GLENCORE

Mount Owen Continued Operations Project

MODIFICATION 2

STATEMENT OF ENVIRONMENTAL EFFECTS

July 2018

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MT OWEN COMPLEX
GLENCORE

MOUNT OWEN CONTINUED OPERATIONS PROJECT

Modification 2
Statement of Environmental Effects

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mt Owen Pty Limited

Project Director: Barbara Crossley
Project Manager: Penelope Williams
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Newcastle

75 York Street
Teralba NSW 2284

Ph. 02 4950 5322

www.umwelt.com.au

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Document Status

Rev No.	**Reviewer**		**Approved for Issue**	
	Name	**Date**	**Name**	**Date**
FINAL	B Crossley	05/07/2018	B Crossley	25/07/2018

Executive Summary

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton and 24 km south-east of Muswellbrook and consists of the Mount Owen Mine (North Pit) and associated infrastructure, Ravensworth East (including the Bayswater North Pit) and Glendell (Barrett Pit). Mt Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), received development consent (SSD-5850) from the Planning Assessment Commission (PAC) for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016. The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant (CHPP) (DA 14-1-2004) and Ravensworth East (DA 52-03-99) and allows for continued and expanded mining until 2031. Implementation of this development consent has commenced with the operations at Mount Owen and Ravensworth East Mines now referred to as the 'Approved Operations'. Glendell Mine continues to operate under a separate consent (DA 80/952) and does not form part of the Continued Operations Project under SSD-5850.

In late 2015, Glencore obtained mining tenements associated with its acquisition of the Integra Underground Mine. Prior to this acquisition, non-Glencore ownership of these tenements restricted the approved North Pit mine plan that formed part of the Continued Operations Project development consent. Mount Owen now proposes to modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access coal reserves from the mining tenements obtained by Glencore through its acquisition of the Integra Underground Mine (the Proposed Modification).

The Proposed Modification will enable access to an additional approximately 35 million tonnes (Mt) of run-of-mine (ROM) coal from the North Pit, mining down to the Hebden Seam. Recovery of the additional coal reserves will result in approximately 46 hectares (ha) of additional surface disturbance (Proposed Disturbance Area), representing an increase of approximately 1.8 per cent (%) to the total disturbance area currently approved under SSD-5850. This change to the North Pit mine plan will allow the extension of the approved mine life through to 2037 (an additional 6 years).

The extent of the current approved North Pit mine plan was restricted in relation to access to lower seams beneath part of the approved North Pit and to the east of the current North Pit approved disturbance area. This resulted in the approved North Pit mine plan pit floor 'stepping up' to mine above the Integra mining tenements as mining progressed southwards and also 'stepping in' along the eastern boundary. The removal of this constraint now allows for the revision of the North Pit mine plan to enable reconfiguration of the progression of mining and to extract the available reserves from within the Proposed Disturbance Area and across the North Pit floor.

No changes are proposed to current approved mining methods, extraction limits, processing rates, transportation methods, the Mount Owen CHPP, operational hours or workforce numbers. The Proposed Modification will utilise existing and approved infrastructure with the exception of some proposed and modified water management works.

This Statement of Environmental Effects (SEE) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to support an application to modify SSD-5850 pursuant to Section 4.55(2) of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Proposed Modification was also referred to the Commonwealth Department of Environment and Energy (DoEE) and was determined not to be a controlled action under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Key Design Considerations

A range of mining options has been considered through the concept design phase to seek an appropriate balance between accessing economic coal reserves whilst avoiding and minimising potential environmental and social impacts. In particular, the design of the Proposed Modification sought to:

- maximise reserve recovery within Glencore mining tenements while minimising the overall Proposed Disturbance Area as far as practicable
- avoid disturbance of the existing Ravensworth State Forest and existing Biodiversity Offset Areas
- minimise impacts to Main Creek and associated alluvium
- minimise impacts to the north-south habitat corridor located to the south-east of the North Pit
- establish a final landform that is safe, stable and non-polluting, providing for sustainable post mining land use options whilst minimising impacts consistent with the key commitments of the approved Continued Operations Project final landform as it relates to landform design, conservation and water management

Key benefits of the Proposed Modification include:

- continuation of the North Pit life to 2037
- improving the economic life of the Mount Owen Mine and providing for the ongoing employment of the existing workforce of up to 660 people, and
- maintaining and, where relevant, building on the existing environmental mitigation and management strategies to minimise impacts associated with the Proposed Modification.

Through the implementation of this Proposed Modification, Mount Owen can contribute additional economic benefits at local, regional and State levels.

Broad Overview of Environmental, Social and Economic Outcomes

This SEE includes a detailed assessment of the potential environmental, social and economic outcomes of the Proposed Modification and identifies the management, mitigation and offset measures that will be implemented as part of the Proposed Modification. A summary of the key findings of the assessment process is provided in **Table 1**.

Table 1 Summary of the Key Environmental, Social and Economic Impact Assessment Findings

Environmental/Social Issue	Overview of Key Outcomes (after proposed Management, Mitigation, Offsets)
Air Quality	Air quality modelling results indicate the predicted area of impact in relation to private residences is consistent with the Approved Operations. There are no private residences (without existing acquisition rights) which are predicted to exceed the relevant air quality criteria. Mount Owen is committed to the ongoing development and implementation of mitigation measures to minimise dust, diesel and blast fume and to minimise prolonged impacts associated with the increased mine life.
Noise	Modelling results indicate that through the refinement of the North Pit mine plan and the implementation of operational controls during adverse weather conditions, the existing conditions relating to noise in development consent SSD-5850 can be met for the Proposed Modification. Consistent with the Approved Operations, during adverse weather conditions a hierarchy of operational controls will be implemented ranging from revising equipment locations, changing the nature of the activity, and shutting down mining machinery to maintain compliance with the relevant approved noise criteria. No additional noise operational controls are required however implementation of the relevant operational controls will be more frequent and intense for the Proposed Modification and in the later stage, the production schedule has been reduced to ensure the relevant noise criteria can be met at the nearest private residences and to minimise prolonged impacts associated with the increased mine life. These management measures will continue to be guided by the real time noise monitoring network which will be extended should the Proposed Modification be approved. The approved Noise Management Plan will be revised to include amendments to the noise mitigation and monitoring commitments.
Blasting	Modelling results indicate that the potential impacts resulting from blasting activities in the North Pit can be managed effectively under the existing Blast Management Plan to ensure no exceedance of the relevant criteria.
Surface Water	The Proposed Modification will have negligible impacts on flow, water quality and water users downstream of the Mount Owen Complex, consistent with the Approved Operations. No significant change to the water balance is associated with the Proposed Modification with water continuing to be managed within the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Consistent with the Approved Operations the return of catchment to Main Creek will be maximised where practicable resulting in minimal impact on annual flow volumes in Main Creek and Glennies Creek in the long term.
Groundwater	The groundwater model utilised for the Continued Operations Project has undergone extensive refinement, further calibration, and peer review to improve its accuracy including the utilisation of additional geological data, further alluvium definition works and the incorporation of monitoring data from the regional monitoring network. The groundwater model was utilised to identify the influence of the Proposed Modification on the groundwater regime by comparing the impacts generated by the approved and proposed mine plans, in a cumulative context. While there will be a localised increase to the area affected by groundwater depressurisation associated with the modified mining operations, the overall level of drawdown is predicted to be less than that predicted for the Approved Operations, attributed to these regional model refinements. No private groundwater or surface water users are predicted to be impacted by drawdown associated with the Proposed Modification, and there will be negligible impact on groundwater quality.

Environmental/Social Issue	Overview of Key Outcomes (after proposed Management, Mitigation, Offsets)
Ecology	The Biodiversity Assessment for the Proposed Modification is subject to transitional arrangements under the *Biodiversity Conservation Act 2017*, and therefore has been undertaken in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment (FBA). The majority of the Proposed Disturbance Area comprises disturbed and low quality vegetation in the form of derived native grasslands and an olive plantation. Biodiversity credits required to offset the impacts of the Proposed Modification comprise: • 1062 ecosystem credits for three native plant community types (6 vegetation zones), and • 177 species credits for the brush-tailed phascogale. The final biodiversity offset strategy to be delivered for the Proposed Modification will meet the relevant offset requirements and may include securing a land based offset, securing credits through the open credit market or paying into the Biodiversity Conservation Fund (or a combination of these measures).
Aboriginal Archaeology	A detailed Aboriginal Cultural Heritage Assessment (ACHA) has been undertaken in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holder Groups. No new sites were found during survey works, however one known site (with high cultural value and low archaeological/aesthetic value) will be directly impacted by the Proposed Modification. One known site located within close proximity to the Proposed Disturbance Area may be indirectly impacted by associated erosion and sediment control works and will be salvaged as part of the Proposed Modification. The existing Aboriginal Cultural Heritage Management Plan (ACHMP) will be updated to include the management and mitigation measures recommended as part of the ACHA. The ACHMP will also be updated to provide for the storage of artefacts salvaged from the Mount Owen Complex at the regional artefact storage facility to be located in the Wollombi Brook Voluntary Conservation Area to be established by Bulga Coal.
Visual Amenity	Consistent with the Approved Operations, the visual impacts associated with the Proposed Modification will be mitigated through the screening effect of rehabilitation and the development of a final landform that incorporates natural design features, including micro-relief, to conform to the surrounding natural environment. This will minimise views of shaped and unshaped overburden emplacement areas and facilitate the amelioration of night time glow from the proposed operations.
Greenhouse Gas and Energy	Consistent with the Approved Operations, the Proposed Modification is considered unlikely to impact national greenhouse gas (GHG) policy objectives due to the relatively small contribution that the Approved Operations and the Proposed Modification will make to national emissions on an annual basis.
Mine Closure and Rehabilitation	The current approved rehabilitation commitments and practices will be retained as part of the Proposed Modification. The proposed changes to the North Pit mine plan result in a modified final landform design which incorporates the relevant design principles as approved for the Continued Operations Project, including the incorporation of micro-relief to achieve a natural landform design, the provision for 518 ha of conservation areas, and the return of catchment area to Main Creek in the long term.
Social Impact	The issues identified through the consultation process for the Proposed Modification were generally consistent with the issues raised and assessed through the consultation process for the Continued Operations Project. With the continued implementation of the management and mitigation measures proposed by Mount Owen as part of the Approved Operations, the Proposed Modification will result in minimal additional social impact to the local community.

Environmental/Social Issue	Overview of Key Outcomes (after proposed Management, Mitigation, Offsets)
Economics	The Proposed Modification is expected to generate net benefits, and is also expected to generate increased economic activity and employment within the NSW community. In total, the Proposed Modification is anticipated to: • generate net economic benefits of $52.9 million to NSW (in present value terms) • generate royalties of an estimated $59 million to the NSW Government (in present value terms) • increase the Gross Regional Product in the locality by a projected $285 million (in present value terms) • increase the Gross State Product by a projected $309 million (in present value terms) • continue employment of the Mount Owen workforce for a further 6 years.

Further details of the predicted environmental and social impacts of the Proposed Modification are provided in the main text of this SEE and associated technical reports in the appendices.

Through the implementation of the management, mitigation and offset measures proposed by Mount Owen, it is considered that the Proposed Modification will result in a significant net benefit at a local, regional and NSW level relative to the Approved Operations.

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1.0 Introduction and Overview of the Proposed Modification

The Mount Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres (km) north-west of Singleton, 24 km south-east of Muswellbrook and to the north of Camberwell (refer to **Figure 1.1**). Mt Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (Glencore), currently manages the three existing open cut operations in the Mount Owen Complex, Mount Owen (North Pit) and associated infrastructure, Ravensworth East (Bayswater North Pit (BNP)) and Glendell (Barrett Pit).

Mount Owen received development consent (SSD-5850) from the Planning Assessment Commission (PAC) for the Mount Owen Continued Operations Project (Continued Operations Project) in November 2016 (refer to **Figure 1.2**). The Continued Operations Project development consent incorporates all previously approved operations at the Mount Owen Mine and Coal Handling and Preparation Plant (CHPP) (DA 14-1-2004) and Ravensworth East (DA 52-03-99) and allows for continued and expanded mining until 2031. Implementation of this development consent has commenced with the operations at Mount Owen and Ravensworth East Mines now referred to as the 'Approved Operations'. Glendell Mine operates under a separate consent (DA 80/952), and does not form part of the Approved Operations.

In late 2015, Glencore obtained mining tenements associated with its acquisition of the Integra Underground Mine. Prior to this acquisition, non-Glencore ownership of these tenements restricted the approved North Pit mine plan that formed part of the Continued Operations Project development consent. Glencore ownership of the Mount Owen Complex and the Integra Underground Mine has provided for the allocation of appropriate mining tenements to each operation with the recently approved Integra Underground Modification 8 allowing for the extraction of additional coal reserves from Glencore mining tenements that would have otherwise become sterilised.

In 2016, Mount Owen commenced a prefeasibility study that included a drilling program to investigate the extent and quality of the resource over the acquired tenements in the vicinity of the North Pit. The drilling program confirmed the presence of mineable reserves and further mine planning was completed to modify the approved North Pit mine design to allow extraction of these reserves. The timing of the lease acquisition and the development of an optimised North Pit mine design did not allow for this area to be included in the approved Continued Operations Project.

In September 2017 Mount Owen modified SSD-5850 (Modification 1) to allow for the construction of a water pipeline from the Integra Underground Mine to the Mount Owen Complex and allow the integration of the Integra Underground Mine into the Greater Ravensworth Area Water and Tailings Scheme (GRAWTS). Mount Owen now proposes to further modify development consent SSD-5850 to allow for the optimisation of the North Pit mine plan to access coal reserves from the mining tenements obtained by Glencore through its acquisition of the Integra Underground Mine (the Proposed Modification).

The NSW Trade and Investment, Division of Resources and Energy (DRE) (now Department of Planning and Environment, Division of Resources and Geoscience (DRG)) supported the Continued Operations Project and considered the coal deposit a significant coal resource which would continue to bring economic benefits to the State and the region. In addition, consultation with DRE throughout the assessment of the Continued Operations Project included discussion regarding the existing mining leases and the objective of avoiding the sterilisation of coal beyond the tenements held by Mount Owen at that time. Mount Owen now seeks to meet this objective through a Proposed Modification to allow access to the identified coal reserves.

The Proposed Modification will enable access to an additional approximately 35 million tonnes (Mt) of run-of-mine (ROM) coal from the North Pit. Recovery of the additional coal reserves will result in approximately 46 hectares (ha) of additional surface disturbance (Proposed Disturbance Area), representing an increase of approximately 1.8 per cent (%) to the total disturbance area currently approved, and require an increased depth across the extent of the North Pit to provide for mining down to the Hebden Seam (refer to **Figure 1.3**). This change to the North Pit mine plan will allow the extension of the approved mine life through to 2037 (an additional six years).

The extent of the current approved North Pit mine plan was restricted in terms of access to lower seams beneath part of the approved North Pit and to the east of the current North Pit Approved Disturbance Area. This resulted in the approved North Pit mine plan pit floor 'stepping up' to mine above the Integra mining tenements as mining progressed southwards and also 'stepping in' along the eastern boundary. The removal of this constraint now allows for the revision of the North Pit mine plan to allow for the reconfiguration of the progression of mining and to extract the available reserves from within the Proposed Disturbance Area and across the North Pit floor.

No changes are proposed to current approved mining methods, extraction limits, processing rates, transportation methods, operational hours or workforce numbers. The Proposed Modification will utilise existing and approved infrastructure, including the approved Mount Owen CHPP, with the exception of some proposed and modified water management structures to manage water from the mining operation.

Key Design Considerations

A range of mining options has been considered through the concept design phase to seek an appropriate balance between accessing economic coal reserves whilst avoiding and minimising potential environmental and social impacts. In particular, the design of the Proposed Modification sought to:

- maximise reserve recovery within Glencore mining tenements while minimising the overall Proposed Disturbance Area as far as practicable
- avoid disturbance of the existing Ravensworth State Forest and existing Biodiversity Offset Areas
- minimise impacts to Main Creek and associated alluvium
- minimise impacts to the north-south habitat corridor located to the south-east of the North Pit
- establish a final landform that is safe, stable and non-polluting, which provides sustainable post mining land use options whilst minimising impacts consistent with the key commitments of the approved Continued Operations Project final landform as it relates to landform design, conservation and water management.

Key Benefits of the Proposed Modification include:

- continuing the North Pit life to 2037
- improving the economic life of the Mount Owen Mine and providing for the ongoing employment of the existing mine workforce of up to 660 people, and
- maintaining and where relevant, building on the existing environmental mitigation and management strategies to mitigate and manage the predicted impacts associated with the Proposed Modification.

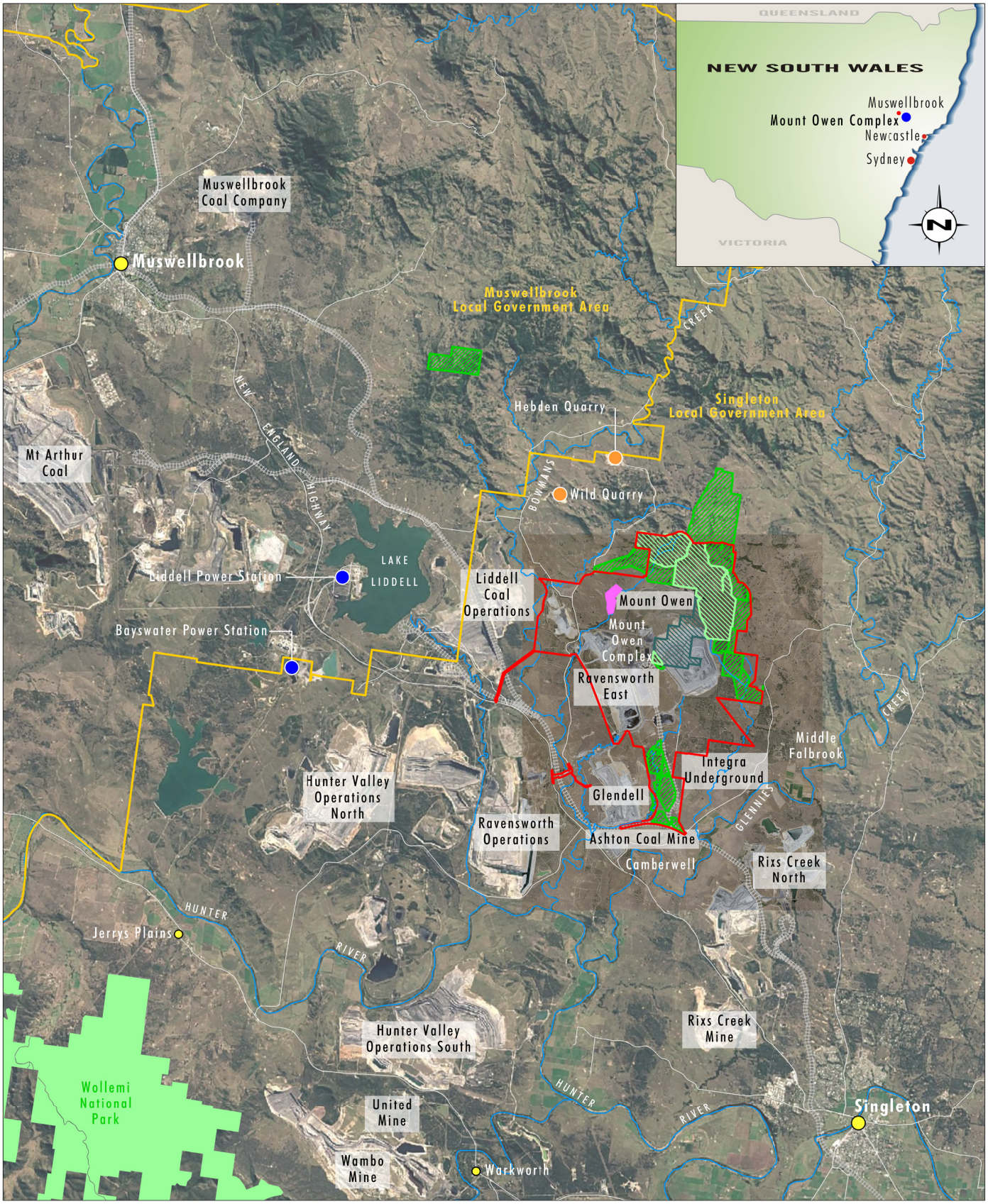

Image Source: Google Earth (2016), Glencore (2017)
Data Source: Glencore (2018), OEH (2013), Forest Corporation of NSW (2013)

0 2.5 5.0 10km
1:200 000

Legend

- SSD-5850 Consent Boundary
- Local Government Area Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Ravensworth State Forest within Approved Disturbance Area
- Yorks Creek Voluntary Conservation Area
- National Park
- Road
- Railway
- Drainage line
- Towns
- Power Stations
- Quarry

FIGURE 1.1

Upper Hunter Valley Context and Approved Mount Owen Operations

File Name (A4): R09/3810_062.dgn
20180629 10.08

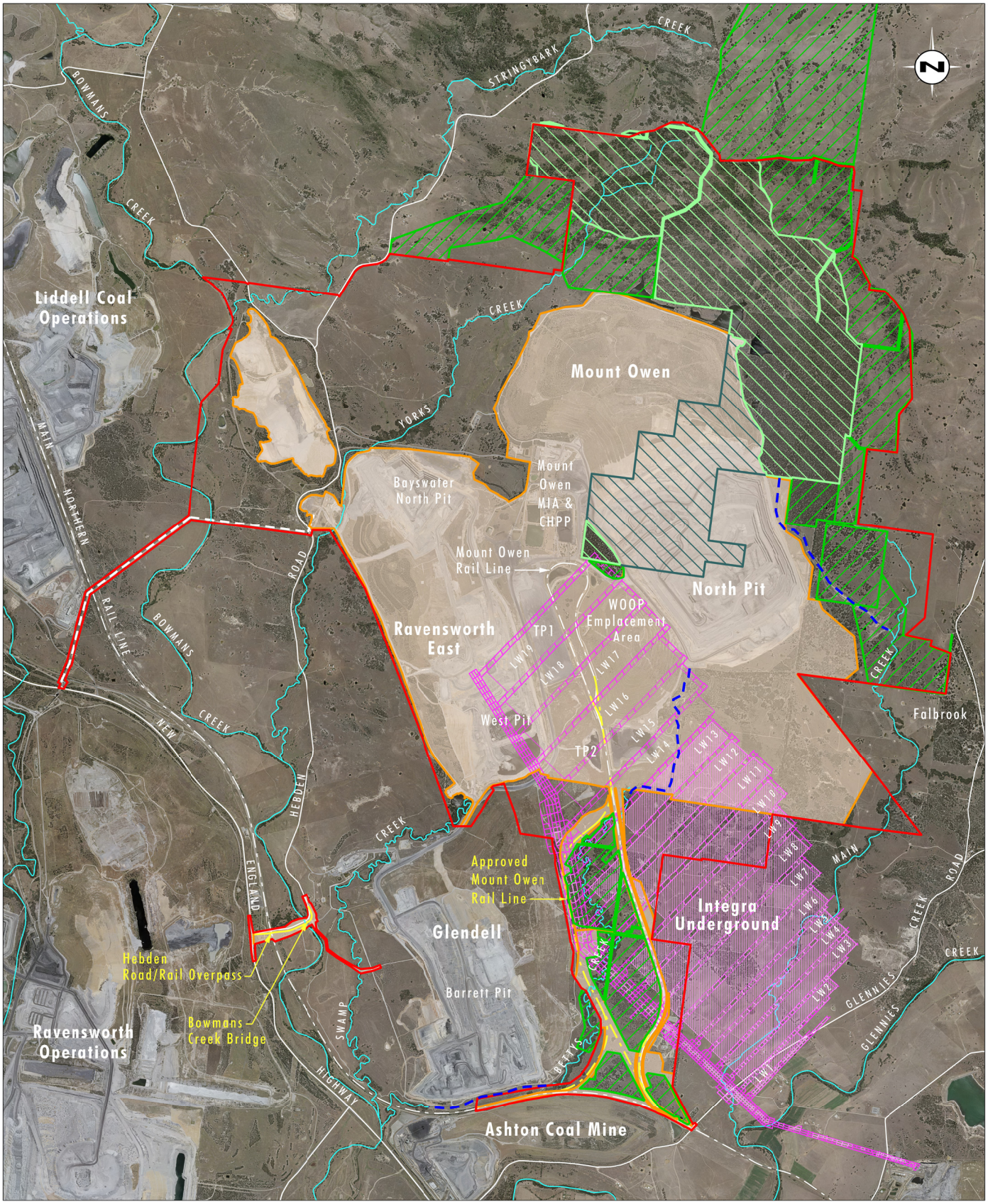

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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1:60 000

Legend

- SSD-5850 Consent Boundary
- Approved Disturbance Area
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Ravensworth State Forest within Approved Disturbance Area
- Approved Integra Underground Mining Area - Middle Liddell Seam Workings
- Integra Underground Workings Middle Liddell Seam as at May 2018
- Existing Bettys Creek Diversion
- Drainage Line

FIGURE 1.2

Approved Operations Overview

File Name (A4): R09/3810_061.dgn
20180522 13.22

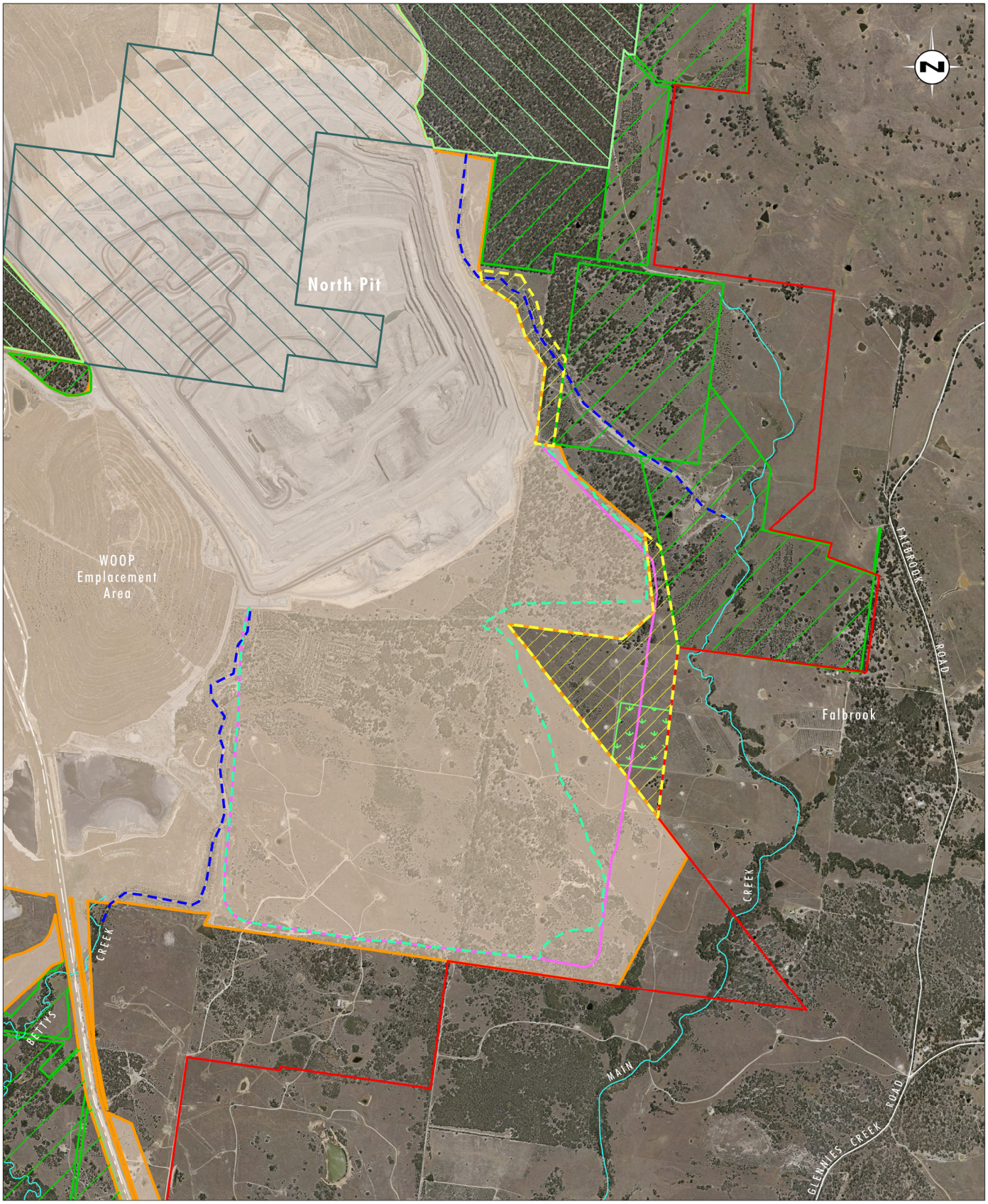

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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1:25 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Ravensworth State Forest within Approved Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line
- Olive Grove (within the Proposed Disturbance Area)

FIGURE 1.3

Proposed Modification Overview

File Name (A4): R09/3810_063.dgn
20180614 13.27

Table 1.1 provides a comparison between the Approved Operations and the Proposed Modification. A detailed description of the Proposed Modification is provided in **Section 2.0**.

Table 1.1 Comparison between the Approved Operations and the Proposed Modification

Component	Approved Operations (SSD-5850)	Proposed Modification
Mining Method	Truck and excavator	No change to mining methods
Target Seams	To Hebden Seam Down to approximately 300 metre (m) depth	No change to target seams Down to approximately 380 m depth (average 340 m)
Total Reserve Recovered	Total of 257 Mt ROM coal (Ravensworth East – 48 Mt Mount Owen – 209 Mt)	Additional approximately 35 Mt ROM coal over the life of the mine (approximately 13% of total approved resource)
Disturbance Area	Approved Disturbance Area of 2534 ha disturbance	Additional approximately 46approximately ha disturbance (increase of 1.8% of total Approved Disturbance Area) Modification to SSD-5850 consent boundary to include Proposed Disturbance Area
Annual Production	Ravensworth East – 4 Mtpa Mount Owen – 10 Mtpa	No change to annual production limit
Mine Life	2031	2037
CHPP Capacity	Up to 17 Mtpa	No change to CHPP capacity
Management of Mining Waste	Emplacement of waste in-pit and out-of-pit, up to maximum height of 230 m Tailings emplacement in Ravensworth East voids (including West Pit), within in-pit tailings cells in North Pit, the BNP void or transfer under the GRAWTS to Liddell Coal Operations (subject to relevant approvals).	Emplacement of waste in Approved Disturbance Areas up to maximum existing approved height Tailings emplacement within West Pit, in-pit tailings cells in North Pit, the BNP void and transfer under the GRAWTS
Water Management	Upper and Middle Bettys Creek Diversions Management of water within the water management system and the GRAWTS Works to provide flood attenuation for Yorks Creek	No changes to existing approved creek diversions Extension of water management system to Proposed Disturbance Area and continued management of water within the GRAWTS Proposed amendments to design of existing Water Management System to provide flood attenuation for Yorks Creek
Operational Workforce	Up to approximately 660 people at Mount Owen Mine and 260 at Ravensworth East	Continued employment of existing Mount Owen workforce (up to approximately 660 people) for an additional 6 years
Hours of Operation	24 hours, 7 days per week	No change to hours of operation
Interactions with Integra Underground	Minimum 250 m separation subject to strict safety and operational controls	No change to minimum separation – implementation of safety and operational controls through integration of Glencore owned mining operations

Component	Approved Operations (SSD-5850)	Proposed Modification
Final Landform	Final voids at BNP and North Pit Final landform approved with commitments relating to landform design (including micro-relief), conservation and water management considerations as part of further detailed mine design	No additional void in final landform Proposed changes to the final void arrangement in North Pit Final landform to be designed to incorporate detailed design commitments relating to landform design (including micro-relief), conservation and water management considerations and be consistent with the existing rehabilitation objectives in the development consent

This Statement of Environmental Effects (SEE) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to accompany an application to modify SSD-5850 pursuant to Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (refer to Appendix 1 for Statement of Authorship and Schedule of Lands). The Proposed Modification was also referred to the Commonwealth Department of Environment and Energy (DoEE) and was determined not to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (refer to **Section 3.3.1**).

The SEE provides an overview of the Proposed Modification and details the proposed changes to the Approved Operations under SSD-5850. Comprehensive government and community consultation was undertaken during the preparation of the SEE, as detailed in **Section 4.0**. This SEE provides a comprehensive assessment of potential environmental and social impacts associated with the Proposed Modification relative to the Approved Operations. The form of this SEE generally follows the requirements of the Department of Planning and Environment (DPE) Mine Application Guideline (October 2015), which outlines the requirements for development applications and modification applications for State significant mining operations.

2.0 Description of the Proposed Modification

The Proposed Modification will allow for the optimisation of the approved North Pit Mine Plan to extract an additional approximately 35 Mt ROM coal extending the approved mine life through to 2037. This section of the SEE includes:

- an overview of the Approved Operations
- a detailed description of the Proposed Modification, and
- a summary of the proposed management commitments that have been incorporated into the design of the Proposed Modification to avoid, minimise and/or mitigate potential impacts.

2.1 Overview of Approved Operations

The Mount Owen and Ravensworth East Mines operate under SSD-5850 which provides for continued operations at the Mount Owen Complex until 2031. The total Approved Disturbance Area is shown on **Figure 1.2** and incorporates all previously approved operational areas for the Mount Owen and Ravensworth East Mines. The Approved Operations have an associated total Approved Disturbance Area of approximately 2534 ha (refer to **Figure 1.2**) and include mining down to the Hebden Seam to a depth of approximately 300 m.

SSD-5850 allows for the extraction of approximately 209 Mt ROM coal from the North Pit and 48 Mt ROM coal from the Ravensworth East Mine, including the previously approved reserves, and maintains the previously approved annual production rate of 10 Mtpa ROM coal from the Mount Owen Mine (North Pit) and 4 Mtpa ROM coal from the Ravensworth East Mine. ROM coal extracted from within the Mount Owen Complex is transported to the Mount Owen CHPP for processing which has an approved capacity of 17 Mtpa. Coarse reject from the CHPP is incorporated into the overburden emplacement areas and tailings are discharged to the West Pit and to in-pit tailings cells in North Pit and BNP, after which tailings will be managed as part of the GRAWTS.

Export product coal is currently loaded onto trains using the Mount Owen Complex rail loading facility and rail line, and is transported to the Port of Newcastle via the Main Northern Rail Line. The current approval also permits the transportation of ROM coal to Bayswater and/or Liddell Power Stations either by rail or conveyor and coal and/or crushed gravel (2 Mtpa) by conveyor to the Liddell Coal Operations and/or Ravensworth Coal Terminal.

SSD-5850 also provided approval for the following infrastructure works:

- road overpass over the Main Northern Rail Line on Hebden Road
- new dual lane bridge over Bowmans Creek on Hebden Road
- additional rail line and northern turn-out west of the existing Mount Owen rail line
- upgrades to the Mine Infrastructure Area (MIA), CHPP and coal stockpile facilities, and
- changes/upgrades to ancillary surface infrastructure including related water management infrastructure and associated facilities.

As outlined above, the Continued Operations Project commenced in 2017 and activates the provisions of SSD-5850 for the Approved Operations. As outlined in **Table 1.1**, the Proposed Modification relates to the modification of the approved North Pit operations, with other aspects of the Approved Operations continuing unchanged under SSD-5850.

The Approved Operations are undertaken in accordance with the environmental management plans, strategies and monitoring programs currently approved and implemented at the Mount Owen Complex. These management plans have been reviewed and revised to incorporate the requirements associated with SSD-5850 and recently, where applicable, to Modification 1. The applicable management plans and strategies under SSD-5850 include:

- Environmental Management Strategy
- Water Management Plan (including sub plans)
- Air Quality Management Plan
- Noise Management Plan
- Blast Management Plan
- Rehabilitation Strategy
- Rehabilitation Management Plan
- Biodiversity and Offset Management Plan
- Aboriginal Cultural Heritage Management Plan
- Historic Heritage Management Plan.

The current approved environmental management plans, strategies and monitoring programs are available on the Mount Owen Complex website (www.mtowencomplex.com.au), apart from the Rehabilitation Strategy which has been lodged with DPE for approval.

The outcomes of monitoring programs are reported annually to the community and regulators through the Annual Review and monthly monitoring reports available on the Mount Owen Complex website.

2.2 Proposed Modification Description

As detailed in **Table 1.1**, the Proposed Modification relates to approved mining operations within the North Pit only, with no change to the Approved Operations within Ravensworth East or approved coal processing and transportation infrastructure, or other approved infrastructure. In addition, the current approved limits on annual coal production and waste generation will remain unchanged. The Proposed Modification will result in the optimisation of the approved North Pit mine plan providing for more efficient mining operations and access to additional reserves from within the acquired Integra mining tenements.

Prior to the acquisition of the Integra Underground mining tenements, the mine plan design for the North Pit did not allow access to the deeper coal seams and was restricted to the east of the approved North Pit footprint. This resulted in the approved pit floor 'stepping up' as it progressed further southwards and the 'stepping in' of the mine plan along its eastern boundary. The acquisition of the Integra Underground Mine and associated mining tenements has removed this constraint and allows for deeper and extended coal extraction across the proposed modified North Pit. Extraction of the additional coal reserves from within North Pit will be provided through an increase in depth of mining within some areas of the approved North Pit down to the Hebden Seam.

The Proposed Disturbance Area represents the total area that would be disturbed outside of the areas previously approved for disturbance (refer to **Figure 1.3**). The total Approved Disturbance Area for the Approved Operations is approximately 2534 ha and the Proposed Disturbance Area is approximately 46 ha, representing an increase of approximately 1.8% to the area currently approved. The Proposed Disturbance Area also extends beyond the approved SSD-5850 consent boundary (refer to **Figure 1.2**), which is proposed to be amended and is shown as the Proposed Modification consent boundary (refer to **Figure 1.3**).

The Proposed Disturbance Area extends further east from the Proposed Modification pit boundary to provide for additional infrastructure such as water management structures and access. In addition, the northern portion of the Proposed Disturbance Area is identified to provide for rehabilitation earthworks only, these works will help to shape and improve the final landform of the North Pit to tie into the surrounding topography, earthworks will not increase the height of the emplacement area in this location. These works are located in proximity to the existing approved Bettys Creek diversion, however, no changes are proposed to the existing Bettys Creek diversion in this area which continues through the South East Offset and South East Corridor Offset areas into Main Creek.

Figure 2.1 provides an east-west cross section that shows the location of the approved and proposed mining and disturbance footprints in relation to the surrounding area including Main Creek. The top of high bank of Main Creek, as established through detailed site survey, is located approximately 160 m from the Proposed Modification pit boundary at its closest point. **Figure 2.1** also depicts the confirmed extent of the alluvium associated with Main Creek, which is located approximately 150 m east of the Proposed Modification pit boundary at its closest point. Further details on the refined extent of alluvial mapping associated with Main Creek are provided in **Section 3.2.2**.

Access to the additional coal reserves will result in amendments to the currently approved progression of the North Pit over the life of Mount Owen operations. A full description of the staged conceptual mine plans detailing the changes in proposed mine progression is provided in **Section 2.2.1**.

The minimum separation distance of 250 m between the proposed North Pit floor and the approved Integra Underground mining operations will be maintained. All operational and safety measures currently implemented will continue and will be enhanced through the common ownership of these mining operations by Glencore.

In addition to the proposed changes to mining within North Pit associated with the Proposed Modification, Mount Owen is also proposing a number of administrative changes to specific conditions of SSD-5850 relating to water management and management of salvaged Aboriginal archaeology artefacts. These ancillary aspects of the Proposed Modification are to reflect updated approaches to the management of these matters and are detailed in **Section 2.2.4**.

2.2.1 Conceptual Mine Plans

As outlined above, access to the additional coal reserves will result in changes to the currently approved progression of the North Pit as part of the Proposed Modification. **Figures 2.2** to **2.4** provide representative conceptual mine plan stages that depict the proposed indicative changes to the mine progression at key stages of the Proposed Modification and form the basis of the detailed environmental assessments in **Section 6.0**.

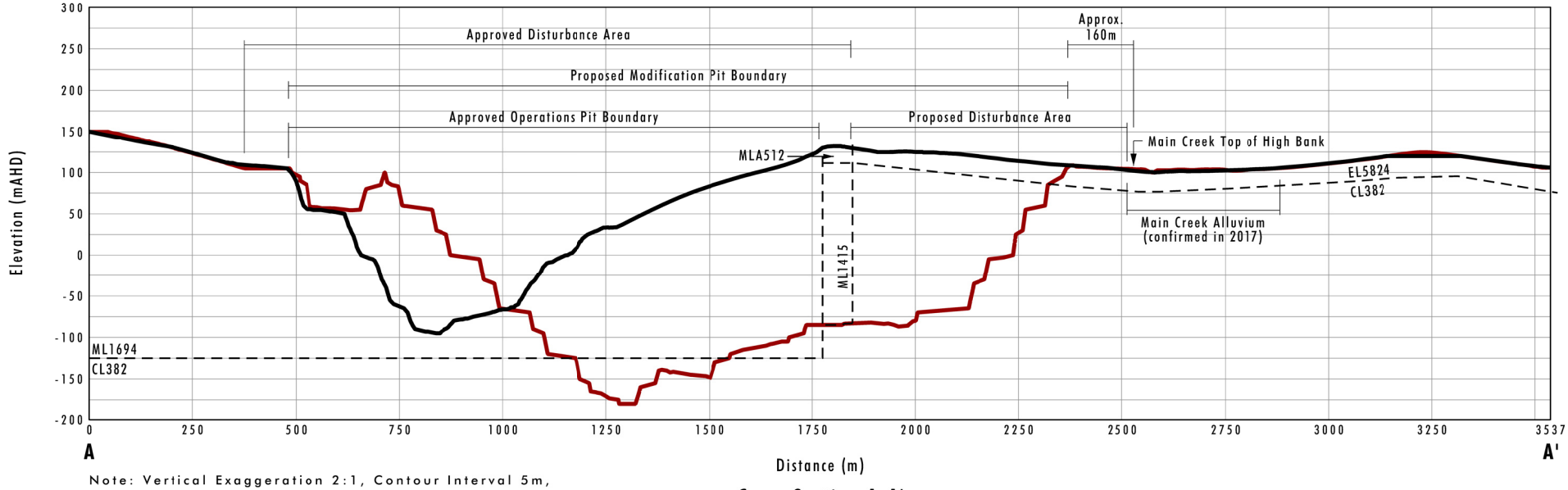
Mount Owen considered a range of constraints to inform the proposed conceptual mine plan design for the Proposed Modification. As part of these constraints studies various mine design options including overburden emplacement schedules, mining progression, fleet numbers and type, and equipment location and scheduling were reviewed. Throughout these studies the design options were reviewed with consideration of the following key objectives:

- minimising potential environmental and social impacts, particularly air quality and noise
- minimising the Proposed Disturbance Area by maximising the use of existing approved disturbed areas and existing infrastructure
- maximising the recovery of economic coal reserves from within the existing North Pit, and
- maintaining the economic viability of the Proposed Modification.

During the detailed air quality and noise assessments undertaken to support the Proposed Modification, further mine plan refinement was undertaken to ensure that the Proposed Modification can continue to be managed to meet the current SSD-5850 criteria for noise and updated standards for air quality for surrounding private receiver locations. These refinements included alterations to mine plans and progression, along with a range of operational controls and measures to be implemented over the life of the Proposed Modification. These refinements and management measures are further detailed in **Section 3.2.1** and assessed in detail as part of relevant assessments included in **Section 6.0**.

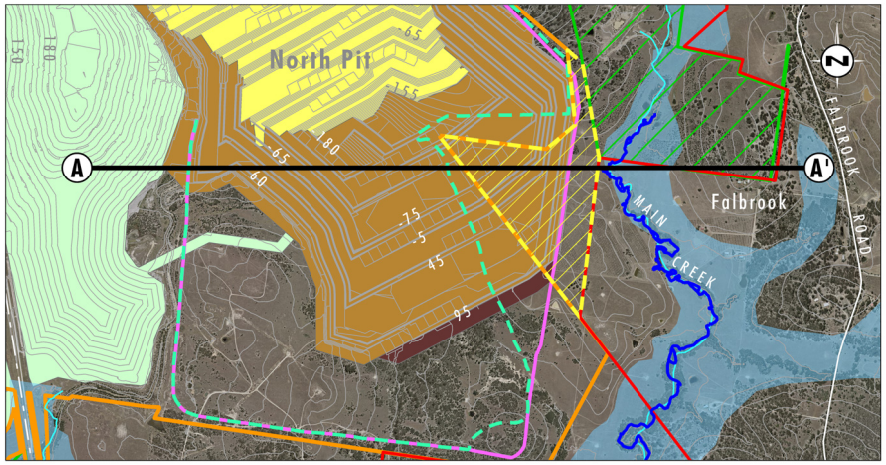
The conceptual mine plan stages presented below have been selected as they are considered to represent indicative key features of the proposed mining progression for the Proposed Modification:

- **Year 2** (approximately 2020) - generally corresponds with Year 5 of the Approved Operations, this represents maximum equipment numbers and production, the emplacement of overburden high within the North Pit landform and to the south of the western out-of-pit (WOOP) emplacement area (refer to **Figure 2.2**)
- **Year 8** (approximately 2026) - generally corresponds with Year 10 of the Approved Operations and represents the North Pit reaching the proposed eastern extent of mining towards neighbouring landholders to the east (refer to **Figure 2.3**)
- **Year 15** (approximately 2033) **–** representing the continuation of the mine life beyond the Approved Operations. Year 15 also represents reaching the southern extent of mining and closest point of mining to neighbouring landholders to the south and south-east. Year 15 includes the slowing of production to ensure the existing noise criteria can be achieved (refer to **Figure 2.4**).



Note: Vertical Exaggeration 2:1, Contour Interval 5m, Tenement Boundaries are Indicative Only

Cross Section A-A'



Plan

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Drainage Line
- Approved Operations Year 10 Mine Plan Landform
- Proposed Modification Year 8 Mine Plan Landform
- Main Creek - Top of High Bank
- Refined Alluvium Mapping (AGE 2017)
- Existing Biodiversity Offset Area
- Active Mining Area
- Active Overburden Emplacement Area
- Rehabilitation - Complete
- Topsoil Removal Strip
- Section Line

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

0 125 250 375m
Vertical Scale 1:7 500

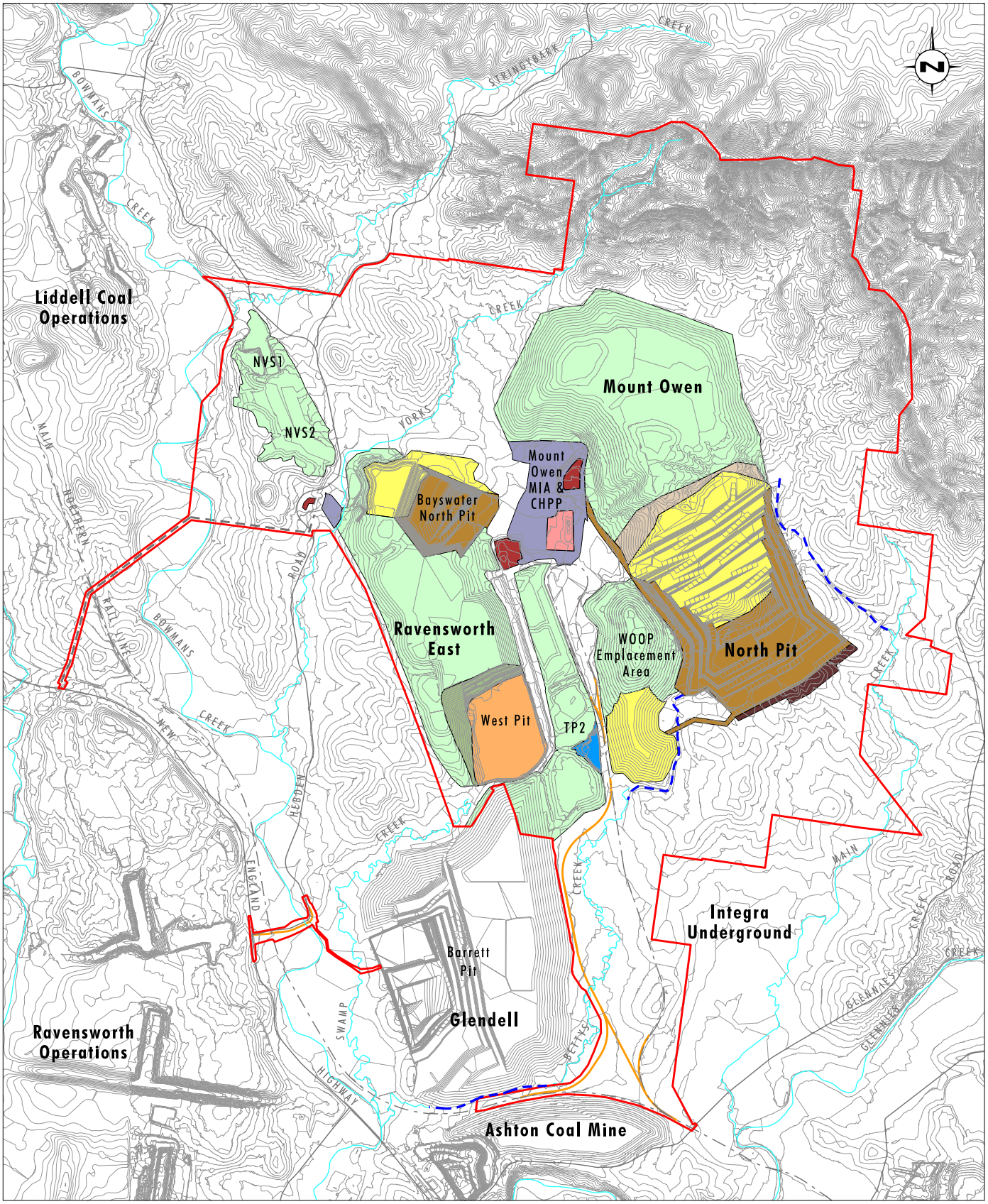
0 250 500 750m
Horizontal Scale 1:15 000

0 0.625 1.25 1.875km
Plan Scale 1:37 500

File Name (A4): R09/3810_064.dgn
20180619 11.04

FIGURE 2.1

North Pit Cross Section Approved Operations (Year 10) and Proposed Modification (Year 8)



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

0 1.0 2.0 3.0km
1:60 000

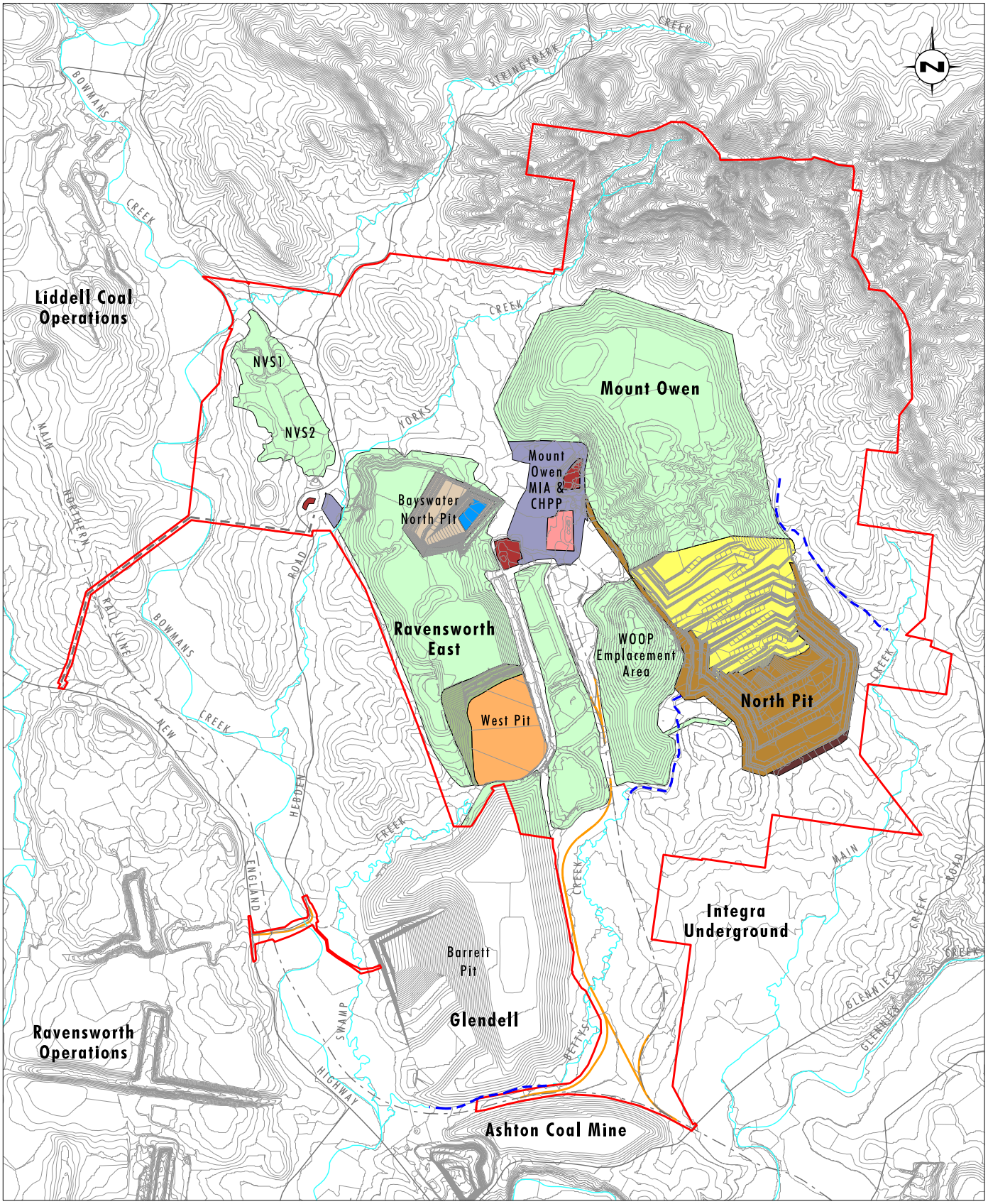
Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Shaped Not Seeded
- Tailings Emplacement
- Topsoil Removal Strip
- Water Storage Area

FIGURE 2.2

Conceptual Year 2 Mine Plan

File Name (A4): R09/3810_083.dgn
20180516 16.29



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

0 1.0 2.0 3.0km
1:60 000

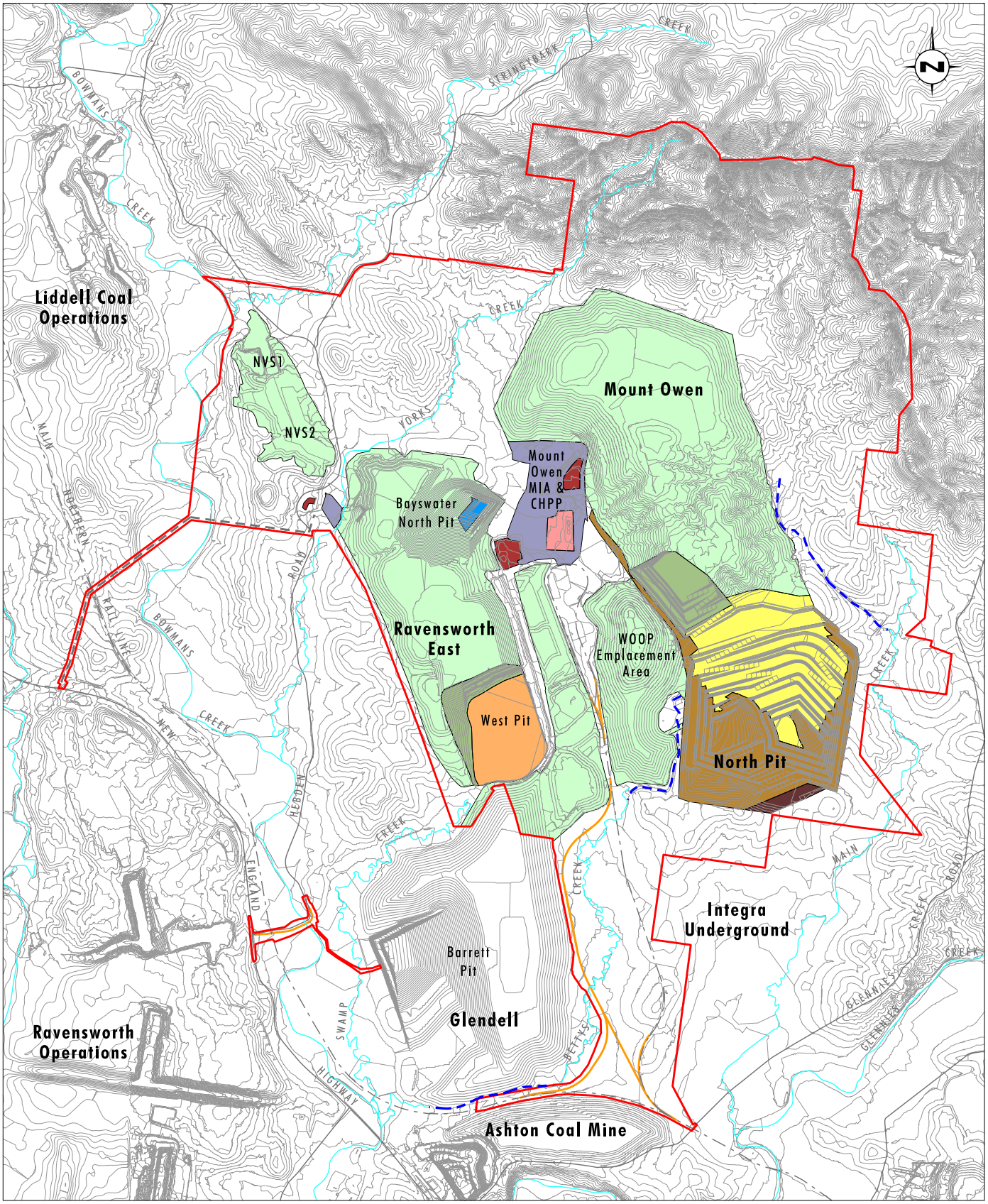
Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Shaped Not Seeded
- Tailings Emplacement
- Topsoil Removal Strip
- Water Storage Area

FIGURE 2.3

Conceptual Year 8 Mine Plan

File Name (A4): R09/3810_084.dgn
20180516 16.37



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

0 1.0 2.0 3.0km
1:60 000

Legend

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

FIGURE 2.4

Conceptual Year 15 Mine Plan

File Name (A4): R09\3810_085.dgn
20180523 12.30

2.2.1.1 Progression of Conceptual Mine Stages

Further detail associated with the progression of mining for each conceptual mine plan stage is provided below.

Year 2

- Mining operations within the North Pit progress south into the Proposed Disturbance Area.
- Emplacement of overburden to the south of the WOOP emplacement area (over the Eastern Rail Pit) as per current Approved Operations.
- Mine haul roads continue to be built into the eastern highwall of the North Pit.
- The North Pit emplacement area is being progressively shaped as mining continues south.
- Mining within the BNP continues as approved.
- The West Pit continues to be used for tailings emplacement and coarse reject will continue to be co-disposed in overburden in the North Pit and the BNP overburden emplacement areas.
- Approved mining operations at Glendell continue in accordance with DA 80/952 with coal hauled via internal roads to the Mount Owen CHPP for processing.

Year 8

- Mining within the North Pit has progressed further south and east with the pit reaching the proposed eastern limit.
- Extension of mining and removal of the previous 'step up' of the North Pit floor allows for the pit to change direction and deviate from the approved North Pit mine plan.
- Haul roads continue to be built into the eastern wall to provide additional acoustic shielding as mining operations progress further south and east towards neighbouring private receiver locations.
- Shaping of emplacement areas and rehabilitation within the North Pit continues in a southerly direction.
- The WOOP emplacement area has been rehabilitated.
- Tailings emplacement continues within the West Pit and via the GRAWTS (subject to approval).
- Coarse reject will continue to be co-disposed in overburden in the North Pit overburden emplacement area.
- Overburden emplacement and shaping within the BNP with the void being used for water storage.
- Currently approved mining activities at Glendell have ceased.

Year 15

- Mining within the North Pit has progressed further south, with the North Pit reaching the southern limit (consistent with southern extent of the Approved Disturbance Area).
- Shaping of emplacement areas and rehabilitation within the North Pit has continued south.
- Continued tailings emplacement within the GRAWTS (subject to approval) with periodic placement in West Pit to assist with the formation of the final landform.

- Rehabilitation is complete within the BNP, with the final void used for water storage and possibly in-pit tailings emplacement through the construction of tailings cells.

The tailings emplacement area in the West Pit will be capped and rehabilitated once mining operations within the North Pit cease around 2037.

Further discussion on the progressive rehabilitation and details of the conceptual final landform are provided in **Section 2.2.3**.

2.2.2 Rejects and Tailings Emplacement

The Approved Operations allows for the emplacement of tailings in West Pit, with additional in-pit emplacement in tailings cells in North Pit, the BNP void, and transfer under the GRAWTS. Tailings are anticipated to be transferred to Liddell Coal Operations(subject to relevant approvals at Liddell) in order to allow the West Pit tailings emplacement facility time to consolidate and dry out prior to capping. The emplacement of tailings from the Mount Owen CHPP in West Pit may still occur during this time to assist with achieving the final landform, and/or for contingency tailings storage, together with in-pit tailings emplacement within tailings cells in the North Pit. If approval is not granted to emplace tailings from Mount Owen CHPP at Liddell Coal Operations (via the GRAWTS) then tailings would be deposited in the BNP void at the completion of mining in this area.

In accordance with the current development consent, West Pit will be capped with overburden to achieve a stable final landform and allow the area to be rehabilitated in accordance with the proposed conceptual mine plans and the mine closure and rehabilitation strategy (refer to **Section 2.2.3**).

The management of coarse reject and other waste material will be consistent with the practices employed for the Approved Operations.

2.2.3 Rehabilitation and Final Landform

Mount Owen has undertaken progressive rehabilitation throughout the life of the Approved Operations. Extensive flora and fauna monitoring are undertaken to measure the success of the rehabilitation programs in place. The conceptual final landform developed for the Approved Operations results in two final voids remaining following rehabilitation (BNP and North Pit). The approved conceptual final landform proposes a natural landform design incorporating micro-relief elements throughout the life of the operation, maximising the return of catchment, particularly to Main Creek, and to achieve a safe, stable and non-polluting final landform.

No change is proposed to the current progressive rehabilitation commitments and practices as part of the Proposed Modification.

The proposed conceptual final landform incorporates the relevant general design principles as approved for the Continued Operations Project including the incorporation of micro-relief to achieve a natural landform design, the provision for approximately 518 ha of conservation areas and the return of catchment area to Main Creek in the long term.

The proposed conceptual final landform is generally consistent with the approved conceptual final landform, however given the changes to the mine plans for the North Pit (including extension of the Proposed Disturbance Area and depth of mining) the following key changes to the final landform are proposed:

- additional emplacement of overburden within the existing North Pit disturbance area up to the current approved height of 230 mAHD

- modification of the progressive rehabilitation schedule within an area of the Ravensworth State Forest to accommodate the additional overburden emplacement (refer to **Section 6.10.1**), and

- no additional voids are proposed as a result of the Proposed Modification, however the amendments to the North Pit mine plan will necessitate changes to the approved final void.

Figure 2.5 provides the proposed conceptual final landform at Mount Owen Mine which has been refined as part of the detailed mine planning process and is discussed in further detail in **Sections 5.3** and **6.10**. **Figure 2.6** provides cross sections through the proposed conceptual final landform, the alignment of the cross sections are shown on **Figure 2.5**.

Figure 2.7 provides an indicative north-south and east-west conceptual comparison focused on the North Pit final void. This comparison illustrates that the key difference between the approved and proposed conceptual landforms is the deeper final void associated with the Proposed Modification. In both the Approved Operations and Proposed Modification scenarios, natural landform features are incorporated into the design of overburden emplacement areas above natural ground level. The variability in relief in the conceptual final landform for the Proposed Modification can also be seen in the contours shown on **Figure 2.5**. A plan view comparison of the approved and proposed conceptual final landforms is provided in **Section 5** (refer to **Figure 5.2**).

As detailed in **Section 5.3**, a number of alternative options for the proposed conceptual final landform have been reviewed and considered in the design of the Proposed Modification. These options were presented to the NSW Resources Regulator and DPE through the assessment process to identify key assessment issues and assist with developing an acceptable final landform design. The conceptual final landform options considered are detailed in **Section 5.3**, and the key matters raised by the NSW Resources Regulator and DPE, and how these matters are addressed in the proposed conceptual final landform are detailed in **Section 6.10**.

2.2.4 Ancillary Developments

The Proposed Modification relates specifically to the amendment of the approved mine plans associated with the North Pit with the exception of the installation of water management infrastructure where required (refer to **Section 6.5**). There are two administrative modifications to specific conditions of SSD-5850 as detailed below. Otherwise, the existing infrastructure at the Mount Owen Complex will support the continued mining operations with no additional infrastructure approvals required.

2.2.4.1 Flood Mitigation Works – Yorks Creek

As part of the Approved Operations, Mount Owen committed to providing additional off-line detention capacity at the Ravensworth East MIA and the implementation of flow conveyance at Hebden Road, in order to address potential flooding issues in Yorks Creek in the vicinity of Hebden Road. To satisfy this commitment, Mount Owen proposed to modify the existing Industrial Dam at the Ravensworth East MIA to provide off line detention storage for flood events associated with Yorks Creek above the 10% Annual Exceedance Probability (AEP) event.

Additional flood modelling has been completed to guide an alternative design process to address any potential flooding issues in Yorks Creek associated with the Approved Operations. The outcome of that assessment concludes that suitable detention storage can be provided within existing Dam 5 and Dam 6 located on the northern side of the North Pit emplacement area to effectively manage the previously identified flooding issues at Hebden Road. This additional detention capacity will be achieved through the modification of the existing outlet structures to these dams. Accordingly, the works previously proposed at the Ravensworth East MIA are no longer required. These proposed works are discussed further in the Surface Water Impact Assessment (refer to **Section 6.5**).

The proposed detention works at Dam 5 and Dam 6 removes the requirement of SSD-5850 Schedule 3 Condition 26(c) (iv) requiring *appropriately detailed plans, design objectives and performance criteria for the remediation of the dirty-water dam near Hebden Road, prior to its use as an offline flow detention area for Yorks Creek*. The proposed use of Dam 5 and Dam 6 to provide the required attenuation will be documented in a revision to the current Water Management Plan approved under SSD-5850.

2.2.4.2 Aboriginal Artefact Storage Facility

The Statement of Commitments for the Continued Operations Project included a commitment to construct a suitable fit for purpose artefact storage facility to store cultural heritage artefacts recovered during previous research and salvage programs and for items recovered for the Project, within 2 years of approval for the Project. SSD-5850 Schedule 3 Condition 34 requires the preparation of an Aboriginal Cultural Heritage Management Plan (ACHMP) which includes a strategy for the storage of heritage items salvaged on site as reflected in the Statement of Commitments. Following the approval of the Continued Operations Project, the ACHMP was updated and approved to include the storage of artefacts at a facility within the existing Yorks Creek Voluntary Conservation Area (VCA) at the Mount Owen Complex.

Since this time Glencore has been investigating the potential to provide a central artefact storage facility to service Glencore mines in the Hunter Valley with the proposed location now at Bulga Coal's Wollombi Brook VCA. The proposal of providing a central artefact storage facility at Bulga Coal was initially raised by the RAPs and Knowledge Holders at the Aboriginal Cultural Heritage Working Group meetings at Mount Owen and Bulga Coal, with all attendees not objecting to the concept of having a central storage facility at the Wollombi Brook VCA. In addition, Mount Owen has formally consulted with relevant Knowledge Holders and RAPs on the proposed change to the management of salvaged artefacts (refer to **Section 4.5**). The proposed Wollombi Brook VCA artefact storage facility will provide for secure storage of artefacts as well as meeting and catering facilities (e.g. BBQs). The detailed design and the Plan of Management for the artefact storage facility will be confirmed through continued consultation with the Aboriginal Cultural Heritage Working Group.

Subject to the Proposed Modification being approved, the Mount Owen ACHMP would be updated to remove the current commitment to construct an artefact storage facility within the Yorks Creek VCA and allow for the storage of artefacts at the Wollombi Brook VCA artefact storage facility. Mount Owen intend to commence the storage of artefacts from the Mount Owen Complex at the Wollombi Brook artefact storage facility within 12 months of the Wollobmi Brook artefact storage facility being constructed.

2.2.5 Development Schedule

With the exception of water management structures (which will be constructed as required as mining progresses) no significant construction is required as part of the Proposed Modification.

Mining operations associated with the Proposed Modification are expected to commence in Q3 2019 with mining operations within the North Pit progressing into the Proposed Disturbance Area through preparatory pre-strip works. Mining operations are expected to be completed by the end of 2037. A detailed closure plan will be developed in accordance with the relevant consent requirements within 5 years of planned closure of the mining operations.

2.3 Management Commitments

Mount Owen has undertaken detailed investigations which have considered a number of mine plans and considerable refinement of the proposed extent of mining to avoid or minimise the potential impacts of the Proposed Modification.

As detailed in **Sections 3.2.1** and **6.0**, a range of conceptual mine plan refinements has been undertaken and additional operational controls will be implemented as part of the Proposed Modification to minimise the impacts associated with the Proposed Modification.

As discussed in **Section 2.1**, the Approved Operations at the Mount Owen Complex are undertaken in accordance with the approved environmental management plans and strategies under SSD-5850. Should the Proposed Modification be approved, further updates will be undertaken to incorporate the management requirements resulting from the Proposed Modification. This will include general updates to reflect the modified operations as well as specific revisions to reflect updated and revised management commitments required as a result of the Proposed Modification.

A copy of the development consent (SSD-5850) is provided in **Appendix 2**. The proposed updates to the relevant SSD-5850 conditions of consent and management commitments are summarised below and further detail relating to the associated environmental assessment is provided in **Section 6.0**:

- Revisions to the Noise Management Plan to update the operational noise control protocols and attended and real time noise monitoring locations (refer to **Section 6.2**) in accordance with consent condition - Schedule 3, Condition 7 – Noise Management Plan.

- Revisions to the Blast Management Plan to include specific blast impact criteria for Main Creek (refer to **Section 6.3**), in accordance with consent condition - Schedule 3, Conditions 8 (Blasting Criteria) and 15 (Blast Management Plan).

- Revisions to the Water Management Plan (Surface Water Management and Monitoring Plan) to update proposed alteration to the flood attenuation commitments for Hebden Road, updates to the monitoring program and other operational updates to the approved Water Management System (refer to **Section 6.5**), in accordance with consent condition - Schedule 3, Condition 26 - Water Management Plan.

- Revisions to the Biodiversity and Offset Management Plan to include the proposed Biodiversity Offset Strategy for the Proposed Modification, once finalised (refer to **Section 6.6**) in accordance with consent condition - Schedule 3, Condition 31 – Biodiversity Management Plan.

- Revisions to the Aboriginal Cultural Heritage Management Plan, prepared in accordance with consent condition - Schedule 3, Condition 34 to incorporate two known sites as Category 2 salvage items (refer to **Section 6.7**) and amend the artefact storage facility commitment as outlined in **Section 2.2.4**.

- Implementation of vegetation screen along Glennies Creek/Falbrook Road to minimise potential visibility of the North Pit from the intersection of Glennies Creek, Falbrook and Middle Falbrook Roads (refer to **Section 6.8**) to satisfy the requirement of consent condition - Schedule 3, Condition 39(e) to undertake reasonable and feasible measures to shield views of mining operations and associated equipment from users of public roads and privately-owned residences.

- Revisions to the Rehabilitation Strategy and Rehabilitation Management Plan to reflect the proposed conceptual final landform and key matters raised by NSW Resources Regulator and DPE in relation to proposed conceptual final landform (refer to **Section 6.10**) and in accordance with consent condition - Schedule 3, Condition 43 (Rehabilitation Strategy) and Condition 45 (Rehabilitation Management Plan).

In addition to the SSD-5850 consent conditions identified above, Mount Owen seek to have Schedule 2, Condition 5 updated to allow for the extended Mount Owen Mine life to December 2037.

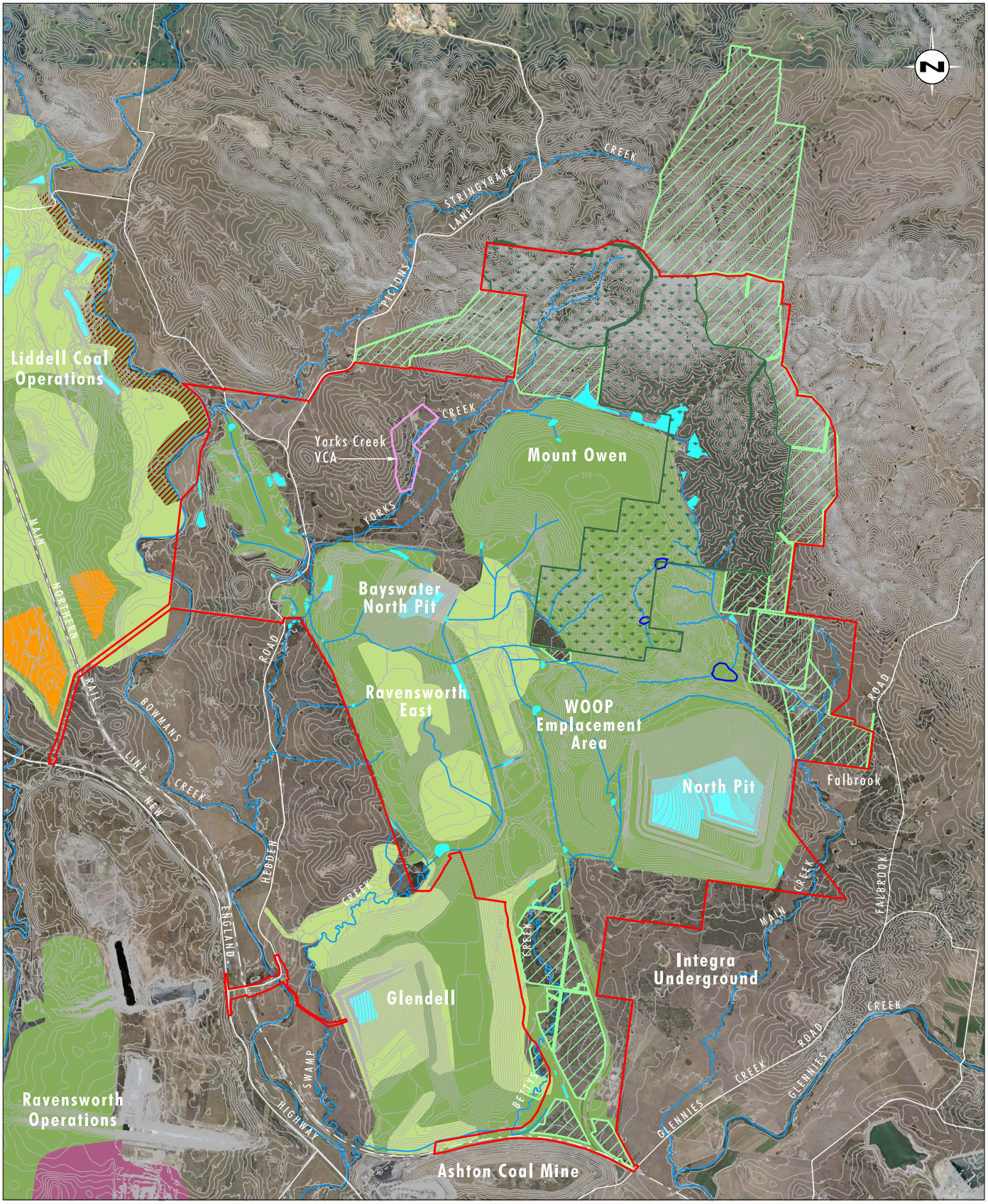


Image Source: Glencore (2017)
Data Source: Glencore (2018), Ravensworth Operation Vegetation: Umwelt (2010), Liddell Coal Operations Vegetation: Umwelt (2016)
Note: Contour Interval 5m(AHD). Equilibrium Water Level shown in North Pit Void.

