MANGOOLA
OPEN CUT
GLENCORE

MANGOOLA COAL CONTINUED OPERATIONS PROJECT

ENVIRONMENTAL IMPACT STATEMENT

JULY 2019

umwelt
Environmental & Social
Consultants

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OPEN CUT
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Environmental Impact Statement

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Mangoola Coal Operations Pty Limited

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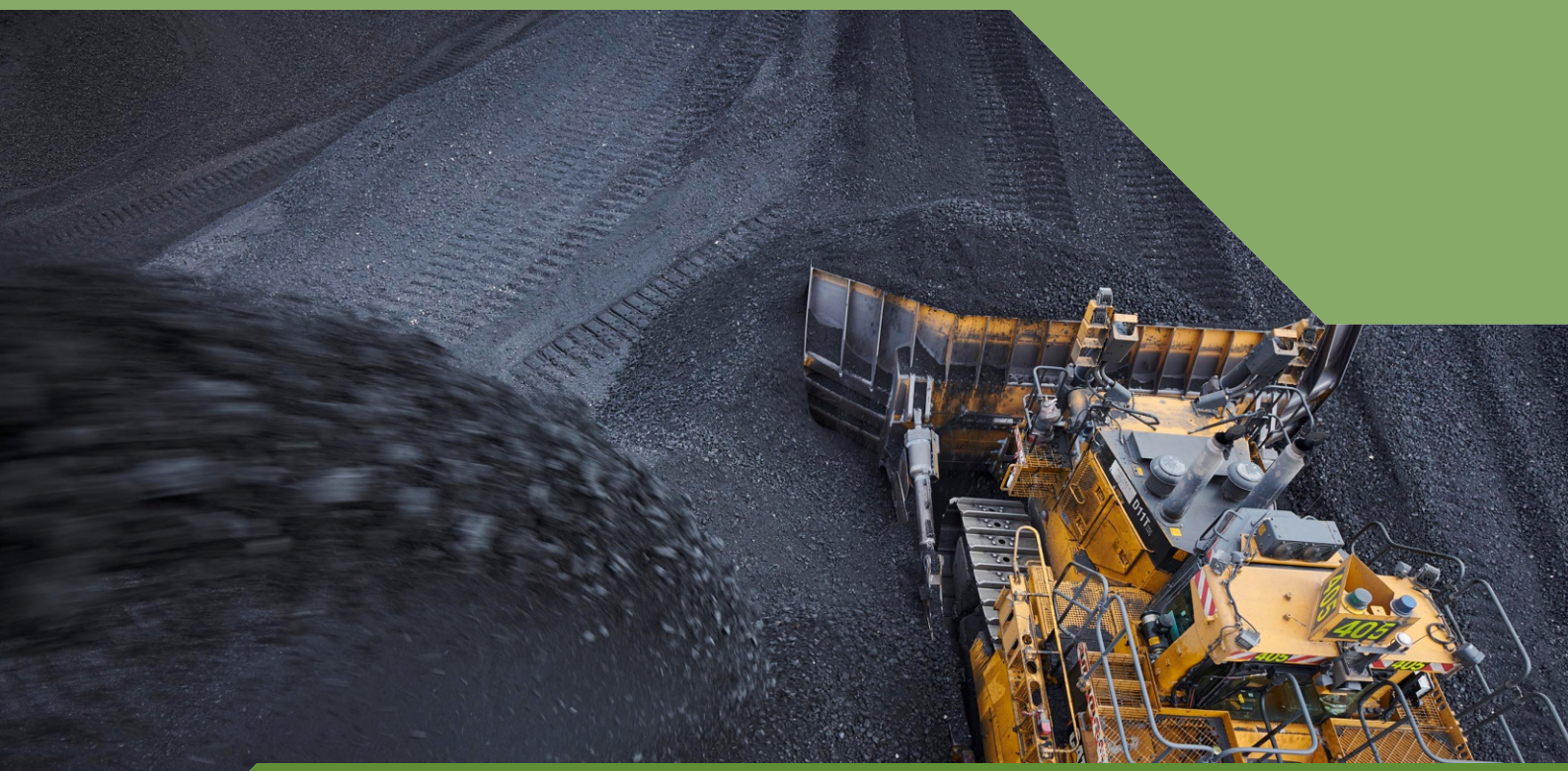
EXECUTIVE SUMMARY



Executive Summary

Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of New South Wales (NSW). Mangoola Coal Operations Pty Limited (Mangoola) has operated the Mangoola Coal Mine under Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

Mangoola has identified further coal resources to the north of the existing mine and is seeking approval to extract these coal resources by continuing the existing Mangoola Coal Mine into this new mining area. The Mangoola Coal Continued Operations (MCCO) Project would provide access to approximately 52 Million tonnes (Mt) of additional coal resources which represents approximately eight years of mining in the additional resource. It is currently planned that operations in the MCCO Additional Project Area would commence in approximately 2022 (subject to the timing of commencement of the MCCO Project) which would mean that the MCCO Project will require approval to operate until 2030, which represents an extension of one additional year beyond the existing approved life of the mine.

This Environmental Impact Statement (EIS) has been prepared to assess the environmental and social impacts of the MCCO Project and will accompany a Development Application under Divisions 4.1 and 4.7 of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Project Overview

The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce.

The MCCO Project is proposed to comprise the following key components:

- open cut mining peaking at the same rate as that currently approved (13.5 Million tonnes per annum of run of mine coal) using truck and excavator mining methods
- continued operations within the existing Mangoola Coal Mine
- mining operations in a new mining area located within the MCCO Additional Project Area, to the north of the existing mine
- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the MCCO Additional Project Area

- establishment of an out-of-pit overburden emplacement area
- distribution of overburden and interburden between the MCCO Additional Project Area and the existing mine in order to optimise the final landform design of the integrated operation
- realignment of a portion of Wybong Post Office Road
- continued use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine for the life of the MCCO Project with some minor additions to the existing mobile equipment fleet. This will include hauling coal from the MCCO Additional Project Area to the existing coal handling facilities and use of existing tailings facilities
- construction of a water management system to manage mine water, sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine
- continued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS)
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles. A final void will remain in the north-west of the MCCO Proposed Additional Mining Area while significant volumes of overburden and interburden will be taken south into the existing approved mining area and emplaced in the mining void to reduce the size of the void that would otherwise remain in the approved mining area at Mangoola Coal Mine
- rehabilitation will be completed using the same revegetation techniques as currently implemented at the existing mine. These existing techniques are recognised as industry leading practice
- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce of the mine
- continued use of the Mine Access Road for the existing operating mine and access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Project Area for construction, emergency services, environmental monitoring and property management.

The MCCO Project has been designed using a detailed social, economic and environmental risk-based approach that aimed to maximise resource extraction efficiency and optimise the use of existing mining infrastructure, whilst seeking to minimise impacts on the environment and community. As discussed in later sections of this EIS, the key learnings from the existing mining operations at the site; the stakeholder engagement program; the comprehensive social impact assessment; and the detailed environmental studies, have all been considered in refining the design of the MCCO Project. Numerous changes were made to the design of the MCCO Project as an outcome of these studies, resulting in reduced environmental and social impacts.

Benefits of the Project

Mining within the existing approved mining area is scheduled to be completed by about 2025 if the MCCO Project does not proceed. The MCCO Project will extend the operational life of Mangoola Coal Mine for approximately five years beyond 2025 and provide for the economic recovery of available coal resources using the existing infrastructure, facilities and experienced personnel. The MCCO Project is a logical continuation of the existing mining operations at Mangoola Coal Mine and will provide the following key benefits:

- maximise efficient recovery of the state's coal resources
- provide for ongoing use of the existing Mangoola Coal Mine infrastructure which has an operational life beyond the life of the existing mine
- provide ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising to a peak of approximately 480
- ongoing opportunities for local businesses and service providers
- provide a net benefit to the Upper Hunter region of $92.6 million (M) in net present value (NPV) terms
- provide a net benefit of $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- provide significant export earnings for Australia
- provide for a fully integrated rehabilitation program and final landform in accordance with leading practice natural landform design principles across the existing and proposed mining areas
- use the same leading practice environmental management approach and controls as the existing operation.

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

Broad Overview of Environmental, Social and Economic Outcomes

This EIS includes a detailed assessment of the potential environmental, social and economic outcomes of the MCCO Project and identifies the management, mitigation and offset measures that will be implemented. 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 and Offsets)
Social and Economic	• Through Mangoola's pre-emptive project and mine design which avoids and minimises impacts, the social impacts of the MCCO Project have been minimised where practicable • A key focus from a social assessment perspective is the impact of the MCCO Project on proximal landholders due to perceptions of impacts on property value and a dwindling sense of community, and amenity impacts associated with being near neighbours to a large development • To address these issues, a number of mitigation and enhancement strategies are proposed, including the continued implementation of a Voluntary Planning Agreement with Muswellbrook Shire Council; the development of a Community Enhancement Program; implementation of a range of existing and new mitigation measures to address the identified impacts; a series of property specific measures; and the implementation of a Social Impact Management Plan for the ongoing monitoring and management of social impacts • These mitigation measures have been specifically targeted to address the issues identified in the Social Impact Assessment and based on stakeholder feedback • The Social Impact Assessment has found that while a number of social and environmental issues have been raised by landholders in proximity to the MCCO Project – the broader community of Muswellbrook is more accepting of the proposal due to the predicted economic benefits at a local and regional level • The MCCO Project is not anticipated to place any additional pressure on population as a result of the operation and/or construction workforces. The MCCO Project will provide ongoing employment opportunities for the existing workforce (approximately 400 employees) for an additional five years of mine life providing significant ongoing benefits for local and wider communities through employment, use of local services, community participation, local and regional expenditure, community investment and payment of royalties and taxes • A cost benefit analysis of the MCCO Project indicates that the overall net benefits of the Project (after full incorporation of costs, including environmental and social costs) would be in the order of $408.6M in NPV terms.
Noise	• As part of the design of the MCCO Project, Mangoola has incorporated a range of noise controls to minimise noise impacts • Seven residences are predicted to experience noise from the MCCO Project at levels where it is expected that voluntary acquisition rights will apply as outlined in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (VLAMP) • Nineteen residences (located on 14 properties) with predicted exceedances of 3-5 dB above the project noise trigger levels will be offered acoustic treatments to reduce noise inside the residence • There are predicted to be no exceedances of the sleep disturbance criterion • No adverse cumulative noise impacts are anticipated as a result of the MCCO Project • There are no predicted changes to operational road traffic noise • Construction road traffic is not predicted to exceed the relevant criterion • Noise impacts will continue to be managed through the implementation of proactive noise management and monitoring measures which will be used to adaptively manage mining operations as required to minimise noise impacts.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Air Quality	• The MCCO Project will comply with the applicable annual average PM_{10}, incremental 24-hour average PM_{10}, $PM_{2.5}$, TSP and dust deposition criteria, as outlined in the VLAMP, at all privately owned residences • The maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations for the MCCO Project when considered alone meet the criteria at all private receivers. When the MCCO Project is considered cumulatively with existing background levels the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations are predicted to meet the criteria at all but one sensitive receiver (property ID 83). Property ID 83 is subject to voluntary acquisition under the existing approved operation and is within the predicted noise voluntary acquisition zone for the MCCO Project. The modelling indicates that the MCCO Project will contribute to, but will not be the primary cause of, exceedances of the criteria • Proactive and reactive dust control measures will continue to be implemented to minimise dust emissions over the life of the MCCO Project, including by adaptively managing the mining operations to minimise impacts in adverse conditions • Comprehensive air quality management controls have been incorporated into the design of the MCCO Project to minimise the contribution of the MCCO Project to impacts on local and regional air quality.
Blasting	• Blasting activities will be managed so that relevant blast criteria are met at private residences and blast sensitive infrastructure • Road closures will be limited to no more than one per day (noting that more than one road may need to be closed during a closure event).
Water Resources	• A comprehensive water management system has been designed for the MCCO Project to manage water in accordance with legislative requirements and relevant guidelines • The water management system for the MCCO Project builds on the existing system at Mangoola Coal Mine and maximises water recycling and reducing external water import • The MCCO Project Additional Mining Area void will intercept groundwater in the bedrock including in the coal seams. There will be no direct take of any alluvial groundwater as a result of the mining within the MCCO Proposed Additional Mining Area • Mining will continue to reduce flux (flows) between the bedrock and the Wybong Creek alluvium with the majority of the total change in flux during active mining (maximum 33 Megalitres (ML)/year) attributed to the continued operations within the approved Mangoola Coal Mine (maximum 30 ML/year). The incremental change due to mining within the MCCO Proposed Additional Mining Area is a maximum of 3 ML/year • The key potential impacts of the MCCO Project on surface water relate primarily to the ephemeral Big Flat Creek, with water capture associated with the mine water management system resulting in reduced catchment flowing to Big Flat Creek (and to a smaller degree to Wybong Creek) and resulting reductions in flow • Water quality in downstream watercourses is not predicted to be adversely impacted by the MCCO Project. No adverse impacts related to water quality have been predicted by the surface water assessment • Modelling indicates the potential for groundwater drawdown to impact one private bore due to mining in the MCCO Proposed Additional Mining Area. Another private bore is already predicted to be impacted by mining within the Approved Project Area. Mangoola will offer to monitor any private bores where impacts are predicted and should any bores be affected by the MCCO Project, Mangoola will repair the bore, provide an alternative water supply or implement other measures agreed with

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	the landowner • Flood modelling indicates some small localised changes to flooding in Big Flat Creek, however, there are no adverse impacts on private landholders or on flooding in Wybong Creek • Studies indicate that existing water licences held by Mangoola are sufficient for the water needs of the MCCO Project • No changes to the approved water discharge arrangements are required.
Biodiversity	• Avoidance of impacts to key biodiversity values was a key driver for the MCCO Project and the impacts were reduced through changes to the mine plan and infrastructure design • The biodiversity impacts of the MCCO Project are being assessed, managed and offset under the Framework for Biodiversity Assessment and the NSW Biodiversity Offsets Policy for Major Projects • The MCCO Project will result in the disturbance to approximately 570 hectares (ha) of native vegetation and fauna habitat, of which 356 ha is woodland or open forest and 214 ha is derived native grassland • Four NSW listed threatened ecological communities occur within the MCCO Additional Project Area, one of which is listed as threatened at the Commonwealth level; White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community • Eleven threatened species have been recorded in the MCCO Additional Project Area including five birds, four bats and two orchids • Mangoola has secured a biodiversity offset package for the MCCO Project that fully satisfies the credit requirements of the MCCO Project. This includes the establishment of land-based offsets that significantly contribute to local and regional conservation.
Historic Heritage	• No potential heritage items of local or state significance were identified in the MCCO Additional Project Area • Direct impacts on the identified potential heritage items that are within the MCCO Additional Project Area will not result in an adverse impact to the historical heritage of the wider study area or the local area more broadly • No indirect impacts to any listed or potential historical heritage items were identified.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Cultural Heritage	• A comprehensive Aboriginal Cultural Heritage Assessment process was completed for the MCCO Project in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holders for the MCCO Project • The assessment noted that the surrounding area is held to be of higher significance to many members of the Wonnarua and Gomeroi community, however based on consultation with RAPs, the sites and/or places within the MCCO Additional Project Area were held in no higher significance or value(s) than any other • The assessment process found the MCCO Additional Project Area has a relatively low cultural significance when compared to other places within the wider region • An archaeological survey identified 26 Aboriginal sites that would be impacted by the MCCO Project (11 Isolated Finds and 15 Artefact Scatters). A majority of these (92 per cent) sites were assessed as having low scientific significance and two sites (8 per cent) have either low-moderate or moderate scientific significance • Mangoola has developed management and mitigation measures in consultation with the RAPs involved in the assessment and these will be implemented in consultation and participation of the knowledge holders and community stakeholders.
Traffic and Transport	• The MCCO Project will require the realignment of a portion of Wybong Post Office Road • The proposed realignment will have minimal impact on travel distances (approximately 1.6 km longer when travelling towards Muswellbrook) and will provide an improved standard of road over the realigned section. The change in travel time associated with the increased length of Wybong Post Office Road is approximately 55 seconds. Travel time heading west along Wybong Road towards Sandy Hollow is decreased by this time while travel time heading east towards Muswellbrook is increased due to the intersection with Wybong Road being further west than the current intersection point • During construction the MCCO Project is predicted to result in short term traffic increases, including an average of approximately 16 heavy vehicles per day and a peak of approximately 35 heavy vehicles per day. The assessment has confirmed that all intersections which were modelled will continue to operate at acceptable levels of service • During construction of the haul road overpass of Wybong Road a two-lane bypass road is proposed to be in place to enable Wybong Road to remain open • The MCCO Project does not seek any increase to the current approved maximum annual production rate or employment levels and as such, no operational traffic changes are anticipated above those that have been previously assessed and approved.
Visual	• The proposed operations are not expected to be visible from any private residences • The MCCO Project would be visible from small sections of public roads surrounding the site • Visual impacts associated with views from public roads will be reduced over time with progressive rehabilitation • The progressive rehabilitation of emplacement areas and shaping of the final landform through the continued use of natural landscape design principles is expected to reduce the visual impact of emplacement areas.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Land Use and Agriculture	• The primary existing land use of the MCCO Additional Project Area is mining and low intensity grazing • The mine owned grazing land impacted is primarily low productivity land • The MCCO Project is not predicted to result in adverse impacts on surrounding private agricultural land and the mining operations are expected to continue to coexist with the surrounding agricultural land uses • The MCCO Project will have some impacts on some rural residences (for example impacts above relevant noise criteria), however, these will be addressed by impact mitigation and management measures and overall, the proposed mining operations are expected to be able to continue to coexist with the surrounding land uses in the region.
Rehabilitation and Final Landform	• The existing approach to final landform establishment and rehabilitation at Mangoola Coal Mine, which includes the use of natural landform design principles and rehabilitation of native woodland communities are recognised as industry leading practice. These practices will be applied to the MCCO Project • The rehabilitation strategy proposed aims to minimise environmental impacts throughout the life of, as well as upon completion of, the MCCO Project • The MCCO Project will provide for a fully integrated rehabilitation program and final landform • The existing approved final landform for Mangoola Coal Mine has one final void. The MCCO Project plans to establish this void generally as currently approved however improved due to the application of a revised natural landform design and shallower slopes on the low wall. One additional void is planned for the MCCO Additional Project Area. Both of the voids proposed have been designed to minimise the areas of unusable land • Ecological rehabilitation on the site will contribute to the biodiversity offset strategy for the MCCO Project • The Biodiversity Offset Strategy will improve local and regional biodiversity outcomes through establishment of strategic habitat corridors, while also providing areas for managed agriculture.
Greenhouse Gas	• The predicted greenhouse gas emissions associated with the MCCO Project have been quantified, including the scope 1, 2 and 3 emissions. The implications of the predicted emissions in the context of climate change policy have been assessed • A range of energy and greenhouse gas management initiatives will be implemented as part of the MCCO Project to improve energy efficiency and reduce the greenhouse gas emissions of the on-site mining operations.
Waste	• The existing waste management plan will be updated to incorporate the MCCO Project. The existing plan is based on the principles of avoid, re-use and recycle, with waste disposed of in accordance with legislative requirements where necessary.

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

The development of a coal mine and associated infrastructure is limited, by its nature, to the location of the coal resource. For this project, the resource proposed to be extracted is located adjacent to an existing operating coal mine, on land owned by Mangoola (with the exception of small sections of public road corridor and paper roads) currently used for low intensity grazing. The MCCO Additional Project Area generally consists of land with lower land capability and in the absence of mining, low intensity agriculture would be the most likely primary land use. In terms of land use, given the higher value that will be generated by mining the available coal resources when compared to the alternate values to be generated by agricultural land uses that would otherwise occur, it would be reasonable to determine that mining was the preferred land use for the site for the duration of the MCCO Project. Post mining, the area will be rehabilitated and whilst the predominant post mining land use is proposed as native vegetation/conservation, that land (outside the final void) would be capable of being used for low intensity grazing as it is currently.

The site currently has a range of biodiversity values and some of these values will be impacted by the MCCO Project, however, Mangoola has developed an offset strategy that fully offsets these impacts in accordance with government policy and which will contribute to conservation outcomes in the local area and region.

Since the commencement of operations at Mangoola Coal Mine in 2010 the existing operation has contributed over $8.2M to Muswellbrook Shire Council in contributions under the current Voluntary Planning Agreement and provided further funding and grants to various local community-based initiatives and groups of over $650,000. In addition, during the five year period between 2013-14 and 2017-18 Mangoola paid approximately $229M in royalties to the State of NSW.

Mangoola spent approximately $153M on employee salaries and supplier contracts for the period of 2017/18, with an estimated total of $47M going to the Shires of Muswellbrook and the Upper Hunter, with $129M to the Hunter Region overall.

The continuation of operations at Mangoola Coal Mine through the MCCO Project will allow for the ongoing employment opportunities for the local workforce, continued business to local suppliers and continued contributions to Muswellbrook Shire Council and payment of royalties to the State of NSW.

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

The detailed cost benefit analysis undertaken for the MCCO Project following relevant NSW Government guidelines has identified that the benefits of the MCCO Project will outweigh the costs, including consideration of environmental and social costs.

With the implementation of the management, mitigation and offset measures proposed by Mangoola, the assessment has concluded that the MCCO Project would result in a net benefit to the NSW community.

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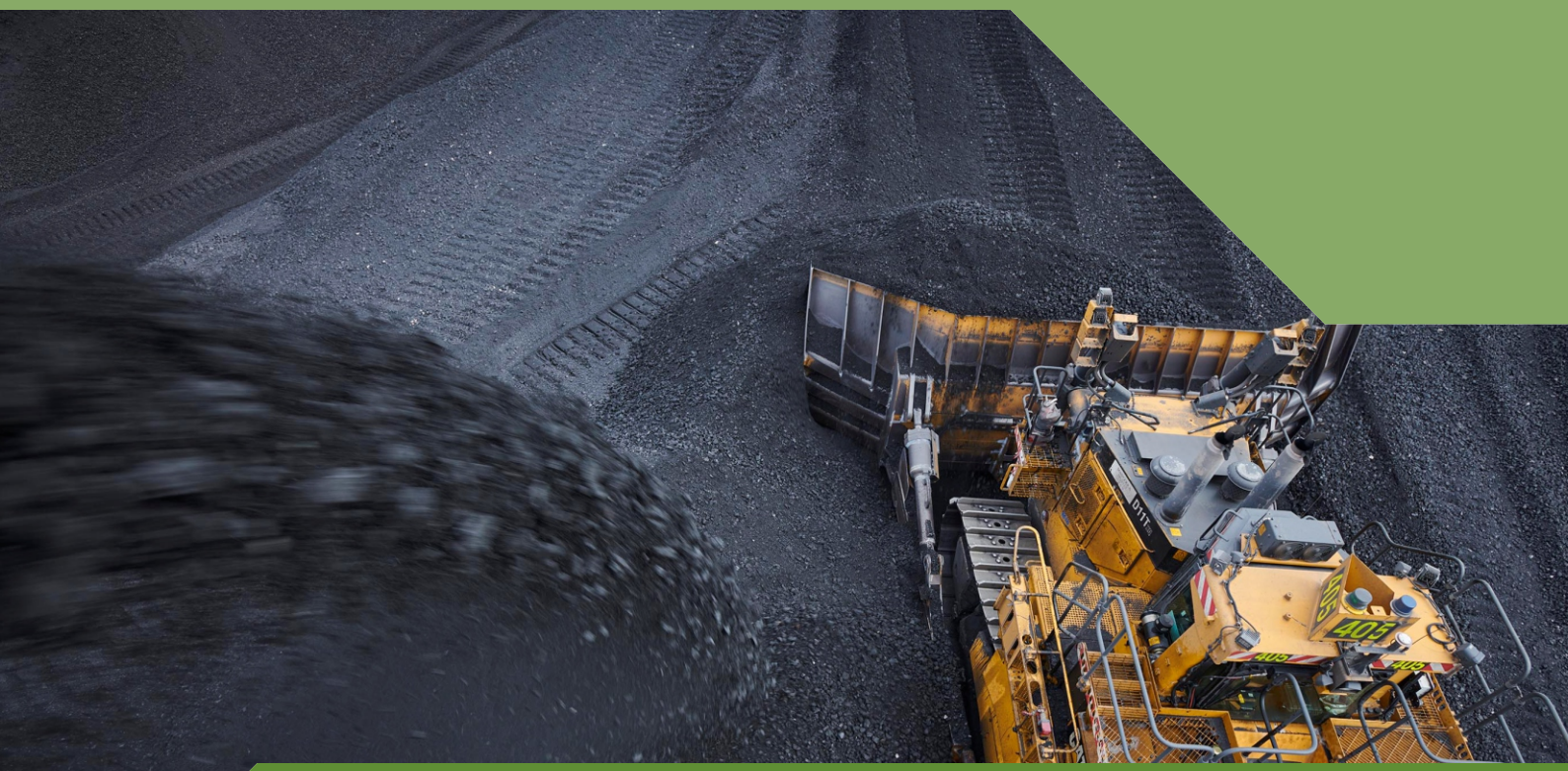
SECTION 1.0
Introduction



1.0 Introduction

Mangoola Coal Mine is an existing open cut coal mine located approximately 20 kilometres (km) west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley of NSW (refer **Figure 1.1**). Mangoola Coal Operations Pty Limited (Mangoola) which is owned by Glencore Coal Pty Ltd (Glencore) has operated the Mangoola Coal Mine in accordance with NSW Project Approval (PA) 06_0014 since mining commenced at the site in September 2010.

Following exploration within Mangoola's Assessment Lease (AL) 9, Mangoola has identified further coal resources to the north of the existing Mangoola Coal Mine and Wybong Road. Mangoola is seeking approval to extract these further coal resources by continuing the existing mine into this new mining area. The Project is referred to as the Mangoola Coal Continued Operations (MCCO) Project and would provide access to approximately 52 Million tonnes (Mt) of additional coal resources which represents approximately eight years of mining in the additional resource. It is currently planned that operations in the MCCO Additional Project Area would commence in approximately 2022 (subject to the timing of determination and commencement of the MCCO Project) which would mean that the MCCO Project will require approval to operate until 2030, which represents an extension of one additional year beyond the existing approved life of the mine.

The MCCO Project Area includes the existing Approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area as shown on **Figure 1.1**. The MCCO Additional Project Area includes the Proposed Additional Mining Area to the north of the existing mine.

The MCCO Project has been designed using a multi-disciplinary social, environmental and economic risk-based approach that aimed to maximise resource extraction efficiency and maximise the use of existing mining infrastructure, whilst seeking to minimise impacts on the environment and community. The design of the MCCO Project has been changed to reduce impacts as an outcome of preliminary environmental and social studies, and through applying the key learnings from the history of mining operations at the site.

Based on the current progression of mining and future planning the currently approved operation will complete mining in the Approved Project Area by 2025. The MCCO Project will extend the operational life of the Mangoola Coal Mine for approximately five years and provide for the economic recovery of coal resources using the existing infrastructure, facilities and experienced personnel. The MCCO Project is a logical continuation of the existing mining operations at Mangoola Coal Mine and will provide the following key benefits:

- maximise efficient recovery of the state's coal resources
- provide for ongoing use of the existing Mangoola Coal Mine infrastructure which has an operational life beyond the life of the existing mine
- provide ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising up to approximately 480
- provide a net benefit to the Upper Hunter region of $92.6 million (M) in net present value (NPV) terms
- provide a net benefit of $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- provide significant export earnings for Australia

- provide for a fully integrated rehabilitation program and final landform in accordance with leading practice natural landform design principles across the existing and proposed mining areas.

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

This Environmental Impact Statement (EIS) has been prepared to assess the environmental and social impacts of the MCCO Project and will accompany a Development Application under Divisions 4.1 and 4.7 of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The new development consent being sought will replace the existing Mangoola Project Approval and the MCCO Project will operate under the new State Significant Development (SSD) consent which will regulate future mining at the Mangoola Coal Mine including both the existing and proposed mining areas.

1.1 Project Overview

The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine into a new mining area to the immediate north of the existing operations. The MCCO Project will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce.

The MCCO Project is proposed to comprise the following key components:

- open cut mining peaking at the same rate as that currently approved which is 13.5 Million tonnes per annum (Mtpa) of run of mine (ROM) coal using truck and excavator mining methods
- continued operations within the existing Mangoola Coal Mine
- mining operations in a new mining area located within the MCCO Additional Project Area, to the north of the existing mine
- construction of a haul road overpass over Big Flat Creek and Wybong Road to provide access from the existing mine to the MCCO Additional Project Area
- establishment of an out-of-pit overburden emplacement area
- distribution of overburden (and interburden but hereafter collectively referred to as overburden for ease of reference) between the MCCO Additional Project Area and the existing mine in order to optimise the final landform design of the integrated operation
- realignment of a portion of Wybong Post Office Road
- continued use of all existing or approved infrastructure and equipment for the Mangoola Coal Mine for the life of the MCCO Project with some minor additions to the existing mobile equipment fleet. This will include hauling coal from the MCCO Additional Project Area to the existing coal handling facilities and use of existing tailings facilities
- construction of a water management system to manage mine water, sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine
- continued ability to discharge excess water in accordance with the Hunter River Salinity Trading Scheme (HRSTS)

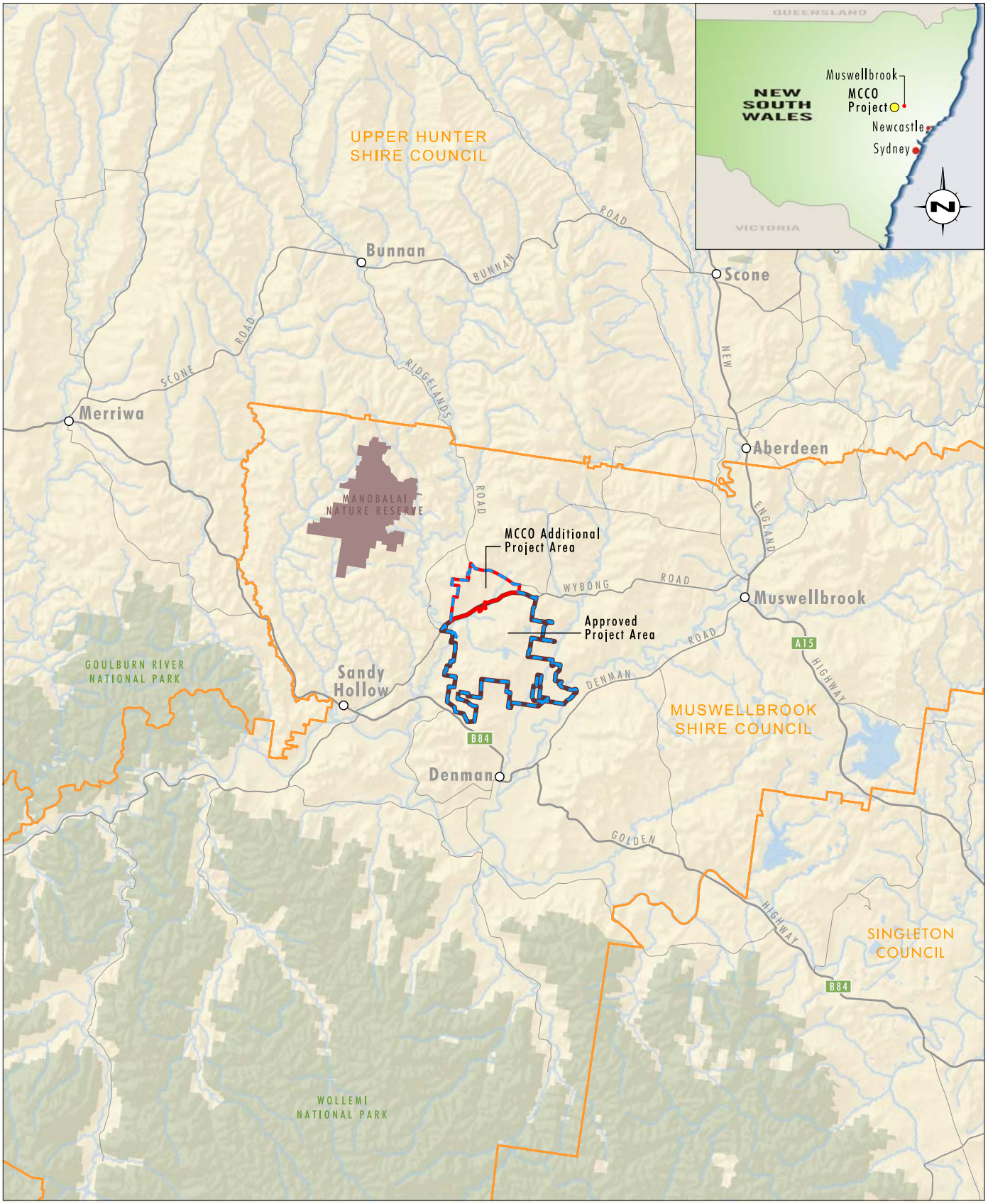
- establishment of a final landform in line with current design standards at Mangoola Coal Mine including use of natural landform design principles. A final void will remain in the north-west of the MCCO Proposed Additional Mining Area while significant volumes of overburden will be taken south into the existing approved mining area and emplaced in the mining void to reduce the size of the void that would otherwise remain in the approved mining at Mangoola Coal Mine
- rehabilitation will be completed using the same revegetation techniques as currently implemented at the existing mine. These existing techniques are recognised as industry leading practice
- a likely construction workforce of approximately 145 persons. No change to the existing approved operational workforce of the mine
- continued use of the mine access for the existing operating mine and access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Project Area for construction, emergency services, environmental monitoring and property management.

Figure 1.2 illustrates the key features of the MCCO Project and further details are contained in **Section 2.0** and **Section 3.0**.

1.2 Project Objectives

As part of the planning process for the MCCO Project, Mangoola developed the following key objectives:

- develop the MCCO Project in a manner that prevents occupational disease and injuries
- develop the target coal resources to maximise efficient recovery
- provide acceptable economic returns for all stakeholders (internal and external)
- conduct mining in an environmentally responsible manner to minimise project specific and cumulative environmental and social impacts
- maximising the use of existing infrastructure and equipment including the development of an integrated mine plan with the existing operations enabling equipment to be less concentrated across the total mining areas
- minimising additional mining disturbance footprint by maximising the use of existing disturbed areas and utilising the existing infrastructure
- provide ongoing employment opportunities for the Mangoola workforce
- developing comprehensive mitigation and management strategies to mitigate and offset predicted impacts associated with the MCCO Project
- deliver high quality rehabilitation including the use of leading practice natural landform design principles and establishment of high-quality native vegetation
- establishing a final landform that is safe, stable and sustainable.



Data Source: Glencore (2019), LPI (2016)

0 5 10 20km

Legend

- MCCO Project Area
- Approved Project Area
- MCCO Additional Project Area
- Local Government Area

FIGURE 1.1

Regional Locality Plan

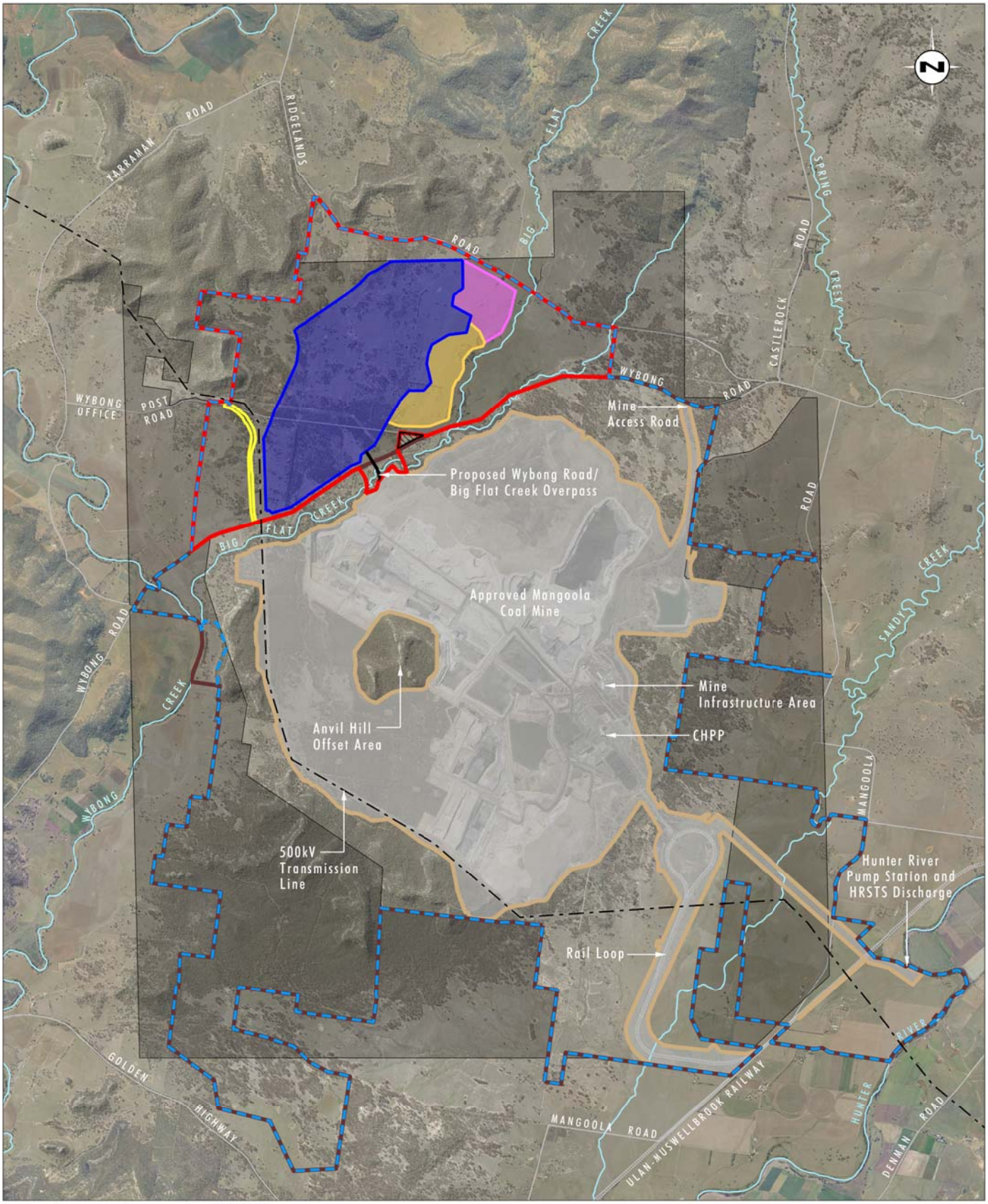


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area
- Assessment Lease 9

FIGURE 1.2

Key Features of the Mangoola Coal Continued Operations Project

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1.3 Project History

Glencore purchased the Mangoola operation from original owners, Centennial Coal, in October 2007, following granting of PA 06_0014 in 2007. The Anvil Hill Project (as it was originally named) was renamed Mangoola Coal Mine at this time.

Mining operations at Mangoola Coal Mine commenced in September 2010. Since the granting of the Project Approval, Mangoola Coal Mine has been subject to eight modifications, including gaining approval in 2014 to increase annual ROM coal production from 10.5 to 13.5 Mtpa.

Coal produced from Mangoola Coal Mine is provided to both the Australian domestic market and the export market. Mangoola Coal Mine is approved to operate until November 2029, however, without the MCCO Project the mine would likely exhaust coal extraction in 2025 based on anticipated production rates. Product coal is transported from Mangoola Coal Mine to the Port of Newcastle and domestic power stations by rail via the Ulan-Muswellbrook Railway, with an approved rail transport capacity of up to 10 trains per day.

Mangoola currently holds a number of mining tenements covering the existing operations, the MCCO Additional Project Area and surrounding lands. Mangoola holds Mining Lease 1626 and Mining Lease 1747 for the existing approved mining operations and AL 9 and Exploration Lease (EL) 5552 over surrounding landholdings. Further details on the existing approved operation are provided in **Section 2.0**.

Mangoola has been conducting exploration within the MCCO Additional Project Area since 2014 to define the economic potential of future mining in this area. Further to the exploration phase, a project planning phase has been completed which involved the consideration of a number of mine plans, infrastructure requirements and project objectives.

1.3.1 Key Project Design Considerations

The MCCO Project has been designed to maximise resource recovery and operational efficiencies between the proposed MCCO Additional Project Area and the Approved Project Area whilst aiming to minimise environmental and social impacts. Changes to the MCCO Project through the design and assessment phase have reduced environmental and social impacts including:

- the overall disturbance footprint
- impact on threatened species
- the number of noise affected residences through changes such as reducing the amount of mining equipment operating in the MCCO Additional Project Area, reducing both the number of and maximum heights of emplacement areas and additional noise controls such as haul road bunds.

Mangoola has a range of existing environmental management controls and processes in place that will be readily applied to manage impacts associated with the proposed mining operations. The MCCO Project incorporates these leading practices including minimising dust generation through a high level of active dust control and reduced visual, landform and water impacts through the use of natural landform rehabilitation principles for emplacement areas. The MCCO Project design also includes a range of environmental and social management and mitigation measures, including measures relating to cultural heritage values, which minimise impacts (refer to **Section 8.0**).

With the location of the MCCO Proposed Additional Mining Area adjacent to the existing operation, mining can be integrated with the existing operation to efficiently extract the economically mineable resources. By utilising the available resources at the existing mine including the infrastructure, mobile equipment and workforce, Mangoola can efficiently and economically mine the MCCO Proposed Additional Mining Area.

The MCCO Project also provides the opportunity to transport overburden from the MCCO Proposed Additional Mining Area into the existing approved mining area to assist in reducing the size of the final void that would otherwise remain. This emplacement strategy also provides flexibility with the ability to schedule overburden emplacement activities to respond to unfavourable meteorological conditions and thereby minimising impacts.

Once the key elements of the MCCO Project were established, Mangoola implemented a detailed project design, stakeholder engagement and environmental and social impact assessment process. This process allowed the findings of the technical studies and consideration of stakeholder views to inform the MCCO Project design and thereby further minimising impacts (refer **Section 1.4** for details of this process). This has included a range of impact avoidance measures being incorporated into the MCCO Project design including measures to:

- minimise noise emissions through mine design (e.g. design of emplacement areas and reduced equipment intensity in the MCCO Additional Mining Area)
- minimise dust generation (e.g. progressive rehabilitation to reduce windblown dust)
- minimise the disturbance footprint (e.g. minimise impacts on the threatened orchid, *Prasophyllum petilum*)
- efficiently manage water resources
- continue to apply the leading practice approach currently used at Mangoola Coal Mine to establish the final landform for the MCCO Project
- address a range of issues raised by MCCO Project stakeholders including blasting and visual impacts.

Through this iterative design process the potential environmental and social impacts of the MCCO Project have been minimised below those which would occur if the mine plan only focussed on economic outcomes.

1.4 Feasible Project Alternatives

Detailed concept and pre-feasibility studies have been completed for the MCCO Project considering mining options, layouts, overburden emplacements and infrastructure arrangements to determine the proposed MCCO Project design as described in this EIS. During each of these studies, environmental and social impacts were key considerations that informed the design.

A fundamental objective in the MCCO Project's concept and pre-feasibility mine planning stage was to identify potential alternatives for mining the identified coal resources that were viable within the existing AL 9 exploration areas using largely the existing equipment fleet that is already in place at Mangoola Coal Mine. Various open cut mining configurations were considered as part of the planning to optimise the MCCO Project's environmental and economic outcomes.

Underground mining of the identified coal resources for the MCCO Project was not considered as a feasible alternative as due to the depth and configuration of the coal resource, it is more suitable for open cut mining. To date, limited exploration has been completed specifically targeting the deeper coal seams suitable for underground mining within AL 9. Geological modelling has identified that there may be seams within AL 9 suitable for future underground mining. Subject to further detailed geological investigation and future market conditions, there may be the potential for further mining operations to be proposed at a future date for the remaining coal resources within AL 9.

The key issues considered in assessing the viability and feasibility of various alternatives and developing the final design were as follows:

- financial viability
- resource recovery efficiency
- efficient use of existing infrastructure and equipment fleet
- minimising noise and dust emissions on the surrounding community
- minimising impacts on biodiversity and water resources
- minimising social impacts
- existing mining operations and landform
- the future final landform.

Prior to formal stakeholder engagement on the MCCO Project, various alternatives were considered based on options to maximise the use of existing infrastructure and maximise economic resource recovery whilst minimising environmental and community impacts. This included consideration of a number of different mine plan options. Mangoola has prepared a Mine Plan Options Report (refer to **Appendix 2**) which discusses the MCCO Project mine plan along with the various mine plan and final landform options investigated to inform the proposed conceptual mine plan that is presented and assessed in this EIS.

Environmental studies of all key environmental issues were undertaken as part of the project planning process so that environment, heritage and social values could be considered in project decision making. This included quantitative noise and air quality modelling, which was undertaken as part of the mine plan development and assessment process, including consideration of the additional mining areas and out of pit overburden emplacement arrangements. As described in the following sections this modelling assisted Mangoola to identify areas of higher impacts and ensure these were considered in the project design as well as guiding the implementation of reasonable and feasible mitigation as part of project design to reduce the impacts of the MCCO Project.

The result of the extensive technical, environmental, social and economic evaluations of various mine options was the development of the MCCO Project for which approval is being sought as summarised in the Project Overview (refer to **Section 1.1**) and detailed further in the Project Description (refer to **Section 3.0**).

The following sections outline the evolution of the MCCO Project design and discuss the various mine designs and features that were considered and ultimately found either not to be feasible, or desirable, or able to form part of, the preferred project design.

1.4.1 Alternative Mine Options Considered but Not Selected

As discussed in the Mine Plan Options Report (refer to **Appendix 2**), Mangoola has undertaken detailed studies which considered alternative mine design options. The key alternative mine design options that were considered but not selected during this process are outlined below and shown on **Figure 1.3**.

Additional Western Mining Area

A key alternative to the MCCO Project was to mine additional coal resources to the west of the existing 500 kilovolt (kV) electricity transmission line (ETL) (refer to **Figure 1.3**). This option would have resulted in the mining of an approximate additional 12 Mt of coal and disturbance of an additional 246 hectares (ha) of land. As shown on **Figure 1.3** this mine plan option would have required the realignment of a section of the 500 kV ETL closer to Yarraman Road to the west. Constraints analysis indicated that it would result in increased noise and air quality impacts to private receivers and the requirement to disturb an additional 3140 threatened orchids (950 *Prasophyllum petilum* and 2190 *Diuris tricolour*).

The Additional Western Mining Area was considered uneconomic under current market conditions largely due to the cost associated with the realignment the 500 kV ETL and less desirable due to increased environmental and social impacts particularly with regard to noise, air quality and biodiversity impacts.

Additional Eastern Mining Area

Another mining area was also considered to the north-east of Ridgelands Road to mine an additional 1 Mt of coal (refer to **Figure 1.3**). As shown on **Figure 1.3** this mine plan option would have required the realignment of a small section of Ridgeland Road and the construction of an extensive clean water diversion drain to the north of the realigned road. This option would have resulted in an increased disturbance footprint of 17 ha (inclusive of the required realignment of Ridgelands Road). Constraints analysis also indicated that it would result in increased noise and air quality impacts to private receivers and the requirement to disturb an additional 76 threatened orchids (76 *Diuris tricolour*).

It was also identified early during community consultation that Ridgelands Road is a key road that is used by the local community.

The Additional Eastern Mining Area was considered uneconomic under current market conditions and less desirable due to increased environmental and social impacts particularly with regard to noise and air quality emissions and impacts on travel for the local community.

Mining of Deeper Seams

Another mine plan option that was considered included targeting coal seams deeper than those currently mined at Mangoola Coal Mine, down to the Montrose and Young Wallsend seams. The mining of deeper seams option was discounted due to poor economic outcomes related to a higher strip ratio, lower energy content in these deeper seams (lower than the current target seams) and equipment replacement capital required due to the longer mine life associated with mining the additional coal resources.

This plan would also have resulted in larger and higher overburden emplacement areas and a larger final void which was considered less desirable.

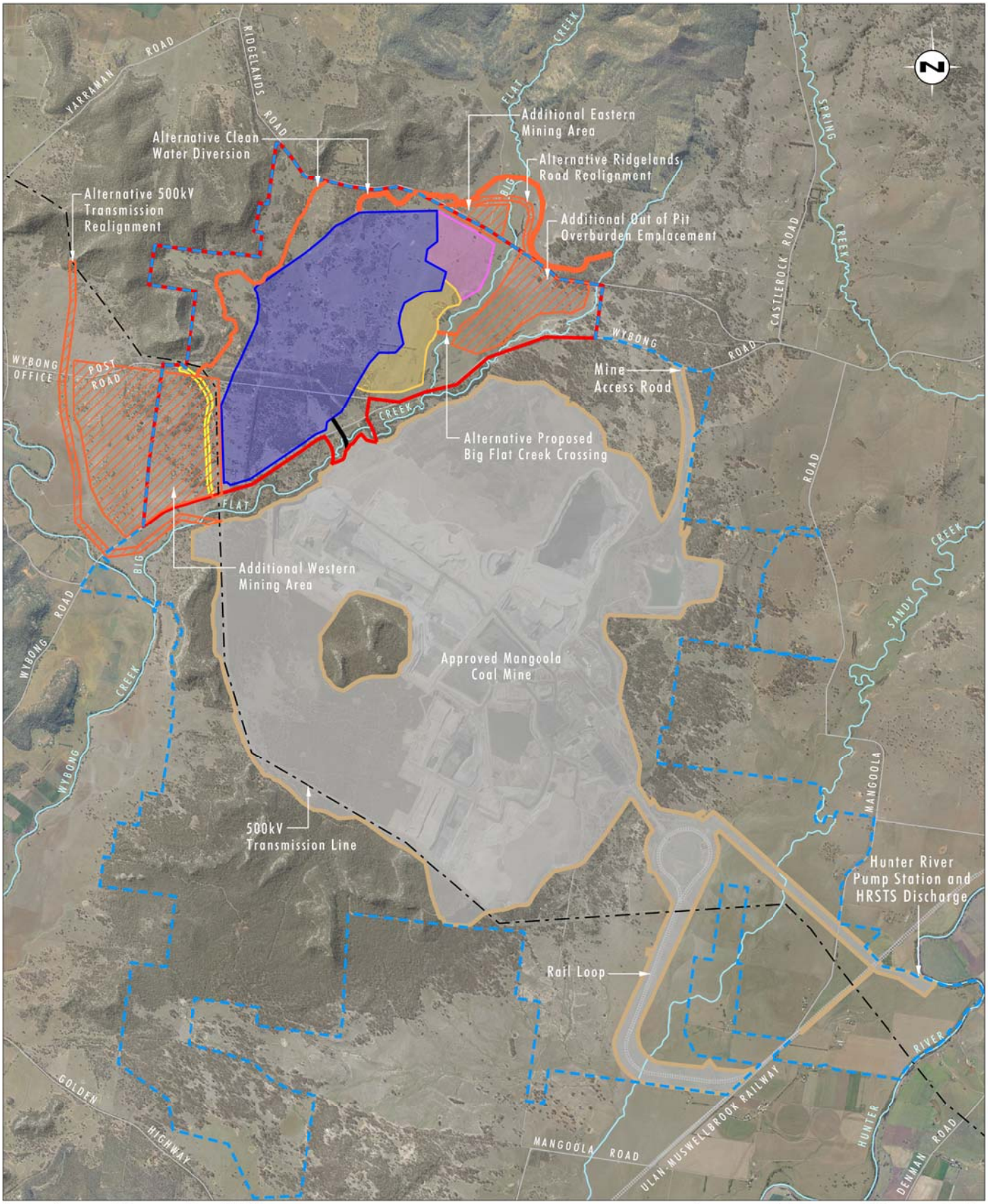

Image Source: Glencore (Apr 2018)
Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Alternatives Considered But Not Selected

FIGURE 1.3

Alternative Mine Options Considered

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Additional Out of Pit Overburden Emplacement

Another feasible mine planning option that was considered was the development of a second overburden emplacement area within the MCCO Additional Project Area as an operationally more efficient alternative to hauling overburden to the south for disposal within the existing Mangoola mining area. This option was included in the Preliminary Environmental Assessment (PEA) (Umwelt 2017) prepared for the MCCO Project.

The Muswellbrook Shire Council (MSC) input into the Secretary's Environmental Assessment Requirements (SEARs), noted '*the location of the out of pit emplacement shown in Fig 6.3* (MCCO Project PEA, Umwelt 2017) *has operations closer to non-mine owned residents in Castlerock Road than has ever occurred with the existing operation. This could result in additional noise and dust impacts on the residents of Castlerock Road. To avoid this, all efforts should be explored in the EA for material to be preferentially placed in the existing approved mine void. This is not located near any non mine-owned residences.'*

In accordance with the above comment, the MCCO Project as proposed has removed this element and developed a conceptual mine plan that removes the requirement for the previously proposed additional out of pit overburden emplacement by scheduling the emplacement of additional overburden to within the existing approved mining area, generating the following benefits:

- further reduces the overall disturbance of the MCCO Project by 75 ha
- removes the requirement for an additional culvert across Big Flat Creek to connect the MCCO Additional Mining Area to the eastern overburden emplacement area
- anticipated to provide an incremental reduction in impacts associated with air quality, noise, visual and surface water
- reduces the size of the void in the existing approved mining area.

Removing the additional overburden emplacement area, whilst resulting in additional mining costs, was identified as an improvement to the integrated final landform and was considered desirable due to decreased environmental impacts. This option was therefore incorporated into the MCCO Project. This is described further in **Section 1.4.4**.

1.4.2 Alternative Infrastructure Locations Considered but Not Selected

As outlined in **Section 1.1**, the mining of the MCCO Additional Project Area will necessitate the realignment of a portion of Wybong Post Office Road, the establishment of the proposed Wybong Road and Big Flat Creek Haul Road Overpass and establishment of water management infrastructure. Alternatives considered as part of the design of this infrastructure are outlined below.

Avoiding the Proposed Wybong Post Office Road Realignment

As requested by MSC, an assessment was undertaken of the implications on the mine plan should Wybong Post Office Road not be relocated and remain in place. This assessment is provided in the Mine Plan Options Report included in **Appendix 2** and in summary found that not relocating the road would:

- result in the MCCO Additional Mining Area being split into two mining areas by the retention of Wybong Post Office Road

- require an additional haul road crossing to be constructed over Wybong Post Office Road in addition to the crossing of Wybong Road, to enable access from the existing approved mining area and then consequently from one mining area to the other mining area within the revised MCCO Additional Mining Area

- as a result of the additional haul road crossing, elevated haul roads would be extended to access both the north and south side of Wybong Post Office Road with significant increased visual impact. Although not modelled, this elevated haul road arrangement would likely have added to the noise impacts to northern and western receivers along with requiring additional road closures and reduced operational efficiency due to more constraints around blasting

- would result in the loss (and potentially the sterilisation) of coal resource from the coal proposed to be extracted from the MCCO Additional Mining Area. A more detailed assessment was not undertaken as the option was not preferred due to adverse impacts on mine planning and mine operations

- may result in three final voids (or require significant overburden rehandle to reduce to two as proposed by the MCCO Project).

Further, the assessment of this option found that from a construction perspective additional disruption to the public would occur due to the construction of the additional crossing of the existing Wybong Post Office Road. If this option was selected, Mangoola would not upgrade any portion of Wybong Post Office Road as proposed by the MCCO Project as there is no justification for an upgrade by Mangoola with the road remaining on its current alignment.

Another theoretical option would be restricting the MCCO Additional Mining Area to the northern side of Wybong Post Office Road only. This option was not further assessed by Mangoola as it would result in the loss of approximately 14.2 Mt of ROM coal or 27 per cent of the planned 52 Mt of ROM coal.

Refinement of the Proposed Wybong Post Office Road Realignment

Once the proposed alignment of Wybong Post Office Road was selected, further work was completed on the design of the road to minimise the impact of works associated with the road realignment on key biodiversity values, in particular threatened orchid species (refer to **Table 1.2**). In this regard the design of the realignment as proposed has resulted in avoiding impacts on 178 threatened orchids (84 *Prasophyllum petilum* and 94 *Diuris tricolour*).

The final design aims to improve the current standard of the re-aligned portion of road by focusing on meeting relevant contemporary design guidelines.

Proposed Wybong Road and Big Flat Creek Overpass

The haul road overpass location of the crossing of Wybong Road and Big Flat Creek was determined by a combination of factors and considerations including:

- minimising the area impacted within the previously proposed biodiversity and Aboriginal archaeological offset corridor adjacent to Big Flat Creek (the haul road alignment was placed to avoid or reduce impacts on threatened species and known Aboriginal archaeological sites)

- achieving a location that is relatively central to the MCCO Proposed Additional Mining Area in order to maximise the efficiency of haulage routes

- limiting disturbance at the existing Mangoola Coal Mine to within the Approved Mangoola Coal Mine Disturbance Area

- alignment with, and maximising truck haulage efficiency to, the existing or planned haul roads in the Approved Project Area
- sight lines along Wybong Road for traffic using this road.

The Proposed Wybong Road and Big Flat Creek Overpass was determined by Mangoola to be the most appropriate location based on the factors and constraints considered above. The design and location selected has avoided impacts on 26 threatened plants (11 *Acacia pendula*, 1 *Prasophyllum petilum* and 14 *Diuris tricolour*) and 8 known Aboriginal archaeological sites.

During the stakeholder engagement undertaken for the MCCO Project stakeholders raised if other alternatives to building the overpass were able to be considered including the potential to develop a tunnel under Wybong Road and Big Flat Creek or divert the road and creek around the MCCO Project. The MCCO Project considered these options in the early planning phases and they were rejected due to the significant impacts that would result.

The suggested alternative to develop a tunnel is not considered to be practicable and is significantly space constrained as the size and depth of a tunnel that would cater for mine trucks and equipment would be very large and the grades would require large laybacks from the creek, significantly impacting Big Flat Creek. The suggested alternative to divert the creek around the MCCO Project are not physically able to be completed due to the location of the existing Mangoola Coal Mine to the immediate south and the location of the MCCO Proposed Additional Mining Area and the rising topography to the north. For the above reasons these suggested alternatives have not been considered any further. The diversion of Wybong Road around the mine would result in significant increases in travel times for people using the road, increased environmental impacts due to the additional construction, required easements and lengthening of the road and is therefore not considered a practicable outcome.

Clean Water Diversions

Two extensive clean water diversions were originally designed to be located to the north of the Proposed Additional Mining Area in order to manage water inflows to the pit (refer to **Figure 1.3**). As originally proposed, the construction of these diversion drains would have increased the disturbance footprint of the MCCO Project by 23.5 ha, impacted on 99 threatened orchids (2 *Prasophyllum petilum* and 97 *Diuris tricolour*) and 1 known Aboriginal archaeological site.

The preferred alternative of constructing staged clean water diversion drains, largely within the Proposed Additional Mining Area footprint, has resulted in these impacts being avoided and much of this land instead being proposed as part of the biodiversity offset strategy for the MCCO Project (refer to **Section 6.9.6**).

1.4.3 Preferred Option – The MCCO Project

As summarised in **Section 1.2** and detailed further in the Project Description (refer **Section 3.0**) the integration of the two open cut mining areas provides significant resource recovery and mining efficiency advantages, positive commercial outcomes, improved final landform outcomes and minimises environmental and social impacts to below those of other options considered, and was therefore identified as the preferred project.

Avoidance of Impacts

Through the iterative design process and the modifications made to the project design, the potential environmental and social impacts of the MCCO Project have been significantly reduced. In total the changes to the physical components of the MCCO Project have resulted in an overall reduction of 400 ha to the total MCCO Additional Disturbance Area.

Due to selecting the preferred option and not proceeding with the alternative mining options and infrastructure locations as shown on **Figure 1.3**, the MCCO Project was able to avoid key environmental and social impacts through the reduced surface disturbance footprint and extent of proposed operations. A summary of the key physical impacts that have been avoided are provided in **Table 1.1**. In addition to these avoided physical impacts there have also been significant reductions in predicted impacts of noise and dust emissions on private receivers by deciding not to proceed with some of the alternative mine plan options. These changes resulted in reduced noise impacts such that up to nine private receivers avoided being within a significant impact zone.

Table 1.1 Physical Impact Reduction

Alternative MCCO Project Option	Number of Threatened Species Avoided (Individuals)	Threatened Ecological Community Avoided (ha)	Archaeological Sites Avoided	Disturbance Area Reduction (ha)
Avoided Impacts				
Additional Eastern Mining Area	76	1.8	nil	16.6
Additional Out of Pit Overburden Emplacement Area	56	5.7	1	74.6
Alternative Ridgelands Road Realignment	60	0.4	nil	7
Alternative 500 kV Transmission line Realignment	632	1.1	nil	33.4
Wybong Post Office Road Realignment Location	178	3.2	1	12.8
Proposed Wybong Road/Big Flat Creek Overpass Location	26	1.0	8	7.8
Clean Water Diversion Drains Removed	99	12.5	1	23.5
TOTAL AVOIDED IMPACTS	**1027**	**25.7**	**11**	**175.7**
Not Selected				
Additional Western Mining Area	3140	38.8	4	245.8
TOTAL NOT SELECTED	**3140**	**38.8**	**4**	**245.8**

1.4.4 Final Landform and Final Void Options

Once the conceptual mine plan for the MCCO Project was determined, further assessment was undertaken by Mangoola of final landform options, specifically related to final voids, balancing the design inputs and expectations surrounding the establishment of a final landform. These inputs and expectations include:

- maximising resource recovery and financial viability
- ability to minimise void size during the mining process
- available material post mining completion for use in rehabilitation activities
- surrounding constraints such as topography and boundaries
- long term stability, safety and non-polluting landform establishment
- visual considerations
- long-term environmental sustainability and minimisation of impacts associated with the final landform.

A key consideration in the planning and design of the final landform for the MCCO Project was the availability of overburden to backfill the mining area within the Approved Project Area in order to achieve the existing approved Mangoola Coal Mine final landform.

The existing approved Mangoola Coal Mine final landform is discussed in **Section 2.9** and the key features include:

- leaving one void
- re-establishment of Anvil Creek
- decommissioning/capping of the existing tailings dams and associated tailings decant dam
- establishment of a rehabilitated landform, constituting a mixture of woodland and grassland areas, using natural landform design principles and revegetation techniques that are widely recognised as industry leading.

The mining and emplacement of overburden results in 'swell' of the material as the emplaced material has an increased pore space when compared to the *in situ* rock pre-mining. As part of the mine planning process Mangoola has forecast that, during the entire life of mining at Mangoola Coal Mine including the MCCO Additional Mining Area, with the forecast total volume of material removed from the ground and if hypothetically all the overburden and loose reject material from the CHPP is placed back into the mined area and there is no overburden placed in the out-of-pit area, and considering swell factor, there is a net volume deficit. Therefore, it is not possible to reinstate the topography to pre mining levels across all previously mined areas. The mining process at the commencement of mining also requires that out of pit overburden emplacement areas are required to provide for the initial start-up mining operating area, before backfilling of the mining void (known as in-pit overburden emplacement) can commence. This means that for the out of pit emplaced material to be put back into the void at the completion of mining it must be rehandled (effectively it must be mined twice). This affects the economics, and the environmental and social impacts of the mine depending on the volume of material requiring handle.

As part of the MCCO Project, as mining progresses, it is proposed to haul significant volumes of overburden from the MCCO Additional Mining Area south for emplacement in the mining void in the Approved Project Area, reducing the size of the final void that would otherwise occur. As described in **Section 1.4.1** this decision has also resulted in the reduction of the disturbance footprint in the MCCO Additional Project Area as the additional out of pit overburden emplacement area to the east of Big Flat Creek is no longer required.

It is proposed that a final void would also remain in the proposed MCCO Additional Mining Area to the north of Wybong Road. After the completion of coal extraction in the MCCO Additional Mining Area, some emplaced overburden would be rehandled and placed back into this void to reduce the size and improve the shape of the void providing the conceptual final landform as discussed in detail in **Section 3.3.4**. A comparison between the footprint of the final voids proposed as part of the MCCO Project with the existing approved final void for Mangoola Coal Mine is provided on **Figure 1.4**. **Figure 1.4** presents the existing approved final void for Mangoola Coal Mine as per PA 06_0014, however this area does not include the slopes of the approved low wall. The MCCO Project proposes to improve this final landform outcome due to the application of a revised natural landform design and shallower slopes on the low wall as described within this EIS. While two final voids would remain under the MCCO Project, the distribution of overburden for emplacement in both voids to reduce their size and improve the shape of each was considered to achieve a balanced outcome and has been selected as the proposed case.

Mangoola considered a range of final void and final landform options through the feasibility phase of the MCCO Project with seven options identified as requiring more detailed consideration. The assessments completed on the final void options discussed below have been completed at a concept level to determine their feasibility, key impacts and high-level costs. The mine plan models of each option were developed to derive the differences in costs of material moved or rehandled.

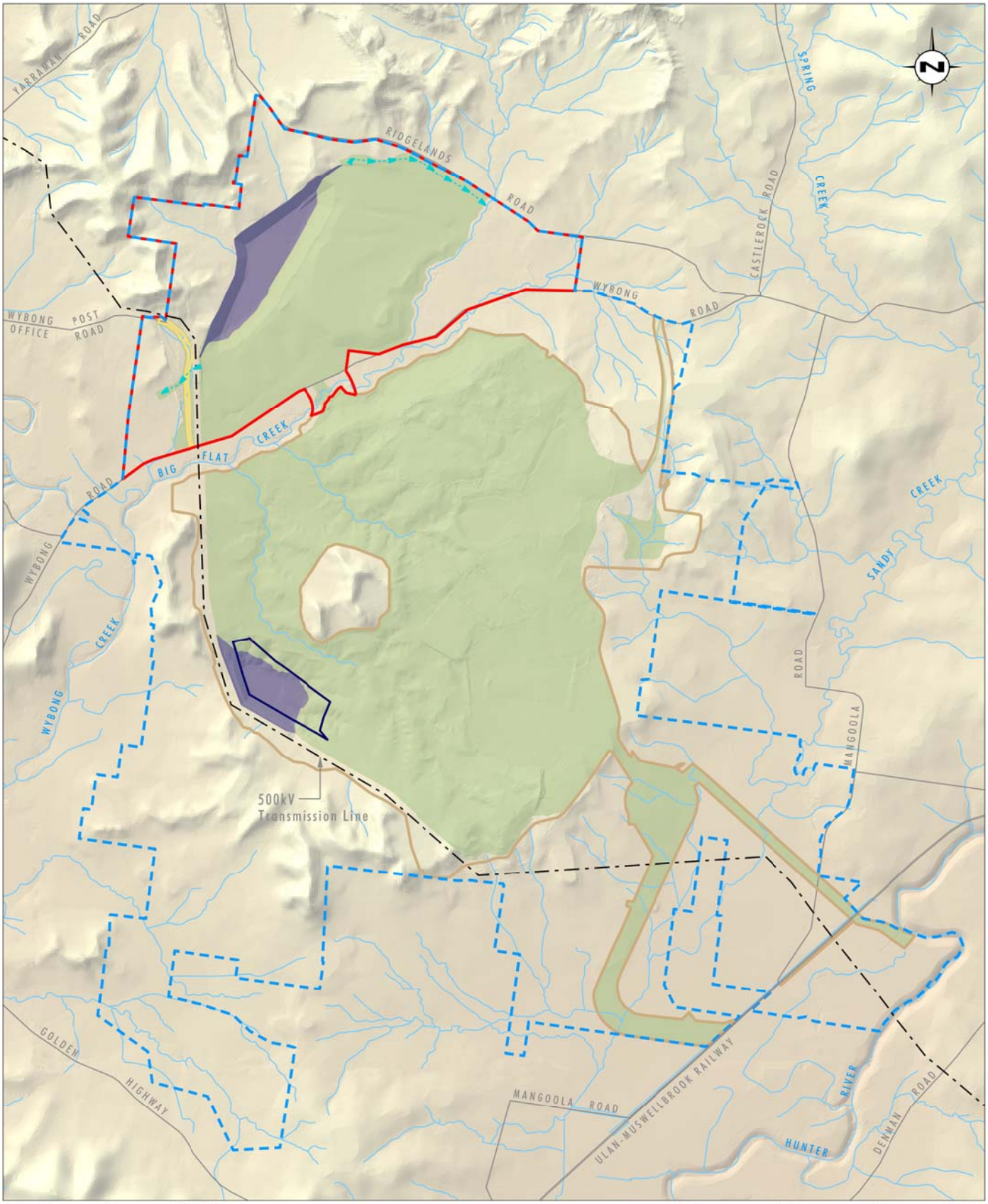
The relative differences in costs as discussed below relate to the baseline cost of the Preferred Business Case and do not include all fixed costs (i.e. the costs to run the mine beyond the actual mining costs).

The assessment of economic differences in each mine plan option has primarily considered the truck haulage and rehandle costs associated with each option. Actual costs to implement each of the options may be greater than quoted depending on the timing of the work to be conducted and the degree of interaction with other mining and rehabilitation activities. The indicative costs and timeframes to complete each case relate incrementally to the 'baseline' case (Case 1) which is the Preferred Business Case as it reflects the most cost effective mining outcome (note that this is not the case proposed in this EIS which is Case 3 the MCCO Project Case). This level of detail is considered sufficient to provide a relative comparison of each option to determine the proposed final void arrangements for the MCCO Project.

Table 1.2 provides an overview of the seven options that have been assessed and includes a description of each case and the incremental cost implications when compared to the preferred business case. Further details are included in the Mine Plan Options Report as provided in **Appendix 2**.

Mangoola takes a proactive approach to mine closure planning and has demonstrated and is recognised for the progressive implementation of rehabilitation works in conjunction with current mining activity.

As discussed in **Table 1.2**, Mangoola has considered the option of not having voids as part of the MCCO Project and found that it is not economically feasible to have no voids at all and that the extensive additional mining activity required to rehandle emplaced overburden to backfill the voids would result in additional environmental and social impacts.



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- MCCO Project Void
- Approved Southern Void
- Clean Water Diversion Drain

FIGURE 1.4

MCCO Project Conceptual Final Landform and Existing Approved Mangoola Coal Mine Final Void

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Table 1.2 Final Void Options Assessed

Option	Description and Key Features
Case 1 Business Baseline Case– All Overburden Emplaced in the MCCO Additional Mining Area	Case 1 considered not transporting overburden from the MCCO Additional Project Area into the Approved Project Area, with all overburden planned to be hauled to an additional overburden emplacement area within the MCCO Additional Project Area. This would result in larger and higher overburden emplacement areas within the MCCO Additional Project Area with heights required up to RL200 (vs. RL180 as in the preferred MCCO Project case) and RL175 (being an additional overburden emplacement area to the preferred case). A conceptual Case 1 final landform is presented on Figure 9 within **Appendix 2**. Under this case the final landform in the MCCO Additional Mining Area would consist of higher overburden emplacement areas which would elevate the noise, dust and visual profile of the mining operation in this area. The final landform visual aspect would be poorer when compared to the Case 2 final landform, with likely steep sided overburden emplacement walls (without significant rehandle of overburden), considering the base footprint is relatively small to fit the additional overburden into. This case is considered the best value option as it is based on the relatively shorter truck cycle times for the MCCO Additional Mining Area to the overburden emplacement areas. However this case is not proposed by Mangoola due to the anticipated greater impacts of noise, dust, visual profile and larger final voids at the completion of the mining operation. For the purposes of this case there has been no assessment of rehandling overburden to reduce the size of the void in the MCCO Additional Mining Area. **Key Features** • No overburden hauled south to the Approved Project Area • Two final voids remain at the completion of operations • The final landform in the MCCO Additional Mining Area would consist of higher overburden emplacement areas which would elevate the noise, dust and visual profile of the mining operation in this area • The final landform visual aspect would be a poorer outcome when compared to the Case 2 final landform, with steep sided overburden emplacement walls (without significant rehandle of overburden) • The cost associated with this case is considered the baseline case with all other cases below compared in a relative sense to this case.

Option	Description and Key Features

Case 2
Initial Integrated Project Case
	Case 2 was the first integrated project case developed in detail as part of the planning and design process for the project and considers all constraints and assessed impacts associated with the MCCO Project with particular emphasis on noise, air quality, mining intensity, economic viability, visual aspects and biodiversity.
	
	Key Features
	
	• Haul approximately 50 million bank cubic metres (Mbcm) of overburden from the MCCO Additional Mining Area to the existing approved mining area for the purpose of establishing the approved final landform
	
	• Two final voids remain at the completion of operations (48 ha in south and 144 ha in north) and become water bodies
	
	  ○ One void in the Approved Project Area commensurate with the existing approved Mangoola Coal Mine final landform however improved due to the application of a revised natural landform design and shallower slopes on the low wall
	
	  ○ One void in the MCCO Additional Project Area with no rehandle proposed post mining. It is recognised that the resulting void is quite angular in appearance with sharp looking ends that remain once mining operations cease (refer to Figure 10 in **Appendix 2**)
	
	• Void low walls in both areas will be shaped at the completion of mining
	
	• Remaining high walls may be selectively blasted and shaped for visual amenity and geotechnical stability reasons
	
	• The incremental total cost commitment associated with Case 2 to Mangoola is estimated at $53M.

Option	Description and Key Features

Case 3
MCCO Project Case (as included in this EIS)
	Case 3 reflects the MCCO Project case that has been considered and assessed in this EIS and for which approval is being sought.
	
	Case 3 is the same as Case 2 with the addition of approximately 5 Mbcm of overburden rehandled at the completion of mining in the MCCO Additional Project Area, to improve the overall shape for the void (removing and softening the sharp looking ends) and reduce the total void area.
	
	While not considered the preferred economic case, this is the option that Mangoola has selected and is seeking approval for as described in **Section 3.3.4**.
	
	Key Features
	
	• As per Case 2 haul approximately 50 Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area for the purpose of improving the final landform
	• Approximately 5 Mbcm overburden rehandle back into the northern final void at the completion of mining in the MCCO Additional Project Area, to improve the overall shape and reduce the total void area
	• Two final voids remain at the completion of operations (48 ha in south and 82 ha in north) and become water bodies
	• Void low walls in both areas will be shaped at the completion of mining
	• Remaining high walls may be selectively blasted and shaped for visual amenity and geotechnical stability reasons
	• It is predicted that both of the final voids (non- backfilled mining areas) will partially fill with water and act as long-term hydraulic sinks. Further discussion of the surface water and groundwater impacts of the MCCO Project are provided in **Section 6.7** and **Section 6.8** respectively
	• The catchment size of the final voids has been minimised where practicable to reduce the surface water take and to increase areas available to be rehabilitated to woodland and/or grassland
	• The MCCO Project Case provides the following benefits:
	  ○ provides a balanced outcome that both achieves economic expectations whilst minimising the size of the final voids
	  ○ improves the visual appearance of the MCCO Project Additional Mining Area void by removing and softening the sharp looking ends
	  ○ achieves and improves upon the existing commitments regarding the establishment of the approved conceptual final landform including the re-establishment of Anvil Creek
	  ○ both voids (non-backfilled areas) act as long-term hydraulic sinks, capturing salt and avoiding impacts on surrounding water quality
	• The additional total cost to Mangoola is estimated at $75M, including the rehandle of approximately 5 Mbcm of overburden post mining and all aspects of Case 2.

Option	Description and Key Features
Case 4 **Non Preferred Case –** **One Void in the North**	Case 4 would involve the haulage of an additional 33 Mbcm of overburden from the MCCO Additional Mining Area to the Approved Project Area (in addition to the 50 Mbcm in Case 2/Case 3) for the purpose of filling the final void in the existing approved mining area void to approximately 150 RL to 160 RL which is consistent with the topography of the surrounding rehabilitated landform. This level is aimed at providing a free draining landform to the re-established Anvil Creek. Noting that there would still be an area with part of an exposed final highwall in this area, however, there would be no final void. However, the size and overall shape of the remaining final void in the MCCO Additional Mining Area would not be improved (as proposed by Case 3) at the completion of mining as available overburden material has otherwise been placed in the Approved Project Area. Figure 12 within **Appendix 2** shows this option as considered. Case 4 is not preferred as Mangoola consider it a better outcome to distribute the emplacement of overburden across both void areas to reduce their size and improve the shape of each void in order to achieve a more balanced landform outcome across the MCCO Project Area as per the proposed Conceptual Final Landform (refer to **Section 3.3.1**). **Key Features** • Haul approximately 83 Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area for the purpose of filling the existing approved mining area void to a level consistent with the topography of the surrounding rehabilitated landform • One final void remains at the completion of operations (132 ha in north) and will partially fill with water and act as a long-term hydraulic sink • Within the existing approved mining area the removal of the void will eliminate the localised groundwater sink and increase the amount of water that can flow out of the backfilled mining area and into the surrounding bedrock. This would occur at a higher rate than Case 3 due to the southern void being backfilled • The final landform in the MCCO Additional Project Area would be generally flat as more overburden is moved to the Approved Project Area and there is not sufficient overburden left to vary the landform in this area • Void low walls in north will be shaped at the completion of mining, however there will be limited filling of the sharp looking ends post mining as there is insufficient overburden material to complete any further works • Remaining high walls may be selectively blasted and shaped for visual amenity and geotechnical stability reasons • The additional total cost to Mangoola Coal is estimated at $114M (this does not include any rehandling associated with the northern void which would come at an additional cost).

Option	Description and Key Features
Case 5 **Non Preferred Case – No Voids**	As per Case 4, Case 5 would involve the haulage of an additional 33 Mbcm of overburden from the MCCO Additional Mining Area to the Approved Project Area (in addition to the 50 Mbcm in Case 2 and 3) for the purpose of filling the existing approved mining area void to approximately 150 RL to 160 RL which is consistent with the topography of the surrounding rehabilitated landform. This level is aimed at providing a free draining landform to the re-established Anvil Creek. Noting that there would still be an area with part of an exposed final highwall in this area. Then following the completion of coal extraction in the MCCO Additional Mining Area, Case 5 would require the disturbance, re-excavation and transportation of approximately 100 Mbcm of material from the existing rehabilitated landform within the Approved Project Area to fill the final void to pre mining topography within the MCCO Additional Project Area. This would result in no final voids, however, it would result in re-disturbance of extensive areas (approximately 394 ha) already rehabilitated and would continue mining impacts for a number of additional years. Figure 13 within **Appendix 2** shows this option including the area of existing rehabilitation that would be required to be re-excavated. Mangoola has assessed the economics of this case and determined that it is not an economically feasible option. Mangoola also determined that this case was also not preferred due to the additional disturbance and environmental impacts that would occur. **Key Features** • Haul approximately 83 Mbcm of overburden from the MCCO Additional Mining Area to the existing approved mining area for the purpose of filling the existing approved mining area void to a level consistent with the topography of the surrounding rehabilitated landform • At the completion of mining, excavate approximately 100 Mbcm from the existing rehabilitated land within the Approved Project Area to fill the final void within the MCCO Additional Project Area • Disturbs approximately 394 ha of existing rehabilitated land • Approximate 4.5-year extension of site works post mining to rehandle the 100 Mbcm of material and associated additional rehabilitation with additional impacts arising from noise and dust for the duration • No final voids would remain • The additional total cost to Mangoola Coal is estimated at $526M and the loss of economic value would see the MCCO Project not supported to proceed.

Option	Description and Key Features
Case 6 **Non Preferred Case – Partial Fill of Final Voids**	Case 6 would involve the haulage of the minimum required (approximately 50 Mbcm) plus an additional 6 Mbcm of overburden from the MCCO Additional Project Area to the existing approved mining area for the purpose of partially filling the existing approved mining area void to approximately 130 RL. The aim of this case was to leave a depression rather than a void, with the intent maintained to re-establish Anvil Creek as per the existing conceptual final landform. There is an expectation that a water lake would still form within the depression. The case also assumes rehandling of approximately 8 Mbcm of overburden from the MCCO Additional Project Area overburden emplacement dumps, post mining, to partially fill the void and reduce the depth of the north void to approximately 111 RL considering the available overburden material remaining. In this case two depressions/voids remain at the completion of operations, being a revised void or depression in the MCCO Additional Mining Area and in the existing approved mining area (see Figure 14 in **Appendix 2**). Considering the size of the depressions remaining, the final landform could be considered to still contain two voids albeit smaller than Case 3, and combined with the incremental costs was not considered to be the preferred case by Mangoola. Highwalls would remain in both cases and be treated as described in Case 2 and 3. **Key Features** • Haul approximately 56 Mbcm of overburden from the MCCO Additional Project Area to the Approved Project Area for the purpose of partially filling the existing approved mining area void to leave a depression rather than a void • Nominally 8 Mbcm overburden rehandle at the completion of mining in the MCCO Additional Project Area, to improve the overall shape, reduce the total void area and depth • Two final voids ultimately remain at the completion of operations with the south void partially filled to form a large depression rather than a defined void and the north also filled further • Void low walls in both areas will be shaped at the completion of mining • Remaining high walls selectively blasted and shaped for visual amenity and geotechnical stability reasons • The additional total cost to Mangoola is estimated at $95M.
Case 7 **Non preferred case – No MCCO Project Case**	No MCCO Additional Mining Area case with mining completed at the end of mining in the existing approved mining area. This option is discussed in **Section 1.4.5**.

The MCCO Project (Case 3), including the commitment to rehandle 5 Mbcm of material, is more costly to achieve than the preferred business case (Case 1) and Case 2 which was the initial integrated mining case considered as part of the planning and design phase for the project, however, it is considered by Mangoola to achieve an appropriately balanced outcome. In summary Case 3 as selected provides the following benefits:

- provides a balanced outcome that achieves economic expectations whilst minimising the size of the final voids
- void in the existing approved mining area commensurate with the approved final landform however improved due to the application of a revised natural landform design and shallower slopes on the low wall
- reduces the overall size and improves the visual appearance of the MCCO Project Additional Mining Area void by backfilling the angular ends of the void and providing rounded ends
- both final voids (non-backfilled mining areas) will partially fill with water and act as long-term hydraulic sinks. Within the existing approved mining area there is potential for water in backfilled areas away from the final void to migrate out and provide recharge to the surrounding bedrock with much of this water moving north and being captured in the northern void
- there will be limited public vantage points from which the remnant highwalls will be visible (particularly once vegetation has been established on adjacent areas)
- minimising the environmental and social impacts that would occur with more extensive rehandling of emplaced overburden including impacts on already rehabilitated areas, dust, noise, water and visual impacts.

Based on the mine planning and final void and landform options assessment, Mangoola has determined that the MCCO Project Case as presented and assessed in this EIS strikes an appropriate balance between mine planning, economic, environmental, social and final landform outcomes.

Mangoola is committed to minimising risks to the community from any residual voids through effective mine planning and through the development of effective final void designs and has committed to design final voids that are safe, stable and non-polluting.

Mangoola will consider the following factors throughout the life of the MCCO Project:

- the ongoing refinement of the life of mine plan to consider final void implications at each stage of planning, with the overall aim of seeking to minimise the size of the final voids
- there needs to be recognition that due to the dynamic nature of mining, mine plans may change through time in response to economic, geotechnical and environmental factors. As such, void positions/size/characteristics may change from that initially envisaged in the proposed mine plans, however, the design of the final voids in each mine plan iteration will meet acceptable outcomes
- final voids and rehabilitated mine sites need to consider opportunities for the economic diversification of an area following the cessation of mining and Mangoola will commit to considering such options as a part of the detailed mine closure and final land use planning process.

Further details with regard to final landform design are discussed in **Appendix 2** and also within **Section 6.17** (Rehabilitation and Mine Closure).

1.4.5 Alternative of Not Proceeding with the MCCO Project

The option of not proceeding with the MCCO Project would mean the closure of the Mangoola Coal Mine following the likely cessation of mining in 2025 once the existing approved mine plan is completed. Whilst rehabilitation and closure works would continue for some years following the cessation of mining, such operations would be at a much lower intensity than the current mining operations and there would be a significant reduction in employee numbers. The ongoing employment opportunities for up to approximately 480 employees would be lost as would the significant flow on effect to the local, regional and State economy.

The MCCO Project will extract approximately 52 Mt of additional ROM coal during its life. The impacts of supplying this coal from an existing mining development are likely to be significantly reduced when compared to supply from a new 'greenfield' mine development. The extraction of this coal now, while there is existing mining equipment operating at the site and available mining infrastructure, is substantially more efficient than seeking to mine the resource at some future date following closure of the existing operations. Not proceeding with the MCCO Project would make it considerably more expensive to extract the coal in the future, with commensurate reductions to taxation and royalty revenue. Such future operations may not be commercially viable as the current benefit of being able to utilise the existing Mangoola infrastructure. The trained and experienced workforce as it currently exists may not be as readily available if the MCCO Project does not proceed as proposed.

Proceeding with the MCCO Project will provide a range of economic and social benefits at local, regional and State levels. Some of the key economic benefits include:

- ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising up to approximately 480 employees
- ongoing opportunities for local businesses and service providers
- an ongoing contribution to the local, regional and State economies
- increase the gross regional product by a projected approximately $599M in NPV terms, over the life of the MCCO Project
- increase the NSW gross State product (including the Hunter region) by $686M in NPV terms over the life of the MCCO Project
- provide a net benefit of $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project.

These and other economic and social benefits would not be realised should the MCCO Project not proceed.

Not progressing with the MCCO Project would have some 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 significant economic benefits of the MCCO Project.

With the implementation of appropriate management, mitigation and offset measures as outlined in **Section 6.0** and **Section 8.0**, and considering the environmental costs as required by NSW Government guidelines, the economic assessment for the MCCO Project has concluded that the MCCO Project would result in a net benefit to the community. Mangoola therefore considers that not proceeding with the MCCO Project is not a desirable alternative.

1.5 Project Development Application

Being development for the purpose of coal mining, the MCCO Project is declared to be a SSD under the provisions of State Environmental Planning Policy (State and Regional Development) 2011 and will require Development Consent under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act.

The NSW Department of Planning and Environment (DPE) is the delegated consent authority to make decisions on SSD applications where there are less than 25 objections to the application, the local council does not object, and there have been no reportable political donations.

The NSW Independent Planning Commission (IPC) is the consent authority for SSD applications where:

- there have been 25 or more public objections to the application, or
- the local council has objected, or
- a reportable political donation has been made.

The MCCO Project Development Application relates to the proposed extraction of approximately 52 Mt of additional coal resources which represents approximately eight years of mining in the MCCO Proposed Additional Mining Area, with some of the mining equipment from the existing approved operation undergoing a progressive transition into the MCCO Additional Project Area during this time. If approved, the development consent for the MCCO Project will replace the existing Mangoola Coal Mine Project Approval and cover all future operations within the MCCO Project Area.

Following the determination of the MCCO Project, should it be approved, Mangoola will continue to operate under the existing Project Approval until the MCCO Project commences (that is, undertakes new works that are not permitted by the existing Project Approval). At this time, it is proposed that all activities including those in the existing approved mining area would be regulated by the new development consent which would prevail to the extent of any inconsistency with the existing Project Approval. The existing Project Approval is planned to be surrendered prior to the commencement of mining within the MCCO Additional Project Area, or as otherwise agreed with the Secretary of DPE.

In practice, this would mean that following the granting of any development consent for the MCCO Project, the entirety of the mining operation would be managed by a new modern development consent with contemporary conditions and requirements. This development consent will require best practice environmental and social management at the mining operation.

Should development consent be granted for the MCCO Project, there would also be various approvals, licences and permits under other NSW legislation that are required prior to the commencement of certain activities associated with the MCCO Project. These are discussed in detail in **Section 4.0**.

In addition to the approvals required for the MCCO Project under NSW legislation, consideration of the MCCO Project is required under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The MCCO Project was referred to the Commonwealth Department of the Environment and Energy (DoEE) to determine whether it constitutes a controlled action under the EPBC Act. On 21 January 2019, the MCCO Project was determined to be a Controlled Action requiring approval under the EPBC Act from the Commonwealth Minister for the Environment. Further discussion of the requirements of the EPBC Act as they relate to the MCCO Project is included in **Section 4.0**.

1.5.1 Environmental Impact Assessment of the Project

This EIS has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Mangoola in accordance with the requirements of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000*, including the Secretary's Environment Assessment Requirements (SEARs) for the MCCO Project. The SEARs were issued by DPE on 15 February 2019 (replacing a previous version of the SEARs issued on 22 August 2017) and identify the specific requirements to be addressed by this EIS. A copy of the SEARs is contained in **Appendix 3**. A checklist of the SEARs and where they have been addressed in this EIS is outlined in **Section 4.3**.

As noted above, this EIS has been prepared to accompany the Development Application for the MCCO Project. Details of the project team and technical specialists responsible for preparation of this EIS are provided in **Appendix 4**.

1.5.2 The Proponent

The proponent for the MCCO Project is Mangoola Coal Operations Pty Limited (Mangoola) which is owned by Glencore Coal Pty Ltd and is part of the wider Glencore group of companies.

1.6 Site Context

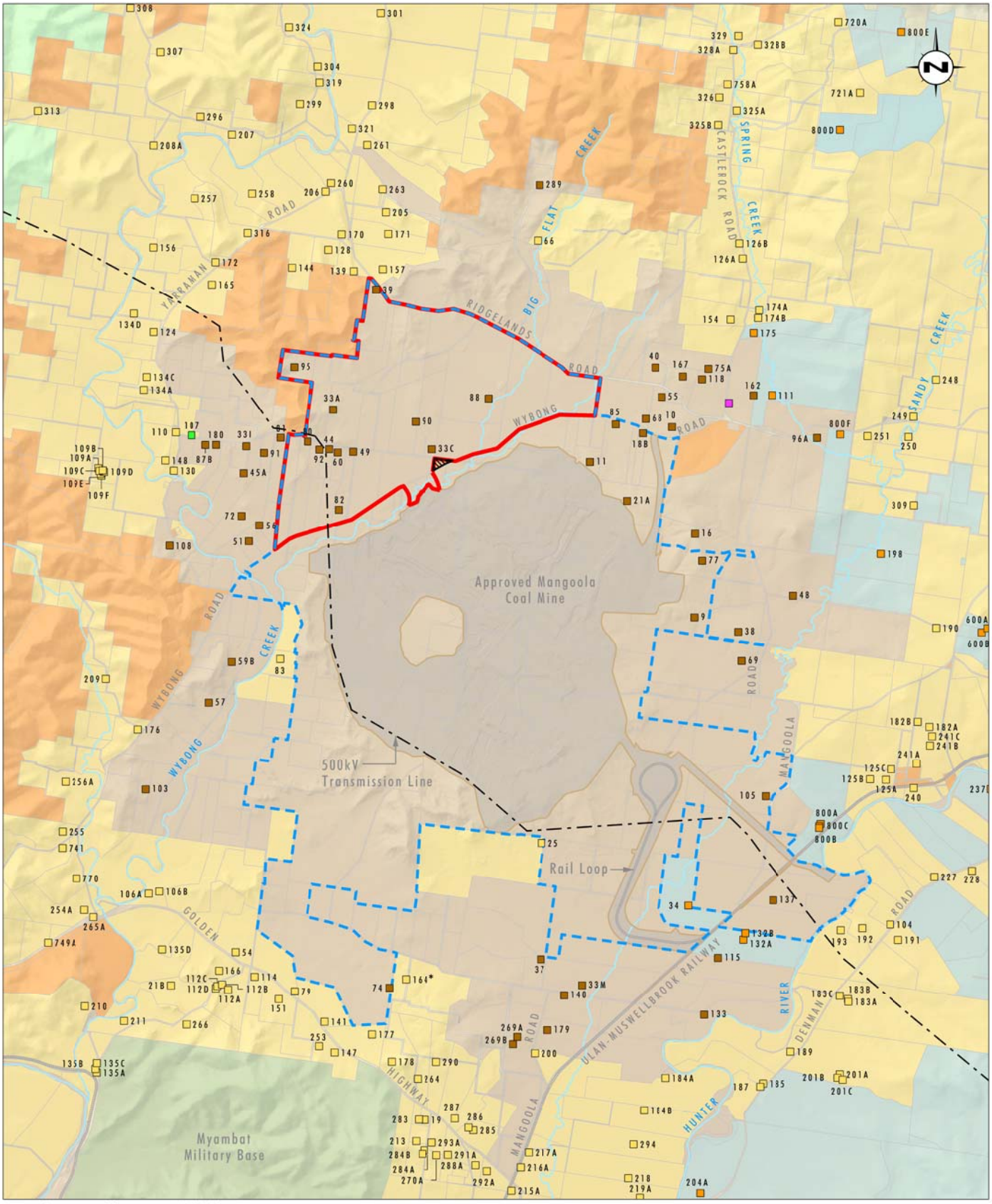
1.6.1 Environmental Setting

The MCCO Project includes both the existing Approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area. The Approved Project Area is dominated by the existing mining operation, including the open cut mining area and associated infrastructure, along with areas of rehabilitated land and native vegetation.

The MCCO Additional Project Area has been used extensively for agriculture since the 1800s and is comprised of rolling grazing land and small patches of native woodland. An analysis of historical aerial photography indicates that most of the area had been cleared by the 1940s. To the north and east are further areas of Mangoola owned grazing land and existing ecological offsets (refer **Figure 1.5**). Land to the north-west and west includes a parcel of forested Crown land and private grazing properties (refer to **Figure 1.5**). A small parcel of Crown land associated with a Travelling Stock Route (TSR) is located at the corner of Wybong Post Office Road and Wybong Road outside the MCCO Additional Project Area (refer to **Figure 1.5**). **Section 1.6.3** and **Section 6.15** provides further details with regard to current and historical land uses.

The topography of the MCCO Additional Project Area is characterised by lower slopes, giving way to undulating hills and rocky outcrops to the north and west (refer to **Figure 1.6**). Lower topographic areas are associated with drainage lines feeding Big Flat Creek to the south. A dominant topographical feature in the surrounding landscape is the series of undulating wooded hills which occur outside and to the north and west of the MCCO Additional Project Area (refer to **Plate 1.1**). These hills rise to a maximum height of approximately 360 metres (m) Australian Height Datum (AHD) and are elevated approximately 200 m above the surrounding area.

The MCCO Additional Project Area primarily lies within the catchment of Big Flat Creek with small sections extending into the Wybong Creek catchment. Big Flat Creek flows to Wybong Creek which is located approximately 600 m to the west of the MCCO Additional Project Area and is part of the upper catchment of the Hunter River (refer **Figure 1.6**). **Section 6.7** provides further details of the surface water environment.



Data Source: Glencore (2019)
Note: *Subject to Negotiated Agreement

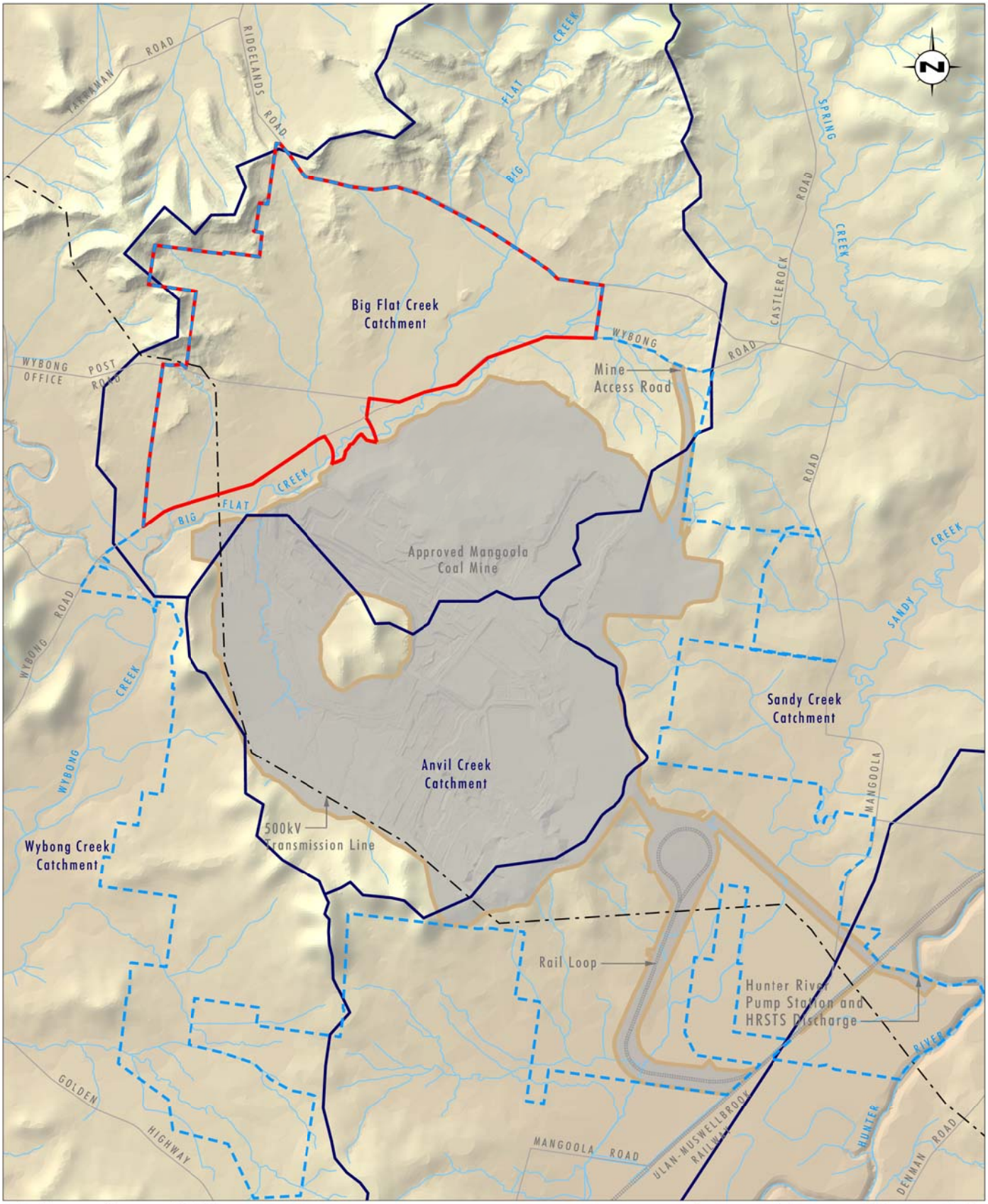
0 1.0 2.0 4.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Crown Land (TSR) Exclusion from MCCO Project Area
- The Commonwealth of Australia
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

FIGURE 1.5

Land Ownership



Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Catchment Boundary

FIGURE 1.6

Existing Topography and Drainage

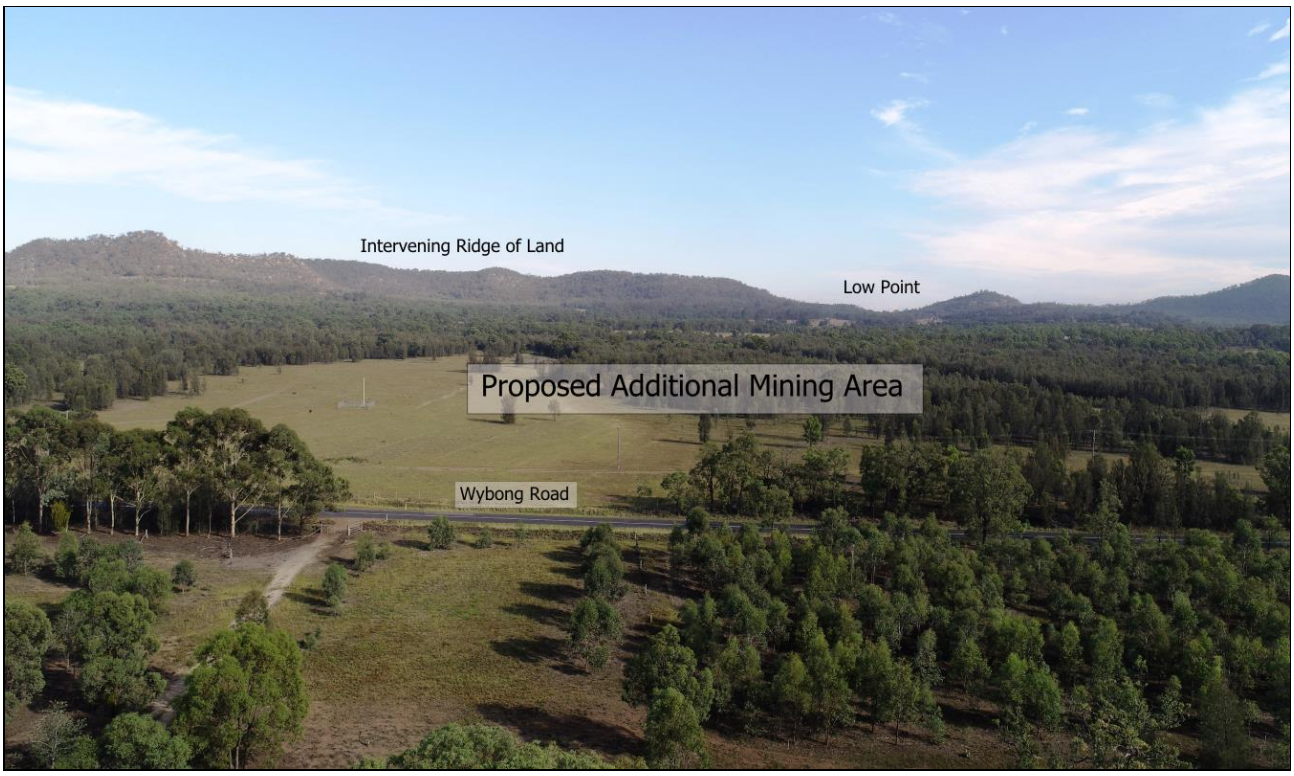


Plate 1.1 View to North of Wybong Road Showing Intervening Ridge of Land

Glencore, 2019

1.6.2 Land Ownership

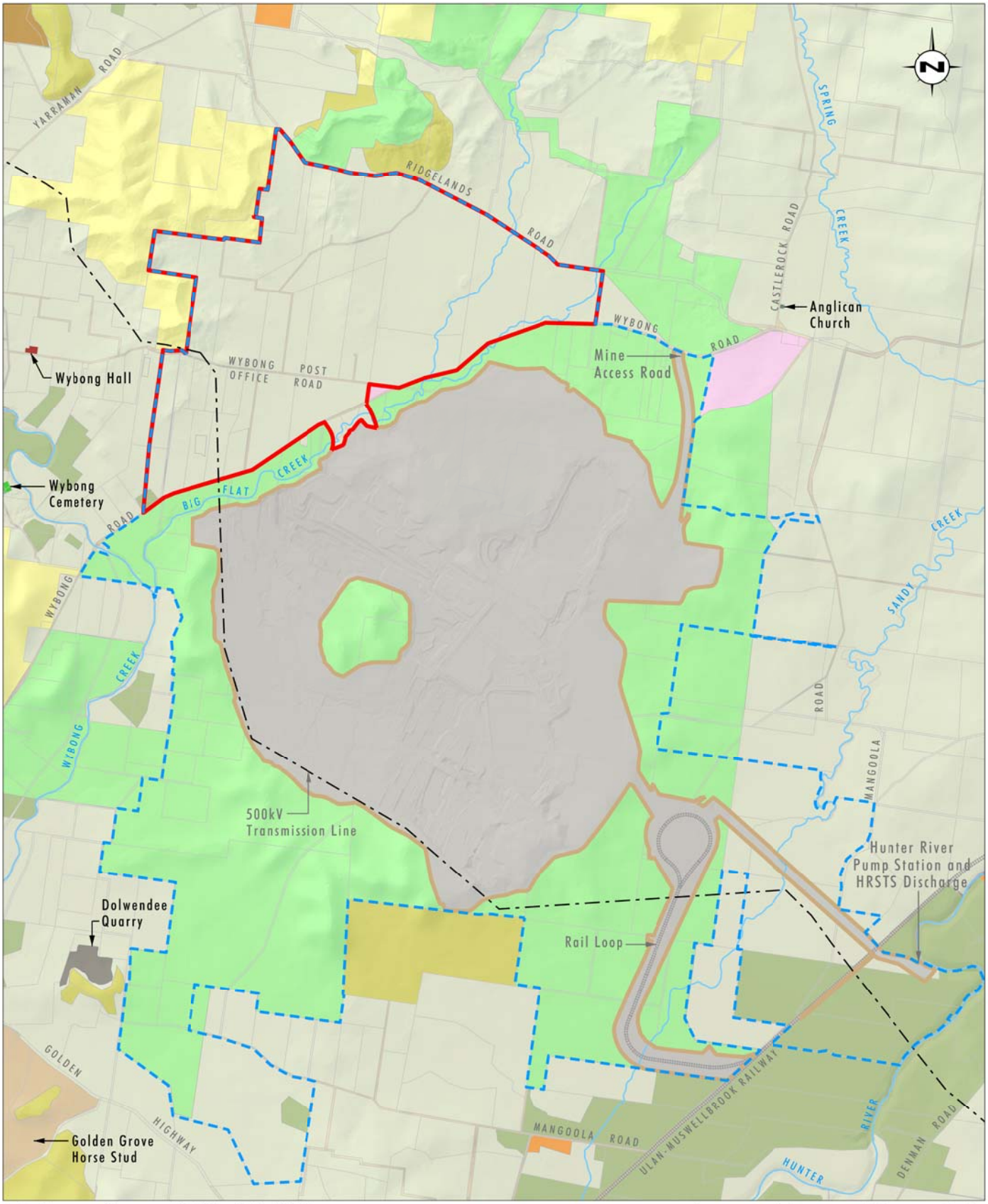
Land ownership in the MCCO Project Area and surrounds is shown on **Figure 1.5**. With the exception of small sections of public road corridors and paper roads, Mangoola owns all land within the proposed MCCO Additional Project Area. The majority of the land immediately surrounding the MCCO Additional Project Area is also owned by Mangoola, with some parcels of Crown and private land situated to the north, west and south.

The nearest private residences to the MCCO Additional Project Area are located on parcels adjoining the northern boundary. Although much of the land surrounding the MCCO Additional Project Area is owned by Mangoola, two private residences remain within the existing Mangoola Coal Mine acquisition zone, both of which are currently unoccupied. These landholders have been notified of acquisition rights in accordance with Mangoola's existing Project Approval and have elected to stay at this time.

The Schedule of Land for the MCCO Project which identifies land to which the Development Application applies, is provided in **Appendix 1**.

1.6.3 Land Use

The locality surrounding the MCCO Project Area is dominated by primary production activities. This primarily includes grazing, including both low intensity grazing and a mixture of more intense cattle grazing and cropping on the Wybong Creek alluvial flats to the west and Hunter River alluvial flats to the south-east, along with other agricultural activities including grape growing to the south-west and east, and small olive groves to the north-west (refer to **Figure 1.7**).



Data Source: Glencore (2019), OEH (2013)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Existing Mangoola Offsets

Land Use:

- Church
- Woodland Area
- Cemetery
- Crown Land
- Grazing
- Horse Stud
- Olive Plantation
- Travelling Stock Route (Crown Land)
- Vineyard
- Wybong Hall
- Mixed, Grazing and Irrigation / Cropping / Improved Land
- Quarry

FIGURE 1.7

Surrounding Land Use

Outside of mining and agriculture, the area surrounding the MCCO Project also supports the rural towns of Sandy Hollow located approximately 10 km to the south-west, Denman located approximately 10 km to the south and Muswellbrook located approximately 20 km to the east of the MCCO Project Area.

There are also a number of rural residences associated with mainly smaller rural land holdings surrounding the MCCO Project Area as shown on **Figure 1.7**. The closest privately owned residences are located on Ridgelands Road, approximately 1.15 km to the north of the Proposed MCCO Additional Mining Area. A ridgeline partially shields these residences from the MCCO Project Area (refer to **Figure 1.5**). Further detail regarding the land use surrounding the MCCO Project Area is provided in **Section 6.15**.

Several significant developments lie farther afield of the MCCO Project as shown on **Figure 1.8**. These include the Dolwendee Quarry (approximately 4 km south-west), Myambat Military Base (approximately 4.5 km to the south) and the existing coal mining operations of Mount Pleasant (approximately 9 km north-east), Bengalla (approximately 8.5 km east) and Mount Arthur Coal (approximately 9.5 km south-east).

The Strategic Regional Land Use Plan (SRLUP) for the Upper Hunter prepared by the NSW Government identifies a passage of land to the north and west of the MCCO Additional Project Area as both Equine and Viticulture Critical Industry Cluster (CIC) (refer to **Figure 1.9**).

No Biophysical Strategic Agricultural Land (BSAL) or CIC occurs in the MCCO Project Area (refer to **Section 4.4.2**). At its closest, a corner of the Equine CIC adjoins the northern most point of the MCCO Additional Project Area, however, it is noted that this land is not currently used for equine related land uses. It is understood that a former equine business, Nightingale Thoroughbreds was located in this area off Ridgeland's Road however it is noted that this has not been operational since 2012. The closest horse studs, Coronet Farm and Golden Grove Thoroughbred horse studs are situated approximately 4 km to the north-west and 6 km south-west respectively of the MCCO Additional Project Area.

Areas of viticulture CIC are mapped along parts of Wybong Creek and Sandy Creek, however it is noted that to the west and east respectively, much of this land is not currently and has not historically been used for viticulture. The former Yarraman Vineyard is located 3 km to the west of the MCCO Additional Project Area within the area of mapped viticulture CIC. It is noted that this site is not currently operated as a vineyard and a feedlot is proposed for the site with SEARs issued in 2016. Wybong Estate Winery is also located approximately 3 km to the north-west of the MCCO Additional Project Area (refer to **Figure 1.7**) with a ridge separating this vineyard from the MCCO Project.

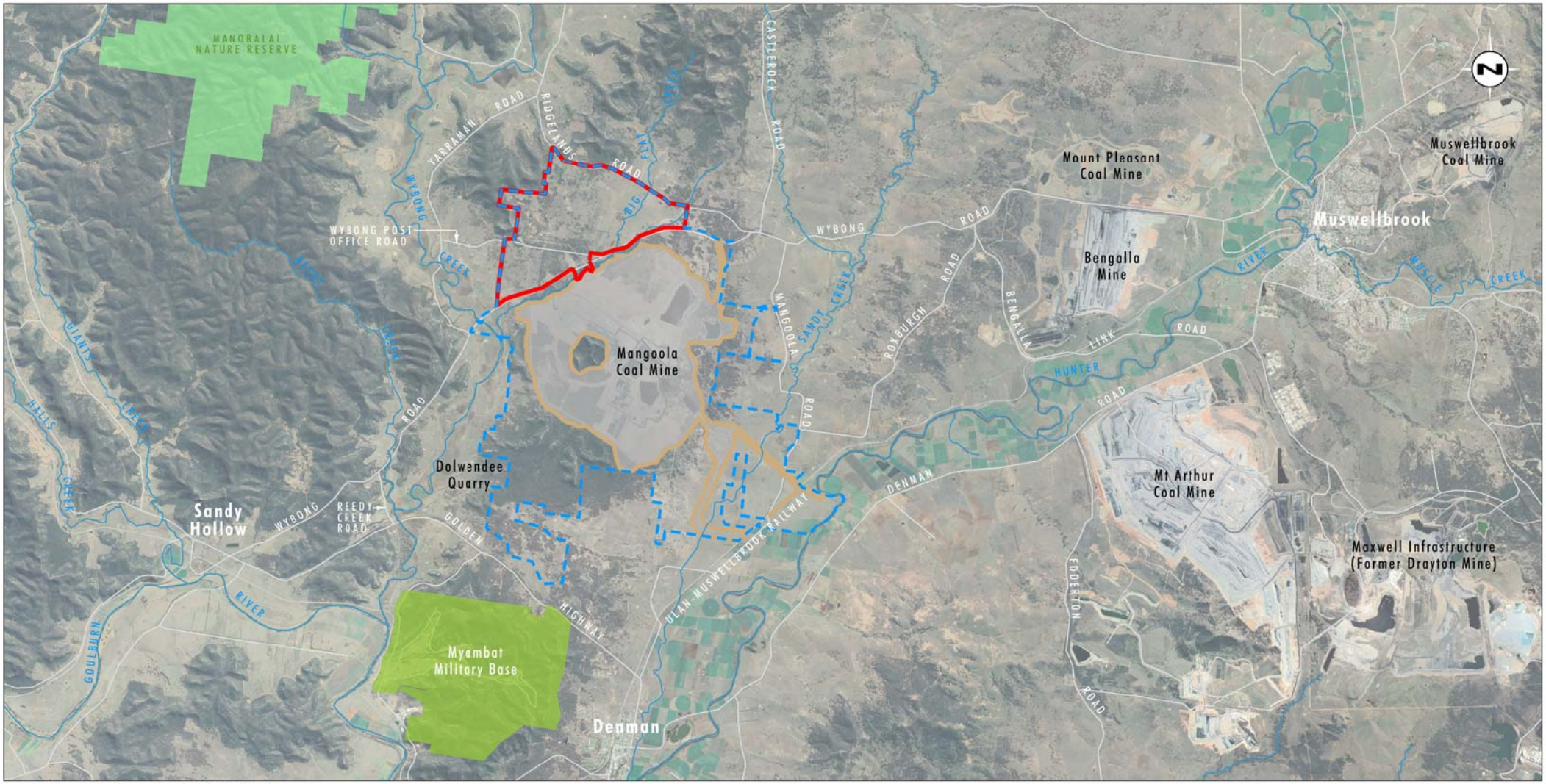


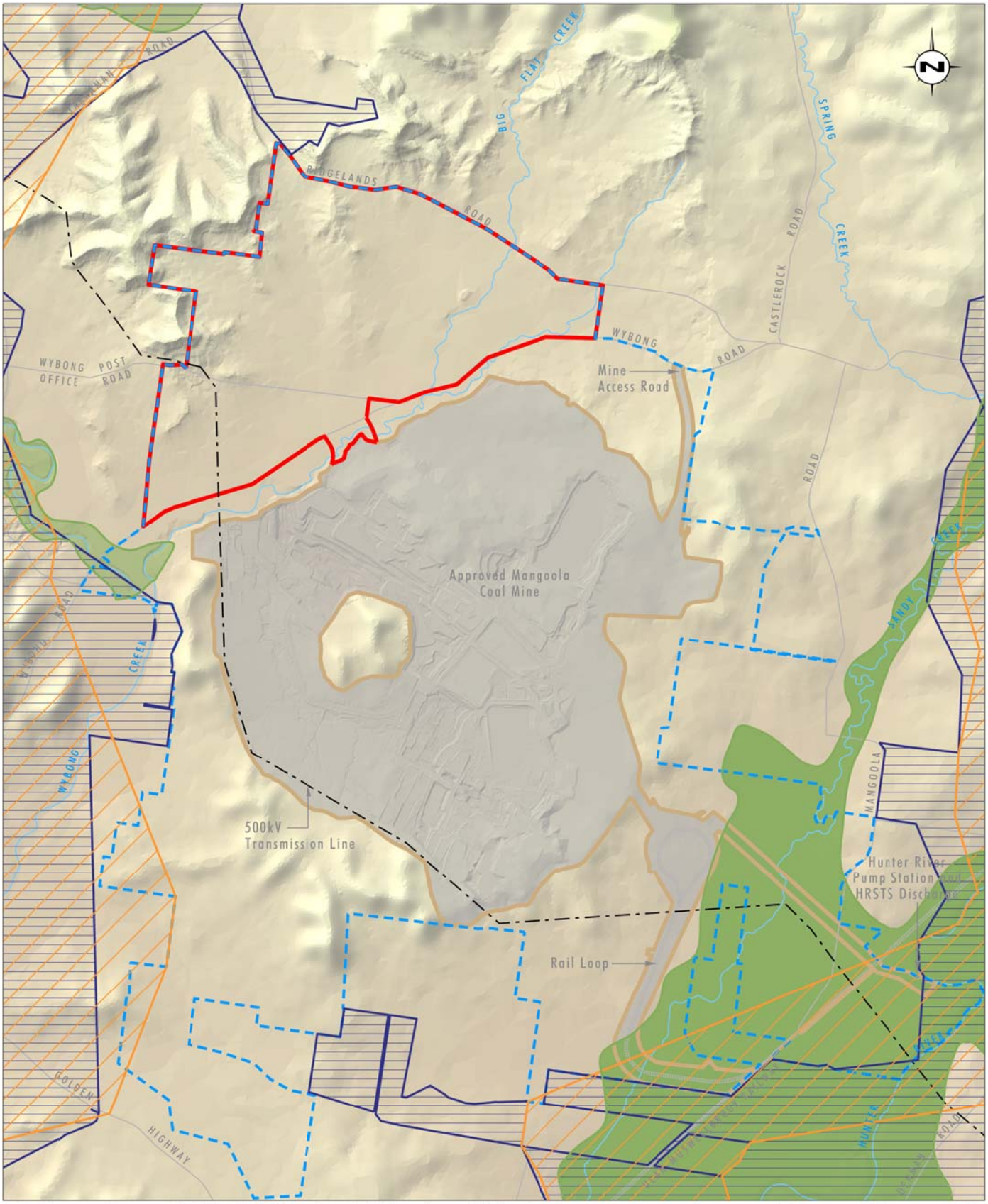
Image Source: Google Earth (2019)
Data Source: Glencore (2019), OEH (2013)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- The Commonwealth of Australia
- Nature Reserve

FIGURE 1.8

Significant Regional Developments



Data Source: Glencore (2019), NSW Department of Planning and Infrastructure

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area

Strategic Regional Land Use Policy (SRLUP):

- Equine Critical Industry Clusters
- Viticulture Critical Industry Clusters
- Biophysical Strategic Agricultural Land

FIGURE 1.9

Strategic Agricultural Land Mapping

1.7 Working with the Community and Stakeholders

Mangoola is committed to building upon its existing relationship with the surrounding community and other stakeholders and continue to work with them to minimise the impacts of its operations and enable coexistence.

Mangoola has an established communication program which includes community meetings, community information sheets and a 24-hour community response line for stakeholders to raise any concerns they may have directly with relevant personnel. Mangoola also has a Community Consultative Committee (CCC) which operates as a more formal mechanism for providing feedback between Mangoola and the community.

Mangoola is committed to maintaining ongoing open and transparent communication by actively engaging and consulting with the community to provide information relating to the environmental, social and operational performance of its operations. Glencore, as the manager of Mangoola, has extensive experience working with local communities at each of its Hunter Valley mining operations. Glencore shares its learnings across its operations and these learnings will continue to be applied at Mangoola to assist in effectively engaging with the local community.

Extensive project specific engagement has been undertaken with interested and potentially affected people and groups in the form of one-on-one meetings, telephone discussions, email correspondence and community information sessions. Further detail regarding consultation completed for the MCCO Project is provided in **Section 5.0**.

Detailed stakeholder engagement was also undertaken as part of the social impact assessment process for the MCCO Project. The most commonly raised issues included property values, sense of community, air quality/dust and noise, followed by traffic, economics, land use and management, environment, health and wellbeing, cumulative impacts, engagement and blasting.

The MCCO Project Area is located within the traditional lands of the Wonnarua and Gomeroi people. Extensive consultation has been undertaken with Aboriginal stakeholders as part of the Aboriginal Cultural Heritage Assessment and Aboriginal Archaeology Assessment processes. Consultation has been undertaken with 37 Registered Aboriginal Parties (RAPs) and the relevant Cultural Knowledge Holders (refer to **Section 5.3** and **Section 6.12**).

1.8 Environmental Impact Statement Structure

This EIS has been prepared in accordance with the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). An overview of the structure of this EIS is provided below.

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

Section 1.0 introduces the MCCO Project, outlines the background, provides an overview of existing operations and environmental context provides a summary of the key project details, including alternatives considered and outlines the EIS structure.

Section 2.0 provides a description of the existing and approved operations at Mangoola Coal Mine.

Section 3.0 contains a detailed description of the MCCO Project as proposed.

Section 4.0 outlines the planning and environmental context for the MCCO Project, including the applicability of Commonwealth and State legislation to the new Development Application.

Section 5.0 describes the stakeholder engagement program and details the key issues identified as part of this process for consideration in the EIS.

Section 6.0 contains a description of the existing environment and a comprehensive analysis and assessment of the key environmental, social and economic issues relevant to the MCCO Project, including the specific and cumulative impacts.

Section 7.0 provides an assessment of the impacts of the MCCO Project on Matters of National Environmental Significance (MNES) as required under the Commonwealth EPBC Act.

Section 8.0 sets out a summary of the management and monitoring measures proposed to be adopted throughout the life of the MCCO Project in order to mitigate impacts.

