**

Table 7.16 Percentage of Time Noise Controls May Need to be Implemented to Achieve Project Noise Trigger Levels

Receiver Area	Period	Year 1	Year 6	Year 13	Year 18
Area 1	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	0%	0%	0%	0%
Area 2	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	0%	0%	0%	0%
Area 3	Contains privately owned vacant land only - no privately-owned residences				
Area 4 North	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	1%	0%
	Winter Evening/Night	0%	8%	13%	0%
Area 4 South	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	0%	3%	3%	0%
Area 5	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	0%	0%	0%	0%
Area 6	No privately-owned land				

Receiver Area	Period	Year 1	Year 6	Year 13	Year 18
Area 7	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	10%	11%	11%	0%
Area 8 West	All-seasons Day	20%	15%	0%	0%
	Non-winter Evening	15%	9%	0%	0%
	Non-winter Night	17%	12%	0%	0%
	Winter Evening/Night	45%	38%	11%	0%
Area 8 East	All-seasons Day	23%	12%	0%	0%
	Non-winter Evening	17%	6%	0%	0%
	Non-winter Night	21%	9%	1%	0%
	Winter Evening/Night	52%	31%	13%	0%
Area 9	All-seasons Day	0%	12%	0%	0%
	Non-winter Evening	0%	6%	0%	0%
	Non-winter Night	0%	11%	1%	0%
	Winter Evening/Night	8%	38%	13%	0%
Area 10	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	2%	0%	0%
	Non-winter Night	0%	3%	0%	0%
	Winter Evening/Night	0%	18%	3%	0%
Area 11	All-seasons Day	0%	0%	0%	0%
	Non-winter Evening	0%	0%	0%	0%
	Non-winter Night	0%	0%	0%	0%
	Winter Evening/Night	0%	0%	0%	0%



Data Source: Glencore (2019), Department of Finance & Innovation (2019)

0 1 2 4km

Legend

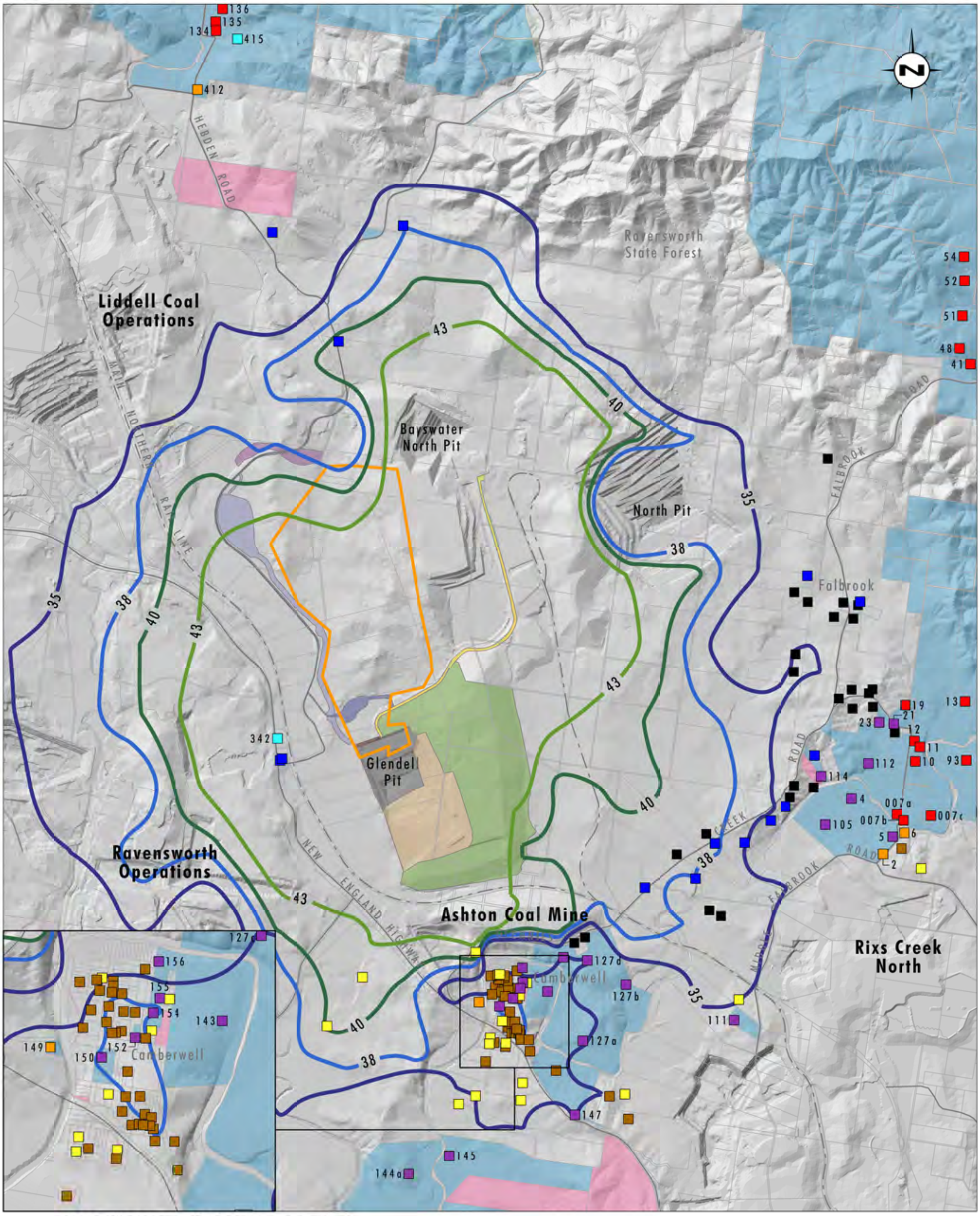
- Project Area
- Defined Receiver Areas
- AGL Macquarie
- Ashton Coal
- Bloomfield Collieries
- Crown Land
- Daracon
- Ausgrid
- Glencore
- Government Authority
- Hunter Valley Operations
- Private
- State Forest
- Private Vacant Land (Acquisition Rights)
- Telstra
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Attended Noise Monitoring Location
- Real Time Continuous Noise Monitoring Location
- Meteorological Station Location
- Supplementary Performance Management Attended Noise Monitoring Location

FIGURE 7.3.1

Defined Receiver Areas and Noise Monitoring Locations

File Name (A4): R08/4166_315.dgn
20191129 8.50

umwelt



Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Umwelt (2019)

0 1.0 2.0 4.0km
1:80 000

Legend

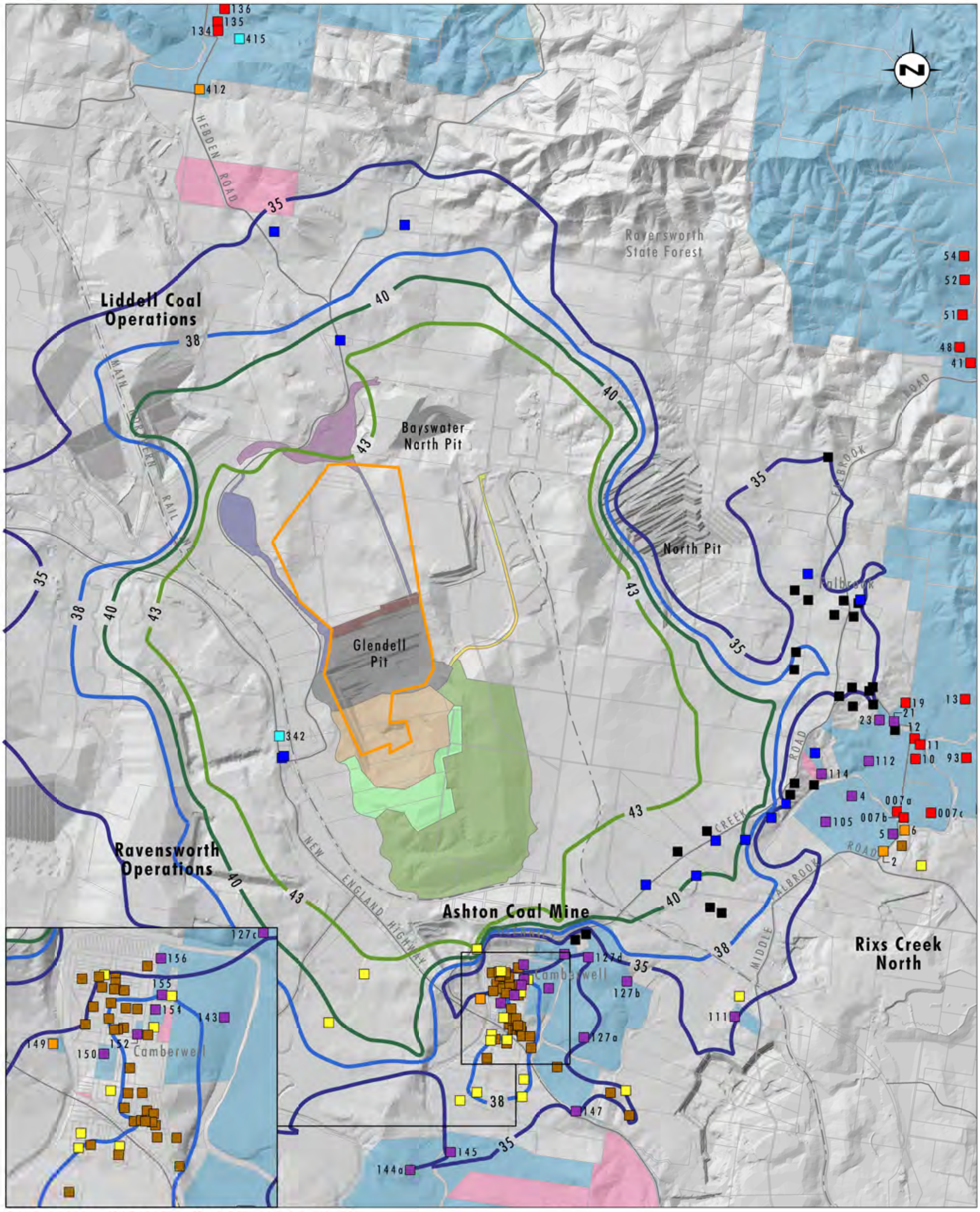
- Glendell Pit Extension
- 35 dB(A) Noise Contour
- 38 dB(A) Noise Contour
- 40 dB(A) Noise Contour
- 43 dB(A) Noise Contour
- Active Mining Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Rehabilitation
- Creek Realignment (Construction)
- Infrastructure (Construction)
- Infrastructure/Internal Access
- Haul Road
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)
- Private Land
- Private Vacant Land (Acquisition Rights)

FIGURE 7.3.2

Predicted Noise Impacts - Year 1

File Name (A4): R08/4166_403.dgn
20191128 14.34

umwelt



Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Umwelt (2019)

0 1.0 2.0 4.0km

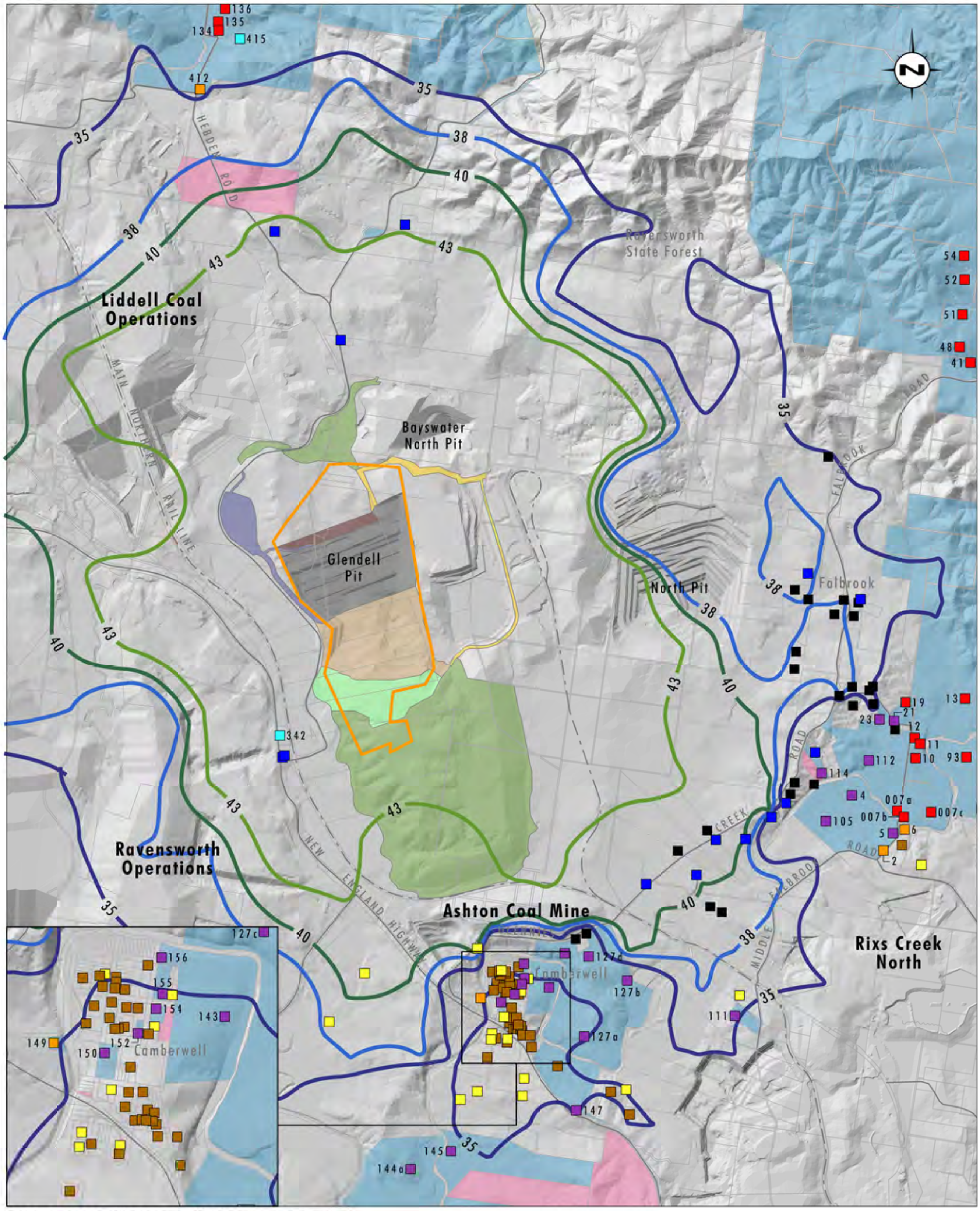
Legend

- Glendell Pit Extension
- 35 dB(A) Noise Contour
- 38 dB(A) Noise Contour
- 40 dB(A) Noise Contour
- 43 dB(A) Noise Contour
- Active Mining Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Rehabilitation
- Creek Realignment (Construction)
- Infrastructure/Internal Access
- Haul Road
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)
- Private Land
- Private Vacant Land (Acquisition Rights)

FIGURE 7.3.3

Predicted Noise Impacts - Year 6

File Name (A4): R08/4166_504.dgn
20191128 14.38



Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Umwelt (2019)

0 1.0 2.0 4.0km

Legend

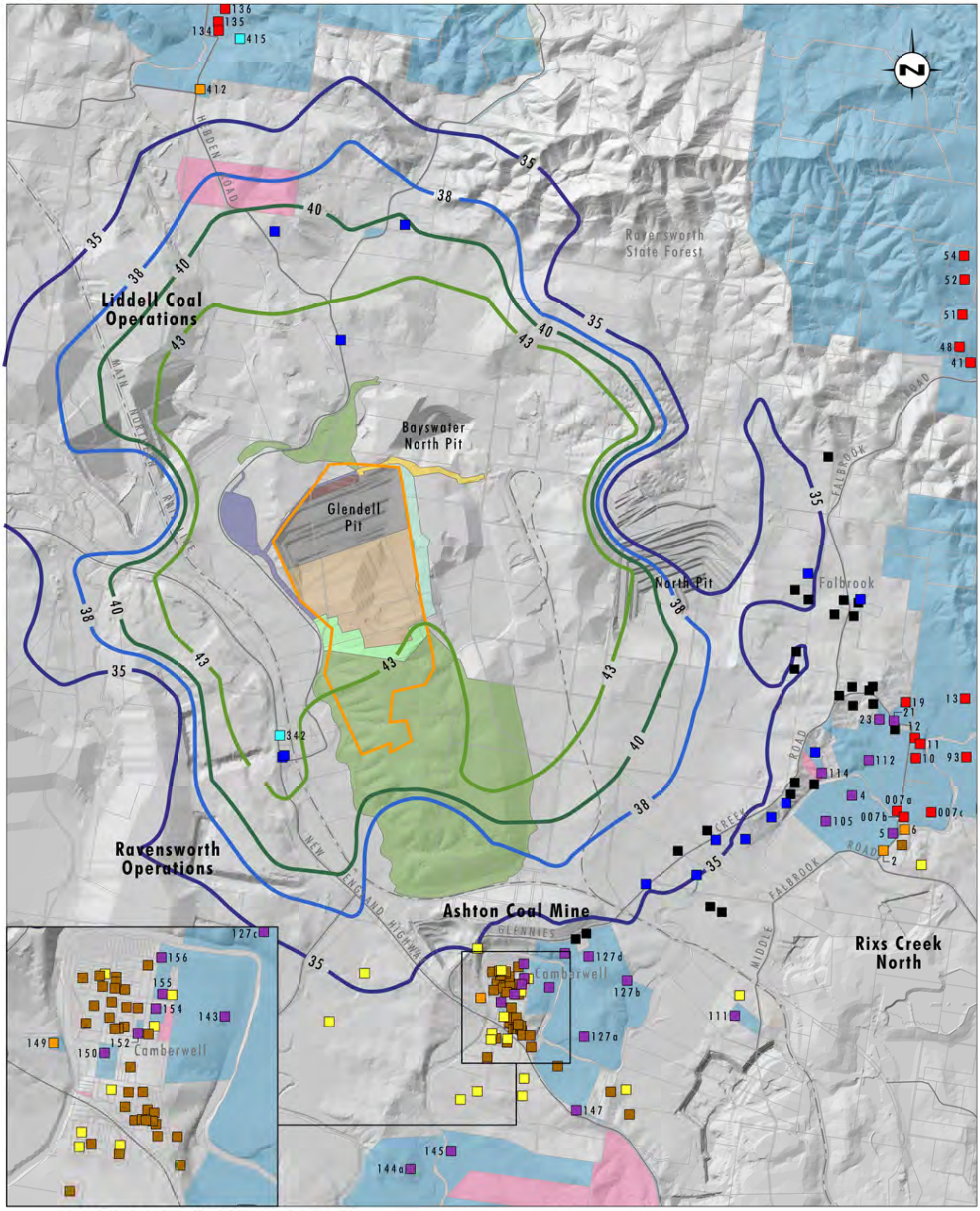
- Glendell Pit Extension
- 35 dB(A) Noise Contour
- 38 dB(A) Noise Contour
- 40 dB(A) Noise Contour
- 43 dB(A) Noise Contour
- Active Mining Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Rehabilitation
- Infrastructure/Internal Access
- Haul Road
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)
- Private Land
- Private Vacant Land (Acquisition Rights)

FIGURE 7.3.4

Predicted Noise Impacts - Year 13

File Name (A4): R08/4166_505.dgn
20191128 14.37

umwelt



Data Source: Glencore (2019), Department of Finance, Services & Innovation (2019), Umwelt (2019)

0 1.0 2.0 4.0km

Legend

- Glendell Pit Extension
- 35 dB(A) Noise Contour
- 38 dB(A) Noise Contour
- 40 dB(A) Noise Contour
- 43 dB(A) Noise Contour
- Active Mining Area
- Active Overburden Emplacement Area
- Topsoil Removal Strip
- Shaping for Final Landform
- Rehabilitation
- Temporary Rehabilitation
- Infrastructure/Internal Access
- Haul Road
- Receptor (Private)
- Receptor (Private - Acquisition Rights)
- Receptor (Private Infrastructure)
- Receptor (Community Infrastructure)
- Receptor (Glencore Owned)
- Receptor (Glencore Owned - Vacant)
- Receptor (Other Mine Owned)
- Receptor (Other Mine Owned - Vacant)
- Private Land
- Private Vacant Land (Acquisition Rights)

FIGURE 7.3.5

Predicted Noise Impacts - Year 18

File Name (A4): R08/4166_506.dgn
20191128 14.42

7.3.4.2 Maximum noise level event (sleep disturbance) - Project

The assessment of sleep disturbance noise levels was based on the noise-enhancing meteorological conditions identified in accordance with NPfI Fact Sheet D (see **Section 7.3.4.1**). ENM's Single Point Calculation feature was used to determine the maximum sleep disturbance noise levels at receiver locations. The predicted $L_{A1,1minute}$ noise levels associated with activities that could result in sleep disturbance are presented in the NIA, refer to **Appendix 14**. Results show that night time noise levels will not exceed sleep disturbance noise goals at any residential receivers.

7.3.4.3 Road impacts - Project

There will be no increase in traffic associated with the ongoing operations as part of the Project, however there will be an increase in traffic volumes associated with the construction phase of the Project peaking in approximately Year 1-2 of the Project. The road noise impacts associated with traffic movements generated by the construction phase of the Project were modelled using the US Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5 Look-Up Tables (U.S. Department of Transportation, 2004). TNM is a highway traffic noise prediction and analysis model used to analyse highway geometries including vehicle speeds, vehicle type, setback distances and the effectiveness of barriers.

Given there are no residential receivers between the New England Highway and the Project Area, the residential receivers (147 and 150), located in Camberwell in close proximity to the New England Highway, are considered to be representative of the receivers that could be affected by the changes to traffic levels.

The traffic volumes in the Traffic and Transport Impact Assessment undertaken for the Project (Puliyapang, 2019) (refer to **Appendix 26**) have been used as the basis for the road traffic noise assessment and are presented in **Table 7.17**.

Table 7.17 Peak (Years 1-2) 2-way Traffic Volumes - New England Highway, Camberwell

Vehicle Classification	Existing Traffic Volumes		Predicted Total Traffic Including Construction Phase Traffic	
	Morning peak [1]	Evening peak [1]	Morning peak [1]	Evening peak [1]
Light	1,292	1200	1,642	1,550
Heavy	103	107	103	107
Total	**1,395**	**1,307**	**1,745**	**1,675**

Note: [1] Morning Peak Hour 5.45 am to 6.45 am, Evening Peak Hour 5.00 pm to 6.00 pm.
Source: Derived from the Sidra Outputs within Appendices D, E, N and O of Appendix 26.

The predicted road traffic noise impacts at the closest private receivers and the relevant assessment criteria are presented in **Table 7.18**.

Table 7.18 Predicted Noise Impacts for Peak Traffic Volumes (Years 1-2), dB(A)

Receiver ID	Existing Traffic Volumes		Peak Traffic Including Construction Phase Traffic		Criteria	
	Morning Peak [5]	Evening Peak [5]	Morning Peak [5]	Evening Peak [5]	Night time [1]	Day time [2]
147	63	63	64	64	55	60
150	50	50	50	50	55	60

Note:
[1] Night time criteria, NSW Road Noise Policy, OEH 2011
[2] Day time criteria, NSW Road Noise Policy, OEH 2011,
[3] Internal noise criteria of 40 dB(A) (OEH 2011), assume 10 dB(A) drop from external noise level (NPfI)
[4] Open Space (passive use) criteria, NSW Road Noise Policy, OEH 2011
[5] Morning Peak Hour 5.45 am to 6.45 am, Evening Peak Hour 5.00pm to 6.00 pm.

The existing and Project noise impacts for property 150 are below the relevant road traffic noise criteria. The predicted existing and construction phase road traffic noise impacts for property 147 are both above the relevant road traffic noise criteria and therefore the relative increase criteria of 2 dB(A) need to be considered. Relative increases in the road traffic noise levels associated with the construction phase of the Project at property 147 are 0.5 dB(A) for the AM peak period and 0.4 dB(A) for the PM peak period which are well within 2 dB(A) of the existing traffic noise levels which will not be discernible from existing road traffic noise levels.

7.3.4.4 Construction noise - Project

In accordance with the ICNG, an assessment of construction noise has been carried out with results showing construction noise is unlikely to be audible at the closest residential receiver (receiver 134), which is located approximately 5 km to the north of the proposed construction activity area. ENM's Single Point Calculation feature was used to determine the construction noise levels at the nearest residential receiver locations under the NPfI default worst case meteorological conditions. The predicted LAeq,15min noise levels associated with the simultaneous operation of the construction fleet under the worst case meteorological conditions is 28 dB(A) at receiver 134. All other residential receivers have lower predicted noise levels.

This falls well under the LAeq (15 min) limits of 45 dB(A) day and 40 dB(A) evening / night. Any construction noise at this receiver would contribute to an acoustic environment that includes noise from adjoining mining and quarry operations (not just the Project), road traffic on Hebden Road and rail traffic on the Main Northern Railway Line. The masking effect of the other contributing noise sources would likely make the construction activities indistinguishable from similar-sounding noise sources, refer to the **Appendix 14** for further detail.

7.3.4.5 Operational modelling results – Mount Owen Consent

From a noise perspective, the Project will result in only small changes to the operations regulated under the Mount Owen Consent. There is no increase in throughput of either the CHPP or rail handling relative to what is currently approved under the Mount Owen Consent other than that associated with the extended period of operations beyond 2037.

From a noise impact modelling perspective, CHPP operations, loading and rail traffic impacts on the Mount Owen Rail Loop have been modelled for the Mount Owen Continued Operations Modification 2 (Umwelt, 2018) assuming worst case production scenarios and these modelled conditions are consistent with the impacts associated with all stages of the Project; accordingly, the Project will not increase noise impacts associated with the Mount Owen CHPP in any year relative to what has previously been modelled for the approved operations under the Mount Owen Consent. The only additional impact in Years 6, 13 and 18 of the Project are the extended use of a dozer or front-end loader at the ROM stockpiles at the Mount Owen CHPP.

The noise impacts of a dozer or front-end loader working on the stockpiles have been modelled under the most noise enhancing conditions during winter nights (i.e. F-class with 2 m/s supporting wind from the north-west) at the most likely affected residences in the Middle Falbrook area (i.e. receiver 114 and 112). The dozer or front-end loader $L_{Aeq,15minute}$ noise level component is relatively insignificant for receiver 114 at 17 dB(A) and 112 at 14 dB(A). As an individual noise source amongst the entire mining operation, the noise impacts from this dozer or front-end loader can be managed to meet the existing Mount Owen Consent noise criteria as this additional dozer or front end loader is a low noise level contributor to the noise levels at the receivers.

The Project will extend the life of the Mount Owen CHPP to 2045. Noise impacts associated with the operation of the ROM coal stockpiles, the CHPP, product stockpiles, rail loading facilities and trains on the Mount Owen Rail Loop will continue during this period as would some plant movement associated with rehabilitation activities. However undertaking rehabilitation activities at the Mount Owen mining areas are not an outcome of this Project and have already been assessed. The noise impacts from these activities will be significantly lower than during the earlier mining phases at all receivers due to the removal of mining related plant at the North Pit during this period.

Accordingly, operations managed under the Mount Owen Consent can continue to be managed to comply with the existing noise criteria under the Mount Owen Consent for the duration of the Project.

7.3.4.6 Cumulative noise - Project

The amenity noise levels calculated for the Project for all receivers for the day, evening and night time periods are 48, 43 and 38 dB(A) $L_{Aeq(15\ minute)}$ respectively. The modelling results confirm that these amenity noise levels are able to be met by the Project at all private receiver locations. Therefore, in accordance with the NPfI no additional consideration of cumulative industrial noise is therefore required.

Notwithstanding this, and due to synergies within operations, the cumulative noise impacts of the existing Mount Owen Complex and the Project, the NIA includes an assessment of the 2 representative years where there will be overlap in full operations to confirm compliance with relevant recommended amenity noise levels under the NPfI. The assessment is based on the recommended rural amenity noise level (during night time) under the NPfI which is 40 (dBA) $L_{Aeq(9\ hour)}$. The results indicate for Year 6 and Year 13 respectively, for winter nights under NPfI default worst case meteorological conditions based on the operational scenarios with reasonable and feasible controls implemented, the ($L_{Aeq,\ 9\ hour}$) amenity noise levels from the operation of the Mount Owen Complex as a whole, do not encroach onto the nearby private receiver locations.

7.3.4.7 Assessment against VLAMP

The relevant VLAMP noise mitigation and acquisition criteria are set out in **Table 7.19**. The criteria apply to operational noise impacts of the Project on privately owned land.

Voluntary Mitigation Rights:

Mitigation rights apply, even with the implementation of best practice management at the mine site, where:

- The noise generated by the development would meet the requirements in **Table 7.19** such that the impacts would be characterised as marginal, moderate or significant, at any residence on the privately owned land, or
- The development would increase the total industrial noise level at any residence on privately owned land by more than 1 dB(A) and noise levels at the residence are already above the recommended amenity noise levels in Table 2.2 of the NPfI, or
- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the RING by greater than or equal to 3 dB(A) at any residence on privately owned land.

Voluntary Acquisition Rights:

Voluntary land acquisition rights apply, even with the implementation of best practice management, where:

- The noise generated by the development would be characterised as significant, according to **Table 7.19**, at any residence on privately owned land, or

- The noise generated by the development would contribute to exceedances of the acceptable noise levels plus 5 dB in Table 2.2 of the NPfI on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls; or
- The development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria in Table 6 of Appendix 3 of the RING at any residence on privately owned land.

Table 7.19 Characterisation of Noise Impacts and Potential Treatments (Table 1 from VLAMP)

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Characterisation of impacts:	Potential Treatment
All time periods **0-2 dB(A)**	NA	Impacts are considered to be negligible	Exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
All time periods **3-5 dB(A)**	< recommended amenity noise level in Table 2.2 of the NPfI; or	Impacts considered to be marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising air quality/amenity
	> Recommended amenity noise level in Table 2.2 of the NPfI, but the increase in total cumulative industrial noise level resulting from the development is <1 dB(A)		
All time periods **3-5 dB(A)**	> recommended amenity noise level in Table 2.2 of NPfI, and the increase in total cumulative industrial noise level resulting from the development is >1 dB	Impacts are considered to be moderate	As for marginal impacts but also upgrade elements like windows, doors or roof insulation, to further increase the ability of the building façade to reduce noise levels
Day and Evening **>5 dB(A)**	< recommended amenity noise levels in Table 2.2 of the NPfI		
Day and Evening **>5 dB(A)**	> recommended amenity noise levels in Table 2.2 of the NPfI	Impacts are considered to be significant	Provide mitigation as for moderate impacts and apply voluntary land acquisition provisions
Night **>5 dB(A)**	Not applicable	Impacts are considered to be significant	Provide mitigation as for moderate impacts and apply voluntary land acquisition provisions

As discussed in **Section 7.3.4**, modelling results indicate no private receivers exceed the project noise trigger level as a result of the Project. Additionally, the Project does not contribute to exceedances of the acceptable noise levels (plus 5 dB in Table 2.2 of the NPfI) on more than 25% of any privately-owned land. Therefore, no private receivers (or privately owned land) have been identified as requiring mitigation or acquisition rights in relation to noise impacts in accordance with the VLAMP as a result of the Project.

7.3.5 Management and monitoring

7.3.5.1 Noise management plan

The approved operations at the Mount Owen Complex currently operate in accordance with the approved Mount Owen Complex Noise Management Plan (NMP) (Glencore, 2019e), which will be reviewed and updated to reflect the relevant aspects of the Project following approval. The suitability of the noise management controls is to be assessed on an annual basis as part of ongoing review of operational risks to the Project. It is noted that the revisions to the NMP will focus on the changes relevant to the Project with the existing noise management processes identified in the approved NMP being applied to the Project where relevant and remaining valid for activities and areas outside the Project.

7.3.5.2 Proactive noise management

During adverse weather conditions, Glencore will continue to initiate changes to operations to mitigate potential noise impacts. Glencore uses predictive forecasting of adverse weather conditions to identify when and where management measures are likely to be required as a result of an adverse weather event. The current NMP outlines the procedural requirements for the predictive forecasting of adverse weather conditions. A typical response to the prediction of an adverse weather event could include:

- Key operational personnel are alerted by the environmental forecast system, or other similar system(s) that operations may need to be modified to avoid noise impact at sensitive receivers.
- Monitoring the noise levels recorded by the real-time noise monitoring network to assess when the noise levels are approaching predefined noise conditions and the modification of operations to adapt to the situation as required.
- Modifying or temporarily ceasing part of the operations, if required, to prevent noise criteria being exceeded.
- Recording the actions taken when management measures are implemented.

The meteorological monitoring sites are linked to the real time monitoring system allowing access to real time weather conditions and the effective management of operations during periods of adverse weather. Glencore will maintain the existing Mount Owen Complex continuous (real time) monitoring network consisting of fixed and mobile continuous noise monitoring units and weather stations.

The monitoring network is currently used as a proactive way to manage operational noise performance. The continuous noise monitors allow noise levels and local meteorological data to be analysed and compared against the development consent and EPL conditions, providing information on the ongoing performance of the mine.

7.3.5.3 Reactive noise management

Real time monitoring is used as an on-site monitoring tool to assist with the investigation of complaints or noise related issues and to inform sites (via alarms) that noise levels are elevated and are nearing compliance limits. Each real time noise monitoring unit is designed to send alerts advising mining personnel that noise at the monitor is approaching performance criteria. Action can then be taken to modify operations where appropriate.

The real time noise monitors have been setup to record directional, low frequency noise sources. In the event an alarm is triggered, the site will record actions taken in response to the alarms in accordance with site procedures.

A Noise Management Trigger Action Response Plan (TARP) has been developed for the approved operations which will be reviewed and updated should the Project be approved. The TARP details the limits and response required by the mine in the event noise alarms are triggered.

7.3.5.4 Monitoring

Noise monitoring at the Mount Owen Complex takes the form of either compliance monitoring or performance management monitoring, in accordance with the approved NMP. Compliance monitoring is by attended monitoring at defined locations, at regular intervals as set out in the statutory requirements. Performance management monitoring utilises real time noise monitoring systems on a continuous basis and allows operations to be managed to reduce noise where necessary. Should compliance monitoring identify noise levels which are at criteria levels this will trigger further performance management monitoring at additional sites over a wider area to allow Glencore to gauge the level of noise and its audibility in the wider environment.

The Mount Owen Complex monitoring locations (including those required under the Mount Owen Consent and EPL) are shown on **Figure 7.3.6**. The existing noise monitoring network is considered sufficient to monitor noise levels associated with the Project, as mining progresses to the north in the Glendell Pit Extension the monitoring network will be reviewed and updated as required.

To ensure ongoing compliance with the relevant noise criteria, Glencore will continue to actively manage the operations by controlling the placement and use of mining equipment, particularly during unfavourable meteorological conditions, as detailed in the NMP. Worst-case weather conditions for all areas other than the Hebden area (Area 11) would be associated with winds from the north-west and during winter inversion conditions with drainage flow from the north-west. The worst-case weather conditions for the Hebden area (Area 11) would be associated with winds from the south-east or during winter inversion conditions with supporting winds from the south-east.

To assess the effectiveness of the control measures and when they should be implemented, Glencore will maintain the current performance monitoring program as detailed in the NMP.

In relation to compliance monitoring, rather than monitoring at all locations detailed in the various development consents and EPLs for the Mount Owen Complex, the Secretary has approved the use of representative monitoring locations to assess compliance with noise criteria for both the Glendell Consent and the Mount Owen Consent, as detailed in the NMP. It is proposed to adopt the same approach for the Project, to be revised as required to suit the mining activities proposed in the Glendell Pit Extension.

Attended monitoring for compliance assessment is currently completed at eight locations surrounding the Mount Owen Complex (N1 – Greenlands; N3 – Middle Falbrook; N4, N11 – Glennies Creek; N8, N9, N10 – Camberwell; and N17 – Hebden), that are considered to be representative of the most sensitive noise receivers. Of the monitoring locations applicable to the Mount Owen Complex, those which are relevant to the Glendell Mine are N3, N8, N9, N10, N11 and N17. N4 is however an effective monitoring location for assessing compliance in other locations and is currently used to determine whether specific compliance monitoring is required at N11. The continued use of N4 as a monitoring location will be reviewed as part of the regular Mount Owen Complex NMP review process. The monitoring locations shown in **Figure 7.3.6** and will be reviewed periodically to ensure monitoring is undertaken at appropriate representative locations. Any changes will be reflected in amendments to the NMP.

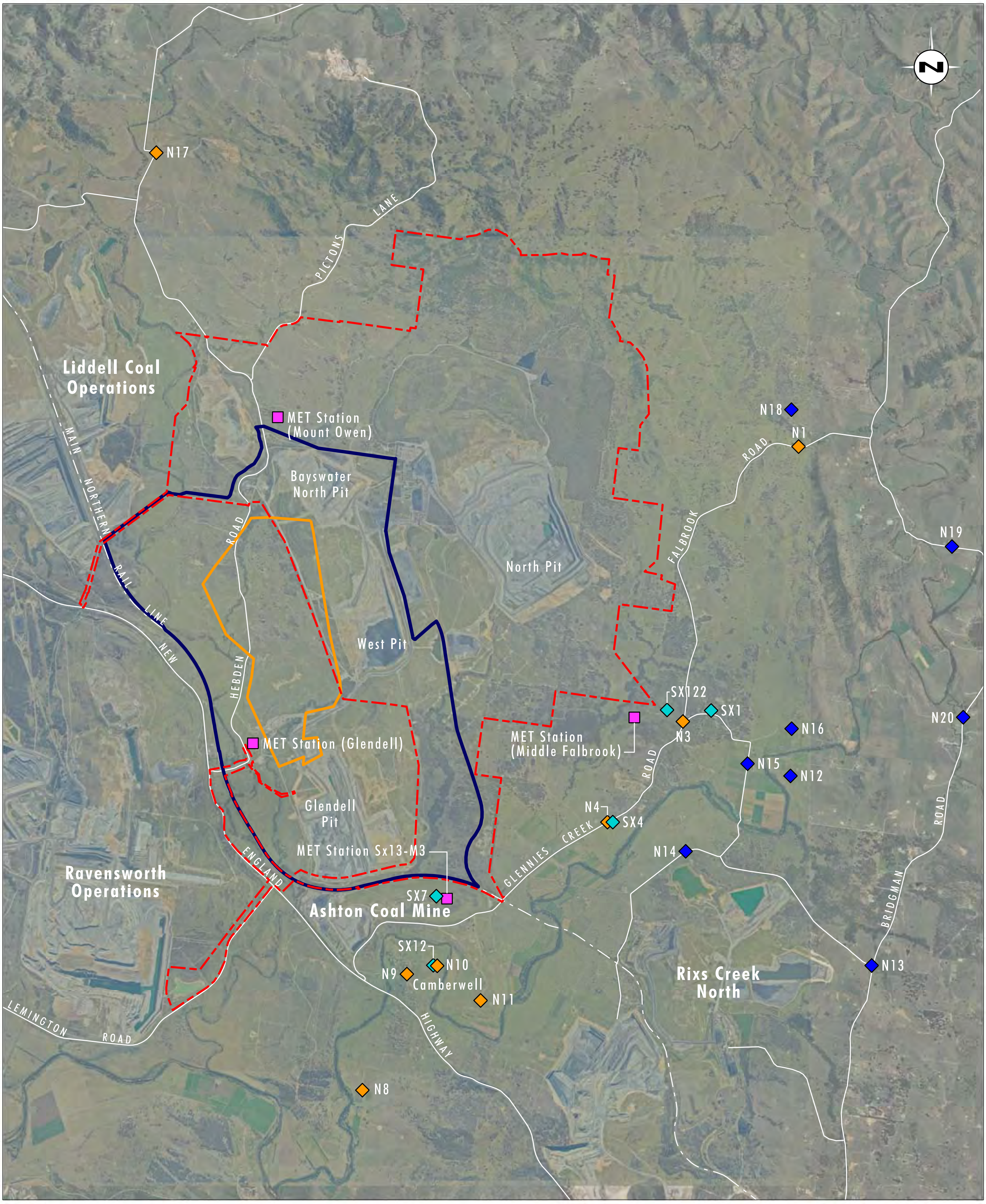


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Attended Noise Monitoring Location
- Real Time Continuous Noise Monitoring Location
- Meteorological Station Location
- Supplementary Performance Management Attended Noise Monitoring Location

FIGURE 7.3.6

Mount Owen Complex
Noise Monitoring Locations

At each compliance noise monitoring location, the nearest privately-owned residence has been used to determine proposed noise monitoring criteria (refer to **Table 7.20**). The proposed noise monitoring criteria are based on the probabilistic noise modelling results (presented in Appendix F Table F.2 of the NIA, refer to **Appendix 14**) and consider noise propagation under standard, noise-enhancing and very noise-enhancing meteorological conditions. If the adopted noise criteria at the compliance noise monitoring location are exceeded, it will be considered that the noise criteria at any of the residences in the defined receiver area may also have been exceeded.

Table 7.20 Adopted Compliance Noise Monitoring Locations and Criteria for the Project

Monitoring location	Closest privately-owned residence	Receiver Area/Residences represented by monitoring location	Adopted Noise Monitoring Criteria for the Project, dB(A)	
			Day/Evening/Night LAeq, 15 min	Night LA1, 1 min
N3	23	Area 4 North all private residences Area 4 South all private residences Area 7 all private residences	40/35/35	45
N8	145	Residences 145, 144a	40/38/37	45
N9	150	Residences 147, 150, 152	40/40/38	45
N10	143	Residences 143, 154, 155, 156	40/40/38	45
N11	127a	Residences 111, 127a, 127b, 127c, 127d	40/40/38	45
N17	134	Area 11 all private residences	40/35/35	45

Note: monitoring location N1 is not relevant to this Project and has been omitted from consideration.

In addition to the compliance monitoring locations, eight supplementary performance management attended monitoring locations (N12, N13, N14, N15, N16, N18, N19 and N20) are located in the region surrounding Mount Owen Complex, also shown **Figure 7.3.6**. Monitoring at these locations is supplementary to the routine compliance monitoring and may be used if potentially high noise levels are recorded at the routine monitoring locations. The additional monitoring locations form part of the performance management program.

7.4 Blasting

A comprehensive assessment of the potential blasting impacts of the Project has been undertaken by Enviro Strata Consulting. This assessment has been undertaken in accordance with the SEARs for the Project (refer to **Appendix 4**), which require a detailed assessment of the likely blasting impacts of the Project on people, animals, buildings, infrastructure and significant natural features having regard to relevant Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines.

As outlined in **Section 6.0**, blasting and vibration impacts were identified by some members of the community as an issue of concern. This is consistent with the community feedback that was received during the Mount Owen Continued Operations Project approval and subsequent Modification 2. As described below, Glencore has continued to acknowledge this feedback and sought to address it through operational controls such as strategic design of blasts and management of charge masses, and as part of the planning and design stages of the Project.

In this regard, Glencore has a demonstrated track record of managing blasting impacts from the operations at Mount Owen Complex with no exceedances of the relevant ground vibration criteria or relevant blast overpressure criteria during the previous 5 years from 2014 to June 2019. Mount Owen Complex has a comprehensive approved Blast Management Plan (BMP)(Glencore, 2018l) in place, and in accordance with this plan Glencore will continue to utilise a range of management strategies informed by regular monitoring and reporting of blasting outcomes. It should be noted that the Project does not impact on any blasting undertaken as per the Mount Owen Consent.

A summary of the key findings of the Blasting Impact Assessment (BIA) is provided in this section and the full report is provided in **Appendix 15a**.

In addition to the BIA, Enviro Strata Consulting have also undertaken a detailed assessment of the blast impacts on the integrity of rock strata between Bowmans Creek and the Glendell Pit Extension. A summary of the key findings of this assessment is provided in **Section 7.4.2.5** and the full report is provided in **Appendix 15b**.

It is noted that potential blast fume impacts have been assessed as part of the AQIA (refer to **Section 7.2**).

7.4.1 Methodology

Ground vibration and airblast overpressure predictive models were developed to assess the potential blasting impacts of the Project. The models were developed based on a review of monitoring data collected from the existing mining operation including the refinement of relevant blast predicting site laws. Glencore has detailed knowledge of the specific geotechnical and geological characteristics of the strata proposed to be mined and how these materials perform when blasted, based on the management of mining in the current Glendell Pit and previous and current mining in the surrounding areas.

A range of blast charge masses and bench heights were modelled for the Project. The modelled blast sizes were selected as being representative of the range of blast sizes that may occur at the mine. It is noted that in practice, each blast will be designed on a case by case basis to comply with relevant ground vibration and airblast overpressure criteria, however, this range of different blast sizes was utilised for assessment purposes.

To assess the blasting undertaken for construction activities such as the blasting that may be required during the construction of the Yorks Creek Realignment, a range of blast charge masses and bench heights were modelled as being representative of the range of construction blast sizes that may occur.

The assessment of the blast impacts on the integrity of rock strata between Bowmans Creek and the Glendell Pit Extension was completed through a visual inspection of the creek bed conditions, creek banks and the area located between Bowmans Creek and the Glendell Pit Extension. In addition to the visual inspection, assessment of the creek bed conditions including identification of rock strata layers and rock strata testing using a non-destructive rock testing method was completed, through the use of a Schmidt Hammer and penetrometer.

7.4.1.1 Blast sensitive locations

A number of blast sensitive locations surrounding the Glendell Pit Extension were identified for consideration in the BIA. These locations are shown on **Figure 7.4.1** and include:

- private residences within a 5 km radius of the Glendell Pit Extension
- heritage items including the Ravensworth Homestead
- infrastructure such as public roads, railway lines, electricity transmission lines, telecommunication tower and cables, prescribed dams, bridges and overpasses, and
- natural features such as Bowmans Creek and the Yorks Creek Realignment.

As shown on **Figure 4.17**, the majority of land surrounding the Project Area is mine owned with the closest private residence (ID 156) located approximately 3.5 km to the south-east of the Glendell Pit Extension in Camberwell.

7.4.1.2 Assessment criteria

The blast assessment criteria relevant to the Project based on the locations identified in **Section 7.4.1.1** are outlined below.

Table 7.21 contains the relevant blast assessment criteria for occupied residences from the ANZECC guidelines, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (1990). This criteria is consistent with the Glendell Consent.

Table 7.21 Residential Blasting Impact Assessment Criteria

Receiver	Peak Particle Velocity (mm/s)	Allowable Exceedance of Peak Particle Velocity	Airblast Overpressure (dBL)	Allowable Exceedance of Airblast Overpressure
Residence on privately-owned land[1, 2]	5	5% of the total number of blasts over a period of 12 months	115	5% of the total number of blasts over a period of 12 months
	10	0%	120	0%

Note:
1 Item listed under Glendell Consent
2 Items consistent with ANZECC (1990) guidelines

The blast assessment criteria associated with property damage relevant to infrastructure and heritage items are provided in **Table 7.22** and criteria associated with surrounding non-Glencore mine infrastructure is provided in **Table 7.23**. It is noted that these criteria are impact assessment criteria and not necessarily limits that must be met but indicate the levels at which no impacts are predicted.

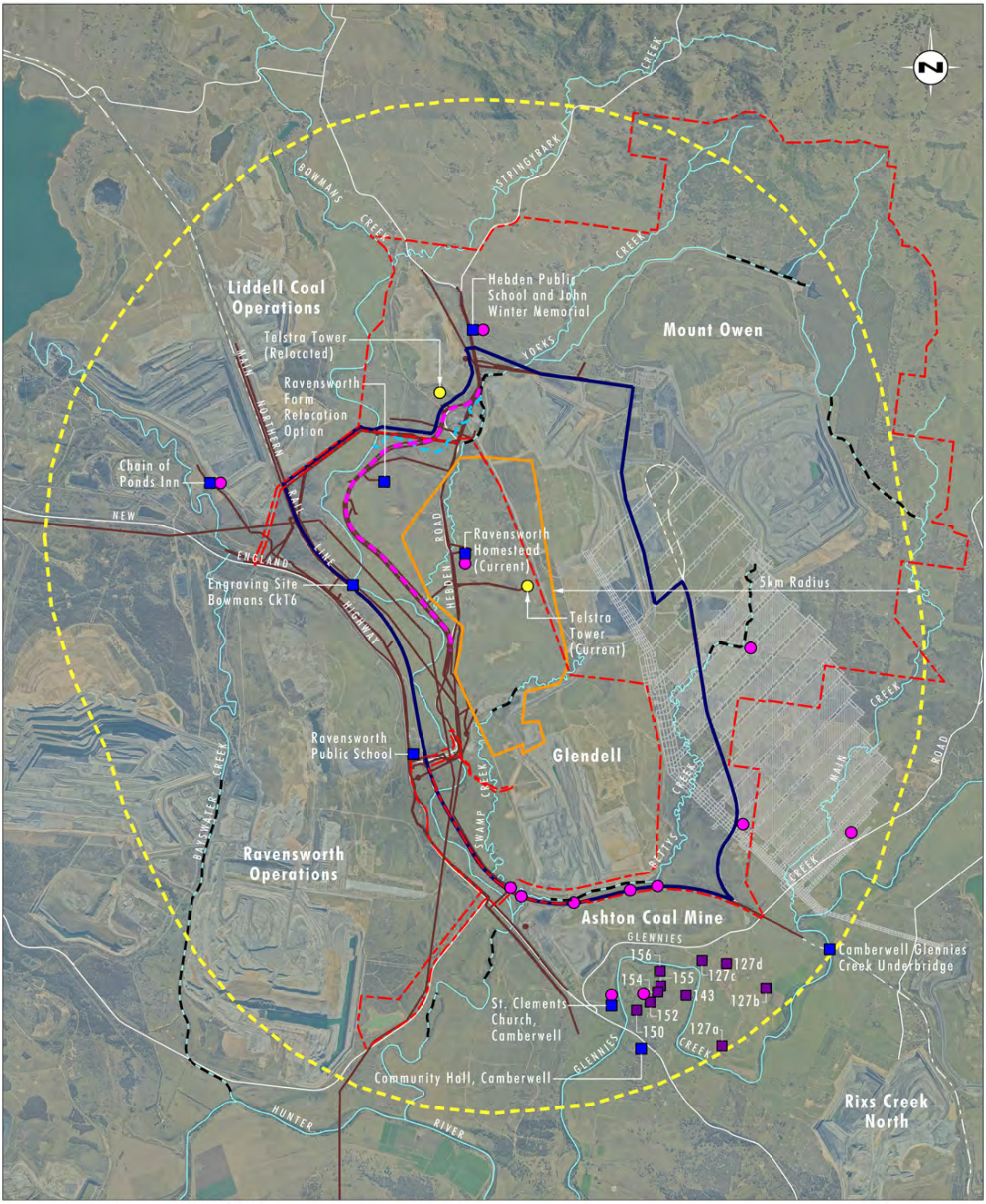


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), AGE (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1 2 4km
1:75 000

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- 5km Radius
- Existing Creek Diversion
- Yorks Creek Realignment
- Hebden Road Realignment
- Powerline/Communications
- Heritage Item
- Existing Blast Monitoring Location
- Telstra Tower
- Private Residence (Acquisition Rights)
- Integra Underground Workings

FIGURE 7.4.1

Blast Sensitive Locations and Monitoring Network

Table 7.22 Infrastructure and Heritage Items Blasting Impact Assessment Criteria

Receiver	Peak Particle Velocity (mm/s)	Allowable Exceedance of Peak Particle Velocity	Airblast Overpressure (dBL)	Allowable Exceedance of Airblast Overpressure
Heritage Items				
St Clements Anglican Church[1,2]	2	5% of the total number of blasts over a period of 12 months	115	5% of the total number of blasts over a period of 12 months
	5	0%	120	0%
Ravensworth Homestead[2, 3]	5	0%	126	0%
Chain of Ponds Inn[2]	10	0%	133	0%
Community Hall in Camberwell[4]	10	0%[6]	133	0%
Ravensworth Public School[5]	25	0%	133	NA
Hebden Public School[2]	16	0%	NA	NA
John Winter Memorial Site[2]	250	0%	NA	NA
Camberwell Glennies Creek Underbridge[5]	50	0%	NA	NA
Aboriginal Engraving Site Bowmans Creek 16	50	0%	NA	NA
Infrastructure				
Electricity Transmission Towers/Poles and Associated Infrastructure[1]	50	0%	NA	NA
Prescribed Dams[1]	50	0%	NA	NA
Railway Lines - Main Northern Railway, Culverts, Bridges and Associated Infrastructure[1]	25	0%	NA	NA
Public Roads[2] and Concrete Bridges	100	0%	NA	NA
Telecommunication Infrastructure	100	0%	NA	NA
Community and Private Infrastructure	25	0%	133	NA
All other Public Infrastructure[2]	50	0%	NA	NA
Natural Features				
Bowmans Creek High Bank[7]	100	0%	NA	NA
Yorks Creek Realignment	100	0%	NA	NA

Note:
1 Item listed under Glendell Consent
2 Item listed under Mount Owen Consent
3 Structure to be relocated and assessed by a specialist consultant to establish new applicable criteria (Ravensworth Farm option only)
4 Item assessed in Ashton South East Open Cut blast assessment
5 Item referenced in Mount Owen Consent; under no applicable compliance limit
6 Private Agreement - Blasting within 0.5 km of infrastructure owned, leased or controlled by ARTC at Camberwell may exceed 25 mm/s for the Main Northern Railway culverts and bridges, providing Clause 5 conditions of the "ARTC Blasting Deed (2013)" have been satisfied
7 Refer to ESC (2019b) for definition of this criterion

Table 7.23 Mine Infrastructure

Receiver	Peak Particle Velocity (mm/s)	Allowable Exceedance of Peak Particle Velocity	Airblast Overpressure (dBL)	Allowable Exceedance of Airblast Overpressure
Integra Underground Workings[1]	10 or 250[2]	0%	NA	NA
Non-Glencore Surface Mine Infrastructure - occupied	25	0%	133	0%
Non-Glencore Surface Mine Infrastructure - unoccupied	100	0%	133	0%

Note:
1 Item listed under Mount Owen Consent
2 10 mm/s safety and personnel withdrawal limit for occupied underground workings and 250 mm/s structural limit for unoccupied workings

7.4.2 Assessment

7.4.2.1 Residences on privately-owned land

The ground vibration modelling for residences on privately-owned land within a 5 km radius revealed that ground vibration levels at all private residences can be managed effectively within the specified blasting criteria shown in **Table 7.21**.

The airblast overpressure modelling has demonstrated that blasting is able to be designed and managed to ensure that airblast overpressure levels can be managed effectively at all private residences to below the criteria shown in **Table 7.21**. A range of pre-blast assessments, including weather monitoring and an assessment of inversion and wind shear conditions, are undertaken prior to any blast to manage overpressure compliance risks.

Due to the substantial distances to private residences (at least 3.5 km), the potential risk of flyrock impact is considered negligible.

Consistent with current practices at Mount Owen Complex, a detailed blast design process will be undertaken for each blast in order to establish the charge masses required to meet the relevant criteria at all private residences.

7.4.2.2 Heritage items

Heritage items assessed include all identified items located within a 5 km radius of the Glendell Pit Extension. The location of these items are shown on **Figure 7.4.1**.

As the Ravensworth Homestead is located within the Glendell Pit Extension, its removal is required. As a mitigation measure, Glencore is proposing to relocate the Homestead and associated buildings to an alternative location. The ground vibration and airblast overpressure modelling indicates that the relocation of the Ravensworth Homestead is required, based on the conceptual mining progression, by approximately the end of Year 5 (approximately 2025) of the Project. This corresponds to an approximate minimum distance to blasting of 1,100 m from the Homestead (approximately near the southern boundary of the Core Estate Lands (refer **Section 7.8**). Until the relocation of the Ravensworth Homestead occurs, blasting can be managed effectively within the specified blasting criteria shown in **Table 7.23**.

As discussed in **Section 3.2.9**, two relocation sites have been proposed, a local move to 'Ravensworth Farm' site in proximity of the new MIA (approximately 630 m from the Glendell Pit Extension) and a site in Broke. However, blast impacts have only been assessed at the local move option due to the proximity of this option to the Glendell Pit Extension, and the considerable distance to the alternate proposed location in Broke (approximately 45 km).

Should the Homestead be approved to be relocated to the 'Ravensworth Farm' site, the BIA modelling indicates that impacts can be effectively managed to maintain the ground vibration levels below the existing vibration limit of 5 mm/s (under the Mount Owen Consent) by managing charge masses which can be achieved either by blasting smaller benches or by the application of deck charges, together with the application of precise initiation timing. Once the relocation works are completed and the Homestead is located at the 'Ravensworth Farm' site, a staged testing program will be carried out to confirm the new vibration limit. The vibration limits for the Ravensworth Homestead are expected to increase once the building is relocated due to the significant improvements to the building foundations completed as part of the relocation. However, until new limits have been confirmed, the current Mount Owen Consent criteria will continue to apply to the Homestead in its relocated position.

A further potentially sensitive site identified in the vicinity of the Project is the Bowmans Creek 16 (37-3-0772) Aboriginal engraving site, which is located approximately 900 m from the Glendell Pit Extension. Ground vibration modelling predicted that the Bowmans Creek 16 Aboriginal engraving site is likely to be exposed to maximum ground vibration levels of less than 10 mm/s (refer to **Appendix 15a)**, which is significantly below the ground vibration criteria of 50 mm/s shown in **Table 7.22.**

All remaining heritage items assessed were found to be below the applicable criteria shown in **Table 7.22**.

7.4.2.3 Infrastructure

Generally, infrastructure items are not assessed in terms of airblast overpressure exposure as levels required to inflict damage are not applicable and/or not predicted to be reached, however the estimated maximum airblast overpressure exposures for all infrastructure with imposed limits are below the specified blasting criteria shown in **Table 7.22**.

There are several types of infrastructure located within 500 m of the Glendell Pit Extension including the current and proposed alignments of Hebden Road, buried communication cables, electricity transmission lines, as well as the current and proposed location of a telecommunication tower. An electrical substation and current and proposed bridges on Hebden Road are also within 500 m of the Glendell Pit Extension. The assessment determined that the predicted ground vibration levels for these infrastructure items can be managed effectively to remain below the applicable ground vibration criteria shown in **Table 7.22**. Any adjustments to these vibration limits will be managed in consultation with the asset owner to seek agreement to modify these limits, where deemed relevant.

In addition, for close range blasting, the potential impact of flyrock and dust on the public roads and adjacent infrastructure can be managed effectively through the development and implementation of a Road Closure Management Plan. In accordance with the current BMP, the Project will operate using an appropriate exclusion zone to manage the risk of flyrock. As discussed in **Section 3.2.3.4**, intermittent road closures of Hebden Road will be required throughout the Project. Where possible, blasts will be conducted in off peak times and at times where school related traffic is not expected, to minimise disruptions on local traffic movements.

The BIA predicted that the remaining infrastructure items listed in **Table 7.22** were all assessed to be subjected to blast related ground vibration and airblast overpressure levels below the applicable criteria, in their current and proposed locations where relevant.

7.4.2.4 Impacts on surrounding mining operations

There are a number of adjacent operating coal mines surrounding the Project Area including the Mount Owen Complex, Integra Underground, Ashton Coal Mine and Liddell Coal Operations. The maximum predicted vibration for the surface infrastructure of these operations were found to be below the applicable recommended vibration levels for both occupied and unoccupied structures (refer to **Table 7.23**).

With regard to Integra Underground operations, underground workings were predicted to receive ground vibration levels from the Project below the applicable vibration limits shown in **Table 7.23**. Vibration impacts on occupied underground workings can be managed via the application of lower Maximum Instantaneous Charge (MIC) to remain below the applicable criteria.

The Mount Owen Complex operates a successful blast notification and management system with nearby mines in relation to the coordination of blasts to avoid concurrent blasting and therefore reduce the potential for cumulative airblast overpressure and ground vibration impacts, which will continue for the life of the Project.

7.4.2.5 Bowmans Creek

The Glendell Pit Extension is offset at least 200 m from the top of the high bank of Bowmans Creek. There are no specific geotechnical or geomorphological features either within Bowmans Creek or between the Glendell Pit Extension and Bowmans Creek that would increase the potential effects of blasting near Bowmans Creek and the associated alluvium. Due to the presence of the Camberwell anticline, the strata in this area dips to the west which is away from the Glendell Pit Extension (refer to **Figure 4.3**). This is favourable as any groundwater losses from the Bowmans Creek alluvium into the hard rock strata would be directed away from the Glendell Pit Extension.

To manage potential impacts to Bowmans Creek (e.g. surface cracking), an appropriate ground vibration limit has been determined as part of the BIA (refer to **Table 7.22**). The associated alluvium material does not present any specific, distinct feature on the ground that could be affected by ground vibration, and therefore a specific vibration limit for the alluvium was not required to be developed. Modelling indicated that at the shortest distance, expected vibration levels will be below the applicable criteria shown in **Table 7.22**.

The identified rock strata underlying Bowmans Creek includes layers of sandstone, siltstone and coal which are considered to form an adequate creek base and are not prone to surface cracking at moderate/high vibration exposure. The non-destructive testing indicated that the creek bed and creek banks are resistant to moderate to high vibration impacts from the Project, however the creek bank is still prone to natural erosion processes and ongoing degradation.

Rock strata fracturing is dependent upon the rock strength characteristics and blasting parameters. The geotechnical assessment of the rock strata revealed moderately strong strata conditions which can sustain substantial blast impacts and prevent any significant damage propagation. It is estimated that strata fracturing due to the impact of blasting is potentially limited to a distance of 12 m from the Glendell Pit Extension.

The Glendell Pit Extension has been designed to maintain a minimum distance of 200 m from the top of the high bank of Bowmans Creek. The BIA considered the risk of damage to underlying rock strata and subsequent damage or crack formation resulting in increased permeability between the Glendell Pit Extension and Bowmans Creek. The BIA considered potential risk of blast impacts resulting in damage to the creek bed or creek bank and subsequently increasing permeability of the underlying strata is low to negligible beyond 12 m distance from the proposed blasts (potential rock strata damage zone). The BIA concludes that any rock fracturing and subsequent increased permeability that results from blasting will not extend far enough to the west to intercept the Bowmans Creek alluvium and result in leakage into the pit.

The geotechnical assessment of blast impacts on the integrity of Bowmans Creek rock strata did not identify any significant risks from blasting for Bowmans Creek. Refer to **Appendix 15b** for further detail.

7.4.2.6 Animals and livestock

Previous investigations of potential blasting impacts have been completed within the area surrounding the Project. The majority of the land surrounding the Project Area is used for cattle grazing and other neighbouring mining operations.

Investigations undertaken by Neil Nelson Advice Pty Limited (Agriculture Consultancy Service) in 2011 included observations made at a Colinta Holdings feedlot, located on Falbrook Road approximately 4 km east of the Project Area. Observations were made during four separate blasts with no disturbance of the livestock observed within the feedlot or within the paddocks adjoining the feedlot during blasting activities. The report concludes that while blasting can result in immediate noise disruption, so does that of passing traffic and general farming equipment.

A review of blasting noise (airblast) and vibration impacts on cattle was also undertaken by SLR at the Mount Owen Complex in 2018. The assessment found that the measured levels are significantly lower than the acceptable levels and concluded the Mount Owen blasting levels are highly unlikely to be causing adverse impacts on cattle within the feedlot approximately 5 km away (SLR, 2018).

Given the history of mining activities within the Project Area and surrounding mining operations, blast noise associated with the Project will not be an unfamiliar noise source to the area and livestock and other animals are likely to be accustomed to blast noise, airblast overpressure and ground vibration impacts. Observations noted above indicate that livestock introduced to the area are also unlikely to be adversely impacted by blasting activities undertaken for the Project. Currently the closest private grazing land is approximately 4 km from the Project Area.

For further detail regarding impacts on animals and livestock, refer to **Sections 7.6** and **7.12**. Impacts on native animals are addressed in **Appendix 20.**

7.4.2.7 Construction blasting

As discussed in **Section 3.2.11**, the Project requires the realignment of the lower reach of Yorks Creek to the north of the Glendell Pit Extension. The realignment works may require relatively small-scale construction type blasting to achieve the required excavation design level, subject to geotechnical characteristics of the rock material to be excavated. The construction blasting (if required), will be undertaken prior to the relocation of Hebden Road and associated infrastructure due to the proximity to the realigned Hebden Road. If necessary, short term road closures may be required, similar to those required for production purposes.

The BIA involved blast vibration modelling based on construction type blasting parameters including benches in the range of 5 to 15 m and concluded that the predicted impacts from construction blasts on the surrounding environment can be managed effectively below the applicable vibration limit criteria.

The results of the BIA indicate that ground vibration and airblast overpressure levels can be managed to meet relevant blast emission criteria at all sensitive receiver locations through appropriate blast design and the implementation of appropriate control measures. Each construction blast will be designed to comply with the relevant criteria identified in **Table 7.21** to **Table 7.23.**

7.4.3 Management and mitigation

No more than eight blast events per week (averaged over a 12 month period) or 2 blast events per day between the hours of 9.00 am and 6.00 pm Monday to Saturday, with an allowance for additional blasts where there are low vibration blasts, misfires or where blasts are required to ensure the safety of the mine or its workers will occur for the Glendell Pit Extension. In addition, consistent with the Mount Owen Consent, 12 blasts per year between the hours of 7.00 am and 9.00 am Monday to Saturday may occur throughout the Project.

Glencore will review and update the existing BMP as part of the implementation of the Project and implement this plan for all blasting operations. The BMP will be revised to detail the application of monitoring and management controls to manage blasting impacts associated with the Project to maintain compliance with relevant blasting criteria as required.

Glencore will consult with the asset owner to seek agreement to modify any vibration limits on infrastructure, where deemed relevant. The BMP will be updated following any changes to the relevant vibration limits.

Glencore will develop and implement a Road Closure Management Plan to manage the impacts on public roads and infrastructure. The risks of flyrock will also be managed via the implementation of the Road Closure Management Plan.

Glencore will continue to liaise with nearby operations through the current blast notification and management system in relation to the coordination of blasts to avoid concurrent blasting and therefore reduce the potential for cumulative airblast overpressure and ground vibration impacts.

Glencore will continue to operate the blasting hotline and provide up to date information for the community relating to the blasting schedule for the Mount Owen Complex.

The existing multi-station blast monitoring system at Glendell Mine will continue to be used. This monitoring system will also be reviewed and revised as required to cover the sensitive receivers located in the vicinity of the Glendell Pit Extension. Glencore will install 2 new blast monitoring stations to the west of the Glendell Pit Extension, representative of the closest locations to infrastructure such as electricity transmission lines. The existing blast monitoring station located at the Ravensworth Homestead will be relocated with the homestead to the recipient site for the Ravensworth Farm option.

When blasting within 300 m of the high bank of Bowmans Creek, as a precautionary measure, Glencore will undertake regular site inspections along the western highwall of the Glendell Pit Extension and the closest section of Bowmans Creek for any damage to identify and monitor blast induced surface impacts such as surface cracking as a precautionary measure. A review of the blast design processes will be undertaken if surface cracking beyond 12 m is observed.

7.5 Water Resources

The Project will interact with both surface waters and groundwater. The potential for adverse impacts on Bowmans Creek and its associated alluvial aquifers was identified as an issue of concern by stakeholders during the community engagement process undertaken during the scoping phase of the Project. In recognition of the interactions with water resources and concern raised by the community, the effective management of this valuable natural resource was a key consideration in project planning and the environmental assessment processes.

Current and approved operations within the Mount Owen Complex include the North Pit and Bayswater North Pit (approved under the Mount Owen Consent) in addition to the Glendell Pit. As outlined in **Section 2.1**, coal mining in the area, including at the Mount Owen Complex, has been undertaken for over 50 years and mining in the Glendell Pit has occurred since 2008. In addition to mining at the Mount Owen Complex, there is an extensive history of mining in the areas within and surrounding the Project Area, as shown in **Figure 4.10**. As such, the Project is located within an area that has both historical and future approved mining related impacts to water resources. This history of mining has and continues to impact on both surface water and groundwater flows in the area. In this regard, the temporal nature of the impacts on both surface water and groundwater systems from historical and existing approved operations needs to be understood to obtain a full understanding of the nature of impacts that the Project will have on this already significantly disturbed system.

The extensive history of past mining and the associated monitoring of the surrounding environment provides an extensive level of baseline information regarding the nature of impacts from mining in the area and the efficacy of different mitigation measures available. The data available from the monitoring associated with these historical and currently approved mining operations also enable models developed for the surface water and groundwater assessments to be calibrated. The combination of monitoring and anecdotal information also enables the results from the assessments to be tested and this provides increased confidence in both the assessment of impacts and the applicability and effectiveness of mitigation measures.

The Project will extend many of the existing groundwater and surface water management processes currently employed at the Mount Owen Complex. As discussed in **Section 2.1.4**, the Mount Owen Complex WMS is an established system with a long history of effective management of potential impacts on water quality. The integration of the Mount Owen Complex with the GRAWTS enables water and tailings to be transferred between the Mount Owen Complex and other Glencore-operated mines and allows for greater flexibility and efficiency in water use and management across these interlinked sites. The existing Mount Owen Complex water management mitigation measures which will be extended to the Project have a high degree of effectiveness as they are based on engineered controls which have a robust performance history.

7.5.1 Approach to assessment

To assess the potential impact of the Project on water resources, comprehensive assessments of the potential surface water impacts (including site water balance) and groundwater impacts were undertaken and are provided in the Surface Water Impact Assessment (SWIA) (refer to **Appendix 16**) and Groundwater Impact Assessment (GWIA) (refer to **Appendix 17**). Components of the studies, in particular the assessment of the recovery of the Glendell Pit Extension final void and the calculation of predicted impacts on baseflows in surface water systems, included inputs combined from both assessments.

These assessments were prepared in accordance with the SEARs for the Project (refer to **Appendix 4**).
In addition, the Project was referred to the Commonwealth DoEE under the EPBC Act. The Project was determined to be a controlled action requiring approval under the EPBC Act from the Commonwealth Minister for the Environment due to its potential impact on biodiversity and a water resource in relation to coal seam gas development and large coal mine development (refer to **Section 5.4.1**).

To ensure a comprehensive assessment of potential impacts on water resources, a risk assessment was developed with expert input from Glencore, Umwelt, AGE and GHD. The risk assessment was refined over the duration of the assessment as additional information became available on both the receiving environment and the Project itself. The approach to the risk assessment was guided by the impact pathway approach used by the IESC for regional assessments. The risk assessment is included with the Assessment of Commonwealth Matters Report attached as **Appendix 10** and includes the final analysis of risk having regard to the outcomes of the assessments and proposed mitigation measures.

The risk assessment also identifies where more detailed assessment studies may be required to inform the detailed design of water management structures (e.g. detailed design features to manage erosion risks and sedimentation) following approval.

7.5.1.1 Key impact pathways

Groundwater

Appendix 16 includes a conceptual hydrogeological model to assist in the understanding of potential impact pathways associated with the groundwater impacts; this includes a conceptual model of the pre-mining environment and the current hydrogeological environment as impacted by historical and approved mining and expected post mining recovery. This conceptual model includes consideration of existing monitoring and modelling undertaken for various assessments prepared for the surrounding approved operations.

The Project Area and surrounding area have been subject to open cut and underground mining for over 50 years which has impacted the local and regional groundwater system. Previous mining operations and existing and approved mining operations have already significantly modified the groundwater environment in the vicinity of the Project Area and surrounds.

Over the life of the Project, these existing and approved mining operations will further affect these systems. The impacts are complex and vary both spatially and temporally depending on the timing and scale of the operations.

As identified in the risk assessment prepared for the identification of impacts on water resources (refer to **Appendix 10**), the following aspects of the Project have the potential to impact on groundwater resources:

- direct interception of Permian (hard rock and regolith) aquifer systems by the mining operations
- depressurisation of Permian aquifer systems as a result of intersection by mining operations
- direct interception of alluvial aquifers in Swamp Creek and Yorks Creek as a result of intersection by mining operations
- induced drawdown in alluvial aquifer systems as a result of depressurisation of Permian aquifer systems
- changes in water quality (positive and negative) in alluvial aquifer systems as a result of changes in flow between alluvial and Permian aquifer systems
- changes in Permian water quality associated with pit lake recovery in mined areas and voids
- contributions to pit lake recovery in final voids.

The above impacts are common to most mining operations in the Hunter Valley, including historical and approved operations in and around the Project Area, and have been considered in both a Project specific and a cumulative context.

A key component of the assessment of the Project's potential impacts on groundwater systems has therefore been understanding the existing impacts associated with previous and approved mining operations in the region.

It is noted that the Project does not propose any changes to the mining operations approved under the Mount Owen Consent and the additional tailings generated by the Project from the Mount Owen CHPP will be disposed of in GRAWTS storages approved for tailings disposal. The Project does not result in any changes to operations approved under the Mount Owen Consent which will alter the way in which the approved operations affect groundwater systems. The additional mined area associated with the Project and the shift of the final void to the north from the presently approved location may affect the recovery timing for the North Pit void and Bayswater North Pit void. These changes are considered unlikely to result in any increased take associated with the operations approved under the Mount Owen Consent and may reduce the overall impact associated with those approved operations. The cumulative impacts associated with approved mining under the Mount Owen Consent are captured in the assessment of cumulative groundwater impacts.

Surface Water

As discussed in **Section 2.1.4**, the Mount Owen Complex and its WMS are located within the catchments of Bowmans Creek and Glennies Creek and their tributaries, including Yorks Creek, Swamp Creek and Bettys Creek (all sub catchments of Bowmans Creek) and Main Creek (a sub catchment of Glennies Creek). All aspects of the Project are located within the catchment area of Bowmans Creek, including the realignment of the lower reach of Yorks Creek. The Project will not have any direct impacts on Main Creek or Glennies Creek other than the licensed extraction of water from Glennies Creek for use in operations.

Previous mining operations have significantly modified local catchments through the capture of runoff from disturbed areas and diversion of upslope runoff around the mining operations (refer to **Section 4.2.3**). Surface water runoff from the disturbed areas of the Bowmans Creek catchment in and around the Project Area are currently managed by the water management systems for the mining operations responsible for the management of these areas. As a result, the catchment area of Bowmans Creek in the vicinity and downstream of the Project Area is smaller than the pre-mining environment. The progressive release of rehabilitated areas to the Bowmans Creek catchment will increase flows in local tributaries and Bowmans Creek itself throughout the life of the Project.

The Project has the potential to affect the quantity of water available for extraction by downstream water users both through changes to catchment areas and impacts on baseflows associated with groundwater impacts. Landform and catchment changes associated with the Project will also impact on flood flows in Bowmans Creek and its tributaries directly affected by the Project. Both of these impact types are significantly influenced by the cumulative effects of other mining operations.

As identified in the risk assessment prepared for the assessment of impacts on water resources (refer to **Appendix 10**, the following aspects of the Project have the potential to impact on surface water resources:

- increased area of disturbance during the operation of the Project and associated impacts from reduced catchment run-off and management of water quality from areas disturbed by the Project
- changes to the site water balance and subsequent impacts to the GRAWTS
- permanent realignment of the lower reach of Yorks Creek, resulting in changes to catchments, flood regimes, flooding behaviour, geomorphology and downstream water quality
- changes to the final void, resulting in changes in pit lake water level recovery and water quality

- changes to final landform catchments and potential impacts on downstream catchments from changes to flow regimes and flooding, and
- reduced baseflow in creeks associated with impacts on groundwater systems.

The Project's impacts on surface water quality is primarily associated with the management of surface water run-off from disturbed areas and the management of water within the Mount Owen Complex WMS and associated GRAWTS. While the pit lake provides a potential source of saline discharge into the environment, as discussed below, the Mount Owen Complex final voids have been designed to operate as long term hydrological sinks which will not spill to the downstream environment meaning potential impacts are avoided.

Water users and potentially impacted properties

The majority of land within and adjacent to the Project Area is owned by Glencore and its subsidiaries or other mining companies including Yancoal (Ashton Coal) and Bloomfield (Rix's Creek). There are no non-mine owned properties along Bowmans Creek in areas downstream of the Project that could be impacted by changes in flows.

A search of the NSW Water Register (WaterNSW 2019) identified works approvals and associated water access licences held by private landholders and Ashton Coal downstream of the Project Area on Glennies Creek. These works approvals are all associated with extractions from the Hunter Regulated River Water Source. There is only one lot not owned by Glencore downstream of the Project Area on Bowmans Creek which has a works approval and associated water access licence for surface water extractions from the Jerrys Water Source. This lot is also adjacent to the Hunter River and Glennies Creek and also has a works approval and associated water access licence for the Hunter Regulated River Water Source. Daracon land located to the west of the Project Area contains 2 licensed bores for stock and domestic use.

A search of the NSW State Government groundwater bore database was conducted by AGE to identify the locations of any private water supply bores in proximity to the Project Area. **Figure 7.5.1** provides the locations of the private registered bores within the database.

7.5.1.2 Groundwater Modelling

A comprehensive assessment of potential groundwater impacts has been undertaken for the Project by AGE and is included as **Appendix 16**.

Potential groundwater impacts associated with the Project were assessed through a 3D numerical groundwater flow model using MODFLOW-USG over an area of approximately 450 km^2. The numerical model was based on the existing Greater Ravensworth Area Groundwater Model (the model) and updated with data from the geological models, the existing monitoring network, as well as publicly available data (i.e. geological maps and groundwater studies for the surrounding region).

The model extent includes Mount Owen Mine, Integra Underground, Rix's Creek North, Liddell Coal Operations (including former underground workings), Ravensworth Operations, Ravensworth Underground Mine, Ashton Coal Mine and Hunter Valley Operations and was used to build upon the regional flow model to best understand the potential impacts on groundwater in the area. The model includes both historical mining and approved mining yet to be undertaken. The GWIA (refer to **Appendix 16**) includes further details regarding the design and operation of the Model. Consistent with the requirements of the IESC Guidelines, the groundwater impact assessment has been peer reviewed. The Peer Review process included a detailed review of model inputs and settings, including calibration processes. The Peer Review has also considered the results of the modelling and the reporting of results. A copy of the Peer Review report for the GWIA is included as an attachment to the Groundwater Impact Assessment in **Appendix 16**.

Due to the existing level of impact on the groundwater systems in the area associated with historical mining and ongoing and future impacts that will occur as a result of the existing approved operations, the modelling undertaken for the Project included 3 different modelling scenarios to enable the impacts from the Project (and existing approved operations under the Glendell Consent) to be differentiated from the impacts from historical and approved operations. The 3 scenarios modelled were:

- “No Glendell” – this model included all historical and approved mining *except* mining approved under the Glendell Consent
- “Approved” – this modelled included all historical and approved mining including mining approved under the Glendell Consent
- “Approved + Project” – this model included all historical and approved mining plus the mining proposed as part of the Project.

By comparing the results of the different modelled scenarios, the incremental impacts associated with the existing approved Glendell Mine and the Project can be identified and considered in the context of both existing approved impacts, incremental impacts associated with the Project and associated cumulative impacts.

The “No Glendell” scenario was primarily run to identify the additional impacts relative to the start of the Hunter Unregulated WSP in 2009 which roughly coincides with the commencement of mining in the Glendell Pit. The comparison of the “No Glendell” and “Approved” modelling scenarios also enables the impacts associated with existing operations at the Glendell Mine on the Swamp Creek and Bowmans Creek alluvium to be better understood. The modelling scenarios also enable the impacts from the Glendell Mine to be differentiated from the expected drawdown impacts associated with the historical and approved mining at Ravensworth Operations, Hunter Valley Operations and Ashton Coal Mine which are either located down-dip from Bowmans Creek and mine coal seams potentially sub-cropping below the associated alluvium or, in the case of Ashton Coal Mine, involve longwall mining below and to the west (down dip) of the Bowmans Creek alluvium. The “Approved” scenario model was also used to calibrate the model using data up to 2018.

The outputs from the “Approved + Project” model identifies cumulative impacts which include any additional impacts associated with the Project. A comparison between the “Approved” model outputs and the “Approved + Project” model allows the incremental impacts associated with the Project to be identified. A comparison between the “Approved + Project Model” with the “No Glendell” model enables incremental take to be identified for the purposes of licensing.

An overview of the key findings of the GWIA is provided in **Section 7.5.3.1** with licensing requirements considered in **Section 7.5.7**.

umwelt

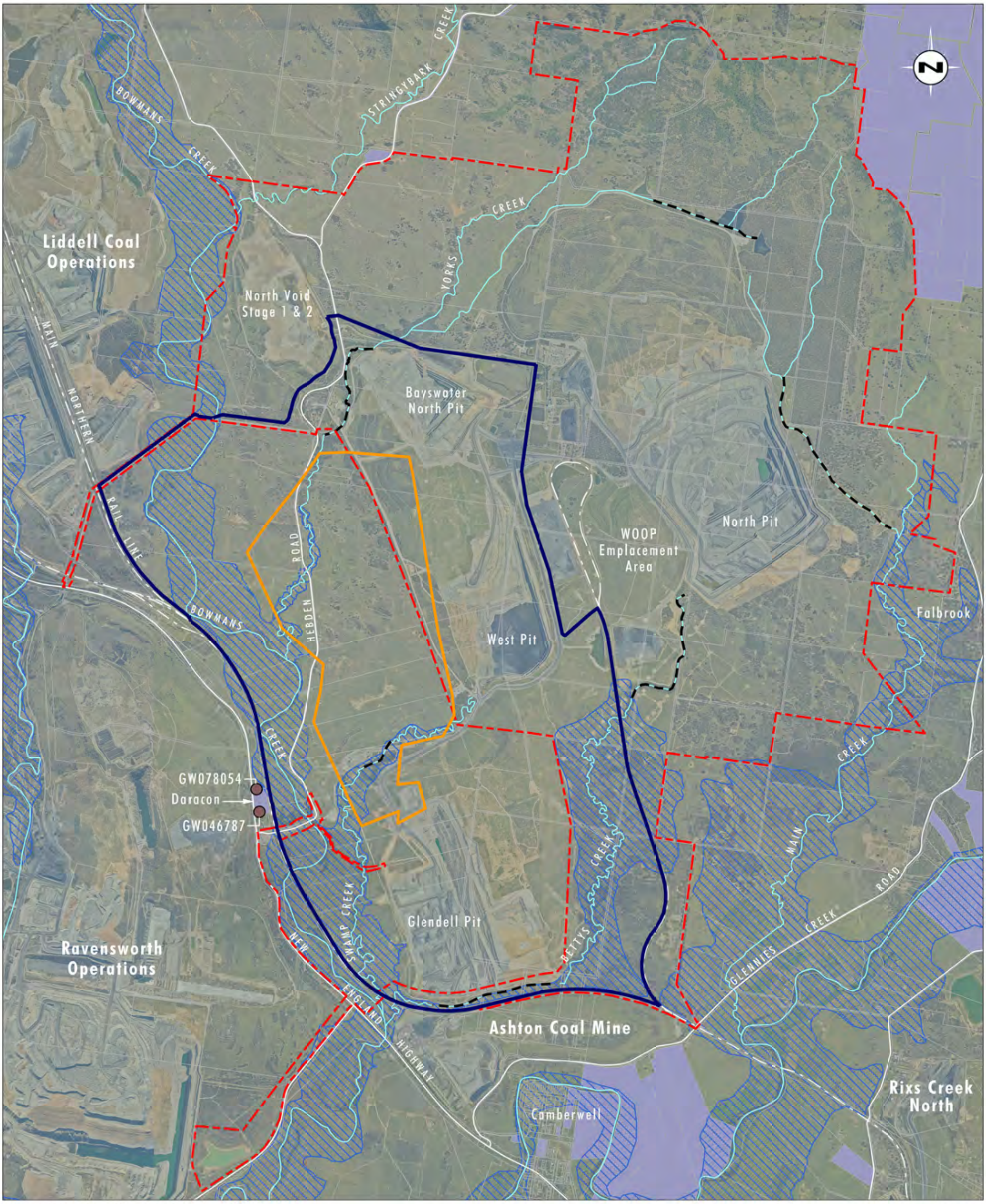


Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend
- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Mapped Alluvium (AGE 2019)
- Drainage Line
- Existing Creek Diversion
- Registered Groundwater Bores on Private Land
- Private Landholder

FIGURE 7.5.1

Registered Groundwater Bores on Private Land

File Name (A4): R08/4166_558.dgn
20191115 11.23

7.5.1.3 Surface water assessment

The following paragraphs summarise the modelling approach for the SWIA undertaken by GHD. Full details of the methodology used are contained in the SWIA, refer to **Appendix 17**. An overview of the key findings of the surface water assessment is provided in **Sections 7.5.7** with licensing requirements considered in **Section 7.5.8**.

Water Balance

A detailed site water and salt balance was used to assess future site water and salinity balance behaviour and water supply reliability for the Project (refer to **Appendix 17**). The site water balance also assesses the adequacy of the proposed WMS changes in managing water demands and storage requirements.

The Project will increase the total disturbance area and extend the life of operations of the Mount Owen Complex. The impact of the Project on the site water and salt balance of the Mount Owen Complex and the GRAWTS was assessed using the Greater Ravensworth Area Water Balance Model (GRAWBM). The GRAWBM is a mass balance model that simulates the water management features and processes at the Mount Owen Complex and the GRAWTS.

The GRAWBM was modified to represent the conceptual WMS, predicted groundwater inflows from the Groundwater Impact Assessment (AGE 2019) and estimated production rates. The modified GRAWBM was used to forecast the likely water surplus or deficit, represented as a simulated change in water storage. The model also simulated the site water balance at other Glencore sites in the GRAWTS, as well as the transfer of water between sites, which are reported as imports to and exports from the Mount Owen Complex.

Final Void Recovery Modelling

A water and salt balance model was developed to assess the behaviour of the approved and proposed final void. The model used rainfall variability from the historical record and used the Australian Water Balance model to estimate catchment runoff. The model considered:

- the geometry of the approved and proposed final voids, based on the approved and proposed conceptual final landforms
- direct rainfall onto and evaporative losses from the final void pit lake surface, based on the same historical rainfall, sampling pattern and rainfall, Total Dissolved Solids (TDS) as the GRAWBM, and
- runoff from the local catchment area reporting to the final void and spoil. The catchment runoff was estimated for the rehabilitated land use used in the GRAWBM.

The key inputs to the final void recovery model for the approved and proposed conceptual final voids are compared in **Table 7.24**. Groundwater inflow inputs were based on modelled inflow data to the Glendell Pit and Glendell Pit Extension void areas. These inflows were obtained using an iterative approach between the groundwater model and the water balance model which considered the effect of pit lake levels on groundwater systems (i.e. the groundwater inflows include consideration of the level of water in the lake at the time and the effect this has on the regional groundwater system).

Table 7.24 Key inputs to the final void recovery model for the approved and proposed conceptual final landforms

Aspect	Approved Conceptual Final Landform	Proposed Conceptual Final Landform
Final void catchment (ha)	339	321
Final landform spoil catchment (ha)	181	258
Initial catchment runoff salinity (mg/L)*	2,710	2,710
Long term catchment runoff salinity (mg/L)*	520	520
Groundwater salinity (mg/L)*	7,700	7,700
Assumed commencement of final void recovery model	2025	2045
Groundwater flows	Varies over time, refer to **Appendix 17** (AGE 2019)	

*Salinity measured in terms of TDS (mg/L)

Consistent with the GRAWBM, the final void recovery modelling of water quality assumes instantaneous and complete mixing.

The model was simulated from the end of mining (2025 and 2045 for approved and proposed conditions respectively) with the water volume in the void and spoil initially empty, reflecting dewatering during operations.

Stream Flow Analysis

The potential impacts on flow regimes in Yorks Creek, Swamp Creek, Bettys Creek and Bowmans Creek were assessed using a catchment scale water balance model. The model sampled potential rainfall variability from the historical record and used the Australian Water Balance Model (AWBM) to estimate catchment runoff. Four scenarios were considered:

- Existing conditions based on the existing Mount Owen Complex WMS.
- Proposed conditions (Year 13) based on the Year 13 conceptual WMS (refer to **Section 3.2.6.4**). This scenario was selected as it has the maximum potential impact on surface runoff catchment areas during operations (refer to **Figure 3.4**).
- Approved conceptual final landform (refer to **Figure 2.4**).
- Proposed conceptual final landform (refer to **Figure 3.6**).

Both the approved and conceptual final landform scenarios assume that the site has been fully rehabilitated with runoff from rehabilitated areas returned to downstream catchments. The proposed conditions, approved conceptual final landform and proposed conceptual final landform models also assumed the progressive rehabilitation and release of clean catchment areas at other operations in the Bowmans Creek catchment consistent with the likely rehabilitation of disturbed areas at these operations.

The model used the AWBM, with parameterisation of undisturbed catchment consistent with the GRAWBM, except for a site specific calibration for Bowmans Creek, which was based on the DPI-Water Bowmans Creek flow gauge.

Flooding

The surface water assessment includes a detailed flooding assessment of the 10% (1:10 year), 5% (1:20 year), 1% (1:100 year), 0.5% (1:200 year) and 0.2% (1:500 year) annual exceedance probability (AEP) flood events as well as the Probable Maximum Flood (PMF). The flooding assessment was undertaken for the existing landform (as a baseline), Year 6 of the Project (to reflect the impacts of the construction of the Hebden Road realignment, Yorks Creek Realignment, the new Glendell MIA and Heavy Vehicle Access Road on flood flows), and the proposed final landform. Impacts for Year 6 and the final landform were compared against existing conditions and include the predicted cumulative impacts associated with changes to landform at both the Mount Owen Complex as well as other mining operations in the Bowmans Creek catchment. The flooding assessment includes consideration of flood extent and depths as well as flow velocities. Details of the flooding study and methods used are set out in the SWIA (refer to **Appendix 17**).

7.5.2 Regulatory context

The Mount Owen Complex exists within a well-regulated water resource management system that has been designed to provide for the sustainable management of the State's water resources. This includes:

- licensing of allowable water take with available allocations having regard to environmental flow requirements of watercourses and the needs of other water users
- control of water pollution, management of sustainable salt loads associated with all water sources, mine water discharges
- guidelines that govern the appropriate design of water management systems for mines to provide for appropriate water quality in accordance with POEO Act requirements.

This regulatory context is discussed generally in **Section 5.0** with further detail provided below.

7.5.2.1 Regulation of water quality

As discussed in **Section 5.2.2**, the POEO Act is the key piece of environment protection legislation that regulates the pollution of water. Section 120 of the POEO Act contains a general prohibition on the pollution of water except where authorised by an Environment Protection Licence. Pollution of waters is broadly defined in the POEO Act as:

> *placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed*

The definition of water pollution also includes the emplacement of material in locations where it has the potential to cause a change in water quality.

The Hunter River Salinity Trading Scheme (HRSTS) is implemented under the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*. The HRSTS is a market-based instrument that uses a cap-and-trade mechanism to control the discharge of salt into the Hunter River. The scheme ensures that salinity in the Hunter River is maintained at an appropriate level that is suitable for local primary producers to use for irrigation and to manage the impact of saline discharges on the health of the river. The scheme is operated by WaterNSW under a service agreement with the EPA.

As discussed in **Section 2.2.2**, neither of the EPLs applicable to the Mount Owen Complex authorise discharges. Instead, the WMS has been designed to manage the risks of spills from storages consistent with relevant NSW guidelines including the Blue Book. Water contained in the GRAWTS which is surplus to operational requirements is able to be discharged via the licensed discharge points under the Ravensworth Operations EPL and/or Liddell Coal Operations EPL. The Project does not propose any change to these arrangements, in terms of either allowable levels of discharge or the location of the existing approved discharge points.

7.5.2.2 Regulation of water 'take'

As discussed in **Section 5.3**, water sources in NSW are managed via WSPs under the WM Act. Provisions within WSPs provide water to support the ecological processes and environmental needs of groundwater dependent ecosystems and waterways. WSPs also regulate how the water available for extraction is shared between the environment, basic landholder rights, town water supplies and commercial uses. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

WALs entitle licence holders to specified share components in the available water that may be sustainably extracted from a particular water source. The actual volume of water available to be extracted may vary, dependent on available water determinations made under the WM Act. Available water determinations are made for each WAL category in each water source and are generally made at the start of a water year, although may be altered at any time.

Landholders also have certain rights to the capture and use of water for domestic, stock, native title and other uses. Extractions pursuant to those rights are generally except from licensing requirements.

Water Sharing Plans

In terms of surface water and alluvial water licensing, the Project is located within the area regulated by the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 (Hunter Unregulated WSP). The Project is located within the Jerrys Water Source. The eastern parts of the North Pit at Mount Owen are located within the Glennies Water Source. The Hunter Regulated River Alluvium Water Source applies to alluvial aquifers associated with regulated sections of the Hunter River; this includes alluvium adjacent to Glennies Creek.

The Water Sharing Plan for the Hunter Regulated River Water Source 2016 (Hunter Regulated WSP) applies to surface flows in the Hunter River and Glennies Creek which are downstream of the Project Area. The Hunter Regulated WSP covers the Hunter River surface water flows and highly connected alluvials described in the plan. The Hunter Regulated WSP is divided into 3 management zones (Zone 1, Zone 2, Zone 3). The zones are defined from a single common point, which is the junction of Glennies Creek with the Hunter River. The Project Area is located to the north of Zone 3A along Glennies Creek. This zone extends from the upper reaches of Glennies Creek Dam to the Hunter River junction.

The coverage of the various Water Sharing Plans and water sources applying to surface flows and alluvial systems in the vicinity of the Project are shown in **Figure 7.5.2**.

Groundwater in the Permian systems are regulated by the North Coast Fractured and Porous Rock Groundwater Sources 2016 (North Coast Fractured and Porous Rock WSP). The North Coast Fractured and Porous Rock WSP commenced on 1 July 2016 and establishes the management regime relevant for groundwater taken from the Permian bedrock. The Project falls within the Sydney Basin – North Coast Groundwater Source of the North Coast Fractured and Porous Rock WSP.

The Proponent is required to hold adequate water entitlements to account for licensable take from water sources as a result of the Project at the time the take occurs.

Landholder Rights

Under the WM Act, extraction of water for basic landholder rights is protected by allocating and prioritising water for basic landholder rights. There are 3 types of basic landholder rights in NSW under the WM Act:

- domestic and stock rights
- native title rights
- harvestable rights.

Native title rights are not relevant to the assessment of licensing requirements for the Project. Domestic and stock rights are relevant to the retention or creation of water storages in the final landform. These rights and their implications for licensing need to be considered in the mine closure planning process.

Landholders are entitled to collect a portion of runoff from their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right' and entitlements are determined from the total contiguous area of land ownership. In the Central and Eastern Divisions of NSW (where the Project is located), landholders may capture and use up to 10% of the average regional runoff for their property without requiring a licence under the WM Act. If the maximum harvestable right is exceeded, licensing for the volume of water extracted from the surface water source exceeding the harvestable right is required under the WM Act.

The total contiguous landholdings at the Mount Owen Complex are currently approximately 8,560 ha. Based on the maximum harvestable rights calculator (DNR 2019), this entitles Glencore to capture up to 599 ML/annum. Existing water storages on the contiguous landholdings outside of the WMS at the Mount Owen Complex have a total catchment area of about 21 ha, with an estimated volume of 165 ML, based on a typical average depth of 2 m. This total volume is well within the maximum harvestable rights. Based on the current contiguous landholdings, an estimated net harvestable rights entitlement of 434 ML is available.

The following classes of dam are exempt from the calculation of the maximum harvestable right:

- dams solely for the control or prevention of soil erosion, provided no water is reticulated or pumped from the dams and the size of the dam is the minimum necessary to fulfil the erosion control function.
- dams solely for flood detention and mitigation, provided no water is reticulated or pumped from the dams.
- dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by regulation to prevent the contamination of a water source.
- dams endorsed for specific environmental management purposes.
- dams without a catchment (i.e. turkey nest dams).

Water captured within the Mount Owen Complex WMS (other than clean catchment areas which report to the WMS) are exempt from the harvestable rights requirements and do not require licensing while meeting the above criteria.

7.5.2.3 NSW Aquifer Interference Policy

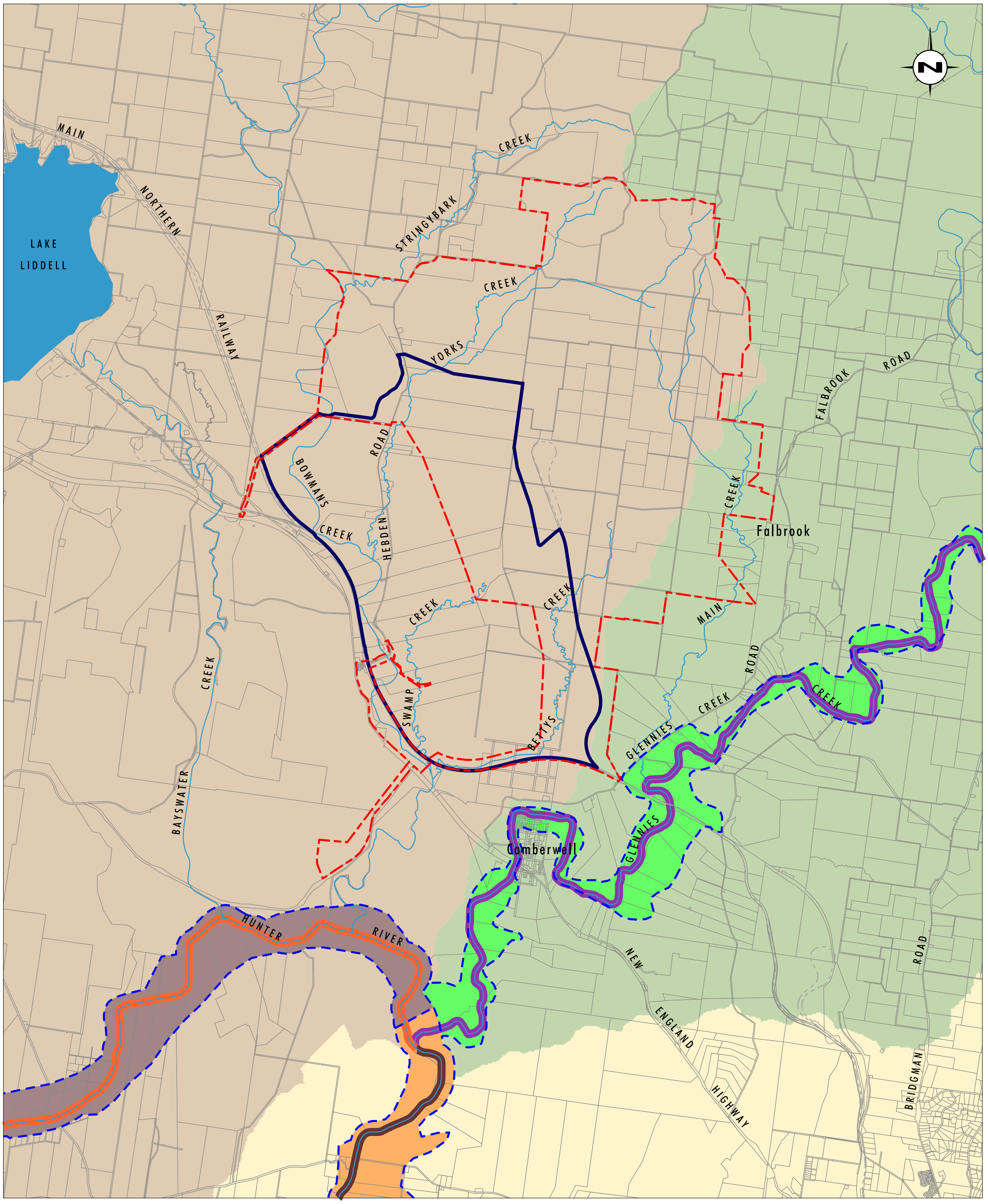
As discussed in **Section 4.4.5**, the AIP applies to activities which will intercept aquifers (such as mining operations). The AIP identifies principles for the licensing of direct and induced take from aquifer interference policies as well as set impact criteria for impacts associated with aquifer interference activities against which projects can be assessed.

7.5.2.4 Regulation of activities in the vicinity of watercourses

In addition to the POEO Act and water take licensing requirements under the WM Act, the WM Act and *Fisheries Management Act 1994* (FM Act) both require approvals for certain works in the vicinity and in the bed of water sources. The 2 key approvals in this regard are:

- controlled activity approvals under section 90 of the WM Act – apply to works within 40 m of a watercourse) and
- dredging permit under section 201 of the FM Act – applies to works in the beds of watercourses.

As discussed in **Section 5.2.2.2**, neither of these approval requirements apply to the Project due to the operation of section 4.41 of the EP&A Act.



Data Source: Glencore (2018), Geoscience Australia (2006), LPI (2017)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Mount Owen Consent Boundary
- Drainage Line

Hunter Unregulated and Alluvial Water Sharing Plan Water Sources:

- Glennies Water Source
- Jerrys Water Source
- Singleton Water Source

- Downstream Glennies Creek Management Zone
- Glennies Creek Management Zone
- Upstream Glennies Creek Management Zone

Hunter Regulated River Water Sharing Plan Management Zones:

- Management Zone 1B
- Management Zone 2B
- Management Zone 3A

FIGURE 7.5.2

Surface and Alluvial Water Sharing Plans

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7.5.3 Existing water resources management and monitoring

As discussed in **Section 2.2.5**, the Mount Owen Complex operates in accordance with the approved Mount Owen Complex Water Management Plan (WMP) (Glencore, 2018k) required under both the Mount Owen Consent and the Glendell Consent. The Water Management Plan includes the following sub plans:

- Water and Salt Balance
- Erosion and Sediment Control Plan
- Surface Water Management and Monitoring Plan
- Groundwater Management and Monitoring Plan
- Surface and Groundwater Response Plan
- Creek Diversion Plan.

These plans detail the various management practices that apply to the management of water and water related impacts at the Mount Owen Complex. The WMP also includes operational details regarding the WMS. The WMP allows for the ongoing assessment of risk as mining operations progress and the implementation of improvements and changes where required. The WMP is an adaptive and responsive document with annual reviews and reviews triggered by incidents, audits or regulatory and operational changes. Following approval of the Project, Glencore will update the existing WMP to reflect the changes to water management associated with the Project.

The following sections outline the general objectives and functions of the Mount Owen Complex WMS, the surface water monitoring program and the groundwater monitoring program.

7.5.3.1 Water management system

The WMS includes mine dewatering systems, water storages, sedimentation and retention basins, settling and tailings ponds and diversion drains.

The approved Mount Owen Complex WMS has the following objectives and functions:

- satisfy regulatory requirements, including meeting required performance criteria
- divert clean water around mining operations to minimise capture of upslope runoff and separate clean water runoff from mining activities
- segregate mine impacted water from undisturbed and revegetated areas with better water quality to minimise the volume of mine impacted water that requires reuse
- reuse of mine impacted water within the WMS and within the GRAWTS to reduce reliance on raw/clean water (that is, extraction from Glennies Creek)
- minimising adverse effects on downstream waterways (including hydraulic and water quality impacts).

As outlined in **Section 2.1.4** water management at the Mount Owen Complex considers 3 categories of water, each with different potential to cause environmental harm being clean, dirty and mine water.

The WMS will evolve over the life of the approved operations at the Mount Owen Complex as mining progresses and runoff from rehabilitated areas is of adequate water quality to be released as clean catchment. The Mount Owen components of the WMS have already been assessed and approved under the Mount Owen Consent. The existing Glendell Pit is near to its approved extent under the Glendell Consent and only minor changes to the existing WMS are expected for the remaining life of the approved operations.

7.5.4 Existing monitoring network

7.5.4.1 Surface water

Surface water quality monitoring at the Mount Owen Complex is undertaken in accordance with the Surface Water Management and Monitoring Plan within the dirty and mine water storages as well as surrounding watercourses upstream and downstream of the site, including in Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and Main Creek. The location of surface water quality monitoring locations is shown on **Figure 7.5.3**. All locations are monitored monthly for pH, EC and TSS.

Monitoring in surrounding watercourses occurs during flow. Project specific monitoring of nutrients and metals has also previously been undertaken. Monitoring of channel stability and stream health is also undertaken on Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and Main Creek. These monitoring points are shown on **Figure 7.5.3**.

Flow monitoring is undertaken on Bowmans Creek (since 1993) and Glennies Creek (since 1956) by WaterNSW and has also undertaken on Bowmans Creek by Liddell Coal Operations (since 2017). The location of these monitoring points is shown on **Figure 7.5.4**. The Water NSW Bowmans Creek and Glennies Creek data has been used to inform the understanding of potential impacts on stream flows in these systems. The duration of the Liddell Coal Operations flow monitoring data is considered to be inadequate to provide any useful flow data for the assessment, particularly given the drought conditions which have prevailed during almost all of the period in which these monitors have been in operation.

The existing monitoring of both the receiving environment and the water quality within the different aspects of the WMS enables an informed assessment of the Project's potential and likely impacts on water quality.

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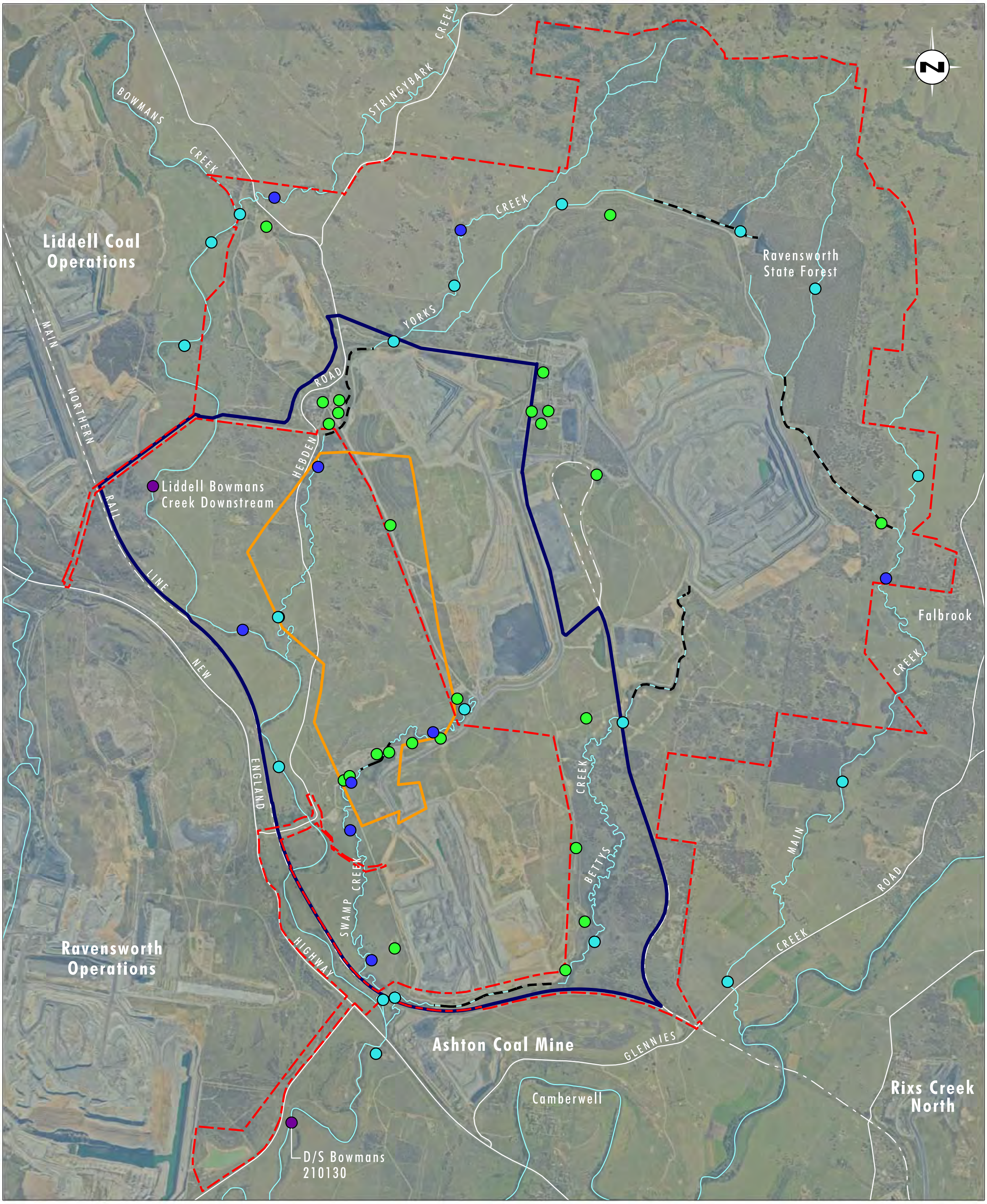

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 3.0km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Surface Water - Channel Stability and Stream Health
- Surface Water Onsite Storage
- Surface Water - Watercourse
- Flow Gauge Monitoring Point

FIGURE 7.5.3

Existing Surface Water Monitoring Points

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Groundwater

The WMP includes a standalone Groundwater Management and Monitoring Plan (GWMMP). This plan outlines a monitoring program to collect groundwater levels and quality measurements.

Glencore monitors groundwater levels within the alluvium and the Permian aquifers using an extensive network of monitoring bores and vibrating wire piezometers (VWPs) to inform groundwater modelling and monitoring of impacts associated with existing operations. The monitoring bores are located in Bowmans Creek, Main Creek, Bettys Creek, Swamp Creek, Yorks Creek and Glennies Creek alluvium, as well as key coal seams and interburden units being mined. The location of monitoring bores within the Mount Owen Complex monitoring network are shown in **Figure 7.5.4**. Additional monitoring of groundwater levels in the vicinity of the Project is also undertaken by Glencore for the Liddell Coal Operations, Ravensworth Operations and Integra Underground operations. **Figure 7.5.4** also shows the Liddell Coal Operations and Integra Underground monitoring bores located in the vicinity of the Project Area. The monitoring network used to inform the GWIA is discussed in detail in **Appendix 16**.

The monitoring bores within the alluvium are typically shallow due to the nature of the local alluvial deposits. The Permian strata is monitored using a combination of monitoring bores and VWPs arrays for the deeper strata within the geological sequence. The monitoring bores at the Mount Owen Complex target the alluvium deposited within the Bowmans Creek, Main Creek, Bettys Creek and Glennies Creek flood plains, as well as key coal seams and interburden units being mined.

Many of the monitoring bores have been installed specifically to inform the assessment of potential groundwater impacts associated with the Project. Importantly, the monitoring network includes a dense cluster of monitoring bores in Swamp Creek and Yorks Creek close to the point of proposed intersection of the Glendell Pit Extension. Additional bores have also recently been installed for this Project in the Bowmans Creek alluvium to assist in the validation of the groundwater model. The GWIA includes a comprehensive review of groundwater monitoring data in the vicinity of the Project.

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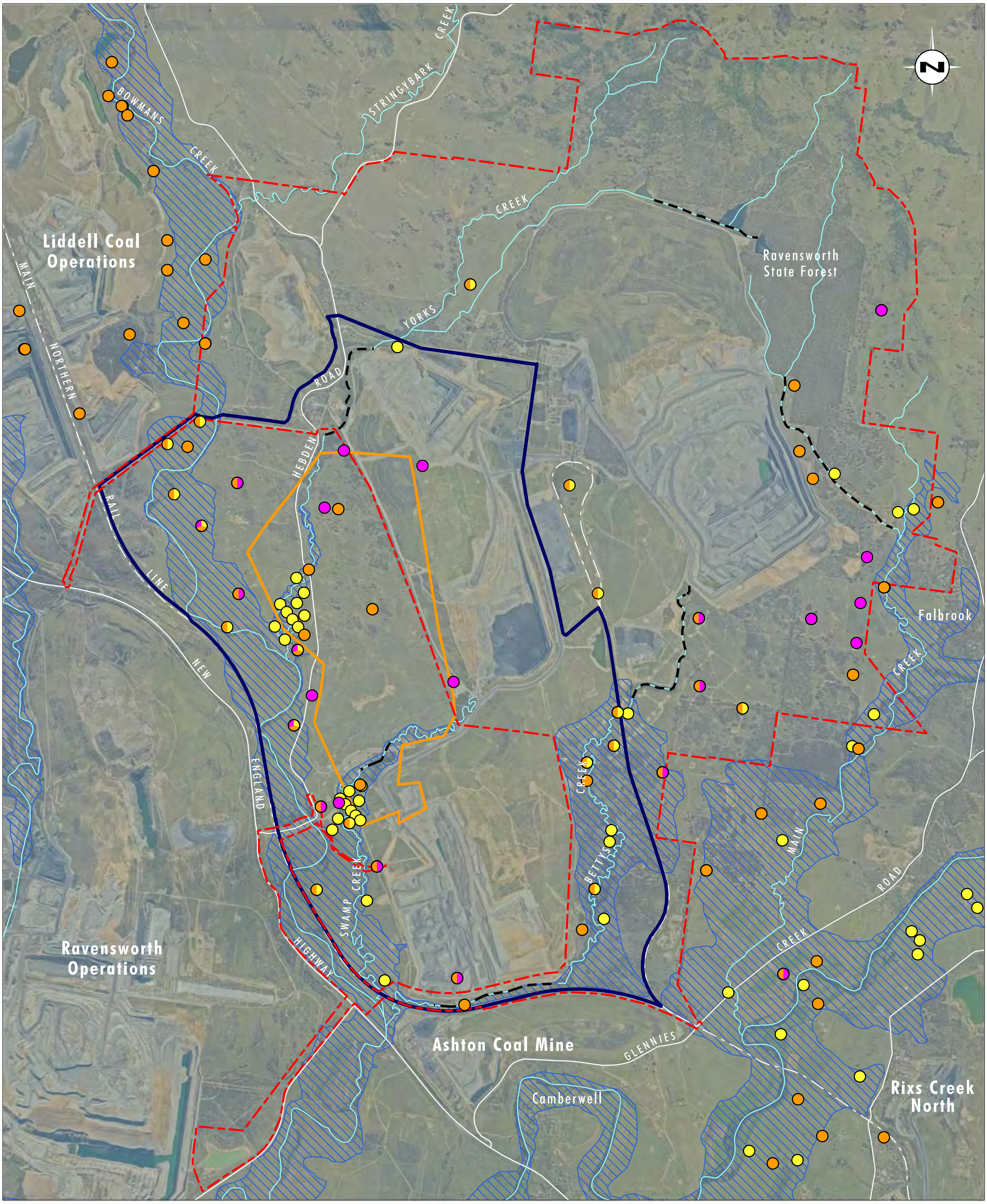

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), AGE (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Mapped Alluvium (AGE 2019)
- Alluvium - Monitoring Bore
- Permian - Monitoring Bore
- Permian - Vibrating Wire Piezometer

FIGURE 7.5.4

Groundwater Monitoring Bores and Extent of Alluvium

File Name (A4): R08/4166_556.dgn
20191129 10.42

7.5.5 Proposed water management system changes

7.5.5.1 Changes to dirty water

The SWIA includes a conceptual design of the changes to the dirty water and mine water systems required for the Project. The proposed conceptual WMS is an extension of the existing WMS of the Glendell Pit maintaining the connection to the broader Mount Owen Complex WMS. The dirty WMS will be extended north along the western boundary of the Glendell Pit Extension, with a series of sediment dams and pumps that will be integrated into the Mount Owen Complex WMS. The existing Glendell MIA will be demolished and replaced by the new Glendell MIA, which will be integrated into the Mount Owen Complex WMS.

The integrated WMS components required for the Project for Years 6, 13 and 18 are presented in **Appendix 17**. The conceptual plans indicate only the likely components of the integrated WMS which are required for a particular stage of mining and do not preclude the construction of some components earlier. The WMS infrastructure will be constructed and modified consistent with the WMS objectives and design principles as and when required so as to support the infrastructure and mine development. The detailed designs will be determined by construction and mining schedules.

7.5.5.2 Changes to clean water diversions

The location of existing clean water diversion at the Mount Owen Complex are shown on **Figure 2.1**. The Project does not impact upon the existing Upper Bettys Creek Diversion, the Middle Bettys Creek Diversion or the Swamp Creek Diversion (part of the Mount Owen Complex WMS). The existing Glendell MIA Diversion of Swamp Creek around the Glendell MIA will be mined through by the Project, as will all sections of the existing extent of Swamp Creek upstream from this diversion. The existing Lower Bettys Creek Diversion will not be directly impacted by the Project however the landform changes associated with the Project will result in parts of the former Swamp Creek catchment being diverted into Bettys Creek; this will result in additional flows into the Lower Bettys Creek Diversion relative to existing conditions and currently approved final landform conditions. The need for any additional works in the Lower Bettys Creek Diversion associated with these planned changes in catchment areas and associated changes to flows in Bettys Creek will be considered when the detailed final landform is developed as part of the detailed mine closure planning process (refer to **Section 7.9**).

The existing Yorks Creek Diversion will be replaced by the Yorks Creek Realignment. The commissioning of the Yorks Creek Realignment and decommissioning of the former diversion will occur prior to the Glendell Pit Extension intersecting with Yorks Creek. The Yorks Creek Realignment and design considerations for the realignment are discussed in further detail below.

In addition to the realignment of Yorks Creek upstream of the Glendell Pit Extension, some small clean water diversions are proposed to minimise interception of water from undisturbed catchments. The proposed clean water diversions are shown conceptually in the conceptual water system figures in **Appendix 17**.

7.5.5.3 Yorks Creek realignment

As outlined in **Section 3.2.11**, the Glendell Pit Extension requires the realignment of the lower reach of Yorks Creek. Yorks Creek is proposed to be realigned to the north, to join Bowmans Creek approximately 4 km upstream of the existing confluence. The realignment of Yorks Creek will require the demolition of the Ravensworth East MIA and removal of the existing access roads to the Ravensworth MIA, which are within the extent of the creek realignment works. These Yorks Creek Realignment works will also include the development of a levee to prevent flood flows up to the 0.1% AEP design flood from Yorks Creek entering the Glendell Pit Extension mining area or final void (refer to **Figure 3.18**).

The need to realign Yorks Creek was identified early in the Project design phase with a number of potential routes considered; these alternatives were discussed in the PEA (Umwelt 2018). Fluvial Systems was engaged to assess the geomorphic constraints of the Yorks Creek Realignment to identify geomorphic issues that needed to be considered in the detailed design of the proposed realignment. The Yorks Creek Diversion Constraints Analysis prepared by Fluvial Systems is attached as **Appendix 18**.

The Yorks Creek Diversion Constraints Analysis considered both the impact of moving the confluence point of Yorks Creek and Bowmans Creek upstream of the current confluence. The analysis also considered the geomorphic characteristics of the existing Yorks Creek alignment and identified design objectives for the realignment having regard to both the existing geomorphic characteristics of Yorks Creek and relevant guidelines for creek and river diversions.