0 1.0 2.0 3.0km
1:65 000

Legend

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

FIGURE 2.5

Proposed Modification Conceptual Final Landform

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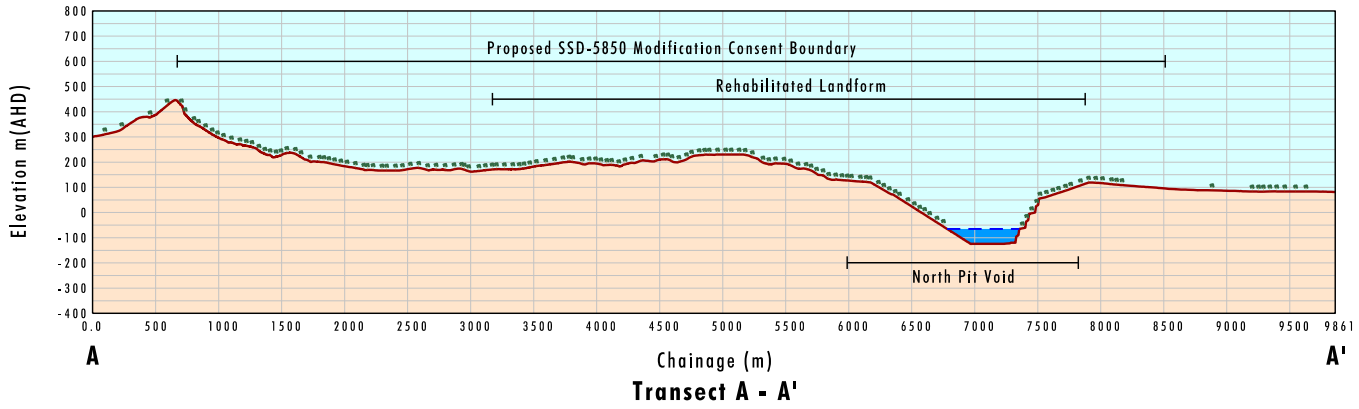
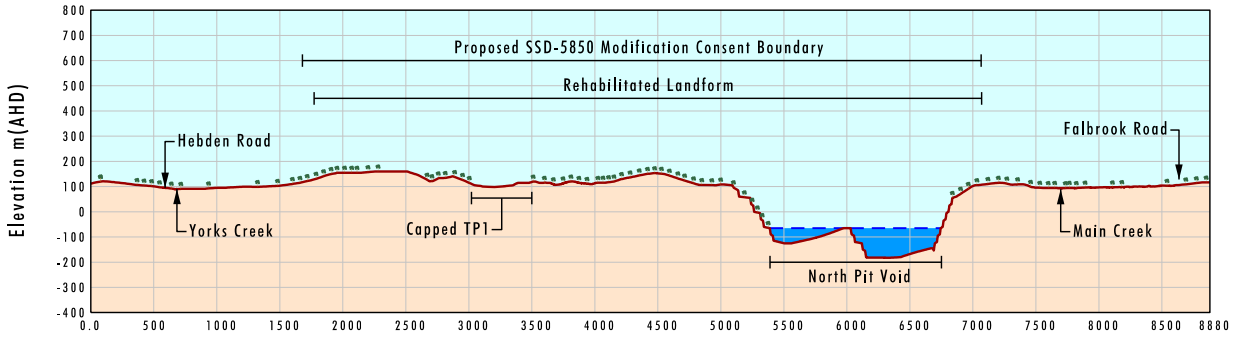
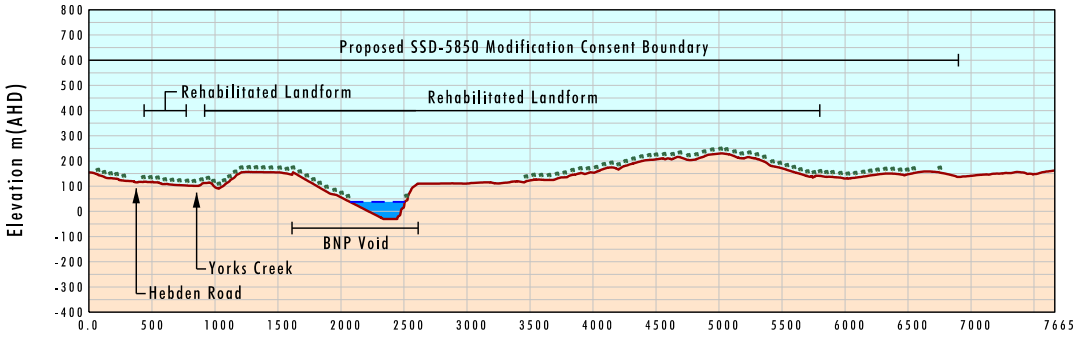
20180724 15.12



Transect A - A'



Transect B - B'



Transect C - C'

Legend

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

Note: Vertical Exaggeration 2:1

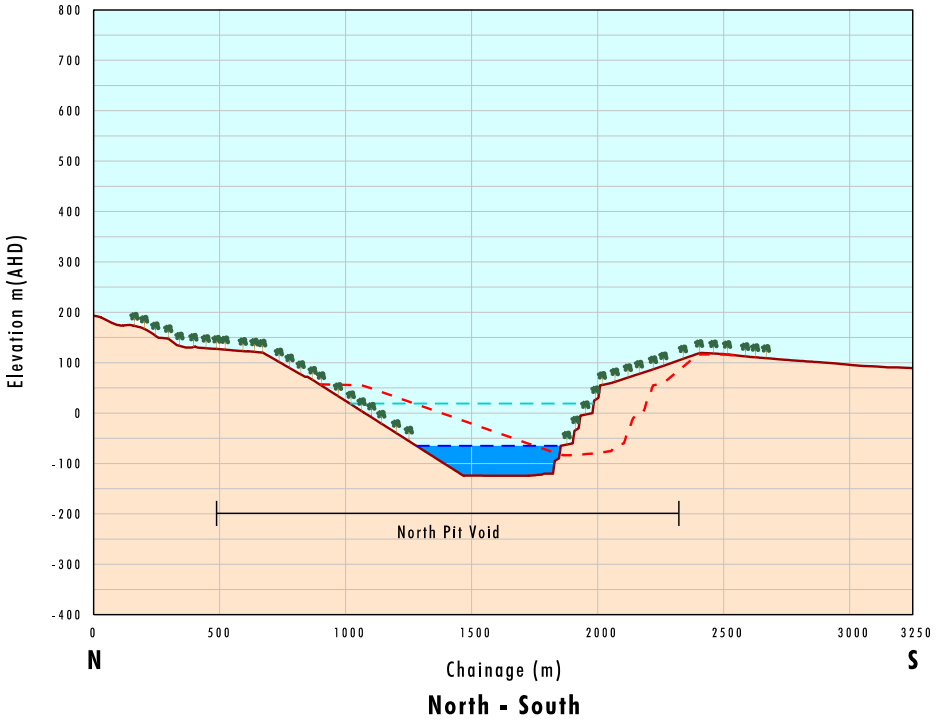
0 1.0 2.0 3.0km
Horizontal Scale 1:60 000

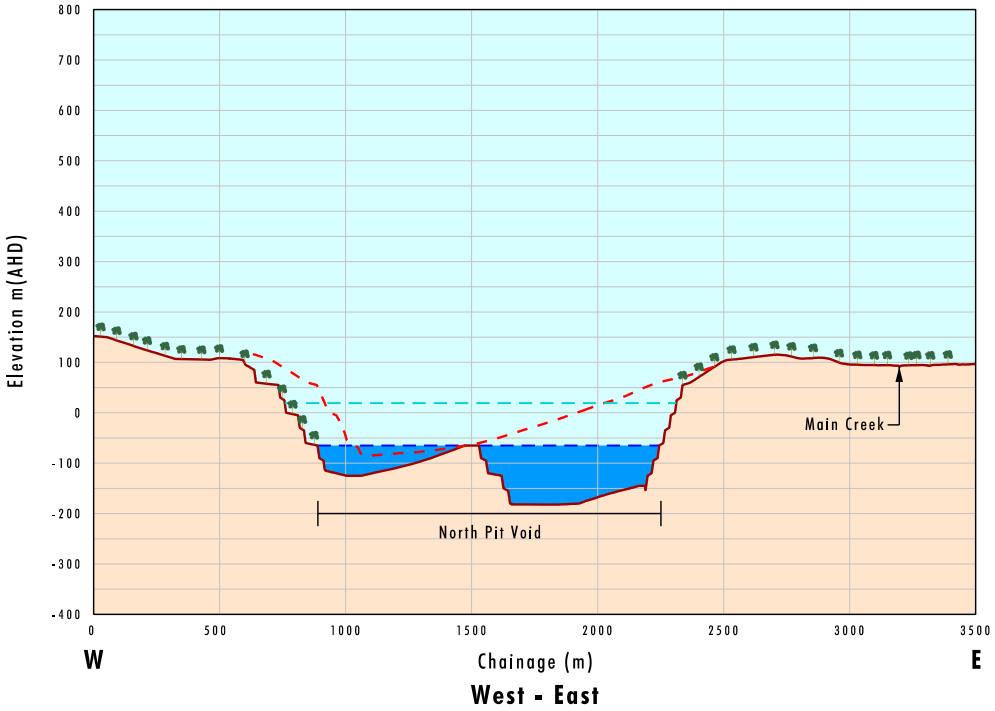
0 0.5 1.0 1.5km
Vertical Scale 1:30 000

FIGURE 2.6

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

File Name (A4): R09/3810_136.dgn
20180619 11.05





Legend

- Approved Operations (Void)
- Proposed Modification Final Landform Surface
- Modelled Maximum Water Storage Water Level - Approved Operations
- Modelled Maximum Water Storage Water Level - Proposed Modification
- Water Storage
- Woodland/Native Vegetation

0 0.5 1.0 1.5km
Horizontal Scale 1:30 000

0 250 500 1000m
Vertical Scale 1:15 000

Note: Vertical Exaggeration 2:1

File Name (A4): R09/3810_232.dgn
20180618 13.44

FIGURE 2.7

Indicative Comparison of Conceptual North Pit Approved and Proposed Final Void

3.0 Strategic Context

This section provides a description of the:

- target resource (including applicable mining tenements, target coal resource and exploration activities)
- Regional Context (including land use, biophysical, environmental and heritage constraints, and economic considerations), and
- Permissibility and Strategic Planning (including all relevant Commonwealth and State legislative requirements applicable to the Proposed Modification).

3.1 Target Resource

3.1.1 Mining Tenements

Details of the existing mining tenements relevant to the Proposed Modification are presented in **Table 3.1**. **Table 3.1** also presents the approved depths of each mining tenement shown on **Figure 3.1**.

Table 3.1 Mining Tenements Relevant to the Proposed Modification

Lease No	Expiry Date	Depth (m)
AL08/MLA512	Renewal pending/ML approval pending	Surface to 15.24 m
AUTH268	25/08/2022	Variable (213.36 to 243.84 m) to 25 m above Middle Liddell Seam
AUTH429	27/07/2019	Surface to 900 m
CL382	11/11/2033 – part transfer to Mount Owen pending	Variable (15 m to 213.36 m) to 900 m
CL 383	12/11/2033	Surface to unlimited depth
EL 5824	Renewal pending	Surface to 20 m
ML 1355	26/07/2033	Surface to unlimited depth
ML 1415	4/07/2020	15.24 m to variable (182.88 m to 213.36 m)
ML 1561	17/02/2026	Surface to 15.24 m
ML 1694	22/10/2034	Surface to variable (15 m to 213.36 m)

The granting of MLA512 is pending and the renewal of AL08 is also pending. Further, a mining lease application is required for a portion of EL5824. Mount Owen is in the process of preparing this mining lease application and will have the relevant mining lease in place prior to commencement of the Proposed Modification.

3.1.2 Exploration Activities

Mount Owen undertakes exploration and prospecting activities across the approved lease areas for the purposes of geotechnical, geological, geophysical, hydrogeological and gas investigations.

During 2016 a specific exploration program was completed within the acquired Integra Underground mining tenements which identified the presence of extractable coal reserves. In June 2017, additional drilling commenced to further define the geological structure and coal quality identified in the 2016 exploration program.

The geological data obtained from these drilling programs has been utilised to guide the development of the conceptual mine plans and also to inform the relevant specialist assessments undertaken to support the Proposed Modification.

3.1.3 Geology and Resource Description

The Mount Owen Complex is located within the Hunter Coalfields towards the north-eastern margins of the Permian and Triassic Sydney Basin. The Hebden Thrust is located in the proposed North Pit area. The Hebden Thrust and the Hunter Thrust constrain the extent of the coal seams to the east (refer to **Figure 3.2**). The Hebden Thrust has caused significant distortion of the coal seams resulting in different target coal sequences for the Approved Operations within the North Pit and the Ravensworth East pits (refer to **Figure 3.3**). The grade of the dips of the coal seams vary throughout the deposit, with some dips being steep (up to 45°) in the areas near the Hunter and Hebden Thrusts where parallel thrusts dislocate the seam by up to 40 m.

The coal seams within the North Pit and the Proposed Disturbance Area are located within the Jerrys Plains Subgroup and the Vane Subgroup (part of the Wittingham Coal Measures). The Jerrys Plains Subgroup outcrops within the North Pit and Proposed Disturbance Area and subcrops below the alluvium associated with Bettys Creek and Main Creek. The Jerrys Plains Subgroup comprises a sequence of coal seams interbedded with claystone, tuff, siltstone, sandstone, and conglomerate. Within the North Pit the relevant Jerrys Plains Subgroup coal seams include the Ravensworth and Bayswater Seams (refer to **Figure 3.3**).

The underlying Vane Subgroup is separated into the Archerfield Sandstone, a quartz lithic sandstone deposit and the Foybrook and Bulga Coal Measures. The Foybrook coal measures comprise coal bearing sequences with wedges of siltstone and sandstone. There are six main coal seams within the Vane Subgroup including the Lemington, Pikes Gully, Arties, Liddell, Barrett and Hebden Seams (refer to **Figure 3.3**).

Within the approved North Pit, coal is currently extracted from the Ravensworth Seams down to the Hebden Seams, with mining reaching depths of approximately 300 m below the current ground surface which varies in accordance with the mining lease limits previously applicable to the North Pit. The Proposed Modification proposes additional mining of the Vane Subgroup coal seams down to the floor of the Hebden Seam which is down to approximately 380 m below the current ground surface at the deepest point. As the Foybrook Formation coal seams dip to the west and become too deep, the Proposed Modification pit floor is designed with a series of steps, with mining proposed to the Hebden Seam in the east where the seam is shallower and stepping up to the Lemington Seam in the western parts of the Proposed Modification pit boundary.

The Approved Operations produces both thermal and semi-soft coking coal. The raw coal characteristics are as follows:

- seam thickness varies, with the maximum seam thickness being approximately 4 m and average seam thickness being 1 m;
- in situ ash levels have an average of 22.5% (ad); and
- calorific value levels are good for a coal-type at this ash level.

Based on the Proposed Modification targeting the same seams as the Approved Operations, the above coal characteristics will be consistent for the reserves mined within the additional areas of disturbance.

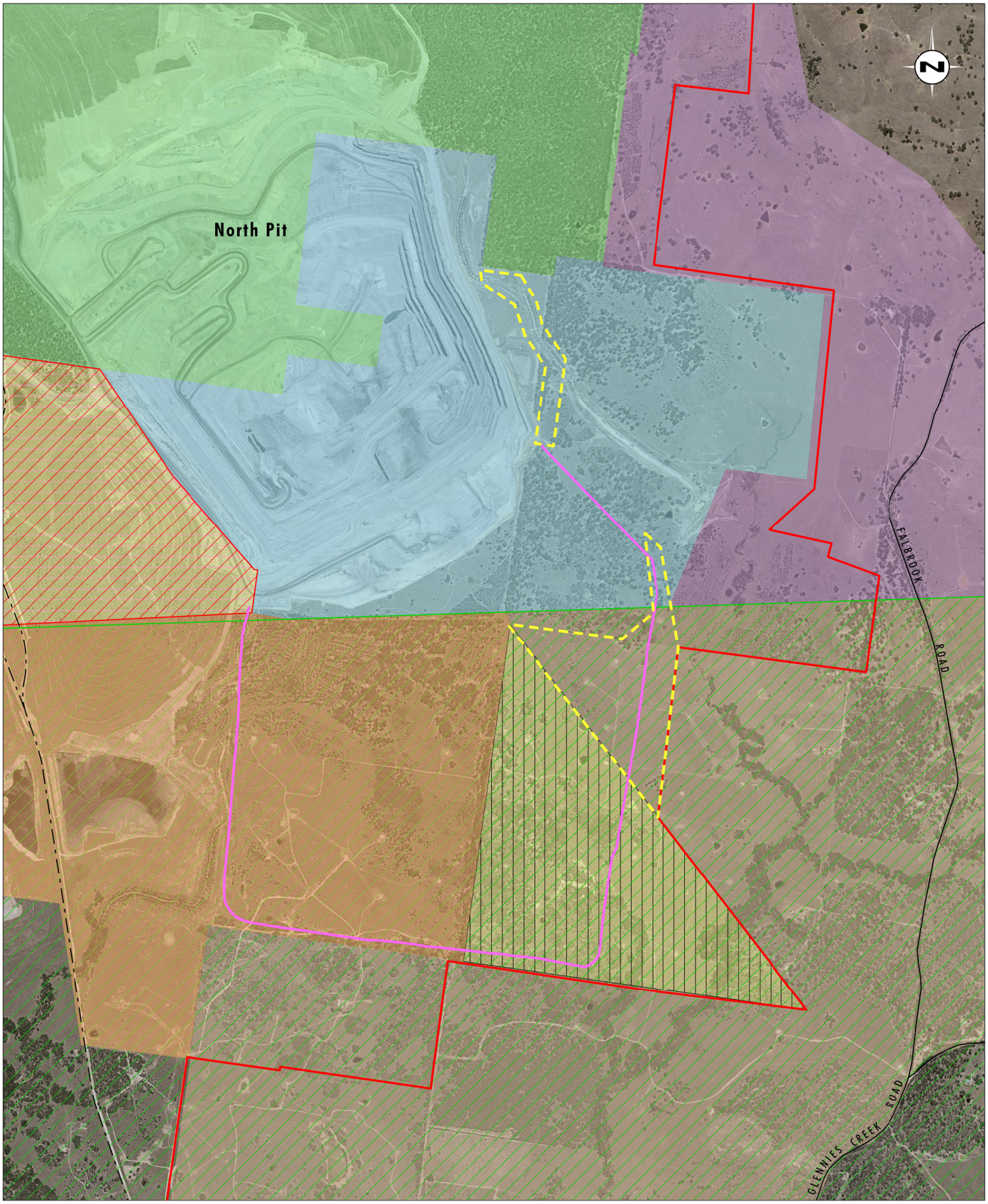


Image Source: Glencore (Feb 2017)
Data Source: NSW Department of Industry (2017), Glencore (2018)

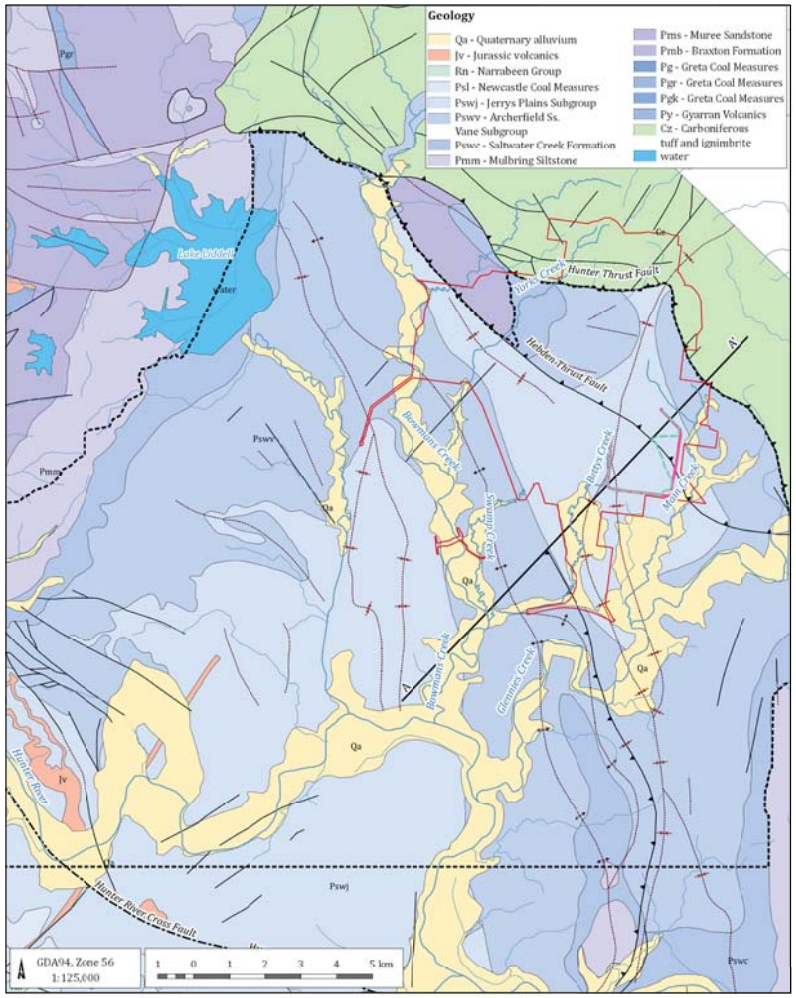
0 0.25 0.5 1.0km
1:25 000

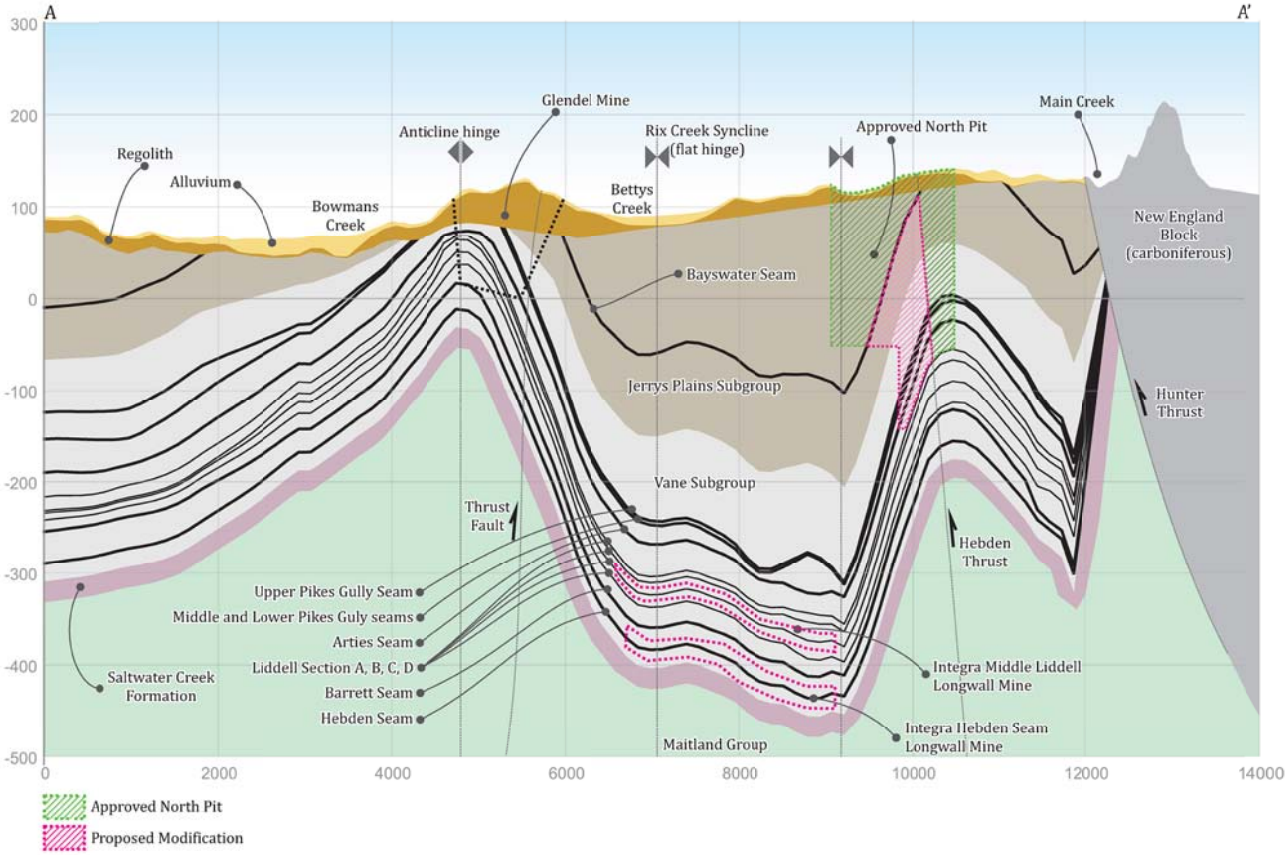
Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- AL08/MLA512
- AUTH268
- AUTH429
- CL382
- CL383
- EL5824
- ML1355
- ML1415
- ML1561
- ML1694

FIGURE 3.1

Mining Tenements Relevant to the Proposed Modification





Proposed SSD-5850 Modification consent boundary
Approved Operations pit shell boundary
Proposed Modification pit shell boundary
Model boundary
Alluvium extent
Cross section (A-A')
Thrust fault
Fault
Anticline
Syncline
Fold
Major drainage
Minor drainage

FIGURE 3.2

Regional Geology

Image Source: Glencore (2018), AGE (2018)

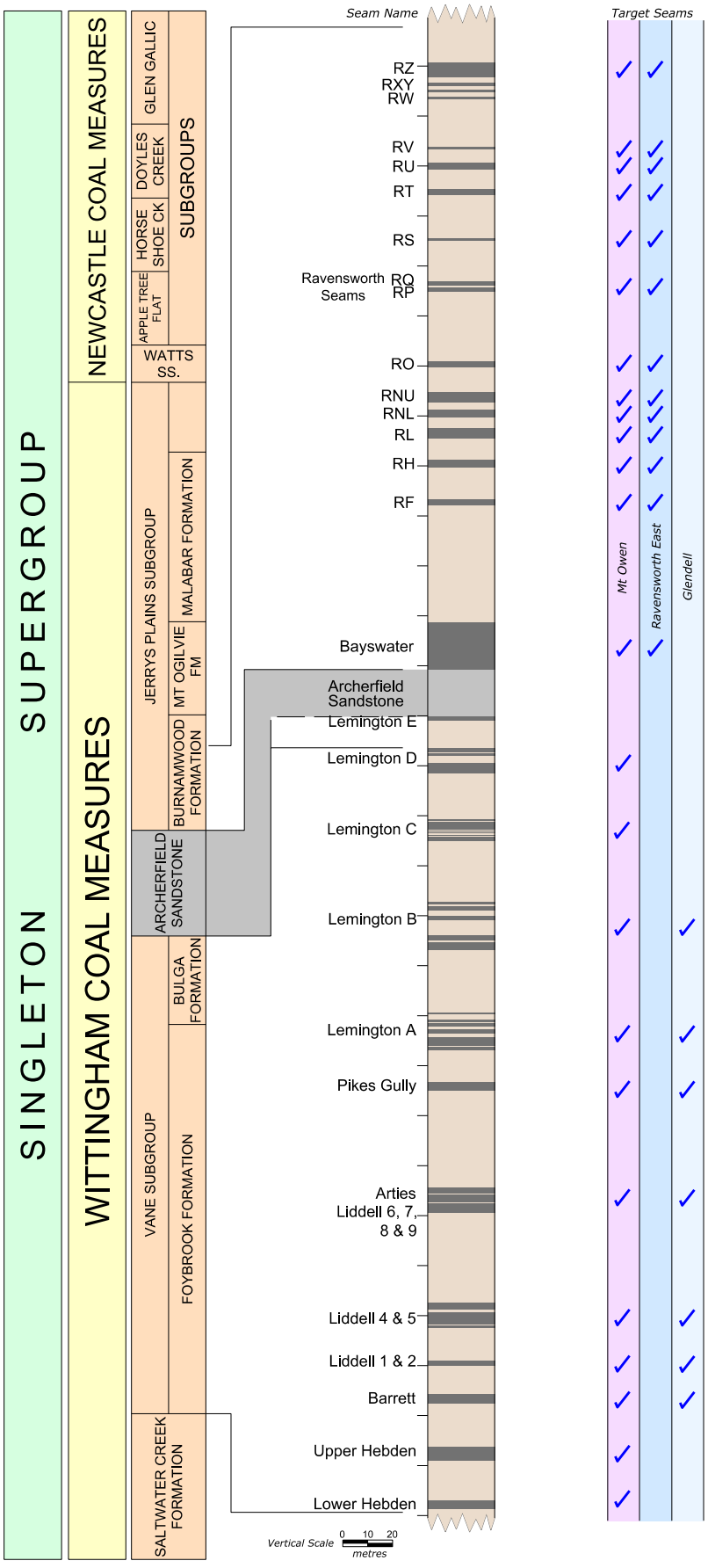


FIGURE 3.3

Stratigraphic Column

Source: Glencore (2017)

3.2 Regional Context

3.2.1 Land Use Constraints

The Proposed Disturbance Area has been historically used for agricultural purposes, including a disused olive plantation. The Proposed Disturbance Area is also used periodically for grazing by Glencore owned grazing operations. At a regional scale, the Proposed Disturbance Area is not mapped as Biophysical Strategic Agricultural Land (BSAL) (Upper Hunter Strategic Regional Landuse Plan 2012). Detailed soil assessments have been completed across the Proposed Disturbance Area and an assessment completed to inform a Site Verification Certificate (SVC) application to DPE. A SVC, confirming that the Proposed Disturbance Area does not constitute BSAL, was issued by DPE on 28 August 2017 (refer to **Appendix 3**). Based on this, and the small area of proposed disturbance, it is considered that the footprint of the Proposed Modification will not have a significant impact on agricultural land uses.

The immediate area surrounding the Mount Owen Complex is dominated by established mining operations including Liddell Coal Operations, Ravensworth Operations, Integra Underground Mine, Ashton Mine and Rix's Creek North (refer to **Figure 1.1**). Although large portions of land within and surrounding the Mount Owen Complex are owned by Glencore or other mining operations, there are a number of private residences located to the south and south-east of the North Pit in the Glennies Creek, Middle Falbrook and Bridgeman areas.

The location of existing private residences, including those private residences and private vacant land with current acquisition rights under existing development consents, are shown on **Figure 3.4**. The nearest private residences to the North Pit are located to the south-east and east of the Proposed Disturbance Area in Middle Falbrook with the closest residence located approximately 2 km (at the closest point) from the North Pit, consistent with the Approved Operations (refer to **Figure 3.4**).

A range of noise, air quality and blast control measures are currently implemented for the Approved Operations to minimise the impact of the mining operation to meet the relevant criteria at surrounding private residences. Mount Owen is committed to continuing this approach for the Proposed Modification and, as part of the development of the conceptual mine plans for the Proposed Modification, a number of revisions were made including:

- optimisation of pit geometry and overburden emplacement sequencing to enable placement of mining equipment lower in the dump and in pit during adverse meteorological conditions,
- re-design of overburden haulage routes from the pit to emplacement areas to maximise shielding from the pit crest and surrounding topography to limit noise emissions from the Proposed Modification. It is noted that this has resulted in approximately 1 Mt of viable coal reserves being left in the mining area to enable design of the haul roads within the eastern high wall of the North Pit,
- detailed review of production planning and mine sequencing to enable the incorporation of required operational controls (such as slowdown in mine progression, provision of low dump areas and, where required, selective mining equipment shut downs) during periods of adverse weather conditions, and
- detailed review of mine plan sequencing and slowing of proposed production in the latter years of the Proposed Modification to reduce noise impacts to meet the relevant criteria at surrounding private residences.

Whilst it is acknowledged that the Proposed Modification represents an extension to the Mount Owen Mine life and the associated impacts, the implementation of operational controls and the refinements to the mine plan indicate the noise, air quality and blast impacts associated with the Proposed Modification are consistent with the Approved Operations and mining can continue within the North Pit within the

existing criteria set under SSD-5850. Further detail regarding the noise and air quality operational controls is provided in **Sections 6.1** and **6.2** respectively.

Camberwell is located approximately 4.5 km from the southern boundary of the Proposed Modification pit boundary. The existing residences within Camberwell are either mine owned, have existing acquisition rights under approved mining development consents, or are predicted to exceed relevant noise and/or air quality criteria such that acquisition rights would be triggered under an approved mining development consent. In relation to the Ashton South East Open Cut (SEOC) Project, there is a discrepancy between the Environmental Assessment documentation and the development consent (MP 08_0182) issued with one residence identified as lot 24A and B in the Ashton SEOC Project development consent (identified as Res ID 152 for this SEE, refer to **Figure 3.4**) not being identified as being subject to acquisition rights.

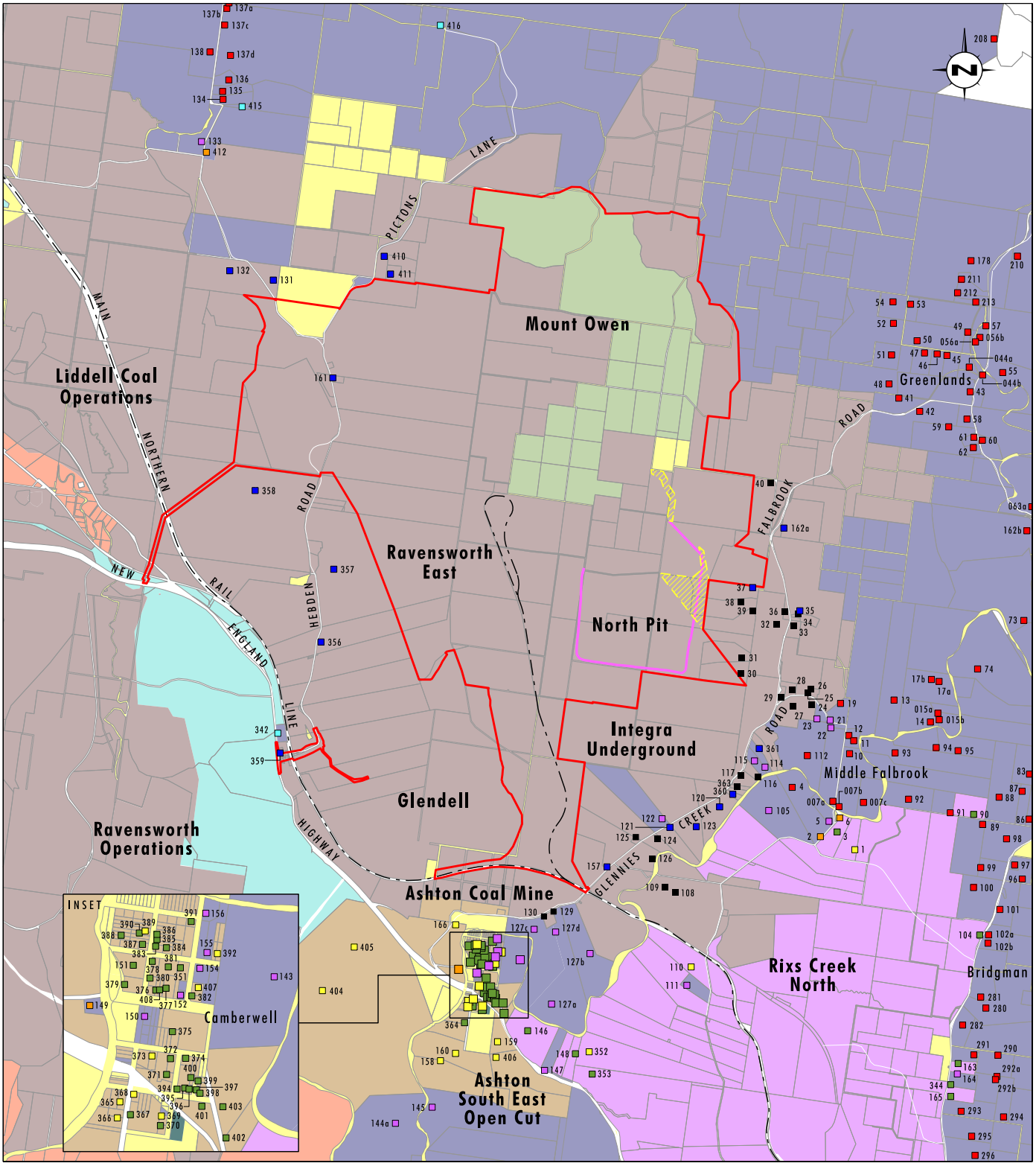
Nevertheless, the Environmental Assessment (Wells Environmental Services 2009), air quality impact assessment (PAE 2009) and noise impact assessment (Spectrum Acoustics 2009) for Ashton's SEOC Project state that the Ashton SEOC Project will result in exceedances of the relevant noise criteria for all properties within Camberwell for all years and air quality criteria for Year 1 of the Ashton SEOC Project that were subject to modelling, and identified all private properties as being within the Acquisition Zone for the Ashton SEOC Project. On this basis, Res ID 152 has been assumed to be subject to acquisition rights for this assessment.

It is also noted that Yancoal submitted a modification to the Ashton SEOC Project development consent in January 2017 requesting that a consent condition be included requiring notification of commencement of the Ashton SEOC Project and the modification of any consent condition specifying a date or inferred fulfilment of an obligation designed to control the impact of the Ashton SEOC Project be linked to the commencement of the project including relevant acquisition rights. The DPE requested a response to the submissions received during the exhibition of the modification in February 2017. Yancoal submitted a Response to Submissions Report to DPE for review dated March 2018, DPE recommended approval of the modification in June 2018 however due to the application receiving 35 objections during the exhibition period, DPE referred the application to the Independent Planning Commission (IPC) on 29 June 2018. At the time that this SEE was finalised no determination had been made. For the purpose of the Proposed Modification the Ashton SEOC Project has been considered as originally approved, where relevant to the completion of detailed assessments in **Section 6.0**.

Privately owned land is located to the north, north-east and north-west of the North Pit (over 6 km from the North Pit). As mining progresses to the south in the North Pit the active mining area will move further away from the existing residences in these locations.

In addition, a large portion of the land to the south and south-east of the Mount Owen Complex is owned by Bloomfield Collieries. Glencore owns an extensive area of land surrounding the majority of the Mount Owen Complex with some land to the immediate west owned by AGL Macquarie. Mount Owen own all the land within the Proposed Disturbance Area. Land within the SSD-5850 consent boundary is comprised of mine owned land, Crown Land, State Forest and government authority or corporation owned land as detailed on **Figure 3.4**.

The Integra Underground Mine is located immediately adjacent to the Mount Owen Complex with the south-west corner of the North Pit overlapping the northern end of the Integra Underground Mine workings (refer to **Figure 1.2**). The minimum separation distance of 250 m between the proposed North Pit floor and the approved Integra Underground mining operations will be maintained as part of the Proposed Modification. Operational and safety measures currently implemented on site will continue and will be enhanced through the common ownership of these mining operations by Glencore.



Data Source: Glencore (2018)

0 1 2 4 km

Scale 1:90 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Ashton Coal
- Bloomfield Collieries
- Coal and Allied
- Crown Land
- Glencore
- Government Authority
- AGL Macquarie
- Private
- State Forest
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 3.4

Land Ownership

File Name (A4): R09/3810_194.dgn
20180618 9.37

3.2.2 Biophysical, Environmental and Heritage Constraints

As outlined above and shown on **Figure 1.1**, the areas surrounding the Proposed Modification have been subject to historical disturbance associated with agricultural land uses and, in the last 30 years, coal mining developments. The Ravensworth State Forest is located within the north-eastern corner of the SSD-5850 consent boundary and surrounding the State Forest and adjoining the Proposed Disturbance Area is the existing Mount Owen Biodiversity Offset Areas (refer to **Figure 1.2**). Mount Owen is committed to maintaining the existing offset areas and has restricted the Proposed Disturbance Area to avoid disturbance within these areas.

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 (Umwelt 2014). The extant forest and woodland in the Proposed Disturbance Area is majority 'regrowth' or logged 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 majority of the Proposed Disturbance Area comprises low quality and disturbed vegetation in the form of derived native grasslands and an olive plantation (refer to **Section 6.6.1** for further description of site vegetation).

The topography of the Mount Owen Complex is characterised by an undulating and hilly landscape extending to lower areas associated with surrounding creek lines. The Proposed Disturbance Area is generally gently undulating and slopes east towards Main Creek. The topography of the Proposed Disturbance Area does not pose any constraints to mining operations or associated water management infrastructure.

In addition, the topography surrounding the Mount Owen Complex includes a ridgeline extending north to south through the north-eastern and eastern extent of the SSD-5850 consent boundary to a height of approximately 385 mAHD. The majority of the residences located within the Falbrook and Middle Falbrook area are located on the eastern side of this ridgeline and as such there is an extent of topographical shielding provided in relation to visual, air quality and noise impacts associated with the mining operations.

The Mount Owen Complex is located within the catchments of Bowmans Creek and Glennies Creek, both of which flow into the Hunter River to the south of the Mount Owen Complex (refer to **Figure 3.5**). Bowmans Creek catchment is located in the north and west portions of the Mount Owen Complex, while Glennies Creek catchment is located in the east and south. Main Creek (a tributary of Glennies Creek) flows for a short section through the Mount Owen Complex, to the east of the Proposed Disturbance Area and then into Glennies Creek to the south-east of the Mount Owen Complex. The Proposed Disturbance Area falls within the Bettys Creek and Main Creek catchments only. The approved mining operation has modified the local catchments of Bettys, Swamp and Yorks Creeks within the Mount Owen Complex through the capture of runoff from mining areas and diversion of upslope runoff around the mining operations. Further detail on the catchments within and surrounding the Proposed Disturbance Area is provided in **Sections 6.4** and **6.5**.

As discussed in **Section 2.2**, the Proposed Disturbance Area extends the North Pit shell further east towards Main Creek and associated alluvium. The alluvium mapping originally utilised by Jacobs Pty Ltd (Jacobs) to support the groundwater impact assessment for the Continued Operations Project was established using the NSW Aquifer Interference Policy (AIP) Highly Productive Alluvium Maps (2013), which were further refined by Jacobs through the geospatial interpretation of available LiDAR data. To inform the development of the conceptual mine plans and the groundwater impact assessment undertaken to support the Proposed Modification further detailed survey and assessment of the upper reaches of Main Creek has been completed to confirm and map the extent of the Main Creek alluvium, based on site specific assessments.

As outlined in **Section 6.4**, the assessment of the extent of alluvium included review of available published data sets, in addition to detailed fieldwork comprising geophysical survey and targeted test pits. The previous extent of Main Creek alluvium mapped by Jacobs and the confirmed extent of the Main Creek alluvium varies, with a comparison of the two alluvium extents provided on **Figure 3.6.**

In addition to informing design of the Proposed Modification, the confirmed extent of the Main Creek alluvium has been utilised to inform the relevant specialist assessments undertaken to support the Proposed Modification. The depth of the Main Creek and Bettys Creek alluvium was also confirmed through targeted test pits and review of monitoring data from the existing groundwater monitoring network, including additional monitoring locations established under SSD-5850, as detailed in **Section 6.4**.

Extensive archaeological investigation and survey has been undertaken within and around the Proposed Disturbance Area in relation to the Continued Operations Project, the previous Mount Owen and Ravensworth East consents and the Glendell Mine consent. The Proposed Disturbance Area has been subject to further archaeological survey and assessment as part of the Proposed Modification which identified one previously recorded Aboriginal site, and did not identify any new sites in the Proposed Disturbance Area (refer to **Section 6.7** for further detail).

No historic heritage sites/items with statutory heritage listings are located within the Proposed Disturbance Area. In addition, none of the identified listed heritage items within the vicinity of the Mount Owen Complex (refer to **Section 6.3.1**) were found to be directly or indirectly impacted as part of the Approved Operations or the Proposed Modification.

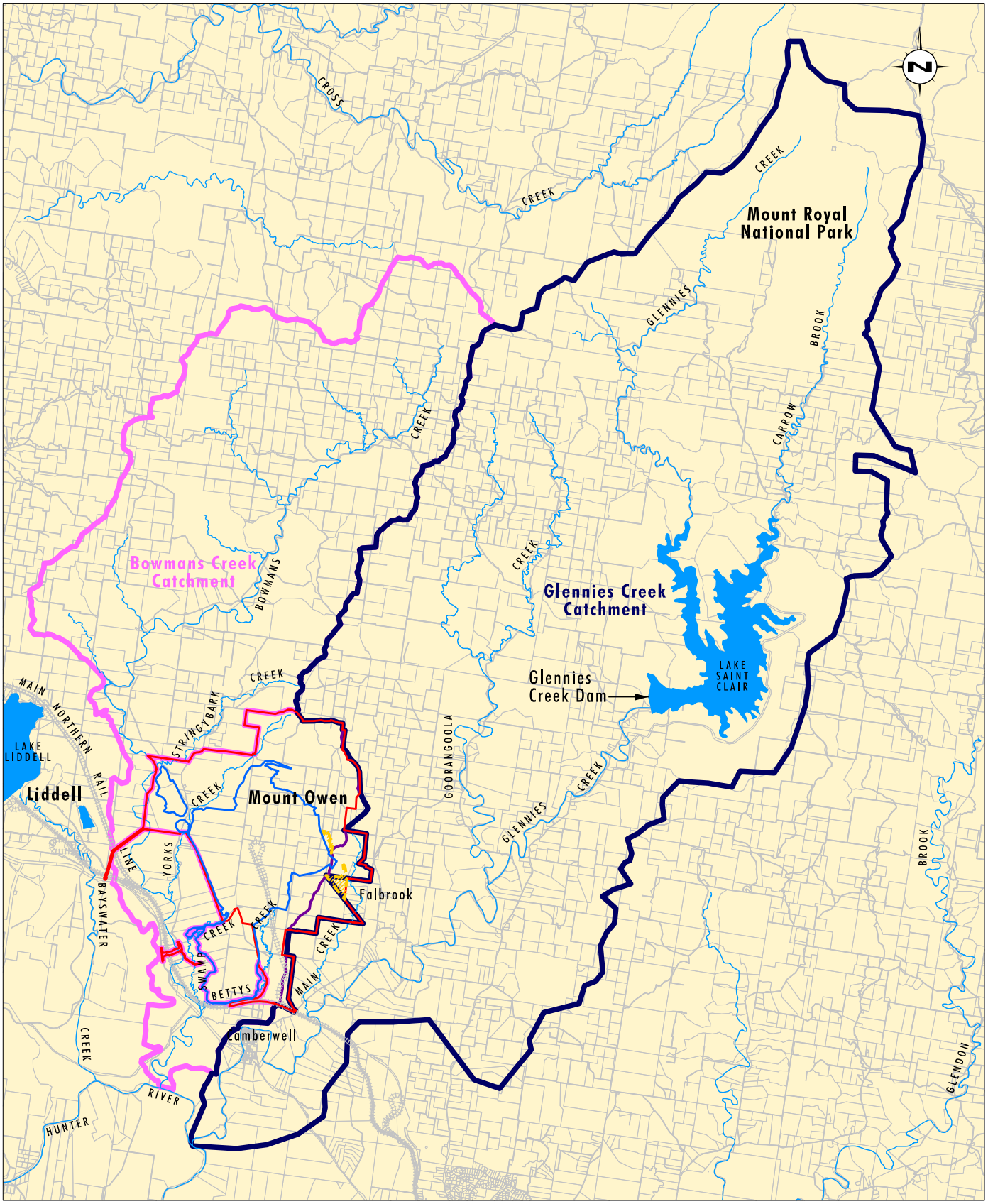
3.2.3 Economic Considerations

Mount Owen has considered a range of constraints to inform the development of the conceptual mine plans to minimise environmental and social impacts whilst maximising the economic benefit of the Proposed Modification. It is considered that the proposed open cut mining method and the progression of mining proposed by the conceptual mine plans is the most economically viable option based on the current progression of approved mining operations and the location of the acquired mining tenements.

As noted in **Section 1.0**, the economic importance of the target resource, and the importance of not sterilising substantial and accessible coal reserves was previously raised by DRE (now DRG) through the assessment of the Continued Operations Project. The Proposed Modification also has the added benefit of utilising the approved Mount Owen Complex infrastructure, with only minor additional water management and other minor ancillary infrastructure required. In addition, the Proposed Modification includes a proposed extension of mining operations at the Mount Owen Mine through to 2037, extending employment for a workforce of up to approximately 660 people to that time.

As discussed in **Section 3.2.1** the proposed conceptual mine plans have undergone refinement through the environmental assessment process to reduce associated environmental impact particularly in relation to air quality and noise impacts. These refinements included detailed economic considerations requiring balance between the reduction of the environmental impact (ultimately resulting in reducing overall coal production from the additional mining area) against the economic viability of the Proposed Modification. The relevant alternatives considered during the development of the Proposed Modification are discussed in **Section 5.0.**

The Cost Benefit Analysis (CBA) undertaken to support the Proposed Modification confirmed that when all potential costs and benefits were considered, the Proposed Modification would generate a net economic benefit of $52.9 million to NSW and royalties of an estimated $59 million in net present value terms to the NSW Government. The economic assessment undertaken to support the Proposed Modification is discussed further in **Section 6.12**.



Data Source: Glencore (2018), Geoscience Australia (2006), LPI (2017)

0 2.5 5.0 10.0km

1:200 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Water Management System Catchment Boundary
- Glennies Creek Catchment Area
- Bowmans Creek Catchment Area
- Intersection of Catchment Boundary
- Cadastre
- Railway
- Drainage Line

FIGURE 3.5

Catchment Context

File Name (A4): R09/3810_209.dgn
20180704 17.40

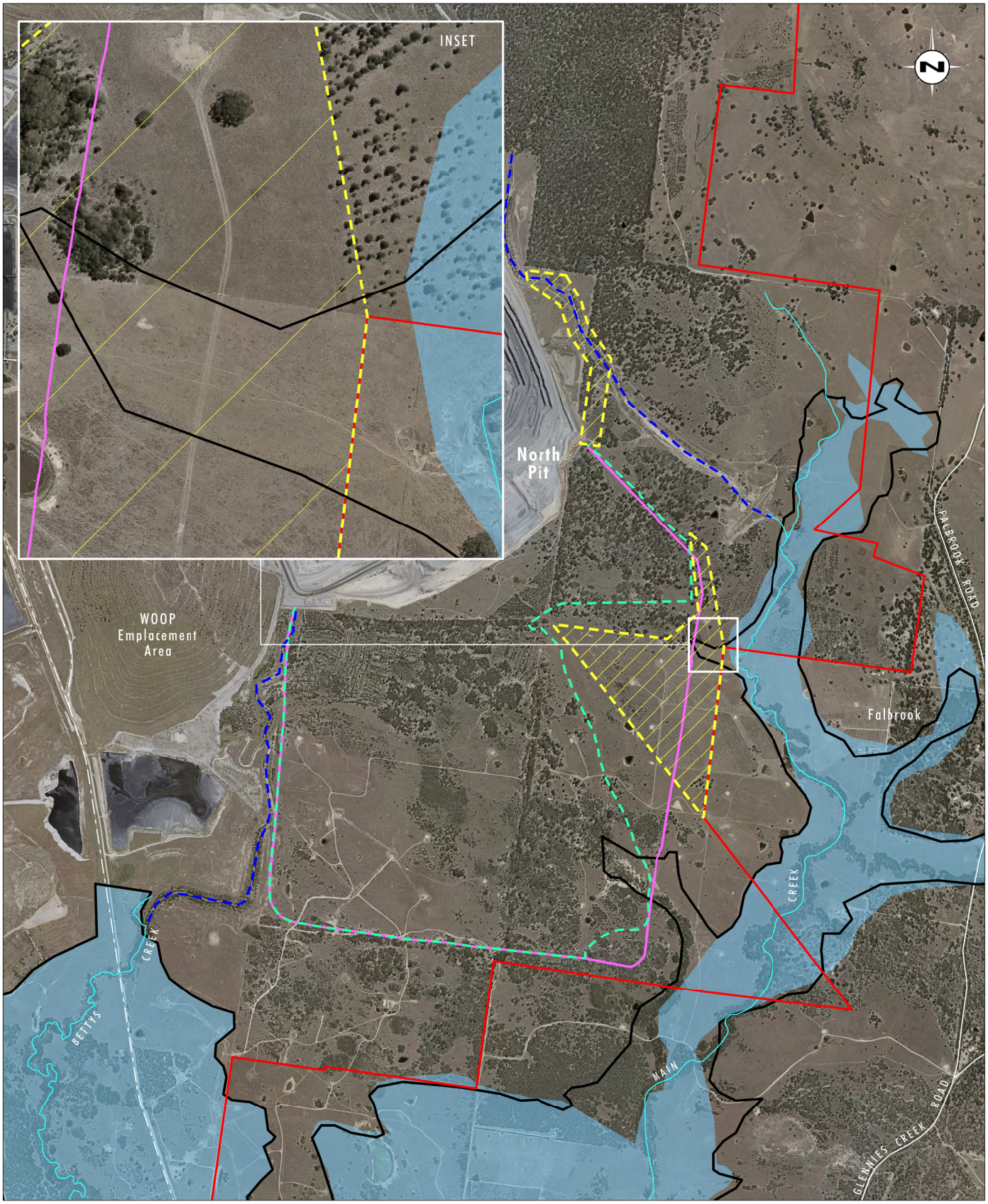


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

0 0.25 0.5 1.0km
Main Scale 1:25 000

0 25 50 100m
Inset Scale 1:2 500

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Drainage Line
- Existing Bettys Creek Diversion
- Mapped Alluvium (Jacobs 2014)
- Refined Alluvium Mapping (AGE 2017)

FIGURE 3.6

Refined Alluvium Mapping

File Name (A4): R09/3810_195.dgn
20180621 10.33

3.3 Permissibility and Strategic Planning

This section identifies relevant Commonwealth and State Legislation and discusses the application of these planning provisions to the Proposed Modification.

3.3.1 Commonwealth Legislation

Table 3.2 provides a review of the relevant Commonwealth environment and planning legislation and its relevance to the Proposed Modification.

Table 3.2 Summary of Commonwealth Legislation and Relevance to the Project

Planning Provision	Comment	Approval Required?
Environment Protection and Biodiversity Conservation Act 1999 **(EPBC Act)**	The EPBC Act is the primary environmental and planning regulatory instrument relevant to the Proposed Modification at a Commonwealth level. 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 any matters of national environmental significance (MNES). MNES are as follows: • World Heritage property • National heritage place • wetlands of international importance (listed under the Ramsar Convention) • threatened species and communities listed under the EPBC Act • migratory species listed under the EPBC Act • nuclear actions • marine areas or reserves • a water resource, in relation to coal seam gas development and large coal mining development, and • Commonwealth land. Detailed ecological and water resources assessments were undertaken to support the Proposed Modification which have concluded that the Proposed Modification would not have a significant impact on relevant MNES. The aspects of the Proposed Modification that are not the subject of the existing EPBC Act approval for the Continued Operations Project or are otherwise exempt from Act (Action), were referred to DoEE in October 2017 to determine whether or not the Action was a controlled action. In December 2017, the referred Action was determined not to be a controlled action and therefore does not require additional approval under the EPBC Act. As such, no further assessment of MNES is required. A copy of the determination is provided in **Appendix 4.**	No

Planning Provision	Comment	Approval Required?
Native Title Act 1993	The *Native Title Act 1993* is administered by the National Native Title Tribunal. The Tribunal is responsible for maintaining a register of native title claimants and bodies to whom native title rights have been granted. These native title holders and claimants must be consulted prior to the granting of a mining lease over land to which the native title claim or right applies. This Act prescribes that native title can be extinguished under certain circumstances, including the granting of freehold land. The *Native Title Act 1993* has implications for the grant of mining leases under the *Mining Act 1992* where there is potentially claimable land within the lease application area. There is no Crown land within the Proposed Disturbance Area. Further, a Native Title Extinguishment Assessment has been completed by Mount Owen for landholdings within the Mount Owen Complex, including the Proposed Disturbance Area. This assessment has confirmed that Native Title has been extinguished for all land parcels within the Proposed Disturbance Area.	No

3.3.2 New South Wales Legislation

3.3.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the primary legislation governing environmental planning and assessment for NSW. The Proposed Modification is characterised as being 'coal mining' and is therefore considered State Significant Development as defined by the provisions of the State and Regional Development State Environmental Planning Policy (SRD SEPP) and requires development consent under Part 4 of the EP&A Act. The Independent Planning Commission (formerly Planning Assessment Commission) is the consent authority for State Significant Development where certain objections and disclosures referred to in subclause 8A (1) of the SRD SEPP are made in respect to an application. For State Significant Development where such objections and disclosures are not made the Minister for Planning is the consent authority (section 4.5(a) of the EP&A Act).

As discussed in **Section 1.0**, it is proposed to modify the existing development consent SSD-5850 for the Continued Operations Project under section 4.55(2) of the EP&A Act. This assessment pathway was confirmed through consultation with DPE during the preparation of the SEE and is documented in a letter from DPE contained in **Appendix 5**. Further details regarding this approval pathway are provided below.

Section 4.55(2)(a) states that *a consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the consent authority and subject to and in accordance with the regulations, modify the consent if it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which consent was originally granted and before that consent as originally granted was modified (if at all). Modifications sought under Section 4.55(2) must be substantially the same development for which the consent was originally granted.*

The Proposed Modification is considered to be substantially the same development as that approved under SSD-5850 as:

- the overall nature and scale of the development remains similar to the Approved Operations,
- there is no change to approved production limits, mining methods, coal processing, product transportation or operating hours,
- the majority of the development remains unchanged from that which is approved,

- the environmental impacts associated with the Proposed Modification are substantially the same as the Approved Operations, and
- the Proposed Modification meets the relevant criteria of SSD-5850 for noise and the revised criteria for Air Quality at surrounding private receivers.

Following an initial briefing regarding the Proposed Modification, DPE confirmed via correspondence in April 2017 (refer to **Appendix 5**) that the DPE agreed that Glencore could lodge the Proposed Modification for assessment under Section 96(2) (now 4.55(2) of the EP&A Act).

Permissibility

The Minister cannot approve the carrying out of a State Significant Development that would be wholly prohibited under an environmental planning instrument. The Proposed SSD-5850 Modification Consent Boundary is located wholly within the area to which the Singleton Local Environmental Plan (LEP) 2013 applies. Under the Singleton LEP (Singleton Council 2013a) the whole of the land on which the Proposed Modification is proposed to be carried out is zoned Rural RU1 Primary Production. Both coal mining and agriculture are permissible land uses within the Rural RU1 Primary Production zone under the Singleton LEP, and therefore the Proposed Modification is permissible with consent.

There are no other environmental planning instruments that regulate the permissibility of mining in the Proposed Disturbance Area except to the extent that the operation of the Singleton LEP in relation to mining is constrained by the State Environmental Planning Policies, which prevail over LEPs to the extent of any inconsistency.

The State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) also provides that mining is permissible where agriculture is also permissible under the provision of an Environmental Planning Instrument.

3.3.2.2 Assessment Requirements

Under section 4.55(3) of the EP&A Act in determining an application for the modification of development consent, the consent authority must take into consideration such of the matters referred to in Section 4.15(1) as they are of relevance to the development. These matters for consideration by the consent authority and the sections where they are addressed in this SEE are provided in **Table 3.3**. **Section 6.0** includes an assessment of relevant environmental impacts associated with the Proposed Modification to determine the level of assessment completed to support the SEE. This has been completed to satisfy the relevant requirements of Section 4.15, and also the assessment guidance provided by DPE dated 11 April 2017 (refer to **Appendix 5**).

Table 3.3 Section 4.15 Matters for Consideration

Matters for Consideration	Relevant SEE Section
(i) any environmental planning instrument	Section 3.3.3
(ii) 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 Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and	Section 3.3.3
(iii) any development control plan,	Not Applicable based on SSD provisions refer to Section 3.3.3

Matters for Consideration	Relevant SEE Section
(iiia) any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4	Section 6.0
(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph),	Table 3.4 below
(v) any coastal zone management plan (within the meaning of the *Coastal Protection Act 1979*),	Not applicable - the Proposed Modification is not subject to any coastal zone management plan
(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality	Section 5.0
(c) the suitability of the site for the development,	Sections 3.0, 5.0 and 7.0
(d) any submissions made in accordance with this Act or the regulations	NA
(e) the public interest	Sections 5.0 and 7.0

Additionally, under Section 4.55(3) the consent authority must also take into consideration the reasons given by the consent authority for the grant of the consent that is sought to be modified.

The Continued Operations Project was referred to the NSW Planning Assessment Commission (PAC) for determination in accordance with the Minister for Planning's delegation. In concluding the Continued Operations Project could be approved, key considerations raised by the PAC Determination Report for the Continued Operations Project (November, 2016) were:

- biodiversity, final landform and rehabilitation outcomes.
- potential air quality impacts had been adequately addressed and would be appropriately managed by the conditions of consent.
- the final cost benefit analysis demonstrated the Project would provide material benefits to the local area and NSW
- potential impacts on water resources can be appropriately managed and licensed.
- noise impacts and Aboriginal Cultural Heritage were addressed and can be appropriately managed through the conditions of consent.

All of the above mentioned key considerations of the PAC, have been addressed in detail in **Section 6.0**.

This SEE has been prepared in consideration of the factors identified in Section 4.55 of the EP&A Act, clause 115 of the EP&A Regulation and in accordance with advice provided by DPE on 11 April 2017 following an initial briefing regarding the Proposed Modification confirming the approval pathway under Section 4.55(2) of the EP&A Act (refer to **Appendix 5**).

This consultation letter also stated that the *SEE for the proposed modification should build upon the contemporary baseline data provided in the EIS for the MOCO Project, to inform the assessment of the potential impacts of the modification, paying particular attention to the relative changes under the modification and any increase in potential impacts. Glencore will also be required to update the relevant technical studies (including air quality, noise, biodiversity and water modelling/assessments) to meet contemporary assessment standards and ensure that any changes in impacts under the modification are clearly identified*.

In addition, since the completion of the EIS for the Continued Operations Project, the NSW Government has released a number of revised assessment guidelines and policies, in addition to major legislative reforms that are relevant to mining projects. Throughout the completion of the SEE Mount Owen has sought confirmation from DPE on the application of this evolving legislative and policy framework to the completion of studies relating to the application of:

- the *Biodiversity Conservation Act 2017*
- the Noise Policy for Industry 2017, and
- the Social Impact Assessment Guidelines 2017.

Copies of these consultation letters are contained in **Appendix 5** with further explanation of the relevance to the assessments provided in **Section 6.0.**

3.3.3 Environmental Planning Instruments

The environmental planning instruments applicable to the Proposed Modification are discussed in the following section.

3.3.3.1 State Environmental Planning Policies

The following State Environmental Planning Policies are relevant to the consideration of the development application for the Proposed Modification.

State Environmental Planning Policy (State and Regional Development) 2011

The SRD SEPP identifies development to which the State Significant Development assessment and determination process under Part 4 of the EP&A Act applies. As discussed in **Section 3.3.2**, the Proposed Modification is for the purpose of coal mining and is State Significant Development as defined by the provisions of the SRD SEPP and requires development consent under Part 4 of the EP&A Act.

The Independent Planning Commission is the consent authority for State Significant Development where certain objections and disclosures referred to in subclause 8A (1) of the SRD SEPP are made in respect to an application. For State Significant Development where such objections and disclosures are not made the Minister for Planning is the consent authority (section 4.5(a) of the EP&A Act).

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

Part 3 of the Mining SEPP requires specific matters to be considered in relation to development applications for applications that will affect existing or proposed mining operations. These requirements are set out below, and the section of the SEE in which each matter is addressed is shown in bold, where relevant.

Clause 12AB of the Mining SEPP identifies non-discretionary development standards for mining and provides that the consent authority cannot impose more onerous standards in any approval in relation to the matters covered by the development standard. The prescribed criteria are summarised below in italics, with the relevant assessment outcomes noted below each criteria in normal type.

Cumulative Air Quality

> *The development does not result in a cumulative annual average level greater than 30 µg/m^3 of PM_{10} for private dwellings*.

The Air Quality Impact Assessment (AQIA) (refer to **Section 6.1**) identifies that the air quality impacts associated with the Proposed Modification are consistent with the Approved Operations. No additional property acquisitions are required as a result of the Proposed Modification.

The Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA 2016) has introduced revised criteria for PM_{10} (25 µg/m^3) and established criteria for $PM_{2.5}$ (8 µg/m^3). The Proposed Modification has also been assessed against these revised criteria as detailed in **Section 6.1**.

Modelling results (refer to **Section 6.1** and **Appendix 6**) indicate several properties in Camberwell with existing acquisition rights have been identified as potentially experiencing PM_{10} concentrations above 25 µg/m^3 in the future, where current levels may be below 25 µg/m^3. At all of these locations the contribution from the Proposed Modification is predicted to be very low at less than 2 µg/m^3. Modelling also indicates that with the Proposed Modification, the relevant $PM_{2.5}$ criteria can be met at surrounding private residences without existing acquisition rights.

Cumulative Noise Level

> *The development does not result in a cumulative amenity noise level greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings.*

The Proposed Modification meets all relevant noise criteria as outlined in Table 2.1 of the NSW Industrial Noise Policy (EPA 2000) (INP) as detailed in **Section 6.2**.

It is noted that amendments to this clause of the Mining SEPP have recently been exhibited and as such constitute a Draft SEPP for the purpose of Section 4.15 of the EP&A Act. The amendments introduced in the Draft Mining SEPP seek to update this clause to reflect the recently released Noise Policy for Industry (EPA 2017) (NPfI). As outlined above, DPE has confirmed that the provisions of NPfI do not apply to the Proposed Modification as the current requirements of the INP continue to apply to the assessment (refer to **Appendix 7**). Notwithstanding, these amendments to the Mining SEPP have the same intent as that outlined above under the INP and as such the noise impact assessment (refer to **Section 6.2**) enables assessment against both the existing and draft SEPP as required by Section 4.15 of the EP&A Act.

Airblast Overpressure

> *Airblast overpressure caused by the development does not exceed:*
>
> *(a) 120 dB (Lin Peak) at any time, and*
>
> *(b) 115 dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months,*

Blasting activities associated with the Proposed Modification will be designed such that the criteria as outlined above will not be exceeded (refer to **Section 6.3**).

Ground Vibration

> *ground vibration caused by the development does not exceed the following at any private dwelling or noise sensitive receiver:*
>
> *10 mm/sec (peak particle velocity) at any time;*
>
> *5 mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months*

Blasting activities associated with the Proposed Modification will be designed such that the criteria as outlined above will not be exceeded (refer to **Section 6.3**).

Aquifer Interference

> *any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified in item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy (AIP) for each relevant water source listed in column 1 of that table.*

The Main Creek and Bettys Creek alluvial aquifers are considered less productive alluvial water sources (under the NSW Aquifer Interference Policy (DTI 2012) (AIP), due to their low natural flow volumes (considered insufficient to yield more than 5 L/sec from a bore) and water quality (TDS > 1500 mg/L) (refer to **Section 6.4**).

The Groundwater Impact Assessment (GWIA) undertaken to support the Proposed Modification included further comprehensive refinements and calibration of the groundwater model developed for the Continued Operations Project (refer to **Section 6.4.3**). As detailed in **Section 6.4.3**, the refinements to the model were informed through further calibration of groundwater within the greater Ravensworth region, including data from additional monitoring locations established as part of the Approved Operations and detailed geological data not previously available.

The refinement for the GWIA has resulted in the predicted impacts to nearby alluvium aquifers being substantially less than that predicted for the Approved Operations. This outcome of the refined modelling is consistent with data obtained from the existing groundwater monitoring program which identifies that existing mining operations have a negligible effect on alluvial aquifers in proximity to Mount Owen Complex. It is noted that there remains an element of conservatism in the refined groundwater model outputs, but notwithstanding the modelling indicates that the Proposed Modification will have negligible impacts on the nearby alluvial aquifer systems.

A summary of the results of the GWIA in relation to the minimal harm criteria for both the alluvial and hard rock water sources relevant to the Proposed Modification is provided in **Section 6.4.6**.

12 Compatibility of proposed mine, petroleum production or extractive industry with other land uses

Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider:

> *i) the existing uses and approved uses of land in the vicinity of the development, and*
>
> *(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
>
> *(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*
>
> *(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and*
>
> *(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).*

As previously discussed, the Proposed Modification relates to the modification of the existing Approved Operations which has been coexisting with neighbouring land uses since the original Mount Owen Mine approval in the early 1990s and mining dates back to the early 1960s within the Mount Owen Complex. The surrounding land use is largely dominated by other mining operations and the Proposed Modification has been designed with consideration of the compatibility with surrounding land uses. There has been

extensive iterative mine plan design to minimise the impact of the Proposed Modification on surrounding land uses. The compatibility of the Proposed Modification with surrounding land uses is considered in more detail in **Section 3.2** and **Section 6.0**.

12A Consideration of voluntary land acquisition and mitigation policy

(2) Before determining an application for consent for State significant development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider any applicable provisions of the voluntary land acquisition and mitigation policy and, in particular:

(a) any applicable provisions of the policy for the mitigation or avoidance of noise or particulate matter impacts outside the land on which the development is to be carried out, and

(b) any applicable provisions of the policy relating to the developer making an offer to acquire land affected by those impacts

The Continued Operations Project was assessed in accordance with the current Voluntary Land Acquisition and Mitigation Policy (NSW Government 2014) (VLAMP). The air quality and noise modelling results indicate that the impacts associated with the Proposed Modification are consistent with the Approved Operations. Therefore the current acquisition and mitigation conditions in SSD-5850 continue to apply, which include:

Acquisition upon request:

Upon receiving a written request from the owner of any land listed in Table 1, the Applicant must acquire the land in accordance with the procedures in conditions 5 and 6 of Schedule 4.

Table 1 – Land subject to acquisition upon request

Acquisition Basis	*Land[a]*
Air Quality	*105[b], 114, 115, 116[d], 133[c]*
Noise	*21, 22, 23*

Notes:

a The location of the land referred to in Table 1 is shown on the figure in Appendix 3.

b 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.

c The Applicant is only required to acquire Lot 31 DP6842 and Lot 2 DP1175728 within property 133.

d Property acquired by Mount Owen

Additional Mitigation Upon Request:

Upon receiving a written request from the owner of any residence listed in Table 1 or Table 2, the Applicant must implement additional mitigation measures at the residence, in consultation with the landowner, in respect of the basis on which that residence is identified in Table 1 or Table 2.

These measures must be reasonable and feasible, and directed towards reducing the air quality and/or noise impacts of the development on the residence. In the case of air quality, mitigation may include measures such as air filters, a first flush drainage system and/or air conditioning. In the case of noise, mitigation may include measures such as double-glazing, insulation and/or air conditioning.

If within 3 months of receiving this request from the owner, the Applicant and the owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.

Table 2 – land subject to additional mitigation upon request

Mitigation Basis	*Residence*
Noise	*12, 19, 93*

A draft revised VLAMP is currently under review (NSW Government 2017) coupled with amendments to the Mining SEPP to give effect to these changes. The draft VLAMP refines the application of this policy to modifications of consent and states:

The policy commences from the date that it is gazetted, and applies to:

- *Modification applications that involve increases in the approved dust or noise impacts of a development.*

As demonstrated by the air quality and noise modelling results (refer to **Sections 6.1** and **6.2**), the Proposed Modification is not predicted to result in increased impacts to any areas of privately owned land not already subject to acquisition rights relative to the Approved Operations. Accordingly, at the point that the revised VLAMP is gazetted, it will not apply to the assessment of the Proposed Modification.

As such, this assessment only considers the requirements of the existing VLAMP (2014) as it applies to the Proposed Modification.

13 Compatibility of proposed development with mining, petroleum production or extractive industry

Clause 13 requires the consent authority to consider development on land that is, immediately before the application is determined:

(a) in the vicinity of an existing mine, petroleum production facility or extractive industry, or

(b) identified on a map (being a map that is approved and signed by the Minister and copies of which are deposited in the head office of the Department and publicly available on the Department's website) as being the location of State or regionally significant resources of minerals, petroleum or extractive materials, or

(c) identified by an environmental planning instrument as being the location of significant resources of minerals, petroleum or extractive materials

And before determining an application to which the clause applies the consent authority must consider:

(i) the existing uses and approved uses of land in the vicinity of the development, and

(ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and

(iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and

(b) evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).

The Proposed Disturbance Area will be located entirely within existing Glencore mining tenements. The geology in the North Pit and the Proposed Disturbance Area is well understood and the mine plan design has been chosen to minimise the potential sterilisation of known coal reserves in the area and the Proposed Modification will utilise the existing mine infrastructure.

Proposed mining operations within the North Pit and the Integra Underground Mine workings overlap within the south-west corner of the North Pit. Mining within the North Pit and Integra Underground Mine target the same seams, however the seams have been influenced by different geological features that affect the seam depth. The North Pit mines seams that have been thrust closer to the surface due to the Hebden Thrust, whilst the Integra Underground mines seams that sit further below the surface in the Rix's Creek Syncline.

The vertical separation between the North Pit floor and the Integra Underground workings is a minimum of 250 m, which is considered adequate to enable the management of safety and operational issues. All operational and safety measures currently implemented for the Approved Operations will continue and will be enhanced through the common ownership of these mining operations by Glencore.

The Proposed Modification is unlikely to impact on the potential for viable petroleum production from within the Mount Owen Complex as the deeper coal seams typically targeted for petroleum production will not be impacted by the Proposed Modification. The Proposed Modification will not adversely impact on any known extractive material resources and is considered compatible with the current and future use of the land.

14 Natural Resource Management and Environmental Management

Clause 14 of the Mining SEPP requires the consent authority to consider whether the consent should be issued subject to conditions aimed at ensuring the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:

> *(a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
>
> *(b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
>
> *(c) that greenhouse gas emissions are minimised to the greatest extent practicable.*

Clause 14 also states that a consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or National policies, programs or guidelines concerning greenhouse gas emissions.

The potential impact of the Proposed Modification on natural resources is discussed in detail in **Section 6.0** and the additional commitments regarding the management of potential environmental impacts are contained in **Section 2.3**.

Clause 14(3) also states *without limiting subclause (1), in determining a development application for development for the purposes of mining, the consent authority must consider any certification by the Chief Executive of the Office of Environment and Heritage or the Director-General of the Department of Primary Industries that measures to mitigate or offset the biodiversity impact of the proposed development will be adequate.*

Mount Owen has consulted with the Office of Environment and Heritage (OEH) during the preparation of the ecological assessment and development of the biodiversity offset strategy. The proposed offset strategy for the Proposed Modification is outlined in **Section 6.6.**

15 Resource Recovery

Clause 15 of the Mining SEPP requires the consent authority to have regard to the efficiency of a proposed mining development in terms of its ability to optimise extraction of the target reserves.

The Proposed Modification has been developed to optimise the recovery of additional coal reserves from the North Pit which would have otherwise been sterilised. This is discussed in more detail in **Section 2.0** and **Section 3.1**.

16 Transport

Clause 16 requires the consent authority to consider whether or not the mining development under consideration should be subject to conditions restricting the use of public roads for product transport or other mining related traffic.