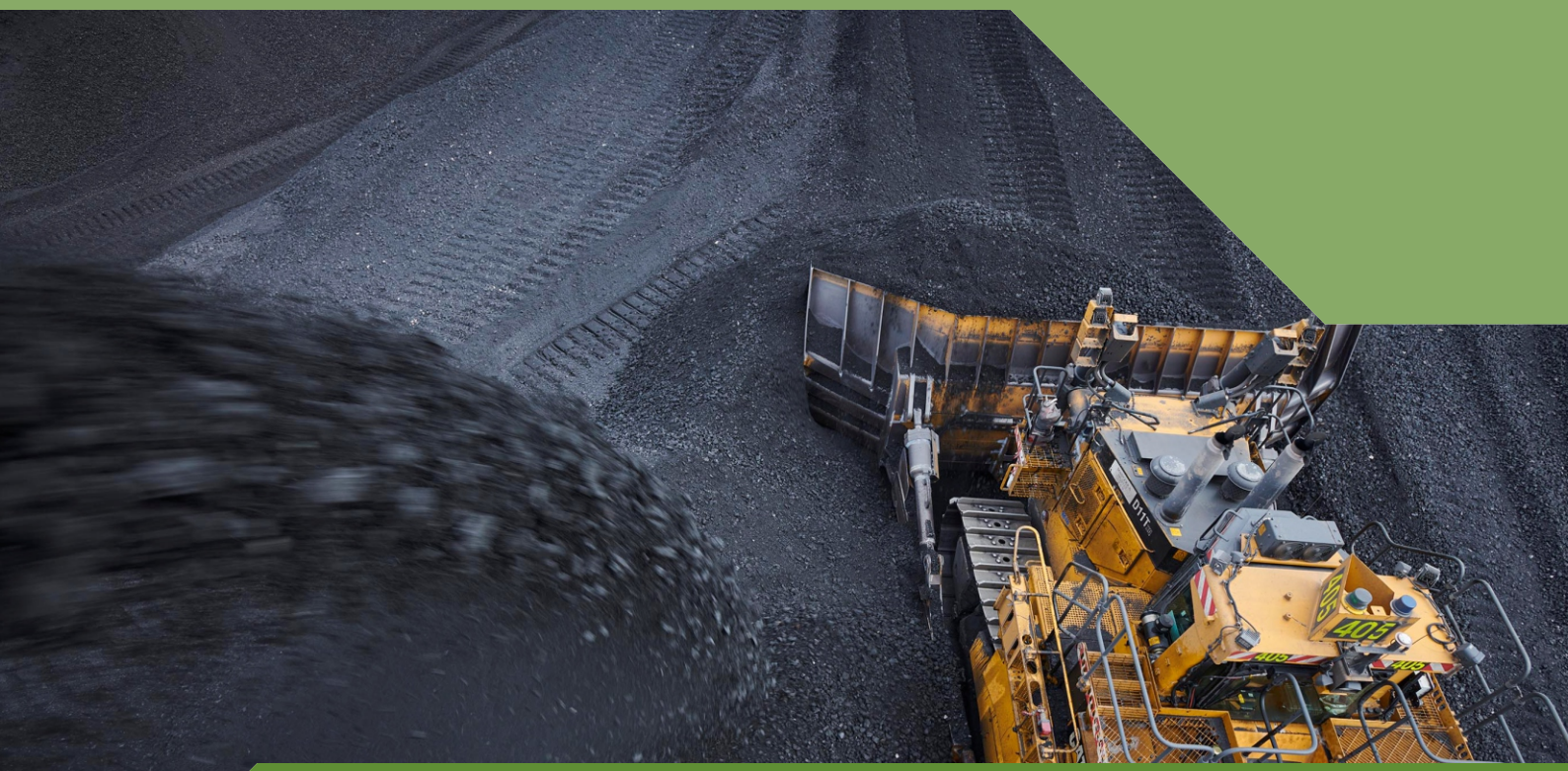
Section 9.0 summarises the key conclusions and provides a justification for the MCCO Project.

Section 10.0 provides a list of the documents that have been referenced throughout this EIS.

Section 11.0 contains a list of Abbreviations and a Glossary of technical terms to assist with reading and understanding this EIS.

Appendices 1 – 25 provide copies of the materials referenced that support this EIS including each of the detailed technical impact assessments.

SECTION 2.0
Approved Operations



2.0 Approved Operations

As discussed in **Section 1.0**, open cut mining has been occurring at Mangoola Coal Mine since September 2010 under PA 06_0014. This section provides a discussion of the approved operations and the planning and environmental approvals in place.

2.1 Background

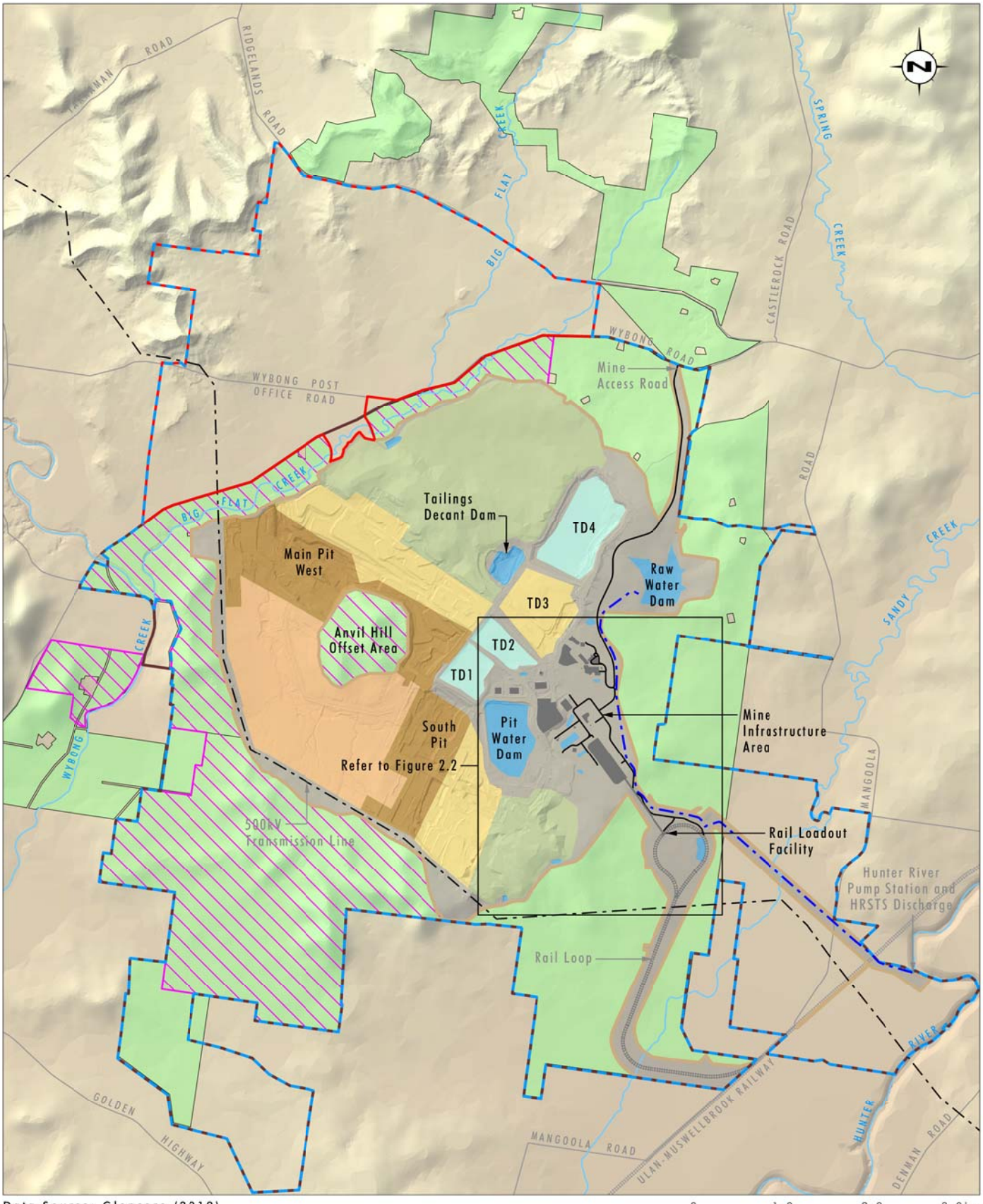
Mangoola Coal Mine was granted PA 06_0014 under s75J of the now repealed Part 3A of the EP&A Act in June 2007. Glencore purchased the operation from its original owners, Centennial Coal, in October 2007 and commenced operations and production under the Project Approval in September 2010.

Since commencement of mining there have been eight modifications to the Project Approval, one (MOD 6) increased the approved maximum extraction rate from 10.5 Mtpa of ROM coal to 13.5 Mtpa ROM coal. Details of each of the eight modifications are provided in **Section 2.2**. The existing approved operations are shown on **Figure 2.1** and **Figure 2.2** and described in further detail in the following sections.

Mangoola holds Mining Lease 1626 and Mining Lease 1747 for the existing approved mining operations. It also holds AL 9 and EL 5552 (refer to **Figure 2.3**) with further details on the approvals, tenements and licences held by Mangoola provided in **Section 2.2**.

Mangoola Coal Mine operates 24 hours per day, seven days per week and is serviced by site infrastructure facilities which include an administration office, workshop and warehouse, bathhouse, Coal Handling and Preparation Plant (CHPP), rail loadout facilities, conveyors and other ancillary facilities.

Truck and excavator mining methods are used to move overburden and excavate ROM coal for transport to the CHPP for processing. Overburden is fractured using open cut drill and blast processes. ROM coal is crushed and washed within the CHPP and loaded into trains via the approved train loading facility. When market conditions allow, ROM coal can be crushed and loaded directly into trains, bypassing the CHPP without being washed.



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Biodiversity Offset
- Aboriginal Cultural Heritage Offset
- Hunter River Pipeline
- Infrastructure
- Infrastructure Domain
- Active Mining
- Remaining Approved Mining Area
- Overburden Emplacement
- Rehabilitation
- Dam
- Tailings Dam (TD1-TD4)

FIGURE 2.1

Existing Approved Operations

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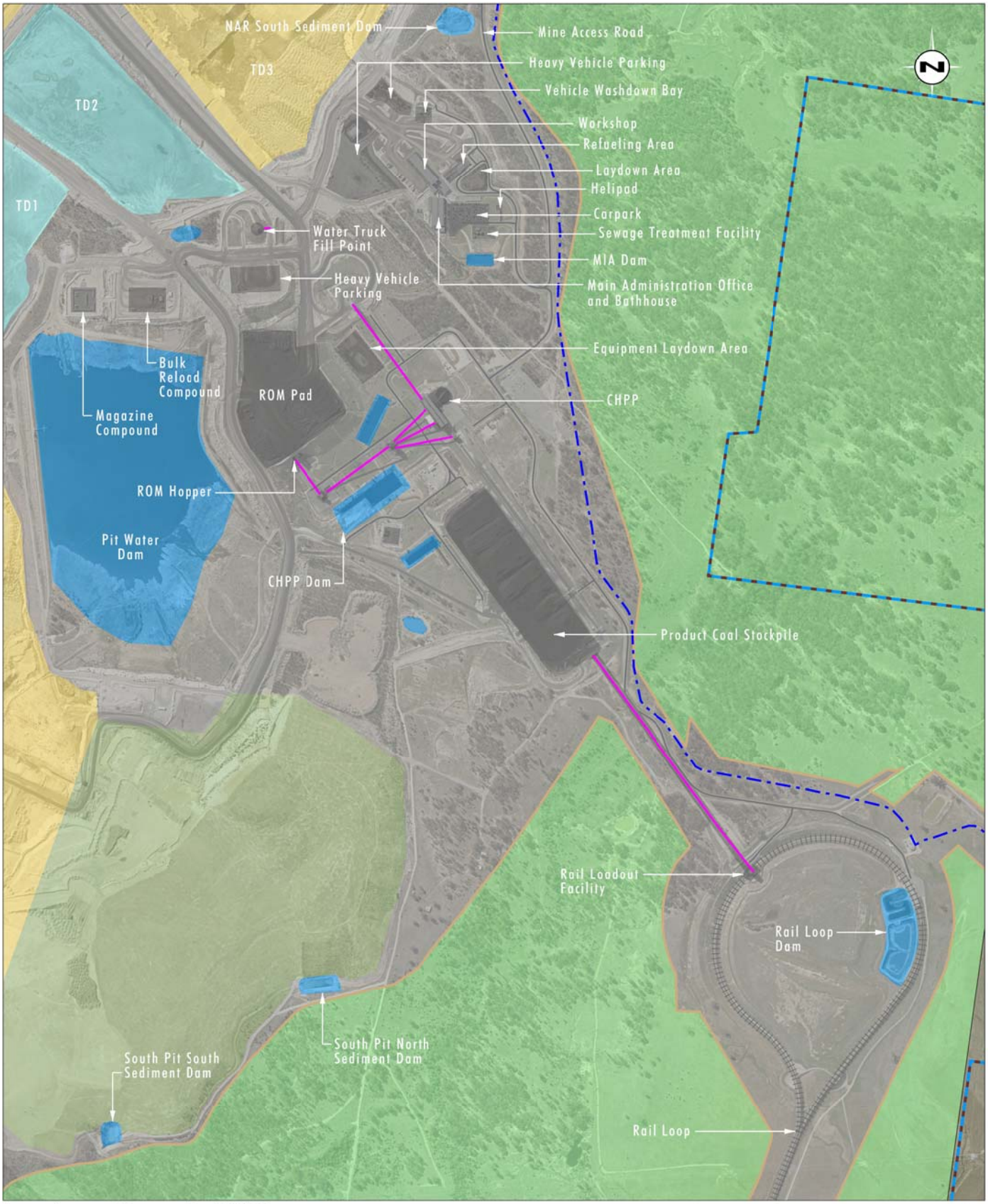

Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Project Area
- Approved Mangoola Coal Mine Disturbance Area
- Biodiversity Offset
- Infrastructure
- Infrastructure Domain
- Overburden Emplacement
- Rehabilitation
- Dam
- Tailings Dam
- Light Vehicle Road
- Conveyor
- Hunter River Pipeline

FIGURE 2.2

Existing Approved Operations Key Site Features

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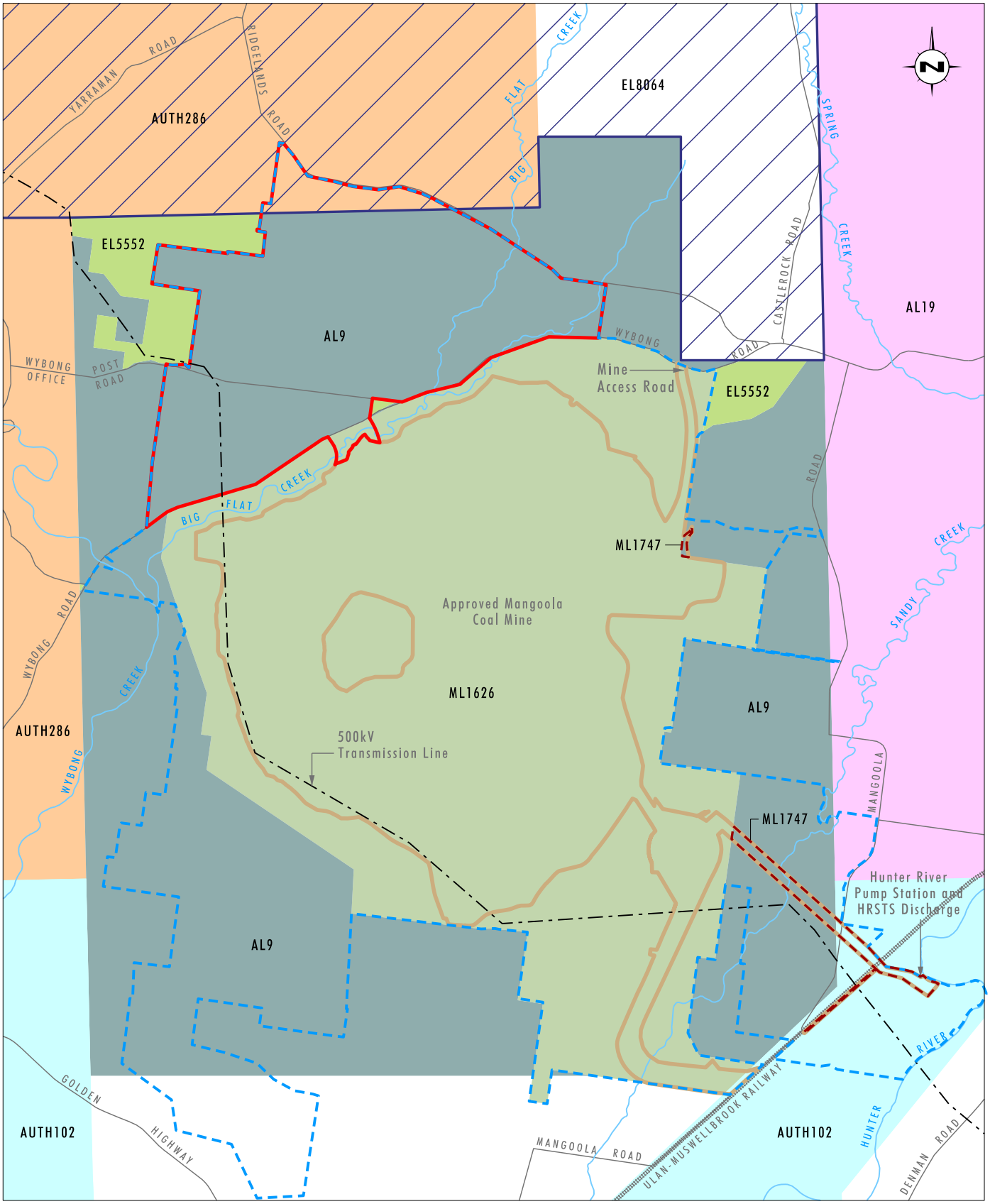

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Mining Area
- EL8064 - Ridgelands Coal Resources Pty Limited
- AL19 - Muswellbrook Coal Company Ltd
- AUTH102 - Secretary of the Department of Planning and Environment
- AUTH286 - Secretary of the Department of Planning and Environment
- AL9 - Mangoola
- EL5552 - Mangoola
- ML1626 - Mangoola
- ML1747 - Mangoola

FIGURE 2.3

Tenements

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20190412 14.58

2.2 Current Approvals and Licences

Operations at Mangoola Coal Mine are approved under PA 06_0014, several mining tenements, an Environment Protection Licence (EPL) 12894 and other supporting licences and approvals. **Table 2.1** outlines each of the planning and environmental approvals and licences that are currently held by Mangoola that authorise the carrying out of mining operations at Mangoola Coal Mine.

Table 2.1 Mangoola Coal Mine Existing Approvals and Licences

Number	Description	Date Granted
Project Approval		
PA 06_0014	Project Approval that authorises and regulates the Mangoola Coal Mine. Originally granted in 2007 and has been modified eight times. Details of each modification are provided below.	7/06/2007
PA 06_0014 MOD 1	PA 06_0014 Modification 1 – 'Early Works Modification', which allowed for the following: • Commencement of defined Early Works activities in parallel with the approved Wybong Road upgrade • Access to the mine site for the purposes of conducting the Early Works by an alternate route to that presented in the original 2006 EA, due to delay in construction of the Bengalla Link Road.	22/07/2008
PA 06_0014 MOD 2	PA 06_0014 Modification 2 – 'Hunter River Pipeline Modification', which allowed for the following: • Relocation of the approved Hunter River water supply pipeline and associated infrastructure • Access to the pipeline construction area for pipeline construction traffic from Mangoola Road • Change of use and capacity of the approved tailings dam to a Raw Water Dam (RWD) • Minor changes to the disturbance footprint for the construction of the rail loop • Minor upgrade to an access track for access to the eastern portion of the Hunter River water supply pipeline corridor.	23/06/2009
PA 06_0014 MOD 3	PA 06_0014 Modification 3 – 'Relocation of the Mining Infrastructure Area (MIA)' which allowed for the following: • Relocation of the MIA • Changes to the components of the CHPP, including the slight re-positioning of the ROM pad, the re-orientation of the CHPP building and a change in the height of the rejects bin.	4/11/2009

Number	Description	Date Granted
PA 06_0014 MOD 4	PA 06_0014 Modification 4 – 'Relocation of 500 kV ETL and mine modifications', which allowed for the following: • Relocation of the 500 kV ETL that bisected the area approved for disturbance from mining • Modifications to the mine plans to take into account the relocation of the transmission line. This included changes to mine staging, site water management and minor increases to the approved project disturbance boundary.	22/06/2012
PA 06_0014 MOD 5	PA 06_0014 Modification 5 – 'Night Time Rail Works', which allowed for the following: • Undertaking of construction activities at night time where the Hunter River pipeline passes under the Ulan to Muswellbrook Railway during a 48-hour period of 'line possession' by Mangoola.	23/02/2010
PA 06_0014 MOD 6	PA 06_0014 Modification 6 – 'Extraction Rate Increase', which allowed for the following: • An increase in the maximum extraction rate from 10.5 Mtpa ROM coal to 13.5 Mtpa ROM coal, an increase in equipment numbers, an increase in workforce numbers, amendments to on-site blasting conditions and redefining a temporary ROM stockpile as a life of mine ROM stockpile • Approval to utilise mined waste rock for gravel production • Approval to install a HRSTS Discharge Point and discharge into the Hunter River.	28/04/2014
PA 06_0014 MOD 7	PA 06_0014 Modification 7 – 'Removal of Schedule 3, Condition 3 – Traffic Noise Criteria', which allowed for the following: • Removal of Schedule 3, Condition 3 in order to align the Project Approval with Modification 6 noise impact assessment predictions and thereby remove duplicated noise compliance measures.	22/08/2016
PA 06_0014 MOD 8	PA 06_0014 Modification 8 – 'Amendment of Project Layout Plan', which allowed for the following: • Update of project layout plan contained in Appendix 2 of PA 06_0014 to represent the layout and scale of the mining operation • Update to the wording of Schedule 3, Condition 2 of PA 06_0014 prescribing that the Proponent carries out the project generally in accordance with the conditions of the Project Approval and Project Layout Plan.	14/06/2017
Mining Tenements		
Mining Lease 1626	Mining Lease – covering the approved Mangoola Coal Mine including the mining areas, coal handling, processing and transport infrastructure, mine infrastructure areas and the site access road.	24/08/2016

Number	Description	Date Granted
Mining Lease 1747	Mining Lease (Mining Purposes) – covers the corridor associated with the Hunter River Pump Station, HRSTS discharge point and associated pipeline and allows for the RWD to reach the designed top water level.	20/11/2008
AL 9	Assessment Lease - exploration authority covering the areas surrounding the approved Mangoola Coal Mine that are outside of Mining Lease 1626.	08/11/2004
EL 5552	Exploration Licence – exploration licence covering residual areas surrounding the approved Mangoola Coal Mine that are not included in AL 9.	08/05/2006
Mangoola Coal Mining Operations Plan (MOP)	MOP - developed in accordance with Condition 3 of Mining Lease No. 1626 and 1747 and includes a rehabilitation management plan as required by Schedule 3, Condition 60 of the Project Approval. Currently operating in accordance with the Mangoola Coal Mining Operations Plan January 2016 – December 2019 prepared by Mangoola Coal Operations Pty Limited.	October 2018
Licences		
EPL 12894	Environment Protection Licence.	7/07/2008
Water Licences (various)	Mangoola holds various water licences as necessary under the *Water Management Act 2000* and *Water Act 1912* that cover water take associated with the operations at Mangoola Coal Mine. This currently includes 17 Megalitres (ML) total share components of Hunter River regulated high security Water Access Licences (WALs), 2758 ML total share components of Hunter River regulated general security WALs and 861 ML share components of Wybong Creek unregulated WALs.	Various

2.3 Coal Mining

Mangoola Coal Mine is an open cut coal operation where mining is primarily undertaken using drill and blasting techniques to break the overburden, excavators loading dump trucks to move overburden and coal, assisted by supporting ancillary mining equipment. The key target seams lie within the Newcastle coal measures and include the Wallarah (where present), Great Northern, Fassifern and Upper Pilot seams.

The general sequence of mining includes stripping of topsoil, removal of overburden, extraction of the coal resource, overburden emplacement, landform establishment and progressive rehabilitation. Dump trucks haul ROM coal to the CHPP via internal haul roads for processing. Mining activities occur 24 hours per day, seven days a week at a maximum approved rate of up to 13.5 Mtpa ROM coal. Mining areas within the Approved Mangoola Coal Mine Disturbance Area include Main Pit West and South Pit and these are shown on **Figure 2.1**.

Mangoola also has approval to produce up to 50,000 tonnes per annum (tpa) of gravel material for use on site. Gravel crushing is approved to be undertaken on site between the hours of 7.00 am and 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays. No gravel crushing is permitted on public holidays

or Sundays. Gravel crushing occurs within mining operational areas as required with gravel typically used for preparing and maintaining internal roads, as part of blast hole stemming, and for other suitable uses.

2.4 Coal Handling, Processing and Transport

Coal handling and processing occurs at the Mangoola Coal Mine CHPP (refer to **Figure 2.2**). The CHPP has the capacity to process the approved 13.5 Mt of ROM coal per annum.

Once delivered by truck to the ROM pad, ROM coal can be placed directly into the ROM bin or placed onto a nominal 250,000 tonne capacity ROM coal stockpile. ROM coal is crushed and washed at the CHPP. This processing separates the raw coal into various products, coarse rejects and fine tailings. The CHPP also has the capability to bypass the washing process by crushing raw coal. The resulting coal products are then delivered to the product coal stockpile via conveyor for transportation off site by train via the rail loadout facility.

The product coal stockpile area has a nominal capacity of 600,000 tonnes. Dozers are used to manage stockpile capacity and blend coal products during reclaim. The bypass system is also utilised where appropriate which allows crushed coal to bypass the CHPP and be transported directly by enclosed conveyor from the surge bin straight to the product coal stockpile area.

Product coal is reclaimed through valves in the floor of the product coal stockpile and transferred to the train loading facility via conveyor. Product coal is loaded onto trains and transported to market via the Mangoola Coal Mine rail loop which is connected to the Ulan-Muswellbrook Railway (refer to **Figure 2.1**). Coal from Mangoola Coal Mine is sold to both the domestic market including supplying the Bayswater and Liddell Power Stations and export markets via the Port of Newcastle.

2.5 Rejects and Tailings Management

Mangoola Coal Mine uses the approved on-site tailings storage facilities, which consists of a series of tailings dams for emplacement of fine tailings material (refer to **Figure 2.1**).

Water drained from tailings emplacement facilities is captured within decant dams or sumps for re-use in the CHPP or for dust suppression. As mining progresses the tailings dams and decant facilities will be decommissioned or mined through with the tailings decant dam being the primary facility being utilised going forward to capture excess water from TD4. The tailings dams and tailings decant dam are shown on **Figure 2.1**.

Coarse rejects from coal preparation is transported by truck to the open cut overburden emplacement areas for emplacement and subsequent covering by overburden material.

2.6 Water Management

Water supply for the Mangoola Coal Mine is sourced from a number of primary resources including water captured by the mine site for pollution control purposes, water collected in accordance with harvestable rights, groundwater inflows to the mining areas and direct pumping of water from the Hunter River under licence.

Mangoola has established a water management system to manage sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation and reuse of mine water.

The majority of managed water is used within the CHPP and for dust suppression. Other uses include fire control and equipment washing and maintenance. The water management system has been designed to maximise water re-use, particularly from tailings drainage, stormwater harvesting and sewerage treatment to minimise extraction from the Hunter River.

Mangoola has approval for the construction and operation of a HRSTS discharge facility on the Hunter River (refer to **Figure 2.1**). This facility has not yet been constructed. To help mitigate periods of excessive water storage which may constrain future mining operations the construction of this facility and associated infrastructure is planned for construction in 2019-2020.

Mangoola currently holds 35 HRSTS discharge credits however these have not yet been required. Discharges will be via the Pit Water Dam and future discharges managed in accordance with the EPL and the HRSTS.

Further detail regarding the existing site water management system is contained in **Section 6.7**.

2.7 Key Supporting Infrastructure

The approved operations at Mangoola Coal Mine are supported by a range of surface infrastructure (refer to **Figure 2.2**) including:

- administration buildings, including bathhouse facilities
- CHPP and associated infrastructure
- train loading facility and rail loop
- workshop
- heavy and light vehicle parking and wash station facilities
- equipment and materials laydown areas
- bulk fuel and lubricant storage and dispensing facilities
- magazine and reload facility
- electrical power reticulation
- Mine Access Road
- tailings management infrastructure
- water management infrastructure including the Hunter River pump station, HRSTS discharge point (to be constructed) and supporting Hunter River pipeline
- water truck fill stations for fire and dust suppression
- waste management systems including in-pit disposal of haul truck tyres and off-site domestic waste transfer arrangements
- parking facilities and a helipad.

2.8 Offsets

Mangoola has established approximately 3,065 ha of Biodiversity Offset Areas (BOAs) for offsetting of predicted ecological impacts associated with the approved Mangoola Coal Mine operations (refer to **Figure 2.1**). These are divided into separate ecological management domains based on their locations and varied management requirements.

The conservation objectives of these areas include:

- conserve and enhance native vegetation and habitats for a range of threatened and migratory species, endangered populations and threatened ecological communities across the BOAs
- improve the habitat values and habitat connectivity of the remnant native vegetation within the BOAs
- successfully establish an additional 1104 ha of treed vegetation within areas of existing Derived Native Grassland in the BOAs
- maintain 330 ha of the BOAs as existing Derived Native Grassland
- implement and maintain sustainable grazing practices as a management action within the Southern Offset.

Biannual inspections of these areas are undertaken by Mangoola and assess:

- the condition of site features such as fences and access tracks
- evidence of erosion
- condition of revegetation/regeneration strategies
- weed infestations
- evidence of pest fauna.

In addition to the biannual inspections, the Mangoola Ecological Monitoring Program is conducted on an annual basis and includes:

- monitoring of remnant vegetation within the Mangoola BOAs
- monitoring of regeneration/revegetation areas within the Mangoola BOAs
- fauna monitoring
- specific threatened species monitoring
- stream health monitoring
- nest box monitoring
- landscape function analysis monitoring
- mollusc monitoring.

To date over 1400 nest boxes have been installed and are being monitored at Mangoola Coal Mine. During 2017, 425 of the 432 nest boxes monitored showed signs of use (both external and internal) and 90 of the boxes contained an animal at the time of monitoring. These included mammals, marsupials, reptiles, birds and their eggs/young.

Tree planting activities are being undertaken to extend and enhance existing woodland areas and create vegetation corridors to link the offset areas and rehabilitation with remnant vegetation to the north and west of Mangoola Coal Mine. During 2018, 68,150 trees and shrubs were planted across 68 ha, taking the total offset area undergoing active revegetation to 360 ha (343,983 trees) since the commencement of mining.

In addition to the Biodiversity offsets, Mangoola has established offsets for Aboriginal cultural values. The approved Aboriginal Cultural Heritage Offset Areas (ACHOAs) include over 1066 ha of land located along portions of Big Flat Creek, Anvil Hill, Wallaby Rocks and the Limb of Addy Hill, as shown in **Figure 2.1**. These areas have been set aside for long term security due to their Aboriginal cultural values. The majority of ACHOAs are located on land established as biodiversity offset areas.

Mangoola has lodged applications with the Biodiversity Conservation Trust (BCT) to establish Conservation Agreements (CAs) across the existing biodiversity and cultural heritage offset areas in accordance with Division 12 of Part 4 of the *National Parks and Wildlife Act 1974* (NPW Act). These applications are currently being processed by BCT. While these applications are being processed Mangoola are treating these areas as conservation areas and have commenced monitoring and reporting requirements in accordance with the draft agreements. These agreements will legally bind current and future landholders to manage and maintain conservation values of the offset areas in accordance with the requirements of the CAs.

During pre-feasibility planning completed for the MCCO Project it was identified that an access corridor would be required across Big Flat Creek and Wybong Road to provide connectivity between the approved Project Area and proposed MCCO Additional Project Area. The location where this access corridor is required includes approximately 12 ha of the originally proposed area of ACHOA-5. This portion of the former ACHOA was excised from the CA as lodged with the NSW Office of Environment and Heritage (OEH). The CA application also effectively provides for protection for the remaining portion of ACHOA-5 in perpetuity.

Mangoola implements a number of management measures to protect Aboriginal sites located within these areas including:

- installation/maintenance of fencing and signage
- bushfire hazard monitoring
- regeneration/rehabilitation of native vegetation communities
- erosion control
- maintenance of existing roads, drains or fences
- feral animal and weed control
- rehabilitation activities.

In addition to the above, annual inspections of the ACHOAs are undertaken to confirm that these areas and the sites they contain are not adversely affected by mining activities (be it directly or indirectly) and to monitor the effects of activities required under other management plans (such as revegetation works). A blast monitoring program is in place to manage the impacts of blasting (including ground vibration) at the rock shelter sites.

2.9 Rehabilitation and Final Landform

Rehabilitation at Mangoola is undertaken in accordance with the requirements of the Project Approval and as approved in the MOP. Areas disturbed during mining are progressively rehabilitated in order to return the land to a sustainable post mining land use in a manner that meets the objectives and targets of government approved rehabilitation plans. Disturbed land rehabilitation is designed to produce a stable landform and sustainable vegetation communities that are consistent with and enhance the surrounding landscape. In accordance with existing approval requirements Mangoola is committed to establishing appropriate native woodland species across much of the rehabilitation area and 700 ha of native grassland across the site (refer to **Plate 2.1**). Vegetation communities proposed within the native woodland areas include:

- Ironbark Woodland Complex
- Bulloak Woodland
- Paperbark Woodland
- Slaty Box Woodland
- Forest Red Gum Riparian Woodland
- Rough Barked Apple Woodland
- Swamp Oak Riparian Forest
- Grey Box Woodland
- Weeping Myall Woodland.

Rehabilitation at Mangoola Coal Mine is completed using natural landform design principles and revegetation techniques that are widely recognised as industry leading practice.

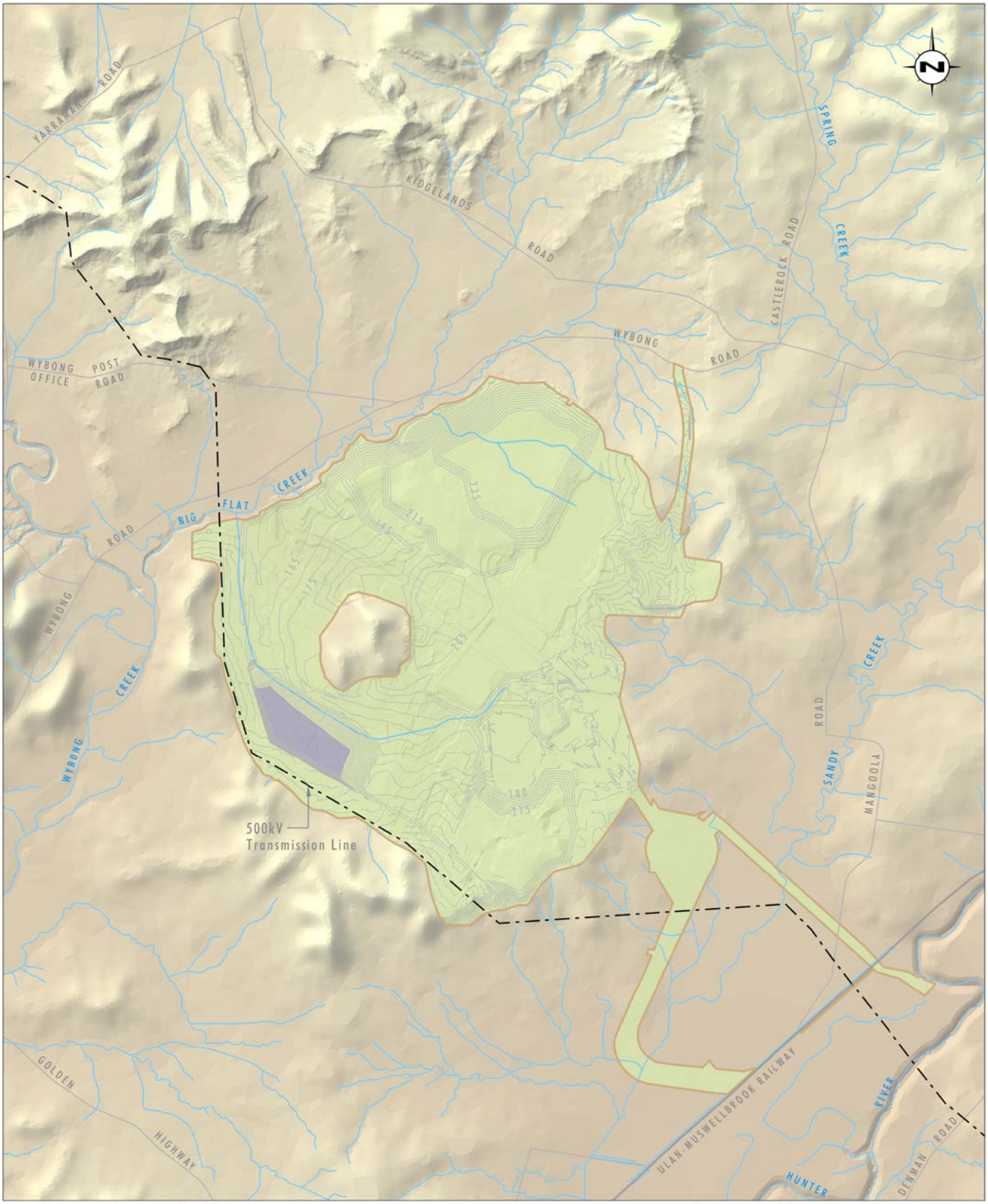
To date, Mangoola has successfully rehabilitated approximately 490 ha of disturbed land in the north-eastern and southern portions of the Approved Mangoola Coal Mine Disturbance Area in accordance with the MOP and approved Rehabilitation Management Plan (refer to **Figure 2.1**). Much of this rehabilitation was completed using natural landform design principles. Mangoola has also commenced a rehabilitation monitoring program which assesses a number of variables including landform stability, vegetation ground cover and weed prevalence. Results so far, as summarised in the Mangoola Coal Mine Annual Reviews (for example, Mangoola Coal, 2018), have reported that revegetation and rehabilitation works have been successful and have yielded species diversities that are generally compatible with target vegetation communities.

Following the completion of mining, infrastructure which is not able to be utilised by subsequent approved land uses will be removed. Soils within and surrounding former infrastructure areas will be assessed for potential contamination. Any contamination present will be remediated and contaminated material will be treated or appropriately disposed of. As with other disturbed areas, former infrastructure areas will be removed and revegetated unless proposed for other land uses.

Dams forming part of the mine water management system will be removed unless they are proposed to be utilised for habitat purposes, are associated with long-term stability and water management, or are beneficial to subsequent land uses (e.g. stock dams). Removal of sediment from mine water dams will occur as required as part of the closure and rehabilitation processes regardless of the suitability of the dams for other purposes.

As per current approvals, one final void is approved to remain as part of the conceptual final landform. The existing approved conceptual final landform for Mangoola Coal Mine is shown on **Figure 2.4**.

Plate 2.1 Existing Rehabilitation in Foreground with Mine Operations in the Background



Data Source: Glencore (2019)
Note: Contour Interval 5m

0 1.0 2.0 3.0km

Legend

- Approved Mangoola Coal Mine Disturbance Area
- Rehabilitation
- Void

FIGURE 2.4

Existing Approved Conceptual Final Landform

2.10 Environmental Management System

Mangoola has developed and implemented a comprehensive Environmental Management System (EMS) to guide the management of its activities at the mine so that environmental and social impacts are minimised and residual impacts are appropriately managed. The EMS provides a framework for managing environmental and social issues in a systematic and integrated way. It has been designed using a continuous improvement approach, so that the approach to managing environmental and social issues enables ongoing performance improvements.

The EMS includes standards, procedures, objectives and targets, which help the operation to maintain and continually improve environmental and social performance. Routine inspections and regular environmental audits are undertaken to assess performance against objectives and targets and identify opportunities for improvement.

The Mangoola EMS has been developed in a manner that is generally in accordance with ISO 14001, the international standard for an EMS.

2.11 Environmental Management Plans

The EMS includes a number of environmental management plans that have been prepared and are periodically reviewed and updated to assist in the management of key environmental issues. Many of these plans have been prepared to satisfy the requirements of the Project Approval and have therefore been prepared in consultation with relevant government agencies and approved for implementation by DPE. The key existing management strategies and plans include:

- Environmental Management Strategy
- Site Water Management Plan, including an Erosion and Sediment Control Plan, Surface Water Monitoring Plan, Groundwater Monitoring Program and Surface and Groundwater Response Plan
- Air Quality Management Plan
- Noise Management Plan
- Blast Management Plan including Closing Public Road Procedure and Blast Fume Management Strategy
- Biodiversity and Offset Management Plan and Strategy
- Aboriginal Cultural Heritage Management Plan
- Conservation Management Strategy
- Energy Saving Action Plan
- Pollution Incident Response Management Plan
- Rehabilitation Management Plan (provided in the MOP).

Details of how these plans will be applied to the MCCO Project, including required revisions or updates, are discussed in the relevant environmental assessment section of this EIS (refer to **Section 6.0**).

2.11.1 Air Quality and Noise Management

Mangoola operates in accordance with approved contemporary air quality and noise management plans, which outline procedures for effective management and mitigation of air quality and noise impacts on the local community. Management and mitigation measures implemented at the existing operations include proactive and reactive operational air quality and noise management and both air quality and noise monitoring networks that incorporate real-time monitoring units.

Proactive control measures are considered as part of the ongoing planning process for existing operations and include the use of predictive meteorological forecasting to assist with mine planning, such as equipment positioning, when adverse meteorological conditions could give rise to elevated dust or noise emissions. Where practicable this includes planning different operating locations in different seasons, taking into account prevailing meteorological conditions in that season. It also includes having day and night time working locations and different emplacement locations that can be used in different meteorological conditions to assist in minimising impacts.

Reactive measures include the use of a tiered alarm system connected to the real time meteorological, air quality and noise monitoring network to ensure compliance with approval limits is maintained. Alarms are sent to relevant personnel when triggered by elevated wind speeds, measured dust or noise levels which are approaching relevant criteria as defined in the relevant Mangoola management plan. Triggering of the monitoring alarms results in operational personnel undertaking a review of current operations and implementing an operational response to minimise emissions, as required. Actions may include the relocation of equipment, targeted use of dust suppression or shut down of particular equipment.

Mangoola maintain a centralised location to record details of relevant external stakeholder communications. A Community Response Line (1800 014 339) is in operation 24 hours per day, seven days per week and is regularly advertised in local newspapers and on the Mangoola website. Complaints are recorded and investigated regardless of whether the alarm system has been triggered or not and where necessary operational changes are made to address the issue raised. Follow up communication with the complainant is undertaken to explain the outcome of complaint investigations. A monthly summary of complaints received is published on the Mangoola website.

2.12 Environmental Monitoring

Under its EMS, Mangoola has an existing approved environmental monitoring program in place to monitor compliance with statutory requirements and to assist with the active management of operations. The environmental monitoring program implemented at Mangoola currently includes monitoring of noise, air quality, blasting, surface water, groundwater and meteorological parameters. This is undertaken at the monitoring locations shown in **Figure 2.5**. There are also a number of regional monitoring sites that form part of the monitoring network that are outside of the frame of **Figure 2.5**. A detailed rehabilitation monitoring program and biodiversity monitoring program are also in place. **Table 2.2** provides a summary of the environmental monitoring network at Mangoola Coal Mine.

The existing environmental monitoring network will be reviewed and updated for the MCCO Project subject to the outcomes of specialist studies undertaken during EIS development. This is discussed further in **Section 6.0** and **Section 8.0**.

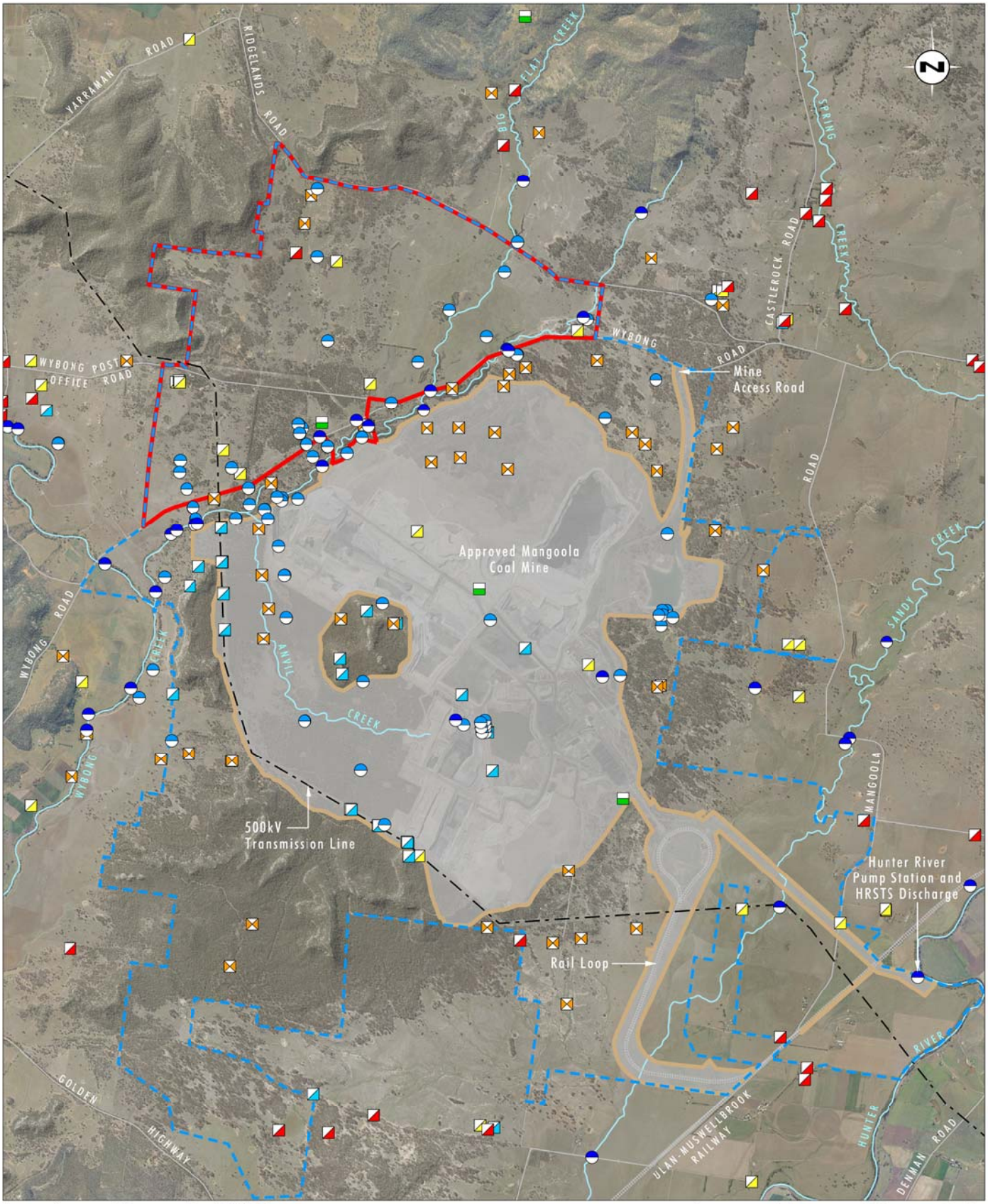


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Air Quality Location
- Biodiversity Location
- Blasting Location
- Groundwater Location
- MET Station Location
- Noise Location
- Surface Water Location

FIGURE 2.5

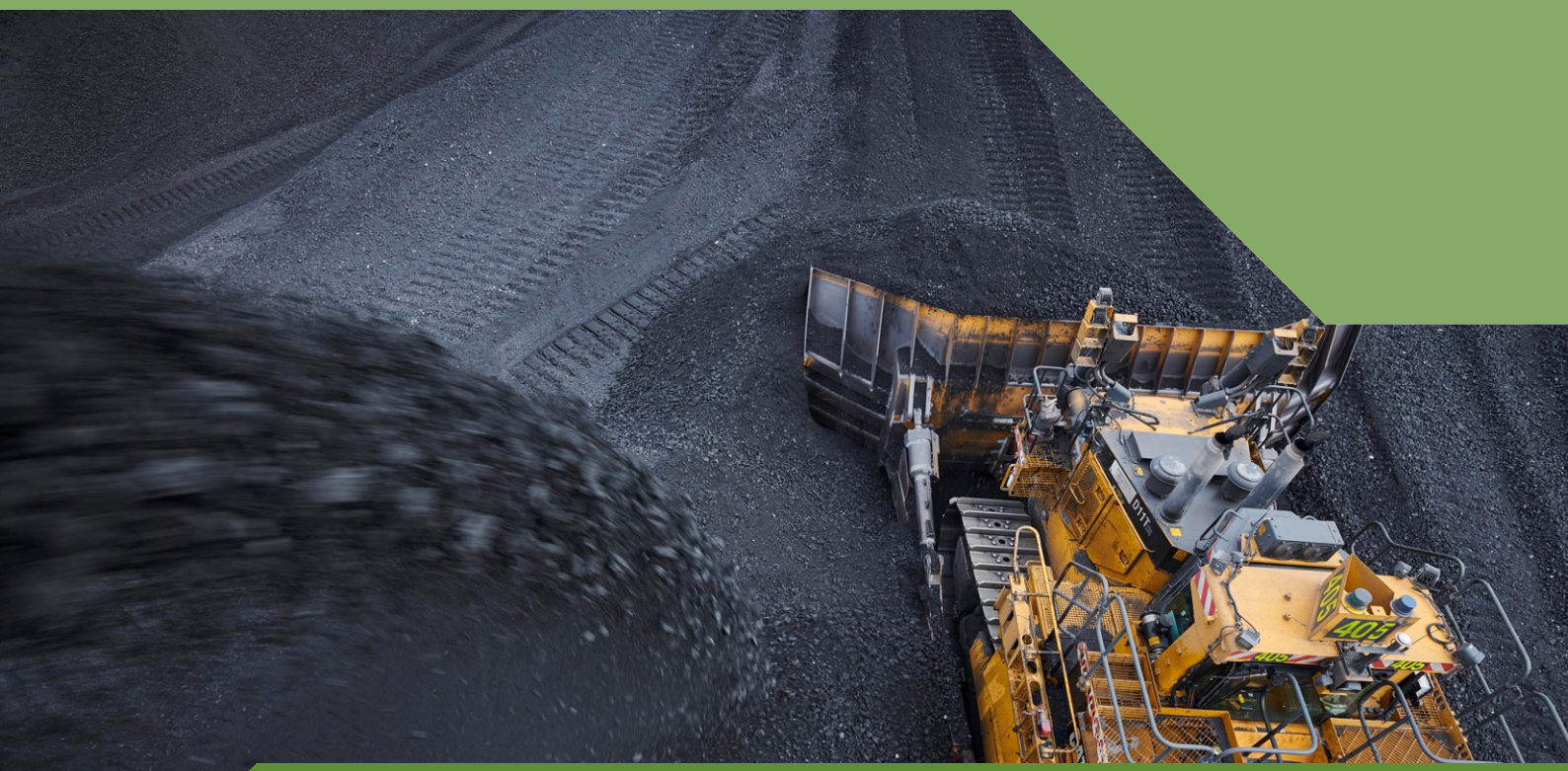
Existing Monitoring Network

File Name (A4): R13/4004_177.dgn
20190621 8.56

Table 2.2 Environmental Monitoring Network

Environmental Aspect	Monitoring Scope
Noise	Attended (compliance monitoring), and un-attended continuous (for proactive and reactive management purposes) monitoring at locations representing the nearest private receivers surrounding Mangoola Coal Mine.
Blasting	Nearest private receivers on privately owned land, significant heritage structures (as required), and significant infrastructure (as required) both on and surrounding Mangoola Coal Mine.
Air Quality	Continuous monitoring of PM_{10} using TEOM and E-samplers. Measurement of PM_{10}, TSP and $PM_{2.5}$ using High Volume Air Samplers. Dust deposition is monitored using dust deposition gauges.
Meteorological	Two meteorological stations monitor site conditions. These are strategically positioned on opposite sides of Mangoola Coal Mine in line with prevailing seasonal wind directions. A third station was recently installed in January 2019 on rehabilitated land within the current operational area.
Surface Water	Routine and high rainfall triggered water quality and flow monitoring is undertaken at creeks, streams and rivers in the region surrounding Mangoola Coal Mine as well as on-site monitoring in the mine water management system for site environmental management purposes.
Groundwater	Water level and a variety of water quality parameters are monitored in shallow and deep alluvium and colluvium deposits, coal measures and other non-coal strata using an assortment of vibrating wire piezometers and groundwater bores.
Biodiversity	Routine monitoring of flora and fauna in rehabilitation and offset areas using a variety of ecological survey and assessment techniques. Aspects include flora and fauna, photo monitoring, landscape function analysis, nest box monitoring, orchid translocation monitoring and Groundwater Dependent Ecosystem monitoring. Survey techniques include transects, plot-based surveys, photo monitoring, spotlight searches, diurnal bird surveys, habitat assessments and nocturnal call playback.

SECTION 3.0
Project Description



3.0 Project Description

3.1 Key Features of the Project

The MCCO Project will allow for the continuation of mining at Mangoola Coal Mine both within the existing approved operational areas and into a new mining area to the immediate north of the existing operations, north of Big Flat Creek and Wybong Road, on land largely owned by Mangoola (all of the land is owned by Mangoola with the exception of some road reserves). The MCCO Project will utilise the existing approved infrastructure at Mangoola Coal Mine (refer to **Figure 2.1** and **Figure 2.2**) and continue with the currently approved maximum rates of coal extraction as the existing mine (refer to **Section 2.0**). The MCCO Project will extend the life of the existing operation providing for ongoing employment opportunities for the Mangoola workforce.

The key features of the MCCO Project are shown in **Figure 3.1** and a summary of the key MCCO Project details are provided in **Table 3.1**.

A more detailed description of the MCCO Project is provided in the following sections.

Table 3.1 Summary of Key Project Details

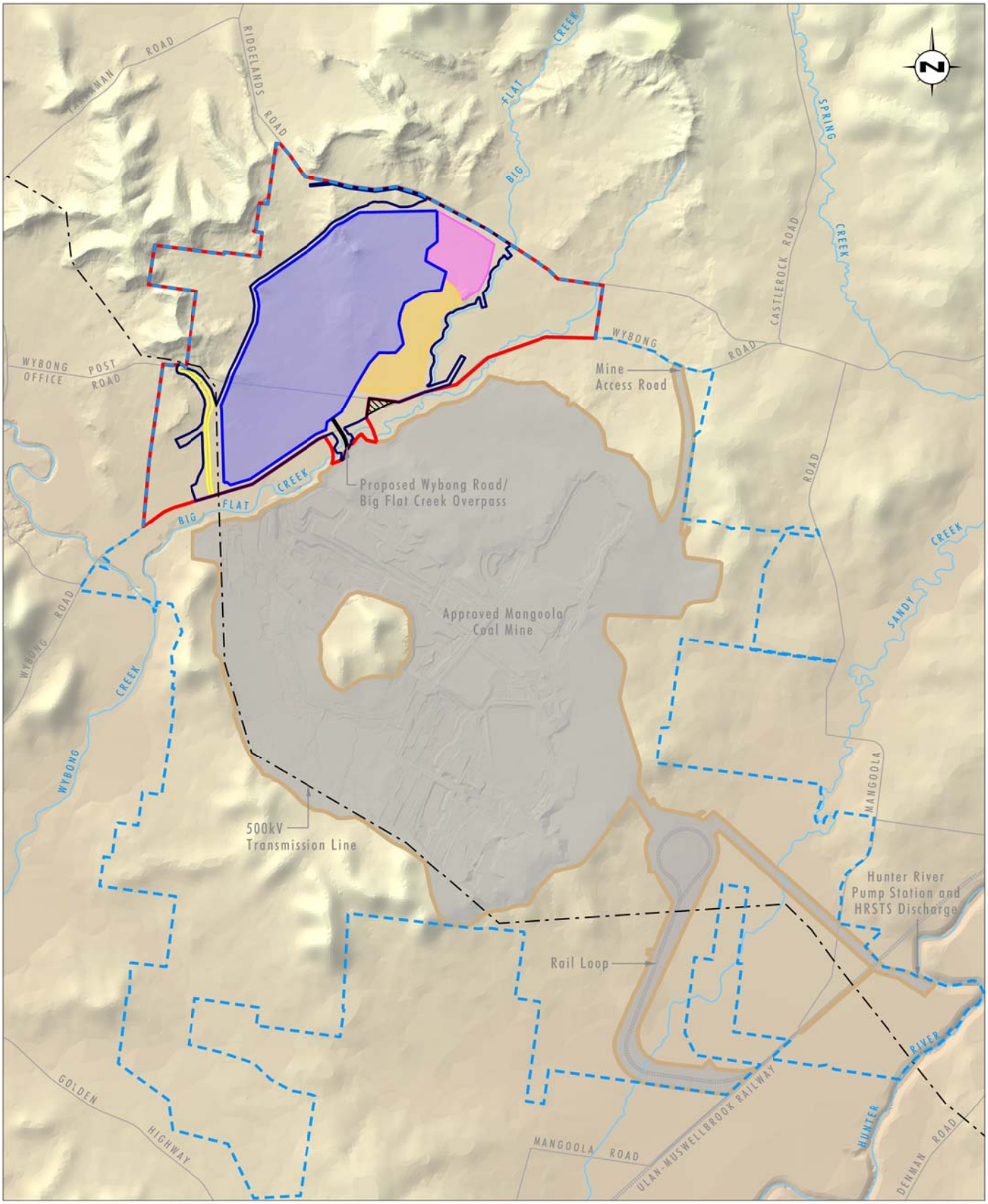
Key Project Components / Aspects	Currently Approved	Proposed
Total Economically Recoverable Reserve	Approximately 150 Mt of ROM coal.	Approximately 52 Mt of additional ROM coal.
Extraction Rates	Up to 13.5 Mtpa ROM coal.	No change.
Life-of-Mine	Approximately 21 years from granting of Mining Lease 1626 (Nov 2029).	Approximately 8 years of mining in additional resource. Represents one additional year beyond existing approval (2030) assuming commencement of mining occurs in 2022 as planned.
Operating Hours	24 hours per day, 7 days per week.	No change.
Operational Employees	Up to approximately 540 total Full Time Equivalent operational personnel. Actual employee numbers year to year adjust to meet operational requirements with current employment around 400.	400 employees rising up to approximately 480.
Construction Employees	200 associated with initial construction works, completed in 2011.	Construction workforce of approximately 145 persons.
Mining Methods	Open cut mining method using truck and excavator fleet.	No change to mining method.

Key Project Components / Aspects	Currently Approved	Proposed
Mine Infrastructure and Equipment	As described in **Section 2.0** (Approved Operations) the Mangoola infrastructure includes a CHPP, product stockpiling, reclaim and train loading facilities, administration offices, workshop, amenities buildings, pipelines and power systems and other associated facilities. Mining is undertaken using hydraulic excavators and a fleet of rear dump trucks. These are supported by dozers, graders, water carts and service vehicles.	Continued use of all existing infrastructure and equipment as described in **Section 2.0** with some minor additions to mobile equipment fleet as outlined in **Section 3.3.2**. Reduced mining intensity in new mining area to the north. Construction of a haul road overpass over Wybong Road and Big Flat Creek to enable connectivity between the MCCO Proposed Additional Mining Area and the existing operation. Construction of water truck fill points. Relocation of mining support infrastructure and services from time to time as mining areas progress.
Blasting	Blasting between 9.00 am and 5.00 pm Monday to Saturday inclusive. No blasting is allowed on Sundays, public holidays, or at any other time without the written approval of the NSW Environment Protection Authority (EPA). Mangoola may carry out a maximum of: • 2 blasts a day • 6 blasts a week, averaged over a calendar year.	No change.
Extent of Mining Areas	Approved Mangoola Coal Mine Disturbance Area is approximately 2294 ha (refer to **Figure 3.1**).	The MCCO Additional Disturbance Area is approximately 623 ha (refer to **Figure 3.1**).

Key Project Components / Aspects	Currently Approved	Proposed
Rehabilitation and Final Landform	As described in **Section 2.0** (Approved Operations) areas disturbed during mining are progressively rehabilitated in order to meet the objectives and targets of all government approved plans. Rehabilitation is designed with the objective of returning much of the Approved Mangoola Coal Mine Disturbance Area to woodland habitat, combined with native grassland areas. One final void of approximately 52 ha will remain as part of the final landform. Rehabilitation at Mangoola Coal Mine is completed using natural landform design principles and revegetation techniques that are recognised as industry leading.	Continued use of successful industry leading revegetation techniques. Distribution of overburden between the MCCO Additional Project Area and the existing mine in order to optimise the final landform design of the integrated operation. Establishment of a final landform using the current design standards implemented at Mangoola Coal Mine including use of natural landform design principles. A final void of approximately 82 ha will remain in the north-west of the MCCO Proposed Additional Mining Area while the existing approved final void at Mangoola Coal Mine will be maintained, however, it will be slightly reduced in size (approximately 48 ha) and result in an improved low wall due to the application of a revised natural landform design.
Tailings and Rejects Strategy	Coarse rejects from coal preparation transported by truck to the open cut overburden areas for emplacement and subsequent covering by overburden material. Tailings emplaced in tailings dams.	Coarse rejects – Continued disposal in overburden emplacement areas at Mangoola Coal Mine and in MCCO Additional Project Area. Tailings – No Change (continued use of existing tailings dams with TD4 providing for adequate capacity to accommodate the MCCO Project).
External Coal Transport	Product coal transported off site via rail from the Mangoola train loading facility at up to 10 trains per day.	No change.

Key Project Components / Aspects	Currently Approved	Proposed
Roads	Mine site access via Wybong Road. No Mangoola related traffic to use Reedy Creek Road, Mangoola Road Roxburgh Road or Castlerock Road to get to or from the site, except in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.	Continued use of existing mine access for operations including maintaining the currently approved restrictions. Realignment of a portion of Wybong Post Office Road to enable operations within the MCCO Additional Project Area. Access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Additional Project Area for construction and other ongoing operational needs such as emergency services, environmental monitoring and property management. Direct access to the MCCO Additional Project Area may be required in rare circumstances to provide access for mining equipment maintenance or mining equipment transport requirements dependent on factors such as mining progression and public road works limitations (e.g. for access for oversize loads). Where access is required from public roads outside of the normal site access routes, consultation will be completed with stakeholders and MSC and a traffic management plan implemented if required for these uncommon occasions.
Power Infrastructure	11 kV power lines currently service Mangoola owned and private properties outside of existing mining areas.	11 kV power lines will require relocation to outside of the proposed MCCO Additional Mining Area.

Key Project Components / Aspects	Currently Approved	Proposed
Water Management	A network of mine water management controls including dams and pipelines. This includes approval to discharge excess water to the Hunter River in accordance with the HRSTS. Abstraction of water from water sources for use at the mine, as required, in accordance with water licences held by Mangoola.	Continued use of existing facilities and infrastructure. Construction of a water management system to manage mine water, sediment laden water runoff, divert clean water catchment, provide flood protection from Big Flat Creek and provide for reticulation of mine water. The water management system will be connected to that of the existing mine via a series of dams and pipelines with some new water management controls proposed within the operational area of the existing mine. Continued ability to discharge excess water in accordance with HRSTS with no change to the approved discharge location.
Gravel Screening and Crushing	Gravel crushing within approved limits to 50,000 tonnes per annum for operational needs.	During operations, gravel crushing within approved limits to 50,000 tonnes per annum for operational needs. During construction, gravel crushing of approximately 200,000 tonnes of gravel will be required for construction based needs. If it is determined that site sourced material is not suitable it will be sourced off site. Prior to the completion of the haul road overpass over Wybong Road and Big Flat Creek gravel required for construction in the MCCO Additional Project Area will be transported via road truck along the Mangoola site access road and Wybong Road.



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Crown Land (TSR) Excluded from MCCO Project Area

FIGURE 3.1

Conceptual Project Layout

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20190430 12.00

3.2 Geology and Resource Description

The MCCO Additional Project Area is located in the north-western coal-producing region of the Hunter Coalfield. The coal seams within the MCCO Additional Project Area form part of the Late Permian Newcastle Coal Measures of the Singleton Super Group. They gently dip to the west at about 2 degrees below horizontal and reach a depth to the floor of the lowest seam of approximately 125 m at the lowest point relative to the highest topographical location within the MCCO Additional Mining Area.

In order of increasing depth, the key target seams for mining within the Proposed Additional Mining Area include the:

- Wallarah seam
- Great Northern seam
- Fassifern seam
- Upper Pilot seam.

Figure 3.2 shows the typical stratigraphy within the MCCO Additional Project Area.

The existing Mangoola Coal Mine operates within the same coal seams and detailed exploration programs have been undertaken in the local area for both Mangoola Coal Mine and the MCCO Additional Mining Area to identify the resources suitable for mining. To date, within the MCCO Additional Project Area 86 boreholes have been drilled, geophysical surveys including seismic survey and downhole geophysical assessments have been undertaken and in-depth geological modelling has been completed. This detailed exploration work and past mining records result in the geometry and structure of the coal deposits in the proposed mining areas being well understood. These deposits are consistent with those in the existing approved mining area.

As described in **Section 2.2**, Mangoola currently holds mining tenements covering the existing operations, the MCCO Additional Project Area and surrounding lands. Relevant to the MCCO Additional Mining Area AL 9 covers the coal resources proposed to be mined within the Proposed Additional Mining Area (refer to **Figure 2.3**).

The coal resources to be recovered from the Proposed Additional Mining Area as part of the MCCO Project are those that are economically recoverable by open cut mining methods and are estimated at approximately 52 Mt ROM coal. Based on an assumed yield of 78.6 per cent it is estimated that approximately 41 Mt of product coal will be recovered by the MCCO Project. The amount of product coal is an estimate only and subject to change based upon actual resource mined, washing efficiency and amount of coal that is able to bypass the CHPP. The balance of material is assumed to be tailings and reject. The MCCO Project will predominantly produce thermal coal to be used for power generation in the Australian domestic and export markets.

Based on the current proposed mine scheduling, this resource would enable continuation of mining operations within the MCCO Additional Mining Area for approximately eight years with equipment and operations transitioning from the existing approved mining area from approximately late 2022 through to approximately 2026 where it is anticipated that the existing approved coal mining operation would be complete. Mining will then continue until the end of mine life in the MCCO Additional Mining Area until approximately 2030 (subject to the timing of commencement of the Project following approval and construction).

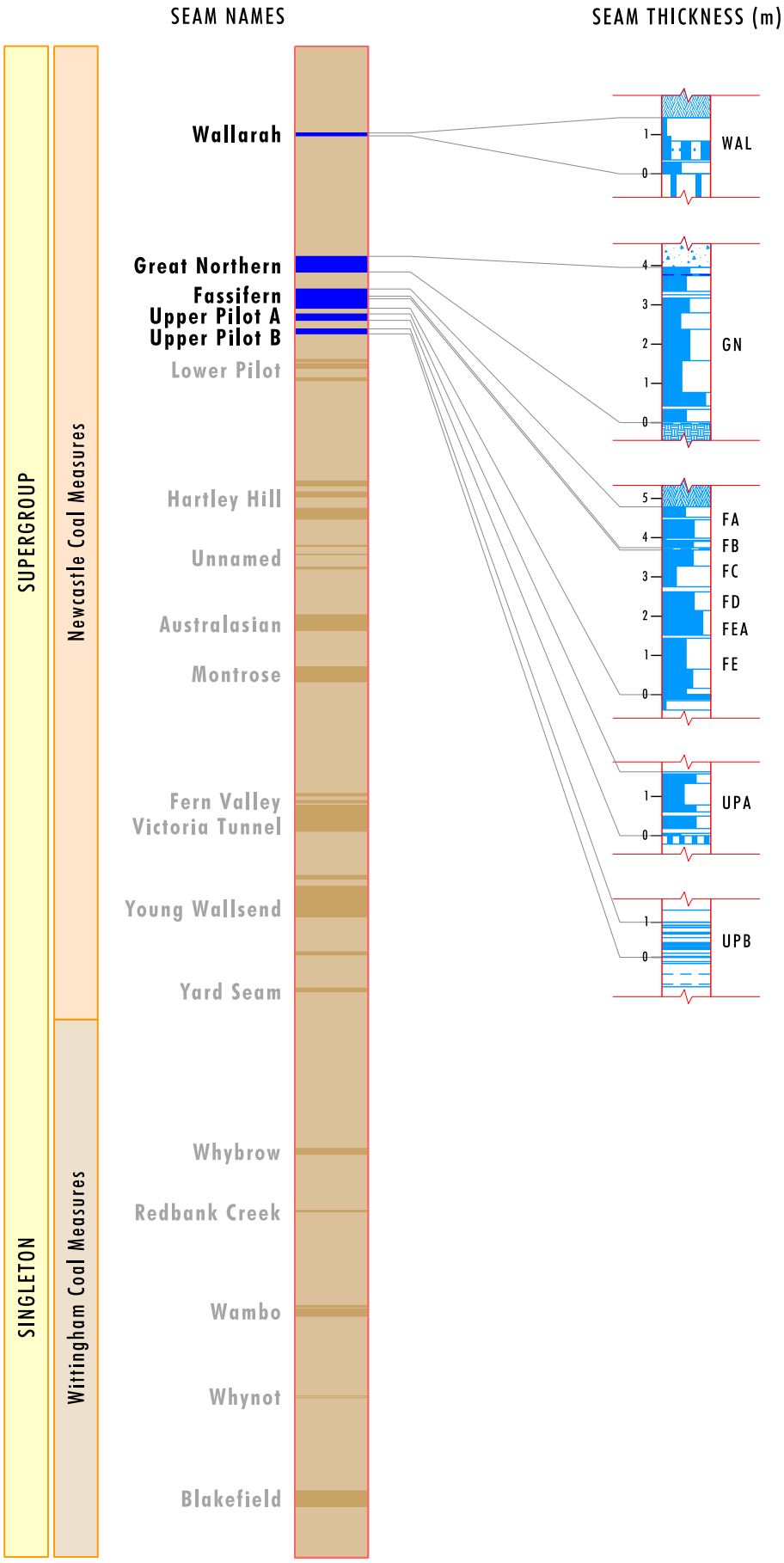

FIGURE 3.2

Typical Stratigraphic Section

Data Source: Glencore (2019)

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20190319 9.40

3.3 Proposed Mining Operations

3.3.1 Conceptual Mine Plan

As discussed in earlier sections the MCCO Project will involve the continuation of mining at the approved Mangoola Coal Mine (as described in **Section 2.0**) and the establishment and integration of open cut mining operations within the MCCO Additional Project Area (refer to **Figure 3.1**). Initially mining will occur concurrently in both operational areas; with a progressive transfer of equipment into the MCCO Additional Project Area occurring as mining is completed within the remaining approved areas at Mangoola Coal Mine.

An indicative production profile for the MCCO Project is provided in **Chart 3.1**.

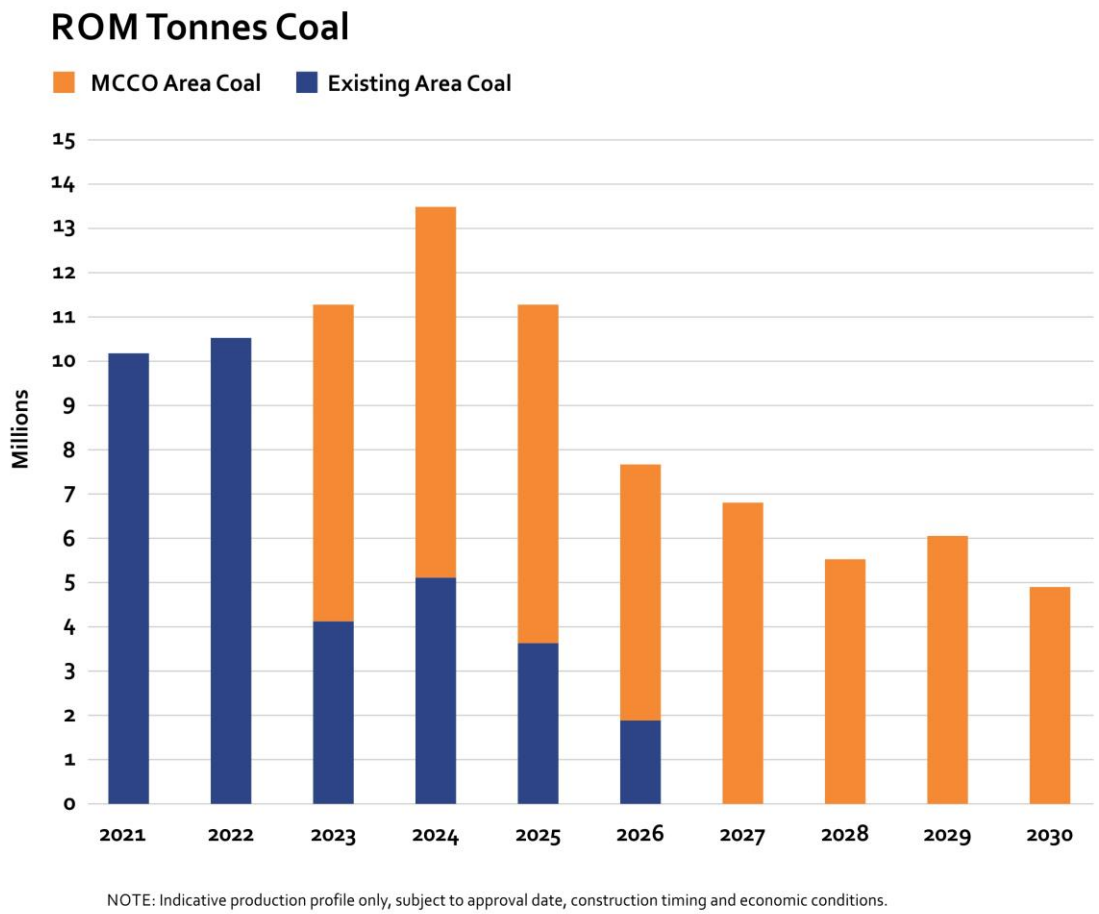


Chart 3.1 Indicative Production Profile

The proposed mine plan has been designed to incorporate a range of measures to limit potential environmental impacts with some of the key design features including:

- mine plan has been designed to integrate with the existing operations enabling equipment to be less concentrated across the total mining areas assisting in reducing noise impacts
- use of haul road bunds in strategic locations to reduce noise
- placement of haul roads below topographical ground level were possible to reduce noise
- design of haul roads to maximise efficiency of equipment, reducing the distance travelled (and consequently reducing dust generation and energy use/greenhouse gas emissions) and noise generation from haul trucks
- designing the mine, where practicable, to provide shielded operating locations for use during adverse meteorological conditions that could enhance noise or generate additional dust
- design and location of infrastructure that is required within the MCCO Additional Project Area to minimise impacts on threatened ecology to avoid known occurrences, particularly the endangered orchid *Prasophyllum petilum*
- design for timely progression of rehabilitation on the outer faces of the emplacement areas, where practicable, to minimise dust generation and minimise visual impacts
- use of temporary rehabilitation, where practicable to limit windblown dust generation
- measures to divert clean water around the mining area and effectively manage water within the mining area.

The above points are a selection of some of the measures incorporated into the Project design to reduce impacts with further discussion of the range of measures adopted for the MCCO Project to minimise impacts provided throughout **Section 6.0**.

Truck and excavator mining methods will be used to move overburden material and excavate ROM coal for transport to the existing CHPP at Mangoola Coal Mine for processing. The MCCO Project seeks to maintain the current approved maximum extraction rate of 13.5 Mtpa and will utilise the existing and approved infrastructure and equipment at Mangoola Coal Mine. Under its existing approval Mangoola Coal Mine is permitted to conduct mining operations until 2029 (21 years from the date the mining lease was granted), however based on current scheduling it is estimated that mining in approved areas will be completed by approximately 2025 if the MCCO Project does not proceed. Should the MCCO Project be approved, this coal would likely be exhausted in 2026 due to the integration of the mining schedule with the MCCO Project Additional Mining Area as shown on **Chart 3.1**.

Under the MCCO Project, ongoing mining at Mangoola Coal Mine would occur for approximately eight years mining in the MCCO Additional Project Area. It is currently planned that operations in the MCCO Additional Project Area would commence in approximately 2022 following approval and completion of construction which would mean that the MCCO Project will require approval to operate until the end of 2030, which represents an extension of one additional year when compared to the existing approval. Should the receipt of all relevant approvals (including approval of relevant management plans) and/or the construction period be delayed and mining operations are not able to commence as planned in approximately 2022 then the MCCO Project will require approval to complete coal extraction as proposed

within eight years from the date of the commencement of mining operations in the MCCO Additional Project Area.

The conceptual staged mine plans for the MCCO Project are shown in **Figure 3.3** to **Figure 3.7**. These include Project Years 1, 3, 5 and 8 as well as the conceptual final landform. The operational years have been selected for environmental modelling and presentation within this EIS as they represent a combination of mining across the two operational areas, include the extremities of the MCCO Proposed Additional Mining Area and capture periods of greatest intensities of mining. Refinements to the conceptual mine plans as presented may occur as a result of geological conditions or project optimisation over the life of the MCCO Project. Such refinements may include the realignment of internal haul roads, or establishment of new haul roads which will be developed as required to maximise efficient extraction and haulage of coal and waste materials between operational areas, as well as additions and refinements to water management infrastructure.

During Project Year 1 mining operations at Mangoola Coal Mine will continue in the approved mining area as described in **Section 2.3** with the South Pit progressing from south to north along the 500 kV ETL while Main Pit will continue to be developed moving from north-east to south-west adjacent to Big Flat Creek (refer to **Figure 3.3**).

With regard to operations proposed in the MCCO Additional Project Area, following an approximate 16-month construction period to prepare the area for mining and establish site access, a portion of the mining fleet will be relocated from Mangoola Coal Mine to within the eastern portion of the MCCO Proposed Additional Mining Area. Mining will commence progressing in a north-westerly direction in Project Year 1. A detailed discussion on the construction activities required prior to Project Year 1 is provided in **Section 3.11**.

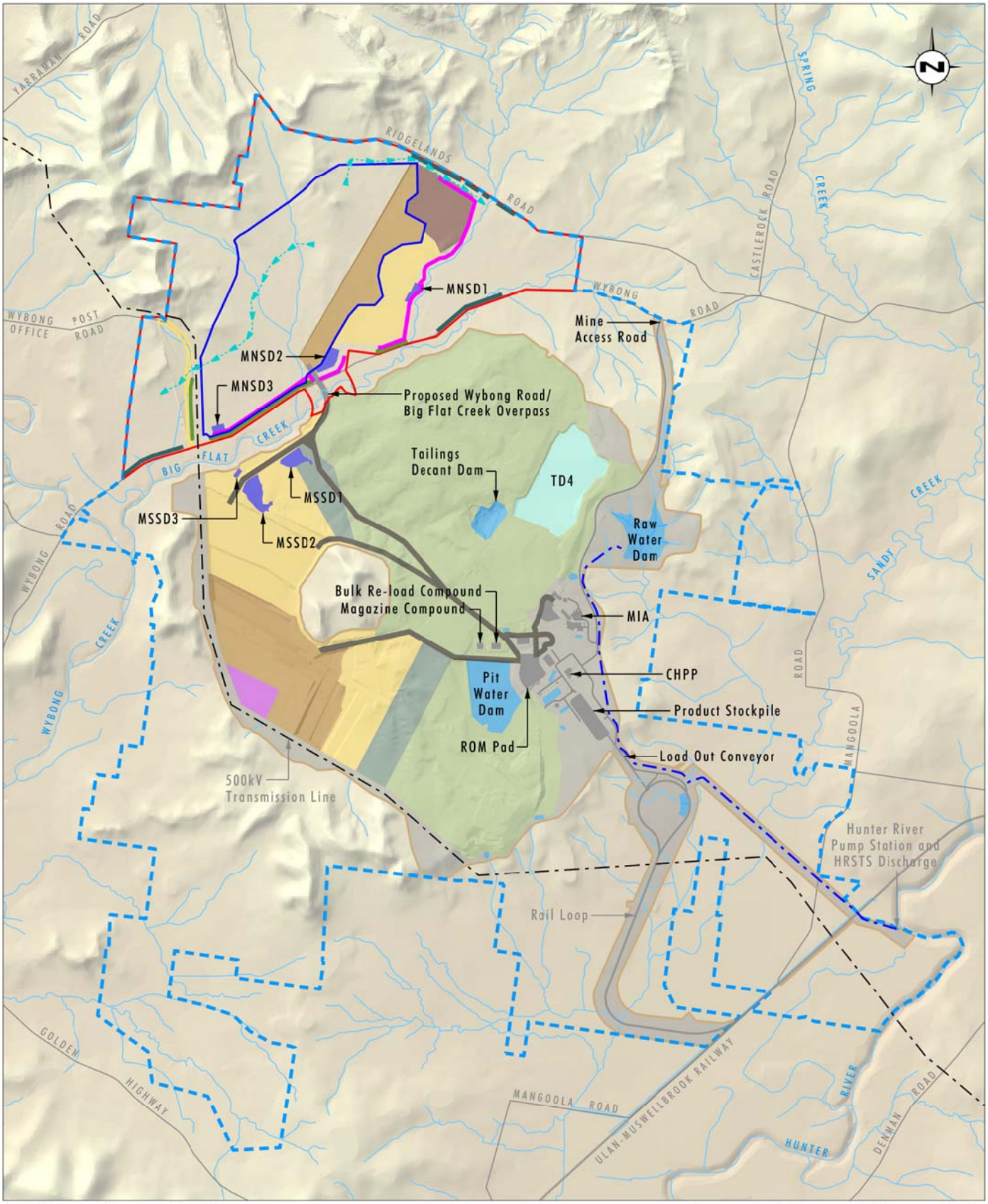
As mining operations commence in the MCCO Proposed Additional Mining Area topsoil will be stripped and principally stored in the Proposed Topsoil Stockpile Area (refer to **Figure 3.3**) for later use in rehabilitation or strategically located for future use adjacent to areas planned for initial rehabilitation. As overburden is removed it will be distributed for emplacement within the existing approved mining area where it will be placed to establish the final landform and used to optimise the final void. Overburden will also be placed within the Proposed Emplacement Area and also used to progressively fill the MCCO Proposed Additional Mining Area as operations progress. Further, it should be noted that as operations commence and progress within the MCCO Additional Project Area a number of Mangoola owned houses, sheds and other structures within the MCCO Additional Disturbance Footprint will require removal as mining advances. These items have all been considered by the historic heritage assessment with no items of significance identified (refer **Section 6.11**).

By Project Year 3, it is envisaged that the existing operation will have amalgamated into a single extraction area in the western extent of the Approved Mangoola Coal Mine Disturbance Area (refer to **Figure 3.4**). Around this time, the mining fleet will have been largely transitioned into the MCCO Proposed Additional Mining Area with the remaining equipment at Mangoola Coal Mine used to complete extraction in focusing on the merged extraction area through to approximately Project Year 5.

From Project Year 5 (refer to **Figure 3.5**) coal extraction operations are planned to be completed or nearing completion in the existing Mangoola Coal Mine with mining operations focussed in the MCCO Additional Project Area through until completion of mining in Project Year 8 (refer to **Figure 3.6**). Once mining is complete within the existing Mangoola Coal Mine there will likely be a reduction in the number of excavators currently in operation and these will be located for use in the MCCO Additional Project Area. The machines not being utilised may be kept for operational use during maintenance periods on the primary use excavators or during periods where environmental and operational conditions permit their use.

A conceptual final landform has been developed for the MCCO Project and includes both the approved and MCCO Additional Project Areas. As shown on **Figure 3.3** to **Figure 3.6**, the areas disturbed by mining will be progressively rehabilitated throughout the life of the mine to achieve a suitable final landform. As discussed in **Section 1.4.3**, detailed analysis of different final void arrangements has been completed as part of designing the MCCO Project. Mangoola has committed to the establishment of a final landform in line with current design standards at Mangoola Coal Mine including the use of natural landform design principles (refer to **Figure 3.7**). Further discussion of the conceptual final landform and rehabilitation program for the MCCO Project is provided in **Section 3.3.4**.

The concept plans which form the basis of this assessment have been developed in consideration of current mining techniques and are based on Mangoola's current understanding of the local geology. Mining operations are, however, dynamic and the specific mine plan layout and sequence shown in the indicative mine plans may be subject to change due to economic conditions, technological advances, operational needs or as further geological data is gathered.



Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Hunter River Pipeline
- Clean Water Diversion Drain
- Flood Levee
- Tree Screen
- Visual Bund
- Infrastructure
- Infrastructure Domain
- Active Mining
- Overburden Emplacement - Active
- Overburden Emplacement - Reshaped
- Approved Dam
- Proposed Dam
- Tailings Dam
- Haul Road
- Rehabilitation
- Prestrip

FIGURE 3.3

Conceptual Stage Plan Project Year 1

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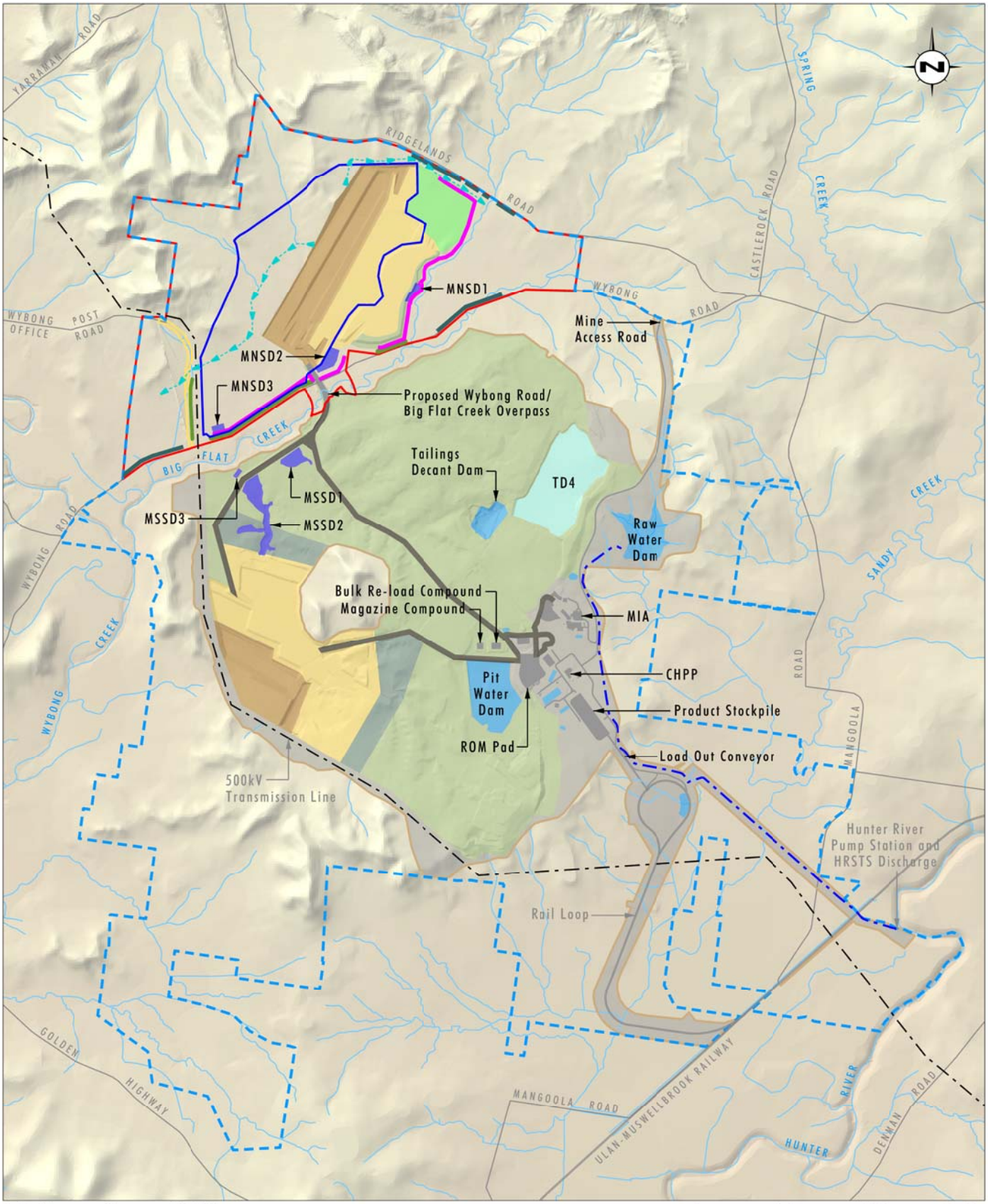
20190704 13.49



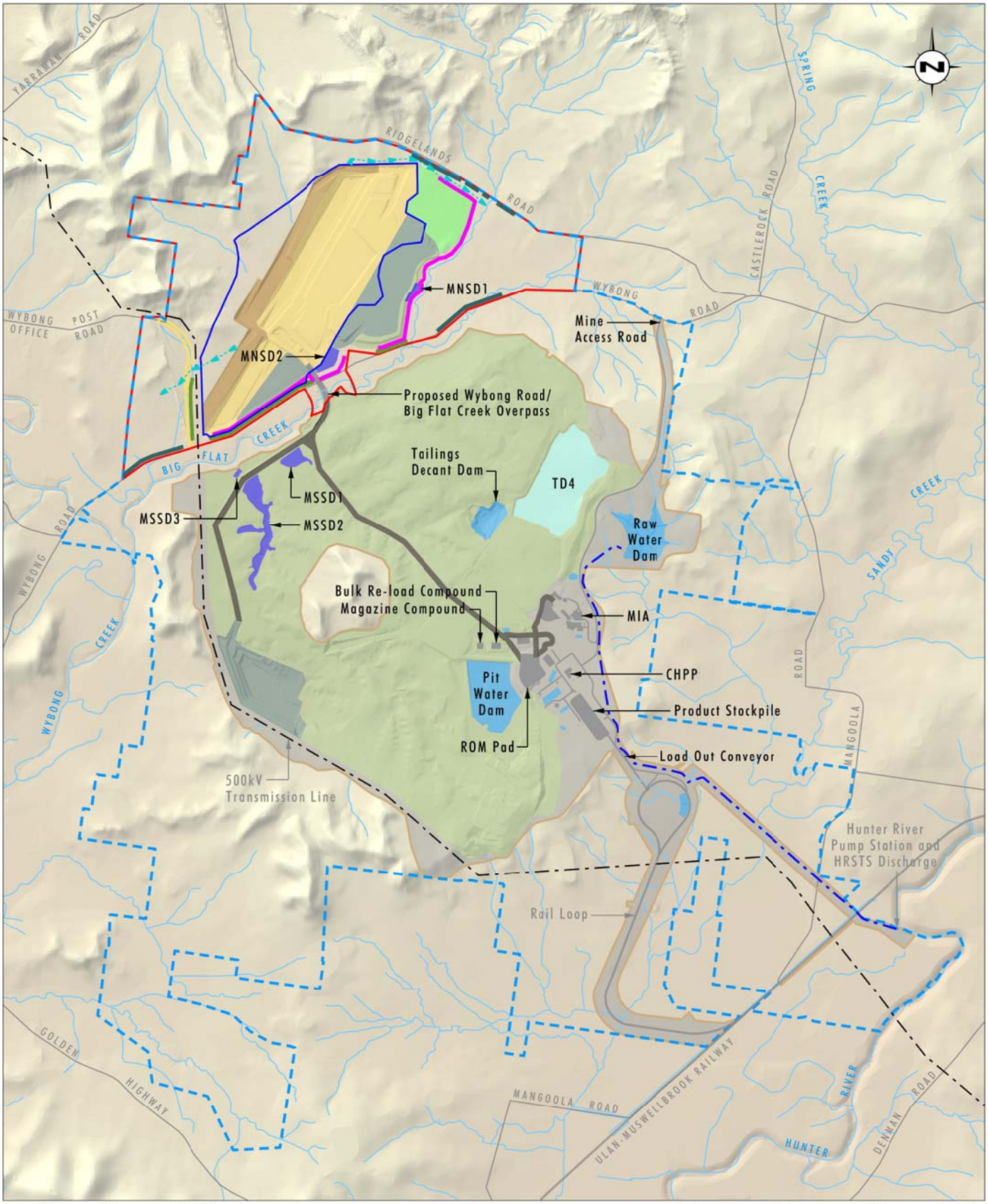
Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Wybong Post Office Road Realignment
- Hunter River Pipeline
- Clean Water Diversion Drain
- Flood Levee
- Tree Screen
- Visual Bund
- Infrastructure
- Infrastructure Domain
- Active Mining
- Overburden Emplacement - Active
- Overburden Emplacement - Reshaped
- Rehabilitation
- Rehabilitation - Temporary
- Approved Dam
- Proposed Dam
- Tailings Dam
- Haul Road

FIGURE 3.4

Conceptual Stage Plan Project Year 3

File Name (A4): R13/4004_105.dgn
20190415 14.04



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Wybong Post Office Road Realignment
- Hunter River Pipeline
- Clean Water Diversion Drain
- Flood Levee
- Tree Screen
- Visual Bund
- Infrastructure
- Infrastructure Domain
- Active Mining
- Overburden Emplacement - Active
- Overburden Emplacement - Reshaped
- Rehabilitation
- Rehabilitation - Temporary
- Approved Dam
- Proposed Dam
- Tailings Dam
- Haul Road

FIGURE 3.5

Conceptual Stage Plan
Project Year 5

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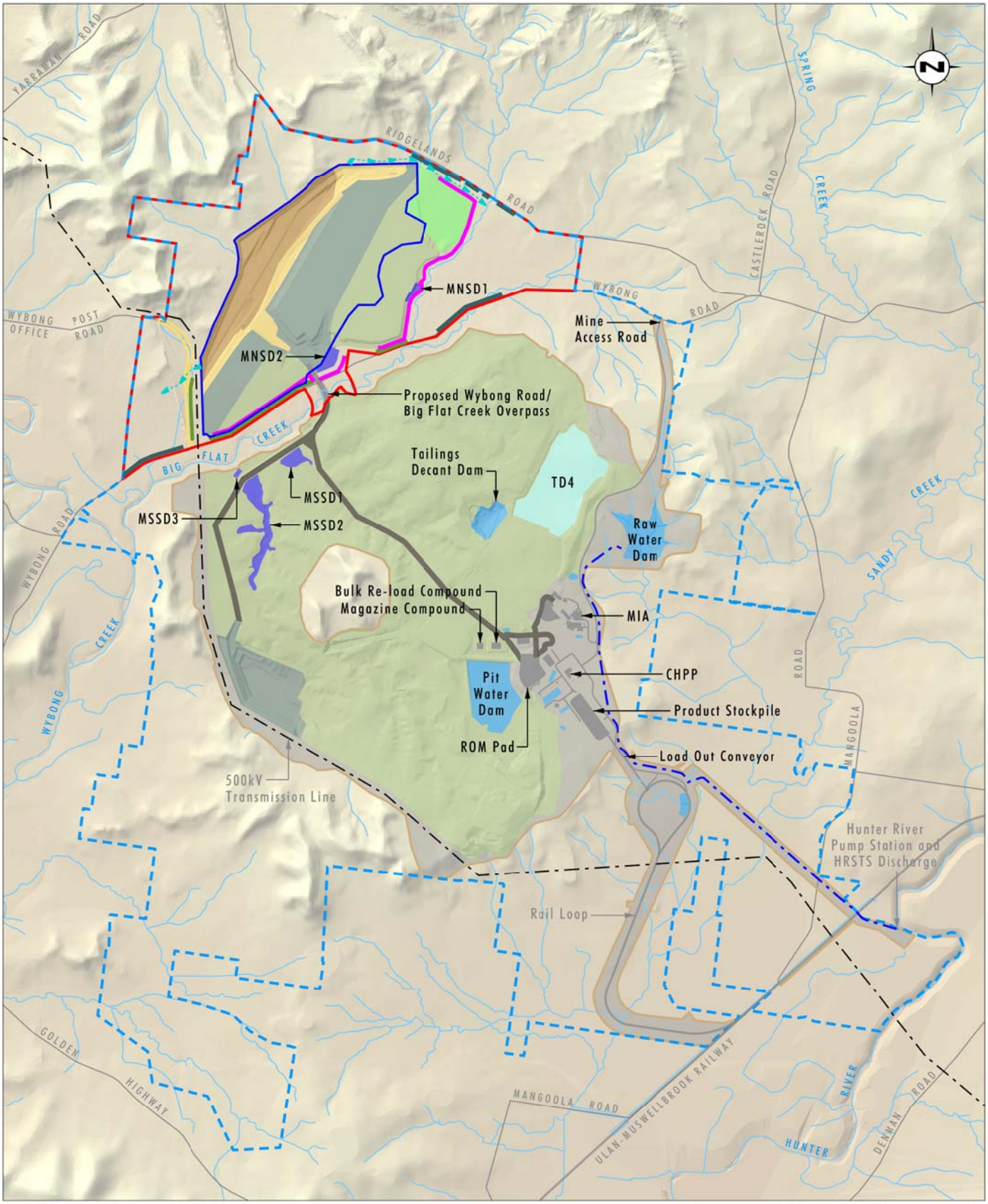
20190415 14.05



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Wybong Post Office Road Realignment
- Hunter River Pipeline
- Clean Water Diversion Drain
- Flood Levee
- Tree Screen
- Visual Bund
- Infrastructure
- Infrastructure Domain
- Active Mining
- Overburden Emplacement - Active
- Overburden Emplacement - Reshaped
- Rehabilitation
- Rehabilitation - Temporary
- Approved Dam
- Proposed Dam
- Tailings Dam
- Haul Road

FIGURE 3.6

Conceptual Stage Plan Project Year 8

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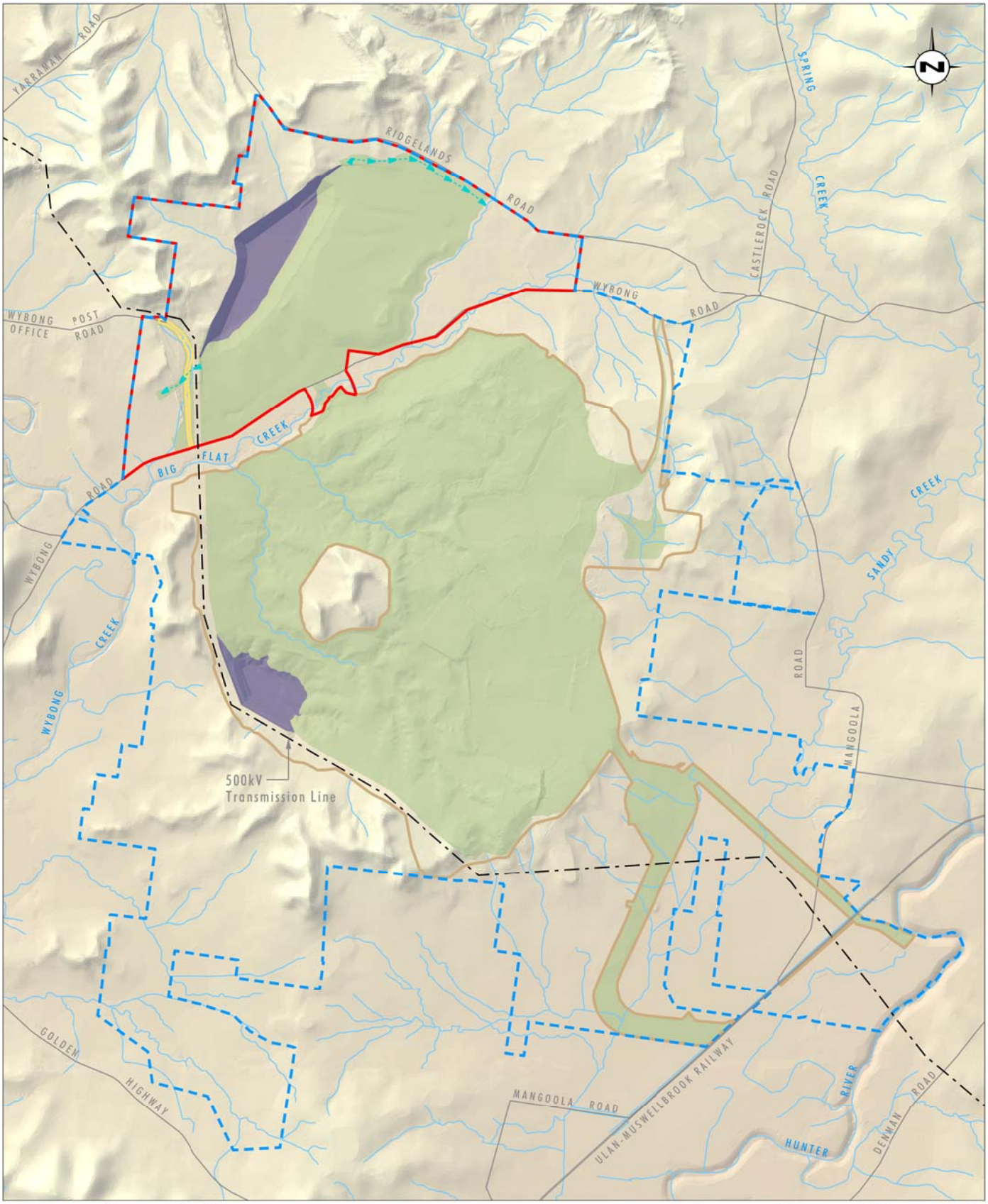
20190415 14.07



Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Rehabilitation
- Void
- Clean Water Diversion Drain

FIGURE 3.7

Conceptual Final Landform

File Name (A4): R13/4004_130.dgn
20190329 13.48

3.3.2 Mining Fleet

Equipment utilised at the existing operations will be progressively relocated into the MCCO Additional Mining Area, as required, during the life of the Project as this operational area increases and available excavation areas decline in the existing approved mining areas.

The truck and excavator method is suited to the progressive backfilling and rehabilitation of mining areas behind the active working areas as the operations advance, as shown in **Figure 3.3** to **Figure 3.7**.

Trucks will be utilised to haul overburden excavated by the excavators to emplacement areas and will also haul extracted coal to the Mangoola ROM coal stockpile for subsequent delivery to the Mangoola CHPP. Trucks used for hauling coal to the Mangoola ROM coal stockpile will also be used to transport coarse and thickened reject material from the CHPP to overburden emplacement areas. The indicative primary mining equipment that will be used over the life of the Project is outlined in **Table 3.2**. This indicative equipment list is subject to change to meet the needs of the mining operations and in response to technological advances in mining equipment, changes in geological or geotechnical conditions or varying marketing requirements which may alter the composition of the fleet, from time to time throughout the life of the Project. Various items of ancillary equipment not listed in **Table 3.2** will also continue to be required, including but not limited to lighting plants, generators, water pumps, mobile cranes, maintenance equipment, delivery trucks and light vehicles.

Table 3.2 Indicative Primary Mining Equipment

Equipment Type	Indicative No.	Equipment Type	Indicative No.
Excavator	5	Drill	3
Rear Dump Truck	34	Grader	3
Dozers (including both tracked and rubber tyred)	13	Water Cart	3
Loaders	2	Fuel and Service Truck	2

Note: The table outlines the indicative numbers of equipment for the production scenario based on the indicative mine plan shown in **Figure 3.3** to **Figure 3.6**. There may be variation in numbers, size and types of equipment used to suit operational needs, provided that the relevant production limits and environmental impact criteria are maintained.

3.3.3 Mining Process

The proposed general sequence of mining is outlined in the following sections and illustrated on **Figure 3.8**.

3.3.3.1 Pre-strip Operations

Pre-strip operations include the removal of vegetation and topsoil ahead of the active mining operation for later use in the rehabilitation of disturbed areas. Pre-strip operations will also be carried out prior to the construction of infrastructure. Establishment of the required erosion and sediment control and water management system infrastructure is a key component of pre-strip operations.

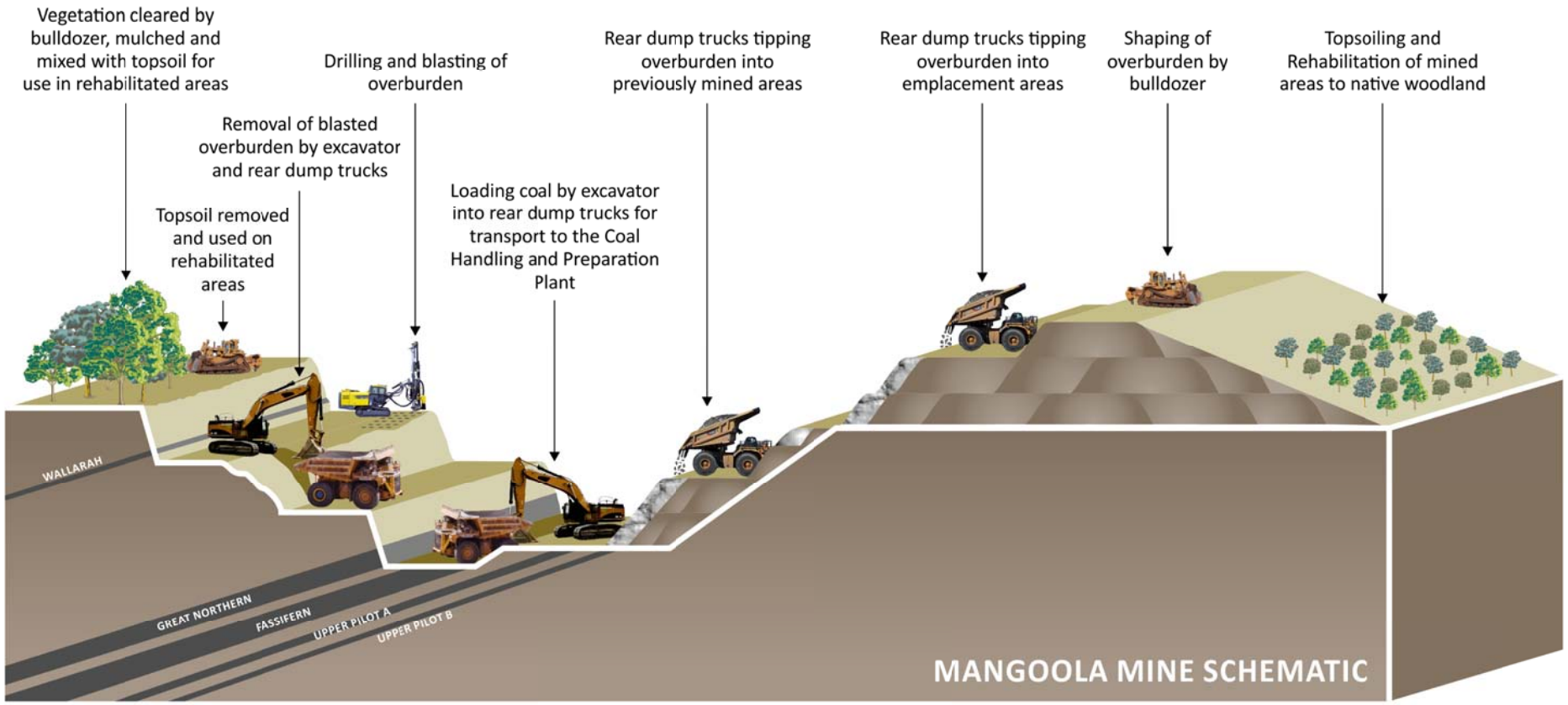


FIGURE 3.8

Mining Sequence

Following the removal of vegetation, topsoil will be stripped and either stored in topsoil stockpiles for later use or placed directly on reshaped overburden for rehabilitation purposes. Removed vegetation may be mulched and added to the topsoil stockpiles. Selected habitat trees removed will be stored for use in rehabilitation. Topsoil management measures for stripping, stockpiling and later re-use in rehabilitation are discussed further in **Section 6.17** with procedures to minimise impacts associated with vegetation clearing, including requirements for pre-clearance habitat checks, seed collection and re-use of suitable habitat trees are discussed further in **Section 6.17**.

3.3.3.2 Overburden Removal and Management

Once the mining area is cleared of vegetation and topsoil, the material lying above or between the target coal seams, known as overburden and interburden respectively (collectively referred to in this document as overburden), is broken up through drilling and blasting to enable it to be removed. The top layer of overburden close to the surface is generally weathered material that may be able to be removed without blasting.

Overburden is typically loaded by excavators into trucks for transportation to the overburden emplacement areas. At times overburden may be ripped and pushed by dozer into adjacent areas for either temporary or permanent placement.

For the establishment of the MCCO Additional Mining Area, overburden will either be emplaced within the Proposed Emplacement Area immediately adjacent to the MCCO Proposed Additional Mining Area (refer **Figure 3.3**) or hauled south to be emplaced in the existing approved mining area. The material taken south will assist to develop the final landform in this mining area. By approximately Project Year 6 all overburden will be used to progressively fill in the MCCO Proposed Additional Mining Area.

The indicative sequence of mining and development of emplacement areas across both operational areas of the Project is shown on **Figure 3.3** to **Figure 3.7**.

The conceptual final landform as shown in **Figure 3.7** will be constructed to enable the integration of the in-pit and out-of-pit overburden emplacement areas with the existing environment, where practicable. The Proposed Emplacement Area within the MCCO Additional Project Area will be developed to a typical height of approximately 180 mAHD, which represents up to approximately 25 m above the existing ground level. Some variations in the height of the final landform (above 180 mAHD) will be established to assist in forming a more natural looking landform. Overburden emplacement within the excavated areas of the adjacent MCCO Additional Mining Area will then be developed progressively to a similar height to the north and west with the landform in the south-west designed to reflect more closely the existing landform height as it drains to Big Flat Creek. Following a detailed analysis of final landform design options by Mangoola (refer to **Section 1.4.4**), it is proposed that a final void will remain in the north-west of the MCCO Additional Mining Area.

Under the MCCO Project, the approved conceptual final landform for the approved mining area will remain largely similar to the current approval. The conceptual final landform for the approved mining area rises to a maximum height of up to approximately 240 mAHD and includes a sequence of undulating hills which complement and connect to the surrounding landscape. Positioned in the centre of the existing Approved Mangoola Coal Mine Disturbance Area, the Anvil Hill Offset Area will be connected via a series of ridgelines which will guide water flow towards the re-established Anvil Creek. On the western boundary, the currently approved single final void lies between the TransGrid 500 kV powerline easement and the re-established Anvil Creek.

Emplacement activities across the operation will be managed to create a variable vertical profile and shape that provides a more natural looking and functioning final landform as per existing practice at Mangoola

Coal Mine. Further discussion of the proposed approach to natural landform development is provided in **Section 6.17**.

The location of overburden emplacement activities will be generally dependent on the source of the overburden, haul distances and weather conditions, and will be actively managed to minimise noise, dust and visual impacts. Mangoola has successfully implemented such active management systems at its existing mining operation. The existing environmental standards and protocols will continue to be implemented by Mangoola as part of the MCCO Project.

3.3.3.3 Blasting

Overburden will generally be blasted prior to removal. In addition, where thickness is sufficient, coal seams may also be blasted prior to extraction.

Mangoola will continue to undertake blasting in accordance with a detailed design process that considers operational, geological and environmental constraints. Blasts will continue to be designed such that potential vibration and blast overpressure impacts on surrounding features, such as infrastructure, residences, sensitive land uses and sensitive locations in the vicinity of the proposed mining operations are appropriately managed in compliance with relevant criteria. All blasts will be monitored and this data used to continually refine and improve the blast design process.

Consistent with existing requirements at Mangoola, blasting will occur between 9.00 am and 5.00 pm Monday to Saturday unless otherwise approved by the EPA. It is noted that the Project Approval currently refers to blasting between 9.00 am and 3.00 pm Monday to Saturday unless otherwise approved by the EPA, however, through Mangoola's EPL, the EPA has approved blasting until 5.00 pm on Monday to Saturday (inclusive). Supplementary timing arrangements may also be put in place considering stakeholder needs for blasts that require road closures. Any such requirements will be outlined in the Blasting Road Closure Management Plan.

Blasting will be limited to a maximum of six blast events per week and two blast events per day (averaged over a calendar year), with an allowance for additional blasts where there are low vibration blasts that generate ground vibration of 0.5 mm/s or less at any residence on privately-owned land, or blasting misfires. The management of vibration and overpressure impacts associated with blasting is discussed in **Section 6.6**.

Blasts will also be designed to minimise the potential of blast fume generation. The management of potential blast fume impacts is discussed in **Section 6.6**. Where necessary, precautionary measures, such as the temporary closure of roads, will also be implemented to ensure public safety is not put at risk as a result of blasting operations. This will include periodic closures for blasts within 500 m of Wybong Road, Wybong Post Office Road, and Ridgelands Road which will be managed in consultation with MSC and with other nearby mining operations to minimise disruption to traffic as much as practicable. Further discussion of blasting road closure management is provided in **Section 6.6**.

3.3.3.4 Coal Removal

Exposed coal will typically be mined by excavators and loaded into trucks for transportation via internal haul roads to the Mangoola ROM coal stockpile and CHPP. Mining within the MCCO Additional Project Area will produce approximately 52 Mt of ROM Coal.

Approximately 150 Mt is already approved to be mined from the Mangoola Coal Mine and the MCCO Project includes the completion of mining of these approved resources.

At times, mined ROM coal may be temporarily stored within the active mining/disturbance area or infrastructure domain (refer to **Figure 2.1**), before being transported to the CHPP, during scheduling conflicts associated with mining multiple seams and CHPP planned processing or works activities.

3.3.4 Rehabilitation and Closure

3.3.4.1 Temporary Rehabilitation

Disturbed areas which will not form part of the active open cut mining operations for extended periods will be seeded with groundcover to reduce potential wind erosion and associated dust emissions and to reduce visual impacts. Indicative temporary rehabilitation areas are shown on the stage plans provided in **Figure 3.3** to **Figure 3.7**.

3.3.4.2 Rehabilitation of Disturbed Areas

Areas disturbed as part of the MCCO Project will need to be progressively rehabilitated following mining activities. The indicative progression of rehabilitation is provided in **Figure 3.3** to **Figure 3.7**. Rehabilitation at Mangoola Coal Mine is completed in accordance with the approved Rehabilitation Management Plan using natural landform design principles and revegetation techniques that are recognised as industry leading. As discussed in **Section 2.9**, to date Mangoola has successfully rehabilitated approximately 490 ha of disturbed land in the north-eastern and southern portions of the Approved Mangoola Coal Mine Disturbance Area. The industry leading practices and approach will continue to be applied to the MCCO Project.

Rehabilitation of disturbed land is designed with the objective of returning much of the MCCO Project Area to woodland habitat generally consistent with ecological communities that would have historically occurred in the area, combined with grassland areas that will provide future opportunity for appropriately managed grazing or native ecosystem establishment. Rehabilitation to achieve this objective will generally take the form of direct seeding of endemic tree, shrub and/or grass species into a growing medium established using soil removed during pre-stripping operations and/or imported material. Tree and shrub seedlings may also be used either instead of, or in addition to, direct seeding where direct seeding alone is deemed unsuitable or past experience has produced suboptimal results. Sterile cover crops will also be used where considered appropriate to provide protection for emerging shrub and tree seedlings, in areas proposed for grassland, for rapid establishment of erosion and sediment control and to minimise dust. Further details on the approach to rehabilitation are discussed in **Section 6.17**.

3.3.4.3 Decommissioning of Mine Infrastructure

As part of the mine closure process, infrastructure which is not proposed to be utilised by subsequent approved land uses will be removed. Soils within and surrounding former infrastructure areas will be assessed for potential contamination. Any contamination present will be remediated and contaminated material will be treated or appropriately disposed of. As with other disturbed areas, former infrastructure areas will be revegetated unless proposed for other land uses.

Dams forming part of the mine water management system will be removed unless they are to be utilised for habitat purposes, are associated with long-term stability and water management, or are beneficial to subsequent land uses (e.g. stock dams). As part of this process water from existing dams within the MCCO Project Area that are no longer required maybe pumped into the final voids. Removal of sediment from mine water dams will occur as required as part of the closure and rehabilitation processes regardless of the suitability of the dams for other purposes.

Two final voids will remain as part of the final landform and will become waterbodies (refer to **Figure 3.7**). It is predicted that both of the final voids (non- backfilled mining areas) will partially fill with water and act

as long-term hydraulic sinks. Within the existing approved mining area there is potential for water in backfilled areas away from the final void to migrate out and provide recharge to the surrounding bedrock with much of this water moving north and being captured in the northern void. Further detail on water recovery in the voids is contained in **Section 6.8**. The catchment size of the final voids has been minimised where practicable to reduce the surface water take and to increase areas available to be rehabilitated to woodland and/or grassland.

Further detail regarding the rehabilitation and closure processes, including the consideration of future land use options is provided in **Section 6.17**.

3.4 Coal Handling, Processing and Transport

The MCCO Project will utilise the existing Mangoola CHPP and coal handling infrastructure (such as conveyors, stockpiles and train loading facilities) for the washing, storage and transport of coal as described in **Section 2.4**. Coal mined from the MCCO Project will continue to be sold to both the domestic market to supply power stations and to export markets via the Port of Newcastle.

No change is proposed to the currently approved Mangoola CHPP and coal handling infrastructure or rail transport infrastructure.

3.5 Rejects and Tailings Management

The MCCO Project will continue to use the approved tailings storage facilities as described in **Section 2.5** for the emplacement of fine tailings material. These facilities have sufficient capacity for the expected tailings generation over the life of the MCCO Project.

Water drained from the tailings emplacement area is captured within the tailings decant dam or sumps for re-use in the CHPP or for dust suppression. The tailings dam and tailings decant dams are shown on **Figure 3.3** to **Figure 3.7**.

Coarse rejects from coal preparation will continue to be transported by truck to the open cut overburden emplacement areas as required for emplacement and subsequent covering by overburden material.

3.6 Water Management

The water management system for the MCCO Project will be integrated with the existing water management system of the Mangoola Coal Mine as described in **Section 2.6**, with water managed across the combined operational areas. This will involve the construction of new water management structures, both within the MCCO Additional Project Area and Mangoola Coal Mine, and will subsequently result in changes to parts of the approved water management system.

The water management strategy for the MCCO Project includes controls to separate clean water and mine water, seeking to prevent the contamination of clean water by mining activities and managing compliance within statutory obligations.

As discussed above, a number of new dams, pipelines and pumping systems, water diversion structures, contour banks, temporary sediment control structures, a flood levee and other water management structures (including dams and water truck fill points) will be required for the MCCO Project, which will be designed to integrate with the existing Mangoola site water management systems. The final number and arrangement of these structures will be determined as part of the detailed design process as the MCCO Project progresses, however, the structures will be contained within the MCCO Additional Disturbance

Area. In the case of the water truck fill point, it may be positioned within the existing disturbed area of the approved disturbance boundary. The flood levee and any additional dams will be designed in accordance with relevant guidelines (refer to **Section 6.7**). The conceptual layout of the water management system for the MCCO Project is discussed in **Section 6.8.1** with key water management structures currently planned also shown on the conceptual staged mine plans (refer to **Figure 3.3** to **Figure 3.6**).

Further detail regarding the proposed MCCO Project water management system is contained in **Section 6.7**.

3.7 Exploration and Monitoring Boreholes

Exploration drilling will continue to be undertaken within AL 9 and, as necessary within EL 5552 exploration areas to obtain further information regarding the resources to be mined as well as define geological, geotechnical and environmental information relevant to the mining and construction activities that will be undertaken. Additional drill holes to install groundwater monitoring bores may also be required. Geotechnical drilling and test pits will also be undertaken as required.

Construction, sealing and decommissioning of boreholes will be in accordance with relevant standards and guidelines published by the Department of Planning and Environment – Division of Resources and Geoscience (DRG) and in force at the time. Completion of exploration and monitoring boreholes may require disturbance outside of the MCCO Additional Disturbance Area as discussed in **Section 3.12**.

Where required, monitoring bores will be licensed under the *Water Management Act 2000* or the *Water Act 1912*, depending on the aquifers being intersected and monitored.

3.8 Infrastructure Requirements

3.8.1 Use of Existing Infrastructure

As described throughout this chapter the MCCO Project has been designed to maximise the use of all existing and approved infrastructure at Mangoola Coal Mine as is described in **Section 2.0**. This infrastructure will be retained and used as required to support the operation of the MCCO Project.

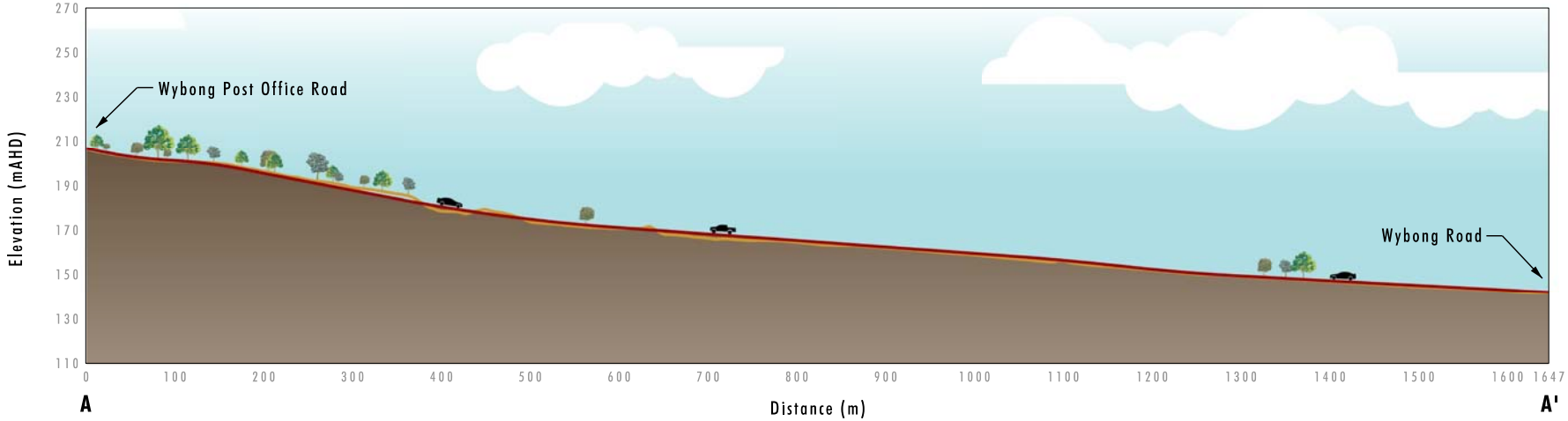
The general layout of the primary existing mine infrastructure area is shown on **Figure 2.1** and **Figure 2.2**.