Diversion components

Due to terrain constraints presented by the ridgeline to the west of the existing Yorks Creek alignment, the proposed Yorks Creek Realignment includes four reaches or zones which were considered in the conceptual detailed design:

- Upper (low gradient) reach - located between the Mount Owen Access Road and the proposed realignment of Hebden Road
- Cutting (low gradient) reach – located in the cutting to be constructed through the ridgeline downstream from the proposed Hebden Road realignment
- Lower (high gradient) reach – a steeper section constructed in bedrock located between the lower end of the cutting and the confluence zone
- Confluence zone – the lower reach of the proposed realignment at the point of confluence with Bowmans Creek.

Consideration of relevant guidelines

There are no specific NSW guidelines for the design of creek diversions. The ACARP study ‘Criteria for Functioning River Landscape Units in Mining and Post Mining Landscapes’ (White et al, 2014) identified a series of criteria for the successful operation and functioning of creek diversions. These criteria were based on research and practice in the Bowen Basin, Queensland. Although the hydraulic criteria might require modification to suit other areas, they are a reasonable starting point for any diversion project, including the Yorks Creek Realignment.

The most comprehensive Australian diversion design guidelines, which incorporate ACARP principles, were produced by Queensland Department of Natural Resources and Mines (2014).

Hancock (2001) made specific recommendations about geomorphic design elements for diversions and rehabilitation works in the Hunter Valley that include:

- Maintenance of the degrees of freedom of the stream – that is the ability of the stream to migrate in its channel boundaries, to incise to a stable bedrock/armoured gravel/vegetation control which will not transmit upstream.
- Provision of flow variability along the stream channel (pool/riffle sequences).
- Provision of meanders as part of the degrees of freedom of the stream.
- Use of indigenous vegetation to form controls on the system – schedules 1 and 2 streams.

- Mixed bed controls (woody debris or competent rock at spacing) on larger defined streams.
- Use of vegetation to form the bank controls, and ecosystem structure.
- Provide as much diversity in channel design and vegetation system as the site allows.

Hancock (2001) (see also Department of Infrastructure, Planning and Natural Resources 2005) supported the design principle that achievement of streams with healthy functioning ecosystems required incorporation of geomorphic variability, stability, resilience and dynamic equilibrium. Rivers are naturally dynamic, so temporal variability in geomorphic forms is to be expected, and the dynamic nature of river geomorphology could be critically important for maintenance of stream health. The design philosophy of Department of Infrastructure, Planning and Natural Resources (2005) and Hancock (2001) is consistent with that of Department of Natural Resources and Mines (2014).

The Yorks Creek Constraints Analysis recommended that the design considers these guidelines, having regard to the geomorphic design elements identified by Hancock (2001).

Matters considered in Yorks Creek Constraints Analysis

The Yorks Creek Constraints Analysis includes a comprehensive review of the following in setting design objectives for the proposed realignment:

- the geomorphological characteristics of the existing Yorks Creek from upstream of Mount Owen Mine access road to its junction with Bowmans Creek, and Bowmans Creek from upstream of the proposed confluence of the proposed Yorks Creek diversion to downstream of the existing Yorks Creek confluence
- the load and grain-size of sediment transported from the Yorks Creek catchment upstream of the proposed realignment to the site of the proposed diversion
- the performance of similar diversions was undertaken by review of selected literature

Additionally, a regional terrain analysis was undertaken to locate potential alternative reference sites that had geomorphic form similar to that of the proposed realignment.

Yorks Creek Realignment Design Objectives

The Yorks Creek Diversion Constraints Analysis (**Appendix 18**) includes a number of key design principles, (refer to Section 6.3 of the Report). Based on the design principles in the Yorks Creek Realignment Constraints Analysis, the following design objectives have been developed for the Yorks Creek Realignment:

- 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.

Conceptual Detailed Design

The conceptual detailed design of the Yorks Creek Realignment (refer to **Appendix 7**) has been developed by Jacobs (Jacobs 2019) having regard to the objectives set out in the Yorks Creek Diversion Constraints Analysis. This design was informed by early flood and sediment movement modelling undertaken for preliminary designs. The conceptual detailed design includes both long sections and cross sections of the creek as well as proposed vegetation treatments. An important feature of the conceptual detailed design is the stilling pond located at the downstream end of the lower (high gradient) reach to mitigate stream flow velocities associated with higher grade (refer to **Section 3.2.11**). A bridge crossing for realignment of Hebden Road has been assumed in the conceptual detailed design for the Yorks Creek Realignment.

The conceptual detailed design has had specific regard to a wide range of factors to ensure it operates as a functioning creek system, as shown in **Table 7.25**.

Table 7.25 Yorks Creek Realignment Design Elements

Design element	Primary Design Objective
Appropriately sized rock will be placed to improve stability for major flood events, considering the relevant ACARP hydraulic guidelines, with particular attention to the risk of excessive valley wall erosion in the lower half of the diversion.	Minimise excessive erosion Maintain sediment transport
Where the bed shear stress exceeds the range of the existing creek, erosion resistant materials will be included. The bed material used in the upper low gradient zone will be free of contamination and have high cohesivity.	Minimise excessive erosion Maintain sediment transport
Measures of bank and bed variability in cross-section and long-profile similar to the existing Yorks Creek.	Provide habitat
Large wood will be sustainably supplied to the diversion channel by the riparian trees. Until such time that the trees are large enough to create significant wood loading, the realignment should be stocked with suitable anchored wood.	Provide habitat Minimise excessive erosion
Riparian vegetation will be similar to the existing Yorks Creek or other local drainage lines not currently disturbed by agriculture.	Provide habitat
An alluvial fan to capture sediment at the beginning of the alignment upstream of the low gradient zone between major flood events.	Maintain sediment transport
Bridge at the Hebden Road realignment crossing will minimise constraints on the movement of water and sediment.	Hydrological integrity Maintain sediment transport
Detailed design of backfill zone, including the levee, to minimise the risk of failure.	Hydrological integrity
Detailed design of confluence of Yorks Creek realignment with Bowmans Creek, considering a possible plunge pool for the management of high stream power in the lower reach of the realignment and replicate existing relatively high habitat value at the existing confluence with Bowmans Creek.	Hydrological integrity Provide habitat
Incorporate natural analogue features within rock cuttings.	Provide habitat
Investigate the potential loss of baseflow through the higher permeability bed and bank materials. Yorks Creek is intermittent, which means that its main contribution to the hydrology of Bowmans Creek is flood flow, rather than baseflow. The permeability of the bank and bed materials is expected to decrease over time.	Hydrological integrity
Appropriate erosion and sediment controls during construction (refer to Section 7.5.3.1).	Minimise excessive erosion Maintain sediment transport

Prior to construction, a Yorks Creek Realignment Plan will be developed which will set out the detailed design of the proposed realignment, key design objectives and performance criteria, and ongoing monitoring requirements.

The potential impacts of the proposed realignment on ecological features is assessed in **Section 7.6**. Changes in stream flow and the impacts of the Yorks Creek Realignment on flooding in both Yorks Creek and in downstream sections of Bowmans Creek are discussed in **Section 7.5.6**. The ongoing monitoring requirements in relation to the performance of the realignment are discussed in **Section 7.5.8** with additional detail provided in **Section 7.6**.

The Yorks Creek Diversion Constraints Analysis also identified that a monitoring program should be developed as part of the detailed design process to assess the success of the constructed design in meeting the relevant design objectives. The monitoring program for channel morphology should be of a "before-after" and "control-impact" design. The "before-after" criteria will set the absolute limits of allowable change in channel dimensions and position. The "control-impact" criteria will allow change in the realignment to be within the range observed in a control site. The monitoring methodology will be set out in the Yorks Creek Realignment Plan and will be based around objectively measured data rather than rapid visual assessment approaches. The sampling design should provide sufficient statistical power to have the capacity to detect change over time.

7.5.6 Groundwater assessment results

Due to the long and extensive history of mining in the region there is little to no historical groundwater monitoring results from which to obtain a sound understanding of pre-mining water table levels. The assessment has therefore focussed on understanding the extent of impacts from existing approved operations to enable the scale and extent of impacts from the Project to be understood.

As is described in the conceptual hydrogeological model in **Appendix 16** the regional groundwater system is in a constant state of flux with some areas continuing to experience ongoing depressurisation associated with active mining operations while others will begin a process of recovery as mining is completed and final voids and in-pit-emplacement areas refill through a combination of groundwater inflows and rainfall contributions and underground mines recover through groundwater inflows. This ongoing state of flux has both spatial and temporal components.

As is discussed in **Appendix 16** despite the Project's proximity to Bowmans Creek, the conceptual model developed indicates that the Project's impacts on Bowmans Creek are expected to be relatively minor relative to other mining operations, due to the location of the Glendell Pit Extension along the Camberwell anticline.

The "No Glendell" and the "Approved" modelling scenarios indicate that the cumulative impacts from historical and approved mining in the area will peak near the end of the life of the Project. The modelling of the "Approved + Project" scenario indicates that the Projects impacts on the Permian system is largely confined to the area immediately surrounding the Glendell Pit Extension. The Project is predicted to have only minor impacts on the alluvial system during the life of the Project with all predicted depressurisation impacts limited to the immediate vicinity of the intersection of the Glendell Pit Extension with Yorks Creek and Swamp Creek.

The Project is predicted to result in increased take from the alluvial systems following the cessation of mining however this occurs in an environment where the impacts from other operations on these systems are declining and, despite an increasing take associated with the Project, overall take from the alluvial systems decline and the water table in the alluvial systems is expected to rise in the post mining environment (albeit slower in some areas than would otherwise be the case). Again, these predictions are consistent with what was expected by the conceptual hydrogeological model and is primarily attributable to the location of the Glendell Pit Extension along the hinge of the anticline resulting in strata dipping away from the Project and the minimal direct interaction with the alluvial system.

Section 7.5.6.1 provides a summary of the Projects predicted impacts on groundwater levels.

Section 7.5.6.3 provides a summary of the Projects predicted impacts on groundwater quality.

The modelled licensing requirements for groundwater take associated with the Project are set out in **Section 7.5.8**.

Section 7.5.8 summarises the proposed monitoring and mitigation measures for the Project.

Potential impacts on water dependent ecosystems are discussed in **Section 7.6** and **Appendix 10**.

7.5.6.1 Predicted impacts on groundwater levels

Groundwater directly intercepted by mining

The groundwater model predicts that groundwater intercepted from the Permian coal measures will vary during the life of the mining operations within the Glendell Pit Extension with an average inflow of 111 ML/year predicted. Inflows are predicted to peak in about Year 17 at 249 ML/year and decline after that. Inflows into the final void following the cessation of mining are modelled to be less than the peak take during the mining phase.

Mining will only directly intercept alluvium where mining removes Swamp Creek and Yorks Creek. In these areas, groundwater from the alluvial system will only be directly intercepted Swamp Creek and Yorks Creek where saturated areas of the alluvium of Swamp Creek and Yorks Creek are exposed. Seepage from these areas into the Glendell Pit Extension is expected to be very low due to the limited saturated thickness in these areas.

Alluvium will be directly intercepted as part of the Hebden Road realignment/and Heavy Vehicle Access Road construction near the existing confluence of Yorks and Bowmans Creeks. These works will only have a temporary impact on any saturated areas of alluvium intersected and these works will not have any long term drawdown impacts on the alluvial aquifer in this area.

In the post-mining phase, regional water tables in the Permian system are predicted to recover with the water table in the alluvium system also predicted to rise. The modelling indicates that the saturated zone in the Bowmans Creek alluvium will rise to close to the point at which the Glendell Pit Extension intersects with the alluvium. The void will be backfilled with spoil at these locations and the inflow into the pit will occur as seepage through spoil. A component of the predicted take is also associated with induced drawdown which is discussed further below. It is noted that the direct take associated with the rising water table in the alluvium occurs well after mining has been completed and does not present an operational risk to mining operations. At the time this impact occurs, the water table will also be considerably higher than it is in the current environment (and prior to the 2017-present drought).

The volume of take from the alluvium and Permian aquifer systems is discussed further in **Section 7.5.7**.

There is no direct impact from the Project on the Main Creek, Glennies Creek or Hunter River alluvium.

Groundwater Impacted by depressurisation of Permian system

There are multiple coal seams intersected by the mining operations associated with the Project. The Middle Liddell seam was chosen to present the drawdown in the GWIA as it is also being actively mined at the adjacent Mount Owen, Ravensworth Operations, Integra Underground, Liddell Coal Operations and Ashton Mine and therefore is subject to significant cumulative impacts. Modelling of the "No Glendell" scenario indicates that historical mining at the Mount Owen Complex and surrounding area has resulted in drawdown impacts within the Permian measures for many km from the Mount Owen Complex with the impacts being caused by the long history of mining in the broader area. These impacts are confirmed through monitoring.

Predictions indicate the zone of depressurisation within the Middle Liddell seam solely attributable to the Project extends approximately 2 to 2.5 km from the Glendell Pit Extension (refer to **Appendix 16**).

Drawdown within the Permian systems eventually impacts on recharge points for coal measures being depressurised. Where the coal seams sub-crop under alluvium, the depressurisation of the coal seams can induce drawdown within the alluvial system through either increased levels of outflow from the aquifer or through reduced inflows where the water table is lowered below the point of sub-crop. This change is represented graphically in the conceptual hydrological model in **Appendix 10**. These impacts on alluvial systems are typically small due to the low permeability in the coal seams relative to the alluvium and rates of rainfall recharge. These impacts on the alluvial systems are therefore typically not measurable or occur over extremely long periods with the change not being perceptible against the natural background fluctuations in the water table.

The groundwater model predicts that the peak change in flow to the Jerrys Water Source alluvial system (which includes the Bowmans Creek, Yorks Creek, Swamp Creek and Bettys Creek alluvium) due to the combined influence of the approved Glendell Mine operations and the Project during the operational phase (i.e. to 2044) is 10 ML/year in about Years 12 to 25. This limited impact on flow to the alluvium is expected because the model predicts only minimal drawdown within the alluvium of Bowmans Creek. **Figure 7.5.5** shows the predicted drawdown associated with mining at Glendell (approved operations and the Project) and the cumulative predicted drawdown during the operational phase. As can be seen from **Figure 7.5.5**, the drawdown impacts on the Bowmans Creek and Swamp Creek alluvium from mining at Glendell are largely limited to the areas adjacent to where alluvium is directly intersected by the Glendell Pit and Glendell Pit Extension and water is intercepted via the alluvium and regolith rather than via the Permian coal seams. In the areas where Glendell's impacts are the highest, cumulative drawdown impacts with the alluvial aquifers are predicted to be up to approximately 2 m.

The groundwater model predicts the change in flow of groundwater to the Jerrys Water Source alluvial system during the operational phase reduces the baseflow in Bowmans Creek by up to 5 ML/year in about Year 22 to 25. This level of reduction is similar to the flow from a house tap. A small, approximately 1 ML/year, reduction in alluvial groundwater flow in the Hunter Regulated River Alluvium Water Source (Glennies Creek alluvium) is also predicted during the operational phase. The predicted take from the Hunter Regulated River Alluvium Water Source is not predicted to have any measurable drawdown impact on groundwater level within the Glennies Creek alluvium.

The Project is not predicted to have any discernible depressurisation effects on alluvium within the Bettys Creek, Main Creek, Glennies Creek or Hunter River alluvial systems. This is consistent with the modelled low levels of take from these systems. Mining at Glendell is predicted to have a negligible impact on groundwater take from the Glennies Water Source alluvium (Main Creek alluvium) with no take predicted during the operational phase and take not predicted to exceed 1 ML/year over the post mining modelling period. The Project is not predicted to have any measurable impacts on groundwater levels with the alluvium in these creek systems.

The model predicts post mining take from the Hunter Regulated River Alluvium Water Source (Glennies Creek alluvium) and the Glennies Creek Management Zone 3A (Glennies Creek surface water) attributable to mining at Glendell remains small but will be greater than the take attributable to the Glendell during the operational phase. This is due to drawdown in the Permian systems continuing to propagate post mining because of the slow re-equilibration of the groundwater system to the changed final landform. While Glendell's contribution to take from these water sources is predicted to increase, the cumulative take continues to decline, and over time, is lower than the modelled take at the commencement of the relevant WSPs.

The predicted take from all alluvial systems during both operations and post mining will not be measurable nor discernible from natural variation. In all cases, the maximum take occurs during a period when overall cumulative take has significantly declined from its peak around the end of the life of the Project and water tables have recovered to levels similar to or higher than existing (2019 levels).

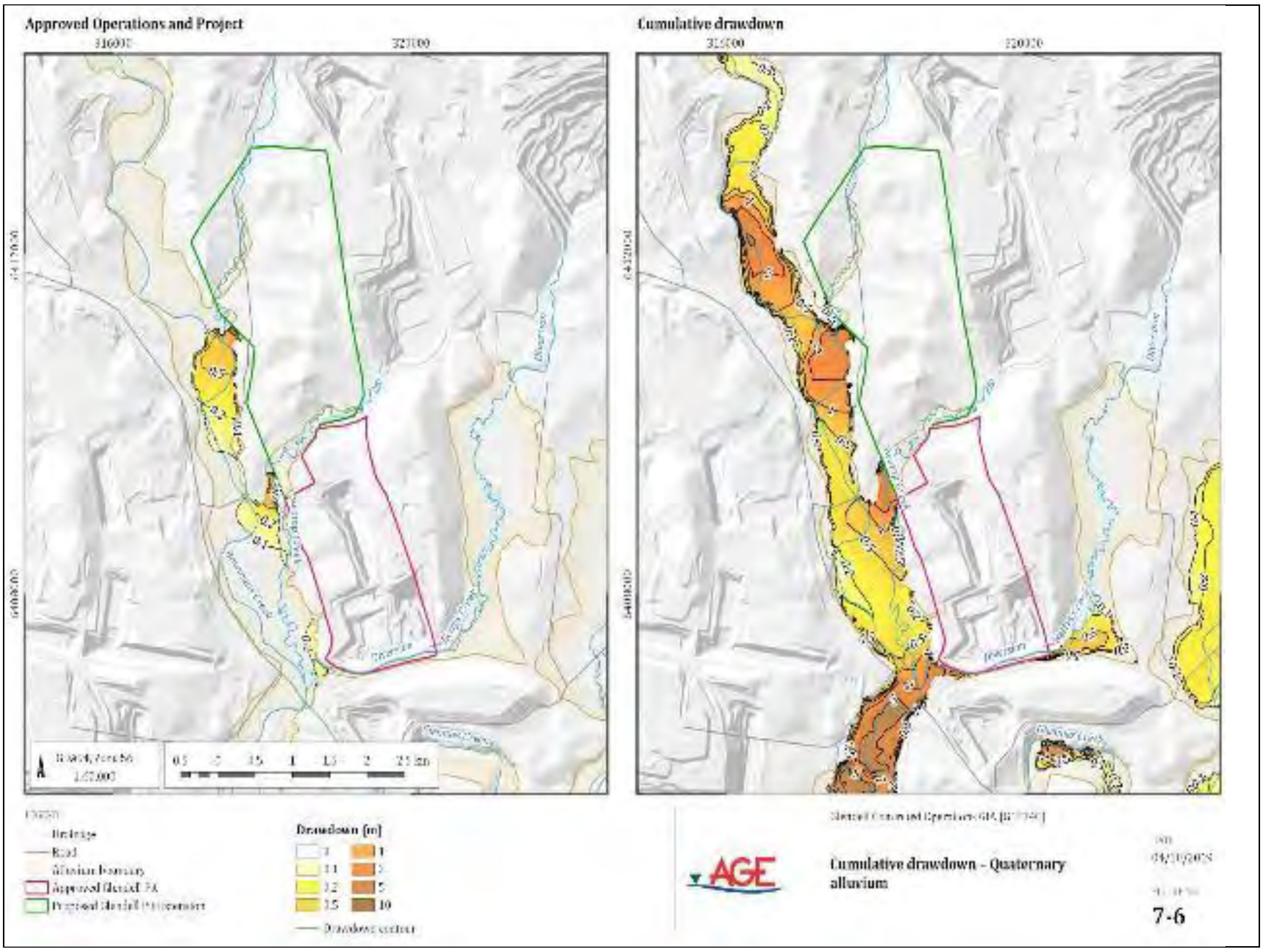

Figure 7.5.5 Predicted Maximum Alluvial Drawdown During Operations

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7.5.6.2 Impacts on Saturation of Alluvium

The model predicts several zones of limited drawdown within the Bowmans Creek alluvium of generally less than 1 m due to the combined influence of the existing approved Glendell Mine and the Project (refer to **Figure 7.5.5**). The drawdown in the southern area of the Bowmans Creek alluvium occurs largely due to the approved operations due to intersection of interconnected regolith, whilst the predicted zone of drawdown to the north, close to the existing confluence with Yorks Creek is generated by the Project (refer to **Figure 7.5.5**). Following the cessation of mining, the Project is also modelled to result in up to 1 m of depressurisation to the north east of the Glendell Pit Extension; this drawdown does not appear to have any material effect on the extent or depth of saturated alluvium in this area.

The zones of drawdown are relatively limited because the rainfall recharge rate to the alluvium exceeds the losses through the base of the alluvium due to mining and therefore there is no significant drawdown predicted. This aligns with current monitoring results that have not detected any significant drawdown within the Bowmans Creek alluvial system associated with mining in the adjacent Glendell Pit. It should be noted that applying average rainfall and streamflow to the model in the predictive phase is likely to understate recharge to the alluvium from natural conditions, and mining induced drawdown will be less observable following high rainfall events.

The potential for the predicted drawdown within the alluvium depends on the saturated thickness within the alluvial aquifer. The modelling indicates that there is commonly between 2 m to 5 m of saturated thickness within the Bowmans Creek alluvium adjacent to the approved Glendell Mine and the Glendell Pit Extension. The changes predicted to occur in the saturated thickness are a function of the cumulative impacts generated by the surrounding existing and approved mining and the Glendell Pit Extension.

Figure 7.5.6 shows the modelled saturation in the Bowmans Creek alluvium for the "Approved + Project" scenario (i.e. cumulative impacts including the Project) over the period to 2044. The modelling indicates that Bowmans Creek alluvium remains saturated adjacent to the Glendell Pit Extension throughout the life of the Project, with the exception of an area to the northwest of the Glendell Pit Extension. **Figure 7.5.7** shows the modelled saturation in the Bowmans Creek alluvium for the 'No Glendell Model' over the period to 2044. A comparison of the 2 model outputs shown in **Figure 7.5.6** and **Figure 7.5.7** indicates that the combined effect of both the existing approved operations at Glendell and the mining of the Glendell Pit Extension has no discernible impact on the extent or depth of saturation in the Bowmans Creek alluvium during operations. In other words, the area of desaturated alluvium is modelled to be present under current conditions and will slightly increase in areas as a result of the cumulative impacts of other mines irrespective of any contribution from Glendell (approved operations or the Project). A further point of desaturation is modelled to be present to the southeast of Glendell Mine in the area adjacent to the Ashton Coal Mine. The modelling indicates that the existing Glendell Mine and the Project have no impact on this area of desaturation. The Project is therefore predicted to have a negligible impact on the extent of saturation during the operational period.

The model results for the "No Glendell" scenario and the "Approved" scenario both indicate that the regional water table begins to recover around the time of the cessation of mining in the Glendell Pit Extension with cumulative groundwater take from all water sources declining from this point. The extent of saturation in all scenarios considered is modelled to increase from around 2044. The Project does not appear to increase the extent of desaturation within the alluvium during the post-mining period however the modelling indicates that the recovery of the water table within the Bowmans Creek alluvium is slower due to the effects of the Project. The Project's modelled impacts on groundwater levels in the alluvium indicate the Project's greatest impact is in the area directly adjacent to the point of intersection of the Glendell Pit Extension with the Swamp Creek and Yorks Creek alluvium (refer to **Figure 7.5.8**). These impacts on the water table are discussed in more detail in **Appendix 10**.

A comparison between **Figure 7.5.8** and **Figure 7.5.7** indicates that water levels in Bowmans Creek are modelled to have recovered to levels similar to existing conditions in the area around the Yorks Creek and Swamp Creek intersection points by at least 2400. Water levels in other parts of the Bowmans Creek alluvium are modelled to be similar to or significantly higher than current groundwater levels. The modelled impacts from existing and approved operations at Glendell Mine are not considered to be significant in terms of either scale or magnitude.

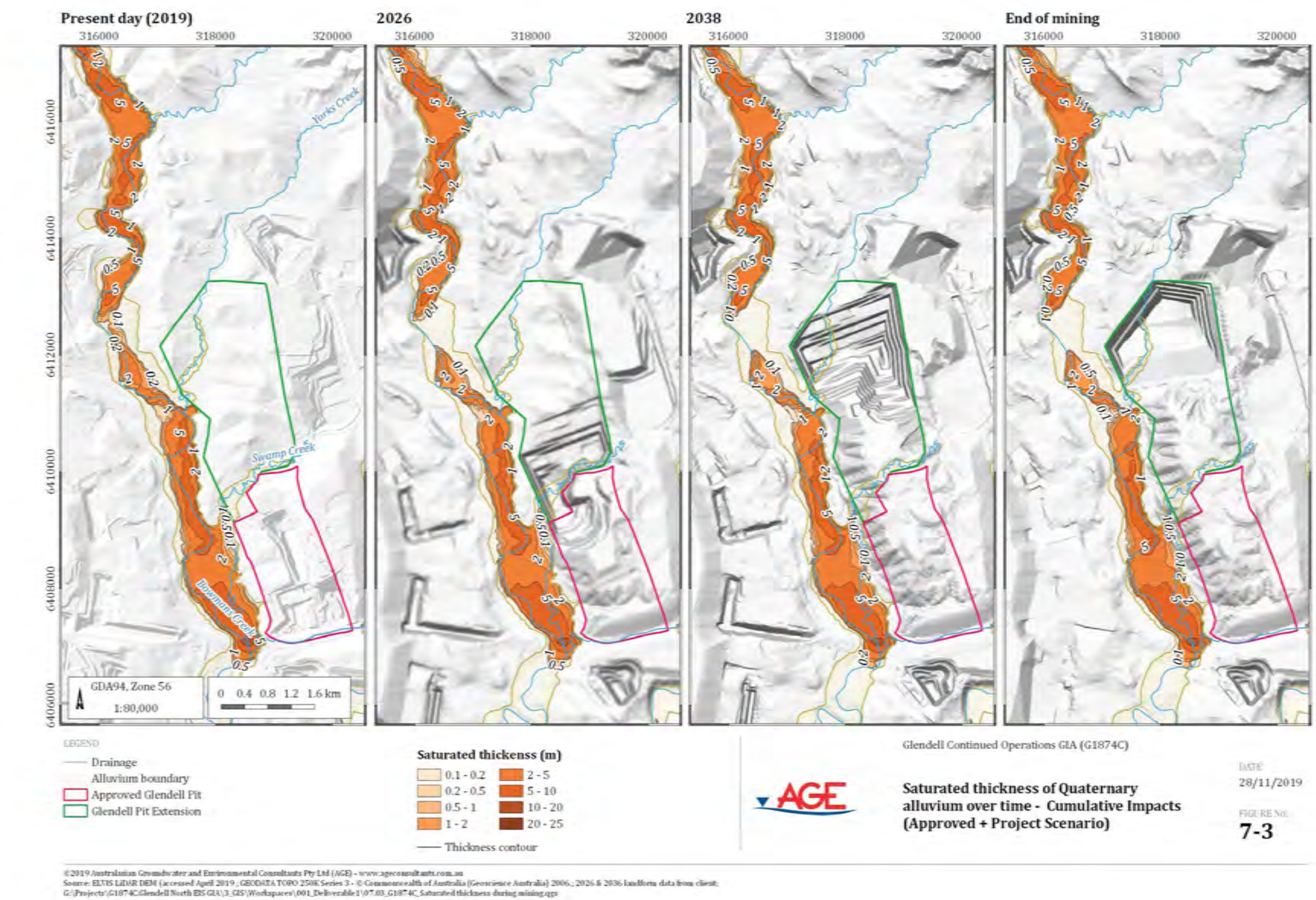

Figure 7.5.6 Saturated thickness of alluvium in Bowmans Creek ("Approved + Project" scenario)

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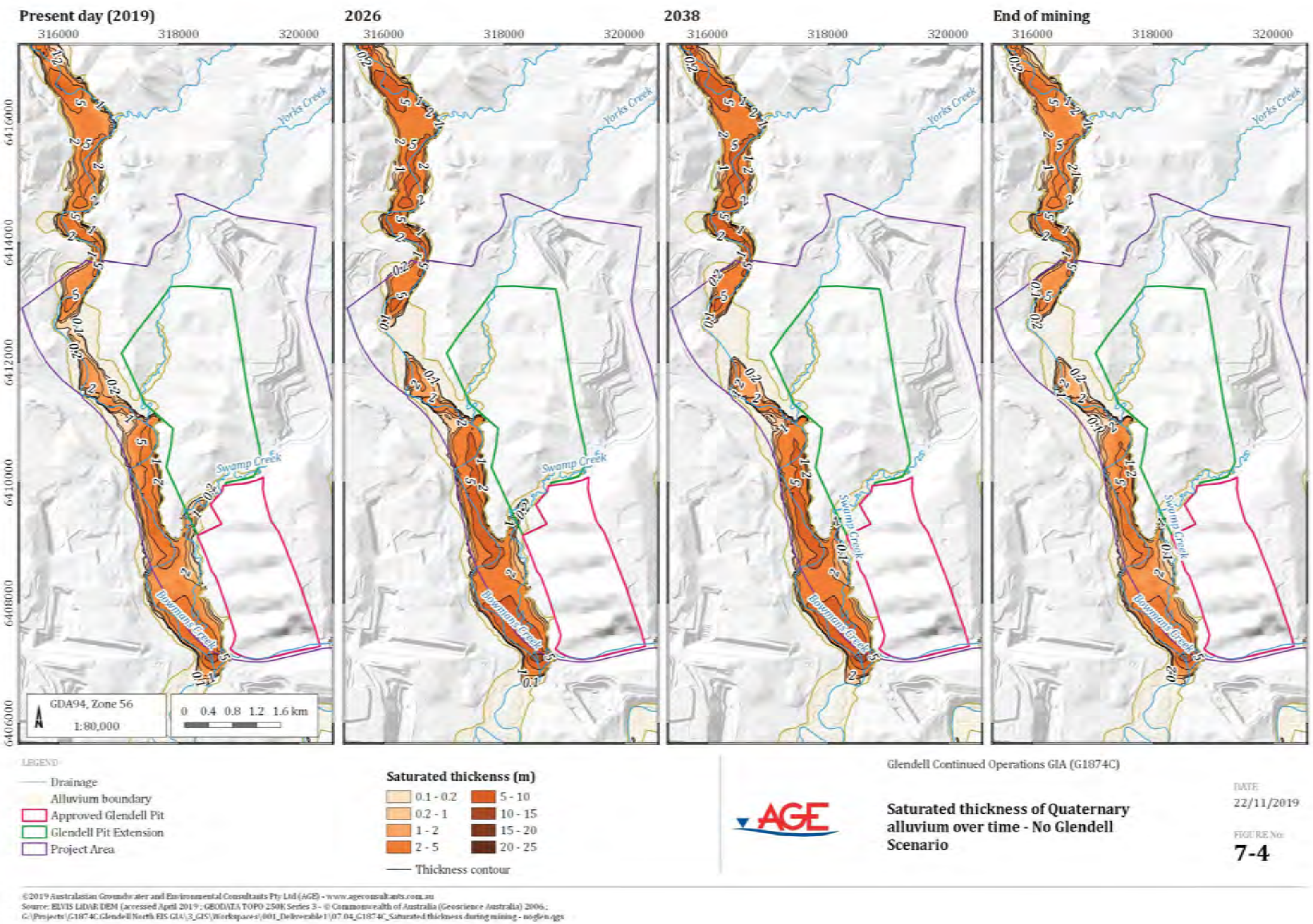

Figure 7.5.7 Saturated thickness of Quaternary alluvium in Bowmans Creek ("No Glendell" scenario)

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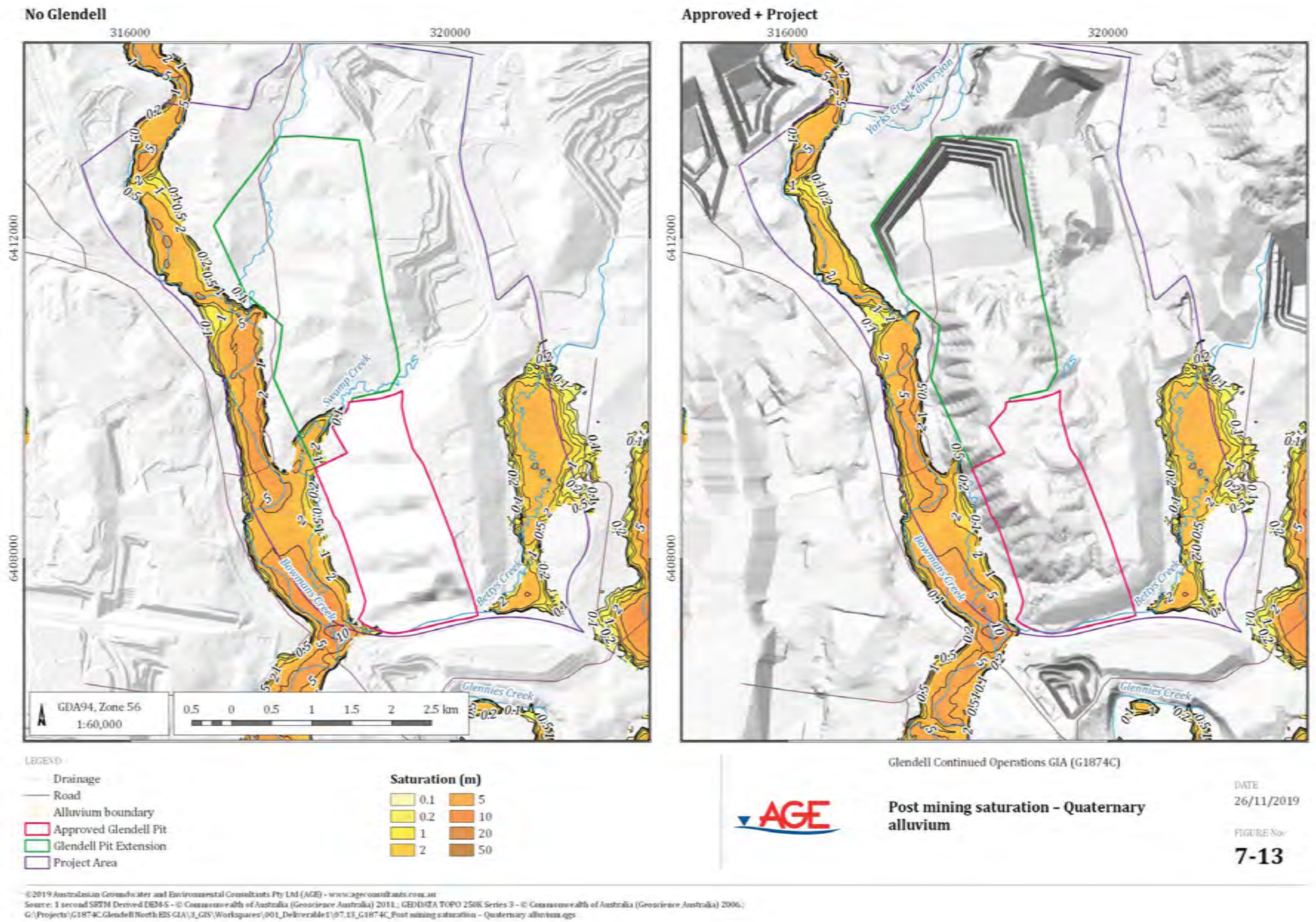

Figure 7.5.8 Saturated thickness of alluvium in Bowmans Creek - 2400

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7.5.6.3 Predicted impacts on groundwater quality

The only sources of potential impact on groundwater quality are:

- seepage of pit lake water through spoil or regolith into the surrounding alluvial aquifer systems
- recharge of Permian aquifers from pit lake water
- induced changes in groundwater flux between the alluvium and Permian aquifers

Post mining, the majority of the Glendell Pit Extension will have been backfilled with overburden, with the remaining area forming a pit lake in the final void. Over time, the spoil will re-saturate until water levels reach a new equilibrium condition. The evaporative losses from the void will be greater than inputs from groundwater, rainfall, and runoff, resulting in a water level in the void remaining below the regional water table creating a permanent zone of residual drawdown. The water balance model (refer to **Section 7.5.6.2**) indicates the evaporation from the lake surface will concentrate salts in the pit lake slowly over time. Salinity levels in the pit lake are not predicted to exceed natural salinity levels in the Permian aquifer system over the modelling period and are therefore not considered to pose a risk of adversely affecting the quality of water in the Permian aquifers.

During the operational phase of the Project, the reduced groundwater flow from the Permian to the alluvium is expected to reduce the salt load to the Bowmans Creek alluvium resulting in an overall improvement in water quality, despite the decline in quantity. Once the system begins to recover and the water table in the Permian system rises, the Permian aquifers will form a recharge point for the alluvial aquifers. This will result in a marginal reduction in groundwater quality, particularly in periods of low rainfall and stream flow. It is noted that this post-mining effect on groundwater quality would reflect the natural pre-mining environment.

The groundwater modelling indicates that there will be no seepage of water from saturated spoil to the downstream surface water environment.

7.5.6.4 Predicted impacts on water users

Registered Bores on Privately Owned Land

Two private (non-mine owned) groundwater bores are located on private property close to Bowmans Creek (refer to **Figure 7.5.1**). Both of these bores are located on land which is managed by Daracon and are not currently used for agricultural or residential purposes. The bores are currently licenced for stock and domestic use only. Based on the data available, it is assumed that both of these bores are installed in the regolith. The geological model indicates the base of the regolith at this location is at approximately 68 mAHD.

The groundwater model predicts that cumulative impacts result in a maximum drawdown in the regolith at the location of these bore of less than 0.2m during operations and less than 0.5 m post mining, of which the Projects contribution to the reduction is less than 0.2m. This predicted drawdown is well within the AIP threshold for minimal impact on water supply works of 2 m cumulative drawdown. The modelling indicates that the overall groundwater level will be at least 72 mAHD at the site of these bores indicating that cumulative groundwater drawdown will not significantly impact the ability for these bores to pump low volumes of groundwater.

The remainder of the private bores recorded in the NSW State government groundwater bore database are not in close proximity to the Glendell Pit Extension, are located on land owned by mining companies and are used for monitoring the impact of mining, or are former water bores or wells no longer in use.

7.5.6.5 Assessment against aquifer interference policy

As discussed in **Section 7.5.2**, the NSW Aquifer Interference Policy includes specific criteria (known as the minimal harm criteria) to assess the predicted impacts of aquifer interference from activities such as open cut coal mining projects. The GWIA includes an assessment of the Project against the minimal harm criteria relevant to the Project. The GWIA concluded that the Project's impacts on groundwater systems do not exceed the applicable minimal harm criteria under the AIP (refer to **Appendix 16** for further detail).

7.5.7 Surface water assessment results

7.5.7.1 Water balance

The water balance modelling indicates the Project is not expected to have a significant impact on the overall water balance, other than the impacts associated with extending the proposed life of the Project (refer to **Appendix 17**).

The Project will increase the overall disturbed area at the Mount Owen Complex, and therefore is expected to increase the volume of catchment runoff captured and managed within the Mount Owen Complex WMS. Similar to the approved conditions, this volume will reduce over time as rehabilitated catchment runoff is returned to the surrounding creek systems. The use of WRD as a transfer dam during operations and the availability of both the Bayswater North Pit and the North Pit voids as water storages once mining in those pit areas is completed ensure that there is sufficient storage capacity within the Mount Owen Complex and the GRAWTS more broadly to manage water storage demands identified by the GRAWBM simulation including the Project.

Consistent with the existing arrangement for the Mount Owen MIA and Glendell MIA, clean water for the new Glendell MIA is proposed to be supplied from Glennies Creek. This is expected to increase the total extraction from Glennies Creek during the period of concurrent operation of both the Mount Owen and the new Glendell MIA. After 2037, the Mount Owen MIA is expected to cease to operate, and extractions from Glennies Creek will reduce. The peak forecast extractions from Glennies Creek of 412 ML/year are well within the high security water licence entitlements already held by Glencore at the Mount Owen Complex (refer to **Section 7.5.8**).

Forecast water inventory at the Mount Owen Complex is expected to be small compared to the available storage capacity at the Mount Owen Complex. The overall water volume stored in the GRAWTS is expected to remain well below the total water storage capacity, especially following the conclusion of mining at Liddell Coal Operations and Bayswater North Pit in around 2023, and in the late 2030s as mining is completed in Mount Owen North Pit and Ravensworth Operations North Pit (refer to **Figure 7.5.9**).

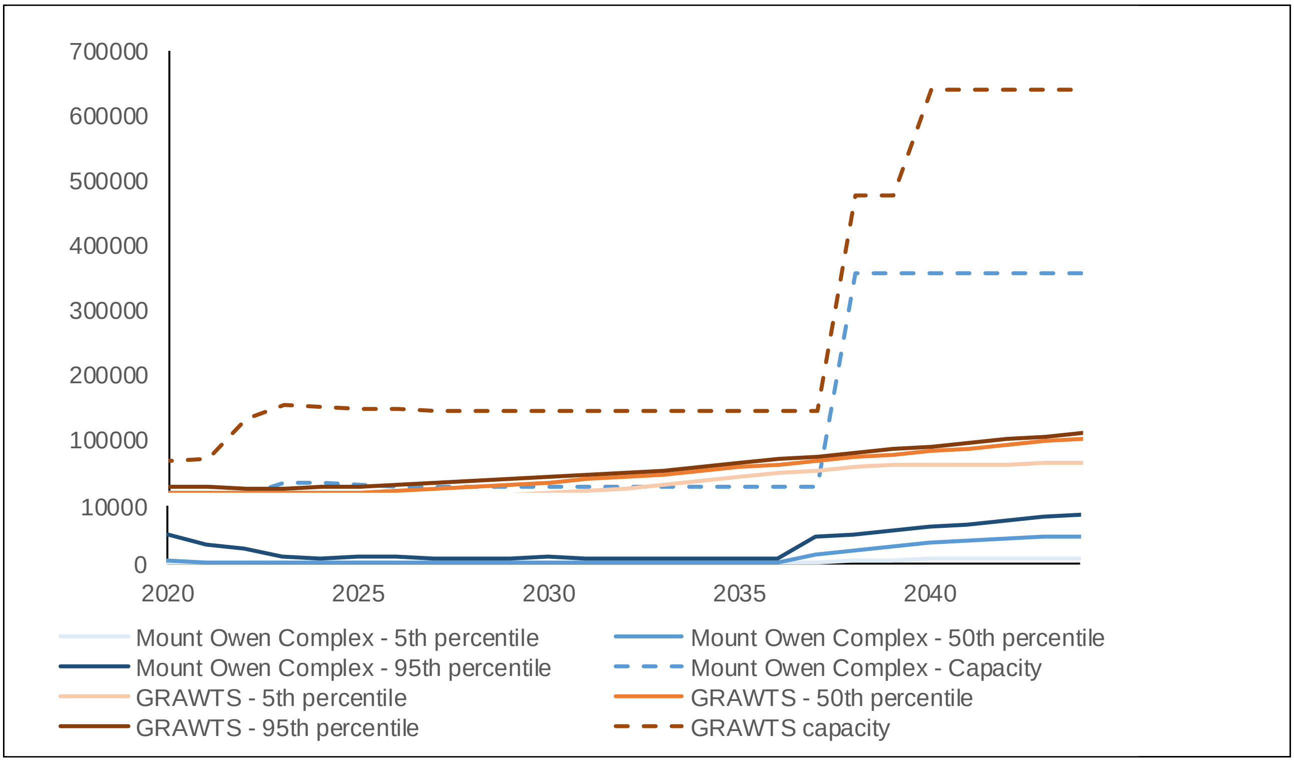

Figure 7.5.9 Forecast GRAWTS Water Inventory

The Project, as part of the Mount Owen Complex, does not propose to discharge water. Glencore proposes to continue to share water within the GRAWTS, including the use of existing water storages and, where necessary, utilise existing approved discharge points under the HRSTS at Ravensworth Operations and/or Liddell Coal Operations. The likely range of discharge volume under the rules of the HRSTS are expected to remain similar to existing approved operations over the life of the Project.

As detailed in **Appendix 17**, the salt balance at the Mount Owen Complex is expected to remain proportional to the water balance. The overall mass of salt at the Mount Owen Complex is expected to increase, due to evapoconcentration of the water recycled within the WMS. The main source of salt at the Mount Owen Complex is from groundwater inflows to the open cut pits and transfers from Integra Underground mine that are reported as imports from the GRAWTS. This salt is entrained in water used for coal processing and dust suppression, which is, in part, returned to the WMS from tailings and catchment runoff from haul road and stockpile areas respectively. As the Project is essentially an extension of the existing operations under the Glendell Consent, any changes as a result of the Project to the site salt balance at the Mount Owen Complex are not expected to affect the discharges under the HRSTS.

7.5.7.2 Final void pit lake

A pit lake will form in the Glendell Pit Extension final void. The pit lake water level will progressively rise as a result of catchment inflows, rainfall infiltration through spoil and groundwater inflows until the evaporation from the pit lake exceeds or equals inflow rates.

The SWIA has modelled the water level for the existing approved conceptual final landform to understand the relative differences between the approved and proposed operations. The same water quality assumptions were used for both run-off and groundwater in both scenarios modelled. **Table 7.26** provides a comparison of the conceptual final landforms for each of the approved and proposed project scenarios. **Figure 7.5.10** shows the modelling results for pit lake water levels and salinity in both the existing approved and proposed conceptual final landform voids.

Table 7.26 Comparison of Approved and Proposed Glendell Conceptual Final Landforms

Aspect	Approved conceptual final landform (Glendell Pit)	Proposed conceptual final landform (Glendell Pit Extension)
Final void catchment (ha)	339	321
Final landform spoil catchment (ha)	181	258
Completion of mining	2025	2045
Maximum Available Storage (GL)	50	250
Equilibrium water level (m AHD)	29	-60
Freeboard at equilibrium water level (m)	41	140
Time to reach equilibrium water level (years)	450	450
TDS of water in final void at equilibrium water level (mg/L)	5,700	6,500

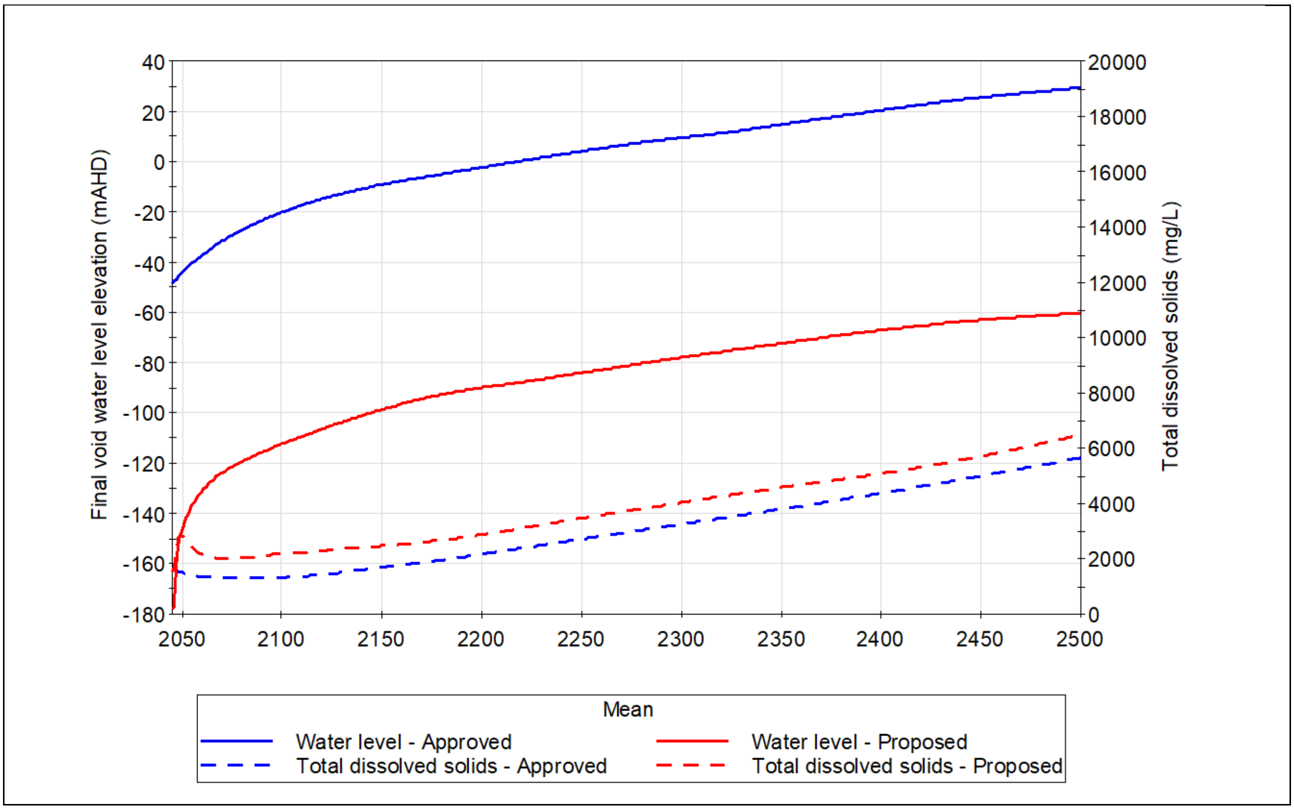

Figure 7.5.10 Modelled water level and salinity (TDS) in approved and proposed final voids (Glendell Pit)

Model results indicate that the final void pit lake would reach an equilibrium level of approximately -60 mAHD by 2500 (approximately 450 years following closure). This equilibrium level is approximately 140 m below the spill level. The equilibrium level of the proposed void would be reached in a similar timeframe to the approved operations, being approximately 450 years post mining. The modelling indicates that both the existing approved and proposed final voids would retain sufficient freeboard at equilibrium to avoid any risk of decant from the pit lake or seepage through regolith or alluvial material into the downstream environment.

An assessment of the geochemical characteristics of material mined as part of the Project (refer to **Appendix 19**) indicates that overburden/interburden materials from the Glendell Pit Extension (and the Mount Owen Complex generally) are likely to produce excess alkalinity, with low metal/metalloid concentrations, and initial moderate salinity dominated by SO_4 and Cl salts. Salinity concentrations are expected to decrease over time with continued flushing, and overburden/interburden materials are expected to have an overall low salinity potential. Salinity levels in the proposed final void pit lake would increase slowly as a result of evapoconcentration, however are expected to be approximately 6,500 mg/L after 450 years of recovery. These salinity levels are similar to those of the existing approved operations and are consistent with the modelled water quality in final void pit lakes at other open cut mining operations in the Hunter Valley. Modelled salinity levels in the final void remain below that of the Permian groundwater systems for the modelling period, meaning any recharge of Permian systems from the pit lake will not adversely affect the quality of water in the Permian systems.

While the proposed final void is deeper and has a larger overall capacity, the catchment areas for both the approved and proposed voids are similar. This is discussed further in **Section 7.5.7.4**.

7.5.7.3 Surface water quality

The existing and approved WMS at the Mount Owen Complex (refer to **Section 2.1.4**) is extensive and includes mine dewatering systems, water storages, sedimentation and retention basins, settling ponds, tailings storages and diversion drains.

The extension to the WMS, as part of the Project, will be integrated into the existing Mount Owen Complex WMS to limit the potential impacts on downstream water quality by managing water that has the potential to cause environmental harm. The conceptual WMS has been designed to continue to divert clean water around mining operations (where practical) and segregate, store and reuse dirty and mine impacted water to minimise adverse effects on water quality from mining operations to downstream waterways.

Surface water quality monitoring is undertaken in accordance with the *Surface Water Management and Monitoring Plan* for the Mount Owen Complex (Glencore 2019) in surrounding watercourses upstream and downstream of the site, including in Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and Main Creek. The existing monitoring data indicates that water quality within each creek system is generally consistent at locations upstream and downstream of the Project. Observed EC, pH and TSS levels were largely found to be below or within the relevant site specific guideline values. Geochemical assessments of coal, overburden and washery tailings and coarse rejects material; indicate that there is a low risk of acid mine drainage associated with the Project due to surplus buffering capacity within overburden material (refer to **Appendix 19**). The geochemical assessment findings are supported by historical monitoring of overburden emplacement areas and tailings facilities at the Mount Owen Complex which do not indicate any evidence of acid mine drainage. Historical sampling of water in sediment dams indicate pH levels with a median value of 8.4. Monitoring of flows upstream and downstream of the WMS also indicate pH values above 7. The results and the predictions in the geochemical assessment (refer to **Appendix 19**) support the contention that acid mine drainage (and associated elevated levels of metals and metalloids) are not a significant environmental risk at the Mount Owen Complex.

The approved WMS is designed to manage water to meet the requirements of the POEO Act, taking account of both historical and current water qualities in the surrounding watercourses, and current and future downstream water users. The risk of adverse water quality impacts associated with overflows during events that exceed the design criteria of storages and potential impacts associated with overflows is currently managed by the WMP for Mount Owen Complex. Once disturbed areas are successfully rehabilitated, there is considered to be negligible risks to downstream water quality associated with run-off from these areas.

Consistent with approved operations at the Mount Owen Complex, no licensed discharges will occur from the Mount Owen Complex as part of the Project. Surplus water on site will be transferred via the GRAWTS to the other Glencore managed sites that form part of the GRAWTS.

The Yorks Creek Realignment has been designed to provide flood conveyance and will include appropriate scour and erosion control measures during construction and operation. These design elements are intended to minimise the potential for erosion resulting in downstream water quality impacts.

The modelling of pit lake recovery in the proposed final void indicates that significant freeboard will be maintained at equilibrium (approximately 140 m) to avoid any risk of decant. Groundwater modelling indicates there is no risk of decant from the final void through spoil to the downstream environment.

As the WMS and final void are designed to avoid any adverse impacts on surface water quality downstream of the Project, no adverse impacts on downstream aquatic ecosystems or downstream water users are expected as a result of the Project.

7.5.7.4 Impacts on catchment areas

Catchment Areas

The Project will change the catchments of Bowmans, Yorks, Swamp and Bettys Creeks and also realign Yorks Creek to a new confluence with Bowmans Creek. As discussed earlier, the changes to catchment sizes affected by the Project will vary over time due to both the Project itself (as a result of additional catchment area being managed within the Mount Owen Complex WMS) and the release of rehabilitated areas managed within the Mount Owen Complex and other mines.

The Project's greatest impact on catchment areas is reflected in the Year 13 stage when the progression of the Glendell Pit Extension mines through the lower reach of Yorks Creek. The catchment areas of the creeks during the life of the Project is set out in **Table 7.27**. **Table 7.27** also includes the conceptual final landform for the currently approved operations for comparative purposes.

Table 7.27 Predicted Impact on Catchment Areas

Catchment	Pre-Mining conditions	Existing conditions (ha)	Proposed conditions (Year 13) (ha)	Approved conceptual final landform# (ha)	Proposed conceptual final landform# (ha)
Bowmans Creek upper*	19,635	15,495	15,495	15,495	15,495
Bowmans Creek lower		3,458	3,428	4,564	4,586
Yorks Creek (existing)	1,230	1,656	14	1,884	184
Yorks Creek (proposed realignment)		N/A	1,400	N/A	1,505
Swamp Creek	2,380	267	50	1,237	348
Bettys Creek	1,810	530	679	865	1,946
Total	**25,0525**	**21,406**	**21,067**	**24,046**	**24,064**

* Areas of Bowmans Creek upstream of the Mount Owen Complex and Liddell Coal Operations water management system catchments.
# Assumes all rehabilitated areas outside of final void catchment areas are returned to downstream catchments.

Overall, the total catchment of Bowmans Creek will increase in both the approved and proposed conceptual final landform compared to existing conditions, with the slight difference reflecting the catchment areas of the approved and proposed final voids. The lower catchment of Bowmans Creek is proposed to temporarily reduce by approximately 339 ha during the operation of the Project before increasing as rehabilitated catchment is returned. This reduction is less than the Additional Disturbance Area associated with the Project as other areas of rehabilitated land at the Mount Owen Complex and Liddell Coal Operations are expected to have been returned to the catchment by the time the maximum extent of impacts associated with the Project occur. In this regard, the cumulative impact on the overall catchment size of Bowmans Creek relative to existing conditions is less than the incremental impact associated with the Project.

The realignment of the lower reach of Yorks Creek will substantially reduce the catchment of the reach of Yorks Creek discharging into Bowmans Creek at the existing confluence point once the Glendell Pit Extension mines through Yorks Creek. In the conceptual final landform, the drainage plan results in a return of flows to Bowmans Creek at this confluence point, however most of the historical Yorks Creek catchment will be diverted to Bowmans Creek via the Yorks Creek Realignment at the upstream confluence point.

The proposed final landform catchment of Swamp Creek is substantially less than in the approved conceptual final landform, as most of the rehabilitated former Swamp Creek catchment is proposed to be diverted to Bettys Creek. In the proposed conceptual final landform, the catchment of the lower reach of Swamp Creek will be slightly larger than the existing conditions.

The catchment area of Bettys Creek will increase as rehabilitated areas are returned during the operation of the Project. The Project will result in the Bettys Creek catchment being substantially increased in the proposed conceptual final landform compared to the approved conceptual final landform due to the diversion of part of the former Swamp Creek catchment to Bettys Creek via WRD. This change will result in Bettys Creek having a similar catchment size to its pre-mining catchment.

While the Project alters the catchment areas of various tributaries of Bowmans Creek during the life of operations, the overall impacts on the Bowmans Creek catchment during operations is considered to be small relative to existing conditions (less than 2% reduction). The conceptual final landform for the Project will have a negligible impact on the overall catchment size of Bowmans Creek relative to existing approved operations. The respective changes to the Swamp Creek and Bettys Creek catchments in the final landform, while significant in percentage terms, are unlikely to have significant environmental impacts as the confluence point of both creeks with Bowmans Creek occur within approximately 150 m of each other. Further, the proposed Swamp Creek catchment will be slightly larger than the existing conditions (which have existed for more than 10 years) and the Bettys Creek catchment will be similar (relative to the approved conceptual final landform)to its pre-mining catchment.

7.5.7.5 Impacts on flow regimes

The Project has the potential to impact on flow regimes in watercourses due to changes to surface water runoff and reductions in baseflow. The Project will change the catchments of Bowmans, Yorks, Swamp and Bettys Creeks and also realign the lower reach of Yorks Creek to a new confluence with Bowmans Creek. Groundwater modelling reported in the GWIA (refer to **Appendix 16**) also predicts changes to baseflow in Bowmans and Glennies Creeks and the Hunter River associated with a delay in the recovery of the groundwater system, however the incremental changes to baseflow for Yorks, Swamp and Bettys Creeks were predicted to be negligible and overall baseflow is predicted to increase following the cessation of mining as regional groundwater systems recover.

The potential impacts on flow regimes in Yorks, Swamp, Bettys and Bowmans Creek have been assessed using a water balance model, consistent in methodology, but distinct from the GRAWBM. For Bowmans Creek, Glennies Creek and the Hunter River, the flow regime water balance modelling also considered the baseflow reductions predicted in the GWIA (refer to **Appendix 16**).

As discussed in **Section 7.5.7.4**, the Project will increase the area of Bowmans Creek catchment managed within the Mount Owen Complex WMS but return slightly more catchment to Bowmans Creek in the final landform compared to approved conditions (as a result of slightly smaller final void catchment area). The proposed Yorks Creek Realignment will move the confluence point for the majority of the Yorks Creek catchment with Bowmans Creek approximately 4 km upstream from its current position. The other major change in terms of impacts on stream flows is the return of rehabilitated areas of the former Swamp Creek catchment to Bettys Creek catchment rather than the Swamp Creek catchment.

As noted above, the GWIA (refer to **Appendix 16**) identified that the incremental changes to baseflow for Yorks, Swamp and Bettys Creeks associated with the Project were predicted to be negligible. The impacts on flow regimes for Yorks Creek, Swamp Creek and Bettys Creek are therefore almost entirely associated with changes in catchment area.

As noted previously, Yorks, Swamp and Bettys Creeks are ephemeral systems and the creek systems are dry between rainfall events with the exception of some pools following flow events. A level of baseflow would be expected in these creeks as subsurface flow which are unlikely to be observable at the surface other than in some pools. During the recent 2017-2019 drought period, there has been negligible flow in all 3 creeks as a result of reduced run-off events and there have not been any pools in any of these ephemeral creeks for over 18 months.

Yorks Creek

The realignment of Yorks Creek will remove approximately 2 km of the lower reaches of Yorks Creek and direct creek flows through a constructed channel.

Results of the flow regime modelling (refer to **Appendix 17**) show that the flows in the Yorks Creek Realignment are expected to be slightly lower than the existing Yorks Creek, due to a reduction in the catchment reporting to the realignment compared to the existing Yorks Creek. In the final landform, some catchment will be returned to Bowmans Creek via the existing Yorks Creek confluence.

Notwithstanding the reduction in catchment, the Yorks Creek Realignment is expected to provide similar streamflow input to Bowmans Creek as compared to the existing Yorks Creek, although at a location further upstream.

Swamp Creek

The results of the flow regime modelling show that flows in Swamp Creek are expected to decrease temporarily as a result of the Project before returning to a flow regime similar to, but slightly higher, than existing conditions.

The majority of the catchment of the rehabilitated site is proposed to be diverted to Bettys Creek rather than Swamp Creek, where flows are expected to increase. As a result, the Swamp Creek flow regime in the proposed conceptual final landform is lower than that for the conceptual final landform for the currently approved mining operations at the Mount Owen Complex.

Bettys Creek

The additional catchment area reporting to Bettys Creek under the Project is comparable to the catchment area diverted by the existing Upper Bettys Creek diversion to Main Creek. This increase in catchment area has a larger impact on high flow events with the flow regime modelling indicating that low flows will be attenuated due to WRD being maintained in the conceptual final landform as a retention basin. Notwithstanding the attenuation effects of WRD, overall flows are modelled to be higher than both existing and approved conceptual final landform conditions but are expected to be similar to pre-mining conditions.

Impacts on low flows and pools in Bowmans Creek

The streamflow in Bowmans Creek has the potential to be affected by both the change in catchment areas and change in baseflow. As discussed earlier, cumulative impacts from existing approved mining operations in the area will also have impacts on both of these factors over the life of the Project.

Table 7.26 shows that the cumulative reduction in the total catchment area of Bowmans Creek under proposed operations (Year 13) is 339 ha, less than 2% of the total catchment area. This change in catchment area is not expected to result in a measurable difference in streamflow.

The overall catchment of Bowmans Creek contributing to stream flows in the vicinity of and downstream from the Project will increase over the life of the Project until all areas of rehabilitated land have been returned to the catchment. This increase in available catchment (approximately 12% increase relative to existing conditions) will have a more significant impact on stream flows than the predicted maximum reduction in catchment during operations.

The Groundwater Impacts Assessment (refer to Appendix 16) predicts a cumulative peak baseflow reduction in Bowmans Creek relative to existing conditions (1/7/2019) of approximately 21 ML/year (0.058ML/day) during operations (of which approximately 2.5ML/year (0.0067ML/day) is attributed to the Project). The reduction in baseflow associated with regional mining impacts increases progressively during the life of the Project with the cumulative peak modelled as occurring shortly after the cessation of mining for the Project in 2046. The reduction of baseflows over this period is attributed largely to the regional depressurisation of the Permian groundwater system associated with other mining operations with some impact of this regional depressurisation modelled as already having occurred. The groundwater modelling indicates however that the existing approved Glendell Mine operations are having only a negligible impact on baseflows and impacts will not be measurable.

From approximately 2046, baseflows are predicted to increase as the regional groundwater system recovers following the cessation of mining within the modelling domain. This recovery in baseflows is reasonably rapid with baseflows in Bowmans Creek modelled returning to existing levels by approximately 2062. Within 40 years of mining within the Glendell Pit Extension ceasing (by which time disturbed areas are expected to have been fully rehabilitated and these catchments returned to Bowmans Creek), baseflows are predicted to be approximately 4ML/year (0.043ML/day) higher than existing conditions. These changes are within the (calibrated) modelled range of natural fluctuations in baseflows in Bowmans Creek associated with climatic changes over the past decade. Predicted reductions in baseflow over the lifetime of the Project represent less than 10% of the modelled variability in baseflows over the past decade and will not be measurable.

The surface flow in Bowmans Creek is recorded at the Bowmans Creek gauge (210130) (refer to **Figure 7.5.5**), with records beginning in November 1993. Since 28 March 2018, the observed surface flow has been zero, which is the first extended period of zero flow observed at the gauge since records began. The only other period of zero flow was recorded for seven days in 2012. During the second half of 2017 through to the time of writing (October 2019), the upper Hunter Valley, has experienced an extended period of below average rainfall, or drought. At the time of writing (October 2019), the last high flow event in Bowmans Creek (>100 ML/day) was in late March/early April 2017. A review of historical rainfall and flow gauging in Bowmans

Creek indicates a long-term decline in average low surface flows in the lower reaches of Bowmans Creek. The reducing trend in observed flow at the Bowmans Creek gauge (210130) during the drought (to zero in the current drought) may be attributable to a range of factors including:

- abnormally low rainfall and reduced surface flows entering Bowmans Creek following rainfall events due to interception by farm storages and dry pools in ephemeral tributaries
- general depressurisation of regional groundwater levels associated with the long history of mining in the catchment between and surrounding the 2 monitoring locations and
- lower alluvial recharge in the period before the current period of rainfall deficit due to repeated periods of lower rainfall since the early 2000s

The flow regime modelling was used to estimate the potential impacts to low flows (surface and subsurface) and the water levels in pools, assuming that the regional water table was sufficiently high that subsurface flow moved through the pool. Based on the results of the flow regime modelling, no measurable impact on total low flows or pools in the lower part of Bowmans Creek is expected as a result of the incremental impacts on baseflow associated with the Project. As noted earlier, following the cessation of mining, cumulative impacts from mining on baseflow are expected to reduce. While the Project is predicted to be responsible for an increased take from alluvial systems post closure, this slows down the rate of increase in base flow recovery rather than causing a further decline in baseflows. This impact is unlikely to be measurable in the context of the natural variability in the system when the recharge effects of high rainfall events and high flow events are considered.

Impacts on baseflows in Glennies Creek and the Hunter River

The GWIA (refer to **Appendix 16**) also predicts some minor baseflow reductions in Glennies Creek and the Hunter River as a result of the Project. There are no predicted impacts on these waterways during operations however minor impacts are predicted in the post mining recovery phase. These predicted impacts are less than the predicted impacts on Bowmans Creek baseflows and, when compared to the long term stream flow record in these watercourses, no measurable impacts on flows in Glennies Creek or the Hunter River are expected.

Downstream water users

No measurable change to the flow regime or water quality of Bowmans Creek is expected as a result of the Project, and therefore no impacts to licensed water users or basic landholder rights are expected.

Potential impacts to downstream water users on Glennies Creek associated with changes in baseflow are also considered to be less than measurable. All predicted reductions in baseflow natural variability will be managed by appropriate licencing on the WM Act.

Riparian and Ecological Values

The expected changes to flow regimes are considered minor in the context of ephemeral Yorks Creek, Swamp Creek and Bettys Creek. No measurable impacts to flow regimes and pools in Bowmans Creek are expected as a result of changes in baseflow.

The realignment of Yorks Creek will remove approximately 2 km of the riparian habitat in the lower reaches of Yorks Creek. These impacts are considered in **Section 7.6**. A design objective of the Yorks Creek Realignment is to provide riparian and aquatic habitat.

The Project's potential impacts on water dependent ecosystems is assessed in **Section 7.6**.

7.5.7.6 Flooding

The Project has the potential to impact the extent of flooding and stability of downstream watercourses, through changes in landform (including the proposed realignment of Yorks Creek) and the resulting changes to catchment area. The realignment of Yorks Creek upstream of the current confluence will also increase flows in Bowmans Creek in the reach between the existing and proposed confluences relative to existing conditions. These increased flows have potential to impact on stream bank stability.

The key issues considered in the assessment of potential flooding impacts are changes in flood depths and changes in velocity.

Impacts on Bowmans Creek associated with Yorks Creek Realignment

As part of the design process for the Yorks Creek Realignment a geomorphological assessment was undertaken by Fluvial Systems (refer to **Appendix 18**) to understand the existing geomorphic characteristics of both Yorks Creek and the receiving environment in Bowmans Creek. The channel of Bowmans Creek was found to have highly variable morphology through hydrologically homogeneous reaches, suggesting complex local channel adjustment to erosive and depositional processes. As a result, there was no statistically significant change in channel dimensions downstream of the existing Yorks Creek junction, indicating the additional flows entering Bowmans Creek from Yorks Creek did not have a significant impact on the morphology of Bowmans Creek. Given the inherent stability of the channel, moving the confluence point of Yorks Creek and Bowmans Creek approximately 4 km upstream of its current location is not expected to result in any rapid and large magnitude adjustment of Bowmans Creek channel downstream of the new confluence. Rather, adjustment would take place incrementally over decades and is unlikely to be measurable against the natural changes in the system and the impacts associated with the return of rehabilitated catchment areas at Liddell Coal Operations (refer to **Appendix 18**).

The flood modelling indicates that the realignment of Yorks Creek slightly increases the flood depths and velocities in Bowmans Creek between the confluence with the proposed realignment of Yorks Creek and the existing Yorks Creek confluence. The flood modelling results indicate localised increases in peak velocity in the order of 0.1 m/s are expected in the section of Bowmans Creek between the current Yorks Creek confluence and the proposed confluence with the Yorks Creek Realignment as a result of the realignment. These changes are considered minor and are not expected to have a significant impact on the stability or water quality in Bowmans Creek.

The Yorks Creek Realignment has been designed to provide flood conveyance while including scour and erosion protection during construction and operation. The results of the flood modelling indicate that the Yorks Creek Realignment design elements are likely to mitigate the potential impact of erosion on downstream water quality.

Preliminary studies as part of the conceptual detailed design of the Yorks Creek Realignment indicate that the design of the creek can effectively manage the expected sediment load in runoff entering the stream.

Flooding in Bowmans Creek

The realigned section of Hebden Road is modelled to remain above flood water levels in Yorks Creek and Bowmans Creek in the 5% AEP event (1 in 20 year flood). This exceeds the performance of the current Hebden Road alignment which is overtopped in a 5% AEP event in Yorks Creek. The conceptual design of the Hebden Road realignment was modelled and is predicted to be partly inundated in a 1% AEP (1 in 100 year event) but remain passable.

The new Glendell MIA is also modelled to remain above flood levels in the 1% AEP event. The design of the Yorks Creek Realignment includes the development of a levee to prevent inundation of the Glendell Pit Extension in flood events up to the 0.1% (1 in 1000 year) AEP event. A similar levee adjacent to the points of intersection of the Glendell Pit Extension with Yorks Creek and Swamp Creek will also be implemented where necessary to prevent flood ingress into the Glendell Pit and Glendell Pit Extension during mining operations. These levees, if required, will also be developed to the 0.1% AEP event design standard.

In the final landform, the flood modelling indicates that a PMF event would exceed the Yorks Creek levee resulting in inflows to the pit (during operations) or final void (post mining). The modelling indicates that the final void would retain a freeboard of at least 100m even if the PMF event occurred with the pit lake at its modelled equilibrium level. Such an event would provide fresh water to the pit lake and, given there is no discharge from the void, the overall impact of such an event occurring are considered to be positive. The PMF modelling also indicates that the conceptual final landform modelled may also result in flood ingress to the final void as a result of elevated water levels in Bowmans Creek. Similar to the modelled overtopping of the Yorks Creek Realignment levee, such an event would not result in any decant from the final void. Relatively minor changes to the final landform would be required to avoid any overtopping from a PMF event at both locations and this will be considered as parts of the detailed mine closure planning process.

Overall, the results of the flood modelling indicate no significant changes to flood affectation of private property or infrastructure as a result of the Project. The Project therefore does not affect consistency with floodplain risk management plans, flood hazard, hydraulic functions, beneficial inundation, emergency management, risk to life from flood or social and economic costs as a consequence of flooding.

Flooding in Yorks Creek (Realigned)

The modelled increase in the peak velocity for the 1% AEP design flood was used to identify areas where watercourse stability in the constructed sections of the Yorks Creek Realignment may potentially be affected. This modelling indicates that some areas of the conceptual detailed Yorks Creek design may be subject to increased erosion risks. These increased erosion risks can be managed through appropriate erosion control measures, such as rock armouring, which are proposed as part of the conceptual design.

Flooding in Bettys Creek

The conceptual final landform associated with the Project includes the redirection of the former Swamp Creek catchment towards Bettys Creek. This proposed increase to the catchment area of Bettys Creek is comparable to the previous reduction in the pre-mining catchment due to the existing Upper Bettys Creek Diversion (to Main Creek) and the loss of catchment to the Mount Owen Complex WMS. Consequently, the post mining flows and flood extents in Bettys Creek are expected to be closer to the pre-mining conditions under the proposed conceptual final landform than the approved conceptual final landform. While the overall catchment of Bettys Creek will be similar to than the pre-mining catchment, localised changes in the topography and stream bed associated with subsidence from the Integra Underground Mine and sediment build-up associated with reduced flows in the intervening period mean there are risks of erosion in Bettys Creek downstream of the point where additional flows enter the creek. As with the realignment of Yorks Creek, these increased erosion risks can be managed through appropriate erosion control measures.

Detailed flood modelling will be required as part of the closure planning to identify areas of the lower Bettys Creek catchment where additional works are required to manage potential risks associated with the increased catchment returning to this system. The final design of WRD as an attenuation feature can also mitigate potential impacts from high flow events and this will be considered in the mine closure planning process (refer to **Section 7.9**).

7.5.7.7 Cumulative impacts

Land use within the catchment of Bowmans Creek includes mining operations, quarrying, grazing and rural residential holdings. Outside of the Mount Owen Complex, established mining operations within the catchment of Bowmans Creek include Liddell Coal Operations to the north-west; Ravensworth Operations to the south-west, Integra Underground Mine to the south-east, and Ashton Coal Mine to the south.

The Project will result in changes to the catchment areas of Yorks Creek, Swamp Creek and Bettys Creek compared to the currently approved final landform at the Mount Owen Complex, but the overall impacts to Bowmans Creek are considered negligible relative to currently approved operations. As the impacts to Bowmans Creek as a result of the Project are considered negligible, it is considered that there will be no measurable changes to the cumulative impacts on Bowmans Creek. It is also noted that the Project will coincide with a reduction in impacts associated with other operations or other part of the Mount Owen Complex including:

- reduced cumulative groundwater impacts as regional groundwater systems recover following the cessation of mining in other pits at the Mount Owen Complex and at other operations
- increased catchment in Bowmans Creek as areas disturbed by mining activities are rehabilitated and run-off is returned to the downstream environment rather than being managed as part of the mine water management systems.

Despite the cumulative increase in the catchment of Bowmans Creek as runoff from rehabilitated areas is returned to the downstream catchment, the flood modelling undertaken as part of the SWIA indicates that no significant changes to flood extent or watercourse stability are expected as result of the Project.

The design of the Yorks Creek Realignment includes elements to mitigate the potential for erosion resulting in downstream water quality impacts. Overall, the cumulative potential impacts on water quality in downstream watercourses are considered negligible.

As the Project and adjacent mining operations operate in a highly regulated water system, any water take associated with the Project or existing approved operations will need to meet the requirements of the WM Act in regard to licensing of water take. As such, the Project is considered to have negligible cumulative impacts on downstream water users. Water licensing is considered further in **Section 7.5.7**.

The Project lies in the Hunter subregion, which was subject to a bioregional assessment (DOEE 2018). The Project lies in an area of potential hydrological impacts, however the bioregional assessment did not identify any large change in flow regimes in watercourses near the Project. The findings from the SWIA and GWIA align with the findings of the bioregional assessment.

7.5.8 Water licensing

7.5.8.1 Pollution licensing

The Project will not involve any discharges to the environment that will cause pollution.

Other than changes to licensed areas (which are likely to change throughout the different phases of the Project), licensing requirements for the Mount Owen Complex under the POEO Act remain unchanged with the Project.

7.5.8.2 Accounting for 'take'

Glencore is required to hold adequate water entitlements to account for licensable take from water sources as a result of the Project at the time the take occurs.

The key water licensing issues associated with the Project are:

- during the operation of the Project, the interception of Yorks Creek downstream of the Yorks Creek Realignment by the Glendell Pit Extension will result in a temporary take from the Jerrys Water Source
- following the completion of the Project, the dams proposed to remain in the conceptual final landform may be accounted for under harvestable rights, on the basis of the water storage volume, or under a water access licence, on the basis of the losses from the dam
- during the operations and in the final landform, pit inflows from Permian aquifers will be treated as take from the Sydney Basin – North Coast Groundwater Source of the North Coast Fractured and Porous Rock WSP
- depressurisation of the Permian groundwater system during operations and the recovery phase is predicted to induce take from the alluvial systems in the Jerrys and Glennies Water Sources and the Hunter regulated Water Source
- the Project's interception with the alluvium in Swamp Creek and Yorks Creek has the potential to result in direct take from the alluvial aquifer system and
- changes in alluvial groundwater levels and flows can affect surface water flows and this indirect take of surface water will require licensing during operations and in the final landform.

Licenses are not required for all take and certain exemptions and landholder rights apply to the calculation of the volume of take that must be licensed. The amount of licensable take will vary over the life of the Project and in the post closure landform. Under the WM Act, persons responsible for the take must hold appropriate license allocations to cover the take at the time the take occurs. As the Project will include groundwater take, the volume of take may be based on a combination of measured take and modelled take.

Approach to calculating take

For the purposes of this assessment, licensable take is considered to be additional take relative to the actual and approved take at the commencement of the relevant WSP. The approach to calculating take for each water source is discussed in detail in **Appendix 16** and **Appendix 17**.

For the purpose of this assessment, available water determinations of 1 ML/unit has been assumed, meaning that 1 share component is equivalent to 1 ML/year.

Calculated Take

Both surface water take and groundwater take will vary over the life of the Project. The actual take at any point in time is required to be covered by either licences or available harvestable rights provisions.

The maximum predicted licensable take for the Glendell Mine (i.e. combined take for both the approved operations and the Project) over the operational period is summarised in **Table 7.28.** The number in parentheses in **Table 7.28** is the predicted period of peak take. The predicted take from alluvial groundwater water sources has been apportioned to groundwater and surface water flows to avoid double counting. **Table 7.28** also shows the total number of share components currently allocated to these water sources (WaterNSW 2019). Note that the 'take' identified in **Table 7.28** does not include the predicted take associated with operations approved under the Mount Owen Consent including the predicted take associated with extractions from Glennies Creek for operational purposes.

Table 7.28 Glendell peak water licensing requirements during operations

Water Sharing Plan	Water source/ management zone	Type	Total Units	Peak volume requiring licensing during mining (ML/year)	
				Approved Glendell Operations and Project	Project only
North Coast Fractured and Porous Rock WSP	Sydney Basin North Coast (Permian aquifers)	Aquifer	63,375.5	249 (Year 17)	249* (Year 17)
Hunter Unregulated WSP	Jerrys (Bowmans Creek, Yorks Creek, Swamp Creek and Bettys Creek)	Aquifer	1,246	10 (Year 12 to 25)	5 (Year 22 to 25)
		Unregulated river (baseflow losses)	2097	5 (Year 22 to 25)	2 Year 18 to 25)
		Unregulated river (Yorks Creek#)		172 (Year 8)	172 (Year 8)
	Glennies (Main Creek and areas of Glennies Creek outside of Hunter Regulated River Alluvium)	Aquifer	10	0	0
		Unregulated river (baseflow losses)	446	0	0
	Hunter Regulated River Alluvium (Glennies Creek alluvium)	Aquifer	24,118	1 (Year 17 to 24)	0
Hunter Regulated WSP	Management Zone 3a - Glennies Creek & Station Creek surface water	Regulated river (general security and high security)	150,284	0	0

* The North Coast Fractured and Porous Rock WSP commenced in 2017 and all take from this water source is attributed to the Project.

Clean catchment in lower Yorks Creek catchment captured in the WMS.

Table 7.28 shows that a peak take of 187 ML/year may be required to be licensed in the Jerrys Water Source assuming maximum take from each water source type occur concurrently. 1ML of alluvial take is predicted from the Hunter Regulated River Alluvium Water Source in Years 17 to 24 of the Project (associated with existing approved mining at Glendell). The water balance indicates that average surface water extractions from Management Zone 3a - Glennies Creek and Station Creek associated with operations will be 412 ML/year. The Project is not predicted to have any licensable take from the Glennies Water Source during the operational phase.

A peak licensable take of 249 ML/year from the North Coast Fractured and Porous Rock WSP attributable to mining at Glendell is also modelled in the Year 17. The timing of peak requirement for the different Project elements may not coincide, meaning that the actual licencing requirement at any specific time may be less.

The maximum predicted licensable take for the Glendell Mine (i.e. combined take for both the approved operations and the Project) after the cessation of mining is summarised in **Table 7.29.** The number in parentheses in **Table 7.29** is the predicted period of peak take. The predicted take from alluvial groundwater water sources has been apportioned to groundwater and surface water flows to avoid double counting. **Table 7.29** shows the total number of share components currently allocated to these water sources (WaterNSW 2019).

Table 7.29 Glendell peak water licensing requirements post closure

Water sharing plan	Water source/ management zone	Type	Total Units	Peak volume requiring licensing post closure (ML/year) Approved Glendell Operations and Project
North Coast Fractured and Porous Rock WSP	Sydney Basin North Coast	Aquifer	63,375.5	<249*
Hunter Unregulated WSP	Jerrys	Aquifer	1,246[#]	4 (approx. 2200)
		Unregulated river (baseflow losses)	2097[#]	18 (approx. 2200)
		Unregulated river (WRD evaporative losses)		39 (from closure)
	Glennies	Aquifer	10	1 (approx. 2250)
		Unregulated river (baseflow losses)	446	0
	Hunter Regulated River Alluvium	Aquifer	24,118	13 (approx. 2350)
Hunter Regulated WSP	Management Zone 3a - Glennies Creek and Station Creek surface water	Regulated river (general security and high security)	150,284	14 (approx. 2500)

* Post closure take under the North Coast Fractured and Porous Rock WSP is less than the peak during mining.
[#] Transfers between surface water and groundwater shares permitted for this water source.

Post mining the entire groundwater regime is predicted to recover due to the closure of all open cut and underground mines represented in the groundwater model. This means that while ongoing impacts are predicted, they occur within a groundwater regime with less cumulative impacts due to the recovery of the other mining operations.

The predicted water take from Jerrys Water Source peaks in approximately 2046 (shortly after mining associated with the Project finishes) then slowly reduces post mining as the groundwater regime adjusts to the changed landforms and recovers to new equilibrium levels. The net groundwater flow from the Permian system to the Jerrys Water Source alluvium returns to 2009 conditions approximately 150 years post mining. Whilst flows to the Jerrys Water Source slowly recover post mining, the proportion of the residual water take attributable to Glendell (Approved and Proposed) increases slightly over time. The Project does not result in any significant increase in cumulative take. **Table 7.29** shows that a peak of 59 ML/year may be required to be licensed in the Jerrys Water Source in approximately 2200 as a result of groundwater associated impacts. While the Glendell Pit Extension final void is located within the Jerrys Water Source, no additional take is associated with the catchment of the final void (as shown in the conceptual final landform refer to **Figure 3.6**) as its catchment is of a similar size to the final void of the Glendell Mine approved at the commencement of the Hunter Unregulated WSP. Evaporative losses from the WRD (approximately 4 ML/Year will require licensing due to the retention basin being designed to retain some water. Evaporative losses have been assessed based on an assumption that the WRD retention basin being full.

The reduction in groundwater flow to the Glennies Water Source (predominately Main Creek alluvium) relative to 2009 conditions due to the Project never exceeds 1ML/Year and will be undetectable.

The Hunter Regulated River Alluvium water source (Glennies Creek alluvium) is predicted to be slower to recover than the Jerrys Water source with flows returning to 2009 conditions at the start of the WSP approximately 300 years post mining. Similar to the Jerrys Water Source the contribution of residual water take attributable to the Glendell Pit Extension increases slowly post mining, peaking at about 18 ML/year after 300 years post mining when the water source returns to 2009 flow volumes. The surface water take associated with this impact on the Glennies Creek alluvial system is regulated under the Hunter Regulated Hunter Regulated WSP (Management Zone 3a) which commenced in 2004. Flows are predicted to return to 2004 levels in approximately 2500, at which point the water take attributable to the Glendell Pit Extension is 14 ML/year.

Licensing Strategy

As discussed above, WALs and/or harvestable rights are required to cover all licensable take at the time the take occurs or is predicted to occur. In the case of water abstractions, (e.g. water pumped from Glennies Creek) the actual take is metered. In the case of induced groundwater take and catchment loss take, the licensable take is typically calculated through modelling.

The following sections identifies the proposed means of meeting licensable take requirements for each WSP. All WSPs are subject to review every 10 years and the licensing requirements for the Project should be reassessed following the review of each plan. Licensing requirements should also be reassessed again prior to the completion of the Project, considering revised groundwater modelling predictions, the nature and scale of any dams remaining in the final landform and the relevant licencing requirements for the water sources at the time.

The licensing of predicted take will be met through a combination of existing licences, acquisition of new licences, harvestable rights and catchment adjustments. The ability to utilise existing licence entitlements will have regard to licencing requirements for all approved operations at the Mount Owen Complex.

Hunter Unregulated WSP

<u>Jerrys Water Source</u>

The predicted licensable take from the Jerry's Water Source during operations peaks at approximately 187 ML/year and in the post closure landform at approximately 43 ML/year.

For the lower Yorks Creek take, given the temporary nature of the take, which will diminish to zero at the completion of the Project, the take may also be accounted for with the entitlement implied by the net harvestable rights entitlement at the Mount Owen Complex during operations of 434 ML.

The predicted groundwater and associated baseflow take of 15 ML/year during operations and combined groundwater and surface water take of 59 ML/year in the post closure landform is likely to be readily sourced given the predicted take represents less than 2% of entitlements available and the take attributable to other operations will have significantly declined by the time the Project's predicted maximum take occurs.

<u>Glennies Water Source</u>

There is no predicted take from the Glennies Water Source during operations.

Modelling indicates up to 1 ML/year of licensable groundwater take is predicted in the post closure landform. The predicted water take from the Glennies Water Source is well within the current overall allocation of share components in this system however the current trading rules for this water source prevent the transfer of groundwater and surface water licence allocations and the current allocation of groundwater licences is limited to 10 units. Cumulative groundwater take from the Glennies Water Source is modelled to exceed 10ML/year. It is noted that the Hunter Unregulated WSP is currently under review and public submissions closed in September 2019.

Hunter Regulated Alluvium Water Source

The predicted induced groundwater take from the Hunter Regulated River Alluvium Water Source of 1 ML/year during operations and 13 ML/year post closure (approximately 2350). This predicted take is well within the existing licence allocations for this water source.

Hunter Regulated WSP

Management Zone 3A

At the Mount Owen Complex, licences are currently held to extract up to 1,188 ML/year of high security, 478 ML/year of general security, 31.2 ML/year of supplementary and 40 ML/year of domestic and stock from Glennies Creek under the Hunter Regulated WSP.

The water balance assessment indicates that the existing licence allocations are sufficient to meet the water requirements of the Project as part of the Mount Owen Complex of up to 412 ML/year.

The predicted take from this water management zone post mining peaks at 14ML/year in approximately 2500. This predicted take is well within the current Mount Owen Complex water allocations and well within the existing licence allocations for this management zone.

North Coast Fractured and Porous Rock WSP

Sydney Basin North Coast Water Source

Glencore has a total entitlement of 1,160 ML/year at the Mount Owen Complex from the Sydney Basin North Coast Water Source under the North Coast Fractured and Porous Rock WSP to account for groundwater intercepted during mining. The model predicts a maximum of 552 ML/year (Year 12) from the Mount Owen Complex (of which 118 ML/year is attributable to Glendell), therefore the current entitlements held by Glencore adequately cover the take under the WSP during operations and post mining.

7.5.9 Water resources monitoring and management

7.5.9.1 Groundwater management and monitoring changes

Other than the installation of additional monitoring bores (see below), the Project will not necessitate any significant changes to the general management framework for groundwater systems to that set out in the Current Mount Owen Complex Water Management Plan.

Low permeability barrier

The installation of low permeability barriers in the alluvium of Swamp Creek and Yorks Creek downstream from the point of intersection by the Glendell Pit was considered during the Project design phase and preliminary modelling of the benefits of such a barrier was undertaken. The purpose of such a barrier would be to prevent alluvial groundwater inflows to the pit. Due to the shallow depth of alluvium in proximity to the pit and the thickness of the permeable regolith underlying the alluvium, the barrier was considered to have negligible benefits. As indicated by the results discussed in **Section 7.5.7**, there is very little predicted alluvial/baseflow take during operations and this take occurs during a period when cumulative take from the system is declining. Accordingly, even if the barrier had been effective, it is unlikely to be considered either a reasonable or feasible measure given the low magnitude of the predicted impacts it would be addressing. As such, the installation of a low permeability barrier in the alluvium of Swamp Creek and Yorks Creek is not proposed for the Project.

Groundwater Monitoring

The Glendell Pit Extension will result in removal of a number of existing groundwater monitoring bores which are located within the disturbance area.

The Mount Owen Complex has an existing and extensive groundwater monitoring network in the vicinity of the Project. A number of the bores will be impacted by the Project. The Mount Owen Complex Groundwater Monitoring and Management Plan (Glencore, 2019c) will be reviewed as part of the management plan update process should the Project be approved. This review will have regard to the need for any supplementary bores.

Groundwater quality analysis will continue consistent with current operations in the existing and proposed new bores to detect any changes in groundwater quality during mining.

The results of the monitoring will be reviewed annually to determine if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken.

Every 3 years the validity of the groundwater model predictions will be assessed by comparing the extraction volumes and groundwater level data against model predictions. If the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for the simulation of mining.

The existing Trigger Action Response Plans (TARPs) contained in the Groundwater Management and Monitoring Plan will be reviewed when the plan is updated for the Project. These TARPs will be reviewed periodically as part of the regular review process of the Plan.

7.5.9.2 Surface water management and monitoring changes

The potential impacts of the Project with respect to surface water will be mitigated by:

- the design of the WMS and integration with the existing Mount Owen Complex WMS
- the design features of the Yorks Creek Realignment to achieve the design objectives (refer to **Section 7.5.5.3** and **Appendix 7**)
- the integration of the Mount Owen Complex WMS with the GRAWTS, which eliminates the need to discharge mine affected water at the Mount Owen Complex and enables the sharing or water between sites which reduces the need for externally sourced water.

Following approval of the Project, the Proponent will update the existing Water Management Plan to reflect the changes to water management associated with the Project.

A Yorks Creek Realignment Plan will be prepared as part of the detailed design prior to construction which includes consideration of flow velocities and sediment movement, and criteria for monitoring performance and stability.

A levee will be constructed at the southern end of the constructed flood plain in the Yorks Creek Realignment to prevent inundation of the Glendell Pit Extension up to a 1 in 1000 year ARI flood event. A similar levee adjacent to the points of intersection of the Glendell Pit Extension with Yorks Creek and Swamp Creek will also be implemented where necessary to prevent flood ingress into the Glendell Pit Extension during mining operations. These levees, if required, will also be developed to the 0.1% AEP event design standard.

Surface Water Monitoring

The existing surface water quality monitoring program at the Mount Owen Complex includes locations in surrounding watercourses upstream and downstream of the site.

The following changes to the surface water quality monitoring program will be implemented:

- Following the realignment of Yorks Creek, the existing location YC3 will be replaced by a new location, YC4, located along the realignment. Observations from this location may be used to assess the performance of the realignment in providing habitat.

- A new monitoring location, BMC6, should be established downstream of the confluence of the Yorks Creek Realignment with Bowmans Creek. BMC6 should be a similar distance downstream of the new Yorks Creek confluence as BMC4 is downstream of the existing confluence, so that the 2 sites are comparable. Observations from BMC6 location may be used to assess the performance of the realignment in minimising adverse impacts of water quality in Bowmans Creek.

- Monitoring of SC3 would cease following disturbance of this area by the Glendell Pit Extension. The existing SC4 would provide adequate coverage for the remnant reach of Swamp Creek.

The indicative locations for the revised surface water quality monitoring locations are shown in **Figure 7.5.11**. The exact locations of the monitoring will be shown in the Surface Water Management Plan as updated for the Project.

The existing monitoring program should continue to monitor physio-chemical parameters of pH, EC and TSS (as turbidity). The monitoring is considered to adequately consider stressors on aquatic biota, consistent with industry practice, given that no discharges will occur from the Mount Owen Complex.

Site specific guideline values for YC4 should be adopted from YC2 and YC3, and for BMC6 from BMC3 and BMC4, until 24 observations have been made to establish site specific guideline values for these new locations.

Monitoring of all new dirty and mine water storages should be integrated into the existing surface water monitoring program at the Mount Owen Complex, as these storages are commissioned.

7.5.9.3 Reporting of results

A summary of the surface and groundwater water monitoring results will continue to be provided in the Annual Review for the Mount Owen Complex. The Annual Review includes:

- a summary of monitoring results

- an analysis of monitoring results against impact assessment criteria and historical monitoring results

- annual site water and salt balance and comparison to the forecast annual average site water and salt balance

- identification of any trends in the monitoring results

- any non-compliances reported during the year

- actions taken to address any non-compliances.

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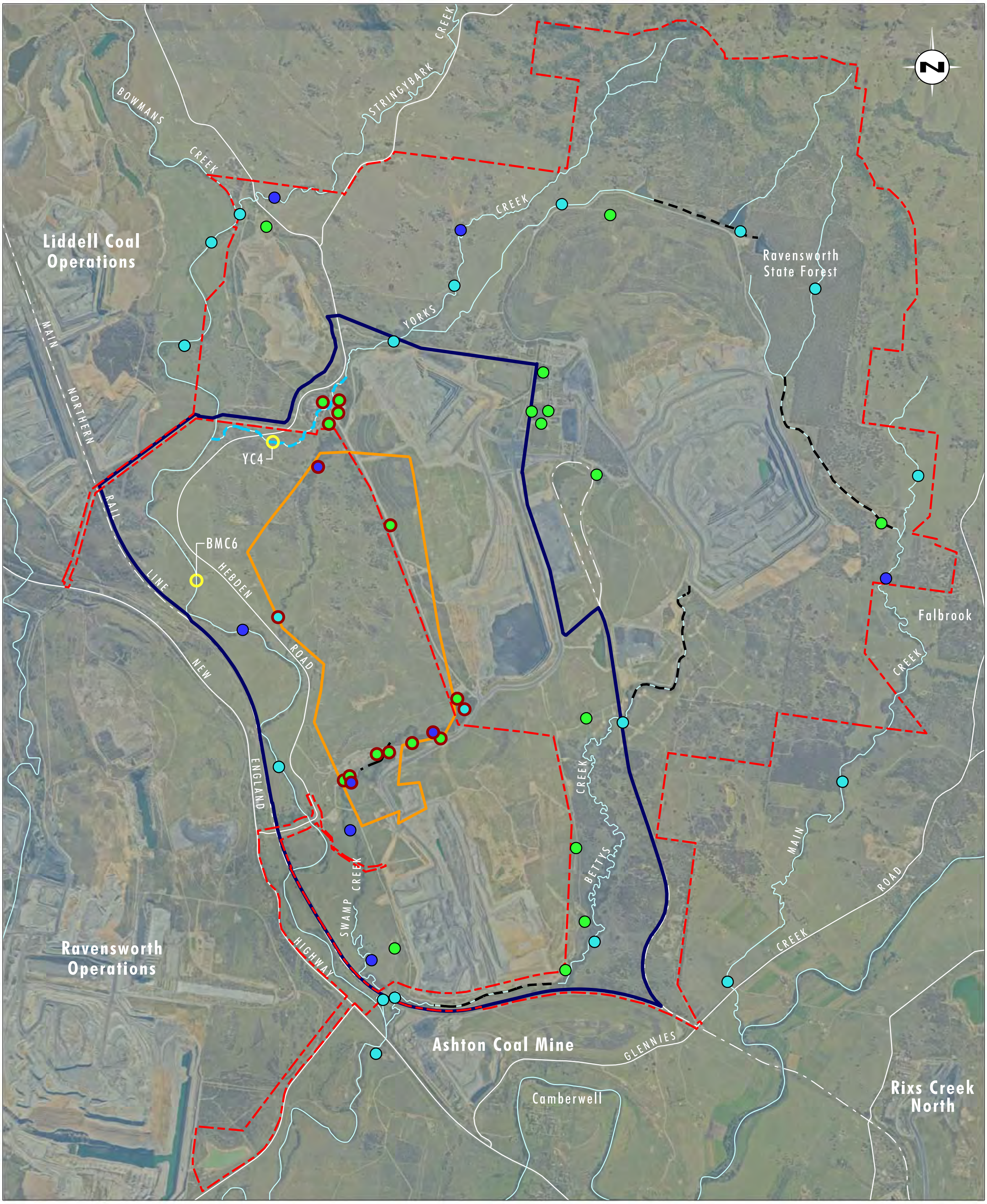

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- Yorks Creek Realignment
- Surface Water - Channel Stability and Stream Health
- Surface Water Onsite Storage
- Surface Water - Watercourse
- Monitoring Location Impacted during Life of Project
- Indicative Location of New Monitoring Point

FIGURE 7.5.11

Proposed Changes to Surface Water Monitoring Locations

File Name (A4): R08/4166_557.dgn
20191129 8.53

7.6 Biodiversity

Biodiversity impacts were identified by the community and other stakeholders as an issue of concern during the consultation for the Project and were previously raised throughout the assessment processes of the Mount Owen Continued Operations Project and its subsequent modifications and Glendell Modification 4.

With regard to Glencore's approach to the design and planning of the Project, potential biodiversity impacts have been recognised and thoroughly considered throughout the project planning process and as described further in this section, the principles of avoid, mitigate and offset have been considered and addressed. The key biodiversity consideration in the Project design have been:

- minimising impacts on Bowmans Creek and the Bowmans Creek alluvial aquifer system,
- minimising disturbance of higher ecological value vegetation communities by developing the mine in an area that has had a long history of extensive disturbance.

Whilst Glencore has strived to minimise impacts on biodiversity through the design process, not all impacts could be avoided.

The Project will result in a range of direct impacts on biodiversity values within the Additional Disturbance Area. Direct impacts include loss of native vegetation and fauna habitats as a result of clearing works for the construction and operation of the Project.

The Project's impacts on groundwater systems (refer to **Section 7.5.6**) have the potential to impact:

- stygofauna and hyporheic fauna that live within groundwater systems
- changes in watertables in alluvial aquifers have potential to impact upon water levels in pools within ephemeral creek systems
- some vegetation, and in particular, riparian vegetation, can draw some of their water requirements from saturated parts of the alluvium or other shallow groundwater systems; impacts on watertables can affect the ability for some vegetation to access this water source.

The realignment of part of Yorks Creek and the removal of the lower reach of Yorks Creek and part of Swamp Creek will also directly impact upon aquatic fauna and aquatic fauna movement that may be present in the directly impacted areas of these creeks.

The water resources risk assessment prepared for the Project (refer to **Appendix 10**) includes specific consideration of the way in which changes to surface water and groundwater systems can affect biodiversity values. These potential interactions have been considered in the assessment and this section includes a detailed assessment of the Project's impacts on terrestrial biodiversity and water dependant ecosystems. This section summarises:

- the assessment methodology used in the assessment of the Project's biodiversity impacts (refer to **Sections 7.6.1** and **7.6.2**),
- the potential impacts on terrestrial, aquatic and subterranean biodiversity values (refer to **Sections 7.6.1** and **7.6.2**)
- identifies the avoidance, mitigation and management measures to be implemented by the Project (**Section 7.6.3**), including the biodiversity offset strategy (refer to **Section 7.6.4**).

A Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt for the Project, refer to **Appendix 20**, in accordance with the SEARs for the Project (refer to **Appendix 4**) and the Biodiversity Assessment Method (BAM) in accordance with the *Biodiversity Conservation Act 2016*. The BDAR also includes an assessment of impacts on aquatic ecosystems. A Stygofauna Assessment has been prepared by Eco Logical Australia (refer to **Appendix 21**) to assess the Projects potential impacts on subterranean fauna.

The Project has also been determined to be a Controlled Action under the EPBC Act due to potentially significant impacts on MNES, including threatened ecological communities and species and impacts on water resources, including water dependent ecosystems. An Assessment of Commonwealth Matters Report has been prepared by Umwelt (refer to **Appendix 10**) which covers the assessment of MNES potentially significantly impacted by the Project. **Appendix 10** draws together the assessment findings of the various biodiversity assessments discussed above and the GWIA and SWIA.

The above studies build on a long history of biodiversity assessment in the area which includes extensive field survey work and monitoring over more than 15 years. This long history of survey and monitoring coupled with the Project specific survey undertaken provides a high degree of confidence in the findings of these assessments.

7.6.1 Terrestrial biodiversity

As noted in **Section 4.2**, the Project Area has a long history of disturbance associated with agricultural activities (more than 190 years) and mining activities (more than 50 years). As a result of this historical disturbance, the native vegetation present in the Project Area has been heavily modified from what would have been present prior to European settlement. Furthermore, with the exception of some remnant older Eucalyptus and Angophora trees, the Project Area is almost entirely regrowth following clearing by previous land uses or rehabilitation of areas disturbed by mining. A review of aerial photography indicates the vast majority of the native vegetation present in the Project Area has regenerated over the past 30 years. Vast areas of the slopes within the Project Area were extensively contoured in the 1960s at closer intervals than standard practice (only 5-10 m) to mitigate the impacts of erosion. A review of the historical aerial imagery also indicates that the riparian vegetation currently along Yorks Creek is predominately swamp oak, and the lower reaches of Swamp Creek and Bettys Creek is also predominately regrowth from the past 40-50 years. The riparian vegetation along Bowmans Creek also appears to have been extensively cleared in the past, with some growth during the past 50 years.

This section summarises the assessment methodology used to assess the Project's potential impacts on terrestrial biodiversity values and the outcomes of that assessment.

7.6.1.1 Terrestrial biodiversity assessment methodology

Part 7 (section 7.9) of the *Biodiversity Conservation Act 2016* (BC Act) requires an EIS to be accompanied by a Biodiversity Development Assessment Report (BDAR), as discussed earlier, the BDAR is included in **Appendix 20**.

Section 6.12 of the BC Act requires the BDAR to be prepared in accordance with the BAM which is established under section 6.8 of the BC Act.

The BAM process is a credit driven system where calculators provided by the NSW government are populated with ecological data about the development to generate 'ecosystem credits' and 'species credits' which then guides the quantum of offsetting requirements for the Project based on a no-net loss objective.

BAM Assessment Area

The BAM requires impacts to be assessed within the 'Development Footprint'. This area represents the additional disturbance, outside existing approved disturbance areas, but excludes areas that conform to Category 1-exempt land as identified by the *Local Land Services Act 2013* (LLS Act) (refer to **Appendix 20** for further detail). The 'Development Footprint' for the purposes of the BAM assessment is shown in **Figure 7.6.1**.

Survey Effort

The BAM requires a specific approach to be undertaken for biodiversity field surveys to identify the vegetation communities, flora species and fauna species that occur within the Development Footprint. Field surveys in accordance with the BAM were carried out within, and in the vicinity of, the Development Footprint during 2017 and 2018. These surveys included targeted surveys for threatened species having potential to occur in the Project Area including, but not limited to, swift parrot, regent honeyeater, koalas and green and golden bell frog. Full details of these surveys are contained in the BDAR. The flora survey effort for the BAM is shown in **Figure 7.6.1.** The fauna survey effort for the BAM is shown in **Figure 7.6.2.**

Allocation of Vegetation Communities to PCTs

The BAM requires all vegetation identified within the Development Footprint to be assigned to a Plant Community Type (PCT). PCTs are defined by the BAM. Vegetation communities can be variable in composition and often a specific area of vegetation may be consistent with 2 or more PCTs; where this occurs, the most appropriate PCT for each vegetation zone is assigned based on a statistical analysis of the vegetation zone and the available PCTs.

Ecosystem-credit species and Species-credits species

- The BAM categorises species as either ecosystem-credit species or species-credit species which are defined as:
- ecosystem-credit species – species that can be reliably predicted to occur in PCTs and have a high likelihood of occurring on the site. Therefore, targeted surveys for ecosystem-credit species are not required
- species-credit species – species that cannot be reliably predicted based on a PCT, distribution or habitat criteria. These species require targeted survey effort to determine their presence or otherwise on the site.
- All non-threatened species and some threatened species are ecosystem-credit species and therefore do not require further specific assessment under the BAM however the presence or likely presence of these species may influence ecosystem offsetting requirements. The remaining threatened species are species-credit species and require further targeted assessment and, where relevant, the calculation of impact species-credits under the BAM.

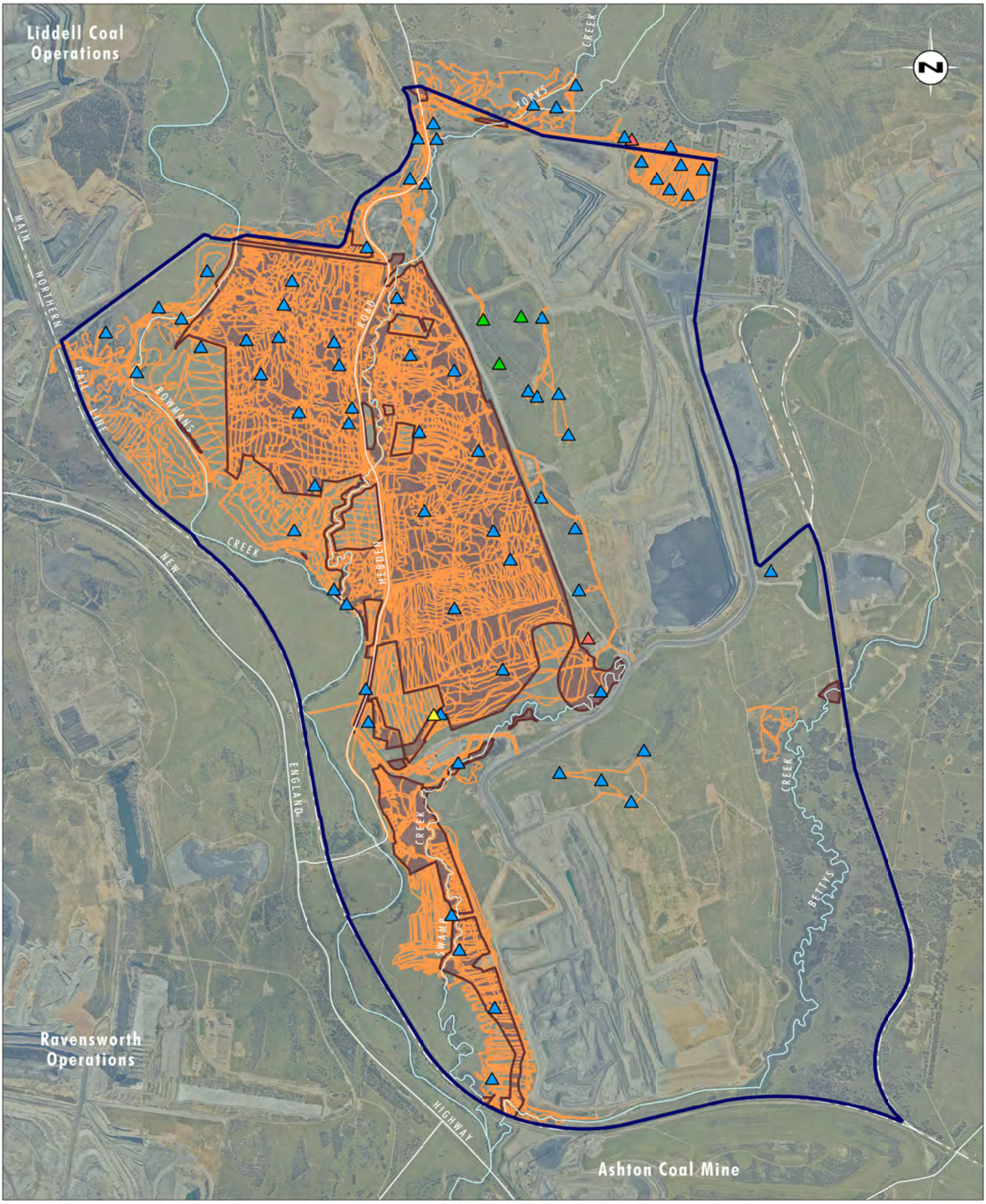

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

0 0.5 1.0 2.0km

Legend

- Project Area
- Biodiversity Assessment Area (Development Footprint)
- Walking Transects
- Floristic Plot
- Semi-quantitative Rapid Assessment
- Qualitative Rapid Assessment
- Koru Environmental Floristic Plot

FIGURE 7.6.1

Project Specific Flora Survey Effort

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20191119 11.38

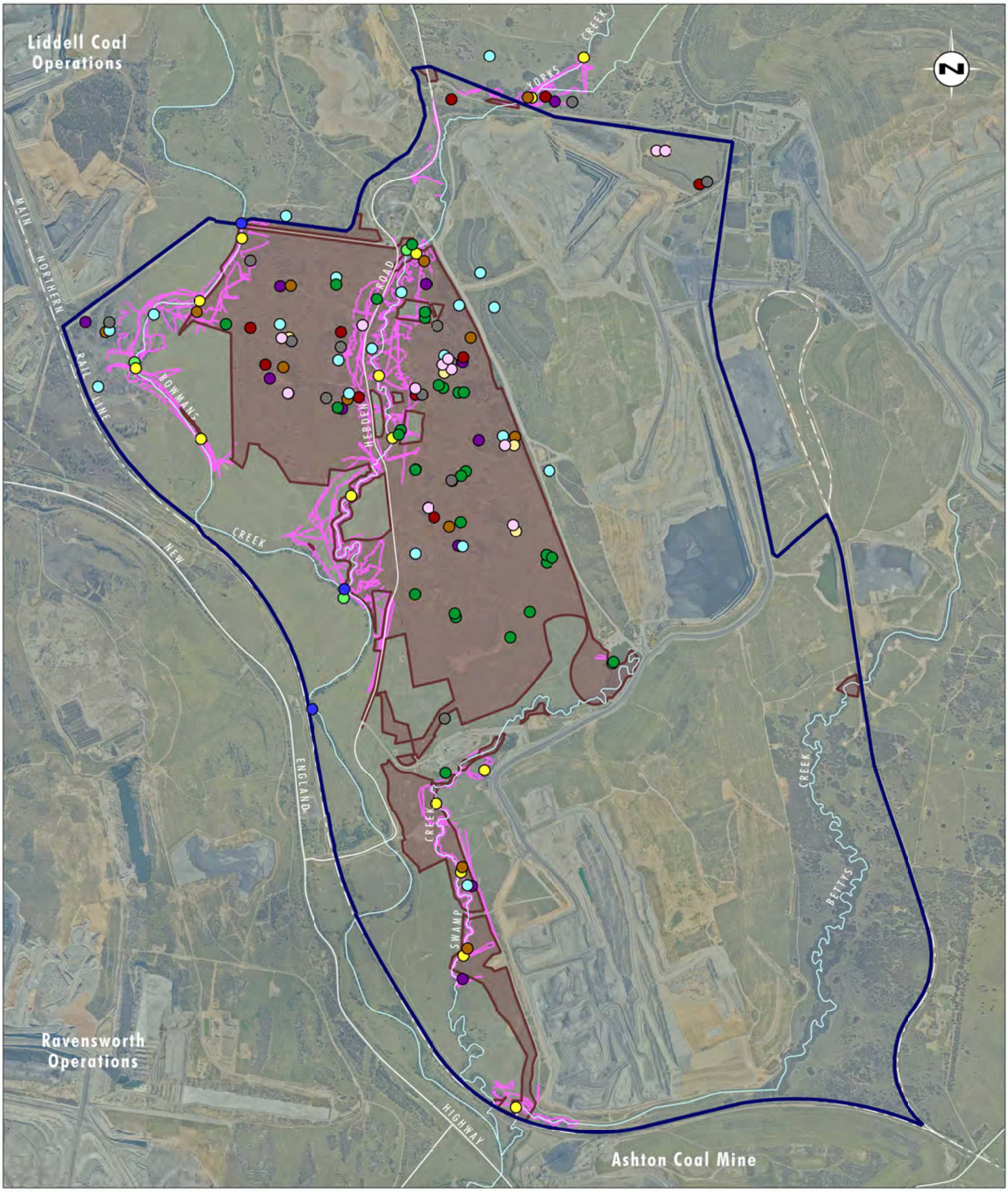

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

Legend

- Project Area
- Biodiversity Assessment Area (Development Footprint)
- Targeted Southern Myotis Breeding Habitat Inspections and Aquatic Habitat Survey Transects
- Anabat Survey
- Aquatic Habitat Survey
- Aquatic Habitat, Fish and Macroinvertebrate Survey
- Raptor Stick Nest, Gang-gang Cockatoo and Glossy Black-cockatoo Breeding Habitat Searches
- Call Playback for Threatened Nocturnal Birds and Mammals
- Pale-headed Snake Survey Locations
- Koala and Bush Stone Curlew Call Playback
- Koala SAT Survey
- Remote Camera for Squirrel Glider, Brush-tailed Phascogale, Common Planigale and Eastern Pygmy Possum
- Green and Golden Bell Frog and Green-thighed Frog Survey Locations
- Swift Parrot and Regent Honeyeater Survey Locations

FIGURE 7.6.2

Project Specific Fauna Survey Effort

7.6.1.2 Key terrestrial biodiversity values

As discussed above, the Project Area has been extensively cleared and grazed since the late 1820s. The extant native vegetation in the Development Footprint is majority 'regrowth' vegetation, that is, it has been previously cleared and its present extent is based entirely on natural regeneration or on targeted planting of canopy species.

The following sections summarise the key biodiversity values found in the Development Footprint.

Native Vegetation

Table 7.30 shows the PCTs mapped within the Development Footprint and the location of these PCTs is shown in **Figure 7.6.3**. **Appendix 20** provides a detailed description of these communities.

Table 7.30 Plant Community Types within the Development Footprint

Plant Community Type (PCT)	Condition Class	Area within Development Footprint (ha)
485 – River Oak riparian grassy tall woodland of the Western Hunter Valley	*Moderate to Good*	2.4
1603 – Narrow- leaved Ironbark – Bull Oak – Grey Box shrub-grass open forest of the Central and Lower Hunter	*Moderate to Good*	26.7
	Regeneration	53.1
	Plantation	1.8
	Derived Native Grassland	386.0
1604 – Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the central and lower Hunter – Woodland	*Woodland Rehabilitation*	0.5
1692 – Bull Oak Grassy Woodland of the Central Hunter Valley	*Moderate to Good*	18.0
	Regeneration	10.2
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	*Moderate to Good*	40.0
	Plantation	1.8
Total		**540.5**

In addition to the native vegetation communities identified above, approximately 55 ha of the Development Footprint contains exotic vegetation. These areas, as a patch, typically contain greater than 50% perennial weed species cover and are located around existing infrastructure or on the lower alluvial flats where there has been a long history of agricultural activities. Under the BAM, areas of exotic vegetation are not subject to a calculator assessment and do not generate ecosystem credits.

Table 7.31 summarises the biodiversity assessment findings for the Project Area in terms of additional disturbance and type of vegetation disturbed.

Table 7.31 Project Area Biodiversity Assessment Summary

Feature	Area (ha)
Project Area	2900.5
Glendell Project Disturbance Area	1827.1
Additional Disturbance Area	749.8
Category 1 – exempt land	135.8
Development Footprint	614.3
Disturbed	19
Exotic Vegetation	54.8
Native Vegetation – Derived Grassland	386.0
Native Vegetation – Woodland/Forest (including rehabilitation)	154.5

Seven of the PCT condition classes (or parts thereof) were identified as conforming to Threatened Ecological Communities (TECs) listed under the BC Act and/or EPBC Act. **Table 7.32** provides a summary of the TECs and the area they occupy within the Development Footprint.