All product coal from the Mount Owen Complex will continue to be transported to the Port of Newcastle by rail. ROM coal will be transported to Liddell Coal Operations and/or Bayswater and Liddell power stations on an as required basis via the existing conveyor.

17 Rehabilitation

Clause 17 of the Mining SEPP requires a consent authority determining a development application for a mining development to have regard to whether or not to impose specific conditions regarding the rehabilitation of land affected by the proposed mining development.

As described in **Section 2.0**, the mining and overburden emplacement areas will continue to be progressively rehabilitated as the proposed mining operations progress and Mount Owen will achieve the proposed conceptual final landform. The Mount Owen and Ravensworth East Mine infrastructure areas will be rehabilitated as part of the closure process following completion of mining operations. The Mount Owen Rail Line will be rehabilitated if no other appropriate future use is identified. Progressive Rehabilitation is discussed in more detail in **Section 6.10**.

Part 4AA Mining and Petroleum Development on Strategic Agricultural Land

Part 4AA of the Mining SEPP provides for the consideration of the NSW Government's *Strategic Regional Land Use Plan* (SRLUP) and the gateway process. The gateway process applies to proposed development located within Biophysical Strategic Agricultural Land (BSAL) and Critical Industry Clusters (CIC) (as defined by the regional mapping presented in the Upper Hunter SRLUP) outside of existing lease areas.

As part of the Continued Operations Project a site verification certificate (SVC 7274) was issued on 25 November 2015 which certifies there were no areas of BSAL within the now Approved Disturbance Area. Assessment was undertaken within the Proposed Disturbance Area using both the Upper Hunter SRLUP assessment methodology and the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (NSW Government 2013) which indicated there was no BSAL within the Proposed Disturbance Area. A site verification certificate (SVC 17_8624) was issued on 28 August 2017 confirming there are no areas of BSAL in the Proposed Disturbance Area (refer to **Appendix 3**).

State Environmental Planning Policy No 33 – Hazardous and Offensive Development

SEPP 33 requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. A hazard assessment is completed for potentially hazardous development to assist the consent authority to determine acceptability.

The Proposed Modification will not result in any changes to the Approved Operations which are not considered hazardous or offensive, therefore no further consideration of SEPP 33 is required.

State Environmental Planning Policy No 44 – Koala Habitat Protection

SEPP 44 restricts 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 Proposed Modification.

An extensive ecological assessment (refer to **Section 6.6**) has been undertaken to support the Proposed Modification and includes a koala habitat assessment. It is unlikely that the koala would be impacted by the Proposed Modification and the requirement for the preparation of a koala plan of management does not apply.

State Environmental Planning Policy No 55 – Remediation of Land

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.

There are no contaminated sites currently recorded within the Mount Owen Complex. Activities carried out at the Mount Owen Complex which have the potential to cause contamination are appropriately managed and any contamination of the land will not affect the suitability of the site for operating as a mine.

3.3.4 Upper Hunter Strategic Regional Land Use Plan 2012

The Upper Hunter SRLUP requires the assessment of impacts from mining and coal seam gas development on land identified as being strategic agricultural land. There are two types of strategic agricultural land identified in the Upper Hunter SRLUP, BSAL and CICs. As discussed in **Section 3.3.3**, assessment of the Proposed Disturbance Area indicated there was no BSAL present and the SVC was issued on 28 August 2017.

The Upper Hunter SRLUP also requires all development applications for mining development that is State Significant Development, and which would potentially impact on agricultural resources and industries, to be accompanied by an Agricultural Impact Statement (AIS). A detailed AIS was undertaken to support the Continued Operations Project, however given the location of the Proposed Disturbance Area and the associated agricultural impacts and final land use opportunities associated with the Proposed Modification are considered to be consistent with the Approved Operations,no further assessment is considered to be warranted for the Proposed Modification (refer to **Section 6.0**).

3.3.5 NSW Aquifer Interference Policy

The AIP clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation, and establishes and objectively defines considerations in assessing and providing advice on whether more than minimal impacts might occur to a key water-dependent asset.

The AIP requires that, where mining will result in a loss of water from an overlying source covered by a water sharing plan (WSP), a water access licence is required under the *Water Management Act 2000* (WM Act) to account for this loss of water. In addition, the AIP requires proponents of mining projects seeking project approval under Part 4 of the EP&A Act to provide estimates of all quantities of water likely to be taken from any water source during and following cessation of the activity, and all predicted impacts associated with the activity. Detailed groundwater modelling has been undertaken to support the Proposed Modification (refer to **Section 6.4**).

The AIP requires that potential impacts of the Proposed Modification on groundwater sources, including groundwater users and groundwater dependent ecosystems (GDEs), be assessed against the minimal impact considerations. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The groundwater modelling undertaken for the Proposed Modification indicates the Level 1 minimal impact considerations will not be exceeded (refer to **Section 6.4**).

3.3.6 Other State Legislation

The Proposed Modification will also be subject to a number of separate regulatory approval processes if approved. As an existing operation, a number of the additional approvals required are already held; however, some will require variation as a result of the Proposed Modification.

Due to the Proposed Modification being State Significant Development, the assessment and approval process for a number of these approvals is aligned with the development application assessment process under Part 4. Section 4.42 of the EP&A Act requires that a number of approvals, if required for a State Significant Development, must be granted consistent with the terms of any development consent granted for the development. Section 4.41 of the EP&A Act removes the requirement for a number of approvals for approved State Significant Developments. The approval requirements under Sections 4.41 and 4.42 of the EP&A Act are included in **Table 3.4**.

Table 3.4 Other Relevant State Legislation

Act	Comment	Further Approval Required?
Approval which does not apply (Section 4.41)		
Fisheries Management Act 1994	A permit under section 201 (dredging or reclamation work), s. 205 (harming marine vegetation) or s. 219 (blocking of fish passage).	No
Heritage Act 1977	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 Part 6 of the Act.	
National Parks and Wildlife Act 1974	An Aboriginal heritage impact permit under s. 90 (Aboriginal Heritage Impact Permit).	
Rural Fires Act 1997	A bushfire safety authority under section 100B (bushfire safety authority).	
Water Management Act 2000	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.	
Approvals Legislation to be applied Consistently with Development Consent (Section 4.42)		
Mine Subsidence Compensation Act 1961 (MSC Act)	An approval under section 15 from the NSW Mine Subsidence Board (MSB) for development within a mine subsidence district.	No
Fisheries Management Act 1994	An aquaculture permit under section 144. An aquaculture permit will not be required for the Proposed Modification.	No

Act	Comment	Further Approval Required?
Mining Act 1992 (Mining Act)	Mining lease application MLA512 (applicable to the Approved Disturbance Area) is pending. A mining lease will also be sought for a portion of Exploration Licence EL5824 for the Proposed Modification. The Mining Act requires all mining operations be subject to a Mining Operations Plan (MOP) approved by the NSW Resources Regulator. The relevant MOP will be updated to include the revised North Pit and associated operations.	Yes
Protection of the Environment Operations Act 1997 **(POEO Act)**	The POEO Act regulates pollution to the environment and requires licences for environmental protection including waste, air, water and noise pollution control. Coal mining and coal works are scheduled activities which require licensing under the POEO Act. The existing Environment Protection Licences (EPL) for the Approved Operations (includes Mount Owen and Ravensworth East EPLs) is considered adequate for the Proposed Modification, subject to updates to reflect the Proposed SSD-5850 Modification Consent Boundary in consultation with EPA.	Yes – premises boundary update
Other State Legislation relevant to the Proposed Modification		
Biodiversity Conservation Act 2016 **(BC Act)**	The BC Act was implemented on 25 August 2017. The introduction of this legislation subsequently repealed the *Threatened Species Conservation Act 1995* (TSC Act). Consultation with DPE confirmed the Proposed Modification is subject to Clause 27(1)(g) of the Biodiversity Conservation (Savings and Transitional) Regulation 2017 and is therefore considered a pending or interim planning application. On this basis, the application for the Proposed Modification can be made within two years of the commencement of the BC Act and the Framework for Biodiversity Assessment (FBA) process is applicable to the determination of the Proposed Modification and Part 7 of the BC Act does not apply. As such, the Ecology Assessment has been prepared in accordance with the FBA and the NSW Biodiversity Offsets Policy for Major Projects (refer to **Section 6.6**).	No
Crown Lands Act 1989 **(Crown Lands Act)**	The Crown Lands Act provides for the administration and management of Crown land in the eastern and central divisions of NSW. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the *Crown Land (Continued Tenures) Act 1989*. There is no crown land, including crown roads, within the Proposed Disturbance Area.	No
Dams Safety Act 1978 **(Dams Safety Act)**	The Dams Safety Act requires that the NSW Dams Safety Committee (DSC) periodically review large dams that may constitute a hazard to human life and property. These dams are known as prescribed dams and are listed in Schedule 1 of the Dams Safety Act. Any new prescribed dams are to be designed to the satisfaction of the DSC. Although no significant dams are proposed for water storage, the proposed use of the Ravensworth East voids for tailings emplacement will be subject to assessment in accordance with the DSC requirements to determine if the tailings emplacement areas are prescribed dams. This is being addressed for the Approved Operations and will not be affected by the Proposed Modification.	No

Act	Comment	Further Approval Required?
Explosives Act 2003 **(Explosives Act)**	A licence is required for the storage of explosives on site. The Explosives Act is administered by WorkCover NSW. Mount Owen's explosives contractor holds the relevant licence to possess and store explosives at the Mount Owen Complex. There will be no change in the quantities of explosive materials as a result of the Proposed Modification.	No
Environmentally Hazardous Chemicals Act 1985 **(EHC Act)**	Under the EHC Act, 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 Proposed Modification, Mount Owen, or the relevant contractor, will obtain a licence prior to the storage, transport or use of prescribed chemicals.	If required
Water Management Act 2000 **(WM Act)**	The Water Sharing Plan (WSP) for the Hunter Unregulated and Alluvial Water Sources 2009 (in force under the WM Act) applies to the surface waters and alluvial groundwater of Bowmans Creek (Jerrys Water Source) and Glennies Creek (Glennies Water Source) and their catchments. The WSP for the Hunter Regulated River 2016 applies to extractions from the Hunter River and Glennies Creek under the WM Act. The WSP for the North Coast Fractured and Porous Rock Groundwater Sources 2016 applies to the coal measure aquifers for the Approved Operations and Proposed Modification under the WM Act. Relevant consideration is required for impacts on surface water, in particular Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek and Main Creek, which, as outlined above, are all regulated within the framework of the WM Act. A WSP indicates that water extraction and interference licensing is required to account for any water loss over the life of the mine and until such time as those losses are negated. The Proposed Modification will not require approval under sections 89, 90 or 91 (other than an aquifer interference approval) of the WM Act due to the exemptions outlined under Section 4.41 of the EP&A Act.	No

4.0 Consultation

An extensive consultation strategy was developed to inform the Continued Operations Project which included consultation with over 200 stakeholders between 2012 and 2015. Mount Owen extended this consultation strategy for the Proposed Modification which included a targeted consultation program (refer to **Figure 4.1**). The consultation strategy for the Proposed Modification aimed to:

- provide the community with an overview of the Proposed Modification and identify key issues and impacts for consideration in the assessment process
- inform the planning and development of appropriate strategies to better manage and enhance the Proposed Modification's impacts, and
- ensure that key stakeholders have the opportunity of a voice in the assessment program.

Figure 4.1 Engagement Process for the Proposed Modification

This section provides an overview of the consultation program undertaken for the Continued Operations Project and details the further consultation program undertaken for the Proposed Modification.

4.1 Continued Operations Project – Stakeholder Engagement

The stakeholder engagement for the Continued Operations Project was a four phase program which aligned with the phases of project development and the environmental assessment process. Phases 1 and 2 sought stakeholder feedback on aspects of the Continued Operations Project design. Phase 3 presented the results of the initial EIS studies and Phase 4 presented updated results and outcomes of the assessment for the refined Continued Operations Project. **Table 4.1** provides a summary of the stakeholder engagement program for the Continued Operations Project.

Table 4.1 Stakeholder Engagement Summary – Continued Operations Project

Consultation	Stakeholder	Number of Participants and / or Meetings and Further Detail
Neighbouring Landholders and Local Community (face to face meetings)	Landholders in Hebden, Camberwell, Falbrook, Middle Falbrook, Bridgeman and Glennies Creek with properties in closest proximity to the Mount Owen Mine, or in areas considered with greatest potential for possible impact from the Continued Operations Project.	47 landholders in Phase 1 and 2 consultation (Continued Operations Project overview and project design), 40 landholders in Phase 3 consultation (outcomes of EIS studies and proposed mitigation/management),) and 14 landholders in Phase 4 consultation (outcomes of updated EIS studies and proposed mitigation/management).
Local Community (Mount Owen Community Information Session 1) (Mount Owen)	As above.	22 attendees - Community Information Day at Mount Owen Mine. Information displays of the existing operation and the Continued Operations Project, and opportunity for a guided Mount Owen Mine tour.
Mount Owen Tenants	Residents tenanting Mount Owen owned properties in closest proximity to the Continued Operations Project.	14 tenants - telephone interviews to gather feedback regarding Mount Owen's existing operations and provide Continued Operations Project overview. Follow up phone calls to discuss outcomes of the EIS studies, including discussions regarding specific impacts and proposed mitigation.
Regional issues assessment stakeholders	Regional service providers (e.g. education, community, health) and other regional stakeholders.	58 stakeholders - consultation to inform the SIA undertaken for the Continued Operations Project, an assessment of regional issues focusing on feedback regarding mining in the Upper Hunter generally and was not specific to Mount Owen or the Continued Operations Project.
NGOs and other Regional Interest Groups	Hunter Environment Lobby Singleton Chamber of Commerce Hebden Wild Dogs Association Rural Fire Service (Glennies Creek) Mount Owen Flora and Fauna Interagency Advisory Group	Seven meetings - meetings held to discuss items of specific interest for each stakeholder, provided information and sought feedback on the proposed management arising from EIS studies.

Consultation	Stakeholder	Number of Participants and / or Meetings and Further Detail
Mount Owen Complex CCC	Mount Owen Complex CCC (8 community members, 1 Singleton Council representative and Mount Owen personnel)	Seven meetings - regular updates during the progression of the Continued Operations Project design and EIS processes.
Mount Pleasant School	Principal and Parents and Citizens representative.	Two meetings to discuss items of specific interest, provide information and seek feedback on the proposed management arising from EIS studies.
Community Information Session 2 (Mount Pleasant School)	Local landholders Community groups Regional stakeholders	December 2013 - information session to inform community stakeholders regarding the outcomes of EIS studies, seek feedback on the proposed mitigation measures and outline the process going forward.
Community Information Session 3 (Mount Owen)	Local landholders Community groups Regional stakeholders	Update sessions conducted 31 October and 1 November 2014 - Information session to inform community stakeholders regarding the outcomes of EIS studies including the proposed Continued Operations Project refinements and an opportunity for a guided site tour.
Workforce briefings	Existing workforce at Mount Owen Complex.	Four briefings in 2013 and ongoing briefings throughout 2014.
Employee / contractor and Supplier Survey	Existing workforce at Mount Owen.	135 employees surveyed by Coakes Consulting; to model patterns of workforce expenditure and community infrastructure usage to inform the Continued Operations Project SIA report.
Industry	Ashton Coal Mine Integra Coal Mine (now Rix's Creek North) Hebden Quarry	Five meetings to provide briefings and discuss potential interactions with the Continued Operations Project.

Further to the consultation program detailed in **Table 4.1**, during the public exhibition period of the Continued Operations Project EIS, 233 submissions were made. This included 12 Government Agency submissions and 221 community submissions (including interest group submissions). Of the 221 community submissions received, 85% stated support for the Continued Operations Project (refer to **Figure 4.2**) with 13% objecting. A further four submissions received provided comments only, neither objecting nor supporting the Continued Operations Project.

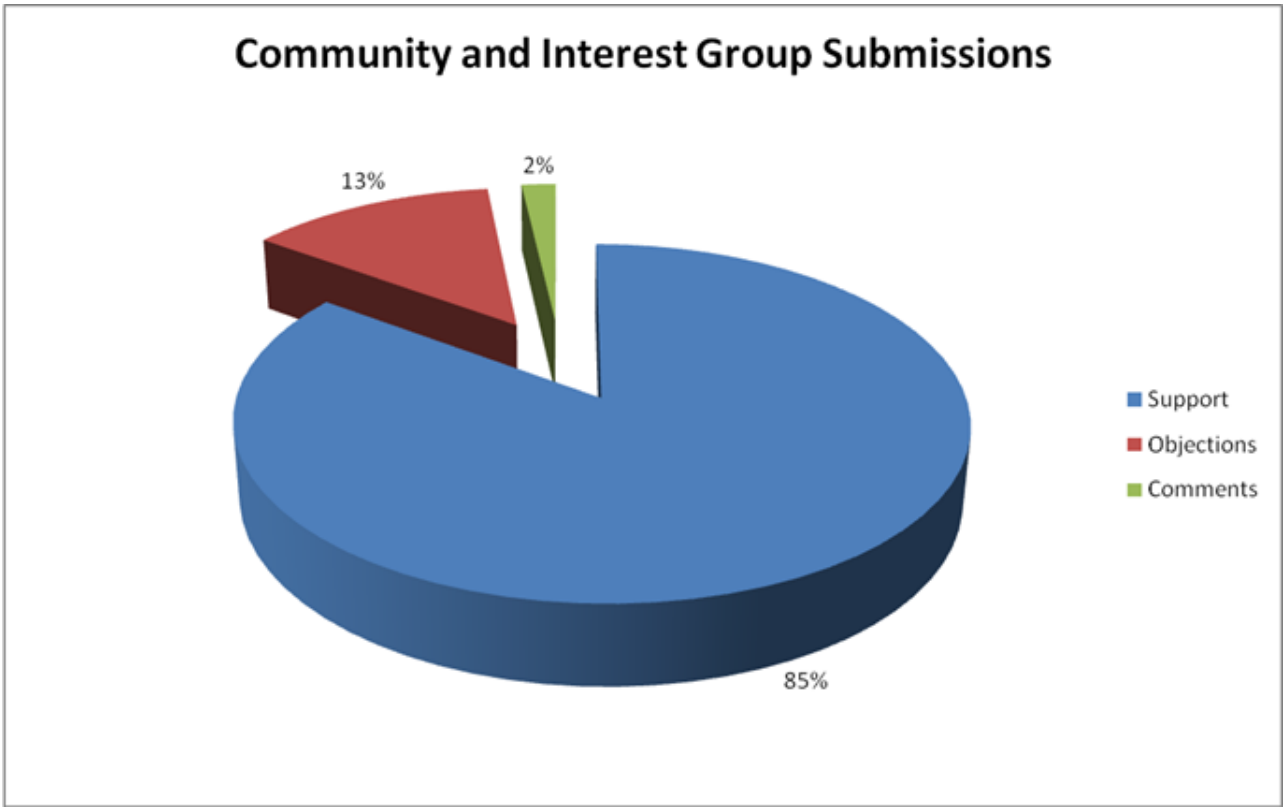


Figure 4.2 Continued Operations Project Community and Interest Group Submissions

Further detail and analysis relating to the issues identified during the consultation program for the Continued Operations Project is provided in **Section 6.11.5**.

4.2 Proposed Modification – Stakeholder Engagement

As discussed in **Section 6.0**, two rounds of targeted consultation were undertaken for the Proposed Modification including:

- **Round 1** - Proposed Modification overview (presenting the Proposed Modification, assessment process and intended consultation program); and
- **Round 2** – Presentation of results of the specialist assessments and proposed mitigation/management.

An overview of the stakeholder engagement including engagement mechanisms undertaken for the Proposed Modification during the preparation of this SEE is outlined in **Table 4.2**.

Table 4.2 Engagement Mechanisms – Proposed Modification

Stakeholder Group	Engagement Mechanisms	Participants or No Briefings
Highly Interested / Near Neighbours (focus on Middle Falbrook, Bridgeman and Glennies Creek)	Face to face meetings and phone calls Community information sheets Community information day	31 briefings offered during each round of consultation with 26 briefings held in total. Further detail provided in **Section 4.3**
Internal Stakeholders (workforce)	Workforce briefings	1 workforce briefing in 2018

Stakeholder Group	Engagement Mechanisms	Participants or No Briefings
Mount Owen Complex and Integra Underground Mine CCC	Face to face (during CCC meetings and private briefings) Community information sheets Community information day	9 members
Government Agencies (DoEE, DPE, NSW Resources Regulator, EPA, Crown Lands and Water Division (CLWD), OEH)	Face to face and telephone briefings Site visits Provision of community information sheets	2 briefings (DoEE, DPE, NSW Resources Regulator, CLWD, OEH) 1 briefing (EPA, Forestry Corporation) Further detail provided in **Section 4.6**
Singleton Council and Councillors	Face to face briefings Provision of community information sheets	4 briefings Further detail provided in **Section 4.6**
Local community (tenants on mined owned land/interested residents/community services) **Community groups and organisations**	Community information sheets Community information day	103 households sent community information sheets 103 household invited to community information day (8 groups of people attended, 7 landowners/tenants and the Principal from Mount Pleasant School)
Special Interest Groups	Provision of community information sheets	8 groups Further detail provided in **Section 4.4**
Business & Industry	Provision of community information sheets	5 groups
Aboriginal Groups	Notification of the Proposed Modification Written correspondence (email and letters) Face to face briefings (Aboriginal Cultural Heritage Working Group meetings) Community information sheets	61 Continued Operations Project RAPs / Knowledge Holder groups 12 people listed on the OEH Singleton Aboriginal Stakeholder Register Further detail provided in **Section 4.5**

Further detail regarding the stakeholder engagement program for the Proposed Modification is provided in the following sections.

4.3 Community Engagement

Mount Owen has an ongoing community engagement program which includes regular engagement with both individuals and groups from the local and regional communities via a range of mechanisms including:

- regular newsletters (biannual) to update the community on the existing operations and Mount Owen Complex initiatives,
- face to face meetings with individuals and/or groups as required/requested, including any meetings required in response to complaints, and
- regular meetings (2 per year) with the Mount Owen Complex CCC. The Mount Owen Complex CCC comprises 8 community representatives, one Singleton Council representative and Mount Owen representatives, and is periodically attended by State government agency representatives.

As previously discussed, targeted consultation has been undertaken with the community in relation to the Proposed Modification, including:

- face to face meetings and phone calls with near neighbours and landholders to outline the Proposed Modification and present the results of the specialist studies to document potential issues across 2 rounds of consultation,
- provision of community information sheets (x2) summarising key aspects of the Proposed Modification, the results of the specialist assessments, also providing information on how stakeholders can be involved in the consultation process. The community were also notified of the Proposed Modification through inclusion in the Winter 2017 edition of the Greater Ravensworth Newsletter, and
- community information day held at Mount Owen Mine in December 2017, providing an overview of the outcomes of the specialist assessments.

Consistent with the issues identified during the stakeholder engagement program for the Continued Operations Project, air quality, noise and blasting impacts were identified by the local community as the most important issues.

- 31 briefings were offered to near neighbours during each round of consultation with 26 briefings held in total. Meetings were declined or not held because:
    - stakeholders stated they had no issues or concerns
    - stakeholders obtained information from other sources including the community information sheets, the CCC meetings or the community information day
    - in 4 instances, no contact was made with the stakeholders after more than 3 attempts.

A detailed issues analysis and a comparison of issues identified by the community in relation to the Proposed Modification compared to the Continued Operations Project is provided in **Section 6.11.5**.

4.4 Environmental and Recreational Groups

Relevant Environmental and Recreational Groups were consulted regarding the Proposed Modification through the distribution of the community information sheets. The following groups were included:

- Mount Pleasant Public School
- Wild Dog Association
- Hunter Environment Lobby
- Singleton Shire Healthy Environment Group
- Centre for Sustainable Ecosystem Restoration (University of Newcastle)
- NSW Rural Fire Service (Goorangoola Captain, Singleton Group Captain)
- Hunter Communities Network.

4.5 Aboriginal Community Engagement

The consultation program for the Continued Operations Project included extensive consultation in relation to the ACHA. There has also been continued consultation with the RAPs and Knowledge Holder Groups

through the Continued Operations Project artefact salvage works, Aboriginal Cultural Heritage Working Group meetings and the quarterly monitoring program. Refer to **Section 6.7.3** for details on the consultation that has been undertaken regarding the Proposed Modification with the RAPs and Knowledge Holder Groups. The full list of all RAPs and Knowledge Holder Groups consulted in relation to the Proposed Modification is provided in the ACHA (refer to **Appendix 14**).

Two separate rounds of consultation have been undertaken with the RAPs and the Knowledge Holder Groups in relation to the Proposed Modification between June 2017 and April 2018, with the first round of consultation being specifically focused on the ACHA undertaken for the Proposed Modification and the second round focused on the proposed storage of artefacts from the Mount Owen Complex at a central artefact storage facility at Bulga Coal's Wollombi Brook VCA.

Detail relating to the first round of consultation undertaken in relation to the ACHA for the Proposed Modification is included in **Section 6.7.3**. The second round of consultation was undertaken in relation to the proposed amendment to the Mount Owen Complex ACHMP to allow for the storage of artefacts at a central artefact storage facility proposed at Bulga Coal's Wollombi Brook VCA. The proposal to store artefacts at a central facility at Bulga Coal was raised at the Mount Owen Aboriginal Cultural Heritage Working Group in August 2017 and at the Bulga Working Group in November 2017, no objection to the proposal was identified at the time and it was resolved to continue with the consultation and approval process.

The second round of consultation with the RAPs and Knowledge Holder Groups included the circulation of a formal consultation letter requesting feedback specifically in relation to this proposal during March and April 2018. Four responses were received from the following:

- Plains Clans of the Wonnarua People
- Lower Hunter Wonnarua Council Inc
- Wonnarua Nation Aboriginal Corporation
- Wanaruah Local Aboriginal Land Council.

Some of the key feedback from the Aboriginal Cultural Heritage Working Group meetings and the targeted consultation with RAPs and the Knowledge Holder Groups includes:

- security of the facility
- access to the facility
- catalogue, identification and storage of artefacts
- facility design in particular the inclusion of an area where artefacts can be studied or researched and also meeting facilities and catering equipment e.g. BBQs
- future consultation regarding administration of the facility and long-term/post mining management of artefacts, including:
    - Return to country (for example after mine sites are rehabilitated).
    - If a Wonnarua museum, or similar, was developed.
    - If a Native Title Determination is made in relation to the area, long-term Care and Control should be discussed with the associated Body Corporate.

These considerations will be addressed through the development of the Plan of Management by Bulga Coal for the Wollombi Brook facility, in consultation with the RAPs and Knowledge Holder Groups.

4.6 Government Authority Engagement

The stakeholder engagement program for the Proposed Modification has included ongoing consultation with relevant government authorities through the design and development of the specialist studies. Engagement has included face to face meetings, site meetings, telephone briefings and formal written consultation. A summary of the engagement undertaken with the relevant government authorities is provided in **Table 4.3**.

Table 4.3 Engagement Mechanisms – Government Authority

Government Authority	Engagement Undertaken
DoEE	• DoEE Assessment Officers visited the Mount Owen Mine in August 2017, inspecting the Approved Operations and the Proposed Disturbance Area. • Initial briefing in August 2017 providing an overview of the Proposed Modification and intended assessment processes. • EPBC Act Referral submitted in October 2017 – Proposed Modification determined not to be a controlled action in December 2017. • Correspondence attached, refer to **Appendix 4**. • Provision of community information sheets.
DPE	• Initial briefing in April 2017 to provide an overview of the Proposed Modification and intended approval pathway under Section 4.55(2) of the EP&A Act. • Correspondence received in April 2017 confirming approval pathway under Section 4.55(2). • Formal correspondence received in December 2017 following a request for advice in relation to the Noise Policy for Industry 2017 (refer to Section 6.2) and the Social Impact Assessment Guideline 2017 (refer to Section 6.11) and relevance to the Proposed Modification assessment process. • Briefing in March 2018 to present findings of specialist studies. • Correspondence attached, refer to **Appendix 5**. • Provision of community information sheets.
NSW Resources Regulator	• Briefing in May 2017 to present overview of the Proposed Modification, intended assessment processes and Conceptual Project Development Plan (CPDP). • Correspondence received November 2017 confirming the transitional arrangements under Clause 27(1)(g) of the BC Regulation 2017 apply to the Proposed Modification as the CPDP for the Proposed Modification was received by the Department prior to the commencement of the BC Act, therefore the former legislative framework applies (FBA), refer to **Section 6.6**. Correspondence attached, refer to **Appendix 5**. • Briefing in November 2017 to present proposed conceptual final landform and options analysis. Correspondence was received in December 2017 the feedback included in this correspondence is detailed and addressed in **Section 6.10**. Correspondence attached, refer to **Appendix 5**. • Significance of resource assessment meeting in March 2018 at Mount Owen Mine. • Provision of community information sheets.

Government Authority	Engagement Undertaken
OEH	• Email correspondence in October 2017 to confirm scope of works for the Surface Water Impact Assessment. • Email correspondence with Heritage Branch in June 2017 to confirm approach for the consultation for the ACHA. • Briefing in September 2017 to provide an overview of the Proposed Modification and present the results of the preliminary ecological surveys. • Briefing in December 2017 to discuss the Biodiversity Assessment Report and associated survey outcomes. • Correspondence received March 2018 confirming BBAM methodology will be accepted for offset site surveys and assessments for up to two years from the start of the BC Act (refer to **Appendix 5**). • Correspondence in April 2018 confirming application of BBAM calculator for offset credit calculations. • Provision of community information sheets.
EPA	• Phone discussion in May 2018 to offer briefing on the outcome of specialist studies with a focus on the noise, air quality and water resources assessments – offer of briefing was declined, provided overview of Proposed Modification and outcome of specialist studies during phone discussion. • Provision of community information sheets.
CLWD	• Briefing in September 2017 to provide an overview of the Proposed Modification and intended scope of works for the surface water and groundwater impact assessments. • Briefing in May 2018 to present results of specialist studies. • Provision of community information sheets.
Singleton Council	• Initial briefing in April 2017 to Council staff providing an overview of the Proposed Modification and intended assessment processes. • Initial briefing in July 2017 to Council Round Table (Councillors) providing an overview of the Proposed Modification and intended assessment processes. • Briefing in April 2018 to Council staff to present findings of specialist studies. • Briefing in May 2018 to Council Round Table (Councillors) to present findings of specialist studies. • Provision of community information sheets.
Forestry Corporation	• Briefing in May 2018 to present results of specialist studies and present proposed conceptual final landform.

5.0 Proposed Modification Rationale

There are a number of contributing factors that have influenced the nature and extent of the Proposed Modification. As discussed in **Section 2.2.1**, Mount Owen has considered a range of environmental constraints to inform the extent of the Proposed Disturbance Area and the development of the conceptual mine plans including the design of the proposed conceptual final landform.

A range of alternative design scenarios has been considered throughout the concept design phase and through the preparation of the SEE to ensure an appropriate balance between accessing economic coal reserves and avoiding and minimising potential environmental and social impacts. The design of the Proposed Modification focused on:

- minimising the Proposed Disturbance Area particularly avoiding Ravensworth State Forest, existing Biodiversity Offset Areas, Main Creek and the associated alluvium, and maintaining the north-south habitat corridor located to the south-east of the Approved Operations (refer to **Figure 5.1**),
- maximising reserve recovery while minimising the overall Proposed Disturbance Area as far as practicable as well as maintaining the economic life of the Mount Owen Mine, and
- detailed review of alternative conceptual final landform design scenarios to propose a final landform that is safe, stable and non-polluting, which provides sustainable post mining land use options whilst minimising impacts consistent with the key commitments of the Approved Operations as it relates to landform design, conservation and water management.

In addition to the above, Mount Owen has also included a range of project design refinements and operational controls to ensure that the impacts associated with the Proposed Modification are consistent with Approved Operations. These refinements and controls are outlined in **Section 2.3** and in relevant assessments in **Section 6.0**.

Details regarding the various conceptual final landform design scenarios and other alternatives considered during the Proposed Modification design are discussed below.

5.1 Proposed Disturbance Area

The extent of the Proposed Disturbance Area has been designed to maximise reserve recovery from Glencore mining tenements and provide for:

- sufficient separation from Main Creek and the associated alluvium (extent of alluvium confirmed through detailed geophysical survey and test pitting in 2017 as detailed in **Section 3.2.2**),
- avoidance of existing Biodiversity Offset Areas and retention of north-south vegetation corridor, and
- utilisation of existing infrastructure with only specific water management infrastructure required.

As discussed in **Section 3.2.2**, Mount Owen undertook detailed geophysical survey to map the extent of the Main Creek alluvium. This detailed mapping has guided the design of the extent of the Proposed Disturbance Area to ensure adequate separation between the Proposed Disturbance Area and the Main Creek alluvium (refer to **Figure 5.1**).

The existing Mount Owen Biodiversity Offset Areas were set aside as ecological offsets for the Approved Operations and Mount Owen are committed to maintaining the existing commitments to protect and maintain these areas in accordance with previous mining approvals (refer to **Figure 5.1**). Accordingly, the Proposed Disturbance Area has been designed to avoid these existing offset areas.

The Proposed Modification requires amending the North Pit mine plan only, mining operations (as modified) will continue utilising all existing Mount Owen and Ravensworth East infrastructure with no significant infrastructure construction required. Minor water management infrastructure will be required within the Proposed Disturbance Area however there is minimal additional disturbance associated with these works.

5.2 Mining Methods

Open cut mining from the North Pit is considered the most viable option to extract the identified reserves. As discussed in **Section 3.2.2** the Mount Owen Complex and the Integra Underground Mining operations overlap in the south-west corner of the approved North Pit. The design of the North Pit for the Approved Operations was originally constrained by the non-Glencore ownership of the Integra Underground mining tenements both to the east of the North Pit and beneath the North Pit floor. The mining tenements acquired through Glencore's purchase of Integra Underground Mine now remove this constraint.

Although the acquired mining tenements were originally associated with Integra Underground Mine, given the location of the reserves in relation to the existing North Pit the most efficient and cost effective way to extract the reserves whilst minimising the environmental impact is through extending open cut mining from the North Pit. Additional coal will be extracted at depth beneath the approved North Pit floor where the approved North Pit previously stepped up, however this is not at current mining depths associated with the Integra Underground Mine. The North Pit is also constrained by steeply dipping coal seams due to the Hebden Thrust, which also contribute to underground mining being unviable in this location, as discussed in **Section 3.1.3**. Additionally, the recently approved Integra Underground Modification 8 allows for the extraction of additional coal reserves from Glencore mining tenements that would have otherwise become sterilised. This is provided for through Glencore ownership of both Integra Underground and the Mount Owen Complex.

Further detail relating to the conceptual mine plan design and refinements is included in **Section 3.2.1**.

5.3 Conceptual Final Landform

The conceptual final landform developed for the Approved Operations, (refer to **Figure 5.2**) proposed a natural final landform design incorporating micro-relief design elements through the life of the operation, conservation (including establishing native vegetation and habitat corridors) and water management to return additional catchment to Main Creek, reduce dirty water catchment and expedite return of clean water to the natural catchments. Mount Owen has incorporated these commitments into the design of the proposed conceptual final landform (refer to **Figure 5.2** and **Section 2.2.3**). The approved conceptual final landform includes two final voids (BNP and North Pit), there are no additional voids proposed as a result of the Proposed Modification. Given the nature of the Proposed Modification, involving deeper mining and additional pit area, there is necessary reconfiguration of the design of the North Pit void. The key differences between the approved and proposed conceptual final landform designs is the size and design of the WOOP emplacement area, the southern end of the North Pit emplacement area and the depth and configuration of the North Pit void (refer to **Figure 5.2**). Note all other aspects of the approved Mount Owen and Ravensworth East final landform remain as approved. Further detailed comparison of the approved and proposed conceptual final landform designs is provided in **Section 6.10.1**.

Mount Owen reviewed a number of alternative design scenarios in relation to the conceptual final landform design and to reduce the size of the final North Pit void. The feasibility of improving the design of the conceptual final landform (particularly the final void) and the design alternatives (which include backfilling) have been taken into account on the basis of the environmental, social and economic considerations for each design scenario.

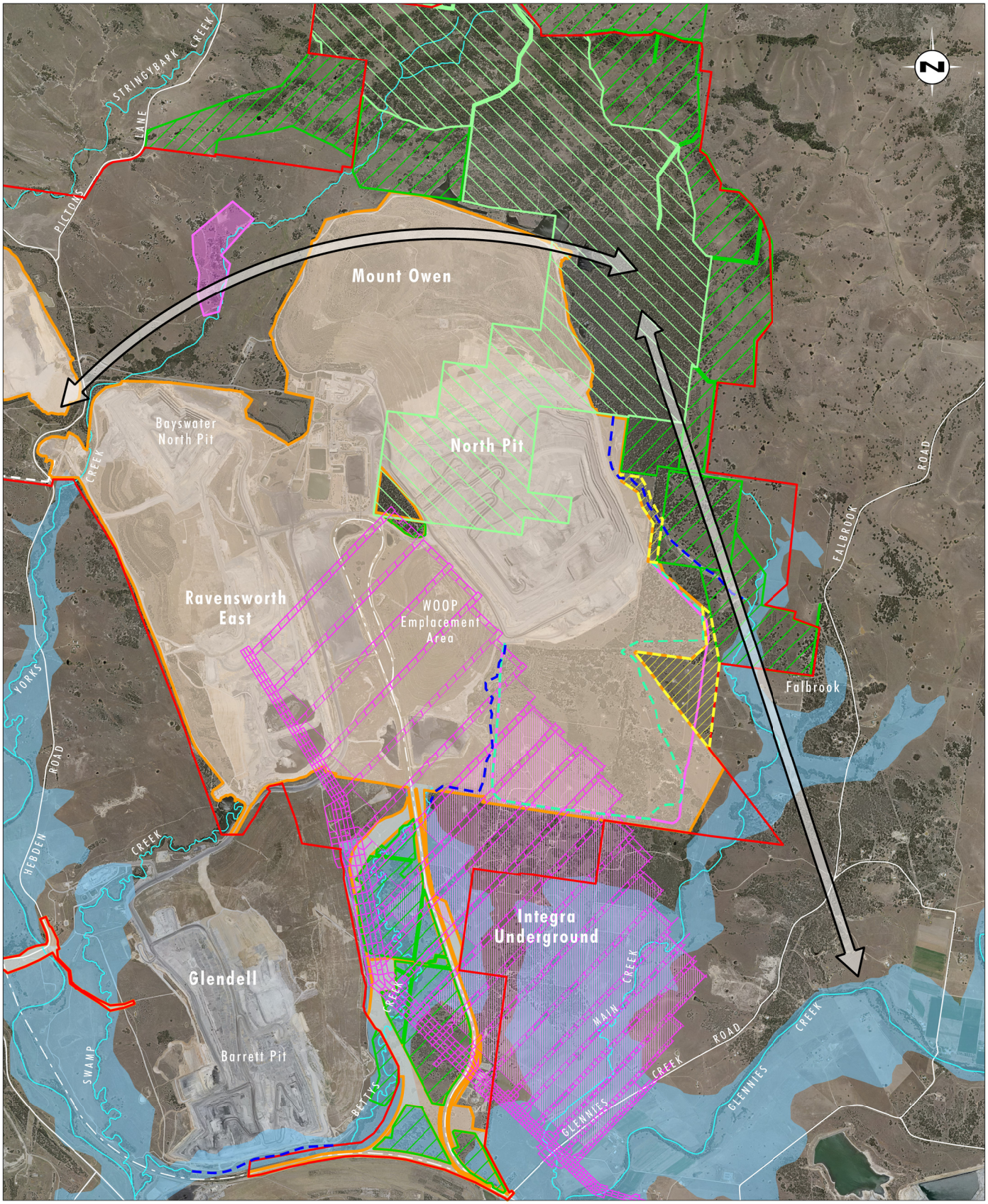


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Existing Bettys Creek Diversion
- Refined Alluvium Mapping (AGE 2017)
- Habitat Corridor
- Yorks Creek VCA
- Approved Integra Underground Mining Area - Middle Liddell Seam Workings
- Integra Underground Workings Middle Liddell Seam as at May 2018
- Drainage Line

FIGURE 5.1

Proposed Modification Design Constraints

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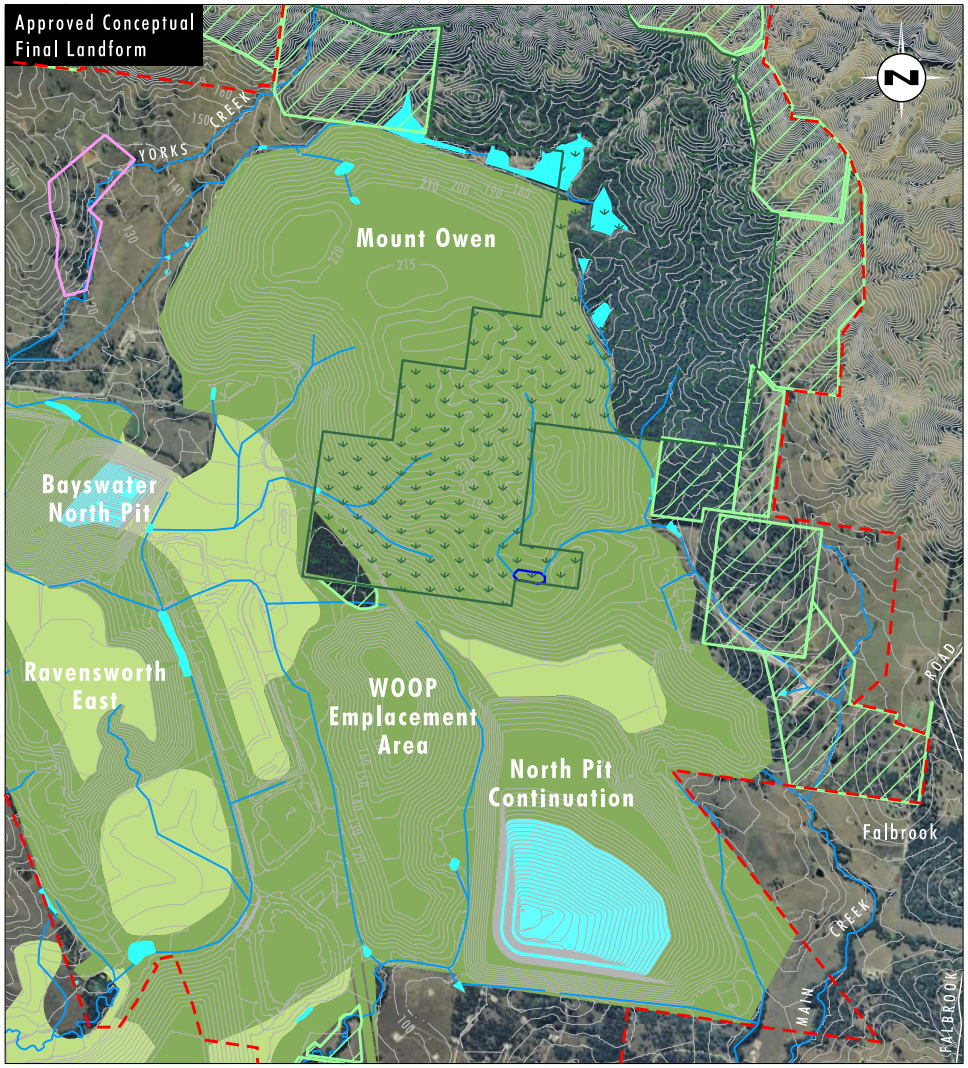
20180614 15.01



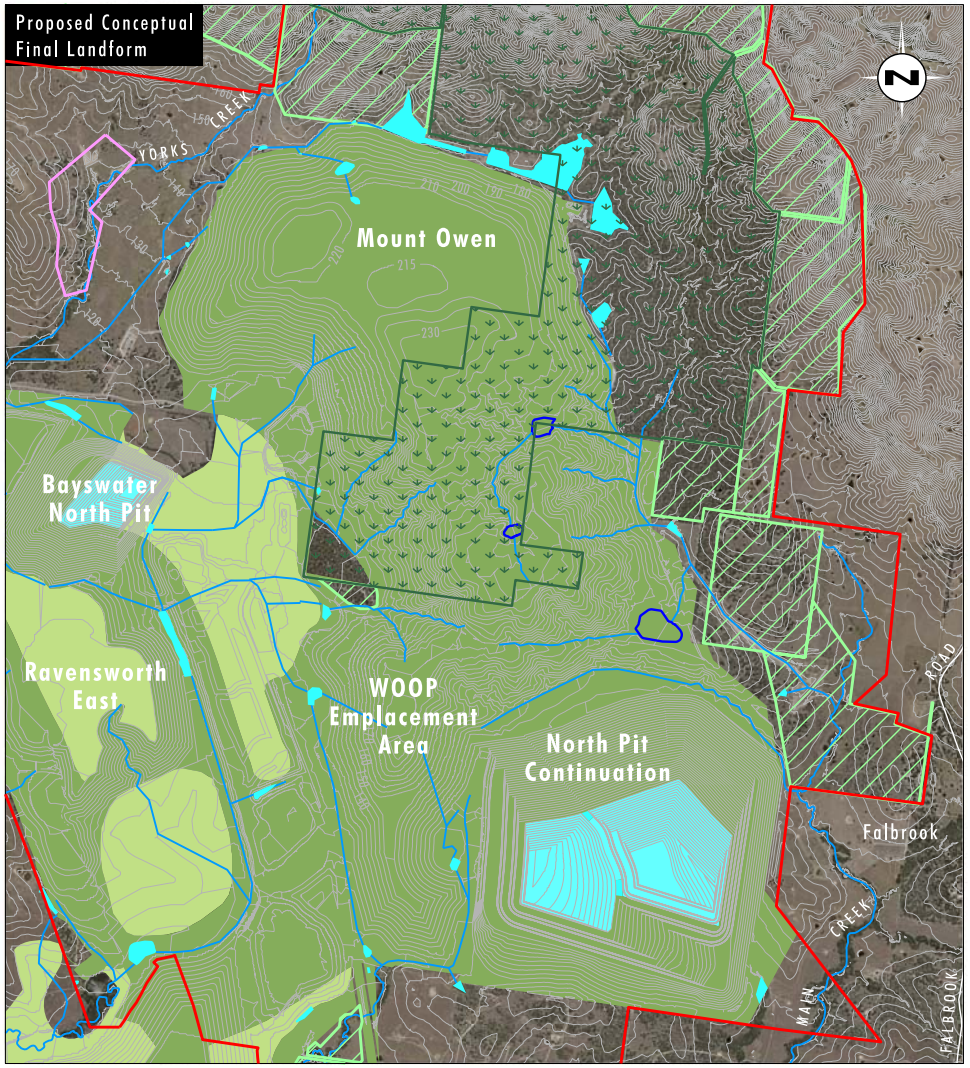


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Image Source: Glencore (2017)
Data Source: Glencore (2018)
Note: Contour Interval 5m(AHD). Equilibrium Water Level shown in North Pit Void.

Legend

- Proposed SSD-5850 Modification Consent Boundary
- SSD-5850 Consent Boundary
- Yorks Creek VCA
- Dryland Attenuation Basin
- Water Storage
- Native Woodland
- Open Grassland (Potential grazing areas) with pockets of Native Vegetation
- Ravensworth State Forest
- Biodiversity Offset Area
- Drainage Line

FIGURE 5.2

Approved Continued Operations Project
Conceptual Final Landform Vs
Proposed Modification Conceptual Final Landform

File Name (A4): R09/3810_235.dgn
20180724 14.57

A summary of alternative design scenarios considered in selecting the proposed conceptual final landform is provided in **Table 5.1** and presented in **Figure 5.3**. These design scenarios have been presented to the NSW Resources Regulator and DPE during the preparation of the SEE. Key issues raised by the NSW Resources Regulator in relation to the proposed conceptual final landform are addressed in **Section 6.10**.

Table 5.1 Final Landform Design Scenario Analysis – North Pit

Design Scenario	Analysis

Proposed conceptual final landform (Figure 2.5)	• Minimal re-handling of material required with completed final landform achieved within 3 years post mining.
	• Upper highwall slopes ~10-18° to provide for long term stability.
	• Void catchment ~390 ha designed to limit catchment returning to the void and maximise catchment to Main Creek.
	• Not feasible to fill the void:
	  ○ Volume of material re-handle required to establish a self-draining landform ~340 Mlcm[1].
	  ○ Delay closure by an additional ~11 years.

Scenario 1 – Partially backfill void (consistent with approved void) (Figure 5.3)	• Significant re-handling of material at end of production with delayed closure by approximately 10 years (associated increased duration of visual, air quality and noise impacts). • Requires re-handling of material at end of production from North Pit and WOOP emplacement areas which will have been progressively rehabilitated by this time. • Extended duration of dirty water management system due to re-handle of material. • Delayed establishment of vegetation from rehabilitation works which will delay establishment of habitat connectivity within the final landform. • Delay in returning runoff from rehabilitated areas to the natural landform. • Void catchment limited to immediate void ~286 ha. • Volume of material re-handle required to achieve landform ~170 million loose cubic metres (Mlcm) Mlcm[1]. • Estimated cost of re-handling overburden material, associated other works and overheads to establish landform design in the range of ~$800 million to $1 billion. • Delay closure by an additional ~4 years.
Scenario 2 - No retained highwall (backfill void with internal slopes ~18°) (Figure 5.3)	• Significant re-handling of material at end of production with delayed closure by approximately 7 years. • Requires equipment working in elevated locations (increased duration and potentially scale of visual, air quality and noise impacts). • Requires re-handling of material at end of production from North Pit and WOOP emplacement areas which will have been rehabilitated by this time. • Extended duration of dirty water management system due to re-handle of material. • Delayed establishment of vegetation from rehabilitation works which will delay establishment of habitat connectivity within the final landform. • Delay in returning runoff from rehabilitated areas to the natural landform. • Void catchment limited to immediate void ~350 ha. • Volume of material re-handle required to achieve landform ~75 Mlcm[1]. • Estimated cost of re-handling overburden material, associated other works and overheads to establish landform design in the range of ~$400 to 500 million. • Delay closure by an additional ~7 years.

Design Scenario	Analysis
Scenario 3 - Retain western highwall only (internal slopes ~18°), requires increase to Proposed Disturbance Area (Figure 5.3)	• Re-handling of material required and additional disturbance area of approximately 31 ha which would require offsetting. • Closure delayed by approximately 3 years resulting in prolonged air quality, noise, visual and blasting impacts. • Increase in final void catchment area from scenario 1 and 2 (~365 ha due to movement of pit crest) resulting in reduction of water returned to Bettys Creek and Main Creek and additional water licences required at end of production. • Volume of material re-handle required to achieve landform ~35 Mlcm[1]. • Estimated cost of re-handling overburden material, associated other works and overheads to establish landform design in the range of ~$150 to 250 million. • Delay closure by an additional ~11 years.
Scenario 4 - Retain western highwall only (internal slopes ~18°) (cut/fill contained within the Proposed Disturbance Area only) (Figure 5.3)	• Loss of approximately 17 Mt ROM coal from total production and associated revenue and royalties. • Significant re-handling of material at end of production required delaying closure by approximately 6 years resulting in prolonged air quality, noise, blasting and visual impacts. • Requires blasting of high wall and re-handling of material at end of production. • Extended duration of dirty water management system due to re-handle of material. • Delayed establishment of vegetation from rehabilitation works which will delay establishment of habitat connectivity within the final landform. • Delay in returning runoff from rehabilitated areas to the natural landform. • Void catchment limited to immediate void ~350 ha. • Volume of material re-handle required to achieve landform ~65 Mlcm[1]. • Estimated cost of re-handling overburden material, associated other works and overheads to establish landform design in the range of ~$300 to 400 million. • Delay closure an additional ~8 years.

[1] - Mlcm calculated from Mbcm assuming a swell factor of 17%

Each design scenario considered in selecting the proposed conceptual final landform (refer to **Table 5.1**) includes a final void of varying configuration. Given the depth of mining proposed and geotechnical constraints created by the complex geology within the North Pit, the mine plan design is restricted through limited space being available for the emplacement of overburden within the North Pit, requiring emplacement of overburden within the WOOP emplacement area in the early years of the Proposed Modification.

The volume of overburden required to completely backfill the proposed North Pit void is approximately 340 million loose cubic metres (Mlcm). The total volume of the WOOP emplacement area is ~55 Mlcm and the North Pit emplacement area is ~450 Mlcm. The volume of overburden required to fill the void to a self-draining landform would necessitate the movement of the entire WOOP emplacement area and a large portion of the North Pit emplacement area, resulting in the removal of significant areas of established rehabilitation. These works would take approximately 14 years post mining, assuming the reshaping of the re-disturbed WOOP and North Pit emplacement areas would be undertaken concurrently with re-handling of material from North Pit. The significant re-handling of material at the end of production will prolong environmental impacts for this period of time e.g. visual, air quality, blasting and noise impacts. Establishment of vegetation from rehabilitation works will also be delayed, which will then delay establishment of habitat connectivity within the final landform. Additionally, there would be an extended duration of the dirty water management system due to re-handle of material which would delay the return runoff from rehabilitated areas to the natural landform.

On balance, the prolonged environmental impacts and significant additional costs associated with backfilling the Proposed Modification void are neither feasible nor appropriate. Backfilling of the void would make the Proposed Modification uneconomic and if backfilling the void was required as a condition of consent, the Proposed Modification would not be likely to gain shareholder support to proceed. As previously noted the approved final landform includes a final North Pit void and no additional voids are proposed as part of the Proposed Modification.

Consistent with the Approved Operations, the proposed conceptual final landform proposes a natural landform design incorporating micro-relief elements throughout the life of the operation, maximising return of catchment, particularly to Main Creek, and aims to achieve a safe, stable and non-polluting final landform.

Further detail regarding the conceptual final landform design including a detailed comparison between the approved and proposed final landform is provided in **Section 6.10**, together with beneficial final land use considerations.

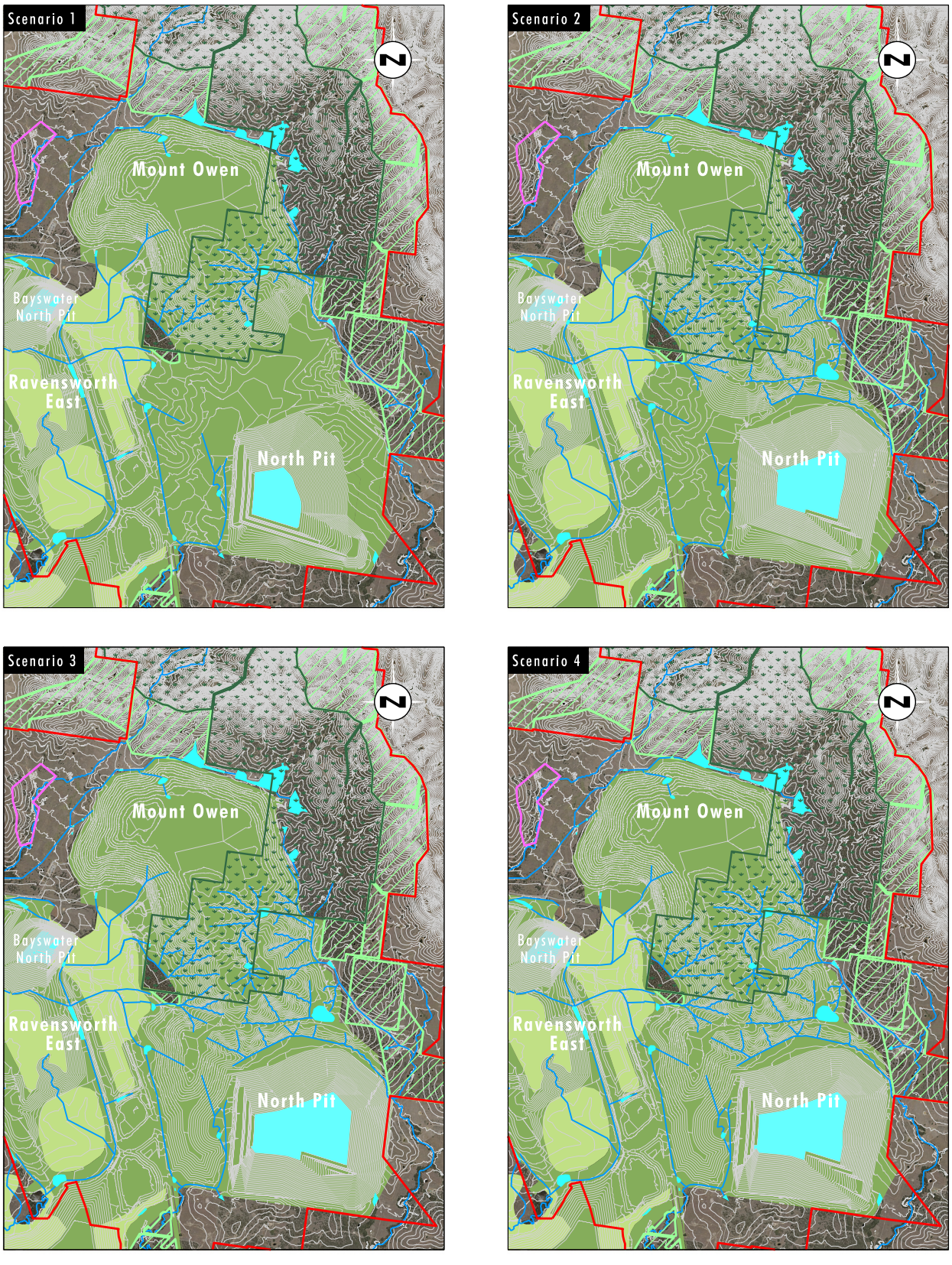
5.4 Alternative of Not Proceeding with the Proposed Modification

The Proposed Modification allows for the extraction of an additional approximately 35 Mt ROM coal from within Glencore mining tenements. The revisions to the North Pit mine plan allow for more efficient mining progression and the extension of the Mount Owen Mine life by an additional 6 years. As discussed in **Section 1.0**, consultation with the NSW Resources Regulator throughout the assessment of the Continued Operations Project included discussion regarding the existing mining tenements and avoiding the sterilisation of coal beyond the tenements held by Mount Owen.

Glencore ownership of the Mount Owen Complex and the Integra Underground Mine has provided for the allocation of appropriate mining tenements to each operation with the recently approved Integra Underground Modification 8 allowing for the extraction of additional coal reserves from Glencore mining tenements that would have otherwise become sterilised. Not proceeding with the Proposed Modification would result in the sterilisation of the accessible coal reserves. The extraction of this ROM coal by extending the existing open cut operations and utilising existing equipment and infrastructure is more efficient than underground mining or reopening operations following closure to extract the identified reserves.

Not progressing with the Proposed Modification would remove the prospect for continued employment opportunities for the workforce at Mount Owen Mine of up to 660 people for an additional 6 years which would have flow on effects to the local, regional and State economies.

Closing the operations following the extraction of the existing approved ROM coal would have potential benefits to the local community and environment in terms of avoiding some of the impacts from mining. However, these potential benefits need to be balanced against the economic and social benefits provided to the community at a local, regional and State level by the implementation of the Proposed Modification, particularly given the impacts of the Proposed Modification are consistent with the impacts associated with the Approved Operations. An economic assessment has been undertaken to assess the costs and benefits associated with the Proposed Modification (refer to **Section 6.12**).



Legend

- Proposed SSD-5850 Modification Consent Boundary
- Yorks Creek VCA
- Water Storage (Water Level in North Pit Indicative Only)
- Native Woodland
- Open Grassland (Potential grazing areas) with pockets of Native Vegetation
- Ravensworth State Forest
- Existing Biodiversity Offset Area
- Drainage Line (Indicative Only)

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

FIGURE 5.3

Conceptual Final landform Design Analysis

6.0 Environmental Assessment

As discussed in **Section 3.3.2**, DPE advised that the SEE for the Proposed Modification should:

> *'build upon the contemporary baseline data provided in the EIS for the Continued Operations Project, to inform the assessment of the potential impacts of the Proposed Modification, paying particular attention to the relative changes under the modification to any increase in potential impacts.'*

Additionally, Mount Owen was required to update the relevant technical studies (including air quality, noise, biodiversity and water modelling/assessments) to meet contemporary assessment standards and ensure any changes in impacts under the Proposed Modification are clearly defined.

Table 6.1 provides a preliminary environmental assessment analysis which identifies the key environmental and social issues that are relevant to the Proposed Modification and where further assessment has been required considering the impact of the Proposed Modification relative to the Approved Operations. Where aspects have been identified as requiring further detailed assessment, this is outlined in the following sections including detailed technical studies, where relevant, provided as appendices to this report.

Table 6.1 Potential environmental impacts associated with the Proposed Modification and further assessment required

Aspect	Environmental Assessment	Further Assessment Required?
Air Quality	The revisions to the North Pit mine plan, increased disturbance area and proposed changes to the overburden emplacement strategy has the potential to change the air quality emissions generated by the Proposed Modification relative to Approved Operations.	Yes, refer to **Section 6.1** and **Appendix 6**
Noise	The revisions to the North Pit mine plan, increased disturbance area and proposed changes to the overburden emplacement strategy has the potential to change the noise emissions generated by the Proposed Modification relative to Approved Operations.	Yes, refer to **Section 6.2** and **Appendix 7**
Blasting	There will be no change to the blasting practices currently undertaken within the North Pit, however blasting impacts have been assessed given the proposed revisions to the North Pit mine plan and the increased disturbance area. Further assessment of blast impacts in relation to Main Creek and the associated alluvium has also been completed in response to issues raised in consultation with DPE (refer to **Section 6.0**).	Yes, refer to **Section 6.3** and **Appendix 8**
Groundwater	The revised North Pit mine plan proposes an increased depth of mining than currently approved, additionally the progression of mining has also been revised and is proposed to occur closer to the alluvial aquifer associated with Main Creek. Detailed groundwater modelling has been undertaken for the Proposed Modification including substantial refinements to the regional groundwater model utilised for the Continued Operations Project and other Glencore projects in the greater Ravensworth area.	Yes, refer to **Section 6.4** and **Appendix 9**

Aspect	Environmental Assessment	Further Assessment Required?
Stygofauna	An assessment has been undertaken to confirm whether stygofauna are present in the area surrounding the Mount Owen Complex and to assess the potential impacts on any significant stygofauna populations associated with groundwater drawdown as a result of the Proposed Modification.	Yes, refer to **Section 6.4** and **Appendix 10**
Surface Water	The Proposed Modification will result in relatively minor changes to the interaction of the mining operation with surface water. Minor changes are proposed to the existing water management system, the Mount Owen Complex water balance, and changes to the final landform will result in changes to the catchment of Main Creek and Bettys Creek.	Yes, refer to **Section 6.5** and **Appendix 11**
Ecology	The Proposed Modification will result in the disturbance of an additional 46 ha of land requiring further assessment of potential impacts on threated fauna species, flora species and vegetation communities, in accordance with revised assessment guidelines.	Yes, refer to **Section 6.6** and **Appendix 13**
Aboriginal Archaeology	The Proposed Modification has the potential to impact on Aboriginal Archaeology and Cultural Heritage as a result of the disturbance of an additional 46 ha of land. Further assessment was undertaken including Aboriginal Archaeology survey and consultation with the relevant Knowledge Holders and RAPs.	Yes, refer to **Section 6.7** and **Appendix 14**
Greenhouse Gas and Energy	The Proposed Modification will result in increased greenhouse gas (GHG) emissions generated as part of the Proposed Modification and the downstream use of coal produced. A Greenhouse Gas Assessment has been completed for the Proposed Modification to quantify the likely GHG emissions relative to the Approved Operations.	Yes, refer to **Section 6.9** and **Appendix 15**
Visual Amenity	The revised North Pit mine plan increases the disturbance area and proposes changes to the North Pit overburden emplacement strategy with the potential to increase the visibility of the mining operations in areas to the south-east and east of Mount Owen.	Yes, refer to Section 6.8
Rehabilitation and Mine Closure	The Proposed Modification will result in a revised conceptual final landform to that currently approved. The Proposed Modification has included a design review in relation to the proposed conceptual final landform, which also included review and proposed amendment to the Rehabilitation Strategy for the Mount Owen and Ravensworth East Mines.	Yes, refer to **Section 6.10** and **Appendix 16**
Social Impacts	The potential social impacts and opportunities associated with the Proposed Modification have been assessed. A community consultation program has also been undertaken to understand stakeholders' views and attitudes towards the Proposed Modification.	Yes, refer to **Section 6.11**, **Section 4.0** and **Appendix 17**
Economic	An Economic Impact Assessment has been undertaken to assess the costs and benefits of the Proposed Modification relative to the Approved Operations.	Yes, refer to **Section 6.12** and **Appendix 18**

Aspect	Environmental Assessment	Further Assessment Required?
Agricultural Resources	The Proposed Disturbance Area has been historically used for agricultural land uses, including an olive plantation, and is also used periodically for grazing by Glencore owned grazing operations. At a regional scale the Proposed Disturbance Area has not been mapped as BSAL. Detailed soil assessments have been completed across the Proposed Disturbance Area and an assessment completed to inform a SVC application to DPE. A SVC, confirming that the Proposed Disturbance Area does not constitute Strategic Agricultural Land, was issued by DPE in 2017. Based on this, and the small area of additional proposed disturbance, it is considered that the Proposed Modification will not have a significant impact on agricultural land uses and no further assessment is warranted.	No – refer to **Section 3.3.4** and **Appendix 3** for SVC details
Traffic and Transport	A detailed Traffic Impact Assessment was undertaken to assess the road and rail traffic impacts associated with the Continued Operations Project. The Continued Operations Project was not expected to result in unacceptable traffic conditions or road service levels. In addition, the construction of the new dual lane bridge over Bowmans Creek and rail overpass over the Main Northern Rail Line on Hebden Road, approved under SSD-5850, was considered to provide improvements to road service levels and safety. Given no significant construction or increase in workforce numbers is proposed as part of the Proposed Modification, traffic levels are anticipated to continue to be similar to current approved traffic levels and no additional impact is anticipated to traffic conditions or road service levels associated with the Proposed Modification. Whilst the Proposed Modification will result in an additional 6 years of coal production in the North Pit and transportation along the Main Northern Rail Line, there will be no increase to the currently approved train movements.	No
Historic Heritage	No historic heritage sites/items with statutory heritage listings are located within the Proposed Disturbance Area. In addition, none of the identified listed heritage items within the vicinity of the Mount Owen Complex were found to be directly impacted as part of the Approved Operations. Based on this it is considered that the Proposed Modification will not have a significant impact on any historic heritage sites or items. Blasting impacts to the surrounding identified historic heritage items have been included in the Blast Impact Assessment, refer to **Section 6.3.**	No
Waste Management	The Proposed Modification is not expected to generate any additional waste streams or increase annual waste volumes relative to the Approved Operations. To manage waste generated by the Proposed Modification, Mount Owen will continue to implement its existing Waste Management Program. In addition, the existing tailings and coarse rejects management strategy (refer to **Section 2.2.2**) will continue to be implemented for the Proposed Modification.	No

Aspect	Environmental Assessment	Further Assessment Required?
Hazards	Mount Owen currently uses a range of hazardous substances on site for its mining operations and coal processing. This includes the utilisation of explosive materials which are supplied by an external contractor. The contractor will hold the relevant dangerous goods licences required for the storage of explosive materials located at Mount Owen Mine. The storage quantities of explosive materials will not change as a result of the Proposed Modification. Other hazardous materials stored on site are managed by Mount Owen in accordance with the existing hazard management system which ensures that those current risks posed to surrounding land users are managed. Should any new hazardous substances or dangerous goods be introduced to the site, they will be identified and managed in accordance with the existing procedures and management plans.	No
Bushfire	No significant infrastructure is proposed as part of the Proposed Modification that would warrant further bushfire threat assessment. Bushfire threat will continue to be managed in accordance with the bushfire management controls included in the Mount Owen Complex Bushfire Management Plan, which will continue to be reviewed and updated as required, in consultation with the Rural Fire Service (RFS).	No

6.1 Air Quality

A detailed Air Quality Impact Assessment (AQIA) has been undertaken by Jacobs to assess the potential air quality impacts associated with the Proposed Modification relative to the Approved Operations. The results of the assessment are discussed in this section and the full AQIA is provided as **Appendix 6**.

As discussed in **Section 2.2.1**, various mine design options were reviewed in developing the conceptual mine plans for the Proposed Modification, with consideration of minimising the potential air quality impacts. Given the conceptual mine plans retain the approved southern extent of the North Pit, has minimal increase to the total disturbance area (1.8%) and does not increase the total annual maximum production, the level of emissions and air quality impact associated with the Proposed Modification is expected to be relatively consistent with the Approved Operations.

Emissions to air associated with mining operations will occur from a variety of activities including material handling, material transport, processing, wind erosion, blasting and potentially, from the spontaneous combustion of coal. These emissions mainly comprise of particulate matter in the form of Total Suspended Particles (TSP), particulate matter with equivalent aerodynamic diameter of 10 microns or less (PM_{10}) and particulate matter with equivalent aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

The AQIA has been carried out in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW “Approved Methods” (EPA 2016). The 2016 version of the Approved Methods introduces revised, more stringent assessment criteria for particulate matter concentrations, compared to the criteria used to assess the Continued Operations Project including more stringent criteria related to PM10 and the introduction of assessment criteria for PM2.5.

The main objectives of the AQIA were to:

- identify potential air quality issues associated with the Proposed Modification
- quantify existing and potential air quality impacts, and
- identify suitable air quality management measures, as appropriate, to minimise impacts.

The assessment was based on the use of an air dispersion model, CALPUFF, to predict concentrations of substances emitted to air due to the mining activities. Model predictions have been compared with air quality criteria referred to by the EPA in order to assess the effect that the Proposed Modification may have on the existing air quality environment relative to the Approved Operations.

The potential air quality issues associated with the approved and proposed mining activities are:

- dust (that is, particulate matter in the form of TSP, deposited dust, PM_{10} or $PM_{2.5}$) from the general mining activities
- fume (that is, NOx emissions) from blasting, and
- emissions of substances from machinery exhausts, that is, diesel exhaust emissions.

6.1.1 Air Quality Criteria

The air quality assessment criteria adopted for the Approved Operations and applicable to the current development consent are the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC 2005a). The relevant air quality criteria for the Approved Operations, in accordance with Schedule 3, Condition 16 of the current development consent (SSD-5850), are provided in **Table 6.2**.

Table 6.2 Air Quality Criteria for Particulate Matter and Deposited Dust (Approved Operations)

Pollutant	Averaging Period		[d] Criterion
Particulate matter PM_{10}	24 hour		[b] 50 µg/m^3
	Annual		[a] 30 µg/m^3
Total suspended particulate (TSP) matter	Annual		[a] 90 µg/m^3
[c] Deposited dust	Annual	Maximum increase in deposited dust level	[b] 2 g/m^2/month
		Maximum total deposited dust level	[a] 4 g/m^2/month

Notes:

[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own).

[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.

[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed to by the Secretary.

As discussed in **Section 6.0**, air quality impacts associated with the Proposed Modification have been assessed against the revised air quality criteria set by the EPA as part of their Approved Methods (2016). These criteria are outlined in **Table 6.3** and are applicable to existing and potential sensitive receptors such as residences, schools and hospitals.

Table 6.3 Approved Methods (EPA 2016) Impact Assessment Criteria (Proposed Modification)

Substance	Averaging time	Criterion	Source
Particulate matter (PM_{10})	24-hour	50 µg/m^3	EPA/DoEE (2016)
	Annual	25 µg/m^3	
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m^3	EPA/DoEE (2016)
	Annual	8 µg/m^3	
Particulate matter (TSP)	Annual	90 µg/m^3	EPA/NHMRC (1996)
Deposited dust	Annual (maximum increase)	2 g/m^2/month	EPA/NERDDC (1988)
	Annual (maximum total)	4 g/m^2/month	
Nitrogen dioxide (NO_2)	1-hour	246 µg/m^3	EPA/NEPC (1998)

The AQIA undertaken to support the Approved Operations was based on an earlier version of the Approved Methods (DEC 2005). The 2016 version introduces a revised, more stringent criterion for PM_{10} as well as new criteria for 24-hour and annual average $PM_{2.5}$. The criteria applicable to the Approved Operations for PM_{10} was 30 µg/m^3. Whilst there was no adopted criteria for $PM_{2.5}$ at the time of the assessment, $PM_{2.5}$ levels associated with the Approved Operations were modelled (PAE 2016).

It is also noted that as part of the amendment to the National Environment Protection Measures (NEPM), which informs the Approved Methods (2016), the EPA aims to move towards a more stringent PM_{10} and $PM_{2.5}$ criteria by 2025, however this approach is not currently adopted by relevant State legislation at this time. Accordingly the Proposed Modification is assessed against the current criteria detailed in the Approved Methods (2016) as these criteria would need to be applied by the consent authority in accordance with the provisions of Clause 12AB of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) (2018 amendment).

As discussed in **Section 3.3.3**, the VLAMP (2014) 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 current VLAMP (2014) remains in force at the completion of this assessment and reflects the previous air quality criteria as defined in the Approved Methods (2005). Accordingly, the current VLAMP does not require assessment against the revised criteria defined in the Approved Methods (2016).

A draft revised VLAMP is currently under review (NSW Government 2017) coupled with amendments to the Mining SEPP to bring the air quality criteria in line with the NEPM standards and EPA criteria.

As discussed in **Section 3.3.3**, the draft revised VLAMP also refines the application of this policy to modifications of consent and states:

> *The policy commences from the date that it is gazetted, and applies to:*
>
> - *Modification applications that involve increases in the approved dust or noise impacts of a development.*

As detailed in the following sections, the Proposed Modification is not predicted to result in an increased area of impact in respect to air quality and noise impacts relative to the Approved Operations. Accordingly, at the point that the revised VLAMP is gazetted, it will not apply to the assessment of the Proposed Modification.

As such, the AQIA only considers the requirements of the existing VLAMP (2014) as it applies to the Proposed Modification.

6.1.2 Existing Environment

Meteorological conditions are important for determining the direction and rate at which emissions from mining operations will disperse. The key meteorological requirements of air dispersion models are, typically, hourly records of wind speed, wind direction, temperature, atmospheric stability class and mixing layer height. For the AQIA, 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.

Three meteorological stations were included in the meteorological data analysis, located within a 20 km by 20 km domain around the Mount Owen Complex. These stations (refer to **Figure 6.1**) are referred to as:

- Glendell Met (SX13 – M1), operated by Mount Owen
- Mt Owen Met (SX8), operated by Mount Owen
- Camberwell, operated by the OEH.

It should also be noted that an additional meteorological station has been installed in Middle Falbrook, consistent with the commitment made by Mount Owen in relation to the Continued Operations Project, however at the time of the analysis, this station did not have a full year of data available and has not been included in the analysis.

Meteorological data from five recent years (2012 to 2016 inclusive) was analysed in order to identify a representative year for the 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 the 2012 to 2016 calendar years.

Wind patterns in the vicinity of Mount Owen Mine are similar to other parts of the Hunter Valley, with the prevailing winds being from either the north-west or south-east.

For the AQIA the 2014 calendar year has been selected as the meteorological modelling year (and also used for the Noise Impact Assessment), based on:

- high data capture rate, relative to other years
- similar wind patterns to other years
- rainfall being slightly below the long-term average, and the preference was for a slightly drier than average year
- air quality conditions which showed similarities to other years and not adversely influenced by bushfire activity.

As discussed above a detailed review of the available meteorological data (2012 to 2016) was undertaken to determine the most appropriate representative year for the air quality modelling for the Proposed Modification. Based on the detailed review undertaken to inform the AQIA, the 2014 meteorological year was considered the most appropriate.

Further detail regarding the metrological data review is provided in the AQIA (refer to **Appendix 6**).