As described in **Section 2.7**, Mangoola has an existing magazine compound and bulk reload compound on site (refer to **Figure 2.2**). As is currently the case, the location of these facilities may be required to change throughout the life of the MCCO Project as mining operations progress. A hazard assessment has been undertaken (refer to **Section 6.19**) which has identified the minimum separation distance that the magazine and ANE storage tank must be located from publicly accessible areas or non-Mangoola owned land. As mining progresses, if required these structures will be relocated to areas within the MCCO Project Area which meet the buffer zone requirements.

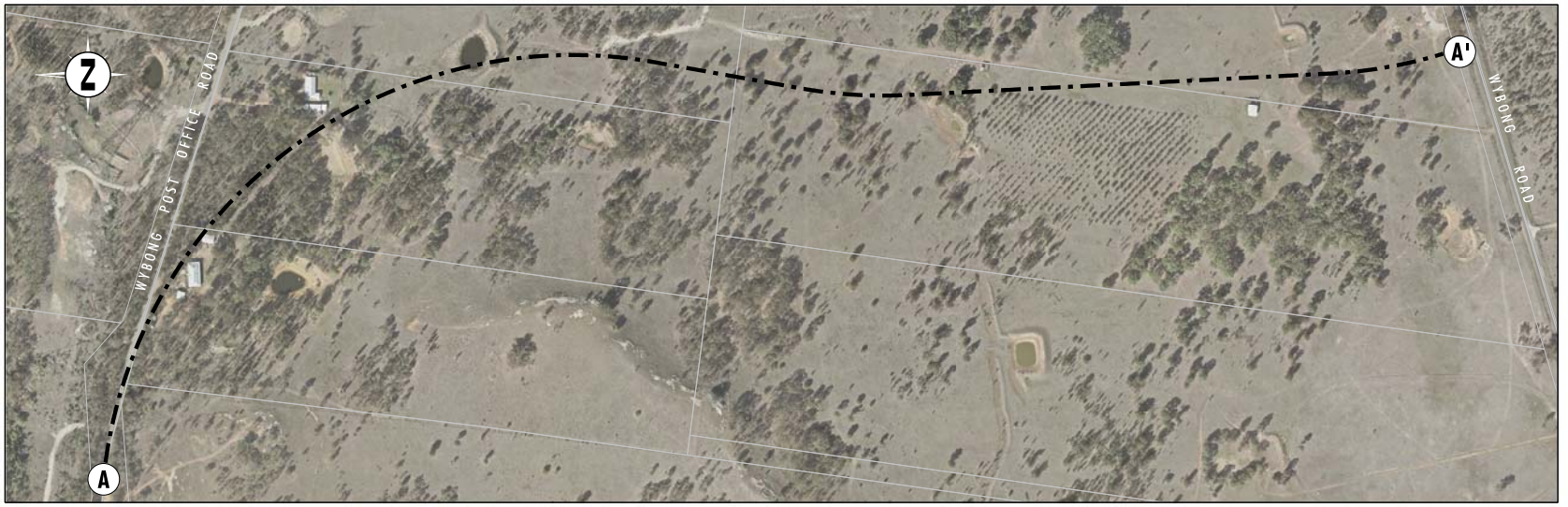
3.8.2 Proposed Additional Infrastructure

3.8.2.1 Wybong Post Office Road Realignment

The MCCO Project will require the realignment of a section of Wybong Post Office Road to enable the establishment and operation of mining activities within the MCCO Additional Project Area. It is proposed that the impacted section of Wybong Post Office Road will be replaced with a realigned portion of road located adjacent to the 500 kV ETL and on land owned by Mangoola as shown on **Figure 3.9**. The realignment will be undertaken by Mangoola in consultation with MSC and is planned to occur during the construction phase.



Cross Section View



Plan View

FIGURE 3.9

Conceptual Wybong Post Office Road Realignment

Legend

Existing Surface

Proposed Design Surface

Note: Vertical Exaggeration 1:2.5

0 40 80 160m
Vertical Scale

0 100 200 400m
Plan and Horizontal Scale

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The realigned portion of Wybong Post Office Road will be designed with an upgraded design standard in accordance with the RMS Road Design Guide (RTA, 2000) for a typical two lane, two-way rural road with a nominal speed limit of 100 km/h. The realigned portion is approximately 1.6 km in length.

The proposed realignment will have minimal impact on travel distances (approximately 1.6 km longer when travelling towards Muswellbrook) and will provide an improved standard of road over the realigned section. The change in travel time associated with the increased length of Wybong Post Office Road is approximately 55 seconds. Travel time heading west along Wybong Road towards Sandy Hollow is decreased by this time while travel time heading east towards Muswellbrook is increased due to the intersection with Wybong Road being further west than the current intersection point.

Mangoola has commenced discussions regarding the proposed realignment and design requirements with MSC. Mangoola has also consulted with TransGrid, Ausgrid and Telstra regarding the realignment of, and interaction with, existing services associated with the road corridor.

The realigned portion of Wybong Post Office Road (refer to **Figure 3.9**) will be fully constructed, other than the junction with the existing Wybong Post Office Road, to the north, and Wybong Road, to the south, prior to it being commissioned to minimise disruptions to traffic. Following the commissioning of the new road, the road reserve running along the existing alignment will be closed. A new road reserve will be opened along the new realigned section of the road.

3.8.2.2 Proposed Wybong Road/Big Flat Creek Overpass

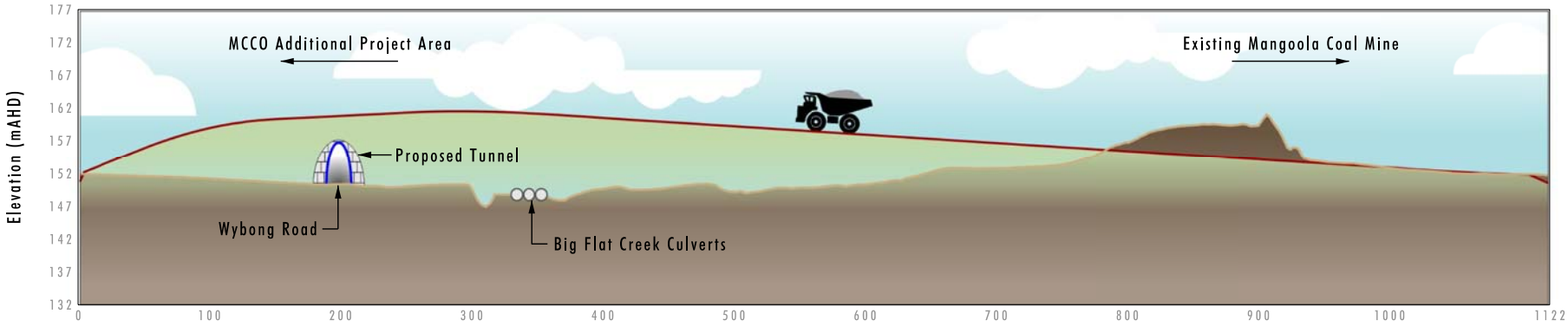
To establish operational access to the MCCO Additional Project Area it is proposed to construct a dual haul road and light vehicle road overpass over Wybong Road and Big Flat Creek to provide access from the existing Mangoola Coal Mine (refer to **Figure 3.10**). The overpass will enable the efficient haulage of material and equipment between the two operational areas and once constructed will ensure that there are no disruptions to traffic flows on Wybong Road.

The overpass will be designed and constructed to meet Austroads and RMS design standards in consultation with MSC. The overpass construction will have an overall width of approximately 150 m including the haul road and light vehicle road, underpass, culvert structures as well as temporary erosion and sediment control works. The overpass is proposed to be a precast concrete arch structure, complete with median bund and perimeter bunds for both vehicle containment and visual amenity. The structure will be rated to carry ultra-class haul trucks and excavators up to 800 tonnes nominal operating mass.

Wybong Road will continue to have two 3 m traffic lanes and a minimum height clearance of 5.4 m to pass through the overpass.

During construction, Wybong Road will be diverted around the overpass construction site. This is proposed to manage and avoid construction interactions with public road traffic and to limit travel impacts to road users. The diversion road will be sealed to a standard suitable for its duration of use and speed zone, with the horizontal and vertical alignments in accordance with MSC design guidelines for rural roads.

In addition to Wybong Road, the haul road overpass will also be required to cross Big Flat Creek. This ephemeral water course will require the installation of pipe culverts under the road formation. The concept design for this culvert is for three culverts designed to convey the 0.1 per cent AEP peak flow event.



Cross Section View

Plan View

Legend

- Existing Surface
- Proposed Design Surface
- Proposed Tunnel
- Rehabilitation

Note: Vertical Exaggeration 1:5

0 20 40 50m
Vertical Scale

0 100 200 250m
Plan and Horizontal Scale

FIGURE 3.10

Conceptual Wybong Road/ Big Flat Creek Overpass

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3.8.2.3 Electricity and Telecommunications Infrastructure

The establishment of operations within the MCCO Additional Project Area will require the relocation, construction and decommissioning of several sections of existing electricity and telecommunications infrastructure. These relocations are shown on **Figure 3.11** and will be undertaken by Mangoola in consultation with the relevant infrastructure owners.

Existing 11 kV transmission lines running through the MCCO Additional Project Area provide power to Mangoola owned residences and private users. Some of these lines will need to be relocated and Ausgrid has been, and will continue to be, consulted as the MCCO Project progresses in this regard.

The relocation of these lines will take place during the construction phase and will occur prior to decommissioning of the existing line for continuity of supply to other users.

Some existing telecommunications and associated infrastructure is also located within the MCCO Additional Project Area and will require disconnection, relocation or protection during construction works as part of the MCCO Project. These services are predominantly owned by Telstra.

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

3.8.2.4 Other Ancillary Infrastructure

Various ancillary infrastructure associated with the operation of an open cut mine will be required including access tracks, fences and gates, fire trails, telecommunications, water pipelines, communications systems and other infrastructure. The specific locations will be determined as part of the detailed mine planning process for each stage and will be detailed as part of the MOP/Rehabilitation Management Plan process over the life of the MCCO Project. All infrastructure will be located within the identified disturbance areas for the MCCO Project, or if not possible, will be subject to appropriate due diligence processes to avoid adverse environmental impacts and, if required, subject to future approvals.

3.8.2.5 On-site Waste Disposal

As part of the MCCO Project, used tyres and inert waste may be disposed of in open cut mining areas. All such waste disposal activities will be undertaken in accordance with the approved Waste Management Plan with wastes classified in accordance with EPA waste classification guidelines.

3.8.2.6 Gravel Screening and Crushing

As discussed in **Section 2.3**, the existing operation is approved to produce up to 50,000 tonnes of gravel per year. This gravel is won through stripped overburden in the pit areas and, where required, processed through a gravel crushing plant for use on site. The gravel is used for blast stemming gravel, road surfacing and other on-site activities. The gravel crushing plant, where used, is mobile and generally follows the pit progression to minimise the distance between the source of gravel production and where it will be used.

The gravel operation will continue as part of the MCCO Project which will require gravel to construct haul roads and for other activities within the MCCO Project Area. It is estimated that around 200,000 tonnes of gravel could be required for internal roads and the diversion of Wybong Post Office Road and other construction needs. Gravel obtained on site will be used where possible; however, additional gravel

material may be sourced from off-site suppliers. Gravel supply has been considered in the estimated construction traffic numbers.

3.9 Operations Workforce and Hours of Operation

The MCCO Project will provide employment opportunities for a workforce up to approximately 400 employees rising up to approximately 480. This is comparable to the existing Mangoola Coal Mine which currently has approximately 400 employees. Without the MCCO Project the existing employment opportunities provided by the Mangoola Coal Mine would likely cease in 2025. With the MCCO Project, Mangoola Coal Mine will continue to operate for eight years from the commencement of mining operations in the MCCO Additional Project Area (currently planned to commence in 2022).

Mining operations will continue to be undertaken 24 hours per day, seven days per week. Consistent with existing Mangoola operations, blasting will be permitted between 9.00 am and 5.00 pm Monday to Saturday except where approved otherwise by the EPA.

3.10 Mine Access

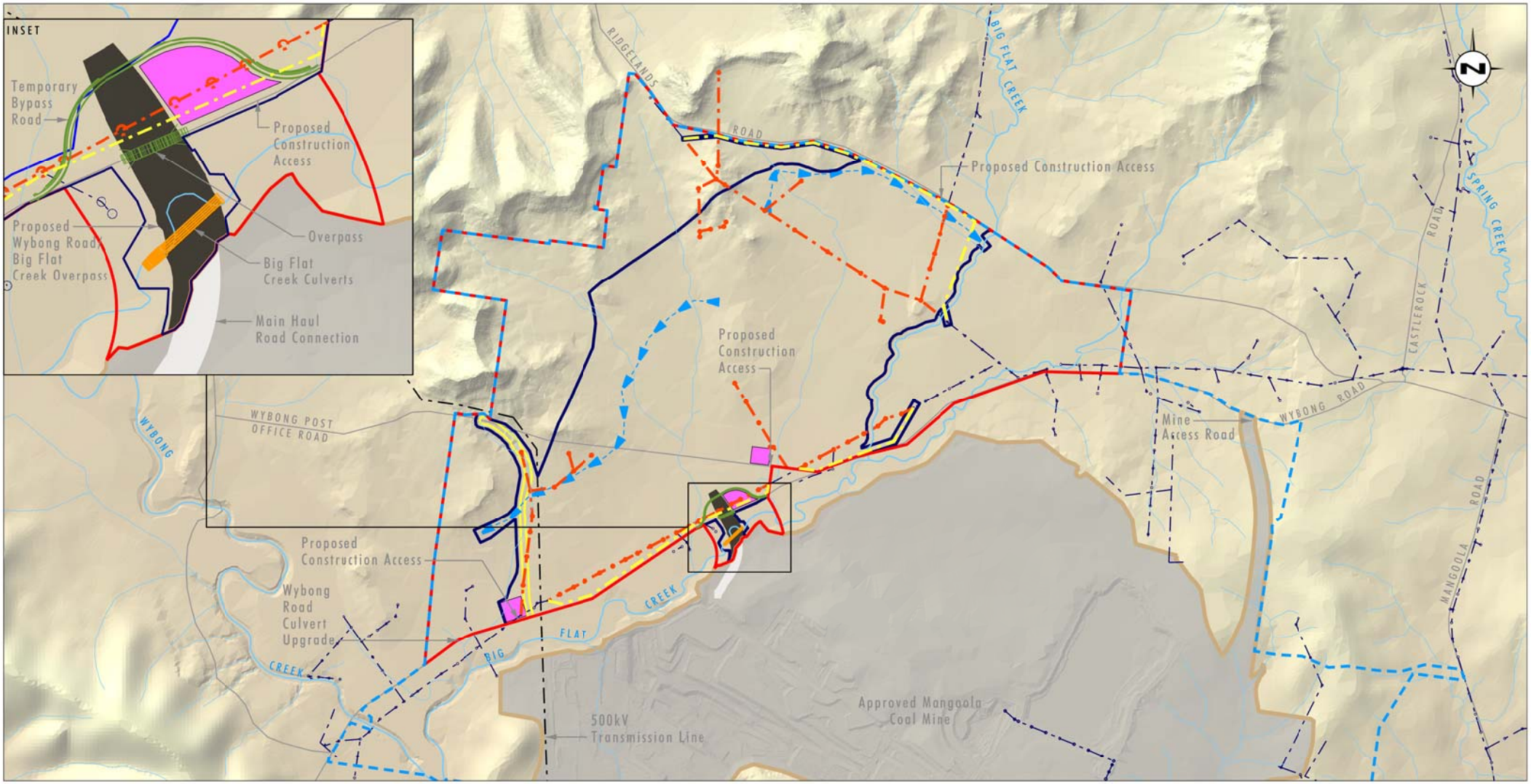
Mangoola currently has a single operational/employee site access point from Wybong Road referred to as the Mine Access Road (refer to **Figure 3.1**). This will be retained as the main entrance for the operations phase of the MCCO Project.

Mangoola does maintain access points to various surrounding Mangoola owned lands for purposes such as environmental monitoring, land management activities and property maintenance and these will continue to be used for such purposes.

In order to establish and manage operations in the MCCO Additional Project Area, access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road will be required for construction and emergency services, as well as for ongoing environmental monitoring, land management and property maintenance activities.

Direct access to the MCCO Project Additional Mining Area may be required in rare circumstances to provide access for mining equipment maintenance or mining equipment transport requirements dependent on factors such as mining progression and public road works limitations (e.g. for access for oversize loads). Where access is required from public roads outside of the normal site access routes, consultation will be completed with stakeholders and MSC and a traffic management plan implemented for these uncommon occasions.

As per the existing Mangoola Project Approval, no mine or MCCO Project related traffic will use Reedy Creek Road, Mangoola Road, Roxburgh Road or Castlerock Road to get to or from the site. Exceptions to this include emergency situations that endanger life, property and/or cause environmental harm; where personnel reside on those roads; where environmental monitoring, maintenance or inspections of infrastructure is required; or where directed by the relevant road authority.



Data Source: Glencore (2019)

0 125 250 500m
Inset Scale

0 0.5 1.0 2.0km
Main Scale

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Wybong Post Office Road Realignment
- Construction Office/Laydown Area
- Clean Water Diversion Drain
- Overpass Construction Footprint
- Culvert
- Temporary Bypass Road
- Transmission Line to Remain
- Transmission Line to be Removed
- Proposed Transmission Line

FIGURE 3.11

Proposed Construction Activities

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3.11 Construction Activities

The MCCO Project has been designed to maximise the use of existing infrastructure, however, as outlined in the previous sections some new or relocated infrastructure will be required to establish access to and operate within the MCCO Additional Project Area. The construction phase for the MCCO Project is planned to occur over an approximately 16-month period prior to Project Year 1 and will include the following key components as described in the previous sections:

- establishment of construction access points, temporary office and equipment laydown areas within the MCCO Additional Project Area
- establishment of the Proposed Wybong Road/Big Flat Creek Overpass and haul road connection to Mangoola Coal Mine
- realignment of Wybong Post Office Road
- establishment of water management infrastructure including clean water diversion drains, dams and pipelines and upgrades to existing culverts under Wybong Road
- relocation of 11 kV transmission lines out of the MCCO Additional Disturbance Area.

An overview of proposed construction activities is provided in **Figure 3.11**.

The above key components of construction, with the exception of the establishment of the Proposed Wybong Road/Big Flat Creek Overpass, the Wybong Post Office Road Realignment and upgrades to existing culverts under Wybong Road will be conducted up to 24 hours per day, seven days per week.

The construction hours for the Proposed Wybong Road/Big Flat Creek Overpass, Wybong Post Office Road Realignment and upgrades to existing culverts under Wybong Road will generally be during the hours of 7.00 am to 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturdays, Sundays and public holidays. Workforce arrival at site, workforce pre-start communications, work site inspections and workforce leaving site may occur outside of the construction hours. Work activities may occur outside of the nominated construction hours, however these will be managed to minimise impacts to the community. It is also noted that some works such as the installation of power utilities may need to be undertaken at specific times to minimise disruptions to users. Construction activities undertaken outside these hours will be managed to meet the relevant construction noise criteria.

A peak construction workforce of approximately 145 people is anticipated however this will vary depending on the timing of construction of the various components of the MCCO Project.

Construction laydown areas and construction workforce offices and facilities will be located within the MCCO Additional Project Area. The exact location of these facilities will be dependent on final designs and on the timing of construction; however, these facilities will be located within the MCCO Additional Disturbance Area generally within the areas as shown on **Figure 3.11**. Water supply for the construction phase is planned to be either sourced directly from site or pumped from the Raw Water Dam at the existing Mangoola Coal Mine via above ground pipeline to either holding tanks or dams within the MCCO Additional Project Area. Mangoola has more than adequate supply within the existing water management system at Mangoola Coal Mine to meet the water requirements for the construction phase. The water requirements for the construction phase are estimated to be in the order of 50 ML which is less than 1 per cent of the average annual water usage of Mangoola Coal Mine which is approximately 5100 ML.

As discussed in **Section 3.10** the existing Mangoola Coal Mine site access will be used for the operation of the MCCO Project. However, during the construction phase, it will also be necessary to establish direct access to the MCCO Additional Project Area from Wybong Road, Wybong Post Office Road and Ridgelands Road. The management of these construction access points will occur via a construction traffic management plan. The construction traffic management plan will be developed in consultation with MSC prior to the commencement of construction activities. The plan will identify the measures to be implemented to manage potential construction related traffic impacts; including any construction access points (refer to **Section 6.13**). Temporary construction access will also be required over Big Flat Creek between the Approved Project Area and MCCO Additional Project Area. This will be established within the MCCO Additional Project Disturbance Area and be managed consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries, or its latest version.

Lighting associated with night time construction works will be managed in compliance with AS4282-1997 Control of the obtrusive effects of outdoor lighting.

3.12 Project Disturbance Area

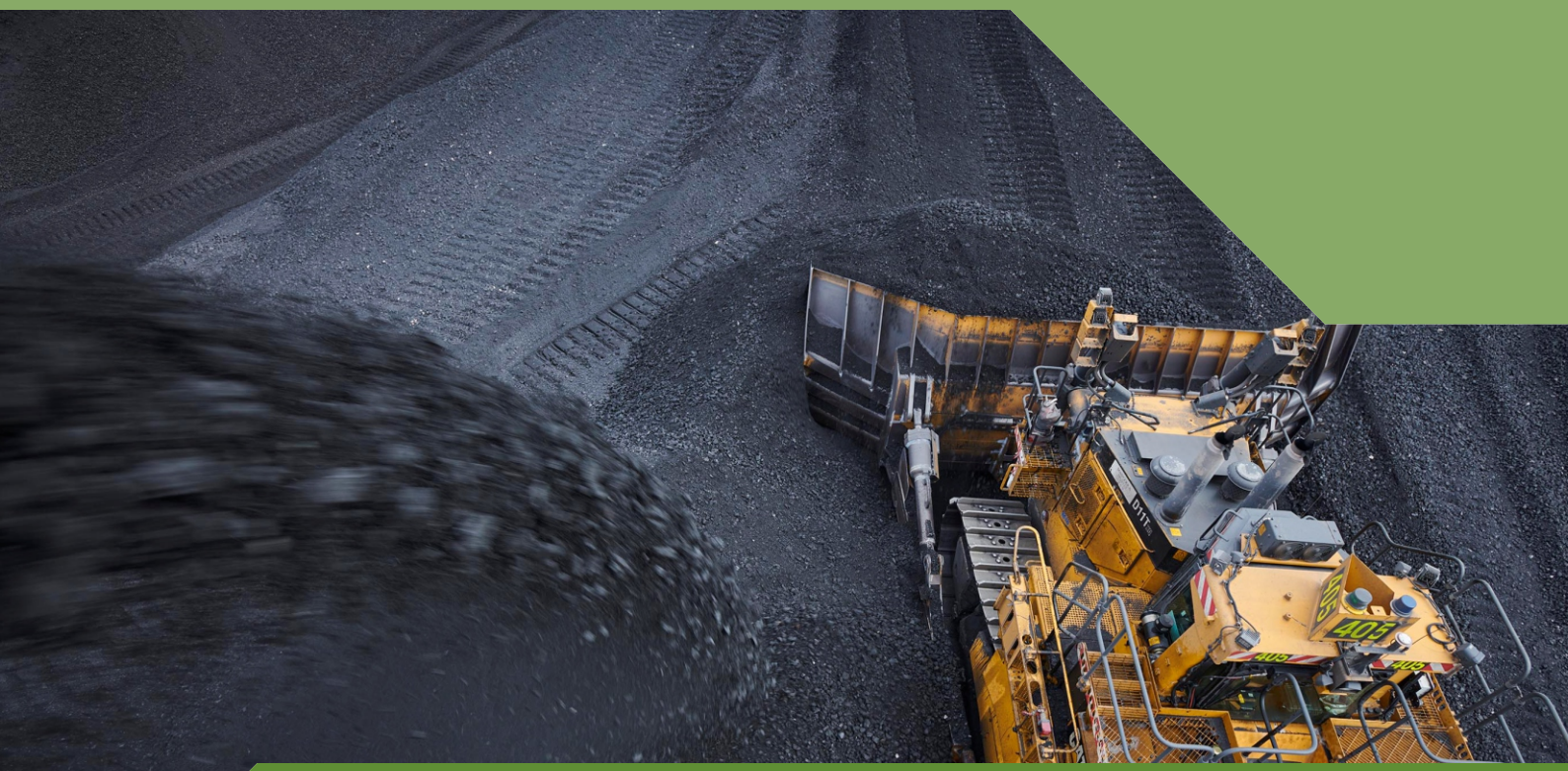
Most activities associated with the construction or carrying out of the MCCO Project involve some degree of surface disturbance although much of the affected land has been previously disturbed by existing or historical activities, or is currently approved for disturbance. The Approved Mangoola Coal Mine Disturbance Area shown on **Figure 3.1** is currently approved for disturbance and ongoing surface disturbance works will occur within this area over the life of the MCCO Project. As this area is approved for disturbance, no further assessment of the disturbance of this area is required as part of this EIS. The ongoing management of disturbance activities in this area will be undertaken in accordance with the approved management controls that are in place for Mangoola Coal Mine.

Where possible, as part of the implementation of the MCCO Project, activities will be undertaken in a manner that limits the amount of physical ground disturbance. However, it is not possible at this early stage of the MCCO Project to accurately identify every area within the MCCO Project Area that will remain intact or will be disturbed over the life of the mine.

Figure 3.11 identifies the areas within the MCCO Additional Project Area that have been identified as potentially being disturbed as a result of the MCCO Project. Due to the difficulty in accurately defining the precise location of minor access tracks, infrastructure alignments and water management infrastructure, minor buffers around areas that are known to be, or are likely to be, disturbed as a result of the MCCO Project, have been applied so that the maximum potential footprint has been identified and assessed in this EIS.

All disturbance works will be located within the identified disturbance areas for the MCCO Project, or if this is not possible for some minor disturbances (such as boreholes, minor access tracks, monitoring equipment installation, fire breaks), will be subject to appropriate due diligence processes to avoid adverse environmental impacts and, if required, subject to future approvals.

SECTION 4.0
Strategic and Statutory Context



4.0 Strategic and Statutory Context

4.1 Statutory Context

The MCCO Project requires approval under both Commonwealth and NSW legislation with the primary planning and environmental approvals required including:

- approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (refer to **Section 4.2.1**)
- granting of a new development consent under Part 4 of the NSW EP&A Act (refer to **Section 4.3.1**).

This EIS provides the environmental, social and economic impact assessments required to accompany the applications for the above planning and environmental approvals for NSW and Commonwealth determining authorities.

This section discusses the application of the various State and Commonwealth environment and planning legislation and policies that are relevant to the MCCO Project.

4.2 Commonwealth Legislation

The EPBC Act is the primary environmental and planning regulatory instrument relevant to the MCCO Project at a Commonwealth level. The operation of the EPBC Act and its application to the MCCO Project is discussed in **Section 4.2.1** below.

The *Native Title Act 1993* is not directly relevant to the approval process for the MCCO Project, however, it does have implications for the grant of mining leases under the *Mining Act 1992* where there is potentially land in respect of which native title has not been extinguished within the lease application area. The implications (if any) of the Native Title Act on the grant of any mining lease necessary for the MCCO Project will be dealt with as part of the mining lease application process.

4.2.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on a matter of national environmental significance (MNES). The MCCO Project does not interact with any World Heritage Properties, National Heritage Places, Ramsar Wetlands, Marine Environments, Commonwealth land, Commonwealth marine areas, the Great Barrier Reef Marine Park and is not a nuclear action. The remaining potentially relevant MNES required further consideration in regard to the MCCO Project.

Approval under Part 9 of the EPBC Act is required for actions that may result in a significant impact on MNES. The MCCO Project was referred to the Commonwealth Minister for the Environment on 30 August 2018 (EPBC Act referral 2018/8280).

On 21 January 2019, the MCCO Project was determined to be a Controlled Action requiring approval under the EPBC Act from the Commonwealth Minister for the Environment due to its potential impact on the following MNES:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (a Critically Endangered Ecological Community (CEEC) listed under the EPBC Act)
- *Prasophyllum* sp. Wybong (an orchid listed as Critically Endangered)
- Regent Honeyeater (*Anthochaera Phrygia*) (a bird listed as Critically Endangered)
- a water resource in relation to a coal mining development.

A copy of the determination of the MCCO Project as a Controlled Action is provided in **Appendix 3**. The assessment path for the MCCO Project is under the bilateral agreement between the Commonwealth and NSW Governments and DoEE has issued its assessment requirements which have been incorporated into the SEARs for the MCCO Project (refer to **Section 4.3.1.2**). This EIS addresses the assessment requirements, with a summary of the assessment findings related to MNES included in **Section 7.0**.

Two previous referrals under the EPBC Act have been submitted for the approved operations at Mangoola Coal Mine. These included one prepared as part of the original mine approval (Reference number 2007/3228) and another for additional disturbance and activities arising from changes to mining operations in 2010 (Reference number 2010/5607). These Actions were determined not to be controlled actions in October 2008 and September 2010, respectively. The current application for approval under the EPBC Act relates to those elements of the MCCO Project that have not previously been referred.

4.3 NSW Legislation and Policies

There are a substantial number of legislative instruments in NSW which regulate the environmental impact of development. The primary instrument is the EP&A Act which regulates the planning and environmental assessment and approval process for development in NSW. The application of the EP&A Act and relevant planning and environmental legislation to the MCCO Project is discussed in **Section 4.3.1** and **Section 4.3.2**. The operation of other environmental legislation in regard to the MCCO Project is discussed in **Section 4.3.3** and in **Section 6.0** in relation to specific Project impacts where relevant.

Section 4.4 discusses the key strategic policies that have relevance to the design and operation of the MCCO Project and which have been considered in the environmental assessment. In addition to the policies discussed in **Section 4.4** there are a large number of impact specific guidance documents and policies that have been considered as part of the environmental assessment of the MCCO Project, these are identified and discussed in the relevant impact assessment sections in **Section 6.0**.

4.3.1 Environmental Planning and Assessment Act 1979

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

4.3.1.1 Approval Pathway

State Significant Development

Clause 8(1)(b) and clause 5(1)(a) of Schedule 1 of State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) prescribe that development for the purposes of 'coal mining' is SSD. Development consent under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act is required before coal mining can be carried out.

For SSD where certain such objections and disclosures are not made, DPE is the consent authority as delegated by the Minister for Planning and Public Spaces. The IPC is the consent authority for SSD where certain objections and disclosures referred to in subclause 8A (1) of the SRD SEPP are made in respect to an application.

Permissibility

The MCCO Additional Project Area is zoned E3 Environmental Management and RU1 Primary Production under the provisions of the Muswellbrook Local Environmental Plan 2009 (LEP) (refer to **Figure 4.1**). Under the provisions of the LEP, open cut mining is permissible with development consent in RU1 Primary Production but is prohibited within land zoned E3 Environmental Management.

Clause 7(1)(b)(i) of the State Environmental Planning Policy (Mining, Petroleum and Extractive Industries 2007) (Mining SEPP) provides that mining is permissible with development consent on land where development for the purpose of agriculture is also permissible under the provisions of an environmental planning instrument. Extensive agriculture is a permissible land use within land zoned E3 Environmental Management. Clause 5(3) of the Mining SEPP provides that the Mining SEPP will prevail where there is any inconsistency between the provisions in the Mining SEPP and the provisions in any other environmental planning instrument (such as the LEP) (subject to limited exceptions not relevant here).

Based on the provisions of the Mining SEPP, development for the purpose of open cut mining may be carried out with development consent in the MCCO Additional Project Area.

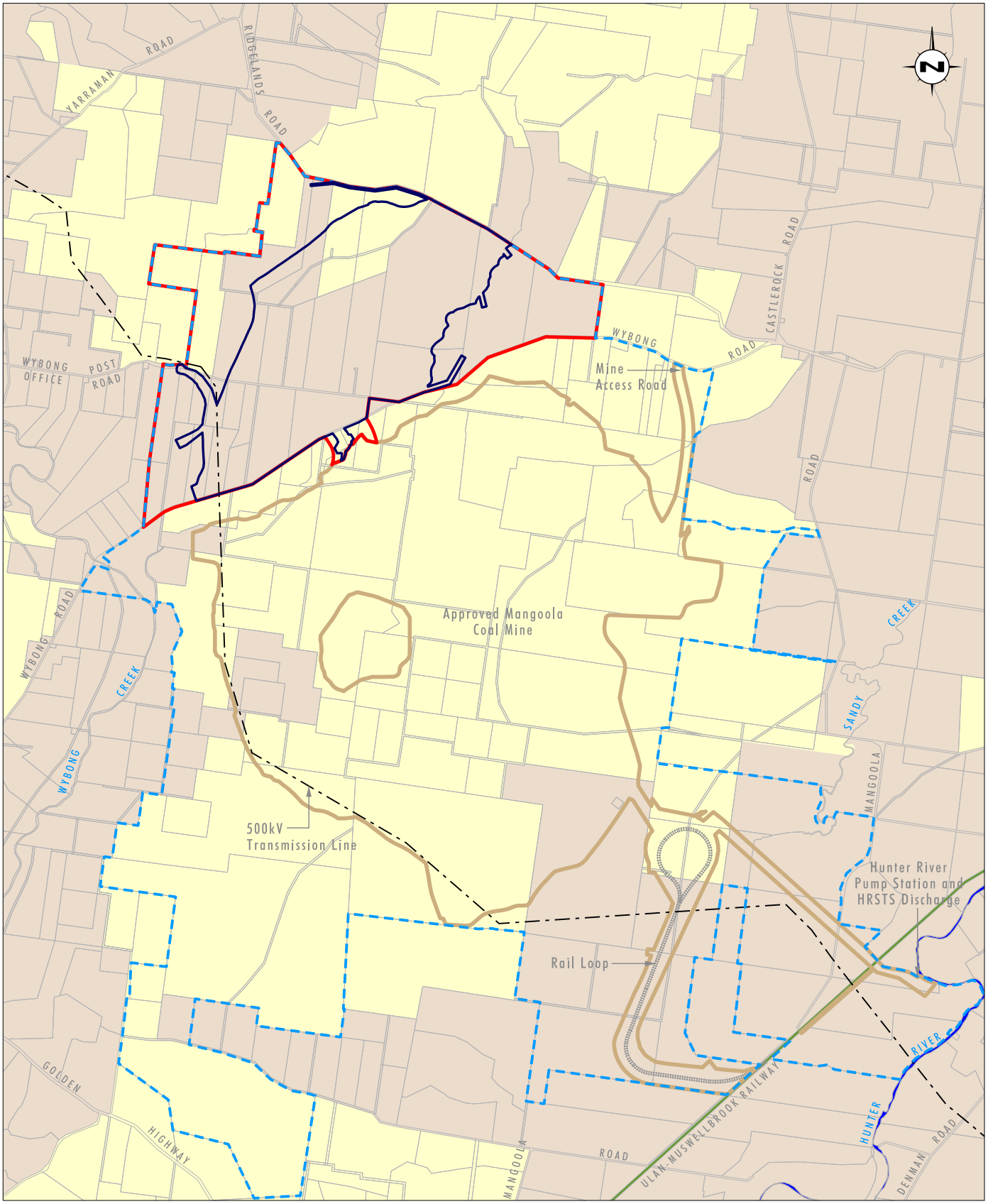
The Approved Project Area is zoned E3 Environmental Management, RU1 Primary Production and SP2 Infrastructure (Rail Infrastructure Facilities) under the provisions of the Muswellbrook LEP. As noted above, mining is permissible with development consent in the E3 and RU1 zones. The only development permitted on land zoned SP2 Infrastructure is development for the purpose shown on the Land Zoning Map, being Rail Infrastructure Facilities, including any development that is ordinarily incidental or ancillary to development for that purpose. No new works are proposed on land zoned SP2 as part of the MCCO Project.

4.3.1.2 Assessment Requirements

As SSD, the MCCO Project is subject to the general assessment requirements under Part 4 of the EP&A Act as amended by the requirements under Part 4 Division 4.1 and 4.7 of that Act. The requirements are discussed below.

Section 4.15 Matters for Consideration

Under Part 4 of the EP&A Act, the consent authority must have regard to the matters set out in section 4.15 of the EP&A Act. The matters for consideration by the consent authority and where they have been addressed in this EIS are provided in **Table 4.1**.



Data Source: Glencore (2019), NSW Department of Planning (July 2018)

0 1.0 2.0 3.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Land Zone:

- E3 - Environmental Management
- RU1 - Primary Production
- SP2 - Infrastructure
- W1 - Natural Waterways

FIGURE 4.1

Land Zoning

Table 4.1 Section 4.15 Matters for Consideration

Matters for Consideration	Relevant EIS Section
(a) The provisions of: (i) Any environmental planning instrument that apply to the land to which the development application relates	**Section 4.3.2**
(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) that apply to the land to which the development application relates	**Section 4.3.2**
(iii) Any development control plan that apply to the land to which the development application relates	Not applicable due to operation of Clause 11 of SRD SEPP
(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 that apply to the land to which the development application relates	Not applicable. Mangoola will hold discussions with Muswellbrook Council regarding a planning agreement relating to the MCCO Project
(iv) The regulations (to the extent that they prescribe matters for the purposes of this paragraph) that apply to the land to which the development application relates	**Section 4.3.1**
(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 6.0** and **Appendix 5** to **Appendix 23**
(c) The suitability of the site for the development	**Section 6.0** and **Section 9.3**
(d) Any submissions made in accordance with this Act or the regulations	Comments to be received on the EIS during the public exhibition period
(e) The public interest	**Section 9.0**

In addition to the requirements under section 4.15, the consent authority must also have regard to an EIS which has been prepared in accordance with the requirements of Schedule 2 of the EP&A Regulation. The requirements of Schedule 2 of the EP&A Regulation and where they are addressed in this EIS are set out in **Table 4.2**.

Table 4.2 Schedule 2 EP&A Regulation Requirements

Regulation Clause	Requirement	Relevant EIS Section
Clause 6(a)	The name, address and professional qualifications of the person by whom the statement is prepared	**Appendix 4**
Clause 6(b)	The name and address of the responsible person	Mangoola Coal Operations Pty Limited Contact: Brian Pease, Project Manager Wybong Road/PO Box 495 Muswellbrook NSW 2333
Clause 6(c)	The address of the land: (i) in respect of which the development application is to be made (ii) on which the activity or infrastructure to which the statement relates is to be carried out	**Appendix 1**
Clause 6(d)	A description of the development, activity or infrastructure to which the statement relates	**Section 3.0**
Clause 6(e)	An assessment by the person by whom the statement is prepared of the environmental impact of the development, activity or infrastructure to which the statement relates, dealing with the matters referred to in this Schedule	**Section 6.0**
Clause 6(f)	A declaration by the person by whom the statement is prepared to the effect that: (i) the statement has been prepared in accordance with this Schedule (ii) the statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates (iii) that the information contained in the statement is neither false nor misleading.	**Appendix 4**
Clause 7(1)(a)	Summary of the EIS	**Executive Summary** and **Section 9.0**
Clause 7(1)(b)	A statement of the objectives of the development	**Section 1.2**
Clause 7(1)(c)	An analysis of any feasible alternatives to the carrying out of the development having regard to its objectives, including the consequences of not carrying out the development	**Section 1.4** and **Section 9.0**
Clause 7(1)(d)(i)	A full description of the development, activity or infrastructure	**Section 3.0**

Regulation Clause	Requirement	Relevant EIS Section
Clause 7(1)(d)(ii)	A general description of the environment likely to be affected by the development, activity or infrastructure, together with a detailed description of those aspects of the environment that are likely to be significantly affected	**Section 6.0**
Clause 7(1)(d)(iii)	The likely impact on the environment of the development	**Section 6.0** and **Appendix 5** to **Appendix 23**
Clause 7(1)(d)(iv)	A full description of the measures proposed to mitigate any adverse effects of the development, activity or infrastructure on the environment	**Section 3.0**, **Section 6.0** and **Section 8.0**
Clause 7(1)(v)	A list of any approvals that must be obtained under any other Act or law before the development may be lawfully carried out	**Section 4.0**
Clause 7(1)(e)	A compilation of the mitigation measures referred to in Clause 7(1)(d)(iv)	**Section 8.0**
Clause 7(1)(f)	The reasons justifying the carrying out of the development in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development	**Section 9.0**

This EIS has also addressed the SEARs issued by DPE for the MCCO Project. The SEARs were originally issued on 22 August 2017 and reissued on 15 February 2019 to incorporate the Commonwealth's assessment requirements following determination of the MCCO Project as a controlled action and other minor updates. A copy of the SEARs is contained in **Appendix 3**. A checklist of the SEARs and where they have been addressed in this EIS is outlined in **Table 4.3**.

Table 4.3 Secretary's Environmental Assessment Requirements for the Environmental Impact Statement

Secretary's Environmental Assessment Requirements	Relevant EIS Section
General Requirements	
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*	Refer to **Table 4.2**
In particular, the EIS must include:	
• a stand-alone executive summary	**Executive Summary**
• a full description of the development, including:	
○ historical mining operations on the site	**Section 2.0**
○ the resource to be extracted, demonstrating efficient resource recovery within environmental constraints	**Section 3.2**
○ the mine layout and scheduling	**Section 3.3.1**
○ coal production rates (run-of-mine and product)	**Section 3.2**
○ coal processing and transport arrangements	**Section 3.3** and **Section 6.13**
○ infrastructure and facilities (including any existing infrastructure or infrastructure that would be required for the development, but the subject of a separate approval process)	**Section 2.4** and **Section 3.8**
○ workforce requirements during all phases of the development (on a full-time equivalent basis)	**Section 3.1**, **Section 3.9** and **Section 3.11**
○ surface disturbance footprint	**Section 3.12**
○ a waste (overburden, rejects, tailings, etc.) management strategy	**Section 6.21**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
○ a water management strategy	**Section 3.6**, **Section 6.7** and **Section 6.8**
○ a rehabilitation strategy	**Section 3.3.4.2** and **6.17**
○ the likely interactions between the development and any other existing, approved or proposed mining development or power station in the vicinity of the site	**Section 6.15.4**
• a strategic justification of the development focusing on site selection and the suitability of the proposed site	**Section 9.0**
• a list of any approvals that must be obtained before the development may commence	**Section 4.0**
• an assessment of the likely impacts of the development on the environment, focusing on the key issues identified below, including:	
○ a description of the existing environment likely to be affected by the development, using sufficient baseline data	**Section 6.0**
○ an assessment of the likely impacts for all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice	**Section 4.0** and **Section 8.0**
• a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of: • whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented • the likely effectiveness of these measures and • whether contingency measures would be necessary to manage any residual risks	**Section 6.0** and **Section 8.0**
• a description of the measures that would be implemented to monitor and report on the environmental performance of the development	**Section 6.0** and **Section 8.0**
• a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS	**Section 8.0**
• consideration of the development against all relevant environmental planning instruments (including Part 3 of the State Environmental	**Section 4.0**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)	
• the reasons why the development should be approved, having regard to: o relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act o the biophysical, economic and social impacts of the project, including the principles of ecologically sustainable development o the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses and o feasible alternatives to the development (and its key components), including the consequences of not carrying out the development	**Section 9.0**
• a signed statement from the author of the EIS, certifying that the information contained within the document is neither false nor misleading	**Appendix 4**
• In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified and experienced person that includes an accurate estimate of the capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*), including details of all the assumptions and components from which the capital investment value calculation is derived	Provided separately to DPE
Key Issues	
The EIS must address the following key issues:	
Land Resources – including: • an assessment of the likely impacts of the development on the soils and land capability of the site and surrounds, paying particular attention to any strategic agricultural land • an assessment of the agricultural impacts of the development, including identification of any strategic agricultural land • an assessment of the likely impact of the development on landforms (topography), including the potential subsidence impacts on cliffs, rock formations and steep slopes • justification for any significant long term changes to the potential agricultural productivity of land post-mining and • an assessment of the compatibility of the development with other land uses in the vicinity of the development, in accordance with the requirements of Clause 12 of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007, paying particular attention to agricultural land uses in the region	**Section 6.15** and **Appendix 19**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
Air Quality – including: • a detailed assessment of potential construction and operational impacts, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2016, and with a particular focus on dust emissions including PM2.5 and PM10, and having regard to the Voluntary Land Acquisition and Mitigation Policy 2018 • an assessment of potential dust and other emissions generated from processing, operational activities and transportation of quarry products • reasonable and feasible mitigation measures to minimise dust and emissions • monitoring and management measures, in particular, real-time air quality monitoring and • an assessment of the likely greenhouse gas impacts of the development	**Section 6.5** and **Appendix 9**

Rehabilitation and Final Landform – including:
• a description of final landform design objectives, having regard to achieving a natural landform that is safe, stable, non-polluting, fit for the nominated post-mining land use and sympathetic with surrounding landforms
• a description of how any outstanding rehabilitation obligations for the existing Mangoola Mine would be satisfied or altered by the development
• an analysis of final landform and post-mining land use options for the site, including the short and long-term cost and benefits, constraints and opportunities of each, and detailed justification for the preferred option
• a detailed description of the progressive rehabilitation measures that would be implemented over the life of the development and how this rehabilitation would be integrated with surrounding mines and land uses
• a detailed description of the proposed rehabilitation and mine closure strategies for the project, having regard to the key principles in Strategic Framework for Mine Closure, and the:
  ○ rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria
  ○ decommissioning and management of surface infrastructure
  ○ nominated final land uses, having regard to any relevant strategic land use planning or resource management plans or policies and
  ○ potential for integrating the rehabilitation strategy with any other offset strategies in the region and
• the measures which would be put in place for the long-term protection and management of the site and any biodiversity offset areas
	Section 6.17

Secretary's Environmental Assessment Requirements	Relevant EIS Section
following the cessation of mining	
Noise & Blasting – including: • a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development in accordance with the Interim Construction Noise Guideline, NSW Noise Policy for Industry and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy 2018 • if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline • an assessment of the likely rail noise impacts of the development under the Rail Infrastructure Noise Guideline • proposed blasting hours, frequency and methods • a detailed assessment of the likely blasting impacts of the development (including noise, vibrations, overpressure, visual and odour) on people, animals, buildings, infrastructure and significant natural features, having regard to the relevant ANZECC guidelines • reasonable and feasible mitigation measures to minimise noise emissions and • monitoring and management measures, in particular real-time and attended noise monitoring	**Section 6.4**, **Section 6.6**, **Appendix 8** and **Appendix 10**
Visual – including: • a detailed assessment of the likely visual impacts of the development on private landholders in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development	**Section 6.14**
Waste – including: • estimates of the quantity and nature of the waste streams that would be generated by the project (including tailings and coarse rejects) and any measures that would be implemented to minimise, manage or dispose of these waste streams	**Section 3.2** and **Section 6.21**
Water – including: • a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures • identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*	**Section 6.7**, **Section 6.8**, **Appendix 11** and **Appendix 12**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
• demonstration that water for the construction and operation of the proposed development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP) or water source embargo • an assessment of any likely flooding impacts of the development • a description of the measures proposed to ensure the development can operate in accordance with the requirements of any of relevant WSP or water source embargo • an assessment of the likely impacts of the development on the quantity and quality of existing surface and groundwater resources including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives • an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users and • an assessment of the likely impacts of the development on a water resource, in relation to coal seam gas development and large coal mining development under the *Environment Protection and Biodiversity Conservation Act 1999* (see Attachment 3)	**Section 7.0**
Biodiversity – including: • an assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment and any other applicable NSW Government Policy • assessment of the likely impacts of the development on listed threatened species and communities under the *Environment Protection and Biodiversity Conservation Act 1999* (see Attachment 3) and • a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects or the Biodiversity Offsets Scheme under the *Biodiversity Conservation Act 2016* (as relevant for Commonwealth matters)	**Section 6.9** and **Appendix 13** **Section 7.0**
Heritage – including: • an assessment of the potential impacts of the development on Aboriginal heritage (cultural and archaeological), including consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage and • identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to the relevant policies and guidelines listed in Attachment 1	**Section 6.11**, **Section 6.12**, **Appendix 15** and **Appendix 16**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
Traffic & Transport – including: • an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the road and rail networks and • a description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required)	**Section 6.13** and **Appendix 17**
Hazards – including: • an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks, blasting impacts and the handling and use of any dangerous goods and	**Section 6.6**, **Section 6.9**, **Section 6.20**, **Section 6.22** and **Appendix 23**
Social – including: • including a detailed assessment of the likely social impacts of the development on the local and regional community in accordance with the Social impact assessment guideline for State significant mining, petroleum production and extractive industry development 2017 and	**Section 6.3** and **Appendix 5**
Economic – including: • including a detailed assessment of the likely economic impacts of the development, in accordance with the Guidelines for the economic assessment of mining and coal seam gas proposals 2015, paying particular attention to: o the costs and benefits of the project; identifying whether the development as a whole would result in a net benefit to NSW, including consideration of fluctuation in commodity markets and exchange rates and o the demand for the provision of local infrastructure and services	**Section 6.2** and **Appendix 5**
Consultation	
During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landholders You must: • consult with:	**Section 5.0**

Secretary's Environmental Assessment Requirements	Relevant EIS Section
○ affected landholders ○ community groups ○ MSC ○ Office of Environment and Heritage (including the Heritage Branch) ○ Environment Protection Authority ○ Division of Resources and Geoscience within the Department ○ Department of Primary Industries (including the DPI Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division) ○ Roads and Maritime Services ○ NSW Rural Fire Service ○ NSW Health ○ NSW Dams Safety Committee ○ Hunter Local Land Services ○ Australian Rail Track Corporation and the Hunter Coal Chain Coordinator and ○ any affected electricity distribution authority and • operate a Community Consultative Committee for the project (or utilise the existing Mangoola Community Consultative Committee) in accordance with the Community Consultative Committee Guidelines for State Significant Projects, and consult with the committee during the preparation of the EIS and	
The EIS must: • describe the consultation process used and demonstrate that effective consultation has occurred • describe the issues raised by public authorities, service providers, community groups and landholders • identify where the design of the development has been amended in response to issues raised; and otherwise demonstrate that issues raised have been appropriately addressed in the assessment If you do not lodge a development application and EIS for the development within 2 years of the issue date of these requirements, you must consult further with the Secretary in relation to the preparation of the EIS.	**Section 5.0**

4.3.2 Environmental Planning Instruments

There are a number of environmental planning instruments that are potentially applicable to the MCCO Project. These are discussed in the following sections.

4.3.2.1 Local Environmental Plans

Muswellbrook Local Environmental Plan 2009

The MCCO Project Area is located within the Muswellbrook Local Government Area (LGA) and is subject to the Muswellbrook LEP. The operation of the Muswellbrook LEP in relation to mining is largely constrained by the application of State Environmental Planning Policies which prevail over LEPs usually to the extent of any inconsistency between a SEPP and LEP.

The MCCO Project Area is located within land zoned RU1 Primary Production zone, E3 Environmental Management and SP2 Infrastructure. The permissibility of the MCCO Project within these zones is discussed in **Section 4.3.1.1**.

4.3.2.2 State Environmental Planning Policies

The following SEPPs are relevant to the consideration of the development application for the MCCO Project.

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

The Mining SEPP regulates the permissibility and assessment requirements for mining, petroleum production and extractive industries and related development. As set out in **Section 4.3.1.1** the MCCO Additional Project Area is on land zoned RU1 Primary Production and E3 Environmental Management under the provisions of the Muswellbrook LEP, with open cut mining permissible in RU1 but prohibited within E3. The provisions of the Mining SEPP prevail and provide for the permissibility of open cut mining in the E3 zoning.

Part 3 of the Mining SEPP requires specific matters to be considered in relation to development applications for mining developments. 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 in **Table 4.4**, with the relevant assessment outcomes noted for each criteria.

Table 4.4 Non-discretionary Development Standards for Mining under the Mining SEPP

Matter	Non-discretionary Standard	Assessment Outcomes
Cumulative Noise Level	The development does not result in a cumulative amenity noise level greater than the recommended amenity noise levels, as determined in accordance with Table 2.2 of the Noise Policy for Industry, for residences that are private dwellings.	The Noise Impact Assessment for the MCCO Project found that the cumulative amenity noise level at private receivers surrounding MCCO Project will not exceed the recommended amenity noise levels with the exception of two private receivers (receiver 83 and 66). Both receivers are predicted to be entitled to voluntary acquisition of their property due to the MCCO Project under the provisions of the NSW Governments Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum and Extractive Industry Developments (2018)(VLAMP).

Matter	Non-discretionary Standard	Assessment Outcomes
Cumulative Air Quality Level	The development does not result in a cumulative annual average level greater than 25 µg/m^3 of PM_{10} or 8 µg/m^3 of $PM_{2.5}$ for private dwellings.	Detailed air quality modelling found that cumulative annual average PM_{10} concentrations are predicted to comply with the non-discretionary cumulative air quality level of 25 µg/m^3 criterion at all surrounding private residences. The detailed air quality modelling also found that cumulative annual average $PM_{2.5}$ concentrations are predicted to comply with the non-discretionary cumulative air quality level of 8 µg/m^3 criterion at all surrounding private residences.
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 per cent of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.	Detailed blast assessment confirms that airblast overpressure levels can be managed effectively within the non-discretionary airblast overpressure criteria at all private residences and potentially sensitive receivers. Any impacts in excess of these criteria would only occur subject to a negotiated agreement with the owner of the residence or sensitive receivers.
Ground Vibration	Ground vibration caused by the development does not exceed: (a) 10 mm/sec (peak particle velocity) at any time, and (b) 5 mm/sec (peak particle velocity) for more than 5 per cent of the total number of blasts over any period of 12 months measured at any private dwelling or sensitive receiver.	Detailed blast assessment confirms that ground vibration levels can be managed effectively within the non-discretionary ground vibration criteria at all private residences and potentially sensitive receivers. Any impacts in excess of these criteria would only occur subject of a negotiated agreement with the owner of the residence or sensitive receiver.

Matter	Non-discretionary Standard	Assessment Outcomes
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 for item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy for each relevant water source listed in column 1 of that Table.	This non-discretionary standard relates to meeting the Level 1 minimal impact considerations specified in the NSW Aquifer Interference Policy. Detailed groundwater modelling confirms that there will be no exceedance of the Level 1 minimal impact considerations except for the impact on four private bores (refer to **Section 6.8**). The modelling predicts potential for drawdown of more than 2 m at one private bore as a result of the MCCO Project with a likely drawdown > 3 m which will exceed the Level 1 minimal impact considerations. An additional bore is located in an area of over 2 m potential drawdown and is predicted to primarily be impacted due to mining at the approved Mangoola Coal Mine. Predicted drawdown at the bore is 7.5 m. The property where this bore is located currently has acquisition rights under the existing Project Approval and are anticipated to have acquisition rights under MCCO Project in accordance with the VLAMP.

Clause 12 of the Mining SEPP, extracted below, requires the consent authority to consider the compatibility of proposed mining developments with existing land uses in the area.

> **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:
>
> (a) consider:
>
> (i) the existing uses and approved uses of land in the vicinity of the development;
>
> (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.
>
> (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).

The MCCO Project includes both the existing Approved Project Area for Mangoola Coal Mine and the MCCO Additional Project Area. The Approved Project Area is dominated by the existing mining operation, including the open cut mining area and associated infrastructure, along with areas of rehabilitated land and native vegetation. The existing land use of the Approved Project Area is predominantly mining, with areas of conservation and grazing.

The MCCO Additional Project Area has been used extensively for agriculture since the 1800s and is comprised of rolling grazing land and small patches of native woodland. An analysis of historical aerial photography indicates that most of the area had been cleared by the 1940s.

The MCCO Project is considered to be compatible with the existing land use of the Approved Project Area which is predominantly mining. With regard to the MCCO Additional Project Area, the existing land use of low productivity agriculture will be replaced by a higher value land use being mining. Post mining the opportunity exists for the rehabilitated landform to be used once again for agriculture; however, as outlined in **Section 6.15** it is planned that much of the area will be rehabilitated to native vegetation. The impact of the MCCO Project on agriculture is assessed in **Section 6.16** and it was concluded that the impact will not be significant.

With regard to surrounding land uses, the assessment in **Section 6.0** identifies that while the MCCO Project is predicted to result in some impacts, it is a continuation of an existing local land use (i.e. mining) and it is broadly compatible with the surrounding land uses. Key elements of the MCCO Project have been designed to minimise impacts on surrounding land uses. The compatibility of the MCCO Project with surrounding land uses is considered in more detail in **Section 6.0** (in particular **Section 6.16**) and **Section 9.0**.

Clause 13 of the Mining SEPP requires the consent authority to consider the potential impact of proposed mining developments on other mining, petroleum production or extractive industry projects or potential resources. While Mangoola Coal Mine occurs in a region with a number of other mines and mining tenements, there are no immediately adjoining mining operations and the MCCO Project is not expected to adversely impact any other mining operations. Some of the existing and proposed biodiversity offset areas for the MCCO Project occur in exploration licence areas, with this being a common occurrence where high value biodiversity areas are identified.

On exploration licence areas held by Mangoola, an evaluation of the potential to mine any coal resources in these areas was undertaken before the offset areas were proposed. For exploration licences to the north held by other parties, the presence of a conservation area on the surface would not necessarily prevent future mining should viable resources be identified, depending on the nature of mining proposed (e.g. underground mining with minimal surface disturbance). It is noted that the provisions of the *Biodiversity Conservation Act 2016* (BC Act) require the Minister to consult with the holder of an exploration licence affected by a proposed Stewardship Agreement about the terms of the proposed agreement prior to entering into the agreement.

There are no petroleum leases overlapping with the MCCO Project. There is a quarry located approximately 4 km to the south of the existing mining area which is not predicted to be adversely impacted by the MCCO Project. The MCCO Project will not adversely impact on any other extractive industry operations or known extractive material resources.

Clause 14 of the Mining SEPP requires the consent authority to consider the impact of a proposed mining project on the natural resources and whether specific environmental management conditions (relating to water resources, biodiversity and greenhouse gas emissions) should be imposed on the development if approved.

The MCCO Project's potential impact on natural resources is dealt with in detail in **Section 6.0**, specifically:

- **Section 6.7** and **Section 6.8** (water)
- **Section 6.9** (biodiversity)
- **Section 6.10** (groundwater dependent ecosystems)

- **Section 6.15** (land resources)
- **Section 6.18** (greenhouse gas).

Project specific commitments regarding the management of potential environmental impacts including impacts on natural resources are contained in **Section 8.0**.

Clause 14(3) of the Mining SEPP requires that the consent authority must consider any certification by OEH for measures to mitigate or offset the biodiversity impact of the MCCO Project. As discussed in **Section 6.9**, the biodiversity impacts of the MCCO Project are being assessed in accordance with the NSW Framework for Biodiversity Assessment (FBA). The FBA assessment concludes that the offsets proposed by Mangoola satisfy the offset requirements for the MCCO Project as identified by the FBA.

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 resources. A key outcome of the MCCO Project is the optimisation of the recovery of coal resources. This is discussed in more detail in **Section 3.0** (and particularly **Section 3.3.1**).

Clause 16 of the Mining SEPP 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 will be transported to markets by train. Mangoola has previously made commitments to avoid using certain roads for access to and from the site and will maintain these restrictions as part of the MCCO Project. Road traffic impacts and commitments relating to construction, workforce, the realignment of the portion of Wybong Post Office Road and ancillary services are considered in **Section 6.13**.

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. Areas disturbed as part of the MCCO Project will be progressively rehabilitated following mining activities and decommissioning and rehabilitation works completed as part of the closure process following completion of mining. The proposed approach to rehabilitation is discussed in further detail in **Section 3.3.4** and **Section 6.17**, building on the existing rehabilitation practices in place at the existing mine which have been recognised as industry leading.

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44)

SEPP 44 restricts the granting of development consent for proposals on land identified as core koala habitat without preparation of a plan of management. Muswellbrook LGA is listed in Schedule 1 of SEPP 44 and therefore SEPP 44 is relevant to the MCCO Project.

An extensive biodiversity assessment (refer to **Section 6.9**) has been conducted for the MCCO Project and included targeted koala surveys and a habitat assessment. The biodiversity assessment recorded some koala feed trees (as per Schedule 2 of the SEPP) which categorised the area as 'Potential Koala Habitat'. The detailed investigations failed to identify any koalas or evidence of an existing population and as such the MCCO Additional Disturbance Area is not considered to represent core koala habitat. Consequently, the requirement for preparation of a koala plan of management does not apply.

State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33)

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 assessment of hazard related to the MCCO Project is discussed further in **Section 6.19**. This assessment concludes that with the incorporation of buffer distances into the design of the hazardous materials storages, that may be relocated as part of the MCCO Project, the level of risk to surrounding land users is tolerable. The MCCO Project would be carried out in accordance with the environmental management system so that the risk of any hazardous event occurring is minimised.

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55)

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

A search of the EPA's NSW Contaminated Lands Public Record Register was undertaken on 17 December 2018. No contaminated sites are currently recorded within the MCCO Project Area. No known contaminated areas occur within the MCCO Additional Project Area which has a long history of low intensity agricultural land uses.

With regard to the existing mining operations, a phase 1 contamination assessment has been undertaken at the Mangoola Coal Mine as part of Mangoola's ongoing environmental due diligence process for the existing mining operations. This assessment identified potential contamination sources, typical of an existing mining operation, including above ground fuel storage tanks and refuelling areas, waste water treatment plant, oil water separator units and truck wash areas. All of these facilities have controls to seek to prevent any contamination from occurring. These areas will be further investigated as part of the mine closure process and any contamination identified remediated.

The management of contamination risks as part of the MCCO Project is discussed further in **Section 6.15.3**.

State Environmental Planning Policy (State and Regional Development) 2011

The SRD SEPP declares that the MCCO Project (as development for the purposes of coal mining) is SSD. The application of the SRD SEPP is largely limited to the issue of approval pathway and is discussed in further detail in **Section 4.3.1**.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State. Amongst a range of other provisions, it specifies that the relocation of power transmission lines and roads constitutes development that is permissible without consent provided that the works are being carried out for or on behalf of a distribution network service provider or pubic authority.

Clause 45 of the Infrastructure SEPP requires that for a development application which involves certain works related to or near electricity infrastructure, the consent authority must give written notice to the electricity supply authority for the area in which the development is carried out, inviting comments about potential safety risks. As discussed in **Section 5.4.4**, Mangoola has consulted with the electricity supply authorities relevant to the MCCO Project, being TransGrid and Ausgrid.

4.3.3 Other State Legislation

In addition to requiring development consent under the EP&A Act, the MCCO Project will require a number of separate regulatory planning and environmental approvals. Due to the presence of the existing Mangoola Coal Mine, a number of these required approvals are already held, however they will require modification to include the MCCO Project.

Due to the MCCO Project being SSD, the assessment and approval process for a number of these approvals is aligned with the development application assessment process under Part 4 of the EP&A Act. Section 4.42 of the EP&A Act requires that a number of approvals, if required for a SSD, cannot be refused if a development consent is granted and must be substantially consistent with the terms of any development consent granted for the development. Insofar as these approvals apply to the MCCO Project, they are discussed in **Section 4.3.3.1** below. Section 4.41 of the EP&A Act removes the requirement for a number of approvals for approved SSD projects; these approvals are discussed further in **Section 4.3.3.2**.

A summary of other relevant environmental and planning legislation that applies to the MCCO Project that are not subject to Sections 4.41 and 4.42 of the EP&A Act are discussed in **Section 6.0**.

4.3.3.1 Approvals Legislation to be Applied Consistently

If development consent for the MCCO Project is granted under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act, the following approvals (refer to **Table 4.5**), which are required for the MCCO Project, as provided for by s4.42 of the EP&A Act they cannot be refused by the relevant authority and must be substantially consistent with the development consent.

Table 4.5 Approvals Legislation to be Applied Consistently with Development Consent

Act	Approval	Authority
Mining Act 1992	New mining leases are required as part of the MCCO Project as shown on **Figure 2.3**. A Mining Operations Plan will also be required to be approved under this Act.	Department of Planning and Environment – Division of Resources and Geoscience
Protection of the Environment Operations Act 1997 **(POEO Act)**	Regulates pollution to the environment. Coal mining and coal works are scheduled activities which require licensing. Mangoola's existing EPL 12894 will require a variation to cover changes associated with the MCCO Project.	NSW Environment Protection Authority
Roads Act 1993 **section 138**	A consent is required under section 138 to work on or above a road or to connect a road to a classified road. Consents under section 138 will be required for: • the road works associated with the realignment of the Wybong Post Office Road • any construction activities on or over public roads or in road reserves (e.g. Wybong Road overpass) • approvals to close road reserves.	The relevant roads authorities (Council or Department of Lands) for Council or Crown Roads or road reserves

The various matters regulated by each of the above approvals are assessed in **Section 6.0**.

4.3.3.2 Approvals Legislation Which Does Not Apply

Under section 4.41 of the EP&A Act, if development consent is granted for the MCCO Project under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act, the following authorisations (refer to **Table 4.6**), which may otherwise have been relevant, will not be required to carry out the MCCO Project.

Table 4.6 Authorisations Which Do Not Apply

Act	Approval
Fisheries Management Act 1994	A permit under section 201 (dredging or reclamation work), section 205 (harming marine vegetation) or section 219 (blocking of fish passage).
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 *Heritage Act 1977*.
National Parks and Wildlife Act 1974	An Aboriginal heritage impact permit under section 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 (refer to **Section 4.3.3.3**).

4.3.3.3 Other Relevant State Legislation

A summary of other State environmental and planning legislation potentially relevant to the MCCO Project subject to a development application under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act and not previously addressed in the above sections is provided in **Table 4.7**.

Table 4.7 Other State Legislation of Potential Relevance to the MCCO Project

Planning Provision	Comments	Further Approval Required?
Crown Lands Management Act 2016	The *Crown Lands Management Act 2016* (CLM Act) provides for the administration and management of Crown land in NSW. Crown land may not be occupied, used, sold, leased, licensed, dedicated, reserved or otherwise dealt with unless authorised by the CLM Act. The Minister may grant a 'relevant interest' such as a lease, licence or permit, over Crown land for the purpose of any infrastructure, activity or other purpose that the Minister thinks fit. As part of meeting these requirements, additional steps may need to be taken by the proponent if the land is determined to have environmental, social or cultural value (including Aboriginal heritage value). Approvals will be required to undertake works in the land located within the Project Area that is currently declared as Crown road reserves unless they are closed or converted to freehold and sold	Yes

Planning Provision	Comments	Further Approval Required?
	prior to impact. Any dealings with the Crown land will also need to address Native Title requirements and any pending Aboriginal land claims over the subject land.	
Dams Safety Act 2015	The *Dams Safety Act 2015* requires that Dam Safety NSW ensure that any risks that may arise in relation to dams (including any risks to public safety and to environmental and economic assets) are of a level that is acceptable to the community. Dams Safety NSW may, by order published in the Gazette, declare a dam or proposed dam to be a declared dam for the purposes of this Act. Any dams required to be constructed as part of the MCCO Project will be subject to assessment in accordance with the Dam Safety NSW requirements to determine if any of these dams will be declared dams. Subject to the detailed design process, approvals under this Act may be required for water storage dams.	Yes
Explosives Act 2003	A licence is required for the storage of explosives on site. This Act is administered by SafeWork NSW. The relevant licences are in place for the possession and storage of explosives on the Mangoola Coal Mine. There will be no change in the quantities of explosive materials being stored on site as a result of the MCCO Project, however, the storage locations may be revised as part of the MCCO Project and this would likely require amendments to the existing licences.	Yes
Environmentally Hazardous Chemicals Act 1985	Under the *Environmentally Hazardous Chemicals Act 1985* a licence is required for any storage, transport or use of prescribed chemicals. Should such a licence be required under this Act during the life of the MCCO Project, Mangoola or the relevant contractor will obtain a licence prior to the storage, transport or use of prescribed chemicals.	If required
Water Management Act 2000	All water extractions from water sources (surface and groundwater) regulated by a Water Sharing Plan (WSP) will require licensing under the *Water Management Act 2000* where they are in addition to extractions permitted under harvestable rights. Mangoola currently holds sufficient licences to account for water take associated with the MCCO Project.	Yes – Licences are required, however, no new licences required as the existing licences are adequate for the MCCO Project.

4.4 Strategic Context

4.4.1 Hunter Regional Plan 2036

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

1. the leading regional economy in Australia
2. a biodiversity-rich natural environment
3. thriving communities
4. greater housing choice and jobs.

The regional plan aims to strengthen the region's economic resilience, protect its well established economic and employment bases and build on its existing strengths to foster greater market and industry diversification. In particular, the intent of the Regional Plan 2036 is to transform the productivity of the Upper Hunter, plan for greater land use compatibility, protect and connect natural areas and sustain water quality and security. The MCCO Project aligns to the following 'directions' in the Regional Plan:

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

Directions 5 and 11 are relevant as they relate to the economic benefits of the MCCO Project through development of economic coal resources.

Direction 13 is related to how the MCCO Project aligns with the Upper Hunter SRLUP which is discussed in **Section 4.4.2**.

Direction 14 is addressed through the modifications made to the design of the MCCO Project to reduce impacts on biodiversity; the completion of a detailed biodiversity assessment following relevant NSW Government policy; the development of a biodiversity offset strategy including the proposed conservation of strategically located land with high biodiversity value; and incorporation of a commitment to high quality native vegetation rehabilitation as part of the MCCO Project.

Direction 15 is addressed through the range of management, mitigation and monitoring measures committed to for the MCCO Project as discussed throughout **Section 6.0** and as summarised in **Section 8.0**.

4.4.2 Upper Hunter Strategic Regional Land Use Plan 2012

The key strategic policy guiding the assessment of mining development in the Upper Hunter Valley region of NSW is the NSW Government's SRLUP. The Upper Hunter SRLUP was approved in September 2012 and applies to the MCCO Project Area. The stated objective of the Upper Hunter SRLUP is to balance the strong economic growth in Regional NSW with the protection of valuable agricultural land and the sustainable management of natural resources. In particular, the Upper Hunter SRLUP identifies the importance of minimising the land use conflicts arising from the rapid growth of coal mining activities and the, at the time, recent emergence of the coal seam gas industry.

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

The potential for the MCCO Project to impact on land identified as being BSAL or a CIC is assessed in detail in **Section 6.15** and **Section 6.16**. As discussed below no BSAL or CIC occurs in the MCCO Additional Project Area.

The assessment of the potential for BSAL within the MCCO Additional Project Area was undertaken following the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land (NSW Government 2013) and Agricultural Impact Statement Technical Notes (DPI 2013). The assessment concluded that no BSAL occurs within the MCCO Additional Project Area.

The gateway process under the Upper Hunter SRLUP has been prescribed through amendments to the Mining SEPP. A Site Verification Certificate was issued by DPE on 10 December 2018 confirming the absence of BSAL and is provided in **Appendix 3**. Therefore the MCCO Project is not subject to the gateway process.

The Upper Hunter SRLUP also requires all development applications for mining development that is SSD and which would potentially impact on agricultural resources and industries to be accompanied by an Agricultural Impact Statement (AIS). The SEARs for the MCCO Project also require the EIS to include an AIS which has been prepared and is presented in **Appendix 20**. A summary of the key findings of the AIS is provided in **Section 6.16**.

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

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

Each of the above issues have been considered in the assessment of the MCCO Project's potential environmental impacts (refer to **Section 6.0**) and proposed mitigation measures (refer to **Section 6.0** and **Section 8.0**).

4.4.3 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) (NOW 2012) 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 take water from a source covered by a WSP, a water access licence is required under the *Water Management Act 2000* to account for this loss of water. In addition, the AIP requires proponents of mining projects seeking consent 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. An assessment of surface water take has been prepared as part of the Surface Water Assessment by Hydro Engineering & Consulting (refer to **Section 6.7** and **Appendix 11**). Groundwater modelling for the MCCO Project was undertaken by Australasian Groundwater and Environmental Consultants as part of the Groundwater Impact Assessment (refer to **Section 6.8** and **Appendix 12**).

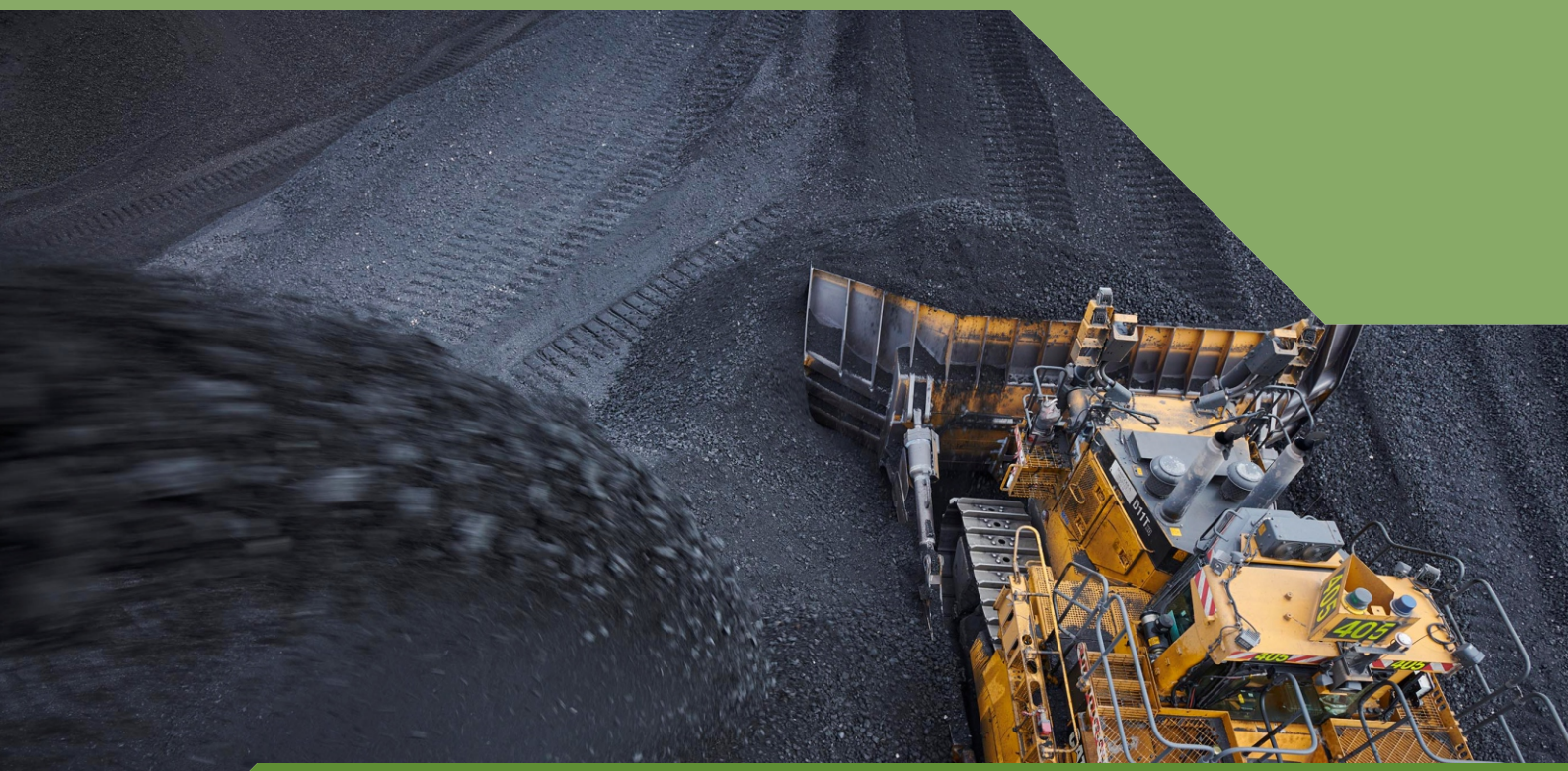
Mangoola currently holds licences under the *Water Management Act 2000* and the *Water Act 1912* (these will be transferred to Water Management Act licences) to account for water take from the porous rock aquifers and alluvium aquifer associated with Wybong Creek, as well as take from the Hunter River. The Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources applies to the MCCO Project Area.

The AIP requires that potential impacts of the MCCO Project 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. Where the predicted impacts are greater than the Level 1 minimal impact considerations then the AIP requires additional studies to fully assess these predicted impacts. A detailed Groundwater Impact Assessment has been undertaken for the MCCO Project which addresses the requirements of the AIP (refer to **Section 6.8** and **Appendix 12**).

In addition, potential impacts on landholder rights and existing registered bores, and GDEs are assessed in **Section 6.8.2.3** and **Section 6.10**.

SECTION 5.0

Stakeholder Engagement and
Identification of Community Issues



5.0 Stakeholder Engagement and Identification of Community Issues

5.1 Historic Engagement Overview

Mining operations at Mangoola Coal Mine were approved in 2007 and commenced in September 2010. As part of the original approval process and throughout the operational period of the mine since that time the community have been actively engaged and their input, key concerns and issues have been considered and addressed through operational changes over the life of the mine, implementation of targeted mitigation strategies and during the planning and design stages of the MCCO Project. This included consideration of the outcomes of past social impact assessment processes (including the assessment for the original mine approval process and MOD 6) which provided valuable information regarding community concerns and desires to be considered in MCCO Project planning.

The key community issues that have been raised historically include concerns regarding noise impacts, air quality, blasting, biodiversity and rehabilitation, visual amenity, traffic and transport including the use of trains used to transport coal from the site.

Over the past nine years of operations and five years of planning for the MCCO Project, Mangoola has worked to put in place a range of strategies, management and mitigation measures to address each of these key issues. These considerations are fundamental to the overall design of the mine with mine planning considering noise, dust, visual, biodiversity, water and other impacts as key design parameters to seek to minimise the impact of the mine on the environment and community.

Ongoing implementation of mitigation measures to minimise impacts is also a key component of the existing operations. These measures work in partnership with the mine planning process to minimise impacts. An overview of the key mitigation measures implemented to date is provided below with further details provided in each relevant technical summary presented in **Section 6.0**:

- Noise – a commitment to continued focus on operational improvements to minimise noise impacts including but not limited to the use of sound attenuated equipment and using noise forecasts for daily operational planning. Noise management is considered in all stages of mine planning and implementation (e.g. equipment operating locations and numbers etc.). Changes were also made to on-site equipment (e.g. low noise rollers on CHPP conveyors) to reduce noise generation. Property specific mitigation measures have also been implemented at a number of surrounding residences

- Air quality – implementation of a range of proactive and reactive dust control strategies informed by real-time dust and meteorological monitoring systems. As for noise, dust management is considered in the day to day planning of mining operations. Mangoola has also implemented a drinking water tank inspection and cleaning program for surrounding residences and a range of other property specific mitigation measures

- Blasting – design of blasts and management of charge masses to limit blast overpressure levels and meet the relevant amenity criteria

- Biodiversity and rehabilitation – development and implementation of a biodiversity offsets package for the approved operations, industry leading approach to final landform design and rehabilitation using native woodland species and development and implementation of a successful threatened orchids translocation program

- Visual amenity – implementation of progressive rehabilitation to assist in shielding views to the approved mining areas and designing the MCCO Project to avoid direct views to the new proposed areas of operations from private residences
- Traffic – public road access to be maintained during the construction phase. Continued commitment to all existing restrictions on using local roads for site access, no increases to operational personnel or traffic above levels previously assessed and approved and only minimal increases during the construction period
- Trains – installation of noise barriers near the rail loop and design of the MCCO Project to keep maximum production levels to within those already approved meaning no additional trains.

Further details of the existing engagement program in place at Mangoola Coal Mine are provided in **Section 5.4.1**. **Figure 5.1** provides a summary of the key engagement undertaken from 2010 to date with **Section 5.2** to **5.4** outlining the specific consultation completed as part of the MCCO Project.

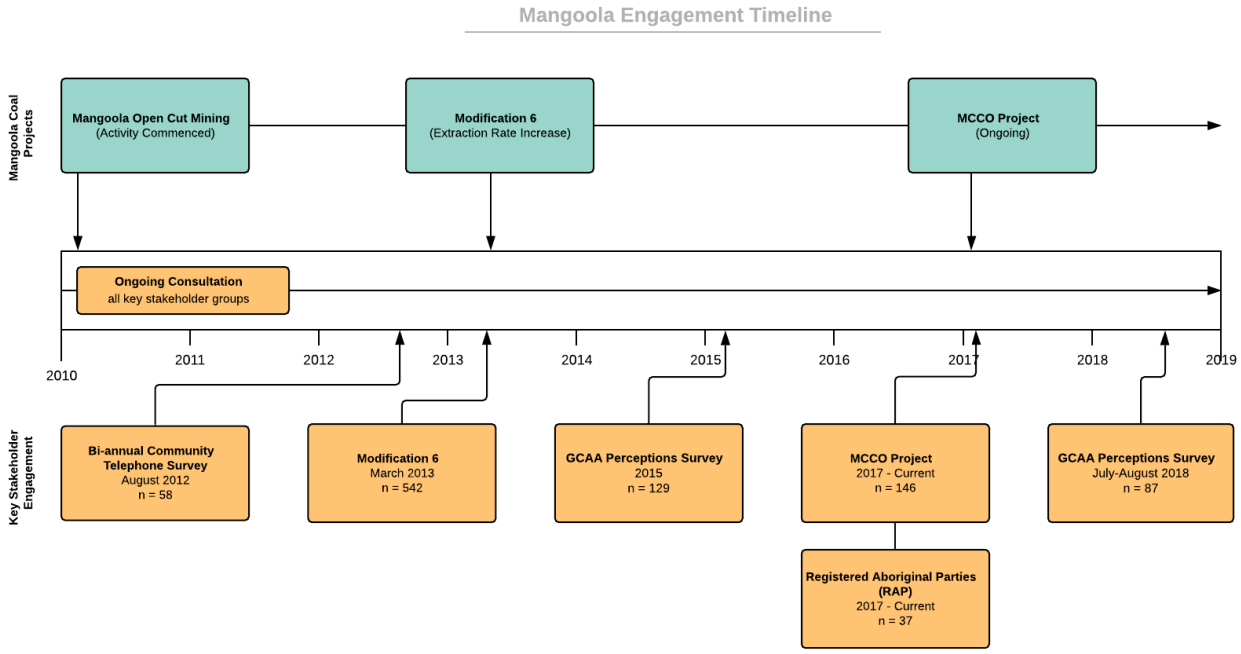


Figure 5.1 Key Engagement Undertaken Between 2010 and 2019

5.2 MCCO Project Engagement Program

As discussed above, engagement has been an integral component of the MCCO Project and a comprehensive stakeholder engagement program has been implemented as part of the MCCO Project.

Given that Mangoola Coal Mine is an established operation, and relationships with the community have been developed over time, the engagement approach adopted for the current assessment, builds on existing relationships and activities. The aims of the engagement program for the MCCO Project were to:

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

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

The engagement program commenced early during the planning phases of the MCCO Project and has continued in an iterative manner throughout the project design and assessment phases as outlined in **Table 5.1**. The outcomes of the program have provided Mangoola with valuable input from key stakeholders and local residents with regard to the impacts of current operations, as well as identifying any perceived impacts associated with the MCCO Project.

Further details of the engagement methods undertaken and stakeholders consulted across the assessment phases are outlined in the following sections, with a summary of the issues raised by stakeholders included in **Section 6.3** and **Appendix 5**.

In summary, the engagement program has involved two community information sessions, three project focussed newsletters and individual meetings with 44 proximal landholders (including 25 landholders in Round 1 as part of the PEA scoping in 2017, all of whom were engaged again in Round 2 (October 2018-February 2019) plus an additional 19. A number of other external meetings and briefings were also completed during the 18-month program of stakeholder engagement separately to the consultation undertaken as part of the SIA. This included consultation with local landholders, relevant government agencies, MSC, Indigenous stakeholders, relevant infrastructure and service providers and Non-Government Organisations, such as the Muswellbrook Chamber of Commerce and Industry.

The outputs of the engagement program have been used to inform different aspects of the MCCO Project's assessment process, including the SIA. The SIA is included as **Appendix 5** and is discussed further in **Section 6.3**.

Table 5.1 Phases of Engagement Program for the MCCO Project

Phase	Purpose	Objectives	Description
Phase one (May to July 2017)	Profiling and issue scoping	• To introduce the MCCO Project • To identify key perceived issues/impacts in relation to the MCCO Project • To obtain an understanding of local community values, needs and aspirations.	Data used to inform the SIA and EIS programs and was used to complete the PEA for submission to DPE.
Phase two (Nov to Feb 2018)	Impact assessment, prediction and mitigation/ enhancement	• To provide the available outcomes of the environmental and social studies undertaken • To identity strategies to manage negative impacts or enhance positive impacts associated with the MCCO Project.	Data used to identify appropriate strategies to address identified impacts.
Phase one and two	Key stakeholder engagement (targeted engagement with key stakeholders e.g. State and local Government representatives, community groups, Indigenous groups)	• To provide regular updates on the MCCO Project.	Data used to inform project and assessment planning in line with stakeholder expectations.
Phase three (mid to late 2019)	Public exhibition phase	• To identify any additional issues in relation to the MCCO Project during the public exhibition phase.	To respond to issues raised during the public exhibition phase.

5.3 Key Stakeholders

A comprehensive stakeholder identification process was undertaken prior to commencement of the MCCO Project. As Burdge (2004) outlines, stakeholders may be affected groups or individuals that:

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

Key stakeholders identified to be engaged on the MCCO Project are outlined in **Figure 5.2**.

Figure 5.2 Stakeholder Groups Consulted

5.4 Engagement Approach

The broader engagement program for the MCCO Project has involved a number of elements and builds upon the implementation of the existing Mangoola stakeholder engagement strategies, namely the Stakeholder Engagement Plan and Community Consultation Strategy AL9, that are currently in place at an operational level. Since the commencement of mining at Mangoola Coal Mine, Mangoola has been committed to developing strong and sustainable relationships with local and regional stakeholders; with this ethos to continue as part of the MCCO Project.

The engagement program commenced during the planning phases of the MCCO Project and has continued in an iterative manner throughout the MCCO Project design and assessment phases. The following sections provide further details on the types of engagement mechanisms/methods undertaken so that stakeholder views have been adequately identified and addressed.

5.4.1 Existing Mangoola Engagement

Mangoola's ongoing operational community engagement program involves a range of information provision and engagement mechanisms that includes personal meetings and telephone liaison; CCC meetings; newsletters; key stakeholder meetings and briefings including with community groups, local and State government; community complaints line; and company website.

The objectives of the broader stakeholder engagement strategy for Mangoola are to build and maintain effective relationships with stakeholders, engage with proximal landholders and communities, invest in local communities, meet the requirements of the Glencore Stakeholder Engagement Protocol and assist to maintain Mangoola's social licence to operate.

Mangoola has established relationships with the local community and key stakeholders and has implemented a program for ongoing engagement as part of its existing mining operations. As shown in **Table 5.2**, the program has included regular consultation with both individuals and groups from the local community, via a range of mechanisms including:

- personal meetings with individuals and/or groups (as required/requested), including meetings in response to specific complaints
- regular meetings with the established CCC with monthly MCCO Project updates provided to all members (commencing in July 2017). The CCC is comprised of community representatives, Council representatives and Mangoola personnel, with meetings periodically attended by State government agency representatives
- regular newsletters to update the community on the Mangoola Coal Mine
- key stakeholder meetings and briefings e.g. community groups, local and state government
- a community complaints line and maintenance of an ongoing complaints register to record all community complaints, investigations and outcomes
- ongoing email and telephone correspondence with stakeholders
- a company website.

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

Outputs of the previous consultation activities have therefore been used to inform planning and the development of the specific stakeholder and community engagement program for the MCCO Project. **Table 5.2** provides a concise summary of all engagement currently undertaken by Mangoola.

Table 5.2 Mangoola Operational Stakeholder Engagement Initiatives

Consultation Target	Engagement Method/Strategy	Description
Personal / Property Specific	Personal Meetings	Meetings with stakeholders at residence (or common meeting area), providing personalised opportunities for engagement and provision of detailed information specific to private landholders.
	Letter Box Drops	Information delivered by Mangoola so that specific information reaches the intended recipients.
	Contact Phone Numbers	All stakeholders provided with a direct line to project team for any queries or information requests.
	Newsletter	A biannual newsletter has been delivered to key stakeholders and available on the company website, outlining project planning updates community investment initiatives, rehabilitation measures and community events. As a result of community feedback, the newsletter will begin to be published quarterly to keep the community informed more frequently.

Consultation Target	Engagement Method/Strategy	Description
	Mangoola Website	Website material updated regularly providing information pertaining to Mangoola operations, including project planning updates, community investment, environmental monitoring results, newsletters and contact information.
	Consultation Database	Consultation Manager database used to capture issues and consultation interactions between Mangoola personnel and stakeholders.
Broader Community	Glencore Coal Assets Australia (GCAA) Perception Survey	Review and analysis of outcomes of a community perception survey undertaken by Umwelt on behalf of GCAA in July and August 2018, with the purpose of providing GCAA with a greater understanding of stakeholder issues and needs relating to company activities, past and present; and to assist in driving business improvement in the areas of environmental performance, stakeholder engagement and community development across neighbouring and regional communities associated with GCAA's operations in both NSW and Queensland.
	Community Consultative Committee	The CCC provides a means for open discussion between Mangoola representatives, the community, MSC and other stakeholders. The CCC meet on a quarterly basis to review ongoing mining operations, discuss community concerns and work together towards equally beneficial outcomes for the local community and the company. Special CCC meetings are called when required, including one extraordinary meeting specific to the commencement of the MCCO Project.
	Blasting Notification Register	Registered stakeholders are sent notifications of impending blasts. Stakeholders are required to call Mangoola directly to be added to the register.
	Community Response Line and Blasting Hotline 1800 014 339	24 Hour Community Hotline that provides information regarding upcoming blasting schedules and road closures.
	Site Tours	Mangoola encourage community members to participate in a site tour. Tours are offered and advertised in the community newsletter and are not subject to minimum numbers. A 4WD coach is used to take participants around the site, under the instruction of engagement team personnel.
Community Investment	Community Investment Initiatives	Mangoola supports a range of initiatives at a local community level. Such initiatives include: • Apprentice Day – Garden Makeover at Sandy Hollow Hall • Apprenticeship Program: preference given to local community • Back to Wybong: Mangoola encourage and organise site tours for visitors of this community event • Denman Hall restorations • Pest and Weed Management Programs • Sponsorship of Muswellbrook Chamber of Commerce and Industry Awards • Sponsorship of National Tree Day Denman

Consultation Target	Engagement Method/Strategy	Description
		• Support for Muswellbrook High School camp students who may not be able to attend camp due to financial hardship • Virtual Reality Filming (through Upper Hunter Mining Dialogue): participants can experience being in an active coal mine • Wybong Hall Insurance: annual payment • Wybong Hall lawn mowing.
	Oral History Project	As required by PA 06_0014, an oral history of Wybong and a heritage report was developed in 2008 to document the history of the Wybong community. This is available on the Mangoola website.(http://www.mangoolamine.com.au/en/publications/OtherPublications/Wybong-Oral-Heritage-Report-Final.pdf).
Specific Engagement on Environmental Management	Landholder Mitigation	Mitigation afforded to impacted landholders within a 4 km radius of operations, including: • Water tank filtering and cleaning (biannual) • First flush systems (checked quarterly) • Solar panel cleaning • Air conditioning installation, maintenance and running costs payment/reimbursement • Wall and floor insulation • Double glazed windows or shutters.
	Fencing	Mangoola and key stakeholders agree on fencing standards and costs are determined equally for each party.
	GIS	Identifies stakeholders spatially and affords monitoring of land ownership and mitigation management criteria.

5.4.1.1 Perception Survey

In addition to the above, GCAA undertakes a community perception survey, every three years, across the mining regions in which it operates, in NSW and Queensland. Telephone interviews/surveys and online surveys are undertaken with proximal landholders and key stakeholders; with random telephone surveys also undertaken within the localities in which Glencore is based to identify and track community attitudes and perceptions in relation to their operations. The most recent of these surveys was undertaken by Umwelt in July to August 2018, to build upon previous surveys implemented since 2010.

The survey affords the tracking of a number of key indicators relating to the company's social and environmental performance and provides evaluation of the approaches operations have adopted in relation to stakeholder engagement and consultation. A sample of 39 proximal landholders and opinion leaders (community groups, local business, Indigenous groups, State and local government representatives) were surveyed; with 48 local community members residing in the Muswellbrook LGA also sampled.

Although not conducted specifically as a part of the engagement program for the MCCO Project, the survey has identified community perceptions of Glencore operations in the wider Muswellbrook community (and the Hunter Valley more broadly) and has involved landholders and key stakeholders relevant to the Mangoola operations. A summary of outcomes of the survey relevant to the current assessment is provided at **Section 6.3** with further details provided in **Appendix 5**.

5.4.2 MCCO Project Engagement - Social Impact Assessment

As has been noted earlier in this section, engagement with key stakeholders has been undertaken to inform both the SIA and EIS programs for the MCCO Project (refer to **Section 6.3** and **Appendix 5**).

A participatory approach to SIA has been adopted for the MCCO Project. Given the established nature of the operation in the community, the engagement for the SIA has built upon, where relevant, Mangoola's existing engagement approach to identify the social impacts relating to the MCCO Project.

SIA is an approach to predicting and assessing the likely consequences of a proposed action in social terms and developing options and opportunities to improve social outcomes. Best practice SIA is participatory and involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense, to provide a complete picture of potential impacts, their context and meaning.

The generally agreed international principles relating to SIA (Vanclay, 2003) and DPE's Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DPE, 2017) (the SIA Guideline) identify social impacts as the matters affecting, directly or indirectly:

- people's way of life, that is: how they live, work, play and interact with one another on a day to day basis
- the community, that is: its cohesion, stability, character, services and facilities
- access to and use of infrastructure, services and facilities, whether provided by local, State, or Commonwealth governments, or by for-profit or not-for-profit organisations or volunteer groups
- their culture, that is: their shared beliefs, customs, values and language or dialect
- their health and wellbeing: health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity
- their surroundings, such as: the quality of the air and water people use, the availability and quality of the food they eat, the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources
- their personal and property rights, particularly whether people are economically affected or experience personal disadvantage which may include a violation of their civil liberties
- their political and decision-making system, such as the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose
- their fears and aspirations, that is: their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

As part of the SIA program for the MCCO Project, a diverse number of stakeholders have been identified and involved in the assessment program. These stakeholders have been identified through a review of:

- Mangoola's existing stakeholder databases
- local community service directories

- media review and analysis
- snowball sampling (i.e. contacts made from initial sources providing contact details of additional stakeholders to be consulted).

Table 5.3 summarises the engagement methods utilised during the SIA engagement program and target stakeholder groups. The key outcomes of the SIA are discussed in detail in **Section 6.3** and **Appendix 5**.

Table 5.3 SIA Community Engagement – Mechanism Summary

Engagement Mechanism	Targeted Stakeholder Group	Number of Meetings/ Participants	Description
Personal Meetings	Landholders residing in proximity to MCCO and CCC members from Wybong, Mangoola, Castle Rock, Manobalai and Muswellbrook Including residents within: • current PA 06_0014 acquisition and management zone • anticipated MCCO Project acquisition and management zone.	44 proximal landholders	Personal meetings with 25 proximal landholders during May and July 2017 to provide information on the MCCO Project and to identify community issues in relation to the MCCO Project. Personal meetings with all of the 25 proximal landholders from Round 1 plus an additional 19 (44 in total) during the period November 2018 through to February 2019 to communicate outcomes of the environmental and social studies, and discuss management strategies; with the aim of consolidating proposed management strategies through stakeholder feedback and endorsement.
	Indigenous groups (including community groups, businesses and service providers)	15	Interviews undertaken with 15 Indigenous stakeholders (representatives of local Indigenous groups and services providers in the Muswellbrook LGA) to further identify the impact of the MCCO Project, cumulative impacts of mining in the region and information on service provision within the area.
Community Information Session	The broader community within the Muswellbrook LGA, including the local communities of Wybong, Mangoola, Castle Rock and Manobalai	Community Information Sessions (x 2) – 48 attendees in total	Two community information sessions were held, one at the Upper Hunter Conservatorium of Music in Muswellbrook on 10 December 2018 and the second at Wybong Hall on 2 February 2019. The objective of the community information sessions were to present the outcomes of the environmental and social studies, discuss management strategies and provide a mechanism for community feedback. The sessions provided an opportunity for community members to ask questions of the MCCO Project team and specialists working on the environmental and social impact assessment studies. Stakeholders were encouraged to view both static and interactive displays including over 30 posters summarising assessment findings; individual demonstrations of comparative

Engagement Mechanism	Targeted Stakeholder Group	Number of Meetings/ Participants	Description
			examples of noise levels; and visual representations of drone footage depicting current and proposed landforms and rehabilitation. Invitations to the event were provided via project newsletters, verbal communication and advertisements published in the local media ('Muswellbrook Chronicle' and 'Hunter Valley News').
Newsletters	Landholders from: • Wybong • Mangoola • Castle Rock • Manobalai • Muswellbrook.	Letterbox drop of newsletters Distribution area included 197 stakeholders	Three MCCO focussed newsletters issued to the local community in: • July 2017 – providing an introduction to the MCCO Project • November 2018 – providing an update on the status of the MCCO Project and providing the outcomes of the environmental and social impact studies • December 2018 – providing responses to frequently asked questions raised during consultation. The newsletters have also been distributed to other stakeholders as relevant. There were also three regular Mangoola Coal Mine newsletters that included MCCO Project updates that were issued and posted on the MCCO Project website, in addition to the three newsletters outlined above.
Mangoola Website	All stakeholders - http://www.mangoolamine.com.au	n/a	Provision of information relating to the MCCO Project including information sheets, newsletters, posters used at community information sessions.

Engagement Mechanism	Targeted Stakeholder Group	Number of Meetings/ Participants	Description
Glencore Perception Survey	Landholders and opinion Leaders (including community, businesses, Indigenous stakeholders, local and State government, non-government organisations (NGOs)) Wider community in Muswellbrook LGA	39 landholders and key stakeholders relevant to the project 48 wider Muswellbrook LGA community residents (randomly sampled)	Monitoring survey of Glencore stakeholders and proximal landholders. Identified community perceptions of Glencore operations in the Muswellbrook community (including Mangoola Coal Mine) and the Hunter Valley more broadly.

5.4.3 Aboriginal Community Engagement

A comprehensive engagement process was undertaken with the Aboriginal community in regard to the MCCO Project in accordance with:

- the *National Parks and Wildlife Act 1974* (NPW Act)
- the *National Parks and Wildlife Regulation 2009* (NPW Regulation)
- reference to relevant OEH guidelines (including the Department of Environment and Conservation (DEC, now OEH) 2005 Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment
- Department of Environment, Climate Change and Water (DECCW, now OEH) Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010
- the principles of The Burra Charter (Australia ICOMOS 1999)
- 15 Indigenous stakeholders engaged as a part of the SIA program.

Throughout the course of the MCCO Project consultation was undertaken with 37 Aboriginal parties who registered an interest in the MCCO Project. Further discussion regarding the consultation process with the RAPs for the MCCO Project is included in **Section 6.12**.

As noted in **Table 5.3**, engagement with Indigenous groups and service providers in the Muswellbrook LGA were also undertaken as part of the SIA for the MCCO Project and outcomes are included in **Section 6.3** and **Appendix 5**.

5.4.4 Infrastructure/Service Provider Consultation

Service providers that have infrastructure located within the MCCO Project Area, or who may provide services for the MCCO Project, have been consulted by Mangoola during the project design and environmental assessment process. Consultation has been undertaken with these service providers so that relevant design or management issues could be identified and addressed proactively.

Key service providers consulted include TransGrid, Ausgrid and Telstra (telecommunications) as well as Australian Rail Track Corporation Ltd (ARTC) and the Hunter Coal Chain Coordinator with regard to the continued operation of the rail loadout facility and transport of coal to the Port of Newcastle. Further consultation will be required with these asset owners and managers as part of the detailed engineering design and implementation phases of the MCCO Project.

Mangoola personnel invited Ridgelands Coal Resources, the holders of EL 8064 to the north of Mangoola Coal Mine, to participate in the EIS process in relation to the MCCO Project in January 2019, and as part of this consultation discussed the proposed water diversion drain to be constructed that will slightly encroach over the southern boundary of EL 8064, and the locations of some of the proposed biodiversity offset areas that are within this EL.

MCCO Project updates or briefings were also provided to representatives from Idemitsu Australia Resources which is the holder of AL 19 west of Muswellbrook and Maxwell Ventures (Management) Pty Limited related to land owned by Malabar Coal near the Mangoola Coal Mine rail loop.

5.4.5 Agency/Authority Consultation

Throughout the MCCO Project, there has been ongoing consultation with both local and State government representatives that has included:

- government agency briefings outlining MCCO Project details, design and strategies to reduce impacts
- meetings with relevant agencies to discuss the assessment approach, assessment outcomes, approach to management, mitigation and offset measures and to address issues specific to the respective agency.

Further details regarding agency consultation are provided in the sections below.

5.4.5.1 Local Government – Muswellbrook Shire Council

Mangoola has met with a range of representatives from MSC including key relevant staff of the Council and the Mayor. Briefings have included coverage of the following topics:

- MCCO Project overview, key impact areas and mitigation strategies
- final landform, land use and mine closure
- ecology and biodiversity offsets
- social impacts and opportunities
- Voluntary Planning Agreement (VPA)
- roads and traffic with specific discussion on the proposed realignment of a portion of Wybong Post Office Road and construction of the haul road overpass over Wybong Road
- noise and air quality impacts.

A summary of these meetings is provided in **Table 5.4**.

Table 5.4 Consultation with Muswellbrook Shire Council

Date	Engagement Mechanism	Purpose
28 June 2017	Meeting	Meeting to provide Mangoola site update and introduce the MCCO Project.
21 February 2018	Meeting	MCCO Project briefing including details of the key project features as proposed. Included specific discussion of MSC road interaction with the MCCO Project including: • Wybong Post Office Road proposed re-alignment of relevant portion and concept design • travel time impacts • Wybong Road overpass and construction phase, concept design and controls • site, construction phase access points • EIS traffic study being completed • recent EIS traffic count data from Wybong Post Office Road.

Date	Engagement Mechanism	Purpose
15 May 2018	Email	Consultation regarding the geotechnical activities associated with the location of the future realigned section of Wybong PO Road.
23 May 2018	Meeting	Consultation with MSC representatives regarding the MCCO Project interactions with existing road infrastructure, including a site visit of the MCCO Additional Project Area.
15 November 2018	Letter	Letter to MSC informing them that the predicted noise and air quality impacts were now available and that Mangoola was commencing the next round of consultation with impacted landholders.
6 December 2018	Email	MCCO Project Community Information Session notification/invitation and provision of Community Information Sheet 2 – Impacts and Assessment Summary.
24 January 2019	Meeting	MCCO Project briefing including results of stakeholder engagement, environmental assessments, Wybong Post Office Road interactions and initial VPA discussion.
11 February 2019	Email	Offer of site visit for MSC representatives and to discuss VPA.
15 March 2019	Letter	Provision of preliminary design drawings of the MCCO Project infrastructure associated with the MSC roads and request for feedback.
10 April 2019	Meeting	Discussed proposed revision of the MSC Mine Affected Roads Strategy, general MCCO Project/MSC issues and initial VPA discussion.
18 June 2019	Letter	Offer of site visit and project update for MSC, Mayor and Councillors.
19 June 2019	Letter	Letter seeking to progress discussions regarding the continuation of the existing VPA.

5.4.5.2 State and Commonwealth Government Agencies

A summary of the key government agency consultation undertaken to date is included in **Table 5.5**. Further consultation with state government agencies has been undertaken through various mechanisms throughout the assessment process to keep agencies informed of MCCO Project progress and outcomes.

Table 5.5 Consultation with Agencies and Authorities

Consultation	Stakeholder	Consultation
State Government Agencies	DPE	Five meetings.
	NSW Office of Environment and Heritage (OEH)	Four meetings and a site visit.
	Environment Protection Authority	Email project update and offer of briefing.

Consultation	Stakeholder	Consultation
	Division of Resources and Geoscience within DPE	Three meetings including a site visit.
	Department of Primary Industries - DPI Water	Email project update and offer of briefing.
	Department of Primary Industries - NSW Forestry	Email project update and offer of briefing.
	Department of Primary Industries - Agriculture and Fisheries	Email project update and offer of briefing.
	Department of Primary Industries – Crown Lands division	Email project update and offer of briefing. Phone discussions with Newcastle and Maitland Office.
	NSW Roads and Maritime Services	Consultation regarding traffic assessment. Email project update and one meeting.
	NSW Rural Fire Services	Email project update and offer of briefing.
	NSW Health	Email project update and offer of briefing.
	ARTC and Hunter Valley Coal Chain Coordinator	Email project update and confirmation of rail requirements of the MCCO Project.
	NSW Dams Safety Committee	Email project update and offer of briefing.
Commonwealth Government Agencies	Department of the Environment and Energy	Two meetings.

5.5 Stakeholder Issues

5.5.1 Infrastructure / Service Provider Issues

As described in **Section 5.4.4** consultation has been undertaken with key infrastructure and service providers so that relevant design or management issues could be identified and addressed proactively. Key infrastructure and service providers consulted included TransGrid, Ausgrid, Telstra, ARTC and the Hunter Coal Chain Coordinator. The key issues raised during this consultation are summarised in **Table 5.6**.

Table 5.6 Infrastructure / Service Provider Key Issues

Stakeholder	Key Issues Raised
TransGrid	Assessment of potential for blasting to impact on TransGrid assets, noting that Mangoola has an existing agreement with TransGrid and the intent is to extend this agreement under similar terms, to the Additional Mining Area.

Stakeholder	Key Issues Raised
Ausgrid	No issues. Confirmed process for network asset relocation.
Telstra	No issues. Confirmed process for proposed realignment of Telstra telecommunications infrastructure.
ARTC	No issues. Confirmed MCCO Project does not affect rail network capacity and poses no change to existing rail access arrangements for Mangoola Coal Mine.
Hunter Coal Chain Coordinator	No issues.

5.5.2 Agency / Authority Issues

As described in **Section 5.4.5** consultation has been undertaken with local, State and Commonwealth Government agencies so that relevant environmental, social and economic issues could be identified and assessed as part of the EIS process. This consultation built on the input to the SEARs provided by these agencies. The key issues raised during this consultation are summarised in **Table 5.7**.

Table 5.7 Agencies and Authorities Key Issues

Consultation	Stakeholder	Key Issues Raised
Local Government	MSC	• Input provided to the SEARs • Wybong Post Office Road realignment and road maintenance • Wybong Road overpass • Construction phase activities and impacts • Assessment impacts such as noise, social and final landform considerations.
State Government Agencies	DPE	• Assessment requirements and approvals process for the MCCO Project • Social impacts • VLAMP • Final landform considerations.
	OEH	• Input provided to the SEARs • Biodiversity assessment requirements and approach • Assessment of biodiversity offsets including use of expert report for orchid species.
	Environment Protection Authority	• Input provided to the SEARs; no additional issues raised.

Consultation	Stakeholder	Key Issues Raised
	Division of Resources and Geoscience within DPE	• Input provided to the SEARs • Final landform considerations • Resource assessment.
	Department of Primary Industries - DPI Water	• Input provided to the SEARs; no additional issues raised.
	Department of Primary Industries - NSW Forestry	• Input provided to the SEARs; no additional issues raised.
	Department of Primary Industries - Agriculture and Fisheries	• Input provided to the SEARs; no additional issues raised.
	Department of Primary Industries – Crown Lands division	• Input provided to the SEARs; no additional issues raised.
	NSW Roads and Maritime Services	• Input provided to the SEARs; no additional issues raised.
	NSW Rural Fire Services	• Input provided to the SEARs; no additional issues raised.
	NSW Health	• No issues raised.
	NSW Dams Safety Committee	• No issues raised.
Commonwealth Government Agencies	Department of the Environment and Energy	• Input provided to the SEARs • Various biodiversity and water matters related to the assessment of the referral of the MCCO Project under the EPBC Act • Assessment of impacts on MNES including impacts on threatened orchids and assessment of impacts on GDEs.

5.5.3 Community Issues

As outlined in the sections above, as part of the SIA program for the MCCO Project, a diverse number of stakeholders have been identified and involved in the assessment program.

Two rounds of direct engagement with landholders were held as part of the SIA process. During these discussions, a number of perceived impacts, both positive and negative were identified relating to Mangoola's existing operations and the MCCO Project. Information was collected through the administration of structured interview guides which addressed a range of topics relating to: community values, project issues and opportunities, engagement approach and potential investment opportunities.

Community issues identified during consultation are summarised below with a more detailed analysis of the issues raised by key stakeholders and the local community provided in **Section 6.3** and within the SIA included as **Appendix 5**.

Round 1 occurred during the issue identification and scoping phase in July 2017 and included a total of 25 face to face and telephone interviews with landholders.

The key issues raised during Round 1 are summarised in **Figure 5.3** and illustrate that the most common operational concerns related to noise (76 per cent) followed closely by dust (72 per cent) and property value (20 per cent).

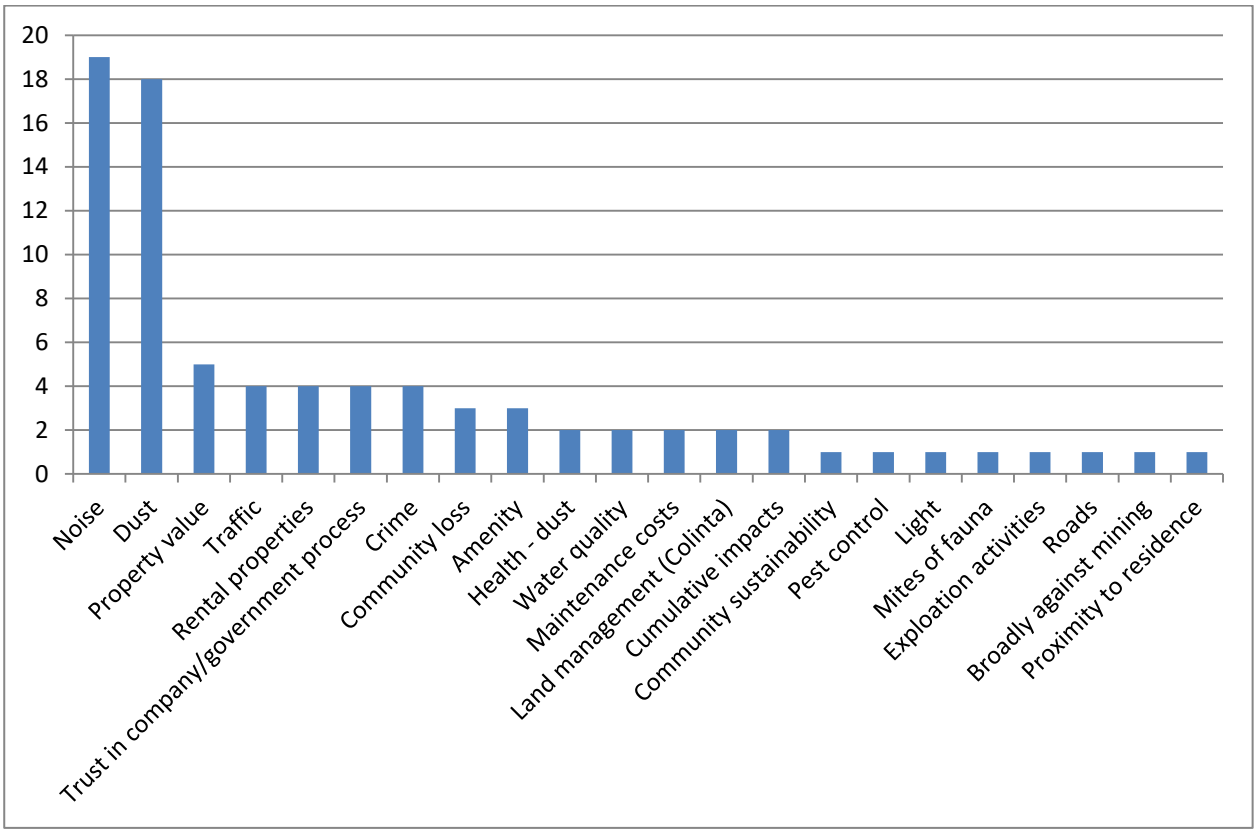


Figure 5.3 Round 1 Consultation Issues Raised

Source: Umwelt (2017))
Note: n=25, multiple responses allowed

Round 2 of engagement was undertaken between October 2018 and February 2019 and included a total of 22 face to face meetings and 22 phone interviews with proximal landholders (defined as landholders and residents residing in close proximity to the current mining operations (within 4 km) in the state suburbs of Mangoola, Castle Rock, Wybong and Manobalai), with representatives from the SIA team only present at these interviews. Round 2 included all of those stakeholders engaged during the first round and a further 19 additional landholders.

As described in **Section 5.4.2**, two community information sessions were also held during this period on 10 December 2018 and 2 February 2019 in Muswellbrook at the Upper Hunter Conservatorium of Music and at the Wybong Hall respectively, with 48 stakeholders attending both sessions.

The key issues raised during Round 2 are summarised in **Figure 5.4** below and generally correlate with the issues raised by stakeholders during Round 1. During Round 2 potential impacts relating to property were the most prominent social impacts identified followed by impacts relating to a loss of sense of community, followed by impacts on social amenity as a result of dust, noise and traffic (refer to **Figure 5.4**). This indicates an evolution of stakeholder concerns beyond the specific issues (e.g. dust and noise) and more to concerns about the implications of those issues on the community (e.g. impacts on property and sense of community).

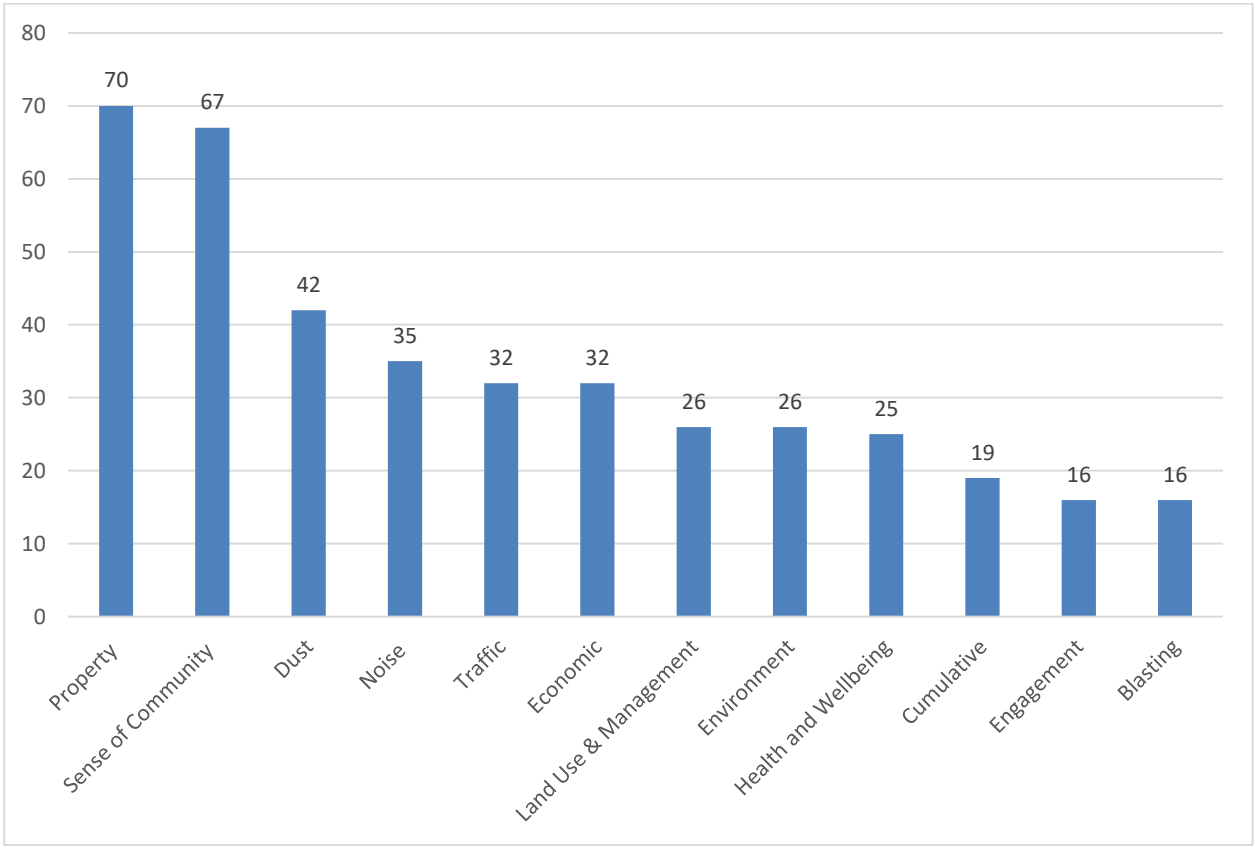
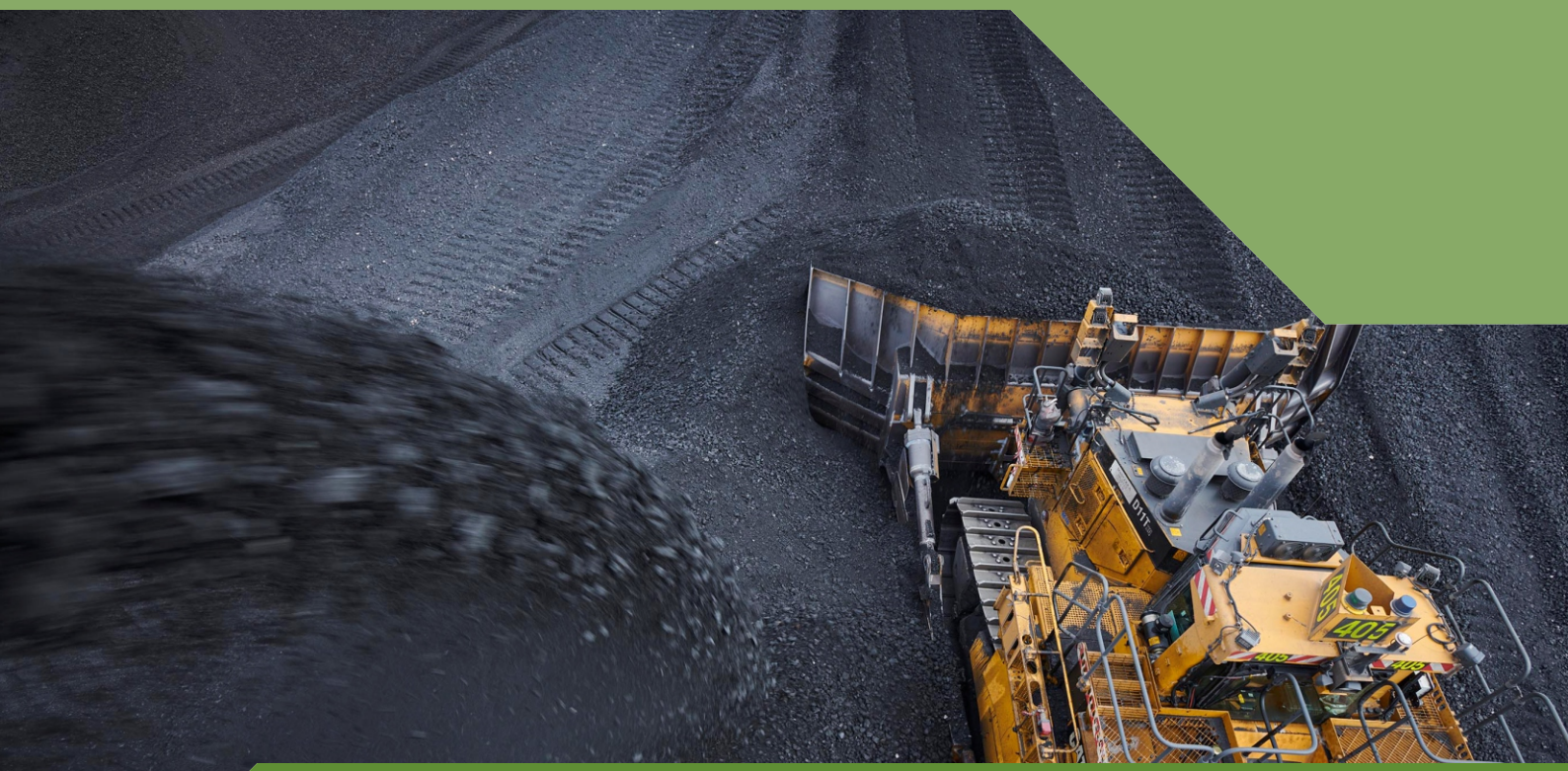


Figure 5.4 Round 2 Consultation Issues Raised
Source: Umwelt (2019)
Note: n=44, multiple responses allowed

A more detailed analysis of the issues raised by key stakeholders and the local community is provided in **Section 6.3** and within the SIA included as **Appendix 5**.