Table 7.32 Summary of TECs within the Development Footprint

Threatened Ecological Community	Listing Status	Area (ha)
BC Act		
Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	81.6
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion	EEC	0.3
EPBC Act		
Central Hunter Valley Eucalypt Forest and Woodland	CEEC	122.9

The distribution of TECs listed under the BC Act and EPBC Act within the Development Footprint are shown on **Figure 7.6.4.**

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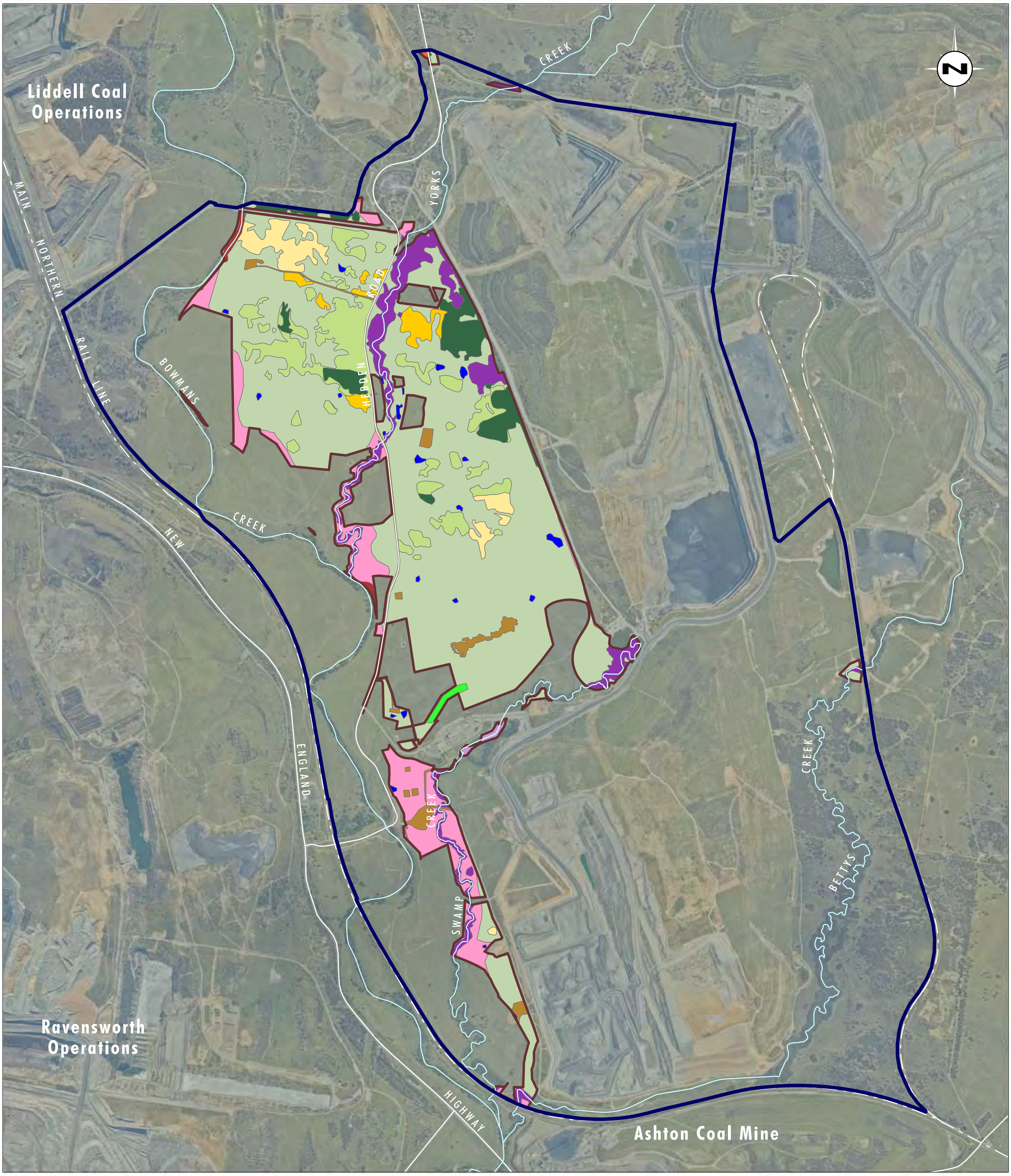

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

0 0.5 1.0 2.0km

Legend

- Project Area
- Biodiversity Assessment Area (Development Footprint)
- 485 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley - Moderate to Good Condition
- 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter - Moderate to Good Condition
- 1603 - Plantation
- 1603 - Regeneration
- 1603 - Derived Native Grassland
- 1604 - Narrow-Leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central And Lower Hunter - Woody Rehab
- 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Moderate to Good Condition
- 1692 - Regeneration
- 1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good Condition
- 1731 - Plantation
- Dam
- Disturbed Land
- Exotic Vegetation

FIGURE 7.6.3

Vegetation Zones in the Development Footprint

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20191030 11.56

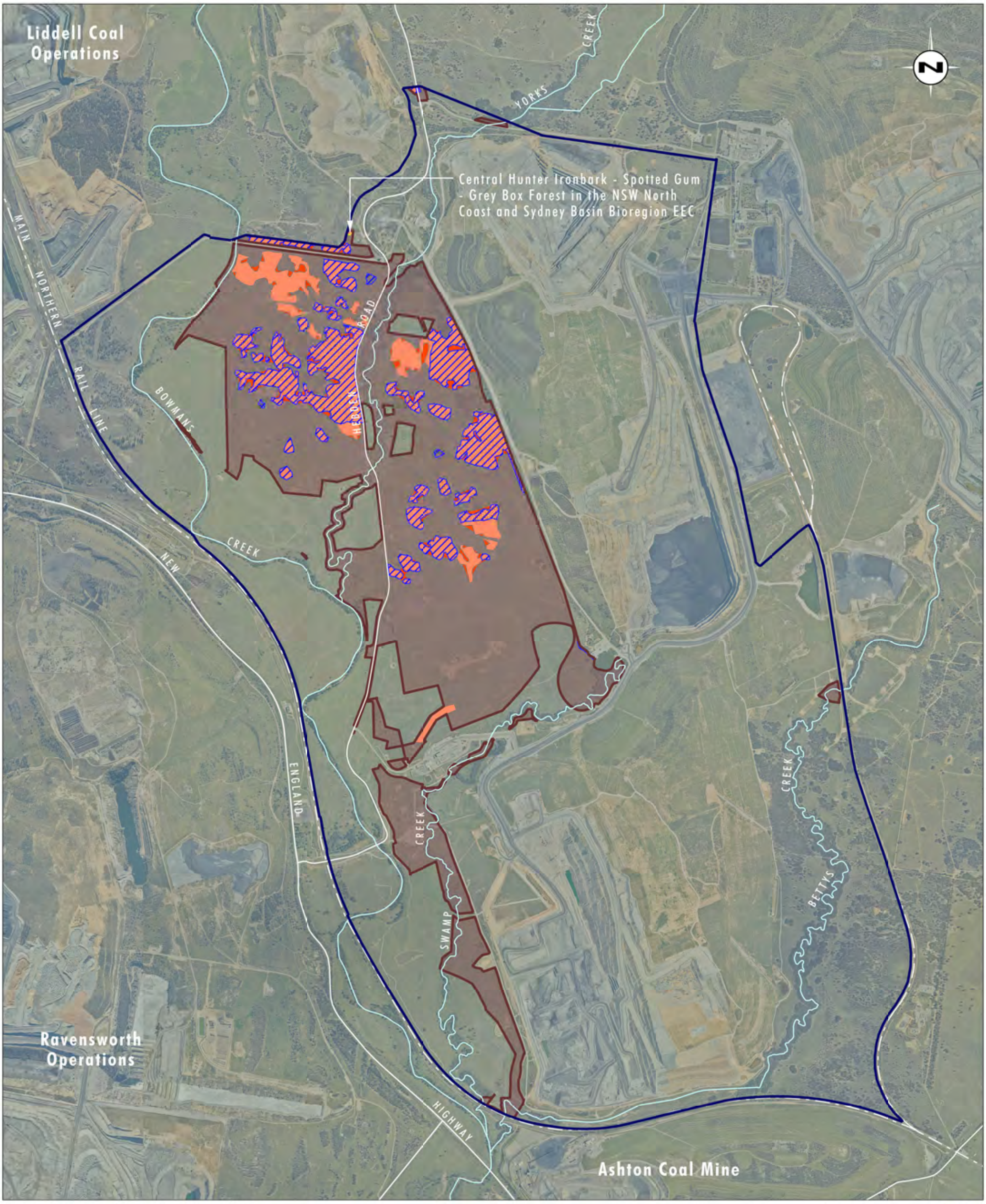

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

0 0.5 1.0 2.0km
1:40 000

Legend

Project Area
Biodiversity Assessment Area (Development Footprint)
EPBC Act:
Central Hunter Valley Eucalypt Forest and Woodland CEEC
Central Hunter Valley Eucalypt Forest and Woodland CEEC - Derived Native Grassland
BC Act:
Central Hunter Grey Box Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregion EEC

FIGURE 7.6.4

EPBC and BC Act Listed Threatened Ecological Communities in the Development Footprint

File Name (A4): R08/4166_535.dgn
20191128 14.57

Threatened Flora and Fauna Species

The surveys undertaken for the Project identified a large range of native and introduced fauna and flora species. These are discussed in the BDAR (**Appendix 20**). Ecosystem and species-credit species recorded in the Development Footprint are shown on **Figure 7.6.5**.

Ecosystem Credit Species

As mentioned above, ecosystem-credit species are not required to be specifically targeted during field surveys, however an assessment of the suitability of habitat in the Development Footprint is undertaken to determine the species presence or otherwise in the vegetation zones identified.

- Ten ecosystem-credit species were recorded in the Development Footprint during surveys undertaken for this assessment or previous surveys:
- dusky woodswallow (Artamus cyanopterus cyanopterus)
- speckled warbler (Chthonicola sagittate)
- spotted harrier (*Circus assimilis*)
- spotted-tailed quoll (*Dasyurus maculatus*)
- white-bellied sea-eagle (*Haliaeetus leucogaster*)
- eastern bentwing-bat (Miniopterus schreibersii oceanensis)
- eastern freetail-bat (Mormopterus norfolkensis)
- scarlet robin (*Petroica boodang*)
- grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*).

In addition, a number of ecosystem credit species have previously been recorded in the wider Mount Owen Complex and have been considered in the assessment of ecosystem credits.

Species-credit Species

Four species-credit species were recorded in the Development Footprint during targeted seasonal surveys undertaken for this assessment. These include:

- tiger Orchid (*Cymbidium canalicatum*) – 1 individual
- southern myotis (*Myotis macropus*) – (46.6 ha of suitable habitat)
- brush-tailed phascogale (*Phascogale tapoatafa*) – (152.1 ha of suitable habitat)
- eastern cave bat (*Vespadelus troughtoni*) – (0.5 ha of suitable habitat).

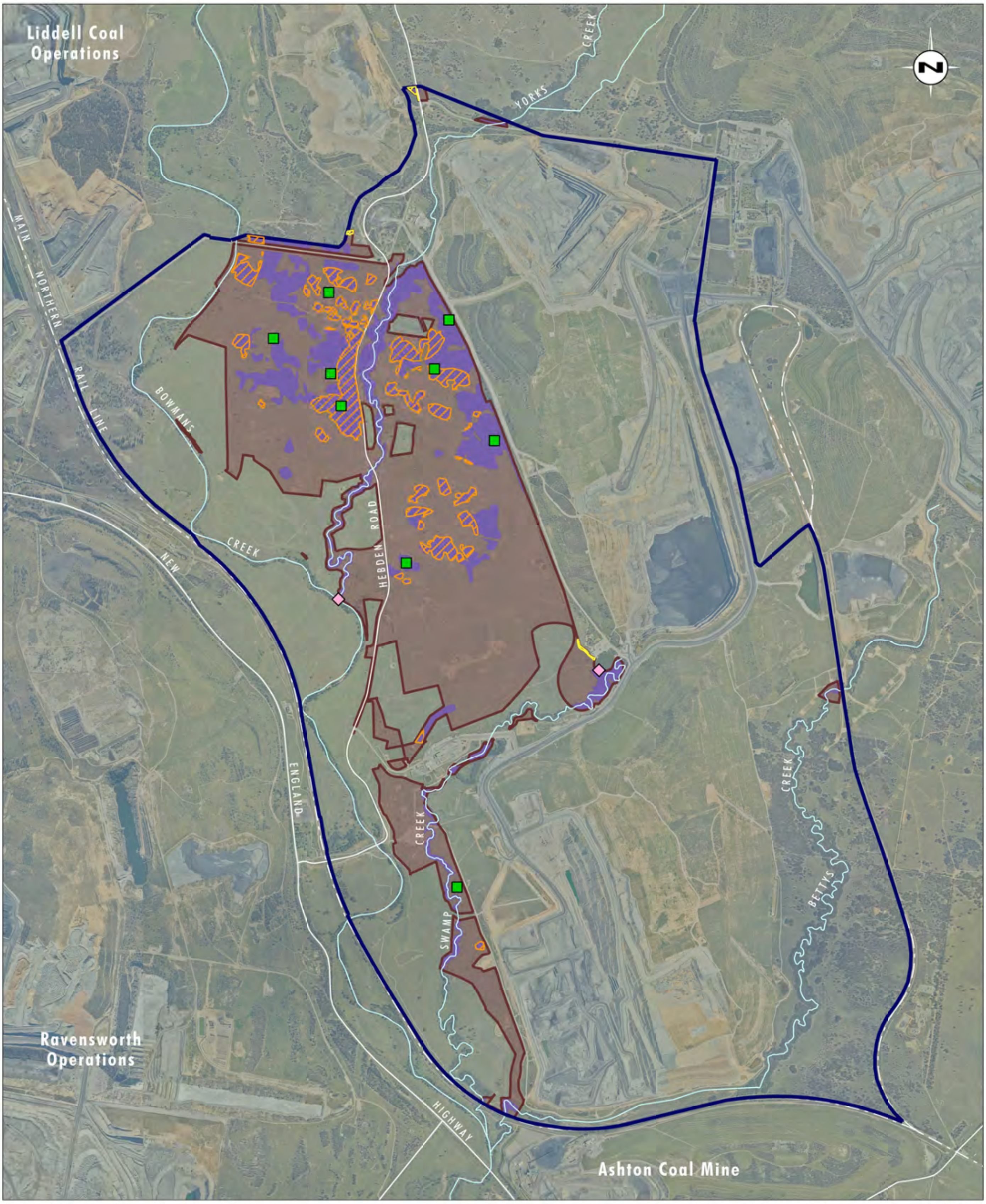

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

Legend

- Project Area
- Biodiversity Assessment Area (Development Footprint)
- Brush-tailed Phascogale
- Brush-tailed Phascogale Suitable Habitat
- Southern Myotis
- Southern Myotis Suitable Habitat
- Eastern Cave Bat Suitable Habitat

FIGURE 7.6.5

Species-credit Fauna Species and Suitable Habitat Locations in the Development Footprint

File Name (A4): R08/4166_569.dgn
20191128 15.03

7.6.1.3 Assessment of impacts on terrestrial biodiversity

Direct Impacts on Terrestrial Vegetation

The BDAR (refer to **Appendix 20**) assumes complete removal of all vegetation within the Additional Disturbance Area. The BAM derives a calculation of the number of 'impact credits' generated by the assumed complete removal of vegetation in the Development Footprint. **Table 7.33** outlines the area of impact of the Project on vegetation communities within the Development Footprint and the number of impact credits generated as a result of this direct impact. A total of approximately 540 ha of native vegetation communities will be impacted in the Development Footprint consisting of approximately 155 ha of woodland or forest vegetation and approximately 386 ha of derived native grassland.

Table 7.33 Direct Impacts of the Project on Native Biodiversity Features

Ecological Feature	Area within the Development Footprint (ha)	Number of Impact Credits Generated
Ecosystem-credits		
Plant Community Type ***Condition class***		
485 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley *Moderate to Good Condition*	2.4	**34**
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter *Moderate to Good Condition*#+	26.7	**502**
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter *Regeneration*#+	53.1	**836**
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter *Plantation*#+	1.8	**33**
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter *Derived Native Grassland*+	386.0	**3,527**
1692 - Bull Oak Grassy Woodland of the Central Hunter Valley *Moderate to Good Condition*+	18.0	**207**
1692 - Bull Oak Grassy Woodland of the Central Hunter Valley *Regeneration*	10.2	**115**
1604 - Narrow-Leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter *Woodland Rehabilitation* *+	0.5	**11**
1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Moderate to Good Condition*	40.0	**679**
1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley *Plantation*	1.8	**28**
Total ecosystem-credits	**540.5**	**5,972**

Ecological Feature	Area within the Development Footprint (ha)	Number of Impact Credits Generated
Species-credits		
brush-tailed phascogale *Phascogale tapoatafa*	152.1	**2,559**
southern myotis *Myotis macropus*	46.6	**732**
Cymbidium canaliculatum – endangered population in the Hunter catchment	1 individual	**2**
eastern cave bat *Vespadelus troughtoni*	0.5	**17**
Total species-credits		**3,310**
Total credits generated		**9,282**

Conforms to *Central Hunter Grey Box - Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC (BC Act)
* Conforms to *Central Hunter Ironbark - Spotted Gum - Grey Box Forest in NSW North Coast and Sydney Basin Bioregion* EEC (BC Act)
+ Conforms to *Central Hunter Eucalypt Forest and Woodland* CEEC (EPBC Act)

Indirect impacts on Terrestrial Vegetation

The Project is not expected to result in any substantial indirect impacts on the terrestrial biodiversity values of surrounding lands during the construction or operational phases of the Project. Some minor indirect impacts associated with habitat connectivity, fugitive light emissions, air quality, noise, blast, groundwater changes, weeds and feral animals may occur during the construction and operational phases, however, once the proposed mine rehabilitation has become established, the long-term connectivity of the area will be improved. The potential impacts on terrestrial vegetation associated with groundwater changes is addressed in **Section 7.6.2.6** and **Appendix 10**. These indirect impacts will be similar to those currently experienced with the existing operations within the Mount Owen Complex and will therefore not substantially change with the Project. Mitigation measures for indirect impacts, consistent with the existing operations, are described in **Appendix 20.** These include feral animal and weed control, control systems for noise, air quality, lighting and blasting, restriction of access and vegetation clearing procedures.

7.6.2 Eco-hydrological assessment

Detailed assessments of the impact of the Project on aquatic biodiversity due to groundwater and surface water impacts have been undertaken as part of the EIS. The following summary should be read in conjunction with the following specialist reports:

- the Assessment of Commonwealth Matters Report (refer to **Appendix 10**)
- the BDAR (refer to **Appendix 20**) of this EIS which includes an Aquatic Ecology Assessment
- the Surface Water Impact Assessment (refer to **Appendix 17**) and **Section 7.5** of this EIS which discusses surface water impacts
- the Groundwater Impact Assessment (refer to **Appendix 16**) and **Section 7.5** of this EIS which discusses groundwater impacts
- the Stygofauna Assessment (refer to **Appendix 21**).

7.6.2.1 Assessment methodology

Potential impacts on water dependent ecosystems were considered in the water resources risk assessment prepared for the Project which was based on an impact pathway approach. This risk assessment is included in **Appendix 10**.

Riparian and Aquatic Habitat Description and Mapping

Detailed aquatic habitat assessments were undertaken at seven locations along Bowmans Creek, four locations along Swamp Creek, six locations along Yorks Creek and one on Bettys Creek. An assessment of the aquatic habitat characteristics within each of the sampling sites was undertaken, and indicators of stream condition were also noted.

During the survey, no flow was recorded in Yorks and Bettys Creeks due to the prolonged dry conditions experienced in the Hunter Valley between 2017 and the time of the assessment. Minimal flow was observed in Bowmans Creek during the survey period. Bowmans Creek had residual pools of water with Swamp and Yorks Creeks mostly dry at the time of the surveys with only very isolated small shallow pools identified during surveys undertaken through the 2017-18 survey period.

Key fish habitat mapping has been prepared by Fisheries Ecosystems Branch of NSW DPI for LGAs across NSW. The intent of the mapping was to recognise key fish habitat that are important to the sustainability of recreational and commercial fishing industries, maintenance of fish populations and the survival and recovery of threatened aquatic species. The definition includes most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank but excluding first and second order streams that only flow for a short period following rain and farm dams on these streams (NSW DPI 2013).

For the purposes of the application of the FM Act, NSW DPI has developed a classification scheme for the sensitivity of key fish habitat, to define the importance of habitat for the survival of fish and the ability of the habitat to withstand disturbance. The classification of the watercourses within and in proximity to the Project Area for fish passage was assessed in accordance with NSW DPI (2013).

Aquatic Fauna Survey

Aquatic fauna surveys were conducted on the 30 and 31 October and 1 November 2018. The surveys involved both macroinvertebrate sampling and vertebrate trapping. Aquatic fauna survey locations are shown on **Figure 7.6.6**.

Macroinvertebrate Survey

Macroinvertebrates were sampled at 3 locations along Bowmans Creek including one at the existing confluence with Yorks Creek, one upstream of the proposed Yorks Creek Realignment confluence and one downstream of the existing confluence (refer to **Figure 7.6.6**). The macroinvertebrate survey was conducted in accordance with the AUSRIVAS sampling protocol for edge habitats at all the sites due to the lack of riffle sites and flowing water (AUSRIVAS 2007).

A detailed description of the sampling procedures is set out in **Appendix 20**.

Aquatic Vertebrate Fauna Sampling

Aquatic vertebrate fish sampling was undertaken in Bowmans Creek at 3 locations where pooling water was present. The site locations include one upstream of the proposed Yorks Creek Realignment, one site at the existing confluence with Yorks Creek and one site located downstream of the existing confluence with Yorks Creek (refer to **Figure 7.6.6**).

A detailed description of the sampling procedures is provided in the Aquatic Impact Assessment, refer to **Table 7.34**.

Stygofauna

Thirteen bores were sampled during the survey, in addition to the existing sixteen bores previously sampled as part of the Mount Owen Continued Operations Modification 2 (ELA 2018) which were used for this assessment.

Groundwater Dependant Terrestrial Vegetation

As discussed in **Section 7.5**, the long history of open cut and underground coal mining in the local area has significantly modified the regional groundwater system and existing approved operations will continue to influence groundwater systems over the life of the Project. A conceptual hydrogeologicial model was developed for the Project (refer to **Appendix 10**) to inform the water resources risk assessment process and the assessment of groundwater related impacts in a dynamic groundwater environment.

The modelled changes in water table and areas of saturation were considered in terms of potential impacts on pools of water and potential impact on vegetation communities present in the areas of identified change. The methodology used for the assessment of impacts associated with groundwater changes are contained in the Assessment of Commonwealth Matters Report (refer to **Appendix 10**). This assessment has considered the impacts of the Project's changes to groundwater systems relative to both existing conditions and modelled groundwater conditions associated with existing approved operations. The assessment has also had regard to the natural variability within the groundwater system associated with climatic effects.

Changes in water table levels were then considered in the context of the vegetation communities present in areas where the Project was predicted to have an impact on water potentially accessible to the vegetation.

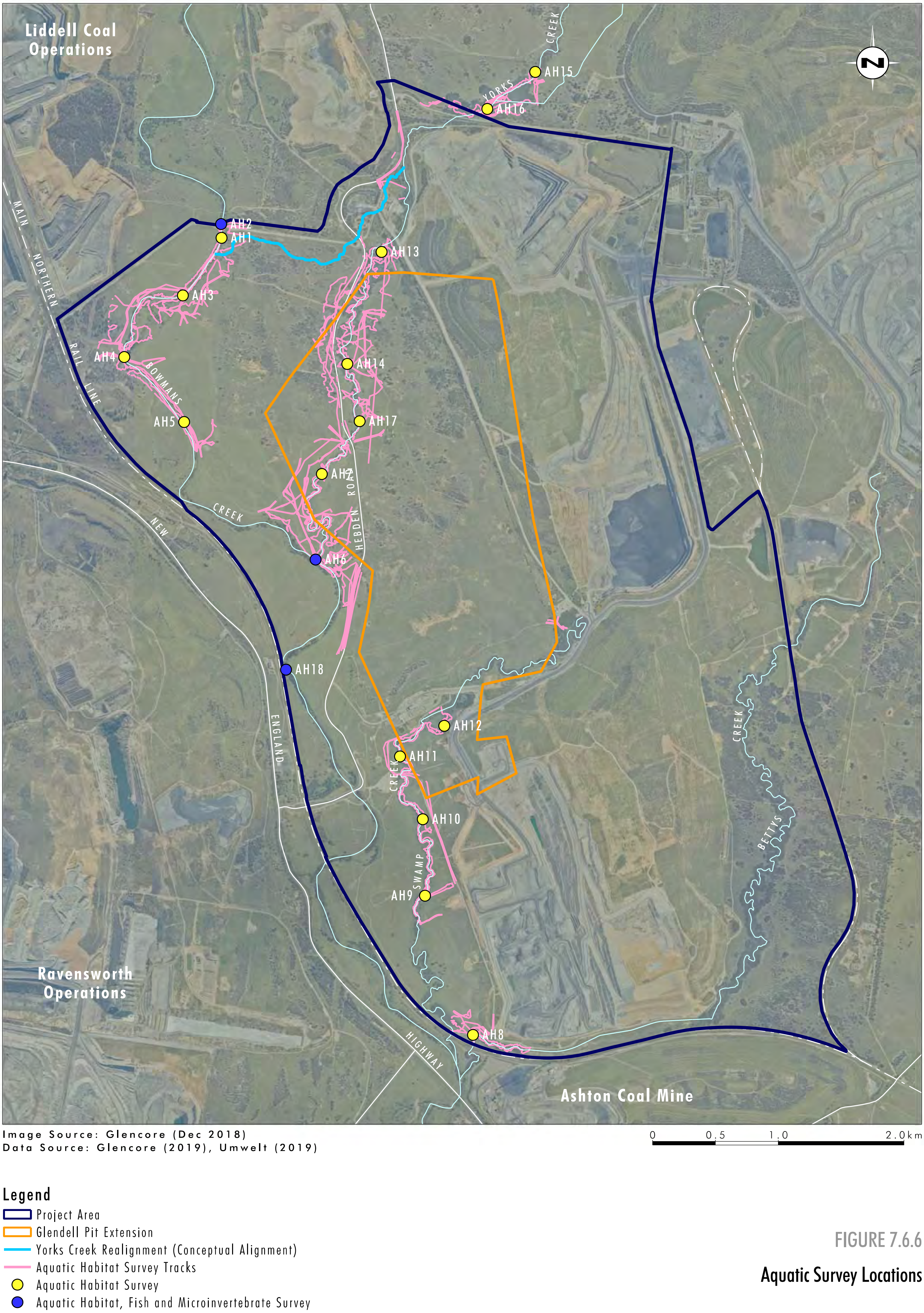

FIGURE 7.6.6

Aquatic Survey Locations

File Name (A4): R08/4166_570.dgn
20191030 13.54

7.6.2.2 Riparian and aquatic habitat values

Bowmans Creek

Bowmans Creek is located adjacent to the Glendell Pit Extension and contains a variety of aquatic micro-habitats for a comparatively wide range of aquatic flora and fauna species, despite the low water levels recorded at the time of the survey.

Although predominantly dry during the survey period, pool and run habitats were common within Bowmans Creek, with evidence of pool/riffle sequences, overhanging riparian vegetation and fallen woody debris and snags that would provide niche habitat during periods of inundation recorded during surveys.

Bowmans Creek supports a narrow strip of riparian vegetation that was observed to be depauperate and occurring in disjunct patches likely as a result of historical and ongoing land use. A moderately dense canopy is dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) with scattered forest red gum (*Eucalyptus tereticornis*) on the edge of floodplain grasslands. Mid-storey and shrub layers were generally absent from riparian vegetation however sandpaper fig (*Ficus coronata*) was present in low abundance, along with introduced pepper tree (*Schinus areira*) in some parts of this community. The ground layer comprises a mix of exotic and native grasses, sedges, rushes and forbs.

The presence of aquatic vegetation was located only in association with pools along Bowmans Creek where encroaching floodplain vegetation was commonly observed throughout the generally dry creek beds.

Bowmans Creek demonstrated reasonable aquatic species diversity with a total of 15 fauna species recorded during aquatic vertebrate sampling. An assessment of fish habitat classification and sensitivity undertaken in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (NSW DPI 2013) has identified Bowmans Creek as including:

- Type 1 - Highly sensitive key fish habitat
- Class 2 – Moderate key fish habitat.

Yorks Creek

Yorks Creek is ephemeral, is frequently dry and is considered typical of the 3rd order watercourses in the local area.

No water flow was observed in the Yorks Creek watercourse at the time of survey. Water was scarcely observed along Yorks Creek with the exception of a few small, very shallow pools scattered along the watercourse. These pools contained no aquatic vegetation at the time of survey and were likely a result of limited run off from the adjacent floodplain. The width of riparian vegetation along Yorks Creek increases upstream with correlation to the meandering stream formation. Riparian vegetation of Yorks Creek narrows to disjunct patches downstream towards the confluence with Bowmans Creek as a result of historical and ongoing land use.

Instream vegetation was limited to common reed (*Phragmites australis*) and spiny-headed mat rush (*Lomandra longifolia*) occurring in a wet depression upstream of the Bayswater North Pit, and sharp rush (*Juncus acutus* subsp. *acutus*) an exotic species which was commonly recorded in the dry watercourse.

Except for the lower section near the confluence with Bowmans Creek, Yorks Creek is *not* mapped as key fish habitat by Fisheries Ecosystems Branch of NSW DPI.

An assessment of fish habitat classification and sensitivity undertaken in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) has identified Yorks Creek as being:

- Type 3 - Minimally sensitive key fish habitat
- Class 3 – minimal key fish habitat.

Yorks Creek demonstrated poor fish habitat during the survey period. The presence of water was reduced to small, shallow pools persisting, providing limited refuge habitat for aquatic species.

Swamp Creek

No water flow was observed in Swamp Creek at the time of survey. Stream substrate materials were found to be variable with influences of sedimentation. Substrates generally consisted of mud/clay deposits over cobble or gravel substrate. Although dry, pool and run habitats were common, with evidence of pool/riffle sequences during periods of inundation. Evidence of erosion was minor with deep steep banks generally stabilized by grasses, rushes, exotic shrubs, pepper tree (*Schinus areira)* and swamp oak (*Casuarina glauca*). Overhanging riparian vegetation was consistently recorded within Swamp Creek while macrophyte cover was not present. Fallen woody debris and snags were also commonly recorded. Deep leaf litter was commonly observed throughout the Project Area indicating that Swamp Creek has been without water for an extended period of time.

The sections of Swamp Creek within the Glendell Project Disturbance Area are *not* mapped as key fish habitat by Fisheries Ecosystems Branch of NSW DPI.

An assessment of fish habitat classification and sensitivity undertaken in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013) has identified Swamp Creek as being:

- Type 3 - Minimally sensitive key fish habitat
- Class 3 – Minimal key fish habitat.

Bettys Creek

Bettys Creek is ephemeral with short periods of flow common after heavy rain events. Small shallow pools were evident along the creek during the survey, however additional aquatic microhabitats such as pool/riffle sequences and rocky substrates were not observed.

Bettys Creek supports similar riparian vegetation structure to Swamp Creek with well-defined riparian vegetation dominated by swamp oak (*Casuarina glauca*), with rough-barked apple (*Angophora floribunda*) occurring in low numbers. Bettys Creek generally comprises a narrow channel, with widths in the order of 3 to 5 m. The channel is typically well vegetated by a mix of sedges and rushes, dominated by the introduced sharp rush (*Juncus acutus* subsp. *acutus*), indicating an intermittent flow regime. Bank heights were generally 1 to 3 m and evidence of active erosion was frequently observed.

Bettys Creek demonstrated high levels of leaf litter and detritus as well as minor influences from encroaching riparian and floodplain vegetation culmination. The ephemeral habitats of Bettys Creek are likely to lack a wide range of aquatic vertebrate and invertebrate species due to an absence of suitable habitat structures and habitat variability.

An assessment of fish habitat classification and sensitivity undertaken in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013) has identified Bettys Creek as being:

- Type 3 - Minimally sensitive key fish habitat
- Class 3 – Minimal key fish habitat.

7.6.2.3 Groundwater dependent ecosystems

A review of the Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (GDE Atlas) shows potential for terrestrial GDEs to be present in the Project region. The GDE Atlas was developed as a national dataset of Australian GDEs to inform groundwater planning and management. The register indicates there are areas of low and high potential terrestrial GDE interaction along Yorks Creek, Bettys Creek, Swamp Creek and Bowmans Creek. There is moderate potential aquatic GDE along Bowmans Creek. The GDE Atlas does not identify any wetlands in the areas potentially impacted by the Project. Additionally, there are no wetlands in close proximity to the Project that are likely to be affected by the Project and this GDE type is therefore not considered further.

Stygofauna

Four stygofauna taxa, and one troglofauna taxon were collected in the shallow alluvial aquifers as part of the survey undertaken for the Stygofauna Assessment (ELA, 2019), which brings the total known stygofauna taxa within the vicinity of the Mount Owen Complex to seven. The assessment showed that all taxa identified in the surveyed bores have a broad distribution in the Hunter Valley and are widespread along the alluvial aquifers in the region, including the Hunter River.

Terrestrial vegetation

Vegetation mapping for the area of investigation was overlaid with areas where the water table is modelled to occur within 10 m of the surface in 2019 to further refine the location of potential GDEs in the area of investigation. Only saturated areas of layers 1 and 2 in the model (the alluvium and regolith) were considered in the assessment as these are the only strata in which water can be readily accessed by terrestrial vegetation. The vegetation communities, located within areas where the water table is modelled as being within 10 m of the surface in 2019, and their assessed likelihood of dependence on groundwater, are shown on **Figure 7.6.7** and listed in **Table 7.34**.

Table 7.34 PCTs mapped in areas of shallow groundwater and likely level of groundwater dependence

Plant Community Type	Likely Level of Groundwater Dependence
485 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley	High
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter	Low
1692 - Bull Oak Grassy Woodland of the Central Hunter Valley	Low
1604 - Narrow-Leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	Low
1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	Moderate

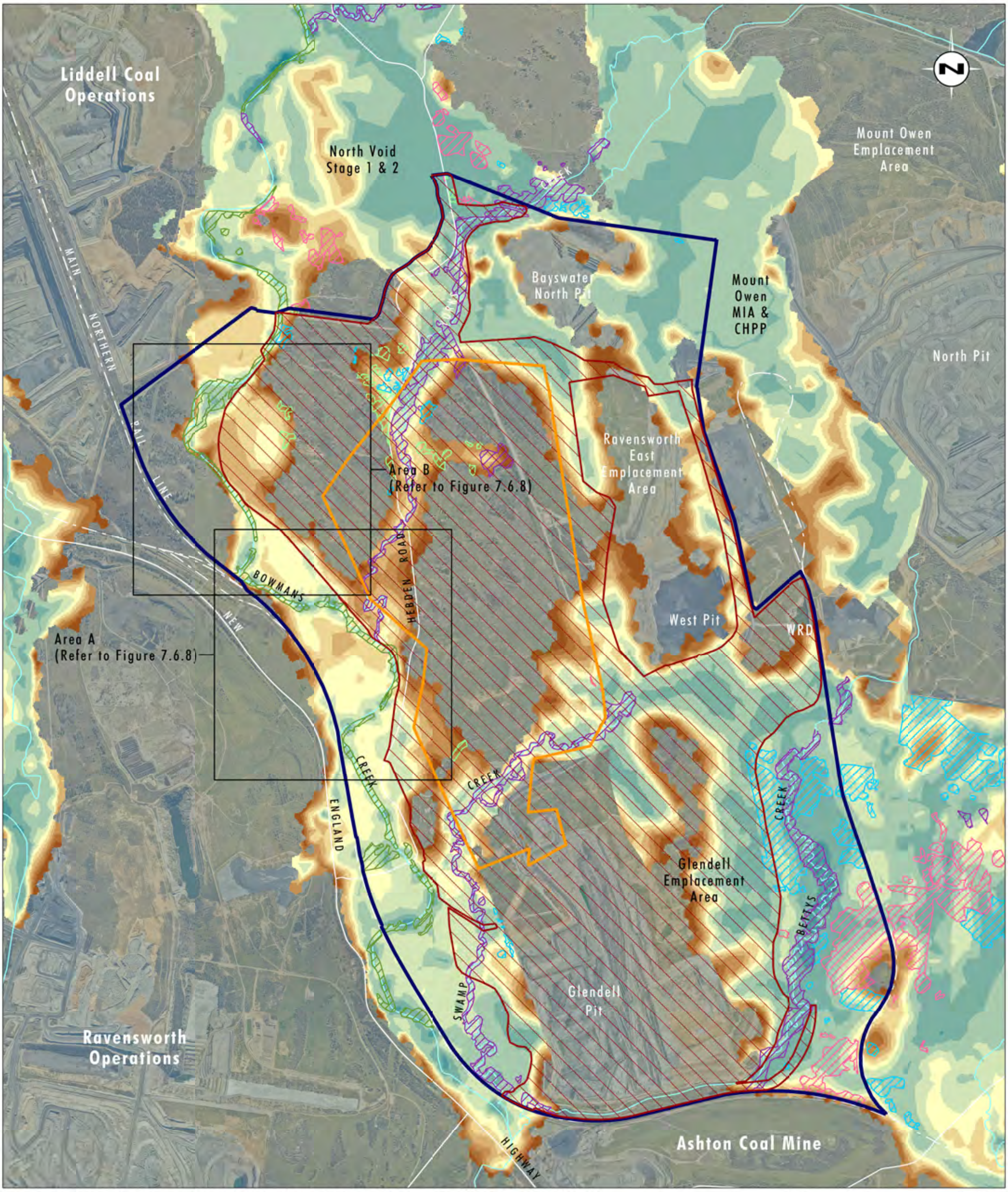

Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), AGE (2019)

0 0.5 1.0 2.0km

Legend

- Project Area
- Glendell Pit Extension
- Glendell Project Disturbance Area

Depth to Water Table (m)

- Less than 0
- 0 to 1.0
- 1.0 to 2.0
- 2.0 to 3.0
- 3.0 to 4.0
- 4.0 to 5.0
- 5.0 to 6.0
- 6.0 to 7.0
- 7.0 to 8.0
- 8.0 to 9.0
- 9.0 to 10.0

- 485 - River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley - Woodland
- 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter - Woodland, Regeneration and Plantation
- 1604 - Narrow-Leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter Woodland, Rehabilitation and regeneration
- 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley - Woodland and Regeneration
- 1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Forest

FIGURE 7.6.7

Vegetation Communities and Modelled 2019 Water Table

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7.6.2.4 Direct Impacts on ecological water-dependent ecosystems

The Project will directly impact on Yorks Creek and Swamp Creek as the Glendell Pit Extension progresses to the north and mines through sections of the creeks (refer to **Section 3.2.11**). The lower reach of Yorks Creek will also be impacted by the construction of the realigned section of Hebden Road and the Heavy Vehicle Access Road. As discussed in **Section 3.2.11,** Yorks Creek will be realigned prior to being directly impacted by the Glendell Pit Extension. A conceptual detailed design for the realignment is discussed in **Section 7.5.5.3**. The realignment is proposed to be permanent and has been designed with consideration to a wide range of environmental factors. The design of Yorks Creek Realignment aims to re-establish stream connectivity to create a free passage for aquatic fauna. Best practice techniques for design have been explored as a part of this Project for the construction of the realignment to reduce instream barriers and has considered *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003).

The proposed design of the Yorks Creek Realignment presents a minor increase in stream gradient, however this is considered to present a negligible impact to the overall stream health. The realignment will promote a natural, unimpeded stream flow allowing the free movement of fish between instream refuge structures should flow return to Yorks Creek as drought conditions ease. The Yorks Creek Realignment also includes specific provision for the recreation of riparian habitat consistent with the existing Yorks Creek riparian habitat.

Removal of Riparian Habitat

The riparian habitat adjacent to the sections of Swamp Creek and Yorks Creek directly impacted by the Glendell Pit Extension and the Yorks Creek Realignment works, will be cleared. There may also be some impacts on riparian vegetation along Bowmans Creek at the proposed new confluence point with the Yorks Creek Realignment. The construction of the realigned section of Hebden Road may also require some clearing of small areas of riparian vegetation adjacent to Bowmans Creek. The construction of the realigned section of Hebden Road and the Heavy Vehicle Access Road will require the removal of some riparian vegetation in the lower reaches of Yorks Creek.

The removal of the riparian vegetation within the Additional Disturbance Area is assessed as part of the BDAR and is discussed in **Section 7.6.1.3**.

The Yorks Creek Realignment includes the reestablishment of riparian vegetation along the realigned section of Yorks Creek. The conceptual detailed design also includes the use of woody debris in the channel and the creation of riffle areas and ponds within the channel to enhance instream habitat values for when the creek is flowing. These features of the Yorks Creek Realignment design will ensure that it operates as a healthy functioning ephemeral creek system. The establishment of riparian vegetation along the realigned section of Yorks Creek will also maintain terrestrial habitat connectivity between the upper reaches of Yorks Creek and Bowmans Creek.

Direct Impact on Aquatic Ecology

The Project will mine through Yorks Creek and Swamp Creek and significantly reduce flow in the remnant reach of Yorks Creek downstream of the Yorks Creek Realignment. The construction of the realigned section of Hebden Road and the Heavy Vehicle Access Road will also directly impact on the lower reaches of Yorks Creek. These aspects of the Project have the potential to impact on any aquatic fauna that may be present in the sections of creek impacted.

As both Yorks Creek and Swamp Creek are ephemeral creek systems, they have few or no pools. Direct impacts on aquatic communities located within the creeks will be limited to circumstances where the creeks contain water at the time of impact and the pools have been colonised by fauna movement from Bowmans Creek. These aquatic ecosystems are typically temporary, and the loss of these habitats is not considered to be a significant impact. The impacts associated with the loss of this potential habitat on other vertebrate fauna such as amphibians is assessed in the BDAR.

The Project will not result in the creation of barriers to fish movement.

7.6.2.5 Indirect impacts on ecological water-dependent ecosystems

Downstream water quality

Potential impacts to the water quality downstream of the Yorks Creek Realignment are considered specific to scour and erosion control during construction. Design and construction elements have been considered to reduce potential impacts of erosion to water quality downstream of the new confluence, refer to **Appendix 17** for further detail.

The extension to the water management system, as part of the Project, will be integrated into the existing water management system including mine dewatering systems, water storages, sedimentation and retention basins, settling and tailings storage facilities and diversion drains. The water management system aims to limit the potential impacts on downstream water quality by managing water that has the potential to cause environmental harm.

No measurable change to the water quality in surface water systems is expected as a result of the Project, and therefore no impacts to aquatic ecosystems are expected.

Impacts on Flow Regimes

The Project will change the catchments of Bowmans, Yorks, Swamp and Bettys Creek and also realign Yorks Creek to a new confluence with Bowmans Creek.

Groundwater modelling also predicts small changes to baseflow in Bowmans and Glennies Creek and the Hunter River associated with a delay in the recovery of the groundwater system (refer to **Section 7.5.6**). The incremental changes to baseflow for Glennies, Yorks, Swamp and Bettys Creeks are predicted to be negligible and overall baseflow is predicted to increase following the cessation of mining as regional groundwater systems recover. These changes are discussed in more detail in **Section 7.5.6**.

While the Project alters the catchment areas of various tributaries of Bowmans Creek during the life of operations, the overall impacts on the Bowmans Creek catchment during operations is considered to be small relative to existing conditions (less than 2% reduction). The conceptual final landform for the Project will have a negligible impact on the overall catchment size of Bowmans Creek relative to existing approved operations.

The terrain developed by the in-pit emplacement of overburden as part of the mining of the Project will result in a reduction to the Swamp Creek catchment during the life of the Project. This will result in reduced flows to the remnant sections of Swamp Creek downstream of the Project which is likely to result in reduced creation and recharge of pools. Given the ephemeral nature of the creek, the potential impacts on the temporary aquatic ecosystems in the sections of the creek is not considered to be significant. Water from the rehabilitated slopes of the south-western part of the final landform will be directed towards Swamp Creek and enable the return of some catchment flows to the lower reach of the creek. This will return downstream aquatic habitats (where present) to a standard similar to existing conditions.

The reconfiguration of final landform drainage in the central areas of the Mount Owen Complex to direct runoff towards Bettys Creek rather than Swamp Creek will increase the catchment of Bettys Creek relative to its current conditions but return the catchment to a similar size to its pre-mining catchment. The WRD will be used as a retention basin in the final landform to manage flows into Bettys Creek to minimise erosion and scouring risks. This change is unlikely to have any significant adverse impacts on aquatic ecosystems in Bettys Creek and is likely to contribute to improved riparian and aquatic ecosystems in this system.

Flood modelling indicates that the proposed realignment of Yorks Creek approximately 4 km upstream of the existing confluence will have a negligible impact on flood levels and flow velocities in Bowmans Creek. The Project is not predicted to have any significant impacts on flood flows in Bowmans Creek. As a result, the Project is considered unlikely to have any observable impact on aquatic fauna in Bowmans Creek as a result of changes in flow regimes.

Impacts on Aquatic GDEs due to changes in baseflow

The Surface Water Impact Assessment (refer to **Appendix 17**) includes a detailed assessment of the Project's predicted impacts on low flows and pools as a result of changes in baseflows due to groundwater impacts. These changes are detailed in **Section 7.5.6**.

Flow regime modelling was used to estimate the potential impacts to low flows (surface and subsurface) and the water levels in pools, assuming that the regional water table was sufficiently high that subsurface flow moved through the pool. Based on the results of the flow regime modelling, no measurable impact on total low flows or pools in Bowmans Creek or Glennies Creek is expected as a result of the incremental impacts on baseflow associated with the Project. Any consequential impacts on aquatic fauna are predicted to be small and not observable in the context of natural fluctuations.

Accordingly, the Project is unlikely to have any observable impact on aquatic GDEs in Bowmans Creek or Glennies Creek associated with changes in baseflows.

All baseflow in Yorks Creek, Swamp Creek and Bettys Creek is expected to occur as subsurface flows through alluvial material. Pools in these systems are uncommon and are typically short-lived with little evidence of aquatic habitats observed during the surveys undertaken for the Project. The Project's predicted impacts on baseflow in these systems is therefore considered to have only negligible impacts on any aquatic ecosystems that may be present in pools in these creeks.

Potential impacts on aquatic ecosystems in permanent pools in Bowmans Creek associated with reductions in water table is discussed in **Section 7.6.3** below.

Impacts due to changes in water table

The assessment considered the cumulative impacts from mining on water tables and the incremental impact. As discussed in **Section 7.5.9**, the maximum cumulative impact on alluvial take occurs in approximately 2046 and this date was selected from the model to understand the cumulative and incremental (Project related) impacts on water tables. The long-term impacts on water tables was also considered by examining the modelled cumulative and incremental impacts on water tables in 2500. Three areas were identified as having reductions in water tables associated with cumulative and/or incremental impacts worth investigating:

- the area of Bowmans Creek alluvium close to the confluence with Yorks Creek (Area A in **Figure 7.6.7**)
- an area further to the north on Bowmans Creek where there is a modelled area of desaturation of the alluvium associated with cumulative impacts (Area B in **Figure 7.6.7**) and

- the area around the point of intersection of the Glendell Pit Extension and Swamp Creek where the impacts are largely attributable to the Project.
- The Project is predicted to result in some additional lowering of the water table in the areas close to the point at which the Glendell Pit Extension intersects the Yorks Creek (Area A) and Swamp Creek alluvium in 2046 and this impact is modelled to persist in the areas closest to the Glendell Pit Extension out to 2500. The area of additional impact around the Swamp Creek intersection is located almost entirely within the Glendell Project Disturbance Area and will be largely covered by overburden emplacement required for natural landform shaping purposes. Accordingly, the impacts associated with changes to groundwater levels on terrestrial GDEs in this area were not assessed any further; the impacts on Area A are considered further below.

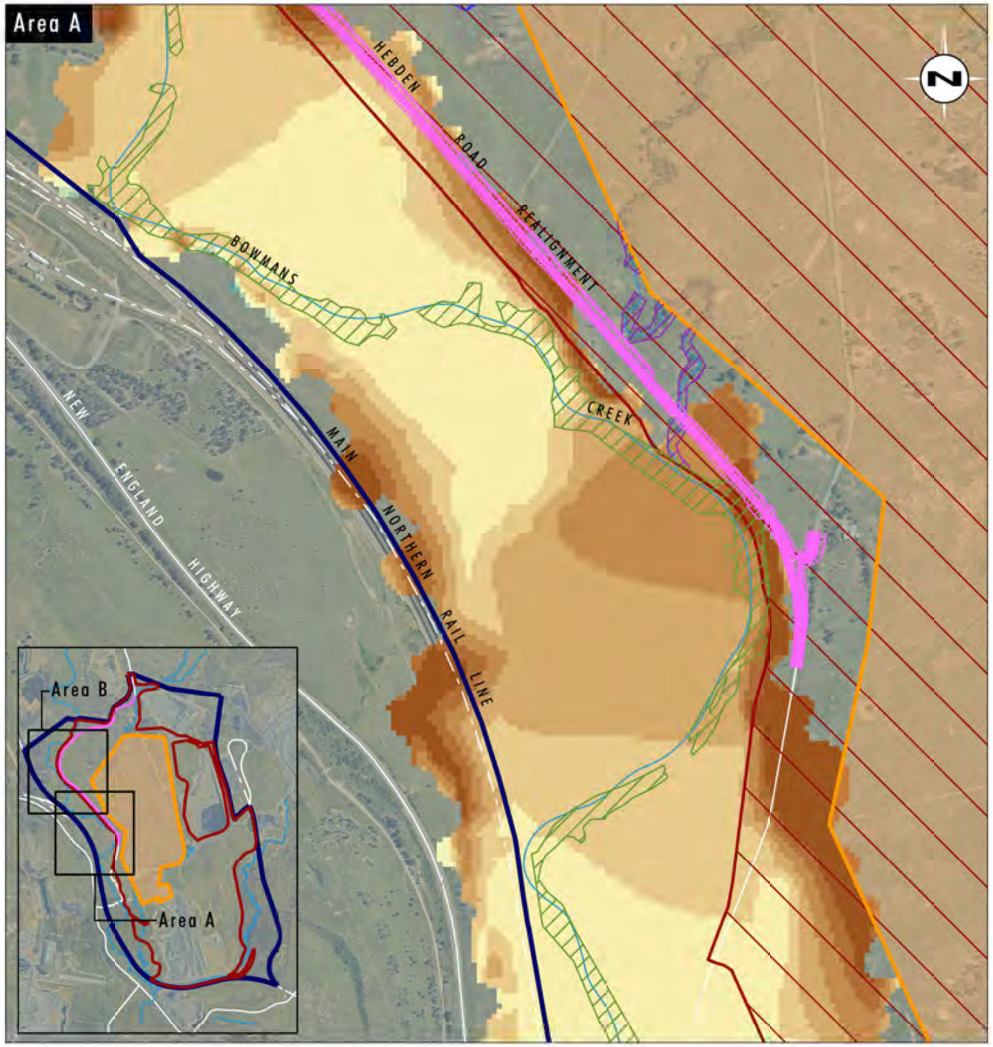
Figure 7.6.8 shows the relative changes in water table level in Area A and Area B in 2046 (Cumulative Scenario) relative to 2019 modelled conditions. As can be seen from **Figure 7.6.8,** there is a predicted lowering of the water table in the vicinity of the Yorks Creek and Bowmans Creek confluence of up to 2 m with greater reductions modelled within the Glendell Project Disturbance Area. A review of the Project's incremental contribution to cumulative impacts (refer to **Appendix** 10) indicates the the Project is:

- not predicted to have any observable impact on the water table level in Area B relative to existing approved operations in 2046 or 2500
- predicted to result in an incremental impact on a section of Bowmans Creek in Area A in 2046 of generally up to 1 m
- predicted to result in a 1 m decline relative to the modelled 2019 levels in the area around the existing Yorks Creek/Bowmans Creek confluence with a small area of decline of up to 1.5 m.
- It should be noted however that the water table in Area A is higher in 2500 than that modelled for the Cumulative Scenario in 2046 due to reduced cumulative impacts on the water table in this area associated with other mining operations.

The Project's impacts on terrestrial GDEs are constrained to Area A. The predicted cumulative impacts on the water table in the area of River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley in Area A appear to be almost entirely associated with the Project in both the short to medium term and the long term. These changes are likely to occur over a period of 5-10 years commencing around the time mining in the Glendell Pit Extension progresses close to this area (approximately Years 6-10). The lower water table in this area is predicted to be permanent in a short section of Bowmans Creek alluvium in Area A (approximately 250 m) close to the existing confluence with Yorks Creek where the water table is modelled to be up to approximately 1 m lower than modelled 2019 levels. This modelled reduction in groundwater levels will occur against a background of natural fluctuations in groundwater levels following rainfall events and high river flow events. Larger declines are modelled closer to the Glendell Pit Extension however, as shown on **Figure 7.6.8**, these areas are within the Glendell Project Disturbance Area where Hebden Road will be realigned and landform changes associated with overburden emplacement and final landform integration will occur.

By 2500 groundwater levels in all other areas of the alluvium will have generally recovered to levels similar to or above modelled 2019 levels in all areas along Bowmans Creek even with the effect of the Project other than a small area in Area A. This recovery is predicted to commence shortly after mining associated with the Project ceases. The Project's primary impact being to slow the rate of recovery in some areas adjacent to the Glendell Pit Extension. The water table level in Area B is modelled to be similar to or higher in 2500 than modelled 2019 levels. Accordingly, the Project is not considered likely to have any observable impacts in Area B relative to existing approved operations.

umwelt



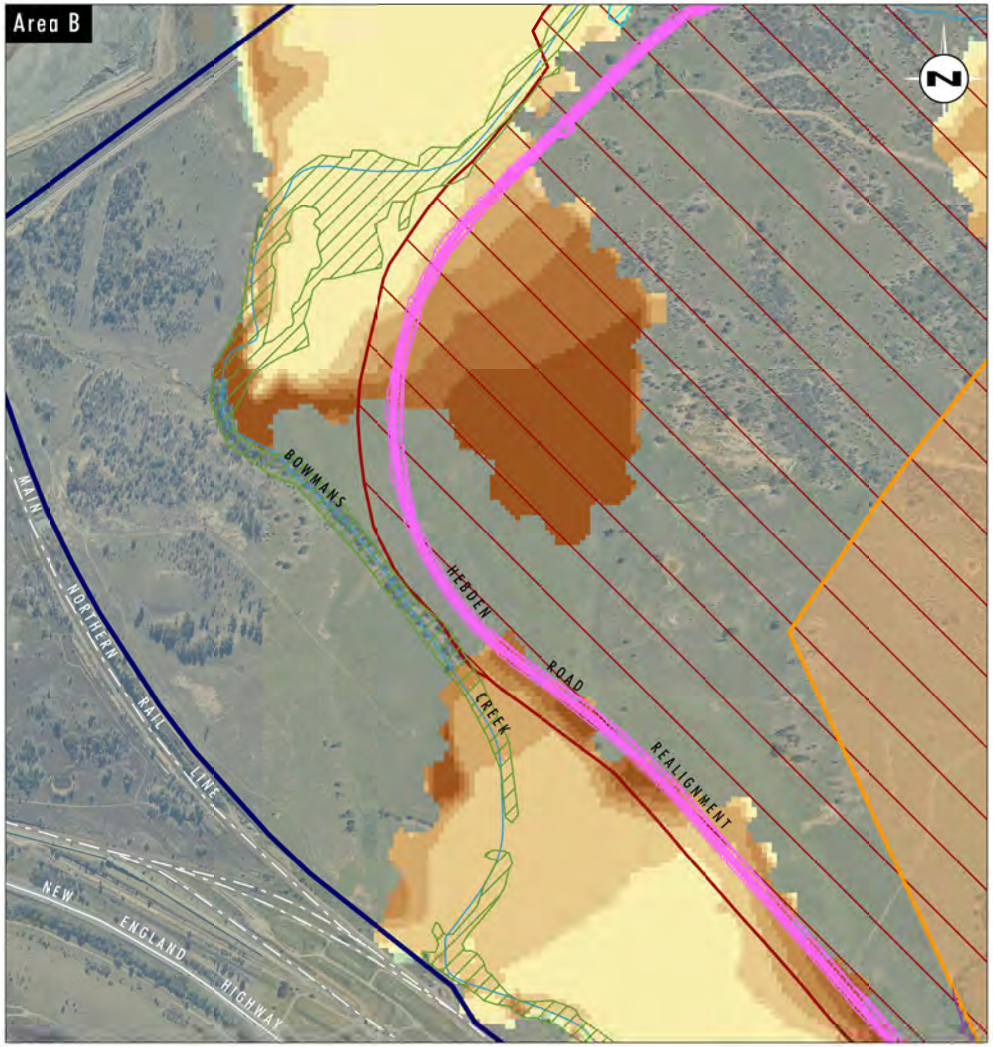


Image Source: Glencore (2018)
Data Source: Glencore (2019), AGE (2019), Umwelt (2019)

0 250 500 750m

Legend

- Project Area
- Glendell Pit Extension
- Glendell Project Disturbance Area
- Hebden Road Realignment (Conceptual Alignment)

Change in Depth to Water Table (m)

- Greater than -2.5
- -2.5 to -2.0
- -2.0 to -1.5
- -1.5 to -1.0
- -1.0 to -0.5
- -0.5 to 0.0
- 0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- Greater than 2.5

Vegetation Community

- 435 - River Oak Riparian Grassy Tall Woodland in the Western Hunter Valley
- 1692 - Bull Oak Grassy Woodland of the Central Hunter Valley
- 1731 - Swamp Oak Weeping Grass Grassy Riparian Forest of the Hunter Valley

FIGURE 7.6.8

Change in Water Table: Focus of Assessment 2019 (Approved Scenario) relative to 2046 (Cumulative Scenario)

File Name (A4): R08/4166_590.dgn
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Aquatic GDEs

Bowmans Creek meanders through the flood plain adjacent to the Glendell Pit Extension and pools within the creek can form windows to the underlying aquifer. During a particularly dry period in 2017 – 2019, Bowmans Creek was observed to reduce to a series of disconnected pools, interconnected through the underlying alluvial groundwater system. The aquatic ecosystems in these pools in Bowmans Creek and the adjacent riparian vegetation potentially depend on the underlying alluvial water table, particularly during extended dry periods such as that occurring throughout 2017 – 2019. The reduction in the water table in this area attributable to the Project is modelled as being between 1 and 1.5 m below the 2019 modelled levels in a 250 m section of Bowmans Creek with cumulative impacts modelled as resulting in an approximately 2 metre reduction in the water table in this area. . A pool is present in this area.

This modelled cumulative reduction is less than the natural variability in the alluvial water table levels observed over a 12 month period in 2018 due to extended drought conditions (refer to **Section 3.4.3.4**) with an overall decline of over 4 m observed in this area between 2015 and 2019 due primarily to climatic factors. During 2018 and 2019, water remained in this pool and the water depth was greater than the predicted drawdown impacts associated with the Project indicating water is likely to remain in this pool even during extreme dry periods.

Should this pool dry, this would result in localised impacts on some aquatic species. While this is a significant impact on the ecosystem potentially impacted, there are no recorded threatened or endangered species within the area of potential impact and no significant impacts on broader aquatic species populations are expected as a consequence of this impact.

Terrestrial ecosystems

As described above, the Project's potential impacts on groundwater in areas where moderate to highly groundwater dependent ecosystems are located is limited to a small area of River Oak Woodland in Area A (refer to **Figure 7.6.8**), as described in **Appendix 10**.

The bulk of the area potentially impacted is located with the Additional Disturbance Area and may be impacted by the construction of the Hebden Road realignment. A small area of Swamp Oak Weeping Grass Riparian Forest of the Hunter Valley located along the lower reaches of Yorks Creek is also in the area of potential impact however this community will be removed as part of the Hebden Road realignment and Heavy Vehicle Access Road works and is not considered further. The remaining areas potentially impacted are limited to fringing vegetation along an approximately 250 m length of Bowmans Creek in Area A. The modelling indicates a potential cumulative decline in water table in this area in the order of up to 2 m relative to modelled 2019 levels (refer to **Section 7.5.6**) of which the Project is modelled as contributing up to 1 m.

The reduction in the water table in Area A (both cumulatively and attributable to the Project) does not result in any desaturation of the alluvium where River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley is located. The predicted reduction in the water table (Cumulative Scenario) of up to 2 m over a 25 year period is well within the natural variability in water tables (in excess of 4 m) observed in this area. The trees in this area are expected to able to adapt in the timeframes concerned and 'chase' the water through deeper roots. Accordingly, no significant impact upon the River Oak Riparian Grassy Tall Woodland of the Western Hunter Valley community in this location is expected as a result of either the Project or cumulative impacts.

Cumulative groundwater impacts are modelled to result in a desaturation of the Bowmans Creek alluvium in Area B. The Project is not predicted to increase the extent of desaturation in this area but is modelled to delay the recovery of the water table level. This delay in recovery is not predicted to have a significant additional impact on terrestrial vegetation in this area relative to existing approved operations given the likely period for recovery in the Approved Scenario.

7.6.2.6 Impacts on subterranean GDEs

As previously discussed, cumulative groundwater modelling for the Project indicates that there will be complete desaturation in 2 small sections of the Bowmans Creek alluvium. This will potentially isolate a 5.5 km length of alluvium from both upstream and downstream reaches for a longer period then already likely to occur under existing approved operations, effectively extending the period for a potential barrier to stygofauna movement. As the stygofauna collected during this current round of sampling all came from the section modelled as being isolated, it is possible that, over time these will be lost from this reach. However, the loss of these species will be localised, as all are widespread in the Hunter Valley and recolonization would occur following resaturation and reconnection. As discussed above, the desaturation is not caused by the Project and would occur regardless of the proposed Glendell Pit Extension, rather it is due to existing operations which are already approved.

Drawdown from the Project poses negligible additional threat to stygofauna communities in the Bowmans Creek alluvium.

7.6.2.7 Threatened species, endangered populations and TECs assessed under the FM Act

No FM Act listed threatened aquatic flora or fauna species were recorded within the Project Area.

An assessment of significance was undertaken in accordance with Part 7A of the FM Act and concludes that the Project is unlikely to result in a significant impact on an endangered population of the Darling River hardyhead or the purple spotted gudgeon, which are known to occupy the Hunter River catchment.

No additional threatened aquatic species, populations or EECs potentially impacted by changes in surface and groundwater conditions have potential to occur within the Project Area.

7.6.3 Biodiversity avoidance and mitigation measures

7.6.3.1 Terrestrial vegetation

Avoidance

Glencore undertook a detailed biodiversity constraints study as part of the Project's pre-feasibility assessment to guide the design of the Project. Through this process, alternative mining options were considered (refer to **Appendix 1**) and Glencore sought to minimise the environmental and community impacts associated with the Project whilst maximising the economic resource recovery. Key elements of the project design have been designed to ameliorate the impacts on significant biodiversity features, such as threatened species, endangered populations, TECs and their habitats. The approach was to avoid biodiversity impacts where practicable and maximise use of existing disturbed areas. It is noted that avoidance can be challenging for resource projects as by necessity the resource extraction occurs where the resource is and this limits the ability to 'move' an impact, whereas there is more ability to relocate infrastructure or other project components.

Project design decisions reduced the overall impact of the Project on matters of biodiversity significance. The Project has avoided impacts on the riparian vegetation along Bowmans Creek except for a small area related to the Yorks Creek Realignment. The majority of the Additional Disturbance Area comprises heavily modified vegetation in the form of grazed derived native grasslands, exotic grasslands and existing disturbed areas. The derived native grasslands represent lower quality habitat for a range of threatened species. The remainder of the Project Area predominantly comprises a mixture of native vegetation in a regenerative or rehabilitated state, which provides lower quality habitat for native flora and fauna than remnant woodland and forest would. These areas of native vegetation comprise approximately 20% of the Development Footprint and 25% of the Additional Disturbance Area.

A number of mining and infrastructure options were considered and not selected, and further specific design changes were implemented during the early stages of designing the Project that ameliorated the impacts of the Project on significant biodiversity features. These impact reductions which are discussed in further detail in **Appendix 1** have resulted in maximising the utilisation of previously disturbed areas and minimisation of disturbance of key vegetation communities.

Glencore will continue to seek opportunities to minimise impacts on biodiversity as part of the implementation of the Project.

Mitigation Measures

The Mount Owen Complex has an existing approved Biodiversity and Offset Management Plan (Glencore, 2018f) which provides guidance for minimising the impacts of its operations on biodiversity. The existing plan will be updated and implemented for the Project to mitigate adverse biodiversity impacts during construction and operation. This will include specific measures to manage potential impacts on fauna species in the Project Area during vegetation clearing, management of retained vegetation and biodiversity monitoring. Mitigation measures will include (but not be limited to) measures that address the following direct and potential indirect impacts:

- landform and rehabilitation establishment
- salvage of biodiversity features, including habitat resources (e.g. hollow logs, tree hollows, fallen timber and rocks/boulders), threatened flora species and material for rehabilitation (e.g. seed collection, and topsoil) for mine rehabilitation
- a pre-clearing procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees
- weed management
- pest animal control
- fencing and access control
- bushfire management
- riparian zone management
- erosion and sedimentation control
- providing appropriate environmental management measures as part of the mining operations to minimise the potential for indirect impacts
- workforce education and training.
- The management measures to be implemented are described in the existing approved management plans (refer to **Section 2.2.5**) and these measures will contribute to the maintenance of habitat quality in adjacent remnant habitats.

The Mount Owen Complex has undertaken progressive rehabilitation throughout the life of Glendell, Ravensworth East and Mount Owen Mines. During this time, Glencore has put extensive effort into rehabilitation works including widespread flora and fauna monitoring and research projects in order to develop rehabilitation techniques and ensure the development and success of the rehabilitation programs in place to re-establish areas of native vegetation and fauna habitat. The rehabilitation of significant areas of the landscape disturbed by the Project to native vegetation consistent with surrounding communities is a key aspect of the Project that will mitigate the adverse impacts of the Project and will likely contribute to improved long term biodiversity outcomes in the area. The Rehabilitation and Mine Closure Strategy for the Project (and the Mount Owen Complex more broadly) is discussed further in **Section 7.9**.

7.6.3.2 Aquatic ecology

The Project has avoided significant impacts on Bowmans Creek by designing the Project to avoid all direct impacts other than those associated with the construction of the confluence with the realigned section of Yorks Creek.

The location of the Glendell Pit Extension along the Camberwell anticline and the modified groundwater environment means that cumulative groundwater impacts are also significantly lower than would be the case for a 'greenfield' project. The timing of the Project also means that rehabilitated catchment areas are returned to Bowmans Creek during the life of the Project which mitigates the Project's impacts on stream flows.

The following section considers the range of additional mitigation and management measures that will be implemented for the Project to further mitigate potential impacts on aquatic ecosystems.

Construction Phase Mitigation and Management Measures

A range of general mitigation measures are proposed to be employed during the construction phase of the Project to minimise impacts to aquatic ecological values, including:

- workforce education including inductions for staff, contractors and visitors to the site to inform relevant personnel of the relevant controls to be implemented to minimise impacts on aquatic ecosystems (e.g. erosion and sediment controls, clearing controls, water management controls, pollution controls)
- the extent of works within the Yorks Creek riparian corridor will be clearly marked so that areas of ecological value outside the proposed disturbance area are not impacted.

To minimise the impacts on water quality, erosion and sedimentation associated with spills and/or construction activities within the watercourse, works within or adjacent to the watercourse will be undertaken in accordance with a Construction Erosion and Sediment Control Management Plan which will include specific requirements to address works within the riparian zones. In addition, designs for works within or near watercourses will provide for the retention of natural functions and maintenance of fish passage in accordance with *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003). The realignment of both Yorks Creek and Hebden Road will necessitate a new crossing of Yorks Creek. A bridge will be used for this crossing which is considered to be the preferred crossing type in terms of mitigating potential barriers to fish movement.

The design of the Yorks Creek Realignment includes elements to mitigate the potential for erosion resulting in downstream water quality impacts. The conceptual detailed design also includes consideration of riparian habitat and instream structures and features for habitat.

During construction of the Yorks Creek Realignment, a combination of constructed channels and pipelines will be used to convey wet weather flows from the upper reaches of Yorks Creek to the sections of Yorks Creek downstream of the realignment works. Detention basins and dams will be constructed in the upstream sections of the realignment to manage high flow events during construction. A Yorks Creek Realignment Plan will be developed to inform the construction and commissioning works for the Yorks Creek Realignment.

Where the Project may require removal of large woody debris from watercourses in the Project Area, these would be relocated to the proposed Yorks Creek Realignment, where practicable.

Operational Phase Mitigation

A range of strategies are proposed to mitigate adverse impacts during the operational phase of the Project. This includes specific measures to minimise the potential impacts on the aquatic ecological values of the Project Area and the locality, including:

- implementation of permit for work controls so that unintended impacts on aquatic habitats are avoided during operations
- ongoing weed management
- regular inspection and maintenance of built watercourse structures to check functionality and minimise blockage of fish passage
- management of spills
- mine water will be contained and re-used within the Mount Owen Complex water management system or GRAWTS, with any mine water discharges managed in accordance with the HRSTS
- all sediment and erosion control dams will be designed to meet relevant Blue Book design requirements
- re-instating the creek landform and re-establishing riparian vegetation for the realignment of Yorks Creek.

Other than the monitoring associated with the Yorks Creek Realignment, no additional aquatic monitoring is considered to be warranted given the low levels of impacts predicted by the Project.

7.6.3.3 Groundwater dependent terrestrial ecology

The Project's potential impacts on groundwater in areas where medium or highly groundwater dependent ecosystems are located is limited to a small area of River Oak Woodland (refer to **Figure 7.6.7**). The species potentially impacted are expected to be able to adapt to the proposed changes in groundwater levels given the small magnitude of the change and the time period over which the change is predicted to occur.

The predicted impacts on groundwater levels are within the levels of natural variability of groundwater levels and the Project's impacts are considered unlikely to be differentiable against the impacts of this natural variation.

Due to the limited impact the Project's predicted changes are likely to have of terrestrial ecosystems no additional monitoring is proposed.

7.6.3.4 Stygofauna

Due to the limited impact the Project is predicted to have on stygofauna no additional mitigation measures of monitoring of stygofauna is proposed.

7.6.4 Biodiversity offset strategy

Glencore is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

The biodiversity offset strategy will be developed during the assessment process in consultation with the BCD and DPIE and based on the credits required to be retired to offset the impacts of the Project as specified in the BDAR and the offset options available under the BC Act and BC Regulation including:

- land based offsets (Glencore would retire the required number and class of credits (determined in accordance with the BDAR and the offset rules in the BC Regulation) through the establishment of new Stewardship Sites (and the subsequent retirement of credits) or by retiring credits from existing Stewardship Sites)
- ecological rehabilitation (allowable for mining projects);
- purchasing credits from the market, and/or
- paying into the Biodiversity Conservation Fund.

Under the BAM process, calculated biodiversity credit requirements of the Project have been identified as:

- 5,972 ecosystem credits for six native plant community types (10 vegetation zones)
- 2 tiger orchid (*Cymbidium canaliculatum*) endangered population credit
- 732 southern myotis (*Myotis macropus*) credits
- 2,559 brush-tailed phascogale (*Phascogale tapoatafa*) credits
- 17 eastern cave bat (*Vespadelus troughtoni*) credits
- The existing approved Mount Owen Complex Biodiversity and Offset Management Plan (BOMP), which provides guidance for minimising the impacts on biodiversity will be updated as part of the implementation of the Project. It is noted that the updates to the BOMP will focus on the changes relevant to the Project only, with the management processes identified in the approved BOMP remaining valid.

7.7 Aboriginal archaeology and cultural heritage

The Project Area is located within the traditional country of the Wonnarua people, whose history extends from the present day back many thousands of years. The Project Area is also within the modern day Native Title registered claim of the Plains Clans of the Wonnarua People, and is also within the Wanaruah Local Aboriginal Land Council (WLALC) boundary.

An Aboriginal Cultural Heritage Assessment Report (ACHAR) has been prepared by Australian Cultural Heritage Management (ACHM) in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holder groups to assess the Aboriginal cultural heritage values of the Project Area and surrounds (refer to **Appendix 22**).

An Aboriginal Archaeological Impact Assessment (AAIA) was prepared by OzArk Environmental & Heritage Management (OzArk) to assess the scientific (archaeological) values of sites and artefacts identified within the Additional Disturbance Area and this report is included as Section 11.5 within the ACHAR (refer to **Appendix 22**).

Throughout all stages of the assessment process, the RAPs were invited to identify how they would like to participate in the Project's Aboriginal cultural heritage assessment process, including what cultural information they wanted to share to inform the assessment process, and if any information should remain non-disclosed in the assessment and reporting process.

Notification through newspaper advertisements and community letters to Aboriginal groups and Aboriginal people as provided by agencies were issued to seek expression of interest in becoming a RAP for the Aboriginal cultural heritage assessment process. In total, 32 parties registered to participate and were consulted for the Project, including groups identifying as Wonnarua. Some of these parties are also represented by larger groups or families including Plains Clan of the Wonnarua People (PCWP) and Wonnarua Nation Aboriginal Corporation (WNAC) hereon referred to as *Knowledge Holder* groups. The Knowledge Holder groups were invited to attend workshops to identify cultural values relating to the Project Area.

The RAPs not involved in the consultation and reporting processes associated with the Knowledge Holder groups are referred to as the *Community RAPs* and were directly consulted by ACHM and Glencore to develop management recommendations and measures relevant to their cultural significance values statements and assessment concerns. WNAC participated in all aspects of the consultation throughout the Aboriginal cultural heritage assessment process.

Throughout the Aboriginal cultural heritage assessment process, Glencore has engaged with representatives of the PCWP to gain their values input. This has included numerous meetings and phone calls. At the time of writing the PCWP had not provided their values assessment for consideration in the process. The offer for inclusion of PCWP values remains open through the assessment process. Whilst specific input has not been received, the engagement has raised the PCWP's concerns regarding colonial frontier violence and claims of a massacre of Aboriginal people. This was the subject of an Application under section 9 and 10 of the ATSIHP Act, made by some members of the PCWP, and which has since been withdrawn. It was also the focus of detailed historical research into conflict between Aboriginal people and European settlers that was completed for the Project. Further details on early conflict between Aboriginal people and European settlers is provided in **Section 7.8**.

The consultation process has also facilitated the Knowledge Holder groups being able to consult with a number of Aboriginal people who were not RAPs for the Project, including Wonnarua Elders with knowledge and important contributions to the process. Further details of the consultation process are provided in **Section 7.7.2**. The understanding of significance and the management recommendations provided by the Community RAPs has also informed Glencore in its development of cultural heritage recommendations for the Project.

An overview of the ACHAR and AAIA is provided in this section.

7.7.1 Methodology

The ACHAR and AAIA have been aligned to:

- SEARs for the Project (refer to Appendix 4)
- National Parks and Wildlife Act 1974 (NPW Act)
- National Parks and Wildlife Regulation 2009 (NPW Regulation)
- Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005)
- the principles of The Burra Charter (Australia ICOMOS 2013)

- Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (OEH 2010)
- the key elements of the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010).

The approach taken acknowledged and respected that Aboriginal people have the right to directly participate in matters that may affect their heritage, and have the right to maintain culture, language, knowledge and identity.

The objective of the ACHAR was to ensure that Aboriginal people have the opportunity to participate in and improve the outcomes of the assessment by:

- providing relevant information about the cultural significance and values of the Aboriginal objects and/or places within the Project's Additional Disturbance Area
- influencing the design of the method to assess cultural and scientific significance of Aboriginal objects and/or places within the Project's Additional Disturbance Area
- actively contributing to the development of cultural heritage management options and recommendations for any Aboriginal objects and/or places within the Project's Additional Disturbance Area
- being provided with a draft of the assessment reports and inviting comment on the drafts before they are finalised and submitted as part of this EIS.

7.7.2 Consultation process

Consultation with the Aboriginal community was undertaken with reference to the relevant DEC 2005 and DECCW 2010 guidelines and in accordance with the principles of The Burra Charter (Australia ICOMOS, 2013).

Consultation for the Project was undertaken in four stages as outlined below:

- **Stage 1:** Glencore conducted formal notification of the Project and the ACHAR process and provided the opportunity for Aboriginal parties to formally register their interest in the Project.
- **Stage 2:** Glencore conducted initial Project description consultation, which included presenting information in relation to the Project to all the RAPs who registered an interest in Stage 1. This consultation included details of the Project Area and potential impacts, proposed avoidance of harm measures and a description of the proposed works. Initial consultation with the RAPs also included provision of the draft Aboriginal Cultural Heritage Assessment and Consultation Methodology and an overview of the Draft Aboriginal Heritage Survey Methodology, for review and comment. Consultation with the RAPs involved a combination of consultation forums, which included small and large group briefing sessions, inspections of the Project Area and site inductions. Specific project briefings were also provided to PCWP and WNAC.
- **Stage 3:** Further consultation which refined the cultural heritage assessment approach with the Community RAPs was completed by Glencore, ACHM and OzArk. A detailed AAIA was undertaken by OzArk involving representation by RAPs on all field survey days. The ACHA approach actively involved the Community RAPs in the assessment of their cultural heritage values, the likely Project impacts, if approved, and the development of management measures. Glencore also engaged with the WNAC through a cultural values site visit and closed values meeting/workshop.

- As noted above, Glencore has engaged with the PCWP since the commencement of the Project. At the time of writing the PCWP have not provided their values as input into the ACHAR. The offer for inclusion of PCWP values remains open through the assessment process.

- As part of the assessment approach, Glencore also conducted regular consultation; and provided information to the community RAPs and Knowledge Holder groups in relation to the Project, and information requirements in relation to the preparation of any separate reporting. To assist the groups, Glencore provided access to materials and the Project Area, to enable them to assess their cultural heritage values, the likely Project impacts, and their suggested management measures.

- **Stage 4:** Glencore commenced the 28-day review and comment period of the draft ACHAR with the Knowledge Holders and Community RAPs in mid-September 2019. Feedback and submissions received during the review and comment period were incorporated into the final ACHAR.

All Knowledge Holders and Community RAPs were invited to participate in the cultural heritage assessment process from the time of their registration, with extensive consultation undertaken over more than 18 months to inform Project design, the ACHAR and the broader environmental assessment of the Project. Participation opportunities have been provided through:

- participation in the extensive field work undertaken for the AAIA and historic archaeology investigation including surveys and test excavation onsite and discussions on findings
- small and large group cultural values workshops, which included briefings on the findings of the AAIA
- individual meetings including site tours
- opportunity for development of an independent cultural heritage values assessment by PCWP
- cultural values site visit and closed values meeting/workshops for the WNAC
- cultural values site visit and closed values meeting/workshops for the Community RAPs
- completion of questionnaires as a part of the workshops
- walks on Country
- receipt of community information sheets
- general correspondence via phone and email.

Full details of the consultation process undertaken in relation to the ACHAR are contained in **Appendix 22**.

Glencore, ACHM, OzArk and Umwelt would like to thank the Knowledge Holder groups and RAPs for their participation in and contribution to this assessment process.

7.7.3 Previous Aboriginal heritage studies

An extensive history of Aboriginal cultural heritage and archaeological assessment exists for the Mount Owen Complex and surrounds. In recent decades, the Upper Hunter Valley has become one of the most intensively studied regions in NSW with numerous archaeological surveys and excavations conducted in advance of proposed mining activity. This body of research has identified numerous archaeological sites, and provides a broad understanding of archaeological site patterning at local and regional levels.

An overview of the extensive history of past archaeological research undertaken within and surrounding the Project Area, a summary of key information on investigation type and area, and number of previously recorded archaeological sites is provided in **Appendix 22**.

Searches of the BCD (formerly OEH) administered Aboriginal Heritage Information Management System (AHIMS) register identified 302 previously recorded Aboriginal archaeological sites within a 6.7 km by 8.7 km combined search area, centred on the Additional Disturbance Area.

As a result of these previous studies, among others, 39 valid Aboriginal sites have been previously recorded within or in close proximity to the Additional Disturbance Area. These sites are comprised of isolated finds and artefact scatters, typically occurring on eroding banks and spurs and elevated flat areas overlooking watercourses. A relatively low proportion of sites were found at distances greater than 200 m from watercourses.

7.7.4 AAIA methodology

OzArk prepared a comprehensive AAIA as part of the broader ACHAR in **Appendix 22**. This AAIA has built on the comprehensive body of Aboriginal archaeology survey work and research undertaken in parts of the Project Area and the wider locality over a period of more than 30 years.

The archaeological assessment has been designed to meet the following objectives:

- undertake background research on the region to formulate a predictive model for Aboriginal site location within the Additional Disturbance Area
- identify and record objects or sites of scientific or archaeological significance within the Additional Disturbance Area, as well as any landforms likely to contain further archaeological deposits
- assess the likely impacts of the Project to Aboriginal archaeological sites and/or deposits and provide management recommendations.

Archaeological Assessment Consultation and RAP Involvement

The consultation process for the AAIA was undertaken as part of the consultation for the broader ACHAR, which commenced in November 2017 and has continued throughout the assessment process. Community RAPs, PCWP, WNAC and the WLALC were involved in all facets of the archaeological assessment including a review of the survey and test excavation methodologies, participation in field survey and test excavation program, and site identification and recording.

In addition, all Community RAPs and Knowledge Holder groups were provided a draft copy of the AAIA report for 28 days of review and comment, as an appendix to the draft ACHAR in mid-September 2019.

Field Survey

A comprehensive field survey was undertaken within the Project Area to build on the extensive previous archaeological record. The survey and test excavations undertaken within the Project Area was completed by OzArk, the Knowledge Holder groups and the Community RAPs over several weeks in April, May and September 2018, totalling 25 days.

The archaeological survey for the Project included the entirety of the Additional Disturbance Area. The aim of the archaeological survey was to gain knowledge of the archaeological potential and characteristics of all landforms in the Additional Disturbance Area, rather than to locate each and every artefact. Pre-determined transects were inspected via walking at sufficient spacing by the surveyors to determine the archaeological potential of all landforms within the Additional Disturbance Area. Community RAPs and representatives from the Knowledge Holder groups assisted the survey by identifying objects/features of cultural interest and placed flags at these artefact locations to assist with the recording of sites. Each of the 39 previously recorded sites within the Additional Disturbance Area were also re-assessed to determine their current condition and scientific values.

Following the archaeological survey and review of its findings, a test excavation program was planned and executed across 12 sites to provide more information on potential subsurface deposits within the Additional Disturbance Area. The landscape has undergone varying levels of disturbance however there was still potential for partially intact features and/or archaeological deposits to exist within the Additional Disturbance Area. A total of 152 excavation squares (0.5 m by 0.5 m) were excavated at 12 separate localities. Refer to the **Appendix 22** for further details on the test excavation program methodology.

In addition, 5 further artefact finds (3 isolated finds and 2 artefact scatters) were made during the historic archaeology test excavation process, which were assessed and included within the findings of the AAIA. RAPs were also involved in this test excavation program which was conducted over 4 weeks in October/November 2018. For further detail on the historic archaeology test excavation process, refer to **Appendix 23**.

7.7.5 Scientific archaeological assessment

The archaeological survey completed by OzArk recorded 69 new Aboriginal cultural heritage sites, 52 of which are located within or closely adjacent to the Additional Disturbance Area. Of the 69 new Aboriginal sites, there were 39 artefact scatters, 29 isolated finds and one scarred tree. It should be noted that the scarred tree is outside of the Additional Disturbance Area and will not be impacted by the Project. Of the artefact scatters, 32 sites recorded less than 10 artefacts and no site contained more than 70 artefacts. The locations of the recorded sites are shown in **Figure 7.7.1**.

The 39 previously recorded sites, as referred to in **Section 7.7.4**, are located within or closely adjacent to the Additional Disturbance Area. **Figure 7.7.1** also displays the locations of the previously recorded sites.

From the test excavation program, 180 artefacts were recovered averaging 1.18 artefacts per excavation square. There were only 2 excavation squares that recorded more than 15 artefacts, both of which were located at the first excavation site. Overall, this indicates an extremely low and sparse density of artefacts. Apart from one site, the excavation squares presented low incidence of subsurface deposits. It would appear that this is due to historic disturbances in the area and that the visible surface artefacts are remnants of sites that have been comprehensively disturbed by previous land uses.

In total, the archaeological assessment considered 91 known sites located within the Additional Disturbance Area (refer to **Figure 7.7.1**). These sites include stone artefacts, PADs and isolated finds.

No evidence of colonial conflict or skeletal remains was identified during the survey or test excavation programs. As such, nothing in the current archaeological assessment was able to corroborate or extend the scant information the written sources provide regarding colonial conflict.

7.7.6 Archaeological significance assessment

All newly recorded Aboriginal archaeological sites were assessed for their archaeological (scientific) significance. Of the previously recorded sites, only the sites within the Additional Disturbance Area were assessed for their significance.

The overall scientific significance of sites within the Additional Disturbance Area is low due to:

- widespread soil loss that affects nearly all portions of the Additional Disturbance Area and surrounding locality

- major disturbances from agricultural activities and approved mining activity including built infrastructure, stockpiles, tracks, the diversion of water away from creeks and other mine related impacts such as revegetation programs
- the archaeological landscape within the Additional Disturbance Area being fragmented by approved mining
- the varying degrees of archaeological salvage that has been carried out.

The majority of sites recorded during this assessment have been assessed as having low scientific significance. In most cases this is because the sites are low density scatters or isolated finds in landforms with thin A Horizon soils where further subsurface archaeological deposits are unlikely. In some cases the artefacts may be more numerous but erosion has affected a large percentage of the site and the visible artefacts are displaced and of limited archaeological value.

Of the 91 sites located within the Additional Disturbance Area:

- 77 have been assessed as having low scientific significance due to being isolated finds or low-density artefact scatters
- 9 sites have low-moderate scientific significance
- 5 sites have moderate scientific significance
- no sites have high scientific significance.

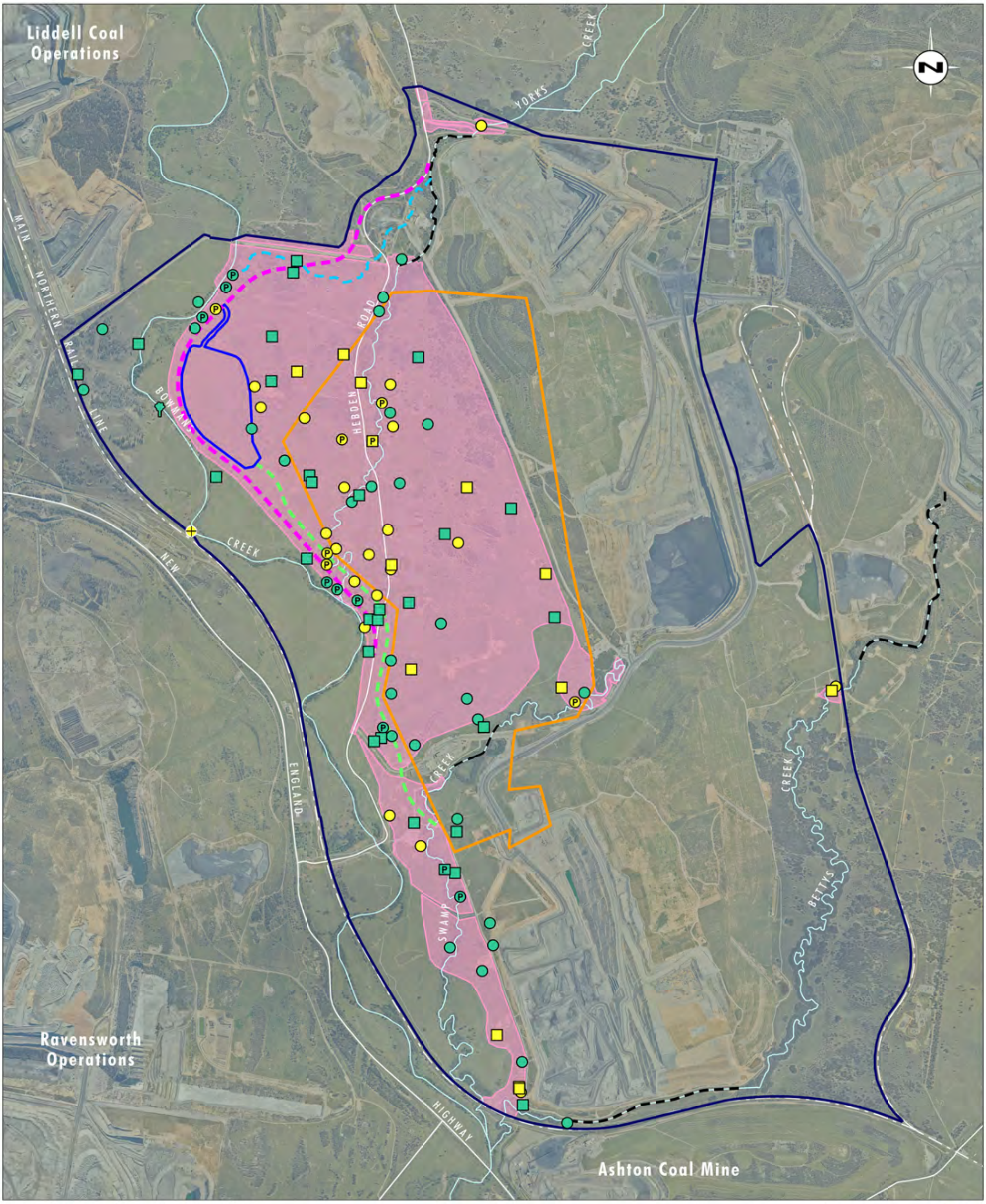

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), OzArk (2019)

0 0.5 1.0 2.0km

Legend

- Project Area
- Additional Disturbance Area
- Glendell Pit Extension
- Existing Creek Diversion

Project Features:

- MIA
- Heavy Vehicle Access Road
- Yorks Creek Realignment
- Hebden Road Realignment

Previous Sites Recorded in the Additional Disturbance Area:

- Artefact Scatter
- Artefact Scatter with PAD
- Isolated Find
- Isolated Find with PAD
- Engraving

OzArk Recorded Sites:

- Artefact Scatter
- Artefact Scatter with PAD
- Isolated Find
- Isolated Find with PAD
- Scarred Tree

FIGURE 7.7.1

Aboriginal Archaeology

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7.7.7 Cultural heritage values assessment

The ACHAR noted that the numerous Aboriginal stakeholders who participated in the cultural values assessment process hold values which relate to the wider Hunter Valley region generally and less directly to the Project Area specifically. There was very little additional information presented in any of the workshops, site visits or written material which relate specifically to the Project Area as much of the information related to overall values and cumulative impacts.

The ACHAR found that cultural values expressed by the participants have been consistent in voicing an over-arching concern for the wider landscape and criticism of the negative impact of mining on that landscape. Consistent in the material collected is a sense of 'loss' or 'outrage' and grief at the treatment of Aboriginal people since First Settlement (dispossession and genocide are mentioned repeatedly) through to more contemporary experiences (i.e. the Stolen Generation).

The ACHAR also identified a consistent theme of the '*powerlessness'* Aboriginal people often feel when confronted by situations where they feel disempowered or unable to exercise influence on decision makers. There is a sense of loss and lament for what once was, but with a very strong expression of '*corporate'* ownership of the wider region by the Wonnarua people. There is also an element of celebrating the survival of those who are now 'speaking for country'. While the wider Hunter Valley region associated with the Wonnarua people is significant to those concerned, there is little direct evidence (anecdotal or otherwise) of any particular or specific places or values of significance within the Project area.

For many of the Aboriginal stakeholders, the contemporary attachment to place appears based on the linkage to archaeological places which were created by 'the ancestors' and thereby constituting a connecting thread to a cultural world from another time. In a similar sense, there was some attachment to the Ravensworth Homestead expressed during the site visits. This attachment was based largely on the premise that Wonnarua people had most likely lived and worked on the estate through time, rather than any specific historical associations.

This general lack of direct or specific cultural knowledge in no way diminishes the strength of connection to the places within the Project Area. However, the attachment to place is one which is predominantly of contemporary association rather than traditional knowledge, custom, lore or practice.

The ACHAR noted that the surrounding area is held to be of higher significance to many members of the Wonnarua community, however the sites and/or places within the Additional Disturbance Area held no higher significance or value(s) than any other.

This ACHAR has ascertained that there are no traditional cultural values associated with the Additional Disturbance Area (directly and specifically) held by the participants in the ACHAR process. By 'traditional' cultural values, we refer to these in the Native Title sense as an inherited and cohesive body of 'traditional' knowledge, laws and customs that are still observed and maintained by a group. However, in common with many urbanised communities, strong contemporary cultural values exist in almost universal claims of 'connection' to the land in question, and a sense of anguish and/or anger at having been 'disconnected' from the land in question by historical circumstances.

ACHM found that the Project Area has undergone considerable modification since European settlement. Traditional Aboriginal lifeways and customs began to disappear in the early days of contact with Europeans and had largely disappeared before the turn of the 19th Century. Much of the natural landscape no longer exists in any cohesive manner, as the long history of agriculture and mining in the area has irreversibly altered the landscape. Combining the historical disconnection of people from place with the extensive landscape modification since settlement means that the Project Area has a relatively low cultural significance when compared to other places within the wider region. This is also consistent with the archaeological assessment, which has determined that the majority of the archaeological sites are of low scientific significance.

7.7.8 Aboriginal cultural heritage impact assessment

The proposed Project would directly impact 91 Aboriginal archaeological sites if approved, consisting of 55 artefact scatters and 36 isolated finds (refer to **Figure 7.7.1**). The loss of the 91 sites would contribute to the cumulative harm inflicted on Aboriginal sites in the region, however, the archaeological assessment found that the sites are neither remarkable in their manifestation nor contain artefacts that are not commonly represented in the region. The majority of the sites have a low artefact density, are of low scientific significance and the site types are commonly represented across the region. Additionally, it is important to acknowledge that these sites do not contain any rare or unique features, and most have been previously disturbed through previous agricultural practices and other historical land uses.

The predicted direct and indirect impact on the Aboriginal cultural heritage values of the Additional Disturbance Area will add to the cumulative impact of mining development on the cultural heritage resource of the upper Hunter Valley, and this has been considered in the development of detailed management measures, in consultation with the Community RAPs and Knowledge Holder groups.

7.7.8.1 Aboriginal archaeological sites outside the additional disturbance area

Two sites of higher significance have been recorded in locations outside of the Additional Disturbance Area, but within the Project Area. These sites are:

- A scarred tree (GN ST1, 37-3-1561) which is a rare site type in the upper Hunter Valley due to the widespread vegetation clearing that has taken place. This site is situated immediately adjacent to Bowmans Creek outside of the Additional Disturbance Area and will not be impacted by the Project.
- An engraving site (Bowmans Creek 16, 37-3-0722) is the only known site of its type located on the floor of the Hunter Valley. This site is an engraving on a rock face which outcrops on the southern bank of a sharp bend on Bowmans Creek (adjacent to the Main Northern Rail Line).

The Mount Owen Complex Aboriginal Cultural Heritage Management Plan (ACHMP) will be updated to include these sites outside of the Additional Disturbance Area by extending the current site monitoring and verification protocols.

7.7.9 Management and mitigation

The management measures proposed by Glencore are based on the outcomes of the ACHAR and have been aligned to the Aboriginal Community Wellbeing Toolkit and criteria from OEH, in particular the elements that focus on 'Culture'. In the context of the Project, 3 of the 8 key principles of the toolkit have been identified as priority areas. The following 3 principles are the basis of the proposed management measures:

- sense of community
- education and learning
- cultural identity.

The proposed management measures have been developed for the Project based on the assessment outcomes including recommendations from the workshops and other submissions. Whilst a range of different views and recommendations were provided some common themes were presented which strongly aligned with 'Sense of Community', 'Education' and 'Learning and Cultural Identity' principles.

This led Glencore to propose funding projects in:

- Caring for Land – This was a common theme raised by the community. A number of programs would be considered that focus on Education and Learning from the Wellbeing Toolkit.

- Bringing People Together – During consultation there were a range of management measures suggested that involved bringing people together for community and/or Cultural purposes and activities. Glencore would consider funding a program or activities that promote the Sense of Community and Cultural Identity aspects of the Wellbeing Toolkit.

- Cultural Awareness/Education – During consultation there were a range of management measures suggested that involved Cultural Awareness/Education/Training, especially for younger people (both for Aboriginal and non-Aboriginal youth). A number of programs would be considered that focus on Education and Learning with potential flow on effects to the Cultural Identity and Sense of Community aspects of the Wellbeing Toolkit.

The proposed management measures also include:

- alignment to the principles of the Aboriginal Community Wellbeing Toolkit (OEH 2012)

- alignment with findings from the ACHA and the AAIA

- the need for management options to be achievable for practical implementation

- provision of sustainable outcomes to promote intergenerational equity

- ability to show value for money.

The final projects for funding would be developed in consultation as part of updating the Mount Owen Complex ACHMP.

Collection and recording of all surface artefacts at all sites within the Additional Disturbance Area where there is surface evidence of artefacts will be undertaken prior to surface disturbance, consistent with current procedures implemented at the Mount Owen Complex in accordance with the ACHMP.

Glencore will undertake manual archaeological excavation at four locations (GN OS6, GN OS34, Bowmans Creek 7 and Bowmans/Swamp Creek Trench 1) as recommended in the AAIA (refer to **Appendix 22**) to confirm the nature of the archaeological deposits.

The ACHMP will also be updated to include all sites outside of the Additional Disturbance Area but within the Project Area by extending the current site monitoring and verification protocols.

A detailed list of the proposed Aboriginal cultural heritage management and mitigation measures for the Project are provided in **Appendix 5**.

7.8 Historic heritage

7.8.1 Summary

The Project proposes the relocation of the Ravensworth Homestead Complex along with the salvage and recording of the associated archaeological resource.

Extensive heritage studies, including archaeological studies and historical research have been undertaken to allow for a detailed understanding of the property and building group in terms of social history, historical land use and landscape, archaeology, architecture, structural and engineering assessments, land tenure and early interactions between Aboriginal people and colonial settlers. A Statement of Significance, prepared by Lucas Stapleton Johnson (LSJ), indicates that several component features of the Ravensworth Homestead Complex are of Exceptional Significance. These are the archaeological remains relating to the convict era, the spatial arrangement of the Homestead Complex building group, the "H" plan homestead layout and the stonework and timber rafters of the buildings. The Statement of Significance concludes that the archaeological landscape, sites and material culture of parts of the Core Estate Lands (defined in **Section 7.8.3.5**) and Ravensworth Homestead Complex have the ability to be of both State and local significance.

In addition, extensive community consultation has also been undertaken regarding the Ravensworth Homestead Complex relocation, including the formation of the Ravensworth Homestead Advisory Committee (RHAC), an independently chaired committee comprising former owners and members of the local community, to identify and investigate relocation options for the Homestead. Interviews were also undertaken to inform the SIA with other local heritage interested stakeholders, local residents, and a broader community survey was conducted to understand the broader community perspective.

Following a review of 11 alternate options, and 2 relocation methods, 2 relocation options are proposed for the Ravensworth Homestead Complex, namely:

- Ravensworth Farm (Option 1) - involves the intact relocation of all buildings including moving selected trees and plants to the 'Ravensworth Farm' site located within the Project Area and on the original James Bowman "10,000 acre" land grant (Ravensworth Estate Lands). The relocated Homestead will be used by Glencore as an administration and training facility. This option will place the buildings on land with a similar landscape and outlook to the current homestead site and will maximise the retention of building fabric and heritage values including the building complex layout. After mining, the Homestead could potentially return to use as a farmstead with an attached landholding.

- Broke Village (Option 2) – this is a proposal by members of the Broke-Fordwich community and involves the dismantling of the Homestead buildings and relocation to Broke where the buildings would be rebuilt and have multi-purpose usage forming the village square. This outcome will provide lower preservation of heritage values, however, provides greater community benefits with a higher level of public accessibility. This option will require further secondary approvals to enable construction of the proposal on the Broke site, and the securing of land tenure should this option be approved as part of the Project approval.

A Statement of Heritage Impact, also prepared by LSJ, assessed the impact of the Project on the Ravensworth Estate Lands and Ravensworth Homestead Complex, comparing the 2 relocation options as the key mitigation measures.

These studies conclude that of the 2 relocation options, the Ravensworth Farm (Option 1) has the best heritage outcomes. This is because it would preserve more of the heritage values, through the building fabric being left intact, retention of the buildings in their historical context, albeit in a different location, and retention of the buildings in a similar landscape. Option 1 provides for public access by arrangement with Glencore during the mine life and will be available to return to a rural homestead landuse beyond mining. The SIA identifies that the Ravensworth Farm option will have least impact on local resident's sense of place and historical community connections.

The Broke Village option (Option 2) preserves less heritage fabric due to the need to dismantle the structures and rebuild them, but would provide community benefits by re-purposing the buildings as a village centre for Broke, aligned with strategic regional and local planning objectives to support economic diversity, such as tourism and viticulture in rural areas. The SIA identified that the Broke Village option has broader community support across the Singleton LGA.

7.8.2 Approach to assessment

The proposed Project will result in approximately 750 ha of additional land disturbance in order to extend the existing Glendell open cut mine and enable ongoing mining until around 2044. Most of the proposed disturbance will occur on land that was part of the historic Ravensworth Estate, which contains a range of examples of physical evidence of early colonial settlement including the Ravensworth Homestead Complex and associated convict labour and agricultural infrastructure.

The remnant parts of the Ravensworth Estate lands including the Ravensworth Homestead Complex are surrounded by previous and ongoing mining activities that have been occurring since the 1960s. Glencore has owned the Ravensworth Homestead Complex since 1997, and has maintained the vacant homestead and associated buildings in accordance with the approved Mount Owen Complex Historic Heritage Management Plan (Glencore, 2018h) to ensure that there has been minimal deterioration in that time frame. The Ravensworth Homestead Complex is listed in the Singleton LEP as being of local significance.

As part of the Project, Glencore has undertaken detailed heritage investigations and sought input from specialist heritage consultants, contractors and advisors in order to obtain a detailed understanding of Ravensworth Estate and the Ravensworth Homestead Complex in all of its elements. In particular, Glencore has engaged highly respected heritage planning and architectural specialists LSJ, along with other respected heritage consultants in Dr Terry Kass, Dr Mark Dunn, Mr Geoffrey Britton and Ms Colleen Morris, who have investigated the history, setting, vegetation and fabric of the Ravensworth Estate including the Ravensworth Homestead Complex. Building on this information LSJ have prepared a detailed Heritage Analysis (refer to **Section 7.8.4**) and Statement of Significance (HASS) (refer **to Section 7.8.5**), and Statement of Heritage Impact (SoHI) (refer to **Section 7.8.9**) in accordance with the SEARs for the Project. Casey and Lowe (C&L), specialist heritage archaeologists, have completed an analysis of the historic archaeological resources, which included a test excavation program, and have provided an assessment of the significance of those resources. Evidence exists of a range of agricultural activities from early colonial period using convict labour through to early 20th century subdivision and settlement patterns. The HASS identifies the Ravensworth Homestead Complex as having state significant heritage values and the potential archaeological resource associated with the Ravensworth Homestead Complex as also being of state significance.

Glencore has also engaged current and former local residents, former owners of the Ravensworth Homestead Complex property and local stakeholders with historical interests through the formation of the abovementioned RHAC, an independently chaired group tasked with identifying and investigating alternate relocation options with consideration to preserving its heritage value, whilst also providing an end use that is economically viable and allows some form of ongoing access. The RHAC has provided Glencore with independent feedback on these matters and has been involved in all aspects of the Project including the selection of the preferred relocation options.

This section outlines the rigorous identification and assessment of all relocation options undertaken (refer to **Section 7.8.6**) involving the RHAC and Glencore that included consideration of the outcomes of the detailed heritage investigations. The outcome of these investigations and assessments has been the selection of the 2 alternate homestead relocation options briefly discussed above, and described in more detail in **Section 7.8.7**.

In addition, the SIA (**Appendix 11**) processes undertaken for this Project have also separately engaged local and regional stakeholders to understand the potential social impacts and benefits of relocating the Ravensworth Homestead Complex to either of the 2 preferred recipient sites.

The following sections provide summaries of the outcomes of these heritage investigations and assessments and identify where further details are provided in the relevant specialist reports provided as **Appendix 23**. **Appendix 23** consists of the following documentation:

- Appendix 23a – Heritage Analysis and Statement of Significance - Ravensworth Estate (Lucas Stapleton Johnson)
- Appendix 23b – Ravensworth Homestead Complex Measured and Conjectural Drawings (Lucas Stapleton Johnson)
- Appendix 23c – Historic Archaeological Test Excavation Report and Impact Statement for the Core Estate Lands (Casey & Lowe)
- Appendix 23d – Statement of Heritage Impact (Lucas Stapleton Johnson)
- Appendix 23e – Ravensworth Homestead Relocation Justification Report (Glencore)
- Appendix 23f – Ravensworth Homestead Relocation Option Identification and Assessment Report (Glencore), which includes:
  - A. Ravensworth Homestead Advisory Committee Meeting Minutes
  - B. Route Assessment (Mammoth Movers)
  - C. Recipient Site Assessment (Lucas Stapleton Johnson)
  - D. Planning Constraints Assessment (Umwelt)
  - E. Vegetation and Landscape Feature Relocation Schedule
- Appendix 23g – Ravensworth Farm Proposal, which includes:
  - A. Ravensworth Farm, Ravensworth – Heritage Analysis and Statement of Significance (Lucas Stapleton Johnson)
  - B. Ravensworth Farm Option - Visualisation (Truescape)
  - C. Conceptual adaptation drawings (Lucas Stapleton Johnson)
  - D. Preliminary scope of works (Lucas Stapleton Johnson)
  - E. Conceptual landscape plans (Geoffrey Britton)
  - F. Preliminary Earthworks Plan (WSP Engineering)
  - G. Preliminary Footing Design (Mott MacDonald)
  - H. Methodology for the Relocation of the Ravensworth Homestead Complex (Mammoth Movers)

I. Ravensworth Homestead Relocation – Structural Engineers Statement (Mott MacDonald)

- Appendix 23h – Broke Village Proposal, which includes:
  A. McNamara Park, Broke – Heritage Analysis and Statement of Significance (Lucas Stapleton Johnson)
  B. Aboriginal Due Diligence Assessment Report – Proposed Relocation Area for Ravensworth Homestead, Lot 701 at Broke (OzArk)
  C. Ecological Constraints Assessment – McNamara Park, Broke (Umwelt)
  D. Masterplan Concept Document – Ravensworth Homestead, Adaptive Re-Use within Broke Town Centre (SHAC)
  E. Conceptual landscape plan (Geoffrey Britton)
  F. Preliminary earthworks plan (Glencore)
  G. Project Methodology for Dismantle and Rebuild at Broke (HSR (Aust) Group)
  H. Broke-Fordwich Wine and Tourism Economy (Broke-Fordwich Wine and Tourism Association Inc)
- Appendix 23i – Hebden Public School Preliminary Scope of Works

7.8.2.1 Statutory overview

The *Heritage Act 1977* (NSW) and the *Environmental Planning and Assessment Act 1979* (EP&A Act) are the primary statutory controls protecting historic/European heritage within New South Wales. In addition, the Ravensworth Homestead Complex is listed in the Singleton Local Environment Plan, 2013 (LEP) as being of local significance.

As the Project is State Significant Development, the Minister for Planning has delegated consent authority to the NSW Independent Planning Commission (IPC) and the relevant approval provisions of the *Heritage Act 1977* (NSW) and local planning instruments established under the EP&A Act do not apply.

However, this does not exempt the Project from requiring a heritage assessment, which is required to identify and determine the significance of heritage sites, assess the potential impacts from the Project and provide recommendations for their management. The Secretary's Environmental Assessment Requirements (SEARs) for the Project require an assessment of the potential impacts of the Project on the historic heritage values of the Project area. As outlined in Attachment 1 of the SEARs for the Project, this assessment has been undertaken in accordance with guidelines set out in the *NSW Heritage Manual 1996* (Heritage Office and Department of Urban Affairs & Planning), including *Archaeological Assessments* and *Assessing Heritage Significance* and with consideration of the principles contained in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance 1999* (Australia ICOMOS. 2000).

This historical heritage assessment is informed by the separate assessments of Aboriginal cultural heritage and archaeological values prepared for the Project by ACHM *(Aboriginal Cultural Heritage Assessment Report*, ACHM 2019) and OzArk (*Aboriginal Archaeological Impact Assessment: Glendell Continued Operations Project,* OzArk 2019).

7.8.3 Historical context

Detailed research and analysis of historical records was undertaken to inform and support the Heritage Analysis and Statement of Significance prepared by LSJ, which is provided in **Appendix 23a**. The following subsections provide an overview of the results of the detailed historical research.

7.8.3.1 Indigenous heritage

LSJ draws on a range of historical and contemporary sources and describes how prior to European settlement, the proposed Project area was part of the land of the Wonnarua Aboriginal people, who's land was vast and stretched over much of the Hunter Valley. Tindale (1974) estimated that it covered over 5,000 km^2 literature, possibly because of the new settlers' lack of understanding of the complexity of Indigenous society and its association with land. The Wonnarua's neighbours were the Darkinjung (to the south), the Awabakal (to the south east), the Worimi (to the east) and the Wiradjuri (to the west). They had close ceremonial ties to the Darkinung and Wiradjuri people.

Whilst evidence exists of Aboriginal occupation of the Hunter Valley for thousands of years prior to European settlement, the population of the Wonnarua prior to European settlement is unknown, and approximations vary widely. Estimates vary and were most likely made well after populations had declined, so the reliability of these estimates is unknown. Further detail is provided in **Section 7.7**.

7.8.3.2 European settlement

In 1801 a small convict camp was established at Newcastle, the mouth of the Hunter River, to mine the coal and cut timber, and by 1804 a permanent penal station had been established. From 1804 onwards convict timber getters working out of Newcastle began to explore the reaches of the Hunter River looking for timber to log. Between 1803 and 1821, the penal station and its outlying camps around Maitland were the only permanent settlements of Europeans in the Hunter.

In November 1819, a party led by John Howe (a constable from Windsor) including 2 Aboriginal guides, reached the southern edges of the Hunter Valley alluvial plains close to present day Jerry's Plains. In reports to Governor Macquarie, Howe noted the potential for grazing in this new valley, noting that the country was thinly timbered, with twenty trees per fifty acres in some areas. On 15 March 1820, Howe's second expedition reached the Hunter River at Wallis Plains, current day Singleton. Howe reiterated the grazing potential of the land he had passed through, commenting that it was "as fine a country as imagination can form". This marked the beginnings of European expansion into the middle Hunter Valley.

Settlement advanced rapidly and the building of fences to control livestock and the restriction of access across the land impacted directly on local Aboriginal populations, particularly as the farms and estates grew both in size and in number. The numbers of Europeans, and more particularly their stock animals, grew exponentially in the Hunter. Analysis of stock numbers in musters and census data shows the enormous increase from 1821 to 1828, as shown in **Table 7.35**.

Table 7.35 Increases in the area of land granted, sheep and cattle in the Hunter Valley 1821-1828[5]

Year	Land granted in acres	Sheep	Cattle
1821	638	376	236
1825	67,798	8,919	4,495
1828	1,537,488	119,391	46,805

From: Perry, T.M., Australia's First Frontier: The Spread of settlement in New South Wales 1788-1829, Melbourne University Press, Melbourne, 1963, p. 132.

[5] Perry, T.M., *Australia's First Frontier: The Spread of settlement in New South Wales 1788-1829*, Melbourne University Press, Melbourne, 1963, p. 132.

7.8.3.3 Interactions between Aboriginal people and early settlers

An extensive body of research has been undertaken in relation to early interactions between Aboriginal people and early settlers by Dr Mark Dunn to inform the heritage assessment and investigate evidence of a reputed massacre of Aboriginal people thought to have occurred somewhere near Ravensworth. This work is contained in Section 2.3.3 of the HASS (refer to **Appendix 23a**) and Section 11.6 of the ACHAR (refer to **Appendix 22**). Tensions between Aboriginal people and settlers had been apparent since the first land grants were made in the Hunter Valley in 1821-22, with attacks on isolated huts and raids recorded around Wallis Plains (Maitland) and Patricks Plains (Singleton) between 1822 and 1824. Most of the early incidents were concerned with the taking of maize crops with direct contact and violence being a rarity.

However, in late 1825 circumstances changed with a number of fatalities occurring to both Aboriginal people and settlers. Investigations have identified that the most intense period of conflict between settlers and the Aboriginal population in the Upper Hunter valley occurred from 1825 to 1827 with numerous attacks and reprisals occurring, resulting in deaths and injuries being inflicted on both sides. Conflicts occurred at several places across the Upper Hunter, including on the Ravensworth Estate, although no historical evidence was found for a reputed massacre having occurred on the Ravensworth Estate,

These incidents included the killing of Robert Greig in November 1825 in his hut on the banks of the Hunter River (near present day Denman) and a stockman on the same property was missing, presumed dead. Two other unnamed stockmen were speared at Captain John Pike's estate, Pickering, close to the junction of the Hunter and the Goulburn River. The killing of Greig was the first recorded in the area and prompted the then Commandant in Newcastle, Captain Allman, to order a detachment of soldiers to proceed to the area in June 1826. Ten men accompanied by bush constables headed inland to apprehend the identified Aboriginal assailants. None were captured in this action.

Other incidents were recorded including at Edinglassie the estate of George Forbes was also attacked and a shepherd speared, and on 18 June 1826 two convicts assigned to Bowman at Ravensworth were killed by Aboriginal attack, one killed in the bush and another in a hut on the estate. Soon after, the hut of James Chilcott on Falbrook (current day Glennies Creek) was raided. In the same period 2 of Bowman's men, working in the bush on the fences around Ravensworth Estate were attacked, with both men severely wounded.

With the violence now appearing to escalate, the soldiers were joined by a detachment of the newly formed Mounted Police established by Governor Brisbane under the command of Lieutenant Nathaniel Lowe. In August, Lowe's detachment, with local settlers came across and captured a number of Aboriginal men and one boy. The captured group were tethered together and led by one of the mounted troopers to Chilcott's farm, where a number of them were identified as having been involved in the earlier raids. The 3 youngest were released and the rest restrained to be returned to Wallis Plains.

Of the Aboriginal men taken, 5 were killed in the bush, attempting to escape from custody. A sixth man known as Jackey-Jackey, identified as being involved in the killing of Bowman's men, was taken back to the police camp at Wallis Plains where he was executed.

In one account recorded by Rev. Threlkeld, the witness said that one of the Aboriginal men suspected of involvement in the wounding of Bowman's men was captured and brought to Bowman's hut. Here he was secured with a rope around his neck, and then under armed guard he was taken one mile from the hut into the forest, made to climb a tree and tie the rope to an extended branch, whereupon he was shot and left hanging. It is believed that the hut referred to was the original Bowman homestead, approximately 850 m to the west of the existing Ravensworth Homestead Complex.

Despite an inquiry established by Governor Darling and his attorney general Saxe Bannister, it was not known where exactly all the killings had taken place . Lowe was put on trial for the wilful murder of Jackey-Jackey who had been allegedly executed. This was the first time a military officer had been bought before the courts for actions against Aboriginal people. Despite eye witness accounts of the shooting, Lowe was found not guilty in May 1827 and no further action was taken in relation to the other men captured and shot.

Further incidents occurred in August 1826 with 200 Aboriginal warriors reported to have surrounded the Merton property of William Ogilvie near present day Denman, and an attack on Richard Alcorn's hut on the Bridgeman Estate at Falbrook in which two Europeans were killed (current day Glennies Creek).

Two days after the attack on Alcorn's hut, Robert Scott gathered a party of men, including 5 mounted police, four settlers and four Aboriginal trackers to pursue the attackers. Two versions as to what happened were subsequently reported. Scott, in his report, claimed that they came on the camp approximately 20 miles (32 km) from Alcorn's hut in the morning of the third day, whereupon a skirmish occurred. The Australian newspaper however provided a more detailed account as reported to them of a skirmish resulting in the death of 18 Aborigines and the capture of a man and a woman. The plotting of a 20 mile (32 m) radius from Alcorn's hut places this event well beyond Ravensworth Estate and the Ravensworth Homestead Complex.

Between late 1826 and March 1827 a further series of events occurred, including an attack on Samuel Owen, an overseer for James Bowman on 28 March 1827, as well as spearing of cattle, however, reports of violence in the Hunter Valley declined, with few made after mid-1827.

Not all interactions in the middle Hunter during this period were violent. Many of the estates and farms also employed Aboriginal people in work, paying them with food, tobacco and blankets. Although there is no evidence of Bowman employing Aboriginal workers, Robert Scott did on his estate at Glendon, as did William Ogilvie at Merton, including some in permanent work as shepherds. In 1826 Peter Cunningham employed 50 Aboriginal workers to cut and collect his maize crop, George Wyndham employed Aboriginal workers in 1830 and 1833 to cut maize, while William Bell at his Lemington Estate on the Hunter River close to Ravensworth employed Aboriginal men to build bark races for his sheep during shearing in 1833 .

7.8.3.4 The Place – Ravensworth Estate

Following substantial historical research, LSJ defined the relevant historical context for the Project, described as "The Place", as being Bowman's original "10,000 acre" land grant (Ravensworth Estate). This section provides a summary of the history of the Place. Further details are available in **Appendix 23a**.

The original holder of Ravensworth Estate was Dr James Bowman (1784-1846), the colonial surgeon in charge of the Sydney hospital. In 1819 Bowman arrived in the colony of New South Wales and was soon closely involved with the Macarthur family. On 4 November 1823, he married Mary Isabella Macarthur, the daughter of John and Elizabeth Macarthur. John Macarthur was the founder of the Australian Agricultural Company in England in 1824 and he gave Mary a dowry of 2,000 sheep and 200 cattle allowing James Bowman to apply for a land grant upon which he received a ticket to occupy 6,000 acres. The land he chose was bounded by Foy Brook (Bowmans Creek) and including Yorks Creek draining into the Hunter.

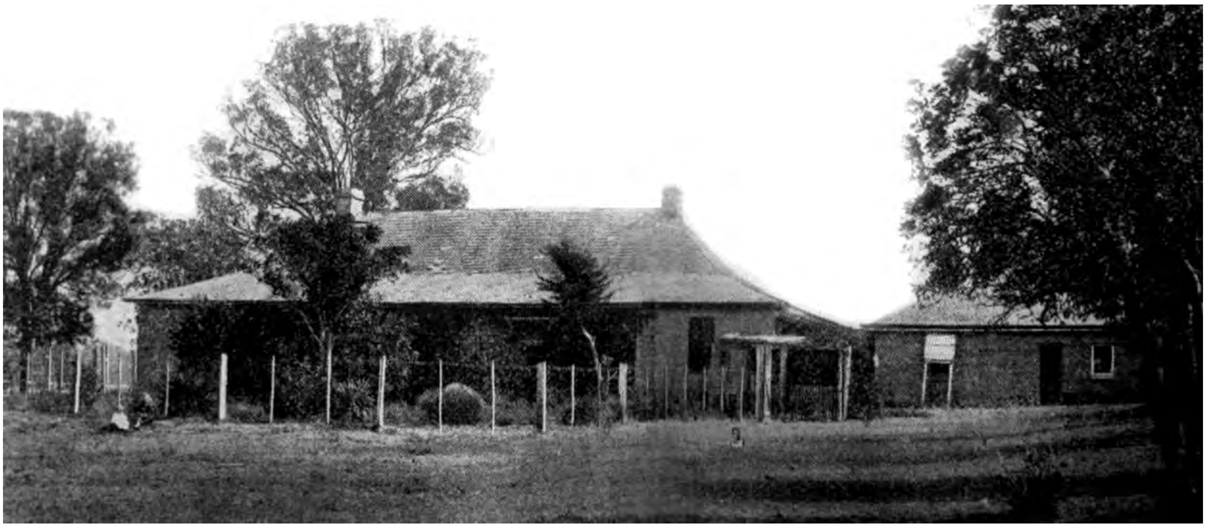
Bowman continued to lease and purchase land nearby, and on 11 November 1826, Bowman applied for an additional grant. He held 5,000 acres by purchase and 6,000 acres by reserve (leased to him), of which 250 acres had been cleared, with his livestock totalling 270 cattle, 3,300 sheep, and 6 horses. He stated that he had erected *"Sheep Sheds, Wool House, Stores, Cottage, Kitchen, huts for ten men etc, which cost me Two Hundred & Sixty Pounds".* In addition, he had built a stout fence 3 miles long and had maintained 34 convicts. **Figure 7.8.1** shows the extent of the Ravensworth Estate (The Place) overlaid on a current aerial photograph.