The AQIA also included a detailed review of the existing air quality data (up to 2017) from the existing air quality monitoring network at the Mount Owen Complex and the EPA monitoring locations within the vicinity of the Mount Owen Complex (refer to **Figure 6.1**). The detailed review of all existing air quality data is provided in the AQIA (refer to **Appendix 6**). The outcomes of this review are summarised below:

- 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.
- In terms of PM_{10} concentrations, most monitoring sites in the vicinity of Mount Owen Complex have experienced at least one day above the EPA's PM_{10} 24hr 50 µg/m^3 criterion in the past five years, but annual averages have complied with EPA criteria for all locations.
- TSP and NO_2 concentrations are below their relevant EPA criteria.
- Deposited dust levels have exceeded EPA criteria at 5 of the 13 monitoring locations on occasion.
- Within the vicinity of Camberwell the PM_{10} annual average is generally consistent with or greater than the revised PM_{10} criterion of 25 µg/m^3.
- The two closest $PM_{2.5}$ monitoring stations, Camberwell and Singleton, have measured $PM_{2.5}$ concentrations which are close to or have exceeded the EPA criteria. A study by the OEH (2013b) found that wood smoke was one of the main factors that influenced $PM_{2.5}$ concentrations, especially in winter.
- Conditions in 2014 were representative of longer-term air quality and meteorological conditions as presented in the AQIA (refer to **Appendix 6**).

The review of the air quality monitoring data also determined the appropriate background levels to be added to model predictions for the assessment of potential cumulative impacts, that is, mining contribution plus non-mining contribution. For this objective, the approach was to make use of data collected from all real-time air quality monitors in the vicinity of the Mount Owen Complex and, at the same time, minimise the potential for adding model predictions to measurements which may already contain contributions from those sources being modelled (i.e. to avoid double counting). Further detail is provided in the AQIA, refer to **Appendix 6**.

6.1.3 Emissions to Air

The most significant emission to air as a result of the Proposed Modification will be dust (i.e. particulate matter) due to material handling, material transport, processing, wind erosion, and blasting. The emission inventories for the Proposed Modification and surrounding mining operations included in the model have been developed to include total dust emissions, estimated by analysing the production schedule, equipment listing and mine plans and identifying the location and intensity of dust generating activities.

The emission factors used for the AQIA have been drawn largely from the following sources:

- Emission Estimation Technique Manual for Mining (NPI 2012),
- AP 42 (US EPA 1985 and updates), and
- ACARP Project C22027 (ACARP 2015).

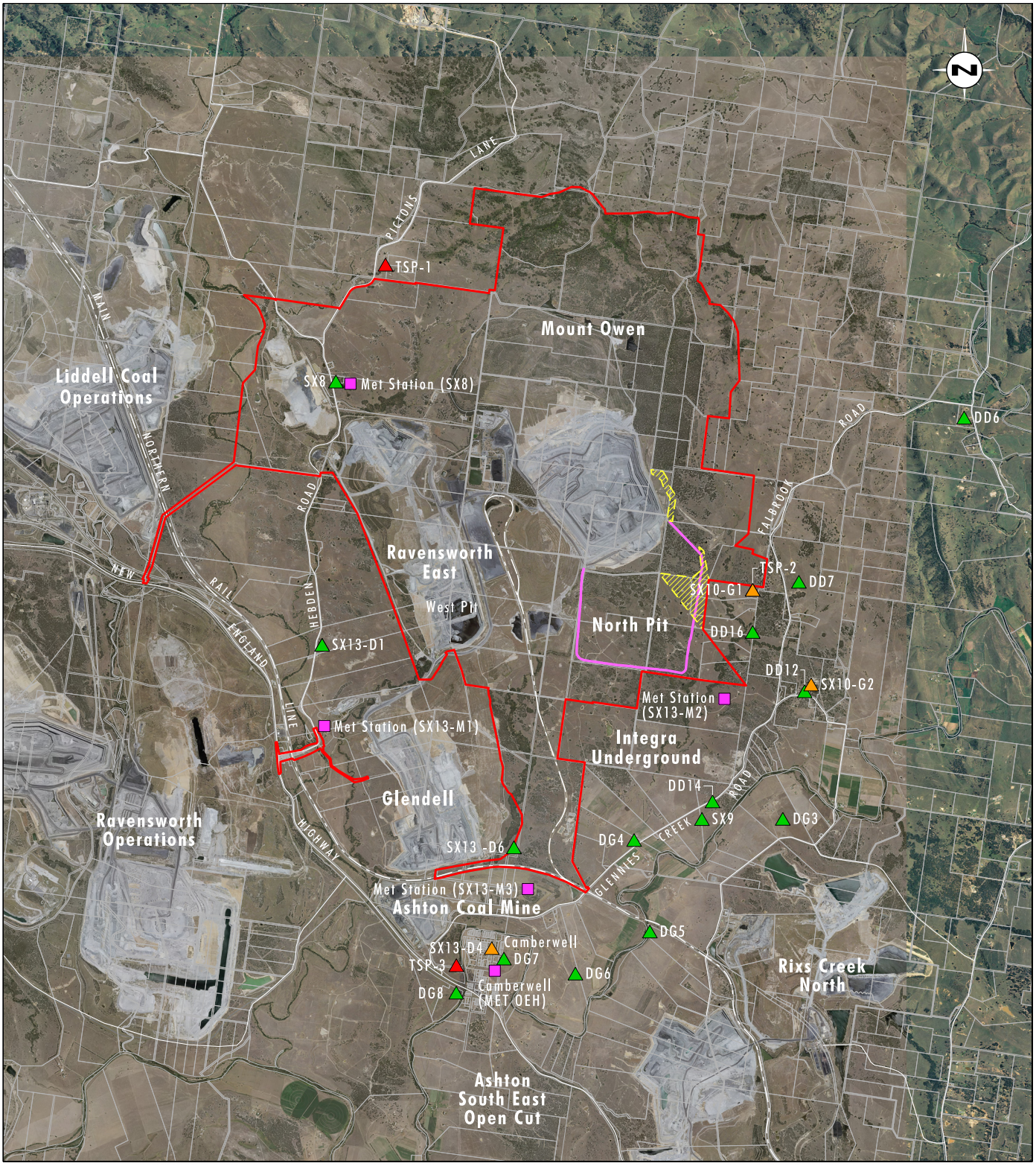


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1 2 4 km
Scale 1:90 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Depositional Dust Monitoring Location
- PM10 Monitoring Location (Continuous)
- TSP Monitoring Location
- MET Station

FIGURE 6.1

Air Quality Monitoring Network

Dust emission inventories developed for each of the modelled scenarios include:

- 2014, representing 'existing' conditions (with the operations approved at that time) and used for model performance evaluations, and

- Year 2, Year 8 and Year 15, representing proposed future conditions, and assuming maximum production for each of these stages.

In addition, the model includes predictions of contributions from the existing mining operations within the vicinity of the Approved Operations, and approved mining operations (not currently operating but with valid development consent) to include the contribution of these mining sources to the total emissions in the surrounding area. This includes Ravensworth East (as approved under SSD-5850), Glendell, Ashton Coal Mine, Ashton SEOC, HVO (part of operations located within model domain), Integra Underground, Liddell Coal Operations, Ravensworth Operations, Rix's Creek and Rix's Creek North. In relation to Rix's Creek, it has been assumed that the Rix's Creek Continuation Project (AECOM, 2015) which is currently under assessment, will be approved. The assumed ROM coal production data and associated emissions are included in the AQIA (refer to **Appendix 6**).

These sources have been included in the model for future mining scenarios reflective of their current approved life and maximum approved production limit in accordance with current consents. 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. The Ashton SEOC has been included as the existing development consent enables mining to occur during the life of the Proposed Modification and has the potential to contribute significantly to air quality in the surrounding area. As previously detailed in the AQIA completed for the Continued Operations Project the Ashton SEOC, along with Rix's Creek North will contribute substantial concentrations of dust to a number of key receiver areas including Camberwell and Middle Falbrook.

6.1.3.1 Refinements to Air Quality Modelling Approach

Key refinements to the air quality modelling approach for the Proposed Modification are:

- selection of the 2014 meteorological year utilised for the modelling (refer to **Section 6.1.2**); and

- revised estimated emissions inventory

The modelling undertaken for the air quality assessment for the Approved Operations (PAE, 2016) utilised meteorological data collected for a one year period between 2011 and 2012. The selection of this meteorological year was queried during the assessment of the Continued Operations Project on the basis that the background particulate matter concentrations for the same period may have been lower than the longer-term averages thereby having the potential to result in a less conservative assessment. This issue was investigated and addressed at the time however a detailed review of all meteorological data that is now available (2012 to 2016) was completed for the AQIA for the Proposed Modification to further refine the selection of representative data. The selection of the 2014 data for the AQIA for the Proposed Modification considered both the longer-term air quality and the meteorological conditions in order to identify the representative modelling year.

The inventories for the Proposed Modification have been refined to incorporate adjustments to the activity lists, for consistency with other surrounding mining operations, in addition to adjustments to emission factors based on more default type approaches. For example, the default factor approach was used for estimating emissions from wheel generated dust, this approach ensures that emissions from this activity will not be dependent on road-silt and moisture content data, as this dataset is limited and may not be representative of long term conditions.

The modelling results indicate that this approach has led to reasonable agreement between the measured and modelled average results, and has avoided the use of model correction factors, which was identified as an issue by DPE and the EPA during the assessment of the Continued Operations Project.

These model refinements and subsequent calibration of the model have driven some of the variation between the predicted emissions associated with the Approved Operations and the Proposed Modification, as discussed in **Section 6.1.5**. However it should be noted that the predicted area of impact in relation to private residences associated with the Proposed Modification is still consistent with the Approved Operations.

Further detail regarding the air quality modelling approach is provided in the AQIA (refer to **Appendix 6**).

6.1.4 Air Dispersion Model

The computer-based dispersion model known as CALPUFF was used to predict the potential air quality impacts of the Proposed Modification, including cumulative impacts. The dispersion modelling accounted for meteorological conditions, land use and terrain information and used dust emission estimates to predict the off-site air quality impacts. The performance of the model was reviewed by comparing predictions to measured results for the 2014 representative year. It was found that the model predictions for annual average concentrations were typically within 10% of the measured results and performed well in the key receiver areas surrounding the Proposed Modification (for further detail refer to **Appendix 6**).

6.1.5 Assessment of Impacts

This section provides an overview of the predicted air quality modelling results for the Proposed Modification, primarily based on model predictions and comparisons to air quality criteria. This includes impacts associated with the Proposed Modification and the cumulative impact when assessing the contribution from all existing and approved mining operations. The complete tabulated list of predicted modelling results and air quality contour plots is provided in **Appendix 6**. The modelling results include both the Approved Operations and Proposed Modification, which has been used as the basis of comparison with relevant impact assessment criteria. The air quality contour plots have been utilised to compare specific results between the Proposed Modification and the Approved Operations.

6.1.5.1 Particulate Matter (PM_{10})

The predicted modelling results indicate that:

- No sensitive locations (excluding community or private infrastructure, or properties subject to existing acquisition rights) are predicted to experience a contribution of greater than 50 $\mu g/m^3$ for maximum 24-hour average PM_{10} concentrations as a result of the Proposed Modification. It is noted that when other cumulative sources are considered the modelling indicates that there may be peak PM_{10} 24-hour levels above 50 $\mu g/m^3$, however this is predicted to occur over 2 to 3 days per year. This is consistent with the predicted levels for the Approved Operations.

- No sensitive locations (excluding community or private infrastructure, or properties subject to existing acquisition rights) are predicted to experience exceedances of the annual average PM_{10} criterion at any stage of the Proposed Modification.

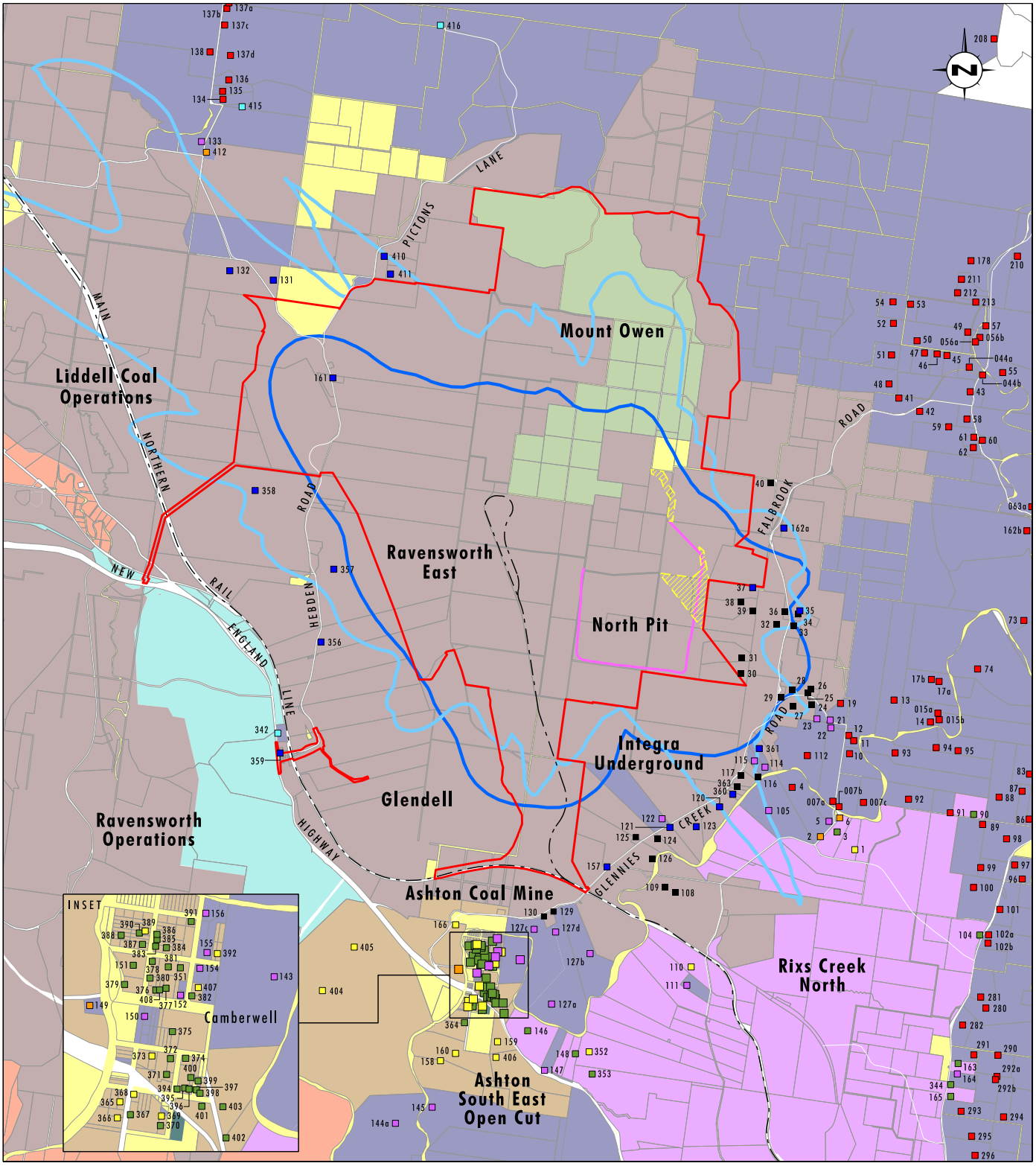
Figure 6.2 provides a comparison of the 24-hour average PM_{10} contours (all modelled years) for the Proposed Modification and the Approved Operations. As discussed in **Section 6.1.3.1**, there have been a number of model refinements since that completed for the Approved Operations, resulting in an obvious change in the shape of these contours. It is important to note that in relation to private residences and private properties (without existing acquisition rights), there is no increase in air quality impacts associated with the Proposed Modification relative to the Approved Operations.

As discussed in **Section 3.3.3** and **Section 6.1.1**, the EPA AQIA criterion for annual average PM_{10} was 30 µg/m^3 at the time the AQIA was undertaken for the Approved Operations. This criterion has been reduced and is now 25 µg/m^3. The predicted modelling results indicate that the cumulative annual average PM_{10} concentrations are predicted to exceed the 25 µg/m^3 criterion in Camberwell in most modelled years. As previously discussed this is based on inclusion of the Ashton SEOC that is not currently operating as well as assumed maximum production rates for all operations. For these reasons, it should also be noted that the predictions at key sensitive receptors for future operational scenarios have been inferred to be conservative estimates of impacts.

Properties in Camberwell, and some properties located to the south and south-east of the North Pit with existing acquisition rights have been identified as potentially experiencing PM_{10} concentrations above 25 µg/m^3 in the future (where currently levels may be below 25 µg/m^3). However it should be noted that at all of these locations the contribution from the Proposed Modification is predicted to be very low at less than 2 µg/m^3, indicating that exceedances in these locations are likely due to impacts from other existing or proposed sources located closer to these residences (refer to **Appendix 6** for further detail). This is consistent with the Approved Operations which were predicted to have minimal contribution to Camberwell.

As discussed in **Section 3.2.1** and further in **Section 6.2**, a range of operational noise control measures are currently implemented during adverse weather conditions for the Approved Operations to minimise the impact of the mining operation to meet the relevant noise criteria at surrounding private residences. These hierarchy of operational controls range from revising equipment locations, revising the nature of the activity, and shutting machines down in order to maintain compliance with noise criteria. In practice these operational controls, which will vary on a daily basis, will lead to lower air quality emissions than that applicable to unconstrained activities. Consequently the estimated air quality emissions should represent conservative estimates and the predicted air quality impacts attributed to the Proposed Modification will also be conservative. That is, the predicted impacts are likely to over-state actual impacts.

Additionally, whilst the Proposed Modification represents an increase to the mine life which will prolong the potential impacts associated with the mining operations, in the later years of the Proposed Modification the model predictions indicate the associated area of air quality impacts associated with the Proposed Modification will decrease. This is attributed to the slowing of production and location of mining operations deep in the North Pit providing a shielding effect.



Data Source: Glencore (2018)

0 1 2 4 km

Scale 1:90 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- 24 Hour Average PM_{10} Concentrations (all modelled years - 50 $\mu g/m^3$) Proposed Modification
- 24 Hour Average PM_{10} Concentrations (all modelled years - 50 $\mu g/m^3$) Approved Operations
- Ashton Coal
- Bloomfield Collieries
- Coal and Allied
- Crown Land
- Glencore
- Government Authority
- AGL Macquarie
- Private
- State Forest
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 6.2

Predicted Worst Case 24 hr Average PM_{10} Concentrations (all modelled years - 50 $\mu g/m^3$) Approved Operations and Proposed Modification

File Name (A4): R09/3810_207.dgn
20180619 15.46

6.1.5.2 Particulate Matter ($PM_{2.5}$)

No sensitive locations (excluding community or private infrastructure, or properties subject to existing acquisition rights) are predicted to experience exceedances of the 24-hour average $PM_{2.5}$ criterion (25 µg/m^3) or the annual average $PM_{2.5}$ criterion (8 µg/m^3) at any stage of the Proposed Modification.

6.1.5.3 Particulate Matter (TSP)

No sensitive locations (excluding community or private infrastructure, or properties subject to existing acquisition rights) are predicted to experience exceedances of the annual average TSP criterion (90 µg/m^3) at any stage of the Proposed Modification.

6.1.5.4 Deposited Dust

No sensitive locations (excluding community or private infrastructure, or residential properties subject to existing acquisition rights) are predicted to experience exceedances of the annual average dust deposition criteria at any stage of the Proposed Modification.

6.1.5.5 Post Blast Fume (NO_2)

Blasting activities have the potential to result in fume and particulate matter emissions. Mount Owen has an existing Blast Management Plan which covers fume management, this 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, the mining operator, continues to work closely with its explosive suppliers to minimise the potential for post-blast fume.

No changes are proposed to the number of blasts per day, permissible blasting hours, blasting practices or blast management procedures as part of the Proposed Modification. Therefore, the extent of potential blast fume impact will be within the extent of potential blast fume impact under the Approved Operations.

6.1.5.6 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 including $PM_{2.5}$). It is the NOx, or more specifically NO_2, and PM_{10} (including $PM_{2.5}$) which have been included in the AQIA. Emissions from diesel exhausts associated with off-road vehicles and equipment are not predicted to result in any adverse air quality impacts.

For Year 2 of the Proposed Modification, modelling indicates that at the nearest sensitive receptors the predicted maximum 1-hour average NO_2 concentrations are in the order of 50 µg/m^3. With the addition of maximum background levels (74 µg/m^3) the results demonstrate compliance with the EPA's 246 µg/m^3 criterion (refer to **Appendix 6**).

The modelling indicates the predicted annual average NO_2 concentrations (which assumes that 50% of the NOx is NO_2) at nearest 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 show compliance with the EPA's 62 µg/m^3 criterion (refer to **Appendix 6** for further detail).

6.1.6 Management and Monitoring

Under development consent SSD-5850 five private receivers (105b, 114, 115, 116, 133c) were provided with acquisition rights subject to air quality impacts associated with the Approved Operations. Since the SSD-5850 development consent was granted, property 116 has been acquired by Mount Owen.

Mount Owen has continued consultation with potentially affected landholders through the consultation program associated with the Proposed Modification. Mount Owen has also contacted all private residents within 4 km of the Mount Owen Mine and offered the inspection and cleaning of water tanks located on their properties. To date, 51 water tanks have been inspected and 40 of those cleaned. The remaining 11 tanks either did not require cleaning upon inspection or the property owner opted for them not to be cleaned.

The existing Air Quality Management Plan, including the standard emission management measures and the reactive and proactive air quality management measures implemented as part of the Approved Operations will continue to be adopted for the Proposed Modification. Monitoring data collected during 2017 indicates only one exceedance of the PM_{10} 24 hour average criteria (50 $\mu g/m^3$) (as reported in the Mount Owen Complex Annual Review 2017). It should be noted that this exceedance was recorded during a period of below average rainfall which contributed to dry conditions throughout the Hunter Valley, DPE was notified of the exceedance and no further action was required. This demonstrates the existing air quality management measures are effective and based on the findings of the AQIA no additional management measures are required.

The meteorological and air quality monitoring network currently operated by Mount Owen (refer to **Figure 6.1**) is suitably set up to measure the key air quality parameters, compliance with air quality criteria, and to allow for the contribution of mining activities to be determined. This monitoring network will continue to be operated as part of the Proposed Modification.

In accordance with Schedule 3, Condition 18 of SSD-5850, Mount Owen will continue to implement all reasonable and feasible measures to minimise the odour, fume, spontaneous combustion, greenhouse gas and dust (including PM_{10} and $PM_{2.5}$) emissions of the development, including through the proactive and reactive management for all emission sources (crustal and combustion).

6.2 Noise Assessment

A detailed Noise Impact Assessment (NIA) has been undertaken by Umwelt to assess the potential noise impacts associated with the Proposed Modification relative to the Approved Operations. The results of the assessment are discussed in this section and the full NIA report is provided as **Appendix 7**.

6.2.1 Assessment Approach

The NIA was undertaken in accordance with the NSW Industrial Noise Policy (EPA 2000) (INP) and other current and relevant guidelines and policies relating to environmental noise resulting from the Proposed Modification, including the Mining SEPP (2007) and the VLAMP (2014).

It is noted that the Noise Policy for Industry (EPA 2017) (NPfI) has replaced the INP. Notwithstanding this, the DPE has advised (in correspondence dated 8 December 2017 (refer to **Appendix 5**)) that the INP may be applied to the NIA for the Proposed Modification on the basis that the NIA was substantially commenced prior to the commencement of the NPfI in October 2017.

The only exception is that the analysis of modifying factors has been reassessed based on the NPfI Fact Sheet C (EPA 2017). This approach has been taken in accordance with the NPfI implementation and transitional arrangements (EPA 2017) where it is noted the 'NPfI modification factor approach reflects more recent understanding of the impact of tonal and low-frequency noise on the community'.

As previously discussed, a draft revised VLAMP is currently under review (NSW Government 2017) coupled with amendments to the Mining SEPP to give effect to these changes. The draft VLAMP refines the application of this policy to modifications of consent and states:

> *The policy commences from the date that it is gazetted, and applies to:*
>
> - *Modification applications that involve increases in the approved dust or noise impacts of a development.*

The modelling undertaken to inform the NIA predicts there will be no increase in impacts to any privately owned land as a result of the Proposed Modification relative to the Approved Operations. Accordingly, at the point that the revised VLAMP is gazetted, it will not apply to the assessment of the Proposed Modification. As such the NIA only considers the requirements of the existing VLAMP (2014) as it applies to the Proposed Modification.

6.2.1.1 Existing Noise Consent Requirements and Criteria

Development consent SSD-5850 contains comprehensive environmental performance conditions, including noise criteria to be met over the life of the Approved Operations. Relevant noise conditions including parts of Conditions 1, 2 and 5 in Schedule 3 – Environmental Performance Conditions, are reproduced below. Conditions 3 and 4 of Schedule 3 relate to construction noise associated with the Hebden Road upgrade works and additional rail line. No further construction or additional infrastructure is proposed and accordingly, the construction related conditions are not relevant to the Proposed Modification.

> ***ACQUISITION UPON REQUEST***
>
> *1. Upon receiving a written request from the owner of any land listed in Table 1, the Applicant must acquire the land in accordance with the procedures in conditions 5 and 6 of Schedule 4.*

Table 1: Land subject to acquisition upon request

Acquisition Basis	*Land[a]*
Noise	*21, 22, 23*

Note: a. The location of the land referred to in Table 1 is shown on the figure in Appendix 3.

> ***ADDITIONAL MITIGATION UPON REQUEST***
>
> *2. Upon receiving a written request from the owner of any residence listed in Table 1 or Table 2, the Applicant must implement additional mitigation measures at the residence, in consultation with the landowner, in respect of the basis on which that residence is identified in Table 1 or Table 2.*
>
> *These measures must be reasonable and feasible, and directed towards reducing the air quality and/or noise impacts of the development on the residence. In the case of air quality, mitigation may include measures such as air filters, a first flush drainage system and/or air conditioning. In the case of noise, mitigation may include measures such as double-glazing, insulation and/or air conditioning.*
>
> *If within 3 months of receiving this request from the owner, the Applicant and the owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.*

Table 2: Land subject to additional mitigation upon request

Mitigation Basis	Residence
Noise	13, 19, 93

Note: The location of the land referred to in Table 2 is shown on the figure in Appendix 3.

NOISE

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.

APPENDIX 4
NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in Table 3 of the conditions are to apply under all meteorological conditions except the following:

(a) during periods of rain or hail;

(b) average wind speed at microphone height exceeds 5 metres/second;

(c) wind speeds greater than 3 metres/second measured at 10 metres above ground level; or
(d) temperature inversion conditions greater than 3°C/100 metres

In accordance with Schedule 3 Condition 7 of SSD-5850 an approved Noise Management Plan (NMP) is implemented for the Approved Operations. SSD-5850 allowed for the acquisition upon request of 3 properties due to noise. All three properties (ID 21, 22 and 23) remain in private ownership and are subject to acquisition upon receiving a written request from the owner in accordance with the procedures in Conditions 5 and 6 of Schedule 4 of SSD-5850. These properties were also afforded mitigation rights with mitigation works commenced at property 21. SSD-5850 also allowed for the provision of additional mitigation measures at 3 residences due to noise. In consultation with the landowner the 3 residences (ID 13, 19 and 93) have enacted their rights and additional noise mitigation works have commenced.

6.2.1.2 Operational Controls

The noise modelling inputs for the Proposed Modification consider mining activities; indicative equipment schedules and relevant sound power levels for the proposed Year 2, 8 and 15 mining operations (refer to **Section 2.2.1**). Further detail relating to the indicative equipment is provided in the NIA (refer to **Appendix 7**).

Consistent with the approach to noise mitigation and management as part of Approved Operations, Mount Owen has committed to the ongoing implementation of noise control measures to minimise noise emissions to the extent practicable and to meet the existing noise criteria at surrounding private residences as part of ongoing operations. The objective of the NIA was to identify and incorporate appropriate controls to ensure that the Proposed Modification can meet the existing noise criteria as defined under SSD-5850. This was completed as an iterative process through the design of the Proposed Modification and includes a hierarchal approach to the application of controls accounting for pit design, operational requirements and the influence of particular noise enhancing meteorological conditions (refer to **Section 6.2.3**).

As discussed in **Section 3.2.1**, refinements were made to the proposed conceptual mine plans in order to manage the predicted noise impacts to meet existing noise criteria, and to minimise prolonged impacts associated with the increased mine life, particularly in relation to private residences located within Middle Falbrook. These include the redesign and relocation of haul roads, reconfiguration of dumping providing for high/low dumping options and slowing of production in later years of the Proposed Modification when active mining reaches its southern extent.

In addition to the conceptual mine plan refinements, the following reasonable and feasible controls have been committed to over the life of the Proposed Modification. 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 Proposed Modification. Where relevant, all of these controls have been factored into the noise model for the Proposed Modification to determine that the existing noise criteria as detailed in SSD-5850 (refer to **Section 6.2.1.1**) are achievable over the life of the Proposed Modification. Consistent with the approach and controls identified in the approved Mount Owen Complex NMP, these controls largely relate to operational measures that are implemented in response to the real time noise monitoring network.

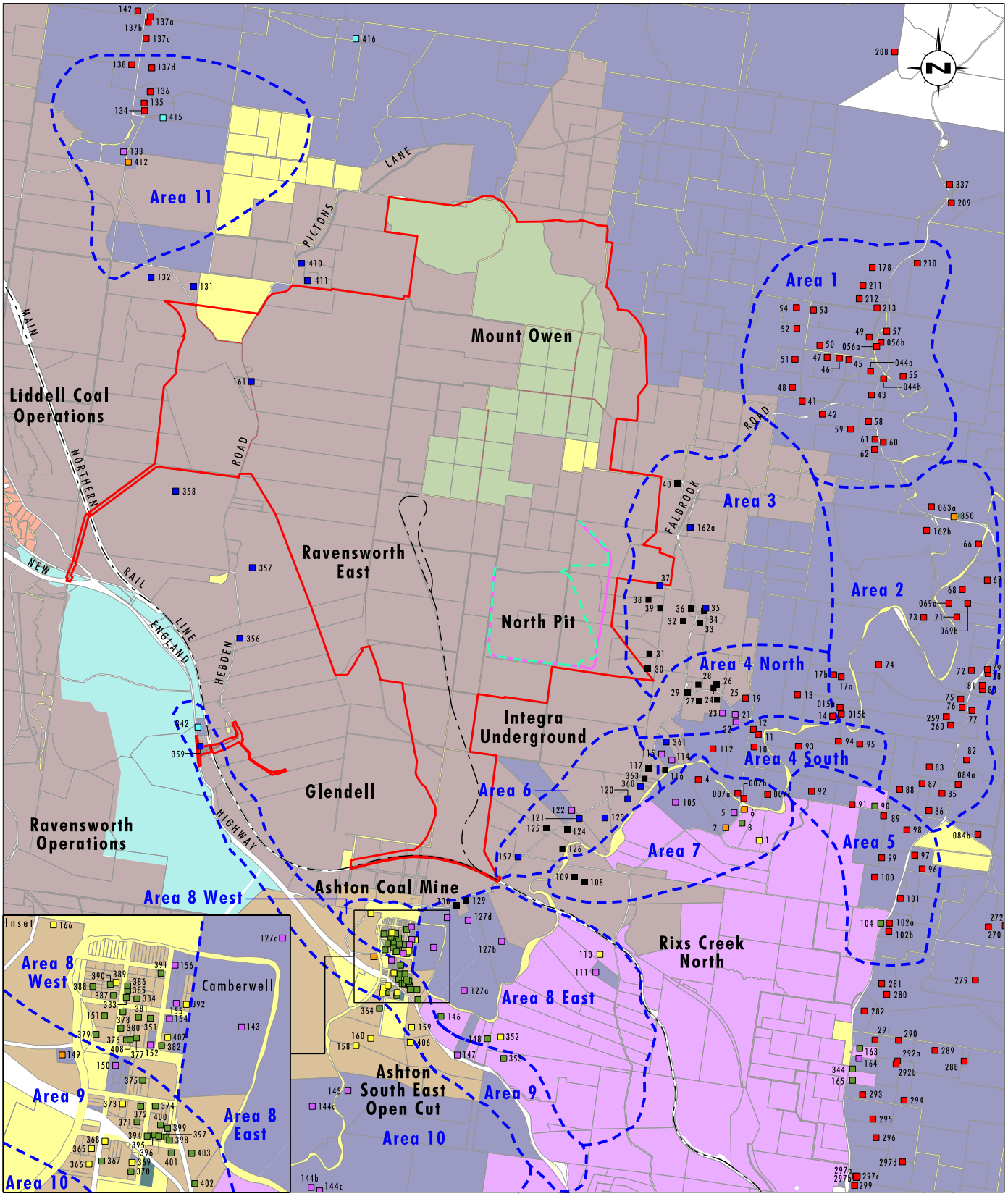
This may include:

- The management of mobile machines during adverse weather conditions, which is when wind conditions or temperature inversion conditions enhance noise propagation towards sensitive receiver locations. In order to control/eliminate noise impacts this may include:
    - providing alternative dumping locations
    - moving parts of the fleet to locations deeper in the pit, and/or
    - revising mining operations to reduce noise impacts including the implementation of a hierarchy of controls ranging from review of equipment locations and nature of activity, through to shut down of equipment as required to maintain compliance with noise criteria.
- Managing a number of ancillary activities to limit their occurrence during adverse meteorological conditions, such as those which may occur during winter night-times, including:
    - limiting ancillary mining equipment (e.g. dozers on overburden dumps, drills) during times of adverse weather conditions
    - reducing bulldozer activity on exposed rehabilitation areas, and/or
    - managing activities located at or near ground surface, such as top-soil and pre-strip, during the later stage of the mine life.
- The inclusion of bunds in strategic locations along some haul roads and, where practicable, locate these along the south-eastern side of the ramps, shielding trucks and equipment on exposed sections of the ramps.
- Location and orientation of haul roads such that they are not aligned with prevailing source to receiver winds where practicable.
- Incorporation of reasonable and feasible noise attenuation on key plant and equipment consistent with current commitments for the Approved Operations.

Further details on the specific mitigation measures incorporated into the relevant mine plans are provided in **Section 6.2.3.1**.

6.2.1.3 Noise Receiver Areas

Receptors in the region surrounding the Approved Operations have been grouped into localities or areas that have similar representative background noise levels. 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, train and road traffic). The defined areas were established as part of the NIA for the Continued Operations Project (Umwelt 2014 and 2016), as referenced in SSD-5850 and are reproduced in **Figure 6.3**. These noise receiver areas have been adopted for the Proposed Modification. The existing Mount Owen Complex noise monitoring network is shown on **Figure 6.4**.



Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Defined Receiver Areas (Project-specific Noise Level)
- Proposed Modification Pit Boundary
- Ashton Coal
- Bloomfield Collieries
- Coal and Allied
- Crown Land
- Glencore
- Government Authority
- AGL Macquarie
- Private
- State Forest
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 6.3

Sensitive Receiver Areas

File Name (A4): R09/3810_204.dgn
20180615 16.26

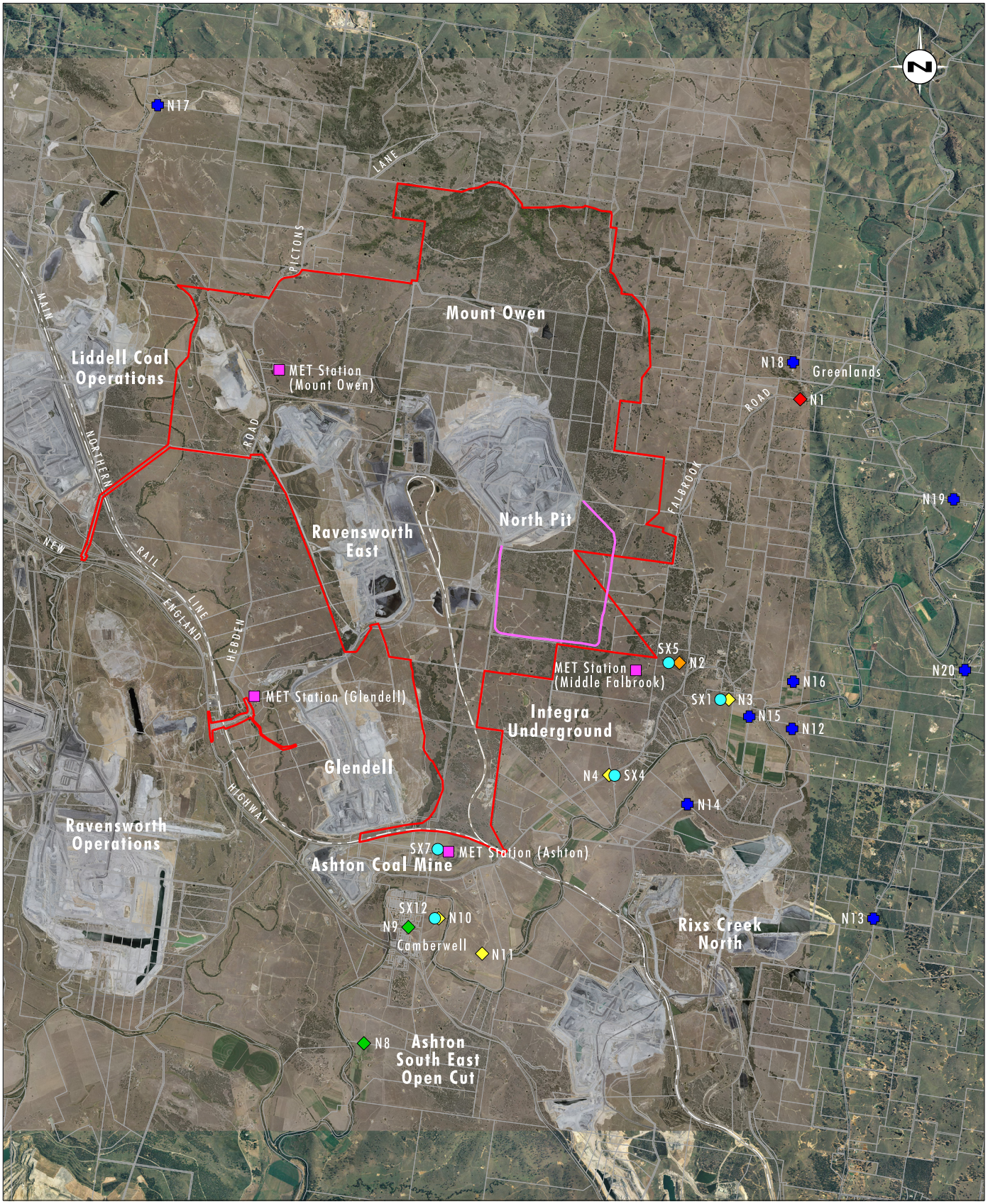


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1.0 2.0 4.0km
Scale 1:90 000

Legend

- SSD-5850 Consent Boundary
- Proposed Modification Pit Boundary
- Routine Validation Attended Noise Monitoring Location
- Combined - Adopted Compliance Attended Noise Monitoring Location
- Glendell - Adopted Compliance Attended Noise Monitoring Location
- Mount Owen - Adopted Compliance Attended Noise Monitoring Location
- Meteorological Station Location
- Real Time Continuous Noise Monitoring Location
- Supplementary Performance Management Attended Noise Monitoring Location

FIGURE 6.4

Existing Noise Monitoring Locations

File Name (A4): R09/3810_229.dgn
20180524 15.00

6.2.2 Predictive Noise Model

In accordance with the INP the prediction of noise levels takes into account all possible noise sources that may reasonably be expected when the Proposed Modification is fully operational.

The computer-based modelling software package Environmental Noise Model (ENM), developed by RTA Technology Pty Ltd, was used to predict the noise levels produced by the Proposed Modification within the surrounding environment. ENM is recognised and accepted by the EPA as a computer modelling program suited to predicting noise impacts from industrial noise sources.

The ENM modelling of the Proposed Modification was based on a number of model inputs:

- Noise source data – Indicative machine and plant sound power levels (SWL) (the SWL data was compiled from current operational noise monitoring data and supplementary data collected by Umwelt from various existing mining operations - refer to **Appendix 7** for further detail).
- Meteorological data – Collated meteorological data was obtained from Glendell Met (SX13 – M1) monitoring station located to the south-west of the active mining areas (refer to **Figure 6.4**) for the period January to December 2014 inclusive. The selection of this meteorological data set is consistent with the AQIA for the Proposed Modification (**Appendix 7**) which was selected as it provided a representative meteorological data set for the surrounding area. The meteorological data was analysed to determine prevailing wind conditions likely to influence the propagation of noise from the Proposed Modification (refer to **Appendix 7** for further detail).
- Proposed mine plans - production schedules and conceptual mine plans for 3 modelled years (Year 2, 8 and 15) (refer to **Section 2.2.1**) including the location of the mining activities, dump locations and the type of machines representative of the proposed mining operation and incorporating the mine design noise control measures as outlined in **Section 6.2.1.1**. The model considered operations for the North Pit, the Bayswater North Pit (in Year 2 model only), the CHPP and train loading facility, and the Glendell ROM haul road.
- Surrounding terrain characteristics - The digital terrain maps of the region surrounding the Proposed Modification were prepared by Umwelt using LiDAR data and the mine plans provided by Mount Owen.

A detailed list of assumptions adopted for the noise modelling for the Proposed Modification is provided in the NIA (refer to **Appendix 7**).

6.2.3 Assessment Methodology

In order to provide quantitative information that could be used to assess the noise implications of the Proposed Modification, the predictive noise model was run using meteorological data representative of each season and each time period (day, evening and night). The assessment methodology involved the following steps:

- The probability of exceedance of the SSD-5850 noise criteria at each of the respective receivers of interest was assessed for the Approved Operations in combination with the Proposed Modification for all meteorological conditions. The predictive noise models of the Proposed Modification included all the noise control commitments of the Approved Operations along with the specific mine design controls detailed in **Section 3.2.1**.

- Additional operational noise controls were then systematically implemented via a predictive process within the noise model, using a hierarchy of control options (refer to **Section 6.2.3.1** for further detail) to reduce the probability of exceedance of the existing noise criteria at the receivers of interest. This required multiple scenarios to be tested through the model; gradually refining and amending the type and level of operational controls applied for each meteorological scenario until the optimum combination was identified. The operational controls that are incorporated into the optimised scenario are designed to offset any noise impacts from proposed changes to mining in the North Pit and the extension of mine life as part of the Proposed Modification. The optimised scenario also accounts for worst case meteorological conditions that enhance source to receiver noise propagation.

- The probability of exceedance of the existing noise criteria includes periods when the meteorological conditions are not applicable according to the definitions in Appendix 4 of SSD-5850 (refer to **Section 6.2.1.1**). Therefore, the objective of systematic implementation of the operational noise controls was to reduce the probability of exceeding the existing noise criteria for each receiver location to less than 10% of the respective time period. This is consistent with the approach taken in the NIA for the Continued Operations Project for the assessment of the noise impacts and the setting of achievable criteria (Umwelt 2014 and 2016). Once an achievable level of operational modification had been identified, this became known as the Optimum Scenario under which the Proposed Modification could continue to meet the existing noise criteria via an augmented set of operating conditions during adverse meteorological conditions. Optimum Scenarios for each period were then checked against applicable meteorological conditions to determine any residual probability of exceedance of the noise criteria (refer to **Appendix 7** for further detail).

6.2.3.1 Modelled Operational Scenarios

As discussed in **Section 6.2.1.2**, in addition to the conceptual mine plan and production schedule refinements, operational noise controls will continue to be implemented over the life of the Proposed Modification in order to meet the existing noise criteria. 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 Proposed Modification. Where relevant, these controls have been factored into the noise model for the Proposed Modification.

The modifications made to the operations for each modelled scenario discussed in **Section 6.2.3** were based on step-by-step changes to operational activities, centred on the following hierarchy of control options (implemented once the mine design noise controls were developed for the Proposed Modification):

- Relocate or shut down ancillary equipment in exposed locations (e.g. rehabilitation and pre-strip dozers)

- Employ first-gear reverse for dozers in exposed locations

- Strategically relocate or shut down ancillary equipment (road construction maintenance, extra water cart(s), drill(s))

- Move activities to lower dumps, or night dumps

- Shut down exposed dozers and/or replace with rubber tyred dozers, and reduce speed of all other dozers

- Reduce speed of trucks, and

- Implement shutdown options based on waste/coal priority.

The hierarchy of control options was used to enable the assessment of the potential noise impacts with indicative controls in place. The actual implementation of control options will depend on the specific meteorological conditions, information from the real time noise monitoring system and operational requirements at that time. The protocols for the implementation of these controls are well established and defined in the approved Mount Owen Complex NMP.

For the purposes of the NIA the optimisation of the operational scenarios identified above have been incorporated into the noise models for key periods. It is important to note that the scenarios identified are not prescriptive or exhaustive, rather they are to confirm that with the implementation of a range of operational controls, Mount Owen can maintain its commitment of managing the Proposed Modification to meet the existing noise criteria outlined in SSD-5850.

It should also be noted that the maximum level of control required to meet the existing noise criteria at each of the receiver locations identified in Schedule 3 Condition 5 of SSD-5850 is only required for the worst case meteorological conditions that are applicable according to the definitions in Appendix 4 of SSD-5850. The actual implementation of operational controls would occur on a sliding scale from initial machine relocations up to the maximum operational constraint proposed, dependent on the actual meteorological conditions at the time of operations.

6.2.3.2 Noise Model Predictions

The modelling results indicate the impacts associated with the Proposed Modification are consistent with the Approved Operations with no further impact to any privately owned residences. Further detail regarding the noise modelling and results is provided in the NIA (refer to **Appendix 7**). A comparison of the 35 dBA and 40 dBA compiled contours for all modelled years during winter evenings/nights (worst case) for the Approved Operations and Proposed Modification is also provided (refer to **Figure 6.5**).

6.2.4 Noise Impact Assessment

6.2.4.1 Operational Noise Impacts

As discussed in **Section 2.2.1**, the Proposed Modification conceptual mine plans include a revised overburden emplacement design and schedule, changes to the progression of mining within the North Pit and the extension of the Mount Owen Mine life, which resulted in potential noise impacts that varied from those predicted for the Approved Operations. However, with the incorporation of appropriate noise mitigation controls and processes, the existing noise criteria under SSD-5850 can continue to be achieved over the life of the Proposed Modification for all private receivers (not subject to existing acquisition rights). Predictions for each modelled scenario are provided in **Appendix 7**.

In accordance with the requirements of the Mining SEPP the assessment has considered potential impacts on private land in accordance with the VLAMP 2014. With respect to vacant land, the VLAMP notes that a 'consent authority should only grant voluntary land acquisition rights where the noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, and a dwelling could be built on that land under existing planning controls'. The modelling results indicate the noise impacts associated with the Proposed Modification are consistent with the Approved Operations and as such there are no additional impacts to private land (as defined in the VLAMP 2014) as a result of the Proposed Modification.

An assessment was also undertaken to identify if the predicted noise levels could exceed the original target Project Specific Noise Levels (PSNL) by more than 5 dB over more than 25% of any private land with dwellings where the predicted noise levels at the dwelling did not exceed the original PSNL by more than 5 dB. No additional private land has been identified where the target PSNLs have been exceeded by more than 5 dB over more than 25% of the property.

As noted in **Section 3.3.3.2**, this assessment has demonstrated that the Proposed Modification is not predicted to result in increased impacts to any areas of privately owned land relative to the Approved Operations. Accordingly, at the point that the draft VLAMP is gazetted, it will not apply to the assessment of the Proposed Modification.

6.2.4.2 Sleep Disturbance

The modelling results indicate that Mount Owen can continue to comply with the sleep disturbance criteria under SSD-5850 during the Proposed Modification (refer to **Appendix 2** for relevant criteria).

6.2.4.3 Low Frequency Noise Analysis

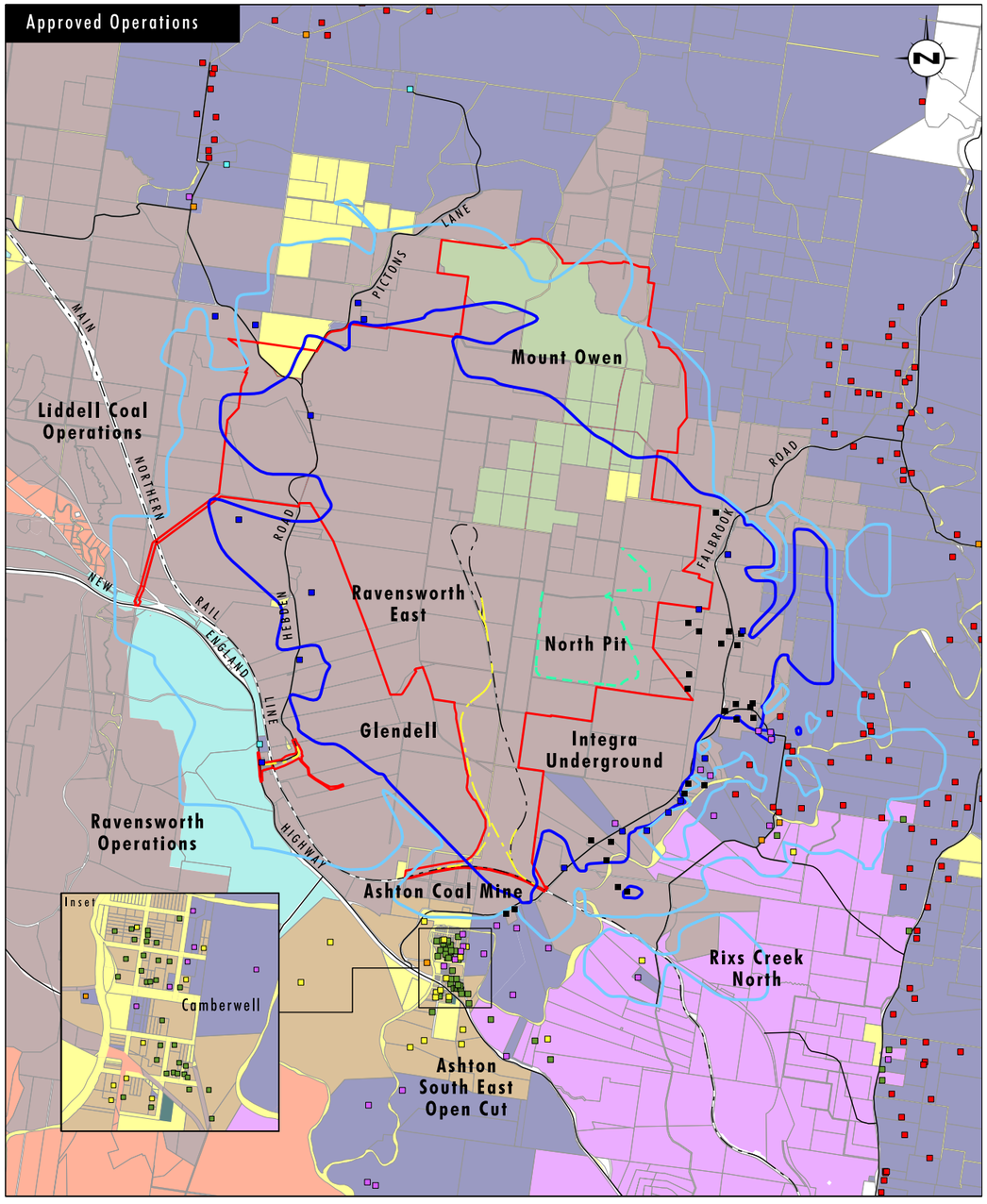
The NIA for the Continued Operations Project (Umwelt 2014) included an analysis of the predicted noise level results for the inclusion of 'modifying factors'. It was found that a strict application of Section 4 of the INP could require the addition of a low frequency noise modifying factor at some receivers under noise enhancing meteorology. However, the analysis found that the predicted low frequency noise levels for the Continued Operations Project were below the DPE 60 dB(C) night time criteria and generally close to the threshold of hearing, i.e. unlikely to be intrusive or cause annoyance.

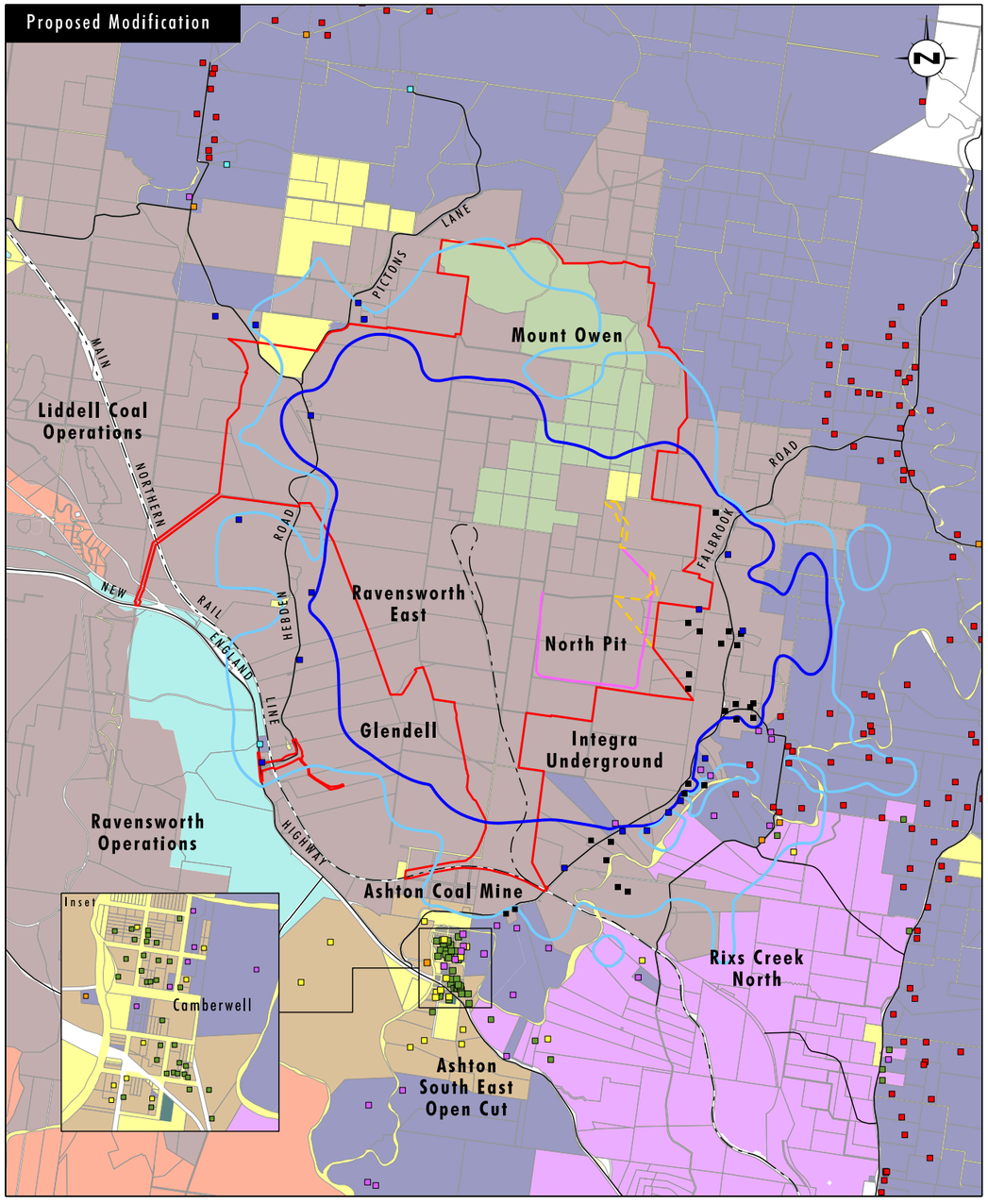
The analysis has been carried out in accordance with the requirements of the NPfI (EPA 2017) and has confirmed that the outcomes for the Continued Operations Project remain unchanged by the Proposed Modification. Therefore, no low frequency modifying factors were applied to the predicted noise levels.

6.2.4.4 Cumulative Noise Impacts

The cumulative noise impact assessment completed for the Continued Operations Project NIA (Umwelt 2014) for the areas surrounding the North Pit indicated that the cumulative noise impacts assessment criteria would not be exceeded based on the Continued Operations Project and the relevant surrounding mining operations. This is on the basis that the INP derived criteria for existing and approved mining operations in this area is designed to protect and preserve the overall cumulative noise environment for these areas. Accordingly, it follows that should all mining operations meet their required noise criteria, the cumulative noise criteria will be met.

As discussed in **Section 6.2.3**, Mount Owen will be able to meet the existing noise criteria under SSD-5850 for the Proposed Modification and therefore there will be no significant change to cumulative noise impacts as a result of the Proposed Modification.





Data Source: Glencore (2018)

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Pit Boundary
- Proposed Disturbance Area
- Noise Impact 35dB(A) Contour
- Noise Impact 40dB(A) Contour
- Ashton Coal
- Bloomfield Collieries
- Coal and Allied
- Crown Land
- Glencore
- Government Authority
- AGL Macquarie
- Private
- State Forest
- Approved Infrastructure
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

0 1.0 2.5 5.0km
1:100 000

File Name (A3): R09/3810_205.dgn
20180618 15.53

FIGURE 6.5

Noise Impact All Modelled Years Winter Evening/Nights
Approved Operations and Proposed Modification

6.2.5 Noise Control Measures

6.2.5.1 Operational Management Controls

Mount Owen's approach to effective noise management includes:

- identification of effective noise management controls during the mine planning, assessment and operational phases
- minimum requirements to be implemented for effective noise management to reduce the potential for impacts, including the implementation of activity specific noise controls and site-wide management systems and procedures
- use of automated systems for early identification of adverse meteorological conditions which are likely to result in noise impacts, i.e. gradient winds and temperature inversions
- monitoring and reporting requirements for noise management
- requirements for the implementation of noise awareness training for employees to facilitate effective noise management.

The management of noise associated with the Mount Owen operations is monitored by both the continuous real time noise monitoring network and attended noise monitoring. During 2017 no exceedance of the noise criteria under SSD-5850 occurred, indicating current operational noise controls are effective in the mitigation of noise impacts associated with the Approved Operations. The approach taken by Mount Owen is designed to maintain a minimum standard for the implementation of the noise control measures required for effective noise management.

As discussed in **Section 3.2.1**, in order to address noise related impacts, particularly in relation to private residences located within Middle Falbrook, refinements were made to the proposed conceptual mine plans. These refinements included redesign and relocation of haul roads, reconfiguration of dumping providing for high/low dumping options and slowing of production in the later years of the Proposed Modification when active mining reaches its southern extent.

In addition Mount Owen will continue to achieve the Approved Operations noise criteria throughout the life of the Proposed Modification through the continued implementation of an adaptive management approach, focused on implementing appropriate operational controls and management strategies to minimise noise impacts. The approach will vary during different mine stages and weather conditions, and will also consider evolving technology and associated equipment noise levels.

6.2.5.2 Noise Management Plan

The Approved Operations currently operate in accordance with an approved NMP subject to SSD-5850. The NMP is updated from time to time to reflect changes in the implementation of environmental management controls utilised by Mount Owen to manage potential noise impacts associated with site operations. As a result of the Proposed Modification, the NMP will be amended to revise the protocol for the implementation of operational noise controls relevant to the Proposed Modification discussed in **Sections 6.2.1** and **6.2.5.1** and 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 Proposed Modification. Further amendments to the NMP are also recommended to update the attended and continuous monitoring network, as discussed in the following **Section 6.2.5.3**.

6.2.5.3 Noise Monitoring Program

The existing noise monitoring program at Mount Owen Complex is a combination of unattended continuous noise monitoring and attended noise monitoring.

Unattended Continuous Noise Monitoring

The current and proposed unattended continuous monitoring network (refer to **Figures 6.4** and **6.6** respectively) consists of five fixed and one mobile unit as detailed in **Table 6.4**. The monitoring units:

- Specifically assess operational performance against the intrusiveness criteria using a $L_{Aeq,\ 15\ minute}$ descriptor;
- Measure and assess the environmental noise levels due to industrial noise sources using the amenity assessment descriptor of $L_{Aeq,\ Period}$; and
- Measure and assess the transient noise levels due to industrial noise sources using the $L_{A1,\ 1\ minute}$ sleep disturbance criteria descriptor.

Table 6.4 Current and Proposed Continuous Noise Monitoring Program for the Mount Owen Complex

Monitoring Unit	Current	Proposed
SX 1 - Middle Falbrook	In place at R026	Discontinue following installation of SX 1a
SX 1a - Middle Falbrook	-	Install by Year 2 in the vicinity of R023
SX 4 - Glennies Creek	In place at R120	Retain
SX 5 – Falbrook	In place at R037	Discontinue following installation of SX 5a
SX 5a – Falbrook	-	Install by Year 2 west of Glennies Creek Road/Middle Falbrook Road intersection
SX 6 - Mobile Unit	Currently located in Greenlands but routinely moved	To be routinely moved
SX 7 - Camberwell	In place on Ashton Coal Mine waste emplacement area	Retain
SX 11 - Middle Falbrook	-	Install by Year 2 in the vicinity of R010, R011 or R012
SX 12 - Camberwell	In place at R143	Retain

Further detail regarding the proposed updates to the unattended continuous noise monitoring program is provided in **Appendix 7**.

Attended Noise Monitoring

The frequency of attended monitoring is currently undertaken in accordance with the requirements of SSD-5850 and the requirements of the applicable Environmental Protection Licence (EPL). Attended compliance noise monitoring for Mount Owen is currently undertaken in accordance with the approved NMP at 5 locations (N1, N3, N4, N10 and N11), that are considered to be representative of the most sensitive noise receivers (refer to **Figure 6.4**). Routine monitoring is also undertaken at N2 to validate the monitoring results from the reference continuous noise monitor SX 5.

In addition to the attended routine compliance monitoring locations, the NMP identifies a number of other supplementary attending noise monitoring locations (N12 - N20, refer to **Figure 6.4**) that may be used if potentially high noise levels are recorded at the routine compliance monitoring locations. The choice and frequency of monitoring at each of these supplementary locations is selected on a risk-based approach that takes into consideration:

- Meteorological conditions that enhance the propagation of noise towards the sensitive receiver locations;
- Noise levels recorded at the continuous noise monitoring units and at the routine monitoring locations; and
- The location and intensity of mining activities at the mining operations in the region.

The details of each of the proposed future attended monitoring locations are provided in **Appendix 7** and the locations shown on **Figure 6.6**. The assessment methodology will be based on the procedures currently in place for assessing the impact of Mount Owen on the surrounding noise environments.

6.2.5.4 Meteorological Data

The current continuous monitoring network includes three 10 m tower weather stations and a fourth 10 m tower fitted with a temperature sensor (refer to **Figure 6.6**).

Mount Owen propose to maintain the current meteorological monitoring program in order to assess the occurrence of noise enhancing conditions as part of the noise monitoring program.

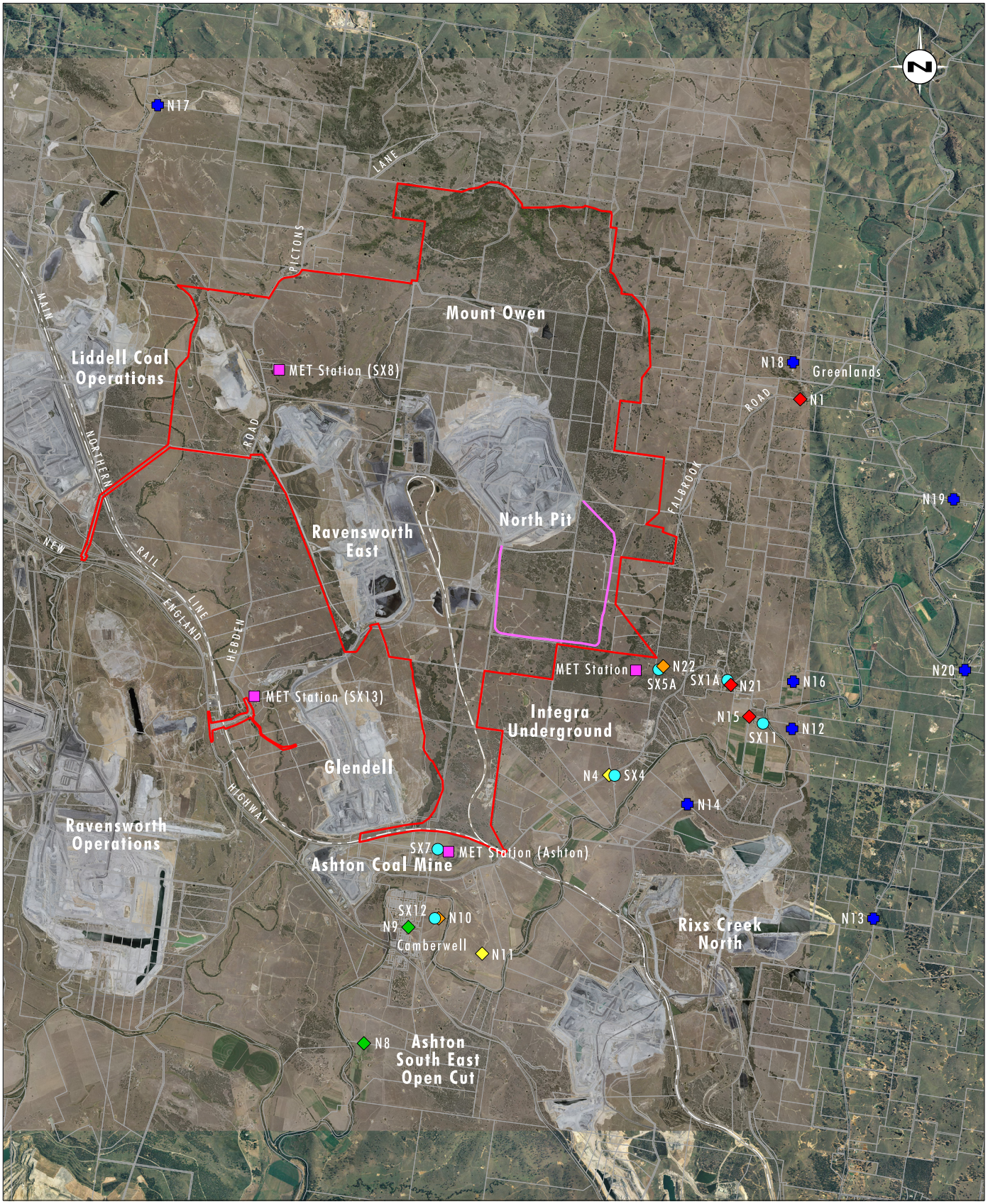


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1.0 2.0 4.0km
Scale 1:90 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Modification Pit Boundary
- Routine Validation Attended Noise Monitoring Location
- Combined - Adopted Compliance Attended Noise Monitoring Location
- Glendell - Adopted Compliance Attended Noise Monitoring Location
- Mount Owen - Adopted Compliance Attended Noise Monitoring Location
- Meteorological Station Location
- Real Time Continuous Noise Monitoring Location
- Supplementary Performance Management Attended Noise Monitoring Location

FIGURE 6.6

Proposed Noise Monitoring Locations

6.3 Blasting

Blasting at the Mount Owen Mine is undertaken in accordance with the approved Mount Owen Complex Blast Management Plan (BMP). The BMP details the relevant management and mitigation measures associated with blasting, and provides a protocol for evaluating and monitoring blast impacts. No change is proposed to the current blast practices at the Mount Owen Mine as a result of the Proposed Modification.

A detailed Blast Impact Assessment (BIA) has been undertaken by Enviro Strata Consulting (ESC) to assess the potential blast impacts associated with the revised mine plans and changes to the locations of blasting associated with the Proposed Disturbance Area. The BIA prepared by ESC is attached as **Appendix 8a**.

Additionally, potential blast impacts associated with blasting in closer proximity to Main Creek and the associated alluvium were raised by the DPE during the initial consultation phase for the Proposed Modification. This potential impact has been assessed in detail and a separate assessment report prepared by ESC (refer to **Appendix 8b**).

It is noted that potential blast fume impacts have been assessed as part of the AQIA (refer to **Section 6.1** and **Appendix 6**).

6.3.1 Blast Sensitive Locations

Potential impacts associated with blasting in the North Pit have been assessed in relation to the surrounding private residences located within a 5 km radius of the North Pit (refer to **Figure 6.7**). All land surrounding the North Pit within a 1 km radius is owned by Glencore subsidiaries. The closest private residences are located to the south-east in the Falbrook and Middle Falbrook areas, with the closest private residence located approximately 1.9 km from the Proposed Modification pit boundary (at the closest point).

As discussed in **Section 3.2.1**, the Integra Underground Mine is located immediately adjacent to the North Pit with the south-west corner of the North Pit overlapping the northern end of the Integra Underground Mine workings (refer to **Figure 6.7**). Potential blast impacts to the Integra Underground Mine have been assessed.

The identified listed historical items and infrastructure located within the vicinity of the North Pit and assessed as part of the BIA are also identified on **Figure 6.7**. These items are consistent with the locations identified and assessed for the Approved Operations.

As discussed in **Section 3.2.2**, the Proposed Modification pit boundary is located approximately 160 m from the top of high bank of Main Creek and approximately 150 m from the associated alluvium at the closest point. This will result in mining activities and associated blasting occurring closer to Main Creek than currently approved. As outlined in **Appendix 8b**, there are no specific geotechnical or geomorphological features either within Main Creek or between the Proposed Modification pit boundary and Main Creek that would increase the potential effects of blasting on Main Creek and associated alluvium. Accordingly, the assessment has focussed on determining an appropriate blast impact limit to prevent impacts to Main Creek as well as examine the potential for proposed blasting activities to result in physical impacts beyond the Proposed Modification pit boundary (i.e. risks of surface cracking).

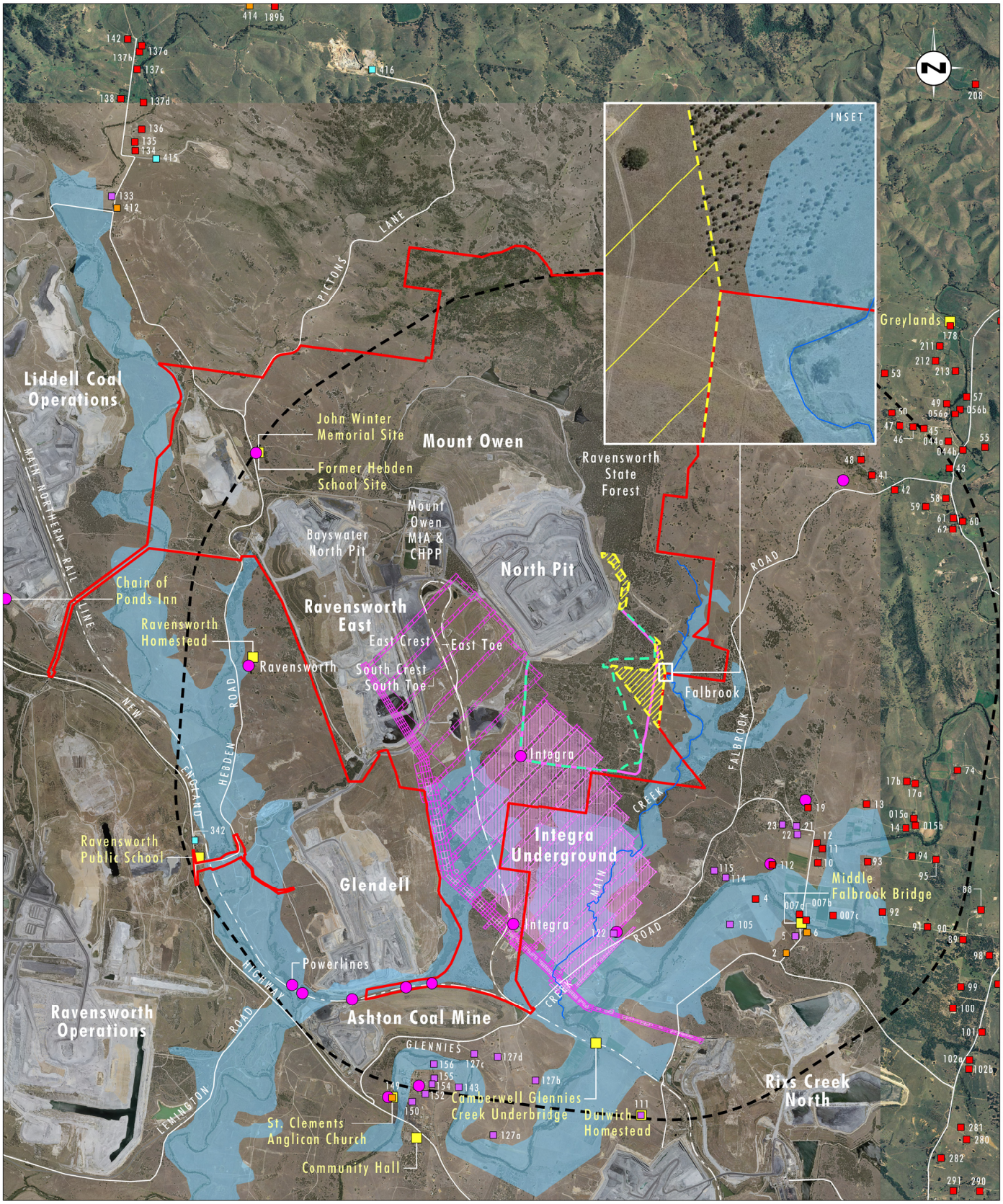


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1.0 2.0 4.0km
Main Scale 1:80 000

0 50 100 200m
Inset Scale 1:4 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Disturbance Area
- Proposed Modification Pit Boundary
- Refined Alluvium Mapping (AGE 2017)
- Approved Integra Underground Mining Area - Middle Liddell Seam Workings
- Integra Underground Workings Middle Liddell Seam as at May 2018
- Proposed Modification Pit Shell 5km Buffer
- Blast Monitoring Location
- Listed Heritage Item
- Community Infrastructure
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure
- Main Creek

FIGURE 6.7

Blast Sensitive Locations and Monitoring Network

File Name (A4): R09/3810_159.dgn
20180702 9.33

6.3.2 Current Blast Practices

In order to maximise blast efficiency, minimise potential vibration and overpressure impacts and to ensure compliance with the relevant consent criteria, the mine operator currently undertakes detailed design for all blasts within the North Pit. A range of blast sizes (measured as Maximum Instantaneous Charge (MIC)) have been modelled to assess the potential blast impacts associated with blasting within the North Pit, with the modelling accounting for the potential worst case scenario. The modelled blast sizes are representative of blasting practices which enable compliance with the existing blast impact assessment criteria based on the varying distance to the surrounding blast sensitive locations. Further detail regarding blast practices and explosives used is provided in the BIA (refer to **Appendix 8a**).

The existing Mount Owen Complex blast monitoring network includes 12 blast monitoring stations (refer to **Figure 6.7**), established to be representative of the blast sensitive locations specified above. This data also enables ongoing review and refinement of the blast site law developed for Mount Owen, which has been utilised in the BIA (refer to **Appendix 8a**).

Schedule 3 Condition 9 in development consent SSD-5850 limits blasting times to 9 am to 5 pm Monday to Saturday inclusive and also allows for up to 12 blasts per year between the hours of 7 am and 9 am Monday to Saturday and excluding public holidays. Up to 2 blasts per day are permitted or 8 blasts per week, averaged over a calendar year. No change is proposed to the frequency of blasting for the Proposed Modification.