The detailed environment and social impacts assessment outlined in **Section 6.0** of this EIS and supported by the technical studies that have been completed and included as appendices have sought to address the issues identified during the consultation process.

SECTION 6.0
Environmental Assessment



6.0 Environmental Assessment

6.1 Identification of Key Environmental and Community Issues

The key environmental and community issues for the MCCO Project as requiring detailed assessment in this EIS were identified through consideration of:

- the environmental and planning context for the locality (refer to **Section 1.0** and **Section 4.0**)
- the risk analysis of potential environmental and social impacts associated with the MCCO Project (refer to **Section 6.1.1** and **Appendix 6**)
- the outcomes of the stakeholder engagement process and feedback received, including the issues raised by the community, government agencies and other stakeholders (refer to **Section 5.0** and **Section 6.3**)
- the SEARs for the MCCO Project (refer to **Section 4.3**)
- baseline environmental and social studies completed as part of preparation of this EIS (refer to **Section 6.2** to **Section 6.22**)
- preliminary environmental studies associated with the pre-feasibility phase of the MCCO Project.

The extensive stakeholder engagement and social impact assessment processes undertaken for the MCCO Project (refer to **Section 5.0, Section 6.3** and **Appendix 5**) identified the issues which stakeholders consider to be the key issues for the MCCO Project that require assessment as part of the EIS. The highest-ranking stakeholder issues (based on number of responses) and where they are assessed in this EIS are:

- property value impacts (refer to **Section 6.3**)
- social issues including stress and anxiety caused by the MCCO Project and loss of sense of community (refer to **Section 6.3**)
- air quality (dust) (refer to **Section 6.5**)
- noise (refer to **Section 6.4**)
- traffic (refer to **Section 6.13**)
- economic (refer to **Section 6.2**)
- land use and land management (**Section 6.15** and **Section 6.16**)
- blasting (refer to **Section 6.6**)
- visual amenity (refer to **Section 6.14**)
- water resources (refer to **Section 6.7** and **Section 6.8**)
- local employment (refer to **Section 6.3**).

Further details of the issues raised by stakeholders are outlined in **Section 5.0**, **Section 6.3** and **Appendix 5**.

6.1.1 Preliminary Environmental Risk Analysis

The PEA (Umwelt, 2017) completed for the MCCO Project in July 2017 included a preliminary environmental risk analysis to identify the key issues that required detailed assessment as part of this EIS. The method used for the environmental risk analysis included:

- establishing the context for the risk analysis process
- identifying environmental and community aspects and potential risks
- analysing risks
- evaluating risks to determine the key issues requiring further assessment.

The preliminary environmental risk analysis identified a number of issues that required further assessment as part of this EIS. The identified risks were rated as high, medium or low. As indicated in **Appendix 6**, the highest risks identified for the MCCO Project prior to the technical environmental and social studies being undertaken were:

- socio-economics – the MCCO Project has the potential to result in both positive and negative impacts (refer to **Section 6.3**)
- noise – specifically the potential for degradation of noise amenity (refer to **Section 6.4**)
- air quality – specifically the potential for degradation of local air quality and impacts on health and amenity (refer to **Section 6.5**)
- water resources – specifically the potential for impacts to quality, quantity or flooding regime and potential impacts on aquifers (refer to **Section 6.7** and **Section 6.8**)
- ecology – specifically the potential impacts to flora and fauna including potential impacts on threatened species, communities and populations (refer to **Section 6.9**)
- Aboriginal cultural heritage and archaeology – specifically the potential for disturbance of heritage values or Aboriginal places and objects (refer to **Section 6.12**)
- greenhouse gas – specifically the emissions of greenhouse gases from the MCCO Project contributing to climate change (refer to **Section 6.18**)
- rehabilitation and mine closure – specifically the potential impact on the landscape and future land use from the final landform design and rehabilitation strategy (refer to **Section 6.17**).

A detailed assessment of each of the environmental and community aspects identified in the preliminary environmental risk analysis as requiring further assessment for the MCCO Project is provided throughout the remainder of **Section 6.0**.

The preliminary environmental risk analysis has also now been revised following completion of the relevant technical assessments. The environmental risk analysis provided in **Appendix 6** identifies both the preliminary risk rating as assessed for the PEA and provides a revised risk rating that considers the EIS assessment findings and control measures proposed for the MCCO Project.

6.2 Economics

Since the commencement of operations at Mangoola Coal Mine in 2010 the existing operation has contributed over $8.2M to MSC under the current VPA and provided further funding and grants to various local community-based initiatives and groups of over $650,000. In addition, during the five year period between 2013-14 and 2017-18 Mangoola paid approximately $229M in royalties to the State of NSW.

In the past financial year (2017/18) Mangoola spent approximately $153M on employee salaries and supplier contracts, with an estimated total of $47M going to the Shires of Muswellbrook and the Upper Hunter, with $129M to the Hunter Region overall. Further to this in 2017/18 $77,000 was spent on local community contributions, and approximately $700,000 on VPA payments to MSC.

These economic benefits to the local region and State are commonly mentioned by stakeholders as the key benefits of projects such as the MCCO Project (refer **Section 6.3.4.1**).

The continuation of operations at Mangoola Coal Mine through the MCCO Project will allow for the ongoing employment opportunities for the workforce, continued business to local suppliers, continued contributions to MSC and payment of royalties to the State of NSW.

To understand the economic impacts of the MCCO Project a detailed Economic Impact Assessment (EIA) has been completed. The EIA looks at both the economic benefits and costs (including environmental and social costs) of the MCCO Project to identify if the economic benefits exceed the costs. As outlined in this section, the EIA has determined that the MCCO Project will result in a net benefit.

The EIA has been undertaken by Cadence Economics and uses the economic assessment framework set out in the Guidelines for the economic assessment of mining and coal seam gas proposals (the Economic Assessment Guidelines) released by the NSW Government in December 2015. The Economic Assessment Guidelines require that economic assessments outline the net present value of the project to the NSW community and provide a Local Effects Analysis (LEA) using the Cost Benefit Analysis (CBA) framework set out in the Economic Assessment Guidelines. In addition to the CBA and LEA, the EIA also provided an assessment of the economic impacts of the MCCO Project on the region based on computable general equilibrium (CGE) modelling.

The EIA was subject to an independent peer review by Emeritus Professor Jeff Bennett and is included as an Appendix to the EIA report (refer to **Appendix 7**). This process was voluntarily undertaken by Mangoola to ensure that the assessment was prepared in accordance with appropriate policies and guidelines, used appropriate methodologies, and provided sound findings of the likely economic impacts associated with the MCCO Project. The peer review was undertaken in a staged manner so that peer reviewer input could be obtained at each key phase of the assessment. The peer review found that the completed EIA was of a high quality and was prepared in accordance with relevant professional standards.

The key findings of the economic assessment are discussed in the following sections and the full report is provided in **Appendix 7**.

6.2.1 Cost Benefit Analysis

A CBA is a method of obtaining a consolidated estimate of the net economic value of a project by identifying the incremental costs and benefits of the project relative to the base case (i.e. no project), placing a quantitative value on these items wherever possible and deriving the share of each item that is attributable to NSW.

The CBA used the NSW Government CBA framework to measure the net benefits (both direct and indirect) to the NSW community. The direct benefits are those that accrue to the proponent and payments made to government. The indirect benefits are those that accrue to other parties that engage with the project proponent and include employees and suppliers. The indirect costs are the costs borne by the community of NSW through environmental and social impacts or public infrastructure costs.

To evaluate the net benefits of the MCCO Project, the economic analysis considers the baseline operations or business as usual case for the currently approved Mangoola Coal Mine in the absence of the MCCO Project. The potential costs and benefits produced by the baseline operations are excluded from the analysis for the MCCO Project.

The baseline ROM coal output of 25.4 Mt is the estimated remaining coal that is currently approved to be mined under the existing project approval and during the assessment period relating to this EIA. Should the MCCO Project not be approved this coal would likely be exhausted by 2025. Should the MCCO Project be approved this coal would likely be exhausted in 2026, as some mining equipment would instead start mining in the MCCO Additional Project area and slow the completion of coal extraction in the existing mining area.

In recognition of the broad range of economic impacts of the MCCO Project, the analysis of costs and benefits have been separated into eight categories according to the part of the community that they accrue to. For instance, Mangoola 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 MCCO Project include workers, suppliers, residents in the local community and Muswellbrook Shire Council. This categorisation assists in apportioning the share of the net benefits of the MCCO Project to the NSW community.

The costs and benefits considered in the analysis are provided in **Table 6.1**.

Table 6.1 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	Any payments to existing landholders	• Opportunity cost of land.
Economic benefit to workers	Wages paid to workers	• Reservation wage for workers in the mining sector.
Economic benefit to suppliers	Revenue paid to suppliers	• Opportunity cost of supplier goods and services.
Net environmental, social and transport-related costs		• Greenhouse gas emissions • Air quality • Traffic and transport • Residual value of land • Noise • Biodiversity • Aboriginal heritage • Non-Aboriginal heritage • Water • Visual amenity • Other social impacts.
Net public infrastructure costs		• Incremental costs for government associated with provision of public infrastructure, net of payments made by the Proponent.

Where it is difficult to place a value on a particular cost or benefit of the MCCO Project, as per the Economic Assessment Guidelines, a qualitative analysis has been undertaken. In some cases these items have been considered qualitatively because there is expected to be no significant difference in outcomes under the baseline and MCCO Project case (such as water resources where all required water allocations

are already held) or because there is no reliable method available to value them in these particular circumstances (such as visual amenity and heritage impacts). The EIA includes a detailed discussion of the various valuation methods considered, and ultimately used, in the CBA (refer to **Appendix 7**).

As discussed above, the CBA is based on calculating the benefits and subtracting the costs of the MCCO Project compared against the baseline scenario where the MCCO Project does not occur. The results are summarised in **Table 6.2**.

The overall finding of the CBA is that the MCCO Project is estimated to provide a net benefit to NSW. This net benefit is estimated to be $408.6M in NPV terms (that is, how much a future sum of money is worth today). This is comprised of $173M and $236.6M in direct and indirect benefits respectively. The incremental indirect costs of the MCCO Project are estimated to be $1.03M.

Table 6.2 Net Benefit Analysis of the MCCO Project ($ million^)

Benefits	NPV*	Costs	NPV*
Direct Benefits		**Direct costs**	
1. Net producer surplus attributed to NSW	0.0		
2. Royalties, payroll tax and Council rates	129.5		
3. Company income tax apportioned to NSW	43.5		
Total direct benefits	**173.0**	**Total direct costs**	-
Indirect Benefits	**0**	**Indirect costs**	
1. Net economic benefit to landholders	0.0	1. Air quality^^^	-
2. Net economic benefit to NSW workers	107.6	2. Greenhouse gas emissions	0.031
3. Net economic benefit to NSW suppliers	129.0	3. Visual amenity^^^	-
		4. Transport impact	0.067
		5. Net public infrastructure cost	2.46
		6. Surface water impact^^	-
		8. Residual value of land	-
		7. Biodiversity impact	1.69
		8. Noise impact^^	-
		9. Loss of surplus to other industries	0.93
		10. Groundwater	-
		11. Aboriginal cultural and Historical heritage^^^	-
		12. Social Costs^^^	-
Total indirect benefits	**236.6**	**Indirect Costs**	**5.18**
Total Project economic benefit	**409.6**	**Incremental Indirect Cost**	**1.03**
NPV of project - ($m)	**408.6**		

^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate. ^^ Included in the operating costs, excluded on the basis that they are confidential. ^^^ Costs are included in the operating costs of the Project and not individually identifiable

The MCCO Project is predicted to generate:

- total corporate taxes of $135.9M in NPV terms for Australia, of which $43.5M is attributed to NSW
- $129.5M in other government revenue for NSW in NPV terms, the largest component of this being royalties of $121M.

The indirect benefits of the MCCO Project are related to the linkages that it will have to the NSW economy through both the labour market and suppliers. The analysis shows that of the $236.6M in estimated indirect benefits:

- worker benefits are predicted to amount to $107.6M in NPV terms over the period 2023 to 2030 of the MCCO Project
- supplier benefits are predicted to amount to $129M in NPV terms based on total NSW-based supplier inputs over the life of the MCCO Project of $639M.

The MCCO Project is expected to result in minor incremental indirect costs, of $1.03M, on the NSW community through greenhouse gas emissions, loss of agriculture output from the land required for the MCCO Project and travel time costs for the users of Wybong Post Office Road. A range of other environmental and social costs are included in the operating costs for the MCCO Project.

6.2.1.1 CBA Sensitivity analysis

An important part of the CBA process is to undertake a sensitivity analysis. This process tests how sensitive the outcomes are to different economic circumstances that could occur in the future.

The sensitivity analysis for the MCCO Project considered all key areas of the CBA, particularly coal prices, key costs (both capital expenditure and operating costs) as well as worker benefits.

This analysis showed that the estimated net benefits are robust in the sense that they remain strongly positive after testing all key assumptions underpinning the analysis. The estimated net benefit of the MCCO Project is most sensitive to the coal price assumptions, however, even assuming coal prices are 15 per cent lower than under the central case assumptions the net benefits are estimated at $369.6M in NPV terms.

The lower bound estimate of net benefits, which takes the most pessimistic assumptions around coal prices, capital expenditure, operational expenditure as well as worker and supplier benefits, yields an estimated net benefit of $350.6M in NPV terms.

The upper bound estimate of net benefits, based on the most optimistic assumptions, is $448.4M in NPV terms. In isolation, assuming higher coal prices of 15 per cent, to those in the central case, the net benefits of the MCCO Project is $451.3M in NPV terms.

The robustness of the results to the sensitivity analysis is a reflection of the relatively low operating costs, the relatively low capital costs required to extract the resource given the use of existing infrastructure and the relatively low level of indirect costs attributable to NSW.

6.2.2 Local Effects Analysis

The LEA assesses employment effects of the MCCO Project with reference to the Upper Hunter. The LEA identifies the economic 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 LEA accounts for the economic benefits to the Upper Hunter region only. It does not include any economic benefits that may accrue to the major regional centres that are located nearby, including Maitland and Newcastle or the broader Hunter region.

The LEA assesses effects on:

- local employment
- non-labour expenditure
- other local industries
- environment and social aspects.

It is expected the MCCO Project will generate indirect benefits to local suppliers and employees of $14.1M and $76.8M respectively and result in the net incremental increase of local council rates totalling $2.7M in NPV terms over the baseline case. Indirect costs associated with the MCCO Project are minor, including transport impact costs and the loss of agricultural output of $1.0M.

Based on these assumptions, the LEA has found that the MCCO Project is estimated to provide a net benefit on the Upper Hunter region of $92.6M in NPV terms.

6.2.3 Flow on Effects

An analysis of the economy-wide impacts or 'flow on effects' of the MCCO Project has been undertaken using a CGE model which measures 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 a new development. The aim of this analysis was to estimate the net benefit of the MCCO Project on economic activity and the living standards of those residing within the Upper Hunter (i.e. the same region used for the LEA analysis), and in NSW.

Cadence Economics considers CGE modelling to be the preferred technique to assess the impacts of large projects as they are based on a more detailed representation of the economy, including the complex interactions between different sectors of the economy.

CGE modelling assesses changes in aspects such as real Gross State Product (real GSP) which is an output measure of the NSW economy and real Gross State Income (real GSI) which is a welfare measure for NSW

residents. At a regional level the model projects change in real Gross Regional Product (real GRP) and real Gross Regional Income (real GRI). The model also projects state-wide and regional employment, export volumes, investment and private consumption.

The analysis found that the MCCO Project is projected to provide significant positive economy-wide impacts to both the Upper Hunter and NSW. **Table 6.3** presents the net economic impacts of the MCCO Project are shown in **Table 6.3**.

In the Upper Hunter region, the MCCO Project is projected to increase GRP by $599.1M in NPV terms. GRI, or regional welfare, is projected to increase by $427.8M in NPV terms, which is considered significant to the relatively small Upper Hunter region. In total, the MCCO Project is projected to increase welfare (which is measured by Gross Regional Income) for each person in the Upper Hunter by $13,102 in NPV terms.

For NSW, the projected increase in GSP is $686.4M in NPV terms, while GSI is projected to increase by $744.9M.

Table 6.3 Economy-wide Impacts of the MCCO Project, 2020 - 2030

Variable	Description	Upper Hunter	NSW Total
Real GRP/GSP^	NPV* - $m	599.1	686.4
Real GRI/GSI^	NPV* - $m	427.8	744.9
Employment	Average - FTE^^	69.7	75.2
Real Wages	Average – Per cent^^	1.31	0.007
Real GRI per person^	NPV* - Dollars	13,102	85

Source: Cadence Economics estimates based on information provided by Mangoola. ^ Real 2018 Australian dollars. * NPV in 2018 Australian dollars based on a 7 per cent real discount rate. ^^ Average over the period 2020 to 2030.

For the period assessed (2020 to 2030) total employment in the region is projected to increase by almost 70 Full Time Equivalent (FTE) workers on average, lower than the average direct employment, taking into account any of the crowding out in other sectors of the economy. Across NSW, employment is projected to increase by just over 75 FTE.

6.2.4 Net Benefit for the Local, Regional and NSW Community

The EIA concluded that overall, the MCCO Project is expected to generate net benefits, and is also expected to generate increased economic activity and employment within the NSW community. The MCCO Project will have a positive economic impact at a local, regional and State level. These benefits include:

- provide a net benefit in the Upper Hunter region of $92.6M in NPV terms
- provide a net benefit $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project
- increase the Hunter Region's GRP by a projected approximately $599M in NPV terms, over the life of the MCCO Project
- increase the NSW GSP (including the Hunter region) by approximately $686M in NPV terms over the life of the MCCO Project.

6.3 Social

A comprehensive Social Impact Assessment (SIA) of the MCCO Project has been undertaken by Umwelt to identify, assess, manage potential negative impacts and enhance positive social impacts associated with the MCCO Project on local and neighbouring communities. SIA is an approach to predicting and assessing the likely consequences of a proposed action in social terms and developing options and opportunities to improve social outcomes. Best practice SIA is participatory and involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense, to provide a complete picture of potential impacts, their context and meaning.

The SIA has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), and the requirements of DPE's Social impact assessment guideline for State significant mining, petroleum production and extractive industry development (DPE, 2017) (the SIA Guideline). The SIA is also consistent with the Social Impact Assessment: Guidance for assessing and managing the Social Impacts of projects International Association for Impact Assessment (International Association for Impact Assessment, 2015).

As discussed in **Section 5.2**, engagement with the community has been a key component of the SIA program, at key phases of the assessment, to afford a participatory approach, and has involved proximal landholders and local and regional stakeholders in the scoping of project issues and identification of strategies to address (negative) and enhance (positive) project impacts. This engagement has been guided by a comprehensive stakeholder engagement program, involving consultation with a broad range of stakeholders for the MCCO Project EIS and SIA.

Given the established presence of the operation in the community, key community issues that have been raised historically include concerns regarding noise, air quality, blasting, biodiversity and rehabilitation, visual amenity, traffic and transport including the use of trains to transport coal from the site. The planning for the MCCO Project included consideration of these previously raised issues as part of the project planning and assessment process. This included consideration of the findings of previous SIAs for the Mangoola Coal Mine. The most recent of these past SIAs was for MOD 6 (Coakes Consulting, 2013) which identified noise and dust as the two most commonly raised issues with both of these issues key considerations in the design of the MCCO Project.

Over the past nine years of operations and five years of planning for the MCCO Project, Mangoola has put in place a range of strategies, management and mitigation measures to address these key issues. A summary of the key findings of the SIA is provided in this section and the full report is provided in **Appendix 5**.

6.3.1 Methodology

The SIA process has involved a number of key phases of work including:

- **Preparatory Planning:** undertaking appropriate planning for the MCCO Project, based on outputs of previous Mangoola Coal Mine EIS/SIA studies and the development of a Stakeholder Engagement Strategy to guide project engagement
- **Profiling:** to define the baseline social context in which the MCCO Project is based
- **Scoping:** to identify key social impacts/issues relevant to the MCCO Project
- **Assessment and Prediction of Impacts:** to evaluate and predict the positive and negative social impacts based on key impact characteristics (extent, duration, vulnerability/sensitivity, severity)

- **Strategy Development:** to identify strategies to minimise negative impacts and enhance positive impacts associated with the MCCO Project

- **Monitoring and Evaluation:** development of a framework that outlines how social impacts should be monitored and evaluated should the MCCO Project proceed.

As discussed in **Section 5.4** Mangoola has an existing stakeholder engagement program for the mining operations and has also implemented a specific engagement program for the MCCO Project. In addition to existing company led engagement activities, and the general MCCO Project consultation program, specific engagement to inform the SIA was also been undertaken with a wide range of stakeholders.

Approximately 146 stakeholders have participated in the SIA engagement program, in addition to engagement undertaken for the broader EIS, across two dedicated rounds of engagement to identify perceived project issues/impacts and to provide feedback on assessment outcomes and mitigation and enhancement strategies. This work builds on the engagement undertaken by the company since commencement of operations.

Commissioning of the SIA early in the project and regular meetings with the project team throughout the assessment program has also provided opportunities to effectively align assessment outcomes with the broader EIS process, and to inform pre-emptive project planning and mine plan design.

Table 6.4 provides a summary of the social impact assessment methods that have been utilised during each phase of the SIA program while **Table 6.5** outlines the various consultation methods that were used.

Table 6.4 Summary of Social Impact Assessment Methods

Method	Description
Phase 1	**Program Planning**
Development of Stakeholder Engagement Strategy	Development of a tailored stakeholder engagement strategy for the MCCO Project. This strategy was informed by previous consultation activities, including the engagement and analysis undertaken for previous SIA's completed for the Mangoola Coal Mine and the Preliminary Social Impact and Opportunities Assessment as part of the MCCO Project PEA (Umwelt, 2017).
Phase 2	**Community Profiling**
Community Capitals Analysis	Assessment and analysis of Australian Bureau of Statistics (ABS) Census data and other relevant social and community indicators and data sets to develop a detailed social baseline profile of the communities of interest. Areas of existing community resilience and vulnerability have been identified through application of a community capitals (assets) analysis.
Post Impact Studies Analysis	Review and analysis of secondary data (including local histories, local government strategic plans and assessment studies, local media, previous EIS/SIA studies, operational complaints) and primary data collected through stakeholder interviews, to understand historical, existing and emerging issues and opportunities within the community.
Township Resource Cluster Analysis	Documentation of the social and economic linkages/associations between the Mangoola Coal Mine and communities within the region through employee, supply/vendor and community investment data analysis.

Method	Description
Indigenous Profile and Issues Analysis	Review of socio-economic statistics relevant to the Aboriginal population. Personal and telephone interviews with RAPs, Indigenous groups and service providers in the Muswellbrook LGA.
Phase 3	**Scoping of Issues and Opportunities**
Key Stakeholder Issues Analysis	First round of personal and telephone interviews with proximal landholders of the MCCO Project to identify perceived issues and opportunities relating to the Project. Ranking of perceived issues and opportunities by relative frequency. Review of community survey data undertaken in the communities relevant to the MCCO Project (GCAA Community Perception Survey, 2018).
Review And Analysis of Existing Company Consultation Mechanisms	Review and analysis of company engagement data including meetings, phone calls, newsletter and community complaints.
Phase 4	**Assessment of Impacts and Opportunities**
Key Stakeholder Issues Analysis - Impacts and Opportunities	Second round of personal and telephone interviews with proximal landholders of the MCCO Project to further identify perceived issues and opportunities relating to the Project. Ranking of perceived issues and opportunities by relative frequency. Two advertised community information sessions held in Muswellbrook and Wybong to provide feedback on the outcomes of assessment studies and to facilitate input on the impact and opportunities relating to the MCCO Project.
Social Risk	Assessment of unmitigated and mitigated social impacts associated with the MCCO Project through review of relevant social and environmental consequence and likelihood ratings. Prediction of social impacts associated with the MCCO Project.
Phase 5	**Prediction of Impact and Strategy Development**
Social Risk Matrix	Categorisation of impacts by social impact category and theme.
Social Impact Management and Residual Risk Ranking	Identification and development of appropriate strategies to address predicted project impacts. Minimisation of extreme, high and medium social impacts through commitment to relevant management and enhancement strategies.

Table 6.5 Consultation Methods Used as Part of SIA

Method	Description
Proximal Landholder Meetings	Personal meetings with proximal landholders to identify perceived social impacts and to discuss outcomes of the environmental and social impact assessment studies (two dedicated rounds of engagement).
Telephone Interviews with Indigenous Services Providers	Telephone interviews with RAPs, Indigenous stakeholders and service providers to identify issues in relation to the MCCO Project and mining more generally within the community; and potential opportunities for impact management and enhancement.
Community Information Sessions	Two advertised community information sessions held in Muswellbrook and Wybong to provide feedback on the outcomes of assessment studies and to facilitate input on the impact and opportunities relating to the MCCO Project.
GCAA Community Perceptions Survey	Review and analysis of outcomes of a community perception survey undertaken by Umwelt on behalf of GCAA in July and August 2018, with the purpose of providing GCAA with a greater understanding of stakeholder issues and needs relating to company activities, past and present; and to assist in driving business improvement in the areas of environmental performance, stakeholder engagement and community development across neighbouring and regional communities associated with GCAA's operations in both NSW and Queensland. The 2018 survey builds upon previous surveys implemented for GCAA since 2010 across its NSW and Queensland operations, with the most recent previous survey being undertaken in 2015. For the purpose of the SIA, data from the perception survey involving landholders, local business, community groups, Indigenous groups, local and State government and NGOs, and residents residing in the broader Muswellbrook LGA, has been reviewed and incorporated where relevant. GCAA operations within the Muswellbrook LGA include the Mangoola Coal Mine and part of the Liddell Coal Mine.
Government Briefings and Consultation	Briefings and meetings with relevant government representatives (local, State and Commonwealth) to present the MCCO Project and obtain feedback on project aspects.
Community Consultative Committee Meetings	Project briefings to the Mangoola Coal Mine CCC to share information about the MCCO Project and obtain committee member feedback on the project.
Community Information Sheets	Development and distribution of a series of (three) project information sheets to near neighbours and key stakeholders at key Project stages: • Project and Process Overview – to describe the MCCO Project and the EIS/SIA process • EIS Project Summary – summary of the key outcomes of the environmental and social impact specialist studies undertaken as part of the assessment program and proposed management approaches • Frequently Asked Questions during Consultation – response to frequently asked questions raised during consultation. Each information sheet also provided MCCO Project and consultant contact details for further information and/or to request a personal project interview or briefing. There were also three MCCO Project updates provided as part of the regular Mangoola Coal Mine newsletters.

Method	Description
Email and Phone Correspondence	Phone calls and emails relating to the SIA process to landholders, as required, to organise meetings, provide information and/or respond to questions relating to the MCCO Project and EIS/SIA process.
Mangoola Coal Mine Website	Provision of information relating to the MCCO Project including information sheets, newsletters, posters used at community information sessions.

6.3.2 Operational Context - Existing Social and Economic Linkages

Major resource projects can make significant social and economic contributions to communities that extend far beyond the location in which a particular operation is based. For instance, the presence of an operation can provide economic contributions to communities through indirect impacts such as employees' household expenditure. Employees (and their families) may also contribute to communities through their participation in community groups and activities, or through their use of health and education services. Likewise, indirect benefits may be experienced in communities where suppliers' head offices are located or where suppliers' business expenditure is undertaken.

Current Mangoola workforce data has been sourced to develop a profile of the operation and its social and economic linkages with the communities within the region. The vast majority of the current workforce is employed full-time, is predominantly male, with a median age of 41 years. Approximately 2 per cent of the workforce identify as being of Aboriginal or Torres Strait Islander descent. Average service at the operations is approximately five years.

The total workforce has increased since the time of the MOD 6 SIA workforce survey work completed in 2012, from an estimated 296 (including contractors) to approximately 400, in line with workforce predictions associated with that modification. The majority of the Mangoola workforce travel to work from within the Muswellbrook LGA (51.1 per cent) followed by the Upper Hunter (22.2 per cent) largely from the townships of Muswellbrook, Denman, Scone and Singleton; with employees and their families using local services and participating in community groups within these communities.

Based on workforce income data, provided by Glencore, and aligned with expenditure scales developed from the ABS Household income and expenditure survey 2015-2016, Mangoola employees spent an estimated $32.2M annually, excluding spend on housing, utilities and telecommunications; with approximately $23.5M likely to be spent within the Muswellbrook and Upper Hunter LGAs. A further $7.5M is expected to be spent elsewhere in the Hunter region.

A total of approximately $102M was spent on suppliers during 2018 to support Mangoola's operations. Around 56.4 per cent of suppliers to the current operations are local, across the Muswellbrook LGA, including the State suburbs of Muswellbrook, Denman, Sandy Hollow and Wybong. A further 15.2 per cent are drawn from the Singleton LGA and 0.9 per cent from the Upper Hunter (Scone and Aberdeen); with others in the Lower Hunter - Maitland (11.5 per cent), Cessnock (2.6 per cent) and Newcastle (8.6 per cent). Approximately $9M was spent in the Muswellbrook and Upper Hunter LGAs alone. A further $70M was spent in the surrounding Hunter region.

Furthermore, in 2017/18 calendar years, Mangoola contributed $164,823 in social investments targeting various local community groups, events and services across the Upper Hunter across the areas of local business (including tourism and events), education, community service and infrastructure.

Given that the MCCO Project would prolong the life of the mine for a further five years if the MCCO Project is not approved these economic and social linkages would be lost. The economic benefits of the MCCO Project have been assessed and are further discussed in **Section 6.2**.

6.3.3 Social Profiling

The primary social area of influence for the MCCO Project has been defined as the localities and communities proximal to the existing Mangoola Coal Mine operations and the stakeholders that reside within these areas. The primary state suburbs of interest (or proximal communities) as defined by the ABS (2016) include Mangoola, Castle Rock, Manobalai and Wybong. The townships of Sandy Hollow, Denman and Muswellbrook are also considered as the townships in closest proximity to the MCCO Project, with data for the Muswellbrook LGA, the Upper Hunter region and the State of NSW also utilised for comparative purposes.

The social profile has utilised a community assets (or capitals) approach in defining the strengths and vulnerabilities of the community across five key areas – natural, social, human, physical and economic.

At a local level, community residents have articulated a desire to see their community, their rural and social amenity protected; and physical assets developed to allow better access to health, education and retail services. These communities have strong social assets and a strong sense of community, but also perceive that this is being impacted by the presence of mining and property acquisitions which are perceived to have reduced and fragmented the community.

At a regional level, issues relating to physical asset development appeared more salient e.g. addressing stress on existing infrastructure and services, addressing safety and capacity of transport/road networks, improving access to health care and aged care facilities, developing more education and training services/opportunities, addressing a diversity of housing issues – affordability, availability and diversity.

There is a regional community perception of dependency on the mining sector, which was coupled with a desire for greater economic diversification, through the development and attraction of other industry and business sectors (as stated in regional and local strategic plans), and the need to address land use conflicts and cumulative impacts e.g. workforce mix, community participation, workforce competition associated with the presence of prominent industry sectors (e.g. mining, thoroughbred and viticulture) within the locality.

The presence of the mining industry and associated mine suppliers in the locality affords a range of local economic benefits to key communities across the region and more broadly, with associated workforces also contributing to the human and social assets within these various localities.

6.3.4 Perceived Issues and Opportunities of the MCCO Project

A key component of the SIA is the process of understanding, from a community perspective, community issues, values and uses associated with the assessment area, and specifically the perceived social impacts and opportunities associated with the MCCO Project.

Engagement activities undertaken to support the SIA program had three main objectives:

- to identify perceived issues/impacts associated with the MCCO Project
- to identify perceived issues/impacts associated with cumulative mining development in the region

- to identify strategies for management and opportunities for enhancement of perceived project issues/impacts.

These objectives were achieved through consultation with:

- **Proximal landholders** - landholders and residents residing in proximity to the current mining operations in the state suburbs (ABS, 2016) of Mangoola, Castle Rock, Wybong and Manobalai

- **Locality residents -** including the surrounding suburbs of Wybong, Castle Rock, Manobalai and Mangoola excluding proximal landholders

- **Indigenous stakeholders -** including some of the Registered Aboriginal Parties and Indigenous service providers and groups (note that this refers specifically to those Indigenous stakeholders consulted as part of the SIA regarding social issues, not to those consulted as part of the Aboriginal cultural heritage assessment program regarding cultural heritage issues which is discussed in **Section 6.12**)

- **Community stakeholders and residents** - in the wider Muswellbrook LGA (local government, business, community groups) in the Muswellbrook LGA.

As part of the wider EIS Community Engagement Process representatives from the MCCO Project have also met with local government representatives, State and Commonwealth Government agencies, local business and industry, community, cultural and heritage groups (associated with the area) and infrastructure and service providers. Key outcomes from this consultation have also been considered as part of the SIA.

6.3.4.1 Proximal Landholders

Perceived impacts identified by proximal landholders cover a range of social impact categories, as defined in the SIA Guideline and reflect the fears and aspirations of the stakeholders consulted. The social impact categories are defined in **Table 6.6** and results from the SIA interviews with proximal landholders are shown in **Figure 6.1**.

Table 6.6 Defined Social Impact Categories

Social Impact Category	Definition
Way of life	How people live, for example, how they get around, access to adequate housing How people work, for example, access to adequate employment, working conditions and/or practices How people play, for example, access to recreation activities How people interact with one another on a daily basis
Community	Including a community's composition, cohesion, character, how it functions and sense of place
Access to and use of infrastructure, services and facilities	Whether provided by local, State, or Commonwealth governments, or by for-profit or not-for-profit organisations or volunteer groups
Culture	Including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country)
Health and wellbeing	Including physical and mental health
Surroundings	Including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity

Social Impact Category	Definition
Personal and property rights	Including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected
Decision-making systems	Particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms
Fears and aspirations	Related to one or a combination of the above, or about the future of their community

Impacts relating to surroundings, including access to and use of the natural and built environment, and its aesthetic value and/or amenity (social amenity), associated with noise and dust, were the most prominent social impact category identified; followed by impacts relating to personal and property rights, community, health and wellbeing and way of life. It should be noted that social impacts are often not mutually exclusive, with significant interconnectivity evident across social impacts and impact themes. For example, a stakeholder concerned about noise may also be concerned about perceived impacts on property value, health and sense of community as a result of noise. **Figure 6.2** further defines the social impact themes that fall within each of the social impact categories.

The most frequently identified social impacts related to property (70), with concerns centred on the potential decrease in property value due to proximity to the mining operation; a sense of entrapment as a result of perceiving to be unable to sell property in the area; and concerns pertaining to acquisition zoning in relation to the MCCO Project. Independent investigations (Tew, 2018) relating to changes in property values and sales data from 2005 to 2018, for properties in proximity to mining operations, was investigated; with the assessment suggesting that rural properties vary markedly in property value and are influenced by many factors including land classification, size and condition; however the negative impacts of mining on property values are more likely to be localised or individually evident, and a consequence of a particular property's proximity to a mining operation.

The second most identified social impacts perceived by landholders in relation to the MCCO Project, related to impacts on rural lifestyle and sense of community (67). This again was a primary concern for landholders in the northern localities of Manobalai and Wybong. In this regard, landholders raised concerns regarding the loss of community members and population decline in the area, as a result of the acquisition of properties by Mangoola and perceived impacts of the operation; and the subsequent impact on the general amenity of the area and community cohesion.

In relation to amenity, dust and noise from existing operations and the potential for increased impacts as a result of the MCCO Project were common concerns. A large majority of landholders consulted expressed that dust was impacting their way of life in a number of different ways, particularly the requirement for additional domestic cleaning of internal and external dwellings, excessive use of swimming pool filtration systems to clean pools, cleaning of water tanks, and concerns that solar panel efficiencies were also being reduced as a result of dust impacts. Current operational noise was also noted by a large proportion of proximal landholders. Night noise was specifically mentioned as affecting sleep and the well-being of family members. The most commonly noted noise sources identified in community interviews were mine vehicles reversing, dozers, loading of rock into empty trucks and passing trains. The perception of noise impacts appears consistent with a review of complaints data for Mangoola across the period January 2013 to November 2018, with noise complaints accounting for over 90 per cent of all complaints received during this period.

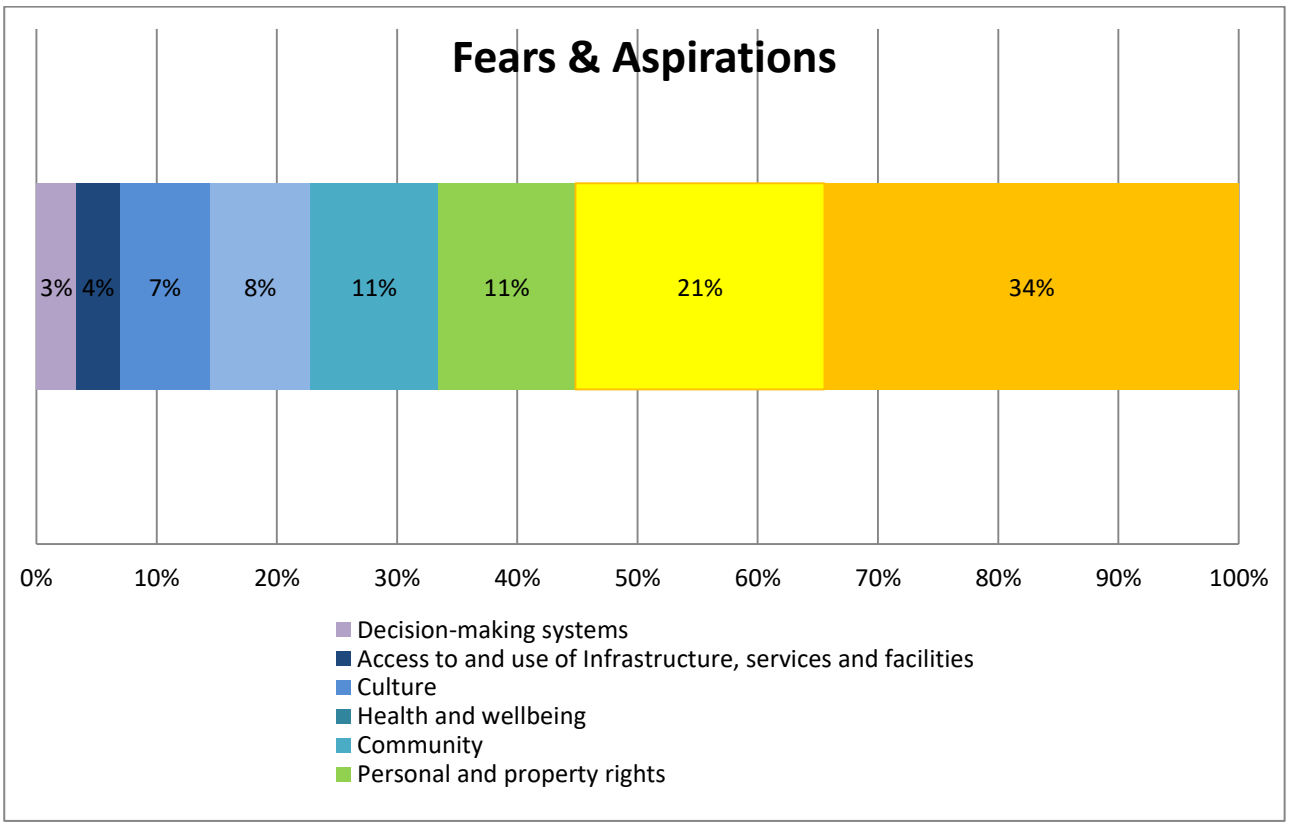
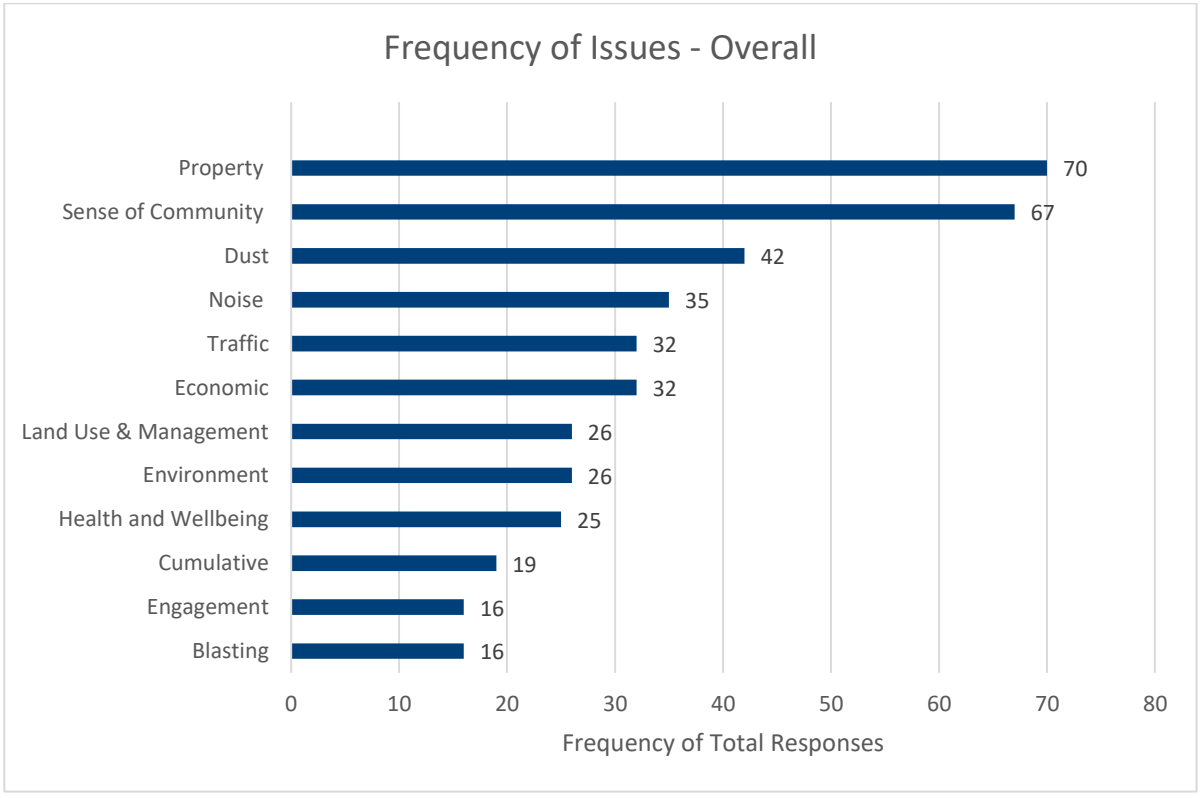


Figure 6.1 Percentage of Fears and Aspirations Raised by Social Impact Category



Note: n=44, multiple responses allowed

Figure 6.2 Perceived Social Impacts Identified by Proximal Landholders

Other issues identified related to traffic, positive economic impact associated with the MCCO Project, land use and management, health and wellbeing (particularly related to concerns about impacts of dust on health), cumulative impacts (particularly impacts of noise and dust/air quality), issues relating to decision making and engagement processes and blasting.

As part of the mine planning process Mangoola has made extensive refinements to the mine plan for the MCCO Project, to address known community issues and key concerns, and as a result of several rounds of noise and air quality constraints modelling. The significant changes that have been made to the mine plan to reduce amenity impacts include: removal of the eastern out of pit emplacement area; changes to the extent of the proposed mining area; changes to mining intensity (intensity of mining has been reduced for the operations planned in the north); and alterations to haul road locations and emplacement schedules as discussed in further detail in **Section 6.4** and **Section 6.5**.

While the presence of a construction workforce was not identified as a high perceived impact by proximal landholders, it has been assessed as part of the SIA. The MCCO Project has been designed to maximise the use of existing infrastructure, however, some new or relocated infrastructure will be required to establish access to and operate within the MCCO Additional Project Area as outlined in **Section 3.11**. The MCCO Project will require up to 145 contractors during its peak construction period, and it is anticipated that such a workforce will be readily available to the MCCO Project.

A construction workforce can often have different impacts on a community than a permanent, operational workforce. Usually a construction workforce is temporary and transient in nature, residing in a location in proximity to a particular project, before moving on to the next project. Because of the temporary, transient nature of construction work, families often do not accompany the worker, preferring to live in one permanent location while the construction worker travels away and resides at a location in close proximity to the MCCO Project. While the influx of a construction workforce has the potential to influence population change, this change, should it occur will be temporary in nature (over a 16-month period).

6.3.4.2 Broader Stakeholders within the Hunter Valley

Consultation was also undertaken with a range of stakeholders across the Hunter Valley as part of the Glencore's community perceptions survey. Although not conducted specifically as a part of the engagement program for the MCCO Project, the survey has identified community perceptions of Glencore operations in the wider Hunter, affording input from a wider range of stakeholders than only those proximal to the existing operation and MCCO Project.

Glencore undertakes a regular community perception survey every three years involving stakeholders relevant to its NSW and QLD operations. In general, the survey affords the tracking of a number of key indicators relating to Glencore's social and environmental performance and provides an evaluation of the approach the operations have adopted in relation to stakeholder engagement and consultation.

The most recent survey was carried out in 2018 and included 133 local landholders and 54 stakeholders across local businesses, community groups, Indigenous groups, local and state government and NGOs, relevant to Glencore's operations in the Hunter Valley. In addition, a total of 196 community members were also randomly sampled from across the Hunter Valley.

In relation to stakeholder perceptions of Glencore's operations in the Hunter Valley the survey results indicated the following.

Care for the Community

When asked if: Glencore cares about local communities in the region with a sample size of landholders (n=126), opinion leaders (n=43), broader community (n=199). 65 per cent of broader community respondents, 62 per cent of opinion leaders and 77 per cent of landholders either agreed or strongly agreed with this statement.

Opportunity to Present Stakeholder Views

When asked if: I feel that I have ample opportunity to present my views about Glencore's activities in the area with a sample size of landholders (n=120), opinion leaders (n=41), broader community (n=190). 63 per cent of broader community, 71 per cent of opinion leaders and 65 per cent of landholders either agreed or strongly agreed with this statement.

Contribution to the Community

When asked if: Glencore makes an important contribution to the local economy in the region with a sample size of landholders (n=121), opinion leaders (n=42), broader community (n=199) 82 per cent community, 86 per cent of opinion leaders and 81 per cent of landholders either agreed or strongly agreed with this statement.

Environmental Performance

When asked: In my opinion Glencore's environmental performance is an example of good practice with a sample size of landholders (n=118), opinion leaders (n=40), broader community (n=189). 53 per cent of community, 66 per cent of opinion leaders and 60 per cent of landholders either agreed or strongly this statement.

When asked: I think Glencore is taking measures to address environmental issues, with a sample size of landholders (n=122), opinion leaders (n=41), broader community (n=193). 64 per cent of community, 80 per cent of opinion leaders and 66 per cent of landholders either agreed or strongly this statement.

Ongoing consultation has also been undertaken with business and industry groups through the Muswellbrook Chamber of Commerce and Industry. Representatives from the project team have attended Chamber breakfasts and have presented information on the MCCO Project on two occasions. The Chamber is largely supportive of the MCCO Project due to the potential positive economic benefits at a local and regional level; and has expressed concerns that the existing operations may be exhausted in approximately 2025 should the MCCO Project not be approved, resulting in associated negative social and economic impacts to the Muswellbrook LGA.

6.3.4.3 Indigenous Service Providers and Community Groups

To further inform the SIA, interviews were also undertaken with local Indigenous groups and services providers in the Muswellbrook LGA. The issue themes identified through this consultation largely related to the cumulative impacts of mining and centred on the sustainability of the mining sector, employment and local procurement opportunities for Indigenous community members, community investment and environmental impacts. In general, respondents expressed an overarching concern for the future sustainability of their communities, but also optimism for the potential of mining contributions and input to effect positive social change. Future opportunities for cooperation and engagement were also welcomed.

6.3.5 Assessment of Social Impacts

The SIA utilised data from several sources to identify the potential social impacts arising from the MCCO Project. Social impacts associated with the MCCO Project have been assessed via a detailed ranking of social impacts according to a number of key criteria, as defined in the SIA Guideline.

In order to prioritise the identified social impacts, a risk-based framework has been adopted with the assessment of social risk considering both the consequences of the potential social impact and the likelihood of the impact occurring to determine an overall risk assessment of the social impact as 'low', 'moderate', 'high' or 'extreme'. Technical and perceived social risk in relation to the consequences that may be experienced by people, due to anticipated impacts/changes associated with the MCCO Project, have been categorised in line with the Social Impact Categories outlined in the SIA Guideline and then further defined within impact themes and sub-impact issues. It is noted that the social risk matrix from the SIA Guideline provides greater emphasis on high and extreme risks, with 16 out of 25 risk rankings (64 per cent) across the matrix being identified as high or extreme.

Each of the identified impacts has been assessed in detail in the SIA. **Table 6.7** provides a summary of the unmitigated predicted impacts associated with the MCCO Project. The predicted impacts after the application of mitigation measures are discussed in **Section 6.3.7** following the discussion of the social impact mitigation and enhancement measures that are proposed to be implemented as part of the MCCO Project. The duration of social impacts largely relate to the extension of the mining operation which is for a period of approximately five years beyond existing planned operations.

Given that the MCCO Project would prolong the life of the mine for a further five years, it can be inferred that the above benefits to the local area annually would be lost if the project was not to proceed. The economic benefits of the MCCO Project have been assessed and are further discussed in **Section 6.2**.

Table 6.7 Unmitigated Predicted Social Impacts

Project Aspect	SIA Category	Social Impact Theme	Extent	Duration	Affected Parties	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)
Acquisition process	Way of Life Community Personal and property rights	Population Change	Wybong SSC Manobalai SSC Muswellbrook LGA	Project life – additional 5 years	Proximal Landholders (7 – Significant; up to possible 13 per cent population change in Wybong SSC)	High	High
					Muswellbrook LGA	Low	Low
Construction of Operation	Way of Life Community Personal and property rights	Economic Employment Local procurement Indirect impacts to locality and region	Muswellbrook LGA and surrounding region	16 months	Indigenous and non-Indigenous population Local business Service providers Employees	Moderate *(Positive)*	High *(Positive)*
Construction workforce	Community Access to and use of infrastructure, and services and facilities	Population Change – influx of workers	Muswellbrook LGA	16 months	Muswellbrook LGA	Low	Low
					Service Providers	Moderate *(positive)*	Moderate *(positive)*
Construction workforce	Surroundings Access to and use of infrastructure, services and facilities Way of Life	Traffic volume and access to the area	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC Muswellbrook LGA	16 months	Proximal Landholders	High	Moderate
					Road Users	High	Moderate

Project Aspect	SIA Category	Social Impact Theme	Extent	Duration	Affected Parties	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)
Government and EIS Process	Decision Making Systems Way of Life	Distrust Lack of knowledge Engagement	Muswellbrook LGA	Existing and future	Proximal landholders	High	Low
					Indigenous community	Moderate	Low
					Muswellbrook LGA community	Low	Low
Mining in the region	Surroundings Health and wellbeing Way of Life	Cumulative: - Social amenity - Dust - Water - Noise - Rail	Muswellbrook LGA	Existing and future	Muswellbrook LGA	Moderate	Moderate
Operational workforce	Access to and use of infrastructure, services and facilities Community infrastructure and services	Population Change - no additional operational workforce	Muswellbrook LGA	Project life - additional 5 years	Proximal Landholders	Low	Low
					Service Providers	Low	Low
Operational workforce	Surroundings Access to and use of infrastructure, services and facilities Way of Life	Road maintenance Safety Property damage	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC Muswellbrook LGA	Project life - additional 5 years	Proximal Landholders	High	Low
					Road Users	Moderate	Low
Presence of Operation	Personal and property Rights	Property impacts include:	Wybong SSC Manobalai SSC	Project life - additional 5 years	Proximal Landholders	High	High

Project Aspect	SIA Category	Social Impact Theme	Extent	Duration	Affected Parties	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)
	Way of Life	Declining property value Uncertainty and potential livelihood impact Inequity given residences fall within different zones	Castle Rock SSC Mangoola SSC		Locality Residents	High	High
Presence of Operation	Community Culture Way of Life	Lifestyle Amenity Connection to place, membership and participation	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal Landholders	High	High
					Locality Residents	High	High
Presence of Operation	Surroundings Health and Wellbeing Way of Life	Social amenity - dust	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal Landholders	High	Low
					Locality Residents	High	Low
Presence of Operation	Surroundings Health and Wellbeing Way of Life	Social amenity - noise	Wybong SSC Manobalai SSC	Project life - additional 5 years	Proximal Landholders (7 – Significant)	High	High
			Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal Landholders (19 – Marginal)	High	High

Project Aspect	SIA Category	Social Impact Theme	Extent	Duration	Affected Parties	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)
Presence of Operation	Health and wellbeing Way of Life	Health and wellbeing – Physical, including potential water contamination, respiratory illness	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal Landholders	Moderate	Low
					Locality Residents	Moderate	Low
Presence of Operation	Health and wellbeing Way of Life	Health and wellbeing - Stress and anxiety	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal Landholders	High	High
					Locality Residents	Moderate	Moderate
Presence of Operation	Surroundings Way of Life	Water - Access to surface and ground water Livelihood	Proximal landholders along Wybong Creek	Project life - additional 5 years), possibly ongoing	Proximal Landholders Private Bore Owners	Moderate	Moderate
Presence of Operation	Surroundings Way of Life	Visual Amenity - Visibility of the mine and overpass Lighting spill Rehabilitation	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Permanent change – reduced once rehabilitation has occurred (approx. 10 years)	Proximal Landholders	Moderate	Low
					Locality Residents	Moderate	Low
Presence of Operation	Surroundings Personal and property rights Way of Life	Blasting: - Social amenity - Property damage - Safety - Noise	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Project life - additional 5 years	Proximal landholders	Moderate	Low
					Locality Residents	Low	Low

Project Aspect	SIA Category	Social Impact Theme	Extent	Duration	Affected Parties	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)
Presence of Operation	Way of Life Community Personal and property rights	Economic Sustained employment and procurement	Muswellbrook LGA and surrounding region	Project life - additional 5 years	Indigenous and non-Indigenous population Existing workforce Local business Service providers	Moderate *(Positive)*	High *(Positive)*
Presence of Operation Offsets	Surroundings	Land Use and Management Increased pests and weed	Wybong SSC Manobalai SSC Castle Rock SSC Mangoola SSC	Duration of Mangoola land ownership	Proximal Landholders to operation and offset areas	Moderate	Moderate

6.3.6 Management and Enhancement Strategies

A range of strategies have been proposed to address the significant (moderate and high) social impacts relating to the MCCO Project. These strategies have been developed through review of existing Mangoola management approaches; stakeholder strategies identified through the SIA engagement program (Rounds 1 and 2); relevant projects and studies relating to social impact management; and the experience of the SIA team across other projects. Additional social criteria are also considered in the development of relevant strategies, including an assessment of the vulnerability of key stakeholders and landholders in proximity to the MCCO Project Area. The summary of predicted impacts considering these mitigation and enhancement strategies is outlined in **Section 6.3.7**.

Mangoola Coal Mine, as an established mining operation, has in place a range of existing mitigation approaches to address environmental and social impacts associated with the mining operations including a VPA with MSC.

In relation to environmental impacts of the operations, predicted impacts are defined by performance-based criteria, as determined by government; and applied through the VLAMP process for acquisition and mitigation. As discussed in **Section 6.4**, seven properties are predicted to fall within the voluntary acquisition zone for the MCCO Project.

To date, as part of Mangoola's existing operations, a range of management strategies have been applied to residences in the current operation's acquisition and active management zones to further reduce impacts of the operations. Such strategies include:

- household sealing and noise mitigation as directed by a qualified structural engineer
- filters for water tanks - first flush systems
- cleaning of water tanks
- cleaning of solar panels
- landscaping/tree planting (on individual properties)
- air-conditioning - provision, maintenance and electricity subsidies.

To date, implementation of such strategies has been defined by previous impact assessments and proximity to the operations. For example, cleaning of water tanks has occurred within 4 km of the active mining area annually and 4 - 6 km of the active mining area biannually, with first flush systems checked quarterly.

The existing management and mitigation strategies are documented in the approved management plans and these strategies will be implemented for the MCCO Project. Further details are also discussed within **Section 6.4** with regard to noise mitigation measures and **Section 6.5** with regard to air quality measures.

A number of new strategies are also proposed to address the identified social impacts relating to the MCCO Project. **Table 6.8** outlines which specific social impacts are addressed by the implementation of the strategies proposed, with further detail provided below.

Additional social criteria are also considered in the development of relevant strategies, including an assessment of the vulnerability of key stakeholders and landholders residing in proximity to the MCCO Additional Project Area.

Table 6.8 Proposed Strategies by Significant (*Moderate and High*) Predicted Social Impacts

Strategy	Strategy Term	Strategy Type	Sense of Community	Property Value	Social Amenity	Traffic - Construction	Economic	Cumulative
Existing Strategies that will be Revised and Continued								
Environmental Management Plans - Noise, Air Quality, Blasting, Traffic, Cultural Heritage	Project life	Management-based			■	■		■
Landholder Mitigation	Project life	Management-based		■	■			
Employment and Procurement	Project life	Performance - based	■				■	
VPA	Project life	Prescriptive	■		■			■
Post Mining Land Use	Post closure	Prescriptive	■	■	■		■	
Glencore and Mangoola Community Investment Program	Project life	Prescriptive	■		■			
Community Engagement Plan	Project life	Management-based	■		■			
New Proposed Strategies								
Community Enhancement Program	Project life	Prescriptive	■	■	■			
Property Specific Measures	A defined period	Prescriptive		■	■			
Social Impact Management Plan (SIMP)	Life of Project	Prescriptive	■	■	■	■	■	■

The following sections outline the key proposed social strategies in further detail.

Voluntary Planning Agreement

Mangoola currently has a VPA in place with MSC. This includes:

- $500,000 to fund local environmental management projects
- $600,000 to fund council's education and training strategy
- $1,200,000 to contribute to the recreation assets renewal fund

- $2,200,000 to fund Denman recreation area enhancements
- $20,000/year to fund MSC environmental management and monitoring
- $55,000/year to contribute to road maintenance costs for part of Wybong Road
- $220,000/year to contribute to general mine affected road maintenance costs
- $235,000/year to contribute to additional environmental and community projects
- $100,000/year to contribute to additional environmental and community projects.

In addition to the above financial contributions Mangoola also uses its best endeavours to engage six apprentices a year sourced from residents with the Muswellbrook LGA and Aberdeen.

In line with Mangoola's existing VPA, Mangoola proposes to continue its existing VPA commitments for the duration of the MCCO Project, to facilitate continued and ongoing support for a range of environmental and community projects within the Muswellbrook LGA. As part of the consultation with MSC, Mangoola propose part of the local community funding component in the VPA is used in the Community Enhancement Program as discussed below.

Community Enhancement Program

To address the issues relating to the perceived devaluation of property, dwindling sense of community, and social amenity, it is proposed that a Community Enhancement Program be developed for residents/landholders located in the defined management zones relating to the MCCO Project. As part of the SIA consultation program a number of suggestions were made by stakeholders that could form potential projects under the Community Enhancement Program. These community suggestions are discussed in **Appendix 5**.

The program would be developed through engagement with the community, as illustrated in **Figure 6.3** with proximal residents/landholders to the Mangoola operations and key stakeholders eligible to participate in the program. The approach for implementing the program will continue to evolve based on community consultation and feedback through the approval process.

The key objectives of the Community Enhancement Program would include:

- working collaboratively with near neighbours/proximal landholders to develop environmental and community benefits for the Wybong district that enhance local values of the area
- facilitating enhancement initiatives for those residents living in the management zone
- addressing perceived issues relating to property devaluation given close proximity to the mining operation
- contributing to the local community and better targeting community investment spend locally.

Once projects have been further defined and prioritised, through the engagement process, small project reference groups may be established to oversee project implementation.

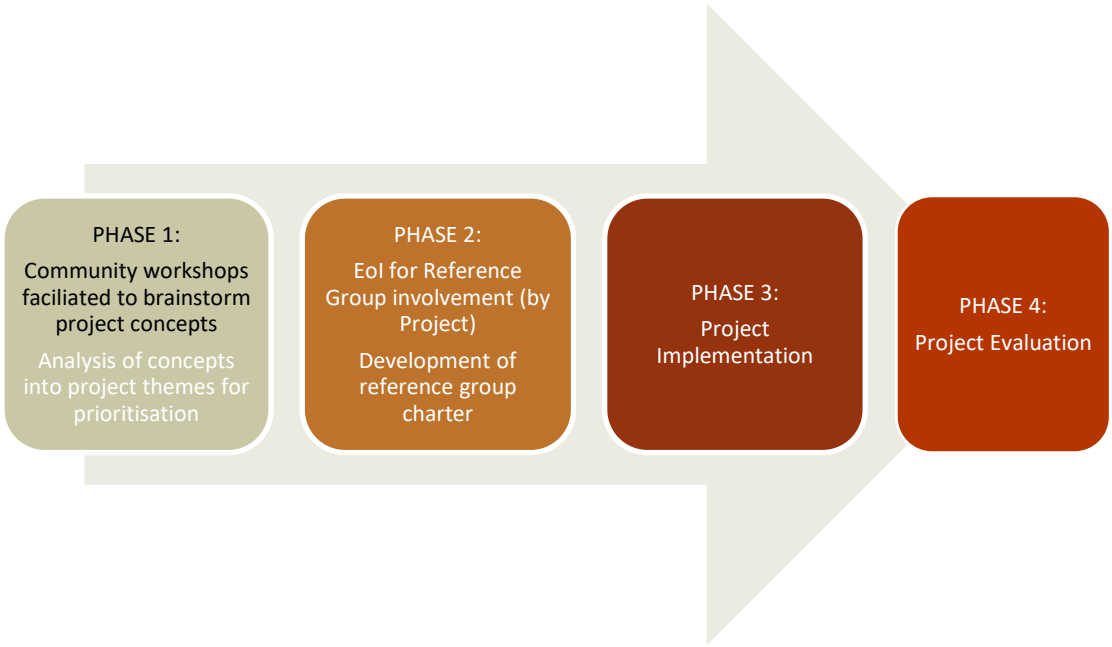


Figure 6.3 Proposed Process for Developing a Community Enhancement Program

Property Specific Measures

For the MCCO Project, further consideration has been given to the impact on proximal landholders to the north of the MCCO Additional Project Area. The SIA Guideline outlines the need for the SIA to evaluate the negative social impacts of a project specifically addressing those who are expected to be adversely affected, including any vulnerable stakeholders.

In reviewing the results of the environmental and social assessments and the consultation undertaken to date a strategy has been developed in relation to property specific measures with a number of proximal landholders who are outside the anticipated VLAMP voluntary acquisition area. This mitigation measure provides direct mitigation for the issues raised by these proximal landholders.

With consideration of privacy, the landholders offered property specific measures to address the identified impacts will be provided separately to DPE.

6.3.7 Mitigated Impacts

The social impact risks of the MCCO Project were re-evaluated in the context of the proposed mitigation measures to identify the mitigated social risk using the SIA Guideline social risk matrix.

Table 6.9 provides a summary of the risk analysis outcomes for the mitigated predicted social impacts associated with the MCCO Project.

Table 6.9 Mitigated Social Impact Risk Assessment Outcomes

SIA Impact Category	Social Impact Theme	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)	Proposed Social Mitigation Strategies	Social Impact Ranking (Mitigated)
Surroundings Health and wellbeing Way of life	Social amenity-noise (Significant - noise acquisition zone). Residents in this zone can elect to be acquired and move, or stay and experience the predicted noise impacts.	High	High	• VLAMP • Existing and proposed mitigation strategies • Community Enhancement Program.	High
Way of life Community Personal and property rights	Economic Employment Local procurement Indirect impacts to locality and region	Moderate *(Positive)*	High (Positive)	• Local employment and procurement strategy.	High (Positive)
Way of life Community Personal and property rights	Economic Sustained employment and procurement	Moderate *(Positive)*	High (Positive)	• Local employment and procurement.	High (Positive)
Way of life Community Personal and property rights	Population change (Acquisition Process)	High	High	• Community Enhancement Program.	Moderate
Personal and property rights Way of life	Property impacts including: Declining property value Uncertainty and potential livelihood impact Inequity given residences fall within different zones	High	High	• Community Enhancement Program • Property specific measures • Existing and proposed mitigation strategies.	Moderate

SIA Impact Category	Social Impact Theme	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)	Proposed Social Mitigation Strategies	Social Impact Ranking (Mitigated)
Community Culture Way of life	Lifestyle Amenity Connection to place, membership and participation	High	High	• VPA contribution • Community Enhancement Program.	Moderate
Surroundings Health and wellbeing Way of life	Social amenity-noise Proximal landholders (19 – marginal)	High	High	• VLAMP • Existing and proposed mitigation strategies • Community Enhancement Program.	Moderate
Health & wellbeing Way of life	Health and wellbeing - Stress and anxiety (proximal landholders)	High	High	• Social Impact Management Plan (SIMP) • VLAMP • Existing and proposed mitigation strategies.	Low
Surroundings Access to and use of infrastructure, services and facilities Way of life	Disruption/ inconvenience to road uses and increased travel times	High	Moderate	• Traffic Management Plan • Community Enhancement Program.	Low
Surroundings Health and wellbeing Way of life	Social amenity - dust	High	Low	• Community Enhancement Program • Existing and proposed mitigation strategies • Property specific measures.	Low

SIA Impact Category	Social Impact Theme	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)	Proposed Social Mitigation Strategies	Social Impact Ranking (Mitigated)
Surroundings Access to and use of infrastructure, services and facilities Way of life	Road maintenance Safety Property damage	High	Low	• Traffic Management Plan • Community Enhancement Program.	Low
Decision making systems Way of life	Distrust Lack of knowledge Engagement (Proximal landholders)	High	Low	• SIMP • Community Engagement Plan • Community Enhancement Program.	Low
Surroundings Way of life	Water - Access to surface and ground water Livelihood	Moderate	Moderate	• Community Enhancement Program • Existing and proposed mitigation strategies.	Low
Surroundings	Land Use and Management Increased pests and weed	Moderate	Moderate	• Community Enhancement Program.	Low
Surroundings Health and wellbeing Way of life	Cumulative: - Social amenity - Dust - Water - Noise - Rail	Moderate	Moderate	• Community Enhancement Program • Continued participation in the Upper Hunter mining dialogue.	Low
Surroundings Way of life	Visual Amenity - Visibility of the mine and overpass Lighting spill Rehabilitation	Moderate	Low	• Community Enhancement Program • Existing and proposed mitigation.	Low

SIA Impact Category	Social Impact Theme	Perceived Social Impact/ Sensitivity	Social Impact Ranking (Unmitigated)	Proposed Social Mitigation Strategies	Social Impact Ranking (Mitigated)
Surroundings Personal and property rights Way of life	Blasting: - Social amenity - Property damage - Safety - Noise	Moderate	Low	• Existing and proposed mitigations.	Low

6.3.8 Monitoring of Social Impacts

Mangoola will develop an SIMP that defines and guides the monitoring and evaluation activities for the MCCO Project, should the project be approved. The SIMP will:

- identify opportunities to enhance positive and mitigate negative social and economic impacts of the MCCO Project on communities
- detail adaptive management and mitigation strategies to address potential impacts of the MCCO Project
- identify appropriate stakeholder responsibilities
- identify appropriate monitoring, reporting and review mechanisms
- outline a process to engage with relevant stakeholders and communities, with a focus on practical mechanisms for the community to collaborate and record their observations and experiences of social impacts.

6.3.9 Summary

The SIA has identified a number of social impacts that Mangoola will need to manage as a part of the MCCO Project. Given the limited life of the additional mining (approximately five years beyond existing planned operations) and Mangoola's pre-emptive mine plan design to avoid and minimise impacts, the social impacts of the MCCO Project have been minimised where possible through project design and the proposed management and enhancement approaches to be adopted.

While a number of social and environmental issues have been raised by landholders in proximity to the MCCO Project, of key focus from a social impact perspective, is the impact of the MCCO Project on proximal landholders due to perceptions of impacts on property value and a dwindling sense of community, and impacts associated with being proximal neighbours to a large development. To address these issues, a number of mitigation and enhancement strategies are proposed, including:

- continued implementation of a VPA with MSC
- development of a Community Enhancement Program that focuses on facilitating enhancement initiatives for proximal landholders within the management zones for the MCCO Project
- implementation of a range of existing and new mitigation measures to address the identified impacts, based on community feedback
- a series of property specific measures
- development and implementation of a SIMP for the ongoing monitoring and management of social impacts.

These mitigation and enhancement measures have been specifically targeted to address the issues identified in this SIA and are based on stakeholder engagement and feedback.

6.4 Noise

A comprehensive assessment of the potential noise impacts of the MCCO Project has been undertaken by Global Acoustics. This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require a detailed assessment of the likely noise impacts of the MCCO Project in accordance with the Noise Policy for Industry (NPfI) (EPA, 2017) and having regard to the VLAMP.

As outlined in **Section 5.5**, noise impacts were identified by the community as one of the issues of most concern. In particular, noise was identified as a key area of concern by near neighbours to the MCCO Project. This is consistent with the community feedback that was received during the preparation of the SIAs that have been completed for the original approval and each of the major modifications that have been undertaken (namely MOD 4 and 6) and during the operational phase of the existing Mangoola Coal Mine. As described below, Mangoola has continued to take this feedback on board and sought to address it through operational changes and as part of the planning and design stages of the MCCO Project.

Since operations commenced at Mangoola in 2010 the number of noise complaints received has fluctuated but generally trended downwards with a significant reduction observed since operations first commenced. In response to the concerns raised during this period, Mangoola has implemented a range of mitigation and management measures to reduce noise related impacts on surrounding private receivers. This has included:

- replacing reversing beepers on mobile equipment with 'quackers'
- personnel and contractors are to be vigilant in identifying and controlling operations and activities that might result in the generation of excessive noise. Noisy operations or equipment which are identified as affecting privately owned residences are to be reported to the supervisor promptly
- restricting, where possible, operations on outer dump faces or elevated dumps in sensitive areas and/or during adverse weather conditions
- trucks operating during the night time are restricted to operational areas, where possible, below the maximum elevation of the overburden emplacement areas
- using predictive meteorological forecasting and real-time noise monitors that incorporate automatic alarms so that proactive control can be implemented
- controlling mine noise at the source through the use of equipment with appropriate sound attenuation fitted and conducting annual sound power testing for equipment to confirm compliance to commitments
- installing and maintaining low noise rollers on conveyor systems
- covering the cost of running and maintenance of air conditioners for private receivers located within the noise management zone for the existing operation.

With regard to Mangoola's approach to the design and planning of the MCCO Project noise modelling was completed on an iterative basis to enable the development of a mine plan that would minimise noise impacts as far as practicable. The detailed assessment included the consideration of a number of project alternatives (refer to **Section 1.4**). Multiple iterations of the mine plan were undertaken prior to Mangoola selecting the proposed mine plan, with the noise impacts of the MCCO Project reduced through this process. The mine plan selected is not the most optimal from an economic perspective, however, Mangoola selected this as the proposed project as it achieves an appropriately balanced outcome between mine planning, economic, environmental and social outcomes and results in reduced noise impacts when compared to some of the other project options assessed.

As part of the project planning process the noise controls that were found to be reasonable and feasible, and which contributed to the effective control of potential impacts, were incorporated into the MCCO Project design. These controls have been included as part of the noise model for the MCCO Project.

Key measures included in the MCCO Project design that have minimised noise include:

- mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the new mining area than currently operating at full production at Mangoola Coal Mine, reducing the amount of noise generated by the equipment operating in the new mining area
- identifying activities that could be modified during times of adverse noise propagating meteorological conditions and the management of equipment during such conditions to minimise noise impacts
- developing designs for emplacement areas to enable alternative emplacement locations during adverse conditions, including the provision of day and night time emplacement locations so that night time activities can be undertaken in better shielded locations
- the inclusion of bunds in strategic locations along key haul roads, where practicable, to shield trucks and equipment on exposed sections
- locating key haul roads below the ground surface to maximise topographical shielding to surrounding receiver areas, where practical
- incorporation of reasonable and feasible noise attenuation on key plant and equipment.

Mangoola is committed to managing noise impacts from its mining operations and has a comprehensive Noise Management Plan in place. During the past seven years there have been a total of nine exceedances of the applicable noise criteria (two in 2017, four in 2016 and three in 2015). These exceedances have been managed in accordance with the Noise Management Plan and appropriate corrective actions put in place in accordance with the Trigger Action Response Plan (TARP) process.

In accordance with this plan Mangoola will continue to utilise a range of proactive and reactive noise management strategies informed by real-time noise and meteorological monitoring systems. Proactive strategies will include utilising meteorological forecasting to plan activities in advance of potentially adverse conditions and ongoing day to day planning of mining operations to reduce noise. Reactive strategies will include the modification or suspension of activities in response to a series of triggers due to noise enhancing meteorological conditions.

As discussed in the following sections, the MCCO Project will trigger voluntary acquisition and mitigation rights for some nearby private properties. The affected landholders have all been approached (where reachable) and offered a summary of the key results of the assessments (air quality, noise and blasting) relevant to their properties and to inform them of their rights should the MCCO Project be approved.

It is also noted that Mangoola propose to retain the existing acquisition and mitigation rights for those receptors previously determined to be impacted by operations within the Approved Project Area as listed in PA 06_0014. Not all of these properties with existing rights would exceed applicable criteria contained within the VLAMP due to the MCCO Project however, Mangoola has decided voluntarily to maintain the existing rights for these landholders.

A summary of the key findings of the Noise Impact Assessment (NIA) is provided in this section and the full report is provided in **Appendix 8**.

6.4.1 Methodology and Existing Environment

6.4.1.1 Modelling

Noise levels were predicted using the Environmental Noise Model (ENM) to determine the acoustic impact of mining operations. Results were determined using the cumulative distribution of results methodology which uses a full set of meteorological conditions (260 meteorological conditions based on assessment of historical meteorological data) to identify the likely noise impacts experienced by private receivers surrounding the MCCO Project. A table providing details of the private receiver locations that have been assessed by the NIA is provided in **Appendix 8**.

Results provided for assessment against intrusive criteria are 90th percentile L_{Aeq} values; that is, the noise level that is likely to be exceeded 10 per cent of the time in the worst-case season. This approach takes account of the influence of local meteorological conditions on the propagation of noise from the MCCO Project.

In addition to assessing Project specific noise against relevant intrusive criteria, the NIA has also assessed cumulative noise impacts, construction noise, and traffic noise. Assessment of intrusive criteria has included the assessment of intrusive noise effects (sleep disturbance) and NPfI modifying factors, including low frequency noise effects.

Modelling was undertaken for Project Years 1, 3, 5 and 8 as they represent a combination of mining across the two operational areas, include the extremities of the MCCO Proposed Additional Mining Area and capture periods of greatest intensities of mining. The project years that have been modelled are considered to represent maximum likely impacts as a result of the MCCO Project.

The conceptual staged mine plans and production schedule have been used to determine relevant noise sources and to predict noise impacts for each modelled year.

6.4.1.2 Meteorological Data

The atmospheric conditions that most affect noise propagation are temperature and wind. Noise levels are increased when the wind blows from noise source to receiver or under temperature inversion conditions (both of which are often referred to as adverse weather conditions), and decrease when the wind blows from receiver to the source.

The NIA analysed representative meteorological data for the region surrounding the MCCO Project to determine the percentage of occurrence of inversions and/or wind effects. Mangoola own and operate three meteorological stations which are located within the MCCO Project Area (refer to **Figure 2.5**).

Analysis of meteorological data indicates that wind from the north to north-west occurs most commonly during the night period in winter (refer to **Figure 6.4**). Outside of winter, the frequency occurrence of this wind direction is low, and south to south-east winds prevail. Therefore, receptors that are located south to south-east of the Mangoola Coal Mine are generally predicted to receive the highest noise levels during winter while receptors located north to north-west of the mine are generally predicted to receive the highest noise levels outside of winter.

FIGURE 6.4

Seasonal Wind Roses

Data Source: Jacobs (2019)

6.4.1.3 Background Noise Levels

The ambient acoustic environment around the Mangoola Coal Mine has been measured and documented for past assessments. A review of previous noise survey and monitoring data has indicated that Rating Background Levels (RBL) measured around the MCCO Additional Project Area during the quietest periods in the winter months are between L_{A90} 20 dB and L_{A90} 30 dB. This background excludes noise from the existing Mangoola mining operation. In accordance with the NPfI, as the RBL during the quietest periods is less than L_{A90} 30 dB the default minimum RBL and project intrusiveness noise levels have been adopted to determine the Project Noise Trigger Levels (PNTL) for use in the assessment as shown in **Table 6.10**.

Table 6.10 Rating Background Levels and Intrusiveness Noise Levels

Time Period	RBL L_{A90} dB	Project Intrusiveness Noise Level $L_{Aeq,15minute}$ dB
Day	35	40
Evening	30	35
Night	30	35

6.4.1.4 Assessment Criteria

The NPfI requires consideration of two types of criteria; the amenity noise criteria and the intrusiveness noise criteria. The amenity criteria seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses whilst the intrusiveness criteria aims to protect against significant changes in noise levels from a particular project.

The intrusive and amenity criteria were determined for each private receiver to identify the noise impact criteria, calculated as the lower (more stringent) of the amenity and intrusiveness criteria, against which the MCCO Project noise impacts were assessed. The MCCO Project specific criteria are presented in **Table 6.11**.

Table 6.11 Project Noise Impact Criteria – dB(A)

Receiver	Day $L_{Aeq,15minute}$	Evening $L_{Aeq,15minute}$	Night $L_{Aeq,15minute}$
Private Receiver	40	35	35
Wybong Hall and Anglican Church	48	48	48

6.4.1.5 Peer Review

The NIA was subject to an independent peer review by EMM and is included as an Appendix to the NIA report (refer to **Appendix 8**). This process was voluntarily undertaken by Mangoola to ensure that the assessment was prepared in accordance with appropriate policies and guidelines, used appropriate methodologies, and provided accurate modelled predictions of the likely noise impacts associated with the MCCO Project. The peer review was undertaken in a staged manner so that peer reviewer input could be obtained at each key phase of the assessment (e.g. at model setup stage, reporting phase etc.). The peer review found that the completed NIA was of a high quality and was prepared in accordance with relevant professional standards.

6.4.2 Assessment

6.4.2.1 Operational Noise

The noise model was used to determine noise levels from the MCCO Project at private receivers, under a range of meteorological conditions, including adverse conditions that propagate noise. The modelling found that after the application of reasonable and feasible noise controls, the MCCO Project is predicted to exceed the PNTLs at a number of private receivers as summarised in **Table 6.12**.

The receivers listed in **Table 6.12** are deemed to have residual noise impacts. Residual noise impacts occur when the best achievable noise levels predicted for a private residential receiver are greater than the PNTL, and all reasonable and feasible noise mitigation measures have been considered. The significance of the residual impact is then assessed as per the NPfI and VLAMP to assess the need for receptor-based treatment options. It is noted that different significance categories (negligible to significant) are specified in the NPfI and VLAMP and have been applied in the NIA consistent with those policies.

Residual noise impact significance levels have been determined in accordance with both the NPfI and the VLAMP. The NPfI and VLAMP methods for determining residual noise impact significance categories differ. The VLAMP method is more conservative as it affords voluntary acquisition rights to private receivers with predictions exceeding PNTL by more than 5 dB. The results from the more conservative VLAMP method are presented in **Table 6.12**.

Table 6.12 Residual Noise Impact Significance Levels Based on VLAMP

Significance Category	Number of Receivers	Receiver ID	Potential Treatment Afforded Under VLAMP
Significant	7	66#, 83^, 110#, 130#, 139, 148#, 205	Voluntary acquisition rights
Moderate	0	-	Receiver mitigation rights
Marginal	19	25*, 128, 144, 154, 170, 171, 176#, 193, 261, 263, 109A#, 109B#, 109C#, 109D#, 109E#, 109F#, 125A, 134A#, 182B	Receiver mitigation rights
Negligible	31	54, 79, 104, 114, 141, 147, 151, 157, 165, 166, 177#, 178, 190#, 192, 206, 240, 251#, 253, 260, 321, 106B, 112A, 112B, 112C, 125C, 182A, 183C, 184A, 241A, 241B, 241C	Low level exceedance that would not warrant receiver-based treatments or control

^ Currently has acquisition rights under existing Project Approval

*Acquisition rights under existing project approval to be maintained

Currently has mitigation rights under existing Project Approval

Fifty-seven private receivers had a 90th percentile prediction that exceeded the PNTL in at least one time period for at least one of the four stages modelled. Seven of these private receivers exceeded the PNTL by more than 5 dB and were deemed under the VLAMP to fall within the significant impact category. Under the VLAMP these seven private receivers would be afforded voluntary acquisition rights should the MCCO Project be approved. Additionally, one private receiver (ID 25) that has acquisition rights under PA 06_0014 is not entitled to acquisition for the MCCO Project, however, Mangoola voluntarily propose to retain acquisition rights for this receiver.

In addition to the receivers entitled to acquisition rights under the MCCO Project, 18 receivers are entitled to mitigation rights (receiver 25 is excluded from this count, as acquisition rights are to be retained). Additionally, six receivers that have mitigation rights under PA 06_0014 are not entitled to mitigation for the MCCO Project; however, Mangoola voluntarily propose to retain mitigation rights for these six receivers.

Relevant to the Wybong Hall and Anglican Church the noise model predicts maximum impacts of $L_{Aeq,15minute}$ 42 and 38 dB respectively. In both cases, predictions are less than the criteria of $L_{Aeq,15minute}$ 48 dB.

Figure 6.5 illustrates the combined worst-case noise results for the MCCO Project and represents the maximum envelope predicted for all stages, and all time periods. That is, this is not the predicted noise level that will occur at all times but is the highest 90th percentile noise level predicted at any stage of the MCCO Project in any season or time period (i.e. day, evening or night).

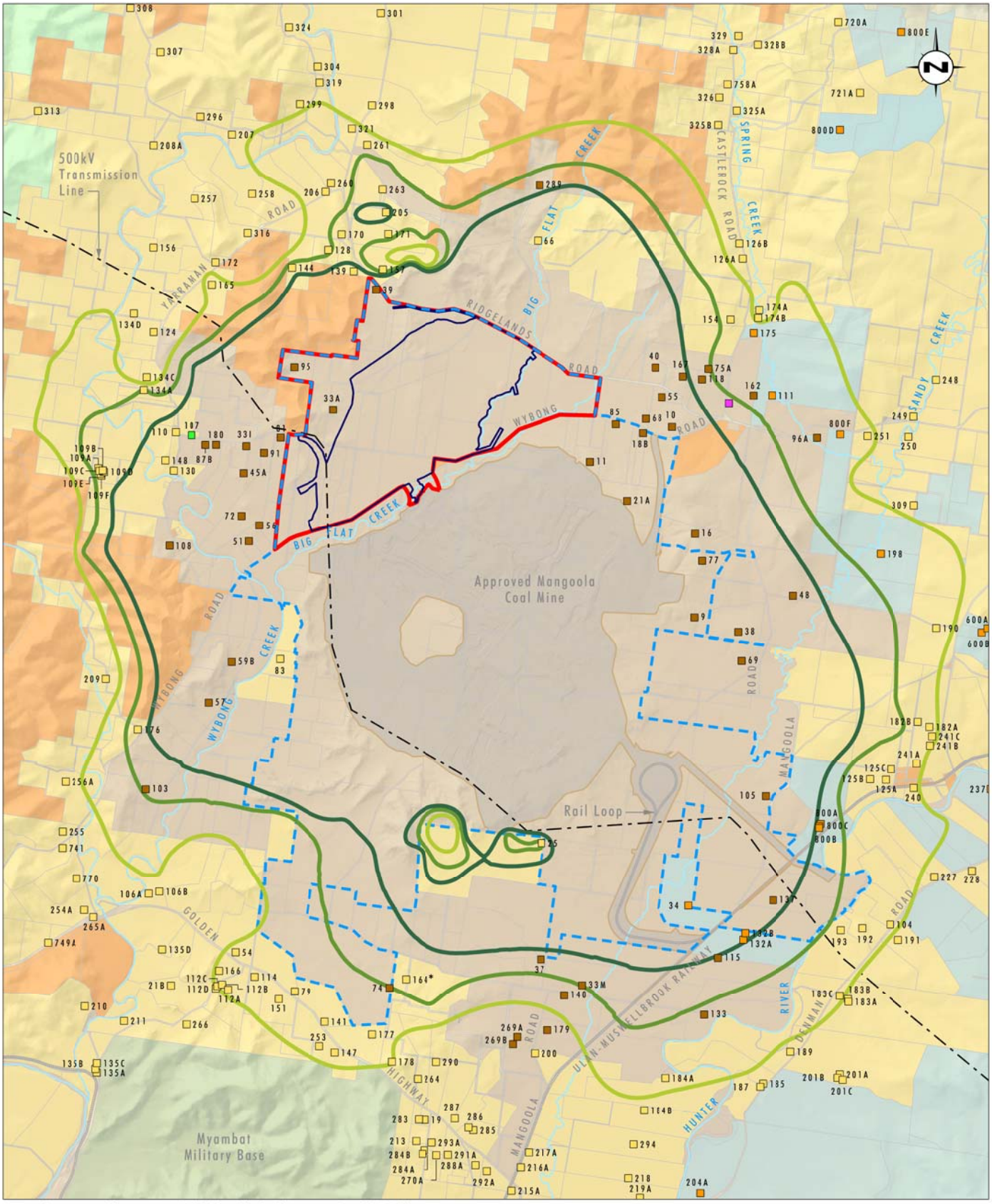
When these noise results were being shared with the local community as part of the stakeholder engagement for the MCCO Project a number of residents situated to the north and north-west questioned why the noise contours looked this way. As illustrated by the contours on **Figure 6.5** the potential noise impacts from the MCCO Project, particularly to the north and north-west are influenced by the existing natural topography, namely a significant ridgeline that is present in this area (refer to **Plate 1.1**). This ridgeline acts as a natural barrier in some areas and results in reduced noise levels for residences that are located on the other side of it. Detailed results for each private receiver for each year modelled along with noise contours for each stage are provided in **Appendix 8**.

As described in **Section 1.5** Mangoola plan to surrender the existing Project Approval prior to the commencement of coal mining within the MCCO Additional Project Area. Prior to this time construction activities within the MCCO Additional Project Area that are proposed to be completed within standard construction hours will be managed in accordance with the recommended construction noise criteria outlined in **Section 6.4.2.3**. For construction activities proposed to be undertaken outside of standard construction hours Mangoola is committed to managing noise such that the cumulative impact from the existing approved Mangoola Coal Mine operations and construction activities do not exceed the operational noise limits prescribed in PA 06_0014.

The proposed noise assessment criteria for the MCCO Project that will apply once mining commences in the MCCO Additional Project Area have been developed and are included in the NIA (refer to **Appendix 8**).

6.4.2.2 Private Land Assessment

For those properties not in the acquisition zone, private land was assessed in accordance with the VLAMP to determine whether acceptable amenity noise levels plus 5 dB would be exceeded over more than 25 per cent of any property area. The percentage of private land exceeding the night period acceptable amenity noise level plus 5 dB was considered as it has the highest model predictions and lowest amenity noise level and was found to be less than 25 per cent in all cases.



Data Source: Glencore (2019), Global Acoustics (2019)
Note: *Subject to Negotiated Agreement

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- The Commonwealth of Australia
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall
- 35 dB(A) Noise Contour
- 38 dB(A) Noise Contour
- 40 dB(A) Noise Contour

FIGURE 6.5

Combined Noise Contours
All Years and All Time Periods
($L_{Aeq, 15minute}$ dB)

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6.4.2.3 Construction Noise

Noise impacts during construction would largely result from noise generated during earthworks and other activities associated with the establishment of the Wybong Post Office Road realignment, construction of the haul road overpass over Big Flat Creek and Wybong Road and construction of water management infrastructure. Construction activities are anticipated to be completed over an approximate 16-month period prior to and during Project Year 1.

The Interim Construction Noise Guideline (ICNG) (DECC, 2009) provides noise management criteria for construction activities. The criteria are intended to guide the need for and selection of feasible and reasonable work practices to minimise construction noise impacts. A worst-case scenario which considered all relevant construction tasks scheduled to occur during the peak construction period was assessed in accordance with the ICNG. For this assessment, the peak construction period is based on the maximum total machine operating hours.

As noise will be generated by the current approved Mangoola Coal Mine, it was assumed that it would be operating at current project approval (PA 06_0014) limits at each receptor in order to obtain a cumulative noise level including both operational and construction noise. The assessment found that three receptors (66, 130 and 148) have 90th percentile predictions exceeding the standard hours 'noise affected' construction criterion, but well less than the ICNG 'highly noise affected' criterion (refer to **Table 6.13**). As discussed in **Section 6.4.2.1** these three receptors are within the acquisition zone for operational noise. These results represent worst case construction noise predictions that may occur during strongly enhancing weather conditions during the peak construction period. During non-enhancing weather conditions, and outside the peak construction period, construction noise should be well below the 'noise affected' construction criterion in all receptor locations (45 dBA for standard construction hours, and 35 dBA for outside standard construction hours). Construction noise criteria outlined in the ICNG has been adopted and are provided in **Table 6.14**.

Table 6.13 Construction Noise Assessment Predicted Exceedances– LAeq,15minute dB

Private Receiver	Construction Criteria (dB)		Non-Enhancing Weather * (dB)		Enhancing Weather ** (dB)	
	Standard Hours	Outside Standard Hours	Prediction	Exceedance	Prediction	Exceedance
66	45	37	37-41	Nil	39-47	2
148	45	37	38-38	Nil	45-47	2
130	45	37	37-38	Nil	44-46	1

* Non-enhancing weather predictions are based on neutral atmospheric conditions

** Enhancing weather predictions are based on 90th percentile results for the worst-case season.

Table 6.14 Recommended Construction Noise Criteria

Construction Hours	Noise Affected (dB)	Highly Noise Affected (dB)
Standard Construction Hours	45	75
Outside Standard Construction Hours	PA 06_0014 noise impact assessment criteria **	NA**

* Highly noise affected criterion not applicable outside standard construction hours; and

** Outside standard construction hours, noise levels should not exceed noise impact assessment criteria listed in Table 2 of PA 06_0014.

Mangoola is committed to undertaking primary noise generating activities associated with realignment of a portion of Wybong Post Office Road, construction of the Big Flat Creek and Wybong Road Overpass and establishment of water infrastructure during standard construction hours for which a criterion of LAeq,15minute 45 dB applies. However, Mangoola propose to undertake some construction tasks associated with these activities outside standard construction hours and is committed to managing noise such that the cumulative impact from the existing approved Mangoola Coal Mine operations and construction activities do not exceed the operational noise limits prescribed in PA 06_0014.

6.4.2.4 Sleep Disturbance

An analysis of maximum noise level events that have potential to cause sleep disturbance was completed for the MCCO Project. Sleep disturbance is assessed by predicting levels from plant items known to generate noise that can stand out above the general mining continuum. Examples of noise sources from mining activities occurring within the night-time that could lead to sleep disturbance include excavator bucket noise, dozer track noise, rear dump truck exhaust and first pass loads into empty truck bodies.

The NIA found that there are no predicted exceedances of the $L_{AF,max}$ criterion of 52 dB at any private receivers for the MCCO Project and as such, no sleep disturbance impacts are predicted.

6.4.2.5 Low Frequency Noise

An analysis of the predicted noise level results for the inclusion of 'modifying factors' was completed as part of the NIA in accordance with the NPfI. These are characteristics of noise received at residences that could result in more annoyance than would normally occur from that level of noise. The modifying factors are tonal noise, low frequency noise, impulsive noise, intermittent noise and duration (if single event).

Low frequency noise is the modifying factor most often applicable to mining operations. Mangoola Coal Mine has a fully attenuated mining fleet, and all major fixed plant infrastructure including the CHPP includes cladding in accordance with current industry best practice. Due to these mitigation measures, Mangoola Coal Mine does not typically attract low frequency noise modifying factor adjustments in the region of the CHPP, as supported by real time monitoring data. Predictive noise modelling confirms low frequency noise modifying factor adjustment should not apply at the nearest, potentially most affected residences to the MCCO Project, including during periods of strong meteorological enhancement. Continued use of the existing infrastructure is proposed, and the current noise attenuated mining fleet will be retained until replacement is required with new mobile equipment purchased for the MCCO Project to also be attenuated. Low frequency noise from the MCCO Project is not expected to increase as a result of the proposed operations within the MCCO Additional Project Area relative to the existing approved operations.

6.4.2.6 Road Noise

The approved maximum ROM coal production rate of 13.5 Mtpa will not change, and no additional staff or traffic associated with the ongoing operation of Mangoola Coal Mine are proposed. As there is no change to operational road traffic volumes associated with the MCCO Project relative to the approved operation, no change in operational road traffic noise impacts are predicted to occur.

Proposed construction activities will generate additional road traffic on the local road network. Construction road traffic noise impact was therefore assessed, for the nearest receptors to Wybong Road in each direction from the mine access point, using projected traffic volumes presented in the Traffic Impact Assessment (refer to **Section 6.13**). All predicted construction traffic noise levels are predicted to comply with the relevant criteria. Accordingly, construction road traffic noise impact is not predicted.

6.4.2.7 Rail Noise

There is no proposed change to the currently approved production rate of 13.5 Mtpa ROM coal and approved rail capacity of 10 trains per day. Therefore, there is not predicted to be any change to existing annual approved rail movements or rail noise associated with the MCCO Project. As noted in **Section 3.0**, the MCCO Project will extend the life of the Mangoola Coal Mine for one year beyond the currently approved life of the mine (subject to the timing of the determination of the Project) and therefore rail noise would occur for one additional year beyond that currently approved.

6.4.2.8 Cumulative Noise

As required by the NPfI the NIA considered the potential for cumulative noise impacts associated with the MCCO Project and other mines and industries. The NIA found that cumulative noise involving significant contributions from the Mangoola Coal Mine does not occur due to noise from other mines being mitigated by weather effects when noise is enhanced from Mangoola Coal Mine, and vice versa. As described in **Section 6.15.4** the nearest mine to Mangoola Coal Mine is the Mount Pleasant Mine which is approximately 9 km to the north-east.

Accordingly, the NIA has concluded that cumulative noise impacts are not predicted as a result of the MCCO Project.

6.4.3 Noise Management and Monitoring

The identification and assessment of reasonable and feasible noise controls have been considered throughout the MCCO Project design process and incorporated into detailed noise modelling.

Mangoola commits to review and update the existing Noise Management Plan and then implement the updated plan for the MCCO Project. The Noise Management Plan will detail the monitoring and management controls to be implemented to manage noise impacts associated with the MCCO Project including ongoing implementation of the proactive and reactive management protocols in response to noise trigger levels defined in the plan.

Mangoola also commits to the implementation of the following project design and operational controls to assist in managing noise emissions from the site:

- haul route alignments within the mining area will maximise the available topographical shielding provided by the mine design, where practicable
- an 8 m high noise bund will be constructed where required on the haul road located on the southern side of Wybong Road connecting the proposed Wybong Road and Big Flat Creek overpass to the Approved Project Area to reduce noise emissions primarily to the north and west

- mobile equipment will be attenuated to sound power levels consistent with the existing fleet
- mobile crushing plant and scrapers will only operate during the day period
- mobile crushing plant will be located in shielded locations of the mining areas that provide a good level of shielding in the direction of the nearest receptors
- significant noise generating fixed infrastructure in the CHPP will remain acoustically treated (clad) at current coverage levels
- the existing 3.5 m high barrier wall installed to sections of the rail spur will be retained.

Mangoola will implement both proactive and reactive noise control strategies informed by real-time noise and meteorological monitoring systems. Proactive noise management will involve the discussion and planning of activities in advance of potentially adverse conditions. Specifically, the proactive noise management approach will include:

- implementation of a system to provide environmental personnel with a daily forecast of expected conditions in the vicinity of the operation, particularly with regard to the potential for noise enhancing meteorological conditions
- using noise forecasts for daily operational planning
- modifying the planned mining activities, as appropriate, to minimise or avoid the potential noise impacts including but not limited to:
    - various levels will be provided for overburden emplacement to allow shielded emplacement during noise enhancing meteorological conditions
    - dozers will be restricted to 1st gear operation if required during periods of noise enhancing meteorological conditions
    - drill pad preparation dozers will be shut down if required during periods of noise enhancing meteorological conditions.

Mangoola will implement reasonable and feasible receiver based noise mitigation measures which may include measures such as double glazing, insulation or air conditioning to residences located within the active noise management zone upon written request.

Mangoola will maintain the existing noise voluntary acquisition and active management rights for affected private land within the existing Mangoola Project Approval regardless of whether or not these rights are required by the current VLAMP due to the impacts of the MCCO Project.

Based on the findings from the NIA the proposed noise monitoring network for the MCCO Project is shown in **Figure 6.6** (note that some changes may be necessary to the proposed locations due to site specific factors and landholder requirements). This figure shows the existing monitoring locations for Mangoola Coal Mine and identifies areas where new sites, both real time and attended are proposed to monitor compliance of the proposed operations within the MCCO Additional Project Area. Mangoola will conduct a detailed review of both the proposed and existing sites following determination of the development application to confirm that the monitoring network provides adequate coverage of the MCCO Project Area in order to validate EIS predictions and monitor compliance with relevant criteria. Mangoola will update the existing Noise Management Plan and then implement the updated plan for the MCCO Project. This will include the revised noise monitoring program.

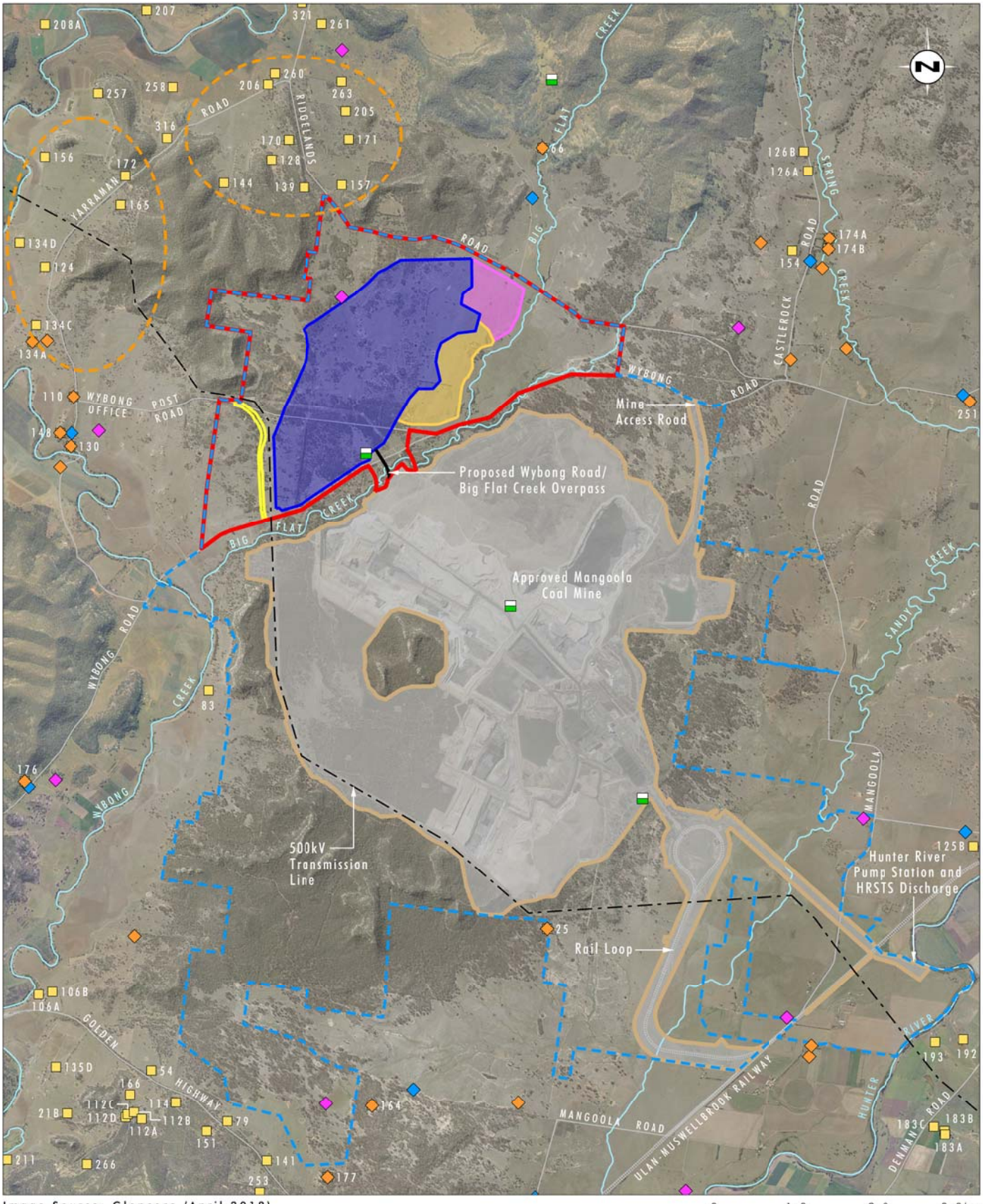

Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Private Residence
- Attended
- Biannual
- Real Time
- MET Monitoring Location
- Area Where Additional Noise Monitoring is Proposed

FIGURE 6.6

Proposed Revised Noise Monitoring Network

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20190516 15.25

6.5 Air Quality

A comprehensive assessment of the potential air quality impacts of the MCCO Project has been undertaken by Jacobs. This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require a detailed assessment of the likely air quality impacts of the MCCO Project in accordance with the Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW and having regard to the VLAMP.

As outlined in **Section 5.5**, air quality impacts were identified by the community as one of the issues of most concern and Mangoola considered this to be a key issue for the MCCO Project. This is consistent with the community feedback that was received during the preparation of the SIA's that have been completed for the original approval and each of the major modifications that have been undertaken, and during the operational phase of the existing Mangoola Coal Mine. As described below Mangoola has continued to take this feedback on board and sought to address it through operational changes and as part of the planning and design stages of the MCCO Project.

Since operations commenced at Mangoola in 2010 the number of air quality complaints received has fluctuated but generally trended downwards with a significant reduction observed since operations first commenced. In response to the concerns raised during this period, Mangoola has implemented a range of mitigation and management measures to reduce air quality and dust related impacts on surrounding private receivers.

In this regard, Mangoola has demonstrated a complying track record of managing air quality impacts from its mining operations and has a comprehensive Air Quality Management Plan in place. Notably air quality monitoring data for the existing mine shows that there have been no exceedances of the annual average PM_{10}, TSP and dust deposition criteria in the past seven years. $PM_{2.5}$ only came into effect as an assessment criterion from 20 January 2017, prior to which it was referred to as an advisory reporting goal. Since this time monitoring has recorded one exceedance of the $PM_{2.5}$ annual average criteria of 8 $\mu g/m^3$ (with a reading of 8.1 $\mu g/m^3$ recorded in 2017 with this exceedance due largely to regional contributions). As described further in the sections below, regional factors which contribute to elevated $PM_{2.5}$ concentrations were identified in the Upper Hunter Fine Particle Characterisation Study (OEH, 2013b). A clear seasonal trend was identified with higher $PM_{2.5}$ concentrations occurring in the cooler months predominantly due to wood smoke from domestic heating.

In accordance with the existing Air Quality Management Plan, Mangoola will continue to utilise a range of proactive and reactive dust control strategies informed by real-time dust and meteorological monitoring systems. Proactive strategies will include utilising meteorological forecasting to plan activities in advance of potentially adverse conditions as well as a range of controls to minimise dust including water carts, road maintenance, water sprays, enclosures and progressive rehabilitation. Reactive strategies will include the modification or suspension of mining activities in response to a series of triggers such as visual conditions, meteorological conditions or elevated ambient air quality conditions.

With regard to Mangoola's approach to the design and planning of the MCCO Project this process has closely considered air quality impacts and incorporated air quality mitigation and management measures into the MCCO Project design. Key measures included in the MCCO Project design that have minimised air quality emissions include:

- reductions to the overall MCCO Additional Disturbance Area through optimisation of the Proposed Additional Mining Area and design of emplacement activities to reduce the area of out of pit emplacement required. This reduced the overall disturbance footprint for the MCCO Project and therefore the area of mining operations that could generate dust

- mine scheduling changes to reduce the overall intensity of mining equipment operating in the MCCO Additional Project Area. This means that there is less mining equipment in the Proposed Additional Mining Area than currently operating at full production at Mangoola Coal Mine, reducing the amount of dust generated by the equipment operating in the MCCO Additional Project Area
- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated dust generation and diesel emissions
- design of emplacement activities so that different emplacement locations can be used in different meteorological conditions to avoid operating in exposed areas in windy conditions that could increase dust generation, where practicable
- inclusion of temporary rehabilitation areas as part of the emplacement area design to reduce wind generated dust
- continued implementation of the air quality management practices of the approved Mangoola Coal Mine (e.g. through a high level of active dust control).

A summary of the key findings of the Air Quality Impact Assessment (AQIA) is provided in this section and the full report is provided in **Appendix 9**.

6.5.1 Methodology and Existing Environment

The AQIA methodology followed the EPA's Approved Methods of the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2016), which specifies how assessments based on the use of air dispersion models should be undertaken. Air dispersion modelling was completed using various inputs including emissions sources based upon representative mine plan stages for the Project, meteorological data and background air quality data. The results were then compared to relevant EPA assessment criterion and the criteria contained within the VLAMP. Further details of the methodology are provided in the following sections with a full description included in **Appendix 9**.

6.5.1.1 Modelling

The CALPUFF modelling system was used to predict dust concentration and dust deposition levels due to the MCCO Project. CALPUFF is an air dispersion model which has been approved by the EPA for these types of assessments. Modelling was undertaken for Project Years 1, 3, 5 and 8 as they represent a combination of mining across the two operational areas, include the extremities of the MCCO Proposed Additional Mining Area and capture periods of greatest intensities of mining. The project years that have been modelled are considered to represent maximum likely impacts as a result of the MCCO Project. The conceptual staged mine plans and production schedule were used to determine relevant emission sources and to predict emission sources for each year.

6.5.1.2 Meteorological Data

Mangoola own and operate a meteorological station which is located within the MCCO Additional Project Area (refer to **Figure 2.5**). Data from this station and the OEH operated Wybong meteorological station were examined and determined to be representative for use in the AQIA. Data from each of these sources were then used in a meteorological modelling program known as CALMET which simulates the meteorological patterns that exist within the region taking into account the effects of local topography and changes in land surface characteristics.

6.5.1.3 Background Air Quality

Mangoola conducts air quality monitoring at the locations shown on **Figure 2.5**. As described in **Section 2.11.1** this includes continuous monitoring of PM_{10} using TEOM and E-samplers, measurement of PM_{10}, TSP and $PM_{2.5}$ using High Volume Air Samplers and monitoring of dust deposition using dust deposition gauges.

A detailed review of all available monitoring data was completed as part of the AQIA and is provided in **Appendix 9**. A summary of key findings of this review is provided below.

Particulate Matter – PM_{10}

Monitoring data indicates there are relatively good air quality conditions in the vicinity of Mangoola Coal Mine, with respect to PM_{10}. This conclusion is based on annual average PM_{10} concentrations which, for the five-year period from 2013 - 2018, ranged between 10 and 15 µg/m^3 and typically less than half the current EPA assessment criterion (25 µg/m^3). Concentrations in the vicinity of Mangoola Coal Mine have also been lower than those measured at Muswellbrook. Occasional exceedances of the 24-hour average PM_{10} criterion of 50 µg/m^3 were recorded during this period, however, this is not uncommon for most parts of NSW, including rural and urban areas. None of these exceedance events were identified as being caused by activities at the existing Mangoola Coal Mine.

Based on this review the following background levels were adopted for modelling purposes:

- maximum 24-hour average = 41 µg/m^3
- annual average = 11 µg/m^3.

Particulate Matter – $PM_{2.5}$

Monitoring data indicates that the highest 24-hour average $PM_{2.5}$ concentrations have exceeded 25 µg/m^3 on at least one occasion in the five-year period from 2013 – 2018 and annual averages have exceeded 8 µg/m^3 on a number of occasions. This is consistent with monitoring conducted at Muswellbrook where there have been exceedances for all years between 2012 and 2018. It should be noted that these levels for 24-hour average $PM_{2.5}$ and annual average $PM_{2.5}$ only came into effect as an assessment criterion from 20 January 2017, prior to which it was referred to as an advisory reporting goal.

Factors which contributed to elevated $PM_{2.5}$ concentrations in the region were identified in the Upper Hunter Fine Particle Characterisation Study (OEH, 2013b). A clear seasonal trend was identified with higher $PM_{2.5}$ concentrations occurring in the cooler months, and predominantly due to wood smoke from domestic heating. Specifically, in Muswellbrook, wood smoke accounted for an average of approximately 30 per cent of the total $PM_{2.5}$, peaking at around 62 per cent in winter.

Based on the review of background data the following assumed background levels were adopted for modelling purposes:

- maximum 24-hour average = 26 µg/m^3 (note, this level already exceeds the relevant EPA criterion so the approach to the assessment was to determine the potential of the MCCO Project to lead to additional exceedances)
- annual average = 5.2 µg/m^3.

Particulate Matter – TSP

Monitoring data shows that TSP concentrations have remained below the EPA's assessment criterion (90 µg/m^3). Based on this review the following assumed background levels have been adopted for modelling purposes:

- annual average = 50 µg/m^3.

Deposited Dust

Monitoring data shows that dust deposition has remained below the EPA's assessment criterion (4 g/m^2/month). Based on this review the following assumed background levels have been adopted for modelling purposes:

- 2.3 g/m^2/month.

Nitrogen Dioxide (NO_2)

The closest known air quality monitoring site that records NO_2 concentrations is located at Muswellbrook. A review of data from this station shows that the maximum NO_2 concentrations have been well below the EPA's 1-hour average criterion (246 µg/m^3). Annual averages have also been well below the EPA's annual average criterion (62 µg/m^3). Based on this review the following assumed background levels have been adopted for modelling purposes:

- 1-hour average = 80 µg/m^3.

6.5.1.4 Assessment Criteria

The relevant air quality assessment criteria for the MCCO Project are those set by the EPA as part of its Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA 2016). These criteria are outlined in **Table 6.15** and are designed to protect human health as well as amenity.

It should be noted that the existing Mangoola Coal Mine was assessed against an earlier version of the Approved Methods (DEC 2005a) which had different criteria. The 2016 version introduced a revised, more stringent criterion for PM_{10} (reducing from 30 µg/m^3 to 25 µg/m^3) as well as new criteria for 24-hour and annual average $PM_{2.5}$.

Table 6.15 Air Quality Assessment Criteria

Substance	Averaging Time	EPA Criterion	Source
PM_{10}	24-hour	50 µg/m^3	EPA (2016)/Department of Environment (DoE) (2016)
	Annual	25 µg/m^3	EPA (2016)/DoE (2016)
$PM_{2.5}$	24-hour	25 µg/m^3	EPA (2016)/DoE (2016)
	Annual	8 µg/m^3	EPA (2016)/DoE (2016)
TSP	Annual	90 µg/m^3	EPA (2016)/NHMRC (1996)
Deposited Dust	Annual (maximum increase)	2 g/m^2/month	EPA (2016)/NERDDC (1998)

Substance	Averaging Time	EPA Criterion	Source
	Annual (maximum total)	4 g/m^2/month	EPA (2016)/NERDDC (1998)
NO_2	1-hour	246 µg/m^3	EPA (2016)/NEPC (1998)
	Annual	62 µg/m^3	EPA (2016)/NEPC (1998)

The air quality assessment criteria set out in **Table 6.15** relate to the total concentration of air pollutants in the air (that is, cumulative) and not just the contribution from project-specific sources. As such consideration of background levels needs to be made when using these criteria to assess impacts.

The VLAMP provides guidance on voluntary mitigation and land acquisition to address dust (particulate matter) impacts from state significant mining, petroleum and extractive industry developments. The VLAMP as recently revised in 2018 brings the air quality criteria in line with the NEPM standards and EPA criteria. From this policy, voluntary mitigation rights may apply where, even with best practice management, the development contributes to exceedances of criteria at any residence or workplace (under certain circumstances) as shown in **Table 6.16**.

Table 6.16 Mitigation Criteria for Particulate Matter from the VLAMP

Substance	Averaging Time	Mitigation Criterion	Impact Type
Particulate Matter ($PM_{2.5}$)	Annual	8 µg/m^3*	Human health
	24-hour	25 µg/m^3**	Human health
Particulate Matter (PM_{10})	Annual	25 µg/m^3*	Human health
	24-hour	50 µg/m^3**	Human health
Particulate Matter (TSP)	Annual	90 µg/m^3*	Amenity
Deposited Dust	Annual	2 g/m^2/month**	Amenity
	Annual	4 g/m^2/month*	Amenity

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).

** Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

The above criteria (with one change as discussed below) also apply to voluntary acquisition rights where the development contributes to exceedances, even with best practice management, at any residence on privately owned land, workplace on privately owned land (in certain circumstances), or on more than 25 per cent of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls. The only difference between the mitigation and voluntary acquisition criteria is in regard to the allowable number of exceedances relating to incremental impact, with the policy allowing for the acquisition criteria 'up to five allowable exceedances of the criteria over the life of the development'.

6.5.1.5 Peer Review

The AQIA was subject to an independent peer review by Dr Nigel Holmes and is included as an appendix to the AQIA report (refer to **Appendix 9**). This process was voluntarily undertaken by Mangoola to confirm that the assessment was prepared in accordance with appropriate policies and guidelines, used appropriate methodologies, and provided accurate modelled predictions of the likely air quality impacts associated with the MCCO Project. The peer review was undertaken in a staged manner so that peer reviewer input could be obtained at each key phase of the assessment (e.g. at model setup stage, reporting phase etc.). The peer review found that the completed AQIA was of a high quality and was prepared in accordance with relevant professional standards.

6.5.2 Assessment

6.5.2.1 Dust

This section provides an overview of the findings of the air quality assessment related to dust impacts. This includes comparing the predicted impacts to the criteria which have been determined by the NSW Government to protect health and amenity.

Figure 6.7 to **Figure 6.10** illustrate the air quality contours for predicted annual average PM_{10}, annual average $PM_{2.5}$, annual average TSP and annual average dust deposition concentrations in relation to neighbouring private receivers for Project Year, 1, 3, 5 and 8.

A discussion on the assessment findings for each of these parameters as well as relevant 24-hour averaging periods are provided below with the full assessment included in **Appendix 9**.

PM_{10}

The predicted cumulative annual average PM_{10} concentrations for the MCCO Project comply with the criteria of 25 µg/m^3 at all private receivers. The AQIA therefore concluded that the MCCO Project will not cause adverse air quality impacts with respect to annual average PM_{10}. This is consistent with the existing situation with the air quality monitoring data for the existing mine showing that no exceedances of the annual average PM_{10} criteria occurred in the past seven years.

The predicted maximum 24-hour average PM_{10} concentrations for the MCCO Project when considered alone meet the criteria of 50 µg/m^3 at all private receivers. When the MCCO Project is considered cumulatively with existing background levels the maximum 24-hour average PM_{10} concentrations are predicted to meet the criteria of 50 µg/m^3 at all but one sensitive receiver (property 83).

Additional investigation of the predictions at property 83 have been carried out and there are only one or two days of predicted exceedances of the cumulative criteria each year and that on these days when the concentration is predicted to exceed 50 µg/m^3, the background level is in the order of 30 µg/m^3 or more; a result which suggests that the MCCO Project would not be the primary cause of an exceedance. In addition, it should be noted that property 83 is subject to voluntary acquisition under the existing approved operation and is within the predicted noise voluntary acquisition zone for the MCCO Project. The predicted PM_{10} impacts at property 83 do not trigger the voluntary mitigation or acquisition criteria in the VLAMP.

$PM_{2.5}$

The predicted cumulative annual average $PM_{2.5}$ concentrations for the MCCO Project comply with the criteria of 8 µg/m^3 at all private receivers.

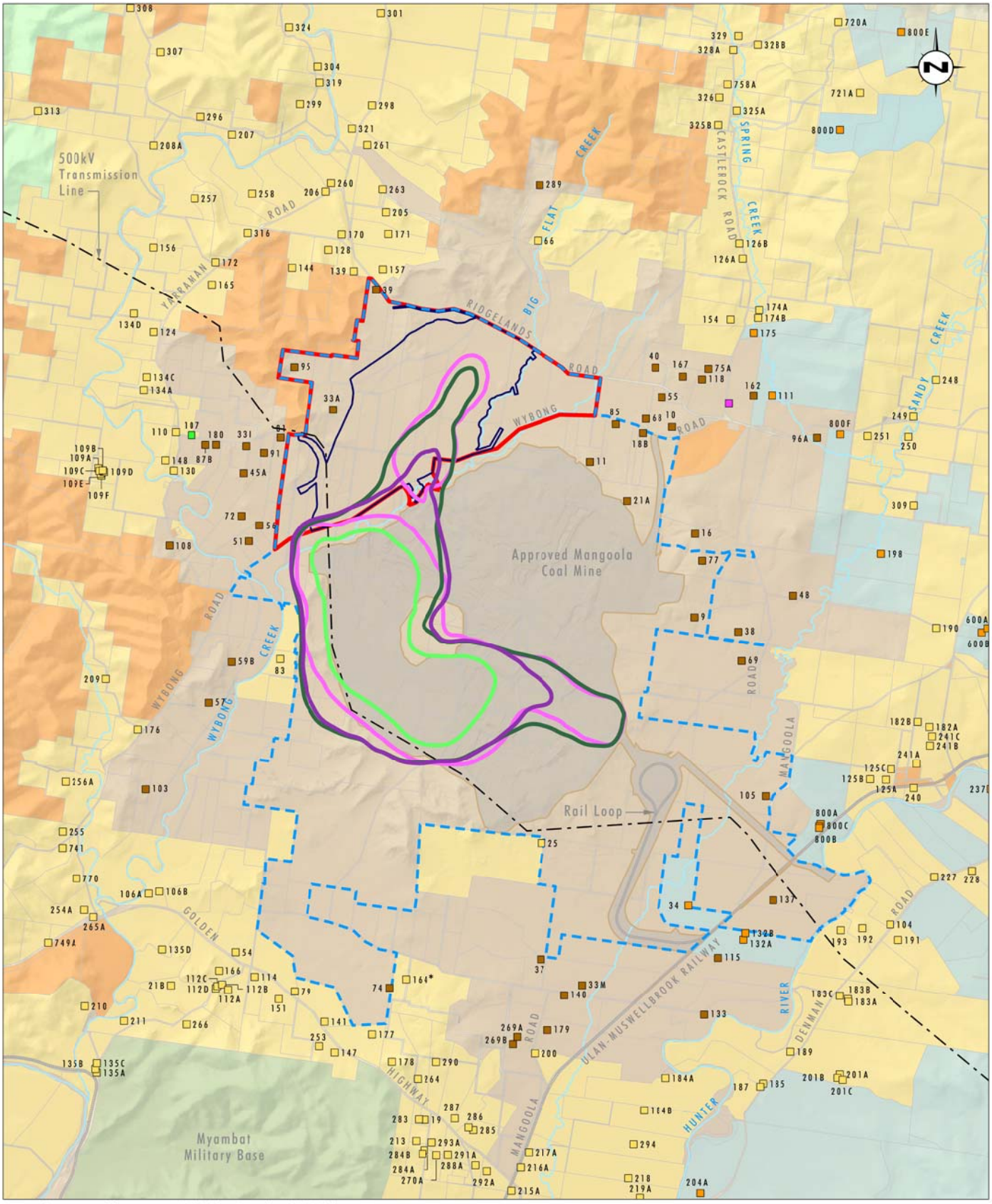
The predicted maximum 24-hour average $PM_{2.5}$ concentrations for the MCCO Project when considered alone will not exceed the criteria of 25 µg/m^3 at any private receivers with the projects contribution predicted to be in the order of up to 5 µg/m^3 at the nearest private receivers.

When the MCCO Project is considered cumulatively with existing background levels the maximum 24-hour average $PM_{2.5}$ concentrations are predicted to meet the criteria of 25 µg/m^3 at all but one sensitive receiver (property 83) in all assessment years.

Additional investigation of the predictions at property 83 indicated there would be up to two days each year when the 24-hour average $PM_{2.5}$ concentration exceeded 25 µg/m^3 at property 83. On these days when the concentration is predicted to exceed 25 µg/m^3, the background level is already in the order of 25 µg/m^3; a result which suggests that the MCCO Project would not be the primary cause of an exceedance. As discussed above, it should be noted that property 83 is subject to voluntary acquisition under the existing approved operation and is within the predicted noise voluntary acquisition zone for the MCCO Project. These results suggest that the MCCO Project will contribute to, but will not be the primary cause of, an exceedance of the 24-hour average criterion. The predicted $PM_{2.5}$ impacts at property 83 do not trigger the voluntary mitigation or acquisition criteria in the VLAMP.

TSP and Dust Deposition

Modelling indicates that there are no private receivers which are predicted to experience exceedances of the annual average TSP criterion (90 µg/m^3) or the annual average dust deposition criteria (4 g/m^2/month).