Figure 7.8.1 The lands forming the Ravensworth Estate held by James Bowman

By 1833, Bowman had amassed a number of land titles through grants and subsequent purchases. Bowman would go on to purchase other land further removed from the Ravensworth Estate, at Segenhoe, Waverley and Timor located further up the Hunter Valley, to support the expansion of his sheep and cattle grazing pursuits.

Other key features either within or in proximity to the Ravensworth Estate included the old and new roads from Muswellbrook to Newcastle to become known as the Northern Road, later the New England Highway which features on early survey maps (Henry Dangar c1831, and Dixon's road plan, April 1833). The 1841 Census showed there were 87 people on Ravensworth including 76 men and 11 females. All the females were colonial born or had arrived free. The males included 32 assigned convicts and 13 others holding Tickets of Leave.

Bowman's official salary ceased in 1838, and by 1842, Bowman had large debts to the Bank of Australasia and was threatened with foreclosure. The loss of his official position, his heavy expenses incurred in the construction of Lyndhurst, his Sydney residence in Glebe, and the cost of liabilities regarding the acquisition of Segenhoe estate and Waverley estate, meant that James Bowman was in a precarious financial position.



Source: Sydney Mail, 15 Feb 1902, pp 416-7 (original negative provided by Fairfax Newspapers)

Figure 7.8.2 Ravensworth House in 1902 as seen from the south with kitchen wing on the right

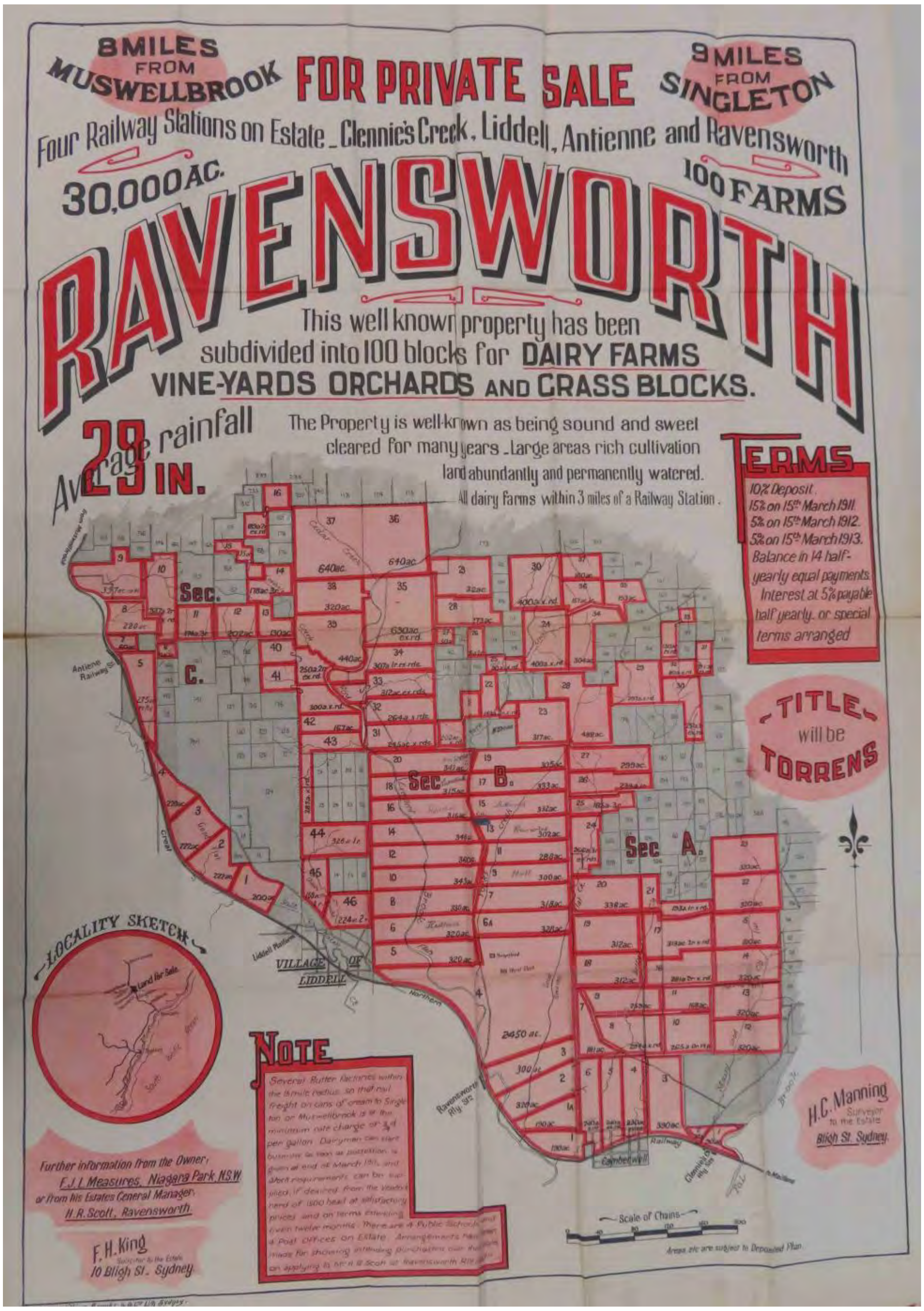
After selling various assets, James Bowman and his wife moved their permanent residence to Ravensworth in 1843. An early photograph of the Ravensworth Homestead is provided in **Figure 7.8.2**. James Bowman died at Ravensworth on 23 August 1846. His place of burial is unknown. Detailed investigations completed by this Project, which included targeted ground penetrating radar and test excavations conducted as part of the archaeological investigation, have found no further evidence suggesting that James Bowman is buried on Ravensworth Estate.

LSJ provide further details of land ownership of the Ravensworth Estate lands following Bowman's death from 1846 to 1920 (refer **Appendix 23a**). Ownership after Bowman included Captain William Russell, who was responsible for the first major subdivision of the original "10,000 acres" of Bowman's 1824 land grants. The Russell family sold the central part of Ravensworth in 1883 to Duncan Forbes Mackay junior who concentrated on merino wool production, cattle and general farming, dairying, maize, as well as maintaining orchards. Mackay ring-barked much of the trees remaining on the property to increase its grazing capacity. The Land Company of Australasia, formed in 1885 to subdivide large estates and to settle British farmers in NSW, purchased the Ravensworth Estate as part of a sale including other former Bowman properties. After several failed attempted auctions, the property was sold in 1902 to W H Mackay, who in turn sold the property to FJL Measures in 1911. An early photograph of the Ravensworth Estate land is provided in **Figure 7.8.3**, showing extensive clearing and ring-barked dead trees.

Source: Sydney Mail, 15 Feb 1902, pp 416-7

Figure 7.8.3 View towards Singleton from the Ravensworth Estate in 1902 showing the landscape following clearing

Measures was responsible for the most significant subdivision of the Ravensworth Estate, with **Figure 7.8.4** from 1911 showing the new lots and some details of purchasers, with the Homestead on Lot 4B. Unfortunately, a number of the purchasers left the district shortly after, and Measures was declared bankrupt in 1916.

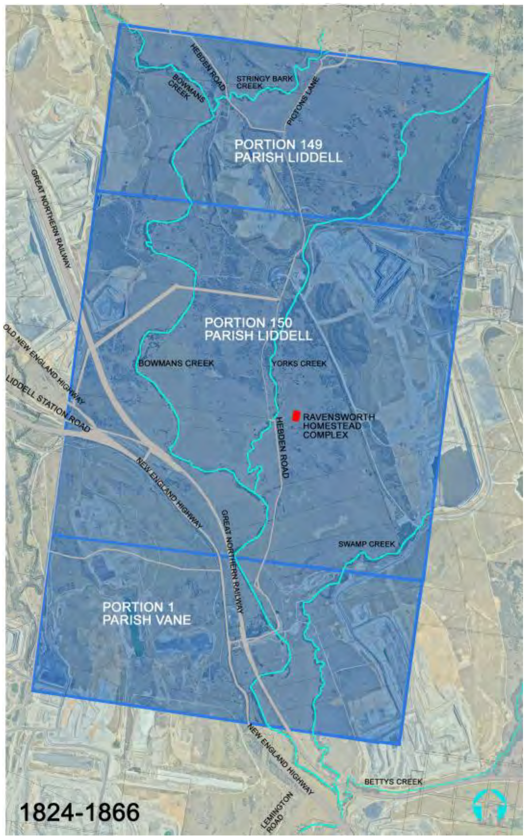


Source: NRS 3829, School file, Hebden, SANSW 5/16256.4

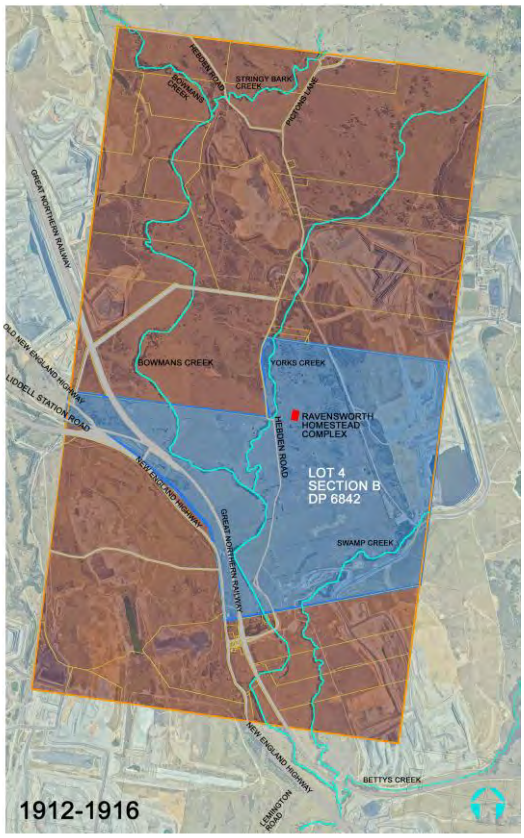
Figure 7.8.4 The original version of the Ravensworth subdivision plan

During the period prior to and after the First World War, a process of sale by subdivision and soldier settlement government policy resulted in the Ravensworth Estate being split into numerous small holdings and sold for agricultural pursuits including grazing, cropping and dairying. In 1920, A.C. Marshall, a Light Horse veteran, selected land containing the Homestead as a Settlement Purchase under the *Closer Settlement Act, 1910*. The property stayed in the Marshall family under G and J Marshall until 1997 when it was purchased by mining company Liddell Southern Tenements Pty Ltd, now part of Glencore.

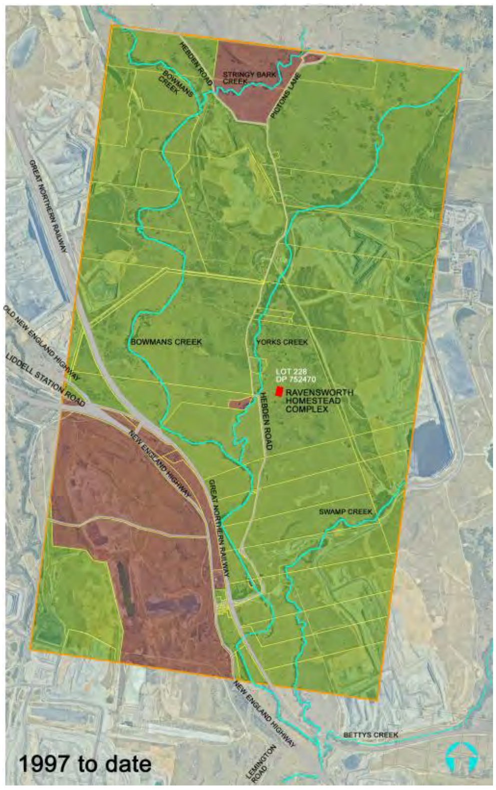
Figure 7.8.5 below provides an overview of the progression of Ravensworth Estate land titles and ownership over time. Mining activity in the Ravensworth area has seen, for the most part, the re-consolidation of the original Bowman "10,000 acre" land grant (The Place) under one owner.



Above: Aerial view of the Place showing boundaries and shaded blue to indicate a single owner, with the focus of the property being the Ravensworth Homestead Complex.



Above: Aerial view of the Place showing the boundaries of the Ravensworth Homestead Complex property as they were from 1912 to 1916 (shaded blue). The remainder of the land was owned by a variety of different, separate owners (shaded brown).



Left: Aerial view of the Place showing that the majority of the land by 1997 was owned by Glencore (shaded green) with only the former Bayswater Estate to the southwest and one or two small pockets of land owned by different, separate owners for mining purposes (shaded brown). Ravensworth Homestead Complex forms part of the mine owned lands.

Figure 7.8.5 The Progression of Land Titles Over Time

7.8.3.5 Core estate lands

The extensive research and investigations undertaken to inform the HASS (**Appendix 23a**), informed by historical research and archaeological field work undertaken by C&L, identified an extended area of land surrounding the Ravensworth Homestead Complex that has retained physical evidence of the earliest period of European colonisation of the estate lands. Features of interest include the potential site of the first homestead at the Ravensworth Estate, cultural plantings, evidence of early cultivation areas, early stone lined dams as well as a range of historical archaeological remains and scattered agricultural features associated with the early development of the Ravensworth Estate.

This area of land for the purposes of this assessment is termed the "Core Estate Lands" and is defined by the allotment containing the Ravensworth Homestead Complex together with the land to the west between Yorks Creek and Bowmans Creek.

The Core Estate Lands also comprise the majority of the land held by the Marshall family following the subdivision of the estate lands by Measures and Reid in the early 20th century (refer to **Figure 7.8.6**).

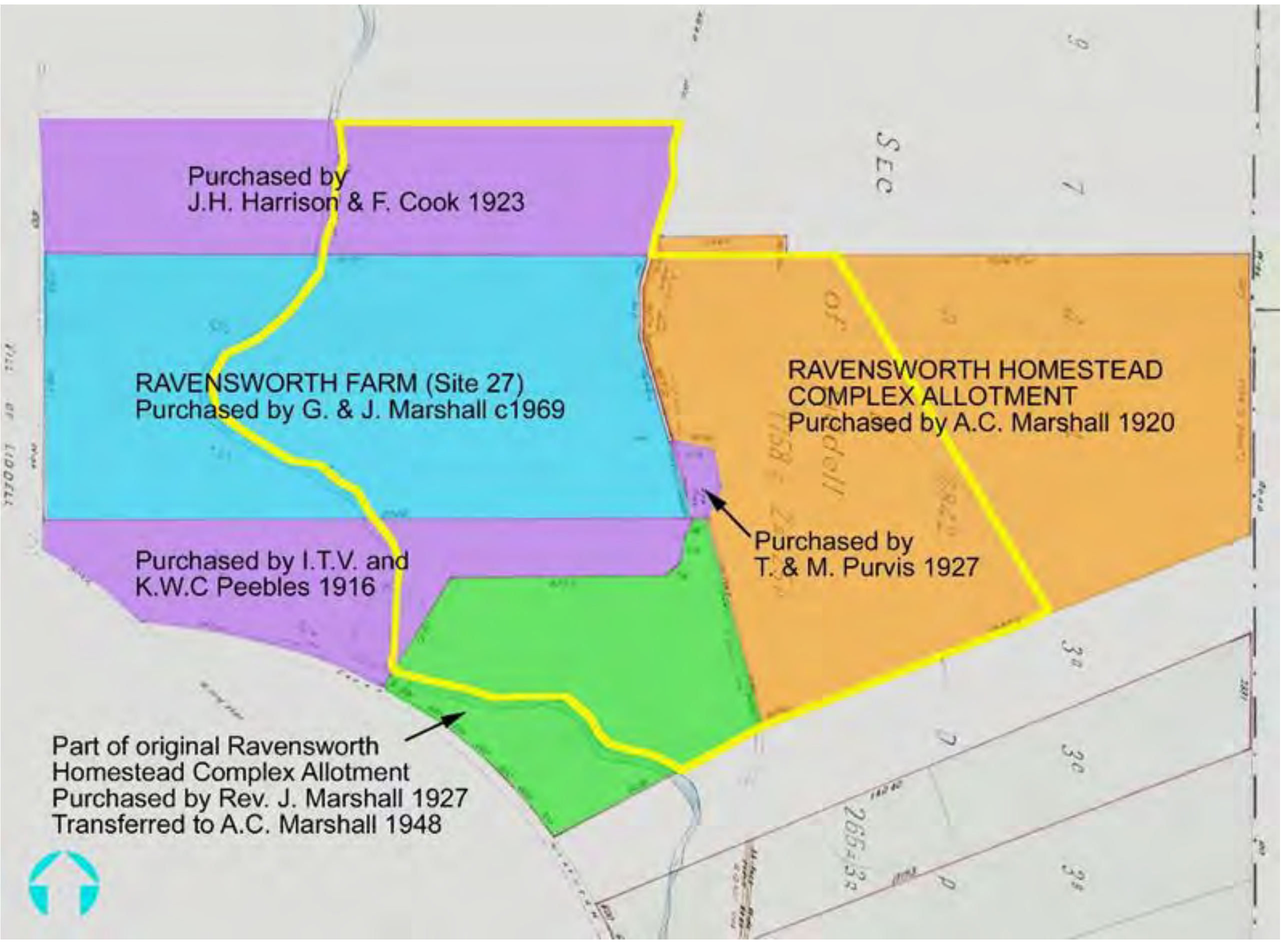


Figure 7.8.6 Detail from Certificate of Title Vol. 3144 Fol. 148 showing the Marshall's land and other 20th century owners of the allotments that comprise the Core Estate Lands (outlined in yellow)

7.8.4 Heritage analysis

7.8.4.1 Physical Evidence – The Place

Landscape of the Place – Ravensworth Estate

Generally, the landform of the Place is typical of the Central Lowlands of the Hunter Valley, which is characterised by undulating to low rolling hills extending to lower areas associated with creek lines that traverse the locality (Bowmans Creek, Yorks Creek, Swamp Creek, Stringy Bark Creek and Bettys Creek) and feed into the Hunter River to the south. These creek lines were the critical water supply required to support the expansion of the colonial agricultural industry, just as they had been integral to the way of life and culture of the Aboriginal inhabitants before them.

However, this natural topography has been substantially altered over the previous 50 years in many locations due to mining activities including open cut mining, the formation of emplacement areas, creation of tailings dams and water management systems, changes to roads and the diversion of creek lines. Regardless, there remains a substantial portion of the Place that retains much of its natural landform, including the majority of the land immediately surrounding the Ravensworth Homestead Complex (refer to **Figure 7.8.7**).

The lands of the Ravensworth Estate (unaffected by mining) have been predominantly cleared for agricultural/pastoral uses and today contain native and exotic grasslands with scattered patches of native regenerated vegetation. Intact mature vegetation occurs along the creeks and tributaries of the area.

The principal watercourse traversing the Ravensworth Estate is Bowmans Creek (formerly Foy Brook). Yorks Creek is an ephemeral tributary of Bowmans Creek branching off the eastern side of Bowmans Creek to the south of the Ravensworth Homestead Complex. Located within the northern portion of the Ravensworth Estate lands is Stringybark Creek which is an ephemeral tributary of Bowmans Creek with a well-defined channel, varying from confined areas with a relatively narrow width to wider open sections.

Swamp Creek is a meandering ephemeral creek-line with adjacent low-lying floodplain areas located within the southern portion of the Ravensworth Estate (also an ephemeral tributary of Bowmans Creek but now mostly subsumed by active open cut mine areas). Swamp creek has numerous dams built near the Ravensworth Homestead in early settlement times to sustain the establishment and maintenance of both early crops and grazing livestock.

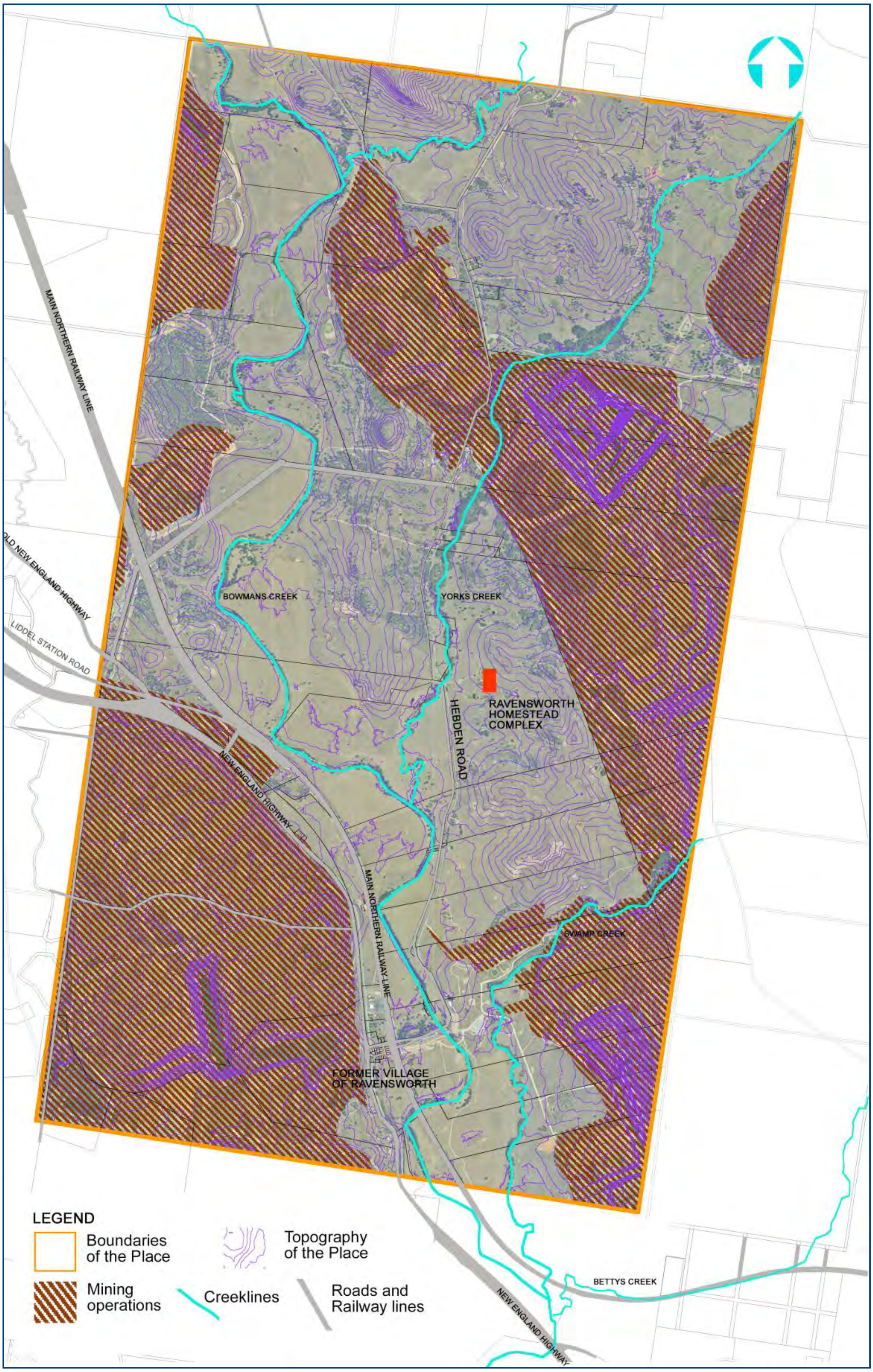


Figure 7.8.7 Cadastral plan overlaid with topographic mapping showing the rolling hills, alluvial flats and existing open cut mining areas (brown) within the boundaries of the Place

A portion of the New England Highway traverses the southwestern corner of the Core Estate Lands as well as a small portion of the Old New England Highway (refer to **Figure 7.8.7**). Both these roadways have their origins in the early 19th century cart track which developed north from Newcastle to reach the prime wool growing areas of the New England region (the Liverpool Plains), in the 1810s and 1820s. The original roadway was known as the Great North Road or Great Northern Road.

The Great Northern Railway was constructed across the Ravensworth Estate lands in 1869 and the land to the south of the railway line was sold off in the 1880s (refer to **Figure 7.8.7**).

LSJ advise that it is now difficult to determine the functional layout of the early Ravensworth Estate from the fence lines within the Place. Most of those remaining intact are likely to be from the 20th century. Exceptions may include those enclosing the Hebden Road corridor and, possibly, those defining the immediate western and southern sides of the Ravensworth Homestead Complex.

Aboriginal Archaeology

An Aboriginal archaeological investigation and report was undertaken by OzArk covering the proposed disturbance area for the Project (*Aboriginal Archaeology Impact Assessment, Glendell Continued Operations Project, Glendell Coal Mine, Ravensworth, NSW, November 2019)* provided in **Appendix 22**. The results of this study informed both the Aboriginal Cultural Heritage Assessment Report by ACHM, and the HASS by LSJ (refer to **Appendix 23a**).

Other Sites and Agricultural Features in the Place

LSJ identified and assessed other individual sites of interest located across the Place (Ravensworth Estate) that relate to the Bowman era (early 19th century), the Russell era (mid 19th century), the Mackay era (late 19th century) and the Measures/Reid era (early 20th century) when the estate lands were subdivided into smaller farming allotments.

The main features of the Place (Ravensworth Estate) are identified in **Figure 7.8.8.**

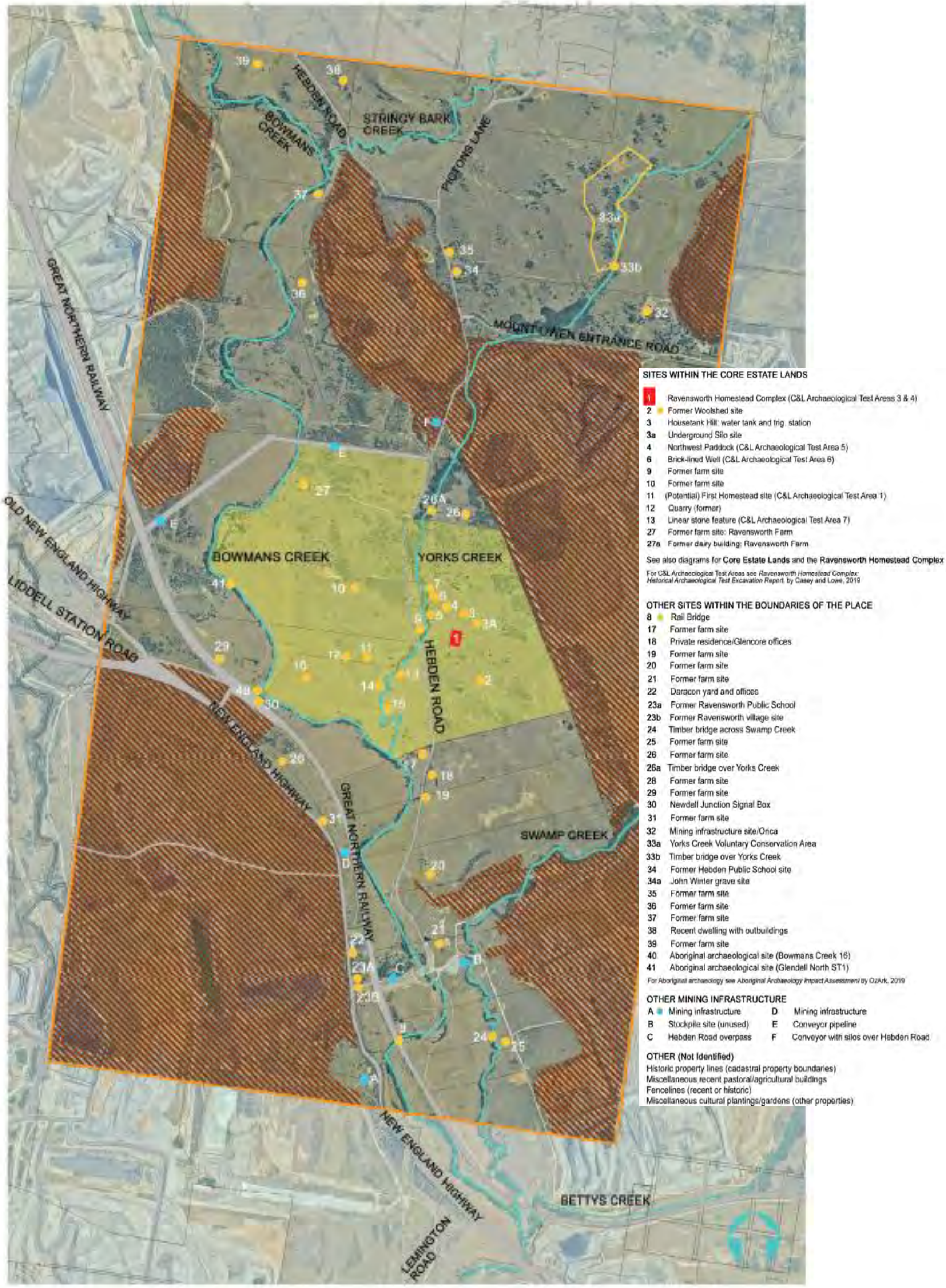


Figure 7.8.8 Location of Other Sites and Agricultural Features

7.8.4.1 Physical evidence – Core estate lands

Landscape of Core Estate Lands

The local landscape of the Core Estate Lands is characterized by 3 generally north-south trending drainage lines – Bowmans Creek in the west, Yorks Creek centrally, and the earlier watercourse of Swamp Creek to the east . Between each of these creeks are similarly north-south trending ridges that generally ascend to the north towards the much higher country linked to the Mount Royal ranges.

The earlier Ravensworth building development (the potential original homestead site) occurred at the western end of these two ridge systems between Bowmans Creek and Yorks Creek while the present homestead complex lies over the western foothills of the ridge system east of Yorks Creek. This latter ridge system is now partly reconfigured and dominated by the post-mining overburden emplacement areas.

Bowmans Creek and its principal tributaries (Yorks Creek and Swamp Creek) watered the majority of the Core Estate Lands. The presence of Swamp Oak as a riparian species and the naming of a related tributary further north as Saltwater Creek, suggests that these local creeks carried brackish water, however it is not known to what extent the salinity levels were an issue in the early management of the estate (Henry Dangar, as early as the mid-1820s, indicated that this may have weighed against permanent settlement).

This local proximity to water sources partly explains the siting of the earliest farm group in the 1820s over the southern end of a rise between Bowmans and Yorks Creeks as well as the siting of the current homestead group adjacent Yorks Creek and one of its tributaries. The traditional siting of farm groups in relation to local water bodies fulfilled both functional and aesthetic purposes.

A historical landscape review by Geoffrey Britton (refer to **Appendix 23a**) of areas within the Core Estate Lands identified numerous associated cultural landscape elements in particular in the area between Yorks Creek and Bowmans Creek shown in **Figure 7.8.9** that provide further insight into the extent of the early development of the Ravensworth Estate. These landscape elements comprise small, shallow dams; remnant plantings; possible cultivation areas; and numerous introduced species along the enclosing creek lines.

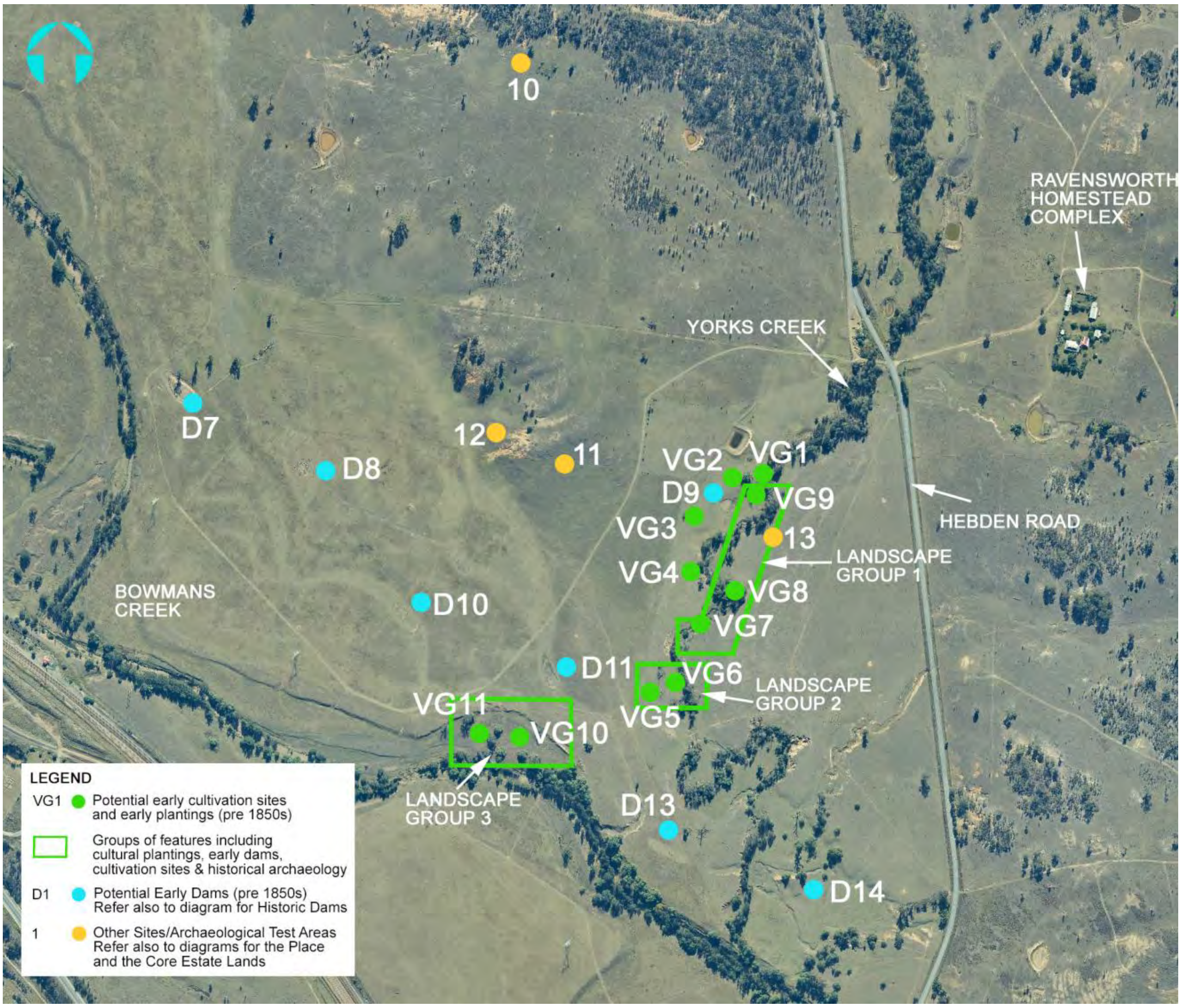


Figure 7.8.9 The area west of Yorks Creek identifying potential early (Bowman period) landscape features

According to the description of the Ravensworth Estate made by Sir W. E. Parry in 1832, a garden of 8 acres with a paling fence and small stream and partly laid out in an ornamental fashion existed in association with the homestead. Investigations of historical evidence revealed two possible locations to the immediate west of the upper dam (D4) to the east of Yorks Creek (containing a brick lined well and a copse of Black Locust trees), and on the western side of Yorks Creek evidenced by enclosing lines of planted Black Locust trees forming an L shape (and potential wind break) enclosing an area of riparian terrace that would have provided rich alluvial soil for a field of cultivation. These features are shown in **Figure 7.8.10**.

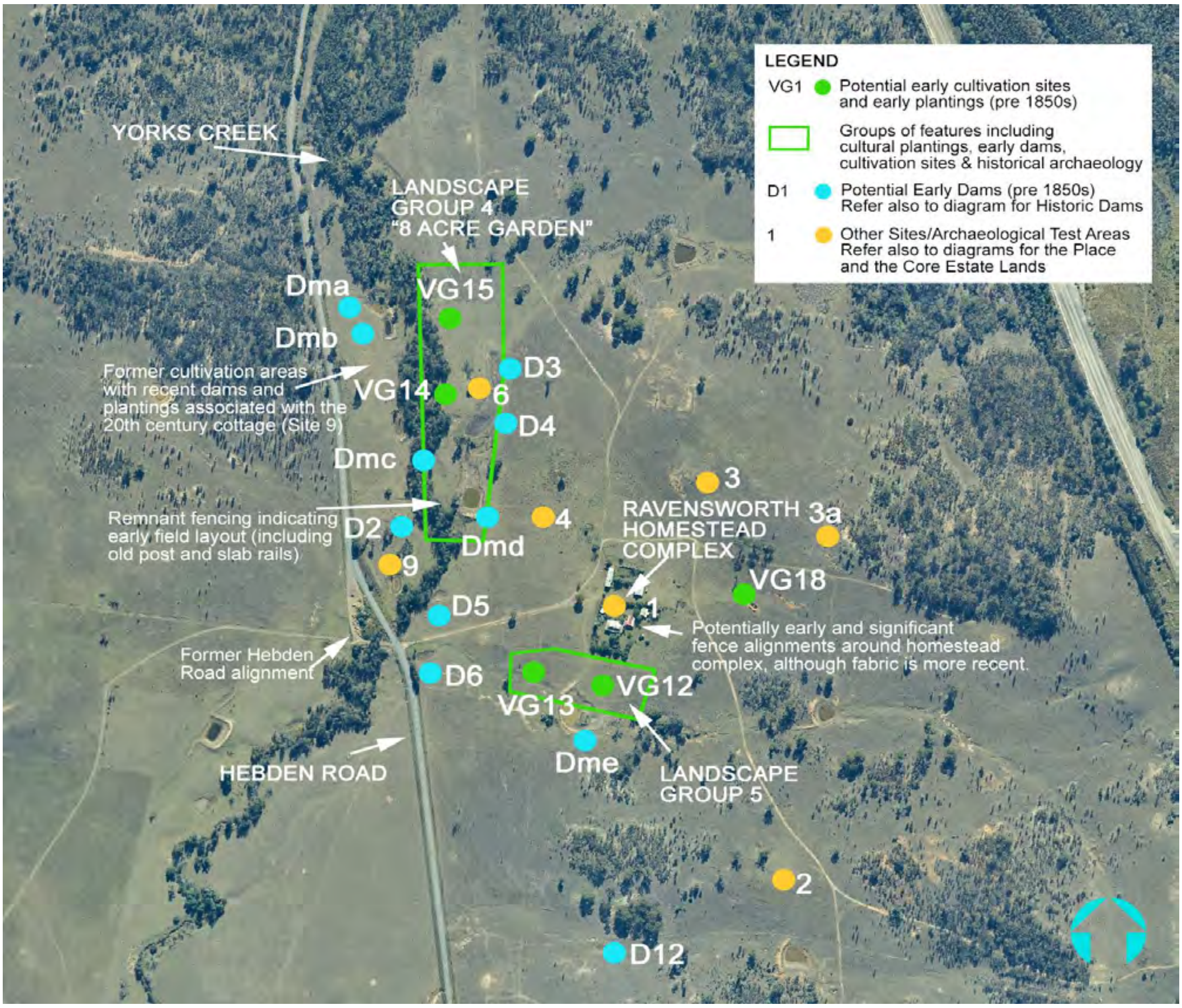


Figure 7.8.10 The area east of Yorks Creek and around the Ravensworth Homestead Complex identifying potential early (Bowman period) landscape features

Dams

Colonial settlers constructed dams or tanks to safeguard against the loss of livestock and crops due to drought. With the availability of a substantial convict labour force it is likely that a number of farm dams would have been built.

Britton describes dams with the potential to demonstrate an earlier period of construction being generally small in scale, relatively shallow in depth with enclosing banks at a low angle of repose, had a distinctly elongated (oval or teardrop) form and they were mostly located in close proximity to the main creek lines rather than at the heads of tributaries. In some cases, sandstone blocks were used in the construction of the dam headwall while in one case, the headwall featured sandstone coursing over ironbark logs.

Fourteen dams were identified consistent with these parameters, either side of Yorks Creek with the potential to be convict-built structures during the Bowman period of ownership (refer to **Figure 7.8.11**).
A further six dams were identified as having the potential of being early dams that had been more recently modified. In some cases, areas of potentially early cultivation were evident in the vicinity of some of these small dams.

Using archival and current aerial photography as well as ground truthing, a number of dams in the Core Estate Lands were investigated. The House Dam to the immediate south of the homestead was found to have been enlarged after the 1958 aerial photo. Current photography shows a much larger dam with a headwall further to the west and a rectilinear-shaped island in the middle.

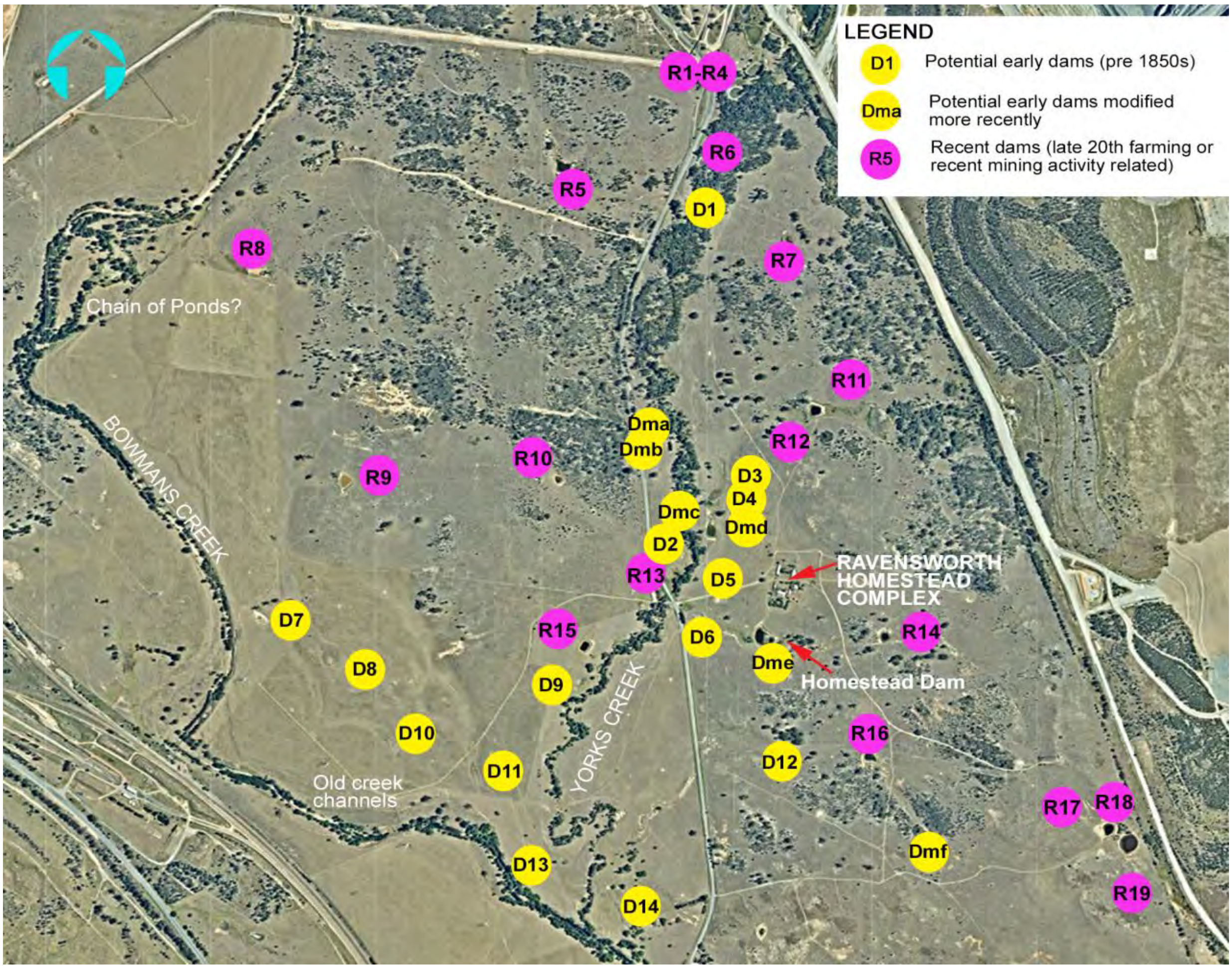


Figure 7.8.11 Core Estate Lands showing the location of various dams, of which 15 appear to be early dams potentially dating from the Bowman period

Homestead Complex Views

An analysis of views towards the homestead was undertaken, including on approach from Hebden Road as well as an analysis of views from vantage points within the Ravensworth Estate, and from the Homestead across the landscape.

On approach from the south along Hebden Road, the homestead is at first obscured by the dense vegetation in its front garden. From this perspective, only the sandstone stables block with its two-part gabled roof is immediately apparent.

Further along the road, the homestead emerges from its garden setting and the roofs of the barn behind also become apparent. Together, the dense concentration of plantings and the ensemble of buildings define the homestead group, which is perceived to sit within a gently undulating expanse of largely open grassland. When approached from the west and southwest – the traditional approach off Hebden Road - the homestead group is seen with a scenic backdrop of rising land to the east and northeast and appears nestled into its contextual landscape (refer to **Figure 7.8.12**).

Above: View of the Ravensworth Homestead Complex as seen looking northeast from Hebden Road. (G. Britton, 2018)

Left: View looking eastwards towards the Homestead Complex from the western ridge on the western side of Yorks Creek and Hebden Road. (G. Britton, 2018)

Mount Dyrring can be seen in the background, above mine overburden rehabilitated with dense tree vegetation.

Figure 7.8.12 Views to Ravensworth Homestead Complex

An analysis of views from the Ravensworth Homestead Complex was also undertaken, including radial analysis diagrams, demonstrating that available views from the Ravensworth Homestead Complex are to the southwest, west and northwest. Views to the east, northeast and southeast are limited due to both natural and manmade landforms.

7.8.4.2 Historical archaeological evidence – Core estate lands

Historical archaeological specialists Casey & Lowe (C&L) were engaged to undertake an assessment of the potential historical (non-Aboriginal) archaeological remains of the Ravensworth Estate. The potential historical (non-Aboriginal) archaeological remains of the Ravensworth Estate, were assessed through an analysis of historical records, site inspection, comparative analysis and test excavations. Further details on the outcomes of the archaeological assessment and significance of the archaeological deposits are provided in the report titled *Ravensworth Homestead Complex: Historical Archaeological Test Excavation Report and Impact Statement for the Core Estate Lands* (November 2019) provided in **Appendix 23c**.

As part of the archaeological assessment C&L engaged historian Dr Terry Kass who provided georeferenced digital copies of historic maps and was the principal author of historical sections of the HASS. These maps provided an essential insight into the early historic settled landscape of Ravensworth by providing precisely-located snapshots of lot ownership and sales at key points in the history of the Ravensworth estate.

Potential sites of interest were shortlisted and identified following a review and synthesis of historical sources, historical cartography and analysis of the topography of the Ravensworth Estate using remote sensing data combined with cadastral and topographic data, and the results of ground penetrating radar survey.

Initially C&L prepared a testing and reporting methodology designed to respond to the SEARs and documented in the report titled *Ravensworth Homestead Complex and Surrounds: Historical Archaeological Assessment & Archaeological Research Design* (September 2018) (HAA & ARD) (refer to **Appendix 23c**). The testing and reporting methodology was discussed with the Heritage Division, Office of Environment and Heritage, in September 2018.

The HAA & ARD identified four broad archaeological phases as follows:

Phase 1:	1820 to 1850:	Bowman era.
Phase 2:	1850 to 1890:	Subdivision, agricultural and pastoral activities.
Phase 3:	1890 to 1950s:	Period of significant subdivision and multiple owners including the early Marshall period of ownership.
Phase 4:	1950s to Present:	Multiple owners including the later Marshall period of ownership.

C&L undertook an archaeological testing program at the Ravensworth Homestead Complex and its immediate surrounds between 29 October and 16 November 2018.

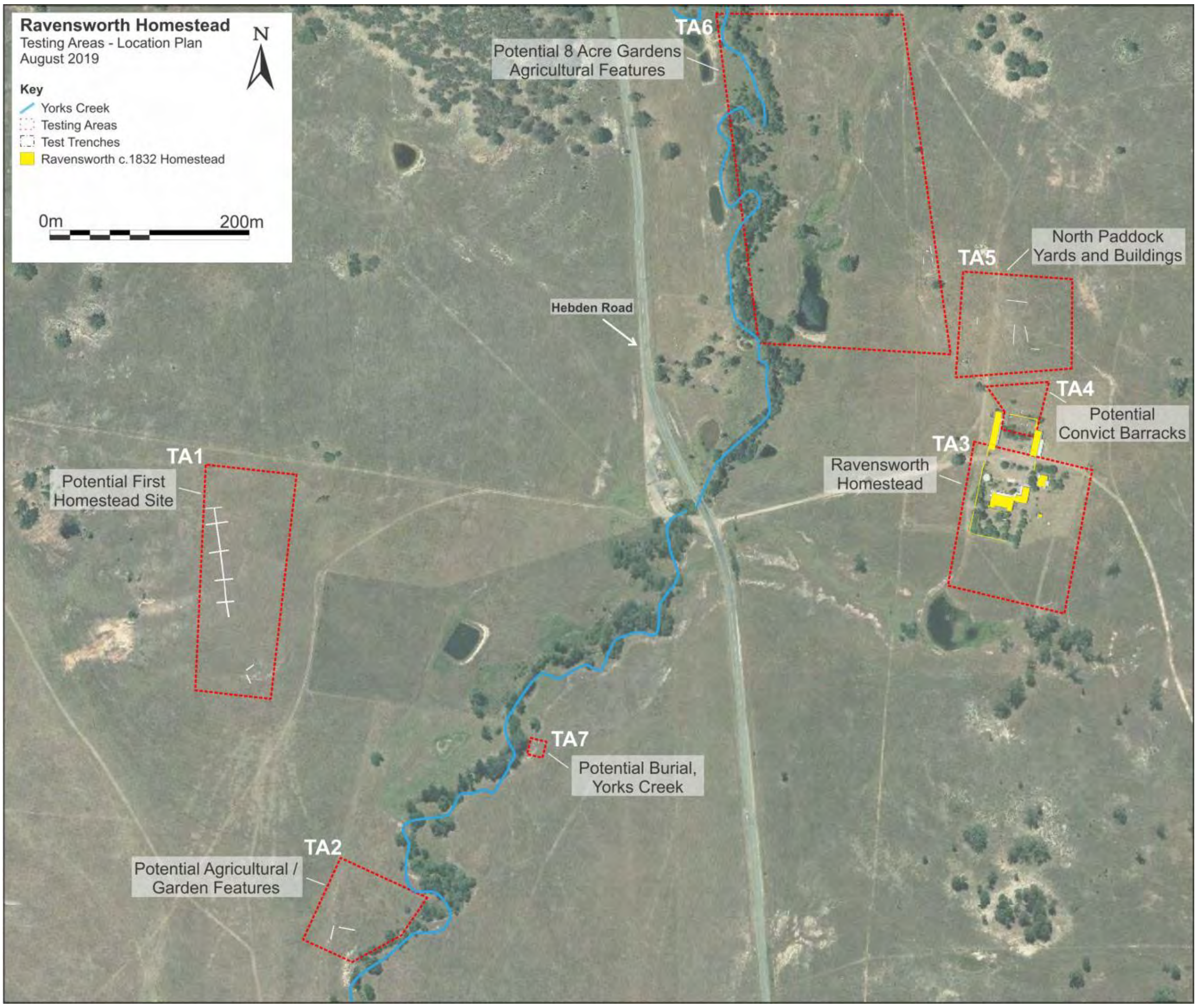
The purpose of the testing program, given the large scale of the property, was to undertake targeted archaeological excavation of potentially State-significant sites related to the Bowman era, including the Ravensworth Homestead Complex , the surrounding cultivation areas, and the potential site of the early house (first homestead) to:

1) Determine the survival, extent and location of the potential archaeological resource.

2) Clarify the archaeological potential and significance of areas of potential state and/or local significance.

3) Inform the environmental assessment process and any options proposed as part of the project, including the potential to relocate the homestead.

A total of 29 trenches across seven test areas were archaeologically investigated as shown in **Figure 7.8.13**.



Source: Casey & Lowe, February 2019

Figure 7.8.13 Location plan identifying the seven test areas for historical archaeological investigation

Results of the archaeological test excavation program at the Ravensworth Homestead Complex is reported in **Appendix 23c**. The report confirmed the survival of early and later19th and early 20th-century archaeological remains across the site. Testing confirmed the presence of intact archaeological remains dating to between 1830-1890s and has shown that their integrity is medium to high.

The main archaeological results included:

- Intact archaeological remains of a large partitioned structure/ building in the form of foundations in the area that local oral history said contained the potential 'convict barracks' or 'accommodation' (Test Area 4).
- Intact archaeological remains buildings/structures in the form of stone foundations, post holes, wall cuts and paths to the north/northwest of the main house (Test Areas 5 and 6).
- Evidence of a previously unknown structure but no burial (Test Area 7).
- Test Area 1 revealed no evidence of the earlier house site - no historic features or relics were identified/ recovered.

- Archaeological evidence of agricultural activity in various areas, including plough marks (Test Areas 2, 6 and 8).
- The archaeological remains across the Project Area have been variously impacted by nineteenth and twentieth-century agricultural activities (including the demolition of structures and the loss of some underfloor deposits) and are being further truncated by environmental processes (wind, weathering, animals etc), all of which have contributed to the loss of topsoil (A horizon) across the site and the wider project area.

According to C&L, the archaeological remains are subject to ongoing environmental and land management processes, which will continue to impact and erode the archaeology over time.

Photographs

The following photographs are examples of archaeological remains uncovered during the historical archaeological testing program at the Ravensworth Homestead Complex and surrounds. Refer to **Appendix 23c** for further details.

Plate 7.8.1: Sandstone foundation trench in Test Area 4 showing evidence of the northern wing or “convict barracks” with finely dressed sandstone block with two cut sockets. Source: Casey & Lowe, 2019

Plate 7.8.2: Sandstone foundation trench in Test Area 4 adjacent to Stables, showing evidence of the northern wing or “convict barracks” with finely dressed sandstone blocks. Source: Casey & Lowe, 2019

Plate 7.8.3: Test Trench TA6/TT7 with herringbone paving (126) clearly visible. View to the north. Scale: 1m. Source: Casey & Lowe, 2019

Plate 7.8.4: Rubble at north end of TT8a with TT8b extending north from the other side of the mound. View to the north. Scale: 500mm. Source: Casey & Lowe, 2019

Plate 7.8.5: Brick lined well (Site 6) located in TA6.

Plate 7.8.6: Linear stone structure forming head of one of the historic dams in TA6.

Plate 7.8.7: Linear stone feature at TA7.

Plate 7.8.8: Remains of former agricultural building (assumed meat house) located in TA5, northwest of main homestead complex.

The Recovered Archaeological Relics

The analysis of the archaeological relics recovered revealed an array of information regarding the dates and potential uses of the areas/structures.

The following photograph (**Plate 7.8.9**) provides examples of the range of archaeological finds sourced during the testing program at the Ravensworth Homestead Complex and surrounds.

Plate 7.8.9: Selection of miscellaneous artefacts from the site, TAs 3, 4, 5, 6, 8 & 9, including (top row) glass marble and slate pencil copper shoe tack glazed ceramic doll head and celluloid comb spectacle lens iron buckle 12/#119. (middle row) iron buckles glass bead kaolin pipe stems copper alloy button frame and (bottom row) copper alloy stud, kaolin pipe stem, slate pencil, porcelain doll shoulder fragment; iron buckle and porcelain button. Source: Casey & Lowe, 2019 (Photo: DSCN9955)

Outcomes

The archaeological testing has confirmed the survival of early and later nineteenth and early twentieth-century archaeological remains across the site with minimal impacts from later nineteenth-century demolition and twentieth-century farming and land-use. The date and context of these remains means they are considered by C&L to be of State heritage significance.

The HASS (refer to **Appendix 23a**) details the physical evidence identified by C&L in the Core Estate Lands.

In summary, C&L identified the archaeology of the Core Estate Lands as having been associated with a number of prominent individuals: James Bowman, Mary Bowman (née Macarthur), and overseers James White and John Larnach along with convict assignment, as well as later owners Captain William Russell and the Marshall family. From its establishment, the property is a good example of an intact colonial rural estate built on convict labour, enhancing its role as a site of archaeological and scientific importance. C&L identified the heritage values of the archaeological resource in the Core Estate Lands as being of state significance. The wider site is associated with an evolving pastoral activity, notably early wool production, and is of local significance.

7.8.4.3 Physical evidence - the Ravensworth Homestead complex

Architectural and Technical Values

LSJ undertook detailed historical investigation of built components of the Ravensworth Homestead Complex . The following information provides an overview of LSJ's findings, which are provided in detail in Section 3.9 of the HASS (refer to **Appendix 23a**).

The group of buildings that forms the Homestead Complex at Ravensworth consists of four stone buildings dating from c.1832 and one timber building dating from c.1900 organised around a farmyard square. All the buildings are single storey and have hipped or gabled pitched roof forms. Most roofs are sheeted in corrugated, galvanised steel with the main house roofed in Welsh slate. LSJ notes that the composition of the square is quite formal. There is evidence there was once a northern wing closing the north side of the farm yard (potential 'convict barracks') and it is possible also there was a west wing to the house forming the south-west corner of the farm yard (archaeological testing program found no evidence of a previous structure). These key buildings and structures, and the composition of the formal square arrangement are shown in **Figure 7.8.14**.

Key buildings include the Main House, Kitchen Wing, the Barn, the Stable, 20th century post and corrugated steel shed and stone water tank, early 20th century Men's Quarters. A stone privy containing a four-seat bench is located outside of the formal square to the southeast. It is possible that the farm yard was enclosed by a stone wall or timber paling fence that has been replaced over the years by the present timber and wire agricultural fences. Across the north end of the farm yard is constructed cattle yards, sheltered by a row of peppercorn trees and including a cattle/sheep loading ramp, all of relatively recent construction.

Based on a detailed comparative analysis of other colonial bungalows including a review by Dr James Broadbent, expert in colonial architecture, the Ravensworth Homestead Complex is considered to be the design of an architect or gentlemen architect, most likely the Scott brothers (Robert and Helenius), and not John Verge as has been previously thought. The Scott brothers were operating in the Hunter Region in the 1820s, notably at their property in Glendon (Singleton), and they had a documented association with James Bowman and the Macarthur Family.

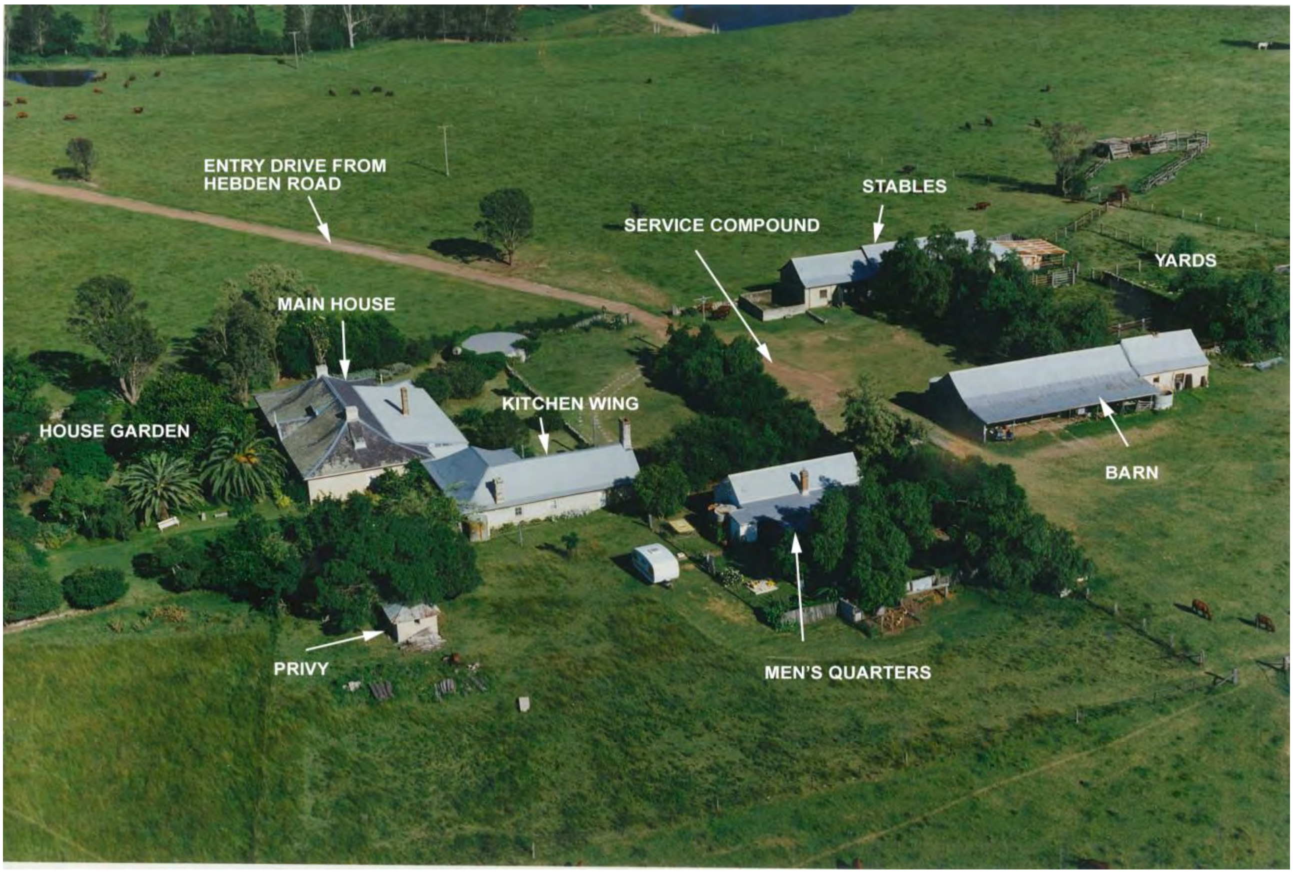


Figure 7.8.14 Late 20th century aerial view of the Ravensworth Homestead Complex identifying the principal features

Apart from the Men's Quarters, all the buildings have very thick walls built in two skins of stone with rubble core, usually 400-600mm thick with very fine workmanship exhibited on the external walls, particularly the front of the House and the Stable. At each corner of the house and each external wall of all of the buildings, the stonemasons have originally provided very fine, dressed, projecting chamfered quoin stones. The key buildings and structures are shown in **Plates 7.8.10** to **7.8.21**. Further details are provided in the HASS (refer to **Appendix 23a**).

The Kitchen Wing and the Barn and Stable buildings have well-constructed hardwood framed bell-cast eaves, probably originally intended for lath and plaster linings. The House and Kitchen wings have timber framed roofs utilising regularly spaced, larger, king rafters (strengthened by collar ties) that support purlins that support the common rafters.

LSJ provide a detailed description of the Main House and its distinguishing features, including the rare "H" plan layout and broken pitch hipped roof over verandahs, and stone flagging on the front (south) and north verandahs. A selection of examples of the extensive photographic record of the key buildings are provided in **Plates 7.8.10** to **7.8.21** below.

Plate 7.8.10: Homestead south (Front) elevation

Plate 7.8.11: Homestead north (Rear) elevation

Plate 7.8.12: Kitchen Wing north elevation

Plate 7.8.13: North elevation of the Barn showing the bellcast eaves

Plate 7.8.14: Roof structure of the Barn.
Photo: D. Liddle, 2018

Plate 7.8.15: Arched columns on east elevation of Stables

The Barn and Stable buildings have well-built king post trust roof framing supporting purlins supporting common rafters. The workmanship is of high quality for both the wall and roof construction, as shown in **Plates 7.8.14, 7.8.15, 7.8.16** and **7.8.17**.

Plate 7.8.16: Stables southern space

Plate 7.8.17: Stables northern most space

Plate 7.8.18: South elevation of Privy

Plate 7.8.19: Four seat bench in Privy

Plate 7.8.20: Stables southern space

Plate 7.8.21: Quoins on Kitchen Wing

The HASS (refer to **Appendix 23a**) includes extensive documentary and photographic records plus descriptions of all physical features covering the development and use of the Homestead Complex. Examples of historical documentary evidence includes a description from Peter Cunningham in 1825 most likely referring to the first homestead site on the west of Yorks Creek, 1828 census records, examination of Bowman's original cheque book butts, and many items of official correspondence. These records show the Homestead was constructed between 1828 and 1832, and trace the evidence of alterations and additions over time.

7.8.4.4 Historical values

LSJ provide a detailed account of historical values of the settlement of the Ravensworth Estate, and the identified components from the Core Estate Lands and the Ravensworth Homestead Complex, related to the NSW Heritage Division guidelines which emphasise the role of history in heritage assessments. The historical themes associated with Ravensworth Estate include:

- Peopling Australia including Aboriginal and Convict themes
- Developing local and regional economies including agricultural, pastoral and mining themes
- Building settlements and towns
- Governing
- Developing Australia’s cultural life, and
- Marking the phases of life.
- Historic associations with prominent people and notable places, historical garden and historic landscape features are detailed in **Appendix 23a**.

7.8.5 Statement of significance

A summary of the statement of significance for Ravensworth Estate and the Ravensworth Homestead Complex is provided below. Further details are provided in the HASS contained in **Appendix 23a** including the grading of significance of components within the Place (Ravensworth Estate lands), the Core Estate Lands and in detail at the Ravensworth Homestead Complex.

The Ravensworth Estate forms part of the traditional lands of the Aboriginal people of the Hunter Valley, the Wonnarua, made more meaningful by the recorded reports of interactions and conflicts between the Wonnarua and the colonists in the Ravensworth locality.

The Ravensworth Estate is representative of the rapid colonisation of the Hunter region in the period 1820s to 1840s and the history of the Place has led to the area of Ravensworth becoming a known locality in the state of NSW, with the Core Estate Lands and Ravensworth Homestead Complex at its centre.

Established in 1824, the Ravensworth Estate is associated with a range of significant colonial places and people including Dr. James Bowman, principal surgeon of the colony of NSW, who established the estate and is one of only a few places where, under Edward Bowman, horticultural experimentation first started in Australia. The Place retains tangible evidence of the colonial period including substantial archaeological remains, landscape features and cultural plantings and made more meaningful by the surviving c1832 homestead complex including its siting and configuration.

The Ravensworth Homestead Complex includes a formally designed farmyard complex of colonial buildings including a good example of a colonial bungalow, with stonework and roof carpentry of note. As originally built, the “H” plan bungalow is a rare feature, indicating a design (potentially) by a gentleman architect.

Because of the relatively modest history of development throughout the 19th and 20th century, the Place has the potential to provide information, by way of further study and archaeological investigation, into colonial building techniques, 19th century lifestyles, agricultural and horticultural practices and the working lives of convicts in a non-institutional setting, which is considered very rare.

Significance Criteria

LSJ prepared a Statement of Significance in accordance with the guidelines set out in the NSW Heritage Office and Planning NSW's publication, Heritage Assessments (2002) with the outcomes summarized below. Further details are contained in the HASS (refer to **Appendix 23a**).

<u>Criterion (a) Historical Significance</u>

The land on which the Ravensworth Estate is located is of historical significance on a local level as forming part of the land of the Wonnarua, and for being located in a region that underwent a turbulent period between 1825-1827 involving a series of attacks and retributions between Aboriginal people and the newly arrived Europeans in the central Hunter Valley.

The land that forms the Ravensworth Estate today is also of historical significance on a Local level for being the substantial remnants of an early (1824) pastoral estate in the Upper Hunter Region of NSW.

The Ravensworth Homestead garden is also of historical significance on a State level as being, along with Camden Park, Camden, NSW, among the few places where the first experiments with hybridisation or plant breeding were carried out in Australia.

The presence of early (1820s and 1830s) roads across the estate lands providing access northwards and westwards to the Liverpool Plains is historically significant on a State level for locating the Ravensworth Estate along an important regional transport corridor (that remains in place today). The later history of the Ravensworth Estate is of some historical significance on a Local level for following a pattern of development that is found throughout the central Hunter Region.

<u>Criterion (b) Historical Association Significance</u>

The Ravensworth Estate is of significance on both a State and local level for its associations with a number of people of historical note and places of historical note located throughout NSW. The richness of the historic associations provides further evidence of the significance of the history of the Ravensworth Estate. Notable associations include Dr James Bowman, John Macarthur, Edward Bowman, James White, John Lanarch, Jackey Jackey, and Augustine Campbell Bowman.

<u>Criterion (c) Aesthetic and/or Technical Significance</u>

The Place, containing the remnants of the Ravensworth Estate, is of some aesthetic significance on a local level as a representational example of a Hunter Valley landscape.

However, the homestead complex of the Ravensworth Estate constructed in c1832, is of aesthetic significance on a State level as a fine example of a very rare, relatively intact "architecturally planned" group of colonial farm buildings located in its late 19th century landscaped setting. The main homestead with kitchen wing and the surviving two balanced farm buildings (barn and stables) form a very rare, symmetrical compound composition of aesthetic appeal and consistent detailing. The formality of composition of the complex of buildings is further reinforced by surviving evidence of the early planning of the broader homestead precinct with an early dam (albeit modified) to the south of the homestead complex, placed on axis with the main house and the 1830s stone grave located to the east placed along the longitudinal axis of the main house. The building group was likely designed, possibly informally, by an architect or gentleman architect of the 1820s and 1830s.

The main house is a fine and relatively rare example of a colonial Georgian bungalow with relatively intact internal configuration and finishes. As originally designed, the single pile "H" plan with central flagged hall, and porch in antis on the front and rear elevations all under one bellcast hipped roof (albeit altered) is extremely rare and comparable with very few others aside from Horsley, Horsley Park; Glenlee, Menangle and Glendon (1837 extension), Singleton. This form is of note for being a Palladian stylistic derivation.

The garden of the main homestead provides the immediate landscape setting for the house and is of some aesthetic significance on a local level being a remnant of a late 19th/early 20th century garden planted within an 1830s-40s layout.

Criterion (d) Social, Cultural or Spiritual Significance

The region of the Upper Hunter, in which the Ravensworth Estate is located, holds high cultural significance (including cultural, historic and aesthetic values) for many Wonnarua people.

Forming part of the broader locality of Ravensworth, the Ravensworth Estate is of social significance on a Local level for providing a tangible focus for the strong sense of place held by past residents of the Hebden area, the village of Ravensworth and the surrounding agricultural lands, many of whom continue to live in the Upper Hunter region.

As one of a group of surviving colonial pastoral estates of the Hunter Region, Ravensworth Estate is held in high esteem by portions of the local community as well as the broader NSW community as indicated by the statutory and non-statutory heritage listings existing for the area

Criterion (e) Research Potential

The Place has moderate to high potential for retaining physical evidence of the history of use of the land by the Wonnarua people, although evidence examined indicated that many sites have low scientific significance.

The Place also has moderate to high potential for retaining physical evidence of the history of agricultural uses dating from the mid-1820s to date. The homestead complex and its immediate surrounds have moderate to high potential to provide further information of significance in relation to colonial building practices and architecture, agriculture and horticultural practices as well as the use of convicts in a non-institutional setting and modes of living dating from the early 19th century through to the early to mid 20th century.

The landform of the garden and farmyard of the homestead complex is evidence of the Bowman period and the vegetation is remnant of the Hill family period (late 19th to early 20th century). The front (south) garden and the immediate landscape setting of the homestead complex have the potential to (via further study including archaeological investigation) provide further information into colonial lifestyles and horticultural practices

The other surviving colonial-built agricultural features in the immediate surrounds of the homestead complex also have a moderate to high potential to yield important information regarding colonial building practices and 19th and early 20th century agricultural practices (via further study including archaeological investigation). Features and archaeological sites of note include the brick beehive cistern, the brick lined wells, the underground silo, the stone lined dam, footings of former buildings and other structures, cultural plantings forming wind breaks, the former woolshed and sheep dip, the configuration of paddocks and their fencing and evidence of early cultivation.

Because the subsequent development of the homestead complex and its surrounds was modest, there exists a relatively large and undisturbed (though weathered) archaeological record relating to the colonial period of the homestead complex. The research potential of the Place for European settlement phases is rare and of high historic significance on a State and local level.

Criterion (f) Rarity

The Ravensworth Homestead Complex and its immediate surrounds are rare on a State and local level given the fine architecturally planned group of buildings configured symmetrically, the “H” plan of the homestead under a bellcast roof, the stone built barn, the form of the stables with an arched porch, the breadth of historical archaeological evidence and sites and the use of the farm for hybridization and plant breeding.

Criterion (g) Representativeness

Ravensworth Estate, established in 1824, is representative of the successful implementation of a new and highly significant government policy introduced in 1822 by Governor Brisbane and Commissioner Bigge in the Hunter Region aimed at the economic and agricultural development of the colony through the management of land and convicts by private landowners.

The place is a representative example of a large pastoral property subdivided in the early 20th century under the Closer Settlement (Amendment) Act 1904, instigated by the government to encourage agricultural development of smaller rural allotments by ex-service personnel and migrants.

The principal characteristics of Ravensworth Estate including its associations with important persons in the development of the colony (Dr. James Bowman and the Macarthur family), the establishment of the property as a sheep run, the c1832 homestead buildings, garden and associated agricultural features located adjacent to a permanent water course (Yorks Creek and Bowman Creek), and the use of overseers/managers with assigned servants in the establishment of the estate, are all representative of a significant pattern of colonisation and history of development that occurred throughout the Hunter Valley and other parts of NSW in the 1820s and 1830s.

Grading of Significance

LSJ rank the relative significance of the components of the Ravensworth Estate, Core Estate Lands and Ravensworth Homestead Complex in accordance with the publication Heritage Assessments (NSW Heritage Branch, 2002) using the rankings Little, Moderate, High and Exceptional, with a ranking of Intrusive for components seen to be damaging to the item's heritage significance.

Summary of Significance

LSJ identify component features of the Place, the Ravensworth Estate, being of High to Exceptional significance being the name of the place "Ravensworth" being in place since the 1820's, the name of Bowmans Creek, evidence of original boundaries of the 1824 land grant, 3 known Aboriginal heritage sites, the surviving historical archaeology relating to convict era features and buildings, and the alignment of Hebden Road.

Within the Core Estate Lands LSJ identify components of High to Exceptional significance including the relationship between the Homestead Complex and Yorks Creek, the surviving evidence of the colonial irrigation scheme including early dams on Yorks Creek with surviving stone or log walls, the cultural plantings along Yorks Creek that relate to colonial agricultural development, archaeology area Site 13, Landscape Group 2 and Group 3 features (refer to **Figure 7.8.9**), the 8 acre garden features in Landscape Group 4 including the brick lined well, any surviving archaeological evidence of the first homestead (Site 11) (refer to **Figure 7.8.9**), the underground silo (Site 3a) (refer to **Figure 7.8.10**), and the entry road from Hebden Road.

Within the Ravensworth Homestead Complex, LSJ rank features of High and Exceptional significance being the archaeological remains relating to the convict era, the spatial arrangement of the Homestead Complex building group including the alignment of perimeter fences and walls (layout not fabric), the "H" plan homestead layout, the other buildings including the kitchen, stables and barn, the stone work and timber rafters of the buildings. In the landscape of the complex, the Giant century plant, and stone water trough, stone edging to the verandah and the iron bread oven door now covering the Victorian era well are ranked High. Further details are provided in **Appendix 23a**.

The Ravensworth Homestead Complex is important as an archaeological landscape containing an 1830s colonial house and associated outbuildings. The homestead buildings, the remnant 19th century farm and garden layout built by convicts all provide evidence of the history of this landscape. This can testify to the way early occupation with expansion of the wool industry, aided by assigned convicts, irrevocably changed the lives of Aboriginal people and modified the landscape of the Hunter Valley.

The survival of the existing buildings indicates that archaeological excavation may contribute further information about the layout of the house, material culture and lives of significant colonial people, convict lives and the assignment system, contact with Aboriginal people and the use of technology and management of water.

LSJ concludes that the archaeological landscape, sites and material culture of the Place (notably parts of the Core Estate Lands and Ravensworth Homestead Complex) have the ability to be of both State and local significance.

7.8.6 Relocation of Ravensworth Homestead complex

As identified by the heritage analysis and archaeological studies undertaken by LSJ and C&L, various components of the Ravensworth Homestead Complex, its immediate surrounds and associated archaeological resources have been identified as being State significant. In recognition of this significance, in the context of the Project, and combined with other factors detailed further in the Ravensworth Homestead Relocation Justification Report (refer **Appendix 23e**), Glencore is proposing to relocate the Ravensworth Homestead Complex to a new site. The relocation is required to allow recovery of the underlying coal resource which will provide substantial benefits to the State and Federal Governments as well as direct and indirect local and regional economic benefits to the community.

The Australia ICOMOS Burra Charter (2013), Article 9 (Location) states:

'Relocation is generally unacceptable unless this is the sole practical means of ensuring its survival.'

In light of the principles within the Burra Charter, other heritage conservation philosophies, and given the heritage significance of the Homestead buildings, the relocation of the Homestead is considered a mitigation measure that substantially retains those key heritage values as much as possible with a focus on recreating the Homestead in the most appropriate manner for a future useful life. Other options such as demolition were not considered appropriate and if the Homestead buildings are not relocated the mine is not able to be developed. An additional mitigation measure includes detailed investigation, recording and salvage of the archaeological deposits to be undertaken as part of the relocation proposal.

Glencore formed the Ravensworth Homestead Advisory Committee (RHAC) to assist with its investigations and decision-making in regard to the relocation and options for the future use of the Homestead buildings. The RHAC is a community-based committee, chaired by an independent facilitator, and consists of former owners, local landholders, members of the local business sector and representatives from the local heritage community. The RHAC sees merit in the relocation of the Ravensworth Homestead as both a mitigation measure for the preservation (as much as practicable) of heritage values and to maintain and potentially improve a useful community resource.

In addition to the formation of the RHAC, Glencore has obtained input from specialist heritage consultants, contractors and advisors to ensure the relocation proposal meets the best possible professional standards. This has allowed Glencore to obtain a detailed understanding of Ravensworth Estate and the associated building group in all of its elements. In addition, Glencore in consultation with the RHAC have investigated many relocation options and considered alternate methods for moving the buildings.

Detailed investigations of potential recipient sites have been conducted in consultation with heritage specialists and the RHAC. Assessment of each of the proposed options considered key matters such as land zoning, cultural heritage, planning constraints and hazards (e.g. flood prone areas and bushfire).

Additionally, key attributes that are similar to the existing Homestead location such as proximity to creek, dam, land slope, vehicular approach and visual catchment have also been considered. Further, consideration was also given to the potential economic viability of each proposal with a view of avoiding the relocated Homestead becoming a stranded asset. These investigations assisted with the short-listing of potential recipient sites.

A summary of the relocation option identification, assessment and selection process is provided below and contained in detail in **Appendix 23f**.

7.8.6.1 Ravensworth Homestead advisory committee

In order to facilitate the process of gaining key stakeholder views on the proposed relocation of the Ravensworth Homestead Complex, Glencore established a committee of key stakeholders with interests in heritage matters, to review and provide guidance on the future of the Ravensworth Homestead Complex.

RHAC Establishment

Glencore established the Ravensworth Homestead Advisory Committee (RHAC) in October and November 2017 as part of the stakeholder engagement and consultation strategy specifically for the relocation of the Homestead. The RHAC membership comprised stakeholders interested in the history and the future of the Homestead Complex and consisted of:

- Mrs Lindy Hyam, independent chair
- Ms Susan Gilroy, president of Singleton Business Chamber
- Dr Cameron Archer, former principal of Tocal College, local historian, Chair and Member to a range of historical and agricultural education boards, including a board with oversight and management of the Tocal Homestead.
- Mr Geoff and Mrs Jenny Marshall, former owners of Ravensworth Homestead
- Mrs Peggy Moore, president of Singleton Historical Society and Museum Inc
- Mr Graeme Cheetham, resident of Middle Falbrook
- Mr David Williams, former resident of Hebden
- Mr Bradly Snedden, Glencore
- Mr Shane Scott, Glencore

In total 14 RHAC meetings were held between December 2017 and November 2019, and details of these meetings are contained in **Appendix 23f**.

The RHAC are supportive of the relocation of the Homestead buildings to a new recipient site and have been involved in all stages of the Project.

RHAC Objectives

The RHAC's function was to assist with the identification and investigation of relocation options for the Ravensworth Homestead Complex with consideration to preserving its heritage value as much as possible, whilst also providing an end use that is economically viable and allows some form of on-going community accessibility, and has secure future ownership.

RHAC Values

The RHACs values were captured by Umwelt as part of the Social Impact Assessment and further details are contained in **Appendix 11** and **Appendix 23f**.

In summary, the homestead holds high aesthetic value to members of the RHAC, namely the design/style of the homestead as being representative of the early colonial period, its craftsmanship and technology of construction using handcrafted sandstone, and the relationship of the homestead building group to its setting as a working agricultural complex.

The RHAC also considers the people and historical events associated with Ravensworth Estate and the homestead to be of high importance, in particular Dr James Bowman, original owner of Ravensworth Estate, and his links to the Macarthur family. Additionally, the RHAC acknowledged the Ravensworth Estate as a general location where interactions occurred between Aboriginal people and colonists.

Singleton Council Representation on RHAC and Ongoing Consultation

In late 2017, a formal approach was made to the Singleton Heritage Advisory Committee (SHAC), which is a Singleton Council formed committee, and Singleton Council for representation on the RHAC. Both the SHAC and Singleton Council chose not to provide representation on the RHAC. Both the SHAC and Singleton Council have been consulted with regarding the proposed relocation of Ravensworth Homestead Complex.

Throughout 2018 and 2019 a number of meetings were held with Singleton Council to identify and discuss available Council land in Singleton for potential relocation of the Ravensworth Homestead Complex and whether an opportunity existed for the relocated buildings to fulfil a community need. Council indicated that there was minimal available land in Singleton and that they were reluctant in becoming the end asset owner of the Ravensworth Homestead Complex due to the ongoing liability. However, Council did express a potential opportunity for the relocation of the Ravensworth Homestead Complex to a site near Lake St Clair, which was considered as part of the option assessment process.

In addition to these discussions, Council expressed a preference that any proposed relocation option should keep the Ravensworth Homestead Complex in Singleton Local Government Area (LGA) given that the Ravensworth Homestead Complex is locally listed in the Singleton Local Environment Plan (2013).

7.8.6.2 Key considerations

The RHAC initially identified a range of issues and factors for consideration when investigating relocation options for the homestead that included the views of the previous owner (Marshall family), Indigenous and European history, the extent of heritage preservation considered appropriate, whether the entire complex of buildings is to be relocated or only some of the buildings, and the appropriate treatment of burials.

With regard to potential relocation recipient sites, the RHAC noted important aspects such as the location of the recipient site in Singleton LGA, its proximity to major transport routes, public transport and utilities particularly water supply, whether the recipient site is subject to flooding, whether the recipient site is of sufficient size to allow for car parking and potential expansion of activities that enhanced the commercial viability of the facility, appropriate end use option that provides community access, education opportunities (archaeological investigation, stone masonry etc), long term commercial viability to avoid the relocated homestead becoming a stranded asset, the future ownership model and when transfer of ownership occurs, and whether the homestead can be protected in future through covenants or other planning instruments.

The above factors and issues were then further refined by the RHAC into the following key considerations which were applied in assessing and selecting relocation options:

- Recipient site is located within Singleton LGA
- End use building arrangement and move methodology retains as much heritage fabric as practicable
- End use is sustainable and commercially viable
- End use provides public access
- Authenticity (verisimilitude) offered by the recipient site
- Preference for public ownership model, and
- End use provides a public benefit

7.8.6.3 Initial recipient site options

As an initial approach to canvas potential interest in the re-use of the Ravensworth Homestead Complex buildings, submissions were sought from the public on possible relocation options for the homestead via an advertisement in the Singleton Argus in February 2018. This public call was followed by a further request for ideas in the Project Community Information Sheet 02 that was issued in July 2018. In total 11 relocation options were identified and investigated. A summary of relocation options considered in regard to proposed usage, LGA within which the option is located, accessibility, perceived commercial viability, ownership model and perceived community benefit is provided in **Table 7.37**.

The approximate location of the proposed relocation options with respect to the homestead's current position is shown in **Figure 7.8.15**. Further details on each proposed homestead relocation option are provided in the Option Identification and Assessment report provided in **Appendix 23f**.

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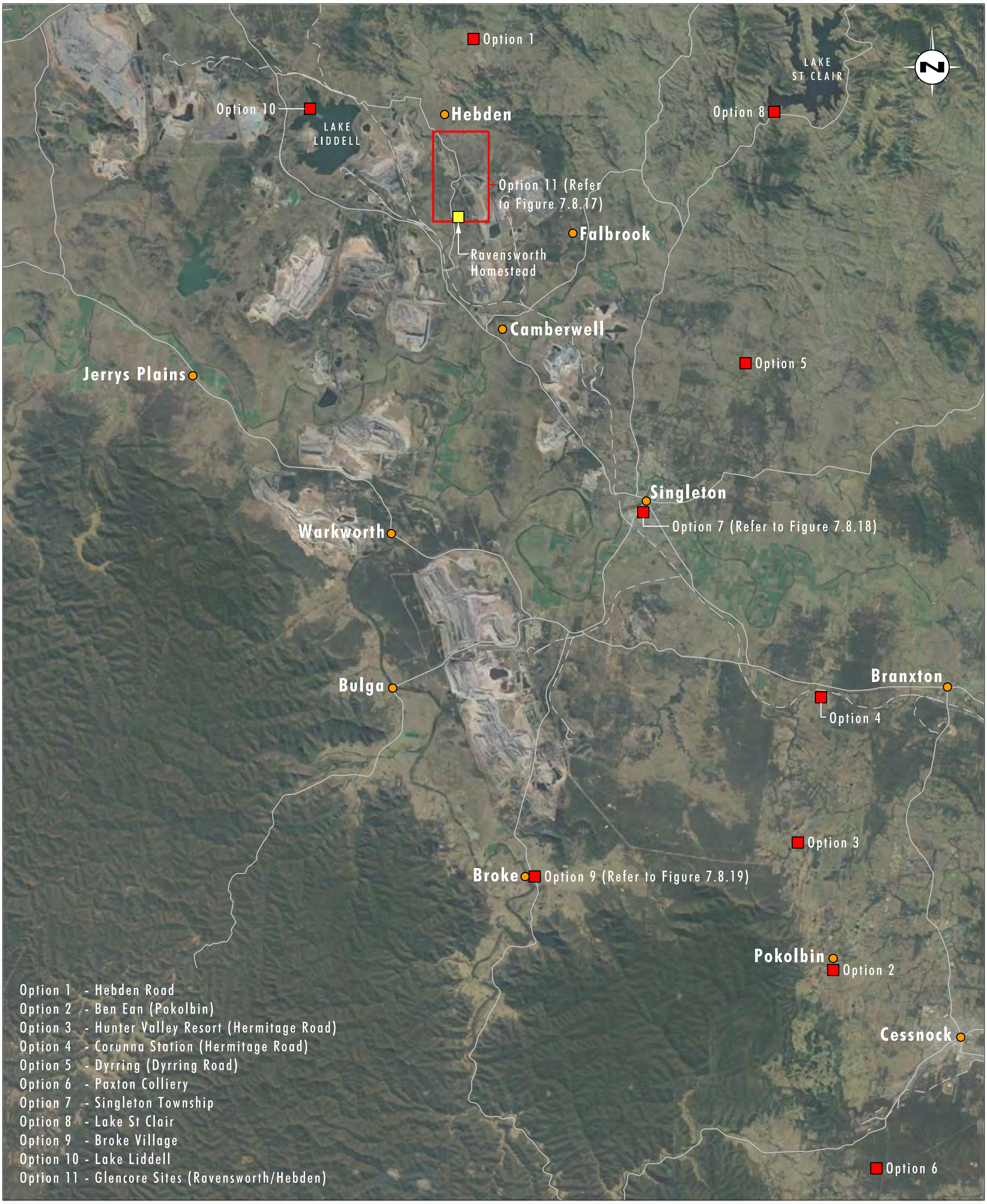

Image Source: Google Earth (2019)
Data Source: Glencore (2019)

0 5 10 15km

Legend

Relocation Options Considered

FIGURE 7.8.15

Relocation Sites Considered

Table 7.36 Summary of Homestead Relocation Options

Relocation Option	Use	LGA	Commercial Viability	Accessibility	Ownership Model	Community Benefit
1. Hebden (Scrumlo Road)	Multi-purpose	Muswellbrook	Limited – low traffic area	Low	Private	Partly – stays in locality
2. Ben Ean (Pokolbin)	Multi-purpose	Cessnock	Yes – high tourist area	High	Trust	High
3. Hunter Valley Resort (Hermitage Road)	Multi-purpose	Singleton	Yes – high tourist area	High	Private	Partly
4. Corunna Station (Hermitage Road)	Short-stay accommodation	Singleton	Potential – high tourist area	Low	Private	Minimal
5. Dyrring (Dyrring Road)	Short-stay accommodation	Singleton	Would likely require a significant funding source	Restricted	State	High
6. Paxton Colliery	Short-stay accommodation	Cessnock	Low	Low	Private	Low
7. Singleton Township	Multi-purpose	Singleton	Potential – land size limitations	High	Public/Private	High
8. Lake St Clair	Multi-purpose	Singleton	Potential – low traffic	Limited	Public	Partly
9. Broke Village	Multi-purpose	Singleton	Potential – high tourist area	High	Trust	High
10. Lake Liddell	Multi-purpose	Muswellbrook	Limited – would most likely require funding	High	Private	High
11. Glencore sites (Ravensworth/ Hebden)	Administration	Singleton	Yes – Glencore ownership	Low	Private (for duration of mining)	Partly – buildings maintained through use and stays in locality

7.8.6.4 Ravensworth Homestead complex relocation methodology

Two methods for relocating the buildings have been considered being moving the buildings wholly intact (or in large intact sections) or dismantling and rebuilding the buildings at a new recipient site. Further details on the move methodologies are contained within Appendix 23f and a summary of each methodology is provided in **Table 7.37**.

Glencore considered the recording and demolition of the Ravensworth Homestead Complex as a potential option (or mitigation measure of the Project). However, given the heritage significance of the Ravensworth Homestead Complex this was not considered appropriate and was assessed no further. Nonetheless, the option to dismantle and repurpose the materials, or some other alternative, remains a decision for the Consent Authority.

Table 7.37 Methods of Building Relocation

Option	Method
Intact Move	Involves the relocation of the buildings wholly intact (or in large intact sections) and requires pre-mobilisation works, design and foundation engineering, excavation of the buildings, placement of steel beams, and jacking and transferring the building onto dollies for transfer to the recipient site. This move methodology has minimal impact on the heritage fabric of the building. Detailed investigations have confirmed that the buildings are able to be moved in this manner. Relocation will require a road corridor that is sufficiently wide enough with appropriate grade to enable the weight and size of each building unit to be transported. Constraints in the existing public road network (width, grade, fixed infrastructure, duration of road occupancy) limit the distance over which the buildings can be transported and subsequent recipient site options. Generally, the larger the building (or building section), the shorter the viable distance is that can be travelled. The Project heritage architects, Lucas Stapleton Johnson, and heritage structural engineers Mott MacDonald, have scrutinised the intact move methodology of the specialist move contractor and are satisfied that the buildings could successfully be relocated without damage.
Dismantle and Rebuild	Involves the dismantling of the Homestead stone by stone, transport and rebuilding at the recipient site. Some components such as roof trusses could be moved intact. The dismantle and rebuild method for moving the buildings removes the road network constraint that the intact move places on the buildings and allows for the buildings to be moved to recipient sites further afield (within economic and environmental constraints). Dismantling has a greater impact on the heritage fabric than an intact move however would enable the buildings to be positioned in a location that allows greater community access and would also allow the buildings to be repurposed to form a facility that meets a community need.

7.8.6.5 Intact move assessment

Initial investigations focused on relocating the homestead buildings to recipient sites using the intact move methodology, to assess the feasibility of moving the buildings wholly intact (or in large intact sections) and it was assessed that the buildings can be moved in this manner. This work also included extensive engineering investigation and analysis. The approach was recognized as resulting in the minimum loss of heritage fabric.

LSJ and Mott MacDonald have scrutinised the intact move methodology of the specialist move contractor and are satisfied that the buildings could be successfully relocated without damage using this move methodology.

Further details on the intact move methodology prepared by Mammoth Movers is provided in **Appendix 23g**.

Key Considerations for Intact Relocation of Buildings

The intact moving of the buildings requires consideration of the following:

- The arrangement, composition and condition of the existing building footings
- The horizontal cutline for each building, which is the cutline where the relocated section of the building is to be parted from the existing building footings
- The depth to bed rock in the immediate vicinity and beneath each building, which is particularly important when considering the building cutline and the depth of excavation required for steel beam installation
- The double leaf arrangement of the wall construction of each building will require care when loading the building and the sealing of the underside of the wall once released from its footing to prevent the potential loss of rubble infill from the cavity
- The weight of each building, which influences steel beam sizing and dolly arrangement, and ultimately the size of the unit (in height and width) that requires transportation
- Constraints of the existing public road network in terms of width, height, longitudinal grade, crossfall, overhead power lines, bridge crossings and other fixed infrastructure. The road network constraints will influence the building unit size that is capable of being transported
- Duration of public road occupancy whilst transporting the buildings to the new recipient site.

A key consideration and constraint in the intact relocation of the buildings are the physical attributes of the existing public road network. A detailed analysis of the public road routes to each potential recipient site was undertaken by Mammoth Movers, with further details provided in **Appendix 23f**.

Route Assessment

A specialist building mover, Mammoth Movers, completed a detailed assessment that investigated the transport routes for moving the buildings to alternative recipient sites, and also investigated the required segmentation of the buildings to facilitate transport within the existing road corridor (refer to **Figure 7.8.16**). The outcomes of the route assessment are summarised below.

Routes were identified and surveys conducted to determine existing road constraints and determine the feasibility of an intact move option along each route.

As travel distance increased for longer travel routes, the complexity of moving the buildings increased due to the multiplication of factors or increased probability of a number of issues arising. Aspects considered were:

- Number of overhead services or infrastructure – powerlines, phone lines, overhead bridges etc
- Roadside infrastructure – trees, signage, poles etc
- Road infrastructure – bridge and drainage culvert allowable loads
- Slopes and crossfalls – necessitating additional traction or braking requirements

- Parking/layover areas – required to check the buildings and equipment along the route and to enable the parking of the convo buildings before and after difficult sections such as major intersections or areas of high slope so that building sections can traverse the obstacle one at a time

- Potential for delay due to equipment failure – e.g. tyre puncture

- Stakeholder delays – i.e. hold ups due to the impact on road users during road occupancy and access requirements.

- Gaining necessary approvals for significant possession of public roads during relocation works.

Key Route Constraints

Key route constraints that were identified in the Mammoth Movers route assessment report are detailed in **Appendix 23f** and included:

- Road/track width,

- Traversable slope

- Traversable crossfall

- Pavement, bridge and culvert load capacity

- Powerlines and overhead infrastructure

- Trees and other roadside infrastructure and obstacles, and

- Layover sites.

The assessment of these constraints was informed by the physical size and configuration of the building components being relocated, the type of construction of the building and the overall building weight.

The routes investigated for transporting the buildings to the potential recipient sites were chosen to minimise route obstacles and included the use of internal mine haul roads as they were considered to provide greater flexibility and minimise impact on other road users.

Mammoth Movers reviewed each of the proposed routes considering the constraints of both the buildings and routes.

It was found that intact relocation of the buildings in sections to Belford, Pokolbin and Paxton is not feasible due to significant slope constraints along Cessnock Road.

The intact relocation of the buildings in sections to Broke, Singleton and Hebden is theoretically possible but requires road works at localised locations along each route. Capital estimates were prepared for the necessary road upgrades to enable relocation to these sites with these works not considered viable. In addition to the high cost of road upgrades, the duration of road occupancy would be excessive for these routes and the subsequent impact on existing road users is also considered a major constraint.

As a result, the intact move of the homestead buildings is limited to locations close to the homestead's current location. The extent of this limit was defined as south along Hebden Road to Bowmans Creek and north along Hebden Road to the existing bridge crossing of Stringy Bark Creek including Pictons Lane.

Further details on the route assessment are provided in **Appendix 23f**.

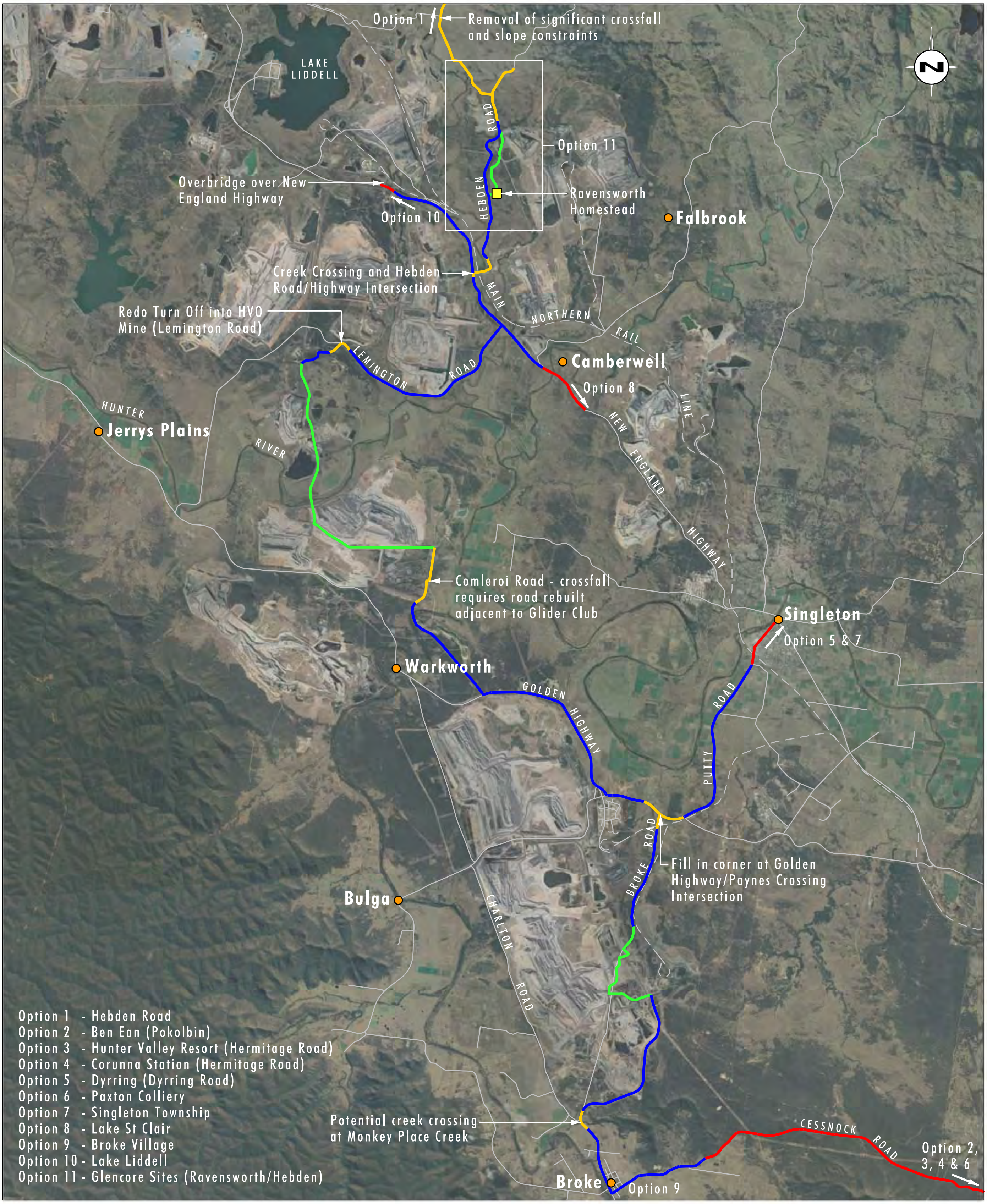

Image Source: Google Earth (2019)
Data Source: Glencore (2019)

0 2.5 5.0 10.0km

Legend

- Route Feasible
- Route requires roadworks
- Route impassable
- Mine route - not surveyed

FIGURE 7.8.16

Outcomes of Route Assessment (Intact Move)

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Recipient Site Suitability Assessment

In parallel with the route assessment, the heritage consultants and the RHAC also completed inspections (separately) of each proposed recipient site. The heritage consultants developed a list of key attributes that they considered the homestead recipient site should have with the focus being on the site's physical attributes (immediate site gradient, proximity from a creek, direction of approach) and wider visual catchment in order to achieve verisimilitude to the existing site. The site assessment also considered building relocation logistics, costs, accessibility and long term economic viability as well as preservation of heritage aspects. The details of aspects considered and the outcome of this assessment is provided in **Appendix 23f**.

In summary:

- Most of the sites inspected were considered to have unsuitable gradients and locations that did not resemble the existing homestead site in any way
- Sites further afield contained complex logistical issues that were difficult to overcome
- Sites close to the homestead's current location in Ravensworth and Hebden were considered preferable given similar setting.

Intact Move Preferred Site

The relocation of the homestead buildings using the intact move methodology is limited to recipient sites within 2 to 5 km of the homestead's current location as the constraints of the existing road network (grade, width, fixed infrastructure) make it impossible to move the buildings any further and/or the cost to upgrade the road to overcome the existing road network constraints is too expensive. In addition, the attributes of sites further afield are not considered consistent with the homestead's current setting with sites close to the homestead's current location in Ravensworth considered to more closely resemble the existing site in terms of gradient and outlook and having the additional benefit of being on the original Ravensworth Estate.

Six sites were investigated for the intact relocation of the homestead buildings and are shown in **Figure 7.8.17**. Each of these sites are situated on Glencore-owned land.

Each site was inspected by the RHAC and heritage consultants and further assessment undertaken that considered:

- Proximity to existing and proposed infrastructure and mining operations;
- Proximity to major transport routes;
- Outlook and visual catchment;
- Direction of vehicular approach
- Whether the site overlies coal reserves;
- Access to water; and
- Planning considerations including zoning and flood risk.

A summary of each site against these considerations is provided in **Table 7.38**.

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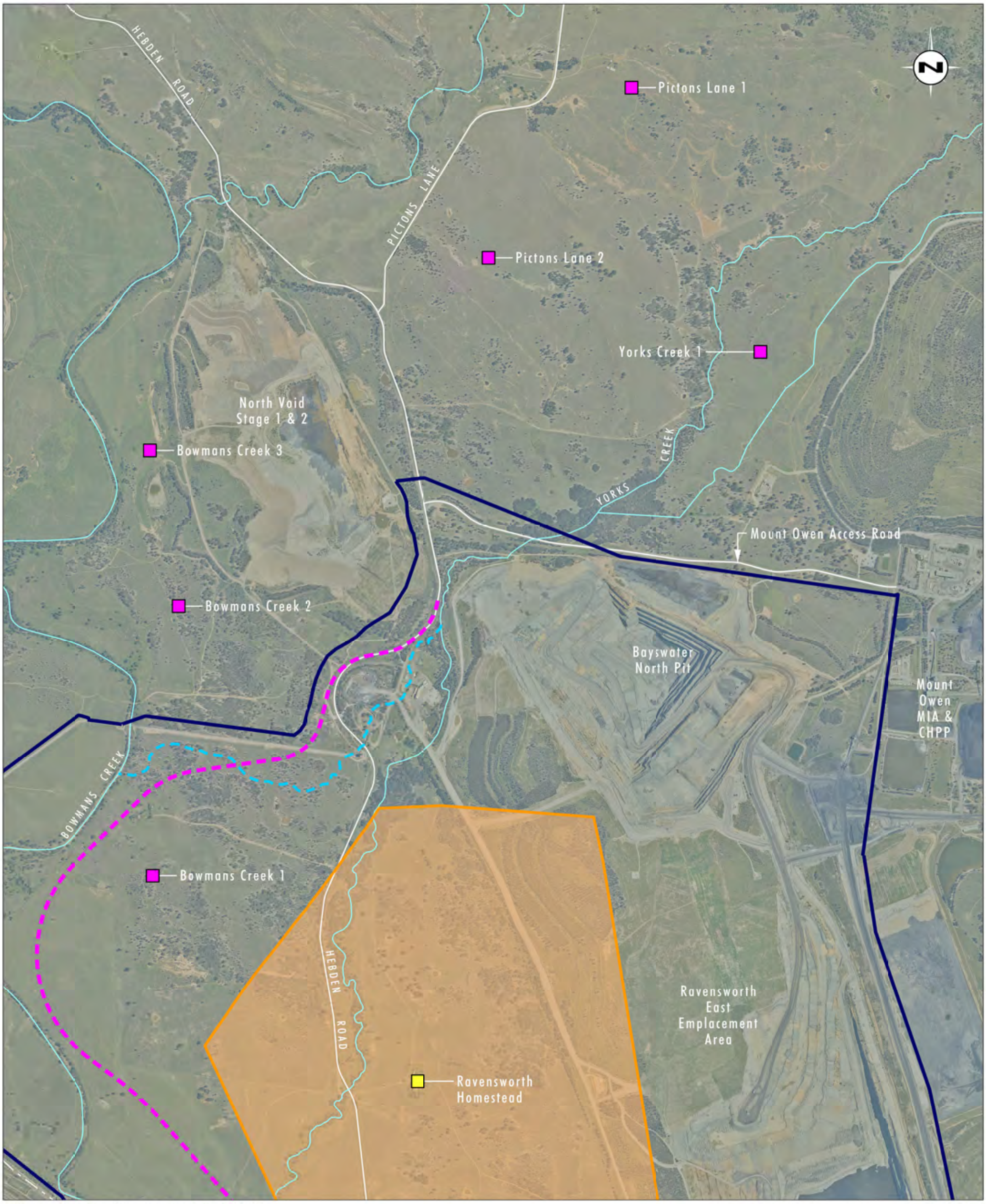

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)

0 0.25 0.5 1.0km
1:25 000

Legend
- Project Area
- Glendell Pit Extension
- Yorks Creek Realignment
- Hebden Road Realignment

FIGURE 7.8.17

Feasible Intact Move Recipient Site Options

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Table 7.38 Summary of Intact Move Recipient Site Assessment

Recipient Site	Proximity to existing and proposed infrastructure	Proximity to major transport corridors	Outlook and visual catchment	Direction of vehicular approach	Overlies coal reserves	Access to water	Planning considerations (zoning, flood risk etc)
Bowmans Creek 1 (Ravensworth Farm)	Adjacent to new MIA for duration of mining. MIA to be removed and site rehabilitated at completion of mining.	Close to New England Highway relative to other sites with good visibility off relocated Hebden Road	Similar outlook and setting to existing homestead site	From west off relocated Hebden Road	Yes, however Bowmans Creek restricts mining access to reserves	Extension of existing raw water pipeline from Glennies Creek to be provided for new MIA, or long term option to draw from Bowmans Creek.	Zoning compatible with proposed use, flood free
Bowmans Creek 2	No infrastructure in immediate vicinity	Close to New England Highway though poor visibility	Rural outlook though enclosed	From south off relocated Hebden Road	Yes, however location of past open cut mining and close to Bowmans Creek	Adjacent to existing dam/s	Zoning compatible with proposed use, flood free
Bowmans Creek 3	No infrastructure in immediate vicinity	Close to New England Highway though with poor visibility	Rural outlook though enclosed	From south off relocated Hebden Road	Yes, however location of past open cut mining and close to Bowmans Creek	Adjacent to existing dam/s	Zoning compatible with proposed use, flood free
Pictons Lane 1	No infrastructure in immediate vicinity	Considerable distance from New England relative to other options with poor visibility	Rural outlook though enclosed	From west off Pictons Lane	No	Existing dam/s on adjacent creek line	Zoning compatible with proposed use, flood free

Recipient Site	Proximity to existing and proposed infrastructure	Proximity to major transport corridors	Outlook and visual catchment	Direction of vehicular approach	Overlies coal reserves	Access to water	Planning considerations (zoning, flood risk etc)
Pictons Lane 2	No infrastructure in immediate vicinity	Considerable distance from New England relative to other options with poor visibility	Rural outlook though enclosed	From west off Pictons Lane	Yes, though high strip ratio and generally uneconomic	Existing dam/s on adjacent creek line	Zoning compatible with proposed use, flood free
Yorks Creek 1	No infrastructure in immediate vicinity	Considerable distance from New England relative to other options with poor visibility	Rural setting though limited views of range to south	From west off Pictons Lane or south off mine access road	Yes, though high strip ratio and generally uneconomic	Would require construction of dam/s.	Zoning compatible with proposed use, flood free

LEGEND

Consideration met (green)　　Consideration partially met (amber)　　Consideration not met (red)

Bowmans Creek 1 (referred to as the "Ravensworth Farm" relocation option) was selected by the RHAC, Glencore and heritage consultants as the preferred recipient site for an intact move as:

- It is located close to the New England Highway with good visibility from the proposed relocated Hebden Road with the homestead less likely of becoming isolated and a stranded asset relative to the other site options
- The homestead will be situated to the west of the proposed relocated Hebden Road similar to its position relative to the existing Hebden Road;
- The site is closest to the existing homestead site relative to other site options, and has a similar setting, slope and orientation compared to the original homestead location, and visual catchment with distant views of the Broken Back Range;
- The site will have access to raw water from Glennies Creek via a new pipeline which will be installed as part of construction of the new MIA
- The land title is held by Glencore which provides security over the ownership during the term of the proposed mining and the Homestead could then transition to private ownership by sale after mining is completed, and
- Glencore owns adjoining land that could be packaged with the Homestead to improve the potential for viable agricultural land use after mining.

7.8.6.6 Dismantle and rebuild move assessment

Following the selection of the Bowmans Creek 1 site (the Ravensworth Farm) as the preferred intact move recipient site, the RHAC still had concerns regarding accessibility and the long term viability of having the homestead remain in the Ravensworth locality.

End-use commercial modelling for a range of alternate recipient sites completed by Morrison Low indicated that site options that place the buildings in high tourist traffic areas such as the Pokolbin and Broke localities, and to a lesser extent Singleton township, had a greater potential to be economically viable and sustainable. However, relocation of the buildings to sites further afield can only occur if the buildings are dismantled and rebuilt due to the road constraints associated with moving the buildings intact.

In order to address the accessibility and long term viability aspects of the local move option, Glencore considered options that sought to position the homestead in a more highly trafficked location. Key requirements identified by the RHAC and Glencore for this alternate option were:

- The homestead was to be kept within the Singleton LGA
- The homestead once relocated was to be publically owned or owned under some other form of equitable ownership structure
- The proposed end use provides public access and fulfils a community need.

All relocation options previously considered for an intact move were re-examined in light of the above requirements. Further details on the dismantle and rebuild move methodology are provided in **Appendix 23h**.

Dismantle and Relocate Site Option Assessment

An assessment of each relocation option against the above requirements is provided in **Table 7.39**. The results of the assessment identifies relocation of the buildings to either Singleton or Broke as being the preferred locality.

Table 7.39 Summary of Relocation Options against Key Requirements

Relocation Option	Use	LGA	Ownership Model	Public Access/ Community Benefit
1. Hebden (Scrumlo Road)	Multi-purpose	Muswellbrook	Private	Private use
2. Ben Ean (Pokolbin)	Multi-purpose	Cessnock	Trust	Would provide public access
3. Hunter Valley Resort (Hermitage Road)	Multi-purpose	Singleton	Private	Attached to other development though accessible
4. Corunna Station (Hermitage Road)	Short-stay accommodation	Singleton	Private	Private use
5. Dyrring (Dyrring Road)	Short-stay accommodation	Singleton	Public (WLALC)	End-use likely to limit public access
6. Paxton Colliery	Short-stay accommodation	Cessnock	Private	Private use
7. Singleton Township	Multi-purpose	Singleton	Potentially Singleton Council	Community facility
8. Lake St Clair	Multi-purpose	Singleton	Potentially Singleton Council	Attached to other development though accessible
9. Broke Village	Multi-purpose	Singleton	Potentially a Trust	Community facility
10. Lake Liddell	Multi-purpose	Muswellbrook	Private	Would provide public access

LEGEND

Consideration met   Consideration partially met   Consideration not met

Site Options and Proposed Site

A range of potential sites were investigated in Singleton and Broke with each subjected to a planning constraints assessment that considered:

- Land ownership
- Zoning compatibility
- Potential for flood inundation
- Impact of building relocation on existing heritage at the recipient site (both Aboriginal and historic)
- Other environmental factors.

Further details on the planning constraints assessment completed for the sites in Singleton and Broke is provided in **Appendix 23f**.

In total four sites were identified by the RHAC and Glencore for investigation in Singleton (refer to **Figure 7.8.18**), and 5 sites were investigated in Broke (refer to **Figure 7.8.19**) and formed the basis of the proposal received from members of the Broke-Fordwich community. The sites were:

Singleton

- Site 1 – adjacent to Council offices on Civic Avenue
- Site 2 – adjacent to Singleton Hospital
- Site 3 – Albion Park
- Site 4 – Singleton Showground

Broke

- Site 1 – Stewart McTaggart Park
- Site 2 – McNamara Park
- Site 3 – Milbrodale Road
- Site 4 – Catholic Church (Adair Street)
- Site 5 – Anglican Church (Rogers Street)

A summary of the constraints assessment completed for the sites in Singleton and Broke is provided in **Table 7.40**.

Image Source: Nearmap (Aug 2019), Google Earth (Aug 2018)
Data Source: Glencore (2019)

0 250 500 750m

Legend

- Project Area
- Glendell Pit Extension
- Relocation Option

FIGURE 7.8.18

Singleton Site Options Considered

File Name (A4): R08/4166_585.dgn
20191119 12.43

Image Source: Nearmap (Aug 2019), Google Earth (Aug 2018)
Data Source: Glencore (2019)

0 100 200 400m

Legend

- Project Area
- Glendell Pit Extension
- Relocation Option

FIGURE 7.8.19

Broke Site Options Considered

File Name (A4): R08/4166_587.dgn
20191119 12.42

Table 7.40 Constraints Assessment of Singleton and Broke Site Options

Site	Land ownership	Other heritage?	Is zoning compatible?	Flood liable?	Other considerations	Preferred Site
Singleton						
Site 1 **adjacent to Council offices**	Singleton Council	Nil	Partially – suitable for office space	Yes	Council would have to agree to becoming asset owner	No – unlikely to obtain land from Council.
Site 2 **adjacent to Singleton Hospital**	Singleton District Hospital	Partially	No – health services only	Partially	Special purpose zoning under LEP.	No – unlikely to obtain land and would require rezoning
Site 3 **Albion Park**	Crown Land	Nil	Partially – community facility	Yes	Native Title considerations	No – would remove public open space from Singleton
Site 4 **Singleton Showground**	Private	Yes	Partially – community facility	Yes	Space for Main House only Local heritage listing of existing buildings.	No – space limitations and impact on other heritage items
Broke						
Site 1 **Stewart McTaggart Park**	Crown Land	Possible (cultural)	Generally – community facility, restaurants and cafes, markets	Yes	Require relocation of other facilities including war memorial, fire station and playground Native Title considerations	No – would require relocation of playground, fire station and war memorial
Site 2 **McNamara Park**	Crown Land	Possible (cultural)	Generally – community facility, restaurants and cafes, markets	Yes	Native Title considerations	Yes – centrally located, does not require relocation of existing facilities or buildings
Site 3 **Milbrodale Rd**	Crown Land	Possible (cultural)	Generally – community facility, restaurants and cafes, markets	Yes	Native Title considerations	No – considered too far removed from village
Site 4 **Catholic Church (Adair Street)**	Catholic Church, Crown Land and private	Yes (church)	No	Partially	Native Title considerations Grave sites May require relocation of church	No – unlikely to obtain land and would most likely require relocation of church and grave sites
Site 5 **Anglican Church (Rogers Street)**	Anglican Church and private	Yes (church)	No	Partially	May require relocation of church	No – unlikely to obtain land and would most likely require relocation of church

LEGEND

Consideration met (green) Consideration partially met (amber) Consideration not met (red)

Sites in Singleton are not considered viable due to either land ownership concerns (Council-owned and NSW Health owned land), space limitations, impacts on other existing heritage and incompatible zoning.

The majority of sites in Broke contain either existing facilities (fire station, playground, war memorial) or other local heritage listed buildings (Catholic and Anglican churches) which would most likely require relocation in order to accommodate the homestead buildings.

The preferred site is Site 2 (McNamara Park) in Broke as it does not impact upon other existing facilities and buildings, is situated on the highly tourist trafficked Wollombi Street (Broke Road) and Milbrodale Road and is centrally located relative to other civic facilities within the village.

Site 2 is Crown Land and Native Title has not been extinguished. Discussions are currently underway with the Native Title Claimant and other key stakeholders regarding land access. The site is also flood prone and would require filling and localised regrading to ensure the relocated buildings are not subject to inundation. It is recognised that land tenure and secondary approvals would be required to allow this option to proceed if approved by the consent authority for the SSD application.

Site 2 (McNamara Park) in Broke is referred to as the "Broke Village" relocation option and further details including usage, ownership and key features of this option are discussed below.

7.8.7 Preferred relocation options

As an outcome of the extensive review and assessment of alternate recipient sites and relocation methods, two preferred relocation options were selected as discussed below:

7.8.7.1 Option 1 – Intact move to Ravensworth Farm site

The Ravensworth Farm relocation option places an emphasis on conserving heritage significance by salvaging significant heritage features through:

- Moving the buildings wholly intact to a site situated on the original Bowman '10,000 acre' land grant in Ravensworth
- Replicating existing site features (approach direction, landform, visual catchment) at the recipient site.

The buildings would be relocated to a site approximately 1.7km from the current homestead location situated outside the proposed Glendell Pit Extension (refer to **Figure 7.8.20**) in a similar configuration and arrangement to their existing configuration and arrangement. At the completion of mining, the final pit crest will be situated approximately 630 m from the relocated homestead. In its new location views of the Glendell Pit Extension final void would not be visible from the Homestead. However part of the rehabilitated in-pit overburden emplacement area would be visible (refer **Appendix 23g**).

The land for the site is owned by Glencore and is zoned RU1 Primary Production and permits usage of the buildings for a wide variety of uses including dwelling, accommodation, information and education facilities and as a facility supporting an open cut mining operation. The site is situated approximately 350m to the east of Bowmans Creek and is situated outside of the Bowmans Creek floodplain and is therefore not subject to flood inundation.

Approach to the relocated homestead will be from the west via a newly constructed access road off the relocated Hebden Road and a new 'House dam' will be constructed to the south of the Main House similar to the existing arrangement.

The relocated homestead will initially overlook the proposed MIA, which will be used to maintain the Project's mining equipment and provide administration and bathhouse facilities for the workforce. At the completion of mining, the MIA would be removed and the site rehabilitated.