6.3.3 Blast Criteria

The relevant blast emission criteria applicable to blasting practices within the North Pit including ground vibration and airblast overpressure are provided in **Table 6.5**. The relevant criteria are consistent with the criteria identified in SSD-5850, in the BIA prepared for the Continued Operations Project (ESC 2014) and in **Appendices 8a** and **8b.**

Table 6.5 Summary of Blast Emission Criteria

Receiver	Peak Particle Velocity (mm/s)	Allowable Exceedance	Overpressure (dBL)	Allowable Exceedance
Residence on privately-owned Land	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%
Historic Buildings and Structures				
St Clements Church	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	5	0%	126	0%
Chain of Ponds Inn	10	0%	133	0%
Former Dulwich Homestead (Kangory)	5	0%	126	0%
Former Hebden Public School	16	0%	NA	NA

Receiver	Peak Particle Velocity (mm/s)	Allowable Exceedance	Overpressure (dBL)	Allowable Exceedance
John Winter Memorial	250	0%	NA	NA
Ravensworth Public School (former)[1] Camberwell Community Hall[1] Greylands and Outbuildings[1]	25	0%	133	NA
Middle Falbrook Bridge over Glennies Creek[1] Camberwell Glennies Creek Underbridge[1]	50	0%	NA	NA
Infrastructure				
Electricity Transmission Lines	50	0%	NA	NA
Prescribed Dams	50	0%	NA	NA
Main Northern Rail Line (including culverts & Bridges)	25	0%	NA	NA
Public Roads	100	0%	NA	NA
Concrete Bridges[1]	100	0%	NA	NA
Industrial buildings and sheds[1]	25	0%	133	0%
Surface Mine Infrastructure - occupied	25	0%	NA	NA
Surface Mine Infrastructure - unoccupied	100	0%	NA	NA
Integra Underground Mine Workings	10 or 250[2]	0%	NA	NA
All other public infrastructure	50	0%	NA	NA
Main Creek[1]	100[3]	0%	NA	NA

NOTES:

[1] Item not listed under current development consent (SSD-5850).

[2] 10 mm/s safety and personnel withdrawal limit for occupied underground workings and 250 mm/s structural limit for unoccupied workings.

[3] refer to ESC (2017) (**Appendix 8b**) for definition of this criteria

6.3.4 Ground Vibration and Airblast Predictive Modelling

The ground vibration and airblast overpressure predictive model utilised for the BIA is based on the model developed for the Continued Operations Project BIA (ESC 2014) with the blast site law updated with the recent data from ongoing blast monitoring completed up to October 2017. The vibration monitoring data was collected at several locations from various blasts undertaken within the Mount Owen Complex and hence is considered fully representative for existing approved blasting activities and the Proposed Modification.

Mining operations within the North Pit and the BNP at Ravensworth East are anticipated to occur concurrently, however blasting within the North Pit and the BNP will be managed to not occur simultaneously. As discussed in **Section 2.2**, there is no change proposed to the mining operations within the BNP as part of the Proposed Modification. Potential blast impacts associated with mining operations within the BNP were assessed as part of the Continued Operations Project (ESC 2014).

6.3.5 Blast Impact Assessment

The aim of the BIA is to identify the potential impacts including ground vibration and airblast exposure as well as flyrock, which may be generated when undertaking blasting within the North Pit. The BIA specifically addresses the potential blast impacts in relation to the surrounding privately owned properties, the identified historical items/infrastructure, Main Creek and the Integra Underground Mine. The modelling results are discussed in the following sections and further detail is provided in the BIA report (refer to **Appendix 8a**).

6.3.5.1 Private Residences

The predicted ground vibration and airblast levels that will be experienced at the surrounding private properties associated with blasting in the North Pit have been modelled for private residences located within a 5 km radius of the Proposed Modification pit boundary. As outlined in **Section 6.3.2**, current blast practices at the North Pit include the use of variable MIC at different locations within the North Pit in order to manage ground vibration and airblast levels. This will continue to be implemented as part of the Proposed Modification. The impact of blasting on private residences located beyond the 5 km radius is considered negligible (i.e. below a human perception level).

Multiple simulations were modelled including charge masses ranging from 33 to 601 kg, representative of the range of MICs to be utilised for blasting within the North Pit (according to the proposed bench heights). The blast modelling accounts for the worst case scenario, i.e. blasting from the edge of the Proposed Modification pit boundary, which corresponds to the minimum distance between the blasting area and private residences.

The level of vibration and airblast applicable to the surrounding private residences will be highly variable, dependent upon the charge mass; with negligible impact (i.e. below a human perception level) for low charge masses (i.e. 33 kg) and increasing for higher charge masses. The estimated vibration exposure for all private residences within the 5 km radius (refer to **Figure 6.7**), using variable charge masses of 33 to 601 kg is in the order of 0.1 to 1.9 mm/s (refer to **Appendix 8a**). This is below the applicable vibration limits specified as 5 mm/s (for 95% of blasts) and 10 mm/s (not to be exceeded) consistent with existing criteria under SSD-5850. The modelled results for the Proposed Modification are consistent with that for the Approved Operations assessed as part of the Continued Operations Project.

The airblast impacts are also highly variable dependent upon the charge mass. The estimated airblast exposure for private residences using variable charge masses of 33 to 601 kg is in the order of 93 to 117 dBL, indicating that higher MIC blasts which are close to private residences will require refined blast design to meet current consent limits. The results of the modelling show that impacts on the surrounding private residences can be managed effectively and remain below airblast criteria by using lower charge masses. Whilst the Proposed Modification represents an increase in the Mount Owen Mine life with

potential prolonged impacts resulting from blasting, relevant blast management practices will continue to be implemented to ensure potential blast impacts will comply with existing criteria. This is consistent with existing blast management practices as outlined in the BMP.

A lower charge mass can be achieved either by blasting smaller benches or by the application of deck charges together with precise initiation timing. For example, based on the modelling results, the predicted airblast level for property ID 114 is 117 dBL at 2 km to the blast (this distance corresponds to blasting in modelled Year 15 only when mining reaches the southern limit). The airblast level can be managed by decreasing the charge mass (to approximately 222 kg) to achieve a predicted airblast value of 113 dBL which is below the 115 dBL airblast limit. Such an approach is consistent with the Approved Operations. There is no restriction on charge masses required for blasting undertaken during the Year 2 and Year 8 mine stage plans as modelling indicates that relevant criteria can be met at all private residences for the Proposed Modification in these years.

The Mount Owen Complex operates using a standard 0.5 km exclusion zone to manage potential impacts associated with flyrock. All land within a 0.5 km radius of the Proposed Modification pit boundary is owned by Glencore subsidiaries and the exclusion zone will continue to be applied throughout the mine life. The closest private residential property is located approximately 1.5 km from the property boundary and 2 km from the dwelling to the Proposed Modification pit boundary, and therefore the potential risks of flyrock on the surrounding private residences are considered negligible.

Detailed modelling results for each identified residential property within the 5 km radius of the Proposed Modification Pit Boundary are presented in the BIA, refer to **Appendix 8a**.

6.3.5.2 Historical Sites and Infrastructure

The following listed historical items and infrastructure were considered as part of the BIA. It is noted that there is no change in distances from the following historic sites/infrastructure locations from the approved to the proposed mining operations, with no additional historic heritage/infrastructure potentially impacted by blasting practices associated with the Proposed Modification.

Historic Buildings and Structures:

- Ravensworth Homestead (local significance)
- Ravensworth Public School (former) (local significance)
- St Clements Anglican Church, Camberwell (local significance)
- Community Hall, Camberwell (local significance)
- Camberwell Glennies Creek Underbridge (Section 170 NSW Stage Agency Heritage Register)
- Chain of Ponds Inn (State significance)
- Middle Falbrook Bridge over Glennies Creek (State significance)
- Greylands and Outbuildings (local significance)
- Former Dulwich Homestead (Kangory Homestead) (local significance)
- Former Hebden Public School and John Winter Memorial Site (local significance).

Infrastructure:

- 132 kV and 330 kV Powerlines including Tension Towers and Substation
- Prescribed dams including TP1 and Ashton Coal Clean Water Dam 1
- Main Northern Rail line
- Local roadways including Hebden Road, Falbrook Road and Glennies Creek Road
- Hebden Road infrastructure including a rail overpass and Bowmans Creek bridge approved under SSD-5850 (currently under construction).

Community Infrastructure:

- Glennies Creek Community Hall
- Glennies Creek Rural Fire Service
- Mount Pleasant Primary School.

Private Infrastructure:

- Daracon Mining Pty Limited – Site Office.

Ground vibration modelling results indicate vibration exposure for all identified historic heritage items and infrastructure will be below the applicable blast impact criteria as outlined in **Table 6.6**. In regards to airblast exposure the associated impacts are generally not applicable to infrastructure items as the levels of impact required to create any damage are very high and unlikely to be exceeded. The listed historic items were assessed against the applicable criteria limits provided in **Table 6.6**, and the modelling results indicate that the airblast exposure for all identified historic items will be below the applicable criteria. The modelled results for the Proposed Modification are consistent with those for the existing Approved Operations assessed as part of the Continued Operations Project.

Detailed modelling results for all historic items and infrastructure identified are provided in **Appendix 8a**.

6.3.5.3 Main Creek

As discussed in **Section 3.2.2**, the distance between the Proposed Modification pit boundary and the top of the high bank of Main Creek is approximately 160 m and approximately 150 m to the edge of the mapped alluvium (at the closest point). A detailed assessment was undertaken by ESC to address the potential impact of blasting within close proximity to Main Creek and the associated alluvium (refer to **Appendix 8b**).

The Main Creek blast assessment established a stability assessment criterion of 100 mm/s for the high bank of Main Creek. This criterion was established through a review of the geotechnical assessment undertaken for the North Pit as part of the Continued Operations Project and similar previous blast impact assessment studies undertaken (refer to **Appendix 8b**). 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.

The rock strength data for the Proposed Disturbance Area from the geotechnical assessment, which is considered representative for the area surrounding Main Creek, indicates moderately strong rock strata conditions. From a blasting perspective moderately strong rock strata is not susceptible to fracturing from blast vibration.

The BIA identified that the vibration exposure for the high bank of Main Creek (minimum distance of approximately 160 m) can be managed effectively to below the assessment criterion of 100 mm/s by modifying the blast design and applying blast management practices as outlined in the BMP (as revised). Accordingly, it is considered that the risk of impacts on Main Creek from blasting practices in closer proximity as a result of the Proposed Modification can be effectively managed through the implementation of existing blast impact mitigation measures.

The assessment of the blast impacts on the alluvium strata (minimum distance of approximately 150 m) concluded low/negligible risks of strata fracturing and subsequent water seepage from Main Creek. The assessment concluded that for the geological conditions and the proposed blasting parameters the maximum strata damage would be limited to approximately 12 m from the edge of the Proposed Modification pit boundary, which is within the identified Proposed Disturbance Area and remains over 138 m from the identified extent of alluvium. Further details on this assessment, including the geotechnical components as well as a review of a range of site specific studies, is provided in **Appendix 8b**.

As part of operational procedures, Mount Owen will continue to undertake regular stability and cracking monitoring along the high wall after blasting, in order to monitor any potential impact of blasting on Main Creek and the associated alluvium.

6.3.5.4 Integra Underground Mine

The Integra Underground Mine is located immediately adjacent to the Mount Owen Complex with the south-west corner of the North Pit overlapping the northern end of the Integra Underground Mine workings. The impact of blasting within the North Pit was assessed in detail for the Continued Operations Project (ESC 2013), when this operation was under the management of a different mining company.

The blast modelling undertaken for the Continued Operations Project revealed that there is a high degree of variability in the potential vibration exposures for various sections of the Integra Underground Mine and it is very much dependent upon the distance between the blasting area and the actual section of the underground mine workings. The modelling results indicated that during blasting activities longwalls both immediately beneath the blasting zone and in close proximity would experience blast vibration levels in excess of the 10 mm/s criteria and personnel withdrawal for the affected longwall areas would be required during blasting. Additionally, vibration estimations for the underground workings were in the order of 0.1 to 26 mm/s, based on modelled blasting scenarios (i.e. MIC of 33 - 791 kg).

These modelled results are below the 250 mm/s vibration limit specified as a structural limit for unoccupied underground workings (for the rock strata) and above the 10 mm/s vibration limit used as a limit for underground personnel withdrawal. Therefore, blasting within some locations in the North Pit will warrant underground personnel withdrawal for occasional blasts exceeding the 10 mm/s vibration limit, without major risks of rock strata damage.

There will be no change to the minimum separation distance of 250 m between the proposed North Pit floor and the approved Integra Underground mining operations as a result of the Proposed Modification. The current BMP requires the implementation of a blast protocol in order to manage blasting impacts between the Mount Owen and Integra Underground operations. All operational and safety measures currently implemented will continue and will be enhanced through the common ownership of these mining operations by Glencore. Therefore, the risks between the two operations in such close contact will be managed effectively through the implementation of existing management controls.

6.3.6 Management and Mitigation Measures

The results of the BIA indicate that the potential impacts resulting from blasting activities in the North Pit can be managed effectively under the existing BMP to ensure no exceedance of the relevant criteria. A summary of the management measures currently implemented in the BMP is provided below:

Control measures for ground vibration:

- use of an appropriate charge mass design and loading procedure
- use of an appropriate initiation sequence to minimise the possibility of hole interaction
- use of a ground vibration predictive model to estimate potential ground vibration levels to aide with the blast design.

Control measures for airblast:

- use of an appropriate charge mass design and avoid overcharging holes
- maintain appropriate blasting parameters, especially for the front row holes (to avoid face burst)
- use of an appropriate initiation sequence to minimise the possibility of hole interaction
- undertake an alternative blast design around identified geological features to avoid face burst and excessive airblast emission
- use of an appropriate quality stemming material and stemming height to enable correct confinement of explosive charges
- use of an airblast predictive model to estimate potential airblast overpressure levels to aid with the design of blasting parameters
- continue with an appropriate pre-blast meteorological condition protocol to avoid blasting in unfavourable weather conditions.

Control measures for flyrock:

- maintain appropriate burden specifications for the front row holes to avoid face bursts and related flyrock incidents
- use of a modified blast design around identified geological features to avoid a potential flyrock incident
- use of an appropriate quality stemming material and stemming height to minimise the possibility of a potential flyrock incident.

Blast Monitoring System

Blasting at the Mount Owen Complex will continue to be monitored by the current multi-station vibration monitoring system (refer to **Figure 6.7**).

Pre-blast Assessment Protocol

The Proposed Modification will result in an ongoing relocation of the blasting operations in relation to the closest residences as mining progresses, and therefore the pre-blast check protocol will be reviewed annually.

Interaction with Integra Underground Mine

Continued implementation (and updating), when required, of a blast protocol to manage withdrawal of personnel from Integra Underground Mine during blasting at locations where the Integra Underground Workings and the North Pit overlap or are within an agreed buffer distance.

In addition, the following management measures will be included as part of the revised BMP for the Proposed Modification:

- Incorporation of the Main Creek blast assessment criterion of 100 mm/s for the high bank of Main Creek
- As part of operational procedures, Mount Owen will continue to undertake regular stability and cracking monitoring along the high wall after blasting, in order to monitor any potential impact of blasting on Main Creek and the associated alluvium.

6.4 Groundwater

A detailed Groundwater Impact Assessment (GWIA) has been undertaken by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) to assess the potential impacts of the Proposed Modification on the existing groundwater regime.

The Proposed Modification proposes to reconfigure the North Pit mine plan to extract additional reserves through increasing the Proposed Disturbance Area by 46 ha and increasing the depth of mining in some areas of the approved North Pit. There has been extensive depressurisation of the hard rock aquifers within and surrounding the Mount Owen Complex, as a result of previous and currently approved mining operations in the area. Additionally, the Main Creek and Bettys Creek alluvial aquifers are considered less productive alluvial water sources (under the AIP guidelines) due to the water quality and their low natural flow volumes (refer to **Section 6.4.1**).

The GWIA has been undertaken in consideration of the relevant legislation and guidelines such as the WM Act and the associated WSPs, AIP, the EPBC Act and related Independent Expert Scientific Committee (IESC) information guidelines for coal seam gas (CSG) and large coal mining development proposals. As noted in **Section 3.3.1**, the Proposed Modification was declared not to be a controlled action for the purposes of the EPBC Act. Notwithstanding, the GWIA has considered the relevant guidelines for consistency with, and to enable comparison to, the GWIA outcomes for the Approved Operations.

The GWIA includes further comprehensive refinements to the groundwater model developed for the Approved Operations (refer to **Section 6.4.3**). This model includes approved mining operations at Mount Owen, Glendell, Ravensworth Operations, Liddell Coal Operations, Integra Underground, Ashton Coal Mine, Rix's Creek North and Hunter Valley Operations. The need for continual refinement of the groundwater model was contemplated through the completion of studies for the Approved Operations on account of the inherent conservatism built into the groundwater model at the time. Further, SSD-5850 Schedule 3 Condition 26(V) particularly requires periodic review and validation of the groundwater model. As detailed in **Section 6.4.3**, the refinements to the model are informed through further modelling of geology within the greater Ravensworth region, and the inclusion of up to date groundwater monitoring data, including from additional monitoring locations established for the Approved Operations.

As outlined in this section, the refinements to the modelling for the GWIA (as extensively detailed in **Appendix 9**) have resulted in the predicted impacts to nearby alluvial aquifers being substantially less than those predicted for the Approved Operations. When considering the differences in the numerical models it is important to understand that models used for mining operations inherently require continuous updates and revisions as new information and data is continually collected through monitoring networks as well as through updates in geological information collected through exploration drilling. The ongoing nature of this model development is a good example of best practice in continuous improvement (refer to **Appendix 9**).

This outcome of the refined modelling is consistent with the groundwater monitoring data which identifies that existing mining operations are having a negligible effect on alluvial aquifers in proximity to Mount Owen (refer to **Appendix 9**). It is noted that there remains an element of conservatism in the refined groundwater model outputs, as inherent in any modelling process, however the modelling indicates that the Proposed Modification will have negligible impacts on the nearby alluvial aquifer systems (refer to **Section 6.4.4**). Notwithstanding, Mount Owen will continue to manage mining operations to appropriately manage impacts on groundwater systems including the implementation of the existing approved groundwater monitoring program over the life of the Proposed Modification (refer to **Section 6.4.7**).

This section provides a summary of the key findings of the groundwater assessment. The GWIA report prepared by AGE is attached (refer to **Appendix 9**).

6.4.1 Existing Hydrogeology

The two main hydrogeological features occurring within and surrounding the Mount Owen Complex are:

- the alluvial aquifers – the area broadly surrounding the Mount Owen Complex contains Bettys Creek, Swamp Creek and Yorks Creek, tributaries of Bowmans Creek; and Main Creek, a tributary of Glennies Creek. Both Bowmans and Glennies Creeks are tributaries of the Hunter River. The alluvial aquifers associated with these systems are shallow unconfined aquifers of limited extent with unconsolidated alluvium. The alluvial aquifers applicable to mining within the North Pit are the Bettys and Main Creek alluviums

- deeper hard rock aquifers that contain the coal measures are semi-confined and contain sandstones, siltstones and coal seams. Water yields from the hard rock aquifers within the Mount Owen Complex are low and have slow groundwater movement. There has been extensive depressurisation of these hard rock aquifers within and surrounding the Mount Owen Complex, as a result of previous and current mining operations in the area.

The alluvium associated with the tributaries of Main Creek and Bettys Creek are located in close proximity to the Proposed Disturbance Area. As discussed in **Section 3.2.2** extensive geophysical survey has been undertaken to confirm the extent of the Main Creek alluvium and monitoring data has been examined in detail to determine the thickness, permeability and water quality of the alluvium in proximity to the Proposed Disturbance Area. The alluvium confirmation process is detailed in **Appendix 9** and was incorporated into the refined groundwater modelling completed for the Proposed Modification.

The alluvium is typically in the order of up to 10 m thick within the Main Creek floodplain and substantially thinner along Bettys Creek where it is up to 5 m thick (**Appendix 9**). Whilst there is a greater saturated thickness within the Main Creek alluvium the creek channels within the area are typically less than 2 m in depth. All monitoring bores installed within the alluvium indicate groundwater depths are below the level of the creeks. This indicates that the creeks are largely disconnected from the groundwater systems and that the groundwater systems do not contribute significantly to baseflow to Main Creek or Bettys Creek.

The Main Creek and Bettys Creek alluvial aquifers are considered less productive alluvial water sources (under the AIP guidelines) (refer to **Section 6.4.6**) due to their low natural flow volumes (considered insufficient to yield more than 5 L/sec from a bore) and water quality as monitoring indicates high salinity (>1,500 mg/L), low transmissivity and low saturated thickness.

6.4.1.1 Existing Groundwater Monitoring network

Mount Owen monitors groundwater levels within the alluvium and hard rock aquifers at the Mount Owen Complex using a network of monitoring bores and vibrating wire piezometers. The monitoring network also includes bores at the adjacent Glencore owned Integra Underground and Liddell Coal Operations (refer to **Figure 6.8**). The monitoring bores within the alluvium are relatively shallow with standard uPVC casing. The hard rock aquifer is monitored using a combination of monitoring bores and arrays of vibrating wire pressure sensors (VWPs) for the deeper strata within the geological sequence. The monitoring bores at Mount Owen target the alluvium deposited within the Bettys Creek, Main Creek, Bowmans Creek and Glennies Creek flood plains, as well as key coal seams and interburden units being mined (refer to **Figure 6.8**). The groundwater monitoring network includes monitoring locations established in the area of maximum predicted drawdown in Main Creek and Bettys Creek alluvium as required under SSD-5850 for the Approved Operations.

6.4.1.2 Groundwater bores

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 Approved Operations. **Figure 6.9** provides the locations of the private registered bores within the database. Three existing private groundwater bores are located to the south-east of the North Pit (with the closest located approximately 2 km from the Proposed Modification Pit Shell) (refer to **Figure 6.9**). A review of the government groundwater bore database indicates that 2 of the bores are authorised for farming purposes (GW067291 and GW049285) with the third bore recorded as a monitoring bore (GW202346).

The depth of one of the bores authorised for farming purposes (GW067291) is recorded in the database as 90 m, however the bore is reportedly cased with a 1.2 m diameter concrete pipe, and has been measured at 10.1 m deep (Geoterra 2009). Recent discussions with the property owner indicate the bore remains actively used. GW067291 is expected to only extract shallow groundwater from the alluvial aquifer along Glennies Creek.

No detail on the construction of bore GW049285 is recorded within the database other than it was constructed as a well. Discussions with the property owners indicate the well has been filled in and is no longer in use.

6.4.2 Groundwater Dependent Ecosystems

The Hunter Unregulated WSP does not indicate the presence of any high priority Groundwater Dependent Ecosystems (GDEs) along Glennies Creek and Bowmans Creek. Mapped vegetation types within the area of Main Creek are shown on **Figure 6.10**. The Central Hunter Swamp Oak Forest community is the main community present within the vicinity of Main Creek which may possibly be groundwater dependent due to reliance in some circumstances on groundwater in periods of drought. However, it should also be noted that this vegetation community also exists further upstream and in other creek systems where there is unlikely to be any significant alluvial groundwater present and the use of any alluvial groundwater would be opportunistic with the community able to rely on soil and surface moisture alone. Additionally, previous studies indicate the Hunter Lowland Red Gum Forest which is mapped as extending well into areas where there is little or no alluvium and where the vegetation would be completely reliant on soil moisture and rainfall. On this basis it was concluded that the Hunter Lowland Red Gum Forest where it occurs in proximity to Mount Owen does not constitute a GDE (Umwelt, 2015).

A Stygofauna Assessment was undertaken by Eco Logical Australia Pty Limited (Eco Logical) to support the Proposed Modification which included the collection of samples from 16 monitoring bores from the alluvium associated with Main, Bettys, York, Swamp and Glennies Creeks as well as the shallow rock and coal seam aquifers. Five taxa of stygofauna were collected (*Notobathynella sp, Cyclopoida, Ostracoda, Hydrobiidae sp. (a snail), Carabhydrus stephanieae* (a subterranean diving beetle)). These taxa were collected from the alluvial aquifers of Yorks Creek, Swamp Creek and Glennies Creek. No stygofauna were collected from the Main Creek and Bettys Creek alluvium or from the coal and hard rock aquifers. All of the taxa collected are known to occur at other locations within the Hunter Valley and generally have a widespread distribution along alluvial aquifers of the Hunter and Pages Rivers. The Stygofauna Assessment report prepared by Eco Logical is included as **Appendix 12**.

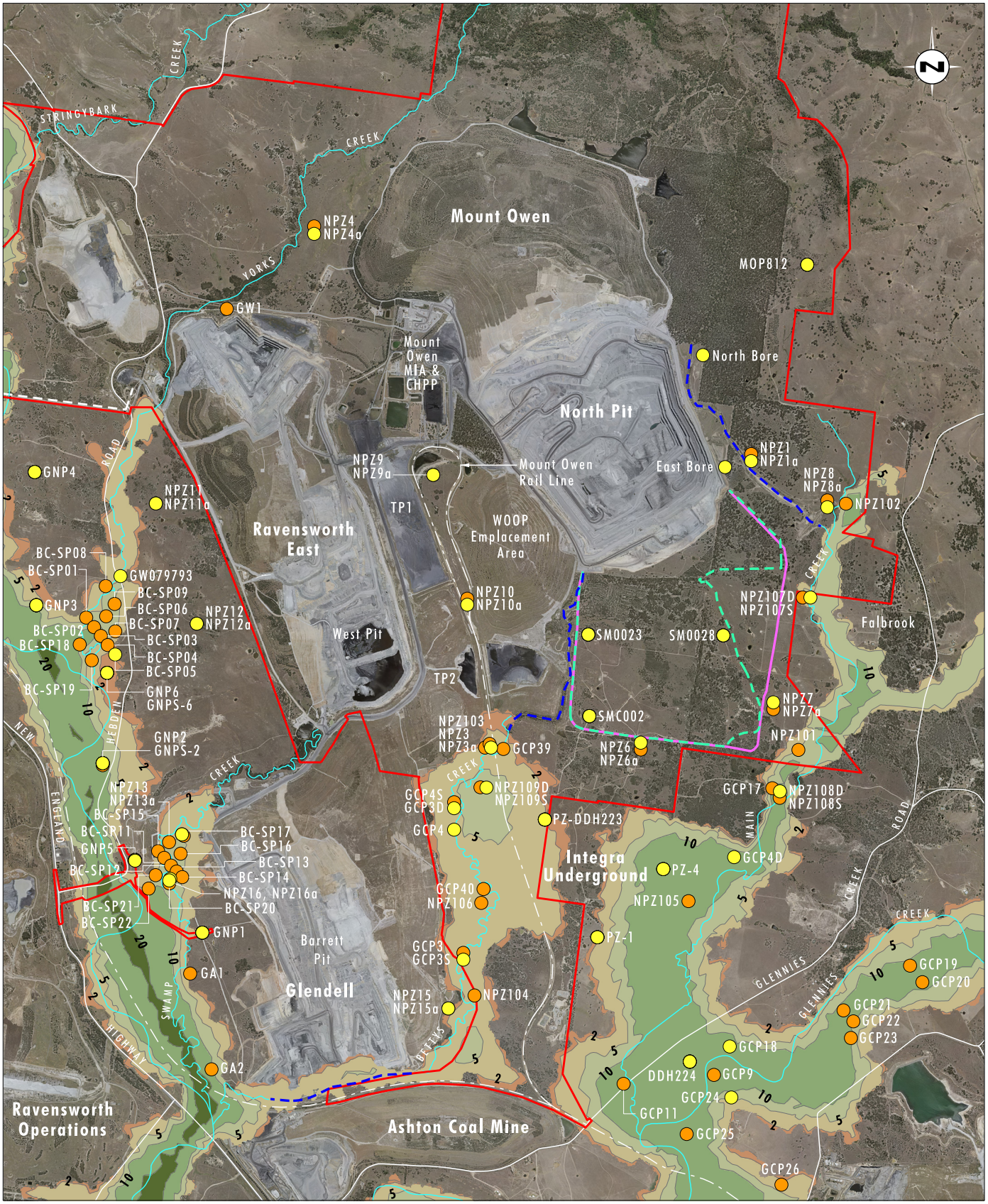


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

0 0.5 1.0 2.0km
1:50 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Pit Boundary
- Drainage Line
- Existing Bettys Creek Diversion
- Alluvium Monitoring Location
- Permian Monitoring Location

Interpolated Alluvium Thickness (m) - AGE 2017:

- 0 - 2
- 2.01 - 5
- 5.01 - 10
- 10.01 - 20
- 20.01 and above

FIGURE 6.8

Groundwater Monitoring Bores and Interpolated Alluvium Thickness

File Name (A4): R09/3810_186.dgn
20180618 10.29

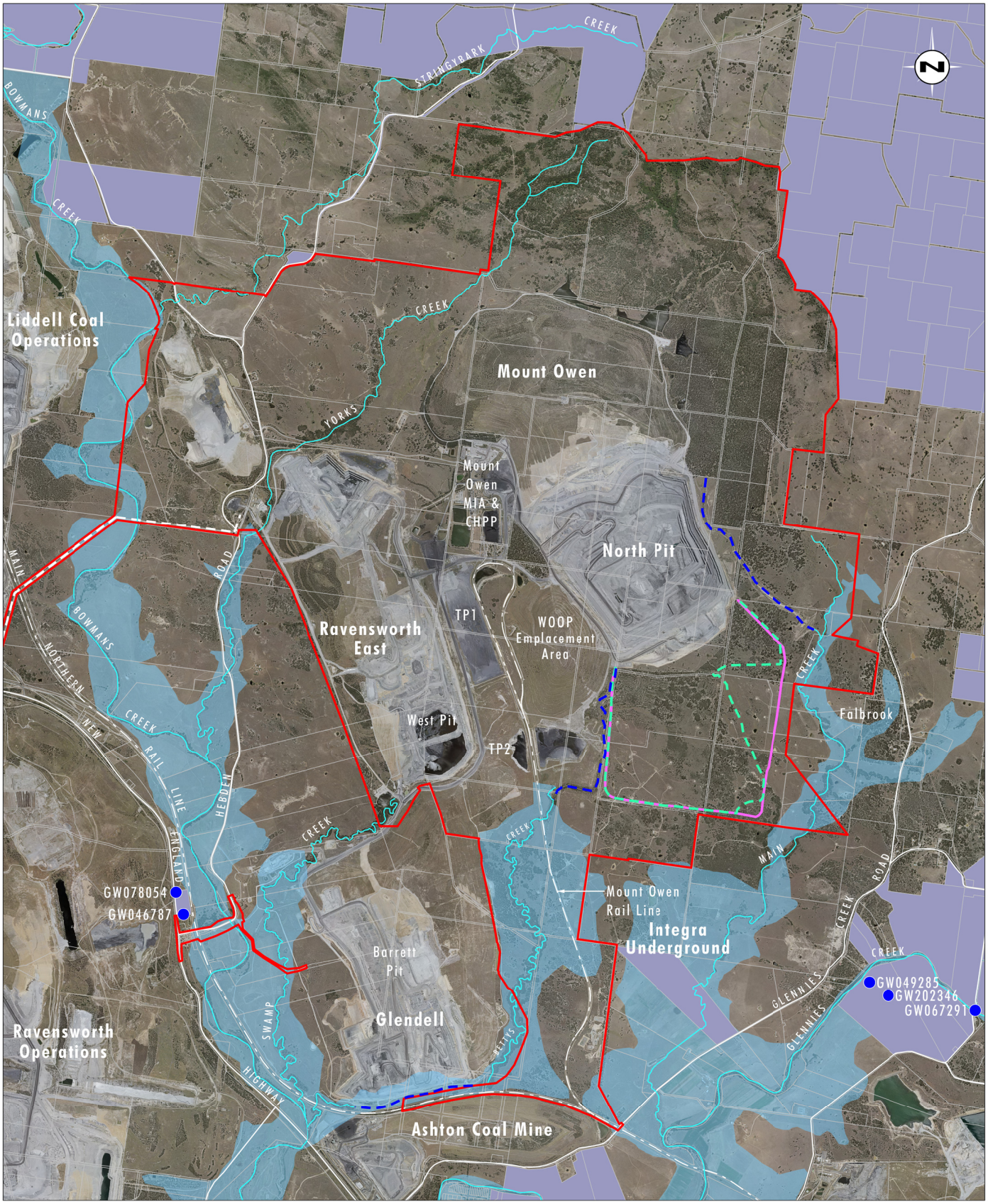


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

0 1.0 2.0 3.0km
1:60 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Pit Boundary
- Refined Alluvium Mapping (AGE 2017)
- Drainage Line
- Existing Bettys Creek Diversion
- Registered Groundwater Bores on Private Land
- Private Landholder

FIGURE 6.9

Registered Groundwater Bores on Private Land

File Name (A4): R09/3810_187.dgn
20180614 15.08

6.4.3 Greater Ravensworth Area Groundwater Model

The Greater Ravensworth Area Groundwater Model (the model) was originally developed for the Liddell Coal Operations Modification 5 in 2013, and subsequently developed further in 2014 by Jacobs (previously SKM) for the Continued Operations Project. During the response to submissions phase of the Continued Operations Project further refinements were made to the model to address the submission made by the IESC (Umwelt, 2015b). AGE has recently made additional refinements to the model for the Integra Underground Mine Modification 8 and the Proposed Modification.

Groundwater Model Refinements

The recent updates to the model for the Proposed Modification include:

- converting model to MODFLOW USG including development of refined model mesh and layers with resolution consistent with the requirements of IESC around Main Creek and Bettys Creek alluvium
- updating water level monitoring dataset from the regional monitoring network
- representing hydraulic conductivity as decreasing with depth in Permian model layers as indicated in field measurements from the region
- adjusting coal seam levels based on an updated geological model of Mount Owen Mine and new geological data from Integra Underground Mine
- updating the thickness and extent of the alluvium based on borehole logs and geophysical investigations along the upper reaches of Main Creek (refer to **Appendix 9**)
- recalibrating the model to water level records from Mount Owen and surrounding operations, and including mine inflows at Integra Underground Mine
- inclusion of detailed mine plan progression for Integra Underground Mine including the approved Integra Underground Mine Modification 8
- updating progression of approved and proposed mining at Mount Owen Mine and Integra Underground Mine
- adding approved open cut mining at Rix's Creek North Mine, and
- predicting impacts on the groundwater regime for the Proposed Modification.

A detailed description of the evolution of the model through this process and the changes made to quantify the impact of the Proposed Modification is included in the GWIA report (refer to **Appendix 9**). The model was used to identify the influence of the Proposed Modification on the groundwater regime by comparing the impacts generated by the approved and proposed mine plans. All currently approved and foreseeable mining operations within the region including the recently approved Integra Underground Mine Modification 8 were included in order to account for all associated cumulative impacts.

The model was calibrated using all available groundwater level measurements from groundwater monitoring bores within the model domain that were considered reliable. A detailed description of the calibration procedure is provided in the GWIA (refer to **Appendix 9**). Of note the calibration informed a number of key updates to the assumptions within the model, including identifying a decrease of permeability with increasing depth within the model and also a reduction in permeability of the regolith layer around the alluvium system. The calibration process for the model, as detailed in **Appendix 9**, confirmed that the model performance, and assumptions within the model, adequately reflect the characteristics of the groundwater systems as identified through the extensive groundwater monitoring program (refer to **Figure 6.8**).

Following calibration, the model was used to estimate changes in the alluvial water table and the Permian groundwater pressure (drawdown), as well as the amount of groundwater intercepted by the Proposed Modification, associated with the proposed mine plans. The influence of the Proposed Modification on the groundwater regime was estimated by comparing the predicted impacts for the approved and proposed mine plans. The following model scenarios were included:

- Approved - Approved Operations and proposed operations within the region (including the approved Integra Underground Mine Modification 8), and
- Approved Operations + Proposed Modification – includes all approved and proposed operations as well as the Proposed Modification.
- No mining at Mount Owen Mine – exclusion of all mining at Mount Owen from the commencement of each WSP

The second model scenario provides an indication of the cumulative impacts from all approved and proposed mining in the model domain. The impacts of the Proposed Modification were determined by comparing the difference between results from the two scenarios. This approach enables the identification of the total impacts of the Approved Operations and Proposed Modification, as well as providing specific detail on the potential impacts associated with the Proposed Modification relative to the Approved Operations.

The intention of the model scenario which excluded all future mining at the Mount Owen Complex from the commencement of each WSP was to quantify the volume of water taken from each water source and the associated drawdown since the commencement of each WSP (i.e. from 2009 for the Hunter Unregulated WSP, and from 2016 for the North Coast Fractured and Porous Rock WSP). The predicted drawdown therefore represents the change in groundwater levels from the commencement of each WSP.

The change in flux to the alluvial aquifers is also relative to baseline fluxes at the commencement of the Hunter Unregulated WSP in 2009. The groundwater inflow from the North Coast Fractured and Porous Rock WSP to the North Pit was not calculated relative to the start of the WSP, and therefore represents a total water take including previously approved mining impacts to ensure water licensing is adequate to account for all groundwater intercepted by mining operations in the North Pit. Further details on predicted water take, and licensing requirements, are provided in **Section 6.4.4**.

It is important to note that the current predicted groundwater impacts associated with the Approved Operations are different to the predicted model impacts presented in the GWIA and EIS for the Continued Operations Project, as a result of the refinements of the model. Therefore, the Continued Operations Project was included in the updated model to ensure the refinements were adopted cumulatively. The predicted impacts associated with the Approved Operations are less than those presented for the Continued Operations Project and are attributed to the refinements made to the model, particularly changes to the hydraulic parameters through the calibration of the model utilising a more extensive database of water level and mine inflow monitoring data from the groundwater monitoring network. This is outlined in detail in **Appendix 9**.

6.4.4 Groundwater Impact Assessment

6.4.4.1 Groundwater Drawdown

The model predicts only two small areas of drawdown within the Main Creek alluvium due to the Approved Operations and the Proposed Modification only (refer to **Figure 6.11**). When considered in isolation the Proposed Modification does not result in any further drawdown than that predicted for the Approved Operations. These predictions are a result of the Proposed Modification targeting deeper coal seams that are separated from the alluvium by intervening interburden strata with limited permeability. The groundwater modelling undertaken to support the Continued Operations Project predicted the potential

for up to 4 m of drawdown where North Pit is adjacent to Main Creek alluvium and 2 m for Bettys Creek alluvium (Jacobs, 2016). As discussed in **Section 6.4.4** the model has been recalibrated and refined and the predicted drawdown within the alluvial aquifer associated with Main Creek for the Approved Operations now predicted to be up to 0.1 m with no drawdown predicted to occur in Bettys Creek alluvium (refer to **Figure 6.11**).

The modelling indicates the 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. These predictions are consistent with current monitoring results which have not detected any significant drawdown within the Main Creek and Bettys Creek alluvial aquifers.

There are multiple coal seams intersected by the mining operations associated with the Proposed Modification. The Middle Liddell Seam was chosen to present the drawdown in the GWIA as it is also being actively mined at the adjacent Integra Underground Mine and therefore illustrates the cumulative groundwater impacts. The predictions indicate the zone of depressurisation within the Middle Liddell Seam extends some 1 to 1.5 km from the North Pit (refer to **Appendix 9**). The drawdown is largely attributable to the Proposed Modification because the Proposed Modification proposes mining down to the Hebden Seam across a greater extent of the North Pit than the Approved Operations. Whilst the drawdown occurs within the Middle Liddell Seam, it is important to note this coal seam is deep, contains poor quality groundwater and therefore does not form a resource with any environmental value.

In addition, modelling of the extent of drawdown impact associated with historical mining at the Mount Owen Complex and within the greater Ravensworth area has indicated drawdown impacts within the Permian measures for a number of kilometres from the Mount Owen Complex. These impacts have been established through extensive historical mining of the coal measures in this area since the late 1970s. Accordingly the modelled drawdown impact associated with the Proposed Modification is within the established area of drawdown established by historical mining in this area.

6.4.4.2 Change in Alluvium and Surface Water Inflow

The model was used to determine the potential for mining to interfere with the alluvial groundwater systems and to provide estimates of indirect 'water take' in accordance with the AIP. Mining will not directly intercept any alluvial aquifers, however, an indirect impact (water take) will potentially occur as the Permian strata become depressurised and the volume of groundwater flowing from the Permian to the alluvium progressively reduces. This water take needs to be accounted for under relevant water licensing.

The model predictions indicate very limited influence on the alluvial systems with a peak change in inflow to the Main Creek alluvium due to the Approved Operations and the Proposed Modification of 3 ML/year in year 12), and 1 ML/year (in year 18) attributable to the Proposed Modification alone. This change in flow due to both the Approved Operations and the Proposed Modification is distributed across a wide area therefore undetectable and unmeasurable within the groundwater regime. This is less than the model prediction for the Continued Operations Project of 15 ML/year, attributed to the groundwater model refinements (refer to **Section 6.4.3**).

6.4.4.3 Drawdown in Private Bores

The Proposed Modification will not result in any detectable incremental drawdown within the alluvial aquifers surrounding the North Pit, and therefore any private groundwater bores reliant on the alluvial system will not be affected.

6.4.4.4 Impact on Groundwater Dependent Ecosystems

As previously discussed, the Proposed Modification will not result in any detectable incremental drawdown within the Main Creek alluvial aquifers above that predicted for the Approved Operations, and therefore potential GDEs reliant on the alluvial systems will not be affected.

Given there will be no drawdown of the alluvial aquifers associated with Yorks Creek, Swamp Creek and Glennies Creek associated with the Proposed Modification there will be no impact on the current stygofauna communities present within these alluvial aquifers. As there were no stygofauna present within the Main Creek and Bettys Creek alluvial aquifers, no further monitoring of stygofauna is considered necessary.

6.4.4.5 Cumulative Drawdown

Approved coal mines within the region operate below the water table in relatively close proximity to the Approved Operations and therefore create a cumulative impact where the zones of drawdown overlap.

The predicted drawdown within the alluvium for the Approved Operations and Proposed Modification with the cumulative impact from all surrounding mining indicates the cumulative drawdown induced by all mining will be up to 0.5 m, with drawdown of up to 0.1 m attributable to the Approved Operations and the Proposed Modification. This level of drawdown, is unlikely to be detectable with monitoring.

Extensive coal mining in the area surrounding the Mount Owen Complex has been undertaken for many years and has resulted in the depressurisation of the hard rock aquifer. The model predictions indicate the Middle Liddell Seam will be significantly depressurised in the region due to the cumulative impacts of historical and existing mining operations (refer to **Appendix 9**). Whilst the drawdown occurs within the Middle Liddell Seam, it is important to note this coal seam is deep, contains poor quality groundwater and therefore does not form a resource with any environmental value.

6.4.5 Post Mining Recovery

6.4.5.1 Post Closure Groundwater Recovery

Post mining conditions were also simulated using the model to determine how the proposed North Pit final void will interact with the groundwater systems. The water balance model developed for the Proposed Modification (refer to **Appendix 10**) indicates the water level within the proposed final void will slowly recover over a period of approximately 320 years stabilising at around -65 mAHD with a predicted freeboard of 155 m, with no surface overflows predicted. This compares with an approved final void water level of 19 mAHD recovering over a period of approximately 500 years. Influencing this change is the increased catchment area and change to the shape and volume of the proposed final void.

Groundwater will gradually seep into the final void and re-pressurise the Permian strata slowly over time. Final void water levels are predicted to be about 120 m to 140 m below pre-mining groundwater levels. A steep hydraulic gradient between the final void and the groundwater systems will remain creating a permanent 'sink' for groundwater flow but will result in an undetectable drawdown from the alluvial aquifers, consistent with the Approved Operations.

As detailed in **Section 6.10**, consistent with the Approved Operations, the proposed final landform for the Proposed Modification has been designed to maximise the catchment returned to Main Creek and Bettys Creek. This return of the catchment is designed to minimise any loss of pre-mining catchment (it will result in additional catchment being returned to Main Creek relative to pre-mining) as well as reducing the net take from the Main Creek system in the long term. The reduction of net take will also limit the potential requirement to hold water access licences for the final landform, enabling this water allocation to be utilised for future land use within the rehabilitated final landform and elsewhere in the catchment.

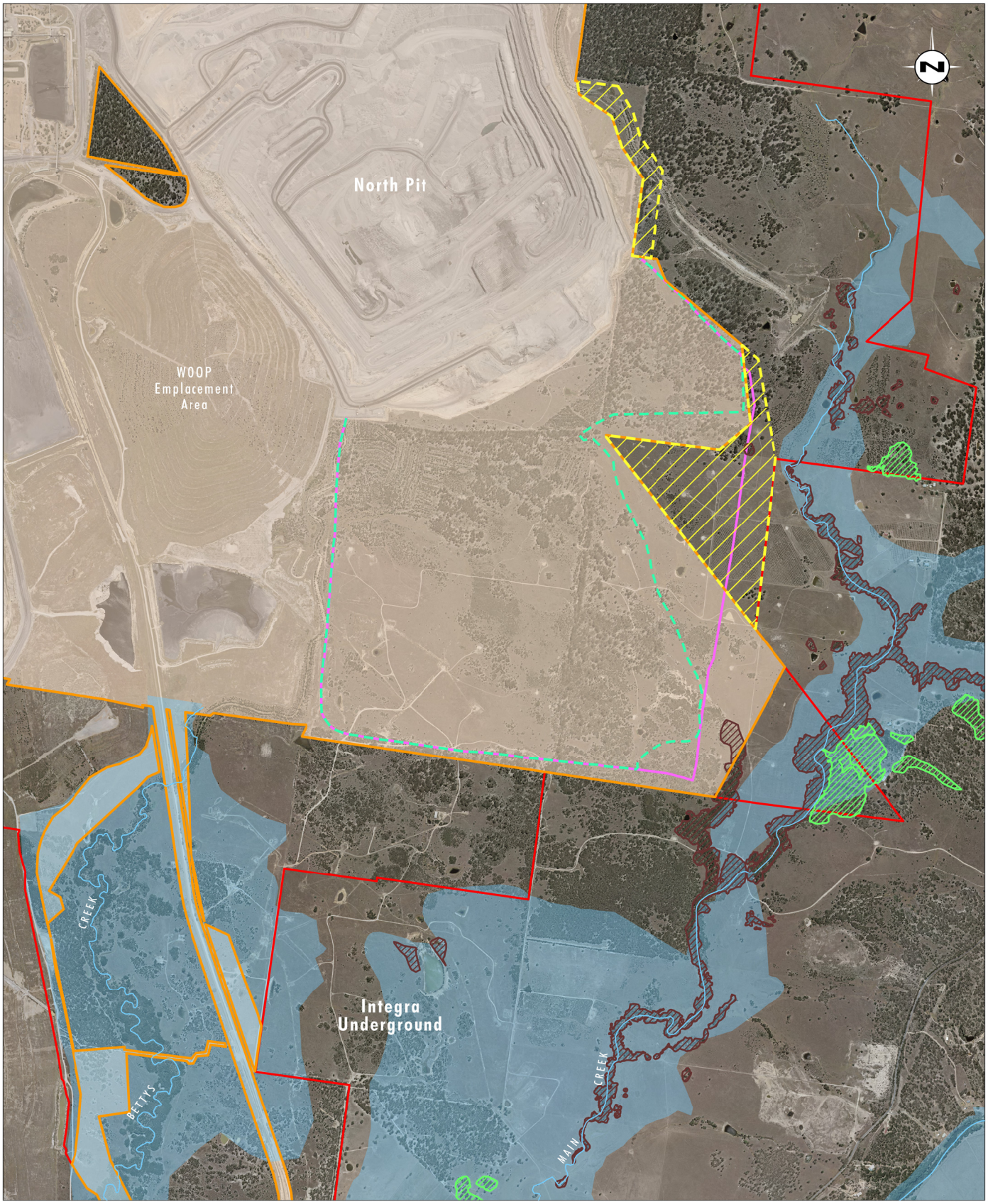


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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1:25 000

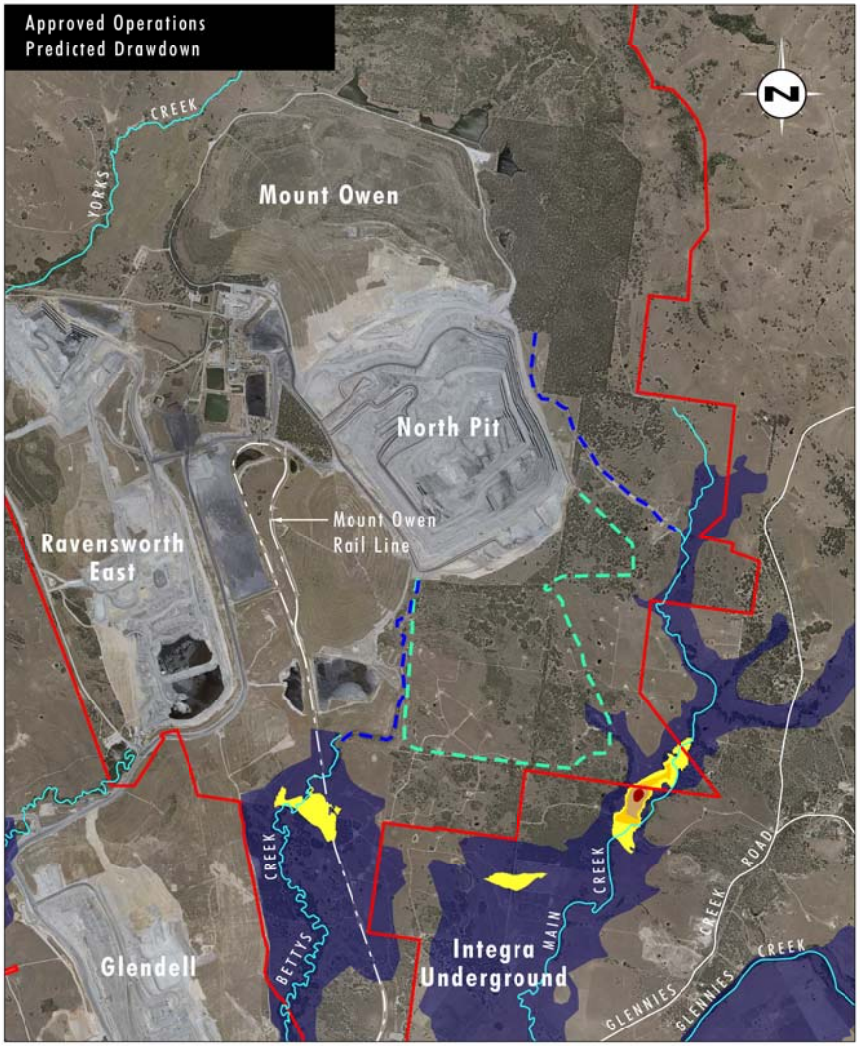
Legend

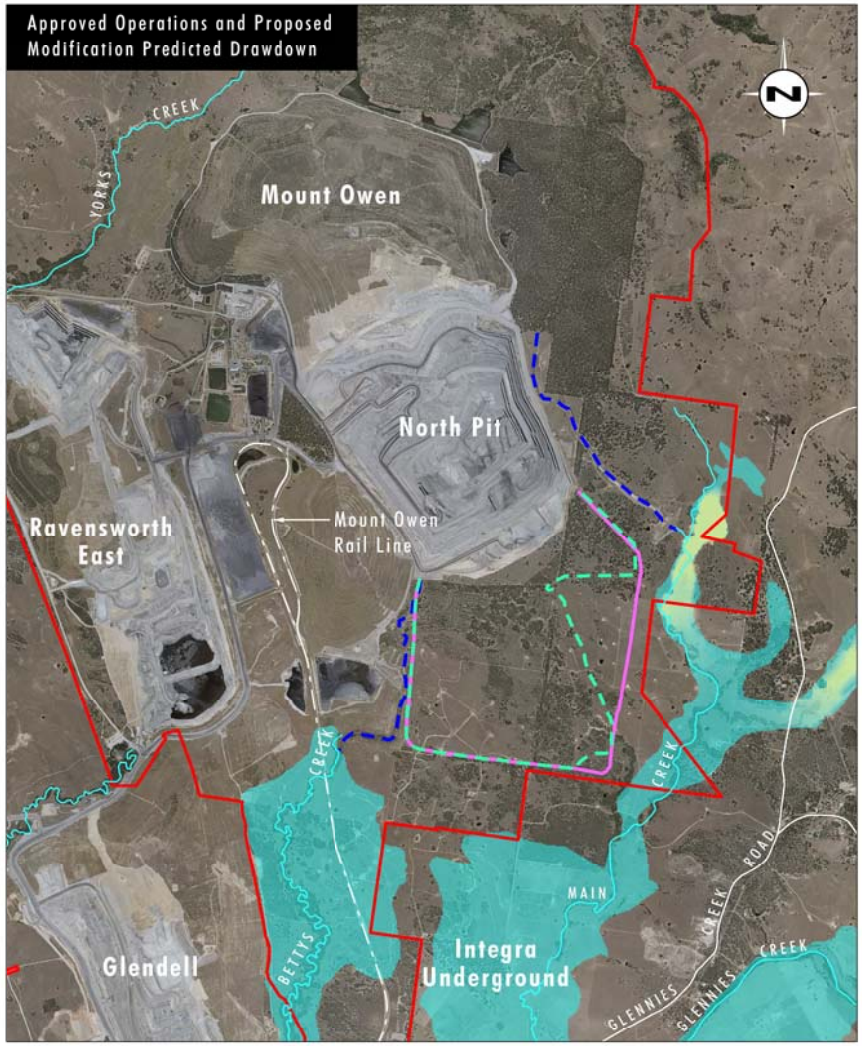
- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Modification Pit Boundary
- Proposed Disturbance Area
- Refined Alluvium Mapping (AGE 2017)
- Central Hunter Swamp Oak Forest
- Hunter Lowland Red Gum Forest
- Drainage Line

FIGURE 6.10

Riparian Ecological Communities

File Name (A4): R09/3810_191.dgn
20180621 10.40





Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Pit Boundary
- Mapped Alluvium (Jacobs 2014)
- Refined Alluvium Mapping (AGE 2017)
- Drainage Line
- Existing Bettys Creek Diversion

Approved Operations Predicted Drawdown (m) - (Jacobs 2015)

- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0

Proposed Modification Predicted Drawdown (m) - (AGE 2018)

- 0.0
- 0.1

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

0 1 2 3km
1:65 000

FIGURE 6.11

Predicted Alluvium Drawdown
Approved Operations vs Proposed Modification
(Project Only)

File Name (A4): R09/3810_192.dgn
20180704 17.47

6.4.5.2 Groundwater Quality

Post-mining water will evaporate from the proposed final void lake surface drawing in groundwater from the surrounding geological units and forming a sink in the groundwater regime. The water balance model (refer to **Appendix 10**) developed for the Proposed Modification indicates the evaporation from the proposed final void lake surface will concentrate salts in the lake slowly over time (refer to **Section 6.5.3**). The gradually increasing salinity will not pose any risk to surface water sources as the final void will remain a permanent sink with a steep hydraulic gradient between the proposed final void and the surrounding Permian strata.

6.4.6 Aquifer Interference Policy

The AIP describes the requirements for a proponent when designing a project, completing an assessment, and how the NSW Government will assess and regulate aquifer interference activities, and also describes minimal impact considerations (or minimal harm criteria) for water pressure, water table and water quality.

As discussed in **Section 6.4.1**, Main Creek and Bettys Creek alluvial aquifers are considered less productive alluvial water sources (under the AIP guidelines), due to their low natural flow volumes (considered insufficient to yield more than 5 L/sec from a bore), and water quality as monitoring indicates high salinity (>1,500 mg/L), low transmissivity and low saturated thickness. The Proposed Modification was determined to have a Level 1 impact as defined in the AIP.

The groundwater impact assessment undertaken by AGE provides a detailed assessment against the requirements of the AIP (refer to **Appendix 9**). A summary of the results of the assessment against the minimal harm criteria for both the alluvial and hard rock water sources is provided in **Table 6.6**.

Table 6.6 Summary of Assessment of Minimal Harm Criteria

	Alluvium	Porous and Fractured Rock
Water Table	• No high priority GDEs or culturally significant sites within 40 m of the predicted water table variations. • No drawdown within the Glennies Creek and Bowmans Creek alluvial aquifers associated with the Proposed Modification. • The model predicts two small areas of drawdown within the Main Creek alluvium (up to 0.1 m) due to the Approved Operations and the Proposed Modification. This compares with the predicted drawdown for the Continued Operations Project of up to 4 m in Main Creek alluvium (adjacent to the North Pit) and 2 m in Bettys Creek alluvium. • Drawdown as result of Proposed Modification will be undetectable. • No registered bores or groundwater users are located within the extent of predicted drawdown. • Main Creek and Bettys Creek are ephemeral in nature and largely disconnected from the groundwater systems and the groundwater systems do not contribute significant baseflow.	• No high priority GDEs or culturally significant sites have been identified within 40 m of the predicted water table variations. • No water supply works have been identified within 1.5 km of the zone of predicted depressurisation.

	Alluvium	Porous and Fractured Rock
Water Pressure	• The model predicts two small areas of drawdown within the Main Creek alluvium (up to 0.1 m) due to the Approved Operations and the Proposed Modification, this compares with the predicted drawdown for the Continued Operations Project of up to 4 m in Main Creek alluvium (adjacent to the North Pit) and 2 m in Bettys Creek alluvium ; drawdown as a result of Proposed Modification will be undetectable	• No water supply works have been identified within the zone of predicted depressurisation.
Water Quality	• Minimal Impact Consideration for less productive groundwater sources state "No mining activity to be below the natural ground surface within 200 m laterally from the top of high bank or 100 m vertically beneath a highly connected surface water source that is defined as a "reliable water supply". The AIP refers to the SRLUP in defining a "reliable water supply", The SRLUP does not define "reliable water supply" however does refer to 'reliable water of suitable quality' which is characterised by having rainfall of 350 mm or more per annum (9 out of 10 years); or properties within 150 m of a regulated river, or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers; or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5 L/s and total dissolved solids of less than 1,500 mg/L. • Review of the data (refer to **Appendix 9**) from the existing groundwater monitoring network (refer to **Figure 6.8**) indicates high salinity (>1,500 mg/L), low transmissivity and low saturated thickness. Therefore the Main Creek alluvium does not meet the criteria of "reliable water of suitable quality" as defined by the SRLUP and a 'reliable water supply' under the AIP. • As discussed in **Section 6.4.1**, Bettys Creek and Main Creek are largely disconnected from the groundwater systems and that the groundwater systems do not contribute significantly to baseflow to Main Creek or Bettys Creek. Additionally, review of the data from the monitoring network also indicates the salinity of the surface water within Main Creek and Bettys Creek also varies from fresh to brackish, depending on the location and climatic conditions during sample collection. • The model predicts two small areas of drawdown within the Main Creek alluvium (up to 0.1 m) due to the Approved Operations and the Proposed Modification. Based on the review of the monitoring data included above, the predicted drawdown (which is lower than that predicted for the Continued Operations Project) will have negligible impact on alluvium water quality.	• Post mining groundwater will gradually seep into the North Pit final void and re-pressurise the Permian strata slowly over time. Final void water levels are predicted to be about 120 to 140 m below pre-mining groundwater levels, and the final void will act as a permanent 'sink' for groundwater flow. The proposed final void lake surface will concentrate salts in the lake slowly over time. The gradually increasing salinity will not pose any risk to surface water sources as the final void will remain a permanent sink with a steep hydraulic gradient between the proposed final void and the surrounding Permian strata.

6.4.7 Groundwater Licensing

The AIP requires the accounting of all water take, either directly or indirectly from groundwater systems. The Mount Owen Complex is located on the catchment divide that marks the boundary between the Jerrys Water Source (Bowmans, Stringybark, Yorks and Swamp Creeks) and the Glennies Water Source (Glennies, Bettys and Main Creeks) (refer to **Figure 6.12**). Three Water Sharing Plans (WSPs) apply to the aquifers and surface waters within the vicinity of the Mount Owen Complex including:

- North Coast Fractured and Porous Rock Groundwater Sources 2016 (North Coast Fractured and Porous Rock WSP)
- Hunter Regulated River Water Source 2016 (Hunter Regulated WSP); and
- Hunter Unregulated and Alluvial Water Sources 2009 (Hunter Unregulated 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 Hunter Regulated WSP covers the Hunter River surface water flows and connected alluvials described in the WSP. The Hunter Regulated Water Source is divided into three 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 (refer to **Figure 3.5**). The North Pit is located adjacent to and 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 Hunter Unregulated WSP includes the unregulated rivers and creeks within the Hunter River catchment, with the Jerrys and Glennies Water Sources being relevant to the Mount Owen Mine (refer to **Figure 3.5**). The Hunter Regulated River Alluvial Water Source which covers the Quaternary alluvium associated with Glennies Creek is also a separate water source managed under the Hunter Unregulated WSP.

The licencing requirements during operations are outlined in **Table 6.7**.

Table 6.7 Groundwater Licencing requirements during operations

Water sharing plan	Water source/ management zone	Type	Peak volume requiring licensing during mining (ML/year)	
			Approved Operations and Proposed Modification	Proposed Modification only
North Coast Fractured and Porous Rock WSP	Sydney Basin North Coast	Groundwater	908 (Year 3)	456 (Year 15)
Hunter Unregulated WSP	Jerrys	Groundwater	0	0
		Surface water	0	0
	Glennies	Groundwater	3 (Year 12)	1 (Year 18)
		Surface water	1 (Year 7)	0
	Hunter Regulated River Alluvium	Groundwater	0	0
Hunter Regulated WSP	Management Zone 3a - Glennies Creek and Station Creek surface water	Surface Water	0	0

There is no predicted water take during operations requiring additional licensing under the Hunter Regulated WSP as a result of the Proposed Modification.

Mount Owen has a total entitlement of 1,160 ML/year from the North Coast Fractured and Porous Rock WSP. The total peak licence requirement is 908 ML occurring in Year 3 (due to the combined influence of the BNP (366 ML) and the North Pit, as modified (542 ML)). Therefore Mount Owen hold sufficient water licences associated with the North Coast Fractured and Porous Rock WSP.

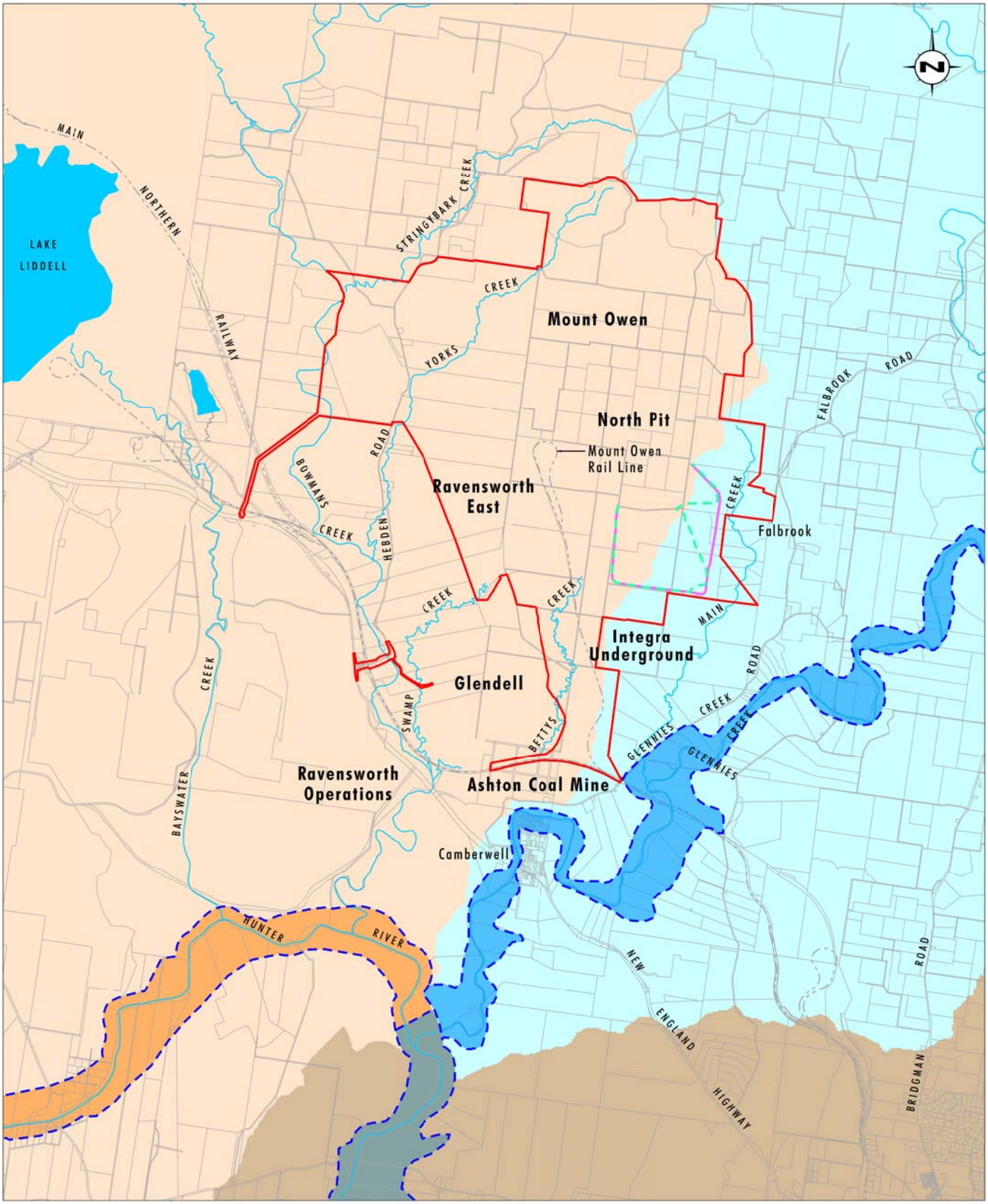
There is no predicted water take during operations requiring additional licensing under the Hunter Unregulated WSP for the Jerrys Water Source or the Hunter Regulated River Alluvium Water Sources as a result of the Proposed Modification. When interpreting the predicted changes in flow due to the Proposed Modification it is important to consider the predicted volumes in context. In considering the Approved Operations and Proposed Modification, the predicted groundwater volume intercepted from the Glennies Water Source peaks at 3 ML/year in Year 12, which is equivalent to 0.1 L/sec. The predicted peak groundwater volume intercepted from the Proposed Modification only, peaks at just 1 ML/year in Year 18. As discussed in **Section 6.4.4.1**, the predicted take of 3 ML/year for the Approved Operations and Proposed Modification is significantly lower than the predicted take of 15 ML/year for the Continued Operations Project. Additionally the predicted change in flow due to both the Approved Operations and the Proposed Modification is distributed across a wide area which is considered to be undetectable and unmeasurable within the groundwater regime.

In accordance with Schedule 3, Condition 21 of the current development consent (SSD-5850) Mount Owen will continue to liaise with CLWD to confirm and resolve the application of licensing requirements for relevant stages of the Proposed Modification.

Licencing requirements relating to the final landform post mining are discussed in **Section 6.5.6.4**.

6.4.8 Groundwater Management and Monitoring

The Mount Owen Complex operates in accordance with the WMP (including sub plans) which was prepared in consultation with NSW government agencies consistent with the requirements of the SSD-5850. The WMP includes a standalone Groundwater Management and Monitoring Plan that was last updated and approved in October 2017 to incorporate the Approved Operations in accordance with the consent conditions of SSD-5850. The Mount Owen Complex has an expansive network of groundwater monitoring bores and given that the predicted impact of the Proposed Modification on groundwater systems and associated users will be negligible, no additional monitoring locations beyond those existing is considered necessary.



Data Source: Glencore (2018), Geoscience Australia (2006), LPI (2017)

0 1.0 2.5 5.0km

1:100 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Proposed Modification Pit Boundary
- Drainage Line

Hunter Unregulated and Alluvial Water Sharing Plan Water Sources:

- Glennies Water Source
- Jerrys Water Source
- Singleton Water Source

Hunter Regulated River Water Sharing Plan Water Sources:

- Downstream Glennies Creek Management Zone
- Glennies Creek Management Zone
- Upstream Glennies Creek Management Zone

FIGURE 6.12

Water Sharing Plans and Water Sources relevant to the Mount Owen Complex

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6.5 Surface Water

A detailed Surface Water Impact Assessment (SWIA) has been undertaken by Engeny Water Management (Engeny) to assess the potential impacts of the Proposed Modification on existing surface water resources.

6.5.1 Surface Water Context

The Mount Owen Complex is located within the catchments of Bowmans Creek and Glennies Creek, which flow into the Hunter River to the south of the Mount Owen Complex. Bowmans Creek catchment is located to the north and west of the Mount Owen Complex; while Glennies Creek catchment, a regulated catchment, is located to the east and south (refer to **Figure 3.5**).

The changes to mining operations associated with the Proposed Modification are located within and adjacent to the sub catchment areas of Bettys Creek (a tributary of Bowmans Creek) and Main Creek (a tributary of Glennies Creek), as well as within the catchment area of the existing approved Mount Owen Complex Water Management System (WMS) (refer to **Figure 6.13**).

6.5.1.1 Catchment Areas and Watercourses

Previous mining operations have modified local catchments through the capture of runoff from mining areas within the WMS and diversion of upslope runoff around the mining operations. For each catchment area intersected by the Approved Operations, the stream order, pre-mining catchment area and current approved final landform catchment area are included in **Table 6.8**. No additional catchments will be intersected by the Proposed Modification.

Table 6.8 Catchment Areas

Watercourse	Schedule (order)[1]	Catchment Areas	
		Pre-mining[2] (ha)	Approved Operations Final Landform[3,4] (ha)
Bowmans Creek	3 (6th order)	25,055	20,510
Yorks Creek	2 (3rd order)	1,230	1,910
Swamp Creek	2 (4th order)	2,380	1,160
Bettys Creek	2 (4th order)	1,810	850
Glennies Creek[5]	3 (6th order)	51,580	52,110
Main Creek	2 (4th order)	2,000	2,530

Notes
[1] Strahler watercourse ordering classification.
[2] Based on 1:25,000 LPI topographical map series.
[3] Does not include WMS catchment areas that are internally draining (including other mine operations), interpolated from 1:25,000 LPI topographical map series, 2012 LiDAR survey and aerial photographs.
[4] Including existing approved creek diversions.
[5] Glennies Creek catchment area based on CLWD information.

Main Creek is a fourth order tributary of Glennies Creek and is an ephemeral creek system, with flows only occurring during storm events or after prolonged periods of heavy rain. Some pools of standing water tend to be present in the downstream reaches. These pools typically exhibit high salinity as a result of evapo-concentration. Main Creek flows in a southerly direction and joins Glennies Creek downstream of Glennies Creek Dam and approximately 6.5 km upstream of the Glennies Creek confluence with the Hunter River (refer to **Figure 6.13**). The majority of the Main Creek catchment is open grasslands, and the riparian zone is mostly well vegetated along the mid portion with a well-defined creek line. The lower portion of the catchment is utilised for grazing, with sections of the creek line poorly defined.

Bettys Creek is a fourth order tributary of Bowmans Creek and is an ephemeral creek system with flows only occurring during storm events or after prolonged periods of heavy rain. Some pools of standing water tend to be present in the downstream reaches. These pools typically exhibit high salinity as a result of evapo-concentration. The catchment of Bettys Creek is highly modified and a large proportion of Bettys Creek catchment is currently incorporated into the Mount Owen Complex WMS. Approximately 490 ha of the upper catchment of Bettys Creek has been previously diverted to the east of the Mount Owen Mine into Main Creek via the Upper Bettys Creek Diversion (refer to **Figure 6.13**). The middle reaches of Bettys Creek have also been diverted to the east around the WOOP emplacement area via the Middle Bettys Creek Diversion. In the currently approved final landform, approximately 130 ha of the upper Swamp Creek catchment is also diverted to Main Creek via the Upper Bettys Creek Diversion (refer to **Figure 6.13**).

Glennies Creek flows from headwaters in the Mt Royal Range to the Hunter River with a pre-mining catchment area of approximately 51,580 ha and has sufficient contributing catchment to maintain flows under most climatic conditions. Glennies Creek Dam is located approximately 17 km upstream of the confluence of Main Creek with Glennies Creek (refer to **Figure 3.5**). Approximately 23,300 ha (i.e. 45% of the catchment) is located upstream of Glennies Creek Dam.

The construction of Glennies Creek Dam was completed in 1983 and forms part of the Hunter Regulated River System. The Hunter Regulated River System is managed by the Water Sharing Plan for the Hunter Regulated River Water Source 2016 (Hunter Regulated River WSP) regulated under the WM Act. Water from Glennies Creek Dam is managed to meet downstream requirements for environmental, irrigation, stock and domestic, town water and water conservation usages. As such the flow regimes in Glennies Creek downstream of Glennies Creek Dam are highly modified.

Yorks Creek is a third order tributary of Bowmans Creek and is an ephemeral creek system. Yorks Creek typically has a defined channel several metres in width and approximately 1 to 1.2 m in depth, with a relatively wide floodplain. The creek varies from highly vegetated and sinuous, to some sections that are hydraulically steep with limited vegetation. The existing Yorks Creek catchment includes the approved diversion of the upper catchment of Swamp Creek (approximately 500 ha) to Yorks Creek. Approximately 120 ha of the catchment are incorporated into the Mount Owen Complex WMS.

6.5.1.2 Water Quality Monitoring

Mount Owen monitors surface water quality in accordance with the Mount Owen Complex Surface Water Management and Monitoring Plan (approved October 2017). This plan includes monitoring of the following elements of the WMS and surrounding creeks:

- surface water flows and quality in upstream and downstream watercourses
- channel stability in upstream and downstream watercourses
- stream health conditions in upstream and downstream watercourses, and
- on-site water storages.

The surface water monitoring program covers all three water category areas within the Mount Owen Complex: clean; dirty; and mine water systems. The clean water system consists of runoff from undisturbed or rehabilitated areas. The dirty water system consists of runoff from disturbed areas (excluding mine water). The mine water system consists of runoff from areas exposed to coal or water used in coal processing or from coal stockpile areas.

The Surface Water Management and Monitoring Plan require monthly monitoring at all monitoring locations within the clean water system for the following parameters:

- flow (by way of visual observation as streams are ephemeral)
- pH
- electrical conductivity (EC)
- total suspended solids (TSS), and
- total dissolved solids (TDS).

Mount Owen also monitors a number of organic and metal/metalloid parameters in the dirty and mine water systems.

Using historical data sets and methods outlined in the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines, site specific water quality triggers have been developed for pH, EC, TSS and TDS and are included in the approved Mount Owen Complex Surface Water Management and Monitoring Plan.

Water quality monitoring data for pH, EC, TSS and TDS are reported in the Mount Owen Complex Annual Environmental Management Report (AEMR). Integra Underground Mine also monitors water quality in Glennies Creek. Data presented in the AEMRs indicates that mining activities have had negligible impact on the water quality in downstream creek systems, including Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek, Glennies Creek and Main Creek.

Further detail regarding water quality monitoring and results is provided in the SWIA (refer to **Appendix 10**).

6.5.1.3 Geochemical Influences

A geochemical assessment was undertaken by Environmental Geochemistry International Pty Ltd (EGI) for the Continued Operations Project (EGI, 2013) which was updated to include the Proposed Modification (EGI, 2018) (refer to **Appendix 11**). The assessments provide an indication of the inherent acidity and salinity of waste material when initially exposed in waste emplacement areas and consideration of the likely elements to be present in surface water/seepage generated within the mining areas. The key observations and results relevant to surface water quality are:

- pH ranged from 4.2 to 9.6, with 96% of samples showing no inherent acidity with a pH >6.
- EC ranged from 90 to 2,100 µS/cm, with 96% of samples classified as non-saline with an EC of <800 µS/cm.
- Elements that are typically considered to be of environmental concern, including aluminium, arsenic, manganese and molybdenum, although being detected in the majority of samples, had median concentrations that were generally low.
- Significant metal/metalloid release would likely only be associated with generation of Acid Rock Drainage (ARD). The solubility of metals/metalloids will largely be determined by pH and therefore control of acid generation will effectively control metal leaching. Initial metals/metalloids that could be released from pyritic materials would include cobalt, iron, manganese, nickel and zinc.