Data Source: Glencore (2019), Jacobs (2019)
Note: *Subject to Negotiated Agreement

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- The Commonwealth of Australia
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

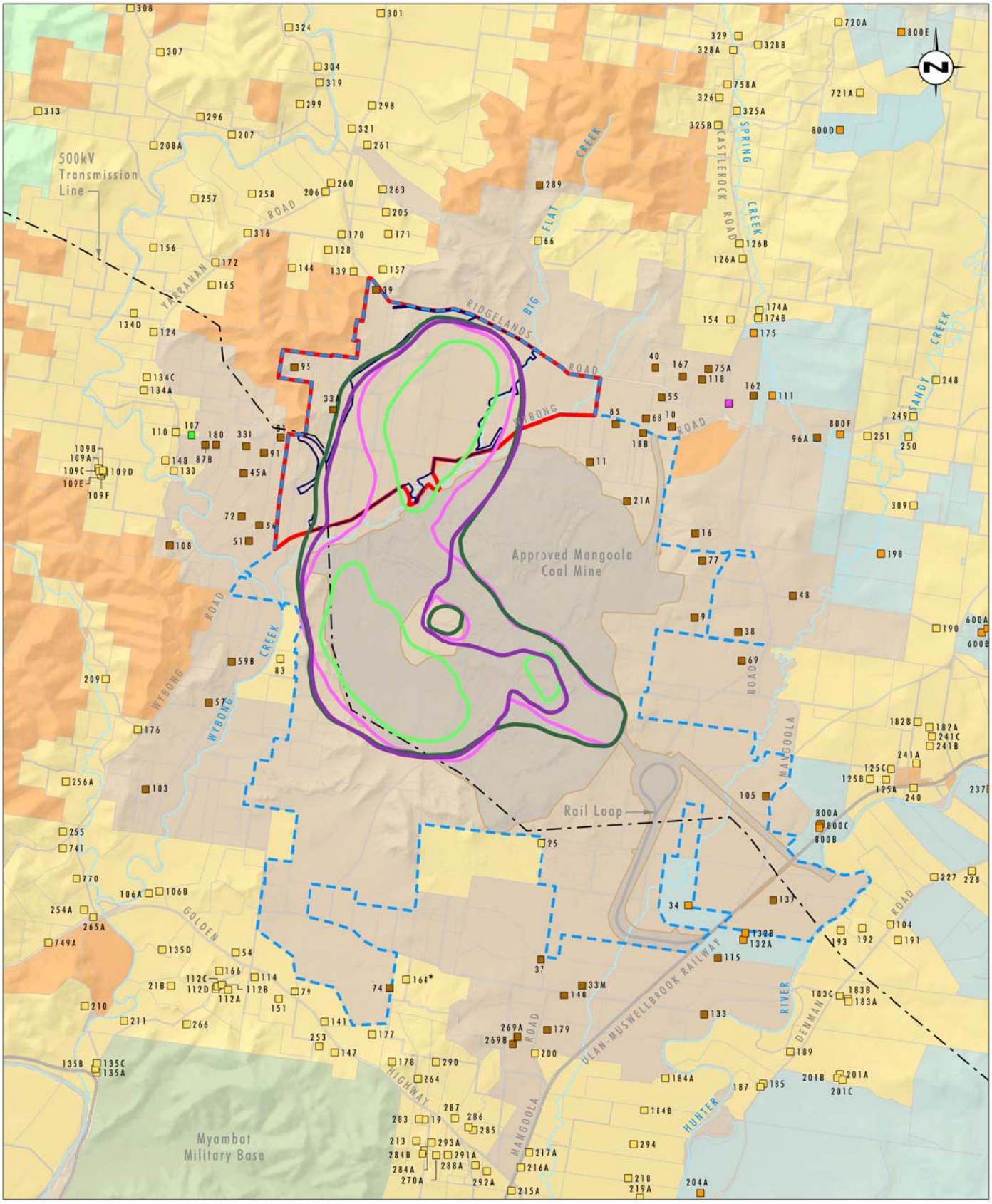
Air Quality Contours:

- 25$\mu g/m^3$ PM_{10} annual average (cumulative)
- 8$\mu g/m^3$ $PM_{2.5}$ annual average (cumulative)
- 90$\mu g/m^3$ TSP annual average (cumulative)
- 4g/m^2/month Dust Deposition annual average (cumulative)

FIGURE 6.7

Predicted Air Quality Contours Project Year 1

File Name: R13/4004_311.dgn
20190621 9.13



Data Source: Glencore (2019), Jacobs (2019)
Note: *Subject to Negotiated Agreement

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- The Commonwealth of Australia
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

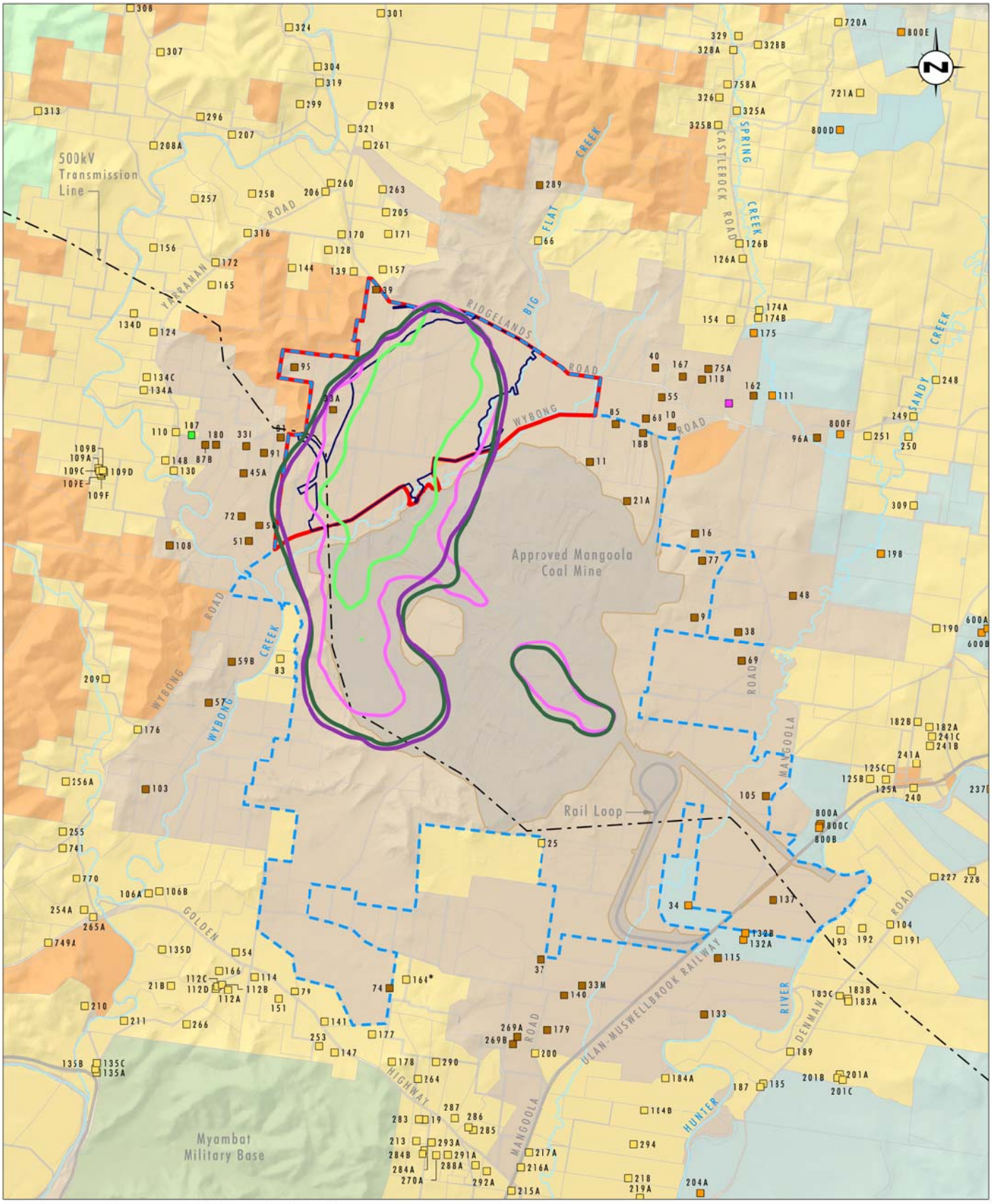
Air Quality Contours:

- 25$\mu g/m^3$ PM_{10} annual average (cumulative)
- 8$\mu g/m^3$ $PM_{2.5}$ annual average (cumulative)
- 90$\mu g/m^3$ TSP annual average (cumulative)
- 4g/m^2/month Dust Deposition annual average (cumulative)

FIGURE 6.8

Predicted Air Quality Contours Project Year 3

File Name: R13/4004_312.dgn
20190621 9.15



Data Source: Glencore (2019), Jacobs (2019)
Note: *Subject to Negotiated Agreement

0 1.0 2.0 4.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- The Commonwealth of Australia
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

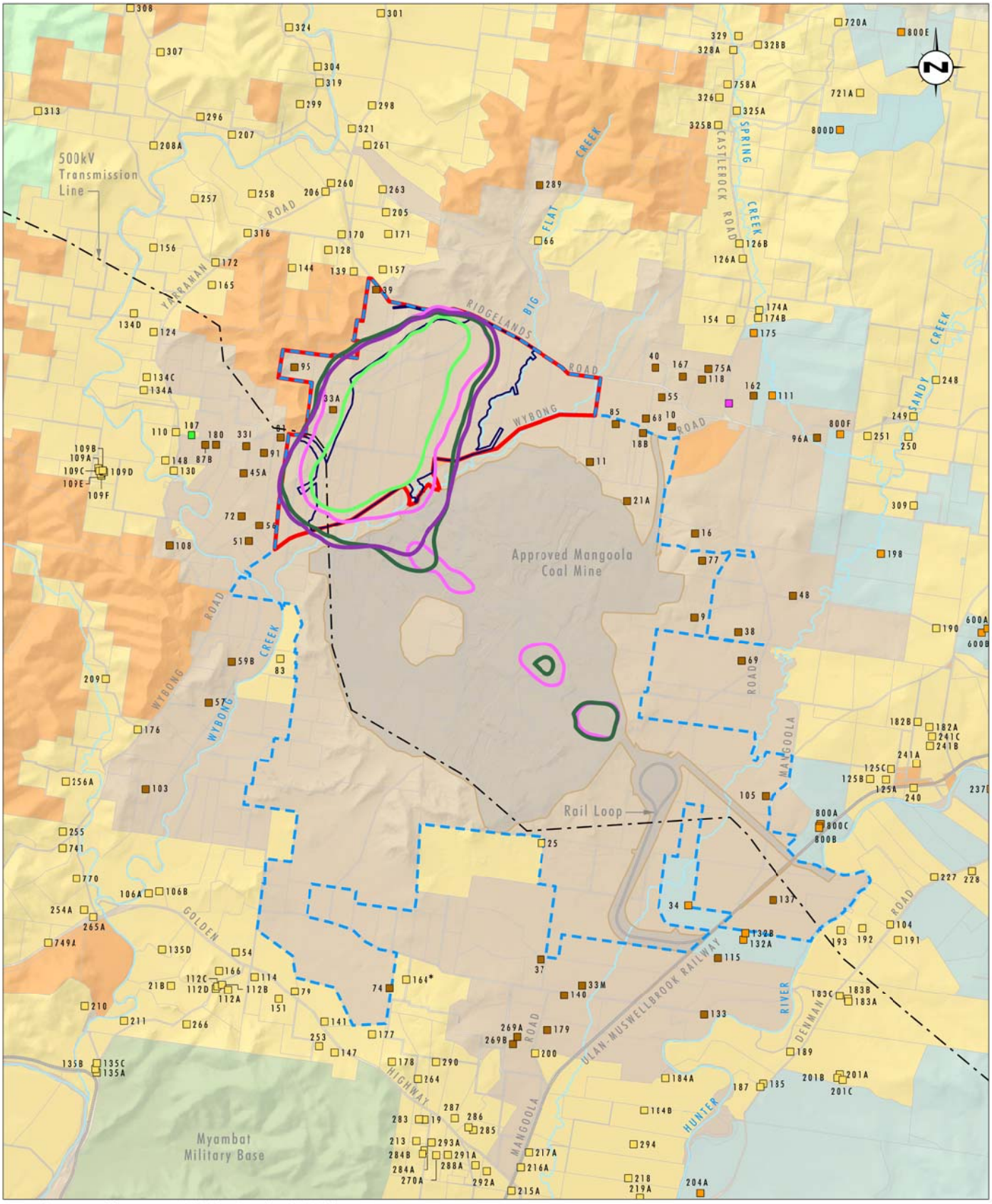
Air Quality Contours:

- 25$\mu g/m^3$ PM_{10} annual average (cumulative)
- 8$\mu g/m^3$ $PM_{2.5}$ annual average (cumulative)
- 90$\mu g/m^3$ TSP annual average (cumulative)
- 4g/m^2/month Dust Deposition annual average (cumulative)

FIGURE 6.9

Predicted Air Quality Contours Project Year 5

File Name: R13/4004_313.dgn
20190621 9.16



Data Source: Glencore (2019), Jacobs (2019)
Note: *Subject to Negotiated Agreement

0 1.0 2.0 4.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Nature Reserve
- The Commonwealth of Australia
- Private Residence
- Mangoola Owned Residence
- Other Mine Owned Residence
- Church
- Wybong Hall

Air Quality Contours:

- 25$\mu g/m^3$ PM_{10} annual average (cumulative)
- 8$\mu g/m^3$ $PM_{2.5}$ annual average (cumulative)
- 90$\mu g/m^3$ TSP annual average (cumulative)
- 4g/m^2/month Dust Deposition annual average (cumulative)

FIGURE 6.10

Predicted Air Quality Contours Project Year 8

File Name: R13/4004_314.dgn
20190621 9.22

6.5.2.2 Blast Fume

Blasting activities have the potential to result in fume and particulate matter emissions. Blast fume emissions comprise oxides of nitrogen (NO_x) including nitric oxide (NO) and nitrogen dioxide (NO_2). It is the NO_2 which has been linked to adverse health effects. It is noted that blast fume does not occur on every blast as it relates to the incomplete oxidation of the explosives used and therefore typically only occurs periodically. In this regard Mangoola has a demonstrated track record of managing blasting to limit blast fume events with only two off-site incidents having occurred over the past seven years (one in 2015 at a property now owned by Mangoola and one in 2013). It is noted that since 2015 Mangoola has put in place additional and improved controls including new forecasting and predictive procedures to manage potential blast fume impacts. Since these additional measures have been put in place there have been no further blast fume events.

To assess the potential impacts of blast fume, modelling of blast fume impacts was undertaken for the MCCO Project using a number of worst case emission scenarios. The assessment found that with the proposed blasting procedures in place, the MCCO Project is predicted to comply with the relevant criteria at all private receivers.

Mangoola has an existing blasting procedure which covers blast fume management. This will be updated and implemented for the MCCO Project to ensure that key fume management actions, such as defining the potential risk zone based upon weather patterns and obtaining permission to fire blasts based on an assessment of real-time weather conditions are adhered to for operations within the MCCO Project Area. Mangoola also continues to work closely with its explosive suppliers to minimise the potential for the occurrence of blast fume.

6.5.2.3 Diesel Emissions

Emissions from diesel exhausts associated with off-road vehicles and mining plant and equipment have been assessed as part of the AQIA. As discussed in **Section 3.3.2** the MCCO Project proposes to largely use the existing equipment fleet that is already in place at Mangoola Coal Mine. The most significant emissions from diesel exhausts are products of combustion including carbon monoxide (CO), NO_2 and particulate matter (PM_{10} including $PM_{2.5}$). The NO_2 and PM_{10} (including $PM_{2.5}$) have been considered as part of the AQIA.

Modelling of the potential NO_2 concentrations associated with diesel use as part of the MCCO Project indicates a maximum 1-hour average concentration at the nearest private receiver location of approximately 50 µg/m^3. With the addition of maximum background levels of 80 µg/m^3, the predicted levels readily comply with the criteria of 246 µg/m^3. Predicted annual average NO_2 concentrations at the nearest private receiver are approximately 10 µg/m^3 or less. With the addition of conservative background levels of 21 µg/m^3, the predicted levels comply with the criteria of 62 µg/m^3. All other surrounding private receivers are more distant and are predicted to have lower levels than those predicted at the nearest residence.

6.5.2.4 Construction Phase

Construction activities associated with the MCCO Project were also assessed as part of the AQIA. Air quality impacts during construction would largely result from dust generated during earthworks and other activities associated with the establishment of the Wybong Post Office Road realignment, construction of the haul road overpass over Big Flat Creek and Wybong Road and construction of water management infrastructure.

The quantity of material handled during the construction phase will be much lower than the quantity handled during the operational phase of the MCCO Project. Subsequently the AQIA found that the potential air quality impacts during construction will be lower than during operations and can be adequately managed with the implementation of standard operational management and mitigation measures such as stabilising exposed areas quickly and implementation of dust management measures including the use of water carts and enforcing constraints on work under extreme unfavourable weather conditions, such as on dry and windy days.

6.5.3 Air Quality Management and Monitoring

Mangoola is committed to effectively managing the air quality impacts associated with the MCCO Project and will implement a range of dust management measures for the key dust generating activities. These measures are currently implemented as part of the existing Air Quality Management Plan for the Mangoola Coal Mine and will continue to be implemented as part of the MCCO Project.

The key measures that will continue to be implemented and that have been incorporated into the modelling of the dust impacts of the MCCO Project include:

- minimising the area of disturbed land at any one time, in line with the approved MOP
- development of a mine plan that provides for timely progressive rehabilitation
- adopting controls for haul road dust emissions
- review of meteorological conditions prior to blasting
- consideration of meteorological conditions in planning the loading and unloading of overburden
- applying water and using dust curtains when drilling overburden
- minimising fall distance during loading and unloading of overburden
- utilising water sprays and water carts on ROM coal stockpile areas
- maintaining the existing covered conveyors and belt cleaning
- maintaining and servicing machinery, exhaust systems and plant equipment in accordance with contemporary maintenance practices
- using dust cameras to monitor dust
- enact the TARP process and to investigate dust levels when the TARP process is enacted to identify likely sources of dust from any complaints or potential compliance issues
- using temporary rehabilitation and stabilisation measures on disturbed land.

In addition to the measures listed above Mangoola implements both proactive and reactive dust control strategies informed by real-time dust and meteorological monitoring systems. Reactive air quality management will assess the need to modify the activities in response to the following triggers:

- visual conditions, such as excessive visible dust
- meteorological conditions, such as dry, strong wind conditions
- ambient air quality conditions (that is, elevated short-term PM_{10} concentrations).

Proactive air quality management will involve the discussion and planning of activities in advance of potentially adverse conditions. Specifically, the proactive air quality management approach will include:

- implementation of a system to provide environmental personnel with a daily forecast of expected dust conditions in the vicinity of the operation
- discussion of the dust forecast at daily operational meetings
- modifying the planned mining activities, as appropriate, to minimise or avoid the potential dust impacts.

The AQIA compared the dust management measures proposed for the MCCO Project to the measures outlined in the NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining (Donnelly et al, 2011). This comparison identified that the proposed measures are consistent with best practice dust mitigation measures.

Based on the findings from the AQIA the proposed air quality monitoring network for the MCCO Project is shown on **Figure 6.11** (note that some changes may be necessary to the proposed locations due to site specific factors and landholder requirements). This figure shows the existing monitoring locations for Mangoola Coal Mine and identifies areas where new sites are proposed to monitor compliance of the proposed operations within the MCCO Additional Project Area. Mangoola will conduct a detailed review of both the proposed and existing sites following determination of the development application to confirm that the monitoring network provides adequate coverage of the MCCO Project Area in order to validate EIS predictions and monitor compliance with relevant criteria. Mangoola will update the existing Air Quality Management Plan and then implement the updated plan for the MCCO Project. This will include the revised air quality monitoring program.

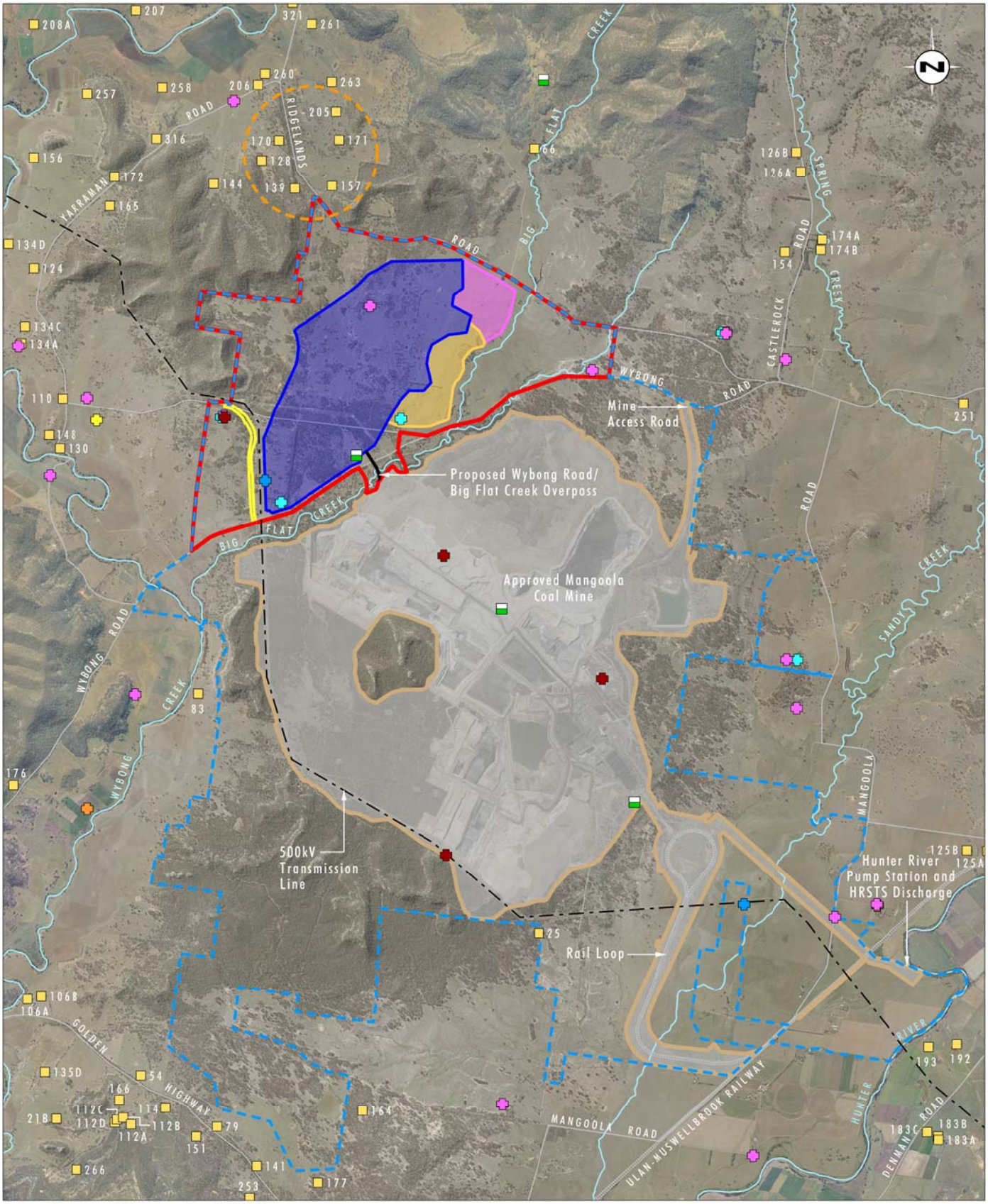


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

0 1.0 2.0 3.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Private Residence
- Depositional Dust Gauge
- Dust Camera
- Esampler
- HVAS
- TEOM
- TSP
- MET Monitoring Location
- Area Where Additional Air Monitoring is Proposed

FIGURE 6.11

Proposed Revised Air Quality Monitoring Network

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6.6 Blasting

A comprehensive assessment of the potential blasting impacts of the MCCO Project has been undertaken by Enviro Strata Consulting. This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require a detailed assessment of the likely blasting impacts of the MCCO Project on people, animals, buildings, infrastructure and significant natural features having regard to relevant ANZECC guidelines.

As outlined in **Section 5.5**, blasting impacts were identified by the community as an issue of concern, particularly in relation to the potential for damage to private property. This is consistent with the community feedback that was received during the preparation of the original approval and each of the major modifications that have been undertaken since that time, and during the operational phase of the existing Mangoola Coal Mine. As described below Mangoola has continued to take this feedback on board and sought to address it through operational changes such as strategic design of blasts and management of charge masses, and as part of the planning and design stages of the MCCO Project.

In this regard, Mangoola has a demonstrated track record of managing blasting impacts from its mining operations with no exceedances of the relevant ground vibration criteria during the previous 5 years and only one exceedance of the relevant blast overpressure criteria which occurred during 2016. Mangoola has a comprehensive Blast Management Plan in place and in accordance with this plan Mangoola will continue to utilise a range of management strategies informed by regular monitoring and reporting of blasting outcomes.

A summary of the key findings of the Blasting Impact Assessment (BIA) is provided in this section and the full report is provided in **Appendix 10**.

6.6.1 Methodology

As the blasting impacts associated with the Mangoola Coal Mine within the Approved Project Area have previously been assessed and approved they have not been considered as a part of this impact assessment. In this regard the BIA has focused on the proposed mining operations within the MCCO Additional Project Area.

Ground vibration and blast overpressure predictive models were developed to assess the potential blasting impacts of the MCCO Project. The models were developed based on a review of vibration and blast overpressure monitoring data collected from the existing mining operation.

A range of blast charge masses and bench heights were modelled for the MCCO Project. The modelled blast sizes were selected as being representative of the range of blast sizes that may occur at the mine in practice. It is noted that in practice, each blast will be designed on a case by case basis to comply with relevant vibration and blast overpressure criteria, however, this range of different blast sizes was utilised for assessment purposes.

6.6.1.1 Blast Sensitive Locations

A number of blast sensitive locations surrounding the MCCO Additional Project Area were identified for consideration in the BIA. These are shown on **Figure 6.12** and include:

- private residences
- public roads
- power transmission lines
- prescribed dams at the existing Mangoola Coal Mine
- rock formations, including rock shelters identified from the Aboriginal archaeology impact assessment (refer to **Section 6.12**)
- identified historic heritage items from the historic heritage assessment (refer to **Section 6.11**).

As shown on **Figure 1.5**, the majority of land surrounding the MCCO Additional Project Area is mine owned with the closest private residences (ID 157 and 139) located approximately 1.15 km and 1.4 km to the north of the MCCO Proposed Additional Mining Area, respectively.

6.6.1.2 Assessment Criteria

The blast assessment criteria relevant to the MCCO Project based on the identified blast sensitive locations identified in **Section 6.6.1.1** are outlined below.

The relevant blast assessment criteria for occupied residences from the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration, are reproduced in **Table 6.17**.

Table 6.17 Residential Blasting Amenity Criteria

Receiver	Ground Vibration (mm/s)	Allowable Exceedance	Overpressure (dBL)	Allowable Exceedance
Residence on Privately Owned Land	5	5 per cent of the total number of blasts over a 12 month period	115	5 per cent of the total number of blasts over a 12 month period
	10	0 per cent	120	0 per cent

The blast assessment criteria associated with property damage relevant to infrastructure and historical items are provided in **Table 6.18**. It is noted that these criteria are impact assessment criteria and not necessarily limits that must be met, but indicate the levels at which no impacts are predicted.

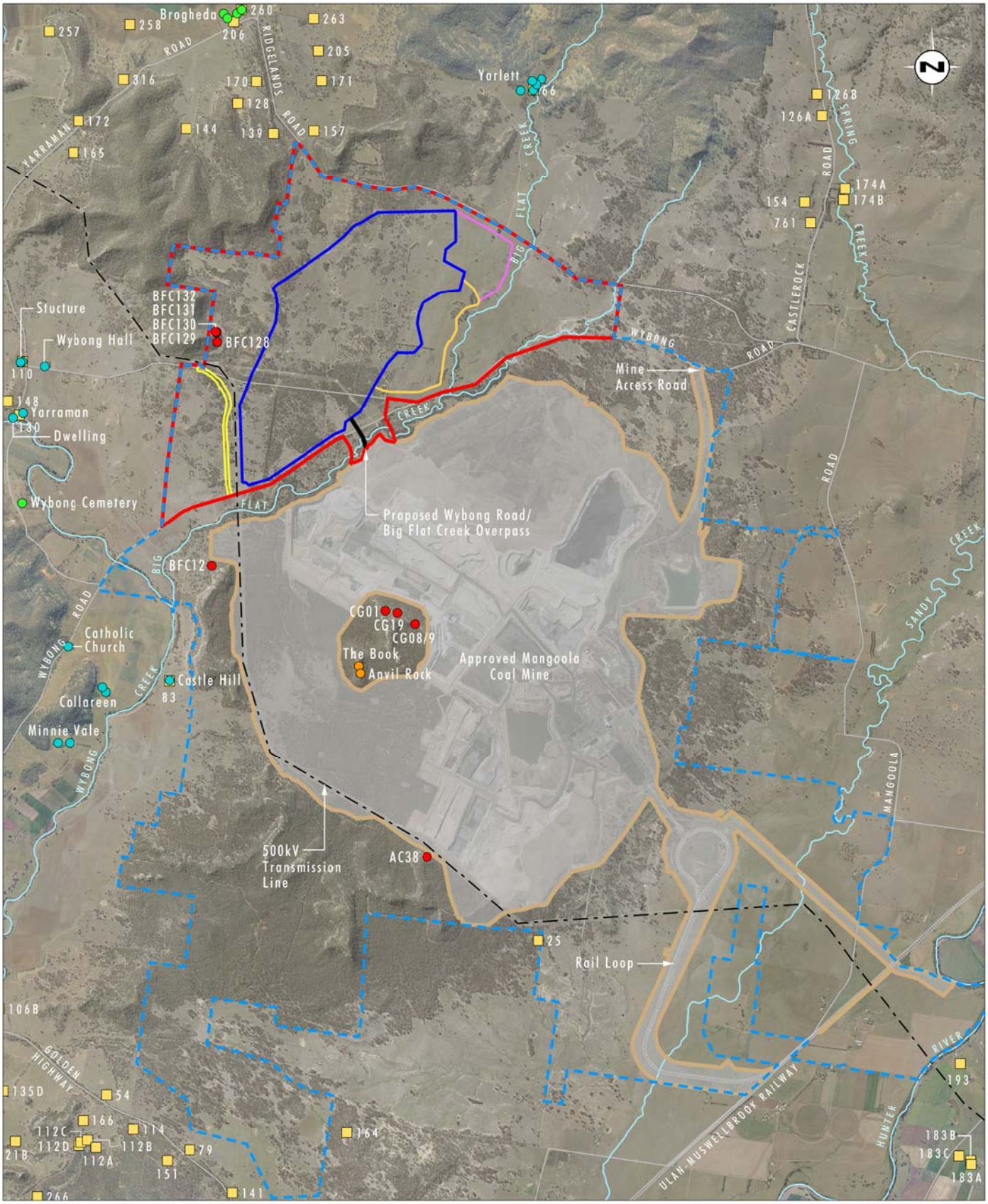

Image Source: Glencore (Apr 2018)
Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Proposed Emplacement Area
- Proposed Topsoil Stockpile Area
- Wybong Post Office Road Realignment
- Private Residence
- Potential Heritage Items
- Rock Formations
- Rock Shelter Sites
- Listed Heritage Items

FIGURE 6.12

Blast Sensitive Locations

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Table 6.18 Infrastructure and Historical Heritage Items Blasting Impact Assessment Criteria

Receiver	Ground Vibration (mm/s)	Overpressure (dBL)
Heritage Items[1]	5	133
Rock Formations and Rock Shelter Sites[2]	Annual assessment 50	
500 kV Electricity Transmission Line Tension Pylons/Suspension Pylons[3]	60 / 125	n/a
11 kV Powerlines - Timber Poles[4]	100	n/a
Buried Telecommunication Cables[4]	100	n/a
Public Roads[4]	100	n/a
Prescribed Water Dams – PWD, RWD[5]	50	n/a
Prescribed Tailings Dams – TD1 and TD2[5]	100	n/a
Mine-owned Infrastructure	Managed internally	-

1. Ground vibration criterion - as presented in ACARP Report No. C14057
   Airblast criterion – based on the airblast limit for damage control as specified in the Australian Standard AS2187.2-2006 (applicable to buildings / sheds only.
2. Currently no specific limit is stated in the Mangoola BMP (2017), however the 50 mm/s safe blasting limit has been determined by specialist analysis (Moore 2018) an annual assessment by a qualified specialist and ongoing vibration monitoring apply
3. As per written agreement between Mangoola and TransGrid (2015). May be varied in the future by an updated written agreement
4. As specified in the ACARP Report No14057 Effect of Blasting on Infrastructure, 2018
5. As specified in the Approved Blast Management Plan

6.6.2 Assessment

The results of the BIA indicate that ground vibration and blast overpressure levels can be managed to meet relevant blast emission criteria at all sensitive receiver locations through appropriate blast design and the implementation of appropriate control measures. Mangoola has a demonstrated track record of managing blasting impacts as discussed in **Section 6.6** and each blast will be designed to comply with the relevant criteria and the design practice at Mangoola incorporates a factor of safety to provide for unexpected conditions (that is, blasts are designed to result in impacts below the limit, not on the limit).

6.6.2.1 Private Residences

The ground vibration modelling for residential receivers within a 5 km radius revealed that ground vibration impacts can be managed effectively within the specified blasting parameters.

The blast overpressure modelling indicated that as operations within the MCCO Additional Project Area move closer to residential receivers in the north and north-west that the management of charge masses will be required to manage blast overpressure levels and meet the relevant amenity criteria. The blast overpressure model assessed a range of blast charge masses and bench heights and has demonstrated that

blasting is able to be designed and managed to ensure that blast overpressure impacts can be managed effectively.

Due to the substantial distances to residential receivers the potential risk of flyrock impact on the adjacent residential receivers is considered negligible.

Consistent with current practices at Mangoola Coal Mine a detailed blast design process will be undertaken for each blast in order to establish the charge masses required to meet the relevant blast emission criteria at all private residences.

6.6.2.2 Infrastructure

Ground vibration impacts on the 500 kV powerlines can be managed effectively to a level below the applicable vibration limit criteria via the continued application of lower charge masses as is current practice at Mangoola Coal Mine. Further, the criteria for 11 kV powerlines and buried communication cables can also be met via the application of lower charge masses. The prescribed water dams located at Mangoola Coal Mine will be exposed to vibration levels well below the applicable criteria as will the prescribed tailings dams.

The vibration impacts on Ridgelands Road, Wybong Road and the proposed realigned section of Wybong Post Office Road can be managed effectively to a level below the applicable vibration limit criteria via the application of lower charge masses when blasting in closer proximity. When blasting at greater distances, the application of larger charge masses will be possible.

The predicted vibration exposure for the MCCO Project infrastructure, including the proposed Wybong Road and Big Flat Creek overpass will be managed internally to provide for safe operation of this structure when blasting within its vicinity.

Where necessary, precautionary measures, such as the temporary closure of roads, will also be implemented to ensure public safety is not put at risk as a result of blasting operations. This will include periodic closures for blasts within 500 m of Wybong Road, Wybong Post Office Road, and Ridgelands Road which will be managed to minimise disruption to traffic as much as practicable. Road closures will be limited to no more than one per day (noting that more than one road may need to be closed during a closure event) and will be managed in accordance with an updated Road Closure Protocol and updated Blast Management Plan.

6.6.2.3 Heritage Items

Predictions of ground vibration and blast overpressure for the identified historic heritage items were found to be below the applicable criteria for all modelled charge masses.

Ground vibration modelling for the rock formations and rock shelter sites also showed that the ground vibration predictions will be below the applicable criteria. As per the current operation, an assessment of potential blast impacts will be undertaken on an annual basis.

6.6.2.4 Livestock

An assessment of potential ground vibration, airblast overpressure and flyrock exposure was completed for surrounding private properties, including land potentially used for grazing. In the absence of accepted blasting criteria for livestock, potential impacts on livestock have been considered in a conservative manner in the context of the relevant residential blasting amenity criteria, which are set to maintain human comfort. The assessment concluded that based on predicted ground vibration and blast overpressure, there were no concerns for the wellbeing of livestock on private land surrounding the MCCO Project Area. All

private grazing land is outside the blast exclusion zone and given the significant distances from any potential blasting to private grazing land (at least 950 m), there is no predicted risk of injury to livestock from flyrock.

With regard to livestock on Mangoola owned land, grazing has occurred on Mangoola land throughout the mining undertaken to date without any adverse impacts from blasting and this will continue with the MCCO Project.

6.6.2.5 Crown Land

There are two areas of Crown land that for some blasts will fall within the 500 m blast exclusion zone, being the small travelling stock reserve on Wybong Road and the edge of the large area of Crown land to the north-west. Where blasts occur within 500 m, the blast exclusion zones will be managed to ensure there are no blast risks to any users of these areas of Crown land.

6.6.2.6 Cumulative Impacts

There are a number of operating coal mines within the Upper Hunter Valley. However, the closest mine to the MCCO Project is Mount Pleasant Mine which is located approximately 9 km to the east. Due to the significant distance from other mining operations, cumulative impacts associated with blasting are not considered likely.

6.6.3 Blasting Management and Mitigation

Mangoola will implement the appropriate blast management controls necessary to meet the relevant criteria for private residential receivers, heritage items, rock formations and infrastructure.

Mangoola will also continue to manage blasting practices for the MCCO Project within the limits of the existing blasting conditions. That is, no more than six blast events per week or two blast events per day between the hours of 9.00 am and 5.00 pm Monday to Saturday, with an allowance for additional blasts where there are low vibration blasts, misfires or where blasts are required to ensure the safety of the mine or its workers.

Mangoola will continue to undertake blasting for the MCCO Project in accordance with a detailed blast design process that considers operational, geological and environmental constraints, with the design and size of each blast determined to meet these constraints and meet blasting criteria. Blast design and sizes will vary over the life of the MCCO Project and will depend on a number of factors including the nature of the overburden/interburden strata material, the design of open cut benches and environmental considerations. The detailed blast design process will seek to maximise blast efficiency, and minimise potential vibration, overpressure, dust and fume impacts. Blasts will be designed to achieve compliance with the site-specific blast conditions.

Mangoola will review and update the existing Blast Management Plan as part of the implementation of the MCCO Project and implement this plan for all blasting operations. The Blast Management Plan will be revised to detail the implementation of monitoring and management controls to manage blasting impacts associated with the MCCO Project to maintain compliance with relevant blasting criteria as required. This will include an updated pre-blast assessment protocol that outlines the process for designing blasts to meet the relevant criteria, which may include limiting the charge mass of blasts close to potentially affected locations or other blast vibration management controls. It will also include updates to the existing road closure protocol to include potential interactions with Wybong Road, Wybong Post Office Road and Ridgelands Road. Blasting related closures of public roads associated with the MCCO Project will be limited to a maximum of one closure event per day (noting that more than one road may need to be closed during a closure event).

Mangoola will offer all private landholders located within 2 km of the Proposed Additional Mining Area a property inspection prior to the commencement of blasting in the MCCO Additional Project Area to establish the baseline condition of private structures.

The existing multi-station blast monitoring system for Mangoola Coal Mine will continue to be used. This will also be reviewed and revised as required to cover the sensitive receivers located in the vicinity of the MCCO Additional Project Area. In this regard the following locations for monitoring will be considered, subject to access arrangements:

- north direction – residential receiver 66 or the closest to it
- east direction – residential receiver 154, or the closest to it
- south direction – residential receiver 83 or the closest to it
- north-west direction – residential receiver 139 or 157 or closest to them.

6.7 Surface Water Assessment

A comprehensive assessment of the potential surface water impacts of the MCCO Project has been undertaken by Hydro Engineering & Consulting Pty Ltd (HEC). This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require an assessment of the likely impacts of the MCCO Project on existing surface water resources and water users. The assessment addresses the requirements of all relevant NSW and Commonwealth Government legislation and policies, has regard to the specific issues raised by EPA, OEH and DPI regarding surface water resources and is guided by the requirements of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC).

A summary of the key findings of the Surface Water Assessment is provided in this section and the full report is provided in **Appendix 11**.

6.7.1 Methodology

The surface water assessment comprised an analysis of the existing hydrological setting and an assessment of the impacts from the MCCO Project on the surface water environment, including on streamflow and the local flood regime.

Hydrologic modelling was undertaken for eight design rainfall events; the annual exceedance probability (AEP) of 1:10, 1:20, 1:100, 1:200, 1:250, 1:500, 1:1000 and the probable maximum flood (PMF). Modelling was undertaken of the existing Big Flat Creek (with the approved Mangoola Coal Mine operations) and also with the fully developed MCCO Project (as at Year 8 – the scheduled end of coal extraction). Hydraulic modelling for the above design events was conducted using the two-dimensional numerical hydraulic model TUFLOW.

The surface water assessment also assessed water management for the MCCO Project, both in terms of upslope runoff diversions and management of water within disturbed portions of the MCCO Project Area. This included water and salt balance modelling in order to forecast the water supply and discharge requirements for the MCCO Project during the operational phase and the behaviour of the final void pit lakes following closure.

A full description of the methodology for the assessment is included in **Appendix 11**.

6.7.2 Existing Environment

6.7.2.1 Existing Surface Water Environment

Watercourses and Catchment Areas

The Mangoola Coal Mine lies within the catchments of Sandy Creek to the south-east, Anvil Creek to the west and Big Flat Creek to the north (refer **Figure 6.13**). Sandy Creek is a tributary of the Hunter River and flows generally north-east to south-west. Anvil Creek flows into Big Flat Creek, which in turn flows to join Wybong Creek. The upper reaches of Anvil Creek were mined through during 2018 by the existing approved Mangoola Coal Mine, with much of this catchment area now reporting to the mine water management system. Wybong Creek is a tributary of the Goulburn River which in turn flows to the Hunter River.

The MCCO Additional Project Area primarily lies within the catchment of Big Flat Creek with small sections extending into the Wybong Creek catchment (refer **Figure 6.13**). The main channel of Big Flat Creek parallels Wybong Road and separates the MCCO Additional Project Area from the existing approved operations. Big Flat Creek has an estimated total catchment area of approximately 37 km^2 (based on the existing [2017] area of the approved Mangoola Coal Mine), while Wybong Creek has an estimated total catchment area of approximately 792 km^2. The catchment boundaries for watercourses within and surrounding the Project Area are shown in **Figure 6.13**. As shown on this figure the existing Mangoola Coal Mine water management system has its own defined catchment area with water captured and managed in this area in accordance with the existing approval and the mines approved Water Management Plan (WMP). Further details with regard to the Mangoola Coal Mine water management system are provided in **Section 7.3** and **Appendix 11**.

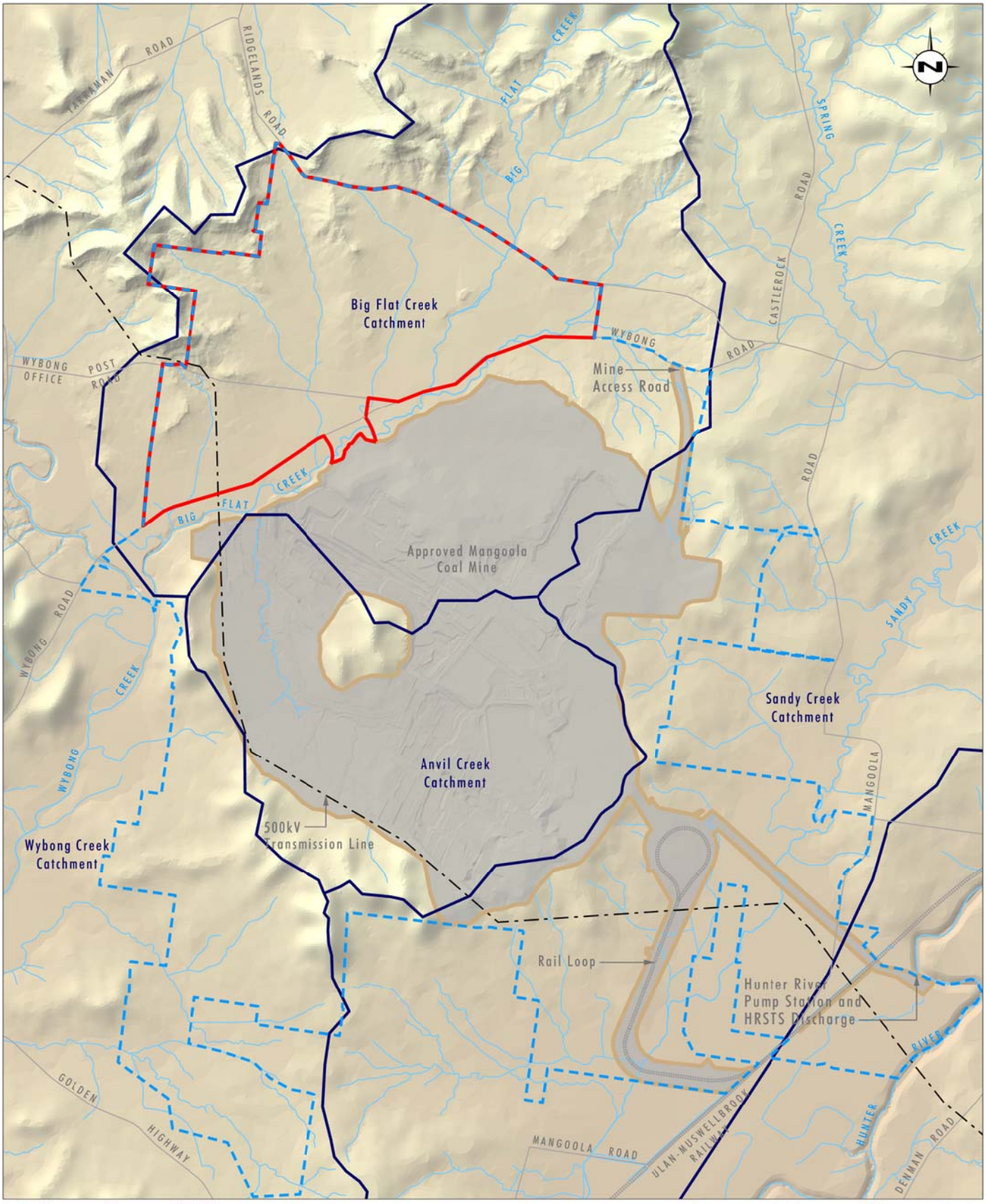
Surface Water Flows

Surface water flows are measured locally at several gauging stations. The locations of these gauging stations are shown on **Figure 2.5**.

Wybong Creek

The available Department of Industry – Water streamflow record for GS 210040 on Wybong Creek spans the period from mid-1955 to 2018. This gauging station is located in an area of rock outcrop, providing good flow control and has a data capture rate of 96 per cent. The flow duration curve for the period of record indicates that Wybong Creek is effectively perennial, with no flow measured over approximately 3 per cent of the record period.

Mangoola's streamflow gauging station on Wybong Creek (SF02) has been recording stream depth data continuously since late 2010. The record for this gauging station indicates similar flow properties as recorded for GS 210040, with slightly higher median and high flows (as would be expected given the larger catchment area reporting to SF02) and slightly reduced flow persistence, with zero flow recorded on approximately 4 per cent of days. The slightly reduced flow persistence may be related to the shorter period of record and/or the presence of alluvium in the stream bed which forms the flow control for the station.



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Catchment Boundary

FIGURE 6.13

Surface Water Setting

Big Flat Creek

Big Flat Creek is ephemeral and with drought conditions in recent times has had very infrequent flows. Flow in Big Flat Creek has been observed to persist for a limited period after rainfall. In order to characterise the streamflow behaviour of Big Flat Creek given the lack of reliable flow records for the creek, the records of a nearby gauging station on Dart Brook (GS 210088) were used, as this station is considered to have similar catchment characteristics to Big Flat Creek. Data at this station were recorded between 1970 and 1983, and again between 2002 and 2008. The recorded flow duration curve for the Dart Brook gauging station indicates no flow was recorded on approximately 28 per cent of days.

Surface Water Quality

A network of water quality monitoring sites are sampled for physico-chemical parameters and total metals on a regular basis in accordance with Mangoola's surface water monitoring plan. Flow conditions are also qualitatively recorded on a monthly basis.

As part of the surface water assessment (refer to **Appendix 11**), results of the monitoring were compared with default guideline trigger values (ANZECC, 2000) for protection of aquatic ecosystems in south-eastern Australian upland rivers and/or guideline values for Primary Industries water supplies (livestock drinking water quality).

The results described below show that the water quality parameters are generally highly variable across the monitoring network:

- average pH values in Big Flat Creek and Wybong Creek have a tendency to trend towards slightly alkaline levels
- levels of total suspended solids (TSS) vary over a wide range, with average values in Big Flat Creek higher than Wybong Creek, and values in the upstream of Big Flat Creek are higher than in the downstream. Lower values were recorded in the Big Flat Creek tributaries
- average turbidity levels in upstream Big Flat Creek and its tributaries exceeded the ANZECC (2000) guideline level in more than half of the samples collected. The proportion was slightly lower in downstream Big Flat Creek, and lower again in Wybong Creek
- the overall salinity in Big Flat Creek is considered high for a natural stream, with the recorded EC exceeding the ANZECC (2000) guideline default trigger value upper bound in the majority of samples at most monitoring locations and with a long-term average EC of approximately 13,000 µS/cm. It is considered likely that the higher salinity levels reflect background conditions and are due to evapo-concentration of shallow groundwater where it comes close to the surface. The Wybong Creek data indicates increased salinity during periods of low or no flow, and low salinity during and following periods of increased flow
- the majority of samples for total metals did not exceed the default ANZECC guideline trigger values. However, several sites did record exceedances for 100 per cent of samples for the following metals:
    - Aluminium: Upstream Big Flat Creek
    - Silver: All sites
    - Zinc: Big Flat Creek.

It should be noted that the monitoring sites that are located upstream on Big Flat Creek and its tributaries, are upstream of mining operations and are therefore reflective of the background water quality in that system and the water quality conditions recorded do not result from the existing mining operations.

Site Water Storage Quality

Water quality in the site water storages and sediment dams was found to be highly variable. In general, the water quality is slightly to moderately alkaline, however levels of EC, TSS, TDS, pH and some metals were highly variable. This is likely reflective of the origin of the water reporting to the particular water storage or sediment dam, and the prevailing climatic conditions and mining operations at the time of sampling.

The mine water management system has, to date, been maintained as a closed system, although controlled release is permitted in accordance with the HRSTS.

Water Users and Existing Mangoola Coal Water Access Licences

Surface water usage in the vicinity of the MCCO Project Area occurs within the Wybong Creek Water Source of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009. The creeks within the greater Wybong Creek catchment have 132 licensed private surface water users, extracting water for domestic and irrigation purposes. The majority of these users are on Wybong Creek upstream of the confluence with Big Flat Creek. There are two users located on Big Flat Creek upstream of the MCCO Additional Project Area. A further 22 water users are located on or near Wybong Creek downstream of the confluence with Big Flat Creek.

The MCCO Project is located in an area governed by the Water Sharing Plan for the Hunter Regulated River Water Source 2003. As per Schedule 3, Condition 25 of the Mangoola Coal Mine Project Approval, Mangoola does not use any licensable water from the Wybong Creek Water Source for mining purposes, other than that incidentally collected by approved mining operations.

Mangoola currently holds a total of 861 ML share components of Wybong Creek unregulated WALs, which is sufficient to account for interception of undisturbed area runoff from both the existing Mangoola Coal Mine and the MCCO Additional Project Area in excess of harvestable rights.

Mangoola also holds 17 ML total share components of Hunter River regulated high security WALs and 2758 ML total share components of Hunter River regulated general security WALs.

6.7.3 Mine Water Management System

The water management system and strategies currently employed at Mangoola Coal Mine are outlined in the approved WMP, and are designed to avoid, mitigate and manage potential impacts on surface water resources by employing controls to separate clean water and mine water, seeking to prevent the contamination of clean water by mining activities and managing compliance within statutory obligations.

The existing WMP will be updated to include the MCCO Additional Project Area. The water management system for the MCCO Project will be integrated with the existing water management system of the Mangoola Coal Mine as described in **Section 2.6**, with water managed across the combined operational areas. This will involve the construction of new water management structures, both within the MCCO Additional Project Area and Mangoola Coal Mine, and will subsequently result in changes to parts of the approved water management system. No changes are proposed to the existing discharge arrangements with all water to be managed within the limits of the existing system.

A schematic of the mine water management system is provided in **Figure 6.14**, which includes proposed system additions as part of the MCCO Project. The majority of mine water supply is obtained from runoff captured from disturbed mine landforms and water reclaimed from the tailings storage. Operational (make-up) water supply is obtained by pumping from the Hunter River via general and high security WALs where necessary, but mine water supply is intended to be primarily met through water generated on site.

The conceptual water management strategy for the MCCO Project has been designed to integrate the water management of the MCCO Project with the existing water management system (refer to **Figure 6.14**). In line with the current water management system, the proposed system for the MCCO Project aims to:

- separate clean, dirty and mine water
- prevent the contamination of clean water by mining activities
- maximise water recycling and reuse opportunities
- effectively manage water across the MCCO Project Area
- manage compliance with statutory obligations.

The development of the proposed water management system will be staged according to progression of MCCO Project mining activities. The proposed layout of the key components of the conceptual water management system for the MCCO Project is shown on **Figure 3.3** to **Figure 3.7**.

As described in **Section 3.6** as part of the water management system, two upslope clean water diversions will be required to be constructed within the MCCO Additional Project Area, one to the north and one to the west. The northern upslope diversion will discharge directly into Big Flat Creek while the south-western diversion will include a culvert crossing under the realigned portion of Wybong Post Office Road with discharge to an existing natural drainage line. The alignment and extent of the upslope diversions has been set to minimise impacts on biodiversity as described in **Section 1.4** and **Section 6.9**.

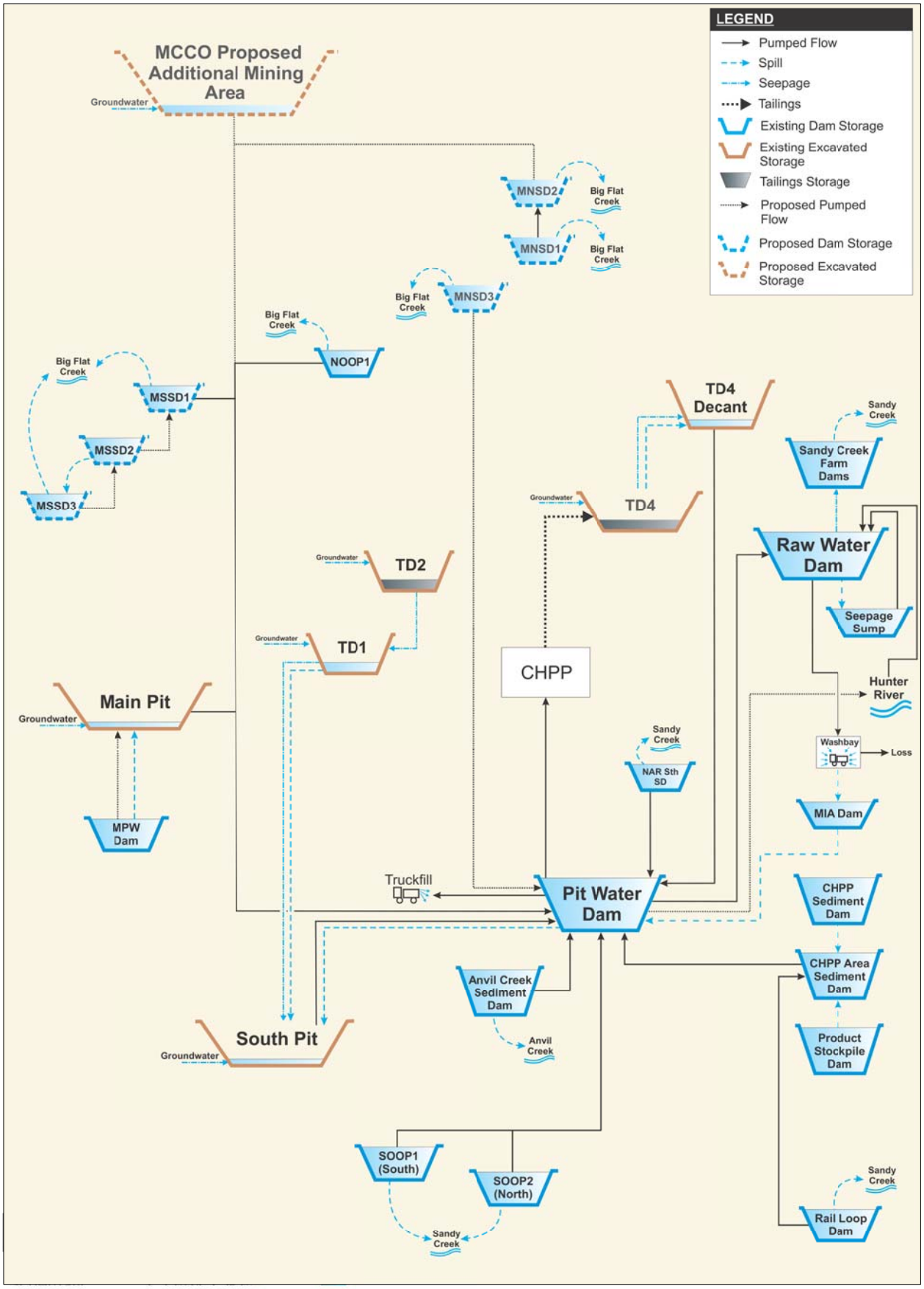


FIGURE 6.14

Water Management System Schematic

Data Source: HEC (2019)

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6.7.3.1 Site Water Balance

A detailed water balance assessment, integrating the MCCO Project with the existing operations, was completed as part of the Surface Water Assessment. The predicted average inflows and outflows are shown in **Figure 6.15** and as expected are similar to the water balance for the existing operation particularly with regard to outflows (or water used). One key change is the additional rainfall runoff generated due to the addition of the MCCO Additional Project Area catchment. Model results indicate that, on average, rainfall runoff provides the highest system inflow, with less than a quarter of the inflows likely to be derived from Hunter River WALs. The majority of outflows will comprise CHPP demand consistent with the existing operations at Mangoola Coal Mine. The existing water licence entitlements for Mangoola Coal Mine provide sufficient water to be balanced in an average year.

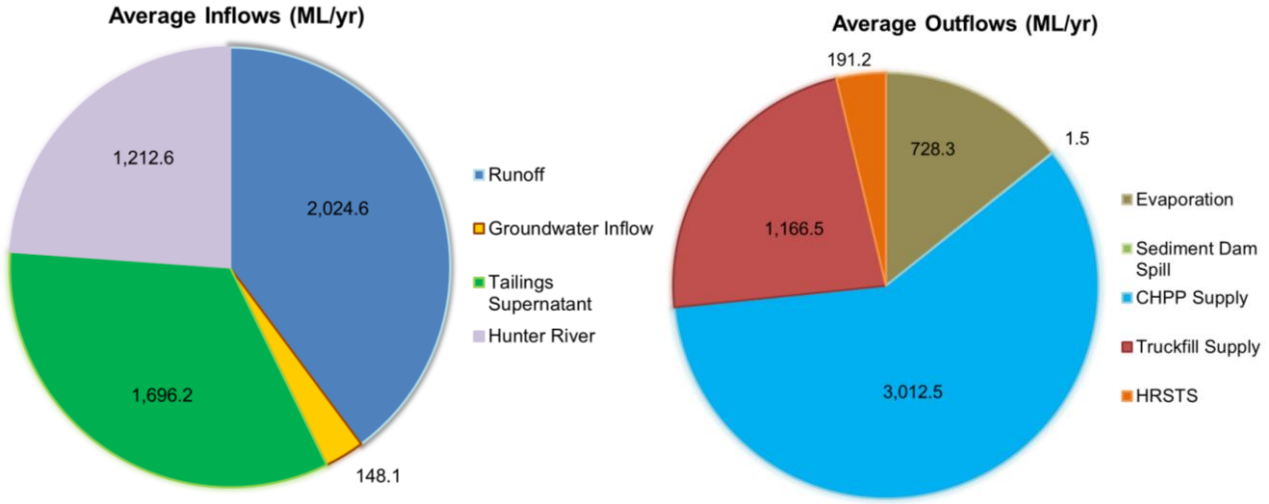


Figure 6.15 Average Predicted System Water Balance

Average supply reliability over all climatic realisations, as well as the lowest single realisation reliability (representing a simulated 'worst case'), indicate a predicted high level of average supply reliability, particularly for CHPP supply. Model simulations indicate that there is a low risk of shortfall.

Should a shortfall in required water occur, additional water would be sourced via the purchase of additional WALs (if available), or one or more of the following actions may be employed:

- reduce haul road dust suppression demand by the use of dust suppression agents
- reduce CHPP water demand by increasing bypass coal (which has a significantly lower water demand compared to washed coal)
- reduce site water demand by scaling back production, and/or
- investigate alternative water supplies.

As discussed in **Section 3.11** Mangoola has more than adequate supply within the existing water management system at Mangoola Coal Mine to meet the water requirements for the construction phase of MCCO Project which has considerably lower demand than the mine (in the order of less than 1 per cent).

6.7.3.2 Final Void Water and Salinity Balance

Two final voids are proposed as part of the MCCO Project; the existing approved void in the approved mining area and a second void in the MCCO Additional Mining Area. Final void water and salt balance modelling was undertaken as part of the Surface Water Assessment to simulate the behaviour of the pit lake that would form in each of the final voids. Based on a geochemical assessment for the MCCO Project (refer to **Section 6.17**), runoff and seepage from overburden is not expected to be acidic and is not expected to contain significant metals concentrations. Therefore, long term salinity is the likely main issue for pit lake water quality.

The model simulates inflow from remnant final void catchment rainfall runoff (including direct rainfall), groundwater inflow from bedrock and spoil seepage as well as outflow due to evaporation and groundwater outflow on a daily basis. The predicted final void water levels and forecast salinity are provided in **Figure 6.16** and **Figure 6.17**. The occasional rises in modelled salinity and concurrent falls in water level as indicated on the abovementioned figures with orange arrows, represent historical drought periods in the modelled climatic record.

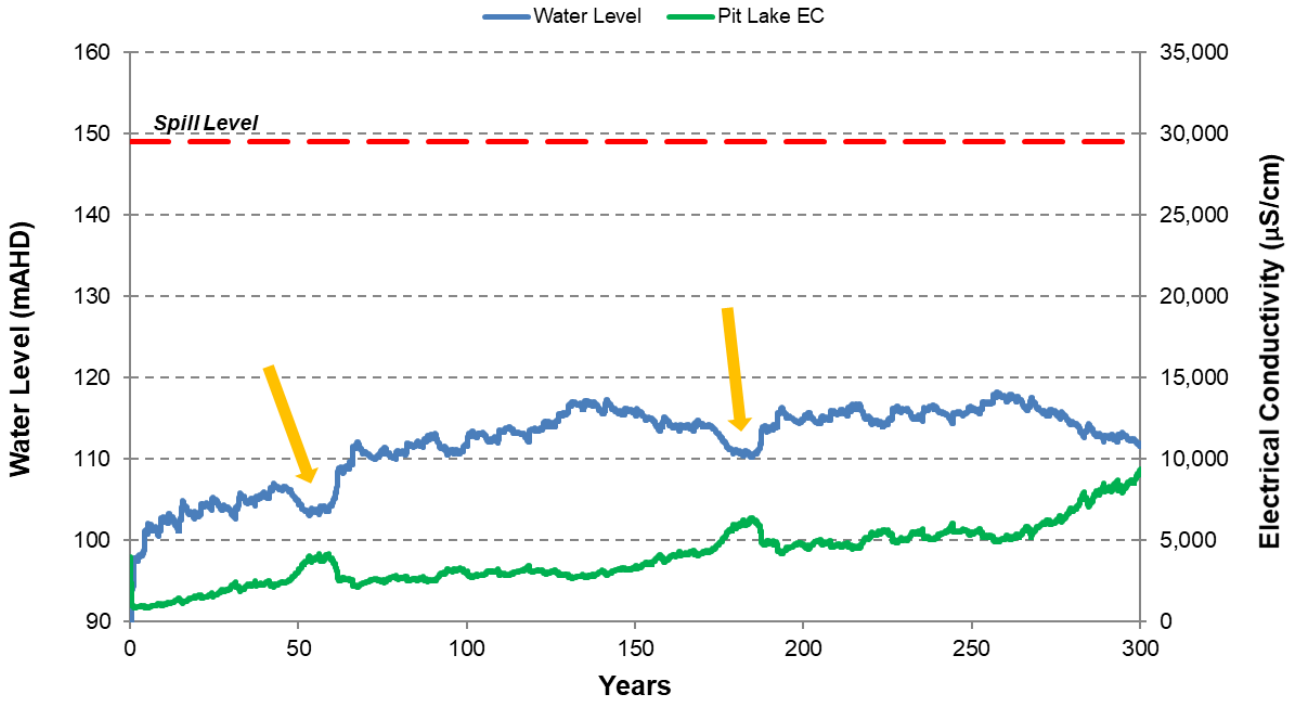


Figure 6.16 Predicted Final Pit Lake Water and Salinity Levels – Approved Mining Area

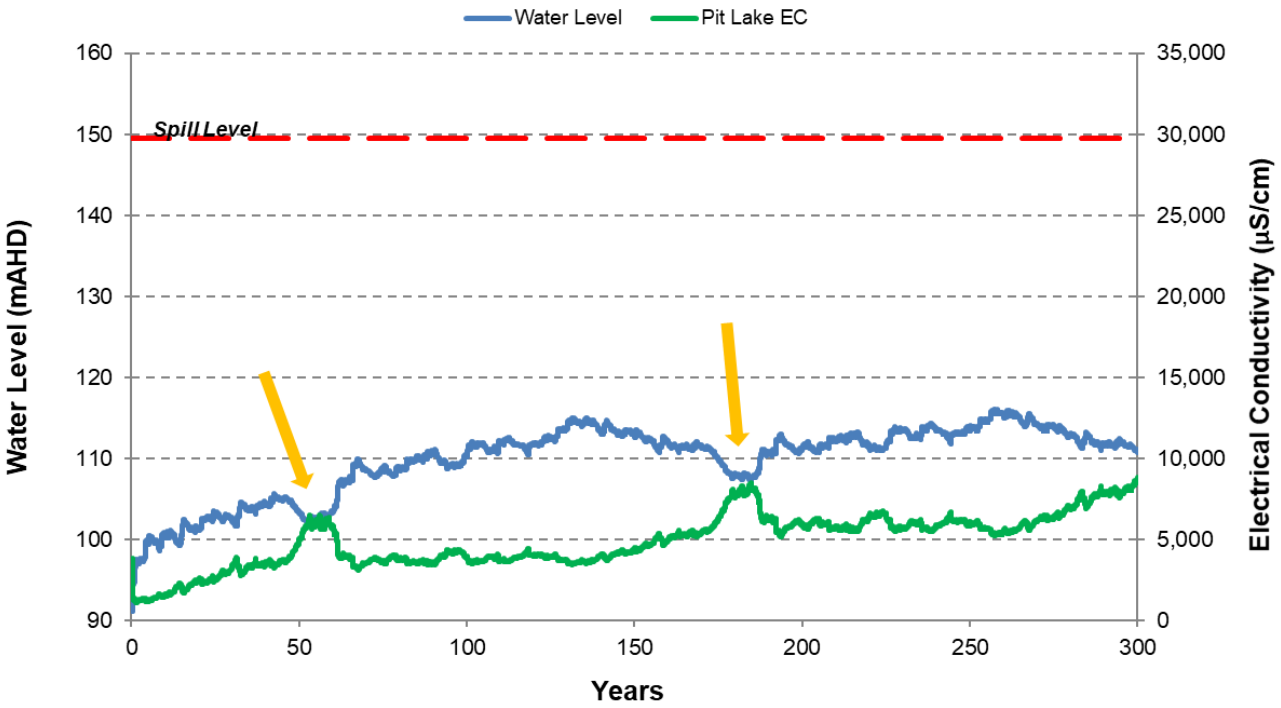


Figure 6.17 Predicted Final Pit Lake Water and Salinity Levels - MCCO Additional Mining Area

The final void modelling results indicate that both the final pit lakes would reach an equilibrium level more than 30 m below their respective spill levels (i.e. the lakes are contained). Equilibrium levels would be reached slowly over a period of more than two hundred years. Final pit lake salinity levels would increase slowly as a result of evapo-concentration.

6.7.4 Assessment

6.7.4.1 Surface Water Impacts

The MCCO Project has the theoretical potential to impact on natural and existing surface water systems, including the potential to impact on flooding, channel stability of the adjacent Big Flat Creek, catchment yield and flow volumes, baseflow, water quality and regional cumulative impacts. These issues were therefore all investigated as part of the surface water assessment. A summary of the key assessment findings is included below.

Flooding and Channel Stability

Flood modelling completed for the MCCO Project predicts some increase in areas of inundation upstream of the proposed haul road crossing of Big Flat Creek, however no increase in inundation extent is predicted over non-Mangoola owned land up to and including the 1:100 AEP event.

Flood modelling also indicates that for all modelled events, without the proposed levee, flooding would be likely to encroach, to a small degree, on the MCCO Additional Project Area. As described in **Section 3.6** and shown on **Figure 3.3** to **Figure 3.6** a flood levee is proposed between the MCCO Additional Mining Area and Big Flat Creek to a crest level equal to a 1:1000 AEP peak flood level plus 0.5 m freeboard. The levee will mostly be incorporated into visual bunds. The visual bunds will take the form of nominally 3.5 m high earthen embankments with the external batter of the bund at 1V:3H, topsoiled and grass seeded. Where proposed, the levee (or the base of the bund) will channelise flooding of Big Flat Creek in some local areas.

Flow velocities and depths are predicted to be very low and hence no erosion protection measures, other than the establishment of vegetation, is required. Where not included in the visual bunds any levee constructed is limited to a nominal 1 m height inclusive of the 0.5 m freeboard, to achieve the required protection.

The flood modelling also included an assessment of the predicted flood depths over Wybong Road for a selection of AEP events. Wybong Road is currently affected by flooding and the MCCO Project is not predicted to materially increase existing flood levels and the trafficability of Wybong Road will remain unaffected for flood events up to the 1:100 AEP. For larger flood events modelled including the 1:1000 AEP and PMF there would only be a minor change with some parts of Wybong Road likely to be affected by flooding under these extreme events, however, it is noted that under these events the road would likely be closed in any case due to flooding impacts in other areas.

Overall, the MCCO Project is not predicted to result in significant increases in flow velocity in Big Flat Creek and therefore the risk of increased erosion in most areas is negligible. Small areas of predicted significant increases in flow velocity occur in areas near the proposed haul road crossing, particularly near the outlet of the proposed culverts. Erosion protection will be included in the design. Apart from the culvert outlet, there is no material effect downstream of the proposed haul road crossing.

Catchment Yield and Flow Volumes

The establishment of operations within the MCCO Additional Project Area is likely to result in reduced long-term catchment yield in Big Flat Creek and Wybong Creek, which may result in a small reduction in surface flow and baseflow.

The potential effect on total surface flow in the downstream creeks has been assessed on the basis of reduction in catchment area relative to Wybong Creek, of which Big Flat Creek is a tributary. The area and percentage of Wybong Creek catchment captured within the MCCO Additional Project Area water management system over the life of the MCCO Project are shown in **Table 6.19**.

Table 6.19 Wybong Creek Catchment Area Captured by MCCO Additional Project Area

Project Year	Captured Area (km^2)	Percentage of Wybong Creek Catchment	
		Area Upstream of (and including) Big Flat Creek	Total Area
1	4.2	0.63 per cent	0.53 per cent
3	4.3	0.64 per cent	0.54 per cent
5	7.8	1.17 per cent	0.98 per cent
8	8.0	1.20 per cent	1.01 per cent
Final Landform	4.1	0.62 per cent	0.52 per cent

It would be expected that average total flow volumes in Wybong Creek would reduce as a result of the MCCO Additional Project Area, by approximately the above percentages. For example, a 1.20 per cent reduction in the mean annual flow of 26,455 ML at GS 210040 (upstream of Big Flat Creek) would amount to an annual average reduction in flow of approximately 317 ML. This volume is adequately catered for by Mangoola's Wybong Creek unregulated WALs.

The captured areas given in **Table 6.19** would currently report (or in the past have reported) to Big Flat Creek. The estimated pre-mine catchment area of Big Flat Creek is 50.6 km^2, while as at 2017, the catchment area was 37 km^2. At the end of the MCCO Project life, it is estimated that the catchment area of Big Flat Creek would have reduced to 23.7 km^2 (with the expanded approved Mangoola Coal Mine and the development of the MCCO Project). This means that 53 per cent of the pre-mine catchment area of Big Flat Creek would be captured in the water management system.

The impact of these catchment changes on the flow regime in Big Flat Creek has been assessed as part of the Surface Water Assessment (refer to **Appendix 11**). A flow rate of 0.05 ML/d is predicted to be exceeded 50 per cent of the time in the existing Big Flat Creek, while near the end of the MCCO Project life, this is modelled to reduce to approximately 0.03 ML/d. The prevalence of effectively zero flow (less than 0.001 ML/d) is estimated to increase from approximately 26.5 per cent of days to 28.3 per cent of days. These predicted changes are small and not considered material given the ephemeral nature of Big Flat Creek, and that there are no licensed surface water users on Big Flat Creek other than Mangoola.

In terms of long term (final void) reduction in catchment area reporting to both creeks, it is estimated that this would total 7.32 km^2. This amounts to 1.1 per cent of the Wybong Creek catchment area upstream of (and including) Big Flat Creek and 0.9 per cent of the total catchment of Wybong Creek. A 1.1 per cent reduction in the mean annual flow in Wybong Creek upstream of (and including) Big Flat Creek would amount to an annual average reduction of 291 ML, as well as a predicted annual reduction of up to 30 ML in baseflow. This predicted reduction in surface flow and baseflow represents a small and likely indiscernible impact to flow in Wybong Creek. Mitigation would involve the permanent retirement of the required volume of water associated with the WAL from the Wybong Creek Water Source within the Hunter Unregulated and Alluvial Water Sources WSP. Mangoola holds sufficient water under WALs to achieve this.

Baseflow Effects

Baseflow is the portion of streamflow that persists and sustains flow in between rainfall events. Following a flow event, it is initially derived from water recharged from stream-bank storage, but in longer dry weather periods it is derived from groundwater discharging to the stream.

In Big Flat Creek, baseflow changes resulting from the MCCO Additional Mining Area are predicted to be negligible.

For Wybong Creek along its full length to the Goulburn River, the predicted additional baseflow loss as a result of the MCCO Additional Mining Area is up to approximately 13 ML/year. Total baseflow reductions of up to 30 ML/year (0.082 ML/d) have been forecast as a result of the approved Mangoola Coal Mine with the MCCO Additional Mining Area. The reduction as a result of the MCCO Additional Mining Area amounts to less than 0.05 per cent of the mean annual total flow at GS 210040. This represents a small and likely indiscernible impact to flow in Wybong Creek. Mangoola has sufficient existing WAL to provide for this reduction as discussed in further detail in **Section 6.8.3.5**.

Water Quality Effects

In accordance with Mangoola's EPL limits and consistent with the provisions of the HRSTS, the MCCO Project proposes to discharge surplus water from the water management system via the approved licence discharge point to the Hunter River where necessary. Discharges will be monitored prior to release to ensure compliance with water quality conditions, and therefore no significant impacts to downstream waters are likely.

The risk of sediment laden water affecting downstream waters are mitigated by the MCCO Project's water management system, which is designed in accordance with design criteria established by the NSW

Government specifically for sediment control at mining and quarrying operations. The current operation has successfully implemented sediment and erosion control measures to manage water quality and these measures will be extended to the MCCO Project.

By managing sediment laden water and mine water within the MCCO Project Area's water management system and, based on flood modelling predictions of small, localised increases in flood flow velocities and associated scour potential in Big Flat Creek, the Surface Water Assessment found that it is not anticipated that water quality in downstream watercourses will be adversely impacted by the MCCO Project.

Regional Cumulative Impacts

In the context of surface water resources potentially impacted by the MCCO Project, there has been significant past development in the upstream, immediate and downstream catchment areas, including widespread agricultural development and urbanisation. There has also been significant development of the surface water resources themselves, including regulation of the water resources, and local and regional water extraction.

The existing Mangoola Coal Mine is the only mine within the Wybong Creek Catchment so therefore there are no cumulative mining impacts on this catchment. Wybong Creek flows into the Goulburn River and the detailed Surface Water Assessment also looked at the broader Goulburn River catchment. The assessment found that the worst case cumulative water take was very small in the catchment and no significant cumulative impacts were predicted. As discussed above, Mangoola has sufficient WALs to cater for all water take associated with the MCCO Project.

Flooding impacts due to the MCCO Project are localised to Big Flat Creek. This creek does not contain any other mines or projects, and therefore there would be no cumulative flooding impacts associated with the MCCO Project.

The MCCO Project is not anticipated to impact downstream water quality, and therefore it is unlikely that the MCCO Project will contribute to any cumulative impacts on downstream water quality. All discharges to the Hunter River via the approved licensed discharge point will be managed in accordance with the EPL and HRSTS which has been designed to manage the salt load of the Hunter River to within sustainable levels.

With regard to water take, as noted above Mangoola holds sufficient WALs for all water take associated with the MCCO Project. The water take licensing system in NSW has been designed to provide for sustainable environmental flows and thereby minimises the cumulative impacts of water take by all water users.

6.7.4.2 Surface Water Licensing Requirements

As outlined in **Section 6.7.2.1** Mangoola currently hold 861 ML in share components of Wybong Creek Unregulated WALs. Based on the findings of the Surface Water Assessment, Mangoola requires a maximum of 317 ML/year (to account for the maximum take / reduction in flow volumes predicted in Project Year 8 due to the reduction in catchment area), and therefore hold sufficient licences to account for this water take. **Table 6.20** provides a summary of surface water licensing requirements.

Table 6.20 Surface Water Licensing Requirements

Water Source	Maximum Water Licensing Requirement	Current Mangoola Share Component Held
Wybong Creek Unregulated	317 ML/year	861 ML in Share Components

6.7.5 Management and Mitigation

Mangoola currently operates Mangoola Coal Mine in accordance with a WMP which was prepared in consultation with NSW Government agencies and subsequently approved. The WMP describes the management of environmental and community aspects, impacts and performance relevant to the site's water management system.

Mangoola will review and update the WMP for the MCCO Project in consultation with DPI Water and DPE and then implement this plan. Subject to the requirements of the conditions of consent, the revised WMP will include updates as necessary to the following:

- a water balance including details of water supply, use, management and transfers
- an Erosion and Sediment Control Plan that is consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries, or its latest version. This will include appropriate measures to guide the implementation of erosion and sediment controls as part of the construction phase of the MCCO Project.
- a Surface Water Management Plan, including:
    - relevant baseline data on channel stability and water quality
    - a description of the revised water management system on site including design objectives and performance criteria
    - trigger levels for investigating any potentially adverse impacts
    - contingency measures that will be adopted in the event of unforeseen impacts or adverse impacts in excess of those predicted may include:
        - conducting additional monitoring to inform the proposed contingency measures
        - refinements to the water management system design to address identified issues
        - implementing stream remediation measures and additional controls (e.g. rock armouring) to reduce the extent and effect of erosion
        - implementing revegetation measures in conjunction with other stabilisation techniques (as required) to remediate impacts of vegetation loss due to erosion.

Mangoola will also review and update the existing surface water monitoring program for the MCCO Project with the monitoring program to be refined over the life of the mining operation as appropriate. This will include the additional monitoring recommended by the Surface Water Assessment as provided in **Appendix 11**. For the initial phases of mining in the MCCO Additional Project Area, Mangoola will undertake the following additional surface water related monitoring in addition to the existing monitoring program:

- monthly water quality monitoring in the MCCO Additional Project Area
- monitoring of water transferred from the MCCO Additional Project Area to the existing operations
- monitoring of areas of erosion risk, including the proposed upslope diversions and downstream of the proposed Wybong Road and Big Flat Creek overpass.

Mangoola will continue monitoring of streamflow, potential erosion and water quality for two years following cessation of operations. Monitoring data will be reviewed at annual intervals over this period. Reviews will involve assessment against long term performance objectives which will be based on the pre-mine baseline conditions or an approved departure from these. If objectives are not met in the two-year period, the monitoring period will be extended.

Mangoola will also prepare a construction phase Erosion and Sediment Control Plan for the MCCO Project to detail the controls required to manage construction works in and adjacent to Big Flat Creek.

While no significant changes to flooding impacts on Wybong Road are predicted due to the MCCO Project, Mangoola also recognises the existing flooding impacts on the road and in the vicinity of the haul road overpass will install appropriate flood warning signage, including flood depth indicators.

As described in **Section 3.6**, Mangoola will construct a flood levee to protect the Proposed Additional Mining Area in the MCCO Additional Project Area from potential flood inundation from Big Flat Creek.

6.8 Groundwater

A comprehensive assessment of the potential groundwater impacts of the MCCO Project has been undertaken by Australasian Groundwater and Environmental Consultants (AGE). This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require an assessment of the likely impacts of the MCCO Project on existing groundwater resources and water users. The assessment addresses the requirements of all relevant NSW and Commonwealth Government legislation and policies including the AIP, national groundwater modelling requirements and the requirements of the IESC.

A summary of the key findings of the Groundwater Impact Assessment (GWIA) is provided in this section and the full report is provided in **Appendix 12**.

6.8.1 Methodology

The GWIA comprised two parts; an analysis of the existing hydrogeological environment, including additional fieldwork and testing and an assessment of the impacts from the MCCO Project on that environment using a groundwater model. Further details of the methodology are provided below with a full description included in **Appendix 12**.

6.8.1.1 Field Work Program

To provide additional information to inform the understanding of the groundwater conceptualisation and numerical modelling, a fieldwork program was undertaken to gather further data for use in the modelling for the GWIA. The fieldwork program comprised a test pit and sampling program to define the boundary and extent of colluvium along Big Flat Creek, packer testing of exploration bores to gather down-hole formation permeability at key stratigraphic horizons and laboratory core permeability testing of interburden samples to confirm hydraulic properties and permeability of different geological units.

A detailed analysis of the field work program, the results and how they have been used to inform the GWIA is provided in **Appendix 12**.

6.8.1.2 Modelling

Potential groundwater impacts associated with the MCCO Project were assessed through a 3D numerical groundwater flow model built using MODFLOW-USG. Although the model was based on the existing models for Mangoola Coal Mine there were several key updates. These included converting the existing model to

MODFLOW-USG, expanding the model boundary, updating the geological layering and updated parameter ranges for each geological unit based upon information collected during the field work program (refer to **Section 6.8.1.1**), accounting for the progression of the mining activities within both the Approved Project Area and the MCCO Additional Project Area, and recalibration of model parameters to observed groundwater trends.

The model was used to identify the influence of the MCCO Project on the groundwater regime by predicting the incremental impacts from the proposed mining within the MCCO Additional Project Area against the impacts generated by mining only the approved Mangoola Coal Mine. The relatively isolated location of the MCCO Project Area within the Hunter Valley means that cumulative groundwater impacts with other operating Hunter Valley mines were considered highly unlikely and did not require modelling. The cumulative impacts from mining at both the approved Mangoola Coal Mine and the proposed mining area within the MCCO Additional Project Area were modelled.

6.8.1.3 Peer Review

The GWIA was subject to an independent peer review by Dr Noel Merrick of HydroSimulations and the peer review findings are included as an Appendix to the GWIA report (refer to **Appendix 12**). This process was undertaken by Mangoola to ensure that the assessment was prepared in accordance with appropriate policies, guidelines and professional practice, used appropriate methodologies, and provided accurate modelled predictions of the likely groundwater impacts associated with the MCCO Project. The peer review was undertaken in a staged manner so that peer reviewer input could be obtained at each key phase of the assessment (e.g. at model setup stage, reporting phase etc.). The peer reviewer stated that:

> the reviewer is of the opinion that the documented groundwater assessment is best practice and concludes that the model is fit for purpose, where the purpose is defined broadly by the requirements of NSW and Commonwealth legislation and policies.
>
> All usual "outputs of concern" are presented to give an overall impression of the environmental effects and their uncertainties. The assessment has been based on data analysis, conceptualisation and groundwater modelling that has been conducted to a very high standard.

6.8.2 Existing Environment

6.8.2.1 Groundwater Resource

There are three 'hydrostratigraphic units' in the vicinity of the MCCO Project Area, which are grouped based on their ability to transmit groundwater. These include the following:

- Quaternary colluvium – occurring as a relatively thin and often unsaturated capping forming a non-homogenous ephemeral aquifer aligned along Big Flat Creek and other tributary drainages
- Quaternary alluvium – forming a relatively extensive alluvial aquifer system within the flood plains of Wybong Creek and Sandy Creek
- Permian and Triassic bedrock sediments – which can be divided into:
    - thin, generally dry and variably permeable weathered rock (regolith)
    - highly weathered water bearing rock along Big Flat Creek
    - non-coal interburden such as conglomerates and sandstones that forms aquitards (a body of rock that retards but does not completely stop the flow of water)

- low to moderately permeable coal seams that act as the most transmissive strata within the coal measures sequence.

The hydrogeological properties of each of these units are described in the following sections.

Due to the distance of the existing Mangoola Coal Mine from other mining operations within the Hunter Valley monitoring to date has not identified any cumulative groundwater impacts associated with other operating Hunter Valley mines.

Colluvial Groundwater

A thin layer of colluvial sediment occurs adjacent to Big Flat Creek and overlies weathered Triassic and Permian bedrock and the fieldwork program undertaken for the MCCO Project has confirmed its extent with the closest alluvium material being associated with Wybong Creek. The colluvium associated with Big Flat Creek thins and transitions to regolith overlying highly weathered bedrock as it extends away from the creek. The regolith typically lies above the groundwater table and any water present will occur after notable rainfall events rather than an interception of the regional groundwater table.

The Big Flat Creek colluvium has been mapped as up to 3.5 m thick in shallow exploratory bores, but is potentially thicker in areas immediately surrounding the main Big Flat Creek drainage line. The materials forming the colluvium range from sand and gravel sized particles to silts and clays. Areas or lenses that are more clay rich will restrict the passage of water through the colluvial material.

There are a number of shallow monitoring bores in the weathered bedrock zone underlying the colluvium that intersect permanent groundwater. It would appear that prior to mining the colluvium close to the creek is likely to have been intersected by the local groundwater table and been partially saturated, especially during wetter periods. Monitoring of water levels within shallow bores adjacent to the existing Mangoola Coal Mine have indicated levels have fallen over time as the approved mining operations have progressed, and the colluvium is likely to have drained in some areas. It is unlikely the colluvium will re-saturate whilst mining operations are being undertaken.

Alluvial Groundwater

There are no highly productive alluvial groundwater units mapped within the MCCO Proposed Additional Mining Area. The closest highly productive alluvium is associated with Wybong Creek and located approximately 1 km to the west of the MCCO Proposed Additional Mining Area, and along Sandy Creek located over 5 km to the south-east of the MCCO Proposed Additional Mining Area (refer to **Figure 6.18**).

The Wybong Creek is highly incised into the alluvium. A comparison of the alluvial groundwater levels with the level of the creek bed from a LIDAR survey indicates that groundwater levels are at a similar elevation to the surface water in the creek. This indicates the creek intersects the regional water table and alluvial groundwater potentially contributes to the creek baseflow.

Historical records from bores located within the alluvium in both Wybong Creek and Sandy Creek indicate bore yields range from relatively low (~0.1 L/s) to high (~25 L/s), and salinity is highly variable ranging from fresh to brackish (TDS <1500 mg/L), to moderately saline (between 1500 mg/L and 7000 mg/L). Whilst there are no estimates of hydraulic conductivity or aquifer storage within the alluvium the variability of the yields in the water bores suggests the permeability and thickness of the alluvium varies across the floodplain.

Permian and Triassic Groundwater

The Permian and Triassic groundwater systems occur in the bedrock strata and contain similar sandstones and conglomerates, with the Permian Coal Measures also containing coal seams including those targeted by the MCCO Project.

The Permian coal measures and Triassic sandstones and conglomerates form less productive groundwater systems, when compared to the shallow alluvial systems, with the coal seams and shallow weathered conglomerates being the most permeable. There is minimal recorded abstraction of groundwater from the bedrock strata for stock, domestic and other agricultural uses, primarily due to low yields and the high salinity of this groundwater limiting beneficial uses.

The current Mangoola groundwater monitoring program monitors groundwater levels within the bedrock strata via a network of over 100 active monitoring bores and vibrating wire piezometers (VWPs) (refer to **Figure 2.5**). This includes sites located around the MCCO Additional Project Area which were installed to collect baseline data.

An analysis of the groundwater monitoring data was undertaken to confirm groundwater quality and potential beneficial uses of the Permian and Triassic groundwater. This identified that salinity is the key constraint to groundwater use with the majority of Mangoola monitoring bores (96 out of 101) recording results in the moderately saline (1500 to 7000 mg/L) to highly saline (15,000 to 35,000 mg/L) range. The groundwater sampled was identified in the GWIA as unsuitable for aquatic ecosystems, irrigation, or potable consumption. Some bores have a suitable salinity for stock watering (assuming that the water is used for watering beef cattle rather than dairy cattle).

A number of monitoring sites are also sampled for a more detailed water quality suite. The extended suite includes testing for total and dissolved metals, hydrocarbons and nutrients. The results indicate that for a number of bores several metals are present in concentrations above guideline thresholds. All tests for hydrocarbons returned concentrations that were below the laboratory limit of reporting. For the nutrient parameters there were exceedances to triggers for ammonia for both aquatic ecosystems, and potable consumption. When compared against the ANZECC guideline values for aquatic ecosystems, irrigation and stock, nitrite concentrations triggered for aquatic ecosystems; and total nitrogen and total phosphorous triggered for long term irrigation. There were no nutrient exceedances for stock watering.

Further details regarding the groundwater monitoring program and results for water quality and beneficial uses are provided in **Appendix 12**.

6.8.2.2 Water Licensing

Mangoola currently holds adequate water licences to extract groundwater as a result of approved mining at Mangoola Coal Mine. The combined allocations for each aquifer type are:

- Hardrock – licensed under the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources to take up to 700 ML/annum groundwater from the porous rock aquifers including the Permian Newcastle Coal Measures and Triassic Narrabeen Group sandstones
- Alluvium – licensed under the Hunter Unregulated and Alluvial Water Sources Water Sharing Plan 2009 (Wybong Management Zone 29) to extract up to 254 ML/annum groundwater from the alluvial aquifer associated with Wybong Creek.

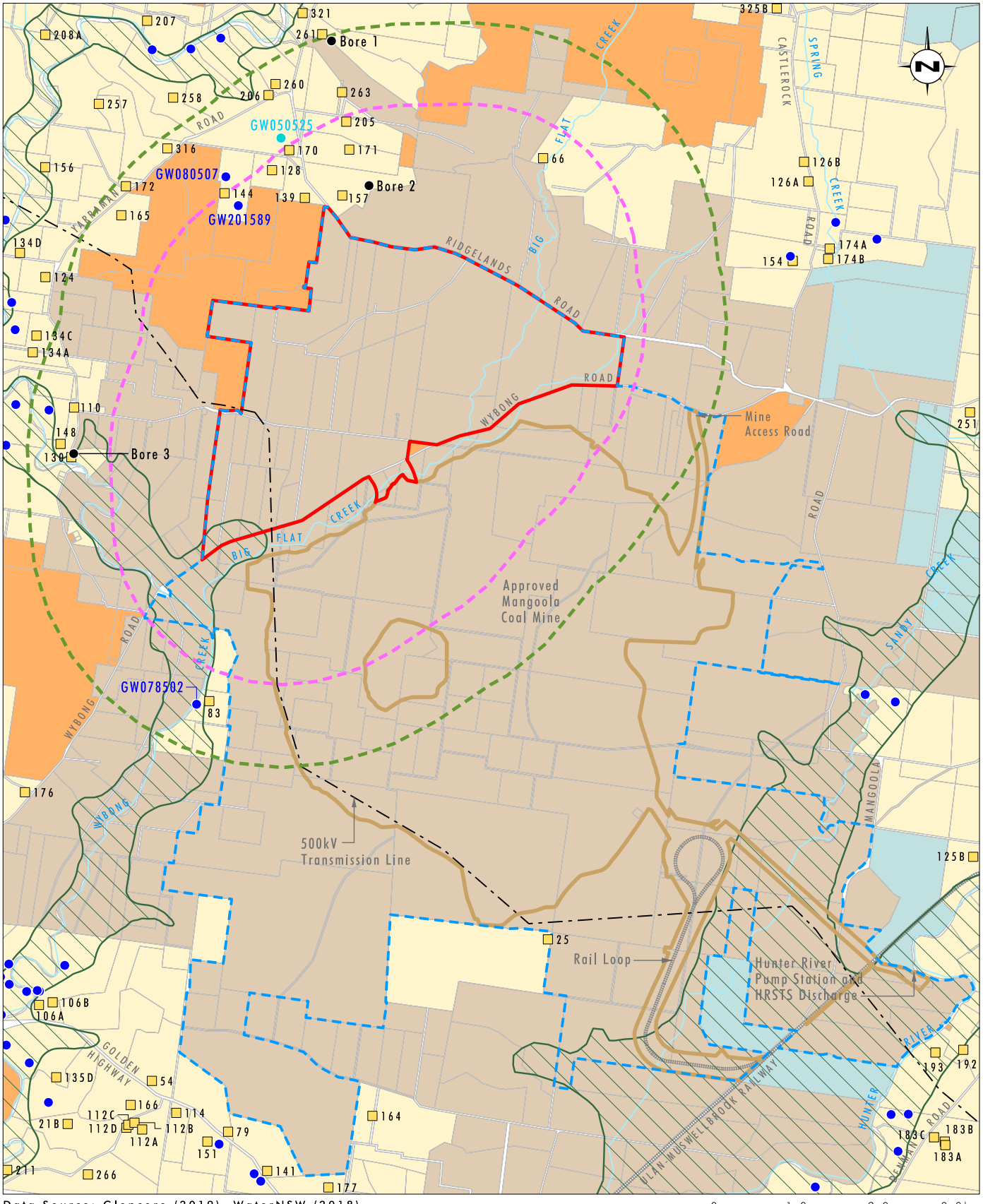
6.8.2.3 Registered Bores on Privately Owned Land

A search of the NSW Government groundwater bore database (Pinneena) was conducted to identify the locations of any registered water bores in proximity to the MCCO Project on privately owned land parcels. In addition, a landholder census identified three bores that were not currently present on the registered bore database. The exact locations of the additional bores are uncertain and indicative locations have been used based on the limited data provided to date (refer to **Figure 6.18**). The results of both searches identified two bores on private land within a 2 km radius of the MCCO Proposed Additional Mining Area, and an additional six bores within 3 km. Available licence details indicate that four of the registered bores were for stock and domestic use, with the fifth converted to a government monitoring bore. One of the stock and domestic bores has since been backfilled and is no longer present.

6.8.2.4 Groundwater Dependent Assets

The IESC Information Guidelines require the identification of water-dependent assets with potential to be impacted by coal seam gas and large coal mines. The Australian Government Bioregional Assessment Programme for the Hunter Subregion includes mapping of water-dependent assets. This mapping was reviewed and identified that the Wybong Creek alluvium and the Hunter River alluvium are noted as alluvial aquifer assets. Both of these have been considered in the GWIA as required. The alluvium along Sandy Creek, and the colluvium along Big Flat Creek, are not differentiated from the bedrock groundwater units in terms of the asset groupings. There are no groundwater springs identified close to the MCCO Project.

Economic dependent water assets have also been considered by the GWIA including water access licenses, basic water rights, water source areas, water supply infrastructure, and regulated rivers.



Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Alluvium Extent
- Proposed Additional Mining Area 2km Buffer
- Proposed Additional Mining Area 3km Buffer
- Crown Land
- Mangoola Owned Land
- Other Mined Owned Land
- Private Land
- Private Residence
- Registered Groundwater Bores
- Groundwater Bore No Longer Exists
- New Groundwater Bores Not on Public Register

FIGURE 6.18

Nearby Registered Bores on Privately Owned Land

6.8.3 Assessment

The groundwater model simulated the existing hydrogeological conditions of the MCCO Project Area and its surrounds and provided predictions of the potential impacts of the future mining activities proposed by the MCCO Project.

6.8.3.1 Groundwater Intercepted by Mining

The groundwater model predicts that groundwater intercepted from the Permian coal measures will vary during the life of the mining operations within the MCCO Additional Project Area with an average inflow of 123 ML/year predicted. Inflows are predicted to peak in about Project Year 2 at 210 ML/year. When considered together, the groundwater take from mining operations within both the Approved Project Area and MCCO Additional Project Area, is predicted to peak at 280 ML/year also in Project Year 2. An assessment of licensing requirements for this take is provided in **Section 6.8.3.5** which confirms that Mangoola has sufficient existing licences to cater for this predicted take.

6.8.3.2 Drawdown in Groundwater Levels

In this section predictions of maximum drawdown during mining are provided for the following scenarios:

- MCCO Additional Mining Area incremental impacts – Maximum drawdown due to only the proposed mining within the MCCO Additional Project Area, to show the incremental impact of mining beyond the impacts already approved for the Mangoola Coal Mine
- With Approved Mining – Maximum cumulative drawdown due to mining within both the Approved Project Area and the MCCO Additional Project Area.

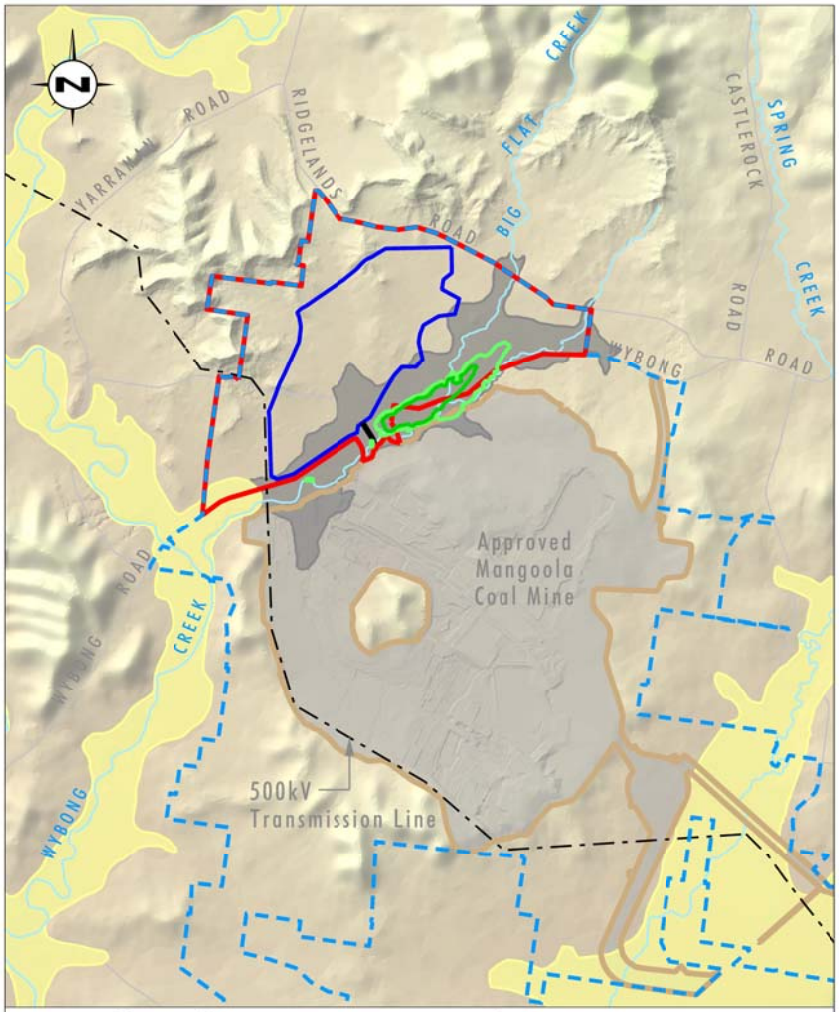
Model predictions for the key groundwater aquifers are provided below.

Alluvium, Colluvium and Regolith

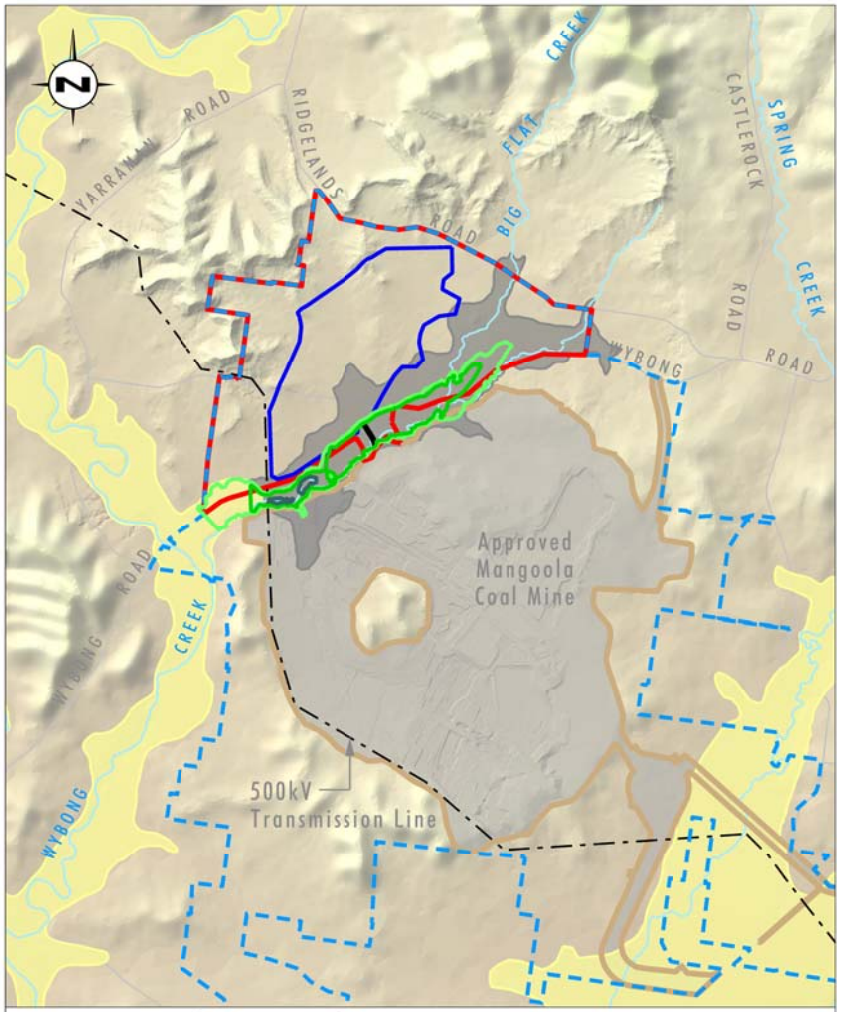
Collectively this modelled layer refers to the shallow strata comprising Wybong Creek alluvium, Sandy Creek alluvium, shallow colluvium along Big Flat Creek, and a thin 2 m thick regolith layer across the remainder of the model area. As shown on **Figure 6.19**, a comparison of the without approved mining and with approved mining scenarios shows that drawdown primarily occurs as a result of the existing approved mining at Mangoola Coal Mine, with the additional proposed mining within the MCCO Additional Project Area extending the predicted zone of drawdown slightly upstream along Big Flat Creek. The limited spatial extent of the shallow drawdown likely reflects the unsaturated nature of the regolith across much of the model area. Once the materials are unsaturated no additional drawdown is possible.

Fassifern and Upper Pilot A Seams

Predicted impacts for the Permian coal measures are based on the results for the Fassifern and Upper Pilot A Seams which represent the lowest seams being mined in the MCCO Proposed Additional Mining Area. The predicted drawdowns during mining are more extensive in the deeper bedrock than the shallow layers (i.e. the alluvium, colluvium and regolith), a result that has already been observed through monitoring as part of the existing operations at Mangoola Coal Mine. Although the cumulative impacts in both model layers extend under the Wybong Creek alluvium, the incremental drawdown from mining within the MCCO Additional Project Area under the alluvium is minimal.



MCCO Additional Mining Area Incremental Impacts



Maximum Cumulative Drawdown (with approved mining)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Proposed Additional Mining Area
- Alluvium Extent
- Colluvium Extent
- Drawdown Contours:
  - 1m
  - 2m
  - 5m

0 1.0 2.5 5.0km

Data Source: Glencore (2019), WaterNSW (2018), AGE (2019)

FIGURE 6.19

Predicted Maximum Groundwater Drawdown
Alluvium, Colluvium and Regolith

6.8.3.3 Change in Alluvial Groundwater and Stream Baseflow Availability

The change in alluvial water resources was determined by comparing water budgets for alluvial zones using versions of the numerical model that contained and excluded the MCCO Proposed Additional Mining Area. The main alluvial resources are associated with Wybong Creek and Sandy Creek.

In accordance with the AIP, the groundwater model was used to determine the mining interference on the groundwater system. As the Permian strata becomes depressurised, flow from the Permian to the alluvium within the zone of depressurisation will slightly reduce. Initially the change in flux compared to pre-mining conditions is almost entirely due to a reduction in groundwater inflow to the alluvium. This can be considered beneficial as it reduces the inflow rate of higher salinity groundwater from the Permian to the overlying alluvium. By the end of mining the change in flux is a combination of a reduction in the groundwater inflow to the alluvium from the bedrock, and increased loss from the alluvium to bedrock.

The modelling assessed the change in flux (flows) predicted by the numerical model between the bedrock and the Wybong Creek Alluvium due to the approved Mangoola Coal Mine and MCCO Proposed Additional Mining Area combined. The majority of the total change in flux during active mining (maximum 33 ML/year) can be attributed to the continued operations within the approved Mangoola Coal Mine (maximum 30 ML/year). The incremental change due to mining within the MCCO Proposed Additional Mining Area is a maximum of 3 ML/year. The numerical model did not predict any changes in groundwater flux to the Sandy Creek Alluvium. This is an expected result as drawdown does not extend in this direction.

The reduced groundwater flux between the Permian strata and the overlying Wybong Creek Alluvium also reduces the rate of groundwater discharge into the Wybong Creek as baseflow.

The change in flux to the Wybong Creek alluvium also induces a change in the baseflow within Wybong Creek of up to 28 ML/year, with the majority of the change once again due to the approved Mangoola Coal Mine (26 ML/year). The gauging station on Wybong Creek (210040) has recorded a mean annual total flow of 28,287 ML/year, indicating the predicted change in groundwater baseflow of 28 ML/year (or 0.1 per cent) is negligible. When considering the change as a result of the MCCO Additional Mining Area (ie. 2 ML/year) this predicted change is even lower at approximately 0.007 per cent.

There is no alluvium underlying Big Flat Creek, therefore flux changes in alluvium are not applicable. The change in surface water flux in Big Flat Creek has been estimated for the reaches adjacent to the mining areas and indicates that baseflow to the creek is predicted to fall by approximately 10 ML/year as a result of the approved Mangoola Coal Mine. Once the bed of the creek becomes disconnected from the groundwater table there are no further baseflow contributions to the creek for the remainder of the approved and proposed mining operations. As the creek will be disconnected from groundwater when the proposed MCCO Proposed Additional Mining Area commences operations, there can be no additional impacts on Big Flat Creek baseflow due to the MCCO Proposed Additional Mining Area.

6.8.3.4 Post-Mining Recovery of Groundwater Conditions

At the end of mining the majority of the two mining areas will have been backfilled with spoil and recontoured to simulate a more natural landform. A final void will remain in each area at the locations shown on **Figure 3.7**. The deepest areas of the voids will be similar to the maximum depths mined being approximately 125 m below ground level.

In this regard post mining conditions were also simulated using the numerical model to predict the effect on the groundwater system in the long term. Post mining conditions were simulated using a transient model run over a period of 500 years.

Post Mining Groundwater Recovery

The model results indicate that groundwater levels will gradually recover over time until an equilibrium state is reached. In both mining areas the long term groundwater levels are predicted to equilibrate at a lower level than under pre-mining conditions, with the final voids (non-backfilled mining areas) acting as long-term groundwater sinks. However, within the existing approved mining area at Mangoola Coal Mine the groundwater contours suggest that there is potential for water in backfilled areas away from the final void to migrate into the surrounding bedrock. This is predicted to be a slow process due to the low permeability of the bedrock strata. Modelling has indicated that any outwards migration will likely occur in the deeper strata as many areas of the near surface layers remain unsaturated, and that the majority of the water exiting the existing approved mining area at Mangoola Coal Mine will either be drawn back towards the Mangoola Coal Mine final void or be captured by the MCCO Proposed Additional Mining Area final void. Although some groundwater from Mangoola Coal Mine is not captured it primarily remains in the deeper layers and does not migrate towards the surface.

Post Mining Changes in Alluvial and Surface Water Fluxes

Water take from the groundwater systems will continue post mining due to the residual drawdown created by flow of groundwater to the final voids and subsequent evaporation from the void lakes.

Post mining predicted changes in flux to the Wybong Creek alluvium indicate that early post mining takes may be slightly greater than those predicted during mining (cumulative maximum 34 ML/year) due to the slow transmission of impacts through the different strata. The majority of the take from Wybong Creek continues to be attributed to the approved Mangoola Coal Mine. Over time the take attributed to the MCCO Proposed Additional Mining Area increases as the system equilibrates. Long term take is predicted to be around 23 ML/year, comprising 10 ML/year due to the Mangoola Coal Mine and 13 ML/year attributed from the MCCO Proposed Additional Mining Area.

The predicted take from the Wybong Creek alluvium is predicted to result in a consequential very minor reduction in surface water flows. The long term reduction is predicted to be around 21 ML/year, comprising 9 ML/year due to the approved Mangoola Coal Mine and 12 ML/year attributed from the MCCO Proposed Additional Mining Area.

Baseflow to Big Flat Creek is predicted to remain impacted throughout the 500-year recovery period, although there is a slight reduction in water take to approximately 8 ML/year after the first 150 years post mining. The long-term impact is due to shallow water levels under the creek remaining lower than under pre-mining conditions. As with Wybong Creek the initial post mining impacts are primarily attributable to the approved Mangoola Coal Mine, with a transition over time to being more attributable to the MCCO Additional Project Area.

Groundwater Fluxes in Backfilled Mining Areas

Post mining 'water take' from the Permian bedrock to the mining areas will require licensing if there is a net loss of water from the system. Predictions of long-term fluxes for each of the MCCO Project mining areas show that although there are groundwater inflows predicted to both mining areas there is only a predicted net loss to the system from the MCCO Proposed Additional Mining Area. The predicted post mining take from the MCCO Additional Mining Area is approximately 57 ML/year. This is well within the 700 ML/year licensed hard rock take held by Mangoola.

Predictions of long-term recovery at the Mangoola Coal Mine suggest that the final void will not capture all water within the backfilled mining area, and there will be a small net outflow from some areas of the mine. Particle tracking has indicated that any outwards migration will likely occur in the deeper strata as many

areas of the near surface layers remain unsaturated, and that the majority of the water exiting the Mangoola Coal Mine will be drawn towards the MCCO Proposed Additional Mining Area final void. Although the southernmost particles at the Mangoola Coal Mine are not captured they remain in the deeper layer and do not migrate towards the surface.

Groundwater Quality

As discussed in the sections above the post mining landscape will be contoured to the proposed conceptual final landform (refer to **Figure 3.7**) and groundwater levels will slowly recover. Water quality changes could emerge as a result of mining through the following mechanisms:

- evaporation concentrating salts within the final void lakes
- rainfall-recharge infiltrating the backfilled spoil and dissolving salts as it passes
- long term changes in water level altering flow directions.

Pit lakes are predicted to form within the final voids in each mining area. As the lakes will form groundwater sinks it is expected that there will be evapo-concentration of any water that flows to them. The likely salinities over time is discussed in **Section 6.7.3.2** and **Appendix 11**.

Geochemical testing of the spoil indicates that there is the potential for rainfall-runoff infiltrating through the spoil to remain less saline than the groundwater in the surrounding bedrock. This would improve the overall water quality within the area if the spoil water were to migrate away from the mining footprint. Based on existing monitoring and the outcomes of the geotechnical assessment, no adverse impacts are predicted with regard to groundwater pH.

Water quality is variable within the bedrock units, with notably higher salinity groundwater present underneath Big Flat Creek. Groundwater quality changes are being observed in bores with falling water levels close to the active Mangoola Coal Mine and Big Flat Creek. This is attributed to the Mangoola Coal Mine acting as a groundwater sink, drawing water towards it and altering the pre-mining flow paths. Any groundwater currently entering the pit will be reporting to the in-pit mining sumps for collection and management and will therefore be contained within the mine water management system.

Post mining the majority of the two mining areas will have been backfilled with overburden, with the remaining areas forming pit lakes in the final voids. Over time the spoil will re-saturate until water levels equilibrate with the surrounding bedrock groundwater. The final equilibrated water levels are predicted to be altered from pre-mining groundwater conditions, and groundwater is likely to move in different directions to those that were present before the mines were established.

The MCCO Proposed Additional Mining Area will remain a strong groundwater sink, and there will be no significant outflow to bedrock from the mining area. Any water quality changes will therefore remain within the mining footprint. The Mangoola Coal Mine is predicted to form a sink around the final void but may allow water to migrate into the bedrock in areas away from the void. As discussed earlier in this Section this will occur slowly and the majority of water that does leave the backfilled mining area of the existing approved Mangoola Coal Mine is predicted to migrate towards the MCCO Additional Mining Area final void or remain at depth in close proximity to the Mangoola Coal Mine footprint. Therefore, although there is the potential for any changes in water quality generated within the mining footprint to migrate outwards into the bedrock it will either be recaptured or remain at depth in strata with naturally high salinity and with no current groundwater users.

The lower equilibrated groundwater heads under Big Flat Creek are predicted to reduce the long term baseflow in the creek by approximately 8 ML/year compared to pre-mining conditions. This could improve the water quality of Big Flat Creek as pre-mining baseflows appear to have been significantly more saline than creek flow generated from rainfall runoff.

6.8.3.5 Groundwater Licensing Requirements

As outlined in **Section 6.8.2.2** Mangoola currently has a combined total entitlement of 700 ML/year from the North Coast Fractured and Porous Rock WSP. Based on modelling, Mangoola require a maximum of 280 ML/year (to account for the maximum take predicted in Project Year 2) from this WSP for the approved and proposed MCCO Project mining, and therefore hold sufficient licences to account for this combined water take.

Mangoola's current entitlement of 254 ML/year from Wybong Management Zone of the Hunter Unregulated and Alluvial WSP, will readily account for the indirect 'water take' predicted from the Wybong Creek Alluvium during mining (modelled to be 33 ML/year for groundwater and 28 ML/year for surface water). When double accounting of water is removed the alluvial take reduces to 5 ML/year (that is, the majority of the alluvial groundwater reduction is replaced by surface water inflow to the alluvium, and therefore only a small amount of alluvial groundwater take requires licensing). Post mining impacts to Wybong Creek are predicted to peak at 34 ML/year from groundwater, and 30 ML/year from surface water. When corrected for double accounting the groundwater take reduces to 4 ML/year. **Table 6.21** provides a summary of groundwater licensing requirements.

Table 6.21 Groundwater Licensing Requirements

Water Sharing Plan	Maximum Water Licensing Requirement	Current Mangoola Entitlement
North Coast Fractured and Porous Rock WSP	280 ML/year	combined total entitlement of 700 ML/year
Hunter Unregulated and Alluvial WSP	34 ML/year for groundwater (adjusted to 5 ML/year to avoid double counting) 30 ML/year for surface water	254 ML/year

6.8.3.6 Impact on Private Bores

Of the eight bores identified within 3 km of the MCCO Project Area, four (three registered and one new bore) are located within an area predicted to experience over 2 m drawdown in the layers above or within the coal seams under base case mining conditions.

Of these, three are located to the north of the MCCO Project. However, when the depths of these three bores are reviewed (based on bore construction logs and landholder information) they appear to be screened at depths where less drawdown is predicted, e.g. the model layer containing bore GW201589 is only predicted to be impacted by ~0.3 m, whereas the drawdown in the deeper layers can be up to 5.2 m. To account for uncertainty in the model the maximum drawdowns predicted in the model layers above and below the expected bore depth have also been extracted and included in the analysis. In this scenario the only bore to the north of the MCCO Project that could potentially be impacted by more than 2 m is Bore 2 (likely drawdown > 3 m under base case conditions), the other two sites are predicted to experience drawdown of less than 0.5 m. Proposed monitoring and mitigation is discussed in **Section 6.8.4**.

The fourth bore that is in an area of over 2 m potential drawdown (GW078502) is located to the west of the approved Mangoola Coal Mine and is predicted to primarily be impacted due to mining at the approved Mangoola Coal Mine. Predicted drawdown at the bore is approximately 7.5 m, although the range could be up to approximately 14.7 m. The property on which this bore is located already has voluntary acquisition rights afforded by the current Project Approval (Property ID 83) and it is anticipated that this property would also be afforded acquisition rights due to the MCCO Project should it be approved.

6.8.4 Management and Mitigation

Mangoola currently operates Mangoola Coal Mine in accordance with a WMP which was prepared in consultation with NSW Government agencies and subsequently approved. The WMP describes the management of environmental and community aspects, impacts and performance relevant to the site's water management system.

The WMP includes a Groundwater Management Plan which outlines a monitoring program to collect groundwater levels and quality measurements. A number of additional monitoring sites have been installed around the proposed MCCO Proposed Additional Mining Area to assess baseline conditions. The monitoring network detailed in the existing Groundwater Management Plan will be augmented with the additional sites installed since the Groundwater Management Plan was developed. To further supplement the monitoring network, the GWIA identified the need for new monitoring bores to confirm the VWP pressure changes, and also to monitor water levels in the Wybong Creek alluvium and GDEs. A bore census and, if necessary, baseline monitoring of those private bores within the predicted zone of water level drawdown should also be implemented.

The Groundwater management Plan will be revised to include the additional monitoring recommended by GWIA as provided in **Appendix 12**. The proposed bore locations are detailed in **Appendix 12** and will be considered for inclusion in the revised monitoring plan. Groundwater monitoring for the MCCO Project will continue to include:

- bi-monthly water levels
- bi-monthly field water quality
- annual comprehensive water quality analysis at selected bores including pH, electrical conductivity, total dissolved solids, major ions, alkalinity, and dissolved and total metals.

The results of the monitoring will be reviewed annually to determine if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken.

Every three years the validity of the groundwater model predictions will be assessed by comparing the extraction volumes and groundwater level data against model predictions. If the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for the simulation of mining.

With regard to potential impacts on private bores, Mangoola will offer to monitor any private bores where impacts are predicted to identify if any impacts occur from the MCCO Project. Should these bores be affected by the MCCO Project, Mangoola will repair the bore, provide an alternative water supply or implement other measures agreed with the landowner.

6.9 Biodiversity

A comprehensive Biodiversity Assessment Report (BAR) has been prepared for the MCCO Project in accordance with the SEARs to assess the potential ecological impacts of the MCCO Project following the NSW Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects (FBA). The BAR has been prepared by Umwelt. The FBA process is a credit driven system where calculators provided by the NSW government are populated with ecological data about the site to generate 'impact credits'. The project is then required to offset these credits through a biodiversity offset strategy.

As outlined in **Section 5.1**, biodiversity impacts were identified by the community and other stakeholders as one of the key issues of most concern during the application for and assessment of the original approval for Mangoola Coal Mine. To address this issue Mangoola has established approximately 3065 ha of Biodiversity Offset Areas to offset predicted ecological impacts associated with the approved Mangoola Coal Mine operations (refer to **Section 2.8** for further details). Mangoola has also put extensive effort into rehabilitation of the mining areas to re-establish areas of native vegetation and fauna habitat. As described in **Section 2.9** rehabilitation is completed using natural landform design principles and revegetation techniques that are recognised as industry leading. The objectives of this rehabilitation are to return a stable, natural looking landform and sustainable vegetation communities that are consistent with and enhance the surrounding landscape. As part of a commitment for the existing mining operations Mangoola has also developed and implemented a successful threatened orchid translocation program.

With regard to Mangoola's approach to the design and planning of the MCCO Project potential biodiversity impacts have been recognised and thoroughly considered throughout the project planning process and as described further in this section through the principles of avoid, mitigate and offset have been considered and addressed.

It is noted that despite being a key community issue for past approvals, biodiversity was not raised as one of the key issues of concern during the SIA consultation conducted for the MCCO Project.

Whilst Mangoola has strived to minimise impacts on biodiversity through the design process, not all impact could be avoided by the proposed design and a detailed assessment of the impacts was undertaken of the MCCO Project. A summary of the key findings of the BAR is provided in this section including details of the key ecological values of the MCCO Additional Disturbance Area and the outcomes of the FBA process. The full BAR report is provided in **Appendix 13**.

There are no proposed changes to the existing approved mining area for Mangoola Coal Mine that will change the existing approved biodiversity impacts of the mine and therefore the Approved Project Area does not require further biodiversity assessment as part of the MCCO Project. This assessment therefore focuses on the MCCO Additional Project Area.