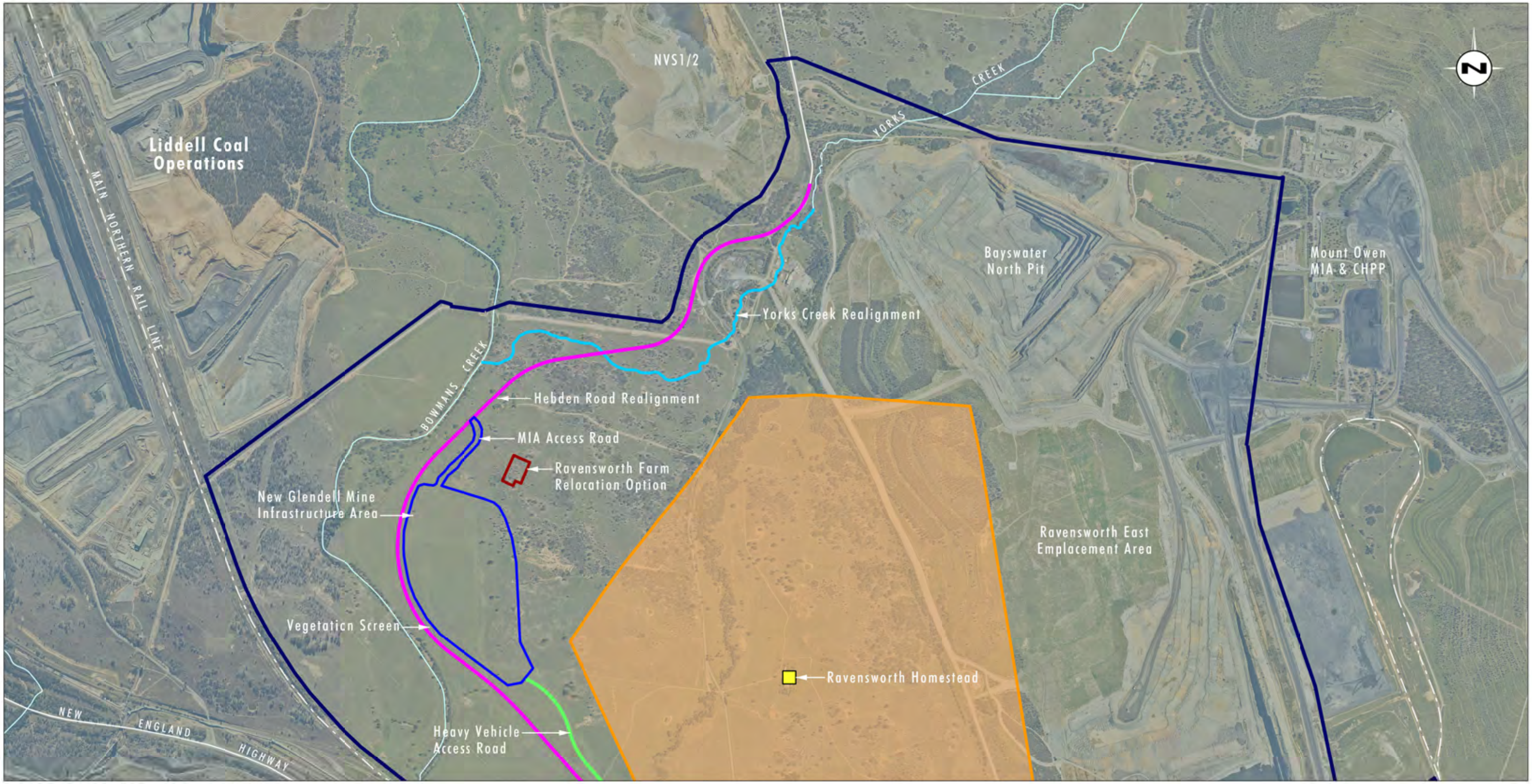

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)

Legend

- Project Area
- Glendell Pit Extension
- New Glendell MIA
- Heavy Vehicle Access Road
- Yorks Creek Realignment
- Hebden Road Realignment

FIGURE 7.8.20

Option 1 Ravensworth Farm

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Further details on the Ravensworth Farm option including the intact move methodology, conceptual scheme drawings, conceptual landscape drawings and preliminary earthworks plan are provided in **Appendix 23g**.

Intact Move Methodology

The intact relocation of the buildings is considered the most sympathetic to the significance of the buildings and would maximise the retention of the existing heritage fabric. The buildings would be transported along a purpose built road of sufficient width to accommodate the relocation of the Main House and Kitchen Wing as whole buildings.

The methodology for the intact relocation of the Ravensworth Homestead Complex would comprise 3 phases as outlined below.

Phase 1 involves a range of preparatory work including:

- Detailed archaeological (both Aboriginal and historical) investigation, recording and salvage within the immediate area of the proposed relocation works. Further details on the post-approval archaeological investigation is provided in the SoHI (**Appendix 23d**).
- Salvage of select plants, trees and other garden features as identified in **Appendix 23f**. Trees and plants salvaged from the existing garden and immediate surrounds would be initially housed in a temporary nursery located onsite before being incorporated into the final landscape scheme.
- Hazardous material assessment and removal as required (e.g. asbestos, lead paint), demolition and removal of identified structures considered of minimal heritage significance such as the Dairy Stalls alteration in the Barn building and the Shearing Shed alterations in the Stable building.
- Sensitive removal of the early 20th century addition to the Main House in order to reinstate the original 'H' plan form.
- Documentation, disassembly and palletisation of identified structures not suitable for intact relocation including the southern room of the Stables.
- Building repair and stabilisation works such as roof timber replacement, tie-down connection of roof members to walls, crack stitching, installation of wall through ties and permanent roof bracing. The final schedule of repair and stabilisation works would be determined following further investigation and consultation with the building mover and heritage structure engineer.
- Construction of transport route from existing site to recipient site.
- Civil works at recipient site including site regrading, drainage, construction of new House Dam, construction of new driveway, footing construction and conduit installation for services.

The Phase 2 (building move) works would be completed by a specialist building mover contractor with expertise in the intact relocation of heritage stone buildings. A detailed move methodology for the intact relocation of the buildings to the recipient site has been prepared by Mammoth Movers and is provided in **Appendix 23g**. In summary, the key steps in moving the buildings includes:

- Installation of temporary structural support or bracing to maintain the buildings in their existing condition during the move
- Excavation around and beneath the buildings and installation of the jacking support frame consisting of steel beams used to spread the load onto a network of hydraulically linked dollies
- The uniform raising of the buildings and transfer onto dollies

- Transporting the buildings to the recipient site via a purpose built road that avoids interaction with public road users
- Placing the buildings onto their new footings and the building up of supports to the underside of the buildings
- Removal of the jacking support frame from under the buildings, temporary bracing and supports and demobilisation of relocation equipment
- Backfilling around the buildings to the final design level
- Separate relocation of disassembled building components that were not suitable for intact relocation to the recipient site and reassembly in their new location using a suitably qualified heritage builder.

The Phase 3 works would occur after the buildings have been moved and would include:

- Internal fit out to suit the proposed end use including service reticulation and wet areas;
- Construction of other adaptation works to suit the proposed end use, and
- Planting of salvaged trees and plants and establishment of gardens in accordance with proposed landscape scheme.

Proposed Use

For the duration of mining (approximately 20 years), the relocated homestead buildings would be used by Glencore as an administration centre consisting of office space, meeting facilities and training rooms as indicated in **Figure 7.8.21**. Conceptual adaptation drawings for the proposed use are shown in **Appendix 23g**.

The relocated Men's Quarters would be used to store and display the history (Aboriginal and historical) of Ravensworth Estate and the associated building group. Additionally, select artefacts salvaged from the archaeological (Aboriginal and historical) investigations would be displayed and incorporated into the new grounds.

At the completion of mining, possible options include return of the homestead to use as a private homestead with an attached landholding suitable for ongoing agricultural uses or an alternate use that suits future land use and interest in the area.

Further details on proposed building modification and adaptation works required to suit the intended end-use are provided in **Appendix 23g**.

Ownership

During mining the buildings will be owned and maintained by Glencore. At the completion of mining, the buildings would transfer ownership in accordance with the future use and interest in the area.

Whilst in Glencore ownership, public access would be provided to the relocated homestead by arrangement upon request.

Key Features

The Ravensworth Farm relocation option has a strong focus on replicating the physical characteristics of the existing homestead site in order to maintain verisimilitude. A summary of the key physical features of the existing and proposed Ravensworth Farm site are provided in **Table 7.41**.

The Ravensworth Farm relocation option keeps the homestead buildings on the original Bowman "10,000 acre" Ravensworth Estate and within the Ravensworth locality. Under this relocation proposal, all buildings would be relocated, arranged and oriented in their existing configuration as shown in **Figure 7.8.21**. A conceptual perspective view of the relocated homestead is shown in **Figure 7.8.22**. In addition, an interpretation of the northern most building, not currently on site, which is believed to have been a 'convict barracks' will be established by constructing a building outline using archaeologically salvaged stone footings and remnant stone pieces to provide an appreciation of the size and location of the original building that would have enclosed the formal Ravensworth Homestead Complex square.

The recipient site would be reshaped to reproduce as far as practicable the key aspects of the original site that have been identified by heritage specialists as contributing to the character and context of the existing homestead position. These aspects include the landform upon which the relocated buildings would sit which would be similar to the current landform in terms of slope and orientation. Additionally, the visual catchment from the recipient site will be similar to the current with mid-range views to the south of Ravensworth Operations emplacement areas and distant views of the Broken Back Range.

In addition, the approach to the Ravensworth Farm site would be from the west via the relocated Hebden Road at an alignment similar to the approach to the current site from Hebden Road. Further, the offset of the recipient site to the relocated Hebden Road is similar in distance to the offset of the current homestead site from the existing Hebden Road.

In considering the significance of the current and former homestead gardens and landscape, a conceptual landscape scheme for the proposed Ravensworth Farm option has been developed and includes the relocation of significant trees and plants and other landscape features from the existing garden and immediate surrounds to the new site. Additional vegetation planting is also proposed along the approach road to the new site and along parts of the relocated Hebden Road. Plantings along the relocated Hebden Road would screen road user views of the MIA. At the completion of mining and following removal of the MIA, select areas of planting along the relocated Hebden road would be removed in order to provide road users with views of the homestead upon approach from the south.

The Ravensworth Farm would have access to water via a pipeline that will be constructed for transferring raw water from Mount Owen mine to the proposed MIA. Further, a new 'House Dam' will be constructed to the south of the new site to replicate the House Dam that is present at the homestead's current site.

Table 7.41 Summary of Key Features of Existing and Proposed Ravensworth Farm Sites

Key Features	Existing Site	Ravensworth Farm
Landform gradient upon which buildings sit	3.1% fall towards the Homestead (2.9 m fall between north east corner of Barn and south west corner of Main House)	3.1% fall towards the Homestead (2.9 m fall between north east corner of Barn and south west corner of Main House)
Approximate elevation of landform at site of Main House	96m AHD	100 m AHD
Distance of homestead buildings from Public Road	275m to the east of existing Hebden Road	297 m to the east of relocated Hebden Road
Direction of approach	Approach from west off Hebden Road	Approach from west off relocated Hebden Road (at similar alignment to existing)
Distance of homestead to watercourse	Western wall of Main House 242m to the east of Yorks Creek	Western wall of Main House 395 m to the east of Bowmans Creek

Key Features	Existing Site	Ravensworth Farm
Distance of homestead buildings from waterbody	132m from Main House southern entrance to centroid of Dam to the south 253m from existing Main House north west corner to centroid of Dam to the north west	124m from Main House southern entrance to centroid of Dam to the south 245m from new Main House north west corner to centroid of Dam to the north west

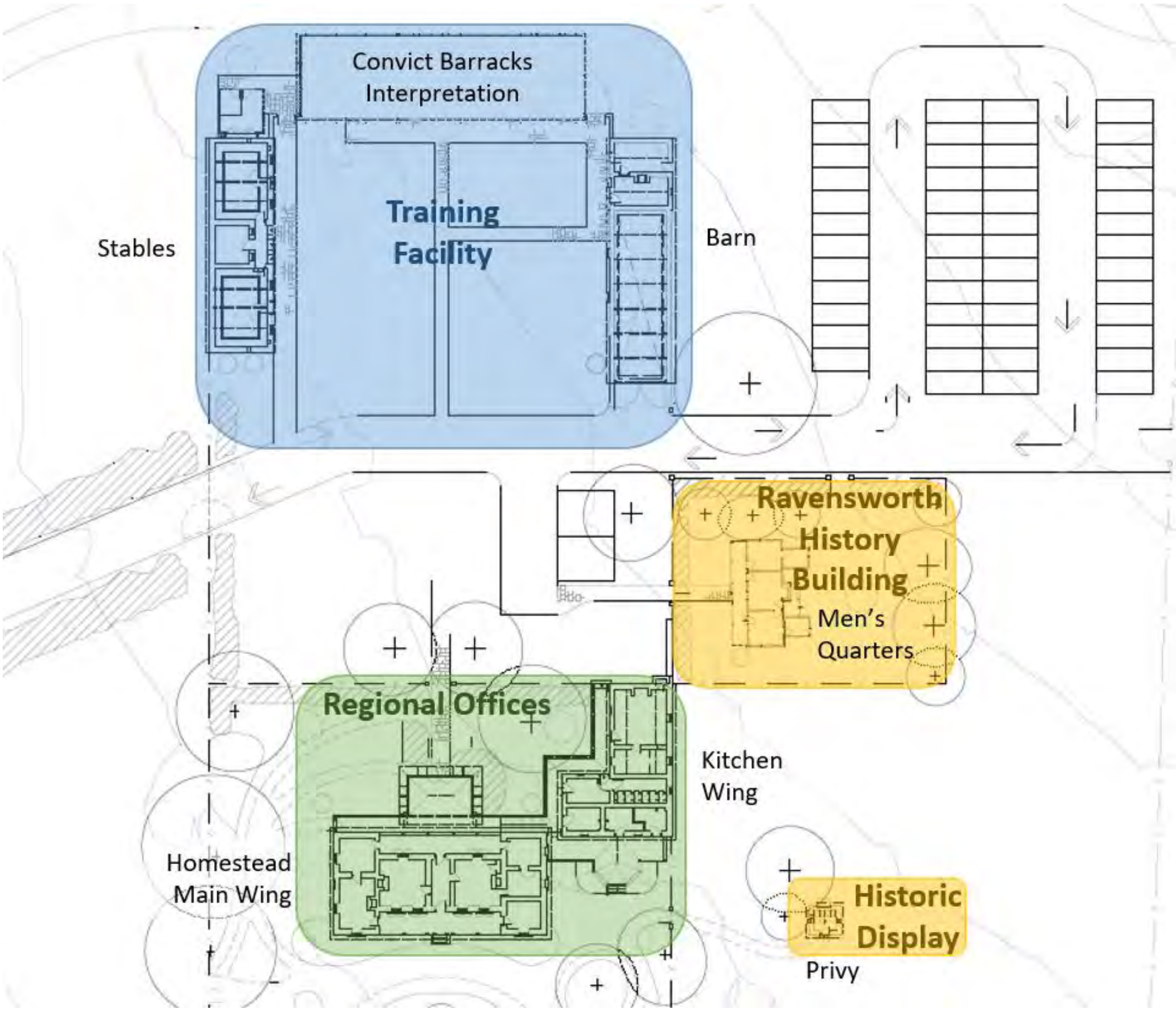


Figure 7.8.21 Ravensworth Farm Conceptual Use Plan

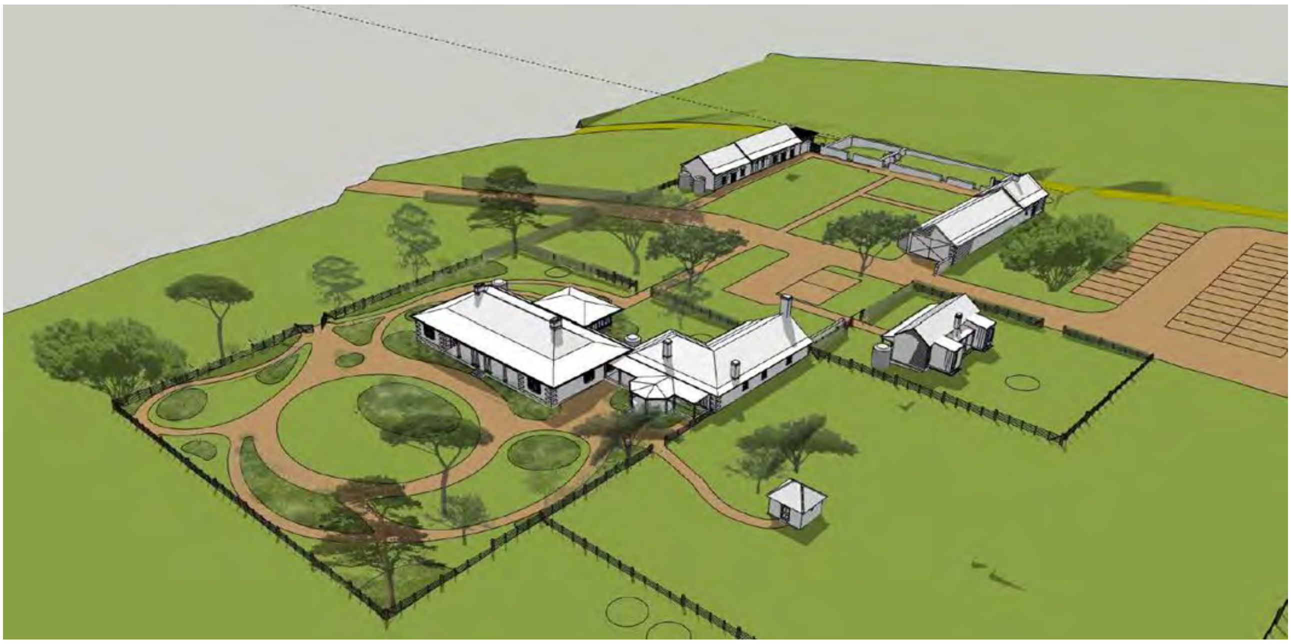


Figure 7.8.22 Ravensworth Farm Perspective View (Conceptual)

7.8.7.2 Option 2 – Dismantle and relocate to Broke

The Broke Village relocation option is a proposal by members of the Broke-Fordwich community that sites the buildings in a publically accessible location to provide an ongoing community benefit through dismantling and rebuilding the homestead buildings to form the Broke village square.

The buildings are proposed to be rebuilt at the southern end of McNamara Park on the corner of Wollombi Street (Broke Road) and Milbrodale Road, and would provide a focal point that links the existing playground (Stewart McTaggart Park), fire station, war memorial and general store to the south with other civic facilities such as churches, Broke Town Hall and Broke Public School to the north (refer to **Figure 7.8.23**).

The buildings are proposed for multi-purpose usage and would provide local employment opportunities, communal interaction and encourage enterprise growth. Landscaping for the grounds will incorporate elements from the original homestead site, including transplanting of select trees and plants. The existing site would require the clearing of vegetation to accommodate the proposed scheme, and additional clearing (including thinning) is likely to be required around the facility to manage bushfire risk.

The site is zoned RE1 Public Recreation Zone and permits with consent usage such as community facilities, information and education facilities, markets, recreation areas, and restaurants and cafes. The site is Crown Land and Native Title has not been extinguished. Discussions are currently underway with the Native Title Claimant and other key stakeholders regarding land access.

The proposed site is currently prone to flooding and would need to be filled with the proposed finished floor levels to be situated above the 1 in 100 year (ARI) flood level with an appropriate freeboard.

Whilst the SSD application includes the dismantling and transportation of the Homestead (if this option is approved by the consent authority), the rebuilding of the Homestead in Broke would be subject to the securing of land tenure and a separate development application process that includes completion of the requisite accompanying assessments. If the requisite approvals cannot be obtained for the Broke Village relocation option within 2 years of commencement of development under the SSD development consent then the Homestead will be relocated to the Ravensworth Farm. Refer to **Section 5.2.1.2** for further details.

Image Source: Nearmap (Aug 2019), Google Earth (2018)
Data Source: Glendell (2019)

0 100 250 500m

Legend
- Project Area
- Glendell Pit Extension
- Relocation Option

FIGURE 7.8.23

Option 2 Broke Village

Further details on the relocation of the buildings, proposed use, ownership and key site features is provided below and **Appendix 23h**. Conceptual scheme drawings, a conceptual landscape plan and a preliminary earthworks plan for the Broke Village option are provided in **Appendix 23h**.

Dismantle and Rebuild Move Methodology

The dismantle and rebuild move methodology would comprise the following phases:

- Phase 1: Pre-move
- Phase 2: Dismantle
- Phase 3: Transport and
- Phase 4: Rebuild (including post move fit-out and commissioning).

The pre-move phase (Phase 1) would involve the detailed survey, photographing and laser scanning of the in-situ building elements to develop a digital Building Information Model of the homestead complex capturing detail and labelling down to individual structural components, fixtures and individual stones on exposed stone walls.

During this phase, testing would be completed for timber, stone and plaster elements of the buildings and suitable replacement materials would be sourced for use in the rebuild phase should building components be too dilapidated for re-use (e.g. termite affected timbers). Approval for replacement materials would be sought from the heritage specialist.

Testing would also be completed for lead paint to supplement previous testing completed for hazardous materials and any identified hazardous materials would be removed from the building complex to enable safe dismantling works.

Salvage of select plants, trees and other garden features as identified in **Appendix 23h** would also occur during this phase. Trees and plants salvaged from the existing garden and immediate surrounds would be initially housed in a temporary nursery before being incorporated into the final landscape scheme.

The dismantle phase (Phase 2) would involve the careful labelling, unpicking and dismantling of building components in a planned approach to keep the building watertight for as long as possible. As such, internal fixtures, floors, ceiling panels and non-structural walls would be removed first, with the roof and structural walls following.

As part of the process, each building component would be cleaned and detailed appropriately and labelled as per the Building Information Model before being stacked onto pallets for transport. Each pallet would be numbered and the contents recorded on a pallet tracking register so that individual building components could be found easily during the rebuild process.

Pallets and building materials sensitive to exposure to weather would be stored in steel containers or suitable shedding and other less weather sensitive materials would be wrapped in plastic or tarpaulin to contain and protect the materials as appropriate.

Elements of the building that are found to be too dilapidated for re-use would be recorded and a suitable replacement sourced using dimensions from the Building Information Model and the approved replacement materials identified in the Preconstruction phase. Should the plastered inner wall leaf be found to be of stone rubble construction then consideration would be given to replacing the inner wall leaf.

During the Dismantle phase, civil works and footing construction would be occurring at the recipient site. The transport phase (Phase 3) will commence at the completion of the recipient site preparation works. Dismantled and replacement building materials would be transported to the new site in an ordered fashion to allow reconstruction of the buildings. Transport of the dismantled building elements would be carried out via road-registered trucks from the current site to the recipient site.

The pallet register would be updated through the transport process as a live document to track transport of building material between sites.

The rebuild phase (Phase 4) of the Homestead would commence with structural walls, and then the roof structure, non-structural walls, ceiling panels, floors and internal fixtures. The works would involve specialist heritage trades using traditional construction methods and mortar and plaster mixes that are representative of the original construction. Nails and other fixings would be replaced during this process. Fixings that are visible, such as bolted truss connections in the stables, would be replaced with appropriate materials as approved by the heritage specialist.

Following reconstruction of the buildings and service installation, final finishes including plaster would be applied and fit out of the buildings for the proposed end use would be completed.

Through the rebuild process the pallet tracking register would be maintained and the Building Information Model would be updated with locations of replaced components.

Finally, salvaged trees and plants would be incorporated into the proposed landscape scheme.

Further details on the dismantling of the homestead and rebuilding in Broke are provided in **Appendix 23h**.

Proposed Use

The relocated homestead under the Broke Village option would have multi-purpose usage. The facility would comprise a number of precincts as shown conceptually in **Figure 7.8.24** with varying proposed uses including:

- Cultural Precinct (Main House and Kitchen Wing) with offices, exhibition (art) space and interpretation space
- Food precinct (Men's Quarters and Barn) with café/restaurant premises, local produce (cheese, bread, ice creamery)
- Tourism precinct (Stables) with cellar door/wine tasting and micro-brewery, and function space
- Market Square with markets (monthly) and major events (Broke Fair, Smoke in Broke etc)
- Service and Amenity with toilets and maintenance and greenkeeper

Further details on proposed building modification and adaptation works required to suit the intended end-use are provided in **Appendix 23h**.

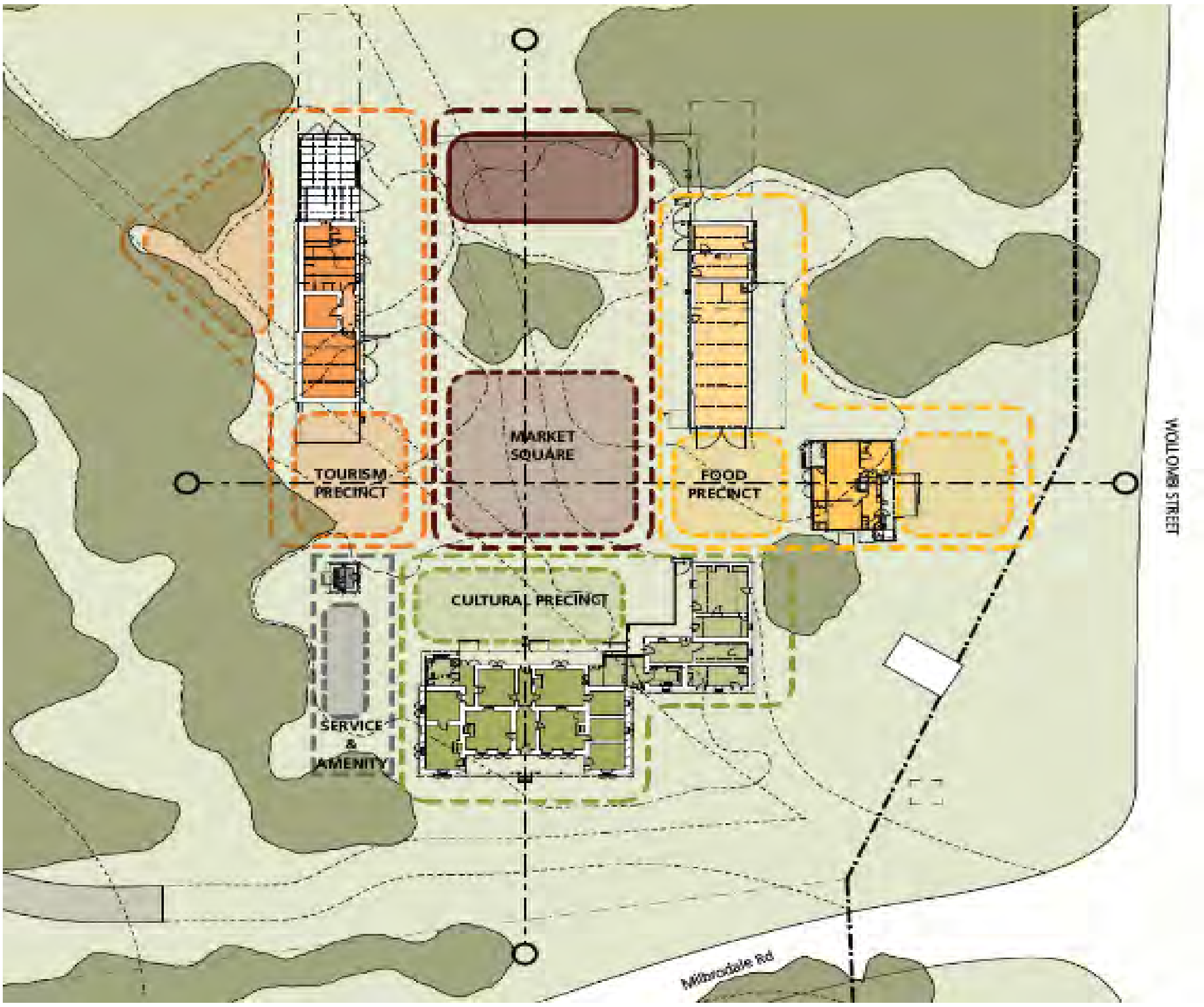


Figure 7.8.24 Broke Village Conceptual Precinct Plan

Ownership

The Broke Village facility is proposed to be owned by a new entity formed under an incorporated association (or similar) comprising members of the Broke-Fordwich community and governed by a board of trustees. The entity would be responsible for the management and maintenance of the facility. Financial benefits generated by the facility would be used for funding other community initiatives in the Broke-Fordwich region such as providing improved infrastructure, services and facilities.

Key Features

The Broke Village relocation option's main focus is providing a useful life for the relocated building group through adaptive reuse in a location where they are publicly accessible and can provide an ongoing community benefit. The location selected within Broke is appropriately positioned for the relocated buildings to function as the village square and provide a focal point for tourist driven opportunities including monthly and annual community events (Smoke in Broke, Broke Village Fair, Broke Community Markets). The facility would include car parking and other services and amenities (refer **Figure 7.8.24** and **Figure 7.8.25**).

In recognition of the heritage significance of the buildings, the proposed concept is to relocate the buildings to the new site in a configuration that is similar to their current configuration, though it is noted that the distance between the Barn and Stables, and Kitchen Wing has been reduced to improve the facility layout. Additionally, the alignment of the building group along the north-south axis has been skewed by approximately 35 degrees in order to better fit with the site arrangement and frontage to Wollombi Street (Broke Road) and Milbrodale Road. The layout and design will be further refined as part of the secondary approval process should this option be approved by the consent authority under this SSD application.

The site would be filled and regraded to be above the predicted 1 in 100 year ARI flood event, or as agreed by the consent authority for the required secondary approvals. It is not possible to replicate the gradient of the existing site at the recipient site as the adjacent landform is generally flat and would result in a final landform that is not in keeping with the surrounding topography. However, approximately 1m of fall has been incorporated into the proposed landform from the north-east corner of the Kitchen Wing to the south-west corner of the Main House, which is consistent with the fall across these buildings at the existing site.

The Broke Fordwich Wine and Tourism Association has identified that their local industry comprises around -45 vineyards, 5 wineries, 18 olive groves, 13 cellar doors, four restaurants/cafes, and over 65 short-stay accommodation facilities. These businesses employ around 300 full time personnel with an additional 100-200 personnel employed seasonally during grape harvest, and utilize a range of suppliers and services. The Association believes that the establishment of the Broke village centre will attract further tourism visitation and strengthen their industry. This will assist in assuring the sustainable future of their businesses, strengthen the local economy as well as improving the aesthetic amenity of the Broke village. This position is further discussed in **Appendix 23i.**

A summary of the key physical features of the Broke Village site and how they compare to the physical features of the existing homestead site are provided in **Table 7.42**

Table 7.42 Summary of Key Features of Existing and Proposed Broke Village Site

Key Features	Existing Site	Broke Village
Landform gradient upon which buildings sit	3.1% fall towards the Homestead (2.9 m fall between north east corner of Barn and south west corner of Main House)	1.1% fall towards the Homestead (approx. 1 m fall from north east corner of Kitchen Wing to south west corner of Main House)
Approximate elevation of landform at site of Main House	96m AHD	79m AHD
Distance of homestead buildings from Public Road	275 m to the east of existing Hebden Road	60 m to the west of Wollombi Street (Broke Road) and 28m to the north of Milbrodale Road
Direction of approach	Approach from west off Hebden Road	From east off Wollombi Street and north off Milbrodale Road
Distance of homestead to watercourse	Western wall of Main House 242 m to the east of Yorks Creek	Western wall of Main House 140 m to the east of Wollombi Brook
Distance of homestead buildings from waterbody	132 m from Main House southern entrance to centroid of Dam to the south 253 m from existing Main House north west corner to centroid of Dam to the north west	No dams present (see distance to Wollombi Brook above).

Figure 7.8.25 Broke Village Perspective View

7.8.7.3 Heritage analysis and statement of significance - Relocation recipient sites

LSJ completed a separate heritage analysis and statement of significance for the Option 1 recipient site “Ravensworth Farm” (provided in **Appendix 23g**), and the Option 2 recipient site McNamara Park in Broke (provided in **Appendix 23h**). Summaries of the significance assessments for these sites are provided below.

Option 1 - Ravensworth Farm

Ravensworth Farm site, which is located within the boundaries of the former Ravensworth Estate, with the current allotment formed as part of land subdivisions in the late 19th and early 20th centuries, being part Lot 32 of DP 545601, owned by Glencore.

The site consists of a complex of farm buildings from the early to mid-20th century including two residences, garage, hay shed/machinery shed, dairy and associated yards, located on a ridge to the east of Bowmans Creek overlooking the alluvial plains to the south and south east. None of these features are listed heritage items in the Singleton LEP.

LSJ assessed the items in accordance with the Heritage Criteria in the guideline (NSW Heritage Office and Planning, 2002), and rank the Option 1 site and associated items in accordance with grading’s provided in Heritage Assessments (NSW Heritage Branch, 2000) as shown in **Table 7.43** below.

Table 7.43 Grading of Significance for components of Ravensworth Farm

Component/Feature	Significance Grading
Weatherboard Cottage	Moderate
1950s House	Little
Hay Shed/ Shearing Shed	Moderate
Dairy	Little
Cultural Plantings: Moreton Bay figs, domestic garden plantings, Hawthorn hedge etc.	Little-Moderate
Associated site and landscape features including windmill, cattle yards and loading ramp, fences, troughs and abandoned structures	Little-Moderate
Ravensworth Farm site	Little

LSJ concludes that Ravensworth Farm is of some significance for its associations with the former Ravensworth Estate lands and as a representative example of a smaller allotment mixed farm property developed as a result of the speculative subdivision of the estate lands in the early 20th century. Ravensworth Farm also has some social significance as forming part of the broader locality of Ravensworth, and for providing tangible evidence of a former distinct community associated with the locality.

Option 2 – McNamara Park, Broke

The proposed recipient site at the township of Broke, NSW, is the existing public reserve of about 12.5 ha located on the west side of Wollombi Street at the corner of Milbrodale Road and called McNamara Park, being Lot 701 of DP 93631. To the east across Wollombi Street is the town street grid of Broke. The land is a relatively level area stretching between Wollombi Street and the Wollombi Brook covered with an open wood of native trees growing in grassland. Adjacent to the Brook, the land falls steeply to the creek bed which is possibly 10 or 15 m below the general level. At the southern end there is a modern concrete bridge crossing the Brook, on Milbrodale Road. The reserve is used for camping and for community markets and festivals such as the annual "Broke Fair", and this occurs more in the north than in the south of the reserve.

The park is accessed by a gravel track from both the northern and southern ends of the park. Smaller dirt tracks lead off this main access road into the open areas of the reserve where camping occurs. Some facilities are provided throughout the camping grounds including an amenities block, car parking areas, picnic shelters, garbage bins, power outlets and the like.

At some locations throughout the reserve there are log and other vehicle barriers, and water courses. At the south-east corner there is a stone construction with plaques recording historical events.

In terms of Aboriginal cultural heritage, key cultural values have been previously identified in the local area include the now-relocated Loders Creek grinding grooves, Baiame Cave, Lizard Rock (also known as Yellow Rock) and the site of the Bulga Bora Ground. Of particular relevance to the village of Broke is Lizard Rock (Yellow Rock), as the escarpment located in the Pokolbin State Forest, is the focus of dramatic landscape views from the town to the south. Lizard Rock is important to the local Aboriginal people. Its outline is suggestive of a lizard and it holds strong spiritual connections for Aboriginal people of the area. The story of Lizard Rock is part of the Wonnarua dreaming.

There are no known cultural values or Aboriginal sites pertaining directly to the location of the McNamara Park, although during consultation for Glencore's Bulga Optimisation Project (Umwelt EIS, 2013) it was noted that Wollombi Brook, which is adjacent to the park, is believed to be a pathway to creation places.

In terms of European settlement, Broke is located on one branch of the Great North Road designed by Surveyor-General Thomas Mitchell and commenced in 1826 to connect Sydney to the Hunter Valley. Constructed by convict work-gangs, the northern branch of the Great North Road from the town of Wollombi passes through the village reserve (to become the village of Broke) and headed north into the Upper Hunter region.

In 1828, Assistant Surveyor Henry Dangar set aside land as a Village Reserve. On 27 November 1831, Surveyor General Thomas L Mitchell named it Broke after Major-General Sir Charles Broke Vere, Bart. The McNamara Park is located on the original "Reserve for Recreation and access to Water" (Bennett, 1859).

LSJ records the land title history of the site and notable nearby features in the village of Broke including the adjacent bridge crossing Wollombi Brook, village store and former Police Station, historical memorials and churches.

LSJ describes views from the periphery of the reserve lands are generally of the village of Broke to the east, northeast and southeast and Stewart McTaggart Park located to the south. From the northern end of the park views of Yellow Rock to the south are also available, but only from the edge of the reserve adjacent to Wollombi Street and views from within the park lands being limited due to the density of the vegetation.

A due diligence assessment of Aboriginal archaeology was conducted by OzArk Environment and Heritage Management Pty Ltd in August 2019 (provided in Appendix 23h), which identified two registered sites near the proposed Option 2 site. Inspection of the site noted that although surface visibility was restricted, the relatively intact nature of the soil profile indicates that there is potential for archaeological material sub-surface, and likely to have good integrity.

LSJ assessed the items in accordance with the Heritage Criteria in the guideline (NSW Heritage Office and Planning, 2002), and rank the Option 2 site and associated items in accordance with grading's provided in Heritage Assessments (NSW Heritage Branch, 2000) as shown in **Table 7.44** below.

Table 7.44 Grading of Significance for component of McNamara Park

Component/Feature	Significance Grading
The public reserve of McNamara Park, located adjacent to the village of Broke on the former Great North Road (Wollombi Street)	Little
Use of McNamara Park as public reserve, town common, camping area and market locale	Moderate
Bicentennial Memorial with cultural plantings	Moderate
Vegetation of the Hunter-Macleay Dry Sclerophyll Forest and the Eastern Riverine Forest including mature trees.	Little
Signage: directional, warning and naming	Little
Camping facilities including amenities block, car parking areas, bollards, signage, power outlets, picnic shelters etc.	Little
Roads and tracks through the reserve	Little

7.8.8 Historical archaeological impact mitigation measures

7.8.8.1 Mitigation of direct archaeological resource impacts

Survey and Salvage

The findings of C&L's archaeological investigations undertaken in 2018 and 2019 are reported in *Ravensworth Homestead Complex: Historical Archaeological Test Excavation Report and Impact Statement for the Core Estate Lands* (November 2019) (provided as **Appendix 23c**) and identified that the homestead complex, and wider place, is likely to provide unique insights into:

- A newly-established frontier and contact/ interaction with Aboriginal people.
- Rural lifeways, including tastes and customs through the 19th to early 20th centuries.
- Material culture and lives of significant colonial people.
- Convict lives and the assignment system and how it was implemented within this landscape.
- Use of technology and management of water, changing transportation and economics and how they shaped life on the estate.

C&L advise that the known archaeological resource and its convict-period archaeology has State significant heritage value. The later periods are of local significance. The proposed Project impacts, which will see the removal of all the archaeological deposits, needs to be appropriately mitigated if the Project is approved. Further, the removal of the State significant archaeological landscape, and any locally significant archaeology, needs to produce an appropriate outcome for the community if it is to be allowed to proceed.

Substantial outcomes, to mitigate the significant impacts of the Project, should include:

- Detailed open area excavation of the identified archaeological resources according to best practice guidelines including excavation reporting and artefact analysis.
- Provision of a repository for the artefacts from the study area. Artefacts belong to the owner of the site and need to be stored in perpetuity.
- Development of a long-term strategy for interpretation/display of artefacts from the Project in the relocated homestead.
- Publishing the results of the archaeological program to ensure public dissemination of the results.
- Consideration of partnering with universities to train/ work with students in best practice heritage and archaeological techniques including legislation, excavation, survey, GIS, artefact analysis and reporting of archaeological results, and the interpretation and display of material and results.

A Heritage Management Plan will be developed for the Project, to the satisfaction of DPIE, and in consultation with the Heritage Branch, to include the heritage impact mitigation measures for the Project.

Specific archaeological mitigation measures recommended by C&L are provided in **Table 7.46** and focus on areas within the Core Estate Lands. The archaeological mitigation measures need to ideally occur prior to any ground disturbance in the Archaeological Program Areas identified by C&L for the Project, including the relocation of the homestead complex buildings. Some early works will require initial investigation in accordance with the early works investigation processes to be included in the Heritage Management Plan.

Table 7.45 Archaeological Impact and Specific Mitigation Measures

Archaeological Program Area	Impact of the Project	Specific Mitigation Measure
A - Ravensworth Homestead Complex	High – all archaeology, State and Local, will be removed as a result of the Project.	Prior to any ground disturbance – a) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. b) The remainder of Area A not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.
B -8 Acre Garden (Landscape Group 4)	High – all archaeology, State and Local, will be removed as a result of the Project.	Prior to any ground disturbance – a) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. b) The remainder of Area B not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.

Archaeological Program Area	Impact of the Project	Specific Mitigation Measure
C - Northern complex	High – all archaeology, State and Local, will be removed as a result of the Project	Prior to any ground disturbance – a) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. b) The remainder of Area C not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.
D - Area to East of Homestead Complex and surrounds	High – all archaeology, State and Local, will be removed as a result of the Project.	Prior to any ground disturbance – a) Targeted archaeological testing - machine and hand excavation. b) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. c) The remainder of Area D not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.
E - Silo	High – all archaeology, State and Local, will be removed as a result of the Project	Prior to any ground disturbance – a) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. b) The remainder of Area E not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.
F - Old House site	High – all archaeology, State and Local, will be removed as a result of the Project	Prior to any ground disturbance – a) Further targeted archaeological testing - machine and hand excavation. b) Targeted open area stratigraphic excavation - archaeological salvage and archaeological sampling - machine and hand excavation. c) The requirement for monitoring within and outside the remainder of Area F, not subjected to targeted archaeological investigation, is to be determined, by the archaeologist, upon completion of the archaeological program.
G - Linear Structure (Landscape Group 2 in SoHI)	High – all archaeology, State and Local, will be removed as a result of the Project	Prior to any ground disturbance – a) Targeted open area stratigraphic excavation – archaeological salvage and archaeological sampling - machine and hand excavation. b) The remainder of Area G not subjected to targeted open area stratigraphic excavation would be managed through the unexpected finds protocol if deemed appropriate, by the archaeologist, at the end of the investigation.

Archaeological Program Area	Impact of the Project	Specific Mitigation Measure
H - Other Areas	Low to High –archaeology, State and Local, may be removed as a result of the Project	Unexpected finds procedure applies

The archaeological program areas referred to in **Table 7.46** are shown in **Figure 7.8.26**.

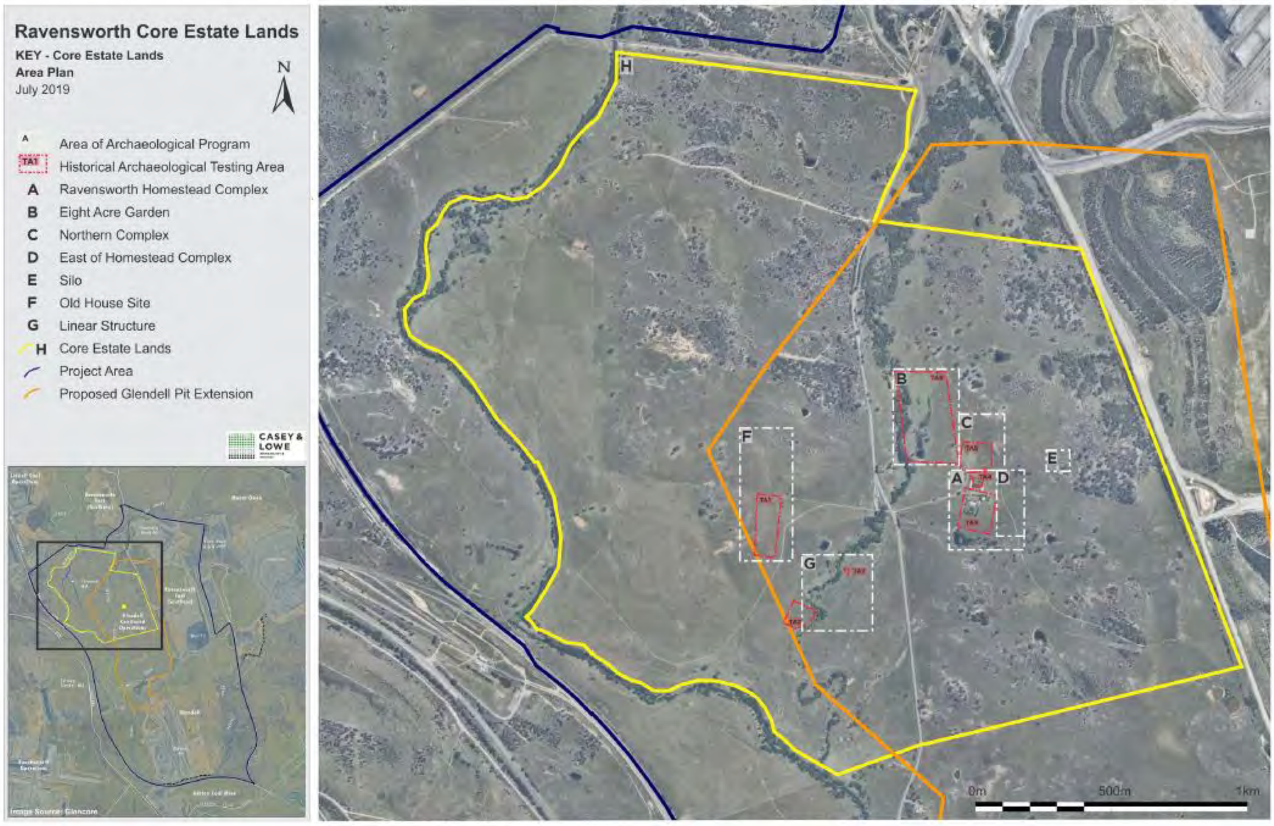


Figure 7.8.26 Areas recommended by C&L for archaeological salvage excavation in relation to the testing areas

7.8.9 Statement of heritage impact

LSJ were engaged to prepare a Statement of Heritage Impact (SoHI) for the Project, encompassing the proposed continuation of the existing Glendell Mine (the Additional Disturbance Area/Glendell Pit Extension/new mining infrastructure area), all of which are located on land that is part of Ravensworth Estate. In addition, the SoHI also assesses the heritage impact of each proposed Ravensworth Homestead Complex relocation option.

The SoHI is provided in full in **Appendix 23d**. The following sections provide a summary of the SoHI findings by LSJ.

7.8.9.1 Methodology

The form and methodology of the SoHI follow the general guidelines for statements of heritage impact outlined in the following documents:

- *Australia ICOMOS Charter for Places of Cultural Significance (The Burra Charter)*, Australia ICOMOS Inc. 2013
- *Assessing Heritage Significance,* NSW Heritage Office, 2001
- *Statements of Heritage Impact,* NSW Heritage Office, 2002
- *NSW Heritage Manual*, NSW Heritage Office, 1996

LSJ reviewed four potential heritage impact assessment methodologies, being an assessment of the impacts of the proposal against the following:

1. the heritage significance of each item,
2. a formal Conservation Management Plan,
3. the provisions of the relevant Local Environmental Plan (Singleton LEP, 2013) or
4. the provisions of the relevant Development Control Plan (Singleton DCP, 2014)

Given that a formal CMP is not prepared for the Project due to the Project approval being sought in accordance with State Significant Development (SSD) policy and therefore not seeking approval through the NSW Heritage Act, and given that the LEP provisions are very general, assessment methodologies 2 and 3 (above) were not adopted. Assessment Methodology 1, being an assessment against the significance of each item was chosen as the most appropriate methodology for the SoHI for the Project. A further assessment was also completed against Assessment Methodology 4 as the Broke Village option will be subject to secondary approvals and as part of those secondary approvals processes the consent authority will need to consider the provisions of the Singleton DCP (2014).

Further details of the assessment impact methodology and impact ranking processes are provided in the SoHI (**Appendix 23d**).

7.8.9.2 The relocation of Heritage items

LSJ notes that the relocation of a heritage item to a new site is not generally considered desirable as it removes the item from its historical location and from its physical setting which may contribute to the culture significance of the item. The Australia ICOMOS *Burra Charter* (2013), supports this position:

"Article 9.1 Location. *The physical location of the place is part of its cultural significance. A building, work or other element should remain in its historical location. Relocation is generally unacceptable unless this is the sole practical means of insuring its survival*".[6]

Whilst this is a general rule applicable to a heritage place, there are exceptions to this where it may not be applicable.

[6] Australia ICOMOS Incorporated, 2013; *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*, p. 5

One of these exceptions is included in Article 9.1 which says "*….. relocation is generally unacceptable unless it is the sole practical means of insuring its survival*."[7] In this regard a number of smaller rural structures around NSW have been moved into theme villages (at Forbes, Griffith and Wilberforce) because, otherwise, they would have fallen down over time or been demolished.

A smaller number of more important buildings have been relocated in Australia, either by moving intact or via being dismantled and rebuilt. A summary of these and their current heritage listing status is included **Table 7.46** below.

Table 7.46 Buildings in Australia that have been Relocated (LSJ, SoHI 2019)

Item	Moved to	Large sections/rebuilt?	Heritage listing
Brigidine Convent, Coonamble, NSW (weatherboard)	Convent Hotel, Halls Road, Pokolbin, NSW	Large sections	No
Buxton Cottage, Mount Hunter, NSW	Wirrinya Place, Grasmere, NSW	Rebuilt	No
Moore's Bond Store, Walsh Bay, NSW	Nearby at Walsh Bay, NSW	Rebuilt	Yes- S170 Register Sydney Ports Corporation
Hornsby Signal Box, Hornsby Railway Station, Hornsby, NSW	Closer to Station House, Hornsby Railway Station, Hornsby, NSW	Intact move	Yes- S170 Register State Rail Authority (part of a group)
Former National Mutual Life Assurance of Australia, Victoria Square, Adelaide, SA	34 m to the north, 199-201 Victoria Square, Adelaide, SA	Intact move but only façade and 1 room deep.	Yes- SA State heritage register
Former skating rink, Ashfield, NSW	Beau Brown Pavilion, Bathurst Showground, Bathurst, NSW	Rebuilt	Yes- local heritage item

The above table shows that some of the places are still, after relocation, considered to be of heritage significance albeit that their significance may have been reduced by the relocation. Accordingly, it can be concluded that aspects of significance can be conserved in spite of an item being moved and these may be sufficient to maintain a state or local heritage significance listing.

7.8.9.3 Relocating the Ravensworth Homestead complex

In the case of the Ravensworth Homestead Complex, LSJ notes that the location of the buildings is of significance and the setting of the buildings does contribute to its significance. Accordingly, relocation is not desirable from a heritage point of view. However, relocation to the Ravensworth Farm site would mitigate loss of significance associated with location and setting (see HASS in **Appendix 23a**).

Given the location of the proposed Glendell Pit Extension, it is not possible to retain the Homestead in its current location. Therefore, the proposal to relocate the Ravensworth Homestead Complex is the "sole practical means of insuring its survival." The justification for this is included in the Ravensworth Homestead Relocation Justification Report (refer to **Appendix 23e**). The justification is mainly the significant economic value of the proposed mine and associated employment opportunities that would be produced, whilst also providing, in the case of the Ravensworth Farm option, a relocation option that provides substantial retention of heritage values.

[7] Ibid.

In the case of the Ravensworth Homestead Complex there are several aspects of exceptional significance under the criteria of aesthetic significance that would, in fact, survive relocation and be evident in the relocated buildings. These are the 'H' shaped plan of the house (which is recommended to be revealed) and the formal arrangement of the buildings around the farm yard. Both these architectural attributes are rare and exceptional in art- historical terms (refer to **Appendix 23a**). There are other attributes that would survive relocation including:

- Group of fine Colonial period buildings
- Good example of a Colonial Bungalow

Accordingly, LSJ notes that the Ravensworth Homestead Complex contains aspects that are worth (and would survive) moving (as opposed to recorded and demolished).

7.8.9.4 Building configuration

LSJ considers that given the significant work to be done to the buildings and immediate surrounds, to achieve the relocation of the Ravensworth Homestead Complex, consideration of the appropriate new configuration is required. LSJ considers the adaptations proposed for the relocation to Ravensworth Farm will retain the 'H' plan form of the house, and the reconstruction of lower walls of the potential 'convict barracks' to appropriate scale and with appropriate materials will be desirable to the interpretation of the place.

The Broke Village option would also retain the 'H' plan form and includes a covered stage area in the location of the potential original 'convict barracks' to enclose the courtyard. According to LSJ some areas such as the proposed outdoor seating, amenities and covered stage area may lead to unsympathetic buildings being constructed. Similarly, the proposed café/restaurant building does not specify materials or provide elevations. Generally, the suggested landscape elements such as paving, garden beds, pergolas etc appear to be of appropriate scale for a retail precinct. LSJ notes that further design development including elevations, material types etc should be developed as part of the secondary approval process.

7.8.9.5 Restorations and repairs

LSJ notes that repairs, restoration and reconstruction works are usually desirable and of positive heritage impact, however they may not be appropriate if they distort the understanding of the place.

Both options do not relocate the 3 northern rooms of the Main House which is assessed to be an appropriate interpretation. The addition, made about 1920, is of low significance and its presence confuses the understanding of the original 'H' shape of the Colonial House form which is of exceptional significance. Both options also include the reconstruction of the rear (northern) verandahs of the Main House which is considered by LSJ to be appropriate.

Both options include reconstructing the east wall of the Stable and the west wall of the Barn. As these changes, although part of the history of the place, can be seen as potential impacts to the fine Colonial building group, LSJ's assessment is that these are appropriate.

Other aspects such as removal of the skillion and roof gable vents, retaining the slate roof, reconstructing the front verandah columns, reconstructing the kitchen bread oven, and removal of the Marshall era alterations such as the sheering facilities and masonry tank at the Stables and cow bales in the Barn are also considered desirable by LSJ.

7.8.9.6 Introduced interpretation

As well as interpretation provided by restoration and reconstruction, providing introduced interpretive devices to heritage places is normally considered desirable. In this case, both relocation options could include substantial amounts of interpretative information about the history and significance of the Ravensworth Homestead Complex and the Ravensworth Estate. This would be in the form of: audio-visual presentations and displays, signage, displays of artefacts etc.

LSJ notes that the Ravensworth Farm proposal includes a dedicated Ravensworth History Building as an adaptation of the Men's Quarters. This facility will be nearby the proposed mining office and consequently will be available for public access upon arrangement. It is also noted by LSJ that whilst the Broke relocation option is at present silent on interpretation, the site is well placed for public visitation and this option would benefit from incorporating introduced interpretation devices into the proposed relocation and adaptation scheme.

7.8.9.7 Attributes of the recipient site

LSJ notes that an appropriate location is, firstly, one that gives verisimilitude to the existing landscape setting including the approach direction (thus allowing interpretation of the pastoral location and character of the existing location). Then, secondly, more practical attributes such as a water supply, proximity to services and proximity to public visitation.

The Ravensworth Farm recipient site provides an immediate land form, verisimilitude of setting (not fully achieved until the completion of mining) and proximity to services and public visitation.

On the other hand, the Broke recipient site does not provide a similar immediate land form nor, in the current conceptual design, a completely authentic arrangement of buildings, nor a visual catchment with verisimilitude to the existing. However, because of its location adjacent to a public through-road, it would provide ready access to services and ready public visitation.

7.8.9.8 Intact relocation vs dismantle and rebuild

LSJ and consultant engineers (Mott MacDonald) have confirmed that they agree that an Intact Move is possible without damage to the buildings (refer to **Appendix 23g**).

By contrast, the proposal to move the Ravensworth Homestead Complex to the Broke Village location involves recording and dismantling the buildings and rebuilding them at the new site where the majority of the building fabric would be disassembled, transported in small pieces, and then rebuilt. While some components, such as the Barn and Stable roof trusses, could be moved intact, the procedure means that a notable amount of the original building fabric would be lost, in particular, mortar, plaster and fixings.

LSJ notes that often after a dismantle and rebuild move, a heritage item is not re-listed. LSJ concludes that given there is the viable alternative of the intact move approach, the dismantle and rebuild approach does not follow the ICOMOS Burra Charter Article 3.1 which, based on respect for existing fabric, uses and associations, calls for a cautious approach of "changing as much as necessary but as little as possible".

7.8.9.9 Heritage impact assessment results

LSJ provides a detailed assessment of the individual components of the overall Project potentially impacting on the heritage values of the Ravensworth Estate, the Ravensworth Farm Option and the Broke Village Option, and includes any mitigation measures nominated in the proposal. The assessment also includes the heritage items and aspects of the broader Ravensworth Estate Lands affected by the Project. Refer **Appendix 23d** for more details.

The Project involves open-cut mining within the perimeter of Ravensworth Estate ('the Place') which is generally of moderate significance and would be of some to notable heritage impact.

Additionally, the Project includes mining within an area of the Ravensworth Estate determined to be the 'Core Estate lands' which is of moderate to high significance and would have notable to very high heritage impact. The Aboriginal archaeological significance of the sites in this area are generally considered to be of low scientific significance, although all Aboriginal artefacts display the cultural connection between the original inhabitants and the land, and accordingly, the impact is to be mitigated by appropriate salvaging procedures and mitigation measures identified in the Aboriginal Cultural Heritage Assessment Report (refer to **Appendix 22**).

Both proposals include open-cut mining within the immediate setting of the Ravensworth Homestead Complex which is of high to exceptional significance and would cause high heritage impact.

The Project would also notably affect the regard in which the land the Ravensworth Homestead Complex is held, and the sense of place it provides as a focus of the locality to the local community (social significance). This would be mitigated considerably by the relocation of the Ravensworth Homestead Complex to the Ravensworth Farm site, which is nearby on the Ravensworth Estate, but would only be mitigated marginally by being relocated to Broke.

The Project includes open-cut mining of the immediate setting of the homestead and under the site of the Ravensworth Homestead Complex which is of high significance and would have high heritage impact in completely changing the physical aesthetic values of the setting and removing the scientific (archaeological) potential of the land. This is mitigated to some extent by the proposal to relocate/rebuild the Ravensworth Homestead Complex at another site. This is mitigated substantially by the proposal for full salvage archaeology of this area which would mean that much of the embodied information about the land will be investigated, recorded and assessed.

The Project includes the open-cut mining of historical archaeological sites of high research potential, including the north-west paddock and the "8-acre garden", and would be of high heritage impact. However, this impact would be substantially mitigated by the proposal to carry out salvaged archaeology which would mean that much of the embodied information about the land will be investigated, recorded and assessed.

The Project includes the removal of some of the buildings, buildings sites and archaeology relating to the late 19th century subdivision of the Estate which are sometimes of moderate significance and this will have notable heritage impact. However, some of the former Ravensworth Estate lands will remain undisturbed including buildings and archaeology relating to the later period of subdivision.

The Project includes re-routing of a section of Hebden Road which is of high significance and would be of notable heritage impact. This is mitigated by the retention of Hebden Road outside the Additional Disturbance Area (but elsewhere within the Estate) and by the proposal to re-route the road within the Additional Disturbance Area.

The Project includes the re-routing of a section of Yorks Creek which is of moderate significance and will be of notable heritage impact. This is mitigated by the retention of Yorks Creek elsewhere within the Ravensworth Estate and the proposed reconnection to and landscaping of Yorks Creek to Bowmans Creek.

The proposal to relocate the Ravensworth Homestead Complex, which is of high significance and contains some exceptional significance values, in an Intact Move to the Ravensworth Farm site would:

- Remove buildings from their historic location which would be a high heritage impact. This is mitigated to some extent by the proposal to site the relocated buildings at a place with similar land form, orientation and pastoral character to the existing location (a visual catchment with verisimilitude to the existing).

- Involve the loss of some building footings which would be of notable heritage impact.

- Retain the great majority of the building fabric by moving the buildings wholly intact which would be accordingly of no heritage impact.

- Retain the aesthetic values of the buildings as examples of Colonial Bungalow architecture and a colonial period farm building group which would have no heritage impact.

- Retain the formal farm yard layout and retain and reconstruct the H-form plan of the house which are attributes of exceptional significance with accordingly no heritage impact.

- Restore and repair dislodged and damaged parts of the buildings of high heritage significance which would be a positive heritage impact.

- Adapt the homestead buildings which are of high heritage significance in a manner that would be of low and acceptable heritage impact.

- Provide confirmed and likely viable future uses for the buildings which is an important consideration in reducing the likelihood of impact by damage-by-neglect in the future.

- Not have any substantial impact on the significance of the Ravensworth Farm Site (Site 27) as this site is of little significance as the proposed Ravensworth Homestead Complex site is suitably removed from the features that make up the modest significance of that site.

The proposal to relocate the Ravensworth Homestead Complex to Ravensworth Farm includes the removal of the homestead garden and other nearby plantings, some of which are of moderate to exceptional significance and this would have high heritage impact as they are part of the history of the property and the setting of the important buildings. This is mitigated by the proposal to salvage the most interesting of the plantings, establish a temporary nursery for their care and to replant this vegetation as part of a sympathetic setting for the relocated Ravensworth Homestead Complex.

The proposal to dismantle the Homestead buildings, which are of high significance and contain some exceptional significance values, and rebuild them at Broke (Dismantle and Rebuild Move) would:

- Remove the buildings from their historical location which would be a high heritage impact. This is not mitigated by the proposed site at Broke which does not have a similar land form or pastoral character to the existing location (does not provide a setting with verisimilitude to the existing)

- Involve the loss of substantial building fabric such as mortar, plaster and fixings and this would have a high heritage impact as they are part of the buildings, although some of the elements such as roof trusses may be able to be relocated in whole sections.

- May retain the aesthetic values of the buildings as an example of Colonial Bungalow architecture although this would be in the form of a rebuilt building or partial replica and this would be of substantial heritage impact as not being entirely the ‘real’ old buildings.

- Not retain a formal farmyard layout in the same dimensions of the existing which is one of the aspects of the place of exceptional significance and would be a high heritage impact. However, the proposal includes the reconstruction of the H-form plan of the main house which is also an attribute of exceptional significance.

- Not reconstruct/interpret the original layout of the buildings as they are not proposed to be rebuilt on the same gradient levels (except for the house/kitchen), which would be a high heritage impact.

- Restore dislodged parts of the buildings and repair by replacement other parts of the buildings of high significance and this would be of possibly neutral heritage impact.

- Adapt the homestead buildings which are of high significance, which would have a high heritage impact due to the amount of change proposed (removal of walls etc.).

- Provide possible viable future uses for the buildings which is an important consideration in reducing the likelihood of impact by damage-by-neglect in the future.

- Not have any substantial impact on the significance of the public reserve at Broke as this site is considered of little significance (and not a local Heritage Item) and is suitably removed from other Heritage Items located at Broke (churches and war memorial).

The proposal to dismantle and rebuild the Ravensworth Homestead Complex at Broke includes the removal of the homestead garden and other nearby plantings, some of which are of moderate to exceptional significance and this would have high heritage impact as they are part of the history of the property and the setting of the buildings. This is only marginally mitigated by the proposal to salvage and establish for them a temporary nursery and replant the vegetation as a part of a sympathetic setting for the Homestead buildings as the buildings are not being rebuilt in a configuration matching the existing or at a place with similar land form and pastoral character (verisimilitude) of the existing location.

7.8.9.10 Heritage impact assessment conclusion

LSJ conclude that the Project will have notable heritage impact on the Core Estate Lands and the setting of the Ravensworth Homestead Complex but that this would be mitigated by the proposal to relocate the homestead buildings and carry out comprehensive salvage archaeology.

Having made a systematic assessment of the heritage impact of both the proposed (Intact Move) relocation to Ravensworth Farm and the proposed dismantling and rebuilding (Dismantle and Rebuild Move) to the town of Broke, LSJ conclude that both proposals have high heritage impact in that they would remove the buildings from their historic location and remove them from their historic and aesthetic setting.

The loss of high archaeological potential of the Ravensworth Homestead Complex site and adjacent north-west paddock and “8-acre garden” sites can be substantially mitigated by undertaking comprehensive salvage archaeological investigation, recording and assessment, which is also proposed as part of the Project. It can be argued that such archaeology is in fact a rare opportunity to investigate a rural-based Colonial convict site that, has not been substantially disturbed (by later development) since its construction in the early 19th century.

The proposal to relocate the Homestead buildings wholly intact (Intact Move) to the nearby Ravensworth Farm site which has an appropriate gradient, orientation and pastoral character (verisimilitude) and to adapt it for a substantive new use prior to it reverting to (potentially) a future use as a rural homestead is a substantial mitigation of the high heritage impact of removing the buildings from their historic location. The proposal to use the Ravensworth Homestead Complex once again as a homestead attached to an adequate parcel of land commensurate with viable pastoral uses is, in LSJs view, the preferred long term/future use for the Ravensworth Homestead Complex in its new location at the Ravensworth Farm site.

However, it is acknowledged that following the closure of the mine in 20 years, the reinstatement of pastoral uses may not be appropriate depending on future community and local government requirements and economic factors in the locality. As such, if an alternative compatible use is proposed prior to the end of mining, which is then assessed and implemented in accordance with any (required) approved historic heritage management plan for the Ravensworth Homestead Complex, then a new, compatible future use for the Ravensworth Homestead Complex may be appropriate.

The proposal to dismantle and rebuild the Ravensworth Homestead Complex buildings at the reserve in Broke (Dismantle and Rebuild Move) does not, in LSJs view, provide a strong mitigation of the proposal to remove the buildings from the historic location, as the process will result in the loss of a substantial amount of heritage fabric, not put the building group in an authentic configuration, nor an appropriate land form or location of pastoral character (not give verisimilitude).

LSJ concludes that neither of the relocation proposals are desirable outcomes on the sole grounds that in isolation, they represent desirable heritage conservation work. However, in the context of the proposed Project, should the Consent Authority approve removal of the Ravensworth Homestead Complex from its existing location for reasons other than heritage, then the best option, by a considerable margin, of the two relocation options proposed is the relocation of the buildings wholly intact (the Intact Move) to the nearby Ravensworth Farm site. LSJ believes that the Ravensworth Farm option (Option 1) puts the buildings in an appropriate setting, involves the least damage to the significant fabric and provides the most likelihood of ongoing sympathetic use, treatment and maintenance.

7.8.10 Community consultation outcomes

Key stakeholders and community members in the wider Singleton LGA identified a range of values in relation to the homestead, with consistency in themes evident across both key stakeholders and respondents of the wider community survey across the Singleton LGA. **Table 7.47** provides further clarity around those stakeholders who participated in consultation around the Ravensworth Homestead. Further details on the program of consultation activities undertaken, and detailed analysis of the results, are provided in the SIA in **Appendix 11**.

Table 7.47 Participants in SIA Consultation on Ravensworth Homestead

Stakeholder	Description
Key Stakeholders	
Near Neighbours	Landholders including residents and businesses residing in proximity to the current mining operation in the localities of Camberwell, Middle Falbrook, Falbrook, Glennies Creek and Hebden
Aboriginal stakeholders	A number of Aboriginal groups and service providers (note that this refers specifically to those Aboriginal stakeholders consulted as part of the SIA regarding social issues, not to all of those consulted as part of the Aboriginal cultural heritage assessment discussed in the EIS). Participants included • Wanaruah Local Aboriginal Land Council (WLALC) • Wonnarua Nation Aboriginal Corporation (WNAC) • Ungooroo Aboriginal Corporation
Community and heritage stakeholders and group representatives	Including community groups and individuals associated with the area with a specific interest in heritage aspects of the project, emergency services and service providers. Participants included: • Members of the Ravensworth Homestead Advisory Committee (RHAC) • Individuals with a specific interest in heritage • Singleton Historical Society and Museum • Singleton Heritage Advisory Committee

Stakeholder	Description
	• Past owners of the Ravensworth Homestead • Emergency services, local bus company and local halls (Hebden Hall & Mount Olive)
Wider Singleton LGA Community	
Wider community	Singleton Local Government Area (LGA) residential and business community. Random sample of residents in the Singleton LGA contacted via a random telephone survey (fixed line and mobile phones) (n=251 from the Singleton Local Government Area and n=22 from the Broke and surrounding community, with a total of n=273).

Outcomes of the consultation have been separated to reflect the views of key stakeholders – those with a more active interest in the homestead and/or those that live in proximity to the Homestead (i.e. near neighbours, Aboriginal groups, community and heritage stakeholders), in contrast to the views of the wider Singleton LGA community, as further described below.

Across stakeholder groups, the level of knowledge of the homestead varied, with key stakeholders holding a higher level of knowledge than the wider community. This finding is not surprising given that the homestead has been owned by Glencore since its purchase in 1997 and as a result has not been accessible to the community, other than through specifically organised meetings/events or upon arrangement.

Overall, respondents agreed or strongly agreed that the homestead was an important part of the heritage of the Singleton LGA (79%); the homestead signifies an important piece of both local (87%) and state (78%) history; and that it is generally important to preserve things of heritage value (92%). All respondents who indicated that they want the homestead to remain in situ (i.e. do not relocate) agreed or strongly agreed with these statements.

Similarly, the majority of respondents agreed or strongly agreed that the Homestead needs to be relocated to avoid deterioration (72%), that it should be available for community use (81%), that it must be commercially viable to be sustainable (67%) and that someone must be responsible for care of the Homestead (94%) (refer to **Table 7.48**) . Respondents advocating that the Homestead remain in situ were less likely to agree that the homestead would deteriorate if left in situ, and that the homestead needed to be commercially viable to be sustainable.

Table 7.48 Wider Community Attitude Statements regarding the relocation of the Ravensworth Homestead

	Strongly disagree	Disagree	Neither agree/ disagree	Agree	Strongly agree
Relocation					
The homestead needs to be relocated, otherwise it will deteriorate like other heritage buildings	7%	10%	11%	46%	26%
I think the homestead should be available for the community to access and use	1%	6%	11%	51%	30%
To ensure the homestead has a sustainable future, it needs to be commercially viable	2%	16%	16%	51%	16%
Someone needs to be responsible for looking after the homestead	0.4%	3%	3%	62%	32%

Relocation Option Preferences

The SIA (refer to **Appendix 11**) provides further analysis of attitudes and response themes from all stakeholders in relation to relocation option preferences. A summary is provided below.

From a combined key stakeholder perspective (near neighbour, heritage groups and Aboriginal stakeholders), option preferences were more closely aligned with 36% of key stakeholders indicating a preference for Option 2 (Broke village) and 32% more supportive of relocation to the Ravensworth Farm Site. 24% of key stakeholders consulted had no preference, with a further 8% outlining that the Homestead should not be relocated at all. The breakdown of each key stakeholder group and their preference is provided in **Figure 7.8.27**.

At the wider Singleton LGA community level, of the 273 respondents that participated in the survey, 61% of respondents that responded to the options question indicated a preference for Option 2 (Broke Village), 29% indicated a preference for Option 1 (Ravensworth Farm site), with 7% indicating a preference for no relocation at all, and 2% with no preference.

A summary of option preferences for the Wider Singleton community and across separate stakeholder groups (Near neighbours, Aboriginal stakeholders and Community and Heritage Stakeholders) is provided in **Figure 7.8.27**.

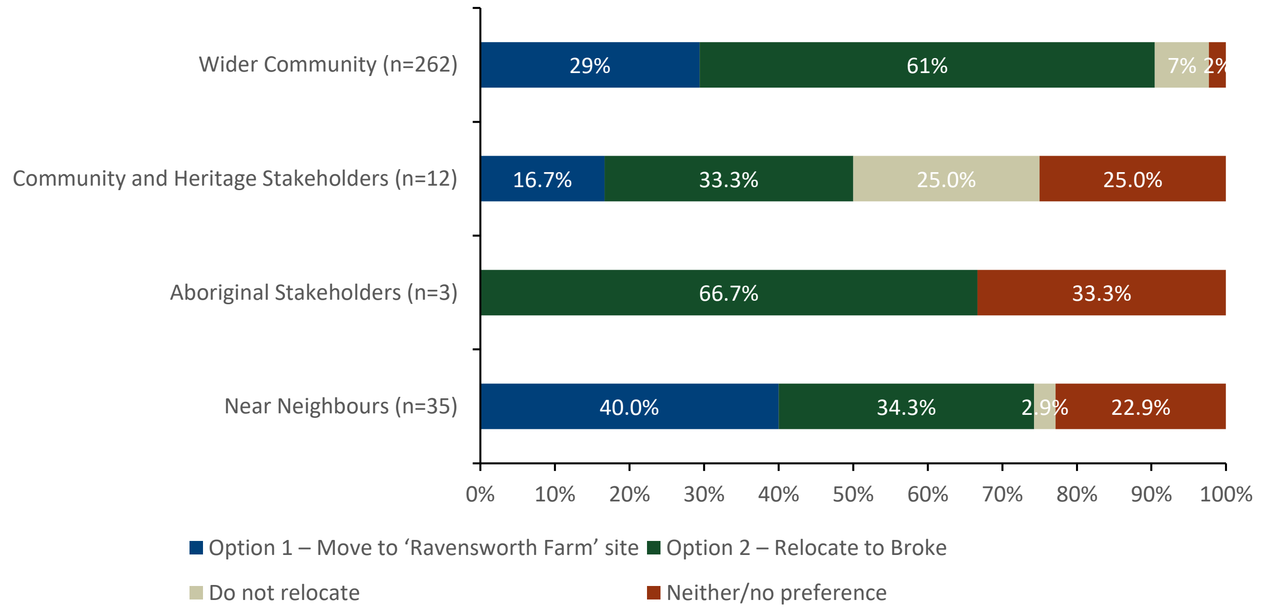


Figure 7.8.27 Of the two options, which do you prefer? Combined Key Stakeholders (n=50) and Wider Community (n=256)

In considering preferences across stakeholder groups, Option 1 (Ravensworth Farm) was more likely to be a preference for near neighbours with stakeholders with a more active interest in heritage issues more likely to indicate that the homestead should remain in situ (do not relocate). Option 2 (Broke Village) was a clear preference for the wider Singleton Community. However, members of community groups and those with an interest in heritage were more divided in their preferences.

In relation to Option 1 (Ravensworth Farm) prominent themes included preference centred around maintaining local history and heritage value given the connection to the Ravensworth locality and its community. As noted by local stakeholders, the homestead is seen to be the last building that represents the history of the Ravensworth village and locality and contributes to local stakeholders' sense of place.

Those stakeholders that identified Option 2 (Broke Village) as their preferred relocation option, justified their option selection on the basis of a number of factors, the most significant of which related to the ability for the wider community to access and use the homestead in the Broke Village. There was also a perception that relocation of the homestead to Broke, would reduce any further risk / damage to the homestead complex due to its current location and any further impact of mining activity.

In addition, there was interest from the Aboriginal stakeholders consulted (n=3) that relocation of the homestead may facilitate the development of a cultural heritage centre within the homestead complex to showcase Aboriginal Art and culture; facilitating further tourism opportunities and local business development.

Risk of damage to the homestead was also raised in association with potential damage to the homestead and its buildings from the relocation method and process. In this regard, there was seen to be less of a risk associated with the intact move to the Ravensworth Farm site.

Further detailed analysis of the outcomes of stakeholder consultation is provided in the SIA (**Appendix 11**).

7.8.11 Management and mitigation

The proposed relocation of the Ravensworth Homestead is a mitigation measure to maximise the preservation of heritage values and fabric associated with the historic buildings. Dependent on the relocation option (Ravensworth Farm or Broke Village), a number of specific mitigation measures for each option are proposed. Refer to **Appendix 5** for a detailed list of management and mitigation measures for each option. The broader heritage management and mitigation measures proposed as part of the Project are outlined below and described in **Appendix 5**.

Glencore will develop a Ravensworth Heritage Management Plan (RHMP) prior to the commencement of any works relating to the relocation of the Ravensworth Homestead Complex to the satisfaction of the Planning Secretary to include the general commitments contained in Section 4.3.1.2 of the Statement of Heritage Impact (refer to **Appendix 23d**).

Glencore will develop an interpretation strategy that includes display and storage proposals for historical archaeological relics salvaged from the Core Estate Lands.

Archival recordings of a number of sites within the Ravensworth Estate will be undertaken prior to any activity associated with the Project that may disturb these sites, refer to **Appendix 5** for a list of these sites.

Glencore will stabilise the Hebden Public School (Site 34) generally in accordance with the preliminary scope of works prepared by LSJ provided in **Appendix 23i**.

Glencore will develop a 3D digital recording of the current Ravensworth Homestead Complex that will enable viewing by the public in the future in order to capture the existing Homestead Complex location and condition, and its interpretation. A Virtual Reality version will be considered to enable smart phone users to “walk” through the original complex, and 3D scanning data will be publicly available for future research purposes.

Management measures associated with Aboriginal heritage are discussed in **Section 7.7** and detailed in **Appendix 5**.

7.9 Rehabilitation and final landform

The creation of appropriate post mining landforms, the effective rehabilitation of areas disturbed by mining and the ability to put these areas to productive use following the cessation of mining are all issues raised by stakeholders in relation to the Project.

The overarching principles that apply to the rehabilitation of the Project are that the rehabilitated landform is safe, stable and non-polluting. These principles also apply to the existing approved operations at the Mount Owen Complex.

This section provides an overview of the proposed conceptual final landform and land uses for the Mount Owen Complex, as amended by the Project, with further detail required by the SEARs as outlined below provided in the Rehabilitation and Mine Closure Strategy (refer to **Appendix 24**), Yorks Creek Realignment Conceptual Detailed Design Drawings (refer to **Appendix 7**), Yorks Creek Diversion Constraints Analysis (refer to **Appendix 18**) and the Mine Planning Options Report (refer to **Appendix 1**).

The Rehabilitation and Mine Closure Strategy (refer to **Appendix 24**) has been prepared to detail the proposed approach to the rehabilitation and mine closure of the Project. The existing approved Mount Owen Complex Rehabilitation and Mine Closure Strategy (subject to the Mount Owen Consent), does not apply to those parts of the Mount Owen Complex regulated solely by the Glendell Consent. The Rehabilitation and Mine Closure 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 Project. Commitments and obligations for those parts of the approved Glendell Mine that are not proposed to be disturbed by the Project will retain their currently approved obligations and rehabilitation completion criteria.

This section of the EIS:

- summarises the general approach to the regulation of rehabilitation at the Mount Owen Complex
- identifies changes to the conceptual landform and land uses associated with the Project
- discusses the rehabilitation practices to be applied to achieve the conceptual final landform and land use
- identifies key risks in achieving the rehabilitation objectives for the Project and the means of managing and mitigating these risks including the process for managing the unexpected cessation of mining operations, and
- includes a discussion of the suitability of the proposed final landform for alternative land uses and the mine closure planning process.
- Consistent with the approved conceptual final landform, one final void is proposed for mining in the Glendell Pit Extension. The Project will not result in any additional voids at the Mount Owen Complex relative to existing approved operations. Development of the proposed conceptual final landform included consideration of potential alternative future land uses and the implications of retaining a final void. The implications of undertaking the mining operations and rehabilitating the final landform to avoid a final void are discussed in **Appendix 1**.

7.9.1 Regulation of rehabilitation

7.9.1.1 Rehabilitation to be undertaken in accordance with management plans

The rehabilitation of disturbance associated with mining projects is regulated by both the development consents applicable to the area and mining leases granted under the Mining Act. Due to the integrated nature of the Mount Owen Complex, all mining activities within the complex operate under a common Mining Operations Plan (MOP)/Rehabilitation Management Plan (RMP) (Glencore, 2019d). The Rehabilitation Strategy (Glencore, 2019h) developed under the Mount Owen Consent however currently only applies to the areas covered by the Mount Owen Consent. Should the Project be approved, a revised Mount Owen Complex Rehabilitation Strategy is proposed to be developed to include the Glendell Pit Extension and the current rehabilitation obligations applicable to the approved Glendell Mine operational area that will remain unchanged as a result of the Project. This updated Rehabilitation Strategy would be based on the Rehabilitation and Mine Closure Strategy (refer to **Appendix 24**).The purpose of the Rehabilitation Strategy is to identify the broad conceptual final landform and land use for the areas covered by providing guidance for the rehabilitation and land management practices and mine closure planning processes for the Mount Owen Complex. The Rehabilitation Strategy is approved by the Planning Secretary and must be consistent with the requirements of the relevant development consent(s).

The detailed rehabilitation practices to be applied in day to day operations and in particular areas are defined in the MOP/RMP prepared for the site. The MOP/RMP is approved by the Resources Regulator.

7.9.1.2 Requirement for security to cover expected closure and rehabilitation costs

Under the terms of the mining leases applicable to the Glendell Pit Extension, security is required to be provided to the Minister administering the Mining Act to cover the expected closure and rehabilitation costs. This security is assessed based on the anticipated costs of rehabilitating the site to a standard which meets the detailed rehabilitation objectives and closure criteria identified under the MOP in force at the time. The security requirements are reviewed whenever the MOP is amended or superseded by a new MOP and on renewal of the mining leases. The calculation (using the Rehabilitation Cost Estimation Tool) is based on costs estimated by the leaseholder and include additional project management costs and a contingency allowance. The security required by the mining lease is set following a review of the rehabilitation cost estimate by the Resources Regulator. In the event of a default by the leaseholder, the security can be accessed by the Resources Regulator and used for the rehabilitation of the site.

Current NSW Government Policy requires the security to be set at a level which covers the full costs of closure including rehabilitating the site.

7.9.1.3 Allocation of rehabilitation responsibilities in overlapping consent areas

The Glendell Pit Extension includes mining in the western part of the Ravensworth East emplacement area located within the Mount Owen Consent Area. The works associated with the realignment of Yorks Creek also include areas within the Mount Owen Consent Area. As discussed in **Section 3.2.17.2**, the rehabilitation and ongoing management of these areas within the Mount Owen Consent Area will be managed under the Glendell Continued Operations Consent following these areas being impacted by the Project. The rehabilitation of all other areas of disturbance within the Mount Owen Consent Area will be managed under the Mount Owen Consent. **Appendix 6** identifies the relevant rehabilitation responsibilities under each of the consents in the conceptual final landform.

7.9.2 Strategic guidance

The key planning strategies relevant to the rehabilitation of the Mount Owen Complex are identified in **Section 4.4**. The Strategic Local Planning Statement being developed by Singleton Council will also provide key strategic guidance on future land use options for the Project. These plans and their application to rehabilitation and mine closure planning at the Mount Owen Complex are discussed further below.

Hunter Regional Plan 2036 (2016) and Upper Hunter SRLUP (2012)

The Hunter Regional Plan (issued by DPE in 2016) provides an overarching strategic planning framework for the whole of the Hunter region, to be supported by more detailed district scale land use plans and infrastructure investment decisions. These detailed district scale land use plans are yet to be completed.

The Hunter Regional Plan refers to a regional productivity transformation over the coming two decades. Drawing on the Smart Specialisation Strategy (RDA 2016) and the Upper Hunter SRLUP, the Hunter Regional Plan identifies industry growth sectors for the region. Currently in the Singleton LGA, mining employment accounts for 23.4% of jobs and manufacturing for 7.5% of jobs.

Potential emerging or strengthened employment opportunities include:

- power generation, technology and mining – land needs to be identified for future technology, manufacturing, resources and diversified power generation sites (including renewable energy)
- growth opportunities in agriculture and agribusiness – ‘high technology primary industry’; this requires the protection of natural resources
- global and regional connectivity, through transport infrastructure for regional products to capital city and international markets
- landscape tourism, linked to the scenic value and food trail possibilities of the viticulture and equine CIC (DPE, 2012)
- knowledge intensive industries, such as research, training and support systems for new technology industries

The Upper Hunter SRLUP also refers to the potential for high value carbon forestry and ecological restoration, as part of the regional mitigation of climate change.

The planning scale of the Hunter Regional Plan is not compatible with detailed identification of site specific land use futures, however it does provide strategic guidance on landscape values and strategic actions that will contribute to a successful transition from the current mining, coal fired energy generation and agriculture based economy.

The Project will provide existing infrastructure such as low and high voltage electricity connections including connections to NSW power grid, extensive water storages, buildings and hardstand areas, a large buffer of land separating the site from surrounding residential uses, connectivity to road and rail transport providing potential for a variety of final land use. By considering these values and actions in the context of the land assets and characteristics associated with rehabilitated mining sites (including final landforms, land capability, biodiversity, infrastructure connectivity and land use compatibility), it is possible to identify strategic opportunities for post mining land uses across the Project Area and more broadly within the Mount Owen Complex.

Singleton Local Environment Plan/Singleton Regional Land Use Strategy

The Project Area and more broadly the Mount Owen Complex is located within the Singleton LGA. The Singleton Regional Land Use Strategy (2008), which has an implementation period extending to 2032, identifies future residential and rural residential growth areas; the value of rural/agricultural tourism linked to the scenic value and biodiversity of the landscape; and the continuation of mining and post mining rehabilitation. The Strategy notes the potential for new post mining uses, but also the need for a strategic review of rehabilitation, infrastructure, and land use options to reduce the risk of incompatible future land uses.

In relation to industrial land, the Strategy notes the potential for adaptive reuse of sites having suitable infrastructure for industrial uses, highlighting former coal mines which have existing water and wastewater infrastructure, roads, rail access, electricity services and are separated from urban areas. The Strategy also notes that some of these sites are currently zoned rural (including the Mount Owen Complex), rather than industrial, which limits the adaptive transition.

Synoptic Plan

The Synoptic Plan (Integrated landscapes for coal mining rehabilitation in the Hunter Valley of NSW) (Andrews 1999) aims to provide a basis for the development of a long term integrated strategy for the rehabilitation of mines sites. The Synoptic Plan includes general principles to be considered in rehabilitation (including final voids and highwall treatments) and a conceptual strategy for establishing habitat linkages within the Hunter Valley through the coordinated design of rehabilitation of areas impacted by mining. 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). These linkages were developed around enhancing biodiversity connectivity between major creek systems and addressing 'missing gaps' in the local and regional biodiversity corridors.

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.

7.9.3 Proposed conceptual final landform and land uses

The conceptual final land uses currently identified for the Mount Owen Complex under the existing Glendell and Mount Owen Consents are a combination of native vegetation and open grassland areas with pit lakes in the Glendell Pit, North Pit and Bayswater North Pit voids. The currently approved conceptual final landform for the Mount Owen Complex is shown in **Figure 7.9.1.**

The proposed conceptual final landform and land uses for the Mount Owen Complex following completion of the Project is also shown in **Figure 7.9.1**.

The Project does not involve any components that require an alteration to the general rehabilitation or land use objectives for the Mount Owen Mine, however the rehabilitation of the North Pit void and part of the North Pit emplacement area may be delayed as a result of North Pit void being used as a water storage for the Project. The use of the Mount Owen CHPP to 2045 will also delay the removal of this infrastructure and parts of the Mount Owen MIA are likely to continue to be used after the completion of mining associated with the Project to serve maintenance needs for plant involved in the rehabilitation of the site and associated workforce related infrastructure.

The Project will result in additional disturbance associated with the Glendell Pit Extension, which extends the existing open cut operations resulting in the final void being located to the north of the presently approved location. The emplacement of overburden material from mining operations will generally be undertaken in-pit to the south as operations progress northwards. While the proposed final void is deeper and has a larger overall capacity, the catchment areas for both the approved and proposed voids are similar as a result of the design of the proposed in-pit emplacement.

Consistent with existing obligations under the Mount Owen Consent, new areas of landform modified as a result of the Project, above natural ground level, will be developed using natural landform techniques and will be progressively reshaped and rehabilitated when they reach the proposed final landform design, over the life of the Project.

There are no additional voids proposed within the final landform as a result of the Project. Consistent with the approved final landform, the proposed void has been designed with retained highwalls, designed to be stable in the long term. The Project will not affect the range of different final land use options that could be suitable for the Mount Owen Complex. The existing infrastructure lends itself to a multitude of potential different industrial and agricultural land uses. The void also has the potential to provide viable options (e.g. water storage), and the complex also has potential tourism and recreational uses. Alternative final land uses will be investigated in detail during the development of the Mine Closure Plan.

Sections 7.9.3.1 and **7.9.3.2** detail the key changes in terms of final landform and land use relative to approved operations at the Glendell Mine.

7.9.3.1 Proposed changes to conceptual final landform

The Project includes the following key changes to the currently approved final landform:

- realignment of lower reach of Yorks Creek
- realignment of part of Hebden Road around mining areas
- Glendell Pit final void being located further to the north
- extension of Glendell in-pit emplacement area to the north and integration with the Ravensworth East emplacement area
- implementation of natural landform drainage into the areas of Glendell in-pit emplacement established as part of the Project
- WRD water storage retained to function as a retention basin in the final landform
- increased catchment draining to Bettys Creek and reduced final landform catchment for Swamp Creek.

To avoid the need for large out of pit emplacement areas, and the associated disturbance of new areas, the Project will require an increase in the maximum emplacement height within the Glendell in-pit emplacement areas from approximately 160 mAHD to approximately 185 mAHD with selected areas up to approximately 200 mAHD to achieve a more natural landform. The Project will also include emplacement on the Ravensworth East emplacement area which will increase the height of emplacement in this area to approximately 185 mAHD in places. The variation in height in the Glendell and Ravensworth East emplacement areas will result in increased landform variability which will provide a more natural looking final landform for these areas. The implementation of natural landform design principles in these areas will also improve the overall visual appearance of these areas once shaped and revegetated.

The final landform associated with the Project will remain below Mount Owen Complex's maximum approved landform height of approximately 230 mAHD (North Pit emplacement area). Additionally, no changes to the final landform in the North Pit emplacement area, North Pit void or WOOP emplacement area currently approved under the Mount Owen Consent are proposed. Cross sections comparing the approved and proposed Glendell conceptual final landform designs are shown on **Figure 7.9.2** and **Figure 7.9.3** and a cross section through the proposed conceptual final landform and the approved conceptual final landform at Mount Owen Mine is provided on **Figure 7.9.4**.

The Project will also directly impact on an area of alluvial flats to the west of the proposed Glendell Pit Extension. Approximately 34 ha of this area is Verified BSAL as assessed under the Interim Protocol. This area contains Land and Soil Capability (LSC) Class 3 and 4 land and is impacted by the following Project components:

- Hebden Road realignment
- new MIA
- Heavy Vehicle Access Road
- relocated telecommunications and electricity infrastructure and
- water management infrastructure.

The Hebden Road realignment and relocated telecommunications and electricity infrastructure will remain in the final landform however the Heavy Vehicle Access Road, new MIA and associated water management infrastructure will be removed unless required for another approved land use in the final landform. 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 LSC Class 4 land (approximately 21 ha).

The rehabilitation objectives for different parts of the landform are based on the proposed conceptual end land use for the area and/or its landscape/ecological function (e.g. creek and drainage lines). These rehabilitation objectives are discussed further in **Section 7.9.4**.

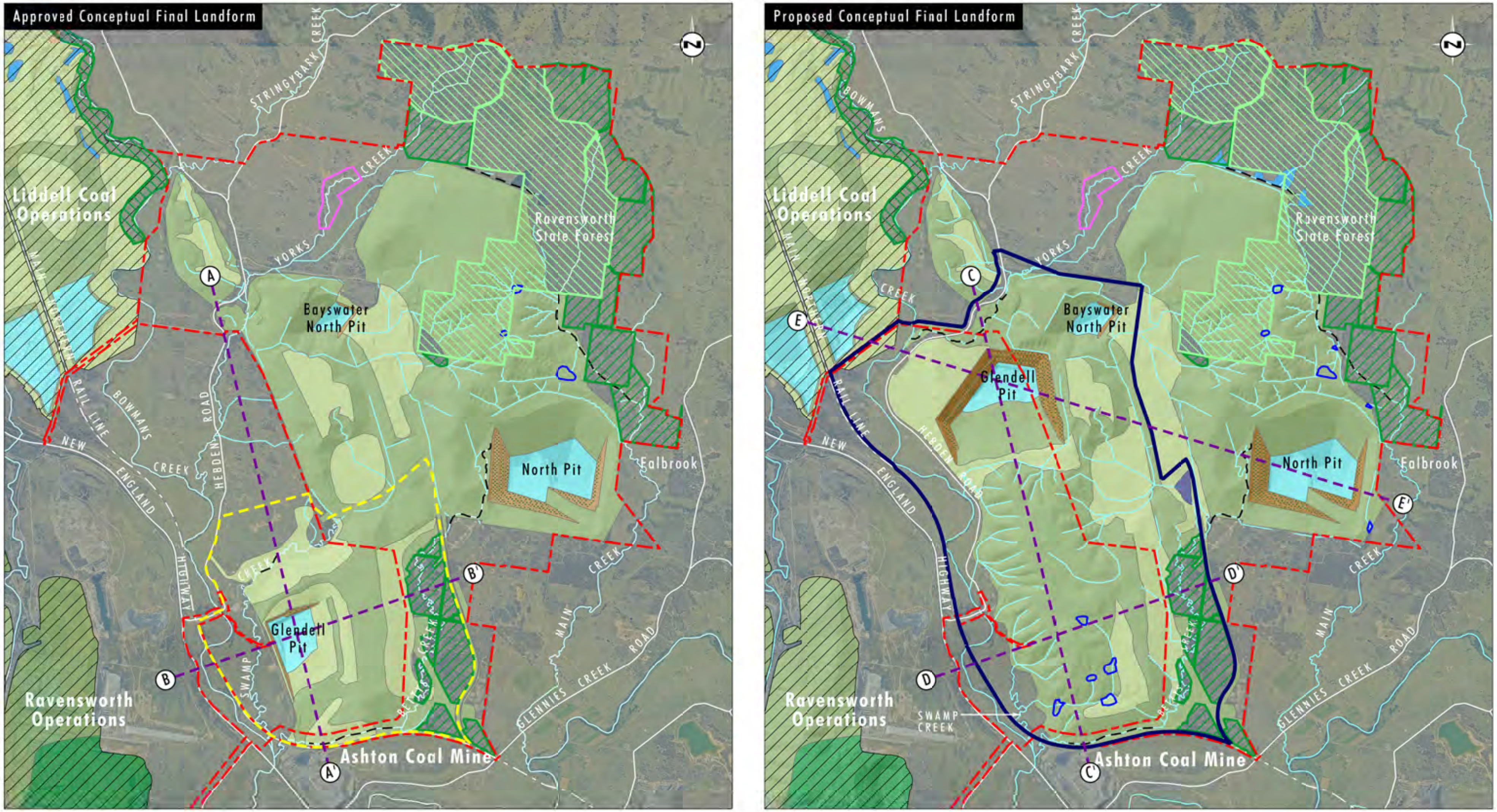


Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), Ravensworth Operation Vegetation: Umwelt (2010), Liddell Coal Operations Vegetation: Umwelt (2016)
Note: Equilibrium pit lake water level shown in voids, Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

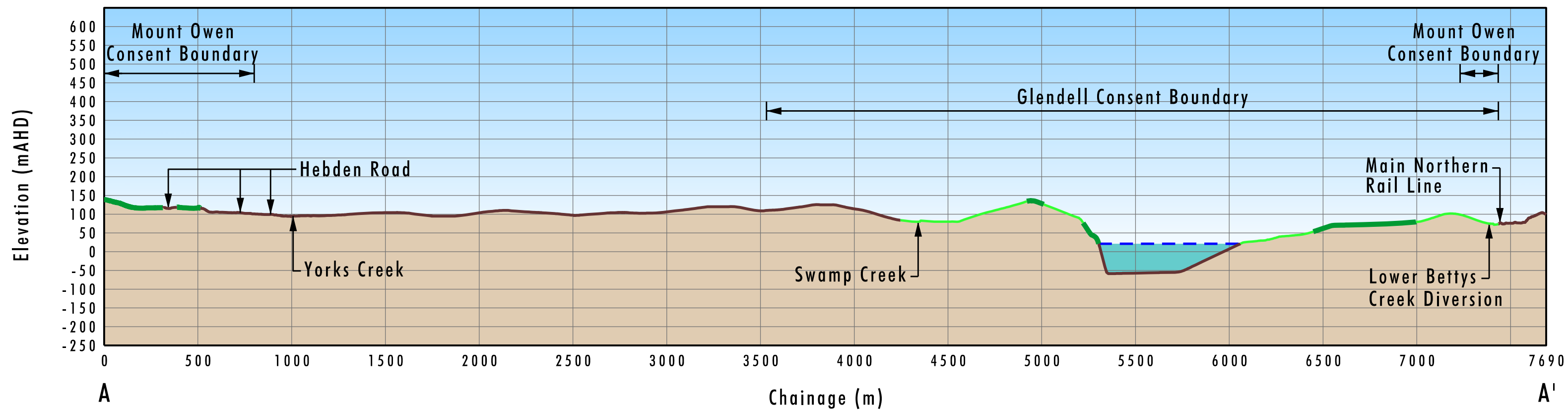
- Project Area
- Glendell Consent Boundary
- Mount Owen Consent Boundary
- Creek Diversion/Realignment
- Native Vegetation
- Open Grassland (Potential Grazing Area with pockets of Native Vegetation)
- Grazing (Ravensworth Operations)
- Vegetated benches on Retained Highwall
- Retained Highwall
- Dryland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

FIGURE 7.9.1

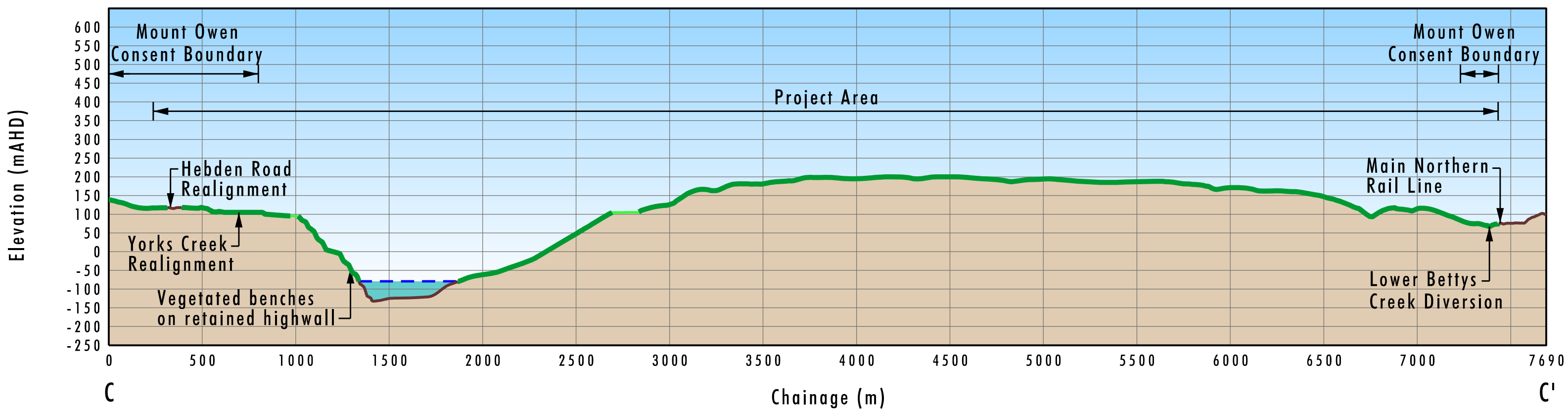
Approved Conceptual Final Landform vs Proposed Conceptual Final landform

File Name (A4): R08/4166_529.dgn
20191129 14.42

umwelt



A-A' Approved Conceptual Final Landform



C-C' Proposed Conceptual Final Landform

0 1.0 2.0 4.0km
Vertical Scale

0 0.5 1.0 2.0km
Horizontal Scale

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

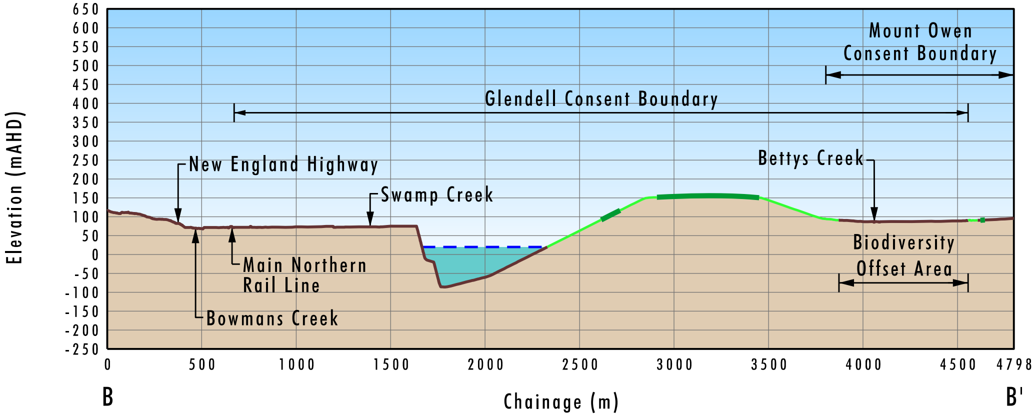
Legend

- Landform Surface
- Rehabilitated Final Landform Surface (Native Vegetation)
- Rehabilitated Final Landform Surface (Open Grassland with Pockets of Native Vegetation)
- Modelled Maximum Pit Lake Level
- Pit Lake

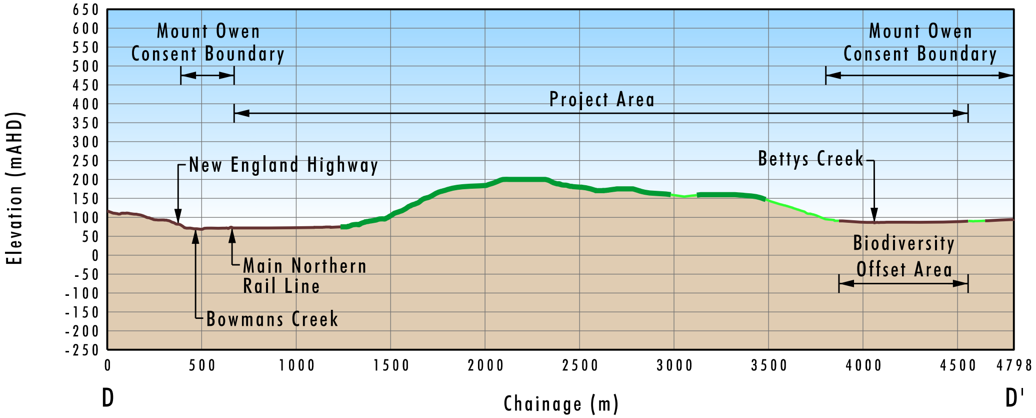
FIGURE 7.9.2

Conceptual Final Landform
Cross Section Comparison
Cross Section A and C

File Name (A4): R08/4166_530.dgn
20191119 13.27



B-B' Approved Conceptual Final Landform



D-D' Proposed Conceptual Final Landform

0 1.0 2.0 4.0km
Vertical Scale

0 0.5 1.0 2.0km
Horizontal Scale

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

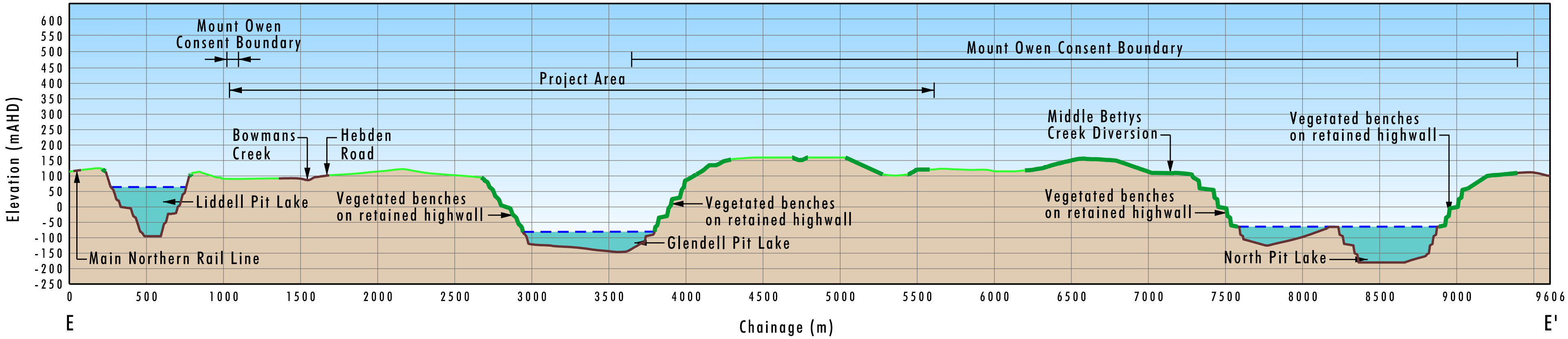
Legend

- Landform Surface
- Rehabilitated Final Landform Surface (Native Vegetation)
- Rehabilitated Final Landform Surface (Open Grassland with Pockets of Native Vegetation)
- Modelled Maximum Pit Lake Level
- Pit Lake

FIGURE 7.9.3

Conceptual Final Landform Cross Section Comparison Cross Section B and D

File Name (A4): R08/4166_531.dgn
20191119 13.31



E-E' Proposed Conceptual Final Landform

Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1.0 2.0 4.0km
Vertical Scale

0 0.5 1.0 2.0km
Horizontal Scale

Legend

- Landform Surface
- Rehabilitated Final Landform Surface (Native Vegetation)
- Rehabilitated Final Landform Surface (Open Grassland with Pockets of Native Vegetation)
- Modelled Maximum Pit Lake Level
- Pit Lake

FIGURE 7.9.4

Conceptual Final Landform Cross Section E

File Name (A4): R08/4166_532.dgn
20191119 13.36

7.9.3.2 Proposed changes to conceptual final land use

As can be seen from **Figure 7.9.1**, the conceptual land uses proposed for the existing approved operations at the Mount Owen Complex are broadly consistent with those proposed in the conceptual final landform as modified by the Project. There is very little proposed to change to the land uses in the Mount Owen Consent Area apart from the WRD water storage being used as a retention basin in the final landform and the changes associated with the Glendell Pit Extension affecting the Ravensworth East emplacement area.

The key land use changes in the final landform associated with the Project is the movement of the Glendell Pit void further to the north, modifications to the Glendell emplacement area (including increased height of emplacement), the increased extent of native revegetation in the final landform and the realignment of part of Yorks Creek. The realignment of part of Hebden Road will remove approximately 13 ha of land from grazing and potential cropping use.

The increased native vegetation areas in the rehabilitated landscape are designed to improve regional habitat connectivity. Some of the areas targeted for native vegetation rehabilitation are currently available for grazing uses however, as discussed in **Section 7.12**, these areas are currently low productivity grazing lands which have been heavily disturbed by past clearing and agricultural uses. Flatter areas in the final landform have been targeted for open grassland uses. These areas are considered the most likely to be able to support sustainable grazing practices into the future with reduced erosion risks.

The location of the native vegetation in the final landform is designed to establish and enhance native vegetation corridors to promote regional fauna movements across the Mount Owen Complex and surrounding region. The conceptual habitat corridors to be created are shown in **Figure 7.9.5**. These corridors will be developed throughout the life of operations at the Mount Owen Complex through progressive rehabilitation of emplacement areas. These corridors are proposed to achieve improved linkages to existing remnant vegetated areas of Ravensworth State Forest as well as the significant areas of woodland area being planted and regenerated in offset areas associated with Mount Owen Complex and approved offset lands for other mining projects in the area (e.g. Liddell Coal Operations offsets to the north west).

The proposed 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.

The proposed final land uses for the site are consistent with the objectives of each of the strategic plans in that it increases the land area identified for ecological restoration and will significantly enhance regional biodiversity linkages. Importantly, the site also provides a number of opportunities for alternative land uses with employment opportunities which can occur concurrently with the proposed biodiversity outcomes.

As a result of other recent mining projects in the Singleton LGA, Glencore has committed to ongoing consultation with Singleton Council to assist with the development of strategic land use planning that will help to provide a sustainable future for the community of Singleton post-mining. As part of the recent approval for the Mount Owen Continued Operations Modification 2, Glencore has committed to the development of a final land use strategy to investigate the potential post-mining beneficial land uses for the Mount Owen Complex. The final land use strategy will be developed as part of the mine closure process and will consider alignment with local strategic planning instruments, provision of a sustainable future for the community, utilisation of existing infrastructure and ecological rehabilitation requirements.

7.9.4 Proposed rehabilitation and mine closure strategy

As part of the approval process for mining operations approved under the Mount Owen Consent, a Rehabilitation Strategy was prepared to provide guidance for the rehabilitation and closure process applicable to the area within the Mount Owen Consent Area. This strategy was developed in consultation with the Resources Regulator and Singleton Council and has regard to strategic local, regional and State planning policies and strategies relevant to rehabilitation and the long-term use of land in the area.

The Mount Owen Rehabilitation Strategy draws heavily on the extensive and successful rehabilitation experience at the Mount Owen Complex and other Glencore operations in the Hunter Valley. The currently approved Rehabilitation Strategy under the Mount Owen Consent does not formally extend to areas outside the Mount Owen Consent Area but has regard to local and regional linkages with native vegetation areas to be developed under rehabilitation commitments under the approved Glendell and Liddell Coal Operations Consents.

As noted above, the Project will result in an extension of mine life, additional disturbance and a modified final landform to that currently approved. However, the overall strategy for rehabilitating the proposed conceptual final landform is generally consistent with the currently approved Rehabilitation Strategy for the Mount Owen Consent and existing rehabilitation practices. Significant areas of the Mount Owen Complex are well advanced in terms of native vegetation rehabilitation objectives and significant research has been undertaken at the Mount Owen Mine which has informed these rehabilitation practices. The learnings from these practices and the rehabilitation practices at other Glencore operations in the Hunter Valley will be applied to the rehabilitation of the Mount Owen Complex, including the Glendell Pit Extension.

The Rehabilitation and Mine Closure Strategy for the Mount Owen Complex incorporating the Project is included as **Appendix 24**. The Rehabilitation and Mine Closure Strategy includes the final landform design objectives and is developed as a consolidated strategy for the Mount Owen Complex and has regard to the existing approved Mount Owen Rehabilitation Strategy.

The Rehabilitation and Mine Closure Strategy is not intended to be prescriptive in relation to the rehabilitation practices adopted but rather provides the conceptual rehabilitation and closure objectives and preliminary completion criteria for the Mount Owen Complex including the Project. Consistent with the existing regulatory framework, the detailed rehabilitation practices to be implemented at the Mount Owen Complex including the Glendell Pit Extension will be documented in the MOP/RMP. The existing results of rehabilitation at Glencore operations in the Hunter Valley, including the Mount Owen Complex provide a high degree of confidence that the rehabilitation objectives set out in the Rehabilitation and Mine Closure Strategy can be achieved for the Project.

Section 7.9.4.1 describes the key final landform design considerations for the Project which are contained in the Rehabilitation and Mine Closure Strategy. These are broadly consistent with the existing approved Rehabilitation Strategy under the Mount Owen Consent. The two main areas where the Project differs from existing approved operations are the proposed realignment of part of Yorks Creek and the handling of soils in the area of Verified BSAL and rehabilitation of this area. These are discussed in **Sections 7.9.4.2** and **7.9.4.3** respectively. **Section 7.9.4.4** sets out the rehabilitation objectives for the Mount Owen Complex. **Section 7.9.4.5** discusses the key rehabilitation risks in relation to the Project.

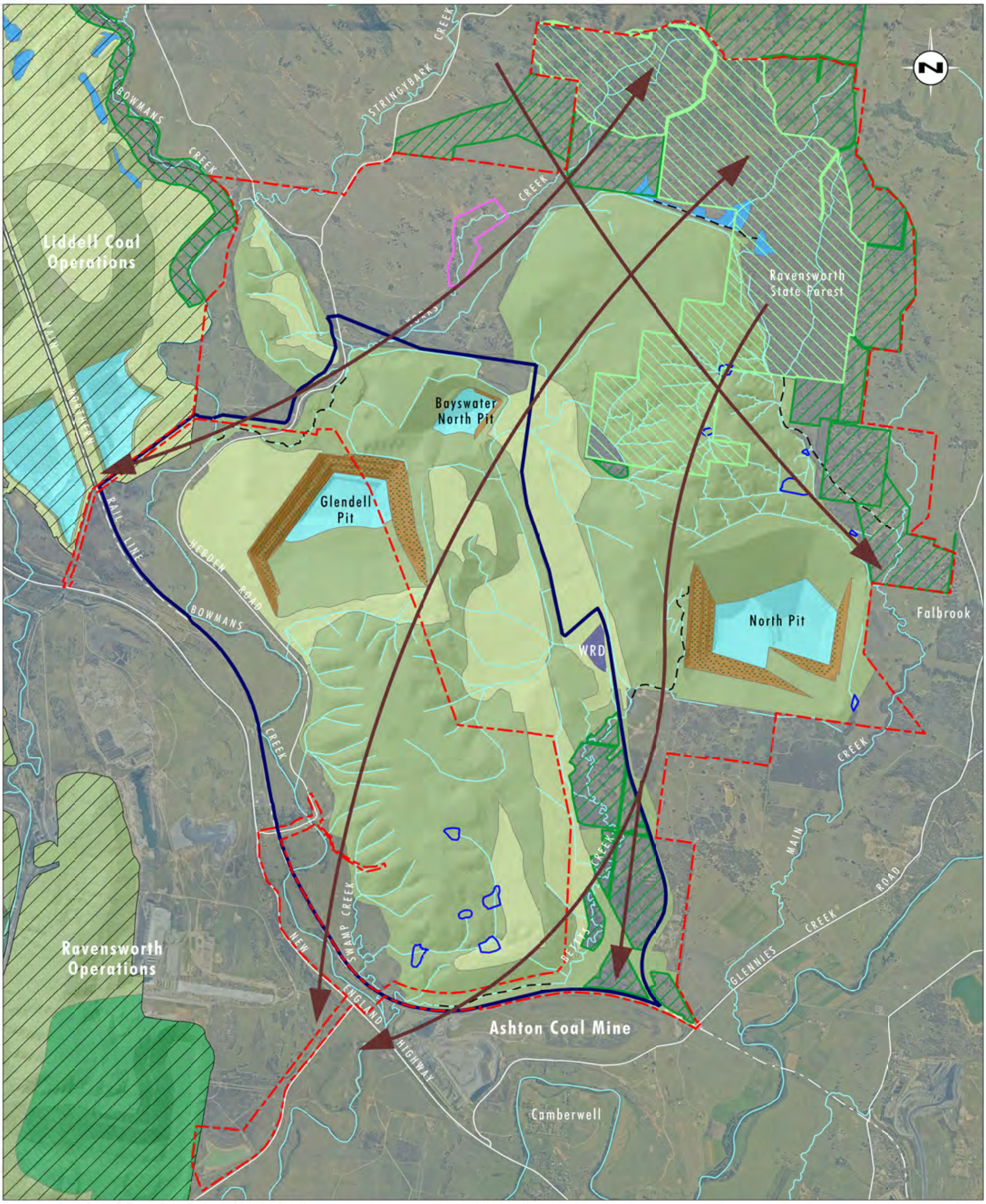


Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), GHD (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

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 7.9.5

Conceptual Regional Habitat Linkages through the Conceptual Final Landform

File Name (A4): R08/4166_571.dgn
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7.9.4.1 Proposed final landform design considerations

The following section discusses the general design considerations relevant to the conceptual final landform design including the small area of Verified BSAL within the Additional Disturbance Area and the design of the Yorks Creek Realignment. Further detail in relation to the conceptual final landform design and management requirements is provided in the Rehabilitation and Mine Closure Strategy, refer to **Appendix 24**.

The proposed conceptual final landform has been developed in consideration of natural landform design principles that will be incorporated into the design of the shaped overburden emplacement areas. The inclusion of more detailed natural landform design elements will assist in effectively managing runoff, enhance the long-term stability of the landform and be largely sympathetic to the profile of the post-mining land use landscape. The proposed conceptual final landform will integrate with the conceptual final landform design approved under the Mount Owen Consent including maximising the drainage and return of water to surrounding natural catchments.

As previously discussed, consistent with approved Glendell Mine operations, a single final void will remain in the Glendell Pit Extension. This final void is proposed to be located approximately 3.4 km to the north of the location of the approved final void. The relocation of the final void to the north would not result in a material change to the conceptual final void catchment area.

The proposed final void will consist of highwalls, benches, low walls and ramps. The highwall will consist of an unmined rock face which represents the limit of the Glendell Pit Extension extending from the surface down to the pit floor, made up of a series of sloped walls and benches designed to achieve acceptable long term geotechnical stability. The low wall is the surface of the emplaced overburden within the pit. The final reshaped batter angle of the low walls within the proposed final void ranges from 10° to 18°. The design of the Glendell Pit Extension has been refined to maximise the use of in-pit overburden emplacement areas and negate the need for out-of-pit emplacement areas.

The proposed conceptual final landform in the Project Area has been designed to maximise surface water drainage away from the final void and towards the natural environment, specifically Bowmans Creek, Swamp Creek, Yorks Creek and Bettys Creek. The final landform design includes re-instating some of the natural flows to the lower reaches of Swamp Creek and the former Yorks Creek lower reach. Former parts of the Swamp Creek catchment will be diverted to the Bettys Creek catchment via WRD which will function as a retention basin to assist in the management of flows from high rainfall events, improving the ability of downstream areas to convey high flows with reduced erosion risks. As discussed in **Section 7.5.7.4**, the final landform catchment of Bettys Creek will be similar to its pre-mining catchment.

Specific details of drainage design in the rehabilitated landform and final landform catchments will be provided in the MOP/RMP to be prepared and revised should the Project be approved.

7.9.4.2 Reinstatement of BSAL

Approximately 34 ha of Verified BSAL, as mapped in accordance with the Interim Protocol, may be disturbed as a result of the Project. Approximately 13 ha of this BSAL has been mapped as LSC Class 3 with the remaining 21 ha mapped as Class 4.

The construction of the MIA, Heavy Vehicle Access Road and the realignment of part 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 LSC Class 4 land (approximately 21 ha).

Soils from the BSAL areas directly impacted by the Project will be stripped prior to the construction of infrastructure. The area between the Hebden Road realignment and the Heavy Vehicle Access Road will contain a vegetated area to screen views of the Heavy Vehicle Access Road and adjacent mining operations from Hebden Road users. These vegetated areas will require minimal soil disturbance.

Some soil stripped for the Heavy Vehicle Access Road and MIA may be used for bunding on the Hebden Road side of the infrastructure. The use of these soils as bunding also provides an effective means of stockpiling some of this material for the life of the Project. Excess stripped soil 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 LSC 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 BSAL areas impacted by the Project if required, or otherwise used on mine rehabilitation areas
- the amelioration of other soil resources obtained from on-site
- 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 mine 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 at the MIA location 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 Rehabilitation and Mine Closure 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.