- The majority of weathered Permian materials are expected to be non-acid forming (NAF) with excess acid neutralisation capacity (ANC) and are not expected to require special handling. The process of mixing and dilution through mining is expected to be sufficient to mitigate ARD from any occasional thin zones of pyrite that may be present.

- The majority of overburden/interburden, coal and washery waste materials are typically NAF and are likely to be a source of alkalinity in leachate and unlikely to release significant concentrations of metals/metalloids. Alkaline leachate will also provide an additional factor of safety in management of any ARD.

- Weathered Permian materials are likely to be sodic and dispersive, which may be subject to surface crusting and high erosion rates. Treatment of materials with gypsum or lime if being used as a plant growing horizon, exposed on dump surfaces or used in engineering structures may be required.

Further detail is provided in the geochemical assessment report (refer to **Appendix 11**).

6.5.1.4 Water Users

The majority of land adjacent to the Approved Operations and Proposed Disturbance Area is owned by Glencore subsidiaries. There is one private landholder with access to Main Creek located downstream of the Proposed Disturbance Area. However, there are no known licensed water users on Main Creek downstream of the Approved Operations. Water is extracted from Glennies Creek downstream of the Approved Operations by Ashton Coal Mine. Water is also extracted from Glennies Creek by Integra Underground Mine by use of a licence agreement with Mount Owen.

6.5.1.5 Current Water Licences

The Hunter Unregulated WSP applies to the watercourses and alluvial groundwater in the vicinity of the Mount Owen Mine. The Mount Owen Mine is located on the catchment divide that marks the boundary between the Jerrys Water Source (Bowmans, Stringybark, Yorks and Swamp Creeks) and the Glennies Water Source (Glennies, Bettys and Main Creeks) (refer to **Figure 6.12**). Water extraction from Glennies Creek is managed under the Hunter Regulated River WSP.

Table 6.9 provides a summary of the licences currently held by Mount Owen with a detailed list provided in the SWIA (refer to **Appendix 10**).

Table 6.9 Current Surface Water Licence Allocation

Type	Total Allocation ML/yr
Hunter Regulated WSP – Management Zone 3a (Glennies Creek)	1,056
Hunter Unregulated WSP - Jerrys Water Source	200
Hunter Unregulated WSP - Glennies Water Source	17

6.5.2 Water Management System

The Mount Owen Complex has a comprehensive WMS, which includes mine dewatering systems, water storages, sedimentation and retention basins, settling and tailings ponds, diversion drains, levee banks and earth bunding around the main coal stockpile, laydown hardstand and fuelling areas.

The WMS at the Mount Owen Complex is an integrated system, that is, the water from the Mount Owen, Ravensworth East and Glendell Mines is managed together within the integrated WMS. In addition, the Mount Owen Complex forms part of the GRAWTS with the Ravensworth Operations, Integra Underground and Coal Operations mining operations. Other nearby mining operations may also participate in the GRAWTS in the future, subject to obtaining relevant approvals and meeting relevant licence conditions. The GRAWTS allows greater flexibility in the management of water by Mount Owen and other participating operations, allowing increased recycling of water between operations which limits the requirement to extract water from surrounding watercourses.

The Approved Operations and Proposed Modification WMS are summarised in the following sections with further detail provided in the SWIA in **Appendix 10**.

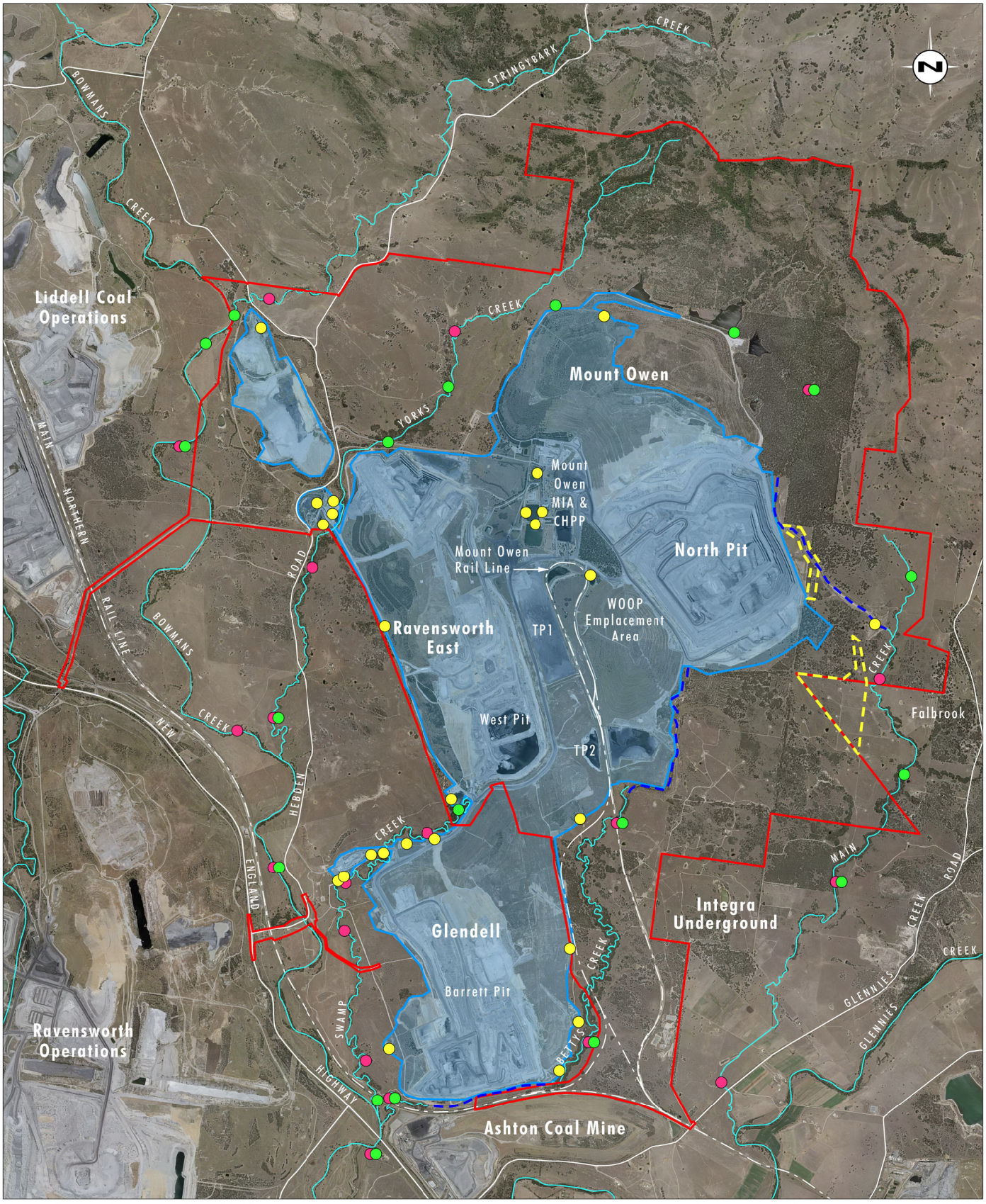

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend

- SSD-5850 Consent Boundary
- Proposed Modification Disturbance Area
- Water Management System Catchment Boundary
- Existing Bettys Creek Diversion
- Drainage Line

Surface Water Monitoring Locations:

- Surface Water - Channel Stability and Stream Health
- Surface Water Onsite Storage
- Surface Water - Watercourse

FIGURE 6.13

Mount Owen Complex Catchments and Surface Water Monitoring Locations

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6.5.2.1 Water Management System – Approved Operations

The approved Mount Owen Complex WMS has the following key objectives and functions:

- diversion of clean water around mining operations to minimise capture of upslope runoff and separate clean water runoff from mining activities
- segregating mine impacted water and runoff 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 (e.g. extraction from Glennies Creek)
- minimising adverse effects on downstream waterways (i.e. hydraulic and water quality impacts).

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 each of the three categories of water are summarised in **Table 6.10**.

Table 6.10 Approved WMS design criteria

Water Category	Water Description	Target Design Criteria
Clean	Runoff from undisturbed or rehabilitated areas.	Release, where practicable, to downstream environment.
Dirty	Runoff from disturbed areas (does not include water captured in mining pit areas or runoff from mine infrastructure areas).	Managed in line with the Blue Book (Managing Urban Stormwater: Soils and Construction Volumes 1 and 2E). Designed to manage runoff from the 5 day, 95th percentile rainfall event.
Mine	Runoff from areas exposed to coal or water used in coal processing or from coal stockpile areas.	Contained for events up to and including the 1% annual exceedance probability (AEP) 24 hour storm event.

A key objective of the WMS is to convey clean water around the mining operation areas or, when runoff water from rehabilitated areas becomes clean, enable the runoff from these rehabilitated areas to flow directly to the downstream environment as opposed to being managed as part of the WMS.

The Mount Owen EPL (EPL 4460) does not permit the discharge of water from the premises to the environment and does not allow for discharge of mine water under the Hunter River Salinity Trading Scheme (HRSTS). There are no licensed discharge points from the Mount Owen Complex to any creek systems. It should also be noted that no discharge has occurred from the Mount Owen Complex WMS over the last 12 years. Water captured within the WMS is reused on site with surplus water transferred from the Mount Owen Complex to storages within the GRAWTS in accordance with existing approvals. There is also approval for the GRAWTS to discharge from Ravensworth Operations and Liddell Coal Operations licensed discharge points, in accordance with the HRSTS. The conceptual WMS Layouts for Year 5 and Year 10 for the Approved Operations are included in the SWIA in **Appendix 10**.

6.5.2.2 Water Management System – Proposed Modification

It is proposed to continue to utilise the existing WMS for the Proposed Modification, integrating the Proposed Disturbance Area into the existing approved WMS which will continue to be part of the GRAWTS as described in **Section 6.5.2.1**.

The conceptual WMS components relating to the Proposed Modification for Years 2, 8 and 15 are presented in **Figures 6.14** to **6.16**. The conceptual drainage system for the proposed conceptual final landform is shown on **Figure 6.17**. Further detail relating to the proposed conceptual design of the WMS and storage capacities is provided in the SWIA (**Appendix 10**), with relevant changes relating to each modelled mining year summarised below.

Year 2

During Year 2 (refer to **Figure 6.14**) as the North Pit progresses in a southerly direction, runoff from the active mining and overburden emplacement areas will be managed within the pit and sediment dams located within the overburden emplacements areas. A clean water drain will be constructed upslope of the proposed haul road to the WOOP emplacement area with runoff draining to the existing Middle Bettys Creek Diversion.

Three dirty water dams (M2, M3 and M4) and associated drains will be constructed to the south of the North Pit to manage dirty water runoff associated with pre-strip operations. Similarly, a dirty water dam (M1) and drainage system will manage runoff from the haul road to the WOOP emplacement area. The shaping of the emplacement area at Year 2 will start to include a dryland attenuation basin (D1) which will provide flow attenuation for the final landform.

Year 8

North Pit mining operations, overburden emplacement area shaping and rehabilitation progresses to the south and east. Three additional dirty water dams (M5, M6 and M7) and associated drains will be constructed to manage potentially dirty runoff from overburden emplacement areas and pre-stripping operations. The shaping of the emplacement area at Year 8 will include an additional dryland attenuation basin (D2) which will provide flow attenuation for the final landform. Initially D2 will act as a dedicated dirty water dam (M7) (refer to **Figure 6.15)**.

Year 15

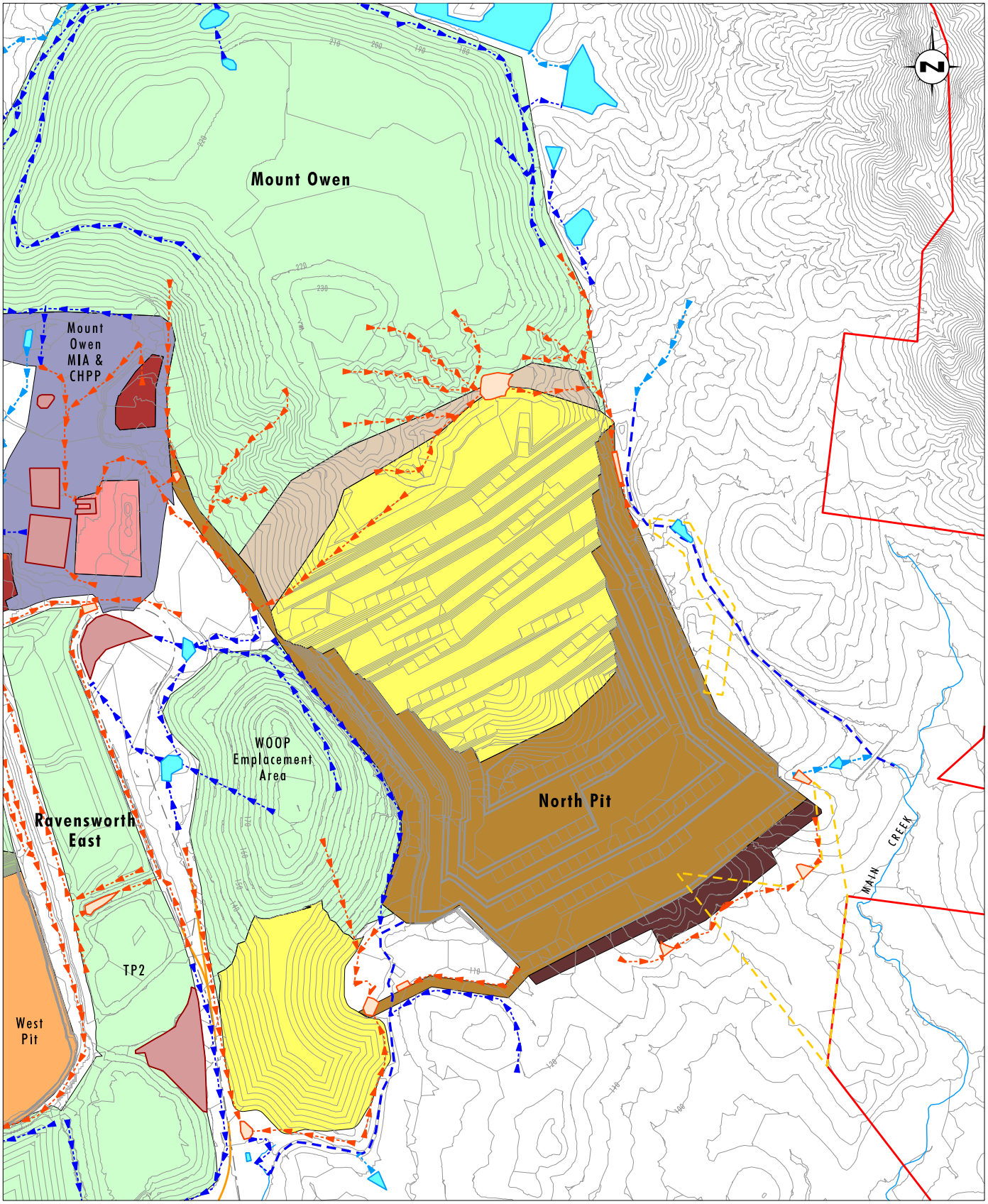
The proposed conceptual WMS for Year 15 is shown on **Figure 6.16**. North Pit will continue to progress south and east reaching the proposed southern limit. Overburden material will continue to be placed within the North Pit emplacement area progressing south. Shaping of emplacement areas and progressive rehabilitation within the North Pit continues when the final landform is achieved. An additional dirty water dam (M8) and any required associated drainage systems will be constructed ahead of the pre-stripping operations to manage any potentially dirty runoff from the disturbed areas. Detention basin D3 will also start to be formed into the final landform which will provide flow attenuation. This continued southern progression of mining and the ongoing construction of dirty water dams will continue through to the completion of proposed mining operations.

Final Landform

When the final landform is achieved, all operations will be complete and the disturbance areas will be completely rehabilitated. The proposed conceptual final landform drainage systems include clean water dams and dryland attenuation basins (i.e. detention basins) (refer to **Figure 6.17**). Dryland attenuation basins are proposed in the final landform to reduce flow velocities whilst maintaining drainage and creek line stability and as such will not store any permanent water.

The key change to the drainage systems associated with the proposed conceptual final landform will be the establishment of drainage lines on the final sections of the rehabilitated North Pit overburden emplacement area, associated with the change in the design of the final landform, as well as drainage lines around the perimeter of the North Pit final void in order to convey upstream catchment runoff away from the final void and into downstream watercourses, particularly Main Creek. A comparison of the approved and proposed conceptual final landforms is provided in **Sections 5.3** and **6.10.1** (refer to **Figure 5.2**).

The final detail of dam configuration, design of the drainage systems and associated licencing will be further investigated and resolved during preparation of the relevant stages of the Mining Operations Plan and in the detailed closure planning process.



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

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Shaped Not Seeded
- Tailings Emplacement
- Topsoil Removal Strip
- Water Storage Area
- Mine Water Dam
- Clean Dam
- Dirty Dam
- Clean Drainage Line
- Dirty Drainage Line
- Natural Drainage Line

FIGURE 6.14

Proposed Conceptual Surface Water Management System Year 2

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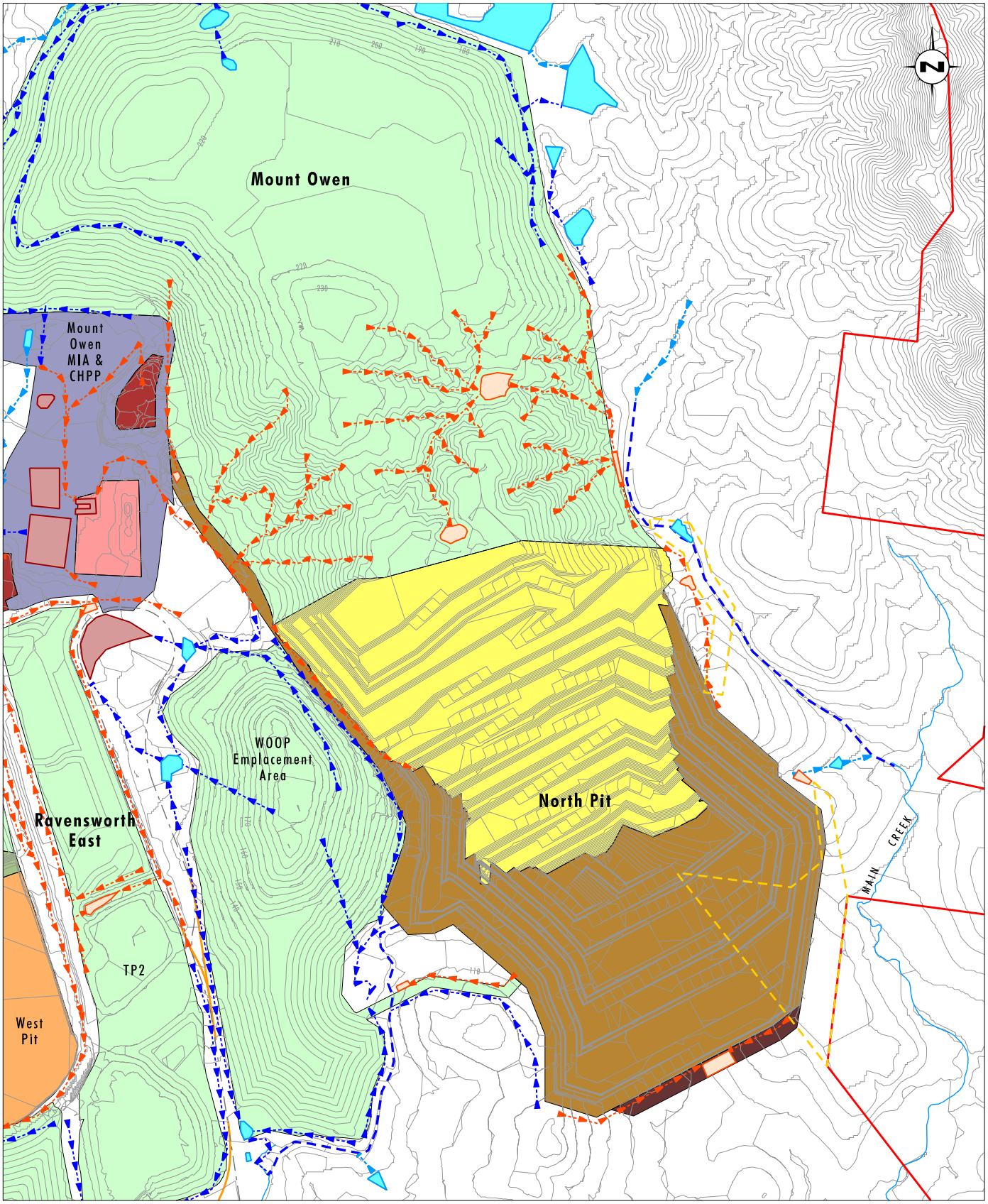

Data Source: Glencore (2018)
Note: Contour Interval 5m

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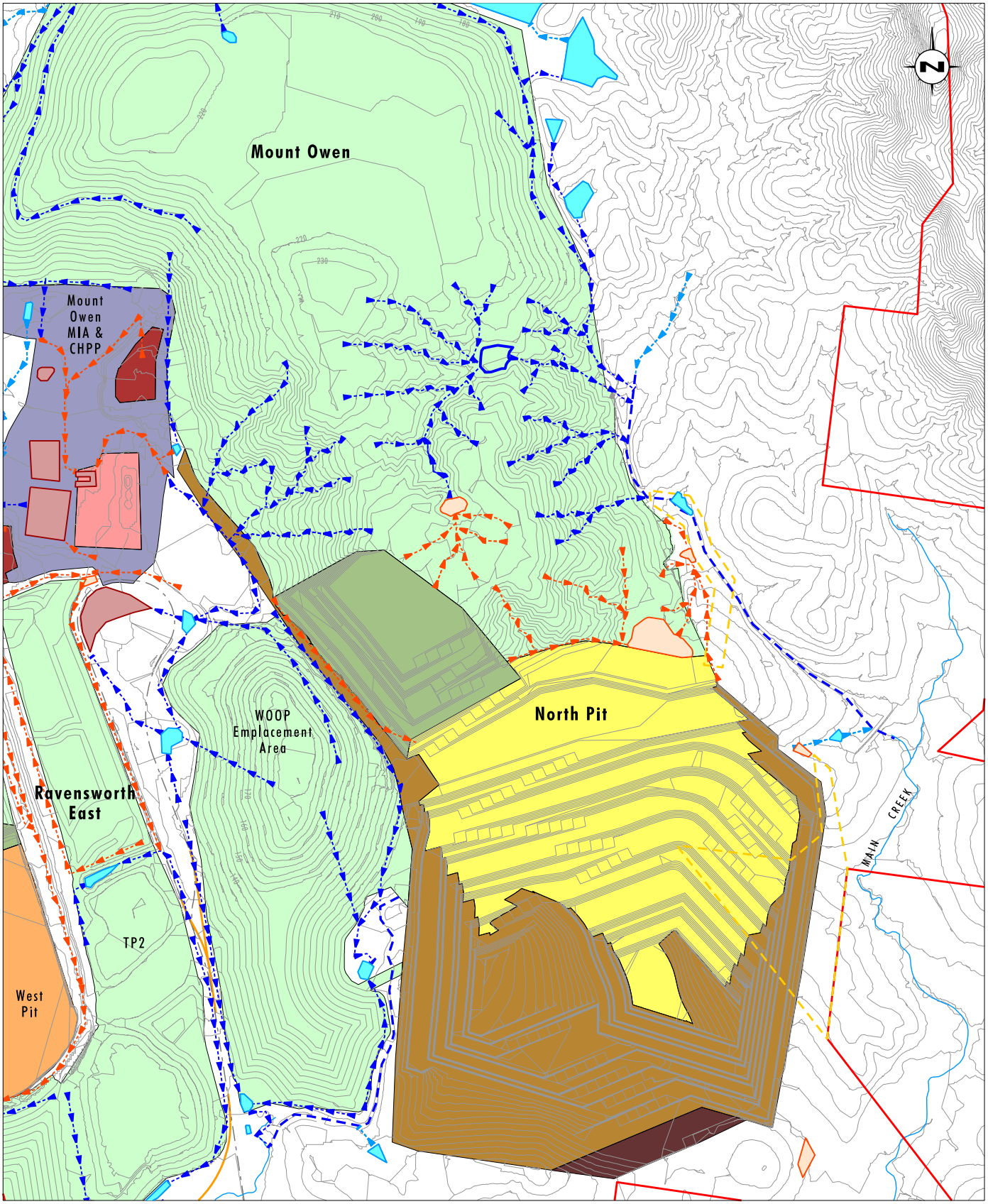
Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Tailings Emplacement
- Topsoil Removal Strip
- Mine Water Dam
- Clean Dam
- Dirty Dam
- Clean Drainage Line
- Dirty Drainage Line
- Natural Drainage Line

FIGURE 6.15

Proposed Conceptual Surface Water Management System Year 8

File Name (A4): R09/3810_211.dgn
20180702 10.23



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

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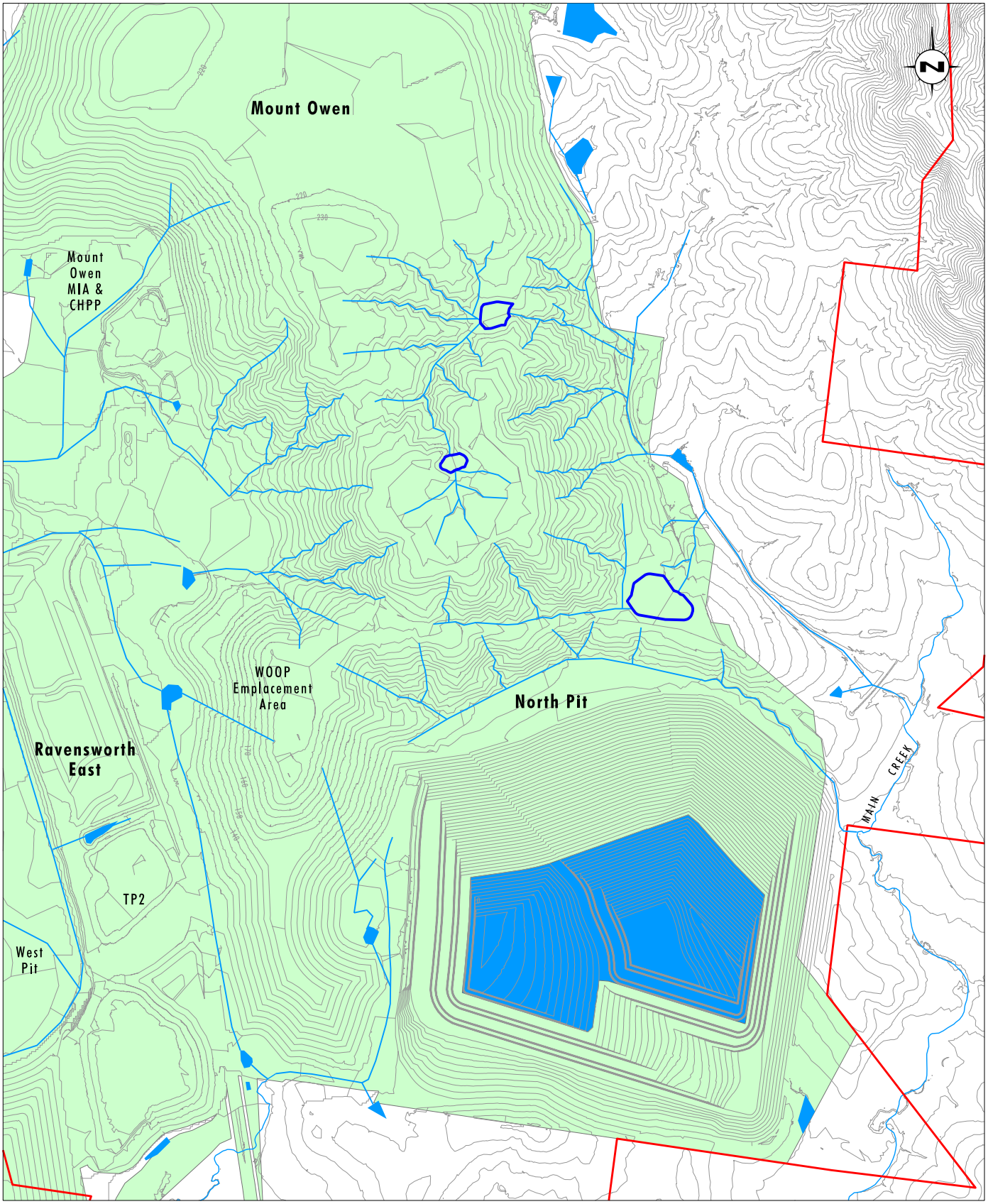
Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Approved Infrastructure
- Existing Bettys Creek Diversion
- Drainage Line
- Active Mining Area
- Active Overburden Emplacement Area
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Infrastructure
- Rehabilitation - Temporary
- Rehabilitation - Complete
- Tailings Emplacement
- Topsoil Removal Strip
- Mine Water Dam
- Clean Dam
- Dirty Dam
- Dryland Attenuation Basin
- Clean Drainage Line
- Dirty Drainage Line
- Natural Drainage Line

FIGURE 6.16

Proposed Conceptual Surface Water Management System Year 15

File Name (A4): R09/3810_212.dgn
20180702 10.24



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

0 0.25 0.5 1.0km
1:25 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Rehabilitation - Complete
- Clean Dam
- Dryland Attenuation Basin
- Drainage Line

FIGURE 6.17

Proposed Conceptual Surface Water Management System Final Landform

File Name (A4): R09/3810_213.dgn
20180702 10.24

6.5.3 Water Balance

The GoldSim site water balance model was updated to simulate the mining and coal handling characteristics associated with the Proposed Modification. The model considers existing and future operations and is used to predict water surplus/deficits and requirements into the future. The Mount Owen Complex water balance model forms part of a water and salt balance model for the GRAWTS.

The predicted water balance for the Approved Operations and the Proposed Modification is provided in detail in the SWIA (refer to **Appendix 10**). In summary, the water balance modelling for the Proposed Modification indicates that the Mount Owen Complex will make water during Year 2. This is primarily a result of increased water recovered from tailings, including tailings from Ravensworth Operations and Liddell Coal Operations being disposed into the West Pit via the GRAWTS. During Years 8 and 15 the modelling indicates a net water loss with a reduction of total water storage on site. This is also a result of tailings from the Mount Owen CHPP being disposed of at Liddell Coal Operations (i.e. 50% during Year 8 and 100% during Year 15) via the GRAWTS.

As discussed in **Section 6.5.2**, export of surplus water from the Mount Owen Complex is provided for via transfers to the GRAWTS. Mount Owen 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 Liddell Coal Operations. The GRAWTS includes a number of large water storages used to manage water. Surplus water transferred from the Mount Owen Complex to the GRAWTS will be stored in these water storages and reused for water supply within the GRAWTS in preference to being discharged. The water balance modelling indicates that the Proposed Modification will have negligible influence on the ability of the GRAWTS to operate and manage potential water discharges via the HRSTS. Additionally there will be no increase in discharges than what is permitted to occur at Ravensworth Operations as a result of the Proposed Modification.

6.5.3.1 Final Void Water Recovery

The results of the final void recovery modelling are summarised in **Table 6.11**, with further detail regarding the water balance modelling provided in **Appendix 10**.

Table 6.11 Approved Operations vs Proposed Modification – Final Void Recovery

Parameter	Approved Operations	Proposed Modification
Water level equilibrium (mAHD)	19	-65
Time to equilibrium water level (years)	500	320
TDS (mg/L)	5,500 at equilibrium	5,200 at equilibrium

The final void recovery analysis indicates that the void will likely reach equilibrium water level after approximately 320 years at approximately -65 mAHD. Equilibrium is predicted to occur earlier than the Approved Operations but to a lower water level due to the increased depth of mining, void catchment area and increased hydraulic gradient into the pit. At this level the void would have a freeboard (i.e. vertical elevation to spill point) of approximately 155 m resulting in there being no risk of potential spill to the environment. The analysis also indicates that the void will have a TDS level of approximately 5,200 mg/L at the time of equilibrium. TDS levels ranging from 1,500 mg/L to 7,000 mg/L are considered to be moderately saline. Further discussion regarding the proposed final landform and options regarding land use is provided in **Sections 5.3** and **6.10**.

6.5.4 Surface Water Impacts

As previously discussed, the Proposed Disturbance Area is located in the catchment areas of Bettys and Main Creeks. A summary of the detailed assessment of the potential surface water impacts is provided in the following sections.

6.5.4.1 Catchment Areas

The estimated changes to the catchment areas from the Approved Operations to the Proposed Modification are included in **Table 6.12**.

Table 6.12 Predicted Catchment Changes

Catchment	Pre-Mining (ha)	Approved Operations Final Landform (ha)	Proposed Modification Final Landform (ha)	% Change, Approved Operations vs Proposed Modification
Bowmans Creek	25,055	20,510	20,500	-0.05
Bettys Creek	1,810	850	840	-1.2
Glennies Creek[1]	51,580	52,110	52,140	0.06
Main Creek	2,000	2,390	2,560	7.1

[1] Glennies Creek pre-mining catchment area sourced from CLWD catchment boundaries used for water licensing

The Proposed Modification final landform will increase the catchment area of Main Creek, compared to the Approved Operations final landform.

The increase in Main Creek catchment area associated with the Proposed Modification relative to the Approved Operations is associated with the return of additional catchment as part of rehabilitation of the overburden emplacement areas. The majority of the rehabilitated landform runoff that flows into Main Creek will enter via the existing Upper Bettys Creek Diversion and as such flows will be managed by the existing detention system in place along this diversion (refer to **Figure 6.13**). Local catchment areas in the middle reaches of Main Creek (i.e. downstream of the Upper Bettys Creek Diversion) will be reduced as a result of the associated increased area of the North Pit final void catchment associated with the Proposed Modification.

The Proposed Modification has a minor impact on the catchment area of Bettys Creek, with a reduction of approximately 10 ha, i.e. ~1%.

6.5.4.2 Flooding and Watercourse Stability

Yorks Creek

As discussed in **Section 2.0**, Mount Owen committed to providing additional off-line detention capacity at the Ravensworth East MIA and the implementation of flow conveyance at Hebden Road, in order to address potential flooding issues in Yorks Creek in the vicinity of Hebden Road as part of the Continued Operations Project. Mount Owen now proposes an alternate design through the refinements to the function of Dams 5 and 6 located on the northern side of the North Pit emplacement area to provide flood attenuation.

The proposed flood mitigation works consist of:

- Dam 5 Spillway Culvert - Conversion of the top 63 ML of dam storage into detention attenuation volume through modification of the existing outlet structure, and
- Dam 6 Spillway Culvert - Conversion of the top 84.5 ML of dam storage into detention attenuation volume through modification of the existing outlet structure.

As discussed in **Appendix 10**, the potential impacts of flooding and watercourse stability applicable to the proposed flood mitigation works were assessed by WSP Parsons Brinckerhoff (2017) using a hydrologic model (XP-RAFTS) and a hydraulic model (HEC-RAS) to represent the catchment areas and creek system.

The modelling results are presented in **Appendix 10** and summarised below:

Dam 5 and 6

- The proposed flood mitigation measures result in minor increases in peak dam levels during the modelled storm events, as well as limiting peak dam outflows to only have minor increases compared to the Approved Operations final landform scenario.
- The proposed flood mitigation measures delay the peak flows from the dams relative to the upstream catchment flows, helping to mitigate peak flow convergence downstream.

Hebden Road

- Negligible increases in peak flows, depths, velocity and time of high hazard conditions for vehicles over Hebden Road for the proposed flood mitigation measures relative to the Approved Operations.

Main Creek

The Proposed Modification has the potential to influence flooding and watercourse stability in Main Creek as a result of catchment changes associated with the Proposed Modification.

The potential impacts on flooding and watercourse stability were assessed using a one dimensional (1D) hydrodynamic model of Main Creek. The model utilises the XP-Storm modelling platform, and OEH confirmed that using an approach that is consistent with the previous flood modelling assessment for the Approved Operations was appropriate for the Proposed Modification.

The modelling results indicate that with the low predicted velocities for flows (as the flows are out of bank), combined with the overall modelled decrease in maximum flood depth and duration in relation to the Approved Operations final landform, the Proposed Modification final landform is not considered to have a significant impact on the Main Creek floodplain, and will not adversely impact any private landholders in the catchment.

The analysis indicates that it is unlikely that the Proposed Modification will result in an overall increase in erosion or scouring of Main Creek. Mount Owen proposes to continue to monitor Main Creek for potential impacts associated with the mining operations, including watercourse stability, as per the existing Surface Water Management and Monitoring Plan (refer to **Section 6.5.7**).

6.5.4.3 Water Quality

The Mount Owen Complex WMS is designed to enable Mount Owen to manage and operate the Approved Operations to meet licence conditions within 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. Consistent with the Approved Operations, no discharges will occur from the Mount Owen Complex as a result of the Proposed Modification with any surplus water transferred via the GRAWTS.

The Proposed Modification final landform has been designed to minimise the catchment contributing to the North Pit final void. As discussed in **Section 6.5.3.1**, the water balance for the final void indicates that, at the predicted recovery rates, the equilibrium water levels within the North Pit final void occur within 320 years at approximately -65 mAHD with a TDS level of 5200 mg/L. As such it is predicted that the final void will remain a self-contained system with a predicted freeboard of 155 m with no surface overflows predicted to downstream watercourses.

Should the Proposed Modification be approved, Mount Owen will update the existing Mount Owen Complex WMP to reflect the changes to water management associated with the Proposed Modification and additional water quality monitoring provisions as outlined in **Section 6.5.6**.

6.5.4.4 Geomorphological and Hydrological Values

The Proposed Modification is not expected to have a significant impact on the geomorphological and hydrological values of local surface water systems. Potential impacts on geomorphological stability and changes to potential erodibility and scour as a result of the Proposed Modification have been assessed and indicate that there is negligible risk of increased erosion or scour.

The proposed flood mitigation measures in the Yorks Creek catchment have been assessed to be consistent with the currently approved flood mitigation works. The proposed flood mitigation measures will continue to maintain peak velocities to be non-scouring (i.e. maximum modelled velocities of 1.7 m/s). It is considered that scour potential along Yorks Creek will not increase as a result of the Proposed Modification relative to the Approved Operations final landform due to the proposed flood mitigation measures.

The Proposed Modification will result in lower peak flows with reduced flood levels and reduced flood duration in the lower reaches of Main Creek compared to the current Approved Operations final landform. Peak velocities of flow during flood events will remain consistent with the Approved Operations final landform. It is considered that scour potential along Main Creek will not be increased as a result of the Proposed Modification.

6.5.4.5 Riparian and Ecological Values

The predicted changes to flow regimes both during and post mining operations associated with the Proposed Modification are predicted to be negligible in the context of ephemeral streams. The changes to flow regimes are also considered to be negligible on a regional scale and likely to have negligible impact on ecosystems and downstream users as the predicted impact is within the natural variation of the existing creek systems.

It is considered that there will be negligible changes to flow regimes with the proposed changes to the WMS to provide flood mitigation works on Yorks Creek.

6.5.4.6 Water Users

There are no known licensed water users downstream of the Proposed Disturbance Area on Main Creek. There is one private landholder downstream of the Proposed Disturbance Area on Main Creek that retains basic landholder rights for domestic and stock use.

The Proposed Modification will not reduce annual flow volumes in Main Creek relative to the Approved Operations landform conditions during operations and will result in only a minor reduction as a result of the proposed final landform. As such, basic landholder rights on Main Creek and Glennies Creek during operations will not be affected as a result of the Proposed Modification. The proposed changes to the WMS to provide flood mitigation on Yorks Creek will have negligible impact on downstream water users.

6.5.4.7 Cumulative Impacts

The Mount Owen Complex is the only surface mining operation located within the Main Creek catchment. Further downstream, Rix's Creek North and Ashton Coal Mine operate within the Glennies Creek catchment. Recent assessment work undertaken by Hansen Bailey (2017) indicated that the Integra Underground Mine could result in some temporary changes to geomorphology and condition of the creeks to be undermined. However, Hansen Bailey (2017) concluded that the Integra Underground Mine was unlikely to generate additional cumulative impacts due to the minor influence of subsidence on surface drainage at a catchment scale.

As discussed in preceding sections the surface water assessment indicates that the Proposed Modification is expected to have negligible additional impact on flow, water quality and water users relative to the Approved Operations downstream, on Main Creek, Glennies Creek, and on the Hunter River.

Therefore it is considered that the Proposed Modification will have negligible cumulative impacts on flows in downstream watercourses, water quality and downstream users relative to the Approved Operations.

Further details on cumulative impact are provided in the SWIA in **Appendix 10**.

6.5.5 Management, Monitoring, Licensing and Reporting

A summary of the proposed management, monitoring, mitigation and licence requirements associated with the Proposed Modification is provided in the following section.

6.5.6 Summary of Proposed Mitigation Measures

The Proposed Modification includes works to the existing approved WMS and the construction of a small height flood levee to protect the North Pit void from inundation during extreme flood events (refer to **Appendix 10**). During operations, additional WMS components will be constructed as work progresses. The operational phase will involve the ongoing management of the WMS. Erosion and sediment control measures are proposed to minimise potential water quality impacts associated with disturbance.

The Mount Owen Complex Erosion and Sediment Control Plan (ESCP) provides a framework for the management of erosion and sedimentation at the Mount Owen Complex. The objective of the ESCP is to ensure that appropriate structures and programs of work are in place to:

- identify activities that could cause erosion and generate sediment
- describe the location, function and capacity of erosion and sediment control structures required to minimise soil erosion and the potential for transport of sediment downstream
- ensure erosion and sediment control structures are appropriately maintained
- fulfil the statutory conditions of the project approval.

Erosion and sediment control will continue to be undertaken in accordance with the ESCP and should the Proposed Modification be approved the ESCP will be updated to include the relevant aspects of the Proposed Modification.

6.5.6.1 Water Management Plan and Monitoring

The existing Mount Owen Complex WMP (and sub plans) (October 2017) was updated to include the requirements of the Approved Operations and more recently in relation to Modification 1. The Mount Owen Complex WMP includes specific monitoring for:

- erosion and sediment control measures
- water balance monitoring
- watercourse stability monitoring and management
- surface water quality monitoring
- flow monitoring

- contingency measures
- decommissioning of the WMS.

Should the Proposed Modification be approved, the Mount Owen Complex WMP and associated sub plans will be updated to include the changes to the WMS and water balance associated with the Proposed Modification.

There are currently three water quality monitoring locations on Main Creek, with one location upstream of the Approved Operations, one mid-stream and the third downstream of both the Approved Operations and the Proposed Disturbance Area. Water quality will continue to be monitored at these locations consistent with the Approved Operations.

Watercourse monitoring will continue which includes monitoring of the Upper Bettys Creek Diversion and Main Creek on an annual basis for watercourse stability and stream health. The updated Mount Owen Surface Water Management and Monitoring Plan (SWMMP) will also include water quality monitoring provisions to monitor for ARD effects, in accordance with the recommendations from the Geochemisty Assessment (refer to **Appendix 11**) .

6.5.6.2 Reporting

Surface water monitoring results will continue to be provided as part of the Annual Review, consistent with the Approved Operations.

6.5.6.3 Licensing Requirements

The objective of licensing under the WM Act is to provide for the sustainable and integrated management of the water sources of NSW for the benefit of both present and future generations based on the concept of ecologically sustainable development. The WM Act defines water access and water sharing strategies within NSW.

As discussed in **Section 6.5.1,** the Hunter Unregulated WSP applies to watercourses and alluvial groundwater in the vicinity of the Approved Operations. The catchment of Bettys Creek is located within the Jerrys Water Source and the catchment of Main Creek is located within the Glennies Water Source. Water extraction from Glennies Creek alluvium is managed under the Hunter Unregulated WSP within the Hunter Regulated River Alluvial Water Source. Surface Water extracted from Glennies Creek is managed within the Hunter Regulated River WSP (refer to **Figure 6.12**).

Table 6.13 summaries the number of WALs and licence shares available for each water source relevant to the Proposed Modification.

Table 6.13 WAL and Licence Shares available under the Hunter Unregulated WSP

Water source	Aquifer access licence units		Unregulated river surface water units	
	No. of WALs	Total units	No. of WALs	Total units
Hunter Unregulated WSP				
Jerrys	10	1,246	19	2,097
Glennies	2	10	12	446
Hunter Regulated River Alluvial	221	24,108	n/a	n/a

The objectives of the Hunter Unregulated WSP are to:

- protect the important water dependent environmental, Aboriginal, cultural and heritage values
- protect basic landholder rights
- manage the river and alluvial groundwater to ensure equitable sharing between users
- provide opportunities for market-based trading of licences and water allocations
- provide flexibility for licence users in how they can use their water
- allow for adaptive management, that is, to allow changes to be made when more information is available.

The objectives of the Hunter Regulated River WSP seek to provide:

- the health and enhancement of this water source and its water-dependent ecosystems, and
- the productive and economically efficient use of water resources, and
- the social and cultural benefits to urban and rural communities that result from the sustainable and efficient use of water.

Consistent with the broad objectives of these WSPs, the Proposed Modification has:

- Negligible impact on GDEs in Main Creek, protecting the health and enhancement of the water source and the water dependent ecosystems
- Negligible loss of catchment or flows to downstream catchments
- No licensed bores in the downstream section of Main Creek. All licensed bores in the Glennies Water Source are upstream and are not affected by the Proposed Modification
- Modelled take from Main Creek alluvium short to medium term (during operations) is negligible. Predicted impacts on the Main Creek alluvium system post closure are also considered negligible in a broader catchment context and any requirement to hold licenses for this future take now would affect the productive and economic use of the water source in the immediate future.

A detailed review of the catchment changes associated with the Approved Operations and Proposed Modification final landform on estimated water take and licensing requirements has been undertaken to determine the licensing requirements for the Proposed Modification both during and post mining. The results of this review are presented in this section.

During Operations

During operations the Proposed Modification will not increase the capture of runoff take from clean catchment areas and runoff from mine water catchments will continue to be contained within the WMS to meet the requirements of the Mount Owen EPL. Additionally no harvesting dams are proposed as part of the Proposed Modification.

Based on 100% capture of runoff at the regional runoff rates of 0.7ML/ha/yr (www.farmdamscalculator.dnr.nsw.gov.au) cleanwater areas captured in the WMS total a maximumof 72 ha (Umwelt, 2016) which translates to approximately 50 ML/yr. Based on Mount Owen landholdings of approximately 5670 ha, Mount Owen has a Harvestable Rights provision of approximately 397 ML/yr (i.e. 5670 ha x 0.7 ML/ha/yr x 10% Harvestable Rights provision). As such, the capture of clean water runoff will not be modified by the Proposed Modification and is within the Harvestable Rights provisions of Mount Owen.

Approximately 192.5 ML of the 200 ML unit licence currently held by Mount Owen in the Jerrys Water Source is associated with evaporative losses from the existing diversion dams located to the north of the Mount Owen Complex. The proposed works to the WMS in relation to Dams 5 and 6 are expected to have negligible impact on the licensed water take (as these are on 3rd order or above watercourses) associated with evaporation losses in these dams.

As discussed in **Section 6.4.7**, during operations the predicted peak groundwater volume intercepted from the Glennies Water Source peaks at 3 ML/year in Year 12, which is equivalent to 0.1 L/sec. The predicted peak groundwater volume intercepted from the Proposed Modification only, peaks at just 1 ML/year in Year 18. This is significantly lower than the predicted take of 15 ML/year for the Continued Operations Project and the predicted change in flow due to both the Approved Operations and the Proposed Modification is distributed across a wide area which is considered to be undetectable and unmeasurable within the groundwater regime.

Current licence allocation held by Mount Owen under the Hunter Regulated WSP are sufficient to meet the water requirements for the Mount Owen Complex during operations.

Final Landform

Mount Owen hold sufficient WALs to licence the predicted take under the Hunter Regulated WSP, within the Glennies Creek Management Zone 3A of approximately 13ML/yr of surface water (refer to **Table 6.7**).

Table 6.14 provides a summary of the post-mining licencing requirements associated with the Proposed Modification with a comparison to the Approved Operations for the Hunter Unregulated and Alluvial Water Sources WSP.

Table 6.14 Licencing Summary – Post Mining Take

	Licences Held (units)	Surface Water (ML/yr)	Baseflow (ML/yr)	Alluvial (ML/yr)	Evaporative Losses (ML/yr)	Maximum Licensable Water Take	Net
Jerrys Water Source							
Approved Operations	200	100	-	7	192.5	299.5	-99.5
Proposed Modification	200	89.1	1	4	192.5	286.6	-86.6
Glennies Water Source							
Approved Operations	0	64	-	15	0	79	-79
Proposed Modification	17	18.9	8	27	0	53.9	-36.9

The post mining licencing assessment indicates:

- Estimated shortfall of 86.6 ML/yr water take from the Jerrys Water Source for the Proposed Modification conceptual final landform.
- Estimated shortfall of 36.9 ML/yr water take from the Glennies Water Source for the Proposed Modification conceptual final landform. It is important to note that this represents a decrease in water take compared to the Approved final landform estimated net water take of 64.1 ML/yr).

The current volume of entitlement available (2,097 unregulated river and 1,246 aquifer units) and the nature of land use within the Jerrys Water Source indicates allocation to account for the predicted take attributable to the Proposed Modification would be readily available. However, the Glennies Water Source is more constrained with limited aquifer units available (currently 446 unregulated river and 10 aquifer units) (**Table 6.13**).

For the Jerrys Water Source the maximum predicted licensable water take is approximately 286.6 ML/yr. Mount Owen currently holds 200 ML of licences in Jerrys Water Source and there is more than sufficient available entitlements on the market for Mount Owen to acquire the additional water allocation required. With regards to take in Glennies Water Source, a maximum long term licensable water take of approximately 53.9 ML/yr is required of which Mount Owen currently holds 17 ML in Glennies Water Source.

Consistent with the licencing strategy accepted for the Continued Operations Project, the licencing requirements for the Proposed Modification will be met through the diversion of catchment areas or through purchasing the appropriate WALs, or a combination of these approaches.

The analysis for the Glennies Water Source indicates that the runoff from an area of rehabilitated mine catchment that is currently proposed to drain to the Yorks Creek catchment (Jerrys Water Source) could be directed to drain to Main Creek (Glennies Water Source). Approximately 53 ha of transfer to Main Creek catchment is required to offset the net predicted take of 36.9 ML/yr. This will increase the estimated net water take from the Jerrys Water Source from 86.6 ML/yr by 36.9 ML/yr to 123.5 ML/yr. That is, under this scenario additional WALs would need to be sourced in the Jerrys Water Source to provide a total of 123.5 ML/yr, to generate a net neutral estimated water take. As previously discussed, the Jerrys Water Source allocation is likely to be readily sourced given the volume of entitlement available.

The predicted water take associated with the Proposed Modification are less than the predictions associated with the Continued Operations Project as refinement of groundwater and water balance modelling and the utilisation of extensive monitoring data collected over time has allowed for further review and refinement of the predicted water take associated with the Approved Operations. It is proposed that continued monitoring and modelling verification will occur in accordance with consent condition Schedule 3, Condition 26 of SSD-5850, in order to refine the water take predictions such that Mount Owen has all necessary post-mining licences for the Proposed Modification in accordance with consent condition Schedule 3, Condition 21 of SSD-5850.

6.6 Ecology

The Biodiversity Assessment Report (BAR) was prepared by Umwelt, and is attached as **Appendix 13**. As detailed in **Section 2.3.2**, the Proposed Disturbance Area consists of areas that have been previously disturbed for agricultural land uses, including an olive plantation, with all of the vegetation consisting of regrowth over the past 30 years. The majority of the Proposed Disturbance Area comprises disturbed and low quality vegetation in the form of derived native grasslands. The derived native grasslands represent lower quality habitat for a range of threatened species. Native forest, woodland and plantation areas comprise less than 20% of the Proposed Disturbance Area.

In addition, the areas surrounding the Proposed Modification have been subject to extensive disturbance associated with agriculture and the development of coal mining. Furthermore, the design of the Proposed Modification has avoided impacts on key biodiversity features of the surrounding area including Ravensworth State Forest, existing Biodiversity Offset Areas and identified regional habitat movement corridors (refer to **Section 2.0**).

The BC Act was implemented on 25 August 2017, repealing the TSC Act. Under the savings and transitional arrangements, where Proposed Modifications are identified as being a pending or interim planning application (in accordance with Clause 27 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (BC Regulation)), Part 7 of the BC Act doesn't apply and the former planning provisions still apply. Specifically, Clause 27(1) (g) defines a pending or interim planning application as:

in the case of development for the purposes of mining—an application for development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (or for the modification of such a development consent) made within 2 years after the commencement of the new Act if the Secretary of the Department of Planning and Environment determines in writing (within 3 months after the commencement of the new Act) that the proponent had submitted before that commencement the conceptual project development plan for the mining project that is required by departmental policy before an application for development consent is made.

Initial ecological survey and preliminary assessment for the Proposed Modification commenced in July 2016. Subsequently, Mount Owen completed the Conceptual Project Development Plan briefing in respect of the Proposed Modification with DRG in May 2017, prior to the commencement of the BC Act on 25 August 2017. This was confirmed by the Deputy Secretary under delegation from the Minister in November 2017 (refer to **Appendix 6**). Accordingly, pursuant to Clause 27(1) (g) of the BC Regulation, the Proposed Modification is considered a pending or interim planning application.

As such, the BAR to support the Proposed Modification has been prepared in accordance with the FBA and the NSW Biodiversity Offsets Policy for Major Projects (Offset Policy) given that Part 7 of the BC Act does not apply. It is noted that this methodology differs from the Approved Operations, as the biodiversity offset strategy was determined under the relevant policies (NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, SSD and SSI (OEH 2011) and OEH Guideline Principles for the use of Biodiversity Offsets in NSW (DECC 2008)), in place prior to the FBA and Offset Policy.

As detailed in **Section 2.0**, the Proposed Modification will not have any impact on the approved Biodiversity Offset Strategy, which will continue to be implemented by Mount Owen in accordance with the requirements of SSD-5850.

The BAR has focussed on the Proposed Disturbance Area which represents all areas of potential disturbance associated with the Proposed Modification outside of the existing disturbance area for the Approved Operations. The Proposed Disturbance Area includes all areas of additional open cut mining and surface infrastructure, and the BAR assumes that there will be complete disturbance within this area.

6.6.1 Local and Regional Ecological Context

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 Approved Operations, 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 (and adjoining Biodiversity Offset Areas) which represents a significant link and refuge area between remnant patches of vegetation in the central Hunter Valley.

The vegetated areas include Ravensworth State Forest; the existing Mount Owen Biodiversity Offset Areas, and other native woodland and forest vegetation that are connected to these conservation areas. The remnant vegetation provides an important habitat 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 Proposed Disturbance Area.

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 (Umwelt 2014). The majority of the extant woodland located within the Proposed Disturbance Area is 'regrowth' or logged vegetation (has been previously cleared and its present extent is based entirely on natural regeneration or on targeted planting of canopy species). However, the majority of the Proposed Disturbance Area comprises disturbed and low quality vegetation in the form of derived native grasslands. The derived native grasslands represent lower quality habitat for a range of threatened species. Native forest, woodland and plantation areas comprise less than 20% of the Proposed Disturbance Area.

Riparian vegetation associated with Main Creek represents the oldest vegetation in the immediate area located adjacent to the Proposed Disturbance Area, generally pre-dating aerial photos from 1958 (Umwelt 2014). The Proposed Disturbance Area has been designed to avoid disturbance to the existing riparian vegetation as far as practicable (based on the set back to Main Creek >160 m).

6.6.2 Methodology

6.6.2.1 Native Vegetation Assessment

Extensive floristic survey effort has been undertaken in the Mount Owen Complex within and adjacent to the Proposed Disturbance Area over more than 20 years, resulting in a detailed understanding of the biodiversity occurring in the surrounding area. Most recently, survey effort for the Continued Operations Project included flora surveys in spring 2011, spring 2012 and in multiple seasons in 2014. Survey methods included vegetation survey plots, BioBanking plots, meandering transects, rapid assessment points and field reconnaissance to identify spatial arrangement of vegetation across the Approved Disturbance Area. Additional floristic surveys were undertaken for the Greater Ravensworth Upper Hunter Strategic Assessment (UHSA) in March and April 2014 and focused on assigning vegetation mapping to biometric vegetation types (BVTs) as per the Vegetation Information System (VIS) database. Seasonal targeted surveys were also undertaken in accordance with the requirements of the FBA throughout 2016 and 2017 for the Proposed Modification.

Vegetation mapping was undertaken as part of the BAR using best-practice techniques to delineate vegetation communities across the Proposed Disturbance Area. Vegetation mapping included:

- preliminary review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- predicting the distribution of particular vegetation communities based on understanding the distribution of BVTs (OEH 2017) and plant communities as described by the Greater Hunter Native Vegetation Mapping Project (Sivertsen et al 2011)
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data, and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata in accordance with relevant guidelines.

6.6.2.2 Threatened Species

Threatened species survey design was informed by a review of previous documents and reports relevant to the Proposed Modification including ecological reports, previous ecological surveys undertaken in the vicinity of the Proposed Disturbance Area and relevant ecological database searches. Similar to the floristic survey effort at the Mount Owen Complex, extensive fauna survey has been undertaken within and adjacent to the Proposed Disturbance Area over more than 20 years, resulting in a detailed understanding of the fauna species occurring in the surrounding area.

A preliminary assessment using the Threatened Species Profile Database (TSPD) was undertaken which provided a list of species-credit species that might require survey and the suitable survey periods for each species. The results of these database searches, literature review and TSPD review were used to design the survey requirements for species-credit species so that adequate surveys were undertaken as part of the FBA.

Species-credit Flora Surveys

Targeted flora surveys and transects for cryptic and seasonal species-credit flora species were undertaken within the Proposed Disturbance Area (refer to **Figure 6.18**) over the following survey periods:

- 26 to 30 September 2016
- 28 February to 2 March 2017
- 7 to 9 March 2017
- 9 to 12 October 2017
- 4 December 2017.

Opportunistic species-credit flora species searches were also undertaken during all other (i.e. fauna) surveys periods, including:

- 27 to 29 July 2016
- 3 to 6 April 2017
- 11 to 13 July 2017.

Species-credit Fauna Surveys

Targeted surveys of seasonal species-credit fauna species were undertaken over the following survey periods (refer to **Figure 6.19**), being:

- 27 to 29 July 2016
- 26 to 30 September 2016
- 28 February to 2 March 2017
- 7 to 9 March 2017
- 3 to 6 April 2017
- 11 to 13 July 2017
- 9 to 12 October 2017.

6.6.3 Results

6.6.3.1 Biometric Vegetation Types and Vegetation Zones

Surveys of the Proposed Disturbance Area identified three Plant Community Types (PCTs) being:

- HU815 Spotted Gum – Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter
- HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley – Moderate to Good Condition, and
- HU945 – Swamp Oak – Weeping Grass Grassy Riparian Forest of the Hunter Valley.

The PCTs were then categorised into six vegetation zones based on assessment of condition (refer to **Figure 6.20**). **Table 6.15** below details the current site value scores for each of the vegetation zones in the Proposed Disturbance Area. The raw site condition attribute data for each of the vegetation zones is provided in **Appendix 13**.

Table 6.15 Vegetation Zone Site Value Scores

Veg Zone	PCT Name	Current Site Value Score
1	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - *Moderate to Good*	75.17
2	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - *Moderate to Good - Plantation*	49.48
3	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - *Moderate to Good - Derived Native Grassland*	19.27
4	PCT1601/HU815 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - *Moderate to Good - Derived Native Grassland Olive Plantation*	8.33
5	PCT1692/HU906 Bull Oak Grassy Woodland of the Central Hunter Valley - *Moderate to Good*	53.47
6	PCT1731/HU945 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - *Moderate to Good*	71.78

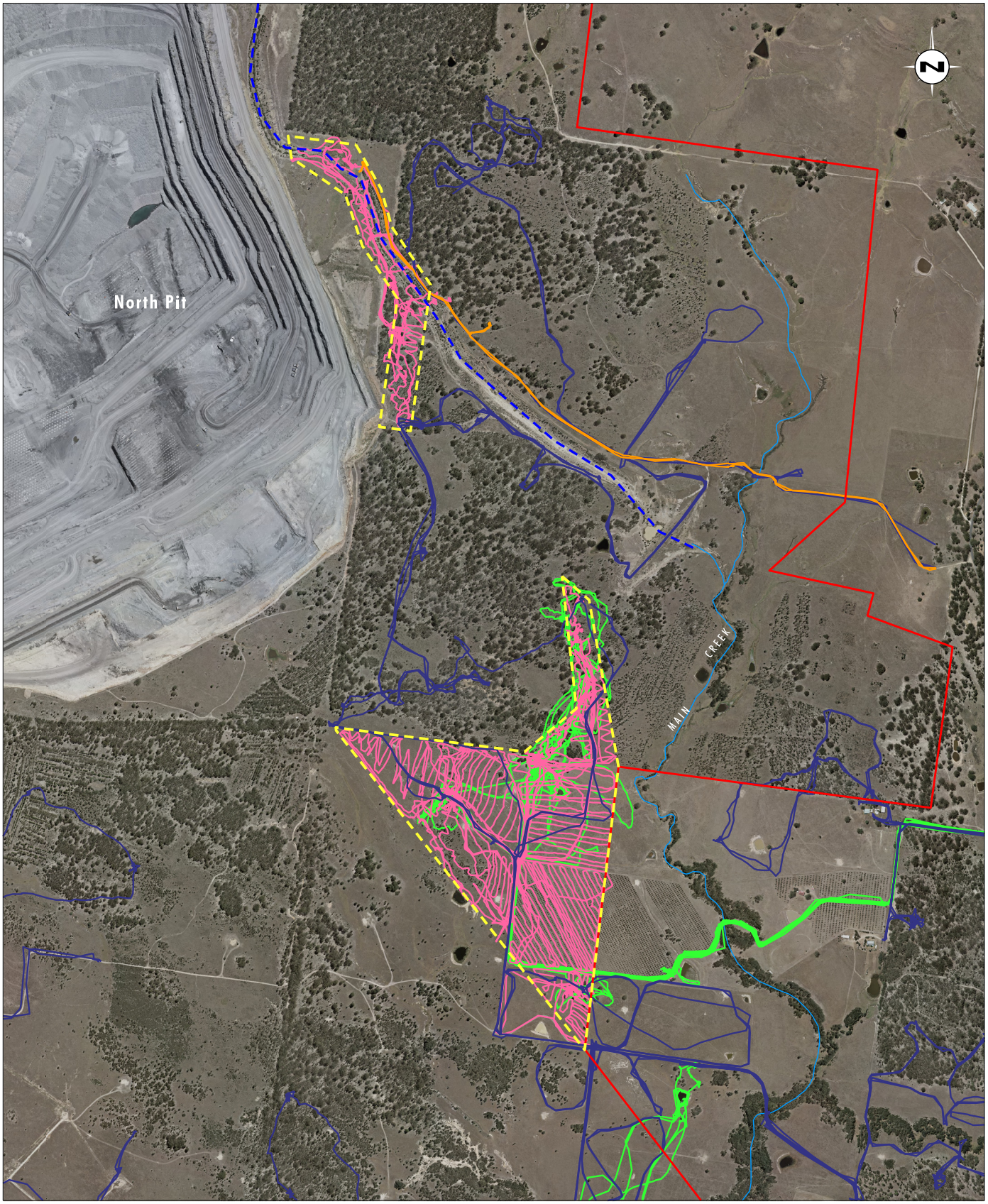


Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Targeted Species-credit Flora Transect (Dec 2017)
- Targeted Species-credit Flora Transect (Oct 2017)
- Targeted Species-credit Flora Transect (Feb - Mar 2017)
- Targeted Species-credit Flora Transect (Sep 2016)
- Existing Bettys Creek Diversion
- Drainage Line

FIGURE 6.18

Targeted Species-credit Flora Transect Locations

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20180702 10.28

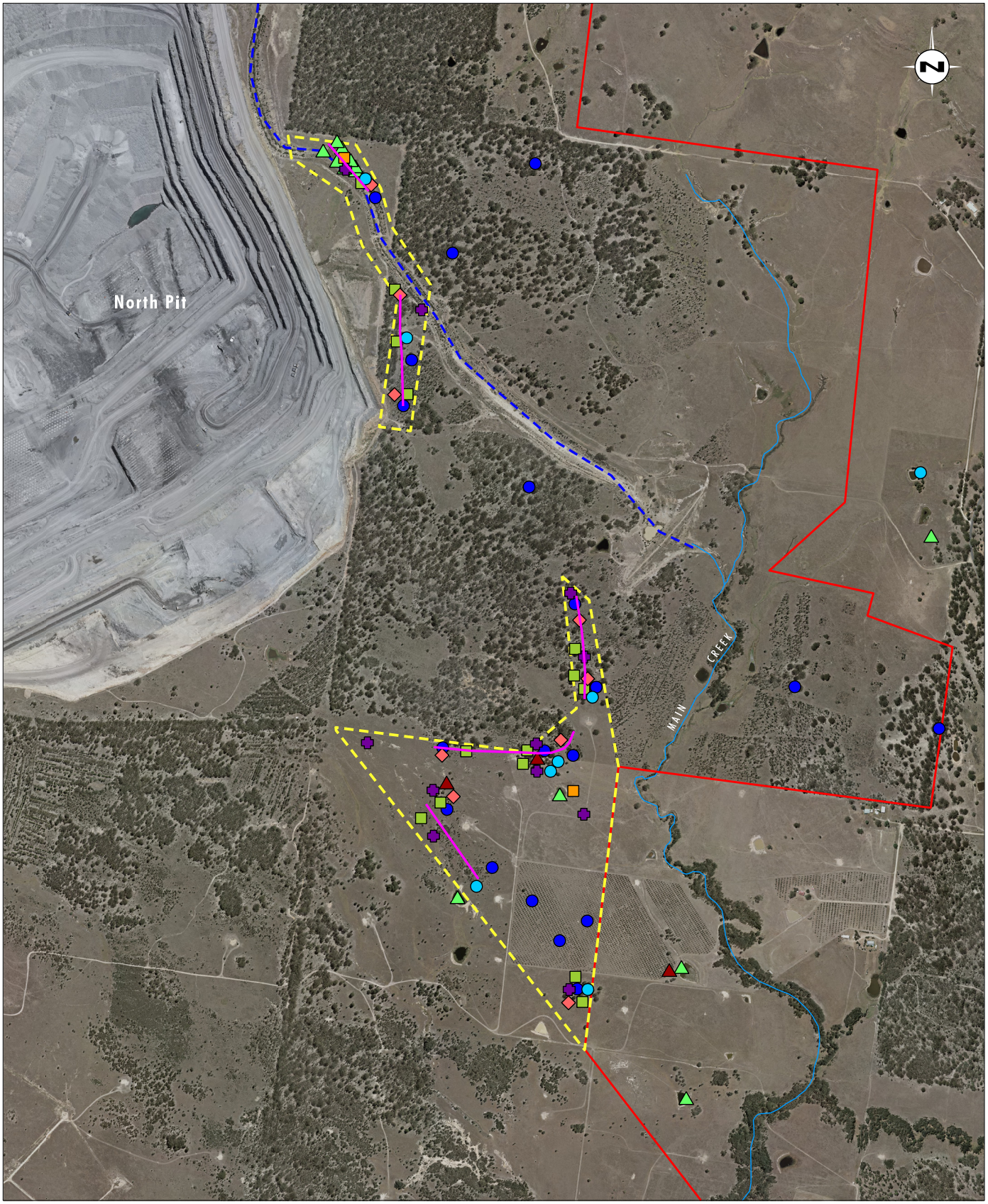

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line

Proposed Modification Surveys (2016-2017):

- Anabat Survey
- Green and Golden Bell Frog Survey
- Hollow Inspection Survey
- Koala SAT Survey
- Remote Camera
- Herpetological Search
- Winter Bird Survey
- Spotlight Surveys
- Green-thighed Frog Survey

FIGURE 6.19

Targeted Species-credit Fauna Survey Effort

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20180702 10.29

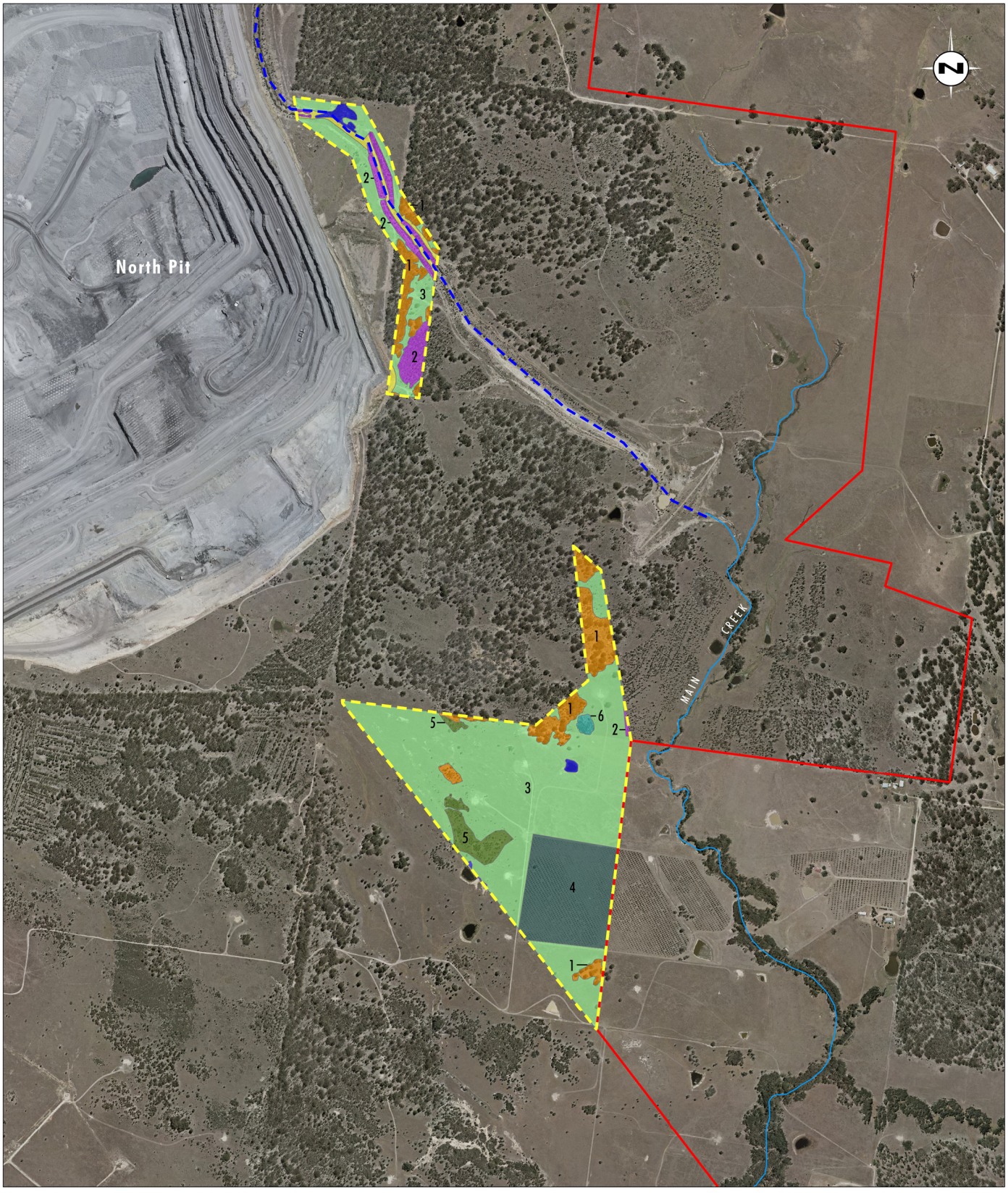

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018)

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line

Vegetation Communites:

- Zone 1 - HU815/PCT1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter - Moderate to Good
- Zone 2 - HU815/PCT1601 - Moderate to Good - Plantation
- Zone 3 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland
- Zone 4 - HU815/PCT1601 - Moderate to Good - Derived Native Grassland - Olive Plantation
- Zone 5 - HU906/PCT1692 Bull Oak grassy woodland of the central Hunter Valley - Moderate to Good
- Zone 6 - HU945/PCT1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley - Moderate to Good
- Dam
- Disturbed Land

FIGURE 6.20

Vegetation Zones in the Proposed Disturbance Area

File Name (A4): R09/3810_198.dgn
20180702 10.29

6.6.3.2 Threatened Ecological Communities

One threatened ecological community was recorded in the Proposed Disturbance Area (refer to **Figure 6.21**), being:

- Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Communities (EEC) listed under the BC Act.

The following threatened ecological communities had the potential to occur in the Proposed Disturbance Area, however were ruled out based on a lack of diagnostic features and conformance to descriptions outlined in NSW Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee guidelines for interpreting listings for species, populations and ecological communities under the BC Act and EPBC Act:

- Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions EEC listed under the BC Act
- Central Hunter Valley Eucalypt Forest and Woodland Critically Endangered Ecological Community (CEEC) listed under the EPBC Act.

6.6.3.3 Ecosystem-credit Species

Four ecosystem-credit species were recorded in the Proposed Disturbance Area during survey (refer to **Figure 6.22**). These include:

- grey-crowned babbler (Pomatostomus temporalis temporalis)
- squirrel glider (Petaurus norfolcensis)
- east coast freetail bat (Mormopterus norfolkensis) – foraging habitat only
- eastern bentwing-bat (Miniopterus schreibersii oceanensis) – foraging habitat only.

A full fauna species list from the surveys undertaken is included in **Appendix 13**.

6.6.3.4 Species-credit Species

The following species-credit species were predicted to occur by the BioBanking Credit Calculator (BBCC) or identified from database searches/literature reviews and considered to occur in the Proposed Disturbance Area:

- Austral toadflax (*Thesium austral*)
- netted bottle brush (*Callistemon linearifolius*)
- Illawarra greenhood (*Pterostylis gibbosa*)
- *Ozothamnus tesselatus*
- pine donkey orchid (*Diuris tricolor*)
- *Pterostylis chaetophora*
- scant pomaderris (*Pomaderris queenslandica*)
- Singleton mint bush (*Prostanthera cineolifera*)

- slaty red gum (*Eucalyptus glaucina*)
- small snake orchid (*Diuris pedunculata*)
- small-flower grevillea (*Grevillea parviflora subsp. parviflora*)
- tall knotweed (*Persicaria elatior*)
- Weeping Myall population in the Hunter catchment
- white-flowered wax plant (*Cynanchum elegans*)
- Cymbidium canaliculatum population in the Hunter Catchment
- Eucalyptus camaldulensis population in the Hunter catchment
- *Prasophyllum sp. Wybong*
- brush-tailed phascogale (*Phascogale tapoatafa*)
- eastern pygmy-possum (*Cercartetus nanus*)
- green and golden bell frog (*Litoria aurea*)
- green-thighed frog (*Litoria brevipalmata*)
- Koala (*Phascolarctos cinereus*)
- pale-headed snake (*Hoplocephalus bitorquatus*)
- regent honeyeater (*Anthochaera Phrygia*)
- southern myotis (*Myotis macropus*)

From the list of species predicted to occur within the Proposed Disturbance Area only the brush-tailed phascogale was recorded. This species was recorded on remote cameras within the woodland habitats of the Proposed Disturbance Area (refer to **Figure 6.23**). This species was also recorded during the surveys undertaken for the UHSA, through the use of remote cameras west of the Mount Owen Mine near Hebden Road and Lake Liddell. The species has also been previously recorded in Ravensworth State Forest (Forest Fauna Surveys 2017).