6.9.1 Methodology

The threatened species and ecological communities known or likely to occur within the MCCO Additional Project Area were identified through a systematic approach that comprised relevant database searches, a review of recent literature and targeted field surveys. There has been a long history of biodiversity survey and investigation across the MCCO Project Area and surrounds associated with the Mangoola Coal Mine and there was substantial local biodiversity data that was available to inform the BAR.

Database searches were undertaken to develop a candidate list of threatened flora and fauna species and threatened ecological communities (TECs) that have previously been recorded, or are predicted to occur within 10 km of the boundary of the MCCO Additional Project Area. The information obtained was used to

inform survey design, and was also used to assist in the assessment of potentially occurring threatened and migratory species and endangered populations. Relevant databases included:

- Bionet Vegetation Classification Database (OEH 2018c)
- OEH Online Search Tool (OEH 2018d) for known/predicted threatened communities in the Hunter IBRA subregion
- DoEE Protected Matters Search Tool for known/predicted EPBC Act-listed TECs.

A preliminary assessment using the BioBanking Credit Calculator was undertaken to provide a candidate list of species-credit species that might require targeted survey and the suitable survey periods for each species. The results of the database searches, literature review and preliminary assessment using the BioBanking Credit Calculator were used to design the survey requirements for species-credit species so that adequate surveys were undertaken.

The vegetation of the MCCO Additional Project Area was surveyed over ten sampling periods. Flora surveys included floristic plots, rapid assessments and opportunistic surveys in order to accurately sample the vegetation communities and potentially occurring threatened flora species within the MCCO Additional Project Area.

Targeted surveys and transects for cryptic and seasonal threatened flora species that are identifiable in September/October (i.e. during the flowering period for these species) have been conducted across the MCCO Additional Project Area and wider Mangoola land holdings over numerous years. The surveys within the MCCO Additional Project Area were primarily undertaken between 2013 and 2016. Specific searches for pine donkey orchid *(Diuris tricolor*) and Tarengo leek orchid (*Prasophyllum petilum*) were undertaken across the MCCO Additional Project Area (or parts thereof) over consecutive years (excluding 2012) from 2010 to 2018.

Fauna surveys across the MCCO Additional Project Area area were undertaken from June, July and August of 2009, 10 to 14 March 2014 and 15 to 17 February 2017. Fauna survey methods included a range of survey techniques including targeted searches, call playback, anabat echolocation recording, spotlighting, remote detection camera sampling and meandering transects.

Following completion of the field survey, the BioBanking Credit Calculator (BBCC) Version 4.1 (Major Project Assessment Type) was applied in accordance with FBA methodology (OEH 2014) to calculate the credit requirements for the MCCO Project.

6.9.2 Key Biodiversity Values

The following sections provide a summary of the key biodiversity values for the MCCO Additional Project Area.

6.9.2.1 Native Vegetation

Surveys of the MCCO Additional Disturbance Area identified six Biometric Vegetation Types (BVTs) (excluding exotic pastures) (refer to **Figure 6.20**) being:

- HU812 - Forest Red Gum grassy open forest on floodplains of the lower Hunter
- HU816 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter

- HU817 - Narrow-leaved Ironbark - Bull Oak - Grey Box Shrub - Grass Open Forest of the Central and Lower Hunter

- HU821 – Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple Shrubby Woodland of the upper Hunter

- HU906 - Bull Oak grassy woodland of the central Hunter Valley

- HU945 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley.

Figure 6.20 shows the vegetation communities mapped within the MCCO Additional Disturbance Area. The BAR provides detailed descriptions of these communities. It is noted that they surveys identified that some of the BVTs occur in a range of condition classes (e.g. woodland and derived native grassland forms).

Parts of some of the above BVTs were also identified as conforming to listed Threatened Ecological Communities (TECs). Four TECs listed under the BC Act and one TEC listed under the EPBC Act were recorded being:

- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC) (BC Act)

- Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)

- Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC (BC Act)

- White Box Yellow Box Blakely's Red Gum Woodland EEC (BC Act)

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community (CEEC) (EPBC Act).

The distribution of the TECs is shown on **Figure 6.21**.

6.9.2.2 Threatened Flora and Fauna Species

The FBA methodology categorises species as either ecosystem-credit species or species-credit species which are defined as:

- ecosystem-credit species – species that can be reliably predicted to occur in Plant Community Types (PCTs) and have a high likelihood of occurring on the site. Therefore, targeted surveys for ecosystem-credit species are not required

- species-credit species – species that cannot be reliably predicted based on a PCT, distribution or habitat criteria. These species require targeted survey effort to determine their presence or otherwise on the site.

All non-threatened species and some threatened species are ecosystem species and therefore do not require further specific assessment under the FBA methodology. The remaining threatened species are species-credit species and require further assessment and, where relevant, the calculation of impact species-credits under the FBA methodology.

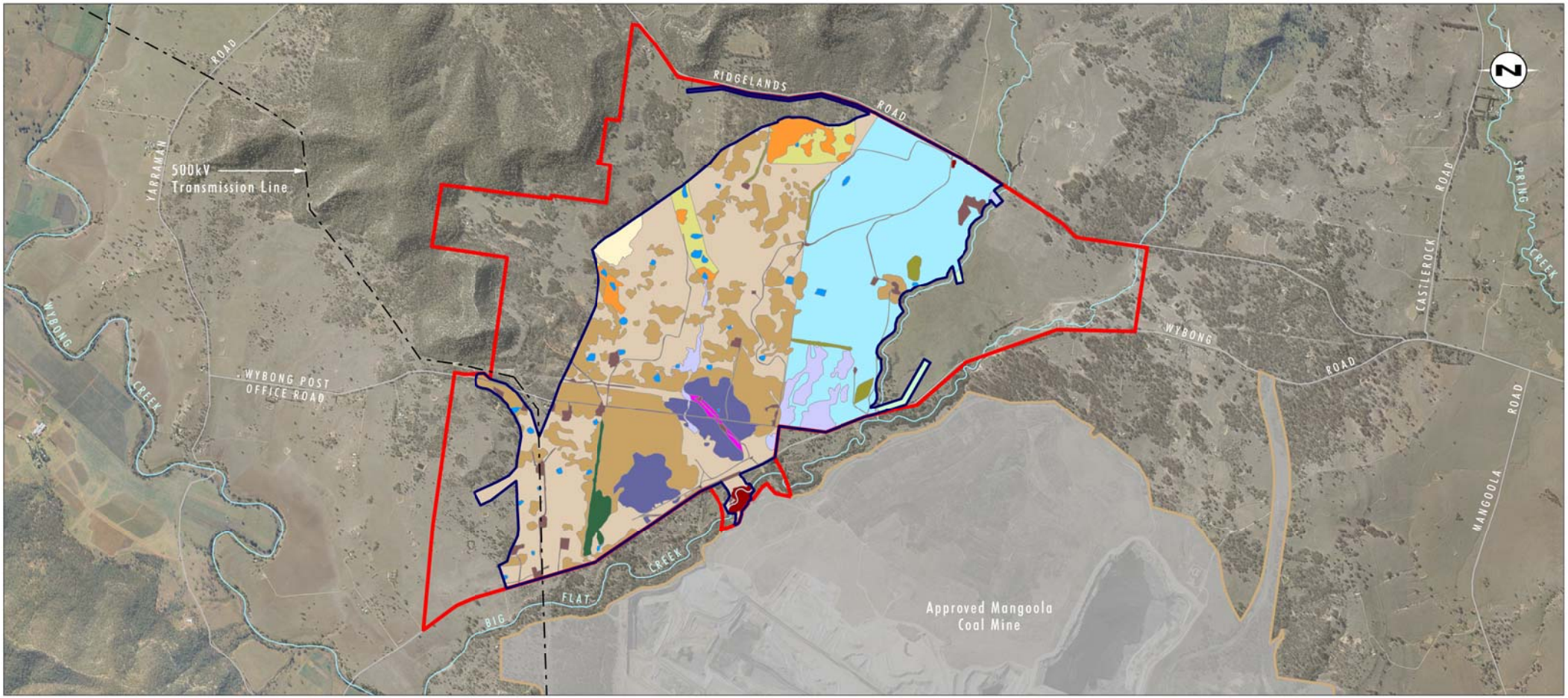


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Additional Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Disturbed Land
- Exotic Rushland
- Mixed Species Revegetation Plantation
- Water Body
- HU812/PCT1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good
- HU812/PCT1598 - Moderate to Good - Derived Native Grassland
- HU816/PCT1602 Spotted Gum - Narrow-leaved Ironbark Shrub - Grass Open Forest of the Central and Lower Hunter - Moderate to Good
- HU817/PCT1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter - Moderate to Good
- HU817/PCT1603 Moderate to Good - Derived Native Grassland
- HU817/PCT1603 Low - Derived Native Grassland
- HU821/PCT1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter - Moderate to Good
- HU869/PCT1655 Low - Derived Native Grassland
- HU906/PCT1692 Bull Oak Grassy Woodland of the Central Hunter Valley - Moderate to Good
- HU906/PCT1692 Moderate to Good - Derived Native Grassland
- HU945/PCT1731 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley - Moderate to Good
- HU945/PCT1731 Moderate to Good Condition - Other

FIGURE 6.20

Vegetation Types of the MCCO Additional Disturbance Area

File Name (A4): R13/4004_316.dgn
20190621 9.47

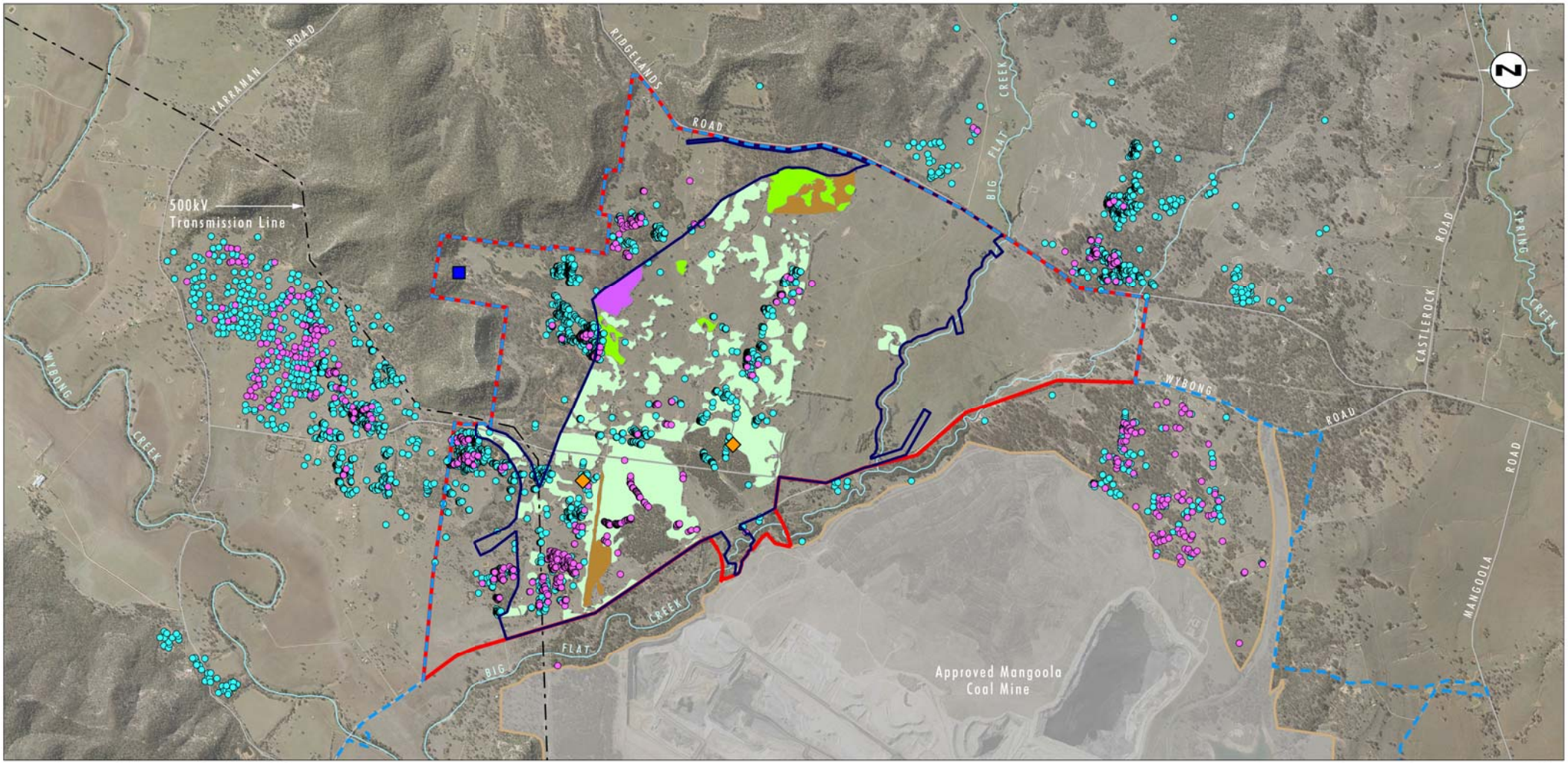


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

0 0.5 1.0 2.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions
- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions
- White Box Yellow Box Blakely's Red Gum Woodland
- Brush-tailed Rock-wallaby Scat Record
- Southern Myotis
- Pine Donkey Orchid (*Diuris tricolor*) Locations
- Tarengo Leek Orchid (*Prasophyllum petilum*) Locations

FIGURE 6.21

Threatened Species and Ecological Communities Within and Surrounding the MCCO Additional Disturbance Area

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20190516 15.45

Ecosystem Credit Species

Seven ecosystem-credit species were recorded in the MCCO Additional Disturbance Area during targeted surveys. These include:

- glossy black-cockatoo (*Calyptorhynchus lathami*)
- grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- little lorikeet (*Glossopsitta pusilla*)
- speckled warbler (*Chthonicola sagittata*)
- varied sittella (*Daphoenositta chrysoptera*)
- squirrel glider (*Petaurus norfolcensis*)
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)
- southern myotis (*Myotis macropus*) (forging habitat).

Species Credit Species

Four species credit species were recorded in the MCCO Additional Disturbance Area (refer to **Figure 6.21**) during surveys undertaken for this assessment. These include:

- pine donkey orchid (*Diuris tricolor*) – 1326 individuals
- Tarengo leek orchid (*Prasophyllum petilum*) – 691 individuals
- southern myotis (*Myotis macropus*) – breeding habitat – 0.9 ha
- large-eared pied bat (*Chalinolobus dwyeri*) – breeding habitat – 2.1 ha.

A range of other threatened species were predicted to occur by the BioBanking Credit Calculator (Major Project Assessment Type) and were therefore also considered in the assessment.

Of the species listed above, two threatened species are also co-listed under the Commonwealth EPBC Act. Commonwealth listed species are discussed in further detail in **Section 7.0** and include the following:

- Tarengo leek orchid (*Prasophyllum petilum*) (note the local occurrence of *Prassophyllum petilum* is also referred to as *Prasophyllum sp*. Wybong under the EPBC Act threatened species listing (refer to **Section 7.0**)
- large-eared pied bat (*Chalinolobus dwyeri*).

6.9.3 Avoidance and Mitigation Measures

6.9.3.1 Avoidance

As noted above, there has been a long history of biodiversity assessment at the Mangoola Coal Mine and the key biodiversity values of the area were understood from project commencement and have been considered in the design of the MCCO Project.

Mangoola undertook a detailed biodiversity constraints study as part of the MCCO Project's pre-feasibility assessment to guide the design of the Project. Through this process, alternative mining options were considered and Mangoola sought to minimise the environmental and community impacts associated with the Project whilst maximising the economic resource recovery. Key elements of the MCCO Project design have been designed to ameliorate the impacts on significant biodiversity features, such as threatened species, endangered populations, TECs and their habitats. The approach was to avoid biodiversity impacts where practicable and maximise use of existing disturbed areas. It is noted that avoidance can be challenging for resource projects as by necessity the resource extraction occurs where the resource is and this limits the ability to 'move' an impact, whereas there is more ability to relocate infrastructure or other project components.

These design decisions reduced the overall impact of the MCCO Project on matters of biodiversity significance. The majority of the MCCO Project Area comprises heavily modified vegetation in the form of grazed derived native grasslands and the MCCO Project largely avoids the highest quality remnant forest and woodland occurring on the slopes within the MCCO Project Area.

A number of mining and infrastructure options were considered and not selected and further specific design changes were implemented during the early stages of designing the MCCO Project that ameliorated the impacts of the MCCO Project on significant biodiversity features. These impact reductions which are discussed in further detail in **Section 1.4** and in summary have resulted in the following:

- a reduction in disturbance of approximately 400 ha
- avoidance of over 4000 threatened orchids including both *Diuris tricolor* and *Prasophyllum petilum*
- avoidance of a major realignment of the 500kV Transmission Line, realignment of Ridgelands Road and a second crossing of Big Flat Creek
- avoidance of impacts on three stands of Weeping Myall (*Acacia pendula*) Woodland.

Mangoola will continue to seek opportunities to minimise impacts on biodiversity as part of the implementation of the MCCO Project.

6.9.3.2 Mitigation Measures

Mangoola has an existing approved Biodiversity and Offset Management Plan and Strategy which provides guidance for minimising the impacts of its operations on biodiversity. This existing plan will be updated as part of the implementation of the MCCO Project and be implemented to mitigate adverse biodiversity impacts during construction and operation. This will include specific measures to manage potential impacts on fauna species in the MCCO Project Area during vegetation clearing, management of retained vegetation and biodiversity monitoring. Mitigation measures will include (but not be limited to) measures that address the following direct and potential indirect impacts:

- vegetation and habitat clearing protocols
- feral animal and weed control
- fencing and access control
- bushfire management
- sediment and erosion control
- dust, noise and lighting impacts
- pathogen management.

The management measures to be implemented are described in the existing approved management plans and these measures will contribute to the maintenance of habitat quality in adjacent remnant habitats.

6.9.4 Assessment

The construction and operation of the MCCO Project will result in a range of direct impacts on biodiversity values within the MCCO Additional Disturbance Area. Direct impact includes loss of native vegetation and fauna habitats as a result of clearing works and works associated with the construction and operation of the Project. **Table 6.22** outlines the impacts of the Project on vegetation communities and the biodiversity credit required to be offset to counterbalance this impact. A total of 570 ha of native vegetation will be impacted by the MCCO Project consisting of 356 ha of woodland or open forest and 214 ha of derived native grassland.

The MCCO Additional Disturbance Area is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding lands during the construction or operational phases of the MCCO Project. Some minor indirect impacts associated with habitat connectivity, fugitive light emissions, dust, noise, groundwater changes, weeds and feral animals may occur during the construction and operational phases, however, once the proposed mine rehabilitation has become established, the long-term connectivity of the area will be improved. These indirect impacts will be similar to those currently experienced with the existing mine in operation and will therefore not substantially change with the MCCO Project. Mitigation measures for indirect impacts are described in the Biodiversity Assessment Report and exist for the current mining operation. These include feral animal and weed control, control systems for noise, dust, lighting and blasting, restriction of access and vegetation clearing procedures.

Table 6.22 Direct Impacts of the MCCO Project on Native Biodiversity Features

Ecological Feature	Area of Impact (ha)	Number of Impact Credits Generated
Biometric Vegetation Type		
HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter	14.67	1,874
HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter – Moderate to Good - Derived Native Grassland	15.24	
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	6.30	369

Ecological Feature	Area of Impact (ha)	Number of Impact Credits Generated
HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	295.25	13,457
HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter – Moderate to Good – Derived Native Grassland	197.49	
HU821 Blakely's red Gum - Narrow-leaved Ironbark - Rough-barked apple shrubby woodland of the Hunter	6.46	253
HU906 Bull Oak grassy woodland of the central Hunter Valley	30.76	1,597
HU906 Bull Oak grassy woodland of the central Hunter Valley – Moderate to Good – Derived Native Grassland	1.64	
HU945 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	2.95	168
Total	570	17,718
Species-credit Species		
large-eared pied bat ***Chalinolobus dwyeri***	2.10	**27**
southern myotis ***Myotis macropus***	0.9	**20**
Tarengo leek orchid ***Prasophyllum petilum***	691 (Individuals)	**8,983**
pine donkey orchid ***Diuris tricolor***	1,326 (individuals)	**17,238**

6.9.4.1 Aquatic Ecology

The MCCO Additional Disturbance Area is within close proximity to Big Flat Creek which is a tributary of Wybong Creek with the Proposed Wybong Road and Big Flat Creek overpass required to be constructed over it. Big Flat Creek and Wybong Creek are both part of the Hunter River catchment, which is characterised by variable and unpredictable patterns of flow and water levels exacerbated by heavily cleared catchments and prevalence of agricultural land use. Big Flat Creek is ephemeral and only flows after rainfall. As discussed in **Appendix 11** the creek also has generally poor water quality (naturally occurring, not related to the existing mining operations).

Targeted aquatic habitat assessment and qualitative sampling was undertaken within appropriate habitats within the MCCO Additional Disturbance Area. A detailed Aquatic Impact Assessment report is included as Appendix D of the BAR.

Potential aquatic impacts associated with the MCCO Project include:

- removal of riparian vegetation on the banks of Big Flat Creek for the construction of the haul road crossing of the creek
- removal of snags and in-stream vegetation within the MCCO Additional Disturbance Area – predominantly non-native grasses and weed species though some small beds of sedges/reeds were recorded
- temporary obstruction of fish passage during construction associated with either temporary filling or removal of material from the watercourse
- potential for increased sediment load downstream of the MCCO Additional Disturbance Area due to disturbance activities in the creek
- risk of spills and pollution associated with construction equipment working in the watercourse.

The impact of the MCCO Project on riparian communities has been addressed through the generation of ecosystem credits, in accordance with the FBA.

Big Flat Creek is ephemeral and only flows after rainfall and therefore very minimal fish habitat exists, however, at the time of construction there may be semi-permanent pools in the MCCO Additional Disturbance Area that provide potential habitat to support native fish. Draining and/or filling of these pools may result in adverse impacts, however, any such impacts are considered temporary, localised and unlikely to significantly impact local fish populations. Following construction, instream habitats are likely to re-populate during rainfall events.

There are minimal impacts likely on aquatic ecological systems associated with operation of the MCCO Project as sufficient safeguards will be in place to prevent surface water runoff impacting aquatic ecosystems through the water management controls put in place as part of the mining operations (refer to **Section 6.7**).

No *Fisheries Management Act 1994* listed threatened aquatic flora or fauna species were recorded within the MCCO Additional Disturbance Area, however potential habitat for the Darling River hardyhead (*Craterocephalus amniculus*) Endangered Population in the Hunter Catchment was identified downstream of the Project Area in Wybong Creek. The MCCO Project is not predicted to result in an adverse effect on the Darling River hardyhead Endangered Population in the Hunter River catchment.

No nationally listed threatened aquatic species, endangered populations, TECs or aquatic migratory species are expected to occur in the watercourses within the MCCO Additional Disturbance Area and therefore no adverse impacts on these aquatic biodiversity values are predicted.

Aquatic Ecology Avoidance and Mitigation

There were two key design changes that reduced the impact of the MCCO Project on aquatic ecology being:

- removal of an initially proposed second out of pit overburden emplacement area. This emplacement area would have required a second crossing over Big Flat Creek impacting an additional area of aquatic habitat and riparian corridor
- refining the location and minimising the footprint of the haul road overpass over Big Flat Creek to reduce impacts. This included avoiding impacts on threatened flora and fauna species, seeking to minimise the area of vegetation impacted and reducing the overall construction disturbance footprint.

A range of general mitigation measures are also proposed to be employed within the MCCO Additional Project Area during the construction phase of the MCCO Project to minimise impacts to aquatic ecological values, including:

- employee education including inductions for staff, contractors and visitors to the site to inform relevant personnel of the relevant controls to be implemented to minimise impacts on aquatic ecosystems (e.g. erosion and sediment controls, clearing controls, water management controls, pollution controls)
- the extent of works within the Big Flat Creek riparian corridor will be clearly marked so that areas of ecological value outside the proposed disturbance area are not impacted.

To minimise impacts on water quality, erosion and sedimentation associated with spills and/or construction activities in the watercourse, works within or adjacent to the watercourse will be undertaken in accordance with an updated Water Management Plan which will include specific requirements to address works within the riparian zones. In addition, designs for works within or near watercourses will provide for the retention of natural functions and maintenance of fish passage in accordance with *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003).

6.9.5 Impacts on Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on MNES.

A Referral was submitted to the DoEE in accordance with the EPBC Act in October 2018. The MCCO Project was deemed to be a Controlled Action on 22 January 2019 due to the potential for significant impacts on matters protected under the EPBC Act. The Controlled Action decision was based on DoEE's assessment that the Project is likely to have a significant impact on MNES, including the following ecological matters:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC
- Tarengo leek orchid (*Prasophyllum sp.* Wybong)
- regent honeyeater (*Anthochaera phrygia*).

The Department also considers that the MCCO Project may result in significant impacts to the following species:

- swift parrot (*Lathamus discolor*)
- grey-headed flying-fox (*Pteropus poliocephalus*).

Potential impacts on these matters are discussed in **Section 7.0**.

6.9.6 Biodiversity Offset Strategy

Mangoola is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the MCCO Project. The proposed biodiversity offset strategy has been developed in accordance with the FBA and completely satisfies the credit requirements of the MCCO Project.

As discussed in **Section 6.9.3**, Mangoola has, where possible, altered the MCCO Project to avoid and minimise ecological impacts in the MCCO Project planning stage, and a range of impact mitigation

strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements.

Mangoola and its parent company Glencore have strong records in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them. Mangoola is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. The offset strategy will be implemented following the process outlined in the FBA and the final composition of the offset strategy may evolve as the MCCO Project progresses, however, as noted above, the identified and Glencore owned offsets fully satisfy the offset need for the MCCO Project.

The proposed biodiversity offset strategy consists of the following:

- In-perpetuity conservation using the retirement of biodiversity credits through the establishment of the following Offset Sites:
    - Mangoola Offset Site (located on land adjacent to the impact area for the MCCO Project)
    - Wybong Heights Offset Site.

The location of these offset areas is shown on **Figure 6.22** while **Figure 6.23** highlights the connectivity pathways between these offsets as proposed and existing areas of woodland habitat including large parcels of Crown lands, the Manobalai Nature Reserve, the existing established offset areas of Mangoola Coal Mine and existing established offsets areas for other Glencore projects. As shown on **Figure 6.23** the offsets as proposed for the MCCO Project and their connectivity pathways to other areas of important habitat fall within the Great Eastern Ranges Conservation Corridor Initiative area which has been identified as a priority conservation area for NSW.

- in addition to this, available credits from proposed offset sites currently being finalised by Glencore will be used. These include:
    - 790 credits for HU817 from the proposed Highfields Offset Site
    - *Prasophyllum petilum* credits and *Diuris tricolor* credits from the proposed Mangrove Offset Sites
- 2187 credits generated from the restoration of up to 456 ha of native vegetation communities as part of ecological mine rehabilitation (refer to **Section 6.9.6.1**)
- payment into the Biodiversity Conservation Fund for the small number of remaining credits (refer to **Section 6.9.6.1**).

The assessment of the ecological values of the Mangoola Offset Site was assisted, in relation to *Diuris tricolor* and *Prasophyllum petilum*, by the findings of an Expert Report (refer to Appendix C of the Biodiversity Assessment Report in **Appendix 13**) prepared by Dr Stephen Bell titled 'Expert Report: Expected Presence of Threatened Terrestrial Orchids (*Diuris tricolor* and *Prasophyllum petilum*) – Mangoola Coal Continued Operation Project'.

Glencore has established a strategic approach to biodiversity offsetting, with clusters of biodiversity offset sites being established in the Hunter Valley. These offsets are being positioned with consideration of key landscape features such as adjoining vegetation remnants, National Parks, Crown land, government initiatives (such as the Great Eastern Ranges Initiative), and other existing Glencore offset areas. This strategic offsetting approach has been applied for the MCCO Project.

The proposed Mangoola biodiversity offsets are strategically located as the properties adjoin existing Mangoola Biodiversity Offset Areas which will allow Mangoola to facilitate the expansion of a movement corridor linking offset and rehabilitation areas to the north and west towards Glencore's approved and proposed Mangoola mining areas (refer to **Figure 6.23**). These proposed offset areas are also located close to the MCCO Additional Disturbance Area, providing a substantial local offset.

A significant biodiversity asset of the proposed Wybong Heights Offset Site comes from its position in the regional landscape, particularly its proximity to Manobalai Nature Reserve and its location within the corridor proposed as part of the Great Eastern Ranges Initiative. The Wybong Heights Offset Site is also located in proximity to the Reedy Valley and Esparanga Offset sites established in accordance with Glencore's Bulga Optimisation Project and Mount Owen Continued Operations Project.

The establishment of the proposed biodiversity offsets will result in a substantial increase in the area of land conserved in perpetuity in the local area.

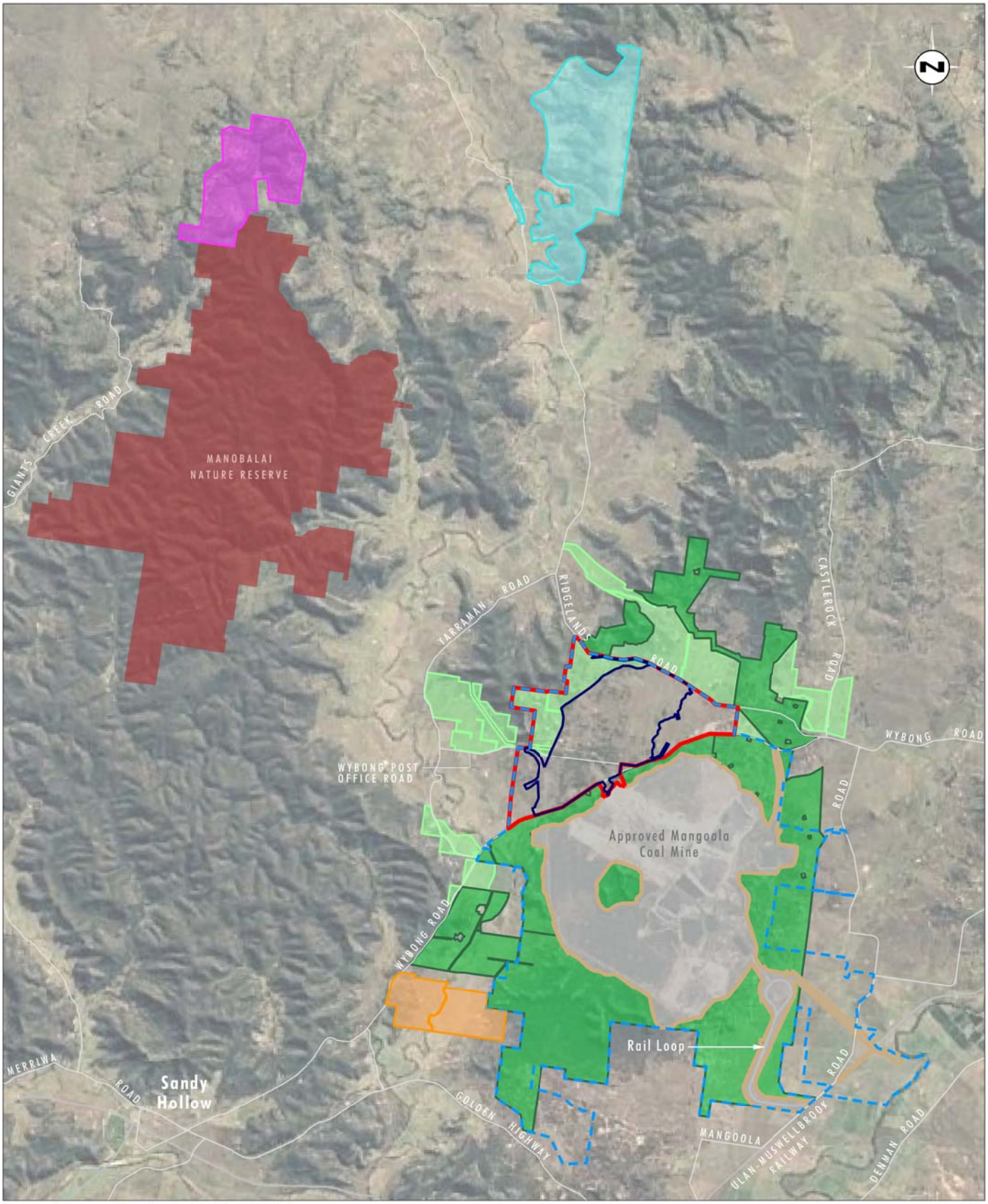

Image Source: Google Earth (Dec 2016)
Data Source: Glencore (2019)
Note: Offset boundaries are based on LPI cadastre

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Existing Offsets
- Highfields Offset Site
- Mangrove Offset Site
- Proposed Mangoola Offset Sites
- Proposed Wybong Heights Offset Site

FIGURE 6.22

Proposed Biodiversity Offset Areas

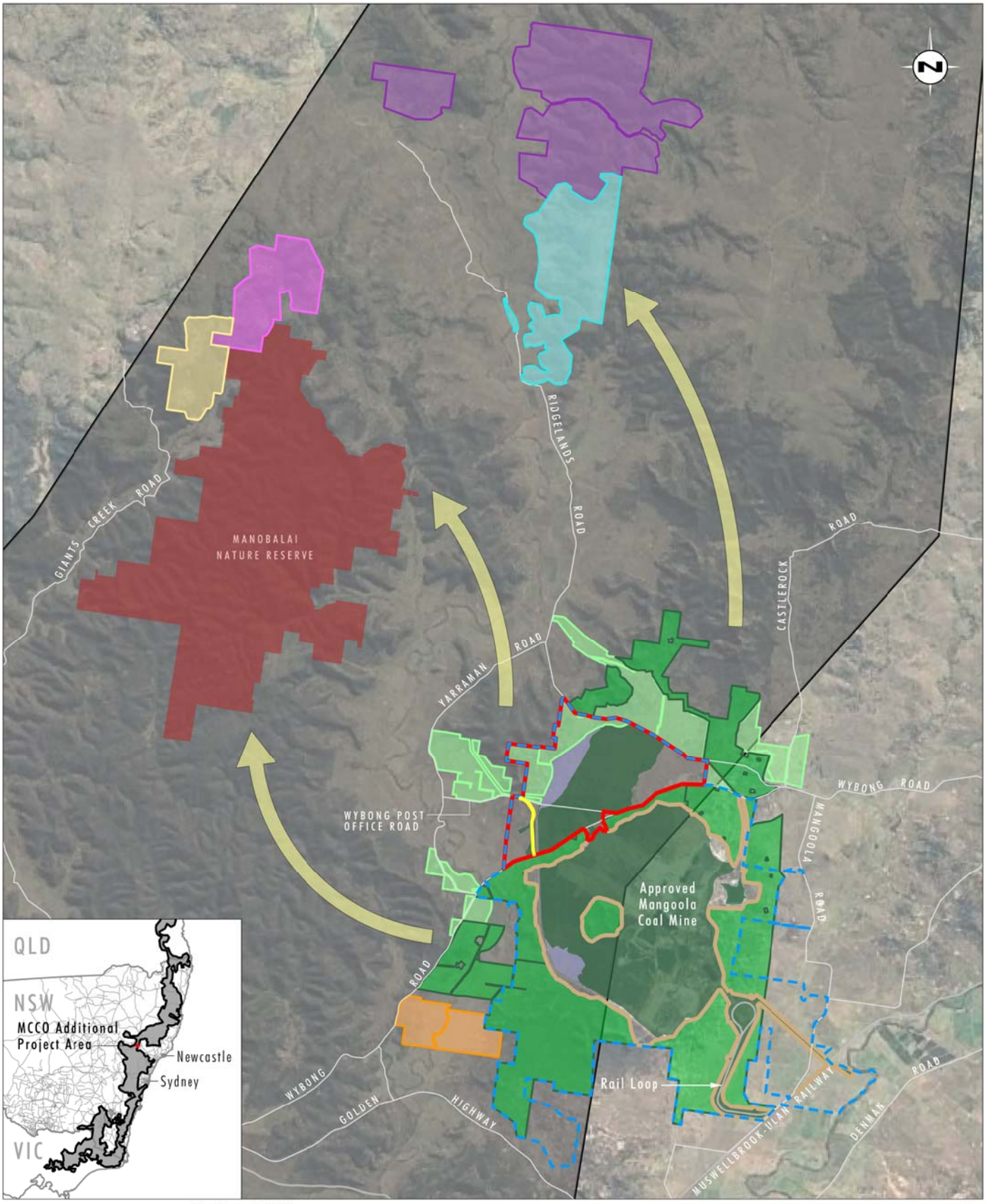

Image Source: Google Earth (Dec 2016)
Data Source: Glencore (2019)
Note: Offset boundaries are based on LPI cadastre

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Connectivity Pathways
- Existing Offsets
- Proposed Mangoola Offset Sites
- Proposed Wybong Heights Offset Site
- Reedy Valley Offset Site
- Esparanga Offset Site
- Highfields Offset Site
- Mangrove Offset Site
- Great Eastern Ranges Conservation Corridor Initiative
- Rehabilitation
- Void

FIGURE 6.23

Connectivity Pathways

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6.9.6.1 Ecological Rehabilitation

The NSW Biodiversity Offset Policy for Major Projects enables the use of ecological mine rehabilitation to contribute towards meeting the offset requirement of a mining project.

Mangoola and its parent company Glencore are committed to the continual improvement of native ecosystem establishment in mine rehabilitation across all of its mine sites and believe that mine rehabilitation plays an important role in mitigating and offsetting impacts on biodiversity and re-establishing key native vegetation communities across the landscape. Mangoola has had considerable success in establishing high quality mine rehabilitation and is recognised as an industry leader in re-establishment of native vegetation on rehabilitated mining areas.

Mangoola aims to develop rehabilitation of mined land that returns the site to a condition where the landforms, soils, hydrology, and flora and fauna are self-sustaining and compatible with the surrounding land uses. Rehabilitation of the overburden emplacement areas is conducted progressively over the life of mine, as an integral component of mining operations. Topsoil is managed to maximise the viability of soil biota, with topsoil management measures including varying stripping depths for different soil types, incorporation of mulched vegetation material into the topsoil resource, limiting topsoil storage stockpiles to a maximum of 3 m in height and minimising any compaction of stockpiles. Mangoola continues to implement a natural landform design process in all final rehabilitation which assists in the creation of a self-sustaining post-mining rehabilitated landform that is compatible with surrounding land and provides habitat for the suite of flora and fauna species encountered in the Mangoola local area prior to mining.

In accordance with requirements of the FBA, a total of 2187 ecosystem credits are proposed to be generated through the establishment of 456 ha of ecological rehabilitation, with the following PCTs proposed to be established within the post-mining landform:

- HU812/PCT1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- HU817/PCT1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
- HU945/PCT1731 Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley.

Further detail regarding the establishment of ecological rehabilitation as part of the final landform is provided in **Section 6.17** and in the BAR.

On past Glencore projects stakeholders have raised questions regarding what would occur should a particular program of ecological rehabilitation not be successful. Mangoola has a demonstrated successful track record in establishing native vegetation rehabilitation and has a high degree of confidence in achieving the required rehabilitation standard. However, in a theoretical circumstance where the required rehabilitation criteria were not met, a range of alternatives are available to retire the required credits. This could include:

- payment into the Biodiversity Conservation Fund (refer to **Section 6.9.7**)
- additional land-based offsets.

6.9.7 Payment into the Biodiversity Conservation Fund

Payment in the now operational Biodiversity Conservation Fund is considered a 'like for like' offsetting option under the FBA. The Fund is managed by the NSW Biodiversity Conservation Trust which uses the Fund to purchase and manage strategic biodiversity offsets. Payment into the fund is an available option for the retirement of any credits under NSW policy. It is understood the intent is that the fund may also be available for Commonwealth listed species/communities requiring offsetting under the EPBC Act under a bilateral agreement between the NSW and Commonwealth governments.

Mangoola currently proposes to pay into the Biodiversity Conservation Fund for southern myotis (*Myotis macropus*) credits that could not be secured at the proposed offset sites. A total of nine southern myotis credits will be purchased to relinquish the residual credit liability for that species.

It is also noted that as part of the final implementation of the offset strategy Mangoola may elect to use the fund to retire other credits, as needed.

6.9.8 Adequacy of Biodiversity Offset Strategy

Table 6.23 outlines the outcomes of the ecosystem-credit analysis for the two proposed land-based biodiversity offset sites and proposed area of ecological rehabilitation for the Project. As identified in **Table 6.23** the biodiversity offsets proposed meet the offset credit liability of the MCCO Project.

As demonstrated in **Table 6.23**, the ecosystem and species-credit requirement for the MCCO Project is completely satisfied by the retirement of credits in accordance with the proposed biodiversity offset strategy outlined above. A core component of the proposed biodiversity offset strategy is strategically located local offsets that will ensure that the biodiversity values impacted by the MCCO Project are offset and conserved in perpetuity.

The land-based biodiversity offsets will be secured under Stewardship Agreements, in consultation with the BCT.

Table 6.23 Summary of Biodiversity Offset Strategy Ecosystem Credit and Species Credit Outcomes

BVT/PCT/Species Credit	Credits Required	Credits from New Offset Sites		Credits from Existing Offset Sites		Credits from Ecological Rehabilitation	Biodiversity Conservation Fund	Total Offset Credits to be Used	Is Credit Requirement Met?
		Mangoola Offset	Wybong Heights Offset	Highfields Site	Mangrove Site				
HU812 Forest Red Gum grassy open forest on floodplains of the lower Hunter	**1,874**	510	0	0	0	1,364	0	**1,874**	Yes
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	**369**	742	2,042	0	0	0	0	**369**	Yes
HU817 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	**13,457**	8,991	3,015	790	0	681	0	**13,457**	Yes
HU821 Blakely's red Gum - Narrow-leaved Ironbark - Rough-barked apple shrubby woodland of the Hunter	**253**	860	2,549	0	0	0	0	**253**	Yes

BVT/PCT/Species Credit	Credits Required	Credits from New Offset Sites		Credits from Existing Offset Sites		Credits from Ecological Rehabilitation	Biodiversity Conservation Fund	Total Offset Credits to be Used	Is Credit Requirement Met?
		Mangoola Offset	Wybong Heights Offset	Highfields Site	Mangrove Site				
HU906 Bull Oak grassy woodland of the central Hunter Valley	**1,597**	0	1,597	0	0	0	0	**1,597**	Yes
HU945 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	**168**	17	0	0	0	151	0	**168**	Yes
Tarengo leek orchid (*Prasophyllum petilum*)	**8,983**	12,637	0	0	3,109	0	0	**8,983**	Yes
pine donkey orchid (*Diuris tricolor*)	**17,238**	124,661	0	0	25,183	0	0	**17,238**	Yes
large-eared pied bat (*Chalinolobus dwyeri*)	**27**	667	0	0	0	0	0	**27**	Yes
southern myotis (*Myotis macropus*)	**20**	0	11	0	0	0	9	**20**	Yes

6.10 Groundwater Dependent Ecosystems

This section characterises the potential GDEs within and surrounding the MCCO Project Area and the extent to which these GDEs are likely to be reliant on groundwater. An assessment of the impacts on identified potential GDEs has then been undertaken based on the groundwater modelling results as summarised in **Section 6.8**.

6.10.1 Methodology

The IESC has developed the 'Draft Assessing Groundwater-Dependent Ecosystems: IESC Information Guidelines Explanatory Note' (Draft Explanatory Note) (Doody, Hancock and Pritchard, 2018). The Draft Explanatory Note describes GDEs as complex dynamic 'natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services' (Richardson *et al*, 2011 – in Doody, Hancock and Pritchard, 2018). They may be 100 per cent dependent on groundwater, such as aquifer GDEs, or may access groundwater intermittently to supplement their water requirements, such as riparian tree species in arid and semi-arid areas (Doody, Hancock and Pritchard, 2018).

The draft Explanatory Note defines GDEs using a combination of typologies from Hatton and Evans (1998) and the GDE Toolbox (Richardson *et al*, 2011) as described in **Table 6.24**.

Table 6.24 GDE typologies

GDE Classification	Description
Subterranean	Aquifer and cave ecosystems.
Aquatic	River-base flow systems: aquatic and riparian ecosystems that exist in or adjacent to streams (including the hyporheic zone) fed by groundwater.
	Wetlands: aquatic communities and fringing vegetation dependent on groundwater-fed lakes and wetlands. These include palustrine, lacustrine and riverine wetlands that receive groundwater discharge and can include some spring ecosystems.
	Submarine discharge of groundwater: Ecosystems which rely on submarine discharge of groundwater for its nutrients and/or physico-chemical attributes.
Terrestrial	Subsurface expression of groundwater: Ecosystems dependent on the subsurface expression of groundwater.

6.10.1.1 GDE Study Area and Assessment Approach

The study area for the GDE assessment is based on the groundwater model extent as shown on **Figure 6.24**. This extent was developed for use in the groundwater model to go beyond the extent of any possible impact on groundwater as a result of the MCCO Project. Therefore, by using this boundary as the area for investigation, all potential impacts have been considered.

The assessment approach for GDEs included:

- setting an outer boundary for the assessment to capture all potential impacts (refer to **Figure 6.24**)
- undertaking a desktop assessment to identify potential GDEs including review of:
    - regional studies
    - previous assessments
    - spatial data including aerial photographs
    - vegetation mapping for the area of interest
- identifying areas where there is the potential for near surface groundwater to occur (based on pre-mining modelled groundwater levels within 10 m of the surface) to identify a potential zone where interactions between terrestrial vegetation and groundwater could occur based on the above information, identify potential GDEs and assess their likely level of groundwater dependence, model the impacts of the MCCO Project on groundwater including the areas containing potential GDEs and use this information to assess GDE impacts.

6.10.2 Potential GDEs in the Study Area

An initial desktop study was undertaken to identify potential GDEs in the area within and surrounding the MCCO Project Area. Known GDE information including regional GDE mapping and vegetation mapping was used to identify the locations of potential GDEs, with the findings provided in the following sections. This desktop analysis was then further refined following the completion of field surveys (including flora, fauna and stygofauna surveys) and site inspections (e.g. inspection of Big Flat Creek and the MCCO Project Area).

6.10.2.1 Regional Studies

The Commonwealth Government has established the National Atlas of Groundwater Dependent Ecosystems (the GDE Atlas) based on current knowledge of GDEs throughout Australia. The GDE Atlas provides an inventory of known and potential GDEs across Australia. The GDE mapping contained in the GDE Atlas comes from two broad sources; national-scale analysis and regional studies undertaken by State agencies. The GDE Atlas contains regional GDE mapping data for the area of interest developed by the NSW Department of Industry - Water. The GDE Atlas, including national and regional scale studies, has been used to map the location of potential GDEs in the area of interest and in relation to the MCCO Project Area on **Figure 6.24**.

The Australian Government Bioregional Assessment Programme for the Hunter Subregion has also included mapping of water-dependent assets. This mapping was reviewed and it shows limited water dependent assets mapped in the vicinity of the MCCO Project Area. Riverine forest is mapped in the vicinity of Wybong Creek and the Goulburn River. A small section identified in the regional mapping as rainforest is also mapped to the north of (and outside of) the MCCO Additional Project Area.

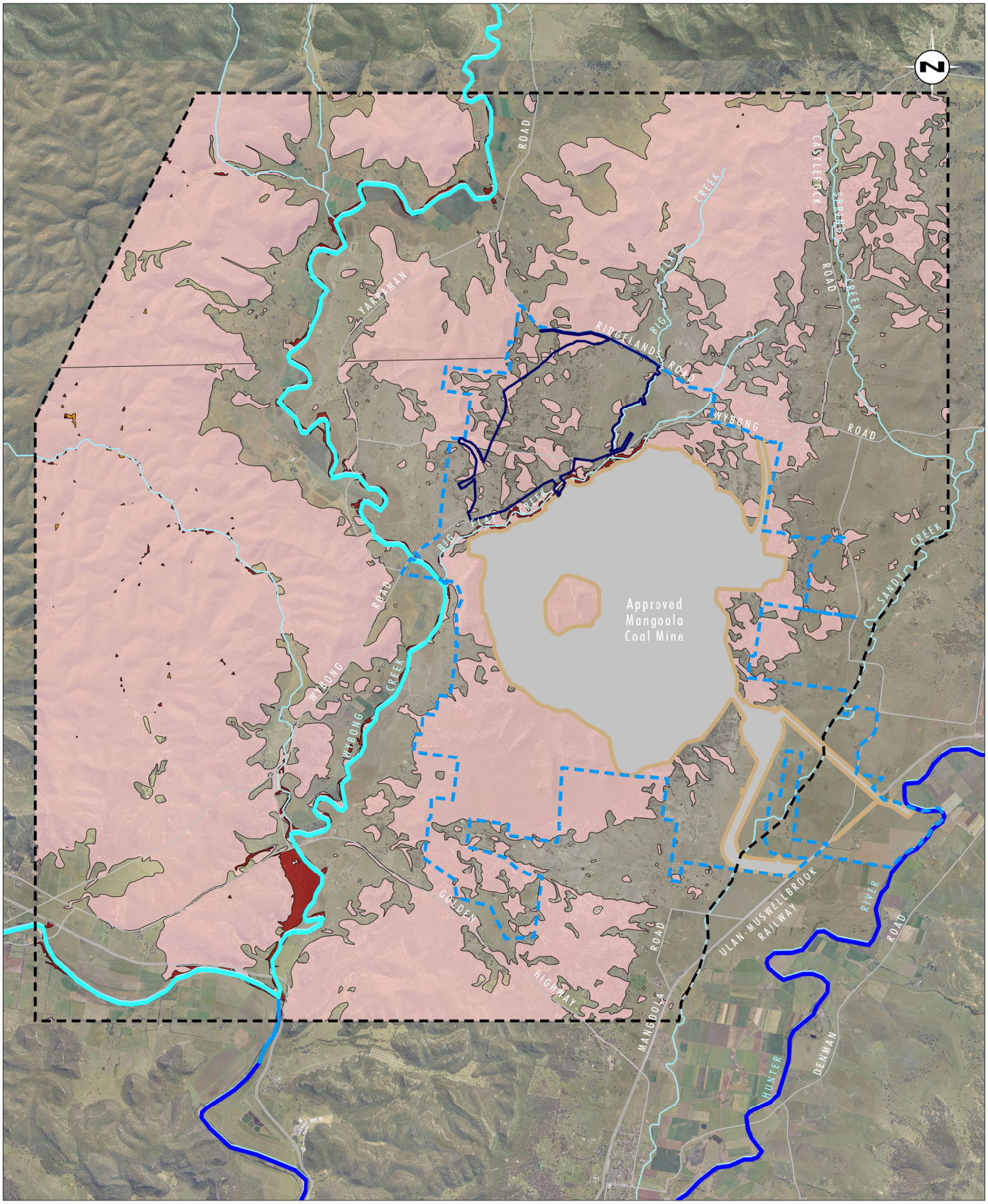

Image Source: Glencore (April 2018), Google Earth (2018)
Data Source: Glencore (2019), BOM (Jan 2018)

0 1.0 2.5 5.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Model Extent (GDE Study Area)

GDE Atlas

Terrestrial Groundwater Dependant Ecosystems:

- High Potential GDE
- Moderate Potential GDE
- Low Potential GDE

Aquatic Groundwater Dependant Ecosystems:

- High Potential GDE
- Moderate Potential GDE
- Low Potential GDE

FIGURE 6.24

GDE Assessment Area and Potential GDEs from Regional Mapping

File Name (A4): R13/4004_123.dgn
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GDE Atlas - Aquatic GDEs

The GDE Atlas identified Wybong Creek as having moderate potential for being a 'river' type aquatic GDE. A small section of the Goulburn River, south of its confluence with Wybong Creek, is identified as having a low potential for being a 'river' type aquatic GDE.

GDE Atlas - Terrestrial GDEs

The GDE Atlas identified a range of woodland and forest vegetation in the area of investigation as having potential to be GDEs. These areas are mapped on **Figure 6.24**. The GDE Atlas categorises vegetation as having a high, medium or low potential to be a GDE.

Within the area of investigation there are terrestrial woodland/forest communities mapped as having a high potential to be a GDE. These are mapped in the vicinity of Wybong Creek, Big Flat Creek and the Goulburn River. River Red Gum/River Oak grassy riparian woodland of the Hunter Valley was identified in the vicinity of Wybong Creek, the Goulburn River and the Hunter River. Swamp Oak/Weeping Grass grassy riparian forest of the Hunter Valley was identified in the vicinity of Big Flat Creek.

A further nine terrestrial woodland/forest communities are mapped as low potential GDEs within the investigation area including within the MCCO Additional Project Area. The area of these low potential GDEs is shown on **Figure 6.24**.

Subterranean

The GDE Atlas did not identify any subterranean GDEs in the vicinity of the MCCO Project and none were identified as potentially occurring based on review of other information.

6.10.2.2 Vegetation Mapping

The Draft Explanatory Note states that terrestrial vegetation located in areas with shallow groundwater (less than 10 m from the surface) are likely to be GDEs as they can often quite easily reach and extract groundwater. As discussed above, this does not necessarily mean that these native terrestrial vegetation communities are highly groundwater dependent, as they may only access groundwater intermittently or to fulfil part of their water requirements.

Considering the above, vegetation mapping for the area of investigation has been overlaid with pre-mining modelled groundwater occurring within 10 m of the surface to further refine the location of potential GDEs in the area of investigation (refer to **Figure 6.25**).

As shown on **Figure 6.25**, 16 PCTs have been mapped in locations where groundwater may occur within 10 m of the surface. While all of these native woodland/forest vegetation communities may at times access groundwater, a review of each of these PCTs has been undertaken to identify those with a higher potential to be dependent on groundwater based on their position in the landscape (e.g. floodplain or riparian) and floristics, along with consideration of the findings of regional mapping discussed above.

These PCTs are listed in **Table 6.25**.

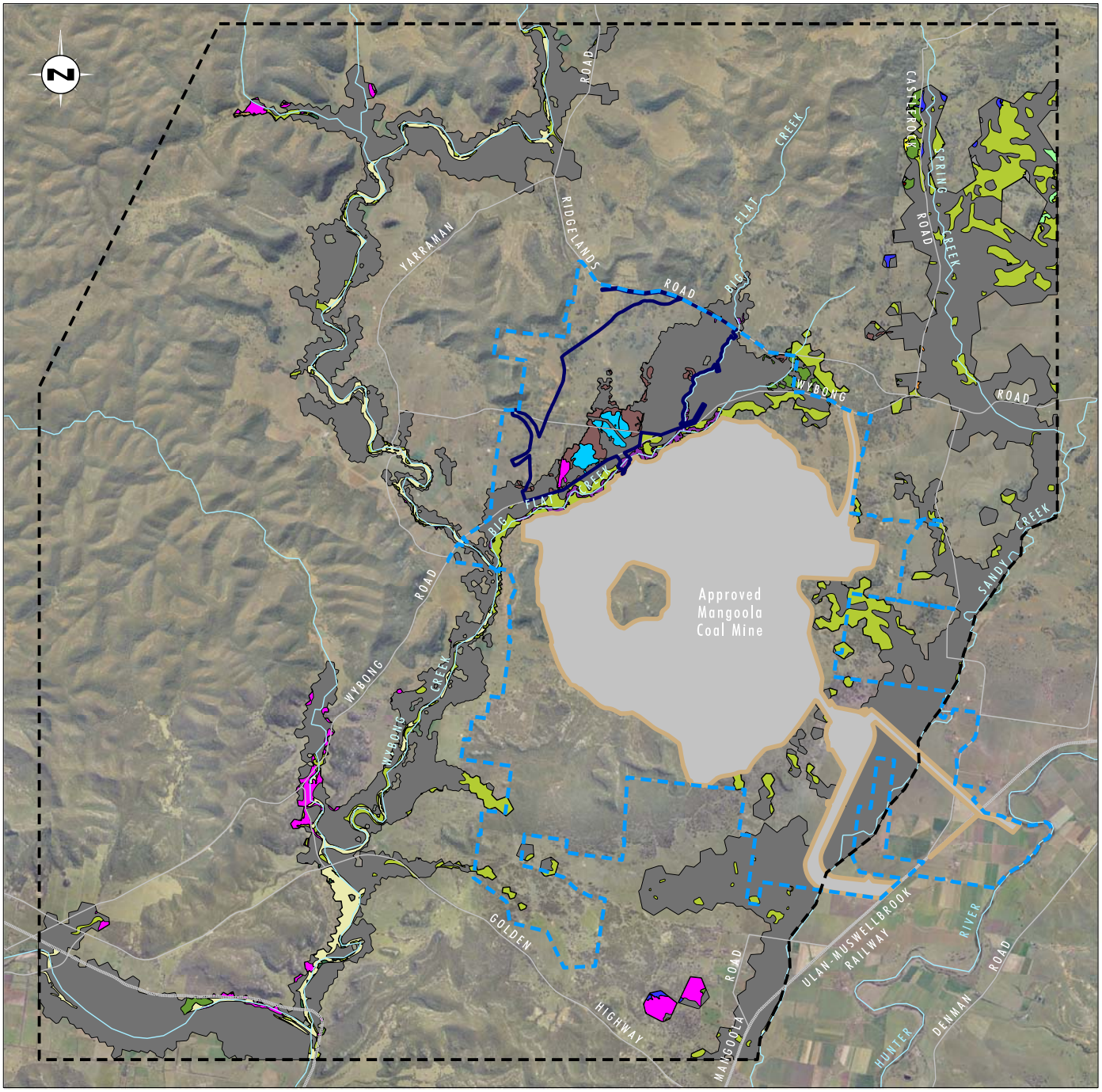


Image Source: Glencore (2018), Google Earth (2018)
Data Source: Glencore (2019), AGE (2019)

0 1.0 2.5 5.0 km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Model Extent (GDE Study Area)
- Groundwater Within 10m of Surface
- HU654/PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley
- HU757/PCT1543 - Ficus rubiginosa/ Alectryon subcinereus/ Notelaea microcarpa/ dry rainforest of the Central Hunter Valley
- HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter
- HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- HU818/PCT1604 - Eucalyptus crebra/ Eucalyptus moluccana/ Corymbia maculata shrub/ grass open forest of the central and lower Hunter
- HU819/PCT1605 - Eucalyptus crebra/ Notelaea microcarpa shrubby open forest of the central and upper Hunter
- HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter
- HU825/PCT1611 - Eucalyptus crebra/ Callitris endlicheri shrub/grass woodland upper Hunter and northern Wollemi
- HU826/PCT1612 - Eucalyptus crebra/ Eucalyptus punctata/ Notelaea microcarpa woodland of Central Hunter
- HU869/PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
- HU883/PCT1669 - Eucalyptus fibrosa/ Eucalyptus punctata/ Eucalyptus sparsifolia/ Corymbia trachyphloia shrubby open forest on sandstone ranges of the Sydney Basin
- HU884/PCT1670 - Eucalyptus sparsifolia/ Eucalyptus punctata shrubby open forest on sandstone ranges of the Sydney Basin
- HU905/PCT1691 - Eucalyptus crebra/ Eucalyptus moluccana grassy woodland of the central and upper Hunter
- HU906/PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley
- HU928/PCT1714 - Eucalyptus camaldulensis/ Casuarina cunninghamiana grassy riparian woodland of the Hunter Valley
- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley

FIGURE 6.25

Native Woodland / Forest Vegetation Communities where Pre-mining Groundwater is within 10m of Surface

Table 6.25 PCTs in Areas of Shallow Groundwater and Likely Level of Groundwater Dependence

Plant Community Type	Likely Level of Groundwater Dependence
HU654/PCT1310 - White Box - Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South Bioregion	Low
HU757/PCT1543 - *Ficus rubiginosa/ Alectryon subcinereus/ Notelaea microcarpa/* dry rainforest of the Central Hunter Valley	Low
HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	Moderate
HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Low
HU818/PCT1604 - *Eucalyptus crebra/ Eucalyptus moluccana/ Corymbia maculata* shrub/ grass open forest of the central and lower Hunter	Low
HU819/PCT1605 - *Eucalyptus crebra/ Notelaea microcarpa* shrubby open forest of the central and upper Hunter	Low
HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Moderate
HU825/PCT1611 - *Eucalyptus crebra/ Callitris endlicheri* shrub/ grass woodland upper Hunter and northern Wollemi	Low
HU826/PCT1612 - *Eucalyptus crebra/ Eucalyptus punctata/ Notelaea microcarpa* woodland of Central Hunter	Low
HU869/PCT1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Low
HU883/PCT1669 - *Eucalyptus fibrosa/ Eucalyptus punctata/ Eucalyptus sparsifolia/ Corymbia trachyphloia* shrubby open forest on sandstone ranges of the Sydney Basin	Low
HU884/PCT1670 - *Eucalyptus sparsifolia/ Eucalyptus punctata* shrubby open forest on sandstone ranges of the Sydney Basin	Low
HU905/PCT1691 - *Eucalyptus crebra/ Eucalyptus moluccana* grassy woodland of the central and upper Hunter	Low
HU906/PCT1692 - Bull Oak Grassy Woodland of the Central Hunter Valley	Low
HU928/PCT1714 - *Eucalyptus camaldulensis/ Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley	High
HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley	Moderate

The categories used to differentiate the likely level of groundwater dependence in the table above have been assigned to each PCT based on the ecological characteristics of the PCT, taking into consideration their typical position in the landscape and the dominant canopy species in the community. An example of each category is provided below:

- Low – PCT typically occurs on slopes, ridges or outcrops – away from permanent of ephemeral watercourses. Canopy species dominated by dry forest eucalypt species including *Eucalyptus crebra*, *Eucalyptus moluccana* or *Corymbia maculata*
- Moderate – PCT typically occurs on the lower slopes or flats, in proximity of a drainage line or depression. Canopy species include more floodplain related Eucalypt species including *Eucalyptus tereticornis* or *Eucalyptus blakelyi* and non-eucalypt species including *Casuarina glauca*
- High – PCT occurs exclusively on floodplains or along a permanent watercourse. Canopy species contain species either known to be or highly likely to be dependent on groundwater, including *Eucalyptus camaldulensis*.

The review of the vegetation communities provided in **Table 6.24** indicates that while there is the potential for each of the vegetation communities listed to access groundwater from time to time based on pre-mining shallow groundwater in these areas, the majority of the communities are considered likely to have a low dependence on groundwater. This assessed likely low level of groundwater dependence is based on the location of these communities in the landscape and their floristics.

Three communities were identified as having a moderate potential for being dependent on groundwater; two typically being riparian communities and one being a floodplain community. One community, being *Eucalyptus camaldulensis*/*Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley was considered to have a higher potential level of groundwater dependence due to its occurrence in the Wybong Creek alluvium which is known to have a larger groundwater resource.

The above assessments of likely groundwater dependence does not mean that these communities will source all their water requirements from groundwater, however, it is considered likely that groundwater makes a contribution to their water requirements (particularly for trees which have deeper root systems). The moderate and high rated ecosystems are expected to be more dependent on groundwater than the low ranked ecosystems.

6.10.2.3 Stygofauna

Stygofauna live in groundwater and therefore if a stygofauna community occurred in the vicinity of the site it would be considered to be a GDE.

A stygofauna assessment has been prepared for the MCCO Project to assess the potential presence of stygofauna, and if present, the impacts of the MCCO Project. The assessment has been undertaken following relevant Commonwealth and NSW Government guidelines and included sampling of bores within and surrounding the MCCO Project Area. A summary of the key findings of the Stygofauna Assessment is provided in this section and the full report is provided in **Appendix 14**.

Existing bores were selected for stygofauna sampling following a review of groundwater drilling logs, water quality, and hydrogeological information. Eleven bores were chosen, including two from the Wybong Creek alluvial aquifer and nine from fractured or porous rock aquifers.

No stygofauna were identified during stygofauna surveys and the assessment found that the bedrock aquifers are unlikely to be suitable habitat because they lack a significant network of interconnected fractures for stygofauna movement. The colluvium within the MCCO Project Area was also found to be

generally unsuitable because it is likely to dry out periodically. The survey also included the Wybong Creek alluvium within the vicinity of the MCCO Project Area. Although no stygofauna were collected from the Wybong alluvium, the stygofauna assessment found that the section of the Wybong alluvium closer to the confluence with the Goulburn River (well to the south of the MCCO Project) is a potentially suitable habitat because of its hydrological connection to the Goulburn River, adequate porosity, and acceptable water quality. However, if a stygofauna community is inferred for the Wybong alluvium, then this community would be the same as the Goulburn alluvium community, since this is the source of colonisation.

In summary, there were no stygofauna communities identified in the vicinity of the MCCO Project Area, however, the potential for stygofauna to occur in the lower reaches of the Wybong Creek alluvium was recognised.

6.10.2.4 Summary of Potential GDEs

Based on the review of available information and field surveys, **Table 6.26** identifies the potential GDEs found to require further consideration for the MCCO Project.

Table 6.26 Potential GDEs

GDE
Aquatic
Wybong Creek - River GDE
Goulburn River - River GDE
Terrestrial
Native woodland/forest vegetation in areas with shallow groundwater (<10 m from surface) and a likely low level of groundwater dependence due to their topographic location and floristics.
Native woodland/forest vegetation in areas with shallow groundwater (<10 m from surface) and a likely moderate level of groundwater dependence. These were riparian and floodplain communities and included: • HU812/PCT1598 - Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter • HU821/PCT1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter • HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley.
Native woodland/forest vegetation in areas with shallow groundwater (<10 m) and a likely high level of groundwater dependence being: • HU928/PCT1714 - *Eucalyptus camaldulensis*/*Casuarina cunninghamiana* grassy riparian woodland of the Hunter Valley.

6.10.3 Assessment

The MCCO Project will result in clearing of native vegetation within the MCCO Additional Disturbance Area. As shown on **Figure 6.25** this will include some woodland/forest vegetation that has access to shallow groundwater and was therefore identified as a potential GDE. The direct impact of clearing of this vegetation has been assessed and will be offset in accordance with the NSW FBA (refer to **Section 6.9**).

The MCCO Project will also result in drawdown of groundwater within the vicinity of the MCCO Project. With regard to GDEs, the predicted drawdowns of relevance are those in layer 1 of the groundwater model which relates to drawdown in alluvium, colluvium and regolith; and in layer 2 which relates to drawdown in shallow weathered bedrock. Beyond these layers, GDEs are not expected to be influenced as there are no GDEs of relevance to these deeper layers of the groundwater model.

As discussed in **Section 6.8.3**, modelling shows that drawdown in layer 1 and layer 2 primarily occurs as a result of the existing approved mining at Mangoola Coal Mine. **Figure 6.26** and **Figure 6.27** show the areas of 1 m or greater drawdown resulting from mining of the MCCO Additional Mining Area in these layers where potential GDEs occur.

As shown on the figures, outside of the MCCO Additional Disturbance Area the predicted drawdowns are 1 m to 2 m and occur in the vicinity of Big Flat Creek. The predicted drawdowns affect areas of:

- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley which as a riparian community is considered likely to have a moderate level of dependence on groundwater
- HU905/PCT1691 - *Eucalyptus crebra*/ *Eucalyptus moluccana* grassy woodland of the central and upper Hunter which is considered likely to have a low level of dependence on groundwater.

It is expected that Swamp Oak - Weeping Grass Grassy Riparian Forest has a moderate potential to be dependent on shallow groundwater resources during periods of reduced surface water flow. The dependence of the vegetation community on groundwater will depend on the depth of root systems and their efficiency at utilising rainfall and surface moisture.

Mangoola Coal Mine undertakes annual ecosystem monitoring for one potential GDE location along Big Flat Creek. The site coincides with an area also identified as having moderate potential to support GDEs during the plant community mapping. The purpose of the annual monitoring is to identify if there are any observable negative impacts on the flora that can be attributed to groundwater depressurisation caused by mining. The 2017 ecological monitoring report for the site notes that although the vegetation may have been partially groundwater dependent until mid-2014, when the water table was drawn down below the root zone, floristic monitoring in 2017 did not observe any dieback that was likely to be associated with de-watering or lack of access to groundwater as a result of mining. The report also comments that the site appeared to be in a good state of health, and that additional floristic monitoring along other sections of Big Flat Creek did not identify areas of unexplained dieback likely to be associated with changes to groundwater.

With regard to the other potential GDEs identified in the area of investigation for GDE impacts, the results of the groundwater assessment have shown that there are no incremental impacts due to the MCCO Project predicted on these GDEs as they are outside the predicted zone of 1 m or greater groundwater drawdown in layers 1 and 2 of the groundwater model. This includes no drawdown impacts predicted on the Wybong Creek or the Wybong Creek alluvium attributable to the MCCO Project (refer to drawdown shown on **Figure 6.26**) and no impact on the Goulburn River.

Monitoring of groundwater impacts on GDEs will be undertaken as part of the Groundwater Monitoring Program for the MCCO Project (refer to **Section 6.8.4**).

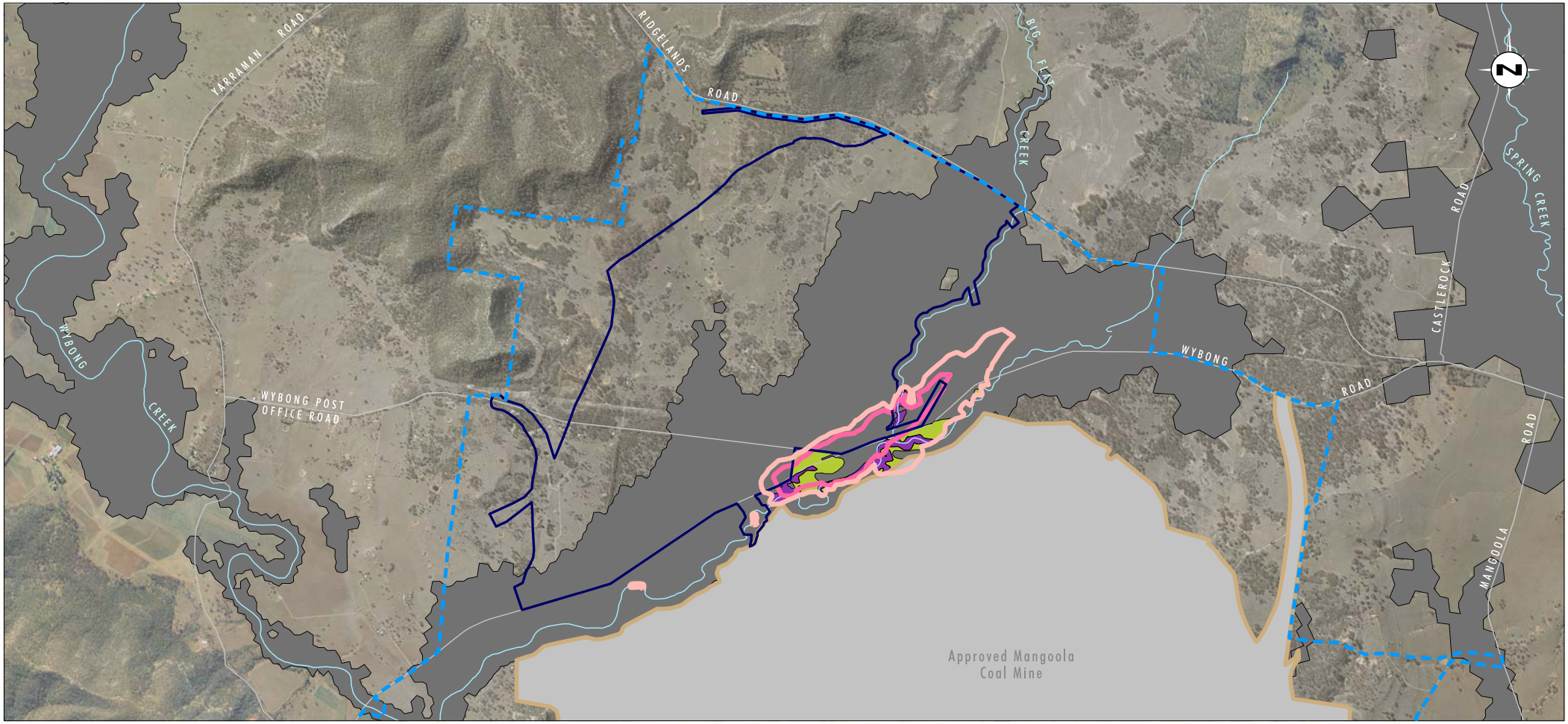


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), AGE (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Within 10m of Surface
- HU905/PCT1691 - Eucalyptus crebra / Eucalyptus moluccana grassy woodland of the central and upper Hunter
- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley

Groundwater Drawdown Contours Layer 1 (metres):

- Predicted Maximum Drawdown - 1m
- Predicted Maximum Drawdown - 2m

FIGURE 6.26

Potential GDE's and Predicted Maximum Groundwater Drawdown Due to the MCCO Project Layer 1 (alluvium, colluvium, regolith)

File Name (A4): R13/4004_344.dgn
20190516 16.15

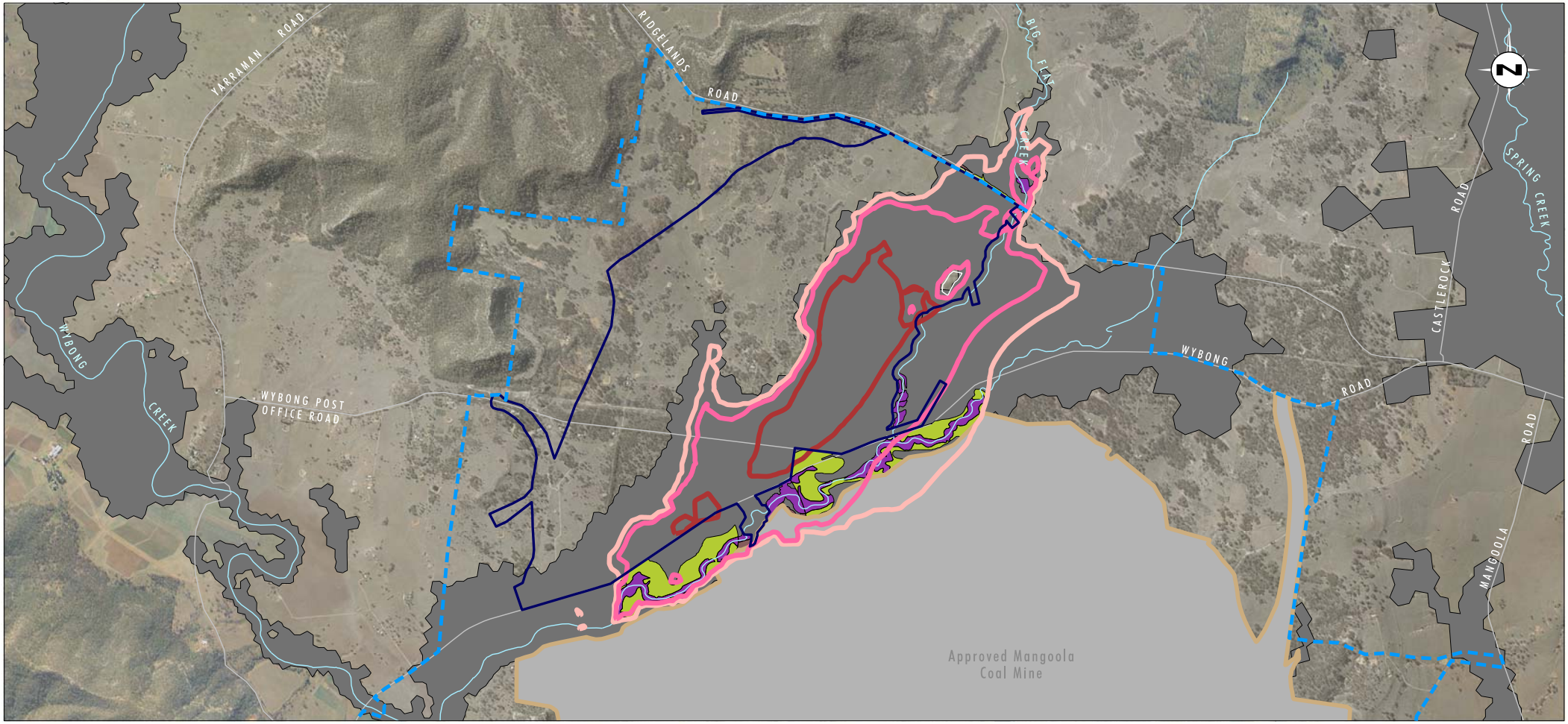


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), AGE (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Disturbance Area
- Groundwater Within 10m of Surface
- HU817/PCT1603 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- HU905/PCT1691 - Eucalyptus crebra/ Eucalyptus moluccana grassy woodland of the central and upper Hunter
- HU945/PCT1731 - Swamp Oak - Weeping Grass Grassy Riparian Forest of the Hunter Valley

Groundwater Drawdown Contours Layer 1 (metres):

- Predicted Maximum Drawdown - 1m
- Predicted Maximum Drawdown - 2m
- Predicted Maximum Drawdown - 5m

FIGURE 6.27

Potential GDE's and Predicted Maximum Groundwater Drawdown Due to the MCCO Project Layer 2 (shallow weathered bedrock)

File Name (A4): R13/4004_345.dgn
20190516 16.15

6.11 Historic Heritage

A comprehensive assessment of the potential impacts of the MCCO Project on historic heritage values has been undertaken by Umwelt. This assessment has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**), which require the identification of historic heritage within the vicinity of the MCCO Project and the assessment of the likelihood and significance of any potential impacts.

A summary of the key findings of the Historical Heritage Assessment (HHA) is provided in this section and the full report is provided in **Appendix 15**.

6.11.1 Historical Context

A detailed review of the historical context of the MCCO Project Area and surrounds was undertaken to gain an understanding of the potential historical resource that may occur within and surrounding the MCCO Project Area. The potential heritage resource of the MCCO Project Area and surrounds generally reflects the documented history of the surrounding region from the mid-19th century onward following European settlement, which indicates that the land has predominantly been utilised by graziers, agriculturalists since this time and the mining industry in more recent times. The potential historical heritage resource of the area generally reflects its history as cleared agricultural and pastoral land and the importance of dairying as a local land use. The historical heritage resource is therefore considered to be typical of the region.

The historical heritage evidence of the MCCO Project Area and surrounds is demonstrative of the documented pattern of settlement and use of the area from the mid-19th century onward, including settlement of the area by Europeans and subsequent use of the land for pastoral and agricultural activities. Sheep and cattle grazing were undertaken across the wider area, supplemented by agricultural activities with the cultivation of crops and, in discrete areas, viticulture. Evidence of former house sites, sheds, yards and other rural structures are similarly demonstrative of the pattern of land use and historical development of the area.

Throughout the nineteenth and early twentieth centuries, a number of core industries characterised the local area of Wybong, and strongly influenced the spatial distribution and nature of development and land use within the landscape.

Dairying was one of the initial impetuses for the division of large estates in the Upper Hunter and by the 1890s dairying had become an important industry in the Upper Hunter. Similarly, the timber industry was common in the Upper Hunter Valley where dense timber has been felled in accessible areas and large regions of open forest thinned and/or ringbarked (Heritage Office & DUAP, 1996:46).

6.11.2 Identification of Historic Heritage Items

To identify if any historical heritage items were located within or in the immediate vicinity of the MCCO Project Area, desktop searches of relevant Commonwealth, State and local Government heritage inventories and databases were conducted.

No listed items were identified within the MCCO Project Area. However, two listed items were identified within the vicinity of the MCCO Project Area and are included **Table 6.27** and identified on **Figure 6.28**.

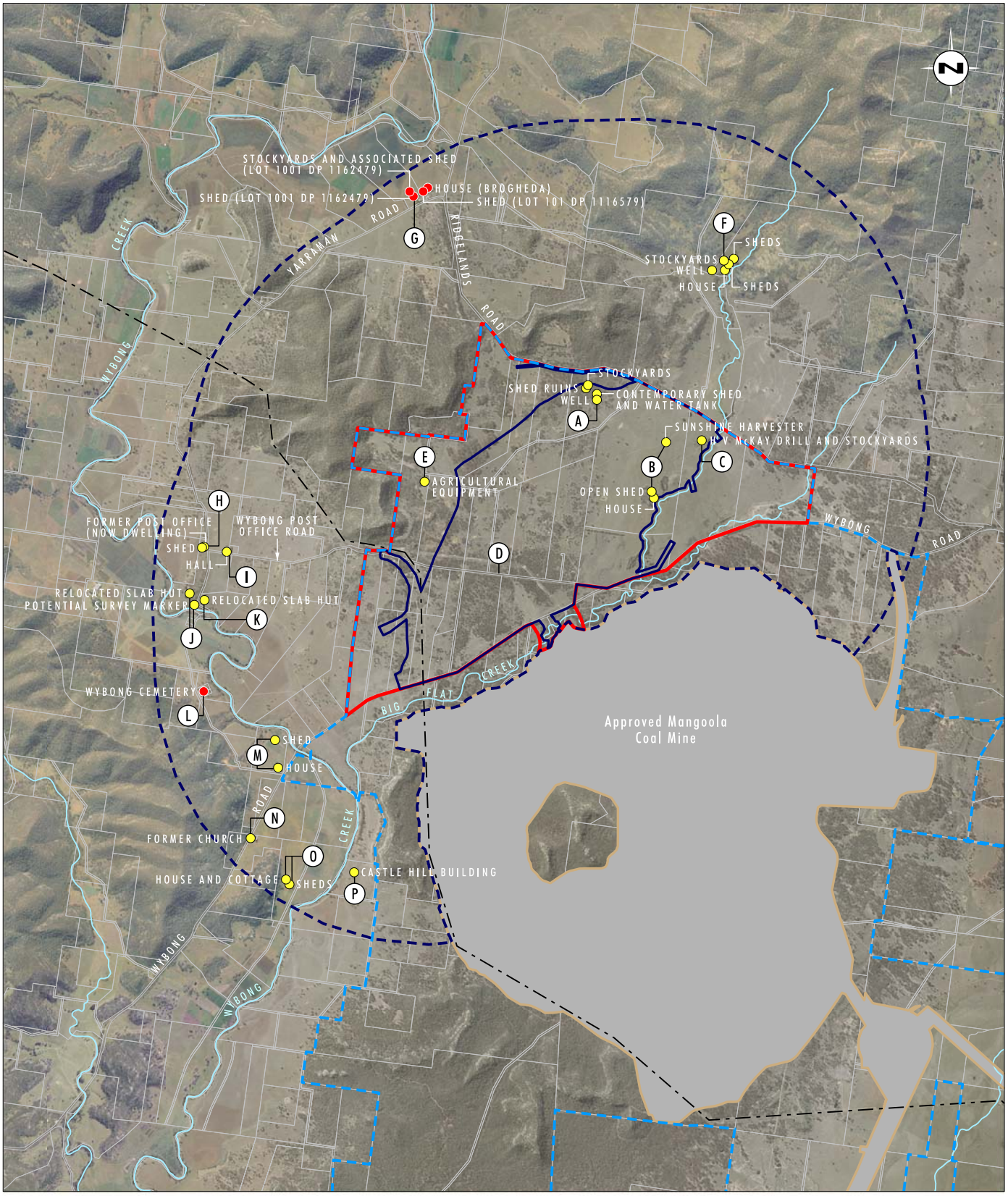


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Historic Heritage Study Area
- Listed Historical Heritage Items
- Potential Historical Heritage Items

FIGURE 6.28

Listed Heritage Items and Properties/Items/Structures Identified to be of Potential Heritage Significance

Table 6.27 Listed Heritage Items Identified

Item Name	Listing and Significance	Distance to Project Area and Disturbance Area
Brogheda	Muswellbrook LEP 2009 Local significance	Approximately 1.6 km outside the MCCO Project Area Approximately 2.7 km from the MCCO Proposed Additional Mining Area at its closest point
Wybong Cemetery'	Muswellbrook LEP 2009 Local significance	Approximately 1.5 km outside the MCCO Project Area Approximately 2.4 km from the MCCO Proposed Additional Mining Area at its closest point

In addition to the two listed heritage items identified, an historical heritage field survey of the MCCO Additional Project Area and targeted visual inspections of specific properties in the surrounding area was undertaken. Based on field survey and visual inspections, 14 additional items were identified to have the potential to be of historical heritage significance.

Of these, four are located within or partially within the MCCO Additional Disturbance Area, and one is located within the MCCO Additional Project Area (but outside of the MCCO Additional Disturbance Area). The remaining nine are located within the wider study area but outside of the MCCO Additional Project Area. All listed and potential heritage items are summarised in **Table 6.28** and shown in **Figure 6.28**.

Table 6.28 Items Identified to be of Potential Heritage Significance

Item ID	Name and Address	Location in Relation to the MCCO Project
A	'Yards and structures'	Within the MCCO Additional Disturbance Area
B	'Millville, structures, yards and tank'	Within the MCCO Additional Disturbance Area
C	'Structures'	Within the MCCO Additional Disturbance Area
D	Wybong Post Office Road	Partially within the MCCO Additional Disturbance Area
E	Agricultural equipment	Outside of the MCCO Additional Disturbance Area but within the MCCO Additional Project Area
F	'Yarlett and structures'	Outside of the MCCO Additional Project Area but within the wider study area
G	'Brogheda Ruins, Shed and Silo'	Outside of the MCCO Additional Project Area but within the wider study area
H	'Dwelling, being the former Wybong Post Office and shed'	Outside of the MCCO Additional Project Area but within the wider study area
I	'Wybong Public Hall'	Outside of the MCCO Additional Project Area but within the wider study area
J	'Dwelling, being a relocated slab hut from Anvil Hill and marked tree (non-Aboriginal)'	Outside of the MCCO Additional Project Area but within the wider study area

Item ID	Name and Address	Location in Relation to the MCCO Project
K	'Yarraman, being a relocated slab hut from Anvil Hill',	Outside of the MCCO Additional Project Area but within the wider study area
L	'Wybong Cemetery'	Outside of the MCCO Additional Project Area but within the wider study area
M	'Rosedale (dwelling and shed)'	Outside of the MCCO Additional Project Area but within the wider study area
N	'Former Church of St Thomas Aquinas'	Outside of the MCCO Additional Project Area but within the wider study area
O	'Collareen'	Outside of the MCCO Additional Project Area but within the wider study area
P	'Castle Hill'	Outside of the MCCO Additional Project Area but within the wider study area

6.11.3 Assessment

6.11.3.1 Significance Assessment

A detailed significance assessment of the potential heritage items that are located within or partially within the MCCO Additional Project Area is provided within **Appendix 15**. This assessment determined that none of the potential heritage items located within the MCCO Additional Project Area meet any of the seven criteria used to define heritage significance, as established by the NSW Heritage Branch (now Division), and do not have any identified research potential. None of these potential heritage items were assessed to meet the criteria for heritage listing.

In addition to this, a broad significance assessment of the wider study area, which includes a consideration of the potential heritage items located outside of the MCCO Additional Project Area and listed in **Table 6.28**, was also undertaken. Of the potential heritage items located outside of the MCCO Additional Project Area but within the wider study area, two were assessed to have significance on a local level; the 'Wybong Hall' and former Church were assessed to have historical, associative, and/or social significance. In addition, early extant estates that are intact, and that are associated with local families with historical associations to the area (including 'Yarlett', 'Collareen' and 'Castle Hill') have also been assessed to have historical significance on a local level, as they are demonstrative of the early settlement and development of the area. These properties may also be of interest for their historical associations with previous owners/occupiers, but are unlikely to meet the criteria for associative significance on a local level.

Other properties or structures, including the relocated slab huts from Anvil Hill and the highly modified post office at the end of Wybong Post Office Road, may also be of local historical interest. However, the significant modification and/or relocation of these specific items has adversely impacted their historical significance, and they are unlikely to meet any of the seven criteria used to assess significance.

It is reiterated, however, that the significance assessment of potential items located outside of the MCCO Additional Project Area presented in the HHA is a preliminary significance assessment only, with no detailed significance assessment undertaken as no impacts are proposed to these potential items.

The significance of the two listed items (being Brogheda and Wybong Cemetery) is already established via their local listings on the Muswellbrook LEP 2009, which identifies these sites as of local significance.

The overall historical (non-Aboriginal) archaeological potential of the MCCO Additional Project Area is assessed as very low, and the anticipated archaeological resource of the MCCO Additional Project Area is unlikely to yield information that would be particularly meaningful, or that would enhance historical information that is already available via other resources.

The HHA also identified potential significant views and/or vistas associated with the locally listed sites Brogheda and Wybong Cemetery. Potential impacts to these views and vistas were considered and assessed as presented in **Section 6.11.3.2**.

6.11.3.2 Potential Impacts of the MCCO Project

The potential impacts of the MCCO Project on historic heritage values were assessed in terms of direct impacts and indirect impacts. Direct impacts are physical impacts to an identified item, including removal and destruction. Indirect impacts include vibration from blasting, which has the theoretical potential to damage/destroy/disturb historical heritage items. A detailed Blasting Impact Assessment was undertaken for the MCCO Project and has considered the identified heritage items as part of that assessment (refer to **Section 6.6** and **Appendix 10**).

Direct Impacts

A significance assessment of potential historical heritage items identified that would be subject to direct impact as part of the MCCO Project was prepared. None of the potential historical heritage items located within the MCCO Additional Disturbance Area and identified in the preparation of the HHA were assessed to meet any of the seven criteria for heritage significance, as defined by the NSW Heritage Branch (now Division).

As none of the potential historical heritage items identified were assessed to be of heritage significance, the heritage impact statement prepared concluded that the MCCO Project would not result in any adverse direct historical heritage impacts.

No potentially significant conservation areas, natural heritage areas, gardens, landscapes, or trees were identified within the MCCO Additional Disturbance Area, and no such areas or elements have previously been identified within or in the vicinity of the current study area as part of any previous assessments undertaken.

No further management recommendations are therefore required with regard to historical heritage for any of the properties, items, or structures located within the MCCO Additional Disturbance Area.

In addition to the above, the historical (non-Aboriginal) archaeological potential of the MCCO Additional Project Area was assessed and was determined to be very low, with any archaeological resource present unlikely to have any significance or research potential. On this basis, it was concluded that the MCCO Project would not result in any identified adverse historical archaeological impacts.

Indirect Impacts

A broader significance assessment was also prepared for the wider study area, which considered the significance of listed and potential heritage items that could potentially be subject to indirect impacts as a result of the MCCO Project. The HHA identified potential indirect impacts associated with the MCCO Project to be potential impacts resulting from vibration due to blasting activity, and potential impacts to any identified significant views or vistas.

The significance assessment determined that the agricultural equipment (Item E) located within the MCCO Additional Project Area and 'Rosedale' (dwelling and shed) (Item M) did not have any identified heritage significance and are therefore no longer considered to be potential heritage items (refer to **Figure 6.28**).

The agricultural equipment and 'Rosedale' are therefore able to be removed and/or otherwise impacted without resulting in any adverse impacts to fabric or elements of heritage significance. No further management recommendations are made for these items.

An assessment of the potential impacts of blasting on the remaining listed and potential historical heritage items within the wider study area was prepared by Enviro Strata (2019) (refer to **Section 6.6** and **Appendix 10**). This assessment concluded that vibration exposures for the listed and non-listed potential heritage items as a result of the MCCO Project will not be higher than 2.1 mm/s. This is below the applicable criteria of 5 mm/s and therefore no blasting vibration impacts are predicted on any potential heritage items.

The only significant views or vistas identified within the wider study area were those to and from the eastern (principal) façade of 'Brogheda' and views from the 'Wybong Cemetery'. To assess the potential visual impacts on the views or vistas of these items a review of aerial photography and the digital terrain model for the MCCO Project was undertaken to determine whether any elements of the MCCO Project would be visible from these locations. This review found that there were no direct views predicted due to the effect of intervening topography and vegetation. As such, no indirect impacts associated with visual impacts were predicted for these items.

In summary, no indirect impacts to any listed or potential historical heritage items within the wider study area have been identified.

6.11.4 Management and Mitigation

Based on the findings of the HHA, no further recommendations for assessment, investigation or recording were made with regards to historic heritage.

With regard to the ongoing management of previously identified sites of relevance to the existing mining operations, Mangoola will update and implement the existing Conservation Management Strategy as part of the implementation of the MCCO Project.

In the unlikely event that unexpected historic (non-Aboriginal) archaeological remains are discovered during works associated with the MCCO Project they would be managed in accordance with the existing process for management of unknown heritage sites/items as detailed within the existing Conservation Management Strategy.

6.12 Aboriginal Archaeology and Cultural Heritage

> *Mangoola and Umwelt would like to acknowledge the Traditional Owners of the MCCO Project Area – the Wonnarua People and Gomeroi People – and pay respect to their cultural heritage, beliefs and continuing relationship with the land.*
>
> *We pay respect to the Elders, both past and present, for they hold the memories, traditions, culture and hopes of Aboriginal people in the area.*
>
> *We thank the Registered Aboriginal Parties, their families and elders for their engagement in this project. Their willingness to participate in discussions during land visits and to contribute in a meaningful way during workshops is greatly appreciated.*

The MCCO Project Area is located within the traditional homelands of the Wonnarua (sometimes spelt Wanaruah) and Gomeroi people, whose history extends from the present day back many thousands of years. The MCCO Project Area is also within the modern day Wanaruah Local Aboriginal Land Council

(WLALC) boundary and within the boundaries of Native Title claims by the Plains Clans of the Wonnarua People (PCWP) and the Gomeroi People.

An Aboriginal Cultural Heritage Assessment Report (ACHAR) has been prepared for the MCCO Project by Australian Cultural Heritage Management (ACHM) in consultation with the Registered Aboriginal Parties (RAPs) and Knowledge Holder groups to assess the Aboriginal cultural heritage values of the MCCO Project Area and surrounds and this report is included in **Appendix 16**.

An Aboriginal Archaeological Impact Assessment (AAIA) was also prepared by OzArk Environmental & Heritage Management (OzArk) to assess the scientific (archaeological) value of sites and artefacts identified within the MCCO Project Area and this report is included as Appendix 11.6 within the ACHAR (refer to **Appendix 16**).

Throughout all stages of the assessment process, the RAPs were invited to identify how they would like to participate in the MCCO Project's Aboriginal cultural heritage assessment process, including what cultural information they wanted to share to inform the assessment process, and what information (if any) should remain non-disclosed in the assessment and reporting process.

In total 37 Aboriginal groups from the local area registered to participate in the MCCO Project community consultation including groups identifying as Wonnarua and Gomeroi. Some of these groups also represented larger groups or families including PCWP, Gomeroi People and Wonnarua Nation Aboriginal Corporation (WNAC) hereon referred to as Knowledge Holders. Groups were invited to attend workshops to identify cultural values relating to the MCCO Additional Project Area or to undertake their own Aboriginal cultural heritage values assessment. Four groups asked to be consulted separately including the WNAC, PCWP, Gomeroi and Hickey family. PCWP provided a separate ACHAR report which identifies the significance of Aboriginal cultural heritage in and around the MCCO Project Area. The publicly disclosed document is included in full in the ACHAR (refer to **Appendix 16**).

All Knowledge Holder groups have provided general statements of cultural values applicable to the MCCO Project Area (alongside the relevant disclosed materials) and have also provided extensive sets of recommendations (either verbally or in their ACHAR) which have been disclosed to ACHM and included in the ACHAR (refer to **Appendix 16**).

The RAPs not being consulted through the PCWP and WNAC are referred to as the Community RAPs, and were consulted by ACHM and Mangoola to develop management recommendations and measures relevant to their cultural significance values statements and assessment concerns.

The ACHAR process has involved consultation with all 37 RAPs. The consultation process has also facilitated the Knowledge Holder groups being able to consult with a large number of Aboriginal people who were not RAPs for the MCCO Project but are traditional owners of the Hunter Valley area, and therefore constitute important stakeholders. These people were Wonnarua and Gomeroi Elders with knowledge and important contributions to the process. Further details of the consultation process are provided in **Section 6.12.1.1**. The understanding of significance and the management recommendations provided by the Community RAPs have informed Mangoola in its development of cultural heritage management recommendations for the MCCO Project.

6.12.1 Methodology

The ACHAR and AAIA have been prepared to satisfy the requirements of the:

- SEARs for the MCCO Project (refer to **Table 4.3**)

- *National Parks and Wildlife Act 1974* (NPW Act)
- *National Parks and Wildlife Regulation 2009* (NPW Regulation)
- principles of The Burra Charter (Australia ICOMOS 1999)
- Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005b)
- Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010a)
- key elements of the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH 2011)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010b).

The approach taken acknowledged and respected that Aboriginal people have the right to directly participate in matters that may affect their heritage, and have the right to maintain culture, language, knowledge and identity.

The objective of the ACHAR was to ensure that Aboriginal people have the opportunity to participate in and improve the outcomes of the assessment by:

- providing relevant information about the cultural significance and values of the Aboriginal objects and/or places within the MCCO Additional Project Area
- influencing the design of the method to assess cultural and scientific significance of Aboriginal objects and/or places within the MCCO Additional Project Area
- actively contributing to the development of cultural heritage management options and recommendations for any Aboriginal objects and/or places within the MCCO Additional Project Area
- commenting on draft assessment reports before they are submitted by the proponent as part of the EIS
- providing input into the intergenerational equity program proposed by Mangoola.

6.12.1.1 Consultation Process

Consultation with the Aboriginal community was undertaken in accordance with the NPW Act and NPW Regulation, with reference to the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005b) and Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010a) guidelines and in consideration of the principles of The Burra Charter (Australia ICOMOS 1999).

The consultation involved:

- **Stage 1:** Mangoola conducted formal notification of the proposed MCCO Project and the ACHAR process and provided the opportunity for local Aboriginal people to formally register their interest in the MCCO Project

- **Stage 2:** Mangoola conducted initial MCCO Project description consultation, which included presenting information on the proposed MCCO Project to all Aboriginal parties who registered an interest in Stage 1. Four of these Aboriginal stakeholder groups asked to be consulted separately. This consultation included details of the MCCO Additional Project Area and proposed impacts and a description of works proposed. Initial consultation also presented the draft survey methodologies for review by the RAPs. Copies of this information were shared with all RAPs. Consultation with the RAPs involved a combination of consultation forums, including one on one meetings, small and large group briefing sessions, including on-site inspections of the MCCO Additional Project Area. Stage 2 also included correspondence with PCWP around a brief for them to produce their own cultural values report for this ACHAR

- **Stage 3:** Mangoola, OzArk and ACHM conducted further consultation which refined the cultural heritage assessment approach with the Community RAPs. The approach actively involved the Community RAPs in the assessment of their cultural heritage values, the likely Project impacts, if approved, and the development of management measures. The MCCO Project also engaged with the Knowledge holder groups via a series of cultural values workshops, while PCWP were engaged to produce their own cultural values report to include in the ACHAR

- **Stage 4:** Mangoola conducted further consultation in relation to the RAPs review of the MCCO Projects draft cultural heritage assessment report, to seek feedback, modify reports as appropriate, receive and review submissions and to incorporate any additional input into the finalised ACHAR.

All RAPs were invited to participate in the assessment process from the time of their registration, with extensive consultation undertaken to inform the MCCO Project, the ACHAR, the AAIA undertaken by OzArk and the broader environmental assessment of the MCCO Project.

Full details of the consultation process undertaken in relation to the ACHAR are contained in **Appendix 16**.

Mangoola, ACHM, OzArk and Umwelt would like to thank the RAPs for the participation in and contribution to this assessment process.

6.12.1.2 Previous Aboriginal Heritage Studies

An extensive history of Aboriginal cultural heritage and archaeological assessments exists for the MCCO Project Area and immediate surrounds. In recent decades, the Upper Hunter Valley has become one of the most intensively studied regions in NSW with numerous archaeological surveys and excavations conducted in advance of proposed mining activity. This body of research has identified numerous archaeological sites, and provides a broad understanding of archaeological site patterning at local and regional levels.

The AAIA provided as Appendix 11.6 in **Appendix 16** provides an overview of the extensive history of past archaeological research undertaken within the MCCO Project Area, a summary of key information on investigation type and area, and number of recorded archaeological sites.

Searches of the OEH administered Aboriginal Heritage Information Management System (AHIMS) register identified 533 previously recorded Aboriginal archaeological sites within a 13 by 16 km combined search area, centred on the MCCO Additional Project Area with 49 sites identified within the MCCO Additional Project Area.

The location of each of these previously recorded sites is discussed further in **Section 6.12.3**. Of the previously recorded sites within the MCCO Project Area, 23 sites are registered as artefact scatters, 16 sites are isolated artefacts, 5 are listed as rockshelters with potential archaeological deposits (PAD), 3 are listed as PAD and 2 are listed as artefacts scatters with PADs. A detailed field validation program was undertaken by OzArk to re-assess the status and condition of these existing sites as part of the archaeological field

survey for the MCCO Project. It is noted that two sites are listed with AHIMS as 'partially destroyed', one site is listed as 'salvaged' and the remainder are listed as 'valid'.

6.12.1.3 AAIA Methodology

OzArk prepared a comprehensive AAIA for the MCCO Project as part of the broader ACHAR. The principal aims of the AAIA were to:

- undertake background research on the region to formulate a predicative model for Aboriginal site location within the MCCO Additional Project Area
- identify and record objects or sites of scientific or archaeological significance within the MCCO Additional Project Area, as well as any landforms likely to contain further archaeological deposits
- assess the likely impacts of the MCCO Project on Aboriginal archaeological sites and/or deposits and provide management recommendations.

The Aboriginal Archaeological Impact Assessment follows the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW (DECCW 2010b) and the field assessment and reporting followed the Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011). The Aboriginal archaeological values assessment is built on the already comprehensive body of Aboriginal archaeology survey work and research previously undertaken in much of the MCCO Project Area.

Archaeological Assessment Consultation and RAP Involvement

The consultation process for the AAIA was undertaken as part of the consultation for the broader ACHAR, as discussed in **Section 6.12.1.1**, and commenced in February 2018. The RAPs were involved in all facets of the assessment including discussions for the development of the survey strategy, review of survey and test excavation methodology, participation in field survey and test excavation program, and site identification and recording. The RAPs were also provided a draft copy of the AAIA report for review and comment.

Field Survey

A comprehensive field survey was undertaken for the MCCO Project to build on the extensive previous archaeological record for the area. Fieldwork was undertaken by OzArk and representatives from the Aboriginal Community from 5–16 February 2018 and test excavation and additional survey occurred from 15–18 May 2018.

The archaeological survey for the MCCO Project included the entirety of the MCCO Additional Project Area. In addition, a 12 ha area of land to the north of Ridgelands Road was also inspected. This area, while outside of the MCCO Additional Project Area, is within the potential blast radius buffer and was inspected to ensure that Aboriginal cultural heritage objects or places will not be harmed by blast vibrations as a result of the MCCO Project. These areas were subjected to full pedestrian survey.

On 15 May 2018 a test excavation was conducted at one location within the MCCO Additional Project Area. Prior to excavation, this site, BFC114a (37-2-5429), was assessed as having potential subsurface deposits. Following the test excavation a single artefact was identified. As a result of the test excavation this site is no longer classified as a site.

6.12.2 Cultural Heritage Values

The ACHAR noted that the numerous Aboriginal stakeholders who participated in the cultural values assessment process hold values which relate to the wider Hunter Valley region generally and less directly to

the MCCO Additional Project Area specifically. There was very little additional information presented in any of the workshops, site visits or written material which relate specifically to the MCCO Additional Project Area as much of the information related to overall values and cumulative impacts.

The ACHAR also found that there are strong ongoing connections to places created and used by ancestors alongside demonstrably strong interests in the manner in which those places are managed or harmed as a result of the MCCO Project. The connection to these places was noted as often being relatively unspecific and generally did not appear to ACHM to relate to any surviving traditional knowledge or customary cultural practices, apart from one Knowledge Holder group who expressed a strong connection to ongoing cultural knowledge in this location.

The ACHAR found that cultural values expressed by the participants have been consistent in voicing an over-arching concern for the wider landscape and criticism of the negative impact of mining on that landscape. Consistent in the material collected is a sense of 'loss' or 'outrage' and grief at the treatment of Aboriginal people since First Settlement (dispossession and genocide are mentioned repeatedly) through to more contemporary experiences (i.e. the Stolen Generation).

The ACHAR also identified a consistent theme in the submissions of the 'powerlessness' Aboriginal people often feel when confronted by situations where they feel disempowered or unable to exercise influence on decision makers. There is a sense of loss and lament for what once was, but with a very strong expression of 'corporate' ownership of the wider region by the Wonnarua and Gomeroi people. There is also an element of celebrating the survival of those who are now ‘speaking for country’. While the entire estate of the Wonnarua people is significant to those concerned, there is little direct evidence (anecdotal or otherwise) of any particular or specific places or values of significance within the MCCO Additional Project Area.

ACHM also found that for many of the informants, the contemporary attachment to place appears based on the linkage to archaeological places which were created by 'the ancestors' and thereby constitute a connecting thread to a cultural world from another time.

This general lack of disclosed direct or specific cultural knowledge in no way diminishes the strength of connection to the places within the MCCO Project Area. However, the ACHAR found that attachment to place is one which is predominantly of contemporary association rather than traditional knowledge, custom, lore or practice.

The ACHAR noted that the surrounding area is held to be of higher significance to many members of the Wonnarua community, however the sites and/or places within the MCCO Project Area held no higher significance or value(s) than any other.

The ACHAR has ascertained that there are no traditional cultural values associated with the MCCO Additional Project Area (directly and specifically) held by the participants in the ACHAR process. By 'traditional' cultural values, ACHM refers to these in the Native Title sense as an inherited and cohesive body of 'traditional' knowledge, laws and customs that are still observed and maintained by a group. However, ACHM states that in common with many urbanised communities, strong contemporary cultural values exist in almost universal claims of 'connection' to the land in question, and a sense of anguish and/or anger at having been 'disconnected' from the land in question by historical circumstances.

ACHM found that the MCCO Additional Project Area has undergone considerable modification since European settlement. Traditional Aboriginal lifeways and customs began to disappear in the early days of contact with Europeans and had largely disappeared before the turn of the 19th Century. Much of the natural landscape no longer exists in any cohesive manner, as the long history of agriculture in the area has irreversibly altered the landscape. Combining the historical disconnection of people from place with the

extensive landscape modification since settlement means that the MCCO Additional Project Area has a relatively low cultural significance when compared to other places within the wider region. This is also consistent with the archaeological assessment, which as discussed in the following section, has determined that most of the archaeological sites identified are of low scientific significance.

6.12.3 Scientific Archaeological Assessment

The archaeological survey completed by OzArk recorded 25 new Aboriginal sites, 24 of which are located within the MCCO Additional Project Area. There were 13 isolated finds and 12 artefact scatters (refer to **Figure 6.29**). One isolated find recorded during the survey, however, was located outside of the MCCO Additional Project Area.

In addition, as discussed in **Section 6.12.1.2** there are a further 49 sites within the MCCO Additional Project Area that are listed on AHIMS as salvaged, valid or partially destroyed, 47 of which are located within the MCCO Additional Project Area. It is to be noted that of the 49 previously recorded sites registered with AHIMS, one [BFC98] has been salvaged under permit and another [BFC114a] has been determined to be 'not a site' following the test excavation. No sites were recorded within the potential blast radius buffer surveyed as part of the archaeological assessment.

In total, the archaeological assessment considered 71 known sites located within the MCCO Additional Project Area (refer to **Figure 6.29**). These sites include stone artefacts, PADs, rock shelters and isolated finds.

6.12.3.1 Archaeological Significance Assessment

Of the 71 sites in the MCCO Additional Project Area, 53 were assessed as having low scientific significance and 11 sites ranged from low-moderate scientific significance to moderate-high scientific significance. The scientific significance of seven sites in the MCCO Additional Project Area include the determination of 'unknown' at some sites where a PAD has been registered but there is no surface manifestation of artefacts. To accurately determine the scientific values at these sites further investigation excavation would most likely be required. However, it is noted that these sites are located outside the Project Disturbance Footprint.

Of the total 71 known sites, 26 are located within the MCCO Additional Disturbance Area including 15 artefact scatters and 11 isolated finds. Of these sites:

- 24 have been assessed as having low scientific significance due to low artefact densities, lack of associated subsurface deposits and observed disturbances
- 2 have either low-moderate or moderate scientific significance with both of these being located in the corridor near Big Flat Creek that is planned to be impacted by the proposed Wybong Road and Big Flat Creek Overpass.

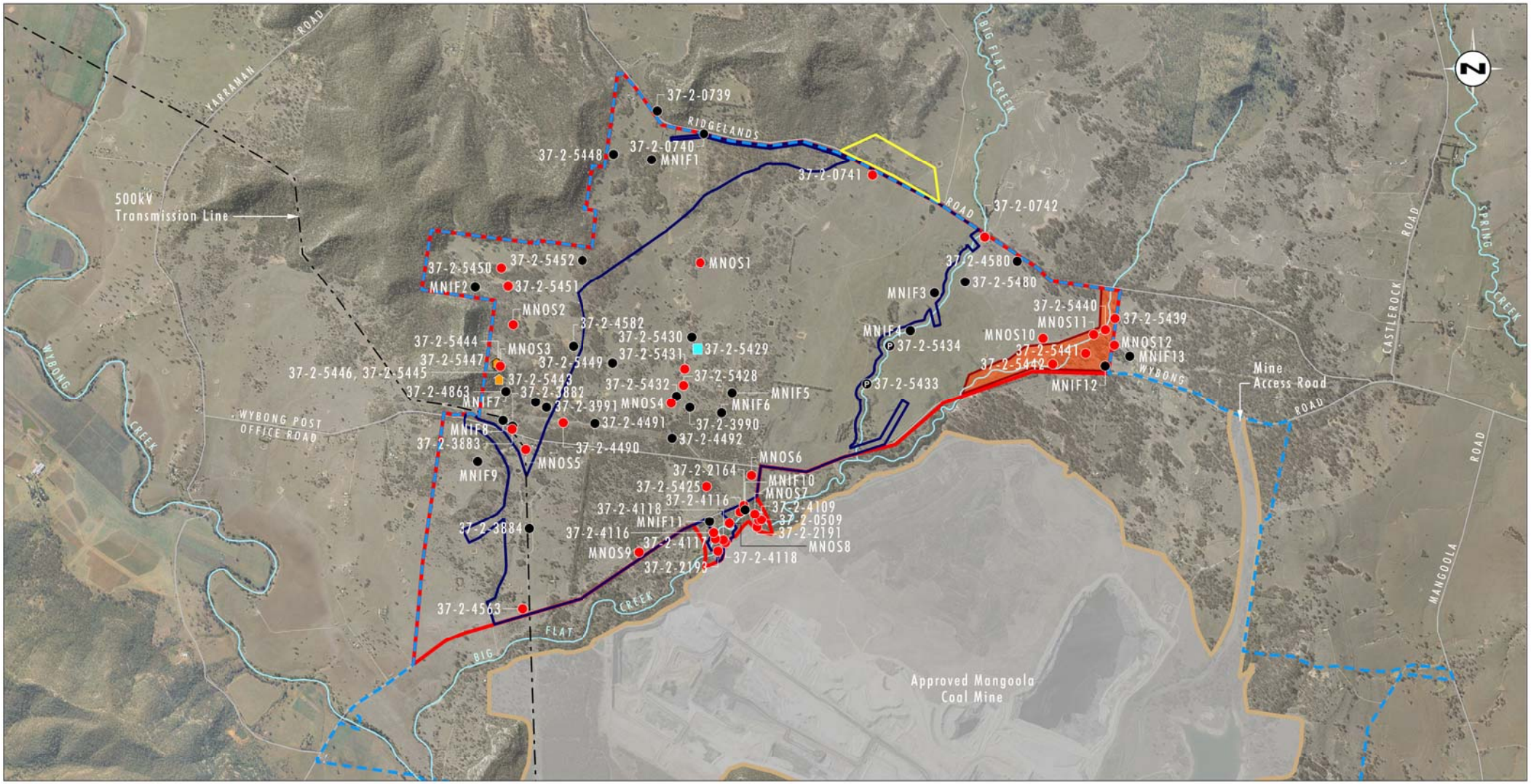


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), AHIMS (2017)

0 0.5 1.0 2.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Potential Blast Radius Buffer Surveyed
- Test Excavation (no longer a site)
- Artefact Scatter
- Isolated Find
- PAD
- Rockshelter, PAD
- MCCO Cultural Heritage Management Area

FIGURE 6.29

Recorded Aboriginal Archaeological Sites

File Name (A4): R13/4004_271.dgn
20190703 8.24

6.12.4 Aboriginal Cultural Heritage Impact Assessment

The MCCO Project would directly impact 26 archaeological sites if approved, consisting of 15 artefact scatters and 11 isolated finds (refer to **Figure 6.29**). The remaining 45 sites will not be impacted by the MCCO Project. The loss of the 26 sites would contribute to the cumulative harm inflicted on Aboriginal sites in the region, however, the archaeological assessment found that as the sites are neither remarkable in their manifestation nor contain artefacts that are not commonly represented in the region, this loss of heritage value is manageable and the intergenerational loss arising from the MCCO Project is considered to be minimal at a regional level.

The predicted direct and indirect impact on the Aboriginal cultural heritage values of the MCCO Additional Disturbance Area add to the cumulative impact of mining development on the cultural heritage resource of the Upper Hunter Valley, and this has been considered in the development of detailed management measures, in consultation with the RAPs, as outlined in **Section 6.12.5**.

6.12.5 Aboriginal Cultural Heritage Management Measures

The management measures proposed by Mangoola for the MCCO Project have been aligned to the Aboriginal Community Wellbeing Toolkit and criteria from OEH, in particular the elements that focus on 'Culture'. In the context of the MCCO Project, four of the eight key principles of the toolkit have been identified as priority areas. The following four principles are the basis of the management measures proposed:

- sense of community
- education and learning
- cultural identity
- leadership empowerment and influence.

The proposed management measures have been developed for the MCCO Project based on the assessment outcomes including recommendations from the workshops and other submissions. Whilst a range of different views and recommendations were provided some common themes were presented which strongly aligned with 'Sense of Community', 'Education and Learning' 'Cultural Identity', and 'Leadership Empowerment and Influence' principles.

This led Mangoola to propose funding projects in:

- Land Management – Potential employment opportunities was a common theme raised by the community. The program proposed focuses on Leadership Empowerment and Influence from the Wellbeing Toolkit
- Sense of Community and Cultural Identity – There were a range of management measures raised that involved bringing people together for community and/or Cultural purposes and activities. The program proposed focuses on the Sense of Community and Cultural Identity aspects of the Wellbeing Toolkit
- Education and Learning – There were a range of management measures raised that involved Cultural Awareness/Education/Training, especially for younger people (both for Aboriginal and non-Aboriginal youth). The program focuses on Education and Learning with potential flow on effects to the Cultural Identity and Sense of Community aspects of the Wellbeing Toolkit.

The proposed management measures also include:

- alignment to the principles of the Aboriginal Community Wellbeing Toolkit (OEH 2012)
- alignment with findings from the ACHA and the archaeological assessment
- the need for management options to be achievable for practical implementation
- provision of sustainable outcomes to promote intergenerational equity
- ability to show value for money.

Table 6.29 contains the proposed management and mitigation measures for the MCCO Project.

Table 6.29 Proposed Management and Mitigation Measures

Action	Proposed Management Measure
On-site Cultural Heritage Management Measures	
Aboriginal Cultural Heritage Management Plan (ACHMP)	
Update ACHMP	The existing ACHMP will be reviewed for the MCCO Project following the granting of Development Consent to outline all Aboriginal heritage management measures for the MCCO Project, responsibilities of all parties and the timeframe for required heritage works. The ACHMP will include a staged approach to the required research and salvage works to ensure that areas required for earliest disturbance are completed as a priority.
ACHMP Dispute Resolution process	The revised ACHMP will include specific provisions regarding ongoing engagement with the RAPs and would include mechanisms for dispute resolution and communications protocols.
Survey, Collection and Analysis	
Survey, collection and analysis	Salvage (excavation, analysis and collection) as per the recommendations of the OzArk AAIA for the salvage of the 26 sites to be harmed within the MCCO Additional Disturbance footprint and planned investigations within the identified rock shelters to determine the veracity of the PAD assessment.
Discovery of previously unknown cultural heritage items	The existing ACHMP includes culturally appropriate management measures for the management of human remains, should this occur. The MCCO Project agrees to follow all relevant NSW Government guidelines regarding the location of human skeletal remains. The existing ACHMP will be updated to include the future disturbance area associated with the MCCO Project and be prepared in consultation with RAPs.
Recording of archaeological sites	The ACHMP will be revised to include the new sites identified in the Aboriginal Archaeology Impact Assessment completed for the MCCO Project.

Action	Proposed Management Measure
Care and Control	
Care and control measures regarding Aboriginal objects	Care and control management measures will be developed and included in the ACHMP for Aboriginal objects recovered through the Archaeological research and salvage program implemented for the MCCO Project and for long term storage of artefacts recovered from previous research and salvage programs. The care and control management measures will have regard to cultural considerations. Mangoola acknowledges the desire for a regional Wonnarua Keeping Place. Mangoola also acknowledged the MCCO Project lies on the overlapping boundary to the Gomeroi Native Title Claim. However, this facility does not currently exist. Stone artefacts retrieved due to the MCCO Project salvage program will be kept on site in an appropriate facility currently being developed as part of the existing Project Approval. Should a regional Keeping Place be developed, subject to community support, Mangoola would consider supporting the relocation of cultural heritage material to that place. Further, Mangoola will consider the repatriation of artefacts across rehabilitation areas as part of a closure planning process at the cessation of mining.
Repatriation of artefacts from MCCO Project Area	Mangoola acknowledges the desire for a regional Wonnarua Keeping Place, however, this facility does not currently exist. Mangoola also acknowledged the MCCO Project lies on the overlapping boundary to the Gomeroi Native Title Claim. Stone artefacts retrieved due to the MCCO Project salvage program will be kept on-site in an appropriate facility currently being developed as part of the existing Project Approval. Should a regional Keeping Place be developed, subject to community support, MCCO would consider supporting the relocation of artefacts. MCCO will consider the repatriation of artefacts across rehabilitation areas as part of a closure planning process at the cessation of mining.
Sites not to be impacted	The MCCO Project will implement the Aboriginal archaeological management measures program for sites in the MCCO Additional Project Area that will not be impacted by the MCCO Project as recommended in the AAIA (see Appendix 11.6 of **Appendix 16**) for the MCCO Project. These measures will be further outlined in the updated ACHMP. As noted in the AAIA 45 sites in the MCCO Additional Project Area will be avoided as they are located outside of the Proposed Disturbance Footprint. Further Mangoola will provide for the maintenance of the landscape in a 23.5 ha area termed here the 'MCCO Cultural Heritage Management Area' that encompasses landforms adjacent to the tributary to Big Flat Creek in the south-east of the MCCO Additional Project Area.

Action	Proposed Management Measure
Off-site Cultural Heritage Management Measures	
Intergenerational Equity	
Education and learning	Currently GCAA through its voluntary Community Investment Program is committed to: • the Galuwa Aboriginal School scholarship program which currently supports 30 scholarships for Aboriginal students from the Upper Hunter in years 6, 7 and 8 to support their academic progress, cultural identity and career aspirations • Singleton Clontarf Academy supporting 80 Aboriginal boys and 4 staff at Singleton High School to support the personal development and education of these boys. GCAA's approach to supporting Aboriginal education is to work closely with NSW Department of Education to provide meaningful and needed Aboriginal education support that compliments and does not duplicate existing initiatives within NSW Education and other providers who support Aboriginal Education. Further support of Aboriginal education following approval of the MCCO Project would be considered, to align to this approach to support similar Aboriginal education initiatives where there is a substantiated gap in support or service provision.
Sense of community and cultural identity	Knowledge holders and RAPs raised a range of issues and potential mitigation strategies with regards to cultural loss, these included: • a desire for community (or groups) to come together outside of development application/disturbance processes • a desire for a range of cultural experiences (such as cultural camps, Elders Camps, teaching to younger generations). Mangoola would consider supporting a program or activities to assist in promoting cultural awareness and education for young people.
Employment, leadership empowerment and influence Land management	Employment opportunities for Aboriginal stakeholders were raised as an item that would benefit the wider community. Mangoola, in consultation or conjunction with GCAA, would consider supporting a traineeship or work experience program through a third party provider in the area of cultural heritage management, biodiversity or land management, ecology, rehabilitation or other appropriately related field. A process and criteria for the application of this support would be developed following approval of the MCCO Project.

The support for the off-site cultural heritage management measures outlined in **Table 6.29** would be available for applications from the local Aboriginal community for a period of three years from the commencement of the MCCO Project. A process and criteria for the application for this support would be developed following approval of the MCCO Project. A budget of $150,000 will be allocated to the off-site cultural heritage management measures as part of the implementation of the MCCO Project.

6.13 Traffic and Transport

A comprehensive Traffic and Transport Impact Assessment (TTIA) has been prepared by GHD in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**). The SEARs require an assessment of the likely transport impacts of the development on the existing road and rail networks.

As outlined in **Section 5.5**, traffic impacts were identified by the community as an issue of concern, particularly potential increases in road traffic. This is consistent with the community feedback that was received during the preparation of the original Project Approval and each of the major modifications that have been undertaken.