Further detail in relation to the management of BSAL is provided in the Rehabilitation and Mine Closure Strategy, refer to **Appendix 24**.

7.9.4.3 Yorks Creek realignment

The lower section of Yorks Creek requires realignment as part of the Project. The proposed conceptual realignment is shown in **Figure 3.18** and described in **Section 3.2.10**. The upper section of the Yorks Creek Realignment overlaps with the existing Yorks Creek Diversion adjacent to the existing 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 up to a 1000 year ARI flood event.

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.

Geomorphic studies were undertaken to identify design objectives for the proposed realignment (refer to **Section 7.5.5**) and to determine the feasibility of constructing a realignment which addressed key geomorphological risks associated with the creek realignment. **Table 7.49** summarises the key design objectives for the Yorks Creek Realignment.

Table 7.49 Yorks Creek Realignment Key Design Objectives

Rehabilitation Design Objective	Description
Physical Stability	Consideration of ACARP hydraulic guidelines Design will be guided by morphologic and hydraulic characteristics of existing creek lines surrounding the locality Design will take into consideration designs and treatments of existing creek diversions surrounding the locality Minimise risk of valley wall erosion
Physical Form	Design will be guided by physical and biological diversity of existing creek lines in the surrounding locality
Woody debris	Design will provide opportunity for woody debris to populate realignment consistent with existing creek lines in the surrounding locality
Bed and Bank Materials	Bed and bank design materials will be informed by the physical diversity of design
Riparian Vegetation	Riparian vegetation will be guided by existing floristics of the local drainage system
Aquatic Invertebrates and Fish	Design will provide sufficient instream habitat zones consistent with observations of the existing creek line Design will avoid fish barriers at crossing points Construction will have regard to potential fish barriers
Reptiles and Mammals in Riparian Zone	Design will provide sufficient riparian habitat zones consistent with observations of the existing creek line
Visual Amenity	Riparian vegetation plantings will consider existing visual amenity of creek lines in the surrounding locality

The confluence with Bowmans Creek will be designed to minimise any scouring and erosive effects in Bowmans Creek.

The conceptual detailed design drawings for the proposed Yorks Creek Realignment (Jacobs 2019) are provided in **Appendix 7**. These designs will be further refined prior to construction and commissioning. The Mount Owen Complex Creek Diversion Plan will be updated to reflect the final design details for the Yorks Creek Realignment once complete.

7.9.4.4 Rehabilitation objectives and closure criteria

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 5 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 preliminary rehabilitation objectives for the Project are represented below in **Table 7.50**.

Table 7.50 Mount Owen Consent rehabilitation objectives and preliminary 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	✓	✓

Feature	Objective	Mount Owen Consent	Glendell Continued Operations Consent
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: o highwall slopes (excluding slopes below the post-mining standing water level) o the size and depth of final voids o the drainage catchment of final voids o any high wall instability risk and o the risk of flood interaction for all flood events up to and 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.	✓	
	• Establish areas of self-sustaining: o riparian habitat, within any diverted and/or re-established creek lines and retained water courses o potential habitat for threatened flora and fauna species and o wildlife corridors, as far as is reasonable and feasible	✓	✓
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. Natural landform features are not required to be incorporated into final void areas below natural ground level.

* The Glendell Pit Extension design criteria includes levees to protect against inundation from flood events up to the 0.1% AEP (1 in 1000 year) storm event. The Surface Water Impact Assessment for the Project (refer to Appendix 16 of the EIS) includes consideration of a PMF on the final void.

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 incorporating the Project are contained in Appendix A of the Rehabilitation and Mine Closure Strategy (refer to **Appendix 24**). 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.

7.9.4.5 Management of rehabilitation risks

As noted in **Section 7.9.3**, the Project will not alter the existing general rehabilitation procedures or post mining land use objectives that currently apply to the approved operations at the Mount Owen Complex. The overall strategy for rehabilitating the Project Area will be generally aligned with and integrated into the Rehabilitation Strategy approved under the Mount Owen Consent. Commitments and obligations for those parts of the approved Glendell Mine that are not proposed to be disturbed by the Project will retain their currently approved obligations and rehabilitation completion criteria.

The conceptual final landform for the Glendell Pit Extension will be established as mining progresses. Overburden areas will be reshaped and rehabilitated progressively to form the proposed final landform. The conceptual final landform design is based on the ongoing use of in-pit overburden emplacement. This approach restricts the rehandle of material and reduces the requirement for out-of-pit emplacement areas which would otherwise increase the area of disturbance associated with the Project.

The retained highwalls within the conceptual final void will be geotechnically stable with the in-pit emplacement of overburden forming a sloping landform on the southern side of the void. The final highwalls will be designed to achieve long term stability.

The option of backfilling the void was considered during the development of the conceptual mine plans for the Project. Backfilling the void is not considered practical due to the associated prolonged environmental impacts and significant additional cost. Backfilling the void would require the rehandling of a significant amount of overburden (approximately 255 Mbcm), disturbance of more than 350 ha of established rehabilitation and an extension of site works post-mining of approximately 12 years, refer to **Appendix 1** for further detail. Such an outcome is considered inconsistent with the general principles of progressive rehabilitation and would delay the development of biodiversity corridor development across the site.

The key risk to rehabilitation associated with the Project is erosion of the final landform surface. This risk is substantially mitigated through existing drainage management practices which are currently applied at the Mount Owen Complex and other mining sites in the Hunter Valley. Detailed erosion management controls, including natural landform design principles, will be identified in the MOP/RMP which is to be developed to the approval of the Resources Regulator for each stage of mining.

Detailed final void design and erosion management control will be developed as part of the mine closure planning process. Key management measures are likely to include:

- final void design will include erosion controls to be installed on the low wall slopes
- final landform drainage designed to divert water away from the void catchment where practicable, and towards the natural environment
- revegetation will include consideration of soil stabilisation measures
- erosion modelling will be undertaken as part of the detailed final landform design process to inform the detailed drainage design and revegetation strategy.

The design of the final void will be reviewed as mining progresses and as part of the mine closure planning process. Alternative land uses identified during the mine closure planning process may influence the final design and final rehabilitation for those areas. The ongoing management processes for rehabilitation associated with the Project are described in the Rehabilitation and Mine Closure Strategy (refer to **Appendix 24**). The detailed design of both landform and rehabilitation practices will be identified in the MOP/RMP and Mine Closure Plan for the Project.

The rehabilitation of tailings facilities also presents technical challenges associated with the drying and consolidation of tailings material. These issues are common to the existing operations and are not exacerbated by the Project. The ability to transfer tailings between the operations linked by the GRAWTS provides a range of concurrent tailings disposal options; this flexibility enables the progressive consolidation of tailings through the use of alternative emplacement of tailings during the consolidation period. This process has been used successfully at the Mount Owen Complex in the past.

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.

7.9.5 Mine closure planning

Glencore undertakes mine closure planning in accordance with its internal Mine Closure Planning Protocol, and in accordance with statutory obligations. Conceptual final landforms and potential final land uses are reviewed on a 5-yearly basis, with more detailed mine closure planning commenced within 5 years of planned closure. The proposed conceptual final landform, along with a detailed mine closure cost estimate are required by the MOP/RMP process as approved by the Resources Regulator, usually at 5-yearly intervals throughout the life of the mine.

As discussed in **Section 7.12**, the rehabilitated landscape will be suitable for agricultural production through low intensity grazing, however the overall productivity of the Project Area as a grazing operation is predicted to be low and therefore unlikely to be utilised for this purpose

Following the cessation of mining, employment opportunities generated by mining activities at the Mount Owen Complex will decline and then cease. 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 and is consistent with local and regional strategic planning objectives. In particular, the opportunity for the future development of alternative post mining employment generating land uses will increase economic diversity in the region, reducing social impacts on the local community and will assist with providing a more robust future local and regional economy, in a post mining context.

The Rehabilitation and Mine Closure Strategy contemplates a detailed examination of potential alternative land uses as part of the detailed mine closure planning process. This is also mandated as part of the Mine Closure Plan requirement under the Mount Owen Consent. Singleton Council is currently preparing a Strategic Local Planning Statement that considers the use of former mine sites for alternative land uses.

The Mount Owen Complex (as amended by the Project) includes features which provide significant opportunities for land uses other than just the grazing and biodiversity land uses identified in **Figure 7.9.1.** These opportunities are discussed further below in **Section 7.9.5.1**. **Section 7.9.5.2** includes an analysis of potential alternative land uses for the Mount Owen Complex having regard to the final landform and opportunities presented by the Mount Owen Complex and surrounding infrastructure.

7.9.5.1 Opportunities for alternative land uses

It is noted that several features of the Mount Owen Complex and surrounding area provide significant opportunities for future high value employment generating land uses following the cessation of mining. These features include:

- installed electricity infrastructure and close proximity to high voltage transmission network
- installed rail infrastructure
- installed road access, hardstand areas and car parks with capacity to handle large workforce numbers
- established water storages (including pit lakes in voids)
- large land holding surrounded by mining and industrial areas
- separation distance from residences
- proximity to Singleton and Muswellbrook for access to future workforce
- established suppliers and service providers
- proximity to port infrastructure at the Port of Newcastle with direct rail access to the port

- existing infrastructure areas located on flat terrain and
- the ability to emplace overburden in a manner which facilitates alternative land uses.

In particular, the pit lakes formed in the Glendell Pit, North Pit and Bayswater North Pit all have potential to be used for high value land uses post closure including aquaculture and industrial water. 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 storages with overburden emplacement areas utilised for upper storage areas, subject to further evaluation. The proposed final landform and additional final void depth as a result of the Project does not preclude alternate sustainable post mining land uses. The deeper Glendell Pit Extension void may also increase the viability of potential end land uses, such as a water storage or waste recycling, re-use and emplacement facility.

Infrastructure areas associated with the Project may also have the potential for being suitable for industrial or intensive agricultural use. In addition, the availability of an existing rail loop and siding in the vicinity of the Project, water from the pit lake voids as well as the large separation of distances from adjoining landholders may also lend parts of the site to being suitable for industrial or intensive agricultural land uses. It is noted that further approvals may be required for any alternative land uses, subject to planning controls that may apply at that time.

Further consideration of potential final land use options is discussed in **Section 7.9.5.2**.

7.9.5.2 Conceptual final land use analysis

Local and regional strategic planning policies will also be considered as part of the detailed mine closure planning process. The Singleton Regional Land Use Strategy and the Hunter Regional Plan are currently the primary documents that provide guidance on this issue. The Mount Owen Complex provides a range of opportunities for different final use options, including industrial uses, power generation, agriculture/agribusiness, landscape tourism and research. Key values relevant to multiple potential final use options include:

- brownfield site (limited potential to further impact to EEC, threatened species, or cultural heritage values)
- established buffer land to minimise impact to neighbouring land uses
- existing industrial (coal processing) infrastructure
- existing ancillary infrastructure (workshops, offices, carparks, hardstand areas etc.) which can be readily repurposed
- diverse, disturbed terrain that can be re-shaped if required
- established water supply/storage and water quality management infrastructure
- voids for tailings storage and existing tailings management system
- voids with high local relief (height difference relative to overburden emplacement areas of approximately 300 m) for potential upper and lower water storage suitable for pumped hydroelectricty
- accessible rail loading infrastructure and rail loop with efficient access to the Main Northern Rail Line and ready access to the Port of Newcastle
- recently upgraded road access to the New England Highway

- connection to communication and electricity infrastructure
- accessible to workforce
- proximity to urban areas (Singleton and Muswellbrook)
- connection to habitat corridors and remnant vegetation areas including the adjacent Ravensworth State Forest

The Singleton Regional Land Use Strategy proposes that all new heavy industrial sites should be serviced by rail access. The Singleton Regional Land Use Strategy prefers that sites do not have frontage/access to the New England Highway or Golden Highway but must have good sealed road access. The intent is that industrial land uses would be consistent with a spatial hierarchy, with industrial service land and light industry closer to the town, and large lot or heavy industry separated from town, to manage amenity impacts.

Potential alternative land uses are considered further below.

Alternative Land Use Analysis

Table 7.51 provides a high level analysis of potential post mining land uses for the Project Area and more broadly the Mount Owen Complex. **Table 7.51** further identifies the land characteristics which would be consistent with sustainable operations of these land uses and the extent to which these beneficial land characteristics or values are present or could be present at the Mount Owen Complex as mine closure and rehabilitation proceed.

Table 7.51 Potential Final Land Use Analysis

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
Ancillary Mining Activities	Brownfield development sites with few environment and community constraints, preferably with existing coal processing infrastructure	Glendell and Mount Owen MIAs, Mount Owen CHPP	The Project will provide for continued mining operations to 2044 and require the continued processing of ROM coal by the Mount Owen CHPP and associated infrastructure and utilise the Mount Owen Rail Loop for coal transportation The Mount Owen Complex is connected to the GRAWTS providing potential water and/or tailings storage, subject to further planning approvals
	Established water supply/storage and management Tailings storage	Glendell Pit, Bayswater North Pit, West Pit, North Pit voids and WRD providing water/tailings storage, connection to GRAWTS	
	Access to road and rail transport and electricity/communication infrastructure	Mount Owen rail loader and loop connecting to Main Northern Rail Line Established communication and electricity connections, upgrade of existing electricity connections as a result of the Project	
	Accessible to skilled mining/heavy engineering workforce	Site is accessible to local workforce	
Power generation (Solar, Gas, and Pumped Hydroelectricity Energy Storage)	Built assets (offices, workshops, car parks etc.)	Glendell and Mount Owen MIAs can be readily repurposed to provide office/workshop facilities reducing establishment costs	Local relief means more potential at this site than many other Hunter Valley mining operations Requires more detailed feasibility studies and further development of regional scale strategic planning for employment transition
	Significant height difference from upper to lower water storages for pumped hydroelectricity	Mount Owen Complex includes voids with high local relief relative to overburden emplacement areas (height difference of approximately 300 m)	
	Water resources/storage of sufficient volume of water at different levels and sufficient water quality	Upper and lower level water storages are potentially available	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
	Connectivity to high voltage electricity transmission grid network Site with acceptable direct environmental impacts and with sufficient buffer land to minimise potential impacts (noise, air quality etc.)	Grid connections will be upgraded as part of the Project, grid connections to main office buildings at Mount Owen – may need further upgrade Established site with extensive mine owned buffer land Close proximity to 132 and 330 kV transmission line network Timing coincides with planned closure of Liddell and Bayswater power stations	
	Land that can be shaped and developed for wind turbines, battery storage, transmission etc. Road/rail access	Opportunity to shape land suitable for generation and storage Large surrounding landholdings and capped tailings areas have the potential to provide level ground for solar panels	
	Accessible to skilled engineering workforce	Road access to New England Highway and State road network Site is accessible to skilled and experienced engineering and power generation workers from local region, support service suppliers and workforce residential areas	
Industrial/Manufacturing Uses	Built assets (offices, workshops, car parks, hardstand areas, sewage systems, water supplies etc.)	Glendell and Mount Owen MIAs can be readily repurposed to provide office/workshop/manufacturing facilities reducing establishment costs	The Mount Owen Complex provides potential opportunities for manufacturing or industrial land uses, subject to detailed feasibility studies and further development of a regional employment transition strategy
	Land resources – potential to create landforms suitable for large industrial sites	Existing suitable flat land for heavy or medium industry in the final landform design, generally in parts of the site with good access to road and rail infrastructure and power supply.	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
	Water infrastructure, storage available to prevent the need for licensed polluted discharge to waters	Site has good track record of managing all water on site and within GRAWTS, with no need for discharge to natural waterways	
	Proximity to urban areas in terms of worker commute	Located approximately mid-way between Singleton and Muswellbrook, New England Highway access	
	Remote or shielded from sensitive residential areas or other sensitive users, where heavy industry is being considered which may have potential air (particulates, odour), visual or noise impacts	The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	
	Access to road, rail and communications infrastructure –for materials and product; access to port or airport infrastructure	The recently completed Hebden Road bridge upgrade and rail overpass has significantly improved accessibility of the Mount Owen Complex from the New England Highway Direct rail access to the Port of Newcastle	
	Access to skilled engineering/ manufacturing workforce	Road access to New England Highway and State road network, established supplier network and service providers	
	Proximity to secure energy supply and potential for co-location of renewable energy	Secure energy supply available and power could also be generated on site (solar, wind or storage based hydro-electricity)	
	Simple land tenure arrangements for zoning and/or subdivision	Large portion of land in consolidated ownership	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
Industrial Agriculture (agribusiness, including intensive production and processing)	Built assets (offices, workshops, car parks etc.)	Glendell and Mount Owen MIA can be readily repurposed to provide office/workshop facilities reducing establishment costs	Parts of the site – generally those closer to road and rail access, and to other site infrastructure, may be suitable, subject to detailed feasibility studies and comparison with other post mining sites
	Land resources – potential to create landforms suitable for large production sites; e.g. glasshouses, composting facilities etc.	Areas around proposed and existing infrastructure and rail loop are well suited. Remainder of the site is moderately steep and hilly, however, there is potential to retain and create additional areas suitable for large scale intensive agriculture/horticulture as part of post mining landform, particularly around proposed MIA and Mount Owen MIA and rail loop areas	
	Access to road, rail and communications infrastructure –for materials and product; access to port or airport infrastructure	Road and rail access in place. Rail access to the Port of Newcastle Road access to New England Highway and State road network, and located midway between Singleton and Muswellbrook	
	Proximity to urban areas in terms of worker commute	Local road access only to Newcastle airport (which applies to all sites in the region)	
	Proximity to secure energy supply and potential for co-location of renewable energy	Proximity to secure energy supply Power could also be generated on site (solar, wind or storage based hydro-electricity)	
	Water for irrigation is available and water can be managed on site (stored, reused, recycled) to prevent the need for licensed discharge to waters	Water availability depends on water quality required – mix of fresh water and saline water available – and extent of treatment may be required to be suitable for horticultural purposes Access to water supply from Glennies Creek (subject to licencing requirements)	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
	Remote or shielded from sensitive residential areas or other sensitive users, where intensive agricultural uses are being considered which may have potential air (particulates, odour), visual or noise impacts	Site is generally remote from sensitive residential areas and screened by landform and vegetation	
	Simple land tenure arrangements for zoning and/or subdivision	Large portion of land in consolidated ownership	
Active recreation/extreme sports (e.g. motocross, BMX, mountain biking, rock climbing and zip lines)	Terrain suitable for (or scope to reasonably shape for) diverse physical challenges	Final conceptual landform will have diverse terrain, potentially including very steep and long slopes and benches suitable for adventure sports (mountain bike courses, zip lines etc.) Brownfield site offers flexibility in terms of terrain design and design of adventure or extreme sports facilities	A number of other mine sites in the Upper Hunter may offer terrain suitable for adventure sports developments More detailed feasibility studies would be required, linked to more detailed regional employment transition planning Glendell and North Pit rehabilitated emplacement areas and North Pit void may be best opportunity for this potential land use Hunter Regional Plan suggests that niche commercial, tourist and recreation activities, set within an agricultural landscape, but not using the best quality agricultural land may be an employment opportunity. This would be relevant to final void sites and adjacent rehabilitated land
	Access to road or rail transport routes	The recently completed Hebden Road bridge upgrade and rail overpass has significantly improved accessibility of the Mount Owen Complex from the New England Highway Access to rail transport	
	In location that can be marketed with other related tourism experiences – such as Wine Country tourism and Sydney market	Location in Hunter Valley and buildings suitable for offices/management of adventure recreation and could be marketed as part of a package of related tourism experiences (note: no framework for this currently exists)	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
	Impacts on ground surface and vegetation can be controlled, with low chance of offsite impacts	Well managed activities could be controlled to minimise direct impacts on existing and rehabilitated native vegetation, and to utilise more disturbed terrain for higher impact activities. Extensive buffer zone with minimal potential for off-site impacts	
	Facilities for offices, cafes, accommodation or other associated infrastructure	MIA areas include water supply, sewage treatment system, hardstand areas, electrical reticulation, fire controls etc and can be readily repurposed to provide café, carpark, office/workshop facilities reducing establishment costs	
Waste, recycling, reuse and product development	Terrain suitable for all aspects of waste processing, including sorting, reprocessing (product development), repurposing, waste to energy, waste disposal	Mount Owen Complex offers diverse terrain, including relatively flat land and infrastructure suitable for processing, and deep voids	A number of other former mine sites in the Upper Hunter are likely to have similar beneficial characteristics To identify optimal locations for this land use, more detailed feasibility studies are required, linked to more detailed regional employment transition planning
	Access to road, rail and communications infrastructure suitable for transporting significant volumes of material	The Mount Owen Complex has access to the Main North Rail Line, with potential to receive waste from the greater regional area The recently completed Hebden Road bridge upgrade and rail overpass has significantly improved accessibility of the Mount Owen Complex from the New England Highway	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
	Remote or shielded from sensitive residential areas or other sensitive users, where waste management activities may have potential visual, noise, odour, or other impacts Connections to waste research organisations and to appropriately skilled workforce	The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	
Aquaculture	Terrain suitable (or which can be shaped to be suitable) for aquaculture ponds and related processing activities, including large areas of flat land, land suitable for ponds or varying sizes	Some potential to create landforms suitable for aquaculture ponds	
	Water quality, water treatment and storage management suitable for intensive aquaculture use, potentially high nutrient/organic load	Access to water supply from Bowmans/Glennies Creek (subject to licencing requirements)	
	Access to good road, rail, power and telecommunications infrastructure. Access to port and airport for rapid distribution to international customers	The Mount Owen Complex has access to the Main North Rail Line. The recently completed Hebden Road bridge upgrade and rail overpass has significantly improved accessibility of the Mount Owen Complex from the New England Highway Secure energy and telecommunications supply available	
	Remote or shielded from sensitive residential areas or other sensitive users, where waste management activities may have potential visual, noise, odour, or other impacts	The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	

Potential Final Land Use	Beneficial Land Characteristic/Values Required	Land Characteristics / Values Present	Comments
High value carbon forestry, ecological restoration, nature based education, low impact recreation, training and research	Site connected to natural vegetation area	Mount Owen Complex and offset areas are immediately adjacent to the Ravensworth State Forest	The location of the Mount Owen Complex, adjacent to the Ravensworth State Forest is a significant advantage over other sites
	Rehabilitated sites with a focus on biodiversity and ecological connectivity Diversity of site conditions relevant to multiple aspects of research	Work on enhancing ecological connectivity is already underway	
	Proximity to education institutions including schools and university students; similarly proximity to markets for nature based tourism (major urban centres, but also international visitors)	The population of the Hunter region is expected to grow, with increasing numbers of school and university students Well located in terms of regional urban centres, proximity to Newcastle and Sydney metropolitan areas, and reasonable airport access	
	Connections with university research	Mount Owen Complex has a long established, strong link to Newcastle University researchers	

As demonstrated in **Table 7.51**, the Project and, more broadly, the Mount Owen Complex provides a range of opportunities for a variety of potential land uses, given the extensive infrastructure and accessibility. The final land use options identified above are considered as potential land uses. Additional review and consideration will be undertaken closer to mine closure and will be dependent on demand and technology available at the time.

It can be seen from the analysis outlined above that there are a number of potential options for beneficial use of final voids. The presence of the void and associated pit lake is considered to provide significant opportunities for high value (and high employment generating) land use options providing economic diversity into the future beyond mining. Whether or not the void is directly used as an asset as part of the final land use (e.g. future mining, pumped hydro electricity generation, extreme recreation activities, aquaculture etc.), the existence of the voids should not constrain the range of potential land uses, provided appropriate access, landform stability and safety considerations are in place.

Consistent with the approved operations at Mount Owen Complex, any final land uses other than agriculture or native vegetation development will require further assessment and approval.

When the detailed mine closure planning process commences, there will be a need for further consideration of the final land use based on State and local government strategic planning and Glencore strategic requirements, the economy and the demand/need for the uses being considered at the time. Consistent with the existing mine closure planning commitments for the Mount Owen Complex, consultation with stakeholders, including the local community and proximate landholders will commence prior to planned closure with a detailed mine closure plan being developed at least 5 years prior to planned closure.

7.10 Visual amenity

An assessment of the potential visual impacts associated with the Project has been undertaken in accordance with the SEARs for the Project (refer to **Appendix 4**). The SEARs require a detailed assessment of the likely visual impacts of the development (before, during and post-mining) on private landowners in the vicinity of the development and key vantage points in the public domain including any visual impacts to vehicles travelling along the New England Highway. The SEARs also require development of all reasonable and feasible mitigation measures to minimise visual impacts (including lighting) associated with the Project.

The Project Area is located within a rural environment and in the vicinity of several other existing visible mining operations. The predominant land uses in the vicinity of the Project Area include coal mining, State forest, grazing and rural residential holdings. The character of the immediate visual environment is strongly influenced by the existing mining operations. Visual amenity was not raised as a key issue of concern by local community stakeholders; however rehabilitation of overburden emplacement areas and the design and appearance of the final landform were a key issue of concern. Impacts of lighting from night operations is also an area of concern and source of complaint from the community in relation to existing mining operations at the Mount Owen Complex.

Progressive rehabilitation has been undertaken throughout the life of the existing mining operations at the Mount Owen Complex, including at the existing Glendell Mine, assisting with reducing the visual impact of overburden emplacement areas and airborne dust. Consistent with existing approved operations, disturbed areas will continue to be rehabilitated as soon as practicable throughout the life of mining in the Glendell Pit Extension. Progressive rehabilitation will consist of the shaping of overburden emplacement areas to create a suitable final landform with adequate surface drainage which is in keeping with the surrounding landscape. This will be achieved through both the form of the reshaped mining areas and use of a range of vegetation types, and the location and shape of vegetation areas to be established across the re-habilitated landform.

7.10.1 Existing landscape setting

Overburden emplacement areas, coal related infrastructure (conveyors, mining surface facilities, rail facilities and lines) and other built infrastructure such as high voltage power lines contribute to the immediate industrial nature of the visual environment in the vicinity of the Project Area. Additionally, both the Liddell and Bayswater Power Stations are currently dominant structures on the horizon to the west. The area surrounding the Project Area is occupied by other mining operations which are visible from the New England Highway, particularly Ravensworth Operations, Ashton Coal Mine, Rix's Creek South Mine and Rix's Creek North Mine. The Ravensworth State Forest is located to the north-west of the Project Area.

Active in-pit mining areas at Glendell Mine are not currently visible from any public or private residential locations, however the existing overburden emplacement area is currently visible (with varying levels of visibility) from the east, southeast and west. The surrounding mining operations (Ashton Coal Mine, Rix's Creek South Mine, Rix's Creek North, Liddell and Ravensworth Operations) are also visible from the New England Highway, Hebden Road, the Main Northern Rail Line, and several surrounding private residential properties.

The approved mining operations at the Mount Owen Complex currently result in a night-time light glow, which, along with other mining operations, affects the local night-time visual amenity. To manage these impacts, Glencore has implemented a range of measures to reduce the impact on the scenic quality of the area including directional lighting, as well as management controls for the placement of mobile lighting on overburden areas to reduce the associated impacts.

Blasting activities have the potential to result in dust and/or post-blast fume. It can vary from a few minutes to hours and whilst there is some potential for the plume to be visible from both public and private locations outside of the Project Area, the visual effect is only relatively short term and temporary. This potential impact will be managed through the blast design process to minimise fume and having regard to meteorological conditions at the time of blasting which is restricted in adverse windy conditions, and reviewed prior to each individual blast.

7.10.2 Methodology

The visual assessment was undertaken to determine the level of visual impact the Project will have on both private receivers and at key public vantage points in the surrounding areas. It is noted that the Project Area is located near the New England Highway and the existing and proposed realigned Hebden Road have potential to result in increased visibility of the mining operations at Glendell Mine. Visibility of the site may also increase at some private residences however the approved final landform would also be visible from these view points, the views are from a long distance and within a viewshed dominated by other existing mining operations. The chosen view points are from representative public viewing points and are considered to be representative of the views that will be created from any private viewing points within the vicinity. The approach to the visual assessment is provided below.

7.10.2.1 View points

Assessment of the visual impacts of the Project included a series of radial analyses and development of a 3D model containing existing and proposed landforms (also utilised as an interactive visual tool for community and agency consultation) to produce photomontages for each stage of the development from the selected view points.

An initial desktop assessment of the existing visual setting and landscapes in and around the Project Area and the proposed mine plans was undertaken to determine the potential locations where the Project may be visible. Radial analyses were then developed using a detailed 3D topographic model, aerial photographs and electronic data files relating to site infrastructure and other infrastructure surrounding the mine site.

The radial analysis illustrates areas that are visible from a height of 1.7 m at that location (i.e. from approximate eye height). It should be noted that the radial analyses are topography based only and do not include vegetation which may in fact screen a portion of a viewshed and so are considered conservative. The radial analysis for the Project Year 18 is presented in this section for each view point. Year 18 represents a scenario where maximum height of the overburden emplacement area is reached and the full progression of the proposed mine footprint is achieved. The individual radial analyses for each project conceptual mine plan year are included in **Appendix 25**.

The radial analyses were used to confirm the areas within the terrain where features of the Project may be visible. The key areas of focus were:

- elevated overburden emplacement areas
- active mining areas and high walls that may be visible from elevated locations
- the proposed haul roads and heavy vehicle access road, particularly haul roads where truck lights may be visible from residences and near the realigned Hebden Road
- the New England Highway, particularly for vehicles travelling east (south) downhill past Liddell Coal Operations towards Glendell Mine
- the proposed Mine Infrastructure Area.

Nine representative view points were selected. These view points are considered to be representative of the public viewing localities that have the highest potential for visual impact. As previously discussed, the view points are also considered representative of the private residences within the vicinity. The view points chosen are illustrated on **Figure 7.10.1**.

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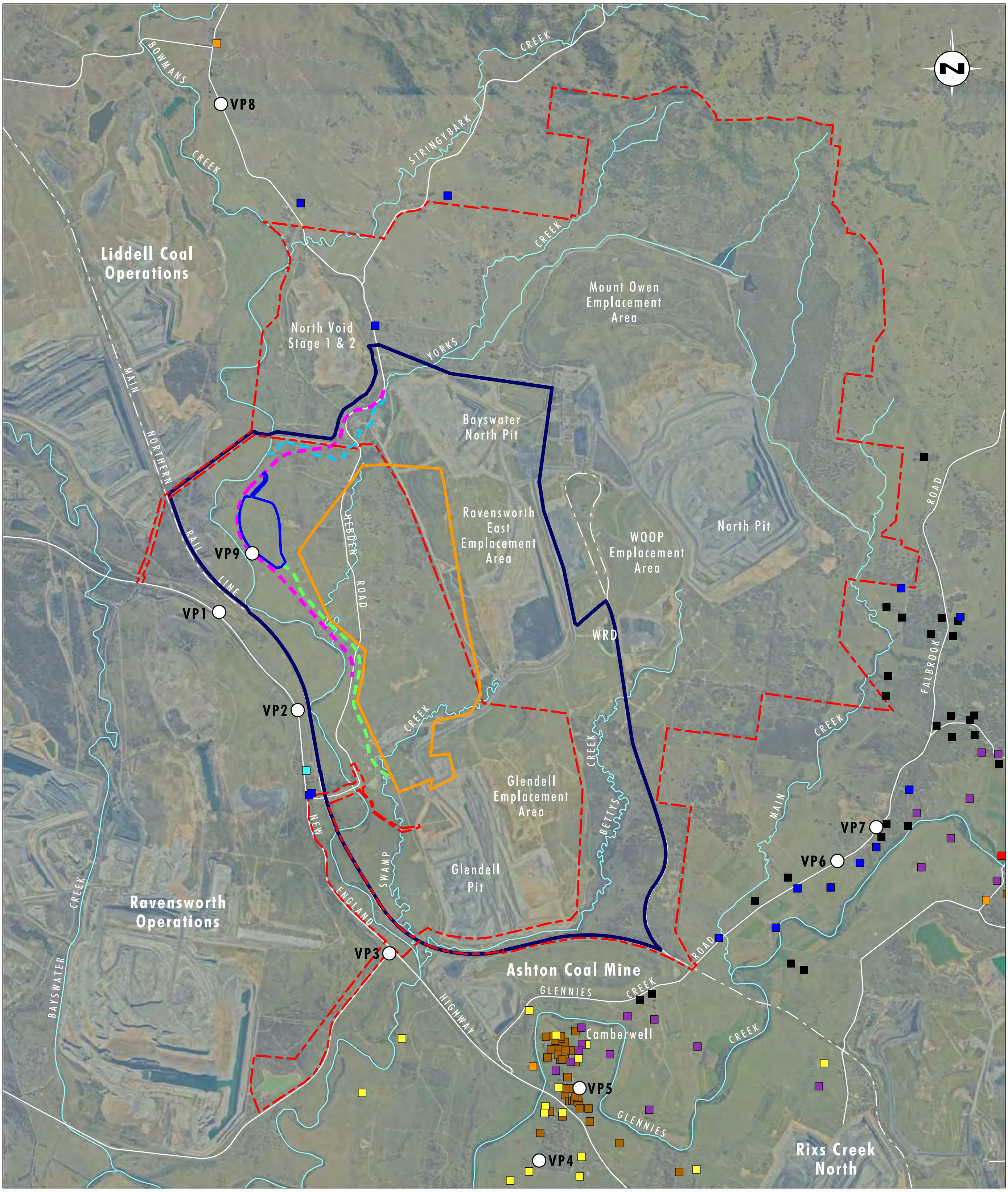

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

0 1 2 3km

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- New Glendell MIA
- Heavy Vehicle Access Road
- Yorks Creek Realignment
- Hebden Road Realignment
- Viewpoint Location
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant

FIGURE 7.10.1

Visual Assessment Viewpoint Locations

File Name (A4): R08/4166_400.dgn
20191128 15.10

View Point 1 (VP1) – New England Highway 1 – provides a representative elevated view from the north for motorists travelling towards the Glendell Mine on the New England Highway.

View Point 2 (VP2) – New England Highway 2 – provides a view looking north west for motorists in close proximity to Glendell Mine on the New England Highway travelling past Glendell Mine.

View Point 3 (VP3) – Lemington Road - provides a view towards Glendell Mine from the intersection of Lemington Road and the New England Highway, representative of a public vantage point located to the south west of the Project Area, note there are no residences with views of the Project Area from the west.

View Point 4 (VP4) – Glennie Street (south of Camberwell) - provides a representative view from a public vantage point from the south of the Glendell Mine, within a rural environment in a location with existing rural residences.

View Point 5 (VP5) – corner of McInerneys Road and Dyrring Street – Camberwell - provides a representative view towards Glendell Mine from the south in Camberwell. Note that the existing mining operations at Glendell are currently obscured from views from Camberwell by the existing Ashton overburden emplacement area located immediately north of Camberwell.

View Point 6 (VP6) – Glennies Creek Road - provides a representative view towards Glendell Mine from a public vantage point located to the south-east in Middle Falbrook and is considered representative of the views achieved from the private residences in the vicinity. The existing overburden emplacement area at Glendell Mine is visible from this view point.

View Point 7 (VP7) – Glennies Creek Bus Stop - provides a representative view towards Glendell Mine from a public vantage point located to the east. The existing overburden emplacement area at Glendell Mine can be seen from this view point.

View Point 8 (VP8) – Hebden Road - provides a representative view towards Glendell Mine from the North on Hebden Road. The existing Glendell Mine is obscured from view from this view point by the existing natural topography and vegetation.

View Point 9 (VP9) – Hebden Road Realignment - provides a representative view of the proposed MIA and active mining areas for motorists travelling south along the realigned section of Hebden Road.

Photomontages for each view point were produced using the 3D model. Each photomontage provides a comparison of the appearance of the landform for the representative mine plan stage within the view of the existing landform from the view point. Constructing photomontages of 'before and after' scenarios illustrates the existing landscape and provides a comparison landscape that includes the Project. For the purpose of this assessment, the 3D model has generated a photomontage to show a true representative view of the proposed landform for each stage and labels have been added to describe the areas where the landform changes in each photomontage. The photomontages prepared for this assessment are included in **Appendix 25** and provide a comparison between existing views and the proposed landform in Year 6, Year 13, Year 18 and the Final landform.

The visual assessment also included a qualitative assessment of potential lighting impacts with consideration to both direct and indirect (or diffuse) lighting effects. The Project includes the demolition of the existing Glendell MIA and the construction of a new MIA in the northern end of the Project Area, which will be approximately 1km closer to the New England Highway. The proposed MIA will also be located in close proximity to the realigned Hebden Road and includes the construction of a Heavy Vehicle Access Road adjacent to the realigned Hebden Road. Potential lighting impacts associated with these works and the movement of mobile plant and equipment on road users along Hebden Road has been considered.

There is no change proposed to all other infrastructure and approved mining areas within Bayswater North and North Pits. This includes no changes proposed to the existing lighting arrangements for these facilities.

7.10.3 Visual assessment

The key aspects of the Project that have the potential to result in visual impacts include:

- construction and use of the proposed MIA and realigned section of Hebden Road including direct views of the MIA and associated operations, views of mobile plant and equipment, exposed surfaces, dust and night lighting during construction and operation
- clearing and overburden removal within the proposed Glendell Pit Extension and active mining operations, which may be associated with views of mobile plant and equipment, exposed surfaces, dust, blasting operations and night lighting
- emplacement of overburden (increased height and varied design), which may be associated with views of mobile plant and equipment, exposed surfaces, dust and night lighting
- rehabilitation, which may be associated with views of mobile plant and equipment and regenerating vegetation.

A combination of these activities will be occurring throughout the life of the Project as the active mining area progresses, and the overburden emplacement area progressively achieves the proposed final landform and rehabilitated areas are established (refer to the conceptual mine plans presented in **Figure 3.2** to **Figure 3.6**). Aspects of these activities may be visible from certain public and private viewing locations at different stages of the mine, with the visible operations changing over time as the rehabilitated landform progresses.

As discussed above, given the proposed Glendell Pit Extension will be located in close proximity to sections of the existing and realigned Hebden Road and that the proposed overburden emplacement area will be higher than the current approved overburden emplacement area then there will be increased visibility from public vantage points. The proposed overburden emplacement area will particularly have increased visibility from the west, south and east of the Project Area. However, views from the south and east are long range (>5km) and in some cases largely obscured by the existing topography and vegetation.

The radial analysis for each view point for the Year 18 mine plan are presented in this section (refer to **Figure 7.10.2** to **Figure 7.10.11**, the remainder of the radial analyses for the Year 6, Year 13 and Final Landform are presented in **Appendix 25**.

Approved Glendell Mine Landform

As previously discussed, the approved overburden emplacement area is the only visible aspect of the approved operations (with varying levels of visibility) from public and private locations to the east, southeast and west (refer to **Figure 7.10.2**). The area surrounding the Glendell Mine is characterised by mining operations with other adjoining operations particularly Ravensworth Operations, Rix's Creek South and Ashton being more prominent in the landscape. The majority of the views of the approved overburden emplacement area are restricted from the south by the Ashton overburden emplacement area and views from public and private view points to the southeast and east are from a distance (ranging from 4 to 7 km).

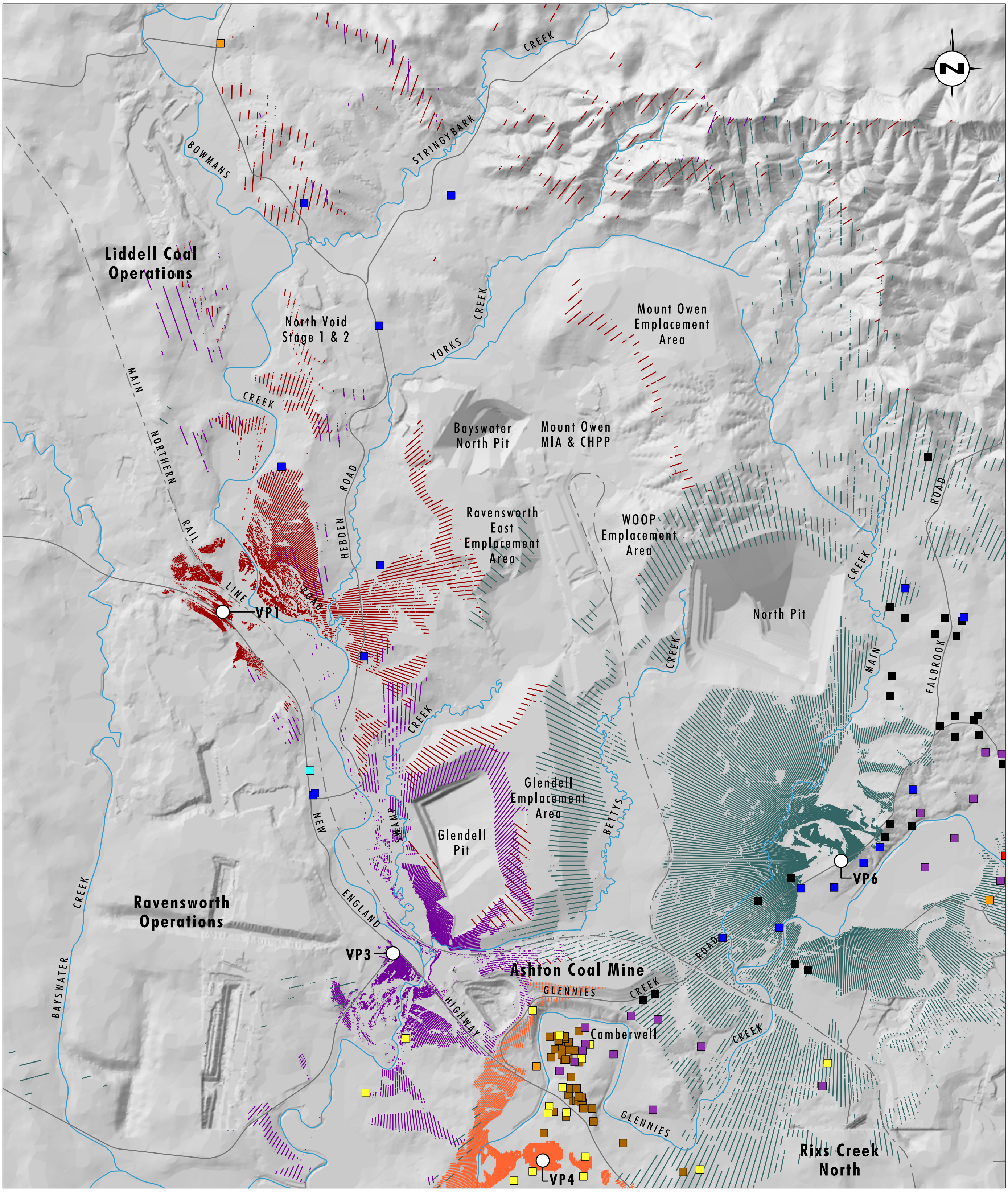

Image Source: Glencore (2019)
Data Source: Glencore (2019), Umwelt (2019)

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location 1
- Terrain Visible from Viewpoint Location 3
- Terrain Visible from Viewpoint Location 4
- Terrain Visible from Viewpoint Location 6
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant

FIGURE 7.10.2

Approved Conceptual Final Landform - Radial Analysis

File Name (A4): R08/4166_423.dgn
20191119 15.13

View Point 1 – New England Highway 1

Given the location of the Project Area in proximity to the New England Highway and the advancement of mining operations to the north, the proposed overburden emplacement area will become more visible as mining progresses. It is important to note that this view will be available to passing motorists on the New England Highway only and is not visible from any private residential properties. The radial analyses completed for this view point (refer to **Figure 7.10.3** and **Appendix 25**) indicates the overburden emplacement area will be visible and the visibility of the landform will become more prominent as mining advances northwards.

The proposed MIA will also be visible from this view point (approximately 1 km to the northeast).

The potential visual impacts from this view point have been further considered and are illustrated by the photomontages included in **Appendix 25**. Although the proposed landform will become more visible at this view point as mining advances, the proposed landform is not considered to be out of keeping with the surrounding mining landscape or natural landform. Additionally, long range views across the landscape will not be affected with key landmarks (e.g. Mount Olive) remaining visible beyond the proposed overburden emplacement area. The progressive rehabilitation of the overburden emplacement area will reduce the associated visual impact during operations. The proposed MIA will also be visible from this view point, however these works are also considered to be in keeping with the existing industrial land uses in the area. The radial analysis indicates there will not be views of the active pit areas associated with the Project.

To minimise the available views from this view point Glencore is proposing to plant tree screens on Glencore owned land to restrict views of the MIA, active mining areas and the lower areas of the proposed overburden emplacement area. Given the proposed height if the overburden emplacement area it will be visible beyond a tree screen however, the proposed progressive rehabilitation of the overburden emplacement area will assist with reducing the associated visual impact.

View Point 2 – New England Highway 2

View point 2, located south of view point 1, provides a motorists view in close proximity to the Project Area when heading north or south along the New England Highway. The radial analyses (refer to **Figure 7.10.4** and **Appendix 25**) indicates the overburden emplacement area will become more visible from this view point as mining progresses. Also there may be views of the proposed MIA and potentially minor views of the highwall within the active pit area. It is important to note that the radial analysis is topography based and does not consider the obstruction of views by vegetation.

The photomontages prepared for this view point are included in **Appendix 25**. When comparing the existing view from this location it is evident that the overburden emplacement area will become more visible as mining operations progress, however the proposed MIA and highwall are likely to be largely obscured from view due to the distance of these views and the obstruction of views provided by existing and proposed vegetation.

As mentioned above views of the operations will be restricted through the planting of tree screens and progressive rehabilitation of the overburden emplacement area as mining progresses.

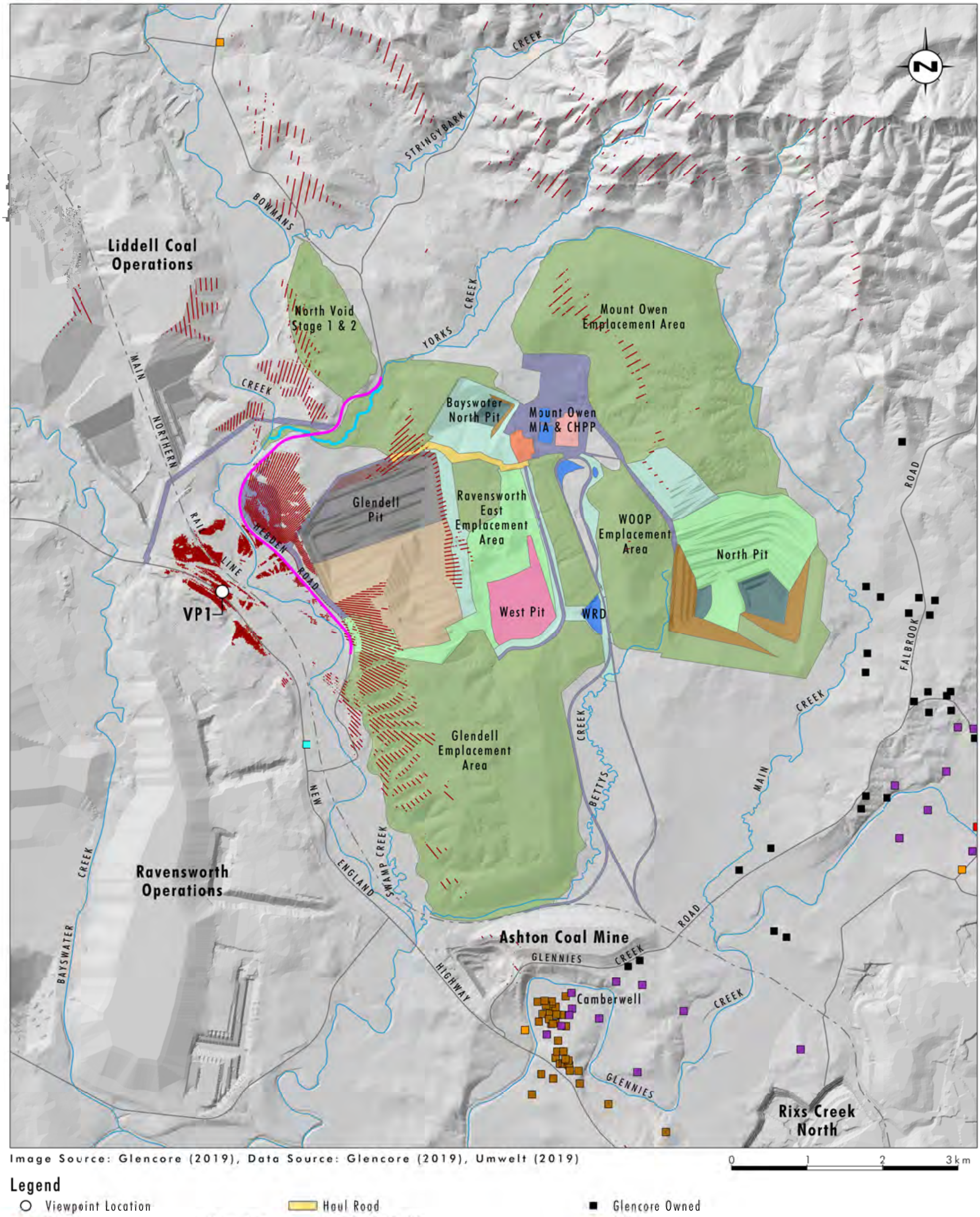

FIGURE 7.10.3

VP1 Radial Analysis - New England Highway 1 - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_393.dgn
20191129 9.08

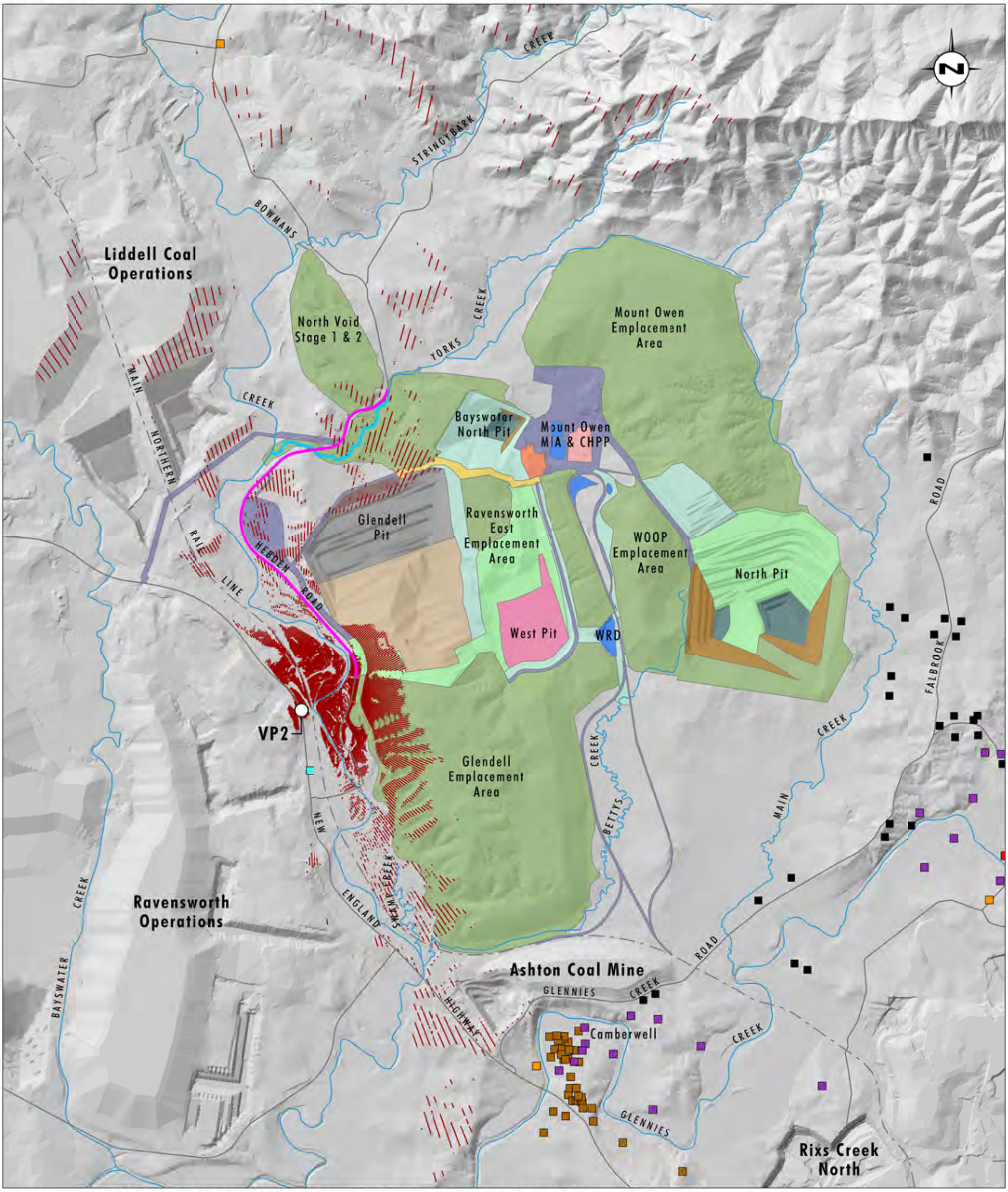

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

0 1 2 3km

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.4

VP2 Radial Analysis - New England Highway 2 - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_397.dgn
20191129 9.06

View Point 3 – Intersection Lemington Road and New England Highway – Looking northeast towards Glendell Mine

View point 3 provides a view looking northeast towards Glendell Mine from the intersection of Lemington Road and the New England Highway. The radial analyses (refer to **Figure 7.10.5** and **Appendix 25**) indicates the overburden emplacement area will become more visible from this view point due to the increase in height and progression of mining operations to the north. The photomontages prepared for this view point included in **Appendix 25** illustrate how the overburden emplacement area is currently visible from this view point and will become more visible with the proposed increase in height of the overburden emplacement area. It should be noted that the approved final landform would also be visible from this view point, however to a lower height, the approved mine features are annotated on the relevant figures for comparison. The progressive rehabilitation of the overburden emplacement area will reduce the associated visual impacts from this view point. Additionally, given the location of this view point, in close proximity to Ravensworth Operations, where the overburden emplacement area is clearly visible, the proposed change to the landform is not considered significant when compared to the current view of surrounding mining operations.

View Point 4 – Glennie Street – Looking North towards Glendell Mine

View point 4 provides a view towards Glendell Mine from the south within the rural residential area to the south of Camberwell. The radial analyses (refer to **Figure 7.10.6** and **Appendix 25**) indicates there will be distant views of the top of the proposed overburden emplacement area (>4 km) from this view point.

The photomontages prepared for this view point included in **Appendix 25** indicate the overburden emplacement area is not currently visible from this location, however will become visible (in the distance) with the proposed increase in height of the overburden emplacement area. It is important to note that views of the approved operations are currently obscured from this view point by the existing Ashton overburden emplacement area, and only views of the very top of the proposed overburden emplacement area will be visible beyond the Ashton emplacement area. Also, once the rehabilitation at the Ashton overburden emplacement area is fully established the proposed overburden emplacement area will be completely screened from view at this view point. Additionally, mining operations associated with the approved Ashton SEOC project (should it be implemented) would be visible from this view point and would have significantly greater visual impact than the proposed operations at Glendell Mine. It is considered that these restricted long-distance views of the proposed overburden emplacement area will be appropriately reduced through progressive rehabilitation.

View Point 5 – McInerneys Road/Dyrring Street

View point 5 provides a view towards the Glendell Mine from within Camberwell. The radial analyses (refer to **Figure 7.10.7** and **Appendix 25**) indicates there will be distant views (>3 km) of the top of the overburden emplacement area from this location.

Similar to view point 4, the photomontages prepared for this view point included in **Appendix 25** indicate the existing overburden emplacement area is not currently visible from this view point, however will become visible (in the distance) with the proposed increase in height of the overburden emplacement area. It is important to note that views of the approved operations are currently obscured from view from this view point by the existing Ashton overburden emplacement area, and views of the proposed overburden emplacement area will be beyond the Ashton emplacement area. Similar to view point 4, once the rehabilitation at the Ashton overburden emplacement area is fully established the proposed overburden emplacement area will be completely screened at this view point. It is considered that these restricted long-distance views of the proposed overburden emplacement area will be appropriately reduced through progressive rehabilitation.

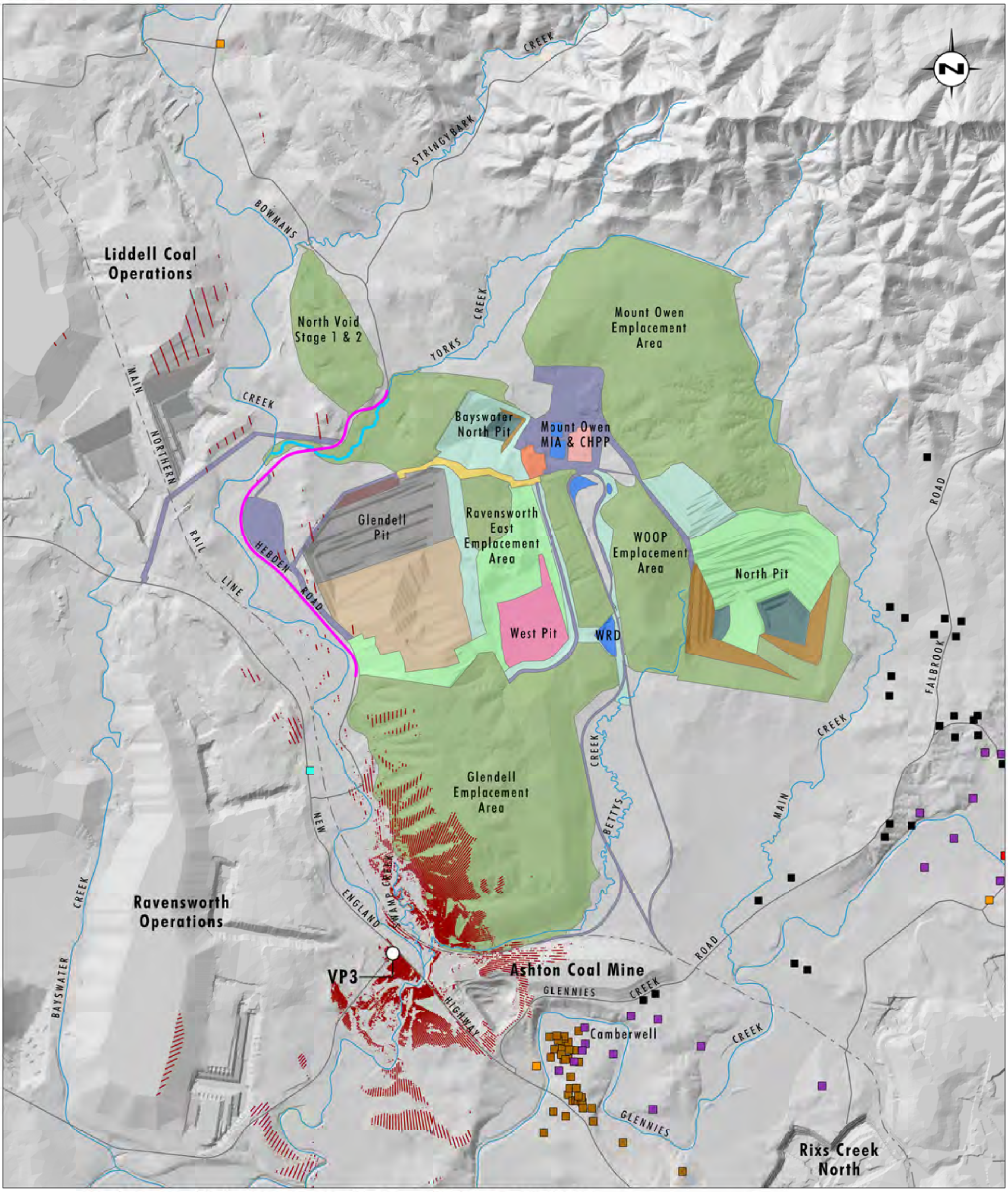

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

0 1 2 3km

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.5

VP3 Radial Analysis - Lemington Road (Brunkers Lane) - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_207.dgn
20191129 9.11

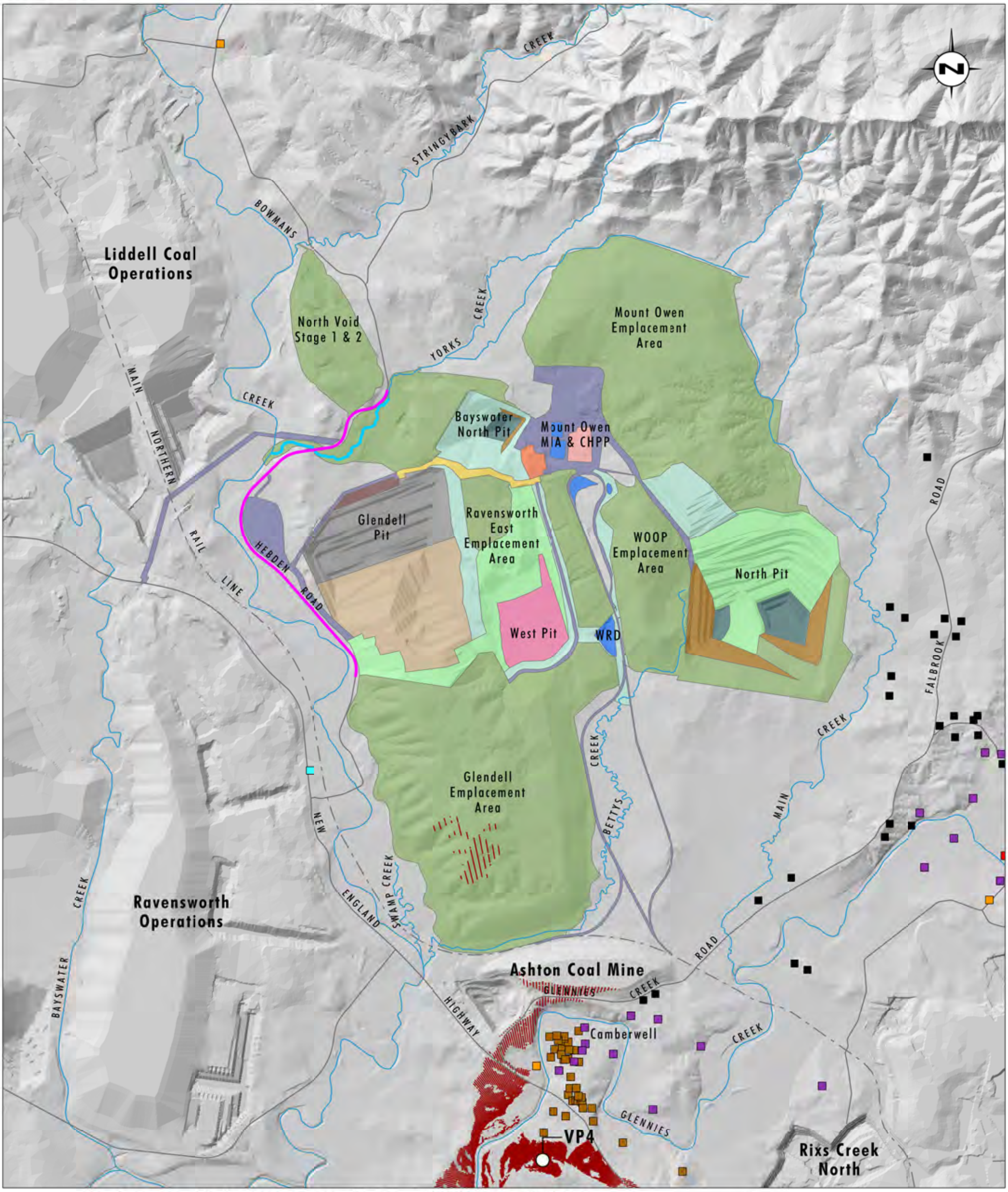

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

0 1 2 3km

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.6

VP4 Radial Analysis - Glennie Street - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_203.dgn
20191129 9.13

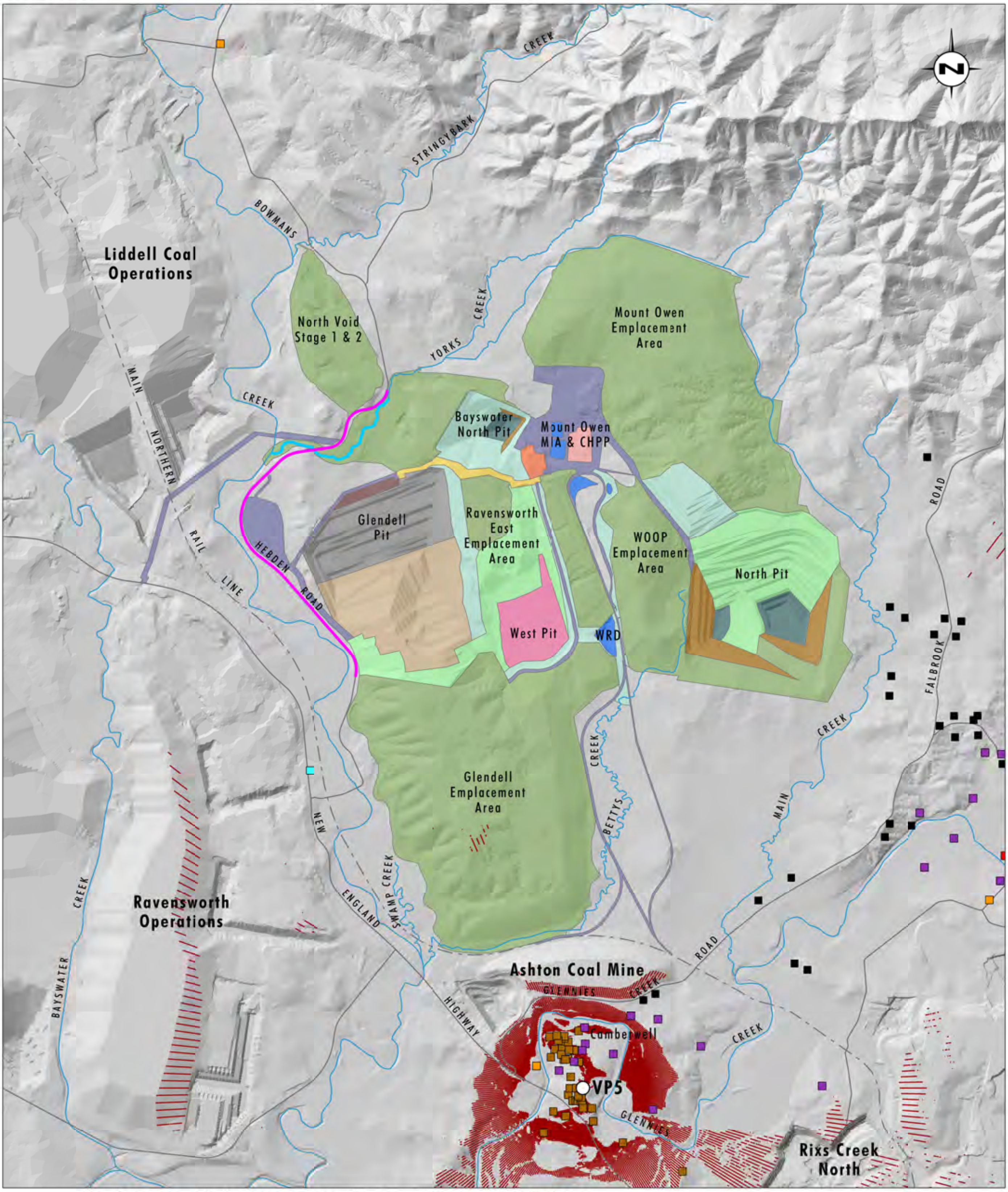

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

0 1 2 3km

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.7

VP5 Radial Analysis - McInerneys Road/ Dyrring Street - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_200.dgn
20191129 9.15

View Point 6 and 7 – Glennies Creek Road and Glennies Creek Bus Stop

View point 6 and 7 provide a view towards the Glendell Mine from the east. The radial analyses (refer to **Figure 7.10.8, Figure 7.10.9** and **Appendix 25**) indicate there will be distant views (> 4 km) of the top of the proposed overburden emplacement area, from these locations, beyond the approved overburden emplacement area.

The photomontages prepared for these view points included in **Appendix 25** show the existing overburden emplacement area and the approved Mount Owen overburden emplacement areas are all visible from these locations. Although the proposed overburden emplacement area will become more visible, these views are from a distance >4km and viewed in the context of other surrounding mining operations. The approved and proposed operations are largely obscured from the residences located to the east and south east of Glendell Mine by vegetation and the existing topography. Any increase in visibility of the proposed overburden emplacement area will be difficult to detect due to the distance and changing landforms of surrounding approved operations. There will not be views of the active pit areas associated with the Project from these view points.

It is important to note that as part of the Mount Owen Continued Operations Modification 2 project Mount Owen committed to planting a tree screen adjacent to the Glennies Creek Road and Middle Falbrook Road intersection to restrict views of the North Pit. Mount Owen will also be implementing planting at various locations on Glencore owned land along Glennies Creek Road which will assist with restricting views of Glendell Mine from the east and southeast.

It is considered that these long-distance views of the proposed overburden emplacement area will be appropriately reduced through progressive rehabilitation and tree screen planting.

View Point 8 – Hebden Road

View point 8 provides a view from the north on Hebden Road towards Glendell Mine. The radial analyses (refer to **Figure 7.10.10** and **Appendix 25**) indicates there will be distant views (> 6 km) of the top of the overburden emplacement area from this location due to the proposed increase in height.

The photomontages prepared for this view point included in **Appendix 25** illustrate there will only be a slight increase in the visibility of the proposed overburden emplacement area beyond the existing topography, a change that will be difficult to distinguish given the limited view. The existing overburden emplacement area at Liddell Coal Operations is visible from this view point and the operations at Glendell Mine are obscured from view by the existing natural topography. It is considered that these long-distance views of the proposed overburden emplacement area will result in only a minor change to the views from this view point.

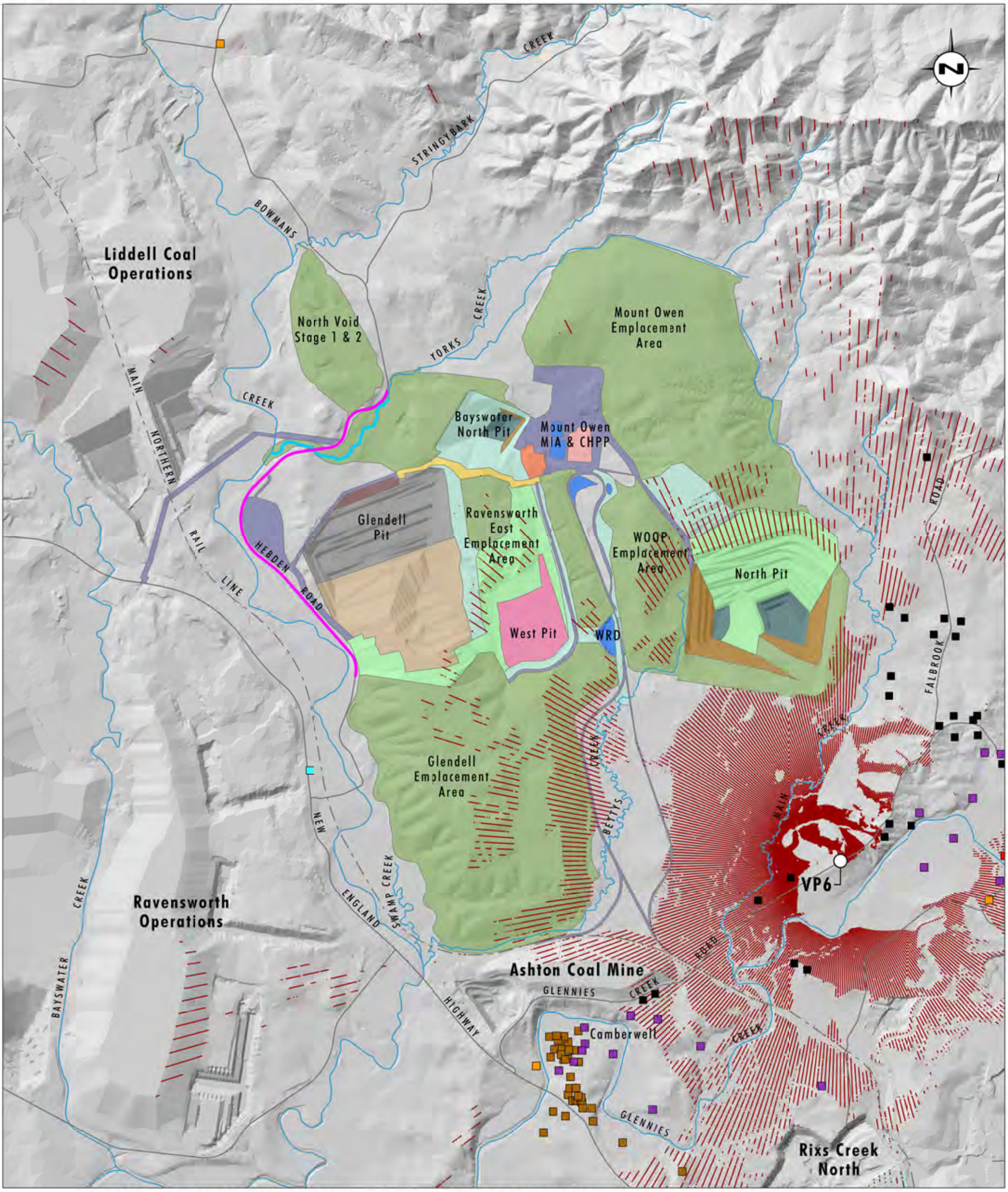

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.8

VP6 Radial Analysis - Glennies Creek Road - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_195.dgn
20191129 9.17

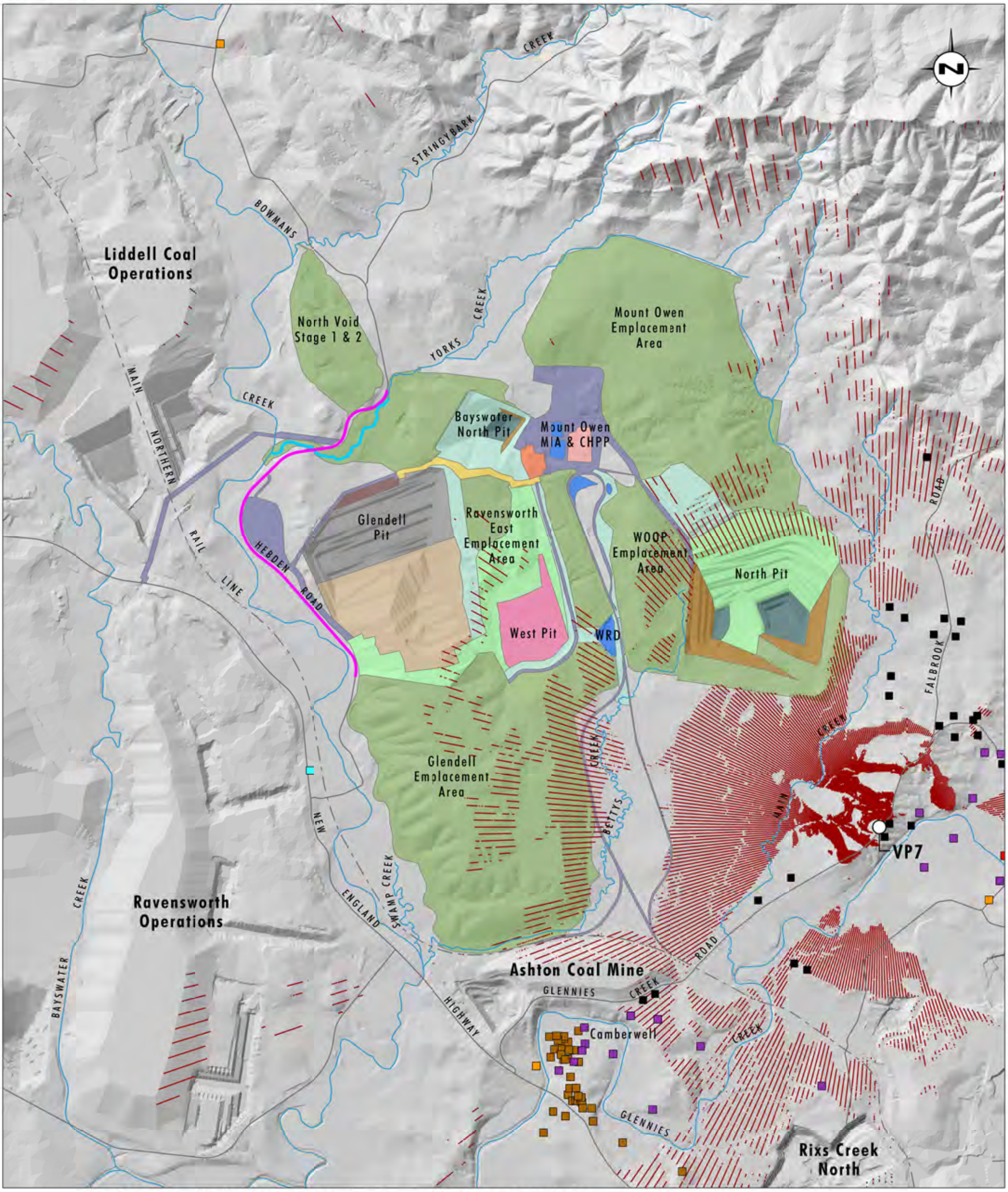

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.9

VP7 Radial Analysis - Glennies Creek Road Bus Stop - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_191.dgn
20191129 9.19

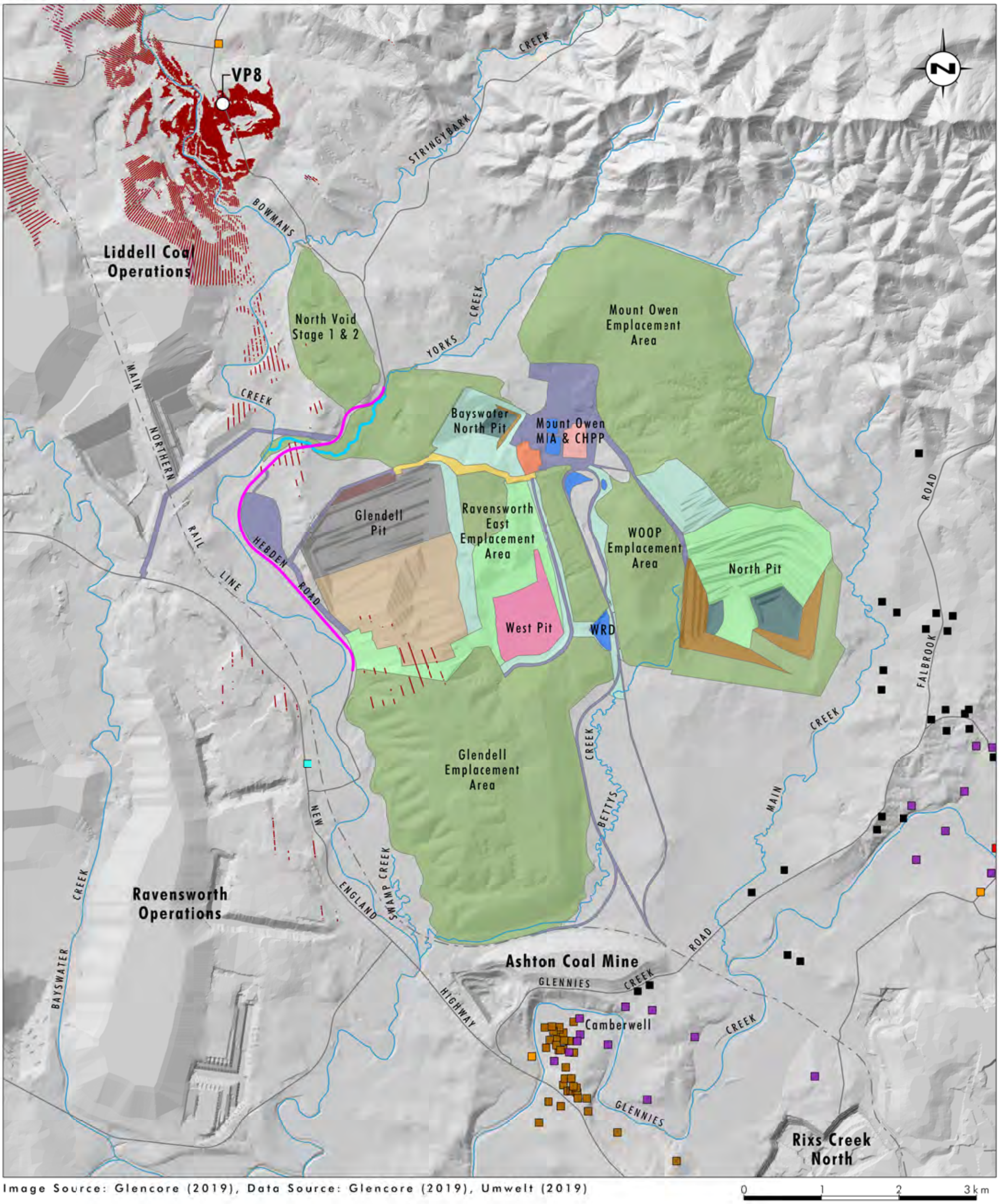

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.10

VP8 Radial Analysis - Hebden Road - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_211.dgn
20191129 9.22

View Point 9 – Realigned Hebden Road

View point 9 provides a view towards the Glendell Mine from the proposed realigned section of Hebden Road. The proposed realignment of Hebden Road will be located in close proximity to the proposed MIA and the Glendell Pit Extension (refer to **Figure 7.10.11**). The radial analysis (refer to **Figure 7.10.11** and **Appendix 25**) indicates the proposed MIA, Heavy Vehicle Access Road and the overburden emplacement area will be visible from this view point. The active pit areas will be largely obscured from view by the existing topography.

To minimise the available views from the realigned section of Hebden Road a small bund and planted corridor will be implemented immediately adjacent to the MIA, refer to **Figure 7.10.11**. The bund and planted corridor will restrict views of the proposed MIA with sections of the bund and plantings removed post-mining to allow views northwards from the realigned Hebden Road towards the Ravensworth Farm homestead relocation site (should this relocation option be pursued). Tree planting will also occur between the existing and realigned Hebden Road and Heavy Vehicle Access Road to restrict views of mobile mining fleet movements by public road users. Additional planting will also be implemented along the Heavy Vehicle Access Road safety bund where considered necessary. **Figure 7.10.12** provides a cross-section of the proposed planting works between Hebden Road and the Heavy Vehicle Access Road. It is important to note that the Heavy Vehicle Access Road will only be used by mobile mining fleet when access to the MIA is required for mechanical work. Movement of mobile mining fleet along the heavy vehicle access road will be significantly less than movement along internal mine haul roads.

Visual impacts associated with active mining areas

Direct views of the active pit areas from outside of the Project Area are limited and will be largely obscured by the existing topography and proposed tree screen planting. As previously discussed, blasting activities have the potential to result in post-blast fume, which can create a visible orange/brown plume and there is the potential for the plume to be visible from both public and private locations outside of the Project Area.

However, this potential impact will be managed through the design process for each individual blast which will be designed to comply with relevant criteria. The potential for post-blast fume impacts will be identified prior to all blasts, taking into account the specific parameters of each blast, to avoid worst-case conditions and to minimise fume emissions from blasting, in accordance with contemporary conditions of approval.

The AQIA modelling results indicate that post blast fume will be contained on site with no exceedance of the relevant EPA criteria at any off-site sensitive receptor location. Additionally, post blast plume is not an existing issue associated with mining operations at Glendell Mine. The Mount Owen Complex currently operates in accordance with a pre-blasting procedure which covers fume/plume management and any associated visual impacts. A site-specific blast management plan will continue to be implemented during operations, including key fume management actions such as defining the potential risk zone based upon weather patterns and obtaining permissions to fire based on an assessment of real-time weather conditions. In addition to general fume management practices, Mount Owen continues to work closely with its explosive suppliers to minimise the potential for post-blast fume and the associated visual impacts.

Visual Impacts associated with the Ravensworth Farm Relocation Site

The Ravensworth Homestead is currently visible from the existing Hebden Road and a number of vantage points from the surrounding existing topography. The homestead is not visible from any private residences. Generally, the views from the Ravensworth Homestead are predominantly to the south and include grassland, lines of riparian vegetation along Yorks and Bowmans Creeks, mining overburden areas (both active and rehabilitated) and distant views of Broken Back Range.

The proposed Ravensworth Farm relocation site will be visible from the realigned section of Hebden Road (refer to **Figure 7.10.13**) and the outlook from the Homestead at this new location will be similar to the current outlook. During operations overburden emplacement areas at Liddell Coal Operations and Ravensworth Operations will be visible. In addition, part of the proposed overburden emplacement area associated with the Glendell Pit Extension will also be visible. All overburden emplacement areas visible from the Ravensworth Farm relocation site will be subject to rehabilitation and revegetation in accordance with the relevant mining operation's MOP/RMP. At the completion of mining, the Glendell Pit Extension pit crest will be situated approximately 630m from the relocated homestead. In its new location, views of the Glendell Pit Extension final void will not be visible from the homestead due to shielding provided by the existing topography immediately to the east.

Further assessment of the visual setting of the existing Ravensworth Homestead site and the proposed relocation site is discussed further in **Appendix 23**.

7.10.4 Summary of visual impacts and mitigation measures

The character of the immediate visual environment surrounding the Project Area is strongly influenced by existing mining operations and the existing approved operations at Glendell Mine are currently visible from a range of locations within the surrounding locality. The surrounding mining operations are also visible from the New England Highway and other public and private locations (to varying degrees), particularly Ravensworth Operations, Ashton Coal Mine, Rix's Creek South Mine and Rix's Creek North Mine. The approved mining operations at Glendell Mine and in the immediate vicinity currently result in a night-time light glow, which affects the local night-time visual amenity.

Views will be available of the proposed overburden emplacement area from some sections of the surrounding road network, particularly from the New England Highway and from the realigned Hebden Road. Views from the New England Highway will be generally short term in nature given the speeds being travelled. Views from both locations will be largely restricted due to the proposed planting of tree screens.

Views of the proposed overburden emplacement area from the south and southeast will either be largely restricted or from long distance. These views will also be within the context of the changing views of the approved overburden emplacement areas at Ravensworth Operations, Mount Owen, Rix's Creek North and Rix's Creek South as mining and overburden emplacement continues.

The progressive rehabilitation of overburden emplacement areas and shaping of the final landform to conform to the surrounding natural environment is expected to reduce the visual impact from all areas where views are possible.

umwelt

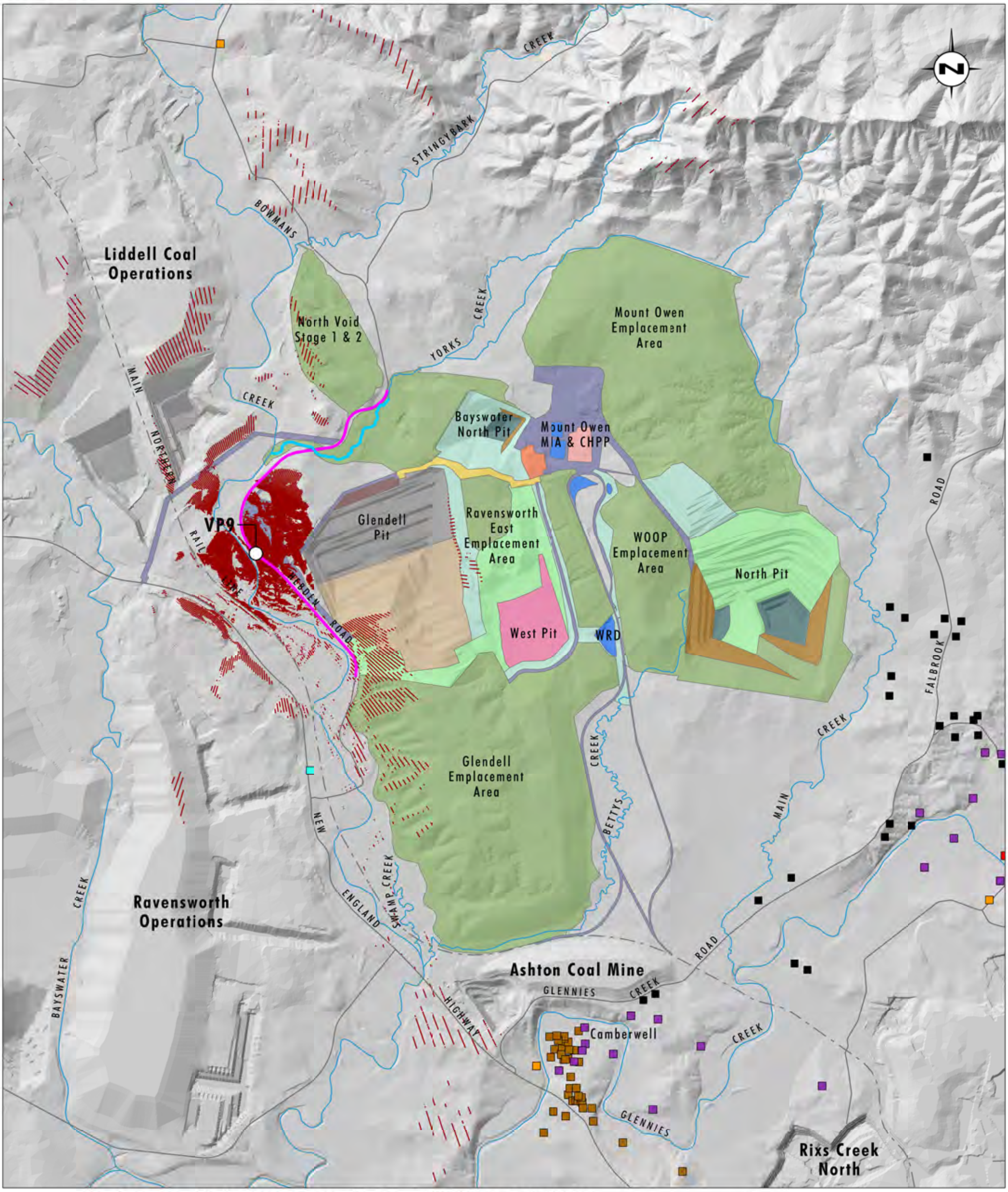

Image Source: Glencore (2019), Data Source: Glencore (2019), Umwelt (2019)

0 1 2 3km

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- Yorks Creek Realignment
- Hebden Road Realignment
- 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 Area
- Highwall
- Tailings Capping in Progress
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.11

VP9 Radial Analysis - Hebden Road Realignment - Year 18 Conceptual Mine Plan

File Name (A4): R08/4166_271.dgn
20191129 9.25

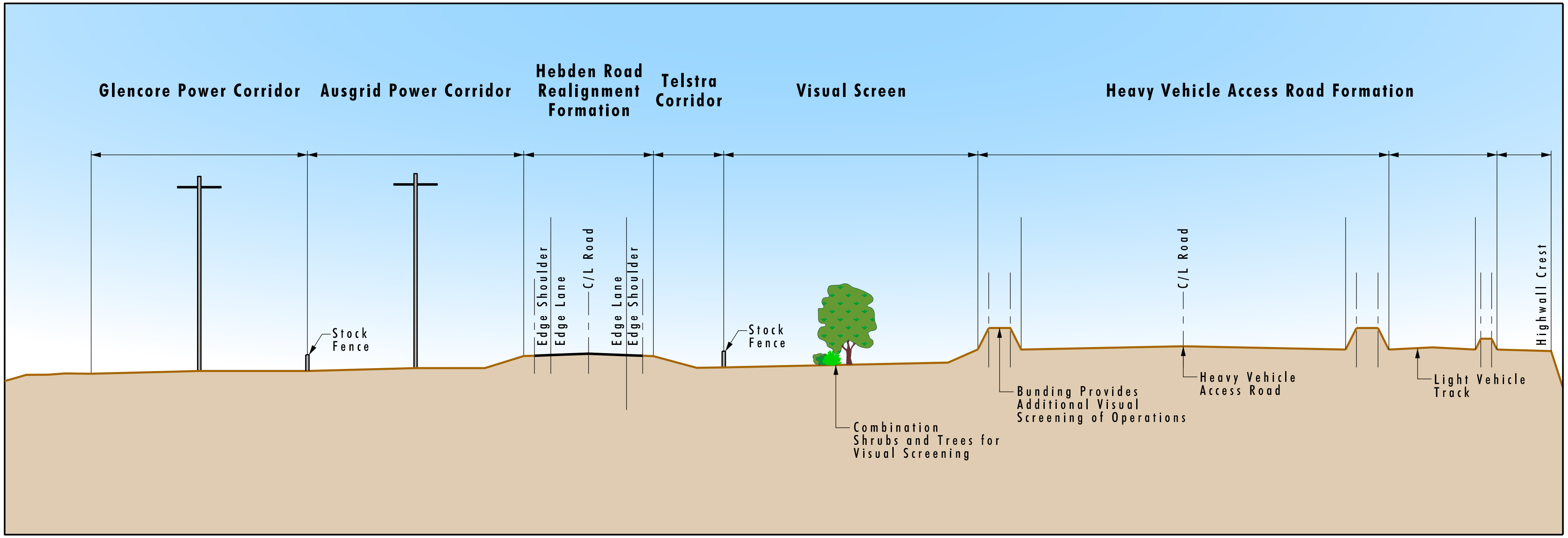

FIGURE 7.10.12

Conceptual Cross Section - Hebden Road Realignment and Heavy Vehicle Access Road

Data Source: Glencore

File Name (A4): R08/4166_401.dgn
20191129 8.56

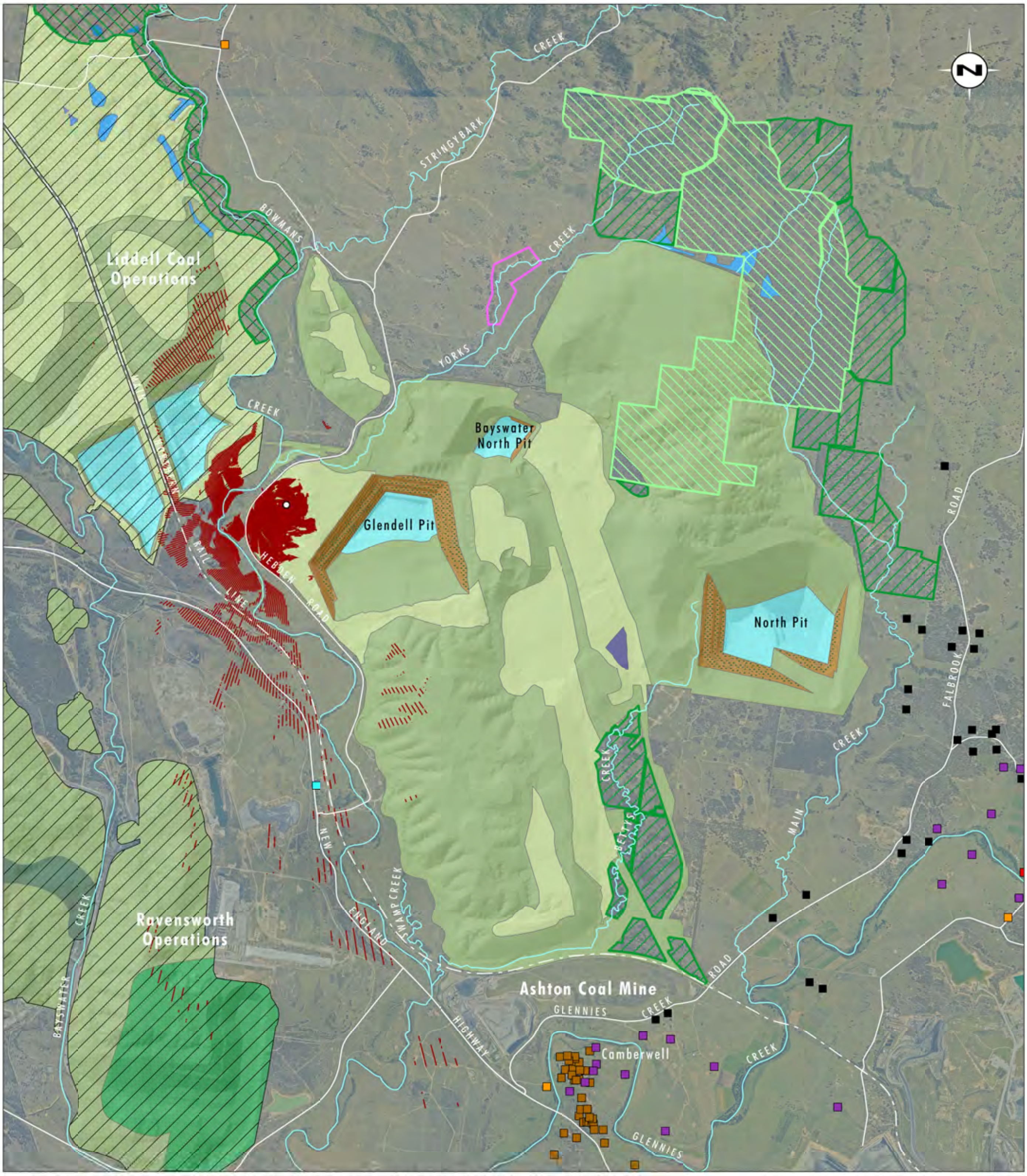

Image Source: Glencore (Dec 2018), Data Source: Glencore (2019), (Umwelt (2019)

Legend

- Viewpoint Location
- Terrain Visible from Viewpoint Location
- 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
- Mount Owen Complex Biodiversity Offset Area
- Ravensworth State Forest
- Yorks Creek Voluntary Conservation Area
- Liddell Coal Operations Biodiversity Offset Area
- Associated with Other Operations
- Private
- Private (Acquisition Rights)
- Private Infrastructure
- Community Infrastructure
- Glencore Owned
- Other Mine Owned

FIGURE 7.10.13

Ravensworth Farm Relocation Option - Radial Analysis - Conceptual Final Landform

File Name (A4): R08/4166_554.dgn
20191129 9.35

7.10.5 Lighting assessment

As previously discussed, the Mount Owen Complex, including Glendell Mine and surrounding mining operations within the vicinity currently result in a night time light glow, affecting the local night time visual amenity. As the Mount Owen Complex operates on a 24 hour basis, lighting is required on site to meet operational and safety requirements but is kept to a minimum where practicable. To minimise impacts on the scenic quality of the area, Glencore has implemented a range of measures including the use of shields and directional lighting for overburden emplacement areas and active mining areas (where required).

Permanent lighting will continue to be required for the existing MIA while it is in use and the proposed MIA, the existing Mount Owen CHPP and other fixed infrastructure areas including coal handling conveyors and stockpiles. Mobile lighting will also be required in active mining and overburden areas. This will be provided by mobile lighting plants and equipment headlights. Generally, mobile lighting plants will be screened from nearby view points by the overburden emplacement area, vegetation or natural topography. The photomontages illustrate that the overburden emplacement area will have increased visibility particularly from the west. It should be noted that there are no private residences located to the west and whilst there is increased visibility of the overburden emplacement area from locations to the south and east these distances are long range (approximately 5 km).

Photomontages were prepared to compare the impact of the lighting associated with the proposed MIA from view point 1 and 2 (New England Highway) for each stage of the development (refer to **Appendix 25**). These are the only locations outside of the Project Area that the MIA will be visible. Although the lighting at the proposed MIA will be visible from these location points at night, it is not considered obtrusive when compared to the existing night time glow associated with the approved operations. Lighting impacts associated with the proposed MIA and mobile mining fleet using the heavy vehicle access road in relation to the realigned section of Hebden Road will be mitigated by the use of bunding and planted screens. Ongoing management of lighting will continue to be undertaken on all emplacement areas that are visible from public roads so that mobile lighting does not impact on road users or local amenity.

Glencore will continue to undertake the following measures to reduce the potential impact of night lighting:

- ongoing management of mobile lighting to reduce the impacts of lighting at night, where practical, positioning lights so they are shielded by walls, overburden emplacement areas and vegetation and the ongoing implementation of procedures for the appropriate placement of mobile lighting plant, and

- all lighting associated with the Project will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

7.10.6 Management and Mitigation

To assist in minimising the visual impacts of the Project, the following controls will be implemented:

- progressive rehabilitation, will be undertaken to reduce the duration of visible soil exposure, including the use of temporary rehabilitation as appropriate

- implementation of a small bund and planting/seeding of tree screens along the realigned section of Hebden Road immediately adjacent to the proposed MIA to reduce the availability of direct views of the proposed MIA by public road users. Select bunding and vegetation would be removed post-mining to allow views northwards from the realigned Hebden Road towards the proposed Ravensworth Farm homestead site.

- Proposed tree planting between the existing and realigned Hebden Road and heavy vehicle access road to screen views of mobile mining fleet movements by public road users. Additional planting would also occur along the heavy vehicle access road safety bund where considered necessary
- proposed tree planting on Glencore owned land to restrict views of the proposed mining operations from the New England Highway
- continued implementation of the pre-blasting procedure and site-specific blast management plan to manage fume/plume resulting from blasting to reduce the associated visual impacts
- ongoing management of mobile lighting to reduce the impacts of lighting at night, positioning lights so they are not pointing off site, and are shielded by walls, overburden emplacement areas and/or vegetation, where practicable. Procedures will continue to be implemented regarding the appropriate placement of mobile lighting plant to reduce the potential for lighting impacts on local residents and public roads
- all new fixed lighting associated with the Project will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

7.11 Traffic and transport

A comprehensive Traffic and Transport Impact Assessment (TTIA) has been prepared by Puliyapang in accordance with the SEARs for the Project and is provided in **Appendix 25**. The SEARs require an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the road and rail networks (refer to **Appendix 4**).

As outlined in **Section 6.0**, traffic and road issues were identified by the community as an issue of concern, particularly maintaining accessibility of the roads and the construction of the Hebden Road realignment being managed to minimise disruptions such as road closures. The design of the Hebden Road realignment takes these concerns into consideration and enables largely “offline” construction to mitigate impacts to road users.

The Project does not propose any increase to the overall existing approved operational workforce numbers for the Mount Owen Complex, however there is an increase in the workforce associated with the Project as the maximum production rates increase over the life of the Project. This coincides with the decrease in production and workforce numbers at Mount Owen North Pit which will cease in 2037.

The construction phase is proposed to largely occur within the first approximately 5 years of the Project (particularly Year 1-2). The Project will generate additional traffic movements along Hebden Road during the construction phase associated with the construction of the following:

- new Glendell MIA
- Heavy Vehicle Access Road
- Hebden Road realignment
- Ravensworth Homestead relocation
- Yorks Creek Realignment
- Glendell MIA removal.

The removal of the Ravensworth East MIA will also occur to allow for the Yorks Creek Realignment. The removal of this infrastructure is approved under the Mount Owen consent, however traffic movements associated with its removal have been included in this assessment.

In addition, the continuation of Mount Owen CHPP operational traffic and coal transport on trains is proposed to extend for an additional 8 years (approximately) beyond the currently approved Mount Owen Complex.

As discussed in **Section 3.1.2**, the construction workforce will vary depending on the timing of the various construction components of the Project identified above and is expected to peak at approximately 350 personnel in Year 1-2 of the Project.

A summary of the key findings of the TTIA is provided in this section and the full report is provided in **Appendix 26**.

7.11.1 Methodology

The assessment reviewed the existing road environment and conditions (i.e. pavement, shoulders, clear zone hazard signage and delineation) in accordance with Roads and Maritime Services (RMS) and Austroad checklist guidelines. Details are provided in **Appendix 26**.

The TTIA undertaken for the Project comprised the following:

- Characterisation of existing traffic conditions through review of previous traffic assessments and traffic count data as available.
- Undertaking traffic counts on the surrounding road network to establish current traffic volumes. Specifically, this involved counts on the following intersections:
  - Hebden Road/Mount Owen Mine Access Road
  - New England Highway/Hebden Road
- Traffic modelling and intersection analysis using SIDRA modelling and an assessment of traffic impacts and any required management measures at the following intersections:
  - New England Highway/Hebden Road
  - Existing Hebden Road/Glendell Mine Access Road (including proposed future use as Ancillary Pad South Access)
  - Existing Hebden Road/Ravensworth East Mine Access Road
  - Existing Hebden Road/Mount Owen Mine Access Road
  - Proposed Hebden Road/Glendell Mine Access Road
  - Proposed Hebden Road/Ancillary Pad North Access

Figure 7.11.1 shows the locations of these intersections.

7.11.2 Existing road and rail network

7.11.2.1 Road network

The principal road network which provides access to the Project includes the New England Highway and Hebden Road. Hebden Road provides local access between the New England Highway at Ravensworth in the south to the New England Highway near Muswellbrook in the north and primarily provides access to the Mount Owen Complex mines and local rural properties. There are also two quarries to the north of the Project which use Hebden Road for haulage of their quarry products.

Intersection surveys for the Project were completed at the New England Highway/Hebden Road intersection and Hebden Road/Mount Owen Mine Access Road intersection.

The existing New England Highway, as measured at the Hebden Road intersection, experiences peak hour flows in the morning between 5.45 am to 6.45 am and in the afternoon from 5.00 pm to 6.00 pm. These peak times are considered to occur during the local network peak times on the New England Highway and are not indicative of peak traffic movements along Hebden Road from the Glendell and Mount Owen mining operations. The Hebden Road/Mount Owen Mine Access Road intersection identified peak times of 5.30 am to 6.30 am for the peak morning period and 6.15 pm to 7.15 pm for the peak afternoon period and these times have been adopted for the assessment.

The data collected during the intersection survey completed for the Project (refer to **Section 7.11.1**) enabled an assessment to be completed of the current road network performance. The operation of the intersections surveyed was assessed by calculating the amount of delay to vehicles using the intersection and, amongst other performance measures, gives a Level of Service (LoS) rating which indicates the relative performance of traffic movements within the intersection.

In accordance with the RMS Guide to Traffic Generating Developments (2002) listed in **Appendix 26**, there are six LoS measures ranging from A (very low delay and very good operating conditions) to F (over saturation where arrival rates exceed intersection capacity). Typically, a LoS D or better is considered to be acceptable, however a LoS E may be acceptable if it also operates with a low degree of saturation.

The results indicate that both intersections surveyed currently operate with a very good level of service, at LoS A during weekday AM and PM peak periods, with one exception at LoS B.

A detailed description of the existing road network is provided in **Appendix 26**.

7.11.2.2 Rail network

Product coal destined for export is transported from mines in the Hunter Valley to the Port of Newcastle via the Main Northern Rail Line, which forms part of the Hunter Valley rail network. The Hunter Valley rail network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line (with some significant stretches of third track) from Maitland to Muswellbrook in the upper Hunter Valley, and a shared single track with passing loops from that point north and west (ARTC, 2018). In 2018, 171 Mt of coal was transported on the Hunter Valley rail network (ARTC, 2019).

The primary users of the Hunter Valley rail network are coal mines, including the Mount Owen Complex, other commodities and freight container trains as well as passenger trains. The Hunter Valley rail network is managed by the Australian Rail Track Corporation (ARTC). The primary role of the ARTC is to ensure that rail corridor capacity in the Hunter Valley can stay ahead of coal demand.

As described in **Section 2.1.3**, the Mount Owen Complex CHPP is approved to process and transport by rail up to 17 Mt of ROM coal per calendar year. Product coal from the Mount Owen Complex is currently transported via rail on the Hunter Valley rail network with the majority to the Port of Newcastle for export.

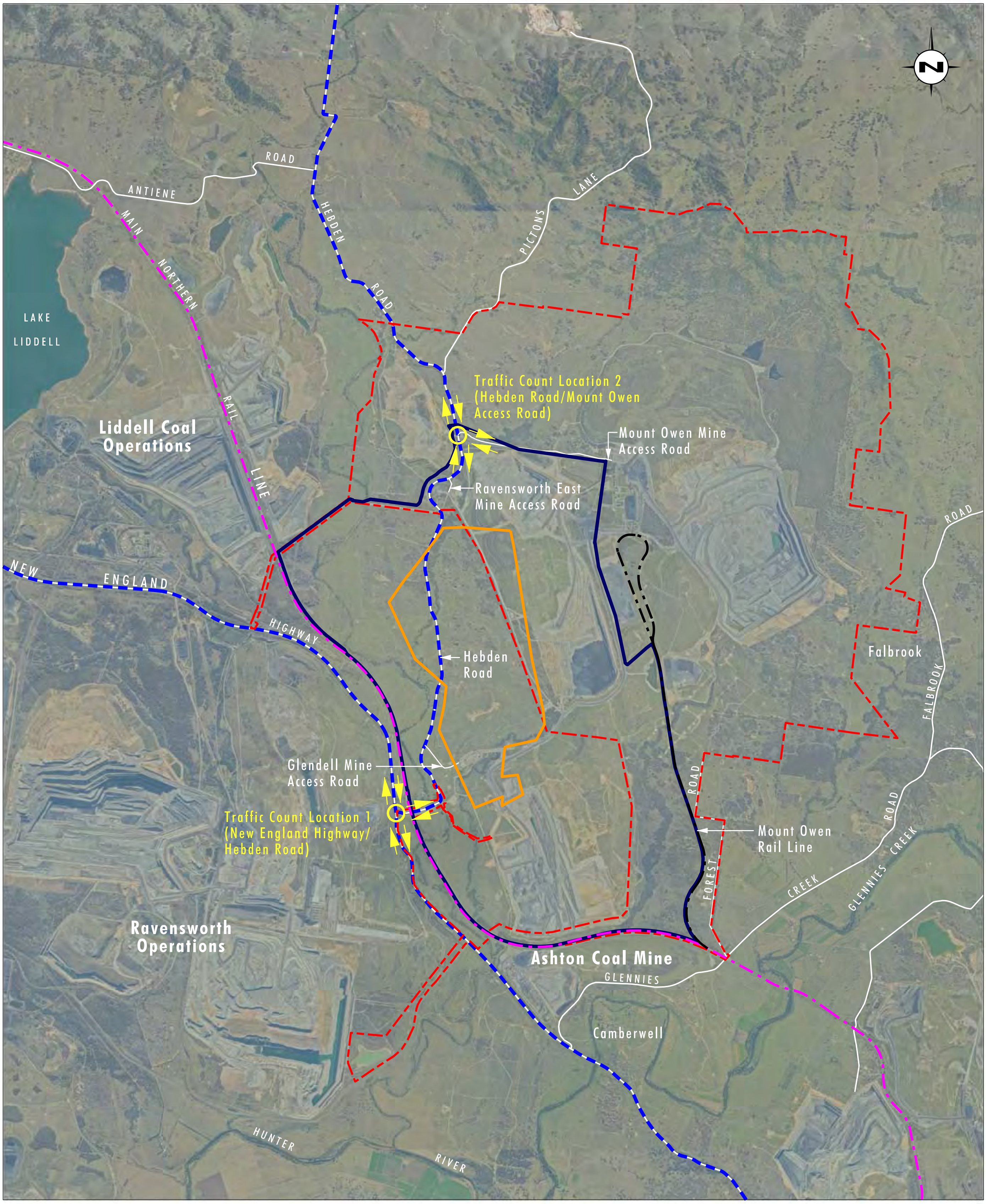

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Traffic Route
- Main Northern Rail Line
- Traffic Count Location

FIGURE 7.11.1

Existing Road Network and Traffic Count Locations

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7.11.3 Road traffic impact assessment

The road traffic modelling has indicated that there is adequate latent capacity to accommodate the additional traffic within acceptable thresholds during the construction and operational phases of the Project. The Hebden Road realignment will be designed and delivered in accordance with relevant road design guidelines and it is expected that impacts experienced will be minor during the construction phase and negligible during the operational phase. The existing and proposed intersections will also offer sufficient capacity to facilitate required traffic movements associated for the life of the Project. The impacts associated with the construction and operational phases of the Project are described in the following sections.

7.11.3.1 Construction phase

As described in **Section 3.2**, the construction phase for the Project is expected to occur within the first 5 years of the Project and is proposed to commence upon approval. The peak construction period has been assumed to occur in Year 1-2 of the Project with a peak construction workforce of approximately 350 personnel. Construction vehicle movements were modelled with a conservative approach as one vehicle for each construction worker including 80% light vehicles and 20% heavy vehicles.

Intersection traffic modelling using SIDRA has been undertaken to analyse the potential traffic impact of the construction traffic at the intersections identified in **Section 7.11.1**. Analysis has been undertaken for the following scenarios:

- 'Base case' scenario – accounts for background traffic volumes combined with current existing development volumes.
- Year 1 forecast scenario – accounts for background traffic volumes including application of a 2% growth factor combined with expected traffic generation by the Project in Year 1 and traffic generated by the construction of project infrastructure.

As discussed in **Section 3.2.7**, the Project will necessitate the realignment of a section of Hebden Road. During construction of this realignment, Glencore will provide appropriate traffic controls and will provide continued access along the existing Hebden Road until the realigned section is commissioned. Minor delays during tie-in works at either end of the realigned section of Hebden Road may occur though these will be planned outside of peak periods to reduce the impact to through traffic with access maintained during this period under stop/go traffic controls.

Relocation of the Ravensworth Homestead will be completed in one of two ways:

- The local Ravensworth Farm option will involve relocation of the homestead buildings intact along a purpose built road to avoid interaction with traffic on the new Hebden Road Realignment, or
- The Broke Village option will transport homestead components on road registered trucks using existing transport routes with no impact on the road network above the anticipated truck movements for the Project.

The final design of the Hebden Road realignment will be prepared in consultation with Singleton Council.

Modelling completed as part of the TTIA predicts that the existing intersections of interest are expected to operate with an acceptable LoS during the construction phase of the Project. The assessment of impacts associated with the construction phase of the Project are summarised in **Table 7.52**.

Table 7.52 Assessment of Traffic Impacts in the Construction Phase of the Project

Requirement	Assessment
Intersection Capacity	The intersection modelling analysis indicated that during the construction of the Project, there will be a negligible impact on intersection performance at the intersections modelled due to the presence of construction traffic. Intersection modelling has demonstrated that there is enough latent capacity to accommodate the additional traffic within acceptable thresholds and all show no change to the LoS at existing intersections.
Road Conditions	Intermittent road closures on Hebden Road due to blasting for construction activities may occur where this blasting occurs within 500 m of the current road alignment. These temporary closures of Hebden Road will be up to approximately 15 minutes.
Road Safety	Negligible impact on road safety conditions on the New England Highway and Hebden Road due to the minor increase in traffic volumes associated with the Project.
Network Efficiency	No anticipated network efficiency impacts associated with the construction of the Project.

7.11.3.2 Operational phase

As discussed earlier, the Project does not propose to increase permanent workforce levels from current approved levels within the Mount Owen Complex, therefore the total traffic associated with the ongoing operations will be similar to current traffic levels. Accordingly, proposed operational traffic demands along Hebden Road are not expected to adversely impact upon existing acceptable traffic conditions and traffic service levels at the New England Highway intersection and on Hebden Road. Impacts were assessed for Year 13 (approximately 2033) as this year has the highest level of production throughout the Project and therefore is a worst-case scenario for the operational phase. However, the forecast total workforce traffic for the Mount Owen Complex for Year 13 is less than the existing operational traffic numbers.

Modelling of the New England Highway and Hebden Road intersection indicates a LoS A for all periods, however during the Year 13 forecast AM peak, modelling indicates a LoS B for the Hebden Road approach lane at the New England Highway intersection due to right turning traffic onto the New England Highway (towards Muswellbrook). It is noted that the right turn is the minor movement from this lane with only 3 vehicles expected to turn right from Hebden Road during the Year 13 AM peak period, in comparison to 22 vehicles turning left. Further, a sensitivity analysis concluded that the reduced LoS is primarily due to growth of the New England Highway through traffic. The traffic associated with the Project does not significantly affect these wait times. A summary of the results from the assessment and the proposed intersection treatments is provided in **Table 7.53** below.

Table 7.53 Summary of assessment results at each Intersection and Proposed Intersection Treatments

Intersection	Performance Indicator	AM Peak			PM Peak			Proposed Intersection Treatment
		2018 Base	2022 Forecast	2033 Forecast	2018 Base	2022 Forecast	2033 Forecast	
New England Highway/ Hebden Road	Degree of Saturation (DOS)	0.511	0.554	0.689	0.279	0.514	0.329	None – Existing arrangement is sufficient
	Level of Service (LOS)	A	A	B	A	A	A	
	95% Back of Queue (m)	4.5	14.5	14	2.5	26.1	7.2	
Hebden Road/ Glendell Access Road	DOS	0.089	0.210	0.144	0.034	0.210	0.084	Channelised Right Hand Short (CHR(s)) (replacing existing Auxiliary Right Turn Treatment (AUR))
	LOS	A	A	A	A	A	A	
	95% Back of Queue (m)	2.1	2.6	0.2	0.5	0.6	0.2	
Hebden Road/ Ravensworth East Access Road	DOS	0.066	0.069	N/A	0.028	0.028	N/A	Basic Right Turn Treatment (BAR)
	LOS	A	A	N/A	A	A	N/A	
	95% Back of Queue (m)	1.0	0.5	N/A	0.3	0.3	N/A	
Hebden Road/ Mount Owen Access Road	DOS	0.053	0.053	0.053	0.035	0.035	0.035	None – Existing arrangement is sufficient
	LOS	A	A	A	A	A	A	
	95% Back of Queue (m)	2.2	2.2	2.2	1.1	1.1	1.1	
Hebden Road/ Proposed Glendell Access Road	DOS	N/A	0.069	0.073	N/A	0.035	0.063	Channelised Right Hand Short (CHR(s))
	LOS	N/A	A	A	N/A	A	A	
	95% Back of Queue (m)	N/A	1.8	2.6	N/A	1.2	2.1	
Hebden Road/ Proposed Ancillary Pad North Access	DOS	N/A	0.115	0.139	N/A	0.050	0.082	Basic Right Turn Treatment (BAR)
	LOS	N/A	A	A	N/A	A	A	
	95% Back of Queue (m)	N/A	0.2	0.2	N/A	0.3	0.2	

As outlined in **Section 3.2.8**, the primary access for traffic associated with the mining of the Glendell Pit Extension will be via a new access road to the new MIA situated off the realigned Hebden Road (refer to **Figure 1.3**). Traffic associated with the Mount Owen MIA and CHPP will continue to access these facilities via the current Mount Owen Access Road off Hebden Road.