It is likely that all of the eucalypt woodland and forest communities in the Proposed Disturbance Area provide suitable habitat for the brush-tailed phascogale. Species credits have been generated for the brush-tailed phascogale in relation to 8.8 ha of suitable eucalypt woodland and forest habitat within the Proposed Disturbance Area, as detailed in **Appendix 13**.

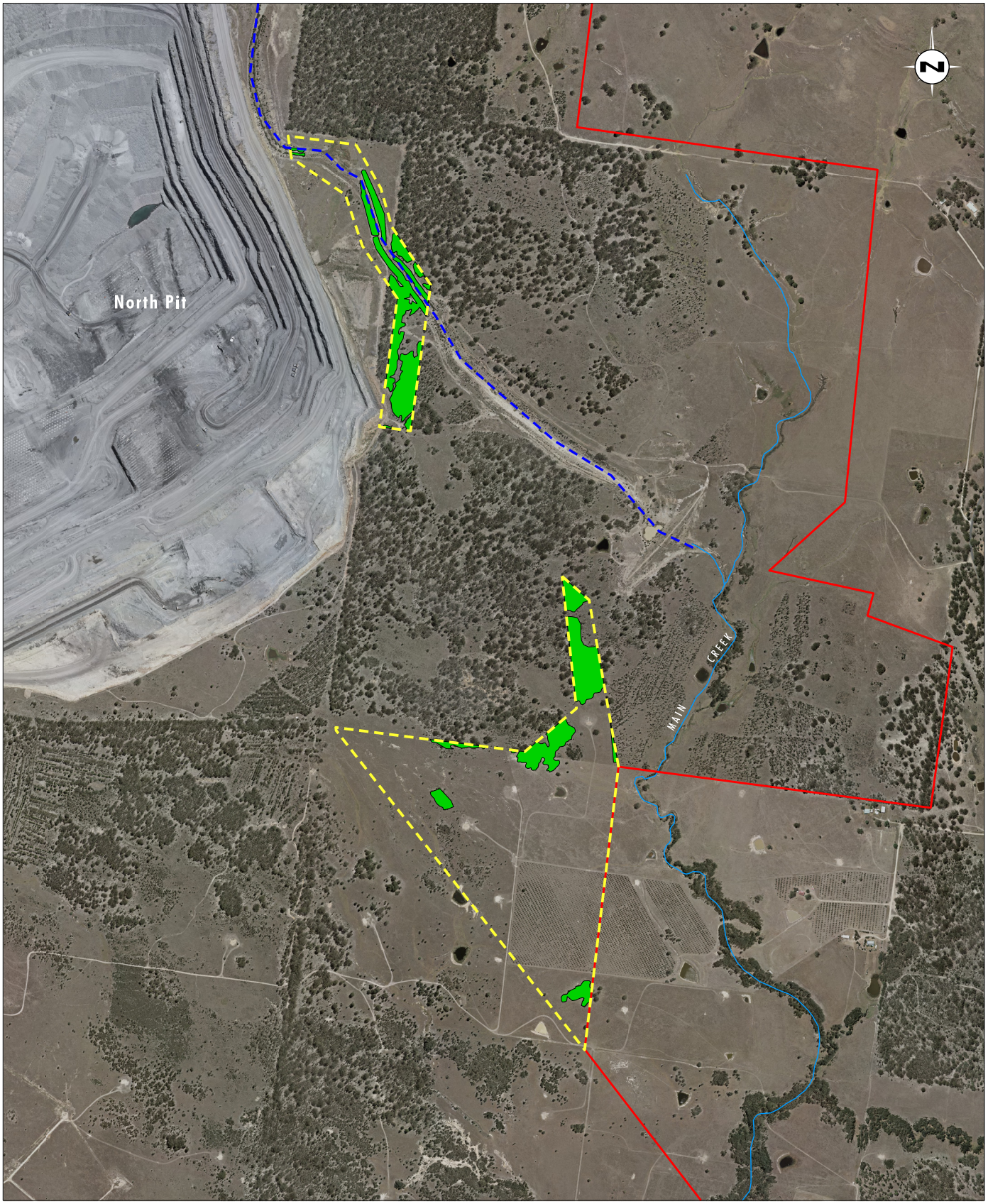

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018), BioNet (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- *Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC* listed under the BC Act
- Existing Bettys Creek Diversion
- Drainage Line

FIGURE 6.21

Threatened Ecological Communities in the Proposed Disturbance Area

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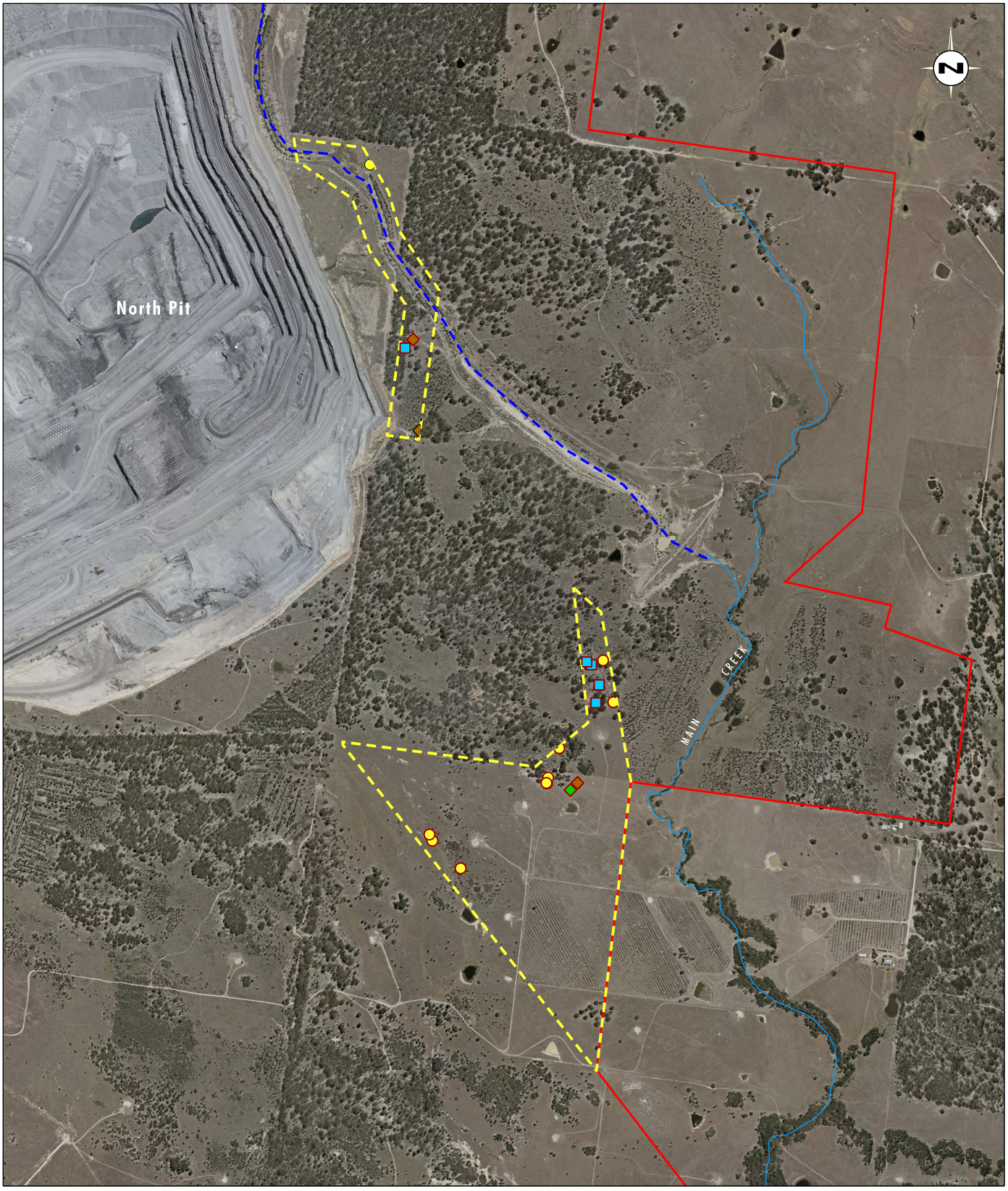

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018), BioNet (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line

Recorded as Part of Current Assessment:

- East-coast Freetail-bat
- Eastern Bentwing-bat
- Grey-crowned Babbler
- Squirrel Glider

Previous Records (including NSW Wildlife Atlas):

- East-coast Freetail-bat
- Grey-crowned Babbler

FIGURE 6.22

Fauna Ecosystem Credit Species in the Proposed Disturbance Area

6.6.4 Avoidance and Mitigation

6.6.4.1 Avoidance

Mount Owen has sought to avoid and minimise potential impacts on the ecological values of the Proposed Disturbance Area throughout the planning process. This planning included targeted avoidance and minimisation of disturbance of key vegetation communities through maximising the use of existing mining facilities, and the avoidance of all areas of the Central Hunter Valley Eucalypt Forest and Woodland CEEC recorded outside of the Approved Disturbance Area and Proposed Disturbance Area. The majority of the Proposed Disturbance Area comprises disturbed and low quality vegetation in the form of derived native grasslands. The derived native grasslands represent lower quality habitat for a range of threatened species. Native forest, woodland and plantation areas comprise less than 20% of the Proposed Disturbance Area and the larger and higher quality remnant patches of native forest and woodland have been avoided. The Proposed Disturbance Area is set back from Main Creek which provides riparian habitat linking the large areas of remnant woodland and forest to the north as part of the Ravensworth State Forest and existing offset areas to the areas of remnant woodland and forest in the south including riparian habitat along Glennies Creek.

6.6.4.2 Mitigation

The following specific control measures, as detailed in the existing approved Mount Owen Complex Biodiversity and Offset Management Plan (BOMP) (prepared under SSD-5850 and DA80/952 and Commonwealth EPBC Act Approval EPBC 2013/6978), are considered to be applicable to the mitigation of impacts on the biodiversity features of the Proposed Disturbance Area:

- landform and rehabilitation establishment utilising species endemic to the area
- 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
- pre-clearing procedure 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
- Glencore Ground Disturbance Permit to identify any specific ecology requirements, such as wildlife spotter/catcher requirements prior to clearing being permitted to commence on site
- weed management
- pest animal control
- fencing and access control
- bushfire management
- riparian zone management including continuing regular inspections and monitoring
- erosion and sedimentation control
- providing appropriate environmental management measures as part of the mining operations to minimise the potential for indirect impacts, and
- workforce education and training.

Should the Proposed Modification be approved, Mount Owen will review and revise the existing BOMP in accordance with the modified development consent requirements. The revised BOMP will guide the implementation of the mitigation steps and will be reviewed and adapted in response to new information.

Monitoring is a tool that is used to assess and inform the ongoing improvement of management actions. The effectiveness and long-term success of mitigation actions will be evaluated against key outcomes, which necessitate regular and appropriately targeted monitoring. This will be achieved through the continued use of formal monitoring programs and due diligence assessments that periodically examine measurable changes over time and provide information on impacts and the success or otherwise of mitigation actions.

6.6.5 Biodiversity Credit Report

Table 6.16 provides a summary of the ecosystem and species credits that require offsetting as a result of the Proposed Modification. Full details on the calculation of the necessary biodiversity credits for the Proposed Modification are provided in **Appendix 13**.

Table 6.16 Credits Required to offset the Proposed Modification

Name	Credits Required
Ecosystem Credits	
HU815 – Spotted Gum - Narrow-leaved Ironbark - Red Ironbark Shrub - Grass Open Forest Slopes of the Central and Lower Hunter	984
HU906 – Bull Oak Grassy Woodland of the Central Hunter Valley	66
HU945 – Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	12
Total Ecosystem Credits	**1062**
Species Credits	
Brush-tailed phascogale (*Phascogale tapoatafa*)	177
Total Species Credits	**177**

6.6.6 Biodiversity Offset Strategy

Mount Owen is committed to delivering a biodiversity offset strategy that appropriately addresses the relevant legislative requirements in accordance with the FBA and the NSW Biodiversity Offsets Policy for Major Projects.

The final biodiversity offset strategy to be delivered for the Proposed Modification will meet the offset requirements identified in **Section 6.6.5** and will include one or a combination of the following offsetting options under the FBA:

- In-perpetuity conservation through the establishment of proponent-managed Stewardship site established in accordance with Part 5 of the Biodiversity Conservation Act 2016, achieved through the retirement of credits. Whilst Mount Owen has identified land within its portfolio that is suitable for meeting the offsetting requirements for the Proposed Modification all alternatives available under the FBA are being considered in seeking to support regional strategic conservation outcomes currently sought by NSW Government Agencies;
- Securing required credits through the open credit market; and/or
- Payments to the Biodiversity Conservation Fund (established under the BC Act). One of the key functions of the NSW Biodiversity Conservation Trust (BCT) is to secure land-based offsets on behalf of proponents who pay into the Biodiversity Conservation Fund (NSW BCT 2018). Through this process the BCT is able to combine offset obligations and funds to establish strategic, larger and more viable offset sites in NSW (NSW Government 2018).

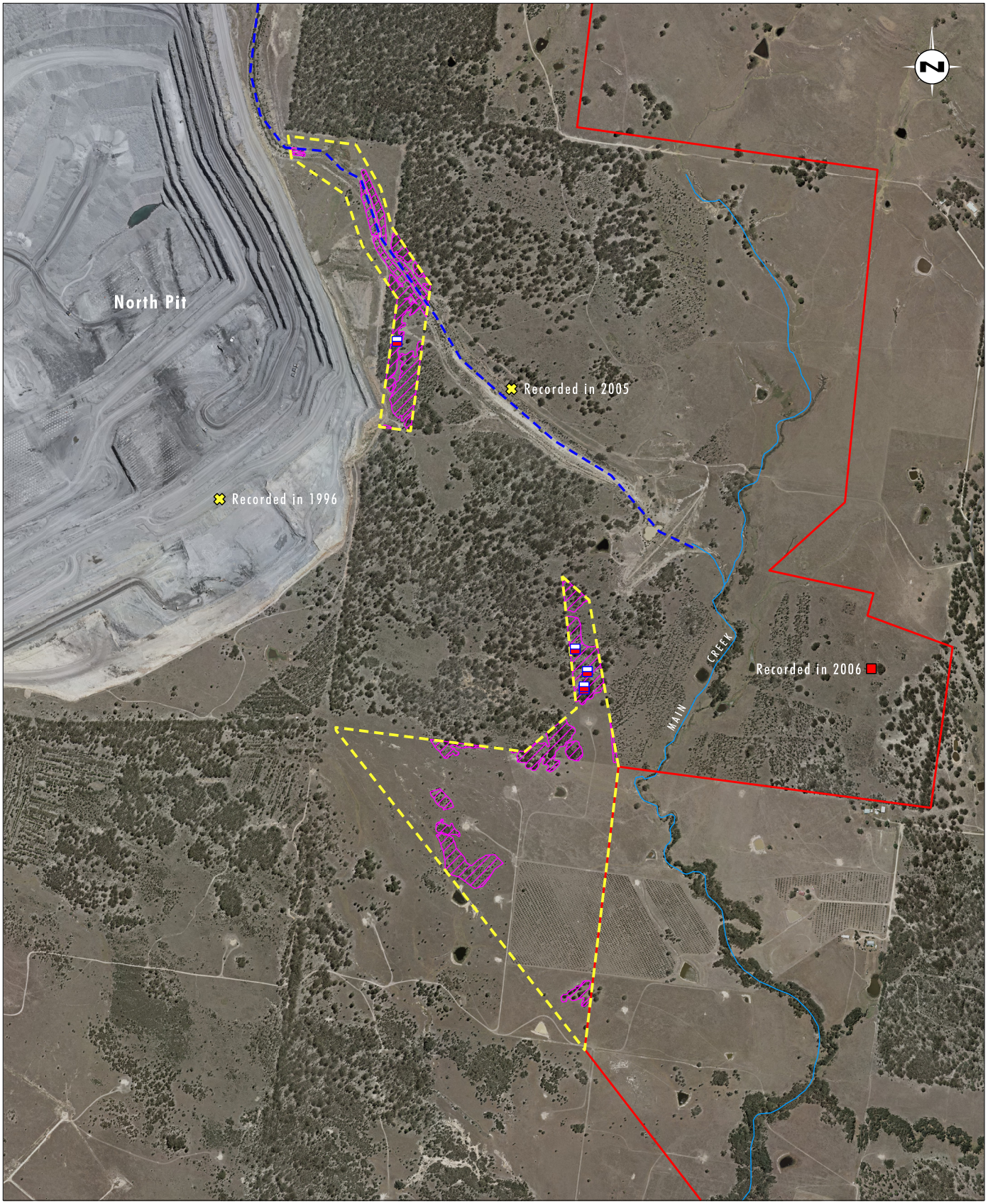

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018), BioNet (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Proposed Disturbance Area
- Existing Bettys Creek Diversion
- Drainage Line

Recorded as Part of Current Assessment:
- Brush-tailed Phascogale
- Potential Brush-tailed Phascogale Habitat

Previous Records (including NSW Wildlife Atlas):
- Green and Golden Bell Frog
- Koala

FIGURE 6.23

Species Credit Fauna Species Locations and Potential Species Habitat in the Proposed Disturbance Area

File Name (A4): R09/3810_221.dgn
20180702 10.31

6.7 Aboriginal Archaeology and Cultural Heritage

The Aboriginal Cultural Heritage Assessment (ACHA) was undertaken by OzArk Environmental and Heritage Management Pty Ltd (OzArk) in consultation with the Aboriginal community. The ACHA follows the Code of Practice for the Investigation of Aboriginal Objects in New South Wales (Code of Practice; DECCW 2010) and the field assessment and reporting follows the Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011). The ACHA report (ACHAR) prepared by OzArk is attached as **Appendix 14**.

6.7.1 Previous Aboriginal Heritage Assessment

A comprehensive Aboriginal Cultural Heritage Assessment was prepared to support the EIS for the Continued Operations Project in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holder groups to assess the Aboriginal cultural heritage values of the Continued Operations Project Area. Three key Knowledge Holder groups were invited to prepare their own Cultural Heritage Assessment Reports and the RAPs also participated in an Aboriginal Archaeological Values Assessment to assess the scientific (archaeological) value of artefact sites identified within the Continued Operations Project Area.

Whilst the regional cultural landscape surrounding the Mount Owen Complex was identified as holding high cultural and historical significance to the Wonnarua people, the landscape within the Mount Owen Complex is extensively disturbed, and the archaeological sites identified were found to be of low and low-moderate archaeological significance.

Detailed management measures were developed in consultation with the RAPs and Knowledge Holder groups including on-site measures to further investigate and manage identified sites, in addition to off-site cultural heritage initiatives to enhance cultural heritage values and knowledge. Mount Owen has also established an Aboriginal Cultural Heritage Working Group to assist in developing and implementing the cultural heritage management measures committed to as part of the Continued Operations Project. Mount Owen is committed to continuing the implementation of the current management measures under the Mount Owen Complex Aboriginal Cultural Heritage Management Plan (ACHMP).

The Continued Operations Project salvage program was undertaken in 2017 within the Approved Disturbance Area, located adjacent to the Proposed Disturbance Area. This salvage program included the collection of surface artefacts at 30 sites (13 artefact scatters and 17 isolated finds) resulting in 189 artefacts being recorded. Included were two sites where limited archaeological excavation took place resulting in a further 187 artefacts being recorded. A number of these sites were salvaged in close proximity to the Proposed Disturbance Area.

There is a long history of archaeological investigation within the Mount Owen Complex and there have been a number of sites recorded either within the Proposed Disturbance Area, or in close proximity. The majority of the identified sites in the vicinity of the Proposed Disturbance Area have been salvaged as part of approved salvage programs. However two sites are listed as being valid: 37-3-1172 (MOCO IF-3), an isolated find, remains extant within the northern portion of the Proposed Disturbance Area and 37-3-0687 (MC-7), an artefact scatter, is recorded as being located approximately 42 m east of the Proposed Disturbance Area (refer to **Figure 6.24**).

6.7.2 Assessment Approach

The purpose of the ACHA was to identify and assess the heritage constraints relevant to the Proposed Modification including the following objectives:

- undertake background research regarding the Proposed Disturbance Area to formulate a predictive model for site/objects location within the Proposed Disturbance Area
- identify and record objects or sites of Aboriginal heritage significance within the Proposed Disturbance Area, as well as any landforms likely to contain further archaeological deposits, and
- assess the likely impacts of the Proposed Modification to Aboriginal cultural heritage and provide management recommendations.

The fieldwork component of the ACHA was undertaken by an OzArk archaeologist, along with representatives of the Registered Aboriginal Parties (RAPs) and Wonnarua Knowledge Holder Groups involved in the assessment undertaken for the Continued Operations Project, on 31 August 2017.

6.7.3 Consultation Process

Initial consultation was undertaken with OEH in June 2017 to confirm the assessment approach for the ACHA. In particular, consultation with the RAPs and Knowledge Holder Groups involved with the ACHA undertaken to support the Continued Operations Project was proposed on the basis that there had been continued consultation with the RAPs and Knowledge Holder groups through the artefact salvage works and Aboriginal Cultural Heritage Working Group meetings. OEH confirmed via email that this approach was reasonable for the Proposed Modification (refer to **Appendix 14**). In addition to the RAPs and Knowledge Holder Groups associated with the Continued Operations Project, the RAPs included on the OEH Hunter Central Coast Branch Regional Operations Division Aboriginal Stakeholder Register for the Singleton LGA, were also consulted. The full list of all RAPs and Knowledge Holder groups consulted is provided in the ACHAR (refer to **Appendix 14**).

The ACHA for the Proposed Modification follows extensive Aboriginal community consultation for the Continued Operations Project (Umwelt 2015a). Australian Cultural Heritage Management Pty Limited was engaged by Mount Owen to undertake Aboriginal community consultation for the Continued Operations Project assessment and to author the ACHA. As the Proposed Modification is immediately adjacent to areas assessed for the Continued Operations Project assessment, the cultural, aesthetic and historic values examined in the Continued Operations Project ACHA have also been used for the assessment for the Proposed Modification (**Appendix 14**).

On 28 July 2017 all RAPs and Knowledge Holder Groups were provided with a copy of the survey methodology for review and comment. During the consultation period responses were received from Tocomwall Pty Limited and Aboriginal Native Title Consultants. Responses to the questions raised during this consultation process were provided and are included in the ACHAR (refer to **Appendix 14**).

The field survey was undertaken on 31 August 2017 by OzArk and representatives of the RAPs and the Wonnarua Knowledge Holder Groups. A draft copy of the ACHAR was distributed for the purpose of review and input into the report. The 28 day review period ended on 4 December 2017 with no feedback requiring incorporation into the ACHAR received.

As discussed in **Section 2.2**, Mount Owen is proposing to amend the ACHMP to allow for the storage of artefacts at a central storage facility proposed at Bulga Coal's Wollombi Brook VCA. The proposal of providing a central artefact storage facility at Bulga Coal was initially raised by the RAPs and Knowledge Holder's at the Aboriginal Cultural Heritage Working Group meetings at Mount Owen and Bulga Coal, with all attendees not objecting to the concept of having a central storage facility. In addition, Mount Owen has formally consulted with relevant Knowledge Holder's and RAPs on the proposed change to the management of salvaged artefacts, further detail regarding the consultation is included in **Section 4.5**. The proposed Wollombi Brook VCA artefact storage facility will provide for secure storage of artefacts as well as meeting and picnic facilities. The detailed design and the Plan of Management for the artefact storage facility will be confirmed through continued consultation with the Aboriginal Cultural Heritage Working Group.

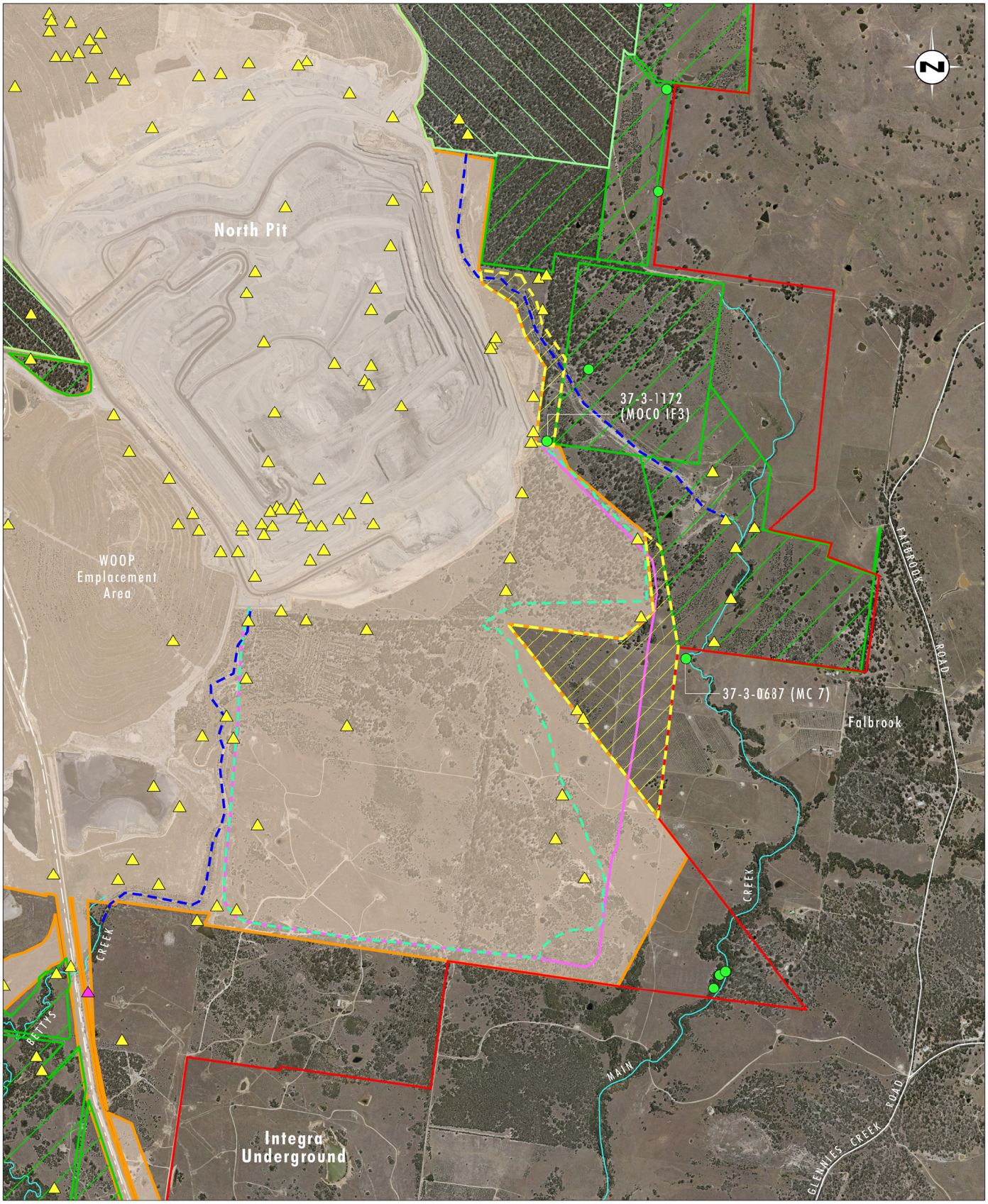

Image Source: Glencore (Feb 2017)
Data Source: Glencore (2018), AHIMS (2017)

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Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Disturbance Area
- Proposed Modification Pit Boundary
- Existing Biodiversity Offset Area
- Ravensworth State Forest
- Drainage Line
- Existing Bettys Creek Diversion
- Valid AHIMS Site
- Salvaged or Destroyed AHIMS Site
- Partially Salvaged AHIMS Site

FIGURE 6.24

AHIMS Sites

File Name (A4): R09/3810_202.dgn
20180702 10.31

6.7.4 Archaeological Assessment Process

6.7.4.1 Survey Methodology

The archaeological survey methodology utilised in the ACHA was developed in accordance with the Code of Practice in consultation with the RAPs with Standard archaeological field survey and recording methods (Burke & Smith 2004).

The following survey methods were applied with three survey priority areas identified within the Proposed Disturbance Area:

- high survey priority - field survey was conducted at 50 m intervals, where possible, with the 4 surveyors spaced 5 m apart. Where field conditions did not allow straight transects, these landforms were investigated more opportunistically where exposures and/or vegetation allowed

- low survey priority - field survey did not include formal survey transects, focussed on areas of exposure where archaeological material had potential to be visible

- no survey priority - field survey comprised only spot checks in these areas previously identified as having been highly modified and extremely unlikely to contain archaeological sites.

A 50 m buffer around the outside of the Proposed Disturbance Area (where possible and warranted) was also included in the survey as well as revisiting and re-recording of any previously recorded sites within 100 m of the Proposed Disturbance Area. The full survey methodology is provided as part of the ACHAR (refer to **Appendix 14**).

The RAPs who attended the field survey considered the survey coverage adequate and provided no further management recommendations concerning the Aboriginal cultural heritage values of the Proposed Disturbance Area at the time.

6.7.4.2 Survey Results

No new Aboriginal sites were recorded during the field survey. Additionally no landforms within the Proposed Disturbance Area were seen as having potential to contain further subsurface archaeological deposits due to generally thin soil coverage and moderate level of previous disturbance across the Proposed Disturbance Area.

A previously recorded site 37-3-1172 (MOCO IF-3) within the Proposed Disturbance Area was revisited during the field survey however despite relatively good areas of exposure the artefact was not located (refer to **Figure 6.24**). This site has been described as having low scientific/archaeological significance. The cultural heritage value of the site was assessed as having high cultural value (Umwelt, 2015a), as the artefact is an indicator of past Aboriginal occupation within the area.

The documented location of previously recorded site 37-3-0687 (MC-7) located outside the Proposed Disturbance Area directly east was also inspected (refer to **Figure 6.24**). No artefacts were observed as long thick grass in this area restricted visibility. The Proposed Disturbance Area in close proximity to the documented location of 37-3-0687 (MC-7) was also inspected with no artefacts observed, indicating the 37-3-0687 (MC-7) site does not extend into the Proposed Disturbance Area. The 37-3-0687 (MC-7) site has high cultural value as it is an indication of Aboriginal occupation within the area, however was assessed as being highly disturbed and of low level archaeological integrity.

6.7.4.3 Likely Impacts to Aboriginal Heritage

Given the nature of the works within the Proposed Disturbance Area, previously recorded site 37-3-1172 (MOCO IF-3) will be directly impacted by the Proposed Modification. The impact to this recorded site has been evaluated as having an overall low heritage impact, when considered in a regional context The loss of this site is considered to contribute marginally to cumulative harm in the region but as the site itself is neither remarkable nor contains artefacts that are not commonly represented in the region, the loss of heritage value (associated with the site) will not greatly add to the cumulative harm to Aboriginal cultural heritage in the region.

As 37-3-0687 (MC-7) is outside of the Proposed Disturbance Area, the site will not be directly impacted by the Proposed Modification, however the site may be indirectly impacted by the Proposed Modification as a result of disturbance associated with erosion stabilisation works including revegetation and/or drainage works. Therefore the proposed management measures will include salvage of this site prior to disturbance.

6.7.5 Management and Mitigation

Based on the recommendations from the ACHAR, the following mitigation measures will be implemented for the Proposed Modification:

- As disturbance to 37-3-1172 (MOCO IF-3) is unavoidable, the surface artefact will be collected for safe-keeping. This collection process will be undertaken under an approved ACHMP and follow the requirements of the 'Group 2' salvage process. As 37-3-0687 (MC-7) is located in close proximity to the Proposed Disturbance Area and may be indirectly impacted in the future by erosion stabilisation works including revegetation and/or drainage works, it is recommended that the site remain *in situ* until impacts are planned, at which time, the site will be salvaged as a Group 2 under the ACHMP.

- Outside of site 37-3-1172 (MOCO IF-3) there are no archaeological constraints within the Proposed Disturbance Area, however, the following precautions included within the ACHMP remain valid:

    - should any items that are suspected to be of Aboriginal origin be discovered within the Proposed Disturbance Area during works, work in the area will cease and advice from a suitably qualified archaeologist will be sought to assess the nature of the find and to suggest an appropriate path forward. Protocols contained in the ACHMP will be followed, and

    - all staff and contractors involved in the Proposed Modification work will undergo cultural heritage inductions to ensure they are aware of the legislative protection of all Aboriginal sites and objects.

The existing ACHMP will be updated to include the management and mitigation measures recommended above in consultation with the Mount Owen Complex Aboriginal Cultural Heritage Working Group. It is noted that the revised ACHMP will focus on the outcomes of this study with the management processes identified in the approved ACHMP remaining valid.

As discussed in **Section 6.7.3** the ACHMP will also be updated to provide for the storage of artefacts salvaged from the Mount Owen Complex at the Wollombi Brook VCA artefact storage facility at Wollombi Brook VCA, as determined in consultation with the Aboriginal community.

6.8 Visual Amenity

6.8.1 Existing visual character

As identified in **Section 3.1.2**, the Mount Owen Complex is located within a rural environment in close proximity to several other mining operations. The predominant land uses in the vicinity of the Mount Owen Complex 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.

In the vicinity of the Mount Owen Complex, mined surfaces, 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 visual environment. Both Liddell and Bayswater Power Stations are dominant structures on the horizon. The area surrounding the Mount Owen Complex is occupied by mining operations which are highly visible from the New England Highway, particularly Ravensworth Operations, Ashton Coal Mine, Rix's Creek Mine and Rix's Creek North Mine. The Ravensworth State Forest is located to the north and north-west of the Mount Owen Complex.

As a result of existing mining operations, power stations and other industries and vehicle/train movements, night time light glow is common. The night time light glow is exemplified on overcast nights as the night light is reflected by the clouds.

6.8.2 Impact of Approved Mining Operation on Visual Character

Views of the approved mining operations are the most prominent from the east, south-east and south, with views of other existing mining operations, notably Ashton Coal Mine, Glendell Mine, Rix's Creek Mine, Rix's Creek North and Ravensworth Operations currently available from the New England Highway, the Main Northern Rail Line, and a number of surrounding properties.

The majority of Mount Owen's mining infrastructure and operations are screened from views from the north and east by the existing topography, vegetation and other mining operations. Parts of the approved mining operations are visible from Hebden Road, Middle Falbrook Road and Glennies Creek Road, with a portion of the rehabilitated overburden area visible from the New England Highway.

The approved mining operations at the North Pit 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, Mount Owen 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 to reduce impacts.

6.8.3 Visual Amenity Assessment Methodology

Assessment of the visual impacts of the Approved Operations, undertaken to support the Continued Operations Project, included a series of radial analyses, panoramic photographs and photomontages for potentially impacted locations.

Radial analyses were developed using 3D topographic information and electronic data files relating to the Continued Operations 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). It should be noted that the radial analyses are topography based only and do not include vegetation which may in fact further screen a portion of a viewshed. Radial analyses were completed using the Approved Operations Year 10 mine profiles as a representation of the maximum height of the constructed landform and the full progression of the proposed mine footprint to gauge the potential visual impact from targeted viewpoints.

The radial analysis confirmed that the only potential views of the Approved Operations within the North Pit from private residences would be from a limited number of residences located to the south-east and east. For this reason, the visual impact analysis focused on selected private residences in the Middle Falbrook area with highest potential for visual impacts, and the view from public roads. The assessment identified 2 private residences in addition to views from public roads, from which visual impacts already existed or were likely to be experienced as a result of the Continued Operations Project (refer to **Figure 6.25**), namely:

- Residence R095 (Viewing Location 3)
- Middle Falbrook Road and Glennies Creek Road Intersection (Viewing Location 5)
- Hebden Road and New England Highway Intersection (Viewing Location 6), and
- Residence R111 (Viewing Location 4).

To assess any further potential visual impact associated with the Proposed Modification, a radial analysis was undertaken to compare the visibility of the Proposed Modification with the Approved Operations from these location points and to ensure there were no additional location points that should be further investigated.

Given the Proposed Modification relates to changes to mining operations within the North Pit only and will not be visible from Viewing Location 6 (refer to **Figure 6.25**), this viewpoint was not investigated further. Similarly further assessment at Viewing Location 4 was not undertaken as part of the Proposed Modification, as residence R111 is located to the south of the Mount Owen Mine and has views of the existing West Pit, North Pit and WOOP emplacement areas which remain unchanged as part of the Proposed Modification. The visual assessment undertaken for the Approved Operations considered that views of the North Pit from residence R111 would likely be shielded by existing topography as mining progresses south into the North Pit. It was also noted that residence R111 has existing planted vegetation that will assist in shielding views of operations within the North Pit from the residence and that the residence is located in close proximity to the existing Rix's Creek North operations and has substantial near field views of the Rix's Creek North operations.

Accordingly there is only potential for changes to the views of the Approved Operations at Viewing Locations 3 and 5 to the south-east of the North Pit (refer to **Figure 6.25**). Photomontages have been prepared to compare the Year 8 mine plan for the Proposed Modification with the Approved Operations Year 10 mine plan from Viewing Locations 3 and 5. An additional photomontage has also been prepared for the proposed Year 15 mine plan and the final landform. The results of this assessment are presented in the following sections.

6.8.3.1 Viewing Location 3 - Residence R095

Figure 6.26 illustrates the radial analysis from residence R095 located on Thomas Lane to the east of the North Pit, with the viewshed from this location extending from the west to the north. These views are at a distance of approximately 4.5 km from the North Pit. Residence R095 has views of the existing North Pit emplacement areas.

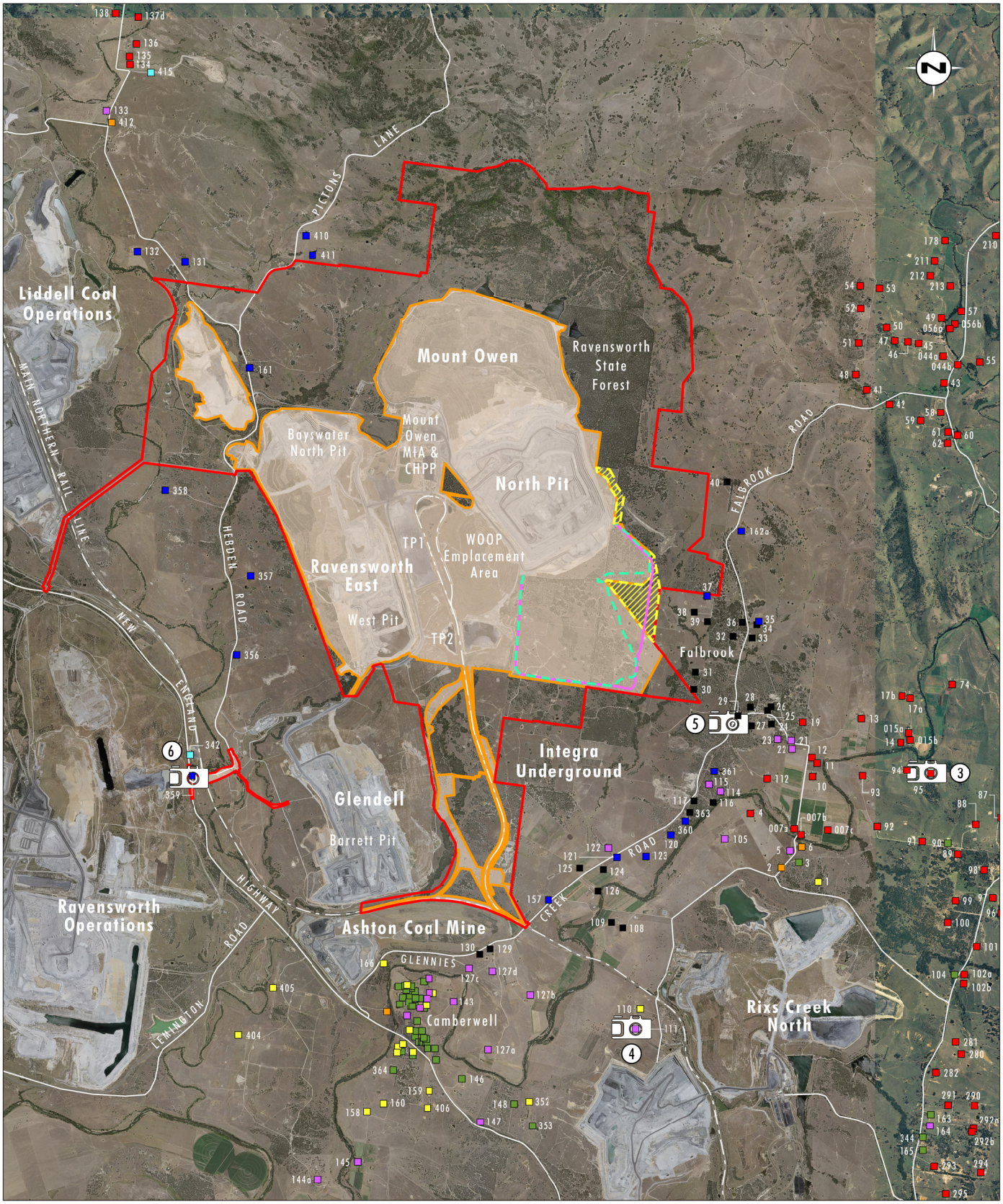
Figure 6.27 provides a comparison between the current view and the photomontage prepared for the Year 10 mine plan for the Approved Operations and the Year 8 mine plan for the Proposed Modification. **Figure 6.28** provides a visual montage of the progression from the Year 15 mine plan to the proposed final landform and also a comparision between the proposed final landform and the approved final landform. The photomontages from this location cover the viewshed presented in **Figure 6.26** and illustrate the following:

- **Current View** – a portion of the current North Pit emplacement area is visible. The Ravensworth East overburden emplacement area is also potentially visible to the north-west from this residence (approximately 7 km away); however, the visible section of the emplacement area only makes up a very small proportion of the viewshed from this location. There is no Mount Owen Complex infrastructure visible from this residence.

- **Proposed Modification Year 8 landform** – the proposed North Pit emplacement area will be in the same location within the viewshed as the approved Year 10 emplacement area, however a larger portion of the active overburden area will be visible due to the extension of the proposed disturbance area and emplacement of additional overburden. The proposed emplacement area will remain a similar height but will have progressed closer to the residence (approximately 4 km), and the length will have been extended further than the Year 10 Approved Operations. Whilst the emplacement area profile is visible, altering the current landscape and views, the final landform and rehabilitation will be consistent with the surrounding natural environment, consistent with the Year 10 Approved Operations. At this stage of the mining operations, a reasonable vegetative cover is expected to exist within the areas where rehabilitation works have been undertaken, assisting in reducing the visual impact. No surface operations will be visible. Views of the active mining area within the North Pit would be largely screened by the existing ridgeline and vegetation.

- **Proposed Modification Year 15 landform** – mining operations will have moved predominantly to the south with the ongoing progression of mining. The North Pit emplacement area will continue at the same height, and although the active overburden emplacement area profile will be visible and still altering the current landscape and views, the majority of the landform will be rehabilitated, assisting in reducing the impact to visual amenity. No surface operations will be visible. Views of the North Pit active mining area will be screened by the existing ridgeline and vegetation.

- **Final Landform** – mining operations have ceased and all overburden areas have been shaped and vegetation is established across the North Pit emplacement area. Although the proposed final landform is modified, the natural landform design remains in keeping with the surrounding landscape and both the distance to nearest public viewing points and the vegetation reduces the visual impact of this change.



Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Modification Disturbance Area
- Proposed Modification Pit Boundary
- Viewing Locations
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 6.25

Visual Assessment Viewing Locations

File Name (A4): R09/3810_123.dgn
20180702 10.32

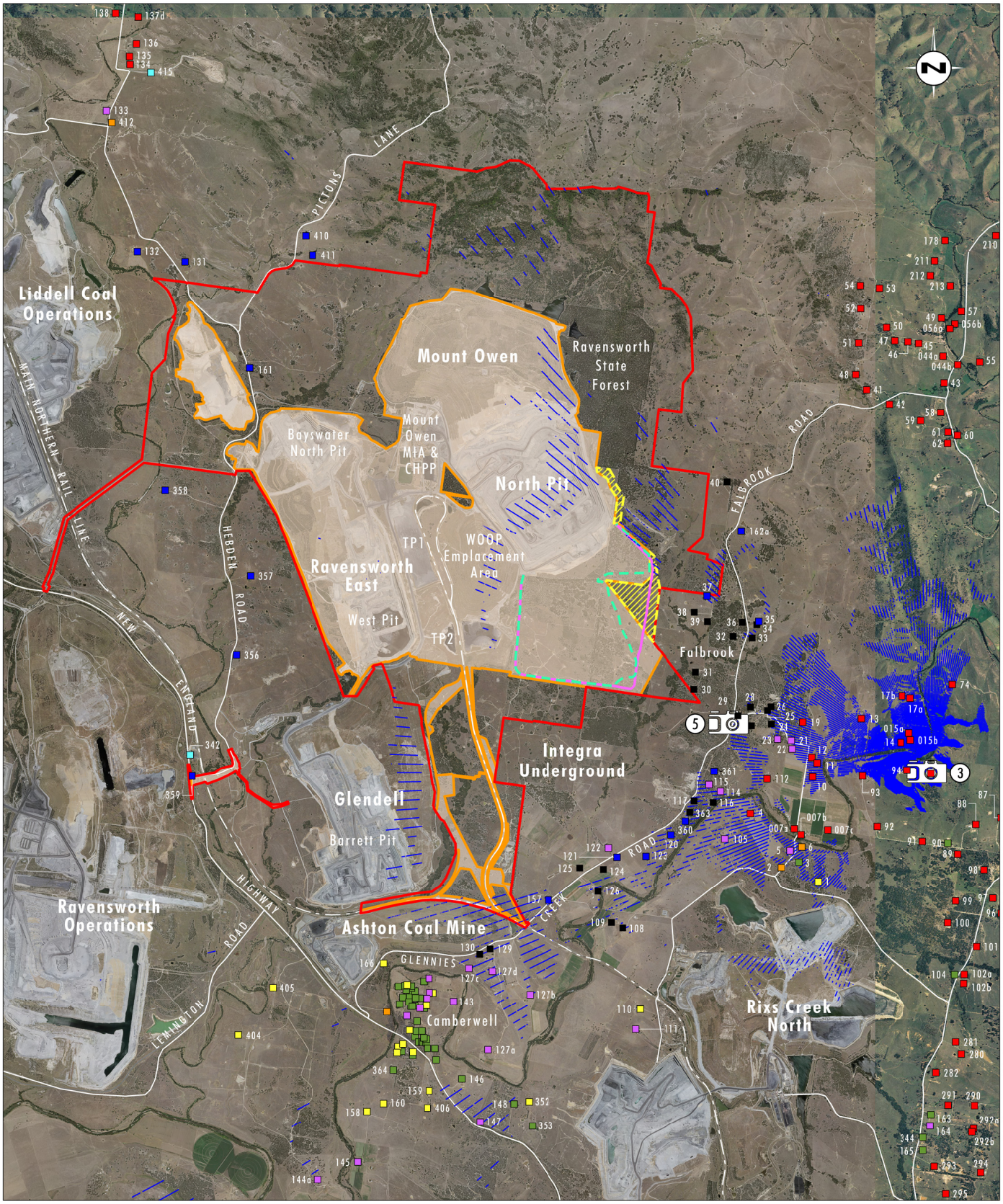


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1.0 2.0 4.0km
1:80 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Modification Disturbance Area
- Proposed Modification Pit Boundary
- Viewing Locations
- Visible Surface
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 6.26

Radial Analysis
Viewing Location 3

File Name (A4): R09/3810_152.dgn
20180702 10.34

FIGURE 6.27

Photomontage from Viewing Location 3 Facing Northwest
Approved Operations Year 10 vs Proposed Modification Year 8

Legend
- Active Overburden Emplacement Area
- Rehabilitation Complete

File Name (A3): R09/3810_121.dgn
20180702 10.37

FIGURE 6.28

Photomontage from Viewing Location 3, Facing Northwest
Proposed Modification Year 15, Proposed Final Landform and
Approved Final Landform

Legend

- Active Overburden Emplacement Area
- Rehabilitation Complete
- Rehabilitation Temporary

File Name (A3): R09/3810_125.dgn
20180723 15.42

6.8.3.2 Viewing Location 5 – Middle Falbrook Road and Glennies Creek Road Intersection (public viewing location)

Figure 6.29 illustrates the radial analysis from the intersection of Middle Falbrook Road and Glennies Creek Road to the east of the North Pit. The viewshed from this location extends from the west-south-west to the north-north-west illustrating the view from one of two public viewing points in the area surrounding the Mount Owen Complex. The existing mining operations, including the WOOP emplacement area, are visible from this viewing location.

Figure 6.30 provides a comparison between the current view and the photomontage prepared for the Year 10 mine plan for the Approved Operations and the Year 8 mine plan for the Proposed Modification. **Figure 6.31** provides a visual montage of the progression from the proposed Year 15 mine planto the the proposed final landform and also a comparison between the proposed final landform and the approved final landform. The visual montages from this location cover the viewshed presented in **Figure 6.29** and illustrate the following:

- **Current View** – at present from this location both the WOOP emplacement area and the North Pit emplacement area are visible, however there are no active mining areas or existing mine infrastructure visible from this location. These views are over a distance of 3 to 4 km, however they still create a moderate impact on the visual amenity of this location. The WOOP emplacement area is located in the middle of the viewshed and the North Pit emplacement area to right of centre. The Glendell Mine is also visible in the left of the viewshed. Rehabilitation of the WOOP emplacement area has been largely completed, thereby minimising visual amenity impacts of this particular landform.

- **Proposed Modification Year 8 landform** – at this stage of the Proposed Modification, the North Pit active mining area will be visible within the viewshed and there will be increased visibility of the North Pit overburden emplacement area to that approved. The majority of the active mining areas are shielded by topography with only limited views of these areas. The key change in visual impacts will be associated with the North Pit overburden emplacement area.

    - It is noted that although the visibility of this area will increase to that currently approved, a reasonable vegetative cover is expected to exist on the WOOP emplacement area and the rehabilitation of the North Pit emplacement area will also occur progressively, which will reduce the overall visual impact consistent with the Approved Operations . Mount Owen proposes to provide a vegetated screen along Glennies Creek Road/Falbrook Road to minimise potential visibility of the North Pit.

    - Mount Owen are also committing to the implementation of a planted screen on Glencore owned-land adjoining the intersection of Glennies Creek Road and Middle Falbrook Road which will be retained following the completion of mining operations and will restrict views of the mining operations from this location during mining operations and will be retained post mining.

- **Proposed Modification Year 15 landform** – at this stage of the Proposed Modification, mining operations will have progressed to the most southern extent of the North Pit with large areas of the North Pit emplacement area rehabilitated. Two active operational areas will still be visible within the viewshed, however reduced through the progression of the proposed mining operations. As with the proposed Year 8 mine plan, at this stage of mining the active overburden emplacement area will be visible within the viewshed. From this stage, the vegetative cover provided by the progressive rehabilitation will effectively reduce the visual impact with the implementation of the final landform consistent with the surrounding natural environment.

- **Final Landform** – mining operations have ceased and rehabilitation is complete. Vegetated areas of the North Pit emplacement area will be visible from this location, with Ravensworth State Forest in the backdrop. Whilst there is proposed modification to the final landform, the design and vegetation remains in keeping with the surrounding landscape reducing the visual impact. The planted screen that Mount Owen have committed to implementing will be retained, which will continue to restrict views of the final landform from this location.

As outlined above from Viewing Point 5 the proposed overburden emplacement areas within North Pit will be more visible from this location relative to the Approved Operations. It is noted that in the surrounding area mining operations are prominent features within the landscape, particularly from roads and other publicly accessible areas, including the New England Highway. In addition, whilst potential long distance views of the proposed overburden emplacement area are possible, through a combination of topographical and vegetative screening, the North Pit will not be visible at the majority of private residences. Mount Owen will continue to implement a range of controls in order to minimise the extent of visual impact to the surrounding area, as detailed in **Section 6.8.5**.

6.8.4 Night-time Scenic Quality

As discussed in **Section 6.8.1**, the Approved Operations currently result in a night time light glow, which along with other mining operations affects the local night time visual amenity. As the site operates on a 24 hour basis, lighting is required on site to meet operational and safety requirements but will be kept to a minimum where practicable. To minimise impacts on the scenic quality of the area, Mount Owen has implemented a range of measures including the use of shields and directional lighting (refer to **Section 6.8.5**).

As part of the Proposed Modification, permanent lighting will continue to be required for the MIA, Mount Owen CHPP and other fixed infrastructure areas including coal handling conveyors and stockpiles. Mobile lighting will also be required in active mining areas in the North Pit. This will be provided by mobile lighting plants and equipment headlights. Generally, mobile lighting plants will be screened from nearby view points by overburden emplacement areas, vegetation or natural topography. As shown on **Figures 6.29** and **6.30**, the elevated areas of overburden emplacement associated with the Proposed Modification will have increased visibility from Viewing Location 5. During night time operations this will include visibility of mobile lighting plants and head lights on mining equipment.

Mount Owen 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 Proposed Modification will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

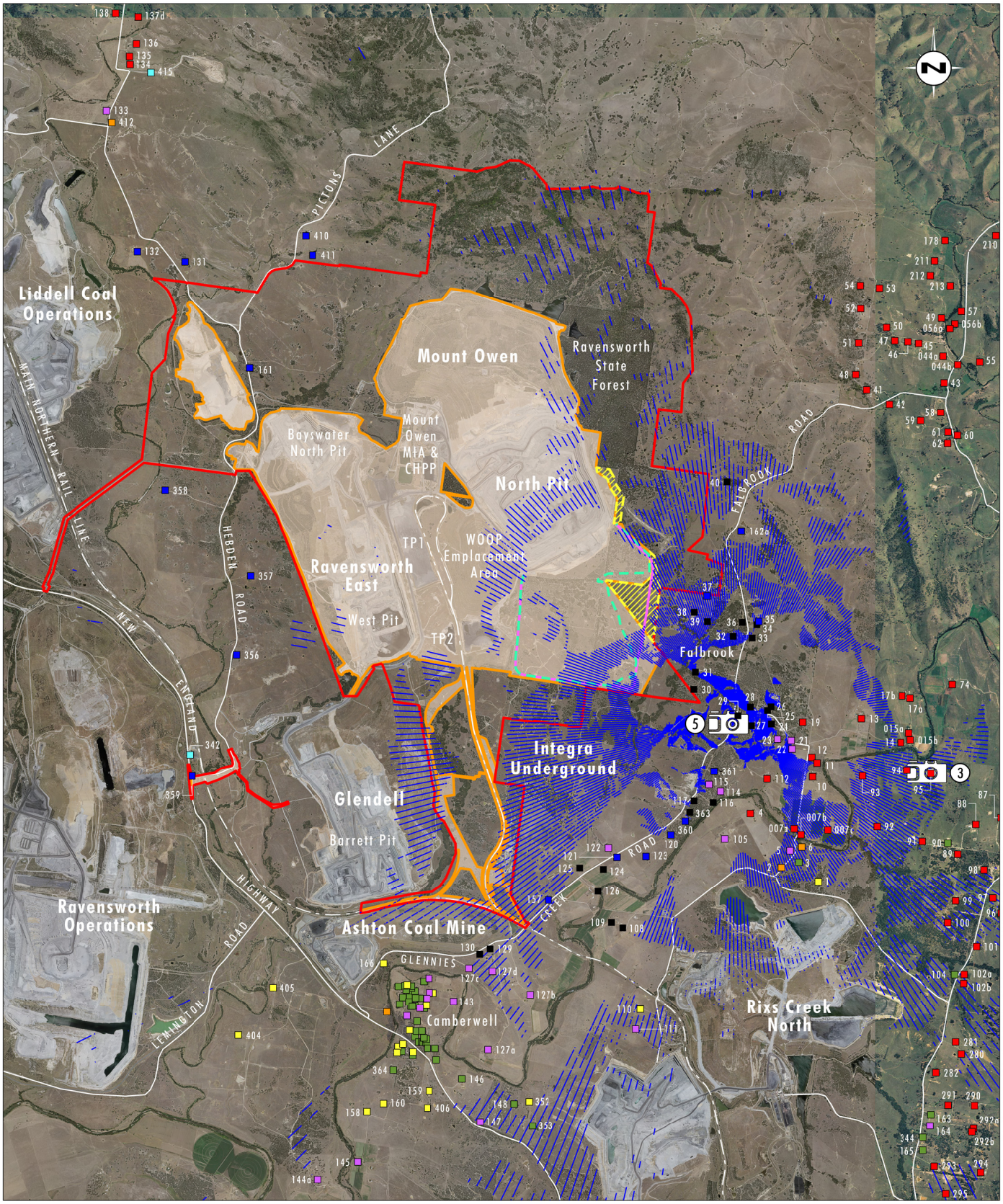


Image Source: Glencore (2017)
Data Source: Glencore (2018)

0 1.0 2.0 4.0km
1:80 000

Legend

- Proposed SSD-5850 Modification Consent Boundary
- Approved Operations Pit Boundary
- Approved Disturbance Area
- Proposed Modification Disturbance Area
- Proposed Modification Pit Boundary
- Viewing Locations
- Visible Surface
- Community Infrastructure
- Glencore Owned
- Glencore Owned - Vacant
- Other Mine Owned
- Other Mine Owned - Vacant
- Private
- Private - Subject to Acquisition Rights
- Private Infrastructure

FIGURE 6.29

Radial Analysis
Viewing Location 5

File Name (A4): R09/3810_153.dgn
20180702 10.38

Legend

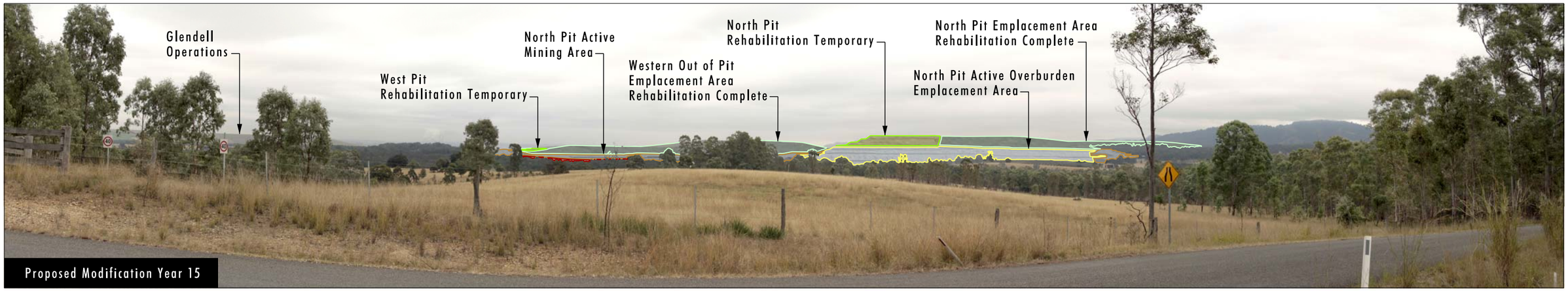
- Active Mining Area
- Active Overburden Emplacement Area
- Rehabilitation Complete

Note: Proposed vegetation screen will obscure views from this location

FIGURE 6.30

Photomontage from Viewing Location 5
Facing West
Approved Operations Year 10 vs Proposed Modification Year 8

File Name (A3): R09/3810_122.dgn
20180709 9.17



Legend

- Active Mining Area
- Active Overburden Emplacement Area
- Rehabilitation Complete
- Rehabilitation Temporary
- Topsoil Removal Strip

Note: Proposed vegetation screen will obscure views from this location

File Name (A3): R09/3810_124.dgn
20180723 15.37

FIGURE 6.31

Photomontage from Viewing Location 5, Facing West Proposed Modification Year 15, Proposed Final Landform and Approved Final Landform

6.8.5 Impact Summary and Visual Mitigation Controls

Consistent with the Approved Operations, the visual impacts associated with the Proposed Modification will be mitigated through the screening effect of rehabilitation and the development of a final landform that conforms to the surrounding natural environment. This will minimise views of shaped and unshaped overburden emplacement areas and facilitate the amelioration of night time light glow from the proposed operations.

Consistent with the Approved Operations to assist in minimising the visual impacts of the Proposed Modification, Mount Owen will continue to commit to the following:

- progressive rehabilitation will be undertaken to reduce the duration of visible soil exposure
- implementation of planted screen on Glencore owned land adjoining the intersection of Glennies Creek Road and Middle Falbrook Road
- ongoing management of mobile lighting to reduce the impacts of lighting, positioning lights so they are not pointing off site, shielded by walls, overburden emplacement areas and vegetation where practicable and the ongoing implementation of procedures for the appropriate placement of mobile lighting plant to reduce impact to local residents and public roads, and all fixed lighting associated with the Proposed Modification will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

6.9 Greenhouse Gas and Energy

A detailed Greenhouse Gas and Energy Assessment (GHGEA) was undertaken by Umwelt to consider the greenhouse gas (GHG) emissions associated with the Approved Operations as part of the EIS process for the Continued Operations Project (Umwelt 2015a). This included the consideration of Scope 1 emissions (primarily from the combustion of diesel and release of fugitive emissions as part of the construction and operation phase) and Scope 2 emissions (electricity use). Scope 3 emissions are indirect emissions that occur downstream generated by third parties during product transport and consumption activities, and represented approximately 96% of the Approved Operations GHG emissions.

The assessment for the Approved Operations indicated that a total of 127,836,000 tonnes Carbon dioxide equivalent (t CO2e) would be produced by the project (96% of which is indirect to the Approved Operations) which equated to approximately 4% of total Continued Operations Project emissions (5,471,000 t CO2e). As such, this assessment concluded that it was unlikely there would be any impact to national GHG policy objectives due to the relatively small contribution the Approved Operations would make to national emissions on an annual basis and the implementation of ongoing energy efficiency initiatives on site to reduce GHG emissions.

A detailed GHGEA has been undertaken to consider the additional GHG emissions associated with the Proposed Modification including a review of relevant GHG emission projections, an evaluation of the climate change impacts and potential mitigation options that may be required in addition to those measures already implemented as part of the Approved Operations. This section provides results of the GHGEA.

6.9.1 Scope

The GHGEA framework is based on the methodologies and emission factors contained in the National Greenhouse Accounts (NGA) Factors 2017 (DEE 2017). The assessment framework also incorporates the principles of The Greenhouse Gas (GHG) Protocol 2004 (WRI 2004). The GHG Protocol provides an internationally accepted approach to GHG accounting. The GHG Protocol provides guidance on setting reporting boundaries, defining emission sources and dealing with issues such as data quality and materiality.

Scope 1 and 2 emissions included in the GHGEA were calculated based on the methodologies and emission factors contained in the NGA Factors 2017 (DEE 2017). Fugitive emissions have been calculated using the Method 1 approach, as described in the NGA Factors 2017 (DEE 2017).

Scope 3 emissions associated with product transport were calculated based on emission factors contained in the National GHG Inventory: Analysis of Recent Trends and GHG Indicators (AGO 2007). Other Scope 3 emissions were calculated using methodologies and emission factors contained in the NGA Factors 2017 (DEE 2017).

The scope of the GHGEA for the Proposed Modification includes:

- estimating direct and indirect (Scopes 1, 2 and 3) GHG emissions associated with the Proposed Modification (i.e. in addition to the Approved Operations)
- estimating energy use directly associated with the Proposed Modification
- qualifying how the Proposed Modification's GHG emissions may impact the environment
- estimating the impact of the Proposed Modification's emissions on national and international greenhouse gas emission targets, and
- assessing reasonable and feasible measures to minimise the GHG emissions and ensure energy use efficiency.

6.9.2 Assessment Methodology

GHG and energy use estimates have been calculated for the operational stages of the Proposed Modification. Forecast GHG emissions for construction and closure phases of mining have not been included in this assessment. There is no significant construction associated with the Proposed Modification and there will be no change associated with closure from the Approved Operations. Forecast emissions associated with the closure phase were assessed as part of the Approved Operations.

The following assumptions were used to estimate the GHG emissions from the operational phase of the Proposed Modification:

- an additional approximately 35 Mt of ROM coal will be recovered
- extension of the approved operations by 6 years
- product yield will average approximately 55%
- 83% of product coal is thermal quality and will be combusted by electricity generators
- 17% of product coal is coking quality and will be consumed in coking plants
- all product coal will be transported approximately 92 km to the port of Newcastle via train
- all product coal will be shipped an average of 9500 km to international markets
- fugitive emissions from the open cut operation will average 0.054 t CO_2-e per ROM tonne (i.e. the default Method 1 emissions factor for NSW)
- the Mount Owen CHPP, workshops and administration buildings will operate for an additional six years, consuming 204,000 GJ per annum, and
- the conveyor linking Mount Owen to Liddell and Bayswater Power Stations will operate for an additional 6 years, consuming approximately 20,000 GJ per annum.

The completeness principle states that all relevant emission sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled (GHG Protocol 2004). The emission sources listed in **Table 6.17** have been excluded from the GHGEA as activity data is not readily available, and modelling activity data is unlikely to generate sufficient emissions to materially change impacts or influence the decision making outcomes of stakeholders.

Table 6.17 Data Exclusions

Emissions source	Scope	Description
Combustion of fuel for energy	Scope 1	Small quantities of fuels such as petrol and LPG
Industrial processes	Scope 1	Sulphur hexafluoride (high voltage switch gear) Hydrofluorocarbon (commercial and industrial refrigeration)
Waste water handling (industrial)	Scope 1	Methane emissions from waste water management
Solid waste	Scope 3	Solid waste to landfill
Business travel	Scope 3	Employees travelling for business purposes
Employee travel	Scope 3	Employees travelling between their place of residence and the Mount Owen Complex

GHG emissions resulting from land use, land use change and forestry (LULUCF) were also excluded from the GHGEA. The assessment makes the assumption that all emissions generated during the land clearing process would be sequestered via rehabilitation plantings.

6.9.3 Life of Mine Greenhouse Gas Emissions

The Proposed Modification's life of mine (LOM) GHG emissions are summarised in **Table 6.18**. The calculations are provided in **Appendix 15**.

Table 6.18 Summary of the additional greenhouse gas emissions associated with the Proposed Modification

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Life of Mine (to 2037)	Scope 1 (Direct)	Diesel use	623,000	2,513,000
		Fugitive emissions	1,890,000	
	Scope 2 (Indirect)	Electricity	310,000	310,000
	Scope 3 (Indirect)	Product use	47,944,000	50,343,000
		Associated with energy extraction and distribution	77,000	
		Product transport	2,313,000	
		Materials transport	9,000	
Total GHG Emissions for LOM of the Proposed Modification				53,166,000

The Proposed Modification is forecast to generate approximately 2,513,000 t CO_2-e of Scope 1 emissions from combusting diesel and releasing fugitive emissions. This represents an increase in annual Scope 1 emissions by an average of approximately 133,000 t CO_2-e per annum, from the Approved Operations. (Note: 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 Proposed Modification is forecast to be associated with approximately 310,000 t CO_2-e of Scope 2 emissions from consuming electricity. This represents an increase in annual Scope 2 emissions by an average of approximately 17,000 t CO_2-e per annum, from the Approved Operations.

The Proposed Modification is forecast to be associated with approximately 50,343,000 t CO_2-e of Scope 3 emissions. Scope 3 emissions will be generated by third parties who transport and consume coal products. This represents an expected increase in annual Scope 3 emissions by an average of approximately 2,650,000 t CO_2-e per annum, from the Approved Operations.

Figure 6.32 demonstrates that the Proposed Modification's GHG inventory is dominated by Scope 3 emissions. Consistent with the Approved Operations, approximately 95% of the Proposed Modification's GHG emissions occur downstream from the mining operation, with the other 5% of the greenhouse gases associated with on-site energy use and fugitive emissions (Scope 1 and 2 emissions).

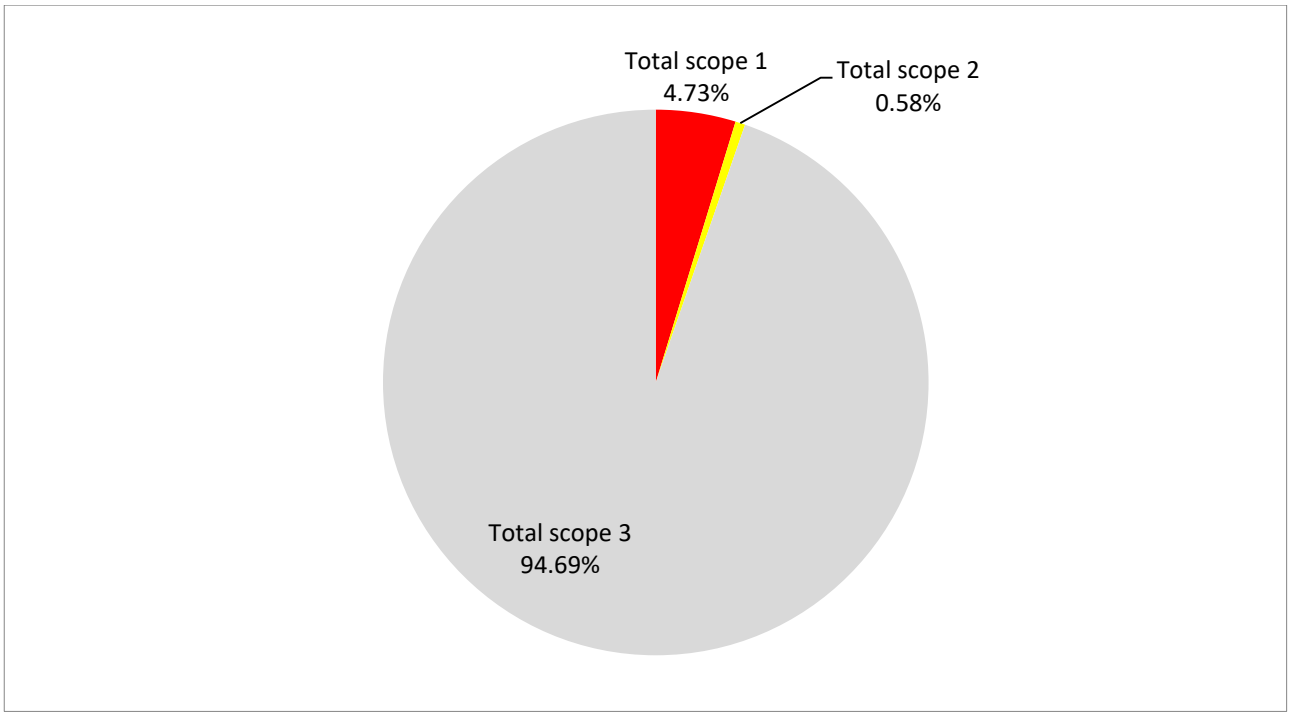


Figure 6.32 Breakdown of Emissions by Scope

Scope 2 and 3 emissions have been included in the GHGEA to demonstrate the potential upstream and downstream impacts of the Proposed Modification. All Scope 2 and 3 emissions identified in the GHGEA are attributable to, and may be reported by, other sectors.

The Proposed Modification is forecast to require approximately 10,218,000,000 MJ of energy from diesel and grid electricity, which represents an average increase of approximately 537,756,000 MJ per annum from the Approved Operations. The industry average energy use for open cut coal mines in Australia ranges between 430 and 660 Megajoules (MJ)/Product tonne (AGSO 2000). The Proposed Modification is forecast to operate with an average energy use intensity of approximately 532 MJ/Product Tonne which is within the normal operating range for Australian open cut coal mines.

6.9.4 Impact Assessment Summary

The GHG emissions generated by the Proposed Modification have the potential to impact the physical environment and the GHG reduction objectives of national and international governing bodies.

Consistent with the Approved Operations, the Proposed Modification is considered unlikely to impact national GHG policy objectives due to the relatively small contribution the Proposed Modification will make to national emissions on an annual basis.

The Proposed Modification will contribute to global emissions, however, 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 which includes all major emission sources and sinks.

6.9.5 Management and Mitigation

Mount Owen has incorporated a range of measures into the Proposed Modification mine plan design to minimise potential GHG emissions, and improve energy efficiency. Energy efficiency was a key driver for the design of the Proposed Modification mine plan as energy usage is a direct driver of cost as well as GHG emissions. The design of the mine plan aims to minimise GHG emissions from the mining operations, primarily through energy use reduction initiatives. This includes limiting the length of haulage routes (where feasible) to minimise transport distances and associated fuel consumption, selection of equipment and vehicles that have high energy efficiency and scheduling activities so that equipment and vehicle operation is optimised.

Mount Owen will continue to mitigate GHG emissions through ongoing energy efficiency initiatives, utilising alternative fuel sources and optimising productivity. On the basis of this GHGEA, the nature and extent of GHG emissions from the Proposed Modification are generally consistent with that of the Approved Operations and as such there are no additional management and mitigation measures identified or recommended.

6.10 Mine Closure and Rehabilitation

A detailed Rehabilitation Strategy (Umwelt 2015a) accompanied the EIS for the Continued Operations Project. This Rehabilitation Strategy was updated to reflect additional commitments made in the Response to Submissions and PAC review process for the Continued Operations Project. The revised Rehabilitation Strategy has been provided to Singleton Council and the NSW Resources Regulator for review. The revised Rehabilitation Strategy has been submitted to the Planning Secretary for approval in accordance with Condition 43 of SSD-5850.

The Proposed Modification does not alter the broad mine closure and rehabilitation commitments and practices at the Mount Owen Complex. The key final landform design parameters relating to the incorporation of the natural landform design features (i.e. micro-relief), maximising the return of catchment to surrounding creek systems including Main Creek, and meeting the conservation objectives for the Approved Operations Biodiversity Offset Strategy, underpin the conceptual final landform of the Proposed Modification. In addition, there are no additional voids within the final landform as part of the Proposed Modification.

6.10.1 Comparison to Approved Operations

The overall Rehabilitation Strategy for the Proposed Modification is consistent with the Approved Operations; however, the Proposed Modification will result in additional areas of disturbance and increase the depth of mining within part of the North Pit. This will result in the extension of the Mount Owen Mine life and a modified final landform to that currently approved.

Consistent with the Approved Operations, a final void will remain within the North Pit. The landform within the final void will include highwalls, benches, low wall and ramps. The highwall is a rock face which represents the edge of the North Pit extending down to the pit floor, made up of a series of steep slopes and benches. The low wall is the external face of emplaced overburden within the pit.

The conceptual final landform for the Proposed Modification comprises a natural landform design through micro-relief design principles that have been incorporated into the shaped in-pit overburden emplacement area (refer to **Figure 2.5**). The proposed final landform also incorporates the design controls developed for the Approved Operations including designing the final landform and drainage of water to natural catchments particularly in relation to Main Creek (refer to **Figure 5.2**). The final landform catchments will be designed in consideration of water licensing requirements. The average final batter of the low wall in the proposed North Pit final void is 18° which is the same internal batter slope in the approved North Pit final void.

Relative to the Approved Operations, the conceptual final landform for the Proposed Modification includes the following key changes:

- additional emplacement of overburden within the existing North Pit disturbance area up to the current approved height of 230 mAHD with resultant changes to the overall final landform for the North Pit emplacement area,

- changes to the depth and design of the final void in North Pit, and

- delay by approximately 4 years in the completion of the majority of the rehabilitation within an area of the existing North Pit emplacement area that will be reinstated as Ravensworth State Forest at the completion of mining, to accommodate the additional overburden emplacement and rehandle for final landform development. In addition, approximately 12.5 ha of the North Pit emplacement area that will be reinstated as Ravensworth State Forest associated with the North Pit haul road and landform shaping works (between the North Pit emplacement area and the WOOP emplacement area) will be rehabilitated at the end of the mine life, delaying the establishment of this area of rehabilitation by approximately 6 years. It should be noted that although the establishment of this rehabilitation will be delayed the proposed conceptual final landform includes changes to the landform in this location which will provide for a more contiguous landform between the WOOP emplacement area and the North Pit emplacement area

While the Proposed Modification does not propose any change to the internal batter of the low wall in the North Pit relative to the Approved Operations, the Proposed Modification includes additional commitments regarding the management of water across the low wall and commitments regarding the use of erosion modelling in the detailed drainage design for the final landform as part of the mine closure process. This commitment follows discussions with the NSW Resources Regulator during the preparation of the SEE which identified potential constraints presented by the low wall slope. Management of potential rehabilitation risks is discussed in further detail in **Section 6.10.2**.