For its existing mining operations Mangoola has implemented some key traffic controls. This includes under normal circumstances not using Reedy Creek Road, Mangoola Road, Roxburgh Road or Castlerock Road for access to and from the site. No project-related heavy vehicle traffic uses Wybong Road west of the mine access road (to the intersection with the Golden Highway) to access the site. These key controls will continue to be implemented as part of the MCCO Project. As part of the existing VPA between Mangoola and MSC, Mangoola pay an annual development contribution towards road maintenance costs incurred by MSC for the maintenance of Council roads affected by the operation of the existing mine.

The MCCO Project does not propose any changes to the existing approved operational employee numbers or maximum production rates and therefore no changes to operational traffic movements above those that have previously been assessed and approved are expected. The construction phase will result in additional traffic movements over an approximate 16 month period and these changes have been assessed in the TTIA. The MCCO Project also includes the construction of an overpass over Wybong Road and the proposed realignment of a portion of Wybong Post Office Road which will have a small effect on travel times. During these construction works there will be no required closures of any public roads, other than disruption for the purposes of the merging of the new infrastructure with the existing roads.

As discussed in **Section 3.1** the MCCO Project will extend the life of the Mangoola Coal Mine by approximately one year beyond that currently approved. Therefore operational traffic and coal transport on trains will extend for a further approximately one year beyond that currently approved.

A summary of the key findings of the TTIA is provided in this section and the full report is provided in **Appendix 17**.

6.13.1 Methodology

The TTIA undertaken for the MCCO Project comprised the following:

- characterisation of existing traffic conditions through review of previous traffic assessments and traffic count data as available
- undertaking intersection surveys during weekday AM and PM peak periods on the surrounding road network to establish current traffic volumes. Specifically, this involved counts at the following intersections:
    - Denman Road/Bengalla Road
    - Golden Highway/Wybong Road
    - Wybong Road/Mine Access Road
    - Denman Road/Thomas Mitchell Drive
- undertaking tube traffic counts on the surrounding road network to establish current traffic volumes. Specifically, this involved counts on the following roads:
    - Wybong Road
    - Ridgelands Road

- Wybong Post Office Road
- Yarraman Road

- traffic modelling and intersection analysis using Sidra 7 modelling software and an assessment of traffic impacts and any required management measures.

6.13.2 Existing Road and Rail Network

6.13.2.1 Road Network

The principal road network that provides access to the MCCO Project includes the Wybong Road, Bengalla Road, Denman Road, Thomas Mitchell Drive and the Golden Highway (refer to **Figure 6.30**). Mangoola currently has a single operational/employee site access point from Wybong Road referred to as the Mine Access Road (refer to **Figure 6.30**). This will be retained as the main entrance for the operations phase of the MCCO Project.

In order to establish and manage operations in the MCCO Additional Project Area, access to/from Wybong Road, Wybong Post Office Road and Ridgeland Road will be required for construction and emergency services, ongoing operational environmental monitoring and property maintenance activities.

The data collected during the intersection survey completed for the MCCO Project (refer to **Section 6.13.1**) enabled an assessment to be completed of the current road network performance. The operation of the intersections surveyed was assessed by calculating the amount of delay to vehicles using an intersection and, amongst other performance measures, gives a Level of Service (LoS) rating which indicates the relative performance of traffic movements within the intersection.

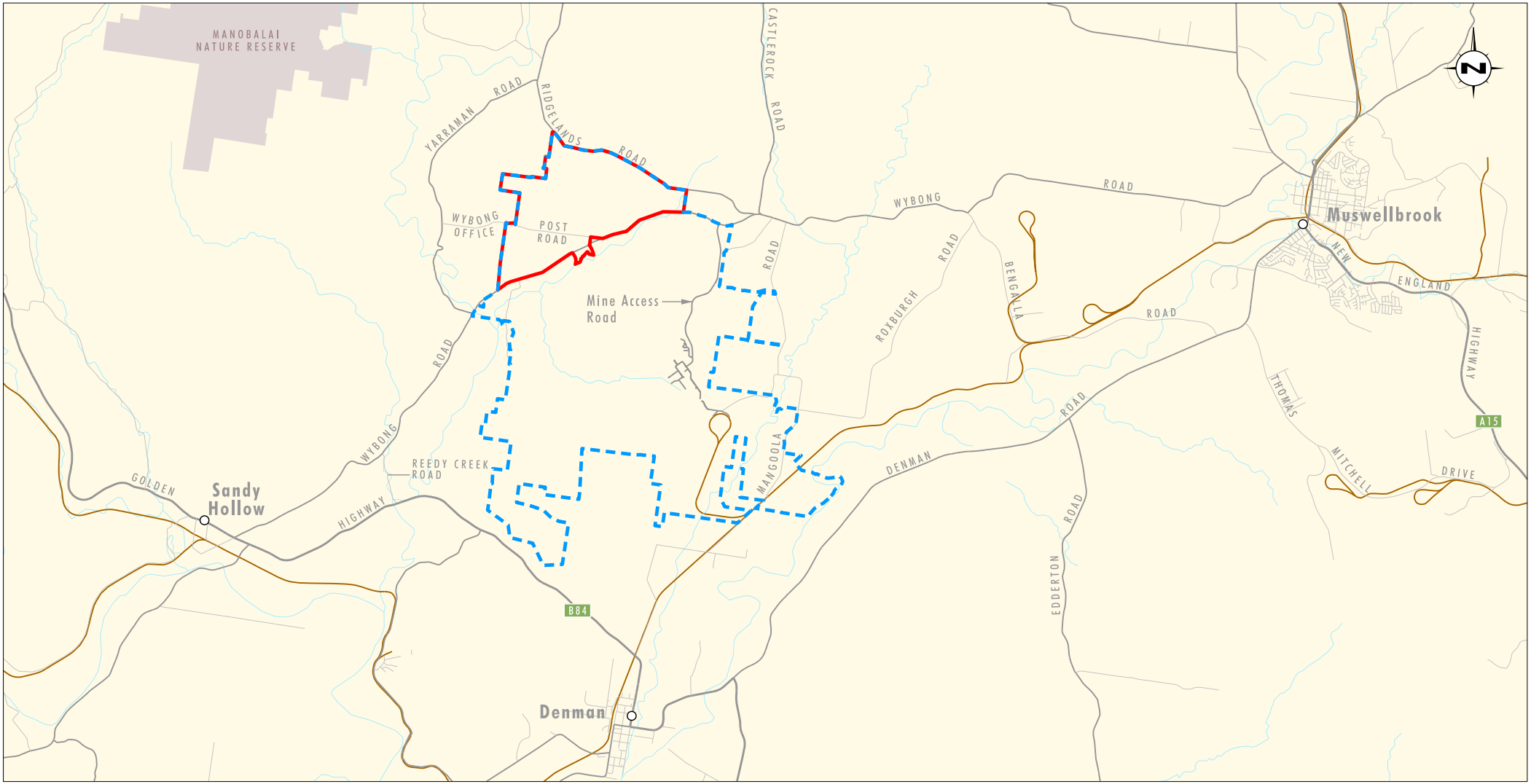
There are six LoS measures ranging from A (very low delay and very good operating conditions) to F (over saturation where arrival rates exceed intersection capacity). Typically, a LoS D or better is considered to be acceptable, however a LoS E may be acceptable if it also operates with a low degree of saturation.

The results indicate that all intersections surveyed currently operate with a good level of service, at LoS C or better, during weekday AM and PM peak periods. Further, existing traffic volumes indicate that Wybong Road, Denman Road, Thomas Mitchell Drive, Bengalla Road and the Golden Highway are operating well within the acceptable limits.

Traffic counts completed on the road network within the immediate vicinity of the MCCO Additional Project Area (including on Wybong Road, Ridgelands Road, Wybong Post Office Road and Yarraman Road) indicated that background traffic levels were very low. With regard to Wybong Road the peak vehicle activity recorded was approximately 100-150 vehicles per hour for the morning period (6.00 am to 7.00 am) and afternoon period (4.00 pm to 5.00 pm) with each coinciding with Mangoola Coal Mine shift changes. Traffic counts in other periods for Wybong Road were much lower at around 30 to 40 vehicles per hour.

Regarding Wybong Post Office Road, which is proposed to be realigned (in part) by the MCCO Project, the traffic counts only recorded up to six (bi-directional) vehicles in an hour. It is noted, that with the exception of Wybong Hall, all residences along Wybong Post Office Road are owned by Mangoola Coal and approximately six of these residences will be required to be vacated due to the MCCO Project, further reducing the traffic levels on this road, post construction.

A detailed description of the existing road network is provided in **Appendix 17**.



Data Source: Glencore (2019), LPI (2016)

0 2.0 4.0 6.0km

Legend

- MCCO Project Area
- MCCO Additional Project Area
- Road
- Railway
- Drainage Line

FIGURE 6.30

Road and Rail Network

20190612 13.23 20190612 13.23
20190703 11.56

6.13.2.2 Rail Network

Product coal is transported from mines in the Hunter Valley to the port of Newcastle via the Hunter Valley rail network. The Hunter Valley rail network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line (with some significant stretches of third track) from Maitland to Muswellbrook in the upper Hunter Valley, and a shared single track with passing loops from that point north and west (ARTC, 2018).

The primary users of the Hunter Valley rail network include a number of existing and approved coal mines, one of which is Mangoola Coal Mine, other commodities and freight container trains as well as passenger trains. The Hunter Valley coal rail network is managed by the ARTC. The primary role of the ARTC is to ensure that rail corridor capacity in the Hunter Valley can stay ahead of coal demand.

As described in **Section 2.4** product coal from Mangoola Coal Mine is currently transported via rail on the Hunter Valley rail network with an approved capacity of up to 10 trains per day. No changes are proposed to the approved capacity as part of the MCCO Project, however, the productive life of the mine will continue for approximately one further year than is currently approved. This small life extension is not considered likely to result in any significant impact on rail transport capacity as the existing network has adequate capacity for existing mine production and no increases in annual train movements are proposed.

6.13.3 Assessment

6.13.3.1 Operational Traffic

As described in **Section 3.1** the MCCO Project does not propose any changes to the existing approved operational employee numbers or maximum production rates and as such, no operational traffic changes are anticipated above those that have been previously assessed and approved. The current movement of workers and service vehicles associated with the operation of the Mangoola Coal Mine have also been captured in the traffic surveys and the assessment that has been completed of the current road network performance (refer **Section 6.13.2.1**) which confirmed that all relevant intersections operate with a good level of service. Further, existing traffic volumes indicate that Wybong Road, Denman Road, Thomas Mitchell Drive, Bengalla Road and the Golden Highway are operating well within the acceptable limits.

As noted above, the productive life of the mine will continue for approximately one further year than is currently approved and this will result in an additional year of operational traffic beyond that current approved. This small life extension is not considered likely to result in any significant impact on roads as the existing network has adequate capacity and is operating at a good level of service.

6.13.3.2 Construction Traffic

As described in **Section 3.11** the construction phase for the MCCO Project is planned to occur over an approximately 16-month period and be completed by 2022. During this phase the MCCO Project is expected to generate additional light vehicle traffic associated with construction personnel, for which a conservative assumption of 145 in bound and out bound worker movements has been assessed, and the following with regard to heavy vehicle movements:

- an average of approximately 31 heavy vehicle movements (inbound and outbound) per day over the course of the construction period
- a peak of approximately 70 heavy vehicle movements (inbound and outbound) per day.

This includes heavy vehicle activity associated with sourcing the required gravel for construction. Subject to suitable resources being available, the majority of gravel is planned be sourced 'internally' from within the

Mangoola Coal Mine. If not available from the mine this material will be sourced from quarries in the region. For materials sourced at Mangoola Coal Mine, the vehicles hauling the material will turn left from the Mangoola Mine Access Road onto Wybong Road and then turn right into the MCCO Additional Project Area via the proposed construction access points off Wybong Road or Wybong Post Office Road.

Intersection traffic modelling, using SIDRA, has been undertaken to analyse the traffic impact of the construction traffic expected to be generated by the MCCO Project. Analysis has been undertaken for the following scenarios:

- a 'no-build' scenario, accounting for background traffic growth only
- a 'build' scenario accounting for the background traffic growth and the expected peak construction traffic associated with the MCCO Project.

The intersection modelling analysis indicates that in the 2022 horizon year, all intersections are expected to operate with a good LoS for both the 'no-build' and 'build' traffic scenarios.

As part of constructing the MCCO Project an overpass will be constructed over Wybong Road and Big Flat Creek to provide access from the existing mine into the MCCO Additional Project Area. During construction of this overpass Mangoola will provide appropriate construction traffic controls and will provide continued access along Wybong Road for through traffic by way of a by-pass road (refer to **Section 3.11**). The final design of the overpass will be prepared in consultation with MSC.

6.13.3.3 Wybong Post Office Road

Mining within the MCCO Additional Project Area will require the realignment of a portion of Wybong Post Office Road. At the western boundary of the MCCO Additional Project Area, it is intended to divert Wybong Post Office Road to the south, where it will intersect Wybong Road via a new priority-controlled T-intersection (refer to **Figure 6.30**).

This proposed realignment of Wybong Post Office Road will extend the trip distance of some road users by approximately 1.6 km. Assuming that vehicles travel at a speed of 100 km/h (the sign-posted speed limit) along this realigned route, this will increase travel times by 55 seconds. As such, the proposed realignment of Wybong Post Office Road is expected to have a minor impact on travel times. When travelling to/from Sandy Hollow or Reedy Creek Road the travel distance will decrease.

Further, traffic counts undertaken on Wybong Post Office Road between 30 November 2018 and 6 December 2018 indicate traffic volumes are low, with up to six (bi-directional) vehicles in an hour. It is noted, that with the exception of Wybong Hall, all residences along Wybong Post Office Road are owned by Mangoola and approximately six of these residences will be vacated due to the MCCO Project works, further reducing the traffic levels on this road, post construction.

The crash data indicates that there have been two crashes recorded in proximity to the Wybong Road/Wybong Post Office Road intersection in the last five years. Wybong Post Office Road currently has a poor-quality road surface condition. The realignment of the road will be constructed in accordance with Austroads Design Guidelines, including two-line marked travel lanes and sealed shoulders which will provide a much better quality road than that which currently exists (refer to **Plate 6.1**). Accordingly, the proposed realigned portion provides an opportunity to improve the road condition and safety for road users.

Plate 6.1 Current (Left) and Representative Proposed Condition of Wybong Post Office Road* (Right)

Glencore, 2019

**Photo reflects the current Mangoola Mine Access Road*

As detailed in **Section 5.4.5**, Mangoola has had preliminary consultation with MSC in relation to the proposed realignment and as part of this process provided MSC with preliminary design drawings associated with the proposed haul road overpass over Wybong Road and the realigned portion of Wybong Post Office Road and associated construction requirements. As part of the implementation of the MCCO Project a detailed concept design will be prepared for the realignment of Wybong Post Office Road in consultation with MSC and submitted to MSC for its agreement. A detailed design will then be prepared for MSC approval prior to construction commencing.

As discussed in **Section 4.3.3.1**, consent is required under section 138 of the Roads Act to work on or above a road or to connect a road to a classified road. Relevant to the MCCO Project consents under section 138 will be required for:

- the road works associated with the realignment of the Wybong Post Office Road
- any construction activities on or over public roads or in road reserves (e.g. Wybong Road/Big Flat Creek overpass)
- approvals to close road reserves.

6.13.3.4 Emergency Vehicle Access

As detailed in the Mangoola Emergency Response Control Plan, managing the responses to emergencies is the responsibility of a designated communications officer. The role includes liaising with key internal personnel (such as response coordinators) and the emergency services to designate the appropriate emergency vehicle access point, which would typically be the Mangoola Mine Access Road. The mine also provides a helipad (located adjacent to the main administration area), which can also be used by helicopter medical services (if required).

During the construction period of the MCCO Project, access to the Mangoola Coal Mine may be interrupted for short periods by traffic controllers. In these circumstances emergency services vehicles would be allocated priority through the work zones.

All roads surrounding the MCCO Project Area are permitted for use in any emergency to avoid the loss of lives, property and/or prevent environmental harm.

6.13.3.5 Rail Transport

With regard to transporting product coal from site as discussed in **Section 3.4** the MCCO Project will not result in any changes to the existing approved capacity of up to 10 trains per day, however, the MCCO Project will extend the life of the Mangoola Coal Mine by approximately one year beyond that currently approved. The MCCO Project will not result in any additional trains on the Hunter Valley rail network and will continue to operate within the approved capacity. As discussed in **Section 5.4.4** Mangoola has consulted with the ARTC regarding the MCCO Project and they have confirmed that '*the MCCO Project does not affect rail network capacity and poses no change to existing rail access arrangements for Mangoola'.*

6.13.4 Management and Mitigation

Modelling completed as part of the TTIA predicts that each of the intersections of interest are expected to operate with an acceptable LoS both for the construction and operational phases. As such, no road upgrades or changes are required to the existing road network as a result of the MCCO Project. In order to guide traffic management during the construction phase a Construction Traffic Management Plan (CTMP) will be prepared in consultation with MSC prior to construction commencing. The CTMP will include appropriate Traffic Control Plans and include detail with respect to:

- traffic control measures in works areas
- restrictions on the delivery of heavy plant and materials to site
- identify the appropriate entry/exit points for the proposed construction compound area(s) i.e. Wybong Road and Wybong Post Office Road and Ridgelands Road
- advising motorists of the change in traffic conditions associated with the work.

With regard to the proposed Wybong Post Office Road realignment Mangoola commit to fully constructing the realignment prior to tying it in with the existing road network (i.e. Wybong Road and the section of the existing road not being realigned) to minimise disruption to traffic during the construction phase.

Further as described in **Section 3.0**, access to/from Wybong Road, Wybong Post Office Road and Ridgelands Road to the MCCO Additional Project Area will be required for construction and other ongoing operational needs such as emergency services, environmental monitoring and property management.

With regard to the operational access Mangoola commits to the continued use of the existing mine access from Wybong Road for operations including maintaining the currently approved restrictions which include no Mangoola related traffic to use Reedy Creek Road, Mangoola Road Roxburgh Road or Castlerock Road to get to or from the site, except in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

6.14 Visual Amenity

An assessment of the potential visual impacts of the MCCO Project has been undertaken in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**) and is presented in this section. The SEARs require a detailed assessment of the likely visual impacts of the development on private landholders in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms, and to minimising the lighting impacts of the development.

Visual amenity was raised as a key issue of concern to local community stakeholders, with key issues relating to decreased amenity and impact on rural outlook. Impacts of lighting from night operations and rehabilitating the final landform to blend in with the existing bushland were also raised by a small number of stakeholders. This is consistent with the community feedback that was received during the preparation of the original Project Approval and each of the major modifications that have been undertaken.

Rehabilitation at the existing Mangoola Coal Mine is completed using natural landform design principles and revegetation techniques that are widely recognised as industry leading. Mangoola is committed to continuing this approach and will implement a fully integrated rehabilitation program and final landform in accordance with leading practice natural landform design principles across the existing and proposed mining areas. With regard to the MCCO Project this has been designed so that there are no direct views available from any private residences.

6.14.1 Methodology

The visual assessment was undertaken to determine the level of visual impact the MCCO Project will have on both private receivers and key public vantage points in the surrounding areas. As the visual impacts associated with the existing mining operations within the Approved Project Area of Mangoola Coal Mine have previously been assessed and approved they are considered as part of the existing environment and have not been further assessed as a part of this impact assessment. In this regard the visual assessment has focused on the new proposed mining operations within the MCCO Additional Project Area and the new infrastructure associated with the MCCO Project. The approach to the visual assessment is provided below.

6.14.1.1 Visual Assessment Locations

An analysis of the potential visual catchment of the MCCO Additional Project Area was completed in order to determine locations within the surrounding landscape that have potential views to any project elements. This was completed based on desktop review of aerial photography and the digital terrain model for the MCCO Project and confirmed through field observations. This then enabled the consideration and selection of representative viewing locations (visual assessment locations) within the potential visual catchment for further assessment.

The process of identifying the visual assessment locations involved an initial desktop review and preparation of a series of radial analyses from private residences and public viewing locations surrounding the MCCO Additional Project Area, to determine the theoretical extent of potential views based on topography and the proposed MCCO Project mine plans. The radial analysis technique is detailed further in **Section 6.14.1.2**. Site inspections and photographs were then used to further refine the selection of the visual assessment locations within each area where potential views were identified.

This process found that there were no predicted views of the proposed mining operations or proposed infrastructure available from any private residences within the area surrounding the MCCO Additional Project Area due to the effects of intervening topography. It also identified that views will be available from public roads in the area and some other public viewing locations in the area surrounding the MCCO Additional Project Area.

Ten representative visual assessment locations were selected. These locations are considered to be representative of the public viewing localities that have the highest potential for visual impact. The visual assessment locations chosen are illustrated on **Figure 6.31** and described below in relation to the MCCO Additional Project Area:

- **Location 1 Castlerock Road** - represents views towards the MCCO Project from the Church on Castlerock Road located to the east
- **Location 2 Wybong Road** - provides a representative view towards the MCCO Project from a public vantage point located to the east
- **Location 3 Wybong Road/Wybong Post Office Road intersection** - provides a representative view towards the MCCO Project from a public vantage point located to immediate south
- **Location 4 Wybong Road** - provides a representative view from a public vantage point of the proposed Wybong Road Big Flat Creek Overpass. Currently the existing operational areas of the Mangoola Coal Mine can be viewed from this location
- **Location 5 Wybong Road** - provides a representative view towards the MCCO Additional Project Area from a public vantage point to the west
- **Location 6 Yarraman Road** - provides a representative view towards the MCCO Additional Project Area from a public vantage point located to the south-west. Currently the existing operational areas of the Mangoola Coal Mine can be viewed from this location
- **Location 7 Yarraman Road/Wybong Post Office Road intersection -** provides a representative view towards the MCCO Additional Project Area from a public vantage point located to the west. Currently the existing operational areas of the Mangoola Coal Mine can be viewed from this location
- **Location 8 Hidden Valley Row** - provides a representative view towards the MCCO Additional Project Area from a public vantage point located to the north-east. Currently the existing operational areas of the Mangoola Coal Mine can be viewed from this location
- **Location 9 Ridgelands Road** - provides a representative view towards the MCCO Additional Project Area from a public vantage point located to the immediate east. Currently the existing operational areas of the Mangoola Coal Mine can be viewed from this location
- **Location 10 Golden Highway -** provides a representative view towards the MCCO Additional Project Area from a public vantage point located to the south-west.

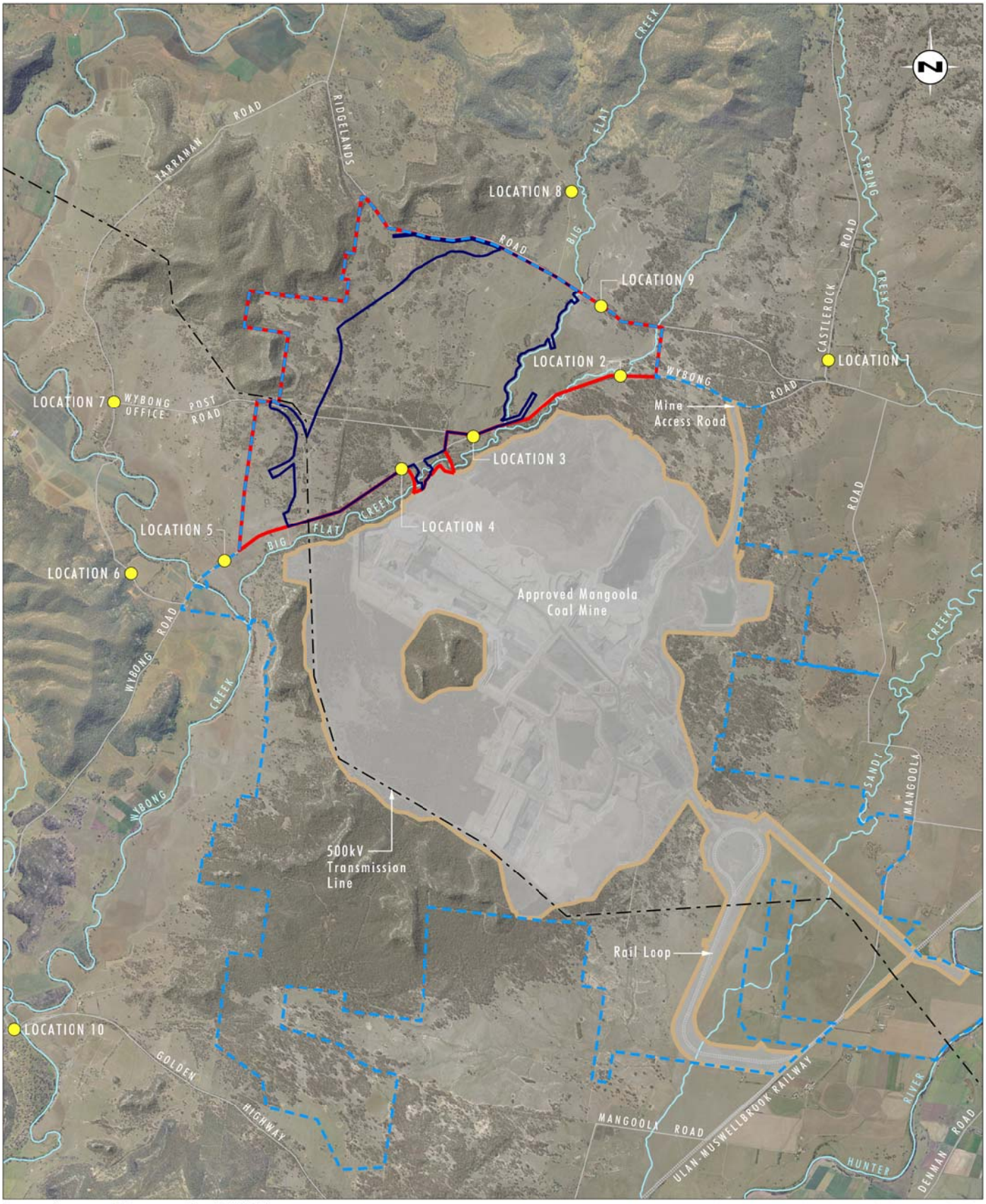


Image Source: Glencore (April 2018)
Data Source: Glencore (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area
- Visual Assessment Location

FIGURE 6.31

Visual Assessment Locations

6.14.1.2 Radial Analyses

For each of the selected visual assessment locations radial analyses are developed using 3D topographic information and electronic data files relating to the MCCO Project to identify what can theoretically be seen from each vantage point. The radial analysis illustrates what is visible from a height of 1.7 m at that location (i.e. from approximate eye height). It should be noted that the radial analyses are topography based only and do not include vegetation which may in fact screen a portion of a viewshed and so are considered conservative. Radial analyses were completed based on the potential worst impact year for each visual assessment location. Year 8 was identified as the worst impact year as it represents a scenario where maximum height of the constructed landform is reached and the full progression of the proposed mine footprint is achieved.

6.14.1.3 Photomontages

Photomontages were completed for select visual assessment locations where the radial analysis identified potential for high visibility of MCCO Project elements. Photomontages are developed using a panoramic photograph (made using a series of individual photos), 3D topographic information, and electronic data files pertaining to the mine plans for the MCCO Project. Constructing photomontages of 'before and after' scenarios illustrates the existing landscape and provides a comparison landscape including the MCCO Project. For the purpose of this assessment, bold, contrasting colours have been used to highlight key project elements in the photomontages.

Photomontages prepared for this assessment include a comparison between existing views and the operations within the MCCO Additional Project Area in Year 3, Year 8 and Final landform.

6.14.1.4 Lighting Assessment

The visual assessment also included a qualitative assessment of potential lighting impacts with consideration to both direct and indirect (or diffuse) lighting effects.

The MCCO Proposed Additional Mining Area is located approximately 185 km from the Siding Spring Observatory, located within the Warrumbungle National Park which means that it is within the defined 'Dark Sky Region' which consists of all land within a 200 km radius of the observatory. In this regard the lighting assessment is required to and has considered DPE's Dark Sky Planning Guideline - Protecting the observing conditions at Siding Spring (DPE, 2016).

It is noted that the currently approved Mangoola Coal Mine is already conducting mining operations within a similar distance from the observatory and that the existing Mangoola Coal Mine infrastructure areas including the CHPP, workshops and load out infrastructure, where the majority of fixed lighting is present is located approximately 192 km from the observatory.

As described in **Section 3.0**, no change is proposed to the currently approved Mangoola infrastructure areas including workshops, CHPP and coal handling infrastructure or rail transport infrastructure. This includes no changes proposed to the existing lighting arrangements for these facilities.

6.14.2 Existing Landscape Setting

The Hunter Valley has a diversity of landforms, vegetation patterns and land uses resulting in considerable variation in scenic quality. In general terms, scenic quality is considered to improve with increasing diversity of topographic ruggedness, vegetation patterns, natural and agricultural landscapes and water bodies (Andrews, 1999).

Extensive clearing for agricultural purposes since early European settlement has created a strong landscape contrast in the Hunter Valley between forested slopes bordering the valley and farmland on the valley floor, including cleared areas for grazing and areas of intensive agriculture along the alluvial river flats. The development of the power and coal industries particularly over the past 55 years has added to this contrast, resulting in areas of strong visual contrast to the surrounding vegetated and agricultural areas (Andrews, 1999).

As identified in **Section 1.6.1**, the Approved Project Area is dominated by the existing Mangoola Coal Mine, including the open cut mining area and associated infrastructure, along with areas of rehabilitated land and native vegetation. The MCCO Additional Project Area has been used extensively for agriculture since the 1800s and is comprised of rolling grazing land and patches of native woodland.

In the immediate vicinity of the MCCO Additional Project Area, mined land, 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 visual environment.

Outside of the mining land, the local area is dominated by remnant native bushland, cleared paddocks and a range of primary production activities. These activities include grape growing to the south-west and east, small olive groves to the north-west and a mixture of cattle grazing and cropping on the Wybong Creek and Hunter River Alluvial flats to the west and south, respectively.

The main topographical feature in the surrounding landscape is the series of undulating wooded hills and ridgeline which occur outside and to the north and north-west of the MCCO Additional Project Area. These hills rise to a maximum height of approximately 360 mAHD and are elevated approximately 200 m above the surrounding area (refer to **Figure 1.6**). These hills are covered in native vegetation and provide a topographic barrier between the MCCO Additional Project Area and the private land to the north, north-west and west.

These various landscape elements provide significant contrast in visual amenity. Areas with a largely natural or agricultural character are generally considered of high visual amenity, while areas characterised by significant mining or industrial landscape features are typically considered to have a low visual amenity.

The night time scenic quality of the local area is not typically rural. As a result of the existing mining operations within the Approved Project Area and associated infrastructure, night light and glow emanating from these activities is common. Also contributing to the existing night time scenic quality is light from moving vehicles, both on the surrounding road network and vehicles operating in the Approved Mangoola Coal Mine Disturbance Area.

6.14.3 Assessment

The key aspects of the MCCO Project that have the potential to result in visual impacts include:

- construction and use of the proposed Wybong Road and Big Flat Creek overpass which may be associated with views of the overpass structure as constructed over Wybong Road, mobile plant and equipment, exposed surfaces, dust and night lighting

- clearing and overburden removal, which may be associated with views of mobile plant and equipment, exposed surfaces, dust, blasting operations and night lighting

- active mining operations, which may be associated with views of mobile plant and equipment, exposed surfaces, dust, blasting operations and night lighting

- emplacement of overburden, which may be associated with views of mobile plant and equipment, exposed surfaces, dust and night lighting

- rehabilitation, which may be associated with views of mobile plant and equipment and regenerating vegetation.

A combination of these activities will be occurring throughout the life of the MCCO Project as each of the active mining areas progress and the overburden emplacement areas progressively achieve their final landform and are rehabilitated (refer to the conceptual staged mine plans presented on **Figure 3.3** to **Figure 3.7**). Parts of these activities may be visible from certain public viewing locations at different stages of the mine, with the visible operations changing over time as the mining landform develops.

As discussed above, the visual assessment has found that there are no predicted views of the proposed mining operations or proposed infrastructure available from any private residences within the area surrounding the MCCO Additional Project Area due to the effects of intervening topography and vegetation.

The visual impact of the MCCO Project has been assessed at each of the visual assessment locations surrounding the MCCO Additional Project Area using radial analysis and where considered necessary, photomontages. All of the radial analysis and photomontages that have been prepared as part of this assessment are provided in **Appendix 18** with a selection of these included below to support the visual assessment discussion below. Due to the effects of intervening topography, particularly due to the significant ridgeline that is located to the north and north-west, views to the MCCO Additional Project Area are restricted. For this reason, no photomontages have been prepared for locations situated on the northern side of this ridgeline as views are not possible.

Visual Assessment Location 1 – Castlerock Road

The radial analysis completed for this location (refer to **Appendix 18**) predicts that intervening topography will not allow views of the operations within the MCCO Additional Project Area from this area.

Visual Assessment Location 2 – Wybong Road

The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area will be visible, from a distance of approximately 1 km when looking towards the west and north-west from this location on Wybong Road. As is currently the case from this location views would also be available to areas of rehabilitation at the existing Mangoola Coal Mine to the immediate south.

The potential visual impacts from this location have been further considered and are illustrated by the photomontage included as **Figure 6.32**. **Figure 6.32** shows the existing landform and predicted views for Project Year 3, 8 and the final landform. To minimise the available views from this location Mangoola is proposing to plant tree screens along parts of Wybong Road and incorporate a visual bund along Wybong Road (refer to **Figure 3.3** to **Figure 3.6**).

As mining progresses within the MCCO Additional Project Area, views from this part of Wybong Road will be available to elements associated with the MCCO Project including areas of active mining, active emplacement areas, reshaped emplacement areas and rehabilitation. Views to parts of the highwall associated with the final void are likely to be visible in the final landform.

Legend

- Active Mining
- Overburden Emplacement Area - Active
- Overburden Emplacement Area - Reshaped
- Rehabilitation Area
- Rehabilitation Area - Temporary
- Void/Highwall

File Name (A3): R13/4004_192.dgn
20190516 16.25

FIGURE 6.32

Photomontage from
Visual Assessment Location 2

In this regard an additional photomontage has been prepared for this location to show the likely views that are expected for the proposed conceptual final landform once rehabilitation has been completed. This is included on **Figure 6.36** and shows that with landform reshaping and rehabilitation using native woodland species as proposed the rehabilitated landform is expected to blend in with the existing landscape.

Visual Assessment Location 3 – Wybong Road/Wybong Post Office Road Intersection

The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area will be visible from this location at the Wybong Road/Wybong Post Office Road intersection.

The radial analysis indicates that the MCCO Project will be visible when looking towards the MCCO Additional Project Area from this location including sections of overburden emplacement in the initial stages and then longer-term views to areas of rehabilitation as this is completed on the outer faces of the emplacement areas. Looking west from this location, the proposed Wybong Road and Big Flat Creek overpass will be visible. As is currently the case from this location views would also be available to areas of overburden emplacement and rehabilitation at the existing Mangoola Coal Mine to the immediate south.

To minimise the available views from this location Mangoola proposes to plant tree screens along parts of Wybong Road, the realigned section of Wybong Post Office Road and incorporate a visual bund along Wybong Road to reduce the visual impacts of the MCCO Project.

Visual Assessment Location 4 – Wybong Road

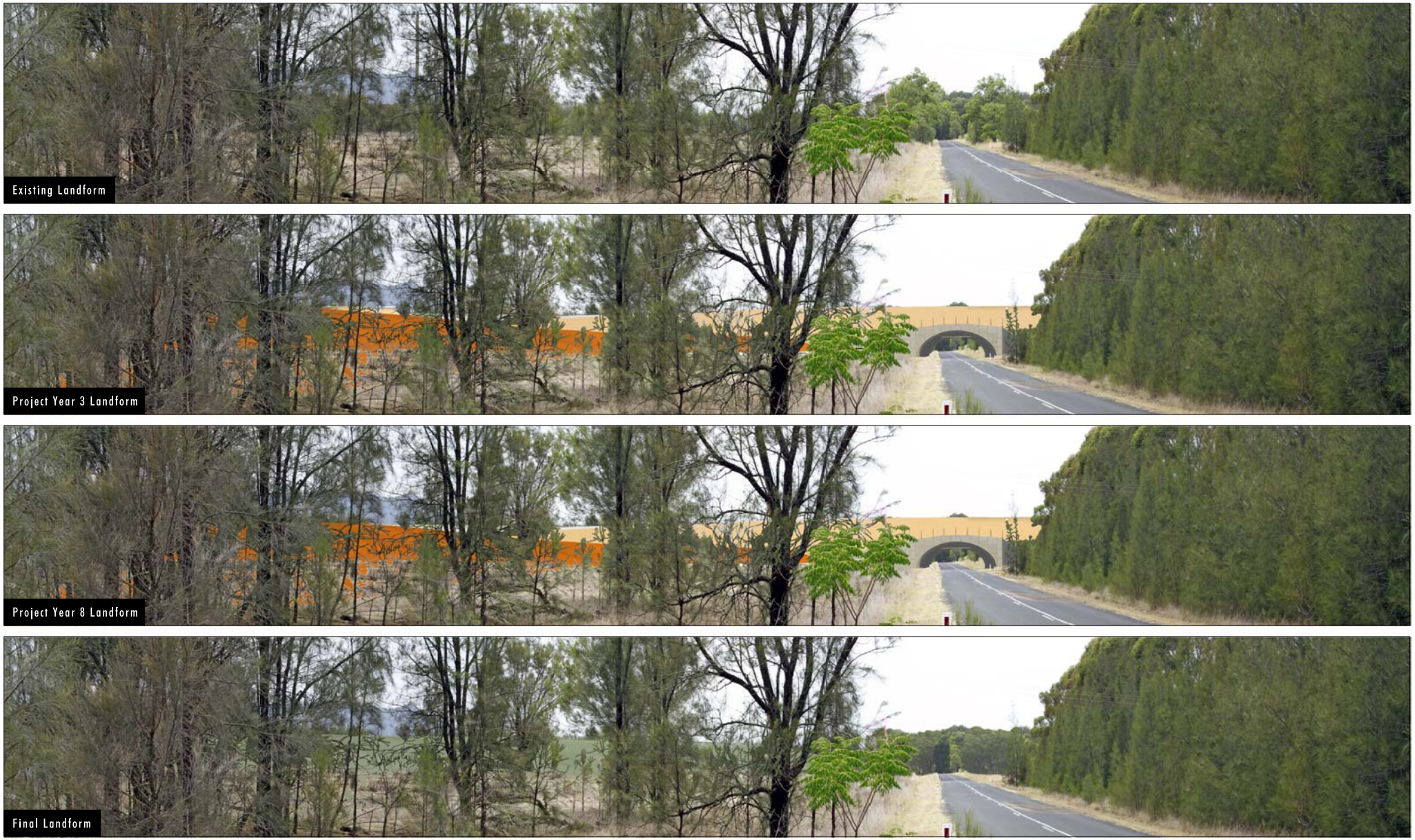
The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area will be visible from this location on Wybong Road including sections of the overburden emplacement area and the proposed Wybong Road and Big Flat Creek overpass. It also predicts that views of the MCCO Additional Mining Area along Wybong Road in this area will be largely shielded by the proposed visual bund. As is currently the case from this location views would also be available to areas of overburden emplacement and rehabilitation at the existing Mangoola Coal Mine to the immediate south.

The potential visual impacts from this location have been further considered and are illustrated by the photomontage included as **Figure 6.33**. **Figure 6.33** provides an indicative representation of views that would be available, including of the proposed Wybong Road and Big Flat Creek overpass when travelling along Wybong Road in this area.

For this location an additional photomontage has been prepared to show the likely views that are expected for the proposed conceptual final landform once rehabilitation has been completed. This is included on **Figure 6.36** and shows that with landform reshaping and rehabilitation using native woodland species as proposed the rehabilitated landform is expected to blend in with the existing landscape.

Visual Assessment Location 5 – Wybong Road

The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area would be visible from this location on Wybong Road including distant views to parts of the overburden emplacement and rehabilitation. As noted in **Section 6.14.1.2** radial analysis is prepared based on topography alone, and in this regard it was identified upon further consideration of this location that views are in fact likely to be shielded by remnant intervening vegetation as illustrated on the photomontage included as **Figure 6.34**.



Legend

- Overburden Emplacement Area - Active
- Rehabilitation Area
- Infrastructure
- Visual Bund

FIGURE 6.33

Photomontage from
Visual Assessment Location 4

Legend

Hidden View of Top Height of Stage Plans

FIGURE 6.34

Photomontage from
Visual Assessment Location 5

Visual Assessment Location 6 – Yarraman Road

The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area would be visible from a distance of approximately 2.4 km when looking towards the east and north-east from this location on Yarraman Road. The radial analysis indicates that potential distant views would be available to parts of the overburden emplacement and rehabilitation. As noted for the assessment of Location 5 radial analysis is prepared based on topography alone, and in this location during the site inspection it was considered likely that any potential distant views from this location on Yarraman Road are likely to be prevented by intervening vegetation.

Visual Assessment Location 7 – Yarraman Road/Wybong Post Office Road Intersection

The radial analysis completed for this location (refer to **Appendix 18**) predicts that intervening topography is likely to prevent views of the operations within the MCCO Additional Project Area.

Visual Assessment Locations 8 – Hidden Valley Right of Way

The radial analysis and photomontage completed for this location (refer to **Appendix 18**) predicts that there would be potential distant views to part of the proposed topsoil stockpile area. With the exception of the initial emplacement of material in this area it is likely that the only views available would be to the rehabilitated surface of the stockpiles. As is currently the case from this location distant views would also be available to areas of overburden emplacement and rehabilitation at the existing Mangoola Coal Mine.

Visual Assessment Locations 9 – Ridgelands Road

The radial analysis completed for this location (refer to **Appendix 18**) predicts that operations within the MCCO Additional Project Area will be visible, from a distance of approximately 500 m when looking towards the west from this location on Ridgelands Road. As is currently the case from this location views would also be available to areas of overburden emplacement and rehabilitation at the existing Mangoola Coal Mine.

The potential visual impacts from this location have been further considered and are illustrated by the photomontage included as **Figure 6.35**. **Figure 6.35** shows the existing landform, rehabilitation at the existing Mangoola Coal Mine and predicted views for Project Year 3, 8 and the final landform. To minimise the available views from this location Mangoola proposes to plant tree screens along parts of Ridgelands Road to reduce the visual impacts of the MCCO Project.

As mining progresses within the MCCO Additional Project Area, views from this part of Ridgelands Road will be available to elements associated with the MCCO Project including areas of active mining, active emplacement areas, reshaped emplacement areas and rehabilitation. Views to parts of the highwall associated with the final void will be also visible in the final landform.

In this regard an additional photomontage has been prepared for this location to show the likely views that are expected for the proposed conceptual final landform once rehabilitation has been completed. This is included on **Figure 6.36** and shows that with landform reshaping and rehabilitation using native woodland species as proposed the rehabilitated landform is expected to blend in with the existing landscape.

Visual Assessment Locations 10 – Golden Highway

The radial analysis and photomontage completed for this location (refer to **Appendix 18**) predicts that intervening topography is likely to prevent views of the operations within the MCCO Additional Project Area from this area.

Legend

- Active Mining
- Overburden Emplacement Area - Active
- Overburden Emplacement Area - Reshaped
- Rehabilitation Area
- Rehabilitation Area - Temporary
- Void/Highwall

FIGURE 6.35

Photomontage from
Visual Assessment Location 9

FIGURE 6.36

Photomontage
Conceptual Final Landform
with Rehabilitation Completed

6.14.3.1 Summary of Visual Impacts

The existing approved operations at Mangoola Coal Mine are currently visible from a range of locations within the surrounding locality. With regard to the proposed operations within the MCCO Additional Project Area the visual assessment has identified that no views are predicted from any private residences due to the effects of intervening topography.

Views will be available to active mining areas including overburden emplacement areas from some sections of the surrounding road network, including along parts of Wybong Road and Ridgelands Road. Views from public roads will be intermittent and generally short term in nature depending on the location due to the speeds being travelled, changing orientations and the effects of intervening vegetation along the road verges. The progressive rehabilitation of overburden emplacement areas, starting with the outer faces from the early stages of the MCCO Project and shaping of the final landform to conform to the surrounding natural environment is expected to reduce the visual impact from all areas where views are possible. Further, as described in the sections above Mangoola proposes to plant tree screens along parts of Wybong Road, the realigned section of Wybong Post Office Road, and Ridgelands Road and incorporate a visual bund along Wybong Road which will assist in minimising the visual impacts of the MCCO Project.

6.14.3.2 Lighting Assessment

As discussed in **Section 6.14.1**, the existing approved 24-hour mining operations within the Approved Project Area currently contribute to a night time glow also referred to as diffuse light, which affects the local night time visual amenity. Lighting is required on site as part of the MCCO Project to meet operational and safety requirements but will be kept to a minimum where practicable and will be installed and maintained in accordance with the relevant Australian Standard (Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting).

The majority of lighting utilised at a mine site is associated with the CHPP, workshops and load out infrastructure all of which is located at the existing Mangoola Coal Mine. The lighting utilised in this regard will not change as a result of the MCCO Project and has already been assessed and approved as part of the existing Mangoola Coal Mine.

Within the MCCO Additional Project Area mobile lighting will be required in active mining and emplacement areas during night time operations. This will be provided by mobile lighting plants and equipment headlights. This will expand the requirements for night lighting further to the north than existing operations. Where possible, mobile lighting plant will be screened from public viewing locations by overburden emplacement areas, vegetation or natural topography, to minimise potential direct lighting impacts. As the visual assessment has identified that there are no private residences that are predicted to have views to the MCCO Additional Project Area, it is considered unlikely that there will be any direct lighting impacts at any private residences due to benefit of intervening topography.

With regard to diffuse lighting impacts or night glow it is considered that the additional influence of the operations within the MCCO Additional Project Area will be minimal due to the lack of fixed lighting planned to be used in this area, viewing distances to private residence and screening effects of intervening topography and vegetation.

As discussed in **Section 6.14.1.4** the MCCO Project would mean that mining operations would continue within an area that is a similar distance from the Siding Springs Observatory to those operations that are already being conducted at Mangoola Coal Mine. As discussed above, the lighting arrangements for the existing mine infrastructure areas would remain unchanged from that which is currently approved and in operation. Further, with regard to new lighting required within the MCCO Additional Project Area Mangoola commits to continue to install and manage lighting to minimise direct and diffuse lighting

impacts. In this regard it is expected that there will be no detectable changes at the observatory with regard to the level of light emitted from the Mangoola Coal Mine with the MCCO Project in place.

Ongoing management will, however, be required on all emplacement areas that are visible from public roads so that mobile lighting does not impact on road users or local amenity. This is typically managed by pointing lights away from public roads and through directing lights down at operational areas where they are required.

6.14.4 Visual Impact Mitigation and Management

To assist in minimising the visual impacts of the MCCO Project, the following controls will be implemented:

- planting/seeding of tree screens along sections of Wybong Road, the realigned section of Wybong Post Office Road and Ridgelands Road to reduce the availability of direct views of mining operations by road users

- progressive rehabilitation, using the same successful methods as described in **Section 2.9**, will be undertaken to reduce the duration of visible soil exposure, including the use of temporary rehabilitation as appropriate

- ongoing management of mobile lighting to reduce the impacts of lighting at night, positioning lights so they are not pointing off site, and are shielded by walls, overburden emplacement areas and/or vegetation, where practicable. Procedures will be implemented regarding the appropriate placement of mobile lighting plant to reduce the potential for lighting impacts on local residents and public roads

- all new fixed lighting associated with the MCCO Project will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

6.15 Land Resources and Land Use

As a large-scale extractive industry development, the MCCO Project will impact on the land resources within the MCCO Additional Project Area by changing the existing topography and relocating soil resources. The MCCO Project will also impact to varying degrees on air quality, water resources, biodiversity, visual amenity and other environmental and social aspects, as outlined in this EIS. Some of these impacts have the potential to interact with surrounding land uses. The potential impacts of the MCCO Project on land resources and the potential for land use conflicts are discussed in this section. **Section 6.15** deals with the potential impacts of the MCCO Project on agricultural productivity in more detail, whilst subsequent sections of this EIS deal with other environmental aspects that have the potential to result in indirect impacts on surrounding land uses (for example air quality, noise, blasting and water).

6.15.1 Landforms and Topography

The topography of the MCCO Additional Project Area is detailed in **Section 1.6.1** and in summary is characterised by lower slopes, giving way to undulating hills and rocky outcrops to the north and west. Lower topographic areas are associated with drainage lines feeding Big Flat Creek. The main topographical feature in the surrounding landscape is the series of undulating wooded hills which occur outside and to the north of the MCCO Additional Project Area. These hills rise to a maximum height of approximately 360 mAHD and are elevated approximately 200 m above the surrounding area (refer to **Figure 1.6**).

The topography of the Approved Project Area has been substantially modified since the commencement of mining operations at Mangoola Coal Mine. These operations have altered the landform creating both temporary landforms, which are still evolving as mining operations progress and rehabilitated final

landforms. The MCCO Project will result in similar alterations to the existing topography and landforms within the MCCO Project Area as described in **Section 3.3**.

As part of the MCCO Project, a natural landform design approach will be applied to the final landform in line with the current method implemented at Mangoola Coal Mine. This approach to final landform establishment aims to provide more sustainable long term hydrological and biodiversity outcomes, allows the development of a variable and diverse post mining landform, and is also considered visually to be more natural in appearance. Mangoola Coal Mine is recognised as a local leading example of how this type of natural landform re-establishment can be successfully implemented.

The proposed final landform for the MCCO Project includes the retention of two final voids; a void in the Approved Project Area consistent with current approvals and a void in the MCCO Additional Project Area resulting from the proposed additional mining operations. The location and design of the proposed voids was determined by Mangoola following detailed studies of various options as discussed in **Section 1.4.4**, including a case considering no final voids which was found by Mangoola to be cost prohibitive and would have resulted in the disturbance of 394 ha of existing and established rehabilitation.

The occurrence of final voids in the landscape will result in a permanent change to the local topography, however, the implementation of the natural landform design principles and revegetation techniques minimises the impact of this change.

The proposed rehabilitation strategy and conceptual final landform for the MCCO Project is discussed further in **Section 3.3.4** and **Section 6.17**.

6.15.2 Soil Resources

A soils assessment has been undertaken for the MCCO Project by EMM with a summary of the key findings provided in this section and the full report provided in **Appendix 19**.

As the land and soil disturbance impacts associated with the operation of the existing Mangoola Coal Mine within the Approved Project Area have previously been assessed and approved, no further assessment of this area was required as a part of this impact assessment. Therefore, the soils assessment has focused on the proposed mining operations within the MCCO Additional Project Area.

6.15.2.1 Soil Landscapes within the MCCO Additional Project Area

The soil types occurring within the MCCO Project Area are mapped on the Singleton 1:250,000 Soil Landscapes Map Sheet (Kovac and Lawrie, 1991) and further defined through detailed soils assessment undertaken as part of this EIS (**Appendix 19**). The soil landscapes identified as being present in the MCCO Additional Project Area include Sandy Hollow (sy), Wappinguy (wp) and Lees Pinch (lp). The location of these soil landscapes and their relationship to the key features of the MCCO Project are shown on **Figure 6.37**.

A summary of the soil landscapes present in the MCCO Additional Project Area is provided below. For more detailed descriptions, refer to the soil assessment report included in **Appendix 19**.

- Sandy Hollow (sy): This landscape is the dominant soil landscape in the MCCO Additional Project Area. The main soil types associated with this unit are Yellow and Brown solodic soils. Yellow and Brown Earths can be found on footslopes and on better drained slopes Yellow Podzolic Soil and Earthy Sands occur (Kovac and Lawrie 1991). Minor sheet and rill erosion occurs on slopes and moderate gully erosion can occur within drainage lines in this landscape

- Wappinguy (wp): This is the second dominant landscape in the MCCO Additional Project Area. The soil types are sourced from a variety of parent materials creating a varied soil landscape where Black Earths, Clayed Soloths and Prairie Soils occur along drainage lines; Solodic Soils, Brown Clays and Red Earths occur on slopes and Earthy Sands occur on sandstone outcrops (Kovac and Lawrie 1991). The landscape is prone to minor to moderate gully erosion and moderate sheet and rill erosion on cleared areas

- Lees Pinch (lp): The Lees Pinch soil landscape is associated with outcropping steep hills and covers a small part of the MCCO Additional Project Area. Soils are generally shallow Solodic Soils or Siliceous Sands and minor to moderate sheet and rill erosion can occur with mass colluvium movement on steep slopes (Kovac and Lawrie 1991).

6.15.2.2 Soil Types within the MCCO Additional Project Area

The soil types within the MCCO Additional Project Area were determined through a soil survey conducted in accordance with the following guidelines:

- Guidelines for surveying soil and land resources (McKenzie et al 2008)

- Australian soil and land survey handbook (NCST 2009)

- The Australian soil classification (Isbell 2002)

- Soil data entry handbook (DLWC 2001)

- Interim protocol for site verification and mapping of biophysical strategic agricultural land (NSW Government 2013).

The detailed soil survey mapped four major soil types within the MCCO Additional Project Area, being Tenosols, Dermosols, Sodosols and Kurosols. **Figure 6.38** presents the spatial distribution of the soil types within the MCCO Additional Project Area.

The MCCO Additional Project Area is situated on the edge of the Permian Singleton Coal Measures mapping with much of the surface geology being formed by the Triassic Narrabeen group (as determined both from regional geological mapping and detailed geological investigations undertaken within the MCCO Additional Project Area). The detailed soil survey undertaken within the MCCO Additional Project Area found that the soils have mostly been derived from the Triassic Narrabeen group. The Sodosol and Tenosol soils found in the MCCO Additional Project Area generally support the soil landscape mapping done by Kovac and Lawrie (1991) Soil Landscapes of the Singleton 1:250,000 sheet (with some localised boundary readjustments following the detailed survey).

There are no clearly Permian derived soils within the MCCO Additional Project Area. Permian derived soils may be located further to the east of the MCCO Additional Project Area, where the Castle Rock, Roxburgh and Brays Hill soil landscapes are located.

Available Soil Resource

As part of the soil assessment a soil stripping assessment and balance was completed to provide information on the resources available within the MCCO Additional Disturbance Area that are considered suitable for use in rehabilitation. **Table 6.30** provides the recommended stripping depths for each soil type within the MCCO Additional Disturbance Area based on the findings of the soil assessment (refer to **Appendix 19**). The total volume of material available for stripping and reuse in rehabilitation is approximately 1,365,000 m^3. This confirmed that the soil types and volumes available are suitable for use in the rehabilitation activities that are proposed to establish soil profiles suitable for the target post mining

land use. Further details with regard to rehabilitation and topsoil management are provided in **Section 6.17**.

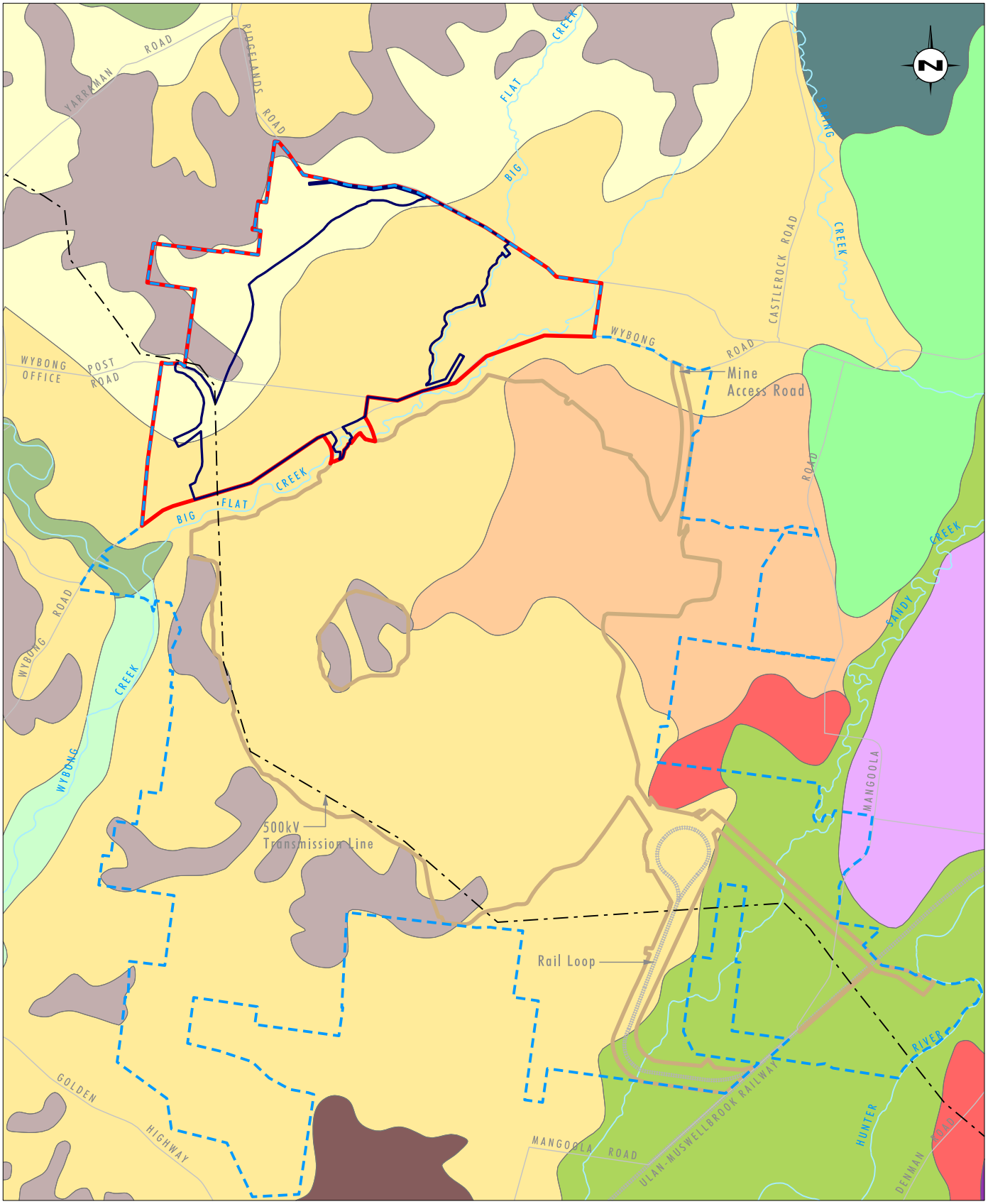
Table 6.30 Available Soil Resource within the MCCO Additional Project Area

Soil Type	Recommended Stripping Depth (m)	Approx. Disturbance Area (ha) for Each Soil Type to be Stripped	Soil Volume Available (m^3)
Sodosol	0.10	479	479,000
Tenosol	1.20	66	792,000
Kurosol	0.90	7	63,000
Dermosol	0.10	31	31,000
Total		**583**	**1,365,000**

6.15.2.3 Strategic Biophysical Agricultural Land

A detailed BSAL assessment of the MCCO Additional Project Area was undertaken following the Interim protocol for site verification and mapping of biophysical strategic agricultural land and is included in **Appendix 19**. As part of this assessment each soil type identified in the MCCO Additional Project Area was assessed against the BSAL criteria. None of the soil types present were found to satisfy the criteria, with most failing multiple physical and chemical soil criteria. In addition, an analysis of slope in the MCCO Additional Project Area determined that some land failed the slope criterion. The result is that no BSAL is present in the MCCO Additional Project Area, a conclusion that is consistent with the results of the broader scale NSW Government's BSAL mapping.

Subsequently, as described in **Section 4.4.2** a Site Verification Certificate was issued by DPE on 10 December 2018 confirming the absence of BSAL.



Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Soil Landscape Mapping Singleton:

- Brays Hill
- Castle Rock
- Dart Brook
- Growee
- Hunter
- Wollombi
- Liddell
- Merriwa
- Ogilvie
- Roxburgh
- Sandy Hollow
- Wappinguy
- Lees Pinch

FIGURE 6.37

Soil Landscape Mapping Units

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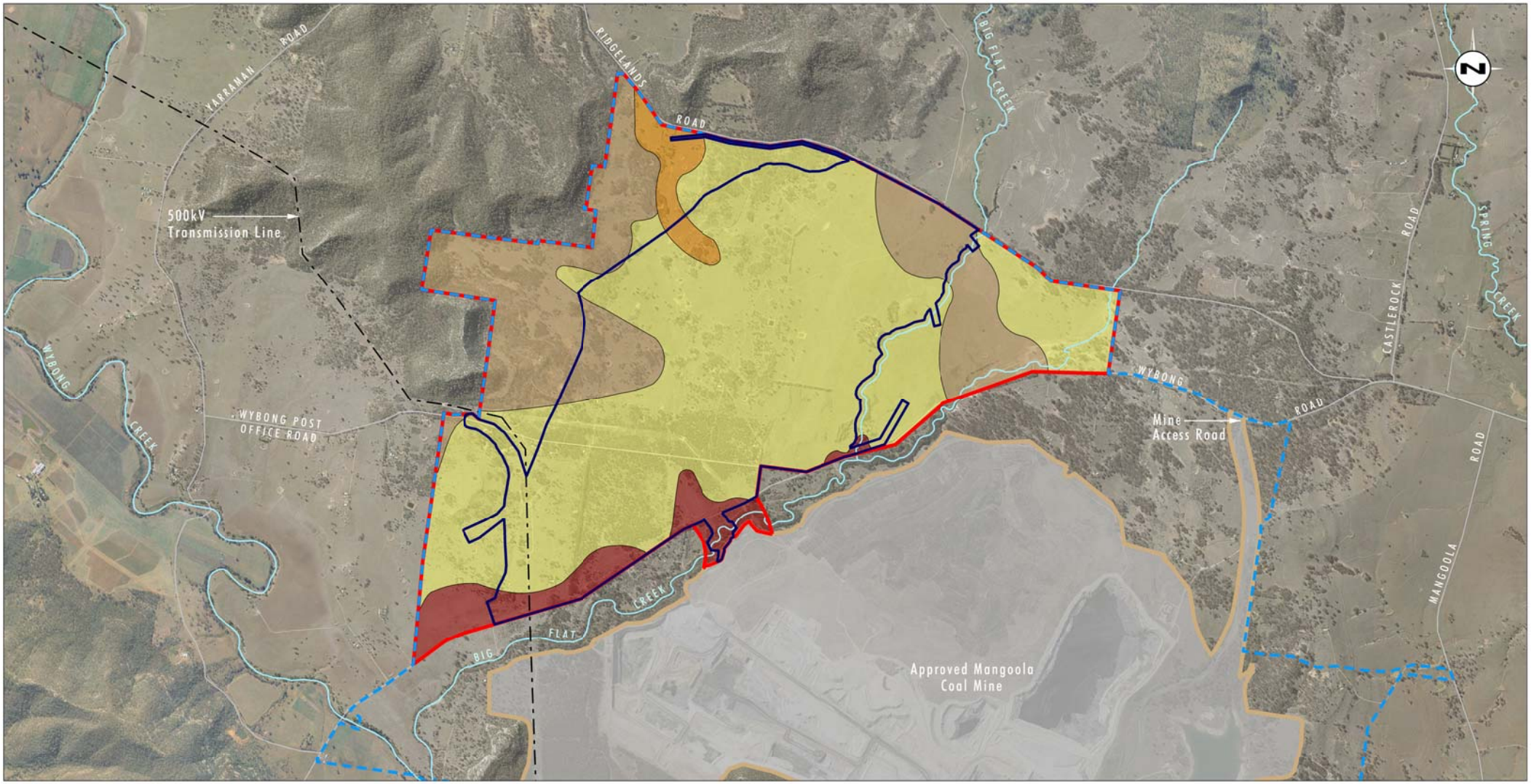

Image Source: Glencore (April 2018)
Data Source: Glencore (2019), EMM (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Soil Types:

- Dermosol
- Kurosol
- Sodosol
- Tenosol

FIGURE 6.38

Soil Types within the MCCO Additional Project Area

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6.15.2.4 Land and Soil Capability

Land and Soil Capability (LSC) is the ability of the land to sustain a range of land uses and land management practices in the long term without degradation of soil, land, air and water resources (OEH 2012, drawing on Dent and Young 1981, Emery 1986 and Sonter and Lawrie 2007). The LSC classes of the MCCO Additional Project Area were assessed in accordance with the requirements of the Land and Soil Capability Assessment Scheme (OEH 2012).

The LSC classes identify limitations on the type and intensity of use as a result of the physical attributes of the soil and the extent to which intensive management is required to prevent on and off-site degradation under varying land uses. The classification does not necessarily reflect existing land uses; rather, it indicates the potential of the land for different agricultural purposes, while maintaining the quality of natural assets.

Table 6.31 presents the descriptions for the eight LSC classes currently used in NSW and an indication of their presence in the MCCO Additional Project Area. The LSC classes identified within the MCCO Additional Project Area are also mapped in **Figure 6.39**.

The majority of the MCCO Additional Project Area is currently suited for grazing (LSC Class 4 and LSC Class 5), with a small portion where cropping may be a viable possibility (LSC Class 3). However, the small size, vegetation and remoteness of the LSC Class 3 land would most likely restrict its use for cropping. The LSC Class 7 of the steep terrain in the north-west is not suited for agricultural use.

All of the land required to be disturbed within the MCCO Additional Project Area has moderate to severe (LSC Class 4), severe (LSC Class 5) and extremely severe (LSC Class 7) limitations to agriculture in their present state. It is noted that following rehabilitation the majority of the MCCO Additional Project Area would be considered LSC Class 6 with the final void area being LSC Class 8. Further information about the agricultural land use potential of the MCCO Additional Project Area and potential impacts on agriculture is provided in **Section 6.16**.

The current post mining land use is for the majority of the MCCO Additional Project Area to be rehabilitated for biodiversity offsets and does not include agricultural uses. However, it is noted theoretically the majority of the post mining landscape (which is considered to be LSC Class 6) could be used for low intensity grazing, which has successfully been demonstrated at other coal mines in the Hunter Valley.

Table 6.31 LSC Classes and their Presence in the MCCO Additional Project Area

LSC Class	General Information	Present within the MCCO Additional Project Area	Present within the MCCO Additional Disturbance Area
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)			
1	**Extremely high capability land (very slight to negligible limitations):** Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices	Not present	Not present

LSC Class	General Information	Present within the MCCO Additional Project Area	Present within the MCCO Additional Disturbance Area
2	**Very high capability land (slight but significant limitations):** Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation	Not present	Not present
3	**High capability land (moderate limitations):** Land has moderate limitations and is capable of sustaining high impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation	Approximately 54 ha	Approximately 41 ha
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)			
4	**Moderate capability land (moderate to severe limitations):** Land has moderate to high limitations for high impact land uses. Will restrict land management options for regular, high impact land uses such as cropping, high intensity grazing and horticulture. These limitations can only be managed by specialized management practices with a high level of knowledge, expertise, inputs, investment and technology	Approximately 313 ha	Approximately 144 ha
5	**Moderate- low capability land (severe limitations):** Land has high limitations for high impact uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long term degradation	Approximately 560 ha	Approximately 421 ha

LSC Class	General Information	Present within the MCCO Additional Project Area	Present within the MCCO Additional Disturbance Area
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)			
6	**Low capability land (very severe limitations):** Land has very high limitations for high impact land uses. Land use restricted to low impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environment degradation	Not present	Not present
Land generally incapable of agricultural land use (selective forestry and nature conservation)			
7	**Very low capability land (extremely severe limitations):** Land has severe limitations that restrict most land uses and generally cannot be overcome. Onsite and off-site impacts of land management practices can be extremely severe if limitations are not managed. There should be minimal disturbance of native vegetation	Approximately 135 ha	Approximately 9 ha
8	**Extremely low capability land (extreme limitations):** Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation	Not present	Not present

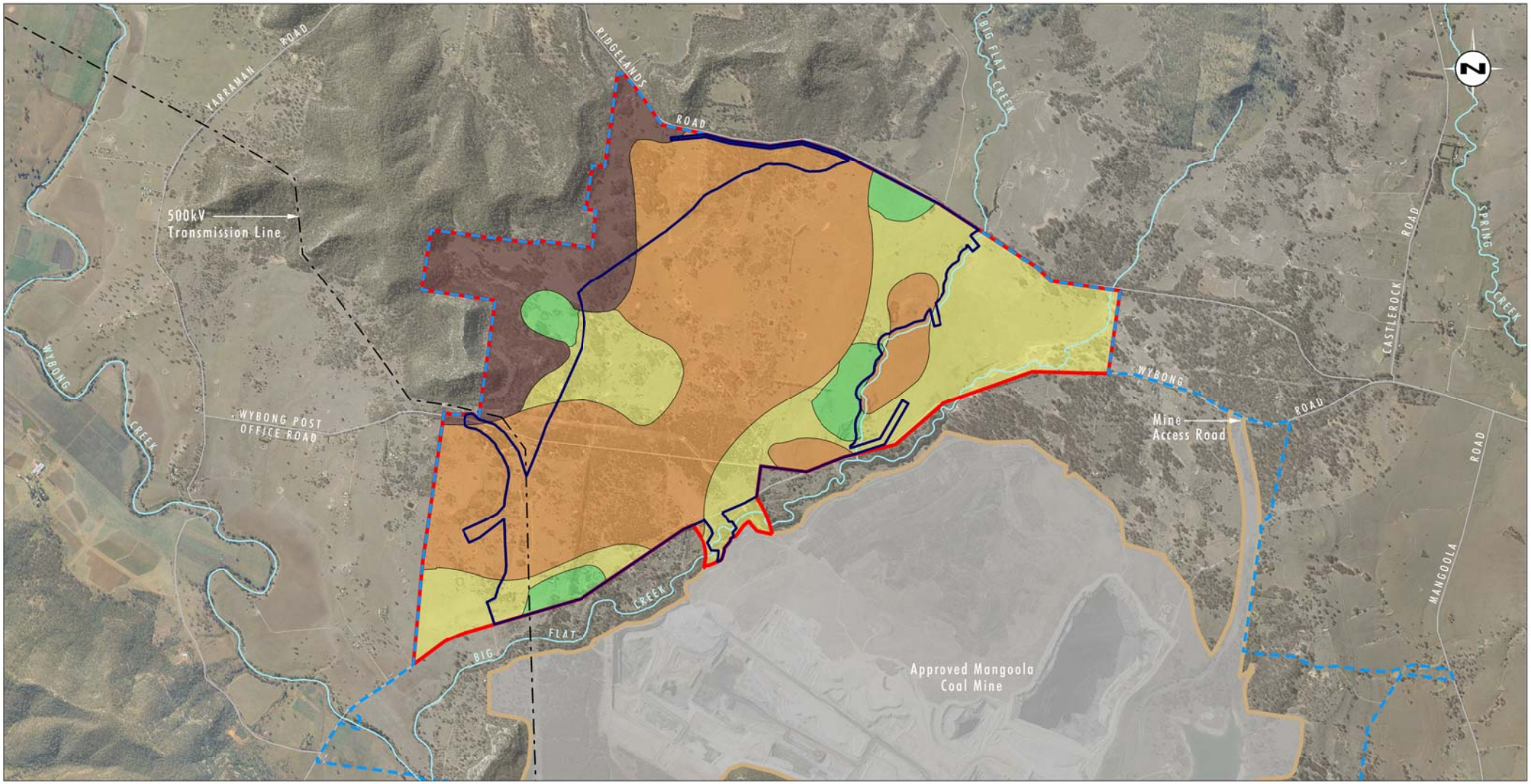

Image Source: Glencore (April 2018)
Data Source: Glencore (2019), EMM (2019)

0 0.5 1.0 2.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Land and Soil Capability Classes:

- Class 3
- Class 4
- Class 5
- Class 7

FIGURE 6.39

Land and Soil Capability within the MCCO Additional Project Area

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6.15.3 Contaminated Land

A search of the EPA's NSW Contaminated Lands Public Record Register undertaken for the MCCO Project Area and Wybong Area did not identify any areas of contaminated land. The MCCO Additional Project Area has been used extensively for agriculture since the 1800s and is comprised of rolling grazing land and small patches of native woodland. There are no known areas of contamination within the MCCO Additional Project Area or areas identified as contamination risks based on past land uses.

With regard to the existing Mangoola Coal Mine, during 2017, a Phase 1 contamination assessment was undertaken (GHD, 2018) to identify the potential for areas of contamination that required remediation or consideration in the future decommissioning of the mine. As a Phase 1 assessment, the report identified potential contamination sources via a combination of desktop review and site inspection. These potential sources include above ground fuel storage tanks and refuelling areas, waste water treatment plant, oil water separator units and truck wash areas. The Phase 1 assessment found the overall likelihood for significant chemical contamination to be present is low and with the controls in place at the Approved Project Area is suitable for ongoing use for open cut mining operations.

As with all activities that involve earthworks and mining, activities carried out as part of the MCCO Project have the potential to cause localised contamination if not properly managed. Consistent with the approach at the existing mine, controls will be put in place to manage this risk as part of the MCCO Project including appropriate chemical handling and storage procedures, appropriate waste management systems, spill and emergency response procedures and equipment, and regular inspection and reporting processes. The management of contamination risks as part of the mine closure process is discussed further in **Section 6.17** and the management of waste is discussed further in **Section 6.21**.

6.15.4 Land Use Assessment

6.15.4.1 Existing Land Use

As identified in **Section 4.3.2.1**, the MCCO Project Area and its surrounds exist on land currently zoned under the Muswellbrook LEP as RU1 Primary Production, E3 Environmental Management and a small area of SP2 Infrastructure associated with the rail corridor. These zonings control the land uses which may or may not occur on these lands.

The E3 Environmental Management zone encompasses a corridor from the northern and north-western portions of the MCCO Additional Project Area along Ridgelands Road down to Wybong Post Office Road (refer **Figure 4.1**). It is also the dominant zoning for land occupied by the existing Mangoola Coal Mine under the Muswellbrook LEP. This zoning extends beyond the MCCO Additional Project Area into private property to the north-east and to the south from the existing Approved Project Area. A parcel of densely vegetated Crown Land zoned E3 Environmental Management also lies immediately adjacent to the western boundary of the MCCO Additional Project Area.

Further to the north-west is the Manobalai Nature Reserve which is zoned E1 National Parks and Nature Reserves.

In addition to mining, parcels of Mangoola owned land are used for agricultural production (zoned RU1 Primary Production). Mangoola holds AL 9 (granted in 2004) and EL 5552 (granted in 2006) over surrounding landholdings. This includes grazing of cattle on land in the north, south, east and west of the MCCO Project Area and cropping along the alluvial floodplains of the Hunter River to the south.

The locality surrounding the MCCO Project Area is also dominated by primary production activities. This area is dominated by grazing activities with a mixture of cattle grazing and cropping on the Wybong Creek

to the west and Hunter River alluvial flats to the south-east, along with other agricultural activities including grape growing to the south-west and east, and small olive groves to the north-west (refer to **Figure 1.7**).

Outside of mining and agriculture, the area surrounding the MCCO Project also supports the following land uses:

- rural towns:
    - Sandy Hollow approximately 10 km to the south-west of the MCCO Project Area
    - Denman located approximately 10 km to the south of the MCCO Project Area
    - Muswellbrook located approximately 20 km to the east of the MCCO Project Area
- small rural holdings
- horse studs, including Coronet Farm and Golden Grove Stud which are located approximately 4 km to the north and 6 km to the south-west of the MCCO Additional Project Area respectively. As discussed in **Section 1.6.3** a former equine business, Nightingale Thoroughbreds was located to the immediate north of the MCCO Additional Project Area off Ridgeland's Road however it is noted that this has not been operational since 2012.

The closest privately owned residences are located approximately 1.15 km to the north of the Proposed MCCO Additional Mining Area, on Ridgelands Road. These residences are shielded from the MCCO Project Area by a ridgeline of undulating hills (refer **Figure 1.5**). Other sensitive receiver locations include a cluster of privately owned residences on Castlerock Road, Castlerock, and several residences adjacent Wybong Creek along Yarraman Road and Wybong Road. All of which lie approximately 2 to 3 km from the MCCO Additional Project Area. There are no predicted views of the proposed mining operations or proposed infrastructure available from any private residences within the area surrounding the MCCO Additional Project Area due to the effects of intervening topography.

Several significant developments lie farther afield of the MCCO Project. These include the Dolwendee Quarry (approximately 4 km south-west), Myambat Military Base (approximately 4.5 km to the south) and the existing coal mining operations of Mount Pleasant (approximately 9 km north-east), Bengalla (approximately 8.5 km east) and Mount Arthur Coal (approximately 9.5 km south-east).

An additional SSD application has received SEARs for the establishment of an Abattoir on Merriwa Road (Golden Highway), Hollydeen and a Feedlot on the former Yarraman Estate vineyard in Wybong. The proposed Feedlot site is situated approximately 2.5 km to the west of the MCCO Proposed Additional Project Area and the proposed abattoir is located approximately 1.5 km west of the MCCO Project Area. There are also two prospective mining projects currently in the exploration stage located within the vicinity of the MCCO Project Area. These include Ridgelands Resources (associated EL 8064) to the immediate north, which is a prospective underground project and Idemitsu's Muswellbrook West (associated with AL 19) to the east which is a prospective open cut project. Neither of these projects currently have been issued with SEARs.

6.15.4.2 Project Impact on Adjoining Land Uses

Mangoola seeks to operate the existing mine in a manner that minimises impacts, where reasonable and feasible, on surrounding land uses with the aim of coexisting with its neighbours and the broader community. There are a range of management measures in place to assist in meeting this objective including comprehensive dust, noise and blasting controls. Mangoola also regularly consults with its

neighbours and the broader community and seeks to contribute to the local Wybong and broader Muswellbrook communities through its community involvement program.

The development of the Upper Hunter SRLUP provides guidance on the strategic use of land insofar as agriculture and critical industry clusters are concerned. One of the key stated objectives of the Upper Hunter SRLUP is to balance the potentially competing interests of mining and agriculture. Further discussion of the SRLUP is provided in **Section 4.4.2**.

Impact of Land Uses within the MCCO Project Area

The MCCO Additional Project Area is situated on land of similar character to that on which the existing Mangoola Coal Mine was developed approximately eight years ago. Prior to mining, the majority of this area was extensively cleared for cattle grazing purposes. Land within the existing Approved Project Area is now used for mining purposes, ecological and archaeological offsetting and primary production associated with the adjoining landholdings. The MCCO Additional Project Area is currently utilised for grazing activities. A portion of this grazing land will be replaced by mining and associated infrastructure and in time biodiversity offsets land as a result of the MCCO Project. Non-operational mining land within the MCCO Project Area will continue to be used for agricultural purposes where practicable.

As the overall nature of the activity undertaken within the Mangoola Coal Mine will not change as it progresses into the MCCO Proposed Additional Mining Area, the continuing use of the MCCO Project Area for mining is considered unlikely to change the nature of interactions with surrounding land uses. As the mining operation moves north it will move closer to some surrounding land uses to the north. The impact of the MCCO Project on these land uses is discussed in **Section 6.15.4**.

Impact on Land Uses outside the MCCO Project Area

Due to its distant location from other operating mines, the MCCO Project will have a minimal interaction with or impacts on nearby mining operations, which include Mount Pleasant, Bengalla and Mt Arthur Coal, all located greater than 8.5 km to the east. Mangoola will continue to consult with the owners of these mines as necessary regarding the ongoing interactions with the operations, including the management of potential cumulative impacts.

The MCCO Project will have minimal impact on existing agricultural activities located outside the MCCO Project Area, with the air quality, noise, blasting and water assessments all indicating the that predicted levels of impact are not expected to result in impacts on agricultural productivity (refer to **Section 6.16**). The MCCO Project is also expected to have no impact on existing equine and viticulture enterprises located to the north, south and east. These activities are generally shielded by topography and are located approximately 2.5 km or greater from the MCCO Additional Project Area.

The MCCO Project will result in some impacts on some of the surrounding rural residences. In particular, the MCCO Project is predicted to result in noise impacts on some residences with a range of management and mitigation measures proposed for these noise impacts (refer to **Section 6.4**).

The MCCO Project requires the realignment of a portion of Wybong Post Office Road. Mangoola has had preliminary consultation with MSC on the design of the MCCO Project and indicative realignment for the impacted section of Wybong Post Office Road to minimise any potential impacts to the surrounding community. The realigned section of Wybong Post Office Road will be fully constructed, other than the junction with the existing Wybong Post Office Road, to the north, and Wybong Road, to the south, prior to it being commissioned as a public road to minimise disruptions to traffic.

As discussed above, while some impacts on some rural residences are predicted, these will be addressed by impact mitigation and management measures and overall, the proposed mining operations are expected to be able to continue to coexist with the surrounding agricultural and non-agricultural land uses in the region. The impacts of the MCCO Project on surrounding residences are addressed throughout the relevant sections of this EIS.

Mining SEPP Clause 12 Land Use Impact Considerations

As required by Clause 12 of the Mining SEPP (refer to **Section 4.3.2**), when considering a development application for a mining project, the consent authority must have regard to the land use considerations identified in **Table 6.32**.

Table 6.32 Mining SEPP Clause 12 Land Use Impact Considerations

Aspect Requiring Consideration	Assessment
The existing uses and approved uses of land in the vicinity of the development	Refer to **Section 6.15.4.2**.
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	Refer to **Section 6.15.4.2**.
Any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses	Assessed throughout to **Section 6.15.4** and **Section 6.0** more generally. The MCCO Project will continue coal extraction in the existing approved mining area and extend into the MCCO Additional Mining Area that has previously largely been cleared for grazing purposes. Mangoola owned land not required for mining or related activities will continue to be utilised for other purposes such as grazing and ecological conservation, thereby maintaining existing land use where practicable. The assessment concludes that the proposed mining operations are expected to continue to coexist with the surrounding agricultural and non-agricultural land uses in the region.

Aspect Requiring Consideration	Assessment
Evaluate and compare the respective public benefits of the development and other land uses	The MCCO Project will occur within the existing approved mining area and the MCCO Additional Project Area that is used by Mangoola for the grazing of cattle. Mining is a higher value land use when compared to low intensity grazing and generates significantly greater economic benefit per hectare. It is also recognised that mining is a shorter term land use which will cease once the available resources have been mined, however, post mining most of the land could again be used for low intensity grazing if desired. However, as discussed in **Section 6.9.6** it is proposed that the land will be rehabilitated to native woodland as part of the biodiversity offset package. As described in **Section 6.9.6** this is planned to provide connectivity to surrounding areas of native woodlands in the region, including the existing Mangoola Offset Sites. The impacts of the MCCO Project on the existing agricultural land uses for the site are assessed in **Section 6.16**. The evaluation of public benefit is provided in **Section 6.2** and **Section 9.0**. The assessment of land use interactions is a key component of this EIS, with assessments of impacts on other land uses through health and amenity impacts (e.g. dust, noise, blasting, visual) and physical impacts (e.g. water, soils, topography, biodiversity etc.). Following completion of detailed assessments of each of these matters, this EIS concludes that while some impacts are predicted, the proposed mining operations are expected to be able to continue to coexist with the surrounding agricultural and non-agricultural land uses in the region.
Evaluate any measures proposed by the applicant to avoid or minimise any incompatibility.	The proposed measures are detailed in **Section 8.0**, and include measures to minimise the air quality, water, noise, blasting and visual impacts of the MCCO Project (amongst others), provide a sustainable post mining landform and land use, and maximise the economic benefits of the MCCO Project.

6.16 Agriculture

An Agricultural Impact Statement (AIS) has been prepared by Umwelt to assess the potential agricultural impacts associated with the MCCO Project. The AIS has been prepared in accordance with the SEARs (refer to **Table 4.3**), Agricultural Impact Statement Technical Notes (DPI 2013), the Upper Hunter SRLUP (2012) and the relevant provisions of the Mining SEPP.

In addition to mining, the MCCO Project Area is used for low intensity agricultural production, namely grazing. As discussed in **Section 6.15.2.4**, the majority of the MCCO Additional Project Area is currently suited for grazing (LSC Class 4 and LSC Class 5), with a small portion where cropping may be a viable possibility (LSC Class 3). However, the small size, vegetation and remoteness of the LSC Class 3 land would most likely restrict its use for cropping. The area of identified LSC Class 7 land of the steep terrain in the north-west is not suited for agricultural use.

The majority of the land required to be disturbed within the MCCO Additional Project Area has moderate to severe (LSC Class 4), severe (LSC Class 5) and extremely severe (LSC Class 7) limitations to agriculture in its present state. Small areas of LSC Class 3 land will also be impacted.

A summary of the key findings of the AIS is provided in this section and the full report is provided in **Appendix 20**.

6.16.1 Methodology

As required by the relevant guidelines the AIS assesses the potential impacts of the MCCO Project on agriculture within a site specific and regional context including; within the MCCO Additional Project Area, the proposed offset sites, the locality (or AIS assessment area) (defined as a 10 km diameter from the centre of the MCCO Additional Project Area) and the Muswellbrook LGA.

The proposed offset sites consist of four rural properties; the proposed Wybong Heights Offset Site, proposed Mangoola Offset Site, the Mangrove Offset Site and the Highfields Offset Site (refer to **Figure 6.22**). The Mangoola Offset Site is partly located inside and partly outside the MCCO Additional Project Area. The Mangrove Offset Site and Highfields Offset Site are already allocated for use as an offset area for the United Wambo Project (not yet determined) and is therefore already considered removed from agricultural land uses. As a result, the components of the Mangrove Offset Site and Highfields Offset Site being used for the MCCO Project do not require further assessment from an agricultural perspective and as such are not further discussed in the AIS.

The AIS identifies and evaluates the potential risks to agricultural resources and enterprises that may occur as a result of the MCCO Project. In this regard the AIS considered the outcomes from the detailed technical studies prepared for the MCCO Project including:

- Social Impact Assessment
- Soils Assessment (including BSAL Assessment)
- Surface Water Impact Assessment
- Groundwater Impact Assessment
- Historic Heritage Assessment
- Biodiversity Assessment (including biodiversity offset strategy)
- Rehabilitation Planning and Management
- Noise Impact Assessment
- Air Quality Impact Assessment
- Blast Impact Assessment.

Additional data has been reviewed and analysed in the context of assessing agricultural resources within the vicinity of the MCCO Project Area including data from the Bureau of Meteorology (BoM), the ABS and OEH eSPADE website.

The detailed agricultural assessment methodology is provided in **Appendix 20**.

6.16.2 Current Agricultural Resources and Enterprises

The following section discusses the existing environment and existing agricultural enterprises, both within and surrounding the MCCO Additional Project Area.

6.16.2.1 MCCO Additional Project Area

Agricultural Resource

The soil assessment completed for the MCCO Additional Project Area (refer to **Section 6.15.2**) assessed the LSC classes in the area. As discussed in **Section 6.15.2**, this assessment determined that the majority of the area (53 per cent) has an LSC Class of 5, while LSC Class 4 covers 30 per cent and LSC Class 7 has been mapped over 13 per cent of the MCCO Additional Project Area. A small area (5 per cent of the MCCO Additional Project Area) was assessed as an LSC Class 3.

Based on the LSC classes, the majority of the MCCO Additional Project Area has moderate to high limitations for high impact land uses such as cropping (LSC Classes 4 and 5) and is best suited for grazing. The steep hills in the north-west of the area, which have an LSC Class 7, restrict most agricultural land uses. There is no high quality agricultural land present in the MCCO Additional Project Area.

The ephemeral Big Flat Creek is the main drainage line in the area. Several smaller, unnamed drainage lines are present as well. With regard to water quality, the EC and Total Suspended Solids (TSS) in Big Flat Creek are considered high for a natural system. The stream flow of Big Flat Creek is unreliable and depends on precipitation. In the current drought conditions, Big Flat Creek has not maintained a significant flow since mid-2017 due to the prolonged effects of the drought. These factors make Big Flat Creek unsuitable for agricultural uses.

Several small stock water dams are present in the MCCO Additional Project Area, serving as a more secure stock water source throughout the year. However, these are also reliant on precipitation.

Agricultural Enterprise

The areas surrounding Big Flat Creek and the gently inclined foot slopes of the MCCO Additional Project Area have been extensively cleared for cattle grazing since prior to the 1960s. The clearing of the steep mid and upper slopes has been minimal due to limitations of this landform.

The majority of the MCCO Additional Project Area, excluding the steeply sloping area of LSC Class 7 land, is used for cattle grazing. Several small, abandoned olive groves are present in the area now used for grazing. All of the land within the MCCO Additional Project Area (with the exception of Wybong Post Office Road and internal paper roads) is owned by Mangoola and either tenanted for residential housing or managed for cattle grazing by the Colinta Pastoral Company (Colinta).

Due to continuing severe drought conditions in 2017 and 2018, the MCCO Additional Project Area had to be destocked in August 2018 and the reduced herd size was relocated to better quality mine owned land to the south of Mangoola Coal Mine.

There are no areas of BSAL, equine or viticulture CIC within the MCCO Additional Project Area.

6.16.2.2 Biodiversity Offset Areas

Agricultural Resource

Based on the analysis completed as part of the AIS approximately 105 ha of the proposed Mangoola Offset Site and 112 ha of Wybong Heights are deemed suitable for cultivation. This equates to approximately 13 per cent and 15 per cent of the proposed offset areas outside the MCCO Additional Project Area, respectively. The proposed Mangoola Offset Site and Wybong Heights Offset Site contain areas that are suitable for grazing, whereas parts of the Wybong Heights property (almost one third) is not suitable for any agricultural use due to the steep topography and dense vegetation. The proposed offset areas, located within the MCCO Additional Project Area is not suitable for cultivation, but can sustain grazing for most parts. This is in accordance with the LSC Classes described in **Section 6.15.2.4**.

The proposed Wybong Heights offset area has a total of 148 ha of BSAL mapped across it. A small area (<1 ha) is associated with the Wybong Creek floodplain, while a larger area of mapped BSAL occurs on a basalt plateau. Review of historic aerial imagery (since 2004) showed that cropping has previously occurred on the Wybong Creek floodplain, while no cropping was evident on the plateau where the vast majority of the regionally mapped BSAL is located. Field observations indicate that some areas of the plateau have a high occurrence of loose surface rock exceeding 60 mm in size. If areas have unattached rock fragments of 60 mm or larger over more than 20 per cent of the area, they are not deemed to be BSAL.

Mangoola went through a process of reviewing the agricultural production potential for the proposed Wybong Heights offset property against the high biodiversity values for the property and set aside some key areas for agriculture before determining the final offset boundaries.

No BSAL has been mapped for the proposed Mangoola Offset Site.

Agricultural Enterprise

The proposed offset areas at Wybong Heights and the Mangoola Offset sites, are predominantly used for grazing. In total, at the proposed Wybong Heights offset area, 516 ha of land currently used for agriculture will be converted from grazing to conservation. Agricultural production will be maintained in other more productive areas of the Wybong Heights property where possible including parts of the alluvial areas surround Wybong Creek. In the proposed Mangoola offset area, approximately 1005 ha of land currently available for grazing are required for offsets and will be removed from agriculture.

The regional mapping completed under the SRLUP shows that aside from BSAL, discussed above, small areas of both Equine and Viticulture CICs are mapped for the Mangoola Offset site. With regard to the mapped CICs it is noted that there are no vineyards or horse studs located in the proposed offset areas.

6.16.2.3 Locality and Muswellbrook LGA

Agricultural Enterprise

Land use in the locality (the area within 5 km from the centre of the MCCO Additional Project Area as shown on Figure 1.2 in **Appendix 20**), predominantly consists of cattle grazing. Cropping occurs in the locality but is generally confined to the floodplain of the Wybong Creek. The number of vineyards in the locality has decreased over time and today only two vineyards remain (Wybong Estate and Yarraman Estate (not currently operational)). This is in accordance with a decline of grape growing in the Muswellbrook LGA over the last decade. There are no horse studs in the AIS assessment area. One small horse stud (Coronet Stud) is located just outside of the locality to the north-east of the MCCO Additional Project Area and is

separated from it by intervening topography. The Golden Grove Thoroughbred horse stud is situated approximately 6 km south-west of the MCCO Additional Project Area.

The existing Mangoola Coal Mine occupies large areas of the southern part of the locality. All Mangoola owned land in the locality, which is not part of the current active mining operations or biodiversity offsets, is used for cattle grazing. Within the AIS assessment area, none of the mine owed land is used for irrigated cropping. Irrigation does occur on the Hunter River floodplains to the south of the AIS assessment area.

According to the broad scale regional mapping prepared as part of the SRLUP, there are approximately 434 ha of BSAL, 862 ha of Viticulture CIC and 1407 ha of Equine CIC mapped in the AIS assessment area (refer to **Figure 1.9**) however as noted above there is only one vineyard and no horse studs within the AIS assessment area.

The main agricultural enterprise within the Muswellbrook LGA is livestock farming for beef and dairy products. Other farming in the LGA includes growing broadacre crops, hay and silage, as well as fruit, nuts and grapes.

6.16.3 Assessment

The assessment of potential impacts on agricultural enterprises and resources considered the following:

- existing land capability and current and historical agricultural uses of the MCCO Additional Project Area
- the area and length of time over which agricultural resources will be impacted by the MCCO Project, beyond the existing approved impact
- proposed final landforms, land and soil capability and land uses
- likelihood that specific levels of land and soil capability will be achieved post mining.

The AIS also considers impacts of the MCCO Project on agricultural resources and uses/enterprises in the locality. The potential impacts of the MCCO Project on agricultural support services and the amenity, lifestyle and connectedness of rural communities were also considered.

6.16.3.1 MCCO Additional Disturbance Area and Proposed Offset Areas

The land within the MCCO Additional Disturbance Area is owned by Mangoola and operated by Colinta as low intensity grazing land. As described in the sections above the land required to be disturbed within the MCCO Additional Project Area predominantly has moderate to severe (LSC Class 4), severe (LSC Class 5) and extremely severe (LSC Class 7) limitations to agriculture.

There are no other agricultural enterprises within the MCCO Additional Disturbance Area. The total area of disturbance is forecasted to be approximately 623 ha. As discussed in **Section 3.3.4.2** post mining the area is planned to be rehabilitated using native vegetation for biodiversity offsets. As such the MCCO Additional Disturbance Area is planned to be permanently removed from agricultural land use, however, should future generations determine that the highest value use of the land is grazing, the rehabilitated landform (outside the final void) would support this land use.

Land in the proposed biodiversity offset areas is recognised as having high biodiversity value and high potential to further enhance this biodiversity value. The agricultural resources (landforms, land and soil capability, access to water, etc.) of the potential biodiversity offset properties included as part of the Project (refer to **Section 6.9.6**) will not be impacted by the MCCO Project. The potential land use change involves management for conservation and, in some areas, regeneration of native vegetation with no

change to soils, landform or water resources. Therefore, while the land use is proposed to change to biodiversity conservation due to the high biodiversity values of these areas, the capability of the land will not be significantly changed.

The proposed Mangoola offset site includes land within the MCCO Additional Project Area, that is not proposed to be disturbed by the MCCO Project and other Mangoola owned land that is immediately adjoining (but outside of the MCCO Additional Project Area (refer to **Figure 6.22**). In total for the proposed Mangoola offset site 976 ha of land available for agriculture will be transferred from grazing to conservation management land use.

The overall reduction of grazing land of Mangoola owned land (due to land disturbed by the MCCO Project and set aside as part of the proposed Mangoola offset site) will be 1588 ha. The total amount of grazing land at Mangoola is approximately 4650 ha, a further 204 ha are leased out to a third party for grazing and circa 519 ha are cropped. Therefore, large areas of Mangoola owned land will remain in agricultural production within the locality.

At the proposed Wybong Heights offset site, a total 516 ha of land suitable for agriculture will be transferred from grazing to conservation management.

Consultation was undertaken with the relevant Colinta Property Managers for the MCCO Additional Project Area and proposed Mangoola and Wybong Heights offset sites. In non-drought years, Colinta generally runs on average 1200 head of cattle on the Mangoola owned land with approximately 350 of these grazed within the MCCO Additional Project Area and 150 within the Mangoola Offset Site (outside of the MCCO Additional Project Area and not subject to assessment). Currently, both the MCCO Additional Project Area and the Mangoola Offset Site are destocked due to drought and the herd size has been reduced. The remaining herd (as of the end of 2018), 400 breeders and approximately 300 calves, are grazed on land to the south of Mangoola Coal Mine. The reduction of grazing land through the MCCO Project (including the proposed biodiversity offsets) will impact on the ability of Colinta to operate on Mangoola owned land in the current way. However, due to the good quality of the southern grazing areas outside of the MCCO Additional Project Area and proposed offsets, the Colinta operation will remain a viable agricultural enterprise.

For the proposed Wybong Height offset area, the Wybong Creek floodplain has the highest agricultural value due to soil quality and access to water. While the basalt plateau has high production value as well, it is reliant on bore water and dams, which have dried out in the current climate. In non-drought years grazing land for approximately 40 per cent of the herd (60 head) will be lost with the proposed offsets, however, grazing will be continued to be carried out in the floodplain areas.

The impacts by the proposed MCCO Project, including proposed offset areas, account for only a very small component of Colinta's operations within NSW and Australia. The complete Mangoola and Wybong Heights herd (1200 head under non-drought conditions) accounts for 20 per cent of Colinta's NSW cattle. Of the breeders that run on the MCCO Additional Project Area, proposed Mangoola and Wybong Heights offset sites make up 11 per cent of the NSW cattle numbers and just over 1 per cent of the Australian herd.

6.16.3.2 Muswellbrook LGA and Locality

Currently there are five mines operating in the Muswellbrook LGA and within the locality of the MCCO Project mining and agricultural land uses currently co-exist. Existing agricultural uses in the locality are dominated by cattle grazing, but also include cropping along Wybong Creek and a vineyard.

As discussed in **Section 1.6.3**, there is no identified CIC land within the MCCO Additional Project Area but equine and viticulture CICs have been mapped within the locality. There is also BSAL land to the north-west

of the MCCO Additional Project Area associated with Wybong Creek. The areas of CICs and the BSAL as mapped by the SRLUP will not be impacted by the MCCO Project based on:

- groundwater modelling did not show any significant drawdown impacts on alluvium, colluvium, shallow regolith and weathered bedrock groundwater in the locality that is utilised for agricultural purposes. There will be drawdown impacts on the deeper groundwater in the locality. As discussed in **Section 6.8.2.3** one registered bore lies within the predicted areas of drawdown of over 2 m at the end of mining and thus will potentially be impacted by the MCCO Project. An additional bore is located in an area of over 2 m potential drawdown and is predicted to primarily be impacted due to mining at the approved Mangoola Coal Mine. Predicted drawdown at the bore is 7.5 m. The property where this bore is located currently has acquisition rights under the existing Project Approval and it is anticipated will have acquisition rights under MCCO Project in accordance with the VLAMP

- the Wybong Estate Vineyard is the only remaining operating vineyard in the locality and is located upstream of the MCCO Additional Project Area. No groundwater impacts have been modelled for the location of the Wybong Estate Vineyard

- the key surface water impacts predicted for the MCCO Project are associated with Big Flat Creek. Based on water quality alone Big Flat Creek is not considered as a suitable resource that is able to be used for agricultural purposes. It is also noted that Big Flat Creek is highly ephemeral and for much of the year this creek is dry and so is also not a reliable source. There will be no significant impacts to Wybong Creek or downstream users

- there will be no direct or indirect impacts to the soil resources of the locality or Muswellbrook LGA outside of the MCCO Additional Disturbance Boundary

- no impacts associated with noise or dust emissions from the MCCO Project are predicted for the existing agricultural enterprises that are within the locality or broader Muswellbrook LGA.

As discussed in **Section 6.4** seven private rural residential properties (totalling approximately 372 ha) have been identified as meeting acquisition criteria under the VLAMP based on predicted noise impacts. The economically viable agricultural land on these properties will be available for ongoing agricultural land uses should the properties be purchased by Mangoola, resulting in no loss of available productive agricultural land.

The MCCO Project will have a minimal impact on local and regional agricultural services and infrastructure. The MCCO Project will result in a very small change in the number of cattle sent to the market. On average 310 calves are turned off the MCCO Additional Project Area and 140 calves from the proposed Mangoola offset areas. Due to drought, however, stock numbers were reduced in recent years.

As described in **Section 6.13** impacts to visual amenity as a result of the MCCO Project will be limited. Local topography largely screens the proposed operation from view. There will be only limited visibility of the MCCO Project along sections of public roads including Wybong Road, the realigned portion of Wybong Post Office Road and Ridgelands Road. These impacts are considered to be small in the regional agricultural context and they are not expected to impact on any of the surrounding agricultural enterprises.

6.16.4 Mitigation Measures

Based on the findings of the AIS, no further recommendations for mitigation measures or management of agricultural resources are deemed necessary as a result of the MCCO Project.

Mangoola has an extensive EMS, designed to mitigate environmental impacts off site. This management system will be reviewed based on the findings of the MCCO Project EIS and additional approval conditions.

Amendments will be undertaken as required based on the additional information and subsequently applied to the existing operation as well as the MCCO Project. As a result it will continue to be a key tool to manage impacts to agricultural lands, whilst noting that no significant impacts to surrounding agricultural lands are predicted.

Land management for the MCCO Project will include ongoing sustainable land management measures including control of noxious weeds and feral animals and management measures to reduce bushfire risk.

6.17 Rehabilitation and Mine Closure

6.17.1 Overview

Final landform design has been a key consideration in the design of the MCCO Project, with the objective of maximising opportunities to achieve a sustainable rehabilitated landform post closure.

The proposed rehabilitation strategy for the MCCO Project, as discussed in this section, has been developed in consideration of the opportunities and constraints associated with the existing local and regional environment, input from government stakeholders, and operational considerations.

The MCCO Project does not alter the broad final landform and rehabilitation objectives and practices currently undertaken at Mangoola Coal Mine. The key final landform design parameters of incorporation of natural landform design features (i.e. micro relief) and providing for biodiversity outcomes underpin the conceptual final landform for the MCCO Project.

As discussed in **Section 5.0**, Mangoola implemented a comprehensive stakeholder engagement program including a number of community and government stakeholders as part of the planning process for the MCCO Project. Both community and government stakeholders consulted did not consider rehabilitation establishment as a key issue due to the high standard of the existing rehabilitation established at Mangoola Coal Mine. The MCCO Project proposes to continue using these same rehabilitation techniques which are recognised as industry leading.

The proposed revegetation strategy involves the revegetation of the MCCO Project Area into two broad categories:

- ecological rehabilitation in the rehabilitated landform of the MCCO Additional Project Area as a component of the biodiversity offset strategy. The make-up of the ecological rehabilitation will be determined by the needs of the offset strategy and is currently envisaged to be made up of Forest Red Gum Grassy Open Forest, Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest and Swamp Oak - Weeping Grass Grassy Riparian Forest

- ongoing establishment of open woodland vegetation and native grassland across the Mangoola Coal Mine consistent with the currently approved Rehabilitation Management Plan/MOP, which includes establishment of open woodland communities including Ironbark Woodland Complex, Bulloak Woodland, Paperbark Woodland, Slaty Box Woodland, Forest Red Gum Riparian Woodland, Rough Barked Apple Woodland, Swamp Oak Riparian Forest, Grey Box Woodland and Weeping Myall Woodland as well as the establishment of areas of grassland.

Consistent with the existing approach to rehabilitation at Mangoola Coal Mine, there will also be some areas of native grassland in the final rehabilitation area.

As outlined in **Section 3.3.4**, a key objective of progressive rehabilitation at Mangoola is to return much of the MCCO Project Area to a mixture of woodland habitat generally consistent with ecological communities

that would have historically occurred in the area and grassland areas that will provide future opportunity for appropriately managed grazing.

As part of the proposed biodiversity offset strategy for the MCCO Project (refer to **Section 6.9.6**), it is currently planned that approximately 456 ha of ecological rehabilitation will be established as part of the rehabilitation strategy for the MCCO Additional Project Area. Further information regarding the proposed biodiversity offset strategy for the MCCO Project is provided in **Appendix 13**.

The proposed biodiversity offset areas for the MCCO Project will be subject to Stewardship Agreements which will provide for their long term protection and management and therefore do not require further consideration in this section.

The conceptual final landform for the MCCO Project is provided in **Figure 3.7**. The indicative final rehabilitation succession pathway is provided in **Figure 6.40**.

The rehabilitated area will aim to provide connectivity to the surrounding remnant vegetation areas such as to the existing and proposed biodiversity offset areas and the crown land situated immediately to the north of the MCCO Additional Project Area (refer to **Figure 1.5**).

With regard to final landform and mine closure planning for the MCCO Project, some of the key design considerations included:

- the proposed retention of one final void in the Approved Project Area for the Mangoola Coal Mine broadly consistent with the current approved Mangoola Coal Mine conceptual final landform, plus a final void remaining in the MCCO Additional Project Area based on the outcomes of the final landform options study undertaken for the MCCO Project (refer to **Section 1.4.3**)

- achieving a natural final landform in areas outside of the voids

- the final landform drainage design and void configuration have been designed in consideration of post mining potential surface and groundwater characteristics

- the visual amenity of the area has been a major focus for the MCCO Project design and the indicative final landform design. The post mining landform and revegetation strategy have sought to be consistent with the local area landform and pre-existing environment

- overburden handling, reject emplacement and rehabilitation procedures have been designed in consideration of geotechnical and geochemical characteristics.

The remainder of this section:

- summarises the key final landform design principles for the MCCO Project and describes the proposed conceptual final landform (refer to **Section 6.17.2**)

- outlines the proposed closure and rehabilitation strategy for the MCCO Project including the objectives and preliminary completion criteria (refer to **Section 6.17.2**)

- describes the mine closure planning processes (refer to **Section 6.17.4**)

- discusses the proposed post-mining land use along the other available post mining land use options and provides an analysis of their suitability for the site, and how they align with strategic land use objectives for the local area and region (refer to **Section 6.17.5**).

6.17.2 Final Landform Design and Final Voids

The development of the final landform for the MCCO Project will include the continued use of natural landform design processes incorporating micro-relief principles, consistent with the existing mining operations. Mangoola aims to return the site to a condition where the landforms, soils, hydrology, and flora and fauna are self-sustaining and compatible with the surrounding land uses (refer to **Section 6.9.6.1**). The key design principles to be used in the natural landform design approach include:

- the drainage density of the final landform is to reflect the nature of the drainage patterns in surrounding landforms
- steeper slopes are to be located higher in the catchment (that is, where water flows are smallest), with slope gradients flattening out downstream
- drainage lines will have both channel and floodplain components to provide stability during frequent flood events
- gentle flow transitions which emulate natural transitions and maintain a balance between scour risk and sediment load.

The micro-relief design process has successfully resulted in a more natural looking rehabilitated landform at the existing Mangoola Coal Mine, and reduced the visual impact of the final landform whilst providing a successful approach to surface water management. The detailed design of the natural landform implemented at the Mangoola Coal Mine has been developed progressively as part of the detailed mine planning process and is included in the staged rehabilitation plans in the MOP. The progressive development of micro-relief in the landform as part of the progressive detailed mine planning process is necessary so that overburden material is efficiently handled and the drainage system of the rehabilitated final landform works effectively as part of the mine water management system. This approach will continue for the MCCO Project.

Figure 3.7 shows the conceptual final landform design for the MCCO Project, incorporating natural landform features. The ecological rehabilitation of the site, including the PCTs proposed to be established, is discussed in **Section 6.9.6.1**.

The conceptual final landform, as shown in **Figure 3.7**, will predominantly consist of an undulating landform which has been designed to maintain consistency with the terrain in the local area and the existing established rehabilitation at the Mangoola Coal Mine. The key features of the final landform are discussed in the following sections.

Overburden Emplacement Areas

The typical final height of the overburden emplacement area in the MCCO Additional Project Area will be up to approximately 180 mAHD. The excavated areas of the MCCO Additional Mining Area will be progressively developed to a height which reflects, where practicable, the proposed final landform and directs surface water flows towards Big Flat Creek. Some variations in the height of the MCCO overburden emplacement areas and final landform (above 180 mAHD) will be established to assist in forming a more natural looking landform.

As discussed in **Section 6.17.4**, some overburden will also be progressively distributed to the existing approved mining area at Mangoola Coal Mine and utilised to reduce the size of the final void that would otherwise occur in this area.

Final exterior emplacement area faces will be designed to be stable without the need for contour banks. The average slope is flatter than 10 degrees. Overburden emplacement areas and the final landform within the currently approved Mangoola Coal Mine will reach a maximum height of approximately 240 mAHD, consistent with the currently approved final landform design.

Final Voids

Consistent with the existing approval, a final void will remain within the Approved Project Area for the Mangoola Coal Mine. An additional final void will also remain within the MCCO Additional Project Area. The landform within the final voids is defined as all land that is not able to be rehabilitated to a subsequent use and will include highwalls, benches, ramps and the area where water will accumulate to form a pit lake. The highwall is a rock face which represents the edge of the mining area and extends down to the pit floor. It consists of a series of steep slopes and benches. The low wall, which is the face of emplaced overburden within the pit is planned to be shaped and rehabilitated and available for other land uses (i.e. either conservation or agricultural land uses) and so is not considered part of the final void.

A range of different final landform and final void configurations were investigated for the MCCO Project as discussed in **Section 1.4.3**. As an outcome from this process, the proposed mine design for the MCCO Project involves the movement of overburden from the MCCO Additional Project Area to the Approved Project Area. The proposed final landform has two final voids remaining at the completion of mining. The existing final landform and void for the approved mining area will be established generally as currently approved, however, as part of the MCCO Project it will be improved due to the application of a revised natural landform design and shallower slopes on the low wall.

At the completion of mining, it is proposed that a second void of approximately 82 ha in surface area will remain on the north-west boundary of the MCCO Additional Project Area.

The key design features and processes associated with the proposed final voids and surrounding landform are outlined below:

- the highwalls may incorporate a series benches of approximately 15 to 50 m width. The stability of the highwalls will be assessed by a suitably qualified geotechnical engineer and appropriate stabilisation measures such as battering down weathered material will be undertaken progressively (where required) to ensure long term stability of the highwalls post-mining

- a safety berm will be established along the top of each highwall, designed to restrict inadvertent access to the highwalls

- the highwall benches will be revegetated with a suitable native vegetative mix using local species, where appropriate, above the predicted final void water level. Highwall treatment will likely be undertaken to facilitate a safe and stable final landform and to soften the visual appearance of the highwalls

- the low walls will be reshaped and revegetated above the predicted final void water level to a safe and stable slope.

As outlined in **Section 6.7**, a groundwater assessment of the final landform (at closure) indicates that the proposed final voids (non-back filled mine areas) will form long-term hydraulic sinks and will be comprised of two open water pit lakes. The final void water balance modelling (refer to **Section 6.7.3.2**) found that these pit lakes will not spill as the predicted water level will reach equilibrium well below the spill point of the voids. Equilibrium levels would be reached slowly over a period of more than two hundred years. Final pit lake salinity levels would increase slowly as a result of evapo-concentration. After approximately 300 years the salinity of the final voids will have an EC of less than 10,000 µS/cm (or less than approximately

6400 mg/L assuming a factor of 0.64 to convert from µS/cm to mg/L). At this water quality the voids would be available for a range of uses (if desired in the post mining landscape) as is discussed further in **Section 6.17.5**.

With regard to groundwater, the MCCO Proposed Additional Mining Area will remain a strong groundwater sink, and there will be no significant outflow to bedrock from the mining area. The void in the approved mining area is predicted to form a sink around the final void but may allow water to migrate into the bedrock in areas away from the void. This will occur slowly and the majority of water that does leave the backfilled mining area of the existing approved Mangoola Coal Mine is predicted to migrate towards the MCCO Additional Mining Area final void or remain at depth in close proximity to the Mangoola Coal Mine footprint.

Geochemical testing of the spoil indicates that there is the potential for rainfall-runoff infiltrating through the spoil to remain less saline than the groundwater in the surrounding bedrock. This would improve the overall water quality within the area if the spoil water were to migrate away from the mining footprint. The Groundwater Impact Assessment (refer to **Appendix 12**) found that based on existing monitoring and the outcomes of the geotechnical assessment, no adverse impacts are predicted with regard to groundwater pH.

Refinement of the design of the final voids will continue throughout the life of the MCCO Project as the mining operations progress. A Final Void Management Plan incorporating the outcomes of specific final void groundwater assessments and identifying the use options for the final voids will be developed and included in the Final Closure Plan. A discussion of final void use options is provided in **Section 6.17.5**.

6.17.3 Rehabilitation Strategy

The rehabilitation strategy for the MCCO Project is consistent with Mangoola's currently approved rehabilitation practices which have been recognised as industry leading (refer to **Plate 6.2**). Rehabilitation will be undertaken in accordance with a revised MOP incorporating the Rehabilitation Management Plan that will be reviewed and updated as part of the implementation of the MCCO Project. The MOP will detail performance measures and criteria for specific rehabilitation areas, to be used as benchmarks against which performance of the rehabilitation practices can be measured. The monitoring of rehabilitation performance will be regularly reported to DPE and DRG.

Disturbed areas will be progressively rehabilitated over the life of the MCCO Project. The indicative sequence for progressive rehabilitation is shown in **Figure 3.3** to **Figure 3.7**, with the conceptual final rehabilitation plan shown in **Figure 6.41**. Whilst it is intended to maximise opportunities for progressive rehabilitation, potential deviations from the indicative schedule may occur due to:

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

Where rehabilitation is delayed due to the above scenarios, overburden areas will be shaped to final landform as close as reasonably practicable behind the active mining operation, however, final revegetation may be delayed until suitable conditions occur and a cover crop applied on exposed areas to minimise dust and erosion.

Temporary revegetation (predominantly fast growing cover crop grass species) will also be used on unshaped overburden emplacements and other disturbed areas that are planned to be inactive for prolonged periods. Temporary revegetation of these areas will improve both visual amenity and the control of dust emissions.

Plate 6.2 Existing Rehabilitation – Recent Rehabilitation in the Foreground and Established Rehabilitation in the Background

6.17.3.1 Proposed Rehabilitation Techniques

Topsoil Management

Mangoola will undertake topsoil handling for the MCCO Project in accordance with the current topsoil handling practices used at the existing Mangoola Coal Mine. The overall objective is to maintain the quality of topsoil for subsequent use in rehabilitation.

Key topsoil and subsoil management and monitoring techniques include:

- material characterisation of topsoil and subsoil will be undertaken at an appropriate scale across the site with representative samples taken to characterise the nature of the soil material and determine any ameliorant techniques that may need to be applied
- topsoil will only be taken when deemed free of significant weed infestation

- where practicable, topsoil will be stripped when moist to help maintain soil structure and to reduce dust generation. Topsoil should not be stripped in an excessively wet or dry condition
- wherever practicable, topsoil will be transferred directly from stripping location to areas that have been reshaped for rehabilitation, eliminating the need for storage and re-handling
- topsoil stockpiles will be located away from traffic areas, at an appropriate distance from watercourses and have appropriate sediment controls
- stockpiles will be generally less than 3 m high to retain biological activity within the topsoil
- stockpiles to be kept longer than three months will be sown with a suitable cover crop to minimise soil erosion and invasion of weed species
- weed growth on topsoil stockpiles will be monitored and subsequently controlled if necessary. Prior to re-spreading, any weed growth will be scalped from the top of the stockpiles to minimise the transport of weeds into rehabilitated areas
- stockpiles will be appropriately identified to minimise the potential for inadvertent use or disturbance.

Substrate Preparation

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

- soil ameliorants will be applied where appropriate
- contour ripping will be undertaken immediately following gypsum application where appropriate and practical in order to incorporate gypsum, topsoil and overburden adequately. Ripping depths will vary depending on the vegetation community planned to be established and will be designed to avoid pulling excess rocks to the surface
- where appropriate and practical, structures such as rock piles, tree hollows, logs and other woody debris will be incorporated into the final landform to assist in establishing micro-habitat to augment the establishment of habitat values of the proposed vegetated corridors
- the installation of appropriate habitat structures (e.g. ponds and habitat trees) will be undertaken where practical.

Decisions regarding appropriate substrate preparation techniques will be driven by the proposed final land use for each particular portion of the MCCO Project Area. For example, areas proposed for native woodland may require additional substrate management when compared to grassland areas, prior to revegetation taking place.

Revegetation

After appropriate surface soil amelioration and tillage is completed for any given area, revegetation will commence as soon as practicable.

As discussed earlier, the rehabilitation strategy for the MCCO Project primarily involves the establishment of ecological rehabilitation. The ecological rehabilitation will be undertaken through the establishment of woodland vegetation communities which will link to remnant stands of native vegetation in the region surrounding the MCCO Project Area. Rehabilitated woodland areas will contain flora species assemblages

characteristic of the dominant vegetation communities impacted by the MCCO Project or known as remnant community type prior to clearance for agriculture.

During the rehabilitation process, the ecological structure of the rehabilitated land will be consistent with what would be expected in a typical disturbed landscape transitioning back to woodland. Succession patterns are likely to be similar to those that are observable in forest areas heavily impacted by bushfire and cleared land (such as agricultural land) regenerating to bushland. Most or all of the vegetation to be disturbed has been previously cleared, and is comprised now of regenerated vegetation that has developed through various successional stages.

The succession pathway expected in rehabilitated areas is represented in **Figure 6.40**. During the early stages of rehabilitation, grasses and fast growing pioneer species will initially dominate with pioneer species such as acacias dominating the mid strata and canopy. As shown in **Figure 6.40**, it is not uncommon for there to be low densities of shrubs and ground layer species as these fast growing pioneer species and young canopy species dominate the upper strata and shade the ground. Pioneer species such as acacias typically die back and thin out within 5 to 15 years, depending on the species. The existence of the pioneer species in the earlier years of vegetation establishment encourages the eucalypt and other canopy species to grow in height. As the pioneer species thin out, other canopy species such as the eucalypt species grow, increase in dominance and occupy a greater percentage of canopy. In rehabilitated areas (and heavily disturbed environments), until pioneer species have started to die back, there is little light available in the lower storeys and typically a consequential low species richness in ground and shrub layers. As the pioneer species die out and canopy height increases, increased species richness can be expected to develop in the understorey.

A seed collection and handling program aimed at maximising the viability and diversity of local seed in the revegetation mix will continue to be implemented as part of the rehabilitation program, however, endemic species will also be supplemented from other sources, where required. As rehabilitation progresses, supplementary plantings may be undertaken to mimic succession processes where necessary in order to achieve the target woodland community.

The final completion criteria for the established communities will be reviewed and modified as part of the MOP process. These criteria will need to have regard to the natural variability found in these communities.

6.17.3.2 Proposed Rehabilitation Monitoring

The currently approved Mangoola rehabilitation monitoring program will be expanded to include the MCCO Project Area and will be undertaken in accordance with Glencore standards. The objectives of the program will be to:

- assess the long term stability and functioning of re-established ecosystems on mine affected land
- assess rehabilitation performance against the completion criteria
- facilitate continuous improvement in rehabilitation practices.

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

6.17.3.3 Revegetation Care and Maintenance

Based on the outcomes of the rehabilitation monitoring program, a care and maintenance program will be implemented so that rehabilitation is sustainable for the long term. The scope of the care and maintenance program will include implementation of, as necessary, weed and feral animal control, fertilising, re-seeding

or planting and erosion and sediment control works. It is envisaged that this program will be continued as required until it can be demonstrated that the rehabilitation of the MCCO Project Area has satisfied the completion criteria.

6.17.3.4 Management of Potential Acid Rock Drainage

The presence of uncontrolled acidic or potential acid forming materials in the post mining landform, and the generation of Acid Rock Drainage (ARD) can represent risks to the success of mine rehabilitation and post mining land uses. To assess if this risk is relevant to the MCCO Project, a geochemistry assessment was undertaken by Environmental Geochemistry International Pty Ltd (EGI). The study assessed the potential for (ARD and other geochemical properties of the materials to be mined in the MCCO Additional Project Area. The full report is provided in **Appendix 21**.

In summary, the EGI geochemical assessment analysed drill hole core samples of overburden and interburden, and samples of current coarse reject and tailings which indicated that overburden/interburden and coarse rejects materials placed in pit back fill and out of pit emplacement areas as part of the MCCO Project are likely to be non-acid forming (NAF) and non-saline. They are also expected to be alkalinity producing, providing an additional factor of safety.

Overburden

The assessment indicated that the vast bulk of overburden and interburden materials represented by the samples tested are unlikely to be acid producing or release significant salinity and will likely be alkalinity producing. This is consistent with the current experience within the Mangoola Coal Mine. The general buffering nature of most of the overburden and interburden material and the likely small proportion (if any) of Potential Acid Forming (PAF) material likely to be present in the mining area provides considerable flexibility in mine materials management.

During mining, visual inspections will be undertaken for evidence of pyrite occurrence to identify the occurrence of any PAF overburden/interburden across the deposit. Should PAF material be identified that requires selective handling, the following management strategies will be considered and implemented as necessary for PAF material:

- co-dispose any PAF material within overburden emplacements along with NAF overburden to buffer potential acid formation
- avoid placing PAF material within 5 m of the natural ground level in out-of-pit emplacement areas to isolate it from any water flow along the interface between the overburden and natural ground
- selective placement of PAF material at least 100 m back from the outer perimeter of the emplacement area with a thick (not less than 20 m) outer zone of NAF materials (preferably high ANC material) and incorporate strategies to limit oxygen transfer to and fluctuating moisture conditions in PAF materials
- selective placement of PAF materials in-pit below the long term recovery water table to allow inundation at closure and prevent long term exposure to atmospheric oxidation.