Due to the close proximity of Hebden Road (including the realigned section) to the Glendell Pit Extension, it is expected that some intermittent road closures will be required where blasting occurs within 500 m of the road. These closures will occur in accordance with current blasting procedures under the Mount Owen Complex Blast Management Plan (Glencore, 2018l). Where possible, blasts will be conducted in off peak times and at times that avoid school related traffic in order to minimise disruptions on local road users.

Modelling completed as part of the TTIA predicts that the existing intersections of interest are expected to operate with an acceptable LoS for the operational phase of the Project. The assessment of impacts associated with the operational phase of the Project are summarised in **Table 7.54**.

Table 7.54 Assessment of Traffic Impacts During the Operational Phase of the Project

Requirement	Assessment
Intersection Capacity	Minor impact on intersection capacity due to increased demand, however intersection modelling has demonstrated that there is enough capacity at the existing and proposed intersections modelled to accommodate the additional traffic with reduction of LoS from A to B in only one case and the remainder at LoS A with no change due to the Project.
Road Conditions	Intermittent road closures on Hebden Road due to mine-related blasting are predicted to result in potential delays of up to approximately 15 minutes for traffic travelling along Hebden Road.
Road Safety	Negligible impact on the New England Highway and Hebden Road during mining operations due to overall workforce numbers remaining below the number for the combined existing approvals at the Mount Owen Complex. The proposed Hebden Road realignment will provide a higher standard that is more compatible with regulatory posted speed limits.
Network Efficiency	No anticipated network efficiency impacts associated with the operation of the Project.

7.11.3.3 Hebden Road realignment

A portion of the current Hebden Road alignment is located within the Glendell Pit Extension. It is intended to realign a section of the existing Hebden Road to the west around the Glendell Pit Extension and new MIA. The proposed realignment is shown on **Figure 3.12**.

The realignment of Hebden Road will extend the trip distance of some road users by approximately 1.2 km. Assuming that vehicles travel at a speed of 80 km/h (the current speed limit) along this realigned route, this will increase travel time by less than 1 minute. As such, the proposed realignment of Hebden Road is expected to have a minor impact on travel times for existing road users.

Transport for NSW crash data indicates that there have been twelve crashes recorded in the vicinity of the New England Highway/Hebden Road intersection, two of which occurred on Hebden Road over a 5-year period from 2013 to 2017. It is noted that Glencore completed an extensive upgrade to the Hebden Road approach to the New England Highway/Hebden Road intersection in 2018 including the removal of a rail level crossing and construction of a new rail overpass bridge and a new dual-lane bridge over Bowmans Creek. This has significantly improved traffic flow on the Hebden Road approach to the New England Highway resulting in reduced travel times and improved road safety at this location.

The Hebden Road realignment will remain classified as a Local Road vested in Singleton Council. The new section of Hebden Road will be designed and constructed in accordance with Austroads Design Guidelines and Singleton Council Design Specifications, including two line-marked travel lanes and sealed shoulders which will increase the safety and the quality of the road over current conditions. Accordingly, the proposed realigned portion provides an opportunity to improve the road condition and safety for road users.

As detailed in **Section 6.0**, Glencore has had preliminary consultation with Singleton Council in relation to the design and location of the proposed alignment. Road users, in particular local residents, two quarries (Hebden Quarry and Wild Quarry), and Hunter Valley Buses, and RMS have also been consulted on the proposed realignment. As part of the implementation of the Project, a concept design has been prepared for the realignment of Hebden Road in consultation with Singleton Council. A detailed design will then be prepared for Singleton Council approval prior to construction commencing.

As discussed in **Section 5.2.2** consent is required under section 138 of the Roads Act to work on or above a road or to connect a road to a classified road. Relevant to the Project, consent under section 138 will be required for:

- the road works associated with the realignment of Hebden Road
- any construction activities on or over public roads or in road reserves
- approvals to close road reserves.

7.11.4 Rail transport impact assessment

With regard to the transportation of product coal from the Mount Owen Complex as discussed in **Section 3.2.4**, the Project will not result in any changes to the existing approved processing capacity of the Mount Owen Complex CHPP (up to 17 Mt of ROM coal per annum), however the processing and transport of product coal will continue for an additional 8 years beyond the current Mount Owen Consent (to 2045).

The 2019 Hunter Valley Corridor Capacity Strategy (ARTC, 2019) sets out how ARTC plans to ensure that rail corridor capacity in the Hunter Valley stays ahead of coal demand. The 2019 strategy indicates that the forecast demand on the Hunter Valley rail network is less than the volume and capacity of the system. This forecast demand includes the current operations at the Mount Owen Complex. The Project will continue to operate within approved capacity and will not result in any additional trains on the Hunter Valley rail network, indicating the Project will not have an impact on the forecast capacity of the Hunter Valley rail network.

It should also be noted, by 2037, when Mount Owen North Pit ceases mining operations, a number of other currently approved mining operations within the Hunter Valley rail network are likely to have also stopped operating in accordance with their current approvals and an overall reduction in train movements along the Hunter Valley rail network is likely to occur.

7.11.5 Management and mitigation

The following management and mitigation measures are proposed to be implemented to ensure the effective mitigation of potential traffic impacts.

It is noted that AustRoads have updated their methodology to replace auxiliary right turn “Type AUR” treatments to short channelised right turn “Type CHR(s)” treatments and this is now considered best practice. Glencore will change line marking at the Hebden Road/Glendell Access Road intersection and the Hebden Road/Ravensworth East Access Road intersection to be in line with the new Austroads methodology to improve delineation along Hebden Road and road safety at each mine access intersection. Any newly constructed intersections as part of the Hebden Road realignment will not use a “Type AUR” treatment.

A Construction Traffic Management Plan (CTMP) will be prepared in consultation with Singleton Council and RMS prior to construction commencing. The CTMP will include appropriate Traffic Control Plans and include detail with respect to:

- traffic control measures in works areas
- restrictions on the delivery of heavy plant and materials to site
- identify the appropriate entry/exit points for the proposed construction compound area(s)
- methods such as signage and local media advertisements for advising motorists of the change in traffic conditions associated with the work
- road closure requirements due to blasting associated with construction works.

With regard to the proposed Hebden Road realignment, Glencore will construct the realignment largely offline to the existing Hebden Road prior to tying it in with the existing road network (i.e. existing Hebden Road not being realigned) to minimise disruption to traffic during the construction phase.

The final design of the Hebden Road realignment will be prepared in consultation with Singleton Council.

Further, Glencore commit to completing a road safety audit during the development of the Hebden Road realignment to ensure that there is no net worsening of road safety conditions associated with the proposed realignment.

With regard to the overall condition of Hebden Road, Glencore will improve delineation on Hebden Road through the Hebden Road realignment which will include lane edge marking and guide posts.

During operations, blasting activities will be conducted (as far as practicable) in off peak times and at times when school related traffic is not expected in order to minimise impacts on Hebden Road travel times and road safety conditions associated with the proposed operations.

7.12 Agriculture

An Agricultural Impact Statement (AIS) has been prepared by Umwelt to assess the potential agricultural impacts associated with the Project. The AIS has been prepared in accordance with the SEARs (refer to **Appendix 4**), Agricultural Impact Statement Technical Notes (DPI 2013), the Upper Hunter SRLUP (2012) and the relevant provisions of the Mining SEPP. The AIS has also been prepared to address the specific requirements in the Conditional Gateway Certificate for the Project, refer to **Appendix 4**.

A summary of the key findings of the AIS is provided in this section and the full report is provided in **Appendix 27**.

7.12.1 Methodology

As required by the relevant guidelines above, the AIS assesses the potential impacts of the Project on agriculture within a site specific and regional context including; within the Project Area and Additional Disturbance Area, the Project Locality (which is based on the size of the Parish Areas within the region and is defined as a 5 km diameter from the centre of the Additional Disturbance Area associated with the Project) and the Singleton and Muswellbrook LGAs.

As discussed in **Section 7.6**, no specific land-based offset sites in relation to the Project have been identified at this stage, therefore assessment of potential offset sites has not been included in the assessment.

The AIS identifies and evaluates the potential risks to agricultural resources and enterprises that may occur as a result of the Project. In this regard the AIS considered the outcomes from the detailed technical studies prepared for the Project.

Additional data has been reviewed and analysed in the context of assessing agricultural resources within the vicinity of the Project Area including data from the Bureau of Meteorology (BoM), the Australian Bureau of Statistics (ABS) and DPIE eSPADE websites.

The detailed agricultural assessment methodology is provided in **Appendix 27**.

7.12.2 Current agricultural resources

7.12.2.1 Agricultural resources in the Singleton and Muswellbrook LGAs

As previously discussed, the Project Area is located within the Singleton LGA and in close proximity to the Muswellbrook LGA, therefore both LGAs have been considered in relation to the agricultural impacts associated with the Project. The Singleton and Muswellbrook LGAs have a size of approximately 489,283 ha and 340,488 ha, respectively. Agriculture in both LGAs encompasses a range of commodities, the most important being livestock, both for slaughter and product as well as the equine (horse) breeding industry. Livestock for slaughter includes cattle and calves, poultry, sheep and lambs, pigs and goats, with slaughter of cattle and calves making up for over half of the of the gross agricultural product value for both LGAs. Milk production is the central livestock production commodity for both LGAs, with wool and egg production also occurring.

The most important crop production in both LGAs is hay and silage. Further cropping/horticultural commodities are broadacre crops, fruit and nuts, grapes, vegetables for human consumption, as well as nurseries and cut flowers.

Approximately a third of the Hunter Valley estimated gross value for hay and silage, as well as value from milk production stems from the Singleton LGA. Almost half of the Hunter Valley estimated gross value for fruits and nuts (excluding grapes) is derived in the Muswellbrook LGA, as is almost a quarter of the hay and silage gross value and 22% of the grape value.

7.12.2.2 Agricultural resources in the Project locality

Topography

As discussed in **Section 4.2.2**, the topography of the Project Locality is characterised by an undulating hilly landscape, gently sloping alluvial plain associated with stream floodplains and large areas of manmade disturbance to the natural topography due to coal mining. Like much of the Hunter Valley, the Project Locality has been subject to extensive clearing for grazing and cropping, as well as coal mining and infrastructure purposes.

Soil Landscapes and Land and Soil Capability

As discussed in **Section 4.2.5**, regional mapping undertaken by Kovac & Lawrie (1991) has mapped the majority of the Project Locality as having the Bayswater and the Liddell soil landscapes.

Regional mapping of Land and Soil Capability (LSC) (OEH 2017) identifies the Bayswater and Liddell soil landscapes as being Class 6 and Class 5 respectively (refer to **Appendix 27** for further detail). Areas associated with the Bowmans Creek, Glennies Creek and Hunter River floodplains are mapped as the Hunter soil landscape on the regional mapping, which has been mapped as LSC Class 3. Based on the LSC regional mapping, the majority of the Project Area and Additional Disturbance Area has severe to very severe limitations to high impact agricultural use.

This regional mapping was undertaken before the occurrence of mining in the area. The LSC mapping appears to have been based on the soil landscape mapping and similarly does not take into account changes in the landscape associated with mining operations and limitations/improvements associated with mining operations and mine rehabilitation are not captured. Open cut mining at the Mount Owen Complex and other mining operations in the surrounding areas has largely been limited to the lower LSC Class 5 and Class 6 land. Additional land uses in the Project Locality are grazing and forested areas.

More detailed LSC mapping of the Additional Disturbance Area has been undertaken as part of the AIS and is discussed further in **Section 7.12.2.3**.

Biophysical Strategic Agricultural Land

There is approximately 2,910 ha of BSAL mapped in the Upper Hunter SRLUP within the Project Locality (i.e. within 5 km of the Additional Disturbance Area). The BSAL mapped under the Upper Hunter SRLUP is largely constrained to the larger creek and river systems with the majority occurring along parts of the floodplains of Glennies Creek, Bowmans Creek and the Hunter River. Some of the mapped BSAL occurs on areas currently disturbed by active mining operations in the Project Locality. Detailed mapping of BSAL has been undertaken in accordance with the Interim Protocol within and surrounding the Additional Disturbance Area and is discussed in further detail in **Section 7.12.2.4**.

Water Resources

As discussed in **Section 4.2.3**, there are several creeks present in the Project Locality, which ultimately join the Hunter River in the southern extent of the Project Locality. The dominant limitation for agricultural use of the surface water is water flow, with a number of the tributaries located in the Project Locality having limited to no permanent flow. As such, Bowmans Creek and Glennies Creek, the main drainage lines, aside from the Hunter River, have the highest importance to agriculture in the Project Locality.

There are two registered water bores on private land owned by Daracon Mining in the vicinity of the Project Area (refer to **Section 7.5.6**) and several mine-owned bores. The private bores are located along Bowmans Creek and are licensed for use for stock and domestic purposes but do not currently appear to be used for this purpose. Salinity of the Bowmans Creek alluvium varies from fresh to brackish, depending on the location. Water quality and flow rate in these two private bores is unknown. The Glennies Creek alluvium in the south of the Project Locality indicates a relatively fresh groundwater system. Groundwater quality in Bettys Creek, Swamp Creek and Yorks Creek alluvium varies between fresh to highly saline. The salinity of Permian derived groundwater is typically highly saline.

Water sampling in the Project Locality indicates that the groundwater from both the alluvium and Permian groundwater systems is not suitable for potable or irrigation uses due to salinity. Groundwater from some areas within the alluvium groundwater system could be used for stock water, but this use is variable and generally limited by the salinity and borehole productivity.

Water resources in the Project Area are discussed further in **Section 7.5**.

Land Uses within the Project Locality

Large areas within the Project Locality are owned by various mining companies and used for mining activities. The prevailing agricultural land use is cattle grazing.

There are no Viticulture or Equine Critical Industry Clusters (CICs) mapped in the Project Locality and there is historical evidence of cropping along Bowmans Creek. There are no vineyards or horse studs within, or close to, the Project Locality.

Some areas of higher soil quality are used for grazing on modified pastures. Cropping is carried out in scattered locations along the floodplains of Glennies Creek and Hunter River. A disused olive grove is located in the eastern part of the Project Locality on Glencore owned land. This olive grove is approved to be removed as part of the approved mining operations under the Mount Owen Consent.

7.12.2.3 Agricultural resources in the additional disturbance area

Topography, vegetation and historical disturbance

The topography of the Additional Disturbance Area is defined by rolling hills and gently sloping to flat alluvial areas associated with Bowmans Creek, Yorks Creek and Swamp Creek.

The Additional Disturbance Area has been extensively impacted by past agricultural activities including cultivation on alluvial flats and lower slopes and clearing in most other areas. Large areas were modified with contour banks and/or contour ploughing in the 1960s and 1970s to mitigate erosion risks associated with past clearing and agricultural activities. The majority of the existing vegetation within the Additional Disturbance Area exists as a result of extensive re-growth over the past 30 years. The vegetation present in the Additional Disturbance Area is discussed in further detail in **Section 7.6**.

Water Resources

The main surface water resources within the Additional Disturbance Area are Yorks Creek and Swamp Creek. These creeks have limited potential as an agricultural resource, mainly due to their ephemeral nature. There is a number of dams located within the Additional Disturbance Area that capture runoff from gully areas, which are the primary source of water for stock.

The Bowmans Creek, Yorks Creek and Swamp Creek alluvium extend into the Additional Disturbance Area (refer to **Figure 7.5.2**). The existing modelled extent of saturated areas of alluvium is shown in **Figure 7.5.5**. As discussed in **Section 7.5**, the cumulative impacts of approved mining operations in the area, in the absence of the Project, are predicted to result in the further lowering of the water table in the Bowmans Creek alluvium before recovering following the cessation of mining. The Projects additional impact on these modelled cumulative impacts are discussed in further detail in **Section 7.5.6**.

The Additional Disturbance Area includes paddock areas that extend to Bowmans Creek and subject to water quality and flow constraints, both Bowmans Creek and the associated alluvial systems provide potential opportunities for supplying water for stock and, potentially, irrigation purposes. There are currently no works licensed for the extraction of water for irrigation purposes from Bowmans Creek adjacent to the Additional Disturbance Area.

Land and Soil Capability

Detailed soil surveys undertaken across the Additional Disturbance Area as part of the BSAL verification process and the AIS have further defined the extent of BSAL (refer to **Figure 4.9**) and the LSC class of the land to be impacted by the Project. This mapping has also further defined the soil types present within the Additional Disturbance Area. An updated assessment of land and soil capability within the Additional Disturbance Area has also been undertaken in accordance with the OEH Land and Soil Classification Guidelines (OEH 2012a) with the results shown on **Figure 7.12.1**. As discussed in **Section 4.2.5** , this LSC mapping has identified that the bulk of the Verified BSAL area is Class 4 land which has moderate to high limitations for high impact agricultural uses.

Table 7.55 details the area of each mapped LSC class within the Additional Disturbance Area. The LSC Class 3 and Class 4 land is largely restricted to the alluvial flats adjacent to Bowmans Creek, Yorks Creek and Swamp Creek.

Table 7.55 Area of Each LSC Class mapped within the Additional Disturbance Area

LSC Class	LSC Class General Description (OEH 2012)	Extent (Ha)
Class 3	**High Capability Land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.	13.0
Class 4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.	50.2
Class 5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.	523.3
Class 6	**Low capability land:** Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation	130.6
Class 7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.	0
Class 8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation	32.8

* Creeks and their closest embankments form 15 ha of the Additional Disturbance Area.

The site specific LSC assessment confirmed that the majority of the Additional Disturbance Area (91%) would only be suited to low intensity grazing. Areas on the floodplain may be suitable to higher intensity grazing or cropping (9% of the Additional Disturbance Area).

Colinta manages the buffer land associated with the Mount Owen Complex, including the Project Area which is currently utilised for cattle grazing.

Glencore and its subsidiary companies own approximately 285,000 ha of agricultural land in Australia, which includes approximately 28,000 ha in NSW. While this land is not exclusively managed for cattle, cattle grazing is the dominant form of agricultural use. A large proportion of the agricultural land is occupied by Colinta, which on average maintain between 40,000 and 50,000 cattle across Australia at any one time. Approximately 5,000 cattle are run in NSW (Glencore, 2017a).

Colinta currently run, on average, 140 breeders on the grazing areas in the Additional Disturbance Area and the land between the Additional Disturbance Area and the New England Highway. This grazing area has been destocked to approximately 40 cattle to accommodate for the current drought conditions. Cattle turned off from the Project Area are sold as feeders or re-stock at the Singleton Saleyard. The cattle are watered through surface dams or pumped groundwater. No additional feeding is carried out. The land is not fertilised and no other land improvement strategies are carried out. Erosion is commonly occurring on steeper slopes as well as on some floodplain areas where sodic soils are present.

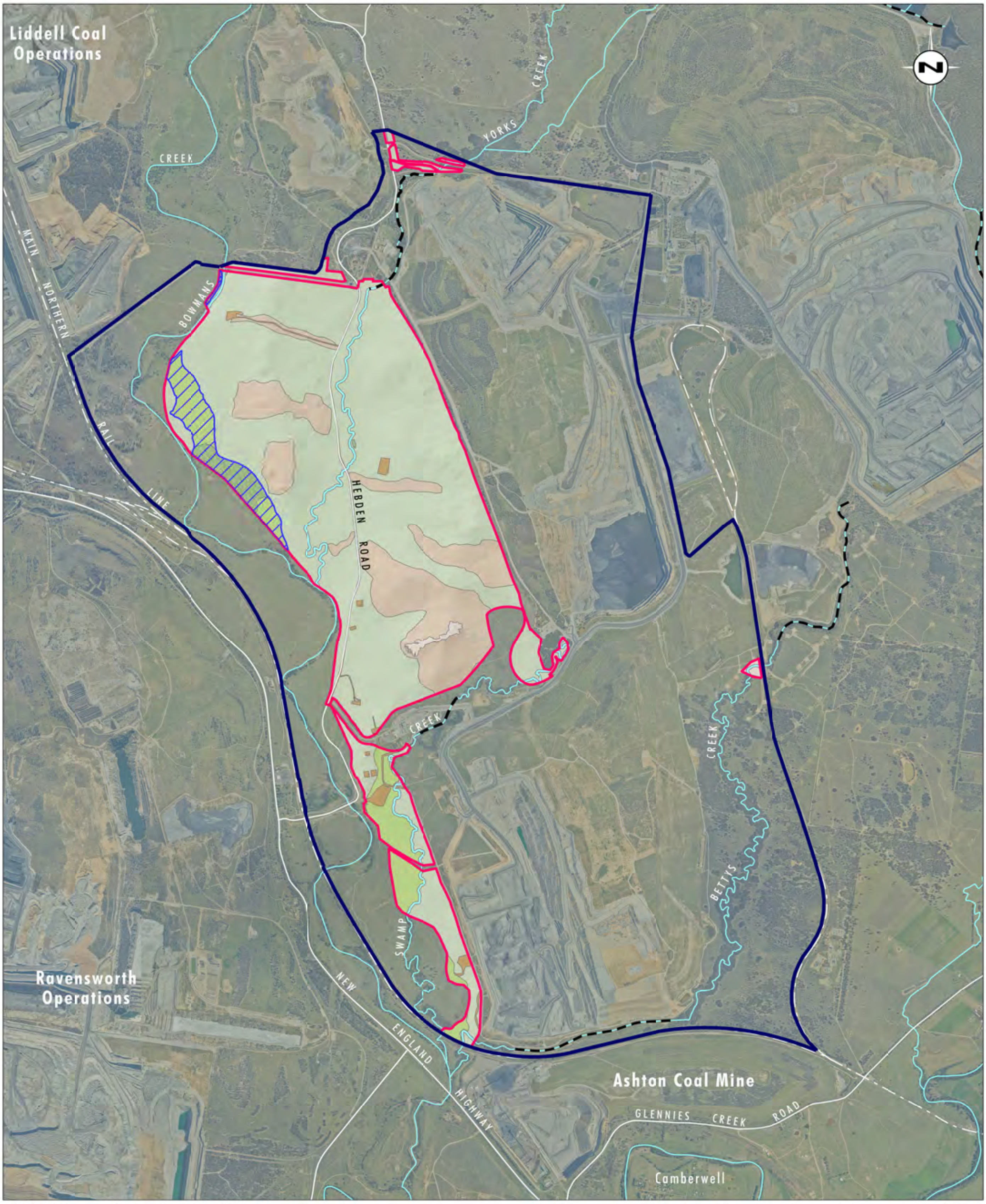

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Umwelt (2019)

Legend

- Project Area
- Additional Disturbance Area
- Existing Creek Diversion
- Verified BSAL
- Creek
- Disturbed

Verified Land and Soil Capability:

- Class 3
- Class 4
- Class 5
- Class 6
- Class 8

FIGURE 7.12.1

Land and Soil Capability in the Additional Disturbance Area

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7.12.2.4 Mapping of BSAL within the additional disturbance area

As discussed in **Section 4.4.4** the total area of Verified BSAL within the Additional Disturbance Area is approximately 34 ha. The majority of this area is situated to the east of Bowmans Creek, with a small (approximately 0.7 ha), parcel located to the north of Bowmans Creek.

Approximately 13 ha of the Verified BSAL has been assessed as being LSC Class 3 land. The remaining 21 ha of the Verified BSAL is mapped as being LSC Class 4 land. It is noted that BSAL is notionally described in the Upper Hunter SRLUP as being land of LSC Class 1, 2 and 3.

The Verified BSAL located in the Additional Disturbance Area represents approximately 1% of the total area of BSAL in the Project Locality (i.e. within an approximate 5 km radius of the Additional Disturbance Area) as mapped in the Upper Hunter SRLUP.

7.12.3 Assessment

The assessment of potential impacts on agricultural enterprises and resources considered:

- existing land capability and current and historical agricultural uses of the Additional Disturbance Area
- the area and length of time over which agricultural resources will be impacted by the Project
- the proposed final landforms, land and soil capability and land uses
- the likelihood that specific levels of land and soil capability will be achieved post mining
- the fragmentation of potential agricultural production areas as a result of the Project.

The AIS (refer to **Appendix 27**) also considers impacts of the Project on agricultural resources and uses/enterprises in the Project Locality. The potential impacts of the Project on agricultural support services and the amenity, lifestyle and connectedness of rural communities were also considered.

7.12.3.1 Impacts on agricultural enterprises/use in the additional disturbance area

Grazing Uses

Aside from areas currently disturbed and the existing creek lines (approximately 1% of the Additional Disturbance Area), the remainder of the land within the Additional Disturbance Area is currently suitable for grazing. The Bowmans Creek and Swamp Creek alluvial floodplain area (LSC Classes 3 and 4) make up 9% of the Additional Disturbance Area and have the fewest limitations to grazing and may also be suitable for cropping. There is evidence of past cultivation on much of this alluvial floodplain as well as paddocks along Yorks Creek with more fertile soils (predominately areas with tenosols). The rolling hills (91% of the Additional Disturbance Area) is suitable for grazing but steeper areas are prone to erosion and mass movement, which stocking rates have to take into consideration.

For the purposes of the agricultural assessment, it has been assumed that all of the Additional Disturbance Area will be removed from agricultural use as a result of the Project. In reality, some of the northern areas may continue to be used for grazing until the Glendell Pit Extension necessitates the exclusion of stock from this area. The viability of grazing paddock areas to the west of the Additional Disturbance Area may also be impacted by the loss of availability of the adjacent grazing land. This impact has been assessed however, is considered an indirect impact.

The post mining land and soil capability mapping is shown in **Figure 7.12.2**. The Rehabilitation and Mine Closure Strategy for the Project (refer to **Appendix 24**) assumes that all Verified BSAL areas outside of 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 LSC Class 4 land (approximately 21 ha).

Based on the conceptual final landform/landuse plan, the rehabilitated landform in the Additional Disturbance Area will be returned to a combination of native vegetation and open grassland as shown in **Figure 3.6**. The open grassland areas are anticipated to be suitable for grazing as a post mining landuse. The pit lake in the final mining void is considered to be unavailable for grazing in the post mining landform.

Table 7.56 compares the existing and post mining land and soil capability within the Additional Disturbance Area. Although the post mining LSC within the Additional Disturbance Area represents a decrease in LSC Class, as previously discussed the Additional Disturbance Area currently has severe limitations to any agricultural use. It should also be noted that there are significant areas of land available for agricultural uses in the broader Singleton and Muswellbrook Regions and the Project will not impact any existing or proposed agricultural use outside of the Project Area.

Table 7.56 Change in Land and Soil Capability within the Additional Disturbance Area

LSC Class	Existing (ha)	Post Mining (ha)	Change (ha)
Class 3 High Capability	13	0	-13
Class 4 Moderate Capability	50	21	-29
Class 5 Moderate – Low Capability	523	616	-38
Class 6 Low Capability	131		
Class 8 Extremely Low Capability	33#	113*	+80

Includes creeklines, disturbed areas and Hebden Road.
*Includes creeklines, disturbed areas, pit lake and retained highwalls and realigned Hebden Road.

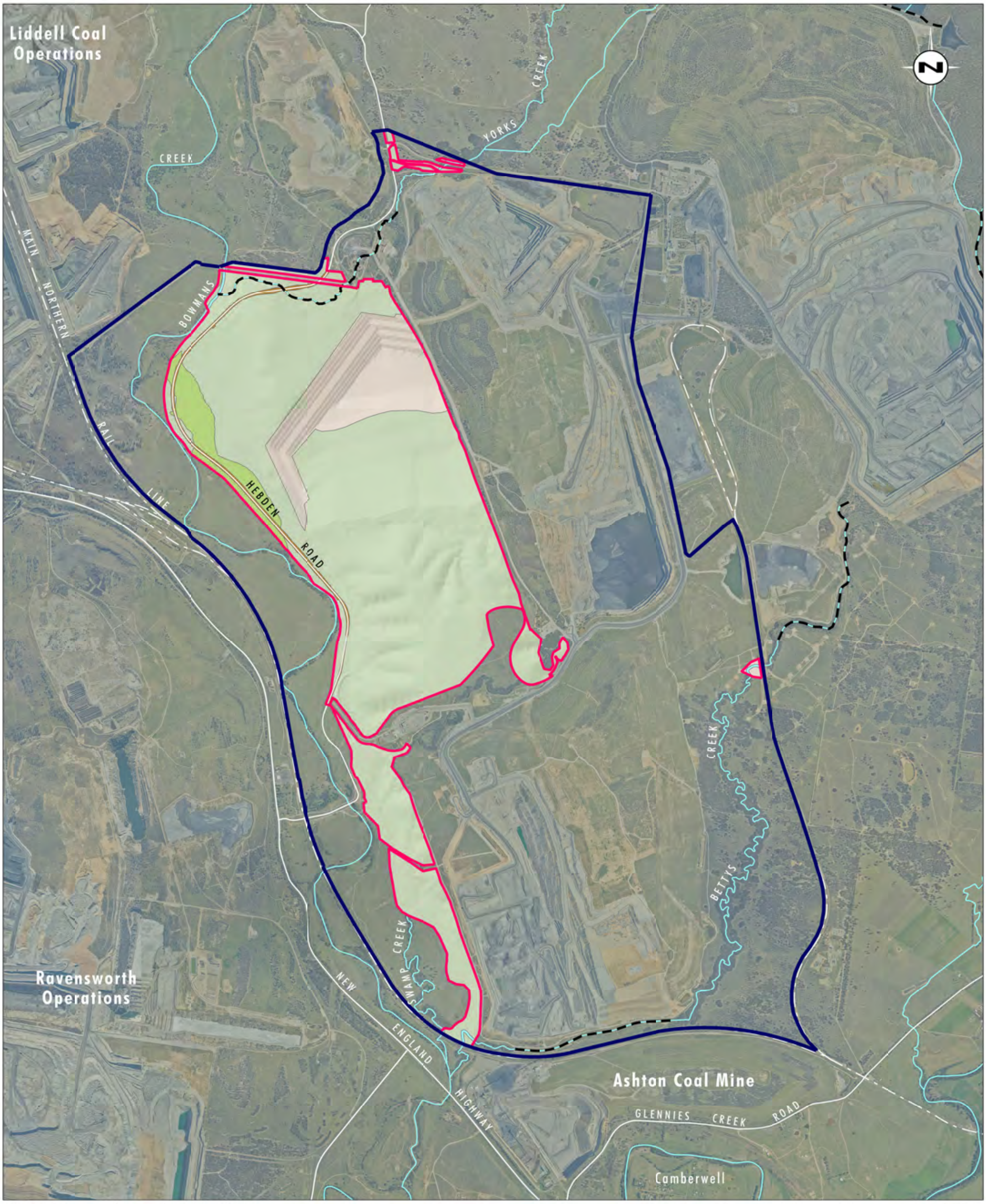

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)

Legend

- Project Area
- Additional Disturbance Area
- Existing and Proposed Creek Diversions

Land and Soil Capability:

- Class 4
- Class 6
- Class 8
- Creek
- Disturbed

FIGURE 7.12.2

Conceptual Post Mining Land and Soil Capability

The AIS has conservatively assumed that, during the life of the Project, all LSC Class 3, 4, 5 and 6 land within the Project Area is suitable for grazing and would be removed from production. This conservative assumption is based on the removal of the Additional Disturbance Area also rendering the grazing areas to the west of the Additional Disturbance Areas (indirect impact area) unviable as a stand alone agricultural operation. During the life of the Project, based on the current Colinta land management practice, the Project would remove a total of 140 breeders through direct and indirect impacts. This accounts for approximately 3% of the Colinta NSW herd and less than 1% of Colinta's Australian herd. Therefore, the Project is not predicted to result in a significant impact on Colinta's operations. The NSW Department of Primary Industry Guidelines "*Beef stocking rates and farm size – Hunter* Region' (DPI, 2006) (DPI Stocking Guidelines) have been used to objectively assess the direct and indirect impacts on stock numbers and production. This assessment has assumed that LSC Class 3 and 4 areas are improved pastures and have a higher production capacity and would be used for vealer production; the Class 5 and 6 areas are assumed to be native pasture and only suitable for weaner production, refer to **Table 7.57**.

Table 7.57 Maximum Production Units (DSE and carrying capacity taken from DPI (2006))

Scenario		Production Units*		
		Additional Disturbance Area	Indirect impact area	Total (units)*
Existing Landscape	Vealer production on improved pastures (Units)	35	150	185
	Weaner production on unimproved pastures (Units)	81	13	94
	Total Units	**116**	**163**	**279**
During Operations	Vealer production on improved pastures (units)	0	0	0
	Weaner production on unimproved pastures (units)	0	0	0
	Total Units	**0**	**0**	**0**
Post-mining landscape	Vealer production on improved pastures (Units)	17	150	167
	Weaner production on unimproved pastures (Unit)	42	13	55
	Total Units	**59**	**163**	**222**

*A production unit is a cow and calf with the calf being sold as either a vealer or weaner depending on land capability

DPI (2006) recommends a herd of a minimum of 40 breeding cows to cover direct costs and to justify the effort of running a grazing operation. Based on this recommendation, the areas within the Project Area subject to indirect impacts would be able to sustain sufficient production levels to cover production costs even with the unavailability of the Additional Disturbance Area. Accordingly, the assumption that the Project would also result in the loss of production from this area is considered conservative.

Assuming that all of the areas indirectly impacted are unavailable for production, the Project will result in a reduction of approximately 279 production units per annum during operations and until the grassland areas in the Additional Disturbance Area have been rehabilitated after mining has finished. In the post mining landscape, under the assumption that indirectly impacted areas can return to production with no changes to LSC classes, a total of 229 production units could be returned to the landscape, 59 units in the Additional Disturbance Area and 163 units in the previously indirectly impacted area. The assessment indicates that the Class 5 and 6 land in the rehabilitated landscape would support approximately 42 production units, suggesting that this aspect of the rehabilitated landscape would provide enough land, by itself, to cover the costs associated with a grazing operation. The additional land available in the areas indirectly impacted by the Project and the rehabilitated Class 4 land is predicted to support a significant herd size if used only for grazing purposes.

Cropping Uses and impacts on BSAL

The LSC Class 3 and 4 land within the Additional Disturbance Area and the areas indirectly impacted by the Project are potentially suitable for cropping and there is evidence of past cropping in some areas.

The Project will directly impact on approximately 63 ha of Class 3 and 4 land that may be suitable for cropping, of which 34 ha has been verified as BSAL. 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 LSC Class 4 land (approximately 21 ha). This represents an overall reduction of approximately 12 ha of Class 3 land. The small area of LSC Class 4 land located in the south of the Additional Disturbance Area adjacent to Swamp Creek may also be suitable for cropping, however the alignment of Swamp Creek and localised terrain features constrain the ability to effectively crop all of this area. This southern area will be directly impacted by water management infrastructure and overburden emplacement for landform shaping purposes with parts of this area identified as being returned to grazing land in the final landform.

The reduced size of paddocks in the alluvial areas east of Bowmans Creek, and the presence of the Hebden Road realignment through these paddocks, has the potential to reduce the viability of some potential broad-acre cropping options (e.g. grains) in this area. It is noted, however, that there is very little support infrastructure for this cropping system in the Hunter Valley and other cropping uses (such as hay or silage) are more likely to be suited to this area. The reduced paddock size and layout, and the fragmentation caused by the realigned section of Hebden Road, is unlikely to result in a significant constraint to this area being used for these production purposes in the future. The availability of water for irrigation purposes is considered to be a greater constraint to this potential production system, which is unrelated to the Project, and this will be also unaffected by the Project.

The Project is predicted to reduce the overall area of land potentially suited to cropping by approximately 33 ha of which the majority is Class 4 land (approximately 23 ha) and only suited for occasional cropping. It is not anticipated that the Project will have any material impact on long term cropping options in the Project Area. The overall reduction in BSAL in the Project Locality (approximately 1% reduction) is not considered to be significant and is considered to be a negligible impact on the overall extent of BSAL within the Upper Hunter SRLUP area.

7.12.3.2 Impacts on Project locality and Muswellbrook/Singleton LGAs

The majority of the land in the Project Locality is owned by resource companies. Agricultural uses in the Project Locality are largely dryland grazing either carried out by resource companies, subsidiaries or leased by a third party.

Indirect impacts associated with the Project (e.g. impacts on air quality, noise, blasting, surface water and groundwater) are unlikely to have any impact on agricultural production outside the area being assessed. Modelling results indicate predicted air quality and noise impacts are consistent with the impacts associated with the approved Glendell Mine. While there is a slight increase in noise and air quality impacts within the Hebden area, these impacts will remain within relevant criteria at all private residences, and no additional acquisition rights under the VLAMP are triggered as a result of the Project. Noise and vibration impacts from blasting have potential to startle livestock, however, there is strong anecdotal evidence to indicate that these blasting impacts do not have any significant impacts on the safety of livestock (refer to **Section 7.4.2.6**).

It is noted that Colinta currently successfully operate a grazing enterprise within the buffer areas around the Mount Owen Complex in closer proximity to the existing operations than any adjoining neighbours. There is no apparent evidence of stress in the Colinta livestock grazed in close proximity to the existing operations (refer to **Appendix 27** for further information). Accordingly, impacts on grazing and other livestock enterprises located further afield are not anticipated.

There are no horticultural, aquaculture or intensive agricultural operations located within the Project Locality that could be adversely affected by particulate matter or dust deposition impacts.

Existing active mining and overburden emplacement areas are currently visible from public viewing points. Whilst the Project will increase the visibility of the mining operations at Glendell Mine, these views are not considered to be significantly different to current views of the approved operations within the Mount Owen Complex and the surrounding mining operations (refer to **Section 7.10**). These impacts are not considered to be significant in the regional agricultural context and they are not expected to impact on any of the surrounding agricultural enterprises.

Agricultural use of the land owned by resource companies or privately-owned agricultural enterprises within the Project Locality will not be impacted by the Project as the agricultural resources available to the Project Locality will not be affected.

Offsite impacts on Strategic Agricultural Land

There are no identified CICs within the Project Locality and there will be no direct or indirect impacts to the soil resources of the Project Locality (outside of the Project Area). The Project will not have any impacts on equine or viticultural activities in areas of the Singleton LGA or Muswellbrook LGAs mapped as being CICs under the Upper Hunter SRLUP.

While approximately 34 ha of mapped BSAL will be directly impacted within the Additional Disturbance Area, no impacts outside of the Additional Disturbance Area are expected as:

- there will be minimal impacts on availability of water resources for agriculture outside the Project Area
- the Project is not predicted to impact surface water quality outside the approved disturbance areas
- there will be minimal additional impacts on groundwater quantity relative to that attributable to the existing approved operations and no measurable impact on groundwater quality
- there will be no direct or indirect impacts to the landforms of the Project Locality, outside of the Project Area.

The Project will have minimal impact on local and regional agricultural services and infrastructure. The Project will result in a minor change in the number of cattle sent to the market.

The proposed Hebden Road realignment would extend the trip distance for some road users by approximately 1.2 km. In order to minimise disruptions to traffic, where possible, the realigned section of Hebden Road will be largely constructed prior to decommissioning of the existing section (anticipated to be completed in Year 1-2). The additional trip distance (approximately less than one minute) and travel time will have a negligible impact on agricultural enterprises using the road.

7.12.4 Management and mitigation

The proposed Rehabilitation Strategy for the land disturbed by the Project (refer to **Appendix 24**) includes a commitment to reinstate 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 LSC Class 4 land (approximately 21 ha). This commitment returns approximately 33% of the potential cropping land impacted by the Project back to a standard that will support intermittent cropping.

Due to the long period of time that the Verified BSAL areas will be utilised for the Project (more than 20 years), stockpiling of soil removed from this area is not considered to be feasible due to the impacts associated with stockpiling this volume of soil and the likely degradation of stockpiled material over the life of the Project. The Rehabilitation and Mine Closure Strategy also includes a commitment to reinstate flatter areas of the terrain to open grassland that would be suitable for grazing land. Soils stripped from BSAL areas impacted by the Project will be prioritised for use in areas identified for future grazing uses to improve the long-term productivity of these areas. Higher quality soils stripped from upper sections of Yorks Creek during the latter stages of the Project can be stockpiled and used for the rehabilitation of the Verified BSAL Areas to LSC Class 4 land. Imported soil and the use of ameliorants will also be considered to supplement the stockpiled material, refer to **Section 7.9** and **Appendix 24** for further detail.

The mine closure planning process will investigate the potential for other agricultural and aquaculture uses in the rehabilitated landform, refer to **Section 7.9** for further detail.

Based on the findings of the AIS, no additional recommendations for mitigation measures or management specific to agricultural resources are deemed necessary as a result of the Project.

7.13 Greenhouse gas

7.13.1 Greenhouse gas and energy

A detailed Greenhouse Gas and Energy Assessment (GHGEA) has been completed for the Project by Umwelt. This assessment has been undertaken in accordance with the SEARs for the Project (refer to **Appendix 4**) and includes:

- a quantitative assessment of the potential Scope 1, 2 and 3 emissions associated with the Project
- a qualitative assessment of the potential impacts of these emissions on the environment
- an estimate of energy use directly associated with the Project
- an estimation on how the Project's emissions will impact state, national and international GHG emission targets/policies
- an assessment of reasonable and feasible measures to minimise GHG emissions and energy use.

A summary of the key findings of the GHGEA is provided in this section and the full report is provided in **Appendix 28**.

The Project has incorporated a range of measures into the design, with the aim of minimising potential GHG emissions and improving energy efficiency. Energy efficiency was a key driver for the design of the mine plan as this results in cost efficiencies and reduced GHG emissions. The Project design therefore inherently minimises GHG emissions from the proposed mining operations. Key measures included in the Project design to minimise emissions include:

- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated fuel consumption
- selecting equipment and vehicles that have high energy efficiency, and
- scheduling activities so that the equipment and vehicle operation is optimised.

The Glencore Code of Conduct specifically requires ongoing consideration of GHG emissions and energy use. In accordance with the Glencore Code of Conduct, Glencore acknowledges the increasing societal and regulatory pressure to reduce carbon emissions to address climate change. Glencore works proactively to manage their energy and carbon footprint and support the development of low emission technologies. Glencore work with policy makers and others to promote the development of a least cost pathway to reducing global emissions while at the same time meeting the needs for affordable energy in developing nations.

The energy efficiency of Glencore's operations is driven by optimising productivity. Glencore has also demonstrated a track record of managing GHG emissions from its mining operations. Glencore requires all mine sites to report greenhouse gas emissions on an annual basis through the National Greenhouse and Energy Reporting Scheme (NGERS), in accordance with the requirements of *National Greenhouse and Energy Reporting Act 2007*.

7.13.2 Methodology

The GHGEA has considered the energy usage and GHG emission impacts for the construction and operational phases of the Project. It also evaluated potential GHG emission mitigation and energy efficiency measures for the Project's operational activities.

The GHGEA was prepared with regard to the National Greenhouse Accounts (NGA) Factors (2018) (DoE 2018) and the World Business Council for Sustainable Development and World Resources Institute Greenhouse Gas Protocol 2004 (GHG Protocol 2004). Scope 1 and 2 emissions were calculated based on the methodologies and emission factors contained in the NGA Factors 2018 (DEE 2018a). Fugitive emissions have been calculated using the Method 1 approach, as described in the NGA Factors. Gas drilling and testing within the proposed mining area has been undertaken, however an NGER compliant model is yet to be completed and the relevant data in order to apply the Method 2 approach was not available at the time of this assessment.

The GHG Protocol provides an internationally accepted approach to the accounting and reporting of GHG emissions by entities. Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for emissions.

Three 'Scopes' of emissions (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes. These scopes are outlined below:

- Scope 1 emissions are direct emissions which occur from sources owned or controlled by the reporting entity, over which they have a high level of control (such as fuel use)

- Scope 2 emissions are those generated from purchased electricity consumed by the reporting entity, which can be easily measured and can be influenced through energy efficiency measures. Scope 2 emissions physically occur at the facility where electricity is generated, that is, the power station

- Scope 3 emissions are indirect emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another reporting entity (e.g. outsourced services, emissions from use of products)

- The assessment boundary for the GHGEA incorporates all significant Scope 1, 2 and 3 emissions. **Figure 7.13.1** demonstrates how the GHGEA assessment boundary interacts with the potential emission sources under Glencore's operational control and other emission sources associated with the Project.

- The assessment has been separated into the following components:

- Construction emissions that relate to the Project under the proposed Glendell Continued Operations Consent

- Operational emissions that relate to the Project under the proposed Glendell Continued Operations Consent

- Operational emissions that relate to the proposed modification of the Mount Owen Consent (SSD5850 Modification)

Further detail on the assessment methodology can be found in **Appendix 28**.

7.13.3 Assessment

The GHG assessment provides forecast energy use and GHG emissions associated with the Project and discusses potential impacts and mitigation measures. GHG and energy use estimates have been calculated for the construction and operational stages of the Project. As the Project incorporates an application for a new Glendell Consent, and a modification to the approved Mount Owen Consent, the impact results have been separated to demonstrate the potential impact of the individual applications.

The GHG forecasts only relate to the expected impact of the Project (i.e. recovery of an additional 135 Mt of ROM coal and the operation of the Mount Owen CHPP for a further 8 years beyond the current Mount Owen Consent). Forecasts do not include forecast emissions from the currently approved operations at both Glendell Mine and Mount Owen Mine.

7.13.3.1 Glendell Continued Operations Consent

Construction Greenhouse Gas Emissions

A number of construction activities are planned to occur within the first 5 years of the Project. The GHGEA only considers the major construction activities associated with the Project and does not include ongoing construction associated with operational activities.

GHG estimates have been prepared for the construction of the following:

- the realignment of Hebden Road

- the realignment of Yorks Creek

- the relocation of Ravensworth Homestead to Broke (i.e. worst-case scenario)

- the construction of the new MIA, and
- the construction of a new heavy vehicle access road.

The demolition of the existing MIA has not been included in the assessment as this is already approved as part of the existing operations. Refer to **Appendix 28** for further assumption details.

All GHG emissions associated the construction phase will be Scope 3 emissions and will be generated by third parties combusting energy and generating industrial emissions in the process of producing and transporting construction materials. Scope 3 emissions will also be generated by contractors consuming energy during the construction process. The construction of the Project is forecast to be associated with approximately 14,000 t CO_2-e Scope 3 emissions, approximately 45% of forecast construction related emissions are attributable to the consumption of construction materials. The consumption of energy during construction contributes 37% of construction emissions, while 18% of construction emissions are attributable to the transport of construction materials, breakdown of the construction related emissions is provided in **Table 7.58**, refer to **Appendix 28** for further detail.

Table 7.58 Construction Greenhouse Gas Emission Summary

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Construction	Scope 3 (Indirect)	Materials use	6,157	13,528
		Diesel use	4,981	
		Materials transport	2,390	
Homestead Relocation	Scope 3 (Indirect)	Diesel use	171	171
Total Emissions for Construction				**13,699**

Operational Greenhouse Gas Emissions

The operational GHG emissions are based on the following operational activities associated with the Project:

- approximately 135,000,000 tonnes of ROM coal will be recovered over the life of the Project
- diesel and explosive consumption will match the mine plan
- electricity use for new MIA will average approximately 6,500 GJ per annum between 2021 and 2045.
- product coal quality will average approximately 27.5 GJ/tonne and has been classified as Bituminous Coal to align with the NGA Factors
- 100% of all product coal will be exported
- fugitive emissions will average approximately 0.054 t CO2-e/ROM coal tonne (i.e. the default emissions factor for coal mines in NSW). NOTE: Gas drilling and testing within the proposed mining area has been undertaken, however an NGER compliant model is yet to be completed and the relevant data in order to apply the Method 2 approach was not available at the time of this assessment. However, review of the interim fugitive gas models developed for the site (based on gas analysis of sampled bore core) estimate that actual fugitive emissions may be at least four times lower than the default emission factor.
- rail transport of product coal will average approximately 92 km
- ship transport of product coal will average approximately 9,500 km

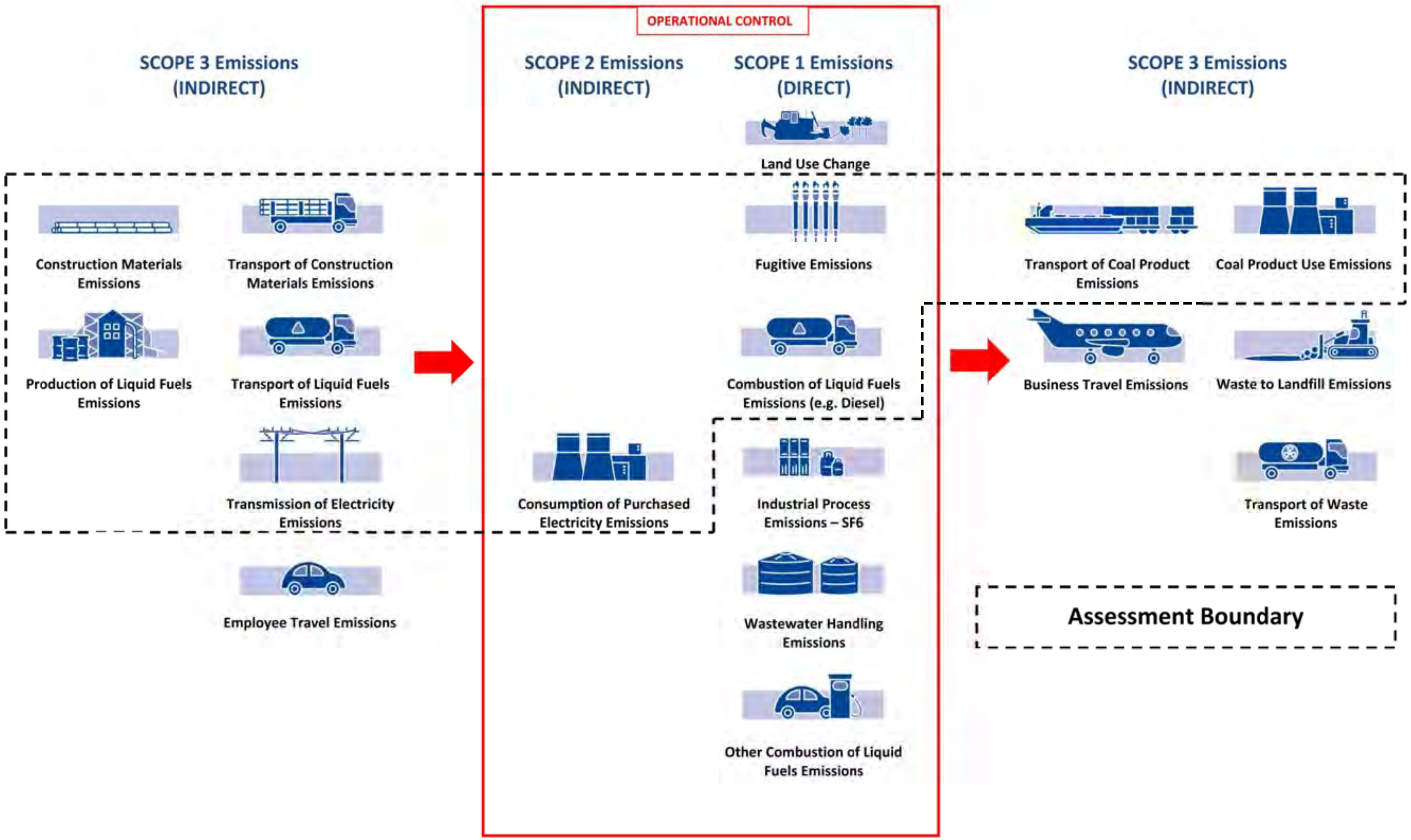

FIGURE 7.13.1

Greenhouse Gas Assessment Boundary

The GHG emissions associated with the Project are summarised in **Table 7.59**, refer to **Appendix 28** for further detail.

Table 7.59 Operations Greenhouse Gas Emission Summary

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Operation	Scope 1 (Direct)	Diesel use	2,630,968	9,932,087
		Fugitive emissions	7,301,119	
	Scope 2 (Indirect)	Electricity	37,050	37,050
	Scope 3 (Indirect)	Product use	209,864,104	220,372,162
		Associated with energy extraction and distribution	141,889	
		Product transport	10,354,195	
		Materials transport	11,973	
Total operational emissions associated with the Glendell Continued Operations Project				**230,341,299**

7.13.3.2 Mount Owen Consent (SSD 5850 Modification)

The following information was used to estimate the GHG emissions from the operational activities associated with the modification of the Mount Owen Consent:

- electricity use will average approximately 205,000 GJ per annum between 2037 and 2045.
- All other electricity use associated with the Project between 2021 and 2036 has not been included in the assessment, as all forecast electricity consumption associated with the Project between 2021 and 2036 has already been assessed as part of the Mount Owen Continued Operations Project (and subsequent modifications). It is also assumed the CHPP would operate at full operational capacity (i.e. 17 Mtpa) up until 2037, to create a contingency for additional projects across the Mount Owen Complex. The Project's forecast production fits within the assumptions made for the Mount Owen Complex assessment (i.e. the Project won't inflate the total Complex's processing requirements beyond 17 Mtpa) up until 2037. From 2037 to 2045 the Project will generate new electricity demands beyond those already assessed as part of the approved operations.

The GHG emissions associated with the Mount Owen Consent are summarised in **Table 7.60**, refer to **Appendix 28** for further detail.

Table 7.60 Mount Owen Modification Greenhouse Gas Emission Summary

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Operation	Scope 2 (Indirect)	Electricity	420,660	420,660
	Scope 3 (Indirect)	Associated with energy extraction and distribution	51,660	51,660
Total operational emissions associated with the Mount Owen Consent				**472,320**

7.13.3.3 Energy use

The following energy use has been assumed for the Project:

- Diesel use associated with recovering approximately 135,000,000 tonne of ROM coal

- Diesel use associated with operational activities associated with the Project mine plan (e.g. progressive rehabilitation)
- 100% of the electricity use associated with the new MIA planned for the Project
- 100% of the CHPP operating a full capacity between 2037 and 2045

The assessment assumptions avoid double counting electricity use across inter-related Development Approvals, and over-estimates electricity consumption between 2037 and 2045 (as the Project will not require the full operational capacity of the CHPP).

The GHGEA has been completed based on the assumption that the Project will consume 40,158,000 GJ of energy from diesel and grid electricity. Energy use associated with the Project is expected to average approximately 1,607,000 GJ per annum (when averaged over the life of the Project).

The industry average energy use for open cut coal mines in Australia ranges between 430 and 660 Megajoules (MJ)/product tonne (AGSO 2000). The forecast energy use intensity associated with the additional coal extracted by the Project is approximately 467 MJ/product tonne, which is at the lower end this range.

7.13.3.4 Total Project operations

The total GHG emissions associated with the Project are summarised in **Table 7.61**, refer to **Appendix 28** for further detail.

Table 7.61 Summary of Total Project Operational Greenhouse Gas Emission

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Operation	Scope 1 (Direct)	Diesel use	2,630,968	9,932,087
		Fugitive emissions	7,301,119	
	Scope 2 (Indirect)	Electricity	457,710	457,710
	Scope 3 (Indirect)	Product use	209,864,104	220,423,822
		Associated with energy extraction and distribution	193,549	
		Product transport	10,354,195	
		Materials transport	11,973	
Total operational emissions associated with the Project				**230,813,619**

The Project is forecast to generate approximately 9,933,000 t CO_2-e of Scope 1 emissions from combusting diesel and releasing fugitive emissions. Annual Scope 1 emissions associated with the Project are expected to average approximately 414,000 t CO_2-e per annum (when averaged over the life of the Project). Annual average Scope 1 emission estimates should not be used to benchmark annual performance, as annual emissions will vary significantly due to normal variations in annual activity.

The Project is forecast to be associated with approximately 458,000 t CO_2-e of Scope 2 emissions from consuming electricity. Annual Scope 2 emissions associated with the Project are expected to average approximately 19,000 t CO_2-e per annum (when averaged over the life of the Project).

The Project is forecast to be associated with approximately 220,424,000 t CO_2-e of Scope 3 emissions over the life of the Project. Scope 3 emissions will be generated by third parties who transport and consume coal products. The Project's GHG inventory is dominated by Scope 3 emissions, approximately 95% of the Project's GHG emissions occur either upstream or downstream of the Project. Approximately 5% of the GHG emissions associated with the Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions).

The proportion of Scope 1 emissions forecast for the Project is most likely overstated. As previously discussed, the assessment has calculated fugitive emissions based on the default fugitive emissions factor for coal mines in NSW. Interim fugitive gas models developed for the site (based on gas analysis of sampled borecore) estimate that actual fugitive emissions may be at least four times lower than the default emission factor. Operational emissions reported under the National Greenhouse and Energy Reporting Scheme are likely to be reported using a site-specific fugitive emission factor (i.e. a Method 2 fugitive emission factor).

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the Project. All Scope 2 and 3 emissions identified in the GHGEA are attributable to, and may be reported by, other sectors.

7.13.3.5 Impact on the environment

The Project's GHG emissions will be highly mobile and can disperse widely across the environment. The accumulation of GHGs or carbon in 'carbon sinks' is the primary impact of GHG emissions. Since the industrial revolution, anthropogenic GHG emissions have accumulated in 3 major carbon sinks - the ocean (30%), terrestrial plants (30%) and the atmosphere (40%) (BOM and CSIRO, 2014).

The accumulation of GHG in the atmosphere is an important driver of global warming, sea level rise and climate change (IPCC 2013). Sea level rise and climate change may have many ramifications for the natural and built environment. The accumulation of GHG in the ocean is a driver of ocean acidification (IPCC 2013).

The Project's direct emissions (Scope 1) are forecast to be approximately 414,000 t CO2 –e per annum.

To put the Project's emissions into perspective, under current policy settings, global greenhouse gas emissions are forecast to reach 56,200,000,000 t CO2-e per annum by 2025 (UNEP 2016). During operation, the Project will contribute approximately 0.00074% to global emissions per annum (based on its projected Scope 1 emissions). The relative environmental impact of the Project is likely to be relative to its proportion of global GHG emissions. Notwithstanding the very small contribution to the total GHG emissions associated with the Project, Glencore takes its direct GHG emissions seriously and as a result has proposed a range of mitigation measures in respect to its direct emissions (which it can control), refer to **Appendix 28** for further detail.

The Scope 2 and 3 emissions associated with the Project should not be considered, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources) as Scope 2 and 3 emissions of the Project are the Scope 1 emission of other parties.

7.13.3.6 Impact on climate change

The Intergovernmental Panel on Climate Change (IPCC) define climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation (IPCC 2007).

Climate change models forecast many different climate change impacts, which are influenced by future greenhouse gas emission scenarios. Climate change forecasts also vary significantly from region to region.

The Project, in isolation, is unlikely to materially influence global emission trajectories. Future emission trajectories will largely be influenced by global scale issues such as; technology, population growth and GHG mitigation policy.

The extent to which global emissions and atmospheric concentrations of greenhouse gases have a demonstrable impact on climate change will be largely driven by the global response to reducing total global emissions that includes all major emission sources and sinks.

7.13.3.7 Impact on policy objectives

The United Nations Framework Convention on Climate Change (UNFCCC) is the leading international forum for setting climate change targets and objectives. In 2015 the UNFCCC successfully negotiated an international climate change agreement between 195 countries (the Paris Agreement).

Australia signed the Paris Agreement on 22 April 2016, and Australia's obligations under the Paris Agreement will drive national GHG policy between 2020 and 2030. Under the Paris Agreement, Australia is obliged to:

- prepare, communicate and maintain a Nationally Determined Contribution (NDC). An NDC outlines the size and type of mitigation contribution each member state will make to the international effort
- pursue domestic mitigation measures, with the aim of achieving the objectives of its NDC
- communicate an NDC every 5 years
- quantify its NDC in accordance with IPCC methodologies, which promote transparency and avoid double counting.

Under the Paris Agreement, the Australian Government has committed to reducing GHG emissions by 26 to 28%, on 2005 levels, by 2030 (Commonwealth of Australia, 2015).

If Australia achieves its 28% mitigation commitment under the Paris Agreement, the DoEE estimates that the Australian economy must set a mitigation trajectory which will save approximately 762,000,000 t CO2-e between 2021 and 2030 (DoEE 2018).

Glencore has reviewed the Project's forecast GHG emissions inventory and advises that it believes the Project is unlikely to materially increase the national effort required to reach Australia's 2030 GHG mitigation target. Glencore also notes that the policy framework provides little assistance to the consent authority (and cannot meaningfully guide the task of the consent authority) in determining the development application. The policy framework does not include any objectives capable of being applied by the consent authority in the context of this Project refer to **Appendix 29**). The policy also does not prescribe the mechanisms by which reductions in GHG emissions are to occur as there are no set prescriptive emission reduction criteria.

The Project's Scope 2 and 3 emissions will be generated in either international jurisdictions, or by Australian facilities with separate environmental approval to generate greenhouse gas emissions.

7.13.4 Scope 3 GHG emissions

Scope 3 emissions are indirect emissions that are associated with the Project but occur at sources owned or controlled by other entities. Scope 3 emissions simply acknowledge that products will continue to generate GHG emissions as they move through a value chain. The Project's Scope 3 emissions are forecast to be generated by electricity generators burning coal in countries such as China, Japan, South Korea and Taiwan.

Most of the product coal generated by the Project will be exported to countries who are parties to the Paris Agreement. These countries have, or are in the process of developing, domestic laws, policies, and measures to mitigate greenhouse gas emissions (to achieve their NDC targets or commensurate climate change policies), refer to **Appendix 28** for further detail.

Glencore has also completed a number of research projects related to low emission technologies, including the Callide Oxyfuel Project, Carbon Transport Storage Company (CTSCo), direct injection coal engines, biochar, nanotechnology, chemical looping and membrane research for power station applications. Glencore is also a foundation member of the International Energy Centre with a number of Australian Universities which offers a Masters of Energy Studies.Greenhouse Gas and Energy Management

Glencore has incorporated a range of measures into the Project design that will minimise potential Scope 1 and Scope 2 GHG emissions and improve energy efficiency. As noted above, energy efficiency was a key driver for the design of the mine plan as reduced energy usage results in reductions in operating costs and GHG emissions.

The GHGEA evaluated the Project's planned GHG mitigation measures against what may be considered best practice for an open cut coal mine in NSW. The evaluation considered a range of potential management measures targeting the key contributors to Scope 1 and Scope 2 emissions, including management of fugitive emissions, diesel use efficiency and electricity use efficiency. A summary of the measures found by Glencore to be both technically feasible and financially reasonable for the Project, and which are therefore proposed to be implemented, is provided in **Table 7.62**. The detailed evaluation of all measures is provided in **Appendix 28**.

Table 7.62 Proposed Scope 1 and Scope 2 Greenhouse Gas Mitigation Measures

Proposed Mitigation Measure	Application to the Project
Limiting the length of material haulage routes to reduce diesel usage and associated emissions	Length of haulage routes has been optimised to minimise dust, noise and fuel use.
Optimising ramp gradients to reduce diesel usage and associated emissions	Ramp gradients have been optimised according to pit geometry parameters.
Continually improve the fuel efficiency of haul trucks operating at the mine to reduce diesel use and associated emissions	Fuel use efficiency has been an important selection criterion when allocating existing equipment to operations. New fuel use technology will be considered should any new trucks be purchased over the life of the Project.
Payload management to reduce diesel usage and associated emissions	Payload will be constantly monitored and actively managed to maintain efficiency.
Reducing rolling resistance of haul roads to reduce diesel use and associated emissions	Haul roads are planned to be constructed of rock rather than of soil or subsoil material where practical and Glencore selectively sources road materials which may include crushed rock for use in on-site roads to provide improved road surfaces and reduced rolling resistance.

Proposed Mitigation Measure	Application to the Project
Scheduling activities so that equipment and vehicle operation is optimised to reduce energy usage and associated emissions	Scheduling activities to optimise plant and vehicle operation is a routine activity. Glencore will continue to prepare long, medium and short term plans to optimise production.
Seek to continually improve the fuel efficiency of mine equipment during the purchase of new equipment	Fuel use efficiency has been an important selection criteria when allocating existing equipment to operations. New fuel use technology will be considered should any new trucks be purchased over the life of the Project.
Blasting strategies to improve extraction and processing energy use efficiency and reduce associated emissions	Through seam blasting will be employed to minimise the need for ripping and parting.
Maximising resource recovery efficiency to maximise energy use efficiency and reduce associated emissions	Long, medium and short term operational plans will be developed to optimise the recovery of approved resources.
Working machines to their upper design performance to optimise energy usage and associated emissions	Glencore's business objectives support and promote effective equipment utilisation and performance rates.
Preventing unnecessary water ingress to reduce pump energy usage and associated emissions	The surface water management system is designed to maximise separation of clean and dirty water systems. Clean water is diverted away from mining areas where practicable.
In-pit servicing to reduce diesel usage associated with transporting equipment	In-pit servicing is a current operational practice that will continue.
Replace lighting plants with LED	Glencore has conducted a review of LED lighting plants across its operations and is currently considering the implementation of LED technology.
Use of chemical dust suppressants to reduce energy consumption by water carts	Dust suppressants will be used on roads at Glendell

Glencore has announced that it will manage global coal production to a total of around 150 Mt per annum going forward as part of a voluntary cap on coal production. However, this does not mean Glencore will freeze its coal projects nor will it be exiting the coal market. Glencore has indicated that it will continue to develop a pipeline of coal projects assessed against market conditions and project economics and while remaining within the coal production cap.

Glencore also participates and supports a range of low emission technology initiatives that seek to reduce greenhouse gas emissions from mining operations and provide a pathway to reduce emissions from the use of its products.

Glencore recognises that over the next 20 years the percentage of the energy generation market supplied by coal is predicted to decline. As the Project meets an existing coal demand and fits within Glencore's committed production cap, Glencore considers that the Project is aligned with the global energy market.

A response to recent commentary and court cases on climate issues related to recent coal projects has been prepared by Glencore and is attached, refer to **Appendix 29**.

7.14 Public safety and health

The SEARs for the Project identify public safety as an issue to be considered in the EIS (refer to **Appendix 4**) including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks, interactions with nearby prescribed dams and the handling and use of any chemicals and dangerous goods. In addition, the SEARs requests a health risk assessment that considers the adverse effects from human exposure to acute and cumulative project related environmental hazards, in accordance with Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards.

To identify potential adverse impacts on public safety, including health, a risk-based assessment approach was utilised during the environmental assessment scoping phase and throughout preparation of this EIS. If a potential risk to public safety or human health was identified, further detailed assessment was completed as part of this EIS. The detailed assessment of each potential risk has been undertaken in accordance with relevant legislation and guidelines, and by appropriately qualified specialists. Where relevant, potential risks to public safety or human health have been assessed against accepted safety or health-based assessment criteria established by the NSW Government. Where relevant criteria are predicted to be met or where NSW Government policy stipulates mitigation measures that are to be implemented (e.g. imposition of voluntary acquisition clauses in any development consent), no further detailed health risk assessment was determined to be required. This screening of public safety and health risks using published guidelines was undertaken with consideration of the tiered assessment approach outlined in Environmental Health Risk Assessment – Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012).

The identified risks to public safety and health, and a summary of the key assessment findings relevant to the identified risk, is provided in **Table 7.63**.

Table 7.63 Identified Risks to Public Safety and Associated Assessment Findings

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Air Quality	Human exposure to particulates (PM_{10} and $PM_{2.5}$)	**Section 7.2** **Appendix 13**	Refer to discussion in **Section 7.14.1**
	Human exposure to NO_2 from blasting	**Section 7.2** **Appendix 13**	The assessment found that with the proposed blasting procedures in place, the Project is predicted to comply with the relevant criteria at all private sensitive receptors.
	Human exposure to diesel emissions	**Section 7.2** **Appendix 13**	Modelling of NO_2 concentrations associated with diesel exhaust emissions indicate compliance with the relevant criteria at all private sensitive receptors. Modelling includes assessment of PM_{10} and $PM_{2.5}$ associated with diesel exhaust emissions, the proposed mitigation measures to manage diesel combustion emissions includes equipment maintenance and engine replacement strategies, see **Section 7.2** for further detail.
Noise	Human exposure to noise during construction	**Section 7.3** **Appendix 14**	Predicted noise levels resulting from construction of the Project are anticipated to be below the ICNG 'highly noise affected' criterion.
	Human exposure to acute and cumulative impact of noise during operation	**Section 7.3** **Appendix 14**	Cumulative noise assessment results indicate the amenity noise levels (day 48 dB(A), evening 43 dB(A) and night 38 dB(A) LAeq(15 minute)) are able to be met at all receiver locations by the Project. Due to the existing synergies within the Mount Owen Complex, cumulative noise impacts of the existing Mount Owen Complex and the Project were also assessed for the two representative years there is overlap with Mount Owen and Glendell both at full operation. The results indicate that the period-based amenity noise levels from the operation of the complex, do not exceed relevant criteria at the nearby residential receivers.
	Human exposure to low frequency noise causing annoyance	**Section 7.3** **Appendix 14**	Predictive noise modelling and existing monitoring data confirms that low frequency noise would not result in more human annoyance than presently occurs from the level of noise generated at the existing Glendell mine. Consequently, no low frequency noise modifying factor adjustments are required for the Project.
	Sleep disturbance from transient noises often with tonal characteristics	**Section 7.3** **Appendix 14**	Predicted night time noise levels from the Project will not exceed sleep disturbance noise goals at any residential receivers.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Blasting	Direct and indirect health risks associated with blasting including risk to life, air quality impacts and noise impacts	**Section 7.5** **Appendix 15a**	Ground vibration and blast overpressure levels can be managed to meet relevant blast emission criteria at all sensitive receiver locations through appropriate blast design and the implementation of appropriate control measures. The existing blast notification system will be continued for the Project so that the surrounding community can be notified of, and prepared for, blasts before they occur. Risks to public safety associated with flyrock will be managed via the application of appropriate exclusion zones and road closures. Due to the substantial distances to residential receivers the issue of flyrock impact on the adjacent residential receivers is considered to be fully managed and the potential risks are considered negligible.
Water Contamination	Contamination of drinking water and health risks associated with human exposure	**Section 7.5** **Appendix 17**	The conceptual water management system, proposed as part of the Project, will be integrated into the existing Mount Owen Complex water management system to limit the potential impacts on downstream water quality by managing water that has the potential to cause environmental harm. The conceptual water management system has been designed to continue to divert clean water around mining operations (where practical) and segregate, store and reuse dirty and mine impacted water to minimise adverse effects on water quality from mining operations. When mining has ceased, water will evaporate from the lake within the void and draw in groundwater from the surrounding geological layers, which results in the lake behaving as a 'sink' in the groundwater regime. The water balance model indicates the evaporation from the lake will concentrate salts in the pit lake slowly over time. However, the gradually increasing salinity will not pose a risk to highly connected surface water sources because the final void will remain a permanent sink with a steep hydraulic gradient (i.e. difference in pressure) between the mine and the surrounding Permian strata. This will mean that any changes to water quality will remain within the final void lake and will not affect the beneficial use category of groundwater or the long-term average salinity in surface waters in the surrounding environment.
	Contamination of surface water and health risks associated with human exposure	**Section 7.5** **Appendix 17**	As discussed above, the Project is not predicted to result in adverse impacts on downstream surface water quality and therefore there is negligible risk of contamination of surface waters such that human health impacts could occur.
	Contamination of groundwater and health risks associated with human exposure	**Section 7.5** **Appendix 16**	As discussed above, the Groundwater Assessment has not predicted any impacts to groundwater quality as a result of the Project and therefore there is negligible risk of contamination of groundwater such that human health impacts could occur. Additionally, there are no known private bores extracting water from the Bowmans Creek alluvium in proximity to the Glendell Pit Extension area.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Bushfire	Direct and indirect health risks associated with bushfire including risk to life	**Section 7.14.3**	The Project has been assessed in accordance with the aims and objectives of *Planning for Bushfire Protection 2018* (PBP 2018). The Project Area has multiple access points with internal roads and bushfire trails providing access for four wheel drive vehicles. The site has a permanent and dedicated water supply for firefighting purposes as well as access to the internal water management system, which is suitable for both aerial and ground firefighting support. The bushfire emergency response procedure currently implemented for the approved operations at the Mount Owen Complex will be updated in consultation with the RFS should the Project be approved. The proposed bushfire management measures have been designed to appropriately manage bushfire risk as part of the Project.
Contaminated Land	Health related risks from human exposure to contaminated land		The Project Area does not contain any areas of known contamination that may cause a significant risk of harm to human health or the environment. As with all activities that involve earthworks and mining, activities carried out as part of the Project have the potential to cause contamination if not properly managed. Consistent with the approach at the existing Glendell mine, controls will be put in place to manage this risk as part of the Project including appropriate chemical handling and storage procedures, appropriate waste management systems, spill and emergency response procedures and equipment, and regular inspection and reporting processes.
Dangerous Goods	Health risks associated with the storage, handling and disposal of dangerous goods	**Section 7.14.2**	A preliminary risk screening has been undertaken for the Project in accordance with NSW government guidelines. The types and quantities of hazardous materials to be stored on site as part of the Project are expected to be consistent with those currently used at the existing Glendell mine, however, may increase over time as production increases. The storage locations of these hazardous materials may change throughout the life of the Project. The potential impacts to off-site land users as a result of the relocation of the hazardous material storages have been considered. To ensure the risks posed to the surrounding land users associated with the relocated storages are appropriately mitigated the hazard analysis identified the required buffer distances between the hazardous materials stores and land ownership boundary. Glencore has committed to design the relocated facilities to incorporate these buffer distances. With these minimum buffer distances, the preliminary risk screening found that the level of risk to surrounding land users is tolerable.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Waste	Health risks associated with the handling and disposal of waste including hazardous waste	**Section 7.15**	Waste management will be undertaken in accordance with Glencore's Waste Management System. Hazardous wastes will include those generated from workshop and equipment maintenance activities, such as rags, gloves, packing materials, machinery components, waste metal, empty drums, oils, lubricants, hydrocarbons and paints. These wastes will be recycled where practicable and otherwise disposed of via a licensed landfill facility. The majority of waste that cannot be reused or recycled will be transported off site by licensed waste management contractors. All licensed waste management contractors are required to have appropriate controls in place to manage risks in accordance with NSW Government guidelines. With these controls in place and considering the nature of hazardous wastes associated with the Project, the risk to human health associated with waste is expected to be low.
Social	Health risks associated with impact to the social wellbeing of the community including social equity issues such as employment, impacts to access and amenity	**Section 7.16** **Appendix 11**	

7.14.1 Particulate matter

The World Health Organisation identifies air pollution as a major environmental risk to health. The measurement and monitoring of air pollution in Australia is governed by the National Environment Protection Measure for Ambient Air Quality (Ambient Air NEPM) (NEPC 1998). The Ambient Air NEPM provides goals for carbon monoxide, lead, nitrogen dioxide, ozone, sulphur dioxide and particulate matter. A key focus of the community, academia, industry and government agencies in Australia over the last several years, including a particular focus in the upper Hunter Valley, is particulate matter.

Particulate matter in air can be dust, smoke, plant spores, bacteria and salt. Human activities resulting in particulate matter include mining, burning of fossil fuels, transportation, agriculture, hazard reduction burning, incinerators, and the use of solid fuel for cooking and heating.

The size of particulate matter determines its potential impact on human health. Larger particles are usually trapped in the nose and throat and swallowed, whereas smaller particles ($PM_{2.5}$) may reach the lungs. Exposure to particle pollution is known to have an impact on human health, particularly for people with pre-existing health conditions. There is no known safe level of exposure where there is no potential for an impact on human health (WHO 2005).

The air quality guidelines adopted in NSW are those recommended by the EPA and are specified in the Approved Methods (EPA 2016). These criteria were set to be consistent with the Ambient Air NEPM (NEPC 1998). The Ambient Air NEPM stated that its desired environmental outcome was '*ambient air quality that allows for the adequate protection of human health and well-being*'.

The VLAMP includes the NSW Government's policy for voluntary mitigation and land acquisition to address dust (particulate matter) impacts from state significant mining, petroleum and extractive industry developments. The VLAMP has air quality criteria in line with the NEPM standards and EPA criteria. These criteria set by the NSW Government have been used as the basis of the assessment of the potential impacts of health associated with particulate matter. It is noted that as discussed above, there is no known safe level of exposure where there is no potential for an impact on human health.

There have been a number of studies into air quality, in particular related to particulate matter, in the Hunter Valley. A paper titled Investigating the Health Impacts of Particulates associated with coal mining in the Hunter Valley (Dalton, C. *et al*, 2014) prepared for the Air Quality and Climate Change Journal focuses on calls for epidemiological investigations into the potential health impacts of coal mining in the Hunter Valley and the challenges that such studies face. The paper identifies some key findings relating to health impacts of particulates in the Hunter Valley including (excerpts below from Dalton, C. *et al*, 2014):

- while there has been much community concern about the health effects of pollution arising from coal mining in the Hunter Valley, it is apparent that, apart from small villages in close proximity to mines that are subject to heavy PM_{10} impacts, the pollution sources that are of greater concern for health are residential wood smoke, industrial and agricultural diesel combustion, and power generation, which contribute substantially to fine particle pollution

- the major impact of mining on this source of emissions may be the increasing use of diesel in mining vehicles and in coal transport including trucks, trains, port shipping and associated infrastructure

- air quality in the most populous areas of the Upper Hunter is good relative to international standards. However, it is important to safeguard the air shed against any deterioration in air quality. There is no clearly established threshold for adverse health impacts within the range of particulate levels encountered in the Upper Hunter.

7.14.1.1 Assessment

PM_{10} and $PM_{2.5}$ are the components of air borne particulate matter that are relevant to human health impacts. As discussed above, the NSW Government has set criteria for PM_{10} and $PM_{2.5}$ that are intended to protect human health.

The predicted maximum 24-hour PM_{10} and $PM_{2.5}$ concentrations for the Project, when considered alone, meet the relevant criteria at all private sensitive receptors. However, cumulative maximum 24-hour PM_{10} concentrations are expected to continue to exceed the EPA's 50 µg/m^3. Modelling results predict that most areas within the model domain will experience at least one day each year when PM_{10} concentrations exceed 50 µg/m^3 due to the contributions of mining operations in the vicinity and other sources. All private properties in Camberwell hold acquisition rights under existing consents, including property ID 156.

As previously discussed, the area surrounding Camberwell is dominated by existing mining operations and the air quality modelling includes predictions of contributions from all existing operations in the vicinity of Glendell Mine. Additional investigation of the cumulative predictions at Camberwell were completed as these are the nearest private sensitive receptors to the Project. This investigation showed that property ID 156 is likely to experience a number of days above 50 µg/m^3 due to combined contributions of mining operations. The maximum contribution of the Project to this location is predicted to be up to 26 µg/m^3. This analysis indicates that Camberwell is experiencing adverse air quality impacts with respect to 24-hour average PM_{10} concentrations due to the combined contributions of all mining operations in the region, based on comparisons between model results and EPA criteria.

As discussed in **Section 7.2.5**, it is anticipated that 24-hour average PM_{10} concentrations will continue to be variable from day-to-day, due to existing conditions and sources as well as extreme events. The proposed operations will continue to be managed in a way that minimises the contribution to off-site PM_{10} levels.

Cumulative annual average PM_{10} and $PM_{2.5}$ concentrations with the Project are predicted to comply with the EPA cumulative air quality criteria of 25 µg/m^3 and 8 µg/m^3 (respectively) at all surrounding private residences that are not subject to acquisition rights under other consents. Air quality monitoring data has indicated that annual average PM_{10} concentrations have exceeded 25 µg/m^3 at Camberwell in four of the past seven years, and at two other locations in 2018 due to drought conditions.

It should be noted that the modelling indicates that the Project will have similar air quality impacts to the existing approved Glendell Mine with cumulative impacts in Camberwell and the Middle Falbrook area declining over time as operations extend towards the north.

Post blast fume emissions are not expected to result in any adverse air quality impacts. This is based on model predictions that show compliance with air quality criteria, and Glencore's existing blast management practices. Emissions from diesel exhausts associated with off-road vehicles and equipment are not expected to result in any adverse air quality impacts, based on model predictions that show compliance with air quality criteria. Construction impacts will be lower than during the Project's operations, however, appropriate dust management will be implemented to make sure that impacts are minimised. Monitoring will continue to be conducted during the construction phase to assess compliance with EPA criteria. It is also noted that the impacts of the Project on air quality have been valued in terms of the estimated health costs attributable to particulate matter emissions, relative to existing approved operations (refer to **Appendix 13**). These estimated health costs have been considered in the cost benefit analysis of the Project (refer to **Section 7.17**).

7.14.2 Hazard

A preliminary risk screening has been completed for the Project in accordance with *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* (DoP, 1992) (SEPP 33), and *Applying SEPP 33* (DoP, 2011). Should a preliminary risk screening of a proposed development determine that the Project is a 'potentially hazardous industry' under SEPP 33, the preparation of a Preliminary Hazard Analysis (PHA) is required.

The preliminary risk screening involves identification and assessment of the storage of specific dangerous goods classes that have the potential for significant off-site effects. If, at the proposed location, and in the presence of controls, the risk level exceeds the acceptable criteria for impacts on the surrounding land use, the development is classified as a 'hazardous' and/or 'offensive' industry as appropriate and may not be permissible within certain land zones in NSW.

A 'hazardous industry' under SEPP 33 is one which, when all locational, technical, operational and organisational safeguards are employed, continues to pose a significant risk. An 'offensive industry' is one which, even when controls are used, has emissions that result in a significant level of offence e.g. odour or noise emissions. A proposal cannot be considered either hazardous or offensive until it is firstly identified as 'potentially hazardous' or 'potentially offensive' and subjected to the assessment requirements of SEPP 33. A PHA is required if a proposed development is potentially hazardous.

A proposed development may also be potentially hazardous if the number of traffic movements for the transport of hazardous materials exceeds the annual or weekly criteria outlined in *Table 2 of Applying SEPP 33* (DoP, 2011). If these thresholds are exceeded a route evaluation study is likely to be required.

7.14.2.1 Preliminary risk screening

Preliminary risk screening is undertaken to determine if a PHA is required. The preliminary risk screening compares the hazardous material storage quantities for the Project that have the potential to create off site impacts, as well as transport quantities and frequency, with the screening thresholds in SEPP 33. If any of the screening thresholds are determined to be exceeded the proposed development should be considered potentially hazardous and SEPP 33 will apply (DoP, 2011).

As a result of mining progressing to the north, the Glendell Pit Extension will mine through the current Glendell MIA which includes the Fuel Farm, Intermediate Bulk Container (IBC) Lube Facility, Workshop and Store. These facilities will be constructed at the new Glendell MIA facility. The Glendell Pit Extension will also mine through the present location of the Explosives Magazine (refer to **Figure 7.14.1**). The Explosives Magazine will therefore also require relocation during the life of the Project.

Table 7.64 provides a list of the hazardous materials to be stored on-site for the Project, dangerous goods class of the material, storage quantity and the respective SEPP 33 screening threshold. The maximum inventory of hazardous materials to be stored on-site for the Project are expected to increase relative to that of the current approved operations at Glendell.

Although the inventories of hazardous materials to be stored on-site for the Project are likely to increase, the transport quantities and frequencies of hazardous materials to the Mount Owen Complex will be unchanged compared to the existing scenario. This is due to the proportional reduction in ROM production at the Mount Owen Mine as production from the Project increases. Therefore, the risks associated with transport of hazardous materials to the Mount Owen Complex will be consistent with the existing approved operation and no further assessment is required.

Based on the estimated maximum proposed Project inventory of explosives (i.e. 60,000 kg) to be stored in the Glendell magazine at any one time, a minimum buffer distance from publicly accessible areas (off-site receivers) of at least 550 m is required to ensure the SEPP 33 trigger value for Class 1.1 materials is not exceeded. Should the actual maximum Project inventory of explosives be less than the estimated maximum proposed Project inventory, the minimum buffer distance will be reduced. For example, if the maximum Project explosives inventory were to remain the same as the existing maximum inventory (i.e. 30,000 kg), the minimum buffer distance would be 450 m. The location of the magazine may change over the duration of the Project as the Glendell Pit Extension progresses to the north. The magazine will at all times be located more than the minimum buffer distance from publicly accessible areas to ensure that the minimum separation distance trigger value for Class 1.1 materials is maintained. As the Project requires the realignment of Hebden Road to allow for the Glendell Pit Extension, two preliminary buffer zones for the magazine have been provided. **Figure 7.14.1** represents the region within the Project area where the explosive magazine may be located prior to the realignment of Hebden Road and the region within the Project area where the explosives magazine (assuming the maximum proposed Project inventory of 60,000 kg) may be located once the Hebden Road realignment is completed and operational. Following completion of the Hebden Road realignment design, the buffer zones may be refined.

As shown in **Table 7.64**, the proposed storage inventories of Class 2.1 flammable gases and Class 3 flammable liquids at the Project are relatively minor and well below the screening thresholds. The buffer distances required to off-site receivers to ensure SEPP 33 triggers are not exceeded for Class 2.1 and Class 3 materials are also relatively small. Glencore will store Class 2.1 flammable gases and Class 3 flammable liquids at the Project in a location such that buffer distances to off-site receivers are adequate to ensure SEPP 33 triggers are not exceeded. Class 8 corrosive substance storage inventories will not trigger SEPP 33 screening thresholds.

The approach outlined above with respect to maintaining adequate buffer distances will ensure that the Project is not considered potentially hazardous with respect to the storage of hazardous materials and, therefore, a PHA is not required.

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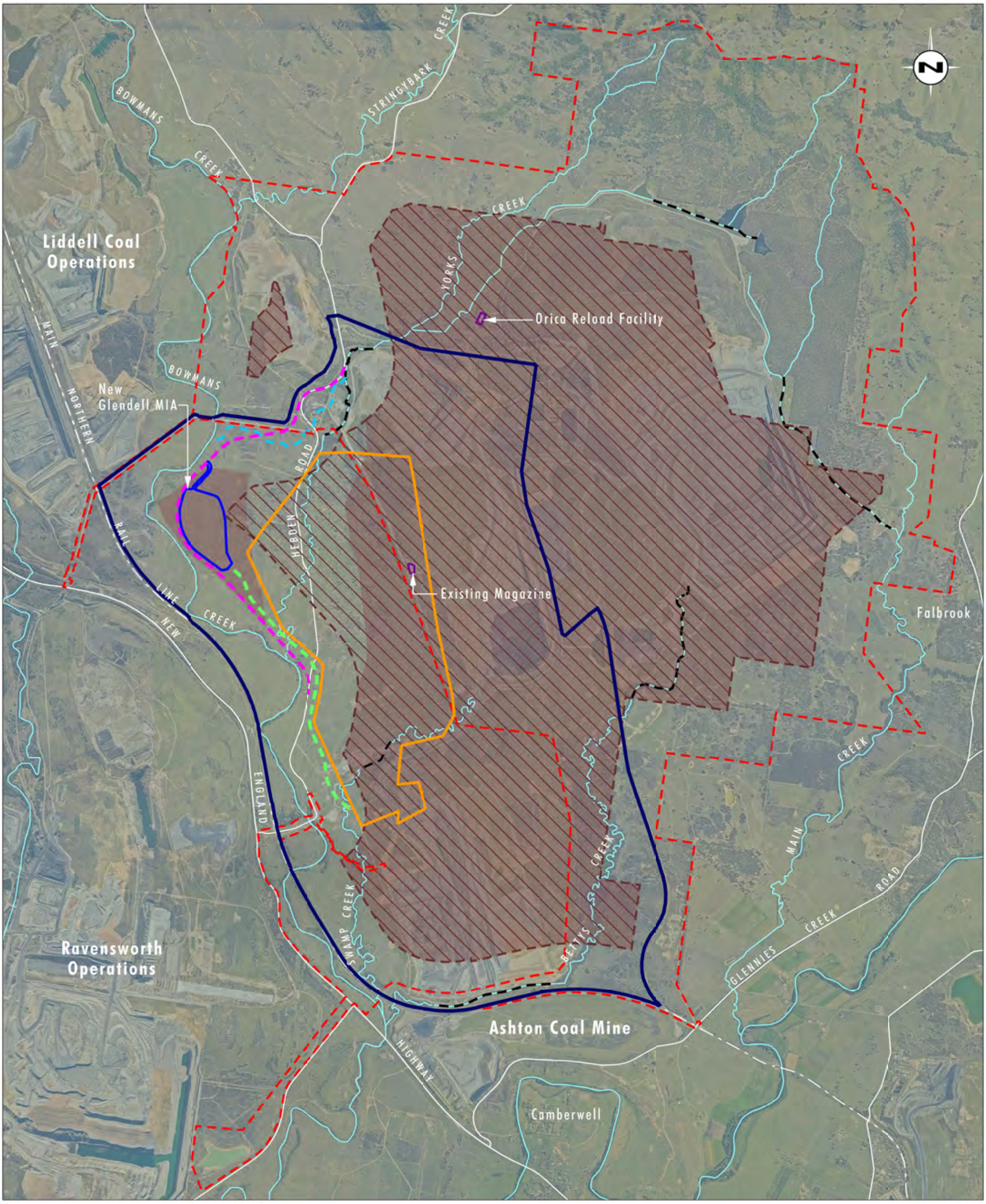

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend
- Project Area
- Glendell Pit Extension
- Mount Owen Consent Boundary
- Existing Creek Diversion
- New Glendell MIA
- Yorks Creek Realignment
- Hebden Road Realignment
- Heavy Vehicle Access Road
- Area suitable for locating the magazine prior to Hebden Road Realignment
- Area suitable for locating the magazine following Hebden Road Realignment

FIGURE 7.14.1

Areas where Explosives Magazine can be located (550 m Offset)

File Name (A4): R08/4166_341.dgn
20191128 15.21

7.14.2.2 Project hazardous materials storage and handling

7.14.2.3 General hazardous materials management

The Mount Owen/Glendell procedure *Hazardous Substances* (Glencore Mount Owen/Glendell, 2018) guides the management of hazardous substances at Glendell and addresses the following aspects of hazardous substances management:

- training and authorisation of personnel responsible for hazardous materials management
- assessment of new and existing hazardous materials and associated potential emergency situations and approval of new hazardous substances for use
- maintaining a register of hazardous substances
- purchase, delivery and storage of hazardous substances including design of storage facilities
- handling and disposal of hazardous substances
- reviewing hazardous substances to assess whether new, safer material alternatives exist and if handling processes can be improved, and
- monitoring the health of people using hazardous substances.

The Mount Owen/Glendell procedure *Hazardous Substances* (Glencore, 2018c) is supported by a range of procedures and plans that relate to hazardous materials management including:

- Hazard and Incident Management procedure (Glencore, 2018b)
- MGO Emergency Spill Response procedure (Glencore, 2018a)
- MGO Pollution Incident Response Management Plan (Glencore, 2019a)
- Mount Owen Complex Non-Mineral Waste Management Plan (Glencore, 2018j)
- Mount Owen Complex Hydrocarbon Management Plan (Glencore, 2018i).

These procedures will be updated to reflect changed operational conditions throughout the life of the Project.

7.14.2.4 Hydrocarbon storage and handling

The storage and handling of hydrocarbons at the Mount Owen Complex is undertaken in accordance with AS1940 – 2017 *The storage and handling of flammable and combustible liquids* (AS1940) with an environment protection focus.

The combustible and flammable liquids storage facilities will be designed, installed and operated in accordance with AS1940.

Glencore will also consider the requirements of AS/NZS 60079.10.1 – 2009 *Explosive atmospheres Classification of areas - Explosive gas atmospheres* for the storage and handling of Class 2.1 flammable gas and Class 3 flammable liquids and implement appropriate designs and controls to ensure ignition sources are not introduced into the defined hazardous area envelope.

Operational controls to manage pollution risks associated with potential spills are discussed in **Section 7.5** and **Section 7.9**.

Table 7.64 Hazardous Materials Storage Inventory

Material	Storage Location	Storage Type	ADG Code[1] Class (PG[2])	Existing Maximum Inventory (kg)	Estimated Maximum Proposed Project Inventory (kg)	Screening Threshold (kg)	Trigger SEPP 33
Explosives – detonators, signal tube, boosters, detonating cord	Magazine	Mounded Magazine	Class 1.1B Class 1.1D	20,000 10,000	40,000 20,000	60,000[3]	Dependent on storage location
Flammable gases – acetylene, aerosols	MIA	Cylinders	Class 2.1	<50	<50	100[4]	No
Flammable liquids – paints, solvents, aerosols	MIA	Packages	Class 3 (II and III)	<500	<500	5,000[5]	No
Corrosives – degreasers	MIA	Packages	Class 8 (III)	<100	<100	50,000	No
Diesel	Fuel Farm at MIA or in-pit	Above Ground Tanks	Class C1	422,000	866,000	NA[6]	NA
Engine and Hydraulic Oils and coolant	Fuel Farm at MIA	Above Ground Tanks	Class C2	100,000	150,000	NA[6]	NA
Engine and Hydraulic Oils	IBC Lube Facility at MIA	IBCs	Class C2	38,000	-	NA[6]	NA

1. ADG Code – Australian Dangerous Goods Code
2. ADG Code Packaging Group
3. Class 1.1 screening threshold at 550 m from off-site receivers
4. Class 2.1 screening threshold at 10 m from off-site locations
5. Class 3 PGII and PGIII screening threshold at 4 m from off-site locations
6. No SEPP 33 quantity screening thresholds for these materials

7.14.2.5 Prescribed dams

The *Dams Safety Act 2015* requires that Dam Safety NSW ensure that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community. Dams Safety NSW may, by order published in the Gazette, declare a dam or proposed dam to be a declared dam for the purposes of this Act.

There are several prescribed dams at the Mount Owen Complex associated with tailings storages. The Project does not directly impact on these. The Blasting Impact Assessment has considered the potential impacts from blasting on these dams and has concluded that blasting associated with the Project can be managed to meet the relevant vibration criteria for these structures.

Any new dams constructed will have regard to the need for licensing under the Dam Safety Act.

7.14.3 Bushfire

The SEARs for the Project require an assessment of hazards (refer to **Section 7.14.2**) including bushfires. This section of the EIS provides a bushfire assessment, including a description of existing bushfire management at the Mount Owen Complex, assessment of potential bushfire hazards applicable to the Project Area and the proposed bushfire management for the Project.

The Mount Owen Complex has a history of safely conducting mining operations, with appropriate procedures in place to respond to fire and other emergencies. The Proponent also has an established relationship with the Rural Fire Service (RFS) and has consulted with the RFS in relation to both the management of the existing operations and the Project.

The majority of the Project Area has been cleared of vegetation associated with approved mining operations and agricultural land uses. Parts of the Project Area are identified as containing bushfire prone land by Singleton Council's Bushfire Prone Land Map (Singleton Council 2019) (refer to **Figure 7.14.1**). It is noted that active operational areas within the Mount Owen Complex have been excluded from the Bushfire Prone Land Mapping, refer to **Figure 7.14.2**. The most significant potential bushfire threat to the Project Area is from the north and north-east of the Mount Owen Mine within the Ravensworth State Forest, which supports forest/woodland vegetation and a potentially significant fuel load capable of sustaining and spreading bushfire. Smaller areas of forest/woodland vegetation within the Project Area also represent a potential linkage between vegetated areas within and adjoining the Project Area, with the potential to support the spread of bushfire.

As described in **Section 7.9.4**, it is considered that there is a very low propensity for spontaneous combustion to occur at the Mount Owen Complex. Small areas of spontaneous combustion have been identified associated with the former Ravensworth East mining area, with no instances of spontaneous combustion in relation to more recent mining at the Mount Owen Complex. The Project is not expected to increase any risk of spontaneous combustion at the Mount Owen Complex.

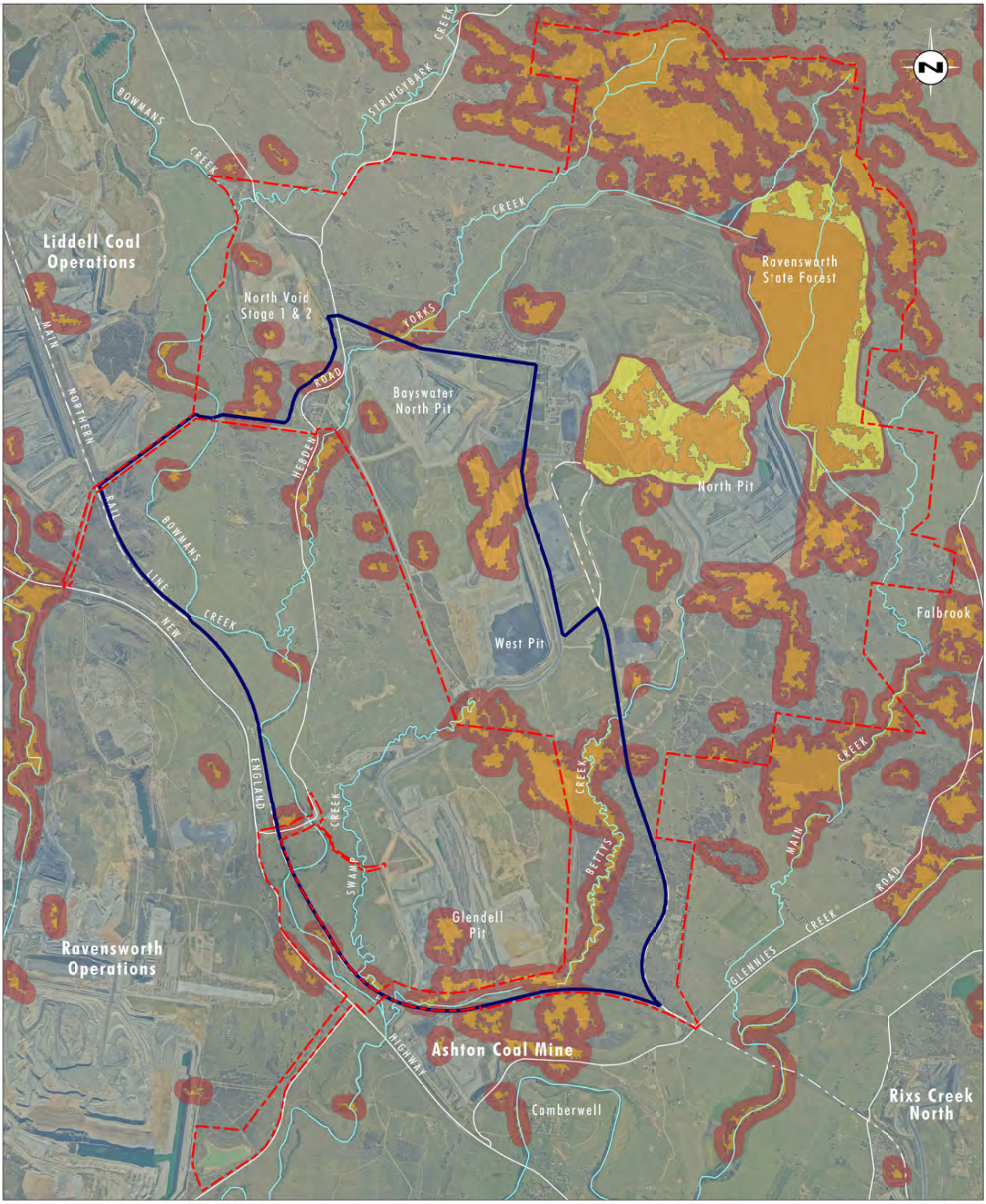

Image Source: Glencore (Dec 2018)
Data Source: Glencore (2019), Singleton Council (2019)
Note: Mount Owen Consent Boundary assumes Narama Pipeline Modification is approved

Legend

- Project Area
- Mount Owen Consent Boundary

Bushfire Prone Land:

- Vegetation Category 1
- Vegetation Category 2
- Buffer

FIGURE 7.14.2

Singleton Council Bushfire Prone Land Map

7.14.3.1 Existing bushfire management

The Mount Owen Complex Bushfire Emergency Response Procedure currently implemented for the existing operations at the Mount Owen Complex was developed in consultation with the RFS, neighbouring landholders and the community.

The Bushfire Emergency Response Procedure has been developed to be consistent with the relevant requirements of the *Rural Fires Act 1997* and the previous RFS guideline *Planning for Bushfire Protection 2006* (PBP 2006).

The objectives of bushfire management on the site are to:

- reduce fire ignition potential
- prevent the spread of fire within and beyond the site
- protect the flora and fauna within the Mount Owen Complex from unplanned fire events
- prevent damage to rehabilitated areas.

The Mount Owen Complex maintains resources for firefighting including maintaining access to water sources, providing water carts fitted with firefighting points and committing to providing earthmoving equipment to establish fire breaks and trails.

The proposed approach to bushfire risk management for the Project is to apply and implement the current management procedures and actions developed for the existing Bushfire Emergency Response Procedure and to review and revise the procedure where necessary to reflect the changes to asset and infrastructure locations as the Project progresses.

Measures to minimise the risk of spontaneous combustion are outlined in **Section 7.9.4**.

7.14.3.2 Bushfire threat assessment

RFS guideline *Planning for Bushfire Protection 2018* (PBP 2018), was issued as a pre-release in August 2018 and is expected to be finalised in 2019. Whilst this document is not yet final, the objective of the pre-release is to provide a transition into the application of PBP 2018 and therefore has been applied to the Bushfire assessment for the Project.

In order to comply with PBP 2018 development must satisfy the aims and objectives of PBP 2018, consider any specific requirements and propose an appropriate combination of bushfire protection measures.

Where mining and associated activities are carried out on bushfire prone land, PBP 2018 requires:

- *Consideration of any hazards and risks associated with bush fire. It may be necessary to implement measures to control and manage any identified hazards and risks.*
- *As a minimum, a 10m asset protection zone (APZ) should be provided around any infrastructure associated with mining and petroleum production.*
- *A bush fire emergency management and operation plan be prepared to cover any mining activities and petroleum production undertaken on bushfire prone land, with consideration to the same provisions detailed in section 8.3.5 of PBP 2018 for wind farms.*

Section 8.3.5 of PBP 2018 requires:

- *10 m APZ from the structures/associated buildings/infrastructure; and the APZ must be maintained to the standard of an inner protection area (IPA) for the life of the development to provide adequate access for firefighting purposes.*
- *Infrastructure (for the purposes of applying APZ) excludes:*
  - *road access to the site; and*
  - *power or other services to the site and associated fencing.*
- *Essential equipment should be designed and housed in such a way as to minimise the impact of bush fires on the capabilities of the infrastructure during bush fire emergencies. It should also be designed and maintained so that it will not serve as a bush fire risk to surrounding bush.*
- *A bushfire emergency management and operation plan should detail measures to prevent fires igniting during the construction and operation phase, and cover:*
  - *work involving risk of ignition that should not be carried out during total fire bans;*
  - *availability of fire-suppression equipment; and storage and maintenance of fuels and other flammable materials;*
  - *notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during the bush-fire fire danger period to ensure weather conditions are appropriate; and*
  - *bushfire emergency management planning.*

The proposed design and location of the MIA allows for the establishment and maintenance of the required 10 m APZ, (refer to **Figure 7.14.2**). APZs currently applied to existing infrastructure within the Mount Owen Complex will continue to be maintained. As previously discussed, resources for firefighting are permanently maintained on site and will continue to be maintained for the life of the Project. The proposed MIA will also be equipped with resources for firefighting including maintaining access to water for firefighting purposes.

The proposed MIA and all other infrastructure areas within the Mount Owen Complex will be accessible by all-weather access roads. The Project Area has existing multiple access points with internal roads and bushfire trails providing access for four-wheel drive vehicles, however additional access points will be created for the new MIA. The entire Mount Owen Complex is inspected regularly to determine the requirement for maintenance of existing roads and fire trails and will be revised to include the Project Area. Access across the Project Area will continue to be assessed and maintained as the Project progresses.

The existing Bushfire Emergency Response Procedure will be updated to include all new access points relevant to the Project Area. During construction of the Hebden Road realignment, the realigned section of Hebden Road will be fully constructed prior to decommissioning of the existing section to avoid any access issues along Hebden Road.

The existing Bushfire Emergency Response Procedure details the responsibility for fire management and the monitoring, review and reporting of fire incidents. The RFS have Fire Control Centres at Darlington, Goorangoola and Glennies Creek. This would be the primary response with backup response located at Singleton and Muswellbrook. Muswellbrook have resources to respond to a HAZMAT emergency event should it be required. Should the Project be approved the Bushfire Emergency Response Procedure would be reviewed and updated in accordance with the relevant requirements under PBP 2018 and in consideration of the relevant aspects of the Project.

With the ongoing review of the Bushfire Emergency Response Procedure in consultation with the RFS as operations progress, it is considered that bushfire risk associated with the Project can continue to be appropriately managed in an effective manner.

7.15 Waste management

The SEARs for the Project identify waste management as an issue to be considered in the EIS (refer to **Appendix 4**). There are several different types of wastes that will be produced by the Project. **Section 3.2** outlines the approach for the ongoing management of reject material and tailings produced from coal processing, while the management of waste water from the water management system is discussed in **Section 2.1.4** and overburden management is discussed in **Section 3.2.3.2** . The focus of this section is to identify and discuss the management of all other waste material that will be produced as a result of the Project.

7.15.1 Waste management principles and processes

In order to provide a standardised approach to waste management across its NSW operations, Glencore developed a Waste Management Guideline, which has been prepared in accordance with all relevant legislation and guidelines. The Waste Management Guideline outlines the measures required to be undertaken across all Glencore operations in relation to waste management. In accordance with the requirements of the Glencore Waste Management Guideline, a site specific Waste Management System will be updated and implemented for the Project.

As an existing operation, the Mount Owen Complex currently has a well developed and implemented waste management plan. This plan is based on the following waste management principles that will continue to be applied in the management of waste materials generated by the construction and operation of the Project:

- waste avoidance through the minimisation of waste generation
- waste re-use
- waste recycling
- waste removal and disposal (all waste that cannot be reused, with the exception of inert wastes that may be disposed of on-site in open cut mining areas with the approval of the EPA, and used large tyres that will be buried in controlled areas within open cut mining areas with the approval of the EPA).

The underpinning strategies for management of waste are focused on minimisation through cleaner production and the aforementioned principles, as well as the appropriate training, segregation, storage and disposal of waste generated on site. The minimisation of waste will be achieved through the following processes:

- consideration of potential waste streams in procurement of materials
- identification and segregation of re-usable and recyclable materials
- education of workforce on waste avoidance, waste stream segregation and recycling
- processing materials for recycling
- considering environmental impacts for waste removal and disposal processes
- waste monitoring and inspection regimes.

The waste management program will continue to include:

- methods, schedules and procedures for the management and responsible disposal of each major waste stream
- methods for monitoring performance against procedures and targets
- documentation on waste disposal methods, locations and quantities
- accountabilities for development, monitoring, control and auditing
- methods to consider re-use and recycling of products.

7.15.2 Predicted waste streams

The waste that will be generated during the construction and operation of the Project will fall into the following waste classes (DECCW 2009 Waste Classification Guidelines):

- General Solid Waste (putrescible and non-putrescible) including construction waste, general office waste and domestic waste.
- Liquid Waste, of which ablution (e.g. waste water from bathhouses, sinks etc.) and operational waste (e.g. oils and coolant fluids following maintenance) is included.
- Hazardous Waste, which includes aspects of construction and operational waste (e.g. coal tar or containers that have previously contained a substance of Class 1 or 5 under the definition of the Transport of Dangerous Goods Code) (National Transport Commission 2011).
- Special Waste, e.g. waste tyres, clinical/first aid and asbestos (potentially present in old buildings on site).

The following sections discuss the key waste streams that will be generated as a result of the construction and operational phases of the Project.

Construction waste

The construction of the proposed Hebden Road realignment and the construction of the proposed MIA are likely to generate inert waste such as concrete, steel and electrical cabling. These waste materials will be recycled where practicable or disposed of at an appropriate facility, with some inert wastes (e.g. clean concrete waste) to be disposed of in appropriate locations within on-site mining voids.

The construction of new, and the modification of existing, infrastructure (outside of the proposed Hebden Road realignment and MIA) will involve predominantly modular/prefabricated components, which are assembled off site and transported to the site for installation. These construction activities are therefore not expected to generate a significant amount of waste material. The excavated material generated during the earthworks phase of construction will be re-used on site. Inert waste such as concrete will be disposed of at appropriate locations in on-site mining voids.

Other waste that may be generated during the construction phase of the Project will include office, domestic and ablution waste, as well as a small amount of waste associated with general maintenance and workshop activities.

Operational waste

Records of waste disposal for the existing Glendell Mine operations show that in 2018 the operations disposed of 1607 tonnes of waste off site, with 1210 tonnes (or approximately 75%) of waste recycled.

As there are no proposed changes to the existing approved operational workforce levels or the maximum production limits for the Mount Owen Complex, the waste generated is anticipated to be similar to that currently generated at the existing Mount Owen Complex. However, as the production and workforce numbers of the Glendell operations increase as part of the Project, the capacity of waste management systems will be increased to ensure efficient management of waste can be achieved.

The key components of operational waste are discussed below.

Office waste

There will be minimal office waste generated by the Project. However, waste that is generated will consist of waste paper (comprising general office paper, photocopy paper), office stationery and paper from other sources. Other wastes will include cardboard and packaging, and toner cartridges from printers/ photocopiers/facsimile machines. Much of this waste will be recycled in accordance with the waste management principles outlined above; the remainder will be disposed of appropriately.

Domestic waste

Domestic waste will be generated by the workforce and contractors at the site and will include food scraps, aluminium and steel cans, glass, plastic and paper containers and putrescible waste. The quantity of this waste is relatively small in comparison to total waste. These wastes will be recycled, where practicable.

Hazardous waste

Hazardous wastes will include those generated from workshop and equipment maintenance activities, such as rags, gloves, packing materials, machinery components, waste metal, empty drums, oils, lubricants, hydrocarbons and paints. These wastes will be recycled where practicable and otherwise disposed of via a licensed landfill facility.

Sediment dams

Sediment from some dams in the mine water management system have the potential to contain elevated levels of hydrocarbons and carbonaceous material as a result of activities carried out in the catchments for these dams. These dams will be regularly cleaned of sediment to maintain their capacity to handle runoff from large rainfall events (refer to **Section 7.5.3.1**). Prior to disposal, a risk assessment will be undertaken and dams with an increased risk of containing hydrocarbons or other potential environmental pollutants will be tested for these contaminants. Sediment that is not contaminated will be co-disposed with overburden in overburden emplacement areas. Any identified contaminated sediment material will either be treated on site and disposed of with overburden when it has been effectively remediated or will be disposed off-site at an appropriately licensed facility.

Ablution waste

Waste from toilets, bathhouses, kitchen sinks and basins are included as ablution waste with all sewage wastewater managed using new treatment facilities that will be built for the Project. Wastewater from the administration offices, workshop and bath houses is collected and treated on site in a number of aerated wastewater treatment plants around the site, which are licensed by Singleton Council. Deactivated sludge from the sewage treatment plant is periodically removed and disposed of by a licensed contractor.

Special waste

Special wastes are those that have unique regulatory requirements. Special wastes associated with the Project will include tyres from mining equipment. Large mining equipment waste such as tyres are currently disposed of in controlled areas within the open cut pits, in accordance with relevant EPA guidelines. This practice will continue as part of the Project.

Demolition waste

The demolition of the Glendell MIA and buildings will generate some construction waste. The extent of waste generated by the Glendell MIA demolition will be mitigated through the use of some infrastructure at the new Glendell MIA. Demolition waste material will be recycled where practicable or disposed of at an appropriate facility, with some inert wastes (e.g. clean concrete waste) to be disposed of in appropriate locations within on-site mining voids.

7.15.3 Ongoing waste management

To manage waste generated by the Project, Glencore will continue to implement its existing waste management program, which is based on the waste management principles described in **Section 7.15.1** and the current requirements of the Glendell and Mount Owen Mine development consents (DA 60/952 and SSD-5850 respectively), and Glenore's Waste Management Guideline (Glencore, 2018m). However, the scale of Glendell waste management facilities will increase as production increases in order to meet these principles and guidelines. Under this system, waste generation will continue to be avoided or minimised as a first principle, then reused or recycled where possible. Waste will continue to be separated on site to allow different waste streams to be appropriately managed. Waste that cannot be reused or recycled will be transported off-site by a licenced waste management contractor.

Ongoing management of waste at the Mount Owen Complex will be undertaken through the continued implementation of the existing Waste Management Plan, which will be updated to incorporate changes from the Project if approved.

7.16 Social

A comprehensive SIA of the Project has been undertaken to identify, assess, manage potential negative impacts and enhance positive social impacts associated with the Project on local and neighbouring communities. SIA is an approach to predicting and assessing the likely consequences of a proposed action in social terms and developing options and opportunities to improve social outcomes. Best practice SIA is participatory and involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense, to provide a complete picture of potential impacts, their context and meaning.

As discussed in **Section 6.4**, engagement with the community has been a key component of the SIA program, at key phases of the assessment, to afford a participatory approach, and has involved nearby neighbours and other stakeholders in the scoping of project issues and identification of strategies to address (negative) and enhance (positive) impacts. This engagement program has been guided by a comprehensive stakeholder engagement program, involving consultation with a broad range of stakeholders for the Project EIS and SIA.

Given the established presence of the Mount Owen Complex in the community, key community issues that have been raised historically include concerns regarding air quality, noise, blasting, visual impacts, biodiversity and rehabilitation. The planning for the Project included consideration of these previously raised issues as part of the planning and assessment process. Glencore has put in place a range of strategies, management and mitigation measures to address these key issues. A summary of the key findings of the SIA is provided in this section and the full report is provided in **Appendix 11**.

7.16.1 Methodology

The SIA process has involved a number of key phases of work including:

- Preparatory Planning: undertaking appropriate planning for the Project, based on outputs of previous Mount Owen Complex EIS/SIA studies and the development of a Stakeholder Engagement Strategy to guide project engagement
- Profiling: to define the baseline social context in which the Project is based
- Scoping: to identify key social impacts/issues relevant to the Project
- Assessment and Prediction of Impacts: to evaluate and predict the positive and negative social impacts based on key impact characteristics (extent, duration, vulnerability/sensitivity, severity)
- Strategy Development: to identify strategies to minimise negative impacts and enhance positive impacts associated with the Project
- Monitoring and Evaluation: development of a framework that outlines how social impacts should be monitored and evaluated should the Project proceed.

As discussed in **Section 6.4** Glencore has an existing stakeholder engagement program for the Mount Owen Complex and has also implemented a specific engagement program for the Project. In addition to existing company led engagement activities, and the general Project consultation program, specific engagement to inform the SIA has also been undertaken with a wide range of stakeholders.

Approximately 600 stakeholders have participated in the SIA engagement program, in addition to engagement undertaken for the broader EIS, across two dedicated rounds of engagement, to identify perceived project issues/impacts and to provide feedback on assessment outcomes and mitigation and enhancement strategies. This work builds on the engagement undertaken by the company since commencement of operations.

Commissioning of the SIA early in the project, and regular meetings with the project team throughout the assessment program, has also provided opportunities to effectively align assessment outcomes with the broader EIS process, and to inform pre-emptive project planning and mine plan design.

Refer to **Section 6.0** for a summary of the social impact assessment methods that have been utilised during each phase of the SIA program and an outline of the various consultation methods used.

7.16.2 Operational context – Existing social and economic linkages

Major resource projects can make significant social and economic contributions to communities that extend far beyond the location in which a particular operation is based. For instance, the presence of an operation may provide economic contributions to communities through indirect benefits such as the household expenditure of the workforce. The workforce (and their families) may also contribute to communities through their participation in community groups and activities, or through their use of health and education services. Likewise, indirect benefits may be experienced in communities where suppliers' head offices are located or where suppliers' business expenditure is undertaken.

Current Glendell Mine workforce data has been sourced to develop a profile of the operation and its social and economic linkages with communities within the region. The vast majority of the current workforce is employed full-time (98%), is predominantly male with a median age of 39 years. Average service at the operation is approximately 7 years.

Approximately 32% of the workforce working at the Glendell Mine reside within the Singleton LGA, with an additional 40% living in the surrounding LGAs of Maitland, Cessnock and Muswellbrook. Overall, almost 95% of the workforce resides within the broader Hunter region, including 13% that live in Newcastle and Lake Macquarie; with the workforce and their families using local services and participating in community groups within these communities.

Based on workforce income data, provided by Glencore, and aligned with expenditure scales developed from the ABS Household income and expenditure survey 2015-2016, the Glendell workforce spent an estimated $13.2 M annually, excluding spend on housing, utilities and telecommunications, with approximately $4.3 M spent specifically within the Singleton LGA. A further approximate $8.2 M is spent elsewhere within the Hunter region, Newcastle and Lake Macquarie.

A supplier survey was also conducted for the Glendell Mine indicating that across the period from January 2017 to June 2019, between approximately $134 and $189 M was spent on goods and services by suppliers with contracts with the Glendell Mine; of which between $6.5 and $9.2 M was spent in the Singleton LGA, between $2.6 and $3.7 M in the Muswellbrook LGA, and between $6 and $8.5 M in the Newcastle LGA. Across the Hunter Valley region more broadly, between $20 and $28.7 M was spent on goods and services by suppliers. Again, it is important to note these estimates provided are for the time period from January 2017 to June 2019 only.

Further, between 2017 and 2019 (including projected spend for the remainder of 2019), Glencore contributed $130,644 in social investments targeting various local community groups, events and services across the Lower Hunter in the areas of local business (including tourism and events), education, community service and infrastructure. Given that the Project if approved, would prolong the life of the mine for a further 21 years than currently approved, these economic and social linkages will continue. The economic benefits of the Project have been assessed and are further discussed in **Section 7.17**.

7.16.3 Social profiling

The primary social area of influence for the Project has been defined as the localities and communities proximal to the existing Glendell Mine operations and the stakeholders that reside within these areas. The state suburbs of interest (or proximal communities) as defined by the ABS (2016) include Camberwell, Falbrook, Glennies Creek, Hebden, Middle Falbrook and Ravensworth. Data for Singleton LGA, Muswellbrook LGA, the Upper Hunter region and the State of NSW are also utilised for comparative purposes.

The social profile has utilised a community assets (or capitals) approach in defining the strengths and vulnerabilities of the community across 5 key areas – natural, social, human, physical and economic.

At a local level, community residents have articulated a desire to see their communities' rural and social amenity protected, and physical capital developed to allow better access to health, education and retail services. These communities have strong social capital and a strong sense of community, but also perceive that this is being impacted by the presence of mining and property acquisitions which have reduced and fragmented communities over time.

At a regional level, issues relating to physical capital development appeared more salient e.g. addressing stress on existing infrastructure and services, considering the safety and capacity of transport/road networks, improving access to health care, developing more education and training services/opportunities, addressing a diversity of housing issues – affordability, availability and diversity.

There is a regional community perception of dependency on the mining sector, which was coupled with a desire for greater economic diversification, through the development and attraction of other industry and business sectors (as stated in regional and local strategic plans), and the need to address land use conflicts and cumulative impacts e.g. workforce mix, community participation, workforce competition associated with the presence of prominent industry sectors (e.g. mining, thoroughbred and viticulture) within the locality.