Table 6.18 details the key changes in terms of rehabilitation and final landform for the Proposed Modification relative to the Approved Operations. It is important to note, the Proposed Modification relates to changes to the North Pit only, and no changes are proposed to the approved Ravensworth East final landform.

Table 6.19 Comparison of North Pit rehabilitation/final landform changes: Approved Operations vs. Proposed Modification

Feature	Approved Operations	Proposed Modification	Comments
Final landform shaping	Natural landform design elements (i.e. micro-relief) incorporated in new areas of landform developed as part of Continued Operations Project. Final landform and drainage to be designed to maximise the return of water to previous natural catchments. The final landform catchments will be designed in consideration of water licensing requirements	Natural landform design elements (i.e. micro-relief) incorporated in new areas of landform developed as part of Continued Operations Project and Proposed Modification. Final landform and drainage to be designed to maximise the return of water to previous natural catchments. The final landform catchments will be designed in consideration of water licensing requirements	No change to that currently approved.
Highwalls	Western and southern highwalls retained in final landform. Parts of eastern slopes of void represent pit floor. Upper benches of southern and western highwalls battered to 15°.	Western, eastern and southern highwalls retained in final landform. Parts of eastern slopes of void represent pit floor. Upper bench of southern highwall battered to 10°. Battering of upper bench of eastern highwall to 18°.	Battering of eastern highwall limited due to proximity to Main Creek and existing Biodiversity Offset Areas. Upper bench of western highwall no longer proposed to be battered/shaped due to potential implications for drainage on the eastern side of existing WOOP emplacement area.
Low wall	Upper slopes of low wall battered to 18°.	Upper slopes of low wall battered to 18°.	No change to design criteria Rehabilitation Strategy for the Proposed Modification (**Appendix 16**) includes an additional commitment to undertake erosion modelling as part of the detailed design of the final landform for the North Pit final void to ensure long term stability issues are addressed in the detailed final landform drainage design.

Feature	Approved Operations	Proposed Modification	Comments
Revegetation commitments	Woodland vegetation on battered slopes. Native vegetation* on benches.	Woodland vegetation on battered slopes. Native vegetation* on benches (except where benches used for drainage flows). Increase in overall area rehabilitated to woodland.	No change to currently approved, focus on re-establishment of woodland vegetation.
Number of voids	2 – Bayswater North Pit and North Pit	2 – Bayswater North Pit and North Pit	No change to that currently approved.
North Pit void catchment area	Approximately 282 ha	Approximately 390 ha	Increase due proposed additional pit footprint and associated final landform updates following acquisition of Integra Underground mining tenements.
North Pit void depth (below natural ground level)	Approximately 170 m	Approximately 275 m	Increase due to removal of stratified lease arrangement following acquisition of Integra Underground mining tenements which allows for recovery of coal from Hebden Seam across a larger pit area.
Modelled maximum pit lake level	Approximately 19 mAHD	Approximately -65 mAHD	North Pit final void will continue to operate as a long term hydraulic sink consistent with Approved Operations.
Time to equilibrium water level	Approximately 500 years	Approximately 320 years	Equilibrium water level is predicted to be achieved sooner for the Proposed Modification however the water level is lower.

Feature	Approved Operations	Proposed Modification	Comments
TDS (mg/L)	5,500 at equilibrium	5,200 at equilibrium	The Food and Agricultural Organisation of the United Nations (FAO 2013) provide the following categories for assessing salinity based on TDS concentrations (ranging from fresh to extremely saline) at the following levels: • Fresh water <500 mg/L • Brackish (slightly saline) 500 to 1,500 mg/L • Moderately saline 1,500 to 7,000 mg/L • Saline 7000 to 15,000 mg/L • Highly Saline 15,000 to 35,000 mg/L • Brine >35,000 mg/L A TDS concentration greater than 4,500 mg/L is generally considered unsuitable for irrigation however salinity in the range of 5,000 to 10,000 mg/L is considered suitable for some stock watering (mature cows and sheep), recreation, industrial water use and the maintenance of ecosystems.
Spill risk	65 m freeboard to spill level at 84 mAHD	155 m freeboard to spill level at 90 mAHD	Risk of potential spill to the environment is extremely low.
Final land use	Mixed woodland and agriculture.	Mixed woodland and agriculture. Slight reduction in area proposed for grassland due to terrain changes.	The battered slopes and highwalls in the final void will be revegetated, increasing the overall area of native vegetation* in the final landform. This is consistent with current consent conditions which promote opportunities to increase the area of woodland in the final landform. Potential future opportunities for alternative final land uses are explored in **Section 6.10.3.1**

*Native vegetation on highwall benches will have regard to potential constraints to rooting depth presented by shallow depth of growing medium. Species selection will be similar to that used in woodland communities but ultimately established vegetation communities may not meet formal woodland structural definitions.

As discussed in **Section 5.3**, a number of alternative final landform design options have been considered in the mine planning process for the Proposed Modification. These options included consideration of reduced highwall areas, reduced slope gradients, and options with both a smaller and a larger void catchment. These options were considered in consultation with the NSW Resources Regulator in November 2017, DPE in March 2018 and Singleton Council in April 2018. The NSW Resources Regulator's comments are discussed further in **Section 6.10.2**.

The NSW Resources Regulator advised during consultation that the key issues in relation to the Proposed Modification from its perspective were:

- slope stability and erosion risks associated with the low wall slopes and the potential impacts on long-term beneficial land use
- the geometric shape of the proposed North Pit final void and potential visual impacts (noting that the final landform should be designed to minimise visual impact, be in keeping with natural terrain features, incorporate micro-relief and maximise the area available for beneficial re-use (i.e. useable land)
- potential impacts on groundwater including:
    - post mining groundwater equilibration, and
    - potential interactions between Bettys Creek and Main Creek and the final void
- other options considered, management of combustion risks associated with coal seams remaining exposed in highwalls
- justification for the design, including economic assessment and beneficial re-use assessment of the proposed final landform options, is required (for example, certain final landforms may take longer to achieve but may provide a more beneficial final land use).

The issues raised by the NSW Resources Regulator are addressed in **Sections 6.10.2** and **6.10.3** below.

As detailed in **Table 6.19**, the key changes in terms of landform design relate to the size and depth of the final void and a decrease in pit lake recovery levels. These changes, in themselves, do not have any material impact on the approved closure strategy for the Approved Operations or the Rehabilitation Strategy. The draft updated Rehabilitation Strategy for the Mount Owen and Ravensworth East Mines (should the Proposed Modification be approved) is attached as **Appendix 16**. This draft updated Rehabilitation Strategy has had regard to comments made by the NSW Resources Regulator and Singleton Council as part of the review process for the current Rehabilitation Strategy for the Mount Owen Mine as well as the issues raised by the NSW Resources Regulator in relation to the Proposed Modification. The Rehabilitation Management Plan will be updated to reflect the Proposed Modification should it be approved.

6.10.2 Management of rehabilitation risks

As noted in **Section 6.10.1**, the changes associated with the Proposed Modification do not have a material impact on the approved closure strategy for the Approved Operations or the current Rehabilitation Strategy. The key rehabilitation risks, discussed below, associated with the proposed conceptual final landform design also apply to the Approved Operations.

An analysis of final landform options was provided in **Section 5.3**, with particular focus on potential options to reduce the size of the final void. In summary, key conclusions relevant to management of rehabilitation risk were:

- the depth of existing operations and the proposed increased depth means battering of highwalls would result in significant additional areas of disturbance and increased extension of the life of operations associated with the rehandle of overburden (which would need to be removed from the North Pit, emplaced in the WOOP and North Pit emplacement areas and then rehandled following the cessation of mining);

- reducing the number of retained highwalls, reducing low wall slopes or reducing void size to levels similar to the currently Approved Operations was investigated, however would result in significant prolonged amenity impacts relative to the Approved Operations and would delay rehabilitation in areas where the rehandled overburden was obtained; and

- Some of the final void design options considered, that involved less rehandle of overburden, resulted in substantially reduced resource recovery.

Although a number of different design options were considered for the Proposed Modification (refer to **Section 5.3**), all would have resulted in increased areas of battered slopes. Reduced slope gradients in battered slopes would either necessitate significant rehandle of overburden or would increase the area of the final void and therefore reduce the area of land potentially available for other land uses.

The management of drainage from the battered slopes in the proposed North Pit void remains the highest rehabilitation risk due to the length of slopes. This risk also exists for the Approved Operations conceptual final landform and is manageable through existing drainage management practices which are currently applied at other mining sites in the Hunter Valley. Additionally, opportunities to direct water flows to hard rock areas will limit erosion risks and reduce long term management associated with constructed drop structures on spoil. The presence of the highwalls on the western and eastern areas of the North Pit void and the area of exposed floor in the south-eastern corner provide these opportunities to manage drainage from the battered low wall. These opportunities would not exist if all highwalls were removed through battering. The additional works associated with battering the highwalls and/or reducing slopes would also extend the life of operations and, under some scenarios, significantly delay the rehabilitation of the final landform.

Table 6.20 identifies how the proposed final landform and Rehabilitation Strategy address the issues that were raised during consultation with the NSW Resources Regulator regarding the final landform options and previous matters raised by the PAC and DPE in relation to the assessment of the Continued Operations Project. In general, the issues raised also apply to the Approved Operations final landform. In light of the comments from the NSW Resources Regulator, the draft Rehabilitation Strategy has been amended to further specify measures to manage both erosion and stability risks associated with the low wall and spontaneous combustion/fire risks (refer to **Appendix 16**). Implications for final land use options are addressed in **Section 6.10.3**.

Table 6.20 Specific Issues raised during Agency Consultation

Issue	Approved Operations	Proposed Modification	Comment
Highwall proximity to Main Creek	Eastern highwall located in excess of 200 m from Main Creek	Eastern highwall located approximately 160 m from Main Creek at its closest point	Geotechnical studies indicate that the eastern highwall will be stable in the long term and pose a low risk of collapse which, if occurred, could potentially result in floodwater ingress from Main Creek (PSM 2017). Highwall stability will be further verified as mining progresses (for safety purposes) and in the development of the final closure plan.
Slope Stability	Low wall battered to 18°. Drainage across slope to be managed to reduce long term erosion risks associated with long slope lengths. Ability to direct flows to exposed rock areas on the southern and western highwalls and exposed floor areas in eastern sections of the North Pit.	Low wall battered to 18°. Drainage across slope to be managed to reduce long term erosion risks associated with long slope lengths. Ability to direct flows to eastern, southern and western highwalls and exposed floor areas in eastern sections of the North Pit.	Consistent with the Approved Operations there are risks associated with drainage on battered slopes. In light of the comments made by the NSW Resources Regulator during consultation on the Proposed Modification, the draft Rehabilitation Strategy (refer to **Appendix 16**) has been updated to include additional focus on drainage management on battered slopes including the requirement for geotechnical assessments to be undertaken to ensure highwall stability prior to enhanced water flows. The detailed design of the drainage for the low wall, highwall and battered slopes on the upper bench of the southern highwall will have regard to erosion modelling and long term stability requirements. The detailed drainage design will be included in the Rehabilitation Management Plan/MOP developed as part of the detailed mine closure planning process.
Establishment of vegetation on highwalls	Native vegetation communities to be established on retained highwall benches. Growing medium to be emplaced prior to planting.	Native vegetation communities to be established on retained highwall benches. Growing medium to be emplaced prior to planting.	The vegetation strategy for highwall areas is as presently approved. The species selection for these areas will be similar to that used for woodland areas, however rooting depth restrictions may limit the ability for woodland vegetation communities to establish on benches. It is noted however that there are extensive areas of vegetation in the Hunter Valley where woodland is growing naturally in very shallow soils and above cliff lines. The use of benches for accessing low wall areas for maintenance purposes may limit vegetation on benches in some areas.

Issue	Approved Operations	Proposed Modification	Comment
Spontaneous combustion and combustion risks associated with exposed seams	Spontaneous combustion has not historically been a risk for operations at Mount Owen Mine. Exposed coal seams in the retained highwalls would be required to be assessed for spontaneous combustion and fire risk as part of the mine closure process.	The Proposed Modification will not result in any increased spontaneous combustion risks. Treatment of potential spontaneous combustion/fire hazards in exposed seams in the highwall would be as per the Approved Operations.	The management of spontaneous combustion does not rely on the emplacement of overburden over exposed seams. In light of the comments made by the NSW Resources Regulator, the draft Rehabilitation Strategy (refer to **Appendix 16**) has been updated to include additional commitments in relation to the management of spontaneous combustion and fire risks in exposed coal seams.

6.10.3 Implications for mine closure and final land use

The Approved Operations conceptual final land use is a combination of woodland and agricultural land. The proposed extension of the mine life associated with the Proposed Modification will result in a delay to the implementation of some areas of rehabilitation at the Mount Owen Mine relative to the Approved Operations however, with the exception of a minor reduction (4 ha) in grassland areas (refer to **Table 6.21**), will not have a material impact on the final land use. **Figure 2.5** shows the conceptual final land use and potential habitat corridors post closure under the Proposed Modification.

Table 6.21 Comparison of vegetation in Approved Operations vs. Proposed Modification final landforms

Project Component	Woodland/Open Forest (ha)	Grassland (ha)
Approved Operations*	2,037	341
Proposed Modification*	2,163 (8.8[#])	337 (36.1[#])
Difference	+126	-4

* Includes Ravensworth East areas
[#] Numbers in brackets indicate existing vegetation in Proposed Disturbance Area

The existing Mount Owen Mine is approved to retain 2 final voids. The proposed final landform and deeper North Pit void does not preclude alternate post mining land uses identified as being potentially available post closure as part of the Approved Operations. The deeper North Pit void may also increase the viability of some potential end uses for the North Pit void such as use as a water storage, pumped-hydroelectricity and waste recycling, re-use and emplacement. The infrastructure areas associated with the Approved Operations also have potential for being suitable for industrial or intensive agricultural use. The availability of access to rail through the rail loop and water in the voids, as well as the large separation distances from adjoining landholders, may also lend parts of the site to being suitable for industrial or intensive agricultural (e.g. poultry, piggeries, mushroom composting and farming) uses in the future. Further consideration of potential final land use options is provided in **Section 6.10.3.1**.

6.10.3.1 Conceptual Final Land Use Analysis

A high level analysis of the potential final land use options applicable to the Mount Owen Complex has been undertaken, including a review of the current applicable land use strategies (Hunter Strategic Plan (2016), the Upper Hunter SRLUP (2012) and the Singleton Shire Land Use Strategy (2008)) in relation to land use planning applicable to mine sites.

Hunter Strategic Plan 2036 (2016) and Upper Hunter SRLUP (2012)

The Hunter Strategic 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 Strategic 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 Strategic 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 Critical Industry Clusters (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 Strategic 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 Mount Owen Complex will provide existing infrastructure, connectivity to road and rail transport, and a large buffer of land, 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 at the Mount Owen Complex, as outlined further below.

Singleton Shire Land Use Strategy 2008

The Mount Owen Complex is located within the Singleton LGA. The Singleton Shire 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.

The Singleton Shire Land Use Strategy proposes that all new heavy industrial sites should be serviced by rail access. The Strategy prefers that sites do not have frontage/access to the New England or Goulburn Highways, 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.

The values attributed to the Mount Owen Complex provide the opportunity for a range of final use options identified by the Hunter Strategic Plan and the Singleton Land Use Strategy, 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 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
- Void with high local relief (height difference of up to 300 m) and upper and lower water storage
- Accessible rail loading infrastructure and rail loop with efficient access to Main Northern Rail Line and ready access to the Port of Newcastle
- Recently upgraded road access to the New England Highway/Freeway system
- Connection to communication and electricity infrastructure
- Accessible to workforce
- Proximity to urban areas (Singleton and Muswellbrook)
- Connection to Ravensworth State Forest and habitat corridors

Table 6.22 provides a high level analysis of potential post mining land uses for the Mount Owen Complex. **Table 6.22** 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 6.22** also provides a brief commentary on the potential land uses which are best aligned with the characteristics and values of the Mount Owen Complex.

Table 6.22 Potential Final Land Use Analysis

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
Future Mining Operations	Accessible and economically viable coal resources	Potential for additional coal resources to be available (subject to further exploration, feasibility investigations, environment impact analysis)	Further mining is not currently planned at Mount Owen and Ravensworth East Mines; however there is further coal resources located within existing Glencore mining tenements. Subject to further exploration, feasibility investigations, and market considerations may become an option in the future to further optimise coal recovery from this area
	Mining Infrastructure (MIA, CHPP etc.)	Existing Mount Owen and Ravensworth East MIA, Mount Owen CHPP	
	Water supply and storage Tailings storage	BNP/North Pit voids providing water/tailings storage, connection to GRAWTS	Glencore ownership of the Mount Owen Complex and the Integra Underground Mine has provided for the allocation of appropriate mining tenements to each operation with the recently approved Integra Underground Modification 8 allowing for the extraction of additional coal reserves that would have otherwise become sterilised. Further advances in mining technology, exploration and geological investigations may lead to further mining within these existing tenements becoming viable
	Rail and road infrastructure providing access to the Port of Newcastle;	Mount Owen rail loader and loop connecting to Main Northern Rail Line	
	Access to communication and electricity infrastructure	Established communication and electricity connections	
	Site with acceptable direct environmental impacts and with sufficient buffer land to minimise potential mining impacts and land use conflicts with sensitive land uses and Critical Industry Clusters (agriculture)	Established mining precinct, with extensive mine owned buffer land. Sensitive land uses in the context of the Mount Owen Complex have been identified and management strategies are in place	
	Accessible to skilled mining workforce	Significant skilled mining workforce in the region	Access and site facilities are in place and have sufficient life expectancy to continue to add value to potential future mining uses

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
Ancillary Mining Activities	Brownfield development sites with few environment and community constraints, preferably with existing coal processing infrastructure	Mount Owen and Ravensworth East MIA, Mount Owen CHPP	The proposed Glendell Continued Operations Project (currently in preparation) will provide for continued mining operations at the Glendell Mine 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 if required (subject to approval)
	Established water supply/storage and management Tailings storage	BNP/North Pit voids 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	
	Accessible to skilled mining/heavy engineering workforce	Site is accessible to local workforce	
Hydro Power	Built assets (offices, workshops, car parks etc.)	Mount Owen and Ravensworth East MIA 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	Mount Owen Complex includes voids with high local relief (height difference of up to 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	
	Connectivity to electricity grid	Grid connections to main office buildings – may need upgrade	
	Site with acceptable direct environmental impacts and with sufficient buffer land to minimise potential impacts (noise, air quality etc.).	Established site with extensive mine owned buffer land	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
	Land that can be shaped and developed for turbines, battery storage, transmission etc. Road/rail access Accessible to skilled engineering workforce	Opportunity to shape land suitable for generation and storage Road and rail access in place. Rail access to the Port of Newcastle, road access to New England Highway (NEH)/Freeway system Site is accessible to skilled and experienced engineering and power generation workers from local region	
Industrial/Manufacturing Uses	Built assets (offices, workshops, car parks etc.) Land resources – potential to create landforms suitable for large industrial sites Water infrastructure, storage available to prevent the need for licensed polluted discharge to waters Proximity to urban areas in terms of worker commute 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	Mount Owen and Ravensworth East MIA can be readily repurposed to provide office/workshop facilities reducing establishment costs 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. Site has good track record of managing all water on site and within GRAWTS, with no need for discharge to natural waterways Located approximately mid-way between Singleton and Muswellbrook The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	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 that provides more direction on preferred sites than is currently available in the Hunter Strategic Plan 2036

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
	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 NEH/Freeway system	
	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	
Industrial Agriculture (agribusiness, including intensive production and processing)	Built assets (offices, workshops, car parks etc.)	Mount Owen and Ravensworth East 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 Consistent with regional plan strategy to protect and enhance agricultural productivity – without impacting on the best 'natural' agricultural land (Land and Soil capability class 3 or better)
	Land resources – potential to create landforms suitable for large production sites; e.g. glasshouses, composting facilities etc.	Areas around 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 existing 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/Freeway system, and located midway between Singleton and Muswellbrook	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
	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 water (subject to licencing requirements)	
	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	
Military/other armed forces or specialist training facility, such as extreme terrain exercises, firing ranges etc.	Terrain suitable for diverse training experiences	Site will have diverse terrain	
	Remote or shielded from sensitive residential areas or other sensitive users, where military activity may have potential visual, noise, ecological or other impacts	The site and established buffer zone, are already managed to minimise potential impacts on surrounding land uses particularly noise Singleton Military Training Area is located approximately 30 km to the south-west. However it is noted there are several other closer mine sites to south and west	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
Active recreation/extreme sports (e.g. motocross, BMX, mountain biking, rock climbing and high ropes)	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 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 North Pit rehabilitated emplacement area and North Pit void area may be best opportunity for this potential land use Hunter Regional Plan 2036 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)	
	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	Mount Owen and Ravensworth East MIA can be readily repurposed to provide café, office/workshop facilities reducing establishment costs	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
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	
	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	
	Connections to waste research organisations and to appropriately skilled workforce		
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 Glennies Creek (subject to licencing requirements)	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mount Owen Complex Land Characteristics/Values	Comments
	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	
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	Hunter Regional Plan 2036 refers to growing 'landscape' tourism, building on existing scenic, fresh produce (including wine) and equine land uses The opportunity at the Mount Owen Complex is more about managing/recreating natural areas (some of which may also be suitable for recreation in the medium term), rather than the gastronomic tourism referred to in the Regional Plan 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	Work on enhancing ecological connectivity is already underway	
	Diversity of site conditions relevant to multiple aspects of research		
	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 6.21**, the Mount Owen Complex could provide strategic opportunities for a variety of potential final land uses, given the extensive infrastructure and accessibility. These final land use options are considered as potential land uses however will be considered closer to mine closure and will be dependent on demand at the time. It can be seen from the analysis outlined above, that there are a number of potential options for beneficial use of the final voids. Whether or not the voids are used directly 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 and safety considerations are in place, in accordance with standard mine closure requirements.

Consistent with the Approved Operations, any final land uses other than agriculture or woodland development will require further assessment and approval.

The Mount Owen Mine operations are expected to extend to 2037 and the detailed mine closure process will commence 5 years prior to planned cessation of mining with a detailed closure plan finalised no less than two years prior to planned cessation of mining. When the detailed mine closure planning process commences in more than 10 years from now, 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.

6.11 Social Impact Assessment

This section documents the outcomes of the Social Impact Assessment (SIA) for the Proposed Modification undertaken by Umwelt. As discussed in **Section 3.3**, since the completion of the EIS for the Continued Operations Project, the DPE has released the Social impact assessment guideline: for State significant mining, petroleum production and extractive industry development (DPE, 2017) (SIA Guideline) which outlines general requirements and requirements for pre-lodgement and application stages of project development respectively. The SIA for the Proposed Modification has been prepared in consideration of this SIA Guideline, however given a comprehensive and recent SIA was undertaken to support the Continued Operations Project (Umwelt, 2014) which is consistent with the requirements of the SIA Guideline, a targeted SIA t was undertaken for the Proposed Modification. This SIA has a strong focus on the key landholders within the vicinity of the Mount Owen Mine in addition to updating the key elements of the Continued Operations Project SIA. This approach and the proposed scope of works for the SIA for the Proposed Modification was confirmed through consultation with DPE (refer to **Appendix 5**).

Given the nature and scale of the Proposed Modification, and comprehensive engagement undertaken as part of the Continued Operations Project SIA, a good understanding of stakeholder issues and impacts is available, with management strategies currently in place as part of the Approved Operations. Where further refinement or changes to impact management may be required, this is noted in **Section 6.11.8**.

6.11.1 SIA Methodology

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 in order to provide a complete picture of potential impacts, their context and meaning.

As is the case with any type of change, some individuals or groups within a community may benefit, while others may experience negative impacts due to a development proposal. 'Impacts' may be positive or negative and may be unevenly distributed. If negative impacts are predicted, it is the role of the SIA to determine the level of impact that can be managed effectively to reduce the degree of impact to those affected; and positive impacts enhanced for community benefit.

6.11.2 SIA Phases

The SIA for the Proposed Modification involved the following key phases:

- updating the existing profile of the social and economic context in which the Mount Owen Complex is located, at a local and regional scale, and summarising existing social and community issues of relevance within the social area of influence
- identifying the impacts and opportunities associated with the Proposed Modification that are most important to the local community through engagement and consultation with proximal neighbours/ landholders and provision of information to key stakeholders and residents in the Singleton LGA
- assessing and predicting the significance of impacts associated with the Proposed Modification, relative to the Approved Operations, integrating both perceived and technical assessments of risk. This approach affords integration with the broader environmental assessment work so that impacts of relevance to technical specialists and community members are adequately discussed and considered in the impact assessment process
- reviewing existing measures in place to manage any additional negative impacts associated with the Proposed Modification or enhance beneficial impacts in a manner that values existing community aspirations and assets, and
- identifying how any additional social impacts will be managed and how any unanticipated social impacts that may result from the Proposed Modification will be identified.

6.11.3 Stakeholder Engagement

Engagement with the community has been a key component of the SIA program. At the commencement of the process, a Stakeholder Engagement Strategy was prepared and engagement was undertaken to:

- provide the community with an overview of the Proposed Modification and identify key issues and impacts for consideration in the assessment process
- inform the planning and development of appropriate strategies to better manage and enhance the Proposed Modification impacts, and
- Ensure that key stakeholders have a voice in the assessment program.

Further detail regarding the consultation program is provided in **Section 4.0**. Further analysis of the issues raised during the stakeholder consultation is provided in **Section 6.11.5**.

6.11.4 Social Context

In the 2016 census, Singleton LGA had a population of almost 23,000 and Bridgman a population of 200. **Appendix 17** provides a summary of the key demographic data for the Bridgeman State Suburb (SS) and Singleton LGA compared to the broader NSW population and these are summarised below. A community capitals framework was used to characterise the area of social influence relevant to the Proposed Modification.

The Proposed Modification is located in the Singleton LGA, in proximity to the locality of Falbrook. Falbrook is located on Falbrook Road, 5 km north-east of Camberwell, within the Bridgman SS.

Many of the key demographic characteristics of Bridgman SS and the Singleton LGA are fairly similar; however the following differences are noted for the Bridgman SS:

- higher percentage of people employed in mining (46%)
- higher percentage of technicians and trades workers (24.3%) and machinery operators and drivers (24.3%) than Singleton LGA and NSW
- higher participation in the labour force (72.5%) than Singleton LGA (64%) and NSW (59%)
- higher median weekly household income ($2062) and higher monthly mortgage repayments ($2292)
- higher percentage of families with children (50%)
- lower percentage of residents renting a property (16.7%)
- higher percentage of people with a Certificate III or IV qualification (36.6%) than Singleton LGA and NSW
- higher proportion of people likely to volunteer (32%)
- less mobile population – only 29% at a different address 5 years ago.

To assess the more functional linkages between the operation and the broader region, a survey was undertaken of the Mount Owen Complex workforce in 2013 as part of the SIA for the Continued Operations Project (Coakes Consulting, 2013) which highlights key residential and expenditure locations for employees and contractors associated with the Mount Owen Complex.

In summary, the report indicated that:

- Singleton (33%), Maitland (22%), Muswellbrook (10%) and Cessnock (7%) were key locations in which employees and contractors resided
- Mount Owen Complex workers directly contribute around $60M to various local economies annually (63% of which is spent in Singleton and Maitland)
- Singleton and Maitland benefit most from the Mount Owen Complex workforce contribution to local communities, through the highest household expenditure, use of local suppliers and greatest participation in community groups, and
- Singleton and Maitland host the highest usage of health service and education institutions by Mount Owen Complex workers and other family and household members.

Therefore in a regional sense, the LGAs of Muswellbrook, Maitland, Cessnock and Newcastle also have functional linkages to the Approved Operations through employee and local supplier residential and expenditure patterns.

Information obtained through consultation in relation to social influence provides an appreciation of landholder and key stakeholder perspectives in terms of values. The Singleton LGA comprises a range of natural assets, including mineable resources as well as natural assets such as Lake St Clair, Mount Royal National Park, Yengo National Park and Wollemi National Park. Stakeholders describe natural features as key factors in their decision to live and work in the area including water ways, such as Glennies Creek, wildlife and agricultural land.

In terms of social capital, there is a perception that the community identity in the area surrounding the Mount Owen Complex has changed significantly over the last 20 years – partly due to the influence of mining and partly in line with changes to small rural localities nationally. Heritage aspects of the locality and the family histories relating to these areas are also key values in the area.

6.11.5 Social Impact Scoping

6.11.5.1 Summary of key findings from the Continued Operations Project stakeholder engagement

As previously noted, an extensive stakeholder engagement program was undertaken as part of the Continued Operations Project from 2012 to 2015, with over 200 stakeholders engaged as part of the associated assessment process during this time.

For the Proposed Modification, further engagement has been undertaken with landholders and stakeholder groups to obtain additional feedback on the issues of most importance relevant to both the Approved Operations and the Proposed Modification. The issues identified during this consultation are discussed in **Section 6.11.6**.

During the consultation program undertaken during the preparation of the EIS for the Continued Operations Project the most common perceived impact themes identified by the community regarding the Approved Operations, as well as other mining operations in the local area, related to air quality and noise, with about 70% of landholders identifying one or both as a current issue. This theme was followed by economics (60%), land management (58%), blasting (55%) and road infrastructure (51%). The majority of these issues were also discussed in cumulative terms, and not specifically attributed to the Approved Operations, with residents reporting difficulties in fully distinguishing issues and impacts associated with individual sites, given their proximity to neighbouring mining operations.

During the public exhibition period of the Continued Operations Project EIS, 233 submissions were made. This included 12 Government Agency submissions and 221 community submissions (including interest group submissions). Of the 221 community submissions received, 85% stated support for the Continued Operations Project with 13% objecting. A further four submissions received provided comments only, neither objecting nor supporting the Continued Operations Project.

Forty three neighbouring residents provided feedback on the Continued Operations Project and the issues identified by local residents as most important are summarised in **Figure 6.33**. Air quality and noise related impacts were the key issues identified, and were often discussed from a cumulative perspective, with landholders identifying these as most challenging given the number of operating mines in the area. Economic discussions were very positive and related to continued local employment, business generation and investment in community activities and infrastructure, and were perceived as key benefits of the Continued Operations Project. Land management, blasting, roads and infrastructure, sense of community, water and visual amenity were also noted.

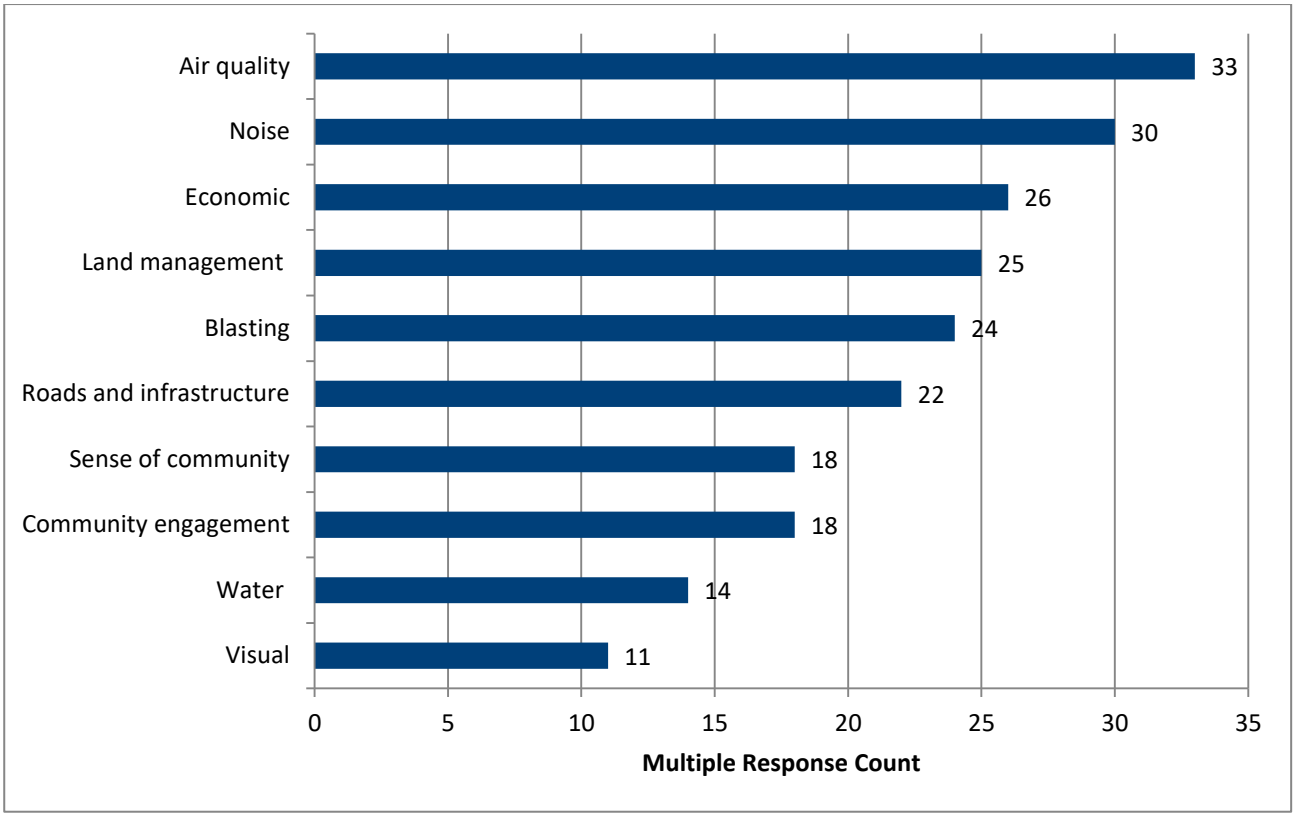


Figure 6.33 Perceived Impact Themes Identified by Neighbouring Landholders for the Continued Operations Project (N=43)

Note: Includes both positive and negative issues/impacts. Multiple responses permitted.
Source: Coakes Consulting (2013)

6.11.5.2 Complaints analysis

Mount Owen maintains an ongoing Complaints Register to record all community complaints, investigations and outcomes. The Complaints Register is available to the public via the Mount Owen Complex website at www.mtowencomplex.com.au. A review of the Complaints Register from the six year period between 2012 and February 2018 has been undertaken to provide some operational context to issues identified by landholders during the SIA consultation.

Mount Owen records all relevant contact with the community via the complaints line even if an investigation concludes that the mine's activities remain in compliance with development consent (and other regulatory) limits or the reported instance is not able to be attributed to the Approved Operations (e.g. a contact regarding a blast is recorded as a complaint even if the investigation finds that no blast from the Approved Operations occurred at the time reported).

6.11.5.3 Number and nature of complaints – Approved Operations

Mount Owen received, investigated and recorded a total of 34 complaints within the approximate 6 year period between 2012 and February 2018. As is shown in **Figure 6.34** below, the most common topics for complaints were blasting and noise, together accounting for 68% of all complaints received during this period.

Blasting complaints focused on larger blasts and associated overpressure, along with the dust created from blasting activities. This is shown in **Figure 6.35** below. Noise complaints included general noise from site machinery, in particular noise from excavation, loading and shovelling activities.

All complaints were investigated by the relevant Mount Owen personnel and/or senior management. Where required, additional management measures were put in place, which included positioning of lights (to address lighting) and relocation of real time monitors (to address noise). All blasting activities that triggered complaints were found to be compliant within development consent approval limits.

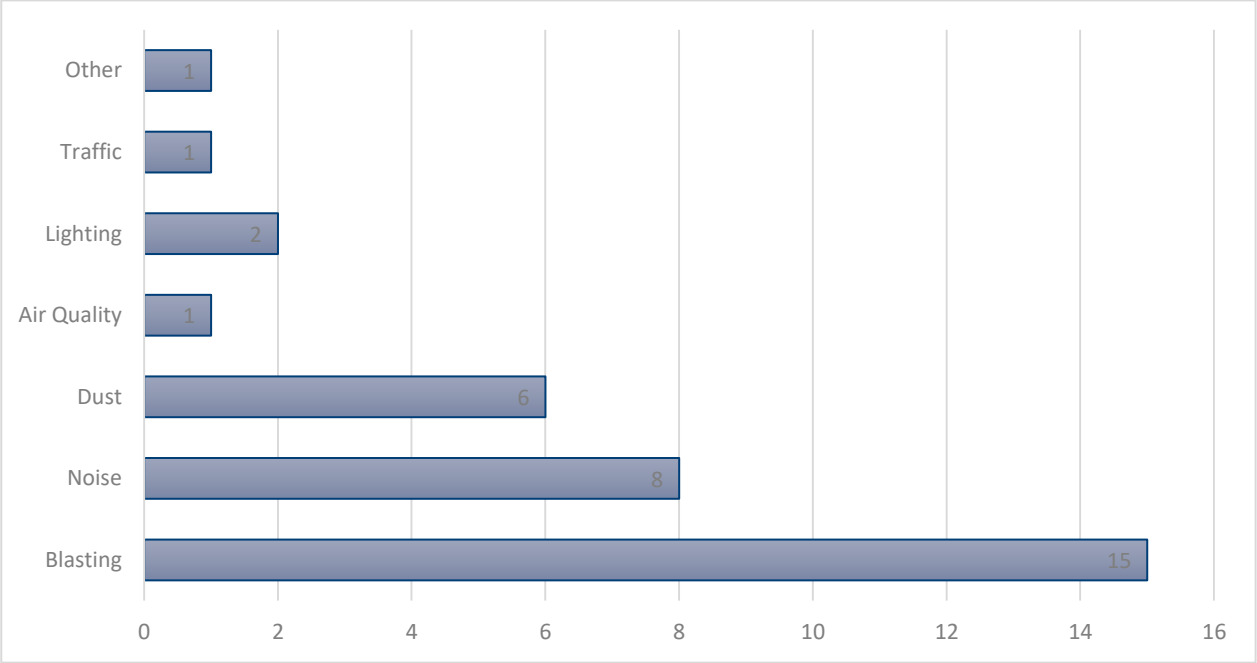


Figure 6.34 Complaints Received by Mount Owen 2012 – February 2018 (N=34)

Source: Mount Owen Complaints Register (2018)

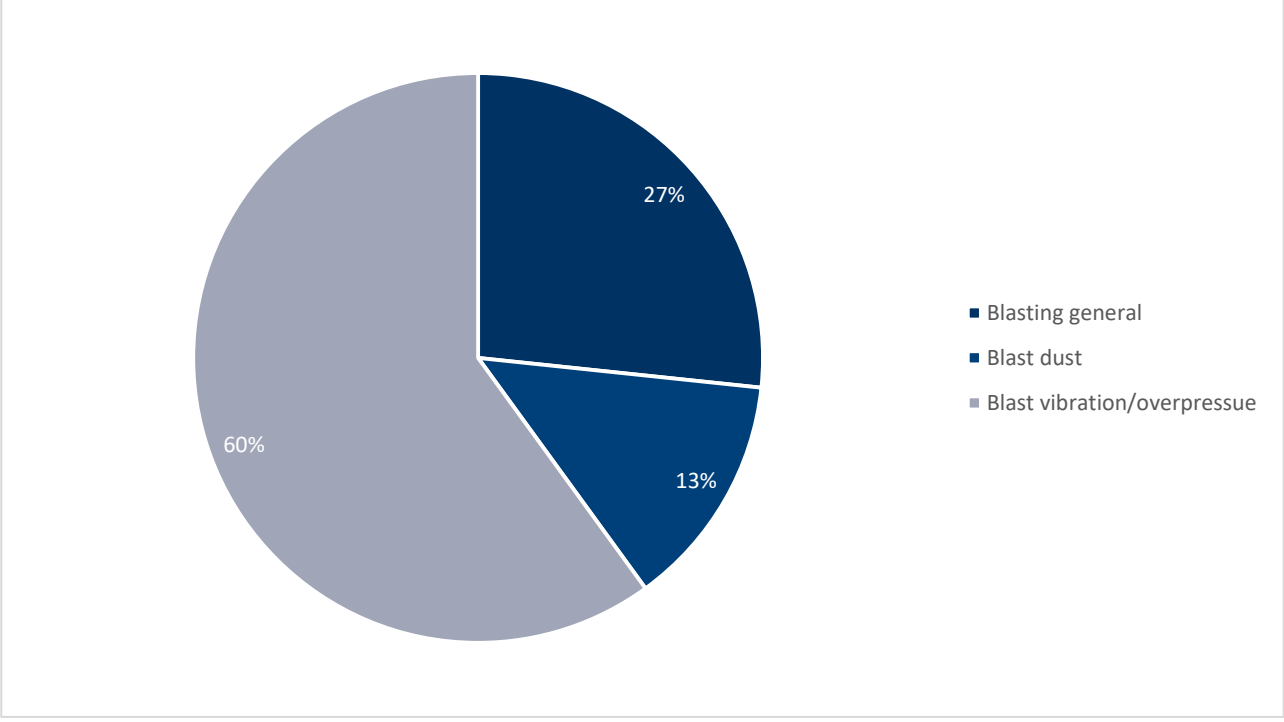


Figure 6.35 Blasting complaints for Mount Owen 2012 – February 2018 (N=15)

Source: Mount Owen Complaints Register (2018)

6.11.6 Perceived Issues and Opportunities – Proposed Modification

As previously discussed, the SIA for the Continued Operations Project included detailed consultation and assessment. For the Proposed Modification, further targeted engagement has been undertaken with landholders and stakeholder groups to obtain additional feedback on the issues of most importance relevant to both the Approved Operations and the Proposed Modification. Consistent with the SIA for the Continued Operations Project, air quality, noise and blasting impacts were identified by the local community as the most important social impact issues, as shown in **Figure 6.36**.

A comparison of issues identified by the community in relation to the Proposed Modification and the Continued Operations Project was undertaken which showed that air quality, noise and blasting were consistently identified as the most important environmental issues for stakeholders, with issues relating to land management, e.g. control of feral animals and weed management, identified as new or emerging issues.

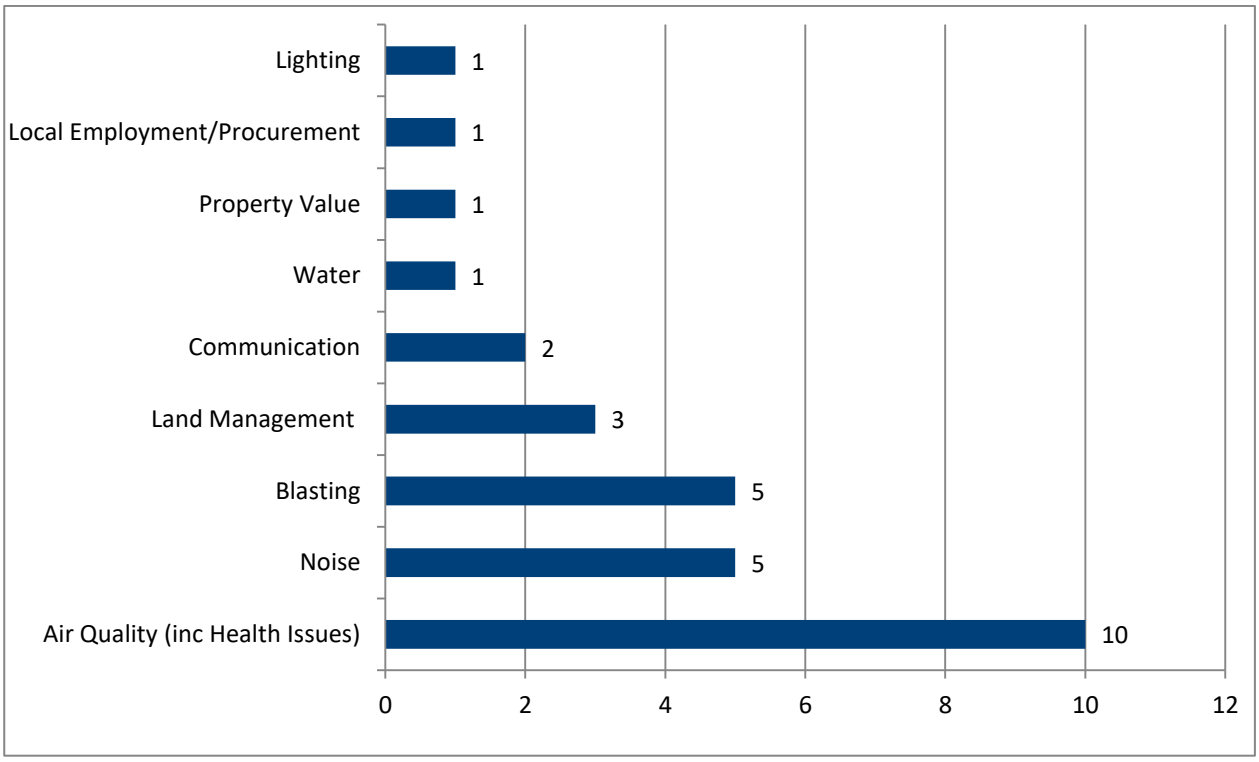


Figure 6.36 Community issues identified during Proposed Modification consultation

Descriptions of each of the salient issues identified by the community are provided below.

6.11.6.1 Air quality

The community identified cumulative air quality impacts (i.e. dust) affecting general amenity as the top issue of concern regarding the mining operations in the local area. Very few community members identified to specific dust issues, with more of a general tendency to regard dust as a cumulative concern to which the Approved Operations are contributors.

For the majority, air quality was a pre-existing concern and no new specific issues relating to the Proposed Modification were raised. The general amenity relating to air quality was a main concern, followed by impacts of dust on health, and dust present in water tanks affecting drinking water quality. The general maintenance of properties as a result of the impact of dust, i.e. dirty gutters, windows or pools, was also identified by local landholders. One stakeholder questioned the function of air quality monitoring on their own property.

6.11.6.2 Noise

In relation to the perceived impact of noise, stakeholders noted that it was a historic concern but had no new issues to raise that directly related to the Proposed Modification. Existing concerns include the general impact of noise on amenity, followed by noise experienced at different times of the day, most notably in the early morning and in the evening. The analysis of the Complaints Register (refer to **Figure 6.34**) reinforces this, identifying noise and blasting as the two most common issues of complaint over the last 6 years (eight complaints out of a total of 34 received).

6.11.6.3 Blast overpressure, vibration and dust

Five members of the community identified concerns relating to blasting. Sub-issues included the general effect of blasting on amenity, as well as the impact of vibration, including tremors after a blast and property damage (i.e. houses shaking, pictures moving, walls cracking).

The analysis of the Complaints Register (refer to **Figure 6.34**) places blasting as one of the top two issues of complaint in the past 6 years (15 complaints out of a total of 34 received). However, the majority of blasting complaints were received from one household, which may explain the level of discrepancy between its higher prominence in the complaints data than in the issues identified during community consultation.

6.11.6.4 Land management (feral animals, weeds, rehabilitation)

Land management has been identified as an emerging issue. Pest and weed management within buffer lands around the mining operations and at residential properties is important to the surrounding community. Stakeholders acknowledge the existing wild dog baiting program in place but would like to see greater coordination between Mount Owen, neighbouring mining operations and also Hunter Local Land Services.

6.11.6.5 Communication and process issues

While not directly related to the SIA, the consultation also indicated two stakeholders felt they didn't receive enough time to prepare submissions for the Continued Operations Project and requested to be notified of the public exhibition period for the Proposed Modification.

6.11.7 Significance Assessment

This section provides an assessment of the significance of the social impacts that have been identified as part of the SIA.

In accordance with the SIA Guideline, the preliminary significance assessment has taken into account the impact characteristics as outlined in **Table 6.23** and categories of social impact, i.e. impacts on:

- way of life
- community
- environment
- personal and property rights, and
- culture
- political systems
- health and well-being
- people's fears and aspirations.

Table 6.23 Impact Characteristic for Assessing Significance (DPE, 2017)

Characteristic	Definition
Duration	• When the impact will occur and over what period
Extent	• Geographic extent of the impact, e.g. broad or localised • Number of people potentially affected by the impact
Sensitivity	• Social value placed on the affected aspect of the social environment by different potentially affected people or groups • Resilience of the potentially affected people or groups, i.e. their ability to adapt and respond
Severity	• The intensity of the potential effect or consequence on the social environment or potentially affected people or group • Whether the effect or consequence is acute or chronic

Table 6.24 outlines the risk ranking matrix that has been used in the prediction of social impacts for the Proposed Modification.

Table 6.24 Risk Ranking Matrix

			Consequence Level				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Catastrophic
Likelihood Level	**A**	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Social Risk Rating							
	Low		Moderate		High		Extreme

Source: Social impact assessment guideline: for State significant mining, petroleum production and extractive industry development (DPE, 2017)

The outcomes of the preliminary assessment process for each impact are provided in **Table 6.25** and build on the summary of impacts outlined in **Section 6.11.6**.

Table 6.25 Summary comparison of evaluation results for negative social impacts, without and with mitigation

Impact description				Impact without mitigation	Impact with mitigation	
Impact	Timing	Affected parties	Impact characteristics	Stakeholder risk rating	Social risk rating	Residual risk description
Air quality – impact on social amenity	Until approximately 2037	Local residents	Dust Fume Emissions	**High**	**Low**	Air Quality Impact Assessment (Jacobs, 2018) indicates the Proposed Modification is not predicted to result in increased impacts to any areas of privately owned land (not currently subject to acquisition) relative to the Approved Operations.
Noise - impact on social amenity	Until approximately 2037	Local residents	Operational noise related to machinery, traffic and mining activities	**High**	**Low**	Noise Impact Assessment (Umwelt 2018) indicates the Proposed Modification is not predicted to result in increased impacts to any areas of privately owned land, relative to the Approved Operations.
Blasting – impact on social amenity	Until approximately 2037	Local residents	Ground vibration and overpressure, Noise Flyrock	**Moderate**	**Low**	Blast Impact Assessment (Enviro Strata Consulting 2018) indicates that the potential impacts resulting from blasting activities can be managed effectively consistent with the Approved Operations. Mount Owen will continue to communicate with the surrounding community regarding blasting activities. Private landholders can register to be informed of the blasting schedule. Mount Owen also operates a 24 hour community response line.

Impact description				Impact without mitigation	Impact with mitigation	
Impact	Timing	Affected parties	Impact characteristics	Stakeholder risk rating	Social risk rating	Residual risk description
Visual – impact to social amenity	Until approximately 2037	Local residents	Change in potential view	**Low**	**Low**	Although there will be increased visibility of the North Pit overburden emplacement area at Residence R095 and from Middle Falbrook and Glennies Creek Roads as a result of the Proposed Modification, this impact will be mitigated through the implementation of progressive rehabilitation and the implementation of a planted screen along Glencore owned land at the Middle Falbrook and Glennies Creek Road intersection.
Dust – impact on health and wellbeing	Until approximately 2037	Local residents	Airborne dust particles	**High**	**Low**	Air Quality Impact Assessment (Jacobs, 2018) indicates the Proposed Modification is not predicted to result in increased impacts to any areas of privately owned land (not currently subject to acquisition rights) relative to the Approved Operations.
Impact on Ecological Values	Until approximately 2037	Local Residents Regional stakeholders Environmental NGOs Government Agencies	Threated fauna, flora species and vegetation communities	**Moderate**	**Low**	The majority of the Proposed Disturbance Area is previously disturbed land with low quality vegetation, grassland and an olive plantation. A biodiversity offset strategy is being developed in accordance with government requirements to appropriately offset the removal of vegetation and fauna habitat within the Proposed Disturbance Area.

Impact description				Impact without mitigation	Impact with mitigation	
Impact	Timing	Affected parties	Impact characteristics	Stakeholder risk rating	Social risk rating	Residual risk description
Land management – mine owned land and areas of community and environmental value	Until approximately 2037	Local residents	Potential for weeds and pests to cross over onto private properties Site rehabilitation	**Moderate**	**Low**	The Mount Owen Complex Biodiversity and Offset Management Plan includes management measures in relation to the control of weeds and feral animals. The Mount Owen Complex has an established land management forum. This group could be further structured to identify relevant strategies to improve land management in line with issues identified through consultation.
Impact of acquisition on local resident population	Until approximately 2037	Landholders subject to acquisition Wider community	Any property subject to acquisition rights	**High**	**Low**	Nil additional properties within acquisition zone as a result of the Proposed Modification relative to the Approved Operations.

6.11.8 Management and mitigation

Mount Owen has a number of existing strategies in place which will address the potential impacts of the Proposed Modification. As such, the predicted social impacts/risks associated with the Proposed Modification have been rated as low when these existing mitigation measures are in place.

Mount Owen already has a Stakeholder Engagement Strategy that outlines how and when they communicate with stakeholders, including their directly impacted neighbours. It is suggested that this document continue to be reviewed annually and adjusted with changes in community sentiment.

The Mount Owen Complex Stakeholder Engagement Strategy is available on the Mount Owen Complex website www.mtowencomplex.com.au/en/community/documents.

6.11.9 Evaluation and monitoring

The social impacts from the Proposed Modification are consistent with the Approved Operations, therefore, there will be minimal additional impact to the local community. Every 3 years Glencore undertake a detailed community survey, and the findings of that survey along with the annual review of the Stakeholder Engagement Strategy, will inform future operational and community engagement for the operation.

6.12 Economics

An Economic Impact Assessment of the Proposed Modification was undertaken by Deloitte Access Economics. The Economic Impact Assessment comprises a cost benefit analysis (CBA) and a local effects analysis (LEA) in line with the *NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals* (2015) and other relevant guidelines. The Economic Impact Assessment is included in **Appendix 18**.

The Economic Impact Assessment considers the Proposed Modification (Project Case), relative to a base or 'business-as-usual' scenario. In this instance the Base Case is the Approved Operations.

6.12.1 Cost Benefit Analysis

A CBA is a method of obtaining a consolidated estimate of the net economic value of the Proposed Modification by identifying the incremental costs and benefits relative to the Base Case (i.e. the Approved Operations with no Proposed Modification), placing a quantitative value on these items wherever possible and deriving the share of each item that is attributable to NSW.

The scope of any CBA for a project is defined by:

- Base Case – identifying the 'business as usual' or 'do nothing' scenario against which to assess the potential economic, social and environmental changes due to the Proposed Modification
- Project Case – full specification of the Proposed Modification scenario to be assessed, relative to the Base Case
- Community of interest – defining the community for which the benefits and costs of the Proposed Modification should be assessed.

For the purpose of this CBA, as the Proposed Modification includes changes to the production schedule at the Mount Owen Mine, the assessment is targeted to the Base Case which includes only those aspects of the Approved Operations which are directly relevant to assessing the incremental impact of the Proposed Modification compared to the Base Case. Specifically, the Base Case involves the continuation of mining activity at the Mount Owen mine beyond 2018 to 2030, and extracting approximately 98 Mt of ROM coal (approved and proposed) at an expected annual production of up to 10 Mtpa ROM coal. Under the Base Case, operations at the Mount Owen Mine require an operational workforce of between 249 and 660 FTEs between 2018 and 2030.

In recognition of the broad range of economic impacts of the Proposed Modification, costs and benefits have been separated into eight categories according to the part of the community that they accrue to. For instance, Glencore will receive the net producer surplus (defined as an economic measure of the overall benefits to the owner of a project, based on the overall revenue of the project less all capital, operating, regulatory and taxation related costs), while royalties and company income tax will be paid to the NSW and Australian Governments respectively. Other third parties that may be impacted by the Proposed Modification include landholders, workers, suppliers, residents in the local community and Singleton Council. This categorisation assists in apportioning the share of the net benefits of the Proposed Modification to the NSW community.

The costs and benefits considered in the analysis are provided in **Table 6.26**.

Table 6.26 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 NSW Government	
Company income tax	Company income tax payable to the Australian Government	
Economic benefit to existing landholders	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* Ambient noise Biodiversity Water* Aboriginal heritage* Non-Aboriginal heritage* Visual amenity*
Net public infrastructure costs		Incremental costs for government associated with provision of public infrastructure *

* Item has been considered qualitatively as per the Treasury Guidelines

The overall finding of the CBA is that the Proposed Modification is estimated to contribute a total net economic benefit for the NSW community of approximately $52.9M (in present value terms – i.e. how much a future sum of money is worth today). **Table 6.27** presents the overall results of the CBA for the NSW community. Each estimate is measured in net present value (NPV) terms, calculated using a 7% discount rate, in 2018 price terms, discounted back to the start of 2018.

Table 6.27 Overall CBA results for NSW community

Summary Item	Value ($m, NPV)
Incremental benefits to NSW	62.9
Incremental costs to NSW	10.1
Overall net benefit of Project Case for NSW community	52.9

Source: Deloitte Access Economics calculations (refer to Appendix 17)

The additional royalties to the NSW Government is the main incremental benefit to NSW of the Proposed Modification in relation to the Base Case. The Proposed Modification is estimated to generate around $59M (in present value terms) in additional royalties for the NSW Government, relative to the Base Case. The key incremental costs of the Proposed Modification (within the NSW community) are the additional external costs, such as the cost of greenhouse gas emissions and particulate matter.

As recommended in the current NSW Government Guidelines for the economic assessment of mining and coal seam gas proposals (2015), where it is difficult to place a value on a particular cost or benefit of the Proposed Modification, a qualitative analysis has been undertaken. The results indicate that these non-quantified externalities would need to generate costs of around $4.99M per year (in real terms) for NSW from 2018 to 2037 to fully offset the estimated net benefits of the Proposed Modification. This is equivalent to undiscounted costs of $99.81M over the period.

The CBA therefore shows that when all potential costs and benefits are considered, the Proposed Modification will deliver a net benefit for the NSW community.

Sensitivity Analysis

The CBA results are subject to the assumptions and valuations applied to each cost and benefit. A sensitivity analysis was completed in order to test the sensitivity of the estimate of net economic benefit by also considering upper and lower bound discount rates, and varying the size of a number of parameters of interest.

Based on the recommendations in the Guidelines, a sensitivity analysis has been undertaken using a lower bound discount rate of 4% and an upper bound discount rate of 10%. In all three scenarios, the Proposed Modification is estimated to deliver a net benefit for the NSW community, that is, the benefits for NSW are estimated to exceed the costs of the Proposed Modification borne by NSW, including the quantifiable externality costs. The estimate of net economic benefits for NSW range from around $39M to $72.5M (in present value terms).

The second necessary component of a sensitivity analysis is to also vary the estimates for different inputs. The variations undertaken as part of this analysis include:

- increasing export coal price forecasts by 30%
- decreasing export coal price forecasts by 20%
- increasing incremental royalties by 25%
- decreasing incremental royalties by 25%
- increasing Project Case company tax by 50%
- decreasing Project Case company tax by 50%
- pricing the cost of carbon according to alternative prices used in the Australian Treasury Clean Energy Future Policy Scenario (around 280% higher than the prices used in the central case scenario, on average)
- pricing the cost of carbon according to alternative US EPA Social Cost of Carbon estimates (5% discount rate scenario) (around 80% higher than the prices used in the central case scenario, on average).

Under all scenarios assessed the Proposed Modification results in a net economic benefit to the NSW community, refer to **Appendix 18** for further detail.

6.12.2 Local Effects Analysis

Local Effects Analysis (LEA) assesses employment effects of the Proposed Modification with reference to the locality. The LEA is intended to be complementary to the CBA for NSW and translates the effects estimated at the State level to the impacts on the communities located near the mine site.

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
- it is not intended that the components of an LEA can be added together to provide a single summary measure – each item reported presents a different local effect
- the LEA does not measure economic welfare outcomes.

The Proposed Modification is situated entirely within the Lower Hunter Statistical Area 3 (SA3). SA3 includes the localities of Singleton, Cessnock and Dungog. The population of the entire SA3 has been used to model the impact of the Proposed Modification as labour and other expenditure is likely to be concentrated throughout this area.

The LEA assesses effects on:

- local employment
- local non-labour expenditure
- other local industries
- environment and social considerations

The Project Case is estimated to directly employ an average of 96 FTE per year from the locality, measured in full time equivalents (FTE), incremental to the Base Case. No changes are proposed to the current peak workforce at Mount Owen as part of the Project Case. The majority of this incremental employment occurs in the final six years of the Project Case when the Base Case does not employ any workers. This direct employment is expected to result in a net increase in income in the locality of around $2.4M a year during ongoing operations, equivalent to 39 FTE employees respectively (assuming that these individuals would earn the average wage in the locality if they weren't employed at the Mount Owen Mine).

In addition to employment, the Proposed Modification is expected to directly spend $16.6M a year in the locality on non-labour inputs during ongoing operations.

The Proposed Modification also creates external costs to the locality. The largest external cost is expected to be from air quality effects. The total value of quantifiable external effects is estimated to be around $463,000 per year during ongoing operations.

6.12.3 Flow on Effects

Computable General Equilibrium (CGE) modelling has been undertaken to analyse the secondary impacts of the Project Case 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).

Based on the capital and operational expenditures, the modelling gauges the wider economic impacts of the development and operation of the Proposed Modification at two levels:

- **Direct impacts** — the economic gains associated with 'core' commercial operations, namely the coal extraction and processing, and revenues generated by the sale of coal exports from the mine.
- **Indirect, induced and crowding out impacts** — the economic gains in related upstream or downstream industries where the benefits associated with increased resource activity are typically the highest. As outlined above, the CGE modelling also captures any crowding out of activity in other sectors of the economy as a result of the Proposed Modification.

Gross Regional Product (GRP) is projected to be negative in 2018-20 as a result of the decrease in capital expenditure relative to the Base Case. The GRP impact is positive in the subsequent years as the positive impact of incremental coal production flows through, peaking at over $106M in 2031 in the locality. The total annual state-wide gross state product (GSP) impacts across the rest of the State peak at around $14M in 2031, and peak at a total of $120M for NSW as whole in 2031.

In NPV terms, over the modelling period, total locality GRP is projected to increase by $285M. There is also an impact on the rest of the NSW economy with an increase of $24M in NPV terms over the period to 2037. Therefore, GSP is projected to be $309M greater over the modelling period under the Project Case scenario.

6.12.4 Net Benefit for the Local and NSW Community

The Economic Impact Assessment concluded that overall, the Proposed Modification is expected to generate net benefits, and is also expected to generate increased economic activity and employment within the NSW community. The Proposed Modification will have a positive economic impact, for the region and the State of NSW. In total, the Proposed Modification is anticipated to:

- generate net economic benefits of $52.9M to NSW (in NPV terms)
- generate royalties of an estimated $59M (in NPV terms) to the NSW Government
- increase the GRP in the locality and in NSW by a projected approximately $285Mand $309M respectively (in NPV terms)
- directly employ around 96 FTE per year from the locality during ongoing operations, incremental to the Base Case. No changes are proposed to the current peak workforce at Mount Owen as part of the Project Case. The majority of this incremental employment occurs in the final 6 years of the Project Case when the Base Case does not employ any workers.

7.0 Conclusion and Justification

This section provides a conclusion discussing the justification for the Proposed Modification, taking into consideration the environmental impacts of the Proposed Modification and the suitability of the site, to assist the consent authority to determine whether or not the Proposed Modification is in the public interest.

Given that the impacts are substantially the same as the Approved Operations, along with additional economic benefits (as detailed in **Section 6.12**) associated with additional coal reserves, the outcomes of the Approved Operation EIS in relation to Ecologically Sustainable Development (ESD) are not affected by the Proposed Modification. As such it is submitted that the Proposed Modification meets the principles of ESD as defined under the EP&A Act, and as detailed in the following sections.

7.1 Environmental Impacts

As detailed in **Section 6.0**, the potential environmental impacts of the Proposed Modification have been identified and are the subject of a detailed assessment based on:

- assessment of the site characteristics (existing environment)
- focused consultation with all relevant government agencies
- engagement with local community and other stakeholders
- 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 were the subject of the comprehensive specialist assessments of the potential impacts of the Proposed Modification relative to the Approved Operations on the existing environment, as detailed in **Section 6.0** and the appendices to this SEE.

The impacts of the Proposed Modification remain consistent with the level of impact predicted for the Approved Operations. The impacts of the Proposed Modification have been kept to a minimum through a comprehensive assessment of alternatives, refinement to the conceptual mine plans and continued commitment to the implementation of management and monitoring measures to avoid, minimise, mitigate or offset potential environmental impacts.

7.2 Suitability of the Site

The Proposed Modification seeks approval to modify the existing SSD-5850 development consent for the Mount Owen and Ravensworth East Mines with both mining operations well established and currently operating. The immediate area surrounding the Mount Owen Complex is dominated by established mining operations; however there are a number of private residences located to the south and south-east of the North Pit in the Middle Falbrook area. Mount Owen undertook mine plan refinements to ensure that the Proposed Modification can continue to be managed to meet the current SSD-5850 criteria for noise and updated standards for air quality for surrounding private receiver locations. These refinements included alterations to mine plans and progression, along with a range of operational controls and measures to be implemented over the life of the Proposed Modification.

A key objective of the Proposed Modification included maximising the use of previously disturbed areas, existing and approved mining infrastructure and further development of existing environmental mitigation and management strategies to mitigate and manage the predicted impacts associated with the Proposed Modification (refer to **Section 3.2.1**), thereby limiting potential for conflicts with other land uses, particularly the surrounding private residences.

7.3 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) is one of a number of objectives of the EP&A Act and is defined by Section 6(2) of the *Protection of the Environment Administration Act 1991*. This section provides an assessment of the Proposed Modification in relation to the principles of ESD.

To justify the Proposed Modification with regard to the principles of ESD, the benefits of the Proposed Modification 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
- 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

7.3.1 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 potential impacts associated with the Proposed Modification, an extensive evaluation of all the key components of the Proposed Modification has been undertaken as part of this SEE. Detailed assessment of all key issues and necessary management procedures has been conducted and is comprehensively documented in this SEE.

The assessment process has involved a detailed study of the existing environment (refer to **Section 5.0**), and the use of engineering and scientific modelling to assess and determine potential impacts as a result of the Proposed Modification relative to the Approved Operations. To this end, there has been careful evaluation to avoid, where possible, irreversible damage to the environment.

A preliminary environmental analysis was undertaken for the Proposed Modification to identify key areas for further impact assessment. The review of appropriate mitigation measures and strategies was also undertaken as a part of the detailed assessment process. The Precautionary Principle has therefore been applied to the assessment of the Proposed Modification by seeking to minimise the potential for serious irreversible environmental damage through:

- careful design and refinement of the proposed conceptual mine plans particularly in relation to noise and air quality impacts
- identification of the potential impacts and the likelihood and consequences of these impacts
- identification of any additional management and mitigation measures relative to the Approved Operations designed to address any additional potential environmental impacts of the Proposed Modification, including the proposed increased mine life and associated prolonged impacts
- implementation of additional monitoring and reporting mechanisms for the Proposed Modification.

Where uncertainty in the data used in the assessment has been identified, a conservative worst case analysis has been undertaken and contingency measures have been identified to manage that uncertainty. Detailed mitigation and monitoring measures will continue to be implemented in accordance with the relevant management and monitoring plans which will be updated as required as part of the Proposed Modification (refer to **Sections 2.3** and **5.0**).

7.3.2 Intergenerational Equity

The EP&A Regulation defines the principle 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 is based on the principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

A range of mining options has been considered through the concept design phase to seek an appropriate balance between accessing economic coal reserves whilst avoiding and minimising potential environmental and social impacts. In particular, the design of the Proposed Modification sought to:

- maximise reserve recovery within Glencore mining tenements while minimising the overall Proposed Disturbance Area as far as practicable
- avoid disturbance of the existing Ravensworth State Forest and existing Biodiversity Offset Areas
- minimise impacts to Main Creek and associated alluvium
- minimise the impact to the north-south habitat corridor located to the south-east of the North Pit
- establish a final landform that is safe, stable and non-polluting, providing for sustainable post mining land use options whilst minimising impacts consistent with the key commitments of the approved Continued Operations Project final landform as it relates to landform design, conservation and water management.

Key benefits of the Proposed Modification include:

- continuation of the North Pit life to 2037
- improving the economic life of the Mount Owen Mine and providing for the ongoing employment for the existing workforce of up to 660 people, and
- maintaining and, where relevant, building on the existing environmental mitigation and management strategies to minimise impacts associated with the Proposed Modification.

There will be no increase in impact associated with the Proposed Modification relative to the Approved Operations, with the exception of prolonged impacts associated with the extension of the mine life. The design of the Proposed Modification and Mount Owen's continued commitment to the management of environmental issues as outlined in this SEE will maintain the health, diversity and productivity of the environment for future generations. Mount Owen will continue to make a significant contribution to maintaining services in the community through the direct and flow on effects of employee and operational expenditure and through the development contributions associated with the Continued Operations Project in accordance with the EP&A Act.

7.3.3 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 Proposed Modification are described in the SEE (refer in particular to **Section 6.6** and **Appendix 13**). Potential impacts are also outlined in the SEE (refer to **Section 6.6**) and measures to ameliorate any negative impact are outlined in **Sections 2.3** and **6.0**.

A key objective of the Proposed Modification is to avoid disturbance of the existing Mount Owen Biodiversity Offset Areas which were set aside as ecological offsets for the Approved Operations. However, the Proposed Modification does result in the disturbance of an additional 46 ha of land.

The final biodiversity offset strategy to be delivered for the Proposed Modification will include some or all of the following offsetting options under the FBA:

- in-perpetuity conservation through the establishment of proponent-managed Stewardship site, achieved through the retirement of credits
- securing required credits through the open credit market and/or
- payment to the Biodiversity Conservation Fund (established under the BC Act 2016).

7.3.4 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. Pricing of resources is also captured in the regulatory regime applying to surface and groundwater extractions.

Mount Owen considered the costs of management measures to minimise potential environmental and social impacts over the life of the Proposed Modification. There will also be additional costs associated with establishing and managing ecological offsets to reduce the magnitude of ecological impacts, and these costs have been accounted for.

Consistent with the Approved Operations the Proposed Modification will continue to optimise the valuation and pricing of the coal reserves 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 reserves and avoiding the isolation and sterilisation of coal through effective mine planning and location of site infrastructure.

7.4 Conclusion

As outlined in **Section 7.3**, the Proposed Modification has been assessed against the principles of ESD as required by the EP&A Act. This assessment has indicated that the Proposed Modification is consistent with the principles of ecologically sustainable development.

The Cost Benefit Analysis and Economic Impact Analysis (refer to **Appendix 18**) describes a range of positive benefits from the Proposed Modification that will result at a local, regional and State level. These benefits include:

- continued employment of the existing workforce of approximately up to 660 full time equivalent positions at the Mount Owen Mine
- a total increase in the royalty revenue stream flowing to the NSW government estimated to be $59M (in NPV terms) over the life of the Proposed Modification.

The cost benefit analysis of the Proposed Modification, which considered external and internal costs including environmental and social externality costs, determined a net benefit of $52.9M to NSW in NPV terms over its life (refer to **Section 6.12**). The Proposed Modification will also provide considerable additional benefits in the form of royalties, taxation and other government revenue which will be recycled through the economy.

The environmental impacts associated with the Proposed Modification are consistent with the Approved Operations. On this basis, it would be reasonable to consider that with the continued implementation of the management, mitigation and offset measures proposed by Mount Owen, the Proposed Modification will result in a substantial net benefit to the NSW community.

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9.0 Abbreviations and Glossary

Terms	Definition
ACHA	Aboriginal Cultural Heritage Assessment
ACHAR	Aboriginal Cultural Heritage Assessment Report
ACHMP	Aboriginal Cultural Heritage Management Plan
AEMR	Annual Environmental Management Report
AEP	Annual Exceedance Probability
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AIP	NSW Aquifer Interference Policy
ANZECC	Australian and New Zealand Environment Conservation Council
AQIA	Air Quality Impact Assessment
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator
BC Act	*Biodiversity Conservation Act 2016*
BIA	Blast Impact Assessment
BMP	Blast Management Plan
BNP	Bayswater North Pit
BOMP	Biodiversity and Offset Management Plan
BSAL	Biophysical Strategic Agricultural Land
BVT	Biometric vegetation types
CBA	Cost Benefit Analysis
CEEC	Critically Endangered Ecological Community
CGE	Computable General Equilibrium
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Clusters
CLWD	Crown Lands and Water Division
CPDP	Conceptual Project Development Plan
CSG	Coal seam gas
DEC	Department of Environment and Conservation
DoE	Department of Environment
DoEE	Commonwealth Department of Environment and Energy
DPE	Department of Planning and Environment
DSC	NSW Dams Safety Committee
EA	Environmental Assessment
EC	Electrical Conductivity
EEC	Endangered Ecological Communities

Terms	Definition
EHC Act	*Environmentally Hazardous Chemicals Act 1985*
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENM	Environmental Noise Model
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESC	Enviro Strata Consulting
ESCP	Erosion and Sediment Control Plan
FBA	Framework for Biodiversity Assessment
FTE	Full time equivalent
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
GHGEA	Greenhouse Gas and Energy Assessment
GRAWTS	Greater Ravensworth Area Water and Tailings Scheme
GRP	Gross Regional Product
GSP	Gross State Product
GWIA	Groundwater Impact Assessment
HRSTS	Hunter River Salinity Trading Scheme
HVO	Hunter Valley Operations
IESC	Independent Expert Scientific Committee
INP	Industrial Noise Policy
LEA	Local effects analysis
LEP	Local Environment Plan
LGA	Local Government Area
LiDAR	Light Detection and Ranging
LOM	Life of Mine
LULUCF	Land use, land use change and forestry
mAHD	Metres above Australian Height Datum
mlcm	Million loose cubic metres
MIA	Mine Infrastructure Area
MIC	Maximum Instantaneous Charge
MLA	Mining Lease Application
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MSB	NSW Mine Subsidence Board

Terms	Definition
MSC Act	*Mine Subsidence Compensation Act 1961*
Mt	Million tonnes
Mtpa	Million tonnes per annum
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
OEH	Office of Environment and Heritage
PAC	Planning and Assessment Commission
PCTs	Plant Community Types
PM	Particulate Matter
POEO Act	*Protection of the Environment Operations Act 1997*
PSNL	Project Specific Noise Levels
RAPs	Registered Aboriginal Parties
RFS	Rural Fire Service
ROM	Run of mine
SEE	Statement of Environmental Effects
SEOC	South East Open Cut
SEPP	State Environmental Planning Policy
SIA	Social Impact Assessment
SRLUP	NSW Government Strategic Regional Land Use Plan
SS	State Suburb
SVC	Site Verification Certificate
SWIA	Surface Water Impact Assessment
SWL	Sound Power Levels
TDS	Total Dissolved Solids
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSPD	Threatened Species Profile Database
TSS	Total Suspended Solids
µg	Micrograms

Terms	Definition
UHSA	Upper Hunter Strategic Assessment
UNFCCC	United Nations Framework Convention on Climate Change
VCA	Voluntary Conservation Area
VIS	Vegetation Information System
VLAMP	Voluntary Land Acquisition and Mitigation Policy 2014
VWPS	Vibrating wire pressure sensors
WM Act	*Water Management Act 2000*
WMS	Water Management System
WSP	Water Sharing Plan
WOOP	Western Out of Pit

GLENCORE

Mount Owen Pty Limited
PO Box 320
Singleton NSW 2330
Australia

p. (02) 6570 0800

www.mtowencomplex.com.au

umwelt

Newcastle

Umwelt (Australia) Pty Limited

75 York Street
Teralba NSW 2284

p. 02 4950 5322

www.umwelt.com.au