The presence of the mining industry and associated mine suppliers in the locality affords a range of local economic benefits to key communities across the region and more broadly, with associated workforces contributing to the economic, human and social assets within these various localities.

7.16.4 Perceived issues and opportunities of the Project

A key component of the SIA is the process of understanding, from a community perspective, community issues, values and uses associated with the assessment area, and specifically the perceived social impacts and opportunities associated with the Project.

Engagement activities undertaken to support the SIA program had 3 main objectives:

- to identify perceived issues/impacts associated with the Project
- to identify perceived issues/impacts associated with cumulative mining development in the region
- to identify strategies for management and opportunities for enhancement of perceived Project issues/impacts.

These objectives were achieved through consultation with key stakeholders and the wider Singleton LGA community through a number of engagement mechanisms, as outlined in **Section 6.4.**

Key stakeholders include near neighbours, Aboriginal stakeholders and community and heritage stakeholders and group representatives (including the RHAC, individuals with an interest in heritage, the Singleton Historical Society and Museum and past owners of the Homestead).

The wider Singleton LGA community includes Singleton LGA residential and business community, and workforce and suppliers at the existing Glendell Mine. Engagement mechanisms for this

As part of the wider EIS Community Engagement Process, representatives from the Project have also met with local government representatives, State and Commonwealth Government agencies, local business and industry, community, cultural and heritage groups (associated with the area) and infrastructure and service providers. Key outcomes from this consultation have also been considered as part of the SIA.

Perceived impacts i.e. the sensitivity/susceptibility/vulnerability of people to adverse changes caused by the impact and/or the importance placed on the relevant social matter identified by stakeholders for the Project cover a range of social impact categories, as defined in the SIA Guideline and reflect the fears and aspirations of the stakeholders consulted. Impacts relating to surroundings, including access to and use of the natural and built environment, and its aesthetic value and/or amenity (social amenity), associated with dust and noise, were the most prominent social impact category identified; followed by sense of community and culture, economic contributions, employment and partnerships, and intergenerational equity. It should be noted that social impacts are often not mutually exclusive, with significant interconnectivity evident across social impacts and impact themes. For example, a stakeholder concerned with dust and noise may also be concerned about sense of community and culture as a result of dust and noise.

Figure 7.16.1 shows the social impact themes identified through consultation and **Table 7.16.1** provides further definition of each of the themes. The perceived community impacts associated with these themes are discussed further in the following sections and shown in **Figure 7.16.2** and **7.16.3**.

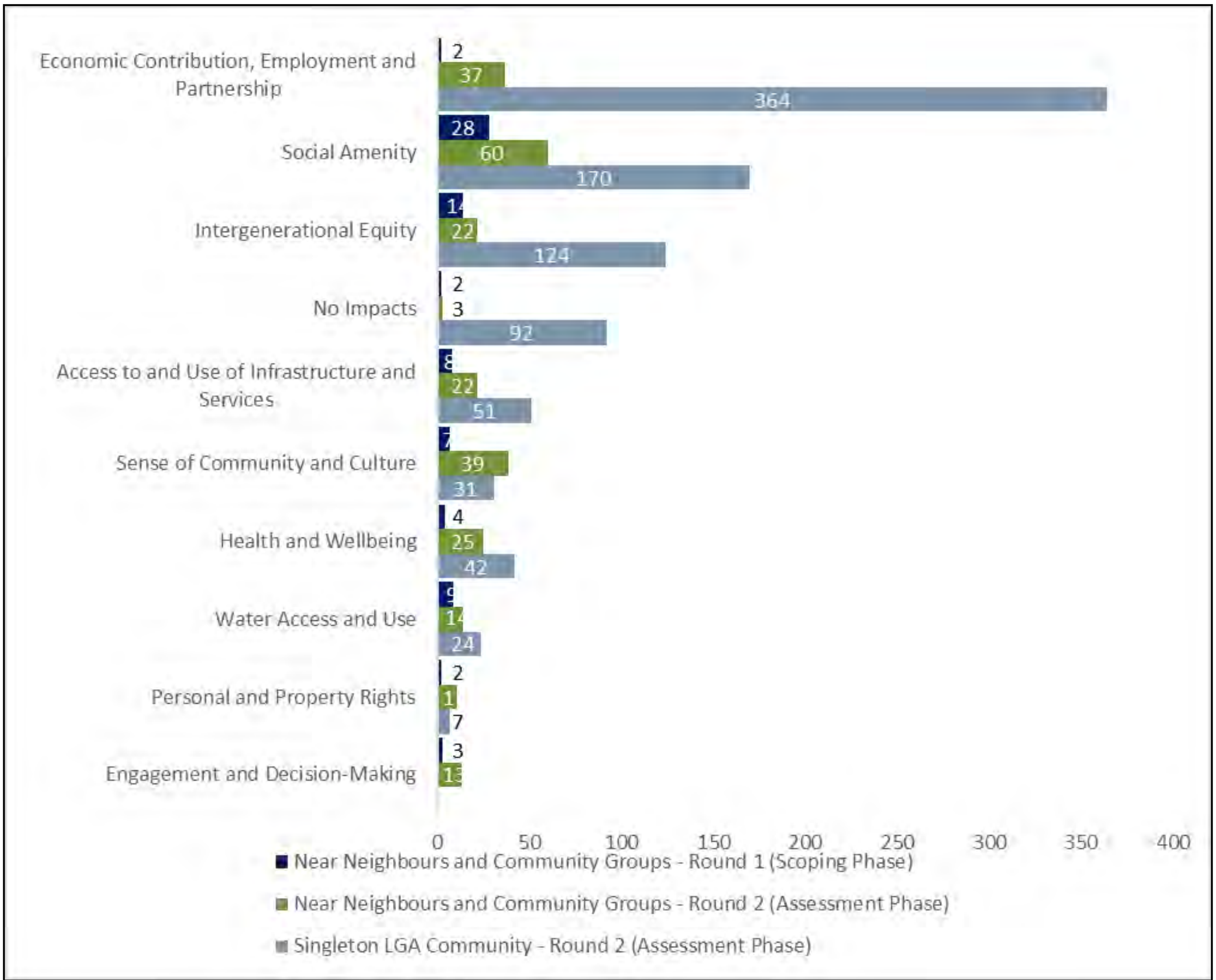

Figure 7.16.1 Perceived stakeholder impacts themes (engagement rounds 1 and 2)

Table 7.65 Defined Social Impact Themes

Social Impact Themes	Definition
Social Amenity	Social amenity concerns primarily relate to the impacts on way of life and rural lifestyle and include the impacts experienced as a result of dust/air quality, operational noise, blasting (vibration and plumes), visual impact and potential odour.
Sense of Community and Culture	Changes to the cohesion and character of the community, including impacts on cultural heritage. This encompasses impacts associated with the Ravensworth Homestead, sense of community and population change.
Economic Contribution and community investment	Contribution to the regional economy and community investment efforts. Opportunities for employment, training and partnerships, particularly for near neighbours, the Aboriginal community and emergency services.
Intergenerational Equity	Intergenerational equity refers to addressing the needs of the present generation without compromising the ability of future generations to meet their own needs (IAIA, 2003). The Intergenerational equity theme includes impacts relating to future land use, land management (including the management of pests such as wild dogs) and climate change.
Access to and use of Infrastructure and , Services	Potential disruption on the local road network due to operational activities e.g. blasting and cumulative effects of mine traffic. Inability to access particular services and facilities in the area, e.g. provision of telecommunications, housing/accommodation.
Health and Wellbeing	Health impacts as a result of dust impacts, including respiratory issues and psychosocial affects relating to the cumulative presence of mining.
Water access and use	Access to and use of water, including impacts on both ground and surface water, and the proposed diversion of Yorks Creek.
Engagement and Decision-Making	Existing engagement mechanisms and the ongoing potential to have a voice in the assessment process - provide input and feedback to decision making.
Personal and Property Rights	Impacts of the project on private property values and the ability to sell / move out of the area.

7.16.5 Social amenity

The most frequently identified social impacts by near neighbours related to impacts on social amenity across the two rounds of engagement, with concerns related to air quality impacts on way of life and rural lifestyle also raised by all stakeholder groups (refer to **Figure 7.16.2**). Health impacts including the potential for respiratory illness and ingestion and/or inhalation of fine particles were frequently raised, with particularly vulnerable groups noted such as children and the elderly. Concerns relating to air quality were centred on the cumulative impacts from Glendell Mine and other mining operations in proximity to the Project and within the broader Hunter Valley region. However, it was noted by near neighbours, located to the south of the Project in Camberwell (the closest private residences to the Project), that the impact on their properties from the Glendell Mine, would be expected to decrease, as a result of the pit progressing to the north.

The cumulative impacts of dust on the wider region were reiterated by Aboriginal and community groups in the Singleton LGA, with concerns raised relating to dust accumulating on cars, houses and the nuisance this causes within the community, as well as health concerns relating to potential respiratory illnesses or potential contamination of drinking water.

Consultation was also undertaken with a range of stakeholders at the Singleton LGA level as part of a random survey of households. The survey identified a number of issues in relation to the presence of mining in the area, but particularly impacts on social amenity as a result of air quality and dust and noise due to the presence of numerous mines within the Singleton LGA.

As part of the mine planning process, Glencore has made refinements to the mine plan for the Project, to address known community issues and concerns, and as a result of several rounds of noise and air quality modelling. Considerations in relation to the mine plan to reduce amenity impacts include: progression of mining in a northerly direction moving away from the closest private residences in Camberwell as the Project progresses; managing noise impacts so they remain within relevant assessment criteria,; and alterations to haul road locations and emplacement schedules, as discussed in **Section 7.2** and **7.3**.

7.16.6 Sense of community and culture

The second most identified social impacts perceived by near neighbours in relation to the Project, related to sense of community, culture and identity and impacts relating to the Ravensworth Homestead. Given the significance, targeted consultation in relation to the homestead was undertaken. Stakeholder issues relating to the homestead are described in **Appendix 11**.

Population change was also raised as an issue, with stakeholders noting that community identity in the area has changed significantly over the last 20 years, partially due to the influence of mining. Stakeholders raised that while the community had previously comprised largely long-term landowners, there were now higher proportions of residents who rent in the area, particularly as a result of the purchase of properties by Glencore and other mining companies.

In contrast, population changes were noted as a positive impact of the Project by the wider community, who acknowledged the growth and subsequent economic stability afforded to the Singleton LGA as a result of people moving to the area for employment.

7.16.7 Economic contribution and community investment

In relation to employment opportunities, both near neighbours and the wider community identified this as an important potential benefit of the Project. Near neighbours expressed an overall sense that employment from the Project and mining in general was a benefit to the community.

It was also raised that economic activity associated with the Project should have maximum benefit for locals, with as much employment and commercial opportunity retained within the Singleton LGA, rather than workers living elsewhere and commuting into the region. This sentiment was also supported by the wider community in relation to the economic benefits that may arise from the Project including support for local businesses and contractors and for the retail sector. Additionally, it was noted that the presence of mining contributes significantly to the social and economic stability of the Singleton LGA.

Employment opportunities were also raised by Aboriginal stakeholders consulted as part of the Project. These stakeholders commonly mentioned the need for increased Aboriginal employment and training opportunities. Overall, Aboriginal stakeholders expressed that they would welcome more feasible and accessible employment opportunities in the mining sector for their community.

Community investment and partnership was also mentioned as a positive impact (both direct and indirect effects) that result from the presence of the mining industry, as well as Glencore more specifically; with Glencore's community investment efforts commended by a number of stakeholders due to the diversity and level of support provided.

7.16.8 Intergenerational equity

Intergenerational equity includes impacts relating to future land use, land management and climate change. Future land use and rehabilitation was a common impact theme across all stakeholder groups. Strong generational connections and the availability of land for the use of current and future generations was also seen to have been impacted by the purchase of impacted properties and offset lands by mining companies; with mining developments seen by some as too rapid, creating dependency on the sector. Some wider community stakeholders recognised the ongoing importance of coal in energy generation and also outlined a preference for extension to existing operations, rather than the development of new mining areas.

Several near neighbours had experienced issues with wild animals, including wild dogs on their land. Recent efforts of Glencore, and other local business operators and residents in the area, through strategies such as baiting, were recognised and considered important to continue.

Climate change was also raised as an issue of concern on a broad scale relating to the overall impacts of mining operations on a local and global scale.

7.16.9 Access to and use of infrastructure, services and facilities

While the project is unlikely to result in any changes to population due to additional workforce requirements, access to and use of infrastructure, services and facilities was noted by some stakeholders in relation to the general presence of the mining industry in the region.

The construction of the Hebden Road realignment and the potential for road closures were identified as an issue of concern for some stakeholder groups. Strategies to address these issues have been included as part of the Project to minimise disruption to the road network, such as constructing the new alignment largely 'offline', provision of email and SMS notifications for planned blasts, and avoiding blasting during peak times of the day. These strategies were largely well received by stakeholders.

Cumulative traffic impacts and infrastructure and service provisions were also raised by a small number of stakeholders. These are described further in **Appendix 11**.

7.16.10 Health and wellbeing

Physical and mental wellbeing concerns were also raised by all stakeholder groups consulted. Physical health impacts outweighed mental health concerns, as physical impacts are more tangible to identify and discuss, such as respiratory difficulties and dust settling in water reservoirs/tanks. Mental health concerns however, tended to centre on the frustrations and stresses caused by living with cumulative mining impacts and the associated degradation to rural and social amenity. A number of near neighbours also noted stresses experienced in having to work through the acquisition process, however it should be noted that there are no acquisitions proposed as part of the Project.

7.16.11 Water access and use

Some issues were raised in relation to the Yorks Creek Realignment and water access and use more generally, with concerns around potential contamination of water systems and supply noted. However, there was also a positive sentiment towards the Yorks Creek Realignment, with some stakeholders expressing that it may improve flow, providing examples of previous successful diversions in the area.

7.16.12 Personal and property rights

Impacts on personal and property rights, noted through engagement with stakeholders, largely focused on the potential for mining to negatively impact property values in the areas in which mines were present, driving property values down. However, increased property values were also highlighted as a potential positive impact of the Project, by a small number of wider community members, given the demand for housing in the region.

7.16.13 Engagement and decision-making

As part of the round 2 consultation, participants were asked to rate their level of satisfaction with their engagement with Glencore on a scale of 1 to 10, with a relatively high average satisfaction score of 7.7 out of 10, obtained across all stakeholder groups.

In relation to stakeholder perception of Glencore's engagement process, a high proportion of near neighbours (94%), two-thirds of Aboriginal Stakeholders and 9 out of 12 community group representatives (82%) acknowledged Glencore have previously engaged with them either personally or through public forums.

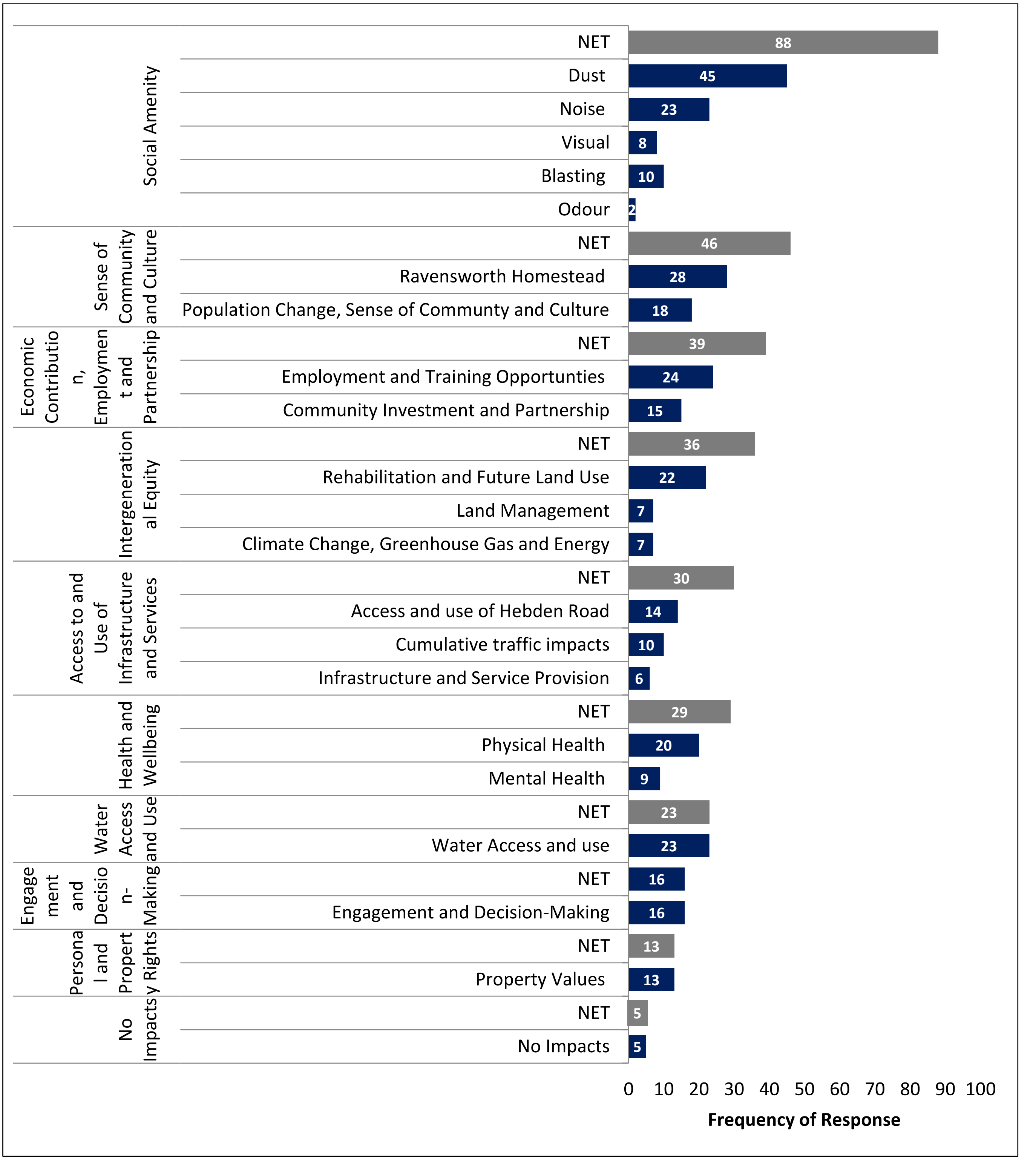

Figure 7.16.2 Perceived Stakeholder Impacts (Key Stakeholders including near neighbours and community groups)

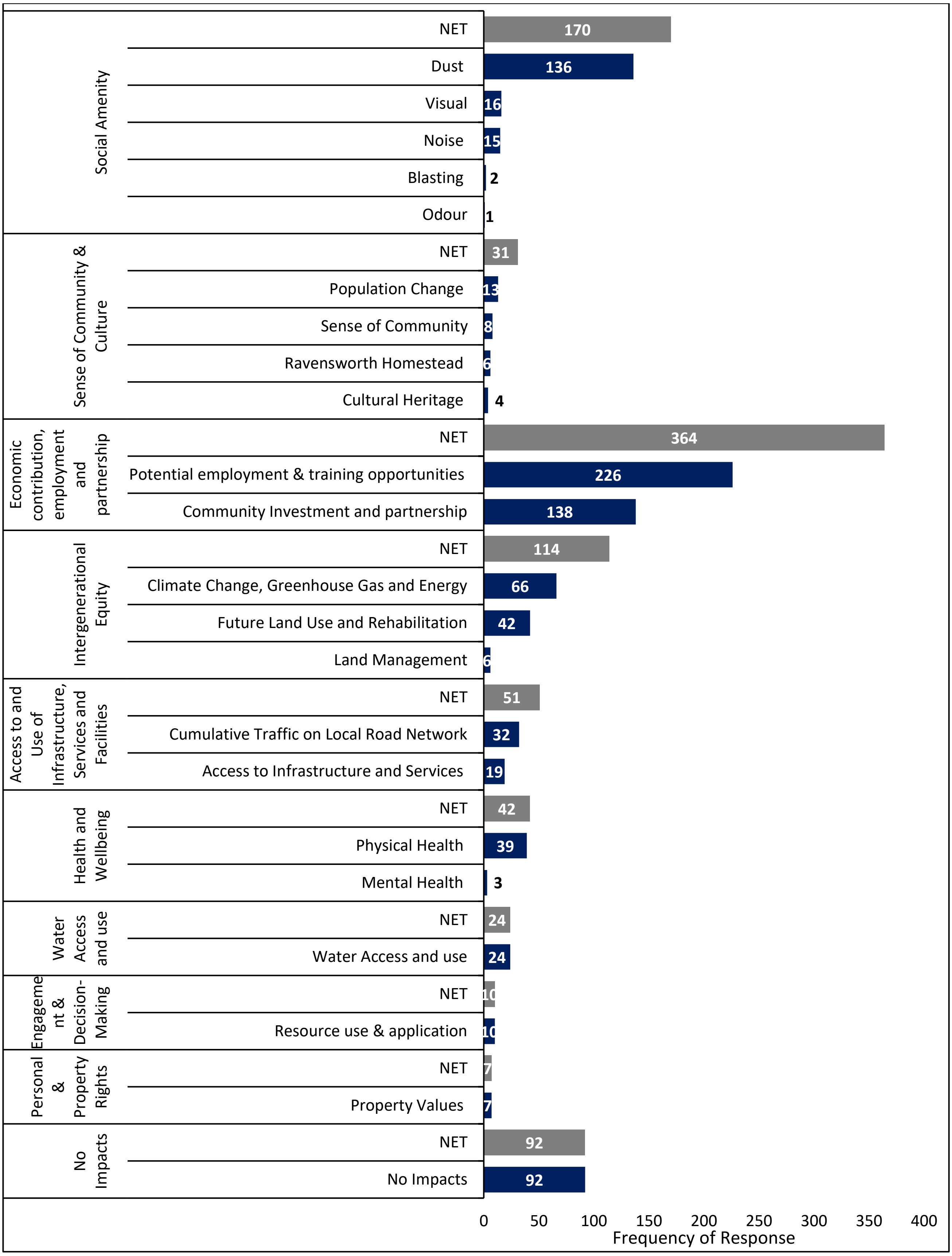

Figure 7.16.3 Perceived Stakeholder Impacts (Wider Singleton LGA Community)

7.16.14 Stakeholder views on heritage and the Ravensworth Homestead

As outlined in **Section 7.19.2**, key stakeholders and community members in the wider Singleton LGA identified a range of values in relation to the homestead, with consistency in themes evident across both key stakeholders and respondents of the wider community survey across the Singleton LGA. **Table 7.66** provides further clarity around those stakeholders who participated in consultation around the Ravensworth Homestead. As mentioned previously, key stakeholders include near neighbours, Aboriginal stakeholders and community and heritage stakeholders and group representatives (including the RHAC, individuals with an interest in heritage, the Singleton Historical Society and Museum and past owners of the Homestead).

Table 7.66 Participants in SIA - Ravensworth Homestead

Stakeholder	Description
Key Stakeholders	
Near Neighbours	Landholders including residents and businesses residing in proximity to the current mining operation in the localities of Camberwell, Middle Falbrook, Falbrook, Glennies Creek and Hebden
Aboriginal stakeholders	A number of Registered Aboriginal Parties (RAPs) and service providers (note that this refers specifically to those Aboriginal stakeholders consulted as part of the SIA regarding social issues, not to all of those consulted as part of the Aboriginal cultural heritage assessment discussed in the EIS). Participants included representatives from: • Wanaruah Local Aboriginal Land Council (WLALC) • Wonnarua Nation Aboriginal Corporation (WNAC) • Ungooroo Aboriginal Corporation • Plains Clan of the Wonnarua People (PCWP)
Community and heritage stakeholders and group representatives	Including community groups and individuals associated with the area with a specific interest in heritage aspects of the project, emergency services and service providers. Participants included: • Members of the Ravensworth Homestead Advisory Committee (RHAC) Individuals with a specific interest in heritage • Singleton Historical Society and Museum • Singleton Heritage Advisory Committee • Past owners of the Ravensworth Homestead • Emergency services, local bus company and local halls (Hebden Hall and Mount Olive)
Wider Singleton LGA Community	
Wider community	Singleton LGA residential and business community. Random sample of residents in the Singleton LGA contacted via a random telephone survey (n=251 from the Singleton LGA and n=22 from the Broke and surrounds community, with a total of n=273).

Overall, all key stakeholders consulted expressed that they had a strong interest in the history of their area (84%); with strong agreement across all key stakeholders consulted that the Ravensworth Homestead was an important part of the heritage of the Singleton LGA (91% of those consulted) and its local history (93%). There was also a strong agreement across key stakeholders that buildings of heritage value should be preserved (94%), with the majority of key stakeholders (69%) concerned that if not relocated, the homestead may deteriorate like other buildings in the area. As a result there was a desire to see a sustainable future for the building(s).

Across stakeholder groups, the level of knowledge of the homestead varied, with key stakeholders holding a higher level of knowledge than the wider community. For key stakeholders consulted, the homestead was valued for its unique aesthetics, namely the design and style of the homestead, its craftsmanship and technology of construction; and for its historical values as a significant building at a local and state level; a prominent working agricultural complex within the region, providing an insight into the early colonial way of life in the Ravensworth locality.

Those that had lived at the homestead and visited, held many fond memories of times spent with family and friends; with several notable connections to key pioneering families identified e.g. Bowman, Russell, Marshall. For the Aboriginal community, the memories were less positive, with the homestead signifying the conflicts of the time between Aboriginal people and early settlers.

At a local community level, while the personal connection to the homestead was stronger for those that had an active interest in heritage and Aboriginal stakeholders, compared to local landholders or the wider community; the homestead was still perceived to be one of the last main buildings that represented a once prospering Ravensworth locality. At a wider Singleton LGA community level, there was still strong agreement that the Homestead was an important part of the heritage of the LGA and should be preserved for its heritage value.

In relation to stakeholder attitude towards relocation, there was a strong view across stakeholder that, if relocated, the homestead should be located somewhere where it could be used for the benefit of the community more broadly, with 63% of key stakeholders and 77% of the wider community in agreement with this view.

7.16.14.1 Identification of potential relocation options

As described in **Section 7.8**, there are two alternate relocation options proposed for the homestead, both of which have been assessed as part of the SIA.

Through the SIA engagement undertaken in Round 2 (personal interviews and survey), key stakeholders and survey respondents were asked to consider the two alternate relocation options and to outline their option preference and details of why that option had been selected. Those consulted were also able to openly present their views on each option and indicate if neither proposed relocation option was preferred (i.e. leave insitu), with reasons for their preferences also noted.

From a key stakeholder perspective (near neighbour, heritage groups and Aboriginal stakeholders), option preferences were closely aligned with 36% of key stakeholders indicating a preference for Option 2 (Broke village) and 32% more supportive of relocation to the Ravensworth Farm Site. 24% of key stakeholders consulted had no preference, with a further 8% outlining that the homestead should not be relocated at all.

In considering preferences across stakeholder groups, Option 1 (Ravensworth Farm) was more likely to be a preference for near neighbours with stakeholders with a more active interest in heritage issues more likely to indicate that the homestead should remain in situ (do not relocate). Option 2 (Broke Village) was favoured by those Aboriginal representatives from the WLALC, Ungooroo and WNAC who participated in the Ravensworth Homestead survey.

At the wider community level, of the 273 respondents that participated in the survey, 61% of respondents that responded to the options question (n=262) indicated a preference for Option 2 (Broke Village), 29% indicated a preference for Option 1 (Ravensworth Farm site), with 7% indicating a preference for no relocation at all, and 2% with no preference.

In summary, sampling of both key stakeholders and the wider Singleton community, Option 2 was the clear option preference, with 57% outlining support for this option, compared to 30% for the Ravensworth Farm option, with an additional 7% outlining that the homestead should not be relocated (refer to **Figure 7.16.4**).

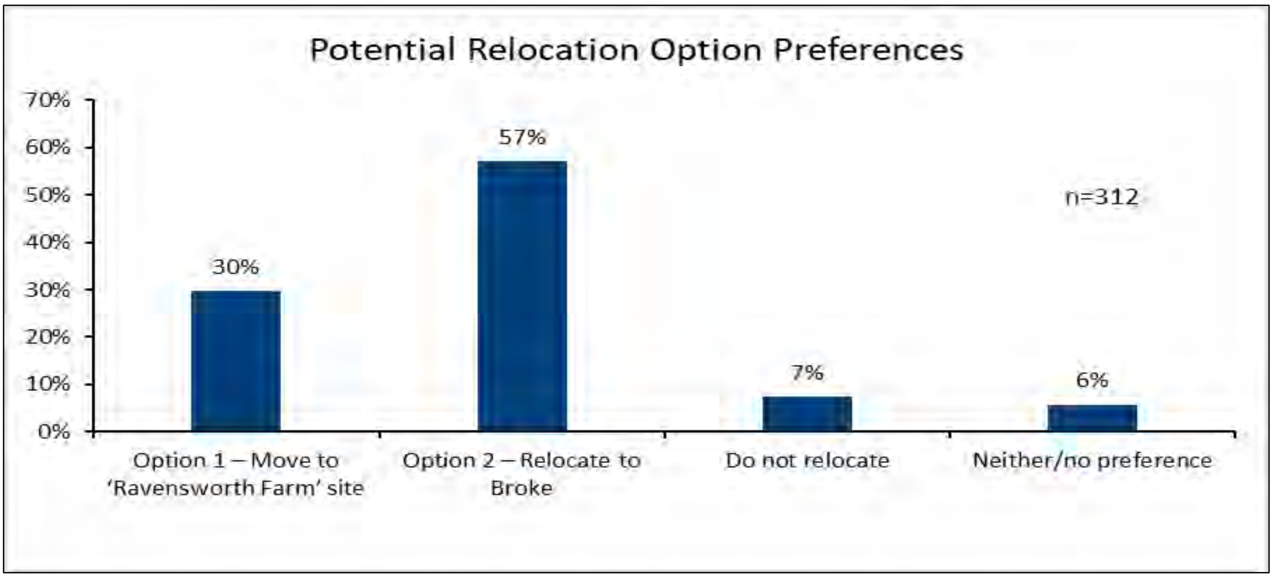

Figure 7.16.4 Potential Relocation Option Preferences (Total Sample)

A further breakdown across all the stakeholder groupings indicate that the wider Singleton community have a clear preference for Option 2 (Broke Village), with near neighbours and members of community groups and those with an interest in heritage, more divided in their preferences. The option to not relocate the homestead, received greater support from this group (refer to **Figure 7.16.5**).

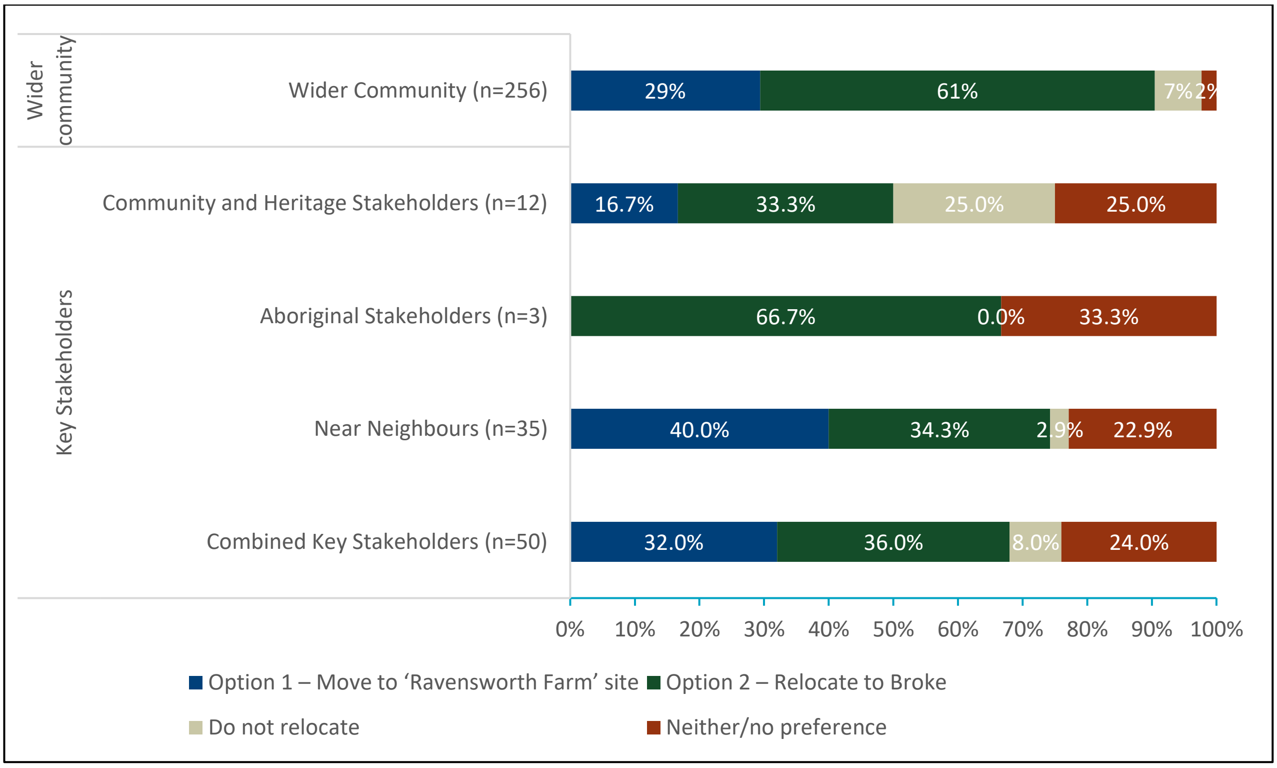

Figure 7.16.5 Preference between Relocation Options - Key Stakeholders (n=50) and Wider Community (n=256)

Those stakeholders that identified Broke Village as their preferred relocation option, justified their option selection on the basis of a number of factors, the most significant of which related to the ability for the wider community to access and use the homestead in the Broke Village. In this regard, stakeholders that indicated a preference for the Broke option often noted that the Ravensworth Farm option would not facilitate public use.

The opportunity for public use and access was also closely related to the other themes noted which included the opportunity to enhance tourism opportunities, particularly the opportunities to associate the homestead with the convict trail and promote both Aboriginal and European cultural heritage. In this regard, there was interest from the Aboriginal stakeholders consulted that relocation of the homestead may facilitate the development of a cultural heritage centre within the homestead complex to showcase Aboriginal Art and culture; facilitating further tourism opportunities and local business development.

There was also a perception that relocation of the homestead to Broke, would reduce any further risk/ damage to the homestead complex due to its current location and any further impact of mining activity (both current and future) in the Ravensworth area. Consequently, there was a view that Broke would be a safer resting place for the homestead complex.

7.16.15 Management and enhancement strategies

A range of strategies have been proposed to address the significant (moderate and high) social impacts relating to the Project. These strategies have been developed through review of existing Glendell management approaches; stakeholder strategies identified through the SIA engagement program (Rounds 1 and 2); relevant projects and studies relating to social impact management; and the experience of the SIA team across other projects. Additional social criteria are also considered in the development of relevant strategies, including an assessment of the vulnerability of key stakeholders and landholders in proximity to the Project Area. The summary of predicted impacts considering these mitigation and enhancement strategies is outlined in **Section 7.16.16**

Glendell Mine has in place a range of existing mitigation approaches to address environmental and social impacts associated with their mining operations. To date, as part of existing operations, a range of management strategies have been applied to residences to mitigate noise and dust impacts to further reduce impacts of the operations. As part of the Project and as outlined in the EIS, management plans (e.g., noise, air quality, blasting, water and traffic management) will be updated and/or enhanced to include project specific measures. These updates will ensure the consistent application of management and mitigation measures for near neighbours and any other impacted stakeholders.

Mount Owen Complex also has an existing Glencore Land and Property Management Protocol that will be extended to involve key stakeholders in the effective management of offset areas and buffer lands. The plan will be amended as required.

Strategies are also in place to engage with stakeholders and to enhance sense of community through the existing Stakeholder Engagement Strategy and Community Investment Programs. It is suggested that these documents continue to be reviewed annually and revised to reflect any changes in community sentiment.

GCAA currently undertake a focus key stakeholder and wider community survey across all their operations in NSW and QLD, with outcomes of this survey process informing planning at operational levels. Based on the outputs of engagement for the current Project SIA, such enhancements to the company's current engagement approach, will include:

- continued facilitation of Falbrook and Hebden Community Gatherings and introduce guest speakers on topics of interest to the community e.g. Landcare, farm productivity, soil erosion, land management e.g. weed and pest control.

- development of a strategy for communication mechanisms to inform near neighbours of proposed Hebden Road closures and operational activities, such as blasting.
- Continued support of a range of local community initiatives
- continued facilitation of local employment, including trainee and apprenticeship programs, and procurement opportunities as part of the Project.

Through the engagement process, key stakeholders were asked to suggest potential mitigation strategies they would like to see considered by Glendell Mine in the development of the Project. Stakeholders reported the need to:

- further engage on the topic of post mining land use, in collaboration with other stakeholders, to ensure the early development of strategic management plans to address land use post mining; with particular attention given to the consideration of community transition and sustainability once operations cease.
- continue to support local community events and facilitate capacity building and economic diversification in the region.

Table 7.67 identifies which specific predicted social impacts are addressed by the implementation of the strategies proposed. Each of the strategies proposed may address the social risk to varying degrees.

Table 7.67 Proposed Strategies by Significant (Moderate and High) Predicted Social Impacts

	Social Amenity	Sense of Community & Culture	Intergenerational Equity	Health & Wellbeing	Access to and Use of Water	Economic Contribution, community investment and partnerships	Personal & Property Rights	Access to &d Use of Infrastructure and Services
Enhancements to existing strategies or those proposed in the EIS								
Revision and update of relevant Project Management Plan's	x			x	x			x
MOC Employment and Procurement						x		
Extension of the existing Glencore Land and Property Management Protocol		x	x		x			
Rehabilitation and Mine Closure Strategy and Mine Closure Plan – a key input being the MOC VPA contribution to the Singleton Council's economic diversity fund			x			x		
Enhancement of Glendell's existing stakeholder engagement strategy		x			x			x
Glencore and MOC Community Investment Program		x				x		x
New proposed mitigation and enhancement strategies								
Community Enhancement Projects	x	x						x
Employment and Training Initiatives		x		x	x	x		x

	Social Amenity	Sense of Community & Culture	Intergenerational Equity	Health & Wellbeing	Access to and Use of Water	Economic Contribution, community investment and partnerships	Personal & Property Rights	Access to &d Use of Infrastructure and Services
Ravensworth Homestead Relocation and associated strategies - to document heritage values, increase cultural awareness and community education		x	x					
Social Impact Management Plan for the Mount Owen Complex with a focus on proximal localities of Camberwell, Middle Falbrook, Glennies Creek and Hebden	x	x	x	x	x	x	x	x

The following sections outline each of these strategies in further detail.

Voluntary Planning Agreement

As part of the Project, Glencore will negotiate a VPA with Singleton Council which will afford opportunities for the Project to contribute to programs designed to improve or address local community issues and perceived impacts through financial contributions to Singleton Council. Local community improvements have been highlighted in the Singleton Council Community Strategic Plan, and further discussion will be held around prioritising the use of contributions in local areas around the project, as well as in the broader LGA.

Community Enhancement Projects

While the existing Glendell operations already have a detailed Stakeholder Engagement Strategy in place; to further address the issues raised by near neighbours and community groups relating to the perceived impacts on sense of community and access to and use of infrastructure, Glencore proposes to identify additional Community Enhancement Projects to benefit stakeholders in close proximity to the mine. Such projects/initiatives will include:

- opportunities to enhance local infrastructure/services enhancements e.g. Hebden Hall and Mt Olive Hall
- stabilisation and improvements to the appearance of the Hebden Public School building (Site No. 34) in line with project heritage commitments
- exploring opportunities to partner with the local RFS on emergency response initiatives.

These projects would be:

- integrated into Glendell's existing Community Investment Programs and/or
- form part of heritage commitments as outlined in the EIS and/or
- considered in the development of the Planning Agreement for the Project, in consultation with Singleton Council.

Employment and Training Initiatives

- As part of the ACHAR, the Project proposes to investigate funding a traineeship or a work experience position in the area of cultural heritage management, biodiversity or land management, ecology, rehabilitation or another appropriately related field, through a third-party provider, such as the National Parks and Wildlife Service (NPWS), who currently offer a 2-year field officer traineeship in land management.
- Glencore will notify the local community of how they can find information regarding available employment opportunities.

Ravensworth Homestead Relocation

As outlined in **Section 3.2.9** of this EIS, the Project is proposing to mine through the project area where the Ravensworth Homestead is situated and two alternate relocation options are proposed as part of the EIS. In order to document heritage values and increase cultural awareness and education in relation to the homestead, the Project proposes to develop a series of interpretive strategies that address the history and significance of the Ravensworth Homestead Complex and the broader Ravensworth Estate. This information would be made publicly accessible through existing services such as the Singleton Public Library.

Interpretive information would include:

- documentation of oral histories: recount of historical events that have taken place at the homestead and its surrounds, family and community stories, community events etc.
- preparation of detailed 3D digital recordings of the exterior and interior of the existing Ravensworth Homestead Complex and development of a digital interpretation of the Ravensworth Homestead Complex for public viewing and research purposes.
- development of interactive and interpretive materials documenting the history across the Ravensworth Estate.

It is also proposed that information be provided to the Singleton Public Library local history collection to further facilitate public access, in line with recommendations made in the Statement of Heritage Impact (refer to **Appendix 23**).

Monitoring of Social Impacts

It is proposed as part of the Project to develop a Social Impact Management Plan (SIMP) for the Complex in accordance with the SIA Guideline that defines and guides the monitoring and evaluation activities for the Mount Owen Complex.

Glencore will develop a Social Impact Management Plan (SIMP) that defines and guides the monitoring and evaluation activities for the Project. The SIMP will be developed in accordance with the SIA Guideline and will:

- identify opportunities to enhance positive and mitigate negative social and economic impacts of the Project on communities
- detail adaptive management and mitigation strategies to address potential impacts of the Project identify appropriate stakeholder responsibilities

- identify appropriate monitoring, reporting and review mechanisms, including the purpose of monitoring and the parameters that will be monitored and how and when monitoring data will be collected
- outline a process to engage with relevant stakeholders and communities, with a focus on practical mechanisms for the community to collaborate and record their observations and experiences of social impacts and any proposed community participation
- include an incident notification and reporting process, including providing applicable information to the community
- develop a process for reviewing the above elements to assess whether they are still appropriate, and whether any new issues have emerged that should be included in ongoing monitoring
- develop a process for making monitoring results and associated information publicly available, including any revisions to the monitoring and management framework.

7.16.16 Assessment of social risks/impacts

The SIA has utilised data from several sources to identify the potential social impacts arising from the Project. Social impacts associated with the Project have been assessed via a detailed ranking of social impacts according to a number of key criteria, as defined in the SIA Guideline.

In order to prioritise the identified social impacts, a risk-based framework has been adopted with the assessment of social risk considering both the consequences of the potential social impact and the likelihood of the impact occurring to determine an overall risk assessment of the social impact as 'low', 'moderate', 'high' or 'extreme'. Technical and perceived social risk in relation to the consequences that may be experienced by people, due to anticipated impacts/changes associated with the Project, have been categorised in line with the Social Impact Categories outlined in the SIA Guideline and then further defined within impact themes and sub-impact issues.

It is noted that the social risk matrix from the SIA Guideline provides greater emphasis on high and extreme risks, with 16 out of 25 risk rankings (64%) across the matrix being identified as high or extreme.

Each of the identified impacts has been assessed in detail in the SIA. **Table 7.16.3** provides a summary of the mitigated predicted impacts after the application of the social impact mitigation and enhancement measures that are proposed to be implemented as part of the Project as outlined in **Section 7.21**. Social impact rankings associated with the assessment of the two potential relocation options for the Ravensworth homestead are also outlined in **Section 7.22.1**. The duration of social impacts largely relates to the proposed life of the mining operation which is expected to be completed by 2044.

Each of the identified impacts has been assessed in detail in the SIA. **Table 7.68** provides a summary of the mitigated predicted impacts after the application of the social impact mitigation and enhancement measures that are proposed to be implemented as part of the Project as outlined in **Section 7.21**. Social impact rankings associated with the assessment of the two potential relocation options for the Ravensworth homestead are also outlined in **Section 7.22.1**. The duration of social impacts largely relates to the proposed life of the mining operation which is expected to be completed by 2044.

Table 7.68 Mitigated Social Impact Risk Assessment Outcomes

Social Impact Theme	Impact Description	Affected Parties	Perceived Social Impact/ Sensitivity	Project Aspect				Social Impact Ranking (mitigated)
				A - Assessment process	C - Construction	O - Operational	E - End of mine life	
Social Amenity	Dust Impacts	Near Neighbours	High			O		Moderate
	Cumulative Dust Impacts	Near Neighbours	High			O		Moderate
	Cumulative Dust Impacts	Singleton LGA	High			O		Moderate
	Noise Impacts	Near Neighbours	High			O		Moderate
	Cumulative Noise Impacts	Camberwell and Glennies Creek	High			O		Moderate
	Cumulative Noise Impacts	Singleton LGA	Low			O		Low
	Blasting impact	Near Neighbours and Singleton LGA	Low			O		Low
	Visual impacts	Near Neighbours and Hebden Road Users	Low			O		Low
	Visual impacts	Singleton LGA and New England Highway Road Users	Low			O		Low
	Odour	Near Neighbours and Singleton LGA	Low			O		Low
Sense of Community	Population Change	Near Neighbours	Low		C			Moderate
	Population Change	Singleton LGA	Low		C			Moderate
	Population Change, Sense of Community and Culture	Near Neighbours	Moderate			O		Moderate
	Population Change, Sense of Community and Culture	Singleton LGA	Moderate			O		Low
	Culture and Heritage	Near Neighbours	Low		C	O		Low
	Culture and Heritage	Aboriginal Community	Moderate		C	O		Low

Social Impact Theme	Impact Description	Affected Parties	Perceived Social Impact/ Sensitivity	Project Aspect				Social Impact Ranking (mitigated)
				A - Assessment process	C - Construction	O - Operational	E - End of mine life	
Economic Contributions, Employment and Partnerships	Economic Contribution and Community Investment	Singleton LGA	High Positive		C	O		High Positive
	Economic Contribution and Community Investment	Near Neighbours	Moderate Positive					High Positive
	Employment and Training opportunities	Singleton LGA	Moderate Positive		C	O		Moderate Positive
	Employment and Training opportunities	Aboriginal Community	Moderate Positive		C	O		Moderate Positive
Intergenerational Equity	Future Land Use and Rehabilitation	Near Neighbours	High				E	Low
	Future Land Use and Rehabilitation	Aboriginal and Community Groups	Moderate				E	Low
	Future Land Use and Rehabilitation	Singleton LGA	Moderate				E	Low
	Land Management	Near Neighbours	Moderate		C	O		Moderate
	Land Management	Singleton LGA	Low					Moderate
	Climate Change, Greenhouse Gas and Energy	Near Neighbours	Low	A	C	O		Moderate
	Climate Change, Greenhouse Gas and Energy	Singleton LGA and Environmental Groups	High	A	C	O		Moderate

Social Impact Theme	Impact Description	Affected Parties	Perceived Social Impact/ Sensitivity	Project Aspect				Social Impact Ranking (mitigated)
				A - Assessment process	C - Construction	O - Operational	E - End of mine life	
Assess to and Use of Infrastructure and Services	Assess to and Use of Infrastructure, Services and Facilities	Camberwell and Hebden	Moderate			O		Low
	Assess to and Use of Infrastructure, Services and Facilities	Singleton LGA	Low			O		Low
	Potential Disruption to Access Due to Realignment of Hebden Road and Blasting	Near Neighbours	Moderate		C	O		Moderate
	Potential Disruption to Access Due to Realignment of Hebden Road and Blasting	Road Users including emergency services and local buses	Moderate		C	O		Moderate
	Cumulative Traffic on Local Road Network	Near Neighbours	Low			O		Low
	Cumulative Traffic on Local Road Network	Singleton LGA	Moderate			O		Moderate
Health and Wellbeing	Physical Health	Near Neighbours	Moderate			O		Moderate
	Physical Health	Singleton LGA	Moderate			O		Low
	Mental Health	Near Neighbours	Low	A				Moderate
Water Access and Use	Water Access and Use	Near Neighbours, Aboriginal Community and Singleton LGA	Moderate		C	O		Moderate
Personal and Property Rights	The impact of the Project on property values	Near Neighbours and Singleton LGA	Low			O		Moderate

7.16.17 Assessment of social impacts resulting from the relocation of the Ravensworth Homestead

As has been noted in **Section 7.19**, impacts to sense of community and culture, and specifically the social impacts that may be associated with the relocation of the Ravensworth homestead were perceived as a high perceived social risk for all key stakeholders and a moderate perceived risk for the wider Singleton community.

In predicting the social impacts of relocation, the two alternate options have been assessed against a baseline of the homestead remaining in its existing location, with no public access. **Table 7.69** provides a summary of the predicted impacts across the relevant stakeholder groups engaged in the SIA, indicating the mitigated predicted impacts after the application of the social impact mitigation and enhancement measures that are proposed to be implemented for the Ravensworth Homestead as part of the Project.

As **Table 7.69** illustrates, the implementation of Option 2 relocation to the Broke Village is likely to result in a 'high' perceived social impact for near neighbours and heritage stakeholders, and an 'extreme' social impact ranking. As referred to in the SIA Guidelines and outlined in the Social Risk Matrix (refer to **Appendix 11**), it is likely that this option would have a major consequence in terms of reduction in sense of community due to the permanent relocation of the homestead to a place that isn't 'Ravensworth', particularly given the homestead is seen to be the last building that represents the history of the Ravensworth locality. This is reflected in responses from those stakeholders who identified a preference for it to remain insitu or be relocated to the Ravensworth Farm site. However, relocation of the homestead to Broke Village (Option 2) is likely to result in a high (positive) impact for the wider Singleton LGA community based on higher community accessibility, anticipated benefits in the local economy etc.

Option 1, the relocation of the homestead to the Ravensworth Farm site is likely to result in a moderate (positive) impact for near neighbours, Aboriginal groups and the wider Singleton LGA community (likely and minimal social impact) and a high social impact (likely and moderate) for heritage stakeholders (refer to **Table 7.69**).

Table 7.69 Predicted Impact Summary resulting from the relocation of the Ravensworth Homestead

Social Impact Theme	Impact Description	Options Assessed	Affected Parties	Perceived Social Impact/ Sensitivity	Project Aspect: A - Assessment process	Project Aspect: C - Construction	Project Aspect: O - Operational	Project Aspect: E - End of mine life	Social Impact Ranking (mitigated)
Community and Culture	Impacts on sense of community and culture as a result of homestead relocation	Broke Village	Near Neighbours	High				E	Extreme
			Aboriginal Groups	High				E	High Positive
			Heritage Stakeholders	High				E	Extreme
			Singleton LGA Community	Moderate				E	High Positive

Social Impact Theme	Impact Description	Options Assessed	Affected Parties	Perceived Social Impact/ Sensitivity	Project Aspect A - Assessment process	C - Construction	O - Operational	E - End of mine life	Social Impact Ranking (mitigated)
		Ravensworth Farm	Near Neighbours	Moderate				E	Mod Positive
			Aboriginal Groups	High				E	Moderate
			Heritage Stakeholders	High				E	High
			Singleton LGA Community	Moderate				E	Mod Positive

7.16.18 Summary

The social impacts of the Project have been minimised where possible through project design and the proposed management and enhancement approaches. These proposed approaches to manage community impacts are the result of the assessment of both technical and perceived community risks, as identified through consultation, complaints data analysis and technical reports prepared by specialist consultants.

As is the case with other developments of this kind, the perceived social impacts/ issues are greatest for those living in closest proximity to the proposal, or those who perceive they will be most directly impacted by the development. Consequently, should approval of the Project be granted, an appropriate social impact management and monitoring framework will be developed to assess the occurrence or non-occurrence of such effects. Furthermore, it will be essential for the company to maintain an ongoing dialogue with near neighbours throughout the operation of the Project in relation to issues of relevance and importance to the community.

The broader LGA community has appeared generally accepting of the proposal due to the predicted positive economic benefits at a local and regional scale; however there is a trend in concerns around cumulative impacts of mining in the Hunter Region, primarily in regards to air quality and intergenerational equity, particularly current land management and future land use, post mining.

In relation to the Ravensworth Homestead and its relocation, Option 2 was the clear option preference, with 57% of survey respondents, outlining support for this option, compared to 30% for the Ravensworth farm option, with an additional 7% outlining that the homestead should not be relocated. However, as noted stakeholder preferences relating to the homestead's potential relocation are influenced by a number of factors, including level of interest in heritage issues, geographic location, level of public accessibility, risk of damage (from mining and the relocation process itself) and perceived option cost.

While a number of social and environmental issues have been raised by landholders and the wider community, of key focus from a social impact perspective, are the impacts of the Project on near neighbours due to perceptions of impact on social amenity and sense of community, the latter (in particularly localities e.g. Camberwell) having been experienced as a result of population loss and change over time.

A number of mitigation and enhancement strategies are proposed to address social impacts, including:

- continued implementation of a VPA with Singleton Council
- continuation/implementation of a range of existing and new mitigation measures to address the identified impacts, based on community feedback
- development and execution of a SIMP for the ongoing monitoring and management of social impacts.

These mitigation and enhancement measures have been specifically targeted to address the issues identified in this SIA and are based on stakeholder input and feedback.

7.17 Economic

A key benefit of the Project includes the economic benefit to the state and region associated with job continuation, capital expenditure, ongoing operational expenditure, and workforce expenditure associated with the Project.

A number of stakeholders discussed the economic benefits to the local region and State as part of consultation for the Project. This feedback included the positive impact mining as a whole, as well as the contribution of Glencore on the economy of the region and the contributions to community groups and causes. Glencore's community investment efforts were commended by a number of stakeholders, who acknowledged the diverse range of projects and community groups that have been supported by Glencore in the past.

In 2018, approximately $25.8 M was spent by Glencore on Glendell Mine workforce salaries, with $18.6 M going to the workforce within the local government areas of Singleton, Cessnock, Maitland and Muswellbrook, and a total of $24.3 M in the Hunter Region broadly. Additionally, from January to December 2018, an additional $55,374 was spent on local community contributions, with spending continuing throughout 2019.

The continuation of operations at Glendell Mine through the Project will allow for the ongoing employment opportunities for the Mount Owen Complex workforce, continued business to local suppliers, continued contributions to Singleton Council and payment of royalties to the State of NSW.

To understand the economic impacts of the Project a detailed Economic Impact Assessment (EIA) has been completed. The EIA looks at both the economic benefits and costs (including environmental and social costs) of the Project to identify if the economic benefits exceed the costs.

The EIA has been undertaken by Ernst and Young (EY) and uses the economic assessment framework set out in the Guidelines for the economic assessment of mining and coal seam gas proposals (the Economic Assessment Guidelines) released by the NSW Government in December 2015. The Economic Assessment Guidelines require that economic assessments outline the net present value of the project to the NSW community and provide a Local Effects Analysis (LEA) using the Cost Benefit Analysis (CBA) framework set out in the Economic Assessment Guidelines. In addition to the CBA and LEA, the EIA also provided an estimate of the economic impacts of the Project on gross State product (GSP) and gross State income (GSI) using computable general equilibrium (CGE) modelling.

The key findings of the economic assessment are discussed in the following sections and the full report is provided in **Appendix 30**.

7.17.1 Cost benefit analysis

A CBA is a method of obtaining a consolidated estimate of the net economic value of a project by identifying the incremental costs and benefits of a project relative to the base case (i.e. no project), placing a quantitative value on these items wherever possible and deriving the share of each item that is attributable to NSW.

The CBA was undertaken in accordance with the Economic Assessment Guidelines to measure the net benefits (both direct and indirect) to the NSW community and local region within which the Project is located. To evaluate the net benefits of the Project, the economic analysis considers the baseline operations for the currently approved Glendell Mine in the absence of the Project. The potential costs and benefits produced by the baseline operations are excluded from the analysis for the Project.

The direct benefits are those that accrue to the proponent and payments made to the NSW government (in the case of the assessment of benefits to the State) and the Local Government in the case of regional benefits. The indirect benefits are those that accrue to other parties that engage with the project proponent and include workforce and suppliers. The indirect costs are the costs borne by the community of NSW or region through environmental and social impacts or public infrastructure costs associated with the Project.

The economic assessment has had regard to the economic benefits and costs associated with the existing approved operations and the Project's economic benefits calculated in the CBA have excluded these net benefits associated with approved operations. The costs and benefits considered in the analysis are provided in **Table 7.70** below.

Table 7.70 Benefit and Cost Items Considered in the CBA

Item	Benefit Components	Cost Components
Net producer surplus	Gross mining revenue Residual value of land Residual value of capital	Operating costs Capital costs Decommissioning costs Environmental mitigation costs Transport management costs Rehabilitation expenses Purchase costs for land Local contributions Taxes (Australian, State and local) Royalties.
Royalties	Royalties payable to the NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	Any payments to existing landholders	Opportunity cost of land
Economic benefit to workers	Wages paid to workers	Reservation wage for workers in the mining sector
Economic benefit to suppliers	Revenue paid to suppliers	Opportunity cost of supplier goods and services

Item	Benefit Components	Cost Components
Net environmental, social and transport-related costs		Greenhouse gas emissions Air quality Traffic and transport Residual value of land Noise Biodiversity Aboriginal heritage Non-Aboriginal heritage Water Visual amenity Other social impacts.
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure, net of payments made by the Proponent

Where it is difficult to place a value on a particular cost or benefit of the Project, as per the Economic Assessment Guidelines, a qualitative analysis has been undertaken. In some cases these items have been considered qualitatively because there is expected to be no significant difference in outcomes under the baseline and Project case or because there is no reliable method available to value them in these particular circumstances (such as visual amenity and heritage impacts). In relation to Aboriginal heritage impacts and the impact to the Ravensworth Homestead, the costs associated with relocation, and archaeological survey and salvage have been included as capital costs however the intangible costs associated with the loss of heritage values has been considered qualitatively. The EIA includes a detailed discussion of the various valuation methods considered, and ultimately used, in the CBA (refer to **Appendix 30**).

As discussed above, the CBA is based on calculating the benefits and subtracting the costs of the Project compared against the baseline scenario where the Project does not occur. The results are summarised in **Table 7.71**.

The overall finding of the CBA is that the Project is estimated to provide a net benefit to NSW. This net benefit is estimated to be approximately $1.15 billion in NPV terms (that is, how much a future sum of money is worth today). This is comprised of $398 M and $754.3 M in direct and indirect benefits respectively. The quantified incremental indirect costs of the Project that are not captured by operational and capital costs are estimated to be $2.4 M in NPV terms.

Table 7.71 Net Benefit Analysis of the Project ($ million^)

Benefits	NPV*	Costs	NPV*
Direct Benefits		**Direct costs**	
1. Net producer surplus attributed to NSW	0.0		
2. Royalties, payroll tax	333.3		
3. Company income tax apportioned to NSW	64.7		
Total direct benefits	**398.0**	**Total direct costs**	**-**
Indirect Benefits		**Indirect costs**	
1. Net economic benefit to landholders	0.0	1. Air quality^^	-
2. Net economic benefit to NSW workers	468.0	2. Greenhouse gas emissions	0.1

Benefits	NPV*	Costs	NPV*
3. Net economic benefit to NSW suppliers	286.3	3. Noise impact^^	-
		4. Transport impact	1.6
		5. Net public infrastructure cost	-
		6. Surface water impact^^	-
		7. Groundwater impact^^	-
		8. Biodiversity impact^^	16.6
		9. Loss of surplus to other industries	0.7
		10. Visual amenity^^	
		11. Aboriginal cultural heritage^^	
		12. Historic heritage	
		13. Other	-
Total indirect benefits	**754.3**	**Indirect Costs**	**19.1**
Total Project economic benefit	**1,152.3**	**Incremental Indirect Cost**	**2.4**
NPV of project - ($m)	**1,149.9**		

^ Real 2019 Australian dollars.

* NPV in 2019 Australian dollars based on a 7% real discount rate.

^^ Management and mitigation costs are included in the capital/operating cost

The Project is predicted to generate:

- total corporate taxes of $202.2 M in NPV terms for Australia, of which $64.7 M is attributed to NSW
- $333.3 M in other government revenue for NSW in NPV terms, the largest component of this being royalties of $296.1 M in NPV terms (approximately $710 M (undiscounted) over the life of the Project).

The indirect benefits of the Project are related to the linkages that it will have to the NSW economy through both the labour market and suppliers. The analysis shows that of the $754.3 M in estimated indirect benefits:

- worker benefits are predicted to amount to $468 M in NPV terms over the period 2021 to 2044 of the Project
- supplier benefits are predicted to amount to $286.3 M in NPV terms based on total NSW-based supplier inputs over the life of the Project of approximately $1.42 billion.

7.17.2 Local effects analysis

The Local effects Analysis (LEA) is complementary to the CBA for NSW and estimated the benefits to the local region. The Economic Assessment Guidelines require that the LEA is conducted for the ABS SA3 region within which the project is located. The Project is situated entirely within the Lower Hunter Statistical Area (SA3) which includes the localities of Singleton, Cessnock and Dungog. The population of the entire SA3 has been used to model the impact of the Project as labour and other expenditure is likely to be concentrated throughout this area.

The LEA has found that the Project is estimated to provide a net benefit on the Lower Hunter SA3 region of $446.7 M in NPV terms. This is comprised of:

- indirect benefits to local suppliers of $134.3 M in NPV terms (based on data from a survey of Glendell suppliers which indicated that 38% of the inputs to production are supplied from the Lower Hunter SA3) and indirect benefits to the workforce of $314.75 M in NPV terms (based on workforce data which indicates that 67% of the mine's direct workforce will continue to be drawn from the Lower Hunter SA3 region)
- quantified incremental indirect costs to the Region of the Project that are not captured by operational and capital costs are estimated to be $2.4 M in NPV terms.

There are a number of important points when considering the results of the LEA, including:

- the results of the LEA are not additive to those in the State level CBA, rather, the results presented are largely already covered in the CBA.
- the LEA does not measure economic welfare outcomes.

7.17.3 Sensitivity analysis

An important part of the CBA process is to undertake a sensitivity analysis. This process tests how sensitive the outcomes are to different economic circumstances that could occur in the future.

The sensitivity analysis for the Project considered all key areas of the CBA, particularly coal price, key costs (both capital expenditure and operating costs) as well as worker benefits.

The analysis showed that the estimated net benefits to the State and Lower Hunter SA3 are robust in the sense that they remain strongly positive after testing all key assumptions underpinning the analysis. The estimated net benefit is most sensitive to the coal price assumptions. However, the lower bound estimate of net benefits (worst-case), which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of approximately $951.4 M in NPV terms and a net benefit to the Lower Hunter SA3 region of $384.7 M in NPV terms.

The upper bound estimate of net benefits (best-case), based on the most optimistic assumptions, is approximately $1.28 billion for the State in NPV terms. In isolation, assuming higher coal prices of 15%, to those in the central case, the potential net benefit of the Project is approximately $1.25 billion in NPV terms.

The robustness of the results to the sensitivity analysis is a reflection of the operating and capital cost efficiencies associated with the use of existing Mount Owen Complex infrastructure and the relatively low level of indirect costs attributable to NSW.

7.17.4 Flow on effects

Computable General Equilibrium (CGE) modelling has been undertaken to analyse the secondary impacts of the Project on the regional and NSW community, as measured by changes in economic activity and employment. A CGE model uses real world data combined with economic relationships drawn from economic theory to estimate how an economy will react to external changes such as government policy, new investment or technology improvements. The model produces measures of economic activity that are commonly used (such as gross domestic product and employment).

CGE modelling assesses changes in aspects such as real Gross State Product (real GSP), an output measure of the NSW economy and real Gross State Income (real GSI) which is a welfare measure for NSW residents. At a regional level the model projects change in real Gross Regional Product (real GRP) and real Gross Regional Income (real GRI). The model also projects state-wide and regional employment, export volumes, investment and private consumption.

The analysis found that the Project is projected to provide significant positive economy-wide impacts to both the Lower Hunter SA3 and NSW. The net economic impacts are presented in **Table 7.72**.

Table 7.72 Economy-wide impacts of the Project, 2021-2044

Variable	Description	Lower Hunter SA3	NSW Total
Real GRP/GSP^	NPV* - $m	2,522.4	3001.9
Real GRI/GSI^	NPV* - $m	2902.4	4514.8
Employment	Average - FTE^^	403.7	488.1
Real Wages	Average – Percent^^	2.25	0.031
Real GRI per person^	NPV* - Dollars	$27,654	$492

Source: EY estimates based on information provided by Glendell.

^ Real 2019 Australian dollars.

* NPV in 2019 Australian dollars based on a 7% real discount rate.

^^ Average over the period 2021 to 2044.

In the Lower Hunter SA3, the Project is projected to increase GRP by approximately $2.52 billion in NPV terms. GRI, or regional welfare, is projected to increase by approximately $2.9 billion in NPV terms, which is considered significant to the relatively small Lower Hunter region. In total, the Project is projected to increase welfare (which is measured by Gross Regional Income) for each person in the Lower Hunter SA3 by $27,654 in NPV terms.

For NSW, the projected increase in GSP is approximately $3 billion in NPV terms, while GSI is projected to increase by approximately $4.5 billion.

7.17.5 Summary of economic benefits

The EIA concluded that overall, the Project is expected to generate significant net benefits, and is also expected to generate increased economic activity and employment within the NSW community. The Project will have a positive economic impact, for the region and the State of NSW even under the most pessimistic assumptions considered. In total, the Project is anticipated to:

- provide a net benefit on the Lower Hunter SA3 region of $446.7 M in NPV terms
- provide a net benefit of approximately $1.15 billion to NSW over the life of the Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $710M over the life of the Project ($296.1 M in NPV Terms)
- increase the Lower Hunter SA3's GRP by a projected approximately $2.52 billion in NPV terms over the life of the Project
- increase the NSW GSP by approximately $3 billion in NPV terms over the life of the Project.

The direct benefits of the Project are a function of its profitability which, in turn, depends on the prevailing coal price. The analysis shows that the combination of the high quality (and therefore value) of the coal reserve and the synergies associated with utilising existing Mount Owen Complex infrastructure underpins the profitability of the Project.

SECTION 8.0

Conclusion and Justification for the Project

8.0 Conclusion and justification for the Project

This section provides a conclusion to the EIS. It includes discussion of the justification for the Project, taking into consideration the associated environmental and social impacts and the suitability of the site, to assist the consent authority to determine whether or not the Project is in the public interest. Other matters considered in the development of the Project design are discussed in **Section 3.0**.

8.1 Environmental, social and economic impacts

As detailed in **Section 7.0**, the environmental, social and economic impacts of the Project have been identified and are the subject of a detailed assessment based on:

- assessment of the site characteristics (existing environment)
- extensive engagement with local community and other stakeholders
- focused consultation with key government agencies
- application of the principles of ecologically sustainable development, including the precautionary principle, inter-generational equity and conservation of biological diversity and ecological integrity, and
- expert technical assessment.

The key issues identified, including those specified in the SEARs, were the subject of comprehensive specialist assessments of the potential impacts of the Project on the existing environment, as detailed in **Section 7.0** and the appendices to this EIS.

Whilst there are many complex aspects which must be read in their entirety to fully understand these assessments, **Table 8.1** provides a very broad overview of the key outcomes of the environment and social impact assessments.

Table 8.1 Key Outcomes of the Environmental and Social Impact Assessments

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Air Quality	• The Project will comply with the relevant applicable annual average and incremental 24-hour average air quality criteria at all private residences that do not currently have acquisition rights under existing development consents • The Project will have similar air quality impacts to the existing approved Glendell Mine with Project specific impacts in Camberwell and the Middle Falbrook area declining as operations progress towards the north and away from these receiver areas • Proactive and reactive dust control measures will continue to be implemented to minimise dust emissions over the life of the Project, including by adaptively managing the mining operations to minimise impacts in adverse conditions • Comprehensive air quality management controls have been incorporated into the design of the Project to minimise the contribution of the Project to impacts on local and regional air quality.
Noise	• The design of the Project, incorporates a range of noise controls through equipment selection, mine scheduling and mine design to minimise noise impacts. • The detailed noise assessment has confirmed that the Project can manage the operations to remain within relevant noise criteria at all private residences.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• Noise levels from the mine will be managed so that no exceedances of the relevant criteria occur at private residences in Camberwell. • Noise levels in Hebden from the Mount Owen Complex operations may increase as mining progresses to the north, however this will occur in the latter stages of the Project and impacts will remain well below relevant noise criteria. • No material changes to operational road traffic noise. • No increase in annual train movements or previously approved rail noise impacts. • No adverse cumulative noise impacts are predicted as a result of the Project. • Noise impacts will continue to be managed through the implementation of proactive noise management and monitoring measures that will be used to adaptively manage mining operations, as required, to minimise noise impacts.
Blasting	• Blasting activities will be managed so that relevant blast criteria are met at private residences and blast sensitive locations. • Intermittent road closures of Hebden Road will be required when blasting is within 500 metres distance of Hebden Road, with up to 15 minutes delay for road users. • Where possible, blasts will be conducted at times that avoid school related traffic and planned road closure will be notified beforehand in order to minimise disruptions on local road users.
Water Resources	Surface Water • The Project requires the realignment of the lower section of Yorks Creek, an ephemeral tributary of Bowmans Creek, of which approximately 1.5 km section has previously been diverted. • The realigned Yorks Creek will join Bowmans Creek upstream of the current alignment. • The Yorks Creek Realignment has been designed to be geomorphically stable, with appropriate aquatic and riparian habitat, and to mitigate the potential impact of erosion on downstream water quality. • The Glendell Pit Extension has been set back at least 200 metres (m) from the high bank of Bowmans Creek to minimise potential impacts. • A comprehensive water management system has been designed for the Project to manage water in accordance with legislative requirements and relevant guidelines. • The water management system for the Project builds on the existing Mount Owen Complex system and the GRAWTS and maximises water recycling and reduces external water import. • No significant flooding impacts are expected due to the Project. • No discharges of mine affected water will occur as part of the Project. • No adverse effects on downstream water quality are expected due to the Project. • The minor changes to stream flows associated with catchment changes and groundwater impacts to baseflows are unlikely to be observable relative to natural variability. Groundwater • The Project will have no significant impact on any registered groundwater bores held by private landholders. • The Project is not predicted to result in any significant groundwater impact relative to existing approved operations. • The long history of mining in the area has significantly modified the groundwater environment in the vicinity of the Project Area and the effects of historical and approved mining operations will further affect these systems over the life of the Project; these impacts are complex and vary both spatially and temporally.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• Detailed modelling of the groundwater system in the region has been undertaken to understand the impact of the Project in the context of impacts associated with historical and approved operations. • The only potential highly productive aquifer in the Project Area is Bowmans Creek alluvium; the Project's impacts on this aquifer system are not predicted to exceed the relevant minimum harm criteria defined in the Aquifer Interference Policy. • Predicted cumulative drawdown in Bowmans Creek alluvium is up to 2 m in isolated areas with much of this predicted drawdown due to existing approved and historical operations. The Project's contribution to cumulative impacts is limited to localised areas adjacent to the point of intersection of the Glendell Pit Extension with Yorks Creek and Swamp Creek alluvium. • The Project's (and cumulative) predicted impacts on the alluvial water table within Bowmans Creek are within the natural variability observed in historical monitoring • Following the cessation of mining associated with the Project, cumulative impacts on the Bowmans Creek alluvium are predicted to decline as the regional water table level recovers. <u>Water licensing</u> • The Project's modelled take from alluvial groundwater systems is predicted to be small with only a minor increase to cumulative take predicted as a result of the Project. • Adequate water entitlements can be obtained to account for licensable take from water sources as a result of the Project at the time the take occurs.
Biodiversity	• Avoidance of impacts to key biodiversity values was a key driver for the Project design and the impacts were reduced through changes to the mine plan and infrastructure design. • The Project will impact approximately 540 ha of native grassland, woodland and forest vegetation. • Three threatened ecological communities occur within the Development Footprint, one of which is listed as threatened at the Commonwealth level; *Central Hunter Valley Eucalypt Forest and Woodland.* • The Project is not expected to result in any substantial indirect impacts on the terrestrial biodiversity values of surrounding lands during the construction or operational phases of the Project. • The impacted land will be rehabilitated with the conceptual final land use returning much of it to a combination of native vegetation and open grassland communities as would have historically occurred in the area. • All impacts to native vegetation and threatened species will be fully offset such that there is no-net loss of biodiversity values. • The predicted drawdown in Bowmans Creek alluvium from the Project poses negligible additional threat to terrestrial groundwater dependent ecosystems. • The Project is not predicted to have any significant impacts on aquatic or subterranean groundwater dependent ecosystems.
Aboriginal Heritage	• A comprehensive Aboriginal Cultural Heritage Assessment was completed in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holders for the Project. • The historical associations with early settlement, conflict, dispossession and survival are important, and the nature of the area as a surviving cultural landscape is of significance to numerous members of the Wonnarua people.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• An archaeological survey identified 91 Aboriginal sites that would be impacted by the Project (36 isolated finds and 55 artefact scatters). Of these sites, the majority (77) were assessed as having low scientific significance, 9 having low-moderate scientific significance and 5 having moderate scientific significance. No sites have been assessed as having high scientific significance • Glencore has developed management and mitigation measures in consultation with the RAPs and Knowledge Holders involved in the assessment and these will be implemented in consultation with, and involving the participation of, the relevant Aboriginal community representatives.
Historic Heritage	• The Project requires the relocation of the Ravensworth Homestead Complex which, along with the associated archaeological resource, have been assessed as having State significant heritage values • The Homestead is listed as an item of local heritage significance under the Singleton Local Environmental Plan 2013 • Extensive heritage studies have been undertaken to allow for a detailed understanding of the property and building group in terms of social history, historical land use and landscape, archaeology, architecture, structural and engineering assessments, land tenure and early interactions between Aboriginal people and colonial settlers • Extensive community consultation has been undertaken regarding the Ravensworth Homestead relocation including the formation of the Ravensworth Homestead Advisory Committee, an independently chaired committee comprising members of the local community, to identify and investigate relocation options for the Homestead; interviews were also undertaken with local residents and other stakeholders expressing an interest in local heritage, anda broader community survey was conducted to understand the wider Singleton community perspective • Following a review of 11 alternate relocation options, and two relocation methods, two reasonable and feasible relocation options are proposed for the Ravensworth Homestead: o Ravensworth Farm (Option 1) - involves the intact relocation of all buildings including moving selected trees and plants to the 'Ravensworth Farm' site located within the Project Area and on the original Bowman "10,000 acre" land grant (Ravensworth Estate Lands). The building will be used by Glencore as an administration and training facility during the life of the Project and, after mining, the Homestead could return to use as a farmstead with an attached landholding. This option will place the buildings on land with a similar landscape and outlook to the current Homestead site and will maximise the retention of building fabric and heritage values including the building complex layout. o Broke Village (Option 2) – this is a proposal by members of the Broke-Fordwich community and involves the dismantling all of the Homestead buildings and relocation to Broke where the buildings would be rebuilt and have multi-purpose usage forming the village square. This outcome will provide lower preservation of heritage values, however provide greater community benefits with a higher level of public accessibility. This option will require further secondary approvals for the Broke site, and the securing of land tenure should this option be approved as part of the Project approval. • A Statement of Significance for Ravensworth Estate and the Ravensworth Homestead Complex has been prepared and a Statement of Heritage Impact undertaken that assesses the impact of the Project on Ravensworth Estate and the Ravensworth Homestead Complex including the two relocation options.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• The Statement of Heritage Impact concludes that the Project will have notable heritage impact on the Core Estate Lands and the setting of the Ravensworth Homestead Complex but that this would be mitigated by the proposal to relocate the homestead buildings and carry out comprehensive salvage archaeology. • The wider Singleton LGA community have identified Option 2 as their preferred outcome for relocation largely due to the associated community benefits including improved accessibility.
Rehabilitation and Final Landform	• The existing approach to final landform establishment and rehabilitation at the Mount Owen Complex, which includes the use of natural landform design principles and rehabilitation to native vegetation and open grassland communities will be applied to the Project • The Rehabilitation and Mine Closure Strategy aims to minimise environmental impacts throughout the life of, as well as upon completion of the Project • The Project will provide for a fully integrated rehabilitation program and final landform • The final landform will generally be designed to direct runoff away from the final voids and into the natural environment, specifically Yorks Creek, Bowmans Creek, Swamp Creek and Bettys Creek catchments • The Project does not result in any additional voids than currently approved under the existing Glendell Consent • The final void will be a long-term hydraulic sink meaning it will not discharge to the environment; pit lake water quality within the final void is predicted to be similar to that of the existing approved final void and other approved final voids in the Hunter Valley • The Mount Owen Complex, including the landform and infrastructure developed as part of the Project, provide significant opportunities for high value land uses following the cessation of mining and these will be considered as part of a detailed mine closure process.
Visual	• The Project is located within an area that has a long history of mining and electricity generation and the visual landscape of the area is heavily influenced by these activities • The Project, including active overburden emplacement activities, will be visible from sections of Hebden Road, the New England Highway and Glennies Creek Road • Visual impacts associated with views from public roads will be reduced over time through the implementation of progressive rehabilitation and the use of visual screening • The increased height of overburden emplacement areas associated with the Project may result in increased visibility at some locations, all of which currently have visual impacts associated with existing operations at Glendell Mine and operations within the Mount Owen Complex or other nearby mining operations; the impacts associated with increased emplacement height are likely to be minimal given the distance from vantage points and the minor increase in height relative to viewing distance • The use of natural landform design principles and increased variability in terrain height will reduce the flat-topped emplacement area design which was identified as being an issue for some stakeholders • Direct views of the active pit areas from outside of the Project Area are limited and will largely be obscured by the existing topography and proposed vegetation screen planting.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Traffic and Transport	• The Project will require the realignment of a section of Hebden Road; the proposed realignment will have minimal impact on travel distances (approximately 1.2 km longer) and will provide an improved standard of road over the realigned section • The new section of Hebden Road will be largely constructed 'off-line' to minimise disruption to existing road users and maintain the existing 80 km/hr standard • The construction and operation phases of the Project will have a negligible impact on road safety conditions on the New England Highway and Hebden Road due to the minor increase in traffic volumes associated with the Project • During construction, the Project is predicted to result in short term traffic increases • The assessment has confirmed that all intersections that were modelled will continue to operate at acceptable levels of service • The Project does not seek any increase to the current approved maximum annual production rate or employment levels of the Mount Owen Complex and as such, no operational traffic changes are anticipated above those that have been previously assessed and approved.
Land Use and Agriculture	• The Project Area has been utilised for agricultural purposes for over 180 years and much of the Additional Disturbance Area shows significant degradation of soil resources associated with past land uses • The majority of the Additional Disturbance Area is currently managed for low intensity grazing production with only limited cropping of alluvial flats (predominately for pasture purposes) over the past 30 years • Approximately 34 ha of the alluvial flats associated with Bowmans Creek have been verified as Biophysical Strategic Agricultural Land (BSAL) in accordance with the Interim Protocol (Verified BSAL); none of the Verified BSAL area is located within the Glendell Pit Extension • The Verified BSAL has been mapped as being either Land and Soil Capability (LSC) Class 3 or Class 4 land which represents a lower level of land capability for BSAL; there is no LSC Class 1 or 2 land (better quality) within the Additional Disturbance Area. • BSAL areas not permanently impacted by either the Hebden Road realignment or areas where landform shaping is required for final landform development and/or drainage purposes. (approximately 21 ha), is proposed be rehabilitated to at least Land and Soil Capability Class 4 • Much of the surrounding land is mine owned significantly reducing the potential for impacts on private land uses • The Project is not predicted to result in adverse impacts on surrounding private agricultural land and the mining operations are expected to continue to coexist with the surrounding agricultural land uses.
Greenhouse Gas	• The predicted greenhouse gas emissions associated with the Project have been quantified, including the scope 1, 2 and 3 emissions. The implications of the predicted emissions in the context of climate change policy have been assessed • A range of energy and greenhouse gas management initiatives will be implemented as part of the Project to improve energy efficiency and reduce the greenhouse gas emissions of the on-site mining operations.
Waste and Hazards	• The existing waste management plan will be updated to incorporate the Project. The existing plan is based on the principles of avoid, re-use and recycle, with waste disposed of in accordance with legislative requirements where necessary • The Project design has had regard to potential hazards associated with the Project.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Social	• An extensive consultation program was undertaken to identify community issues / views of the Project with a range of mechanisms including interviews with key stakeholders, information sessions, information sheets delivered across the LGA and a broader community survey of heritage aspects. • The social impacts of the Project have been minimised where possible through project design and the proposed management and enhancement approaches • The broader Singleton community has appeared generally accepting of the Project due to the predicted positive economic benefits; however, there is a trend in increasing concern around cumulative impacts of mining in the Hunter region, primarily in regard to air quality, intergenerational equity and the prolonged nature of impacts • The perceived social impacts are greatest for those living in closest proximity to the Project, or those who perceive they will be most directly impacted by the development • The social impacts directly related to the relocation of the Ravensworth Homestead have been outlined and stakeholder feedback sought on the potential relocation options being considered • A range of strategies will be implemented to seek to minimise social impacts and maximise benefits including community enhancement projects, and employment and training initiatives; these social impact mitigation measures have been specifically targeted to address the issues identified in the Social Impact Assessment and based on stakeholder feedback • The proposed approaches to manage community impacts have been developed through identification of technical and social/community risks as assessed through consultation, and analysis of complaints data and technical reports prepared by specialist consultants • A Social Impact Management Plan for the Mount Owen Complex will be developed, that defines and guides the ongoing monitoring and management of social impacts • The Project will provide ongoing employment opportunities for the existing workforce for an additional 21 years of mine life (approximately), providing significant ongoing benefits for the local and wider communities through employment, use of local services, community participation, local and regional expenditure, community investment and payment of royalties and taxes.
Economic	• The Project will provide significant ongoing economic benefits for the local and wider communities through employment, local and regional expenditure, community investment and payment of royalties and taxes • A detailed economic analysis of the Project has been undertaken which includes consideration of the Project's economic benefits and costs associated with adverse impacts • The economic assessment predicted that the Project would have substantial net benefits for the State and region under a range of sensitivity scenarios considered including reduced coal prices • The cost benefit analysis (CBA) of the Project indicates that the overall net benefits of the Project to the State would be in the order of $1.15 billion in net present value (NPV) terms • The Local Effects Analysis, which is a CBA of regional economic impacts indicates that the overall net benefits to the Lower Hunter Valley (excluding Maitland and Newcastle) would be in the order of $449 million in NPV terms • The economy wide net benefits of the Project, were estimated through computable general equilibrium (CGE) modelling; Gross State Product is projected to increase by approximately $3 billion in NPV terms as a result of the Project.

The impacts of the Project have been kept to a minimum through:

- obtaining a detailed understanding of the issues and impacts by extensive scientific evaluation and stakeholder engagement
- a comprehensive assessment of project alternatives based on consideration of maximum resource recovery efficiency developed from detailed geological exploration, engineering design and detailed analysis of potential environmental and community impacts
- active engagement with stakeholders, including the neighbouring community, to identify key concerns and issues early in the Project design process
- the mine has been designed around the mitigation of potential amenity impacts, particularly noise and air quality impacts, as these are recognised as key stakeholder concerns, and
- commitment to proactive and appropriate strategies to avoid, minimise, mitigate, offset or manage a range of potential environmental impacts (refer to **Section 7.0** and **Appendix 5**).
- The Project is predicted to deliver significant economic benefits to both the State and regional economy.

8.2 Justification for the Project

Mining operations within what is now the Mount Owen Complex have provided substantial economic benefits at Commonwealth, State, regional and local levels for over 50 years. Based on the current progression of mining, the currently approved operations at the Glendell Mine will be complete by 2023. Production in the Bayswater North Pit will cease in a similar timeframe as the Glendell Mine with the approved mining operations at the North Pit to 2037.

Exploration undertaken within existing exploration licence and mining lease areas north of the existing approved Glendell Pit has identified a substantial mineable reserve, which can be efficiently mined through the continued progression of mining in the Glendell Pit. The mining of these reserves, as part of an established mining operation, through an extension of the existing Glendell Pit, provides a significant opportunity to optimise resource recovery in a manner that utilises existing mining facilities, on mine owned land, in a locality that has a long history of current and past mining activity.

Should the Project not be approved, the closure of the Glendell Mine at the end of its planned life would result in the loss of up to approximately 300 full-time positions, plus the loss of flow-on jobs and significant economic benefits for the local and regional communities. If approved, the Project would provide for ongoing employment opportunities for the Glendell workforce and the wider region. This would also maintain the Mount Owen Complex employment levels for an extended period of time, as production in the Glendell Pit Extension increases and mining in the Bayswater North Pit and North Pit decline. The Project also provides significant ongoing economic benefits to the local area, the region and the State, with an estimated net benefit of $1.15 billion to NSW over the life of the Project in NPV terms. Further details of these economic benefits are discussed in **Section 7.17**.

The Project is a logical brownfield continuation of Glendell Mine to the immediate north of the existing operation. The Glendell Pit Extension is located on mine owned land that is surrounded on 3 sides by current and historical mining operations. The majority of the Project Area has been cleared with only a few remnant areas of trees. Almost the entirety of the vegetation within the Project's Additional Disturbance Area is regrowth that has occurred over the past 30 years, including the riparian vegetation along Swamp Creek and Yorks Creek. Past and approved mining within and surrounding the Project Area has significantly modified the regional groundwater and surface water systems and will continue to do so into the future.

There is substantial buffer distance between the Project and private residences, with the nearest residence being approximately 3.5 km from the Glendell Pit Extension.

The proposed relocation of the Ravensworth Homestead Complex will enable the efficient extraction of coal reserves and maximise the economic benefits of the Project whilst mitigating potential heritage impacts.

The same environmental management approach and controls implemented as part of the existing operations will continue to apply to the Project, which is considered leading practice. This includes integrated mine design and management to minimise dust and noise impacts, manage water, and the implementation of rehabilitation techniques. As part of the implementation of the Project, Glencore will continue to manage and respond to issues or community concerns that arise and seek to continuously improve environment and community mitigation and monitoring.

The Project involves mining that uses the same techniques and equipment as the existing operations. The mine plans have been designed to maximise resource recovery, operational efficiencies and synergies with the existing operations whilst aiming to minimise environmental and social impacts. The extraction of this resource now, while there is existing mining equipment operating at the site, an existing workforce and available mining infrastructure, is substantially more efficient than seeking to mine the resource at a future date following closure of the existing operations. It is highly likely that the economic benefits of mining this substantial resource may never be realised if it is not mined as part of continued operations at the Glendell Mine.

Glencore is committed to transitioning to a low-carbon economy. To assist in meeting the growing needs of a lower carbon economy, globally the company aims to prioritise its capital investment to grow production of commodities essential to the energy and mobility transition and to limit its coal production capacity broadly to current levels. This commitment was made publicly in 2019. The Project will extend the life of the existing operation, maintaining existing production levels at the Mount Owen Complex for approximately another twenty years. In this regard the Project fits within Glencore's commitment of a production cap, as it is focused on sustaining current coal production in order to increase the life of the existing Glendell Mine and is not proposing an increase in production or output from the overall Mount Owen Complex. This continued production from the Mount Owen Complex meets Glencore's existing market demand for coal.

8.2.1 Suitability of the site

The Project is located in an area of past and active coal mining and includes a number of existing mining operations, both within the Mount Owen Complex and immediate surrounds. Glendell, Mount Owen and Ravensworth East mines are well established mining operations in the Upper Hunter Valley, which is the largest coal-producing region in NSW. The Additional Disturbance Area associated with the Project has a long (>180 years) history of agricultural development and the majority of the proposed mining area is significantly degraded as a result of this historical land use with much of the area extensively impacted by erosion and much of the A - horizon missing from areas away from the better quality alluvial flats. Only small areas of remnant vegetation remain within the Project with much of the current woodland vegetation being regrowth that has occurred within the past 30 years.

The long history of mining in the region has significantly modified the groundwater systems and will continue to do so for some time. Existing surface water catchments have also been significantly affected through mining operations, including the historical diversion of Yorks Creek and Swamp Creek.

Existing land uses and land use planning typically present a major constraint to coal mine development in the Hunter Valley. The development of a coal mine and associated infrastructure is limited, by its nature, to the location of the coal resource. The Project is located within one of the most active mining precincts in. the Upper Hunter Valley and the Project seeks to maximise resource recovery from an area that is surrounded by mining operations and has been significantly degraded by past land-uses, limiting the potential for conflicts with other land uses.

Key Project objectives include, maximising the use of previously disturbed areas and existing mining infrastructure, and further development of existing environmental mitigation and management strategies to mitigate and manage the predicted impacts associated with the Project, thereby limiting potential for conflicts with other land uses.

The location of the resource along the Camberwell anticline limits the Projects impacts on the adjacent Bowmans Creek alluvial aquifer and the assessment of groundwater impacts indicates the Project will have only a minor additional impact on groundwater systems relative to approved operations. The Project is not predicted to have a significant impact on surface water systems, largely due to implementation of effective water management principles and the timing of the project having regard to the staging of other Projects in the Bowmans Creek catchment. The integration of the Mount Owen Complex with the GRAWTS enables the sharing of water between Glencore operations, thus reducing the need to obtain licensed water entitlements and reducing discharges. The GRAWTS also enable the disposal of tailings to be effectively managed from a rehabilitation perspective in that it enables consolidation and rehabilitation of tailings facilities in a timely manner and the complete filling of voids.

Glencore has actively and comprehensively engaged with stakeholders including the local community, to seek to understand the key concerns and issues associated with the Project and to assist with managing these issues through appropriate Project design.

Extensive management and mitigation measures have been incorporated into the Project to minimise impacts, including land use impacts and conflicts. As described in **Section 7.9**, the approach to rehabilitation and the extensive revegetation and conservation program proposed is consistent with the Singleton Council strategic land use objectives for the area and the conceptual final land use plan enhances local and regional biodiversity corridors through linkages with remnant vegetation, offset areas and rehabilitation commitments at other mining operations. Additionally, the conceptual final land use has been prepared with consideration of strategic long-term land use planning options within the greater Ravensworth area with parts of the Mount Owen Complex, including the Glendell Mine and associated infrastructure and final void, having significant potential for high value land uses in the future.

As discussed in **Section 7.12**, the existing land classes within the Additional Disturbance Area are predominately of classes that provide limited opportunity for agricultural uses. It is considered that the use of this land for coal mining purposes provides by far the highest economic returns from the land relative to any other identified permissible uses of the land.

8.3 Ecologically sustainable development

An objective of the EP&A Act is to encourage ecologically sustainable development (ESD) within NSW. This section provides an assessment of the Project in relation to the principles of ESD.

To justify the Project with regard to the principles of ESD, the benefits of the Project in an environmental and socio-economic context should outweigh any negative impacts. The principles of ESD encompass the following:

- the precautionary principle

- inter-generational equity
- conservation of biological diversity, and
- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality than the one that is inherited.

8.3.1 The Precautionary Principle

The EP&A Regulation defines the precautionary principle as:

> 'if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
>
> (ii) an assessment of the risk-weighted consequences of various options.

In order to achieve a level of scientific certainty in relation to the potential impacts associated with the Project, this EIS has undertaken an extensive evaluation of all the key components of the Project. Detailed assessment of all key issues and necessary management procedures has been conducted and is comprehensively documented in this EIS.

The assessment process has involved a detailed study of the existing environment (refer to **Sections 4.0** and **7.0**), and the use of engineering and scientific modelling to assess and determine potential impacts as a result of the Project. These models have been calibrated using data gathered from the existing mining operation (e.g. noise, air, water and blast monitoring data) to ensure the models are robust and appropriately characterise the Project, allowing the impacts to be predicted and evaluated. To this end, there has been careful evaluation to avoid, where possible, irreversible damage to the environment.

The decision making process for the design, impact assessment and development of management processes has been transparent in the following respects:

1. Government authorities, landholders potentially affected by the Project, the local community, the Aboriginal community and other stakeholders were extensively consulted during EIS preparation (refer to **Section 6.0**). This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures.
2. The community has been comprehensively engaged throughout the development and assessment of the Project through a range of mechanisms including face to face meetings, presentations, open days and community newsletters to inform Project design and proposed management of key issues (refer to **Section 6.0**), which provided stakeholders with both information and the opportunity to influence Project outcomes.
3. Glencore will update and implement the existing comprehensive EMS. Through implementation of the EMS and related environmental management programs, which seek to implement best practice management. The Project will incorporate the practices implemented and demonstrated to be effective (and in many cases considered to be leading practice) and the existing management plans will be revised to incorporate the additional controls outlined in this EIS.

4. The EIS has been undertaken on the basis of the best available scientific information about the Project Area and has been informed by site specific survey, monitoring, modelling and environmental and social assessment. Where uncertainty in the data used for the assessment has been identified, a conservative worst-case analysis has been undertaken and/or sensitivity analysis undertaken to assess a range of potential impact scenarios. Contingency measures have also been identified to manage areas of identified uncertainty. Extensive management and mitigation measures will be implemented, including monitoring programs to measure predicted against actual impacts of the Project (refer to **Appendix 5**), so that contingency measures, if required, can be implemented in a timely and pro-active manner. As noted earlier the existing operations and the management practices implemented provide a high degree of confidence in both impact predictions and the need for and the likely success of proposed management and mitigation measures.
5. An auditing and review process will be an integral component of the ongoing management strategy for Glendell Mine providing for verification of project performance by independent auditors and relevant government agencies. The Project will implement an auditing and verification process consistent with that currently undertaken at the Mount Owen Complex by independent auditors.

The relocation of the Ravensworth Homestead Complex from its current location is considered the most significant impact associated with the Project due to the significant identified heritage values associated with the Homestead and Estate generally. The two relocation options identified have different benefits in terms of heritage outcomes and social benefits with the Ravensworth Farm option assessed as having overall lower impacts on heritage values than the Broke Village Option, however the Broke Village option was considered by most stakeholders to have the highest social benefits. Both options include the archaeological survey of the Homestead site and the recording of heritage values and the combined effect of the heritage assessment undertaken for this EIS and the results of the archaeological salvage process will capture significant amounts of information regarding the heritage values of the Ravensworth Homestead Complex and Estate.

8.3.2 Intergenerational equity

The EP&A Regulation defines the principal of intergenerational equity as:

> 'that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.'

Intergenerational equity refers to equality between generations. It requires that the needs and requirements of today's generations do not compromise the needs and requirements of future generations in terms of health, biodiversity and productivity.

The objectives of the Project are included in **Section 1.3.1** and with regard to intergenerational equity they include:

- avoiding the sterilisation of accessible reserves within relevant mining tenements
- optimising the use of existing infrastructure and equipment and reducing the environmental impacts associated with constructing new infrastructure
- extending the economic life of the Glendell Mine and Mount Owen Complex infrastructure and providing ongoing employment opportunities
- minimising overburden re-handle through progressive emplacement of overburden in-pit to the south as operations progress northwards reducing associated emissions from the Project
- effectively co-existing with the local community, including Hebden, Camberwell and Middle Falbrook

- minimising disturbance of established mine site rehabilitation that is consistent with surrounding vegetation communities
- minimising impacts on Bowmans Creek and associated alluvium
- relocating the Ravensworth Homestead Complex of historical buildings to a new site and recording the heritage values of the area so that these buildings and their history can be appreciated by future generations
- establishing a final landform that is safe, stable, non-polluting and sympathetic with surrounding landforms and which provides for a range of sustainable post mining land use options.

The Project is not predicted to increase noise and air quality impacts relative to that already experienced in the area and both noise and air quality impacts are predicted to decline at residential areas to the south and east as mining operations progress away from these areas. Project specific impacts in the Hebden area will increase but remain within relevant noise and air quality criteria and cumulative impacts in this area will decline as mining operations at Liddell cease and AGL's Liddell Power station ceases operations.

Greenhouse gas emissions associated with coal combustion, and the established links to climate change, are likely to generate environmental impacts across generations. The Project's predicted impacts associated with greenhouse gas emissions are further discussed in **Section 7.13**. Climate change models forecast many different climate change impacts, which are influenced by future greenhouse gas emission scenarios. Climate change forecasts also vary significantly from region to region. The Project, in isolation, is unlikely to materially influence global emission trajectories with future emission trajectories largely influenced by global scale issues such as technology, population growth and GHG mitigation policy. Irrespective of future policy options, high calorific value/ low ash coal, such as that produced by the Project, is predicted to remain in high demand and will form part of any transition away from coal towards other, lower greenhouse gas intensive energy sources.

A range of environmental management and mitigation measures (discussed in **Section 7.0** and summarised in **Appendix 5**) have been developed and evaluated to minimise the impact on the environment as far as practicable. The design of the Project and commitment to the management of environmental issues as outlined in this EIS will maintain the health, diversity and productivity of the environment for future generations. The Project will also make a significant contribution to maintaining services in the community through the direct and flow on effects of workforce and operational expenditure and through development contributions in accordance with the EP&A Act.

Both relocation options for the Ravensworth Homestead maintain significant elements of the Homestead buildings and the recording of heritage values through the combined effect of the heritage assessment undertaken for this EIS and the results of the archaeological recording and salvage process will capture significant amount of information regarding the heritage values of the Ravensworth Homestead and Estate which will be available for future generations.

The Project will generate significant economic benefits for both the State and local region which is expected to contribute to the wealth of both current and future generations.

8.3.3 Conservation and biological diversity

The EP&A Regulation identifies that the principle of conservation of biological diversity and ecological integrity should be a fundamental consideration in the decision making process. The conservation of biological diversity refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the Project are described in this EIS (refer in particular to **Section 7.6** and

Appendix 20). Potential impacts are also outlined in this EIS (refer to **Section 7.6**) and measures to ameliorate any negative impact are outlined in **Appendix 5**.

NSW Government policy requires the biodiversity impacts of a project to be quantified and offset on a no net loss basis. The impacts of the Project have been quantified and the biodiversity offset strategy will be developed having regard to the NSW and Commonwealth offsetting objectives.

Glencore has a strong track record in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them. Glencore is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. The final composition of the offset strategy will evolve as the Project progresses.

8.3.4 Valuation and pricing of resources

The goal of improved valuation of natural capital has been included in Agenda 21 of Australia's Intergovernmental Agreement on the Environment. The principle has been defined in the EP&A Regulation as:

> 'that environmental factors should be included in the valuation of assets and services, such as:
>
> (i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,
>
> (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,
>
> (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems'

With regard to the polluter pays principle, all surface water associated with mining operations is managed within the GRAWTS, and there is no discharge from the Mount Owen Complex (refer to **Section 7.5**). Pricing of resources is also captured in the regulatory regime applying to the licensing of surface and groundwater take.

Project considerations have included the costs of management measures to minimise potential environmental and social impacts. There will also be additional costs associated with establishing and managing ecological offsets to reduce the magnitude of ecological impacts. In many cases, operational efficiencies are also associated with improved environmental outcomes. For example, efficient haul routes reduce total noise and dust emissions and diesel use (with associated greenhouse gas and particulate emission reductions).

The Project also optimises the valuation and pricing of the coal resources with minimal impact by:

- optimising available use of the existing coal processing and transportation facilities to wash coal and to transport product coal to existing markets; and
- maximising the efficient extraction of the coal resource and avoiding the isolation and sterilisation of coal through effective mine planning and location of site infrastructure.

- The Economic Assessment of the Project (refer to **Appendix 30**) has assumed externality costs for climate change and biodiversity impacts having regard to price signals established through domestic markets.

8.4 Conclusion

As outlined in **Section 8.4,** the Project has been assessed against the principles of ecologically sustainable development as required by the EP&A Act. This assessment has indicated that the Project is consistent with the principles of ecologically sustainable development.

The Economic Assessment (refer to **Appendix 30**) describes a range of positive benefits at a local, regional and State level that will result from the Project. These benefits include:

- ongoing employment opportunities for the existing Mount Owen Complex workforce
- an ongoing contribution to the local, regional and State economies from a well-established mining operation
- a net benefit on the Lower Hunter SA3 region of $446.7 M in NPV terms
- a net benefit of approximately $1.15 billion to NSW over the life of the Project in NPV terms
- a royalty revenue stream flowing to the NSW Government estimated to be $710M over the life of the Project ($296.1 M in NPV terms)
- significant export earnings for Australia.

The revenue, expenditure and employment associated with the construction and operation of the Project will stimulate economic activity in the regional economy, as well as the broader NSW economy. Over the life of the Project, the Hunter Region's Gross Regional Product is projected to increase by $2.52 billion in NPV terms. NSW's Gross State Product (including the Hunter) increases by around $3 billion (NPV terms).

The cost benefit analysis undertaken for the Project assessed the net benefit of the Project when all external and internal costs were considered, including environmental and social externality costs. As noted above, the economic benefits to the local region and the State are significant.

With the implementation of the management, mitigation and offset measures proposed by Glencore, it is considered that the Project would result in a net benefit to the NSW community.

SECTION 9.0

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SECTION 10.0

Glossary and Abbreviations

10.0 Glossary and Abbreviations

Abbreviations

Term	Definition
AAIA	Aboriginal Archaeology Impact Assessment
ABL	Assessment background level
ABS	Australian Bureau of Statistics
ACHA	Aboriginal Cultural Heritage Assessment
ACHAR	Aboriginal Cultural Heritage Assessment Report
ACHM	Australian Cultural Heritage Management
ACHMP	Aboriginal Cultural Heritage Management Plan
AEP	Annual Exceedance Probability
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHIMS	Aboriginal Heritage Information Management System
AIP	NSW Aquifer Interference Policy
Approved Glendell Disturbance Area	Areas approved for disturbance under the Glendell Consent (including areas identified for disturbance under the Glendell Modification 4 application
ANZECC	Australian and New Zealand Environment Conservation Council
AQGHGMP	Air Quality and Greenhouse Gas Management Plan
AQIA	Air Quality Impact Assessment
ARD	Acid rock drainage
ARTC	Australian Rail Track Corporation
ATSIHP Act	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
AUR	Auxiliary Right Hand
BAM	Biodiversity Assessment Methodology
BAR	Basic Right Hand Turn
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	*Biodiversity Conservation Regulation 2017*
BCM	Bank Cubic Meters (volume of rock material in situ)
BCD	Biodiversity and Conservation Division within DPIE
BDAR	Biodiversity Development Assessment Report
BIA	Blast Impact Assessment
Blue Book	Managing Urban Stormwater: Soils and Construction Series
BMP	Blast Management Plan
BNP	Bayswater North Pit
BOM	Bureau of Meteorology
BOMP	Biodiversity and Offset Management Plan

Term	Definition
BP	Years Before Present
BSAL	Biophysical Strategic Agricultural Land
BVT	Biometric vegetation types
C&L	Casey & Lowe Pty Ltd (T/A Casey & Lower Archaeological & Heritage)
CBA	Cost Benefit Analysis
CCC	Community Consultative Committee
CEEC	Critically Endangered Ecological Community
CGE	Computable General Equilibrium
CHPP	Coal Handling and Preparation Plant
CHR	Channelised Right Hand
CHR(s)	Chanellised Right Turn (short)
CIC	Critical Industry Clusters
CLM Act	*Crown Lands Management Act 2016*
CLWD	Crown Lands and Water Division
CPDP	Conceptual Project Development Plan
CTMP	Construction Traffic Management Plan
CSG	coal seam gas
dB(A), dBA	Decibels A-weighted.
dB(C), dBC	Decibels C-weighted.
dB(L)	Decibels Linear
DCP	Development Control Plan
DEC	Department of Environment and Conservation
Development Footprint	The total impact zone assessed by the BDAR in accordance with the BAM
DoE	Department of Environment
DoEE	Commonwealth Department of Environment and Energy
DOS	Degree of Saturation
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment
DPI	Department of Primary Industries
DNG	Derived Native Grassland
DRG	Department of Planning, Industry and Investment – Division of Resources and Geoscience
DSC	NSW Dams Safety Committee
DST	Daylight Savings Time
EA	Environmental Assessment
EC	Electrical Conductivity

Term	Definition
EEC	Endangered Ecological Community
EHC Act	*Environmentally Hazardous Chemicals Act 1985*
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENM	Environmental Noise Model
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESC	Enviro Strata Consulting Pty Ltd
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically sustainable development
EST	Eastern Standard Time
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994*
FTE	Full time equivalent
GCAA	Glencore Coal Assets Australia
GDE	Groundwater Dependent Ecosystem
GHD	GHD Pty Ltd
GHG	Greenhouse Gas
GHGEA	Greenhouse Gas and Energy Assessment
Glencore	The proponents collectively
Glendell Consent	Glendell development consent DA 80/952
Glendell Continued Operations Consent	Proposed development consent to cover the mining of the Glendell Pit Extension – refer to **Section 3.1** of the EIS (SSD9349)
Glendell Continued Operations Disturbance Area	Areas to be disturbed by the Project that are to be managed under the Glendell Continued Operations Consent (refer to Section 3.2.2)
Glendell Modification 4	Section 4.55 application to modify the Glendell Consent for a minor extension of the approved mining area
GPS	Global Positioning System
GRAWTS	Greater Ravensworth Area Water and Tailings Scheme
GRP	Gross Regional Product
GSP	Gross State Product
GWIA	Groundwater Impact Assessment
ha	hectare

Term	Definition
HASS	Heritage Analysis (refer to **Section 7.8.4**) and Statement of Significance (HASS) (refer **to Section 7.8.5**
Heritage Act	*Heritage Act 1977*
HRSTS	Hunter River Salinity Trading Scheme
HVO	Hunter Valley Operations
HVCC	Hunter Valley Coal Corporation Pty Limited (former operator of Mount Owen Mine)
IAP2	International Association of Public Participation
IESC	Independent Expert Scientific Committee
INP	Industrial Noise Policy
Interim Protocol	Interim Protocol for Site Verification and Mapping of Biophysical Strategic Land (NSW Government, 2013)
IPC	Independent Planning Commission
km	kilometre
ktpa	Thousand tonnes per annum
kV	Kilovolt (thousand volt)
lcm	Loose cubic meter (volume of extracted/crushed rock material)
LEA	Local effects analysis
LEP	Local Environment Plan
LGA	Local Government Area
LiDAR	Light Detection and Ranging
LLS	Local Land Services
LLS Act	*Local Land Services Act 2013*
LOM	Life of Mine
LOS	Level of Service
LSC	Land and Soil Capability
LSJ	Lucas Stapleton Johnson & Partners Pty Ltd
LULUCF	Land use, land use change and forestry
m	metre
mg/L	Milligram per litre
mAHD	Metres above Australian Height Datum
Mbcm	Million bank cubic metres
MIA	Mine Infrastructure Area
MIC	Maximum Instantaneous Charge
Mining Act	Mining Act 1992
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
ML	Megalitre (when used in relation to volume of water)

Term	Definition
MLA	Mining Lease Application
Mlcm	Million loose cubic metres
Mtpa	Million tonnes per annum
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan (also referred to as Rehabilitation Management Plan)
Mount Owen	Mt Owen Pty Limited
Mount Owen Additional Operational Area	Additional disturbance areas associated with the Project to be managed under the modified Mount Owen Consent.
Mount Owen Complex	The combined operations of the Mount Owen Mine, Ravensworth East Mine and Glendell Mine
Mount Owen Consent	Mount Owen Continued Operations Project development consent SSD-5850
Mount Owen Operational Area	Areas approved for disturbance/rehabilitation under the Mount Owen Consent (refer to Section 3.3.9)
MSB	NSW Mine Subsidence Board (now Subsidence Advisory NSW)
CMSC Act	*Coal Mine Subsidence Compensation Act 2017*
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAF	Non-acid-forming
Narama Pipeline Modification	Section 4.55 EP&A Act application to modify the Mount Owen Consent to permit the construction and operation of an augmented GRAWTS water linkage between the Mount Owen Complex and Ravensworth Operations
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NERDDC	National Energy Research Development & Demonstration Council
NGER	National Greenhouse and Energy Reporting
NHMRC	National Health and Medical Research Council
NIA	Noise Impact Assessment
NMP	Noise Management Plan
NOx	Nitrogen Oxide
NPfI	Noise Policy for Industry
NPV	Net Present Value
NPW Act	*National Parks and Wildlife Act 1974*
NPW Regulation	*National Parks and Wildlife Regulation 2009*
NSW	New South Wales
OEH	Office of Environment and Heritage (now BCD)
OzArk	OzArk Environmental and Heritage Management
PAF	Potentially acid-forming
PAC	Planning and Assessment Commission (now IPC)

Term	Definition
PCT	Plant Community Type
PCWP	Plains Clan of the Wonnarua People
PA	Planning Agreement
PM_{10}	Particulate Matter less than 10 µm in diameter
$PM_{2.5}$	Particulate matter less than 2.5 µm in diameter
POEO Act	*Protection of the Environment Operations Act 1997*
PSNL	Project Specific Noise Levels
RAP	Registered Aboriginal Party
Ravensworth Homestead Complex/ Homestead Complex	Refers to the c1832 complex of buildings including the main house with attached kitchen wing, the stables, the barn, the men's quarters, the privy, the gardens, farm yard and associated boundary. Shown as Site 1 (C&L Archaeological Test Areas 3 & 4).
RCT	Ravensworth Coal Terminal
Resources Regulator	Department of Planning, Industry and Environment – Resources Regulator
RFS	Rural Fire Service
RHAC	Ravensworth Homestead Advisory Group
RMP	Rehabilitation Management Plan
RMS	Roads and Maritime Services
Roads Act	Roads Act 1993
ROM	Run of mine
RRPMs	Retroreflective Raised Pavement Markers
SEARs	Secretary's Environmental Assessment Requirements
SEE	Statement of Environmental Effects
SEOC	South East Open Cut
SEPP	State Environmental Planning Policy
SEPP 44	State Environmental Planning Policy No. 44 – Koala Habitat Protection
SEPP 55	State Environmental Planning Policy No. 55 – Remediation of Land
SIA	Social Impact Assessment
SIA Guideline	Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DPE, 2017)
SILO	SILO is a database of historical climate records for Australia
Singleton LEP	*Singleton Local Environmental Plan 2013*
SRLUP	Strategic Regional Land Use Plan
SS	State Suburb
SSD	State significant development
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SVC	Site Verification Certificate
SWIA	Surface Water Impact Assessment
SWL	Sound Power Levels

Term	Definition
Synoptic Plan	Synoptic Plan Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW (Andrews, 1999)
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TfNSW	Transport for NSW
TP2	See WRD
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSPD	Threatened Species Profile Database
TSS	Total Suspended Solids
TSR	Travelling Stock Reserve
TTIA	Traffic and Transport Impact Assessment
µg	microgram
µm	micrometre
UHSA	Upper Hunter Strategic Assessment
UNFCCC	United Nations Framework Convention on Climate Change
Verification Area	Parts of the Glendell Continued Operations Disturbance Area where new mining leases are required to carry out aspects of the Project.
VCA	Voluntary Conservation Area
VIS	Vegetation Information System
VLAMP	Voluntary Land Acquisition and Mitigation Policy 2018 (NSW Government, 2018)
VPA	Voluntary Planning Agreement
VWP	Vibrating wire piezometer
WAL	Water Access Licence
WLALC	Wanaruah Local Aboriginal Land Council
WM Act	*Water Management Act 2000*
WMS	Water Management System
WNAC	Wonnarua Nation Aboriginal Corporation
WOOP	Western out-of-pit
WRD	Western Rail Dam (formerly referred to as TP2)
WSP	Water Sharing Plan

Glossary

Glossary	Description
Acid Rock Drainage	Drainage of acidic water from rock material
Additional Disturbance Area	Area to be disturbed by Project outside of current Mount Owen Operational Area and Approved Glendell Disturbance Area
Alluvium	Sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.
Amenity	An agreeable feature, facility or service which makes for a comfortable and pleasant life
Amenity Noise Level	Recommended noise levels scaled to reflect the perceived differential expectations and ambient noise environments of rural, suburban and urban communities for sensitive receivers.
Assessment Background Level (ABL)	The single-figure background level representing each assessment period: day, evening and night (that is, 3 assessment background levels are determined for each 24-hour period of the monitoring period). Its determination is by the methods described in Fact Sheet B.
Aquifer	A water-bearing rock/sediment formation
Archaeological	Pertaining to the study of culture and description of its remains
Attenuation	The reduction in magnitude of some variable in a transmission system, for example, the reduction of noise with distance as it travels through air
Catchment Area	The area from which a river or stream receives its water
Coal Resources	All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points
Coarse Reject	Lumps of carbonaceous shale up to 200 mm in size separated in the coal preparation process
Conservation	The management of natural resources in a way that will preserve them for the benefit of both present and future generations
Day	The period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
Decibel (dB)	The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud.
Ecology	The science dealing with the relationships between organisms and their environment
Ecosystem	Organisms of a community together with its non-living components through which energy and matter flow
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at an offset site.
Electrical Conductivity	The measure of electrical conduction through water or a soil-water suspension generally measured in millisiemens per centimetre or microsiemens per centimetre. An approximate measure of soil or water salinity
Environmental Planning and Assessment Act 1979	NSW Government Act to provide for the orderly development of land in NSW

Glossary	Description
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance
Evening	Refers to the period from 6.00 pm to 10.00 pm.
Fault	A fracture or fracture zone along which there has been displacement of the sides relative to one another. Displacement can be vertical and/or horizontal
Fauna	All vertebrate animal life of a given time and place
Final void	Open cut mining involves the displacement of material to access a mineral resource, which often results in the formation of large pits or 'voids' where that material has been removed. Where a void (non-free draining area) is left after mining, it is typically referred to as a 'final void'.
Final void catchment	All areas where surface water runoff will report to a final void. This can include areas above natural ground level.
Floodplain	Large flat area of land adjacent to a stream which has been deposited during previous stream flow events and is inundated during times of high flow
Flora	All vascular plant life of a given time and place
Geology	Science relating to the earth, the rocks of which it is composed and the changes it undergoes
Groundwater	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table
Habitat	The environment in which a plant or animal lives; often described in terms of geography and climate
Indigenous	Native to, or originating in, a particular region or country
In situ	In its original place
kL (Kilo litre)	One thousand litres
kV (Kilo Volt)	One thousand volts
LA1 Noise Level	The noise level exceeded for 1% of the time. It is used in assessment of sleep disturbance
LA90 Noise Level	The noise level, measured in dB(A), exceeded for 90% of the time, which is approximately the average of the minimum noise levels. The L90 level is often referred to as the ‘background’ noise level and is commonly used to determine noise criteria for assessment purposes
LAeq Noise Level	The equivalent continuous noise level, measured in dB(A), during a measurement period
LAMax Noise Level	The maximum noise energy, measured in dB(A), during a measurement period
Land Capability	The ability of a parcel of land to be used in a sustainable manner (that is without permanent damage) for a given land use
Landform	Sections of the earth’s surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc.)
Mean	The average value of a particular set of numbers
Megalitre (ML)	One million litres
Meteorology	Science dealing with atmospheric phenomena and weather
Mitigate	To lessen in force, intensity or harshness. To moderate in severity

Glossary	Description
Native	Belonging to the natural flora or fauna in a region
Night	The period between 10.00 am and 7.00 pm
Outcrop	Bedrock exposed at the ground surface
Overburden emplacement	An area for placing overburden or waste rock, removed from above and between the coal seams
Particulates	Fine solid particles which remain individually dispersed in gases
pH	Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity
Piezometer	A small diameter bore lined with a slotted tube used for determining the standing water level of groundwater
Protection of the Environment Operations Act 1997	NSW legislation administered by the EPA that regulates discharges to land, air and water
Project Noise Trigger Levels (PNTL)	Target noise levels for a particular noise-generating facility. They are based on the most stringent of the project intrusiveness noise level or the project amenity noise level.
Project Intrusive Noise Levels	Refers to noise that intrudes above the background level by more than 5 decibels.
Radial Analysis	Radial analyses are developed using 3D topographic information and electronic data files relating to the proposed Project to identify what can theoretically be seen from particular vantage points. The radial analysis illustrates what is visible from a height of 1.7 m at that location (i.e. from average eye height)
Rating Background Noise level (RBL)	The overall single figure background level representing each assessment period over the whole monitoring period determined by taking the median of the ABLs found for each assessment period.
Rehabilitation	The process of restoring to a condition of usefulness. In regard to mining, relates to restoration of land from a degraded or mined condition to a stable and vegetated landform
Revegetation	The process of re-establishing vegetation cover
Run-of-mine (ROM)	Bulk material extracted from a mine, before it is processed in any way
Salinity	A measure of the concentration of dissolved solids in water
Scope 1 emissions	Direct emissions that occur from sources that are owned or controlled by the Project (e.g. fuel use, fugitive emissions). Scope 1 emissions are emissions over which the Project has a high level of control.
Scope 2 emissions	Emissions from the generation of purchased electricity consumed by the Project.
Scope 3 emissions	Indirect emissions that are a consequence of the activities of the Project, but occur at sources owned or controlled by other entities (e.g. outsourced services). Scope 3 emissions can include emissions generated upstream of the Project by providers of energy, materials and transport. Scope 3 emissions can also include emissions generated downstream of the Project by transport providers and product use.
Seam	An identifiable discrete coal unit
Sediment dam	A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge

Glossary	Description
Sidra 8.0	Traffic and Transport Modelling Software
Site Specific	Relating to conditions existing at a particular location
Socio-economic	Combination of social and economic factors
Sound Power Level	The total sound energy radiated per unit time measured as 10 times a logarithmic scale, the reference power being 12 picowatts
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Spontaneous combustion	Spontaneous ignition of some or all of a combustible material
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
Stratigraphy	The order and relative position of strata and their relationship to the geological timescale
Subsidence	The vertical movement of a point on the surface of the ground as it settles above a coal panel extracted by underground mining
Surface infrastructure	Any manmade object, facility or structure on the surface of the land
Tailings	Fine residual waste material separated in the coal preparation process
Temperature inversion	An atmospheric condition in which temperature increases with height above the ground.
Topography	Description of all the physical features of an area of land and their relative positions, either in words or by way of a map
Total Dissolved Solids (TDS)	A measure of salinity expressed in milligrams per litre (mg/L)
Total Suspended Particulates (TSP)	A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre ($\mu g/m^3$) for air
Verified BSAL	Areas assessed as being BSAL in Glendell Continued Operation Project Biophysical Strategic Agricultural Land Verification Statement, April 2019)
Woodland	Land covered by trees that do not form a closed canopy

GLENDELL
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