Coarse Reject

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

The routine testing of washery waste samples currently undertaken at Mangoola Coal Mine will incorporate additional parameters to determine if more detailed assessment for PAF is required. PAF coarse reject material will be managed in the same manner as PAF overburden and interburden material, by co-disposing coarse reject with overburden where the mixing of the coarse reject with the substantial buffering capacity of the overburden as proposed by EGI, is predicted to provide adequate buffering capacity to neutralise any PAF risk.

Tailings

Laboratory testing by EGI identified small areas of PAF material within 50 m of the inflow spigot of the existing tailings storage facility. A program of routine sampling and testing of seepage from tailings emplacement areas where the testing has identified a localised risk of ARD will be carried out to check for ARD generation, assess the performance of management strategies, and determine and/or refine non-acid forming/potentially acid forming blending ratios and limestone treatment requirements (if required). This testing will inform the treatment plan and capping strategy for the tailings storage facility.

6.17.3.5 Closure and Rehabilitation Completion Criteria

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

The approved closure and rehabilitation completion criteria outlined in the existing MOP will be retained to apply to the Mangoola Coal Mine. Additional proposed closure and rehabilitation criteria applicable to the MCCO Additional Project Area are outlined in **Table 6.33**. The additional criteria for the MCCO Project Area have been developed considering site specific issues and final land use objectives, Glencore's standards and guided by the Draft Guidelines for the Ecological Rehabilitation of Recognisable and Self-sustaining Plant Communities Types (OEH 2015) and the Biodiversity Assessment Method (BAM) (OEH 2018).

The closure and rehabilitation criteria will be utilised to demonstrate achievement of rehabilitation and final land use objectives. The achievement of the completion criteria will be monitored and reported within the regular reports to be submitted to relevant government agencies.

In addition to the preliminary closure and rehabilitation completion criteria listed in **Table 6.33**, criteria specific to the proposed ecological rehabilitation is detailed in the Biodiversity Assessment Report (refer to **Appendix 13**). The completion criteria proposed for the area of ecological rehabilitation have been developed having regard to the Ecological Rehabilitation Guidelines (OEH 2015) and Biodiversity Assessment Method (BAM) (OEH 2018).

The preliminary closure completion criteria will be applied to the MCCO Additional Project Area throughout the life of the MCCO Project through consideration of the results of rehabilitation and analogue site monitoring programs. Results of any relevant research trials and consideration of stakeholder feedback will be documented in the MOP for Mangoola Coal Mine.

The gradual achievement (or otherwise) of these completion criteria will be assessed and discussed as part of regular statutory reporting processes along with any measures that need to be implemented to meet the criteria. Proposed rehabilitation monitoring is discussed in **Section 6.17.3.2**.

Table 6.33 Preliminary Closure and Rehabilitation Criteria for the MCCO Additional Project Area

Aspect	Objective	Preliminary Completion Criteria
Decommissioning	• All infrastructure that is not to be utilised as part of the future intended land use are removed to make the site safe and free of hazardous materials.	• All surface infrastructure, including offices and workshops, and services which do not have a potential future use associated with any post mining land use will be removed, unless such removal has a greater environmental impact than rehabilitating the area with the infrastructure remaining in place • Where services are buried (i.e. pipelines, cables etc.) and their retrieval may lead to further disturbance, the infrastructure may be left *in situ* provided that they do not pose constraints to the post mining land use. In this situation, the location of the services will be surveyed and marked on the record tracings and a suitable caveat developed to provide that they are readily identifiable for future landholders.
	• All infrastructure that is to remain as part of the future land use is safe and does not pose any hazard to the community.	• Potential hazards (i.e. electrical, mechanical etc.) have been effectively isolated • The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use • Appropriate security measures have been implemented to minimise the potential for unauthorised access during the period that the site is transitioned to the intended final land use.
	• There is no residual soil contamination on site that is incompatible with intended land use or that poses a threat of environmental harm.	• Contamination will be appropriately remediated so that appropriate guidelines for land use are met, e.g. Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) • Where practical, exposed carbonaceous material will be removed and co-disposed within the mining voids or suitably capped *in situ.*
Landform Establishment	• Provide a safe, stable and non-polluting final landform to support associated land uses that can co-exist with surrounding land uses. This includes a commitment to the establishment of long-term landform stability and the establishment of a more natural looking and functioning landform through the use of landform	• Slopes will be safe, stable and non-polluting. The final landform will be free-draining and will be in keeping with surrounding landscapes. Rehabilitated slopes (with the exception of final void retained highwalls and slopes) will generally be, on average, <10 degrees. To allow for the creation of micro-relief in topography, slope angles will be ≥10 degrees in some areas • No significant erosion is present that would constitute a safety hazard or compromise the capability of supporting the end land use • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff

Aspect	Objective	Preliminary Completion Criteria
	design techniques such as 'micro-relief' design principles, where practicable • Landform suitable for final land use and compatible with surrounding landscape as sustainable native ecosystem.	• Surface layer is free of any hazardous materials • Any final void and associated highwall has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose a safety risk • Tailings and reject emplacement areas will be capped and shaped to be free draining • Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and/or baseline data and does not pose a threat to downstream water quality.
Growing Medium Development	• Growing media is capable of supporting sustainable vegetation growth.	• The rehabilitation surface is a suitable growing medium for the proposed end land use • Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer).
Ecosystem and Land Use Establishment and Sustainability – Ecological Rehabilitation	• To create 282 ha of Forest Red Gum Open Forest CEEC, 32 ha conforming to Swamp Oak – Weeping Grass Grassy Riparian Forest CEEC and a further approximately 170 ha of native Narrow-leaved Iron bark – Bull Oak – Grey Box shrub – grass open forest.	• Criteria specific to the creation of Forest Red Gum Open Forest CEEC, Swamp Oak – Weeping Grass Grassy Riparian Forest CEEC and native Narrow-leaved Iron bark – Bull Oak – Grey Box shrub – grass open forest is detailed in **Appendix 13** • Criteria for Ecological Rehabilitation areas are to conform to the Ecological Rehabilitation Guidelines (OEH 2015).

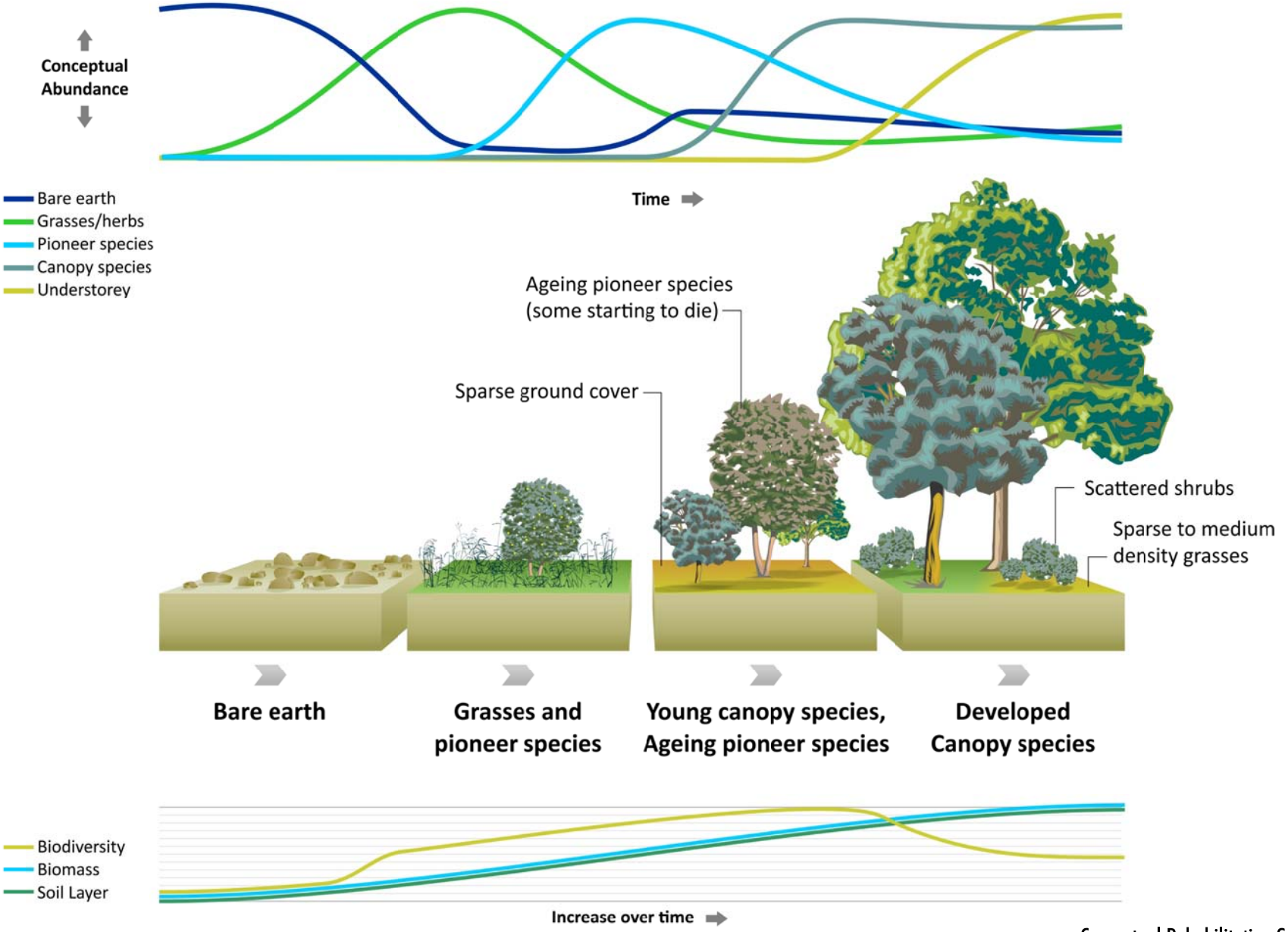
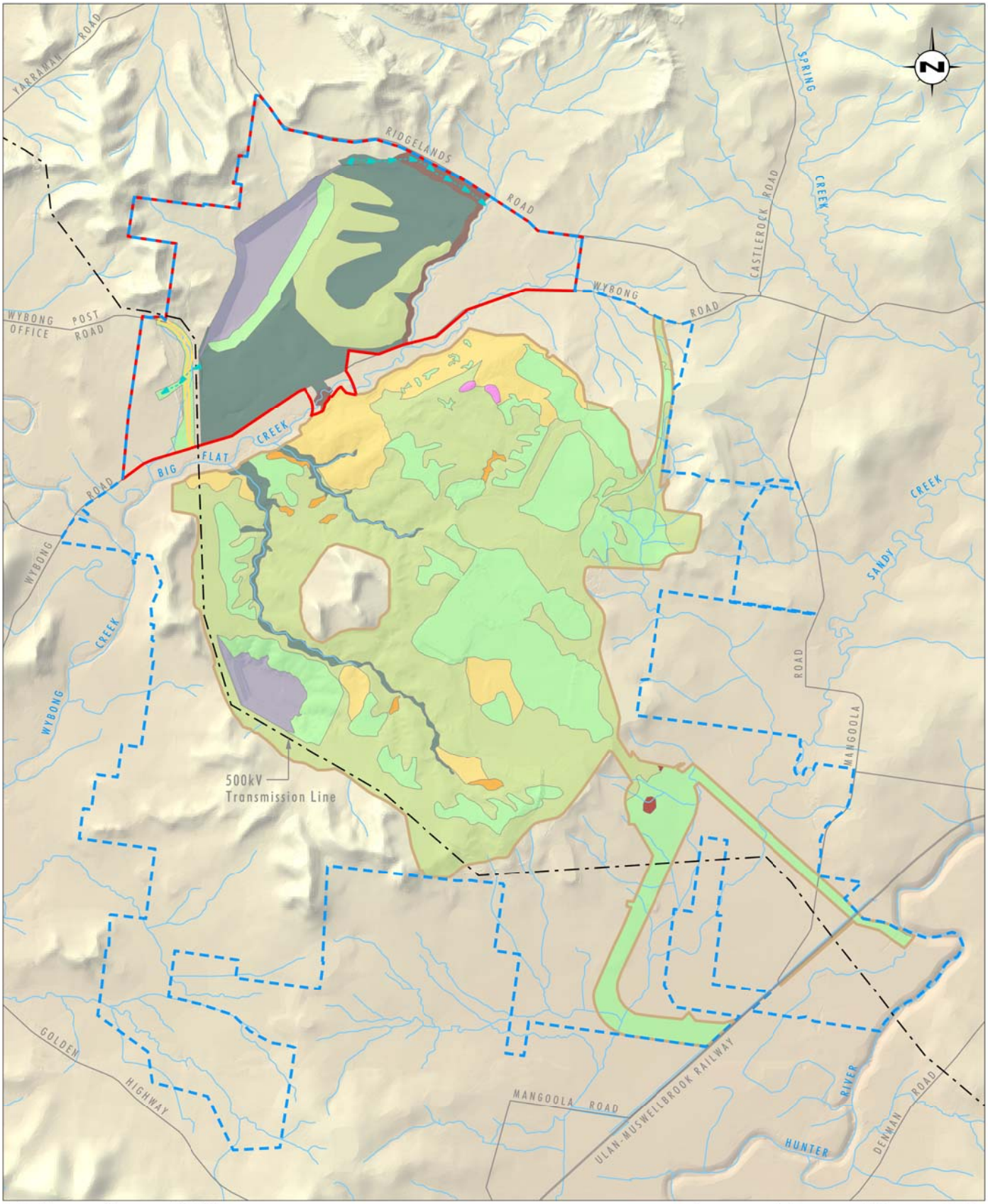


FIGURE 6.40

Conceptual Rehabilitation Succession Pathway



Data Source: Glencore (2019)

0 1.0 2.0 3.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- Wybong Post Office Road Realignment
- Final Void
- Forest Redgum Riparian Woodland
- Grassland
- Ironbark Woodland Complex
- Paperbark Woodland
- Slaty Box Woodland
- Spotted Gum Open Forest
- Swamp Oak Forest
- Weeping Myall Woodland

FIGURE 6.41

Conceptual Final Rehabilitation

6.17.4 Mine Closure Planning

6.17.4.1 Mine Closure Planning Process

Mangoola has implemented a proactive approach to rehabilitation and mine closure for the existing mining operations and proposes to implement the same approach for the MCCO Project. This includes planning for closure as an integrated part of the life of mine planning process. This approach includes developing, implementing and reviewing a mine closure plan that takes into consideration economic, social and environmental factors so that the operation meets its statutory requirements and achieves sustainable post-closure land uses.

The objective of the Mangoola closure planning process is to establish a process to guide all decisions and actions across the life of the mine such that:

- a post-closure vision is identified early in the mine life, and progressively reviewed and refined throughout the life of the mine
- the mine site as a whole is safe, stable and non-polluting
- the mine is designed, planned and operated in a manner that considers closure obligations throughout the mine life
- closure risks and gaps are identified for the mine and a treatment plan is established
- closure costings and financial provisioning is based on a thorough, transparent and justifiable process to provide for sufficient funds to implement required actions following the cessation of mining until completion criteria and relinquishment is achieved
- at the cessation of mining, the closure liability includes those closure items that could not be undertaken during the operational phase of the mine, as far as practicable
- the post mining land uses for the mine are beneficial and sustainable in the long-term as measured against established rehabilitation objectives and criteria
- adverse socio-economic impacts are minimised and socio-economic opportunities are maximised.

The Mangoola approach to mine closure planning considers each phase of the mining operation, with closure planning commencing at the exploration and project phase, continuing through the operational phase and eventually to sign-off of rehabilitation and successful mining lease relinquishment. The level of detail required in a closure plan increases as the operation proceeds towards the planned closure date. A Conceptual Closure Plan was prepared initially and has been refined over the life of the mine. When the mine is within five years of the planned closure date the detailed closure planning process will be initiated.

The existing Conceptual Closure Plan for Mangoola Coal Mine will be updated to include the MCCO Project and will be incorporated into the MOP/Rehabilitation Management Plan and will be developed in consideration of the approach outlined in this EIS, subject to requirements of the development consent conditions. It will include details regarding final land use objectives and completion criteria, rehabilitation and final void management strategies as well as the process for engaging relevant stakeholders in the closure planning process to be adopted throughout the mine life.

The detailed mine closure plan, which will commence five years prior to the planned mine closure will be developed in consultation with government and other stakeholders and will include details covering evaluation of re-use opportunities for facilities, infrastructure and services on the site, with the majority of demolition/decommissioning works to be planned and undertaken as soon as practicable following the cessation of mining, unless alternative post-mining uses are identified or proposed for these assets at the time. Given that the MCCO Project involves eight years of mining, this detailed closure planning process will commence within a few years of the commencement of mining activities under the new development consent, should approval be granted.

6.17.4.2 Closure Objectives

In consideration of the proposed final land use, the rehabilitation objectives for the MCCO Project Area include the following:

- provide for the safety of employees and the public during and following the closure of the mining operations
- provide a safe, stable and non-polluting final landform to support associated land uses that can co-exist with surrounding land uses. This includes a commitment to the establishment of long-term landform stability and the establishment of a more natural looking and functioning landform through the use of landform design techniques such as 'micro-relief' design principles outside of the final void area, where practicable
- establish similar native vegetation communities to those that will be impacted by the MCCO Project
- establishment of ecological rehabilitation as part of the biodiversity offset for the MCCO Project
- inclusion of grassland areas for agricultural land use where appropriate.

6.17.5 Post Mining Land Use

Mangoola owns a large area of land associated with the Mangoola Coal Mine being approximately 10,600 ha. This land holding includes:

- operational mining land, including both areas physically impacted by mining operations and then rehabilitated, and associated operational areas which have not been mined
- areas occupied by infrastructure (e.g. rail loop, transmission lines, roads etc.)
- conservation areas (existing and proposed)
- buffer land which is primarily used for agricultural land uses, including productive alluvial flats and less productive low intensity grazing land.

In planning for post mining land use and divestment of Mangoola's land holdings, this range of different land types needs to be considered. Following the completion of mining, some of this land may be immediately available for divestment by Mangoola and will be able to either continue its existing land use, or used for a range of other post mining land uses. This may include the mining buffer land which has been unaffected by mining activity and is currently used for non-mining land uses.

The operational mining land will require further closure and rehabilitation works prior to it being available for divestment or alternative post mining land uses. Rehabilitation and mine closure were discussed in **Section 6.17.3** and **Section 6.17.4** respectively.

With regard to the operational mining land, the existing post mining land use for the Mangoola Coal Mine is native woodland vegetation and native grassland that are planned for a combination of conservation and low intensity agricultural land uses. A final void is also approved for the existing Mangoola Coal Mine. The MCCO Project does not propose to change the post mining land use of the existing approved mining area, but will expand these post mining land uses into the MCCO Additional Project Area. The primary post mining land use proposed for the MCCO Additional Project Area is native vegetation and conservation (associated with the ecological rehabilitation), forming part of the biodiversity offset strategy for the MCCO Project (refer to **Section 6.9.6**) as well as other areas of open woodland and grassland.

The indicative revegetation strategy is shown in **Figure 6.41**. The return of native ecosystems to the majority of the area disturbed by mining and the creation of habitat corridors is captured in the closure objectives and criteria (refer to **Section 6.17.4**), which have been developed to guide rehabilitation and decommissioning activities discussed in **Sections 6.17.3** and **6.17.4**.

As discussed in **Section 6.15.2**, the soil types across much of the MCCO Additional Project Area have moderately low fertility. Considering the inherently low fertility of the soils and the proposed landform, the use of the proposed re-established grassland areas (outside the final void and not including areas of re-established native woodland vegetation) for low intensity agricultural purposes post-closure is considered a sustainable option. Rehabilitation suitable for low intensity agricultural use has been demonstrated at other coal mines in the Hunter Valley. It is noted that this land use is consistent with the current land use of the MCCO Additional Project Area.

The balance of the post mining land use of the MCCO Additional Project Area is targeted towards the establishment of natural ecological systems and processes and to enhance local and regional native ecosystem linkages. This land use will complement the existing and proposed biodiversity conservation areas established by Mangoola.

Section 6.17.5.1 provides a discussion of how the proposed post mining land uses are consistent with relevant local and regional planning strategies.

While there are proposed post mining land uses for the MCCO Project, it is acknowledged that given the scale of the Mangoola land holding and the variety of values offered by this land, a range of other post mining land uses could be possible. The needs of the community and the region are continually evolving and will change over the life of the MCCO Project and it is not possible at this time to predict the range of desirable post mining land uses that may be applicable post mine closure. Over the life of the MCCO Project or during the mine closure process, a range of desirable alternative land uses may be identified. These land uses may be complementary to the currently proposed final land use (i.e. they could occur in partnership with the proposed conservation and agricultural uses) or they could be an alternative to the currently proposed final land use (e.g. instead of an area being used for agricultural land uses it could be used for an industrial use).

The Mangoola site will provide existing infrastructure, connectivity to road and rail transport, and a large area of buffer of land, providing potential for a variety of final land uses. There are a range of strategic initiatives that are starting to plan for future employment generating land uses in the central and upper Hunter Valley region, including the Hunter Region Plan 2036 which is discussed in further detail below. The Mangoola site has the potential to support a range of different land uses into the future and Mangoola is committed to investigating these further options as the MCCO Project progresses. Mangoola will develop a Post Mining Land Use Strategy for its land holding, including the mining area, as part of the closure planning for the mine. This strategy will include specific consideration of the final voids.

Mangoola's overriding commitments to post mining land uses are:

- to provide a safe, stable and non-polluting final landform. This landform can then be available for a range of different post mining land uses
- to deliver high quality mine rehabilitation, including establishment of native vegetation areas and use of micro-relief
- to deliver rehabilitated land suitable for a combination of conservation and low intensity agricultural land uses
- to continue to investigate complementary and alternative land use options over the life of the MCCO Project and closure process, including consideration of local and regional planning strategies
- to investigate post mining land use options for the proposed final voids.

Further discussion of potential alternative land use options is provided in **Section 6.17.5.2**.

6.17.5.1 Alignment with Strategic Land Use Objectives

The strategic land use objectives for the area surrounding the MCCO Project which have been considered as part of the concept closure planning process for the MCCO Project, include those within the Muswellbrook LEP (2009), the Synoptic Plan and the Strategic Regional Land Use Plan for the Upper Hunter (Department of Planning and Infrastructure 2012) and the Hunter Regional Plan 2036 (DPE 2016). Discussion of the alignment of the conceptual closure plan with the key land use strategies relevant to the MCCO Project is provided below.

Muswellbrook LEP 2009

The MCCO Project Area is zoned RU1 Primary Production, E3 Environmental Management and SP2 Infrastructure under the Muswellbrook LEP (2009), with the RU1 and E3 zonings covering the majority of the MCCO Project Area (refer to **Section 4.3**).

The objectives of RU1 zone which will apply to the post mining land use of the MCCO Project Area are:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base
- to encourage diversity in primary industry enterprises and systems appropriate for the area
- to minimise the fragmentation and alienation of resource lands
- to minimise conflict between land uses within this zone and land uses within adjoining zones
- to protect the agricultural potential of rural land not identified for alternative land use, and to minimise the cost to the community of providing, extending and maintaining public amenities and services
- to maintain the rural landscape character of the land in the long term
- to ensure that development for the purpose of extractive industries, underground mines (other than surface works associated with underground mines) or open cut mines (other than open cut mines from the surface of the flood plain), will not:

(a) destroy or impair the agricultural production potential of the land or, in the case of underground mining, unreasonably restrict or otherwise affect any other development on the surface, or

(b) detrimentally affect in any way the quantity, flow and quality of water in either subterranean or surface water systems, or

(c) visually intrude into its surroundings, except by way of suitable screening

- to protect or conserve (or both):

  (a) soil stability by controlling development in accordance with land capability, and

  (b) trees and other vegetation, and

  (c) water resources, water quality and wetland areas, and their catchments and buffer areas, and

  (d) valuable deposits of minerals and extractive materials by restricting development that would compromise the efficient extraction of those deposits.

The proposed post mining land uses of native vegetation conservation and low intensity grazing are consistent with these objectives. There are also a range of other land use options that would be permissible under this zoning and these will be further considered by Mangoola as part of the Post Mining Land Use Strategy.

The objectives of E3 zone which will apply to the post mining land use of the MCCO Project Area are:

- to protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values
- to provide for a limited range of development that does not have an adverse effect on those values
- to maintain, or improve in the long term, the ecological values of existing remnant vegetation of significance including wooded hilltops, river valley systems, major scenic corridors and other local features of scenic attraction
- to limit development that is visually intrusive and ensure compatibility with the existing landscape character
- to allow agricultural activities that will not have an adverse impact on the environmental and scenic quality of the existing landscape
- to promote ecologically sustainable development
- to ensure that development in this zone on land that adjoins land in the land zoned E1 National Parks and Nature Reserves is compatible with the objectives for that zone.

The proposed post mining land uses of native vegetation conservation and low intensity grazing are consistent with these objectives. There are also some other land use options that would be permissible under this zoning, however, it is noted that the objectives of this zone and consequently the suitable land uses are more limited than for the RU1 zone. A discussed above, Mangoola will further consider potential alternative post mining land uses as part of the Post Mining Land Use Strategy.

Should a desirable post mining land use option be considered that is not compatible with the above zonings, the option would be available for Mangoola (or a subsequent land owner) to consult with MSC regarding the potential to rezone the land. Any such rezoning would only occur where agreed with MSC and subject to demonstrated need.

Upper Hunter Strategic Regional Land Use Plan (DPI 2012)

The Upper Hunter Strategic Regional Land Use Plan (SRLUP) has been developed to provide a strategic framework for delivering the necessary context for government investment priorities, servicing strategies and local environmental plan development for the Upper Hunter. Amongst the various land use types, the SRLUP outlines the importance of the protection of biodiversity through strategic land use planning. It recognises that post mining rehabilitation has the potential to contribute to biodiversity conservation in the longer term, but will require effective design and planning to maximise its landscape in the future.

The SRLUP has provided a regional conservation assessment and has identified and mapped areas of terrestrial and aquatic biodiversity values. It is considered that the proposed final land use of much of the MCCO Project Area as native woodland vegetation that forms vegetation corridors is consistent with these values and in the long term, once the rehabilitation matures, it will contribute to a broader regional conservation outcome by providing an effective corridor link between remnant and rehabilitated native vegetation areas, including Mangoola's existing and proposed conservation areas.

Hunter Regional Plan 2036 (DPE 2016)

DPE has developed a Hunter Regional Plan that outlines a vision, goals and actions for the sustainable growth of the region through to 2036 and provides an overarching strategic planning framework for the whole of the Hunter region, to be supported by more detailed district scale land use plans and infrastructure investment decisions. These detailed district scale land use plans are yet to be completed.

The Hunter Regional Plan 2036 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.

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 planning scale of the Hunter Regional Plan is not compatible with detailed identification of site specific future land uses, 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 MCCO Project Area site falls in the vicinity of the Upper Hunter Valley link portion of the Hunter Region as identified in the Hunter Regional Plan. The Upper Hunter Valley link is intended to progressively increase habitat connectivity through co-ordinated planning and rehabilitation of mining sites. The proposed rehabilitation of much of the site as native woodland therefore aligns with the strategic objectives of the Hunter Regional Plan.

Planning to align with objectives of the Hunter Regional Plan will be a key consideration in the Post Mining Land Use Strategy to be developed by Mangoola. It is envisaged that over time, further implementation of strategies under the Hunter Regional Plan will drive a range of land use needs that may identify new opportunities for the future of the Mangoola land holding.

6.17.5.2 Potential Alternative Post Mining Land Uses

As discussed above, at the time of mine closure, the Mangoola site will provide existing infrastructure, connectivity to road and rail transport, and a large area of buffer land, providing potential for a variety of final land uses should alternative land uses to those proposed be considered desirable in the future.

In addition, the MCCO Project Area may have some value in terms of future mining operations. The MCCO Project Area is located in proximity to exploration areas that may have potential for future mining operations. The MCCO Project Area includes the following key values that could be beneficial for any nearby future mining operation:

- coal processing infrastructure
- established water/storage and management
- access to road and rail transport
- an established buffer zone to proximal landholders
- electricity and communication infrastructure
- accessibility to skilled mining/heavy engineering workforce.

While not proposed as part of this application, it is recognised that the MCCO Project Area may provide an opportunity to support other future mining operations within the local area should exploration activities identify viable resources within or in the vicinity of Mangoola Coal Mine.

Other potential alternative land use options are identified below. These options are not proposed as part of this application, but are identified as options that can be considered as part of preparing the Final Land Use Strategy for Mangoola Coal Mine. As noted above, the proposed final land use for Mangoola Coal Mine is a combination of native vegetation/conservation and native grassland that would support low intensity agriculture.

While some potential alternative land use options are discussed below, it is noted that economic feasibility cannot be assessed at this time as it will depend on the economic environment post mining. The discussion therefore focusses on the attributes of the site that could be beneficial for the identified land use.

With regard to the proposed final voids, they are proposed to be water bodies in a conservation landscape. While alternative uses are not proposed as part of this assessment, the availability of waterbodies in the post mining landscape combined with the predicted water quality within the final voids provides the opportunity for a range of uses. Should such uses be proposed, they would require further detailed consideration at that time subject to the individual water quality needs of each land use, with the following

discussion based on the outcomes of the final void salinity assessment completed as part of the Surface Water Assessment (refer to **Section 6.7**).

As discussed in **Section 6.17.2**, after approximately 300 years the salinity of the final voids will have an EC of less than 10,000 µS/cm (or less than approximately 6400 mg/L assuming a factor of 0.64 to convert from µS/cm to mg/L). This salinity is well below that of seawater (approximately 35,000 mg/L) and would therefore be considered suitable for recreational uses.

At this salinity, the final void pit lakes could also support a range of fish species. Certain fish and other aquatic species can tolerate a broad range of water quality including the salinity values predicted for the final voids, including Silver Perch and Australian bass. The ANZECC Guidelines for Silver Perch identify a salinity of less than 3000 mg/L for freshwater and between 3000 and 35,000 mg/L for saltwater (Australian and New Zealand Environment and Conservation Council). Australian bass can tolerate 12,000 to 15,000 mg/L (Victorian Fisheries Authority). The proposed voids are therefore predicted to have salinity levels after 300 years that would cater for both of these species.

Table 6.34 provides a high level analysis of potential alternative post mining land uses for the Mangoola Coal Mine, including the final voids.

As discussed above, with regard to post mining land uses, Mangoola has committed to provide a safe, stable and non-polluting final landform which will be potentially suitable for a range of different post mining land uses. The land uses currently proposed (native vegetation/conservation and agriculture) are both consistent with the key values and attributes of the site, the surrounding land uses and with the pre-mining land use of the site.

Mangoola also commits to continue to investigate complementary and alternative land use options over the life of the MCCO Project and closure process through the development of a Post Mining Land Use Strategy for its land holdings. This will include specific consideration of the final voids.

Table 6.34 Potential Alternative Final Land Use Options

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine 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 beyond the MCCO Project is not proposed as part of this application however there are further coal resources located within existing Mangoola/Glencore mining tenements in this area. Subject to further exploration, feasibility investigations, and market considerations there may be the opportunity to mine further coal in the Mangoola area. This may include underground coal mining. There are also a number of adjacent tenements held by other companies that could potentially make use of the existing assets on the site in the future. Further advances in mining technology, exploration and geological investigations may lead to further mining within these existing tenements becoming viable. The opportunity may exist for future use of the Mangoola facilities to support future mining.
	Mining Infrastructure (MIA, CHPP, rail loop etc.)	Existing Mangoola MIA and CHPP, rail loop	
	Water supply and storage Tailings storage	Future Mangoola Coal Mine voids providing water/tailings storage, connection nearby future mines	
	Rail and road infrastructure providing access to the Port of Newcastle	Existing Mangoola Coal Mine rail loader and loop connecting to Ulan to Muswellbrook 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 Mangoola Coal Mine have been identified and management strategies are in place	
	Accessible to skilled mining workforce	Significant skilled mining workforce in the region	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
Ancillary Mining Activities	Brownfield development sites with few environment and community constraints, preferably with existing coal processing infrastructure	Mangoola Coal Mine CHPP	Coal resources for potential future underground mining exist in proximity to the Mangoola Coal Mine.
	Established water supply/storage and management Tailings storage	Mangoola Coal Mine voids providing water/tailings storage, connection to nearby mines	
	Access to road and rail transport and electricity/communication infrastructure	Mangoola Coal Mine rail loader and loop connecting to Ulan to Muswellbrook Rail Line Established communication and electricity connections	
	Accessible to skilled mining/heavy engineering workforce	Site is accessible to local workforce	
Pumped Storage Hydro Power	Built assets (offices, workshops, car parks etc.)	Mangoola Coal Mine MIA can be readily repurposed to provide office/workshop facilities reducing establishment costs	Further studies would be required however at present this is unlikely to be a viable option for this site as the void depth may not be sufficient. A design incorporating natural topography could potentially be developed. It is noted however that this would require substantial additional disturbance and for this reason it is considered that other mine sites are likely more suitable.
	Height difference from upper to lower water storages	Mangoola Coal Mine includes voids adjacent to high local relief however it is not considered that this would provide the required height difference	
	Water resources/storage of sufficient volume of water at different levels and sufficient water quality	Upper level water storages could be constructed and lower level storages would be available in the post mining voids	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
	Connectivity to electricity grid Site with acceptable direct environmental impacts and with sufficient buffer land to minimise potential impacts (noise, air quality etc.)	The site is adjacent to the 500kV ETL Grid connections to main office buildings – may need upgrade Established site with extensive mine owned buffer land	
	Land that can be shaped and developed for wind turbines, battery storage, transmission etc. Road/rail access	Opportunity to shape land suitable for generation and storage	
	Accessible to skilled engineering workforce	Road and rail access in place. Rail access to the Port of Newcastle, road access to Golden Highway 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.)	Mangoola MIA can be readily repurposed to provide office/workshop facilities reducing establishment costs	The Mangoola Coal Mine 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.
	Land resources – potential to create landforms suitable for large industrial sites	Existing suitable flat land for heavy or medium industry in the final landform design, generally in parts of the site with good access to road and rail infrastructure and power supply	
	Water supply infrastructure, storage available to prevent the need for licensed polluted discharge to waters	Site has good track record of managing water on site and has a supply from the Hunter River, with no need for discharge to natural waterways	
	Proximity to residential areas in terms of worker commute	Located in proximity to other mines and power stations in Muswellbrook Shire	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
	Remote or shielded from sensitive residential areas or other sensitive users, where heavy industry is being considered which may have potential air (particulates, odour), visual or noise impacts	The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	
	Access to road, rail and communications infrastructure –for materials and product; access to port or airport infrastructure	Upgraded road access to Muswellbrook and New England Highway / Golden Highway Direct rail access to the Port of Newcastle	
	Access to skilled engineering/ manufacturing workforce	Considered available within the regional locality. Also existing training and educational facilities such as the Muswellbrook TAFE could be utilised in this regard	
	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.)	Mangoola Coal Mine MIA can be readily repurposed to provide office/workshop facilities reducing establishment costs	Parts of the site may be suitable for industrial agriculture, subject to detailed feasibility studies and

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
	Land resources – potential to create landforms suitable for large production sites; e.g. glasshouses, composting facilities etc. Large spaces – Some agricultural enterprises are not reliant on high quality land and just need open space with a sufficient buffer zone – e.g. Composting facilities	Areas around existing infrastructure and rail loop are well suited and provide large open spaces. 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 Water in existing dams and potentially in voids for a period of time after mine closure may be suitable for stock watering or pumping to areas where stock watering is required	comparison with other post mining sites. The good transport linkages, access to water and ability to use Mangoola owned (and surrounding) high quality alluvial agricultural lands along the Hunter River (not affected by mining) all contribute to the potential for use as an industrial agriculture site.
	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/Golden Highway system, and located in proximity to Muswellbrook	
	Proximity to urban areas in terms of worker commute	Local road access to Muswellbrook and Highway access 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)	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
	Water for irrigation is available and water can be managed on site (stored, reused, recycled) to prevent the need for licensed discharge to waters	Hunter River water supply infrastructure in place (subject to licensing requirements) 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	
	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 suitable for training purposes. Located in close proximity to Myambat Ammunition Depot located 10 km west of Denman	Parts of the site may be suitable for military and defence related uses, subject to detailed feasibility studies and comparison with other post mining sites. The established buffer zones and proximity to existing defence sites contribute to this potential future use.
	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	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine Land Characteristics/Values	Comments
Active recreation/extreme sports (e.g. mountain biking, trail walking/running, rock climbing, motocross, BMX)	Terrain suitable for (or scope to reasonably shape for) diverse physical challenges such as mountain bike trails, zip lines, archery courses, etc	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	The Mangoola site, along with a number of other mine sites in the Upper Hunter offer terrain suitable for adventure sports developments. More detailed feasibility studies would be required, linked to more detailed regional employment transition planning. Rehabilitated emplacement area and final void areas may be the best opportunity for this potential land use. The 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	Access to highway and rail transport	
	In location that can be marketed with other related tourism experiences – such as Upper Hunter wine tourism and Sydney market	Location in Upper 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 off-site 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	Mangoola Coal Mine MIA can be readily repurposed to provide café, office/workshop facilities reducing establishment costs	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine 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	Mangoola Coal Mine offers diverse terrain, including relatively flat land and infrastructure suitable for processing, and mine voids	Mangoola, along with a number of other former mine sites in the Upper Hunter, are likely to have similar beneficial characteristics for use as waste, recycling, reuse and product development sites , noting that Mangoola is further from some larger regional centres than some of the other mines and therefore may be less desirable. The site would, however, have the necessary physical attributes for such a use.
	Access to road, rail and communications infrastructure suitable for transporting significant volumes of material	The Mangoola Coal Mine site has access to the Main North Rail line, with potential to receive waste from the greater regional area The site is accessible from the New England Highway via upgraded local roads	
	Remote or shielded from sensitive residential areas or other sensitive users, where waste management activities may have potential visual, noise, odour, or other impacts Connections to waste research organisations and to appropriately skilled workforce	The site and established buffer zone, are already managed to minimise noise, odour, lighting and other visual impacts on neighbouring residential land uses	
Aquaculture/Fish Stocking for Recreation (final voids)	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 or for the establishment of in-tank aquaculture areas	Mangoola Coal Mine offers diverse terrain, including relatively flat land and infrastructure suitable for aquaculture product processing, and mine voids for fish habitat and water and waste water Potential to create landforms suitable for aquaculture ponds or tank systems	The final void water quality modelling (refer to **Section 6.7**) is of a quality for several hundred years that would support fish (e.g. Silver Perch and Australian Bass). Once the final voids were established and sufficiently filled with water, the suitability for fish stocking and potentially aquaculture could be further assessed. The same infrastructure benefits (e.g. access to power, water, transport linkages) would provide benefits for such land uses .
	Reliable water supply infrastructure. Water quality, water treatment and storage management suitable for intensive aquaculture use, potentially high nutrient/organic load	Access to water supply from Hunter River (subject to licensing requirements)	

Potential Land Use	Beneficial Land Characteristics/Values Required	Mangoola Coal Mine 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 Mangoola Coal Mine has upgraded local road access to the New England and Golden Highways 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	Mangoola Coal Mine rehabilitation and offset areas are immediately adjacent to the extensive forested areas Rehabilitation terrain is suitable for forestry	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 Mangoola Coal Mine is more about managing / recreating natural areas (some of which may also be suitable for recreation and forestry), rather than the gastronomic tourism referred to in the Regional Plan.
	Rehabilitated sites with a focus on biodiversity and ecological connectivity Diversity of site conditions relevant to multiple aspects of research	Work on enhancing ecological connectivity is already underway	
	Proximity to education institutions including schools and university students; similarly proximity to markets for nature based tourism (major urban centres, but also international visitors)	The population of the Hunter region is expected to grow, with increasing numbers of school and university students Well located in terms of regional urban centres, proximity to Newcastle and Sydney metropolitan areas, and reasonable airport access	

6.18 Greenhouse Gas and Energy

A detailed Greenhouse Gas and Energy Assessment (GHGEA) has been completed for the MCCO Project by Umwelt. This assessment has been undertaken in accordance with the SEARs for the Project (refer to **Table 4.3**) and includes:

- a quantitative assessment of the potential Scope 1, 2 and 3 emissions associated with the MCCO Project
- a qualitative assessment of the potential impacts of these emissions on the environment
- an estimate of energy use directly associated with the MCCO Project
- an estimation on how the MCCO Project's emissions will impact national and international GHG emission targets
- an assessment of reasonable and feasible measures to minimise GHG emissions and energy use.

A summary of the key findings of the GHGEA is provided in this section and the full report is provided in **Appendix 22**.

Mangoola has incorporated a range of measures into the MCCO Project design, with the aim of minimising GHG emissions and improving energy efficiency from the mining operation. Energy efficiency was a key driver for the design of the mine plan as one obvious consequence of reduced energy usage is a reduction in operating costs. Reduced energy usage also means reduced GHG emissions. The MCCO Project design therefore inherently minimises GHG emissions from the mining operations, primarily through energy use reduction initiatives. Key measures included in the MCCO Project design to minimise emissions include:

- limiting the length of material haulage routes (where feasible), thus minimising transport distances and associated fuel consumption
- designing haul roads and haulage routes to minimise energy usage and therefore GHG emissions
- considering energy and fuel efficiency when selecting new equipment (it is noted that the MCCO Project primarily uses the existing equipment and infrastructure and limited additional equipment is required)
- scheduling activities so that equipment and vehicle operation is optimised.

The energy efficiency of Mangoola's operations is driven by optimising productivity. Mangoola has also demonstrated a track record of managing GHG emissions from its mining operations and has an Energy Saving Action Plan in place. Mangoola has met its greenhouse gas reporting obligations under the *National Greenhouse and Energy Reporting Act 2007* (Cth.), and has also managed its greenhouse gas emissions in accordance with the Safeguard Mechanism.

6.18.1 Methodology

The GHGEA has considered the energy usage and GHG emission impacts for the construction and operational phases of the MCCO Project. It also evaluated potential GHG emission mitigation and energy efficiency measures for the MCCO Project's operational activities.

The GHGEA was prepared with regard to the National Greenhouse Accounts (NGA) Factors (2018) (DoE 2018) and the World Business Council for Sustainable Development and World Resources Institute

Greenhouse Gas Protocol 2004 (GHG Protocol 2004). Fugitive emissions have been calculated using the Method 1 approach, which uses a default emission factor for NSW open cut coal mines.

The GHG Protocol provides an internationally accepted approach to the accounting and reporting of GHG emissions by entities. Under the GHG Protocol the establishment of operational boundaries involves identifying emissions associated with an entity's operations, categorising them as direct or indirect emissions, and identifying the scope of accounting and reporting for emissions.

Three 'Scopes' of emissions (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes. These scopes are outlined below:

- Scope 1 emissions are direct emissions which occur from sources owned or controlled by the reporting entity, over which they have a high level of control (such as fuel use)
- Scope 2 emissions are those generated from purchased electricity consumed by the reporting entity, which can be easily measured and can be influenced through energy efficiency measures. Scope 2 emissions physically occur at the facility where electricity is generated, that is, the power station
- Scope 3 emissions are indirect emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another reporting entity (e.g. outsourced services, emissions from use of products).

The assessment boundary for the GHGEA incorporates all significant Scope 1, 2 and 3 emissions. **Figure 6.42** demonstrates how the GHGEA assessment boundary interacts with the potential emission sources under Mangoola's operational control and other emission sources associated with the MCCO Project.

Further detail on the assessment methodology can be found in **Appendix 22**.

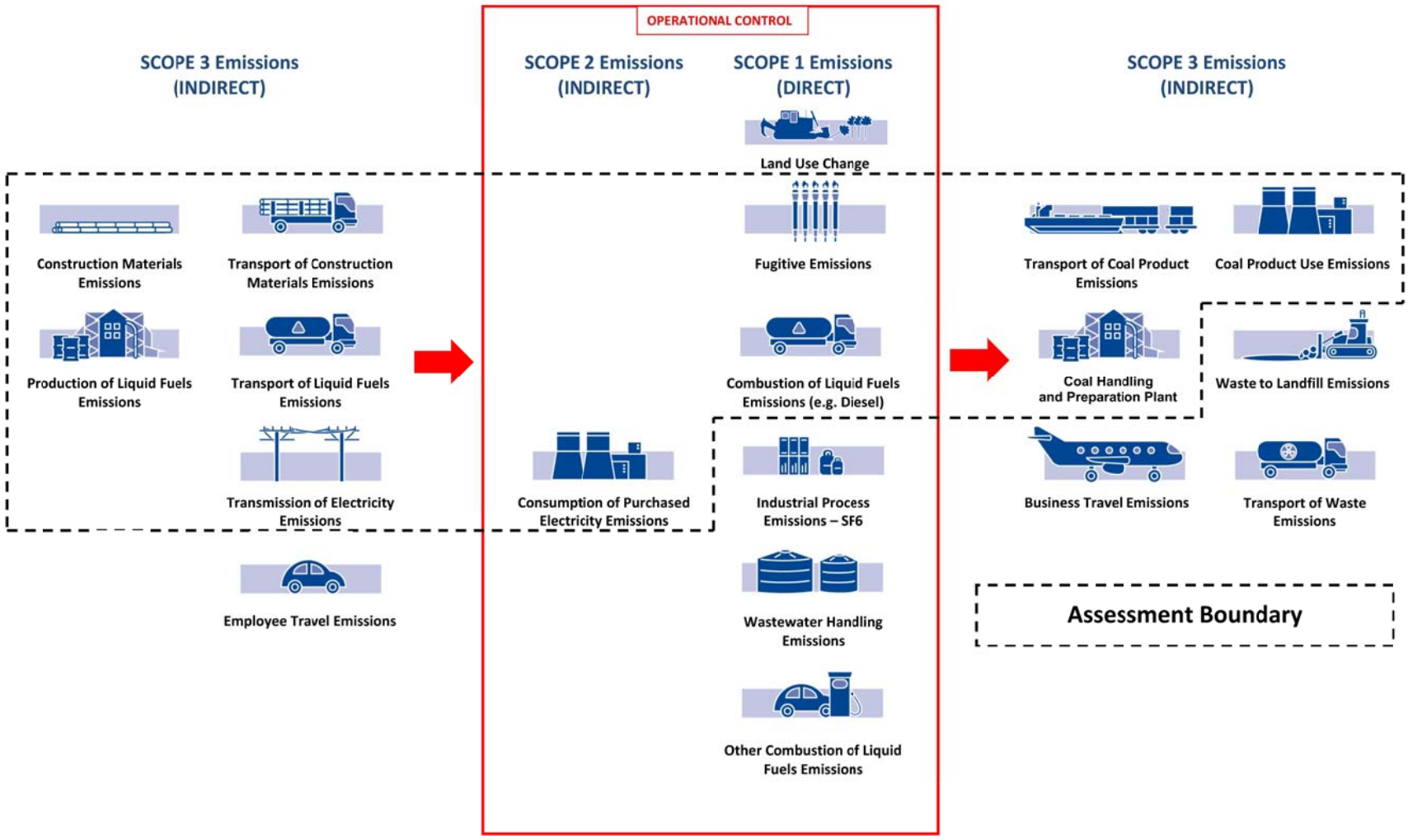


FIGURE 6.42

Greenhouse Gas Assessment Boundary

6.18.2 Assessment

The GHG assessment provides forecast energy use and greenhouse gas emissions associated with the MCCO Project. The assessment also discusses potential impacts and mitigation measures.

6.18.2.1 Predicted Energy Consumption

The MCCO Project's energy requirements will be primarily met through diesel and electricity consumption. Outlined below is a summary of the predicted energy consumption for the MCCO Project:

- the construction activities are forecast to require approximately 15,000 Gigajoules (GJ) of energy from diesel
- the operational phase is forecast to require approximately 7,824,000 GJ of energy from diesel and grid electricity.

The industry average energy use for open cut coal mines in Australia ranges between 430 and 660 Megajoules (MJ)/product tonne (AGSO 2000). The MCCO Project is forecast to operate with an average energy use intensity of approximately 190 MJ/product tonne. The forecast energy use intensity of the MCCO Project is well below the normal operating range for Australian open cut coal mines, as the MCCO Project is expected to have relatively low strip ratios and high product yields. The MCCO Project is expected to operate with a relatively low demand for diesel when compared to other coal mining operations, as ROM coal can be recovered with relatively low overburden movement. Furthermore, the energy demand for producing saleable products is also relatively low, as the ROM coal produced by the MCCO Project is expected to contain a relatively low proportion of waste material.

6.18.2.2 Predicted Greenhouse Gas Emissions

The estimated construction and operational stage emissions for the MCCO Project are shown in **Table 6.35**.

The MCCO Project is predicted to generate or be associated with the following GHG emissions during the operational stage:

- approximately 3,251,000 t CO_2-e of Scope 1 emissions, primarily from combustion of diesel and releasing fugitive emissions. Fugitive emissions result from the release of gas (primarily carbon dioxide and methane) stored in the materials mined
- approximately 403,000 t CO_2-e of Scope 2 emissions from consuming electricity
- approximately 104,287,000 t CO_2-e of Scope 3 emissions. Scope 3 emissions will be generated by third parties who transport and consume coal products.

Approximately 3 per cent of the GHGs associated with the MCCO Project are related to on-site energy use and fugitive emissions (Scope 1 and 2 emissions). The majority of the GHG inventory is dominated by Scope 3 emissions, with approximately 97 per cent of emissions occurring either upstream or downstream of the MCCO Project, and generated by third parties.

Table 6.35 GHG Emission Summary for the MCCO Project

Stage	Scope	Source	Source Totals (t CO_2-e)	Scope Totals (t CO_2-e)
Construction	Scope 3 (Indirect)	Materials use	3,792	6,348
		Diesel use	1,094	
		Materials transport	1,462	
Total GHG Emissions for Construction				**6,348**
Operations	Scope 1 (Direct)	Diesel use	425,353	3,250,870
		Fugitive emissions	2,825,517	
	Scope 2 (Indirect)	Electricity	402,192	402,192
	Scope 3 (Indirect)	Product use	100,191,324	104,286,583
		Associated with energy extraction and distribution	71,205	
		Product transport	4,015,426	
		Materials transport	8,628	
Total GHG Emissions for Life of Mine Operations				**107,939,645**

6.18.2.3 Impact on the Environment

The MCCO Project's GHG emissions will be highly mobile and can disperse widely across the environment. The accumulation of GHGs or carbon in 'carbon sinks' is the primary impact of GHG emissions. Since the industrial revolution, anthropogenic GHG emissions have accumulated in three major carbon sinks - the ocean (30 per cent), terrestrial plants (30 per cent) and the atmosphere (40 per cent) (BOM and CSIRO, 2014).

The accumulation of GHG in the atmosphere is an important driver of global warming, sea level rise and climate change (IPCC 2013). Sea level rise and climate change may have many ramifications for the natural and built environment. The accumulation of GHG in the ocean is an important driver of ocean acidification (IPCC 2013).

The MCCO Project's direct emissions (Scope 1) are forecast to be approximately 407,000 t CO2 –e per annum.

To put the MCCO Project's emissions into perspective, under current policy settings, global greenhouse gas emissions are forecast to reach 56,200,000,000 t CO2-e per annum by 2025 (UNEP 2016). During operation, the MCCO Project will contribute approximately 0.00073 per cent to global emissions per annum (based on its projected Scope 1 emissions). The relative environmental impact of the MCCO Project is likely to be relative to its proportion of global GHG emissions, which as calculated above is very small.

The Scope 2 and 3 emissions associated with the MCCO Project should not be considered, as global projections only represent Scope 1 emissions (i.e. the sum of all individual emission sources) as Scope 2 and 3 emissions of the MCCO Project are the Scope 1 emission of other parties.

6.18.2.4 Impact on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties, and persists for an extended period, typically decades or longer (IPCC 2007).

Climate change is caused by changes in the energy balance of the climate system. The energy balance of the climate system is driven by atmospheric concentrations of greenhouse gases and aerosols, land cover and solar radiation (IPCC 2007).

Climate change models forecast many different climate change impacts, which are influenced by future GHG emission scenarios. Climate change forecasts also vary significantly from region to region.

The MCCO Project, in isolation, is unlikely to influence global emission trajectories. Future emission trajectories will largely be influenced by global scale issues such as; technology, population growth and greenhouse gas policy.

6.18.2.5 Impact on Policy Objectives

Under the Paris Agreement, the Australian Government has committed to reducing GHG emissions by 26 – 28 per cent, on 2005 levels, by 2030 (Commonwealth of Australia, 2015).

If Australia achieves its 28 per cent mitigation commitment under the Paris Agreement, the DoEE estimates that the Australian economy must set a mitigation trajectory which will save approximately 762,000,000 t CO2-e between 2021 and 2030 (DoEE 2018).

The MCCO Project's cumulative Scope 1 emissions (3,2510,000 t CO2-e) will increase the required national mitigation effort by approximately 0.43 per cent. However, it is important to note that mining associated with the MCCO Project ceases in 2030 (subject to timing of granting development consent) and as such will not influence national mitigation efforts after this time.

The MCCO Project's Scope 2 and 3 emissions will be generated in international jurisdictions, and by Australian facilities with environmental approval to generate GHG emissions.

6.18.3 Greenhouse Gas and Energy Management

Mangoola has incorporated a range of measures into the MCCO Project design that will minimise potential Scope 1 and Scope 2 GHG emissions and improve energy efficiency. As noted above, energy efficiency was a key driver for the design of the mine plan as reduced energy usage results in reductions in operating costs and GHG emissions.

The GHGEA evaluated the MCCO Project's planned GHG mitigation measures against what may be considered best practice for an open cut coal mine in NSW. The evaluation considered a range of potential management measures targeting the key contributors to Scope 1 and Scope 2 emissions, including management of fugitive emissions, diesel use efficiency and electricity use efficiency. A summary of the measures found by Mangoola to be both technically feasible and financially reasonable for the MCCO Project, and which are therefore proposed to be implemented, is provided in **Table 6.36**. The detailed evaluation of all measures is provided in **Appendix 22**.

Table 6.36 Proposed Scope 1 and Scope 2 Greenhouse Gas Mitigation Measures

Proposed Mitigation Measure	Application to the MCCO Project
Limiting the length of material haulage routes to reduce diesel usage and associated emissions	Length of haulage routes has been optimised to minimise dust, noise and fuel use.
Optimising ramp gradients to reduce diesel usage and associated emissions	Ramp gradients have been optimised according to pit geometry parameters.
Continually improve the fuel efficiency of haul trucks operating at the mine to reduce diesel use and associated emissions	Fuel use efficiency has been an important selection criteria when allocating existing equipment to operations. New fuel use technology will be considered should any new trucks be purchased over the life of the MCCO Project.
Payload management to reduce diesel usage and associated emissions	Payload will be constantly monitored and actively managed to maintain efficiency.
Increasing haul truck payload to reduce the number of truck loads required and consequently reduce diesel use and associated emissions	Light weight/higher load capacity trays are being considered on some truck models. These trays are a hard wearing, light weight tray, which are custom built to maximise payloads.
Reducing rolling resistance of haul roads to reduce diesel use and associated emissions	Haul roads are planned to be constructed of rock rather than of soil or subsoil material where practical and Mangoola selectively sources road materials which may include crushed rock for use in on-site roads to provide improved road surfaces and reduced rolling resistance.
Reducing idling times to reduce diesel use and associated emissions	Reducing idle times is an ongoing performance measure. Initiatives to reduce idle times will continue to be introduced over the life of the MCCO Project.
Scheduling activities so that equipment and vehicle operation is optimised to reduce energy usage and associated emissions	Scheduling activities to optimise plant and vehicle operation is a routine activity. Mangoola will continue to prepare long, medium and short term plans to optimise production.
Seek to continually improve the fuel efficiency of mine equipment during the purchase of new equipment	Fuel use efficiency has been an important selection criteria when allocating existing equipment to operations. New fuel use technology will be considered should any new trucks be purchased over the life of the MCCO Project.
Blasting strategies to improve extraction and processing energy use efficiency and reduce associated emissions	Through seam blasting will be employed to minimise the need for ripping and parting.
Maximising resource recovery efficiency to maximise energy use efficiency and reduce associated emissions	Long, medium and short term operational plans will be developed to optimise the recovery of approved resources.

Proposed Mitigation Measure	Application to the MCCO Project
Working machines to their upper design performance to optimise energy usage and associated emissions	Glencore's business objectives support and promote effective equipment utilisation and performance rates.
Preventing unnecessary water ingress to reduce pump energy usage and associated emissions	The surface water management system is designed to maximise separation of clean and dirty water systems. Clean water is diverted away from mining areas where practicable, consistent with the mine water management system design outlined in **Section 6.7**.
In-pit servicing to reduce diesel usage associated with transporting equipment	In-pit servicing is a current operational practice that will continue.
Use of chemical dust suppressants to reduce energy consumption by water carts	Dust suppressants will be used on roads at Mangoola.

Glencore, the owner of Mangoola, is committed to transitioning to a low-carbon economy, and has recently announced publicly that it will limit coal production broadly to current levels. The MCCO Project fits within Glencore's production cap commitment as it is focused on sustaining current coal production, and is not proposing an increase in annual production or output.

Glencore recognises that over the next 20 years the percentage of the energy generation market supplied by coal is predicted to decline. As the MCCO Project meets an existing demand, and fits within Glencore's committed production cap, Glencore considers that the MCCO Project is aligned with the global energy market.

In response to recent commentary and court cases on climate issues related to coal projects, Glencore has prepared a position paper for the MCCO Project. This position paper is provided as **Appendix 25**.

6.18.4 Scope 3 GHG Emissions

Scope 3 emissions are indirect emissions that are associated with the MCCO Project, but occur at sources owned or controlled by other entities. Scope 3 emissions simply acknowledge that products will continue to generate greenhouse gas emissions as they move through a value chain. Approximately 96 per cent of the Project's Scope 3 emissions are forecast to be generated by electricity generators burning coal in countries such as Australia, China, India, Japan, Malaysia, Philippines, South Korea and Taiwan.

Most of the product coal generated by the MCCO Project will be exported to countries who are parties to the Paris Agreement. These countries have, or are in the process of developing, domestic laws, policies, and measures to mitigate greenhouse gas emissions.

Glencore has also completed a number of research projects related to low emission technologies, including direct injection coal engines, biochar, nanotechnology, chemical looping and membrane research for power station applications. Glencore is also a foundation member of the International Energy Centre with a number of Australian Universities which offers a Masters of Energy Studies.

6.19 Hazard Analysis

A Preliminary Hazard Analysis (PHA) has been prepared by Umwelt in accordance with the SEARs for the MCCO Project (refer to **Table 4.3**). The SEARs require an assessment of the likely risks to public safety, paying particular attention to the handling and use of any dangerous goods.

The types and quantities of hazardous materials to be stored for the MCCO Project will not change from the types and quantities of hazardous materials currently stored on site for the existing Mangoola Coal Mine. However, the storage locations of some of these hazardous materials may change as a result of the MCCO Project, including the possible relocation of the explosives magazine and stores of ammonium nitrate (AN) and ammonium nitrate emulsion (ANE). The PHA therefore focussed on assessing the proposed changes in storage locations.

A summary of the key findings of the PHA is provided in this section and the full report is provided in **Appendix 23**.

6.19.1 Methodology

An assessment of potential hazards and risk associated with the MCCO Project was conducted with reference to the relevant NSW Government hazardous industry planning guidelines. The purpose of the assessment was to:

- establish the expected change in storage, handling and transport of dangerous goods associated with the MCCO Project
- identify potential hazard events that could lead to off-site impacts associated with the change in storage, handling and transport of dangerous goods
- determine limitations with regard to storage quantities, on-site locations and traffic movements for dangerous goods to minimise the possibility that the proposed design and subsequent operations could lead to off-site impacts exceeding DPE land use criteria.

6.19.1.1 Types and Quantities of Hazardous Materials

As discussed above, the types and quantities of hazardous materials to be stored for the MCCO Project will not change from the types and quantities of hazardous materials currently stored on site for the existing Mangoola Coal Mine. However, the storage locations of some of these hazardous materials may change as a result of the MCCO Project. **Table 6.37** contains a list of hazardous materials stored and used at the Mangoola Coal Mine.

The assessment of the potential hazard associated with these changes was undertaken in accordance with NSW Hazardous Industry Planning and Assessment Guidelines (DoP 2011c).

Table 6.37 MCCO Hazardous Materials Inventory

Material	Storage Location	Storage Type	MCCO Project Storage Capacity
Ammonium Nitrate Emulsion	Orica Compound	Above ground tank	80 T
Ammonium Nitrate	Orica Compound	Bulk	60 T
Diesel	Orica Compound	Above ground tank	60,000 L

Material	Storage Location	Storage Type	MCCO Project Storage Capacity
Detonators, boosters, lead line	Magazine	Mounded magazine	41 T
Diesel additive	Fuel Farm	Drums	450 L
Diesel	Fuel Farm	Above ground tanks	712 kL
LPG	Contractor Yard	Cylinders	100 L
Paints, insect repellent etc.	Contractor Yard	Aerosols	<100 kg
Paints, solvents etc.	Contractor Yard	Packages	<500 kg
Adhesives and hardeners	Contractor Yard	Packages	<100 kg
General Purpose Cleaner	Maintenance	Drums	450 L
Adhesives and hardeners	Maintenance	Packages	<100 kg
Paints, insect repellent etc.	CHPP	Aerosols	<100 kg
Paints, solvents etc.	CHPP	Packages	<500 kg
LPG	Main Store	Cylinders	600 L
Paints, insect repellent etc.	Main Store	Aerosols	<100 kg
Paints, solvents etc.	Main Store	Packages	<500 kg
LPG	Main Building	Above ground tank	7,500 L
Paints, insect repellent etc.	Main Building	Aerosols	<100 kg
Paints, solvents etc.	Main Building	Packages	<500 kg

6.19.2 Assessment

As discussed above, the types and quantities of hazardous materials to be stored in the MCCO Project Area are expected to be consistent with those currently stored at the Mangoola Coal Mine, however, the storage locations of these hazardous materials may change. The potential impact to off-site land users as a result of the relocation of the hazardous material storages therefore requires assessment.

Under SEPP 33 a preliminary risk screening of a proposed development is required to determine the need for further assessment via a PHA (refer to **Appendix 23**). The preliminary risk screening compares the proposed hazardous material storage quantities, as well as transport frequencies and quantities, with SEPP 33 screening thresholds.

The risk screening and classification process indicated the storage quantities of ammonium nitrate (AN) and ammonium nitrate emulsion (ANE) exceed the screening threshold for Class 5.1 materials. The MCCO Project is therefore considered potentially hazardous, requiring a PHA to be prepared.

The estimated frequencies and quantities of hazardous materials to be transported to the MCCO Project Area will remain at the same levels associated with the existing approved operation. Therefore, with regard to transportation of hazardous materials no further assessment is required.

6.19.2.1 Hazardous Materials Storage

Mangoola has identified that it may be necessary to relocate the hazardous materials storage facilities from the Approved Project Area to the MCCO Additional Project Area. This relocation would be undertaken to provide ready access to these materials for use in the mining operations. The facilities would be relocated into a suitable location within the MCCO Additional Project Area. To ensure the risks posed to the surrounding land users associated with the relocated storages are appropriately mitigated, the hazard analysis identified the required buffer distances between the hazardous materials stores and private or publicly accessible land. If the hazardous materials storage facilities are relocated it will be to a location within the MCCO Additional Project Area that provides for the required buffer distances to be achieved.

Table 6.38 shows the required separation distances from off-site land users to ensure no off-site impacts associated with the hazardous materials storages. Based on these buffer distances the areas within the MCCO Additional Disturbance Area that are suitable for location of these storage facilities have been identified (refer to Figure 4.1 in **Appendix 23**). The storage facilities may be located anywhere within these areas.

Table 6.38 Minimum Separation Distances

Storage	Hazard	Minimum Distance to Off-Site Land User (m)
Magazine	Explosion	500 [1]
AN/ANE	Toxic release	1000 [2]

Note 1: Based on *Applying SEPP 33* Figure 5 – Class 1.1 Explosives Overpressure Effects
Note 2: Based on *Multilevel Risk Assessment* IAEA Table III – Effect Categories – Maximum Distance and Area of Effect

With the incorporation of these minimum buffer distances into the design of the relocated storages, the assessment of risk associated with the storage of hazardous materials found that the level of risk to surrounding land users is tolerable. Therefore, the MCCO Project is not considered hazardous as defined by SEPP 33.

6.19.3 Management and Mitigation

The qualitative risk assessment undertaken for the MCCO Project identified a range of technical control measures and non-technical safeguards and procedures that will be put in place to eliminate or mitigate the level of risk associated with the operation of the facility.

The technical control measures that are currently or will be implemented as part of the MCCO Project include:

- locate the Class 1.1 explosives and AN/ANE storages in accordance with the buffer distances specified in **Table 6.38**
- ensure that when relocated, the separation distance between Magazine and the AN/ANE store is maintained in accordance with the Australian Explosives Industry and Safety Group code for storage of UN3375 (ANE) (January 2015) and other relevant standards and codes
- design of diesel tanks and refuelling systems in accordance relevant standards and codes

- review hazardous area classification for relocated flammable liquids, flammable gases and LPG storages
- design of hazardous materials storage area surface drainage systems to prevent spills or runoff from storage areas entering surrounding land/waterways
- storage of dangerous goods in dangerous goods compliant stores (in accordance with relevant Australian Standards) and appropriate segregation of incompatible dangerous goods.

The non-technical safeguards and procedures identified in **Appendix 23** include:

- update the Mangoola emergency response plans and security plans in consideration of any relocated hazardous materials storages
- implement appropriate housekeeping to minimise combustible materials within 30 m of explosives storages, AN/ANE and combustible/flammable liquids stores
- on site speed limits and designated traffic flow directions to consider the new storage locations
- all equipment/vehicles associated with the handling of explosives and AN/ANE are to be regularly inspected and maintained fit for duty in accordance with relevant standards
- all personnel involved in the handling and storage of explosives and AN/ANE are to be appropriately trained
- ongoing implementation of appropriate hot work/safe work procedures for works in the vicinity of hazardous materials.

6.20 Bushfire

The SEARs for the MCCO Project require an assessment of the likely risks to public safety paying particular attention to potential bushfire risks applicable to the MCCO Project (refer to **Table 4.3**).

This section of the EIS provides a description of the existing bushfire management practices at Mangoola Coal Mine, an assessment of the potential bushfire hazards applicable to the MCCO Additional Project Area and the proposed bushfire management for the MCCO Project.

6.20.1 Existing Bushfire Management

Bushfire risk is currently managed at Mangoola Coal Mine under the Mangoola Open Cut Bushfire Management Plan (2017-2021). The approved Bushfire Management Plan was developed in consultation with the NSW Rural Fire Service (RFS), the RFS was also consulted in relation to the MCCO Project (refer to **Section 5.4.5**). The Bushfire Management Plan covers the Mangoola Coal Mine and specified buffer land. Bushfire mitigation and management measures applicable to the existing Mangoola biodiversity offset areas are detailed within the Biodiversity and Offset Management Plan and Strategy.

Substantial vegetation clearing has previously been undertaken across the Mangoola Coal Mine site and the surrounding area, due to the existing approved mining operations and a history of agricultural land uses. The surrounding land use is cleared grazing land and forested land, heavily forested areas exist associated with Manobalai Nature Reserve to the west, south-west and north-west of the site, forested areas to the north on elevated terrain and cleared country associated with Wybong Creek beyond. To the east of the site is lightly forested, with cleared lands associated with the Hunter River and Sandy Creek. To the south of the site is predominately cleared country associated with the Hunter and Goulburn Rivers.

In relation to the MCCO Additional Project Area, the landscape to the west and east is largely cleared agricultural land along the Wybong Creek and Big Flat Creek respectively, with dry sclerophyll forested areas occupying elevated terrain to the north and north-west. The area directly south is occupied by the existing Mangoola Coal Mine.

Parts of the Project Area, including the MCCO Additional Project Area are identified as containing bushfire prone land by MSC's Bushfire Prone Land map (RFS, 2016) (refer to **Figure 6.43**). It is noted that active operational areas within the existing Mangoola Coal Mine continue to be mapped as bushfire prone, although some of these areas have now been cleared of vegetation and the MCCO Additional Project Area would be subject to further clearing activities. The forested area to the south and west of the site support a potentially significant fuel load capable of sustaining and spreading bushfire and represents the most significant bushfire threat to the Mangoola Coal Mine site. Areas of forest/woodland vegetation formations to the north and east within and adjacent to the site also represent a potential linkage between vegetated areas within and adjoining the MCCO Project Area, which has the potential to support the spread of bushfire.

The objective of the Bushfire Management Plan is:

- the protection of life and safety, property and infrastructure, and the environment
- to demonstrate and fulfil the requirements of the existing Project Approval
- provide Mangoola with an emergency response plan in the event of a wildfire
- a document to identify assets at risk of bushfire impact at Mangoola Coal Mine, and to prioritise suitable treatment options.

The ongoing bushfire risk and management planning phases undertaken at the Mangoola Coal Mine under the Bushfire Management Plan are as follows:

- Strategic Phase – Regional scale planning and management by the Hunter Valley Bushfire Risk Management Committee
- Tactical Phase – Local scale, which acts as the conduit between the overall strategic planning objectives and the on-ground operational actions
- Operational Planning Phase – Independent actions broadly directed or informed by the Tactical phase
- Treatment Phase – Treatments carried out by identified responsible person in the works plan
- Post Treatment Monitoring Phase.

6.20.2 Assessment

6.20.2.1 Bushfire Threat Assessment

A bushfire threat assessment has been completed to identify the bushfire threat across the MCCO Project Area based on the likely response of fire to fuel loads, slope and aspect. The assessment involved assessing the vegetation formations and the slope of the land to determine the appropriate Asset Protection Zones (APZs) for the MCCO Project as required in accordance with the methods prescribed in Planning for Bushfire Protection (PBP) 2006 (NSW Rural Fire Service 2006). It is noted that PBP 2006 was developed to provide a guide to the necessary planning considerations when developing areas for residential use which are likely to be affected by bushfire. Similarly, no specific set back distances are prescribed for industrial

buildings in bushfire prone areas, nor does the Building Code of Australia (BCA) provide any bushfire performance requirements for Class 5 – 8 and 10 buildings (including offices, car park, trade buildings, non-habitable buildings etc.). Notwithstanding, all development is required to be consistent with the aims and objectives of PBP. While the requirements of PBP 2006 do not specifically apply, the methods for calculating APZs have been applied when determining the relevant APZs to be applied at Mangoola Coal Mine, under the approved Bushfire Management Plan.

6.20.2.2 Vegetation Formations

There are a range of bushfire prone vegetation types within the MCCO Project Area. The broad vegetation types include grasslands (managed, grazed agricultural grasslands and derived native grasslands), rehabilitation areas (grassland and woodland communities), forests and woodland areas (generally to the south), sedgelands/lowland areas (soils with high moisture content dominated by exotic grasses, exotic sedges and occasional woody shrubs) and grassy woodlands (box and ironbark trees over grassland). The vegetation types have differing attributes such as fuel accumulation and moisture content, and are managed on site to ensure appropriate bushfire strategies are implemented. The corresponding fuel load associated with the vegetation is reviewed annually and reported in the Annual Bushfire Hazard Inspection Report.

6.20.2.3 Slope Analysis

The gradient of a slope directly influences the rate of spread of a bushfire. Bushfire will accelerate when travelling uphill due to the fire preheating the fuel source through radiation and convection. The speed of a bushfire will increase as the slope of the land increases. Slopes also impact fire mitigation, specifically with regards to accessibility and land erosion.

At the local scale, the site terrain grades from lower slopes and plains (flat to <5 degrees) and rises to steep to very steep slopes in the bushland areas to the west and north, and on the rehabilitation batters (with the exception of final void retained highwalls and slopes) will be, on average, <10 degrees. To allow for the creation of micro-relief in topography, slope angles will be >10 degrees in some areas (refer to **Figure 6.44**).

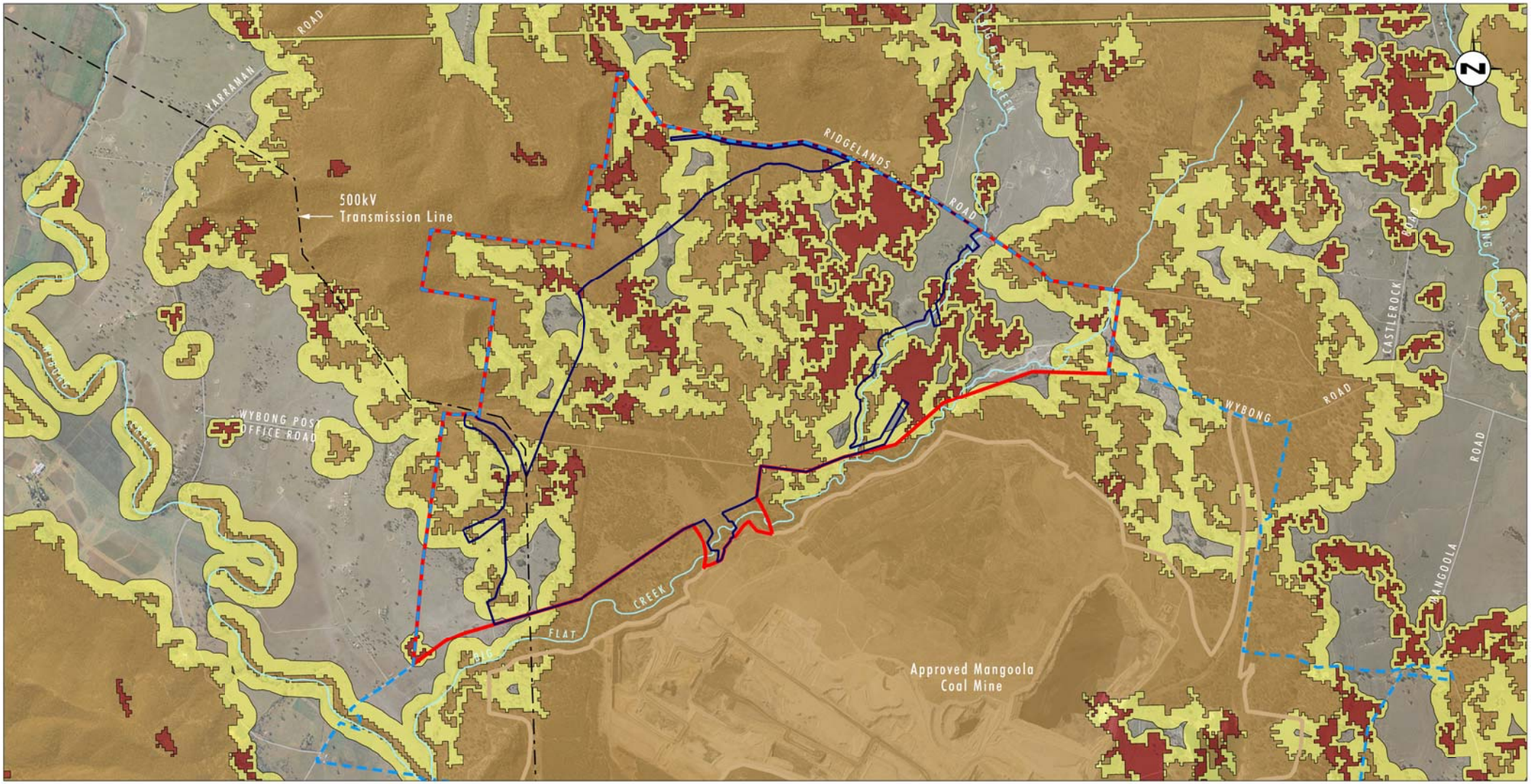


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), NSW Rural Fire Service (2016)

0 0.5 1.0 2.0km

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Bush Fire Prone Land:

- Vegetation Buffer
- Vegetation Category 1
- Vegetation Category 2

FIGURE 6.43

Muswellbrook Shire Council
Bushfire Prone Land Map

File Name (A4): R13/4004_269.dgn
20190624 11.49

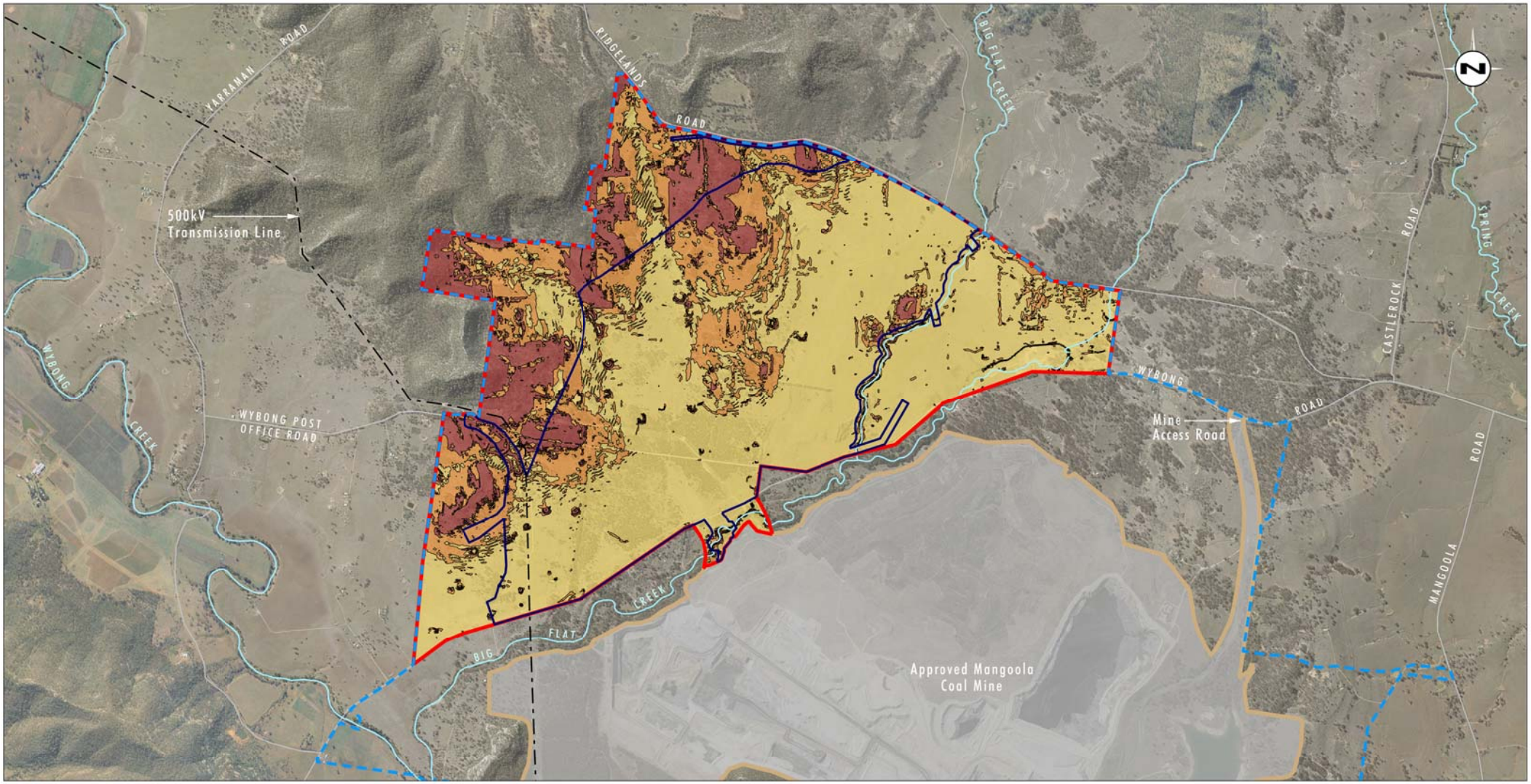


Image Source: Glencore (April 2018)
Data Source: Glencore (2019), EMM (2019)

Legend

- MCCO Project Area
- Approved Mangoola Coal Mine Disturbance Area
- MCCO Additional Project Area
- MCCO Additional Disturbance Area

Slope:

- 0-5%
- 5-10%
- Greater than 10%

FIGURE 6.44

Slope Analysis of MCCO Additional Project Area based on Existing Topography

File Name (A4): R13/4004_268.dgn
20190516 16.45

6.20.2.4 Asset Protection Zones

PBP 2006 states that 'where a bushfire hazard exists on or adjacent to a development site, an Asset Protection Zone (APZ) is to be established between the hazard and the asset'. Essentially, an APZ is a fuel reduced area surrounding a built asset or structure which minimises the impact of fire on that asset. APZs should be maintained so that bushfire fuels are minimised. PBP 2006 determines the minimum distances required for APZs based on the Fire Danger Index (FDI). The FDI for any particular region is based on a combination of the dominant air temperature, relative humidity, wind speed and drought. PBP 2006 assumes a worst-case scenario and applies FDI 100 (catastrophic) to the Hunter Region.

The Mangoola Coal Mine site is currently maintained at varying levels of bushfire risk management to reduce fuel loads and restrict the movement of bushfire across the site. To manage hazard reduction, bushfire management zones are established. These zones are categorised as:

- Asset Protection Zone (APZ):

  APZs are designed to reduce the potential for flame, radiant heat or embers to ignite a structure and to create a defendable space where occupants or fire-fighters can protect that asset. Vegetation within an APZ is generally managed at a high intensity, to levels below 5 t/ha to minimise the fuel available to a bushfire. Where reasonable and feasible, APZs should be managed mechanically and to the minimum standards as detailed in the RFS document 'Standards for Asset Protection Zones' (i.e. groundcover managed to <100 mm high, removal of fire fuels, create canopy separation and retain <15 per cent canopy in APZ). Slashing regularly is ideal.

- Strategic Fire Advantage Zone (SFAZ):

  SFAZ are located in areas that provide bushfire suppression in order to reduce the spread and intensity of fire. A range of activities can be implemented including slashing, maintaining fire breaks or targeted grazing to reduce fuel loads with the aim of reducing the speed and intensity of a future bushfire. The SFAZ aims to reduce the risk of fires spreading within the site and assists in stopping fires spreading onto adjoining lands. SFAZs are typically located close to assets and are used to complement APZs. They also provide areas that assist with making bushfire suppression activities more effective and safer for firefighters. Sustainable agricultural offsets and other landholdings within the Mangoola Coal Mine are considered SFAZ.

  Where reasonable and feasible, fuel reduction and management are applied to the SFAZ to reduce fire spread, either through slashing or periodic grazing. Suitable vehicle access is also maintained through these areas.

- Land Management Zone (LMZ):

  LMZs are areas that are managed to meet relevant ecological, conservation and land management objectives. Biodiversity corridors, offset areas and buffer grazing lands within the Mangoola Coal Mine site are considered LMZ. Where reasonable and feasible, fire protection within the LMZ could include grazing to reduce fuel loads.

  Should the MCCO Project be approved these land management zones would be established across the MCCO Additional Project Area (where relevant) in order to manage bushfire risk. The MCCO Project will utilise the existing and approved infrastructure at Mangoola Coal Mine, with the exception of the proposed Wybong Road and Big Flat Creek overpass and other minor elements as described in **Section 3.8**. No new significant infrastructure requiring asset protection is proposed. The APZs currently established applicable to the existing infrastructure areas at Mangoola Coal Mine, as outlined in **Table 6.39**, will be retained as part of the ongoing operations associated with the MCCO Project.

Table 6.39 Bushfire Management Plan – Mangoola Coal Mine Infrastructure APZs and Maintenance Commitments

Asset	APZ
Main Infrastructure Area (MIA), admin buildings, workshops, water treatment plant, wash bay, substation, laydown and storage areas, tyres storage, coal handling and prep plant, stacker and stockpile	Minimum 30 m
Fuel storage (HAZMAT)	Minimum 100 m
Conveyors	Minimum 10 m
Pit infrastructure areas	Maintain access
Rail loadout and associated infrastructure, booster station, rail load out fuel storage, water rail loop treatment plant, rail loop	Minimum 10 m APZ (visually monitor grassland fuels in SFAZ areas monthly during declared fire season). Access on all designated roads, tracks and trails, maintained and monitored annually.
Pumping and associated infrastructure, Hunter Water Pump, on-site dams	Minimum 10 m APZ (visually monitor grassland fuels in SFAZ areas monthly during declared fire season). Access on all designated roads, tracks and trails, maintained and monitored annually.
Electricity lines, fence lines and access roads	Minimum 6 m firebreak on external fences (visually monitor grassland fuels in SFAZ areas monthly during declared fire season. Access on all designated roads, tracks and trails, maintained and monitored annually. Power line easements maintained by power supply company.
Native vegetation areas and habitat for native species (grasslands, woodlands, forest, wetlands/dams)	Visually monitor grassland fuels in SFAZ areas monthly during declared fire season. Access on all designated roads, tracks and trails, maintained and monitored annually. Back burning undertaken if required (subject to assessment).
Rehabilitation areas	Minimum 10 m APZ to perimeter of rehab areas. Access on all designated roads, tracks and trails, maintained and monitored annually.

The proposed realignment of the portion of Wybong Post Office Road and electricity and telecommunication realignment works will include the removal of vegetation to establish appropriate easements. These easements will be maintained by the asset owner to reduce the risk of bushfire to this relocated infrastructure.

6.20.2.5 Access

All existing infrastructure areas are accessible by all-weather access roads. Property owned by Mangoola has multiple access points with internal roads and bushfire trails providing access for four wheel drive vehicles. Operational areas are inspected regularly in accordance with the Bushfire Management Plan to assess the need for maintenance of existing roads and fire trails. Access across the site and the MCCO Additional Project Area will continue to be assessed and maintained as the MCCO Project progresses in accordance with the Bushfire Management Plan.

6.20.2.6 Water Supply

The existing water management network (which will be extended to the MCCO Additional Project Area) provides adequate water supply for firefighting purposes. The site has a large water supply stored in tanks and dams, which is suitable for both aerial and ground firefighting support. This would provide a permanent and dedicated water supply source during a fire event.

Water supply is monitored so that there is sufficient water available for bushfire response.

6.20.2.7 Emergency Response

Mangoola has an established emergency procedure in place in the event of a bushfire, which is detailed in the Bushfire Management Plan and the Operational Brigade Map. Bushfire threat applicable to the Mangoola Coal Mine will continue to be managed in accordance with the Bushfire Management Plan. The Bushfire Management Plan will be revised to include land management practices to be applied within the MCCO Additional Project Area, in consultation with the RFS.

In the event of an emergency the NSW RFS Hunter Valley Control Centre is contacted, with local firefighting support located at Denman (response time approximately 15 minutes) and Muswellbrook (response time approximately 30 minutes). Muswellbrook also has resources to respond to a HAZMAT emergency events should it be required.

With the continued implementation of the bushfire management controls under the Bushfire Management Plan, which is subject to continual review and update, in consultation with the RFS, it is considered that bushfire risk can continue to be appropriately managed as part of the MCCO Project.

6.20.3 Management and Mitigation

To manage bushfire risk for the MCCO Project, Mangoola will update and implement the existing Bushfire Management Plan in consultation with the RFS.

6.21 Waste Management

The SEARs for the MCCO Project identify waste management as an issue to be considered in the EIS (refer to **Table 4.3**). There are several different types of wastes that will be produced by the MCCO Project. **Section 3.5** outlines the approach for the ongoing management of reject material and tailings from coal processing, while the management of waste water from the water management system is discussed in **Section 6.7** and overburden management is discussed in **Section 6.17** The focus of this section is to identify and discuss the management of other waste material that will be produced as part of the MCCO Project.

6.21.1 Waste Management Principles and Processes

As an existing operation, Mangoola Coal Mine currently has a well developed and implemented waste management plan. The existing waste management plan will be updated to incorporate the MCCO Project. The existing plan is based on the following waste management principles that will be updated and will continue to be applied in the management of waste materials generated by the construction and operation of the MCCO Project:

- waste avoidance through the minimisation of waste generation
- waste re-use
- waste recycling
- waste removal and disposal (all waste that cannot be reused with the exception of inert wastes which may be disposed of on-site within mining areas with the approval of the EPA and used large tyres which will be buried in controlled areas within mining areas with the approval of the EPA).

The underpinning strategies for management of waste are focused on minimisation through cleaner production and the aforementioned principles, as well as the appropriate training, segregation, storage and disposal of waste generated on site. The minimisation of waste as part of the MCCO Project will be achieved through the following processes:

- consideration of potential waste streams in procurement of materials
- identification and segregation of re-usable and recyclable materials
- education of workforce on waste avoidance, waste stream segregation and recycling
- processing materials for recycling
- considering environmental impacts for waste removal and disposal processes
- waste monitoring and inspection regimes.

6.21.2 Predicted Waste Streams

The waste that will be generated during the construction and operation of the MCCO Project will fall into the following waste classes (DECCW 2009 Waste Classification Guidelines):

- General Solid Waste (putrescible and non-putrescible) including construction waste, general office waste and domestic waste
- Liquid Waste, of which ablution (e.g. waste water from bathhouses, sinks etc.) and operational wastes (e.g. oils and coolant fluids following maintenance) are included
- Hazardous Waste, which includes aspects of construction and operational waste (e.g. coal tar or containers that have previously contained a substance of Class 1 or 5 under the definition of the Transport of Dangerous Goods Code) (National Transport Commission 2011)
- Special Waste, e.g. waste tyres and clinical/first aid waste.

The following sections discuss the key waste streams that will be generated as a result of the construction and operational phases of the MCCO Project.

6.21.2.1 Construction Waste

A number of construction activities are likely to generate inert waste such as concrete, steel and electrical cabling including:

- the construction of the haul road overpass over Big Flat Creek and Wybong Road
- the realignment of a section of Wybong Post Office Road
- the construction of the water management system within the MCCO Additional Project Area
- the relocation, construction and decommissioning of several sections of electrical transmission lines.

Inert waste materials generated by these activities will be recycled where practicable or disposed of at an appropriate facility, with some inert wastes (e.g. clean concrete waste) to be disposed of in appropriate locations within mining areas within the MCCO Project Area. Any excavated material generated during construction will be re-used on site.

Other waste that may be generated during the construction phase of the MCCO Project will include office, domestic and ablution waste, as well as a small amount of waste associated with general maintenance and workshop activities.

6.21.2.2 Operational Waste

Records of waste disposal for the existing Mangoola Coal Mine show that in 2018 the operations disposed of 1576 tonnes of waste off site, with 1376 tonnes of waste (or approximately 87 per cent) recycled.

As there are no proposed changes to the existing approved operational employee levels or the maximum production limits the quantity of waste generated is anticipated to be similar to that currently generated by the existing Mangoola Coal Mine. As mining progresses into the MCCO Additional Project Area and is completed within the remaining approved areas at Mangoola Coal Mine the quantity of waste generated by the MCCO Project is likely to be less than the waste currently generated by the Mangoola Coal Mine.

The key components of operational waste are discussed below.

Office Waste

There will be minimal office waste generated by the MCCO Project. However, waste that is generated will consist of waste paper (comprising general office paper, photocopy paper), office stationery and paper from other sources. Other wastes will include cardboard and packaging, and toner cartridges from printers, photocopiers and facsimile machines. Much of this waste will be recycled in accordance with the waste management principles outlined above; the remainder will be disposed of appropriately.

Domestic Waste

Domestic waste will be generated by employees and contractors at the site and will include food scraps, aluminium and steel cans, glass, plastic and paper containers and putrescible waste. The quantity of this waste is relatively small in comparison to total waste. These wastes will be recycled, where practicable.

Hazardous Waste

Hazardous wastes will include those generated from workshop and equipment maintenance activities, such as rags, gloves, packing materials, machinery components, waste metal, empty drums, oils, lubricants,

hydrocarbons and paints. These wastes will be recycled where practicable and otherwise disposed of via a licensed facility.

Ablution Waste

Waste from toilets, bathhouses, kitchen sinks and basins are included as ablution waste with all sewage wastewater managed using the existing treatment facilities. The temporary construction facilities will have pump out sewage systems.

Special Waste

Special wastes are those that have unique regulatory requirements. Special wastes associated with the MCCO Project will include tyres associated with the mining equipment. Large waste mining equipment tyres are proposed to be disposed of in controlled areas on site within the open cut pits, subject to the approval of the EPA.

Should any asbestos be identified on site Mangoola will commission an appropriately licensed contractor to remove and dispose of this material in accordance with legislative requirements.

Exploration Drill Cuttings and Drilling Fluids

Exploration drilling cuttings and drilling fluids as part of any exploration drilling program associated with a Mangoola Coal Mining Lease, Exploration Lease or Assessment Lease may be disposed of within the MCCO Project Area tailings facilities, subject to confirmation that the material within any exploration drilling cuttings and drilling fluids will not harm the environment when mixed with the tailings.

6.21.3 Mitigation Measures

To manage waste generated by the MCCO Project, Mangoola will update and implement the existing site-specific Waste Management System.

Ongoing management of waste as part of the MCCO Project will be through the implementation of the site-specific Waste Management System, and will include details regarding:

- waste streams and their disposal requirements
- storage and treatment requirements
- re-use, recycling and waste minimisation opportunities
- mechanisms for monitoring waste volumes and performance
- training and induction requirements
- the requirement to consider waste management practices within the site Environment and Community Operational Risk Assessment
- reporting requirements
- incident and complaint management
- accountabilities for waste management.

The Waste Management System will also detail the methods for monitoring waste volumes and will include measurable indicators.

6.22 Public Safety and Health

The SEARs for the MCCO Project identify public safety as an issue to be considered in the EIS (refer to **Table 4.3**) including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks, blasting impacts and the handling and use of any dangerous goods. Risk associated with dangerous goods and bushfire risks are assessed in **Section 6.19** and **Section 6.20** respectively. The focus of this section is to outline the process undertaken to identify and assess potential impacts on public safety, including human health, detail the key assessment finding in relation to these issues and identify where these issues are addressed in further detail within this EIS.

A risk screening based assessment approach to identifying potential adverse impacts on public safety, including health, was utilised during the assessment scoping phase and throughout preparation of this EIS. If a potential risk to public safety or human health was identified, further detailed assessment was completed as part of this EIS. The detailed assessment of each potential risk has been undertaken in accordance with relevant legislation and guidelines, and by appropriately qualified specialists. Where relevant, potential risks to public safety or human health have been assessed against accepted safety or health based assessment criteria established by the NSW Government. Where relevant criteria are predicted to be met or where NSW Government policy stipulates mitigation measures that are to be implemented (e.g. imposition of voluntary acquisition clauses in any development consent granted), no further detailed health risk assessment was determined to be required. This screening type of evaluation of public safety and health risks using published guidelines was undertaken considering the tiered assessment approach outlined in Environmental Health Risk Assessment – Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012).

The identified risks to public safety, including health and a summary of the key assessment findings relevant to the identified risk is provided in **Table 6.40**.

Table 6.40 Identified Risks to Public Safety and Associated Assessment Findings

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Noise	Human exposure to noise during construction	**Section 6.4** **Appendix 8**	Predicted noise levels resulting from construction of the MCCO Project are anticipated to be below the ICNG 'highly noise affected' criterion.
	Human exposure to acute and cumulative impact of noise during operation	**Section 6.4** **Appendix 8**	Fifty-seven private receivers had a 90th percentile prediction that exceeded the PNTL in at least one time period for at least one of the four stages modelled. Seven of these private receivers exceeded the PNTL by more than 5 dB and were deemed under the VLAMP to fall within the significant impact category. Under the VLAMP these seven private receivers would be afforded voluntary acquisition rights should the MCCO Project be approved. Additionally, one private receiver (25) that has acquisition rights under PA 06_0014 is not predicted to exceed significant impact criteria for the MCCO Project, however, Mangoola voluntarily propose to retain acquisition rights for this receiver. In addition to the receivers entitled to acquisition rights under the MCCO Project, 18 receivers are entitled to mitigation rights (receiver 25 is excluded from this count, as acquisition rights are to be retained). Additionally, six receivers that have mitigation rights under PA 06_0014 are not predicted to exceed mitigation criteria for the MCCO Project, however, Mangoola voluntarily propose to retain mitigation rights for these six receivers.
	Human exposure to low frequency noise causing annoyance	**Section 6.4** **Appendix 8**	Predictive noise modelling and monitoring confirms that low frequency noise modifying factor adjustments are not required for the MCCO Project as low frequency noise has not been identified as resulting in more annoyance than would normally occur from the level of noise generated. Predicted low frequency noise levels are not expected to increase as a result of the proposed operations within the MCCO Additional Project Area relative to the existing approved operations.
	Sleep disturbance from transient noises often with tonal characteristics	**Section 6.4** **Appendix 8**	The NIA found that there are no predicted exceedances of the LAF,max criterion of 52 dB at any private receivers for the MCCO Project and as such, no sleep disturbance impact predicted.
Air Quality	Human exposure to particulates (PM_{10} and $PM_{2.5}$)	**Section 6.5** **Appendix 9**	Refer to discussion in **Section 6.22.1**.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
	Human exposure to NO2 from blasting	**Section 6.5** **Appendix 9**	The assessment found that with the proposed blasting procedures in place, the MCCO Project is predicted to comply with the relevant criteria at all private receivers.
	Human exposure to diesel emissions	**Section 6.5** **Appendix 9**	Modelling of NO2 concentrations associated with diesel exhaust emissions indicate compliance with the relevant criteria at all sensitive receivers.
Water Contamination	Contamination of drinking water and health risks associated with human exposure	**Section 6.7** and **Section 6.8** **Appendix 11** and **Appendix 12**	Groundwater quality in the area has been compared to guideline values from the ANZECC (2000) guidelines for long-term irrigation, livestock watering (beef cattle) and the Australian Drinking Water Guidelines (ADWG) (NHMRC 2011). Monitoring has confirmed that with regard to the existing quality of groundwater within the local area salinity is the key constraint to groundwater use with the majority of Mangoola monitoring bores (96 out of 100) recording results in the moderately saline (1500 to 7000 mg/L) to highly saline (15,000 to 35,000 mg/L) range. The existing groundwater quality sampled is considered unsuitable for aquatic ecosystems, irrigation, or potable consumption. Some bores have a suitable salinity for stock watering (assuming that the water is used for watering beef cattle rather than dairy cattle). The Groundwater Assessment has not predicted any significant impacts to groundwater quality such that would impact on agriculture as a result of the MCCO Project. The Surface Water Assessment has not predicted adverse impacts on downstream water quality as a result of the MCCO Project and therefore there is minimal risk of contamination of surface waters. The MCCO Project presents a low risk of potential drinking water contamination. However, to address any residual concern about potential dust deposition impacts on drinking water tanks, private landholders living within a 4 km radius of the active mining area will be offered an inspection and if deemed required cleaning of residential rainwater tanks once per year. Private landholders living within a 4 – 6 km radius of active mining operations will be offered and inspection and if deemed required cleaning of residential rainwater tanks every two years, upon written request.
	Contamination of surface water and health risks associated with human exposure	**Section 6.7** **Appendix 11**	As discussed above, the MCCO Project is not predicted to result in adverse impacts on downstream water quality and therefore there is negligible risk of contamination of surface waters such that human health impacts could occur.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
	Contamination of groundwater and health risks associated with human exposure	**Section 6.8** **Appendix 11**	There is limited potential for groundwater contamination to occur as a result of hydrocarbon and chemical contamination. All refuelling activities will occur in areas with adequate bunding and/or provision for immediate clean-up of spills. All chemicals will be transported, handled and stored in accordance with relevant Australian Standards. These controls represent standard practice and a legislated requirement at mine sites for preventing the contamination of the groundwater regime. The Groundwater Assessment has not predicted any impacts to groundwater quality as a result of the MCCO Project and therefore there is negligible risk of contamination of groundwater such that human health impacts could occur.
Bushfire	Direct and indirect health risks associated with bushfire including risk to life	**Section 6.20**	The MCCO Project has been assessed in accordance with the aims and objectives of Planning for Bushfire Protection (NSW Rural Fire Service 2006). The MCCO Project Area has multiple access points with internal roads and bushfire trails providing access for four wheel drive vehicles. The site has a large water supply stored in tanks and dams, which is suitable for both aerial and ground firefighting support. This would provide a permanent and dedicated water supply source during a fire event. The MCCO Project will be managed in accordance with an updated bushfire management plan to be prepared and implemented by Mangoola in consultation with the RFS. The proposed bushfire management measures have been designed to appropriately manage bushfire risk as part of the MCCO Project.
Contaminated Land	Health related risks from human exposure to contaminated land	**Section 3.3.4.3, Section 6.15.3** and **Section 6.21**	The MCCO Project Area does not contain any areas of known contamination that may cause a significant risk of harm to human health or the environment. As with all activities that involve earthworks and mining, activities carried out as part of the MCCO Project have the potential to cause contamination if not properly managed. Consistent with the approach at the existing mine, controls will be put in place to manage this risk as part of the MCCO Project including appropriate chemical handling and storage procedures, appropriate waste management systems, spill and emergency response procedures and equipment, and regular inspection and reporting processes.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Blasting	Direct and indirect health risks associated with blasting including risk to life, air quality impacts and noise impacts	**Section 6.6** **Appendix 10**	Ground vibration and blast overpressure levels can be managed to meet relevant blast emission criteria at all sensitive receiver locations through appropriate blast design and the implementation of appropriate control measures. Risks to public safety associated with flyrock will be managed via the application of appropriate exclusion zones and road closures. Due to the substantial distances to residential receivers the issue of flyrock impact on the adjacent residential receivers is considered to be fully managed and the potential risks are considered negligible.
Dangerous Goods	Health risks associated with the storage, handling and disposal of dangerous goods	**Section 6.19** **Appendix 23**	A Preliminary Hazard Analysis has been undertaken for the MCCO Project in accordance with NSW Government guidelines. The types and quantities of hazardous materials to be stored for the MCCO Project will not change from the types and quantities of hazardous materials currently stored on site for the existing Mangoola Coal Mine. However, the storage locations of some of these hazardous materials may change as a result of the MCCO Project, including the possible relocation of the explosives magazine and stores of ammonium nitrate (AN) and ammonium nitrate emulsion (ANE). The potential impacts to off-site land users as a result of the relocation of the hazardous material storages have been considered. To ensure the risks posed to the surrounding land users associated with the relocated storages are appropriately mitigated, the hazard analysis identified the required buffer distances between the hazardous materials stores and publicly accessible land. Mangoola has committed to design the relocated facilities to incorporate these buffer distances. With these minimum buffer distances, the Preliminary Hazard Analysis found that the level of risk to surrounding land users is tolerable.

Issue Identification	Description of Risk to Public Safety or Health	Relevant Assessment	Summary of Key Findings
Waste	Health risks associated with the handling and disposal of waste including hazardous waste	**Section 6.21**	Waste management will be undertaken following Mangoola's Waste Management System. Hazardous wastes will include those generated from workshop and equipment maintenance activities, such as rags, gloves, packing materials, machinery components, waste metal, empty drums, oils, lubricants, hydrocarbons and paints. These wastes will be recycled where practicable and otherwise disposed of via a licensed landfill facility. The majority of wastes that cannot be reused or recycled will be transported off site by licensed waste management contractors. All licensed waste management contractors are required to have appropriate controls in place to manage risks in accordance with NSW Government guidelines. With these controls in place and considering the nature of hazardous wastes associated with the MCCO Project, the risk to human health associated with waste is expected to be low.
Social	Health risks associated with impact to the social wellbeing of the community including social equity issues such as employment, impacts to access and amenity	**Section 6.3** **Appendix 5**	The SIA engagement process found that there was the perception in the local community that the health and wellbeing of proximal landholders was being impacted by the MCCO Project in a number of different ways, including as a result of the physical environment (safe water, clean air, safe houses) and psychosocial factors e.g. stress and anxiety. The aspects relating to water and air are discussed above. With regard to mental health issues, a level of stress and anxiety was evident amongst some of the landholders sampled, particularly those located to the north of the MCCO Additional Mining Area. The process of assessment was also noted by some stakeholders to have heightened their levels of stress and anxiety, given the need to digest data/information/reports. The key area of focus was the landholders close to the north of the MCCO Additional Mining Area, whereas landholders that are further away from the site and that are predicted to have lower levels of impact have a lower level of risk. Mangoola has committed to implement specific measures as part of the MCCO Project to address this issue (refer to **Section 6.3**).

6.22.1 Particulate Matter

The World Health Organisation identifies air pollution as a major environmental risk to health. The measurement and monitoring of air pollution in Australia is governed by the National Environment Protection Measure for Ambient Air Quality (Ambient Air NEPM) (NEPC 1998). The Ambient Air NEPM provides goals for carbon monoxide, lead, nitrogen dioxide, ozone, sulphur dioxide and particulate matter. A key focus of the community, academia, industry and government agencies in Australia over the last several years, including a particular focus in the upper Hunter Valley, is particulate matter.

Particulate matter in air can be dust, smoke, plant spores, bacteria and salt. Human activities resulting in particulate matter include mining, burning of fossil fuels, transportation, agriculture, hazard reduction burning, incinerators, and the use of solid fuel for cooking and heating.

The size of particulate matter determines its potential impact on human health. Larger particles are usually trapped in the nose and throat and swallowed, whereas smaller particles ($PM_{2.5}$) may reach the lungs. Exposure to particle pollution is known to have an impact on human health, particularly for people with pre-existing health conditions. There is no known safe level of exposure where there is no potential for an impact on human health (WHO 2005).

The air quality guidelines adopted in NSW are those recommended by the EPA and are specified in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA 2016). These criteria were set to be consistent with the Ambient Air NEPM (NEPC 1998). The Ambient Air NEPM stated that its desired environmental outcome was '*ambient air quality that allows for the adequate protection of human health and well-being*'.

The VLAMP includes the NSW Government's policy for voluntary mitigation and land acquisition to address dust (particulate matter) impacts from state significant mining, petroleum and extractive industry developments. The VLAMP has air quality criteria in line with the NEPM standards and EPA criteria. These criteria set by the NSW Government have been used as the basis of the assessment of the potential impacts of health associated with particulate matter. It is noted that as discussed above, there is no known safe level of exposure where there is no potential for an impact on human health.

There have been a number of studies into air quality, in particular related to particulate matter, in the Hunter Valley. A paper titled Investigating the Health Impacts of Particulates associated with coal mining in the Hunter Valley (Dalton, C. *et al*, 2014) prepared for the Air Quality and Climate Change Journal focuses on calls for epidemiological investigations into the potential health impacts of coal mining in the Hunter Valley and the challenges that such studies face. The paper identifies some key findings relating to health impacts of particulates in the Hunter Valley including (excerpts below from Dalton, C. *et al*, 2014):

- while there has been much community concern about the health effects of pollution arising from coal mining in the Hunter Valley, it is apparent that, apart from small villages in close proximity to mines that are subject to heavy PM_{10} impacts, the pollution sources that are of greater concern for health are residential wood smoke, industrial and agricultural diesel combustion, and power generation, which contribute substantially to fine particle pollution

- the major impact of mining on this source of emissions may be the increasing use of diesel in mining vehicles and in coal transport including trucks, trains, port shipping and associated infrastructure

- air quality in the most populous areas of the Upper Hunter is good relative to international standards. However, it is important to safeguard the air shed against any deterioration in air quality. There is no clearly established threshold for adverse health impacts within the range of particulate levels encountered in the Upper Hunter.

6.22.1.1 Assessment

PM_{10} and $PM_{2.5}$ are the components of air borne particulate matter which are relevant to human health impacts. As discussed above, the NSW Government has set criteria for PM_{10} and $PM_{2.5}$ that are intended to protect human health.

There are no private sensitive locations which are predicted to experience exceedances of the annual average PM_{10} or $PM_{2.5}$ criteria at any stage of the MCCO Project. Post blast fume emissions are not expected to result in any adverse air quality impacts, based on model predictions which show compliance with air quality criteria and considering Mangoola Coal's existing blast management practices. Emissions from diesel exhausts associated with off-road vehicles and equipment are not expected to result in any adverse air quality impacts, based on model predictions which show compliance with air quality criteria. The MCCO Project is predicted to comply with the PM_{10} and $PM_{2.5}$ criteria specified in the VLAMP at all private sensitive receptor locations.

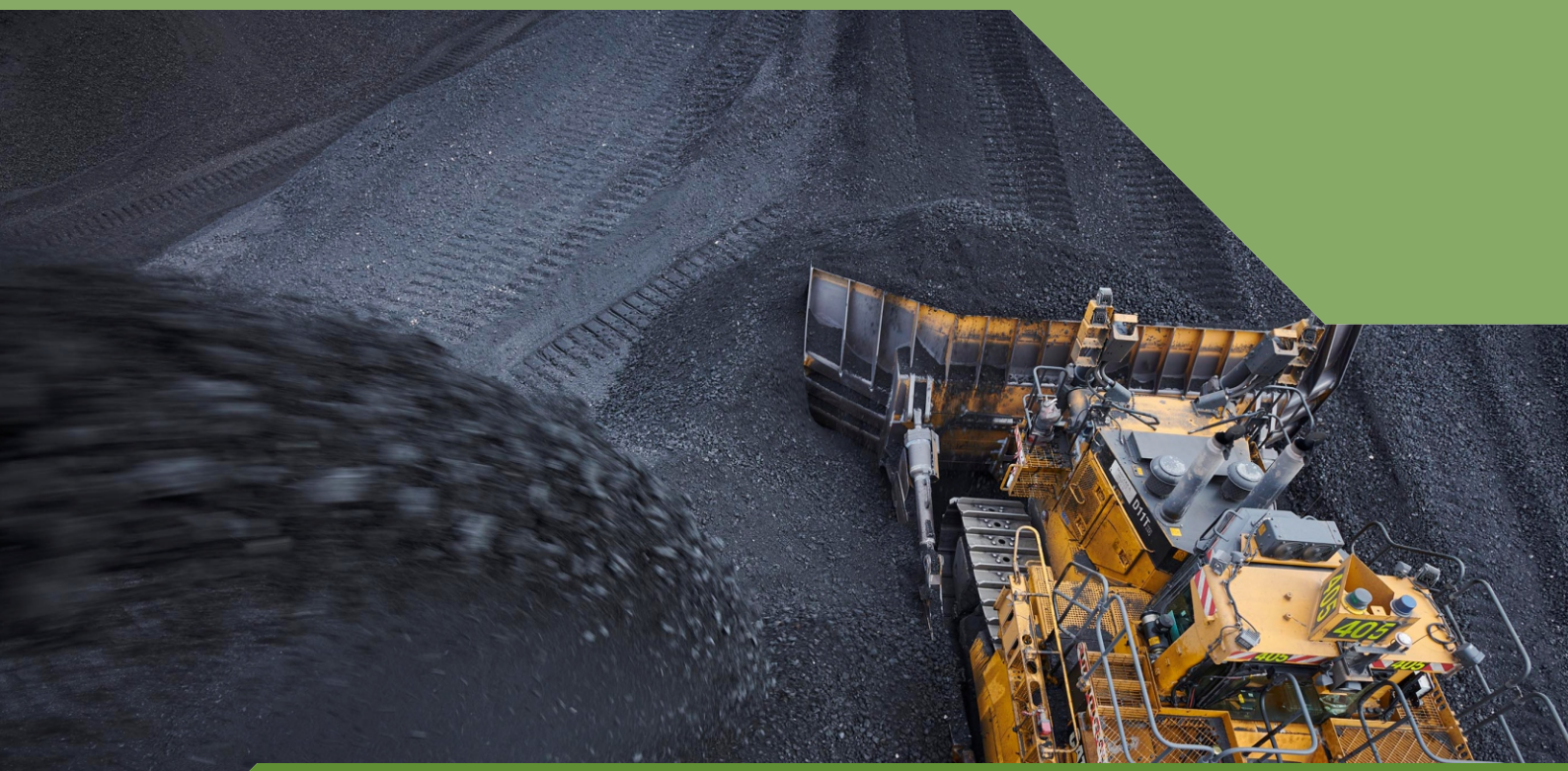
Maximum 24-hour average PM_{10} concentrations are predicted to meet the 50 $\mu g/m^3$ criterion at all but one sensitive receptor location (property 83) in all assessment years. This property is subject to voluntary acquisition under the existing approved Mangoola Coal Mine operations and is within the predicted noise voluntary acquisition zone for the MCCO Project. Further investigation showed that the MCCO Project would not be the primary cause of an exceedance. The predicted particulate matter impacts at property 83 do not trigger the voluntary mitigation or acquisition criteria in the VLAMP.

As for PM_{10}, concentrations of $PM_{2.5}$ will continue to be variable from day-to-day. There are typically a few days each year when $PM_{2.5}$ concentrations exceed the assessment criterion, with wood smoke being a key factor. This trend is expected to continue with or without the MCCO Project, based on model predictions showing that the MCCO Project's contribution to $PM_{2.5}$ concentrations would be relatively low. The modelling did indicate that the MCCO Project will contribute to, but will not be the primary cause of, an exceedance of the 24-hour average criterion at the location most likely to be influenced by emissions from the MCCO Project, being property 83 which is the closest property to the west of the existing Mangoola Coal Mine. As noted above, this property has existing acquisition rights.

A number of tenanted Mangoola owned residences surround the MCCO Project (refer to **Figure 1.5**). Mangoola will provide appropriate management of risk to the tenants including ongoing monitoring of air quality. This will include providing tenants with information regarding the dust levels in proximity to the residence and for properties owned by Mangoola, including within the lease appropriate clauses relating to the tenants ability to terminate the lease without penalty should they have air quality impacts.

It is also noted that the impacts of the MCCO Project on air quality have been valued in terms of the estimated health costs attributable to particulate matter emissions, relative to existing approved operations (refer to **Appendix 7**). These estimated health costs have been considered in the cost benefit analysis of the MCCO Project (refer to **Section 6.2**).

SECTION 7.0
Matters of National Environmental Significance



7.0 Matters of National Environmental Significance

As discussed in **Section 4.1.1**, on 21 January 2019 the MCCO Project was determined to be a Controlled Action which requires approval under the EPBC Act from the Commonwealth Minister for the Environment due to its potential impact on the following MNES:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands CEEC
- Tarengo leek orchid (*Prasophyllum* sp. Wybong) (note in NSW under the FBA this species is referred to as *Prasophyllum petilum* (refer to **Section 6.9**)
- regent honeyeater (*Anthochaera phrygia*)
- water resources – as the Project is likely to result in changes to groundwater and surface water and impact on surface water quality.

In addition, DoEE also considers the MCCO Project may result in a significant impact on:

- swift parrot (*Lathamus discolor*)
- grey-headed flying fox (*Pteropus poliocephalus*).

Under the bilateral agreement, the SEARs for the MCCO Project were reissued to include the assessment requirements from DoEE which were included in full as Attachment 3 of the SEARs. These are listed in **Section 7.1** along with an outline of where each of the requirements has been addressed in this EIS.

Detailed assessments have been undertaken as part of this EIS to assess the MCCO Project's potential impacts on these MNES. The following sections provide a summary of the key MNES assessment findings in relation to Attachment 3 of the SEARs which outlines DoEE's assessment requirements. The following summary should be read in conjunction with:

- the Biodiversity Assessment Report (BAR) (refer to **Appendix 13**) and **Section 6.9** of this EIS which discusses biodiversity impacts and the Assessment of Biodiversity MNES Impacts which is provided as **Appendix 24**
- the Surface Water Assessment (refer to **Appendix 11**) and **Section 6.7** of this EIS which discusses surface water impacts
- the Groundwater Impact Assessment (refer to **Appendix 12**) and **Section 6.8** of this EIS which discusses groundwater impacts.

It is noted that DoEE refers to the MCCO Project as the 'action'. For ease of response to the DoEE assessment requirements this section uses the action and MCCO Project interchangeably.

7.1 DoEE Assessment Requirements

A checklist of DoEE's assessment requirements as outlined in Attachment 3 of the SEARs and where they have been addressed in this EIS is outlined in **Table 7.1**.

Table 7.1 DoEE Assessment Requirements and Response

Requirement	Response and Section Where Addressed
The Applicant must consider each of the protected matters under the triggered controlling provisions that may be impacted by the action. Noting that the above species and communities may not be a complete list, it is the responsibility of the Applicant to undertake an analysis of the relevant impacts and ensure all protected matters that are likely to be impacted are assessed for the Commonwealth Minister's consideration.	All relevant matters have been considered and assessed in this EIS including consideration of all potential controlling provisions (refer to **Section 4.2.1**). To inform this assessment a protected matters database search was undertaken. Key assessments completed include the surface water (**Appendix 11**), groundwater (**Appendix 12**) and biodiversity assessments (**Appendix 13** and **Appendix 24**).
General Requirements	
The Environmental Impact Statement (EIS) must address the matters outlined in Schedule 4 of the EPBC Regulations and the matters outlined below in relation to the controlling provisions.	
The title of the action, background to the action of the action (*sic*) and current status.	The action is titled, "Mangoola Coal Continued Operations Project.' For the background to the action and the current status of the action refer to: • **Section 1.1** (Project Overview) • **Section 1.3** (Project History) • **Section 1.6** (Site Context) • **Section 2.0** (Approved Operations).
The precise location and description of all works to be undertaken (including associated off-site works and infrastructure), structures to be built or elements of the action that may have impacts on MNES.	Refer to **Section 3.0** which provides a description for the action.

Requirement	Response and Section Where Addressed
How the action relates to any other actions that have been, or are being taken in the region affected by the action.	Two previous referrals under the EPBC Act have been submitted for the approved operations at Mangoola Coal Mine which are described in **Section 2.0**. These included one prepared as part of the original mine approval (Reference number 2007/3228) and another for additional disturbance and activities arising from changes to mining operations in 2010 (Reference number 2010/5607). These Actions were determined not to be controlled actions in October 2008 and September 2010, respectively. The current application for approval under the EPBC Act relates to those elements of the MCCO Project that have not previously been referred. The MCCO Project is not related to any other actions.
How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES.	Refer to **Section 3.0** which provides a description for the action.
The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including: i. a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts; ii. a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; iii. analysis of the significance of the relevant impacts; and iv. any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	For biodiversity refer to the biodiversity MNES assessment in **Appendix 24**. For water refer to: • Groundwater – **Section 6.8** and **Appendix 12** • Surface Water – **Section 6.7** and **Appendix 11**.

Requirement	Response and Section Where Addressed
For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: i. a description, and an assessment of the expected or predicted effectiveness of the mitigation measures, ii. any statutory policy basis for the mitigation measures; iii. the cost of the mitigation measures; iv. an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing; v. the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	Refer to **Section 7.1.1**.
Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	A biodiversity offset strategy has been developed for the action following the requirements of the FBA. A discussion of the proposed strategy is provided in **Section 6.9** with further detail provided in **Appendix 13**. A discussion of the offset strategy outcomes with specific reference to MNES is provided in the biodiversity MNES Assessment in **Appendix 24**.

Requirement	Response and Section Where Addressed
Biodiversity (Threatened Species and Communities And Migratory Species)	
Significant impacts associated with proposed action on MNES are associated with the removal of native vegetation, in particular the removal of 691 of Prasophyllum sp. Wybong individuals and the loss of up to 256 ha of habitat critical to the survival of the Regent Honeyeater. These impacts must be appropriately offset for EPBC Act purposes.	
For each of the EPBC Act listed species predicted to occur in the project site, and each of the EPBC Act listed ecological communities likely to be significantly impacted, the EIS/biodiversity assessment report (BAR) must provide: a. survey results, including details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements and/or the NSW Framework for Biodiversity Assessment (FBA); b. a description and quantification of habitat in the study area (including suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advices, conservation advices and recovery plans, threat abatement plans and wildlife conservation plans; and c. maps displaying the above information (specific to each EPBC protected matter) overlaid with the proposed action. It is acceptable, where possible, to use the mapping and assessment of Plant Community Types (PCTs) and the species surveys prescribed by the FBA as the basis for identifying EPBC Act-listed species and communities. The EIS must clearly identify which PCTs are considered to align with habitat for the relevant EPBC Act listed species or community, and provide individual maps for each species or community. d. Description of the nature, geographic extent, magnitude, timing and duration of any likely direct, indirect and consequential impacts on any relevant EPBC Act listed species and communities. It must clearly identify the location and quantify the extent of all impact areas to each relevant EPBC Act listed species or community. e. For each of the EPBC Act listed species and communities likely to be impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the impacts of the action, and a	The impacts of the action on biodiversity MNES are assessed in detail in **Appendix 24**.

Requirement	Response and Section Where Addressed
description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve. f. Quantification of the offset liability for each species and community significantly impacted, and information on the proposed offset strategy, including discussion of the conservation benefit for each species and community, how offsets will be secured, and the timing of protection. All suitable habitat for MNES significantly impacted must be offset. It is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like-for-like'. Like-for-like includes protection of native vegetation that is the same EEC or habitat being impacted, or funding to provide a direct benefit to the matter being impacted i.e. threat abatement, breeding and propagation programs or other relevant conservation measures.	
Offsetting impacts to the *Prasophyllum* sp. Wybong: As *Prasophyllum* sp. Wybong is not a threatened species under the NSW Biodiversity Conservation Act 2016, DoEE will accept the credit liability generated for *Prasophyllum petilum* as the credit liability for *Prasophyllum* sp. Wybong, subject to being satisfied that the proposed offsets meet the offset requirements under the EPBC Act.	
Water Resource, in Relation to Coal Seam Gas Development and Large Coal Mining Development	
The EIS must include a detailed assessment of the potential impacts of the proposed action on water resources. The water assessment must be undertaken in accordance with the IESC Information Guidelines (http://iesc.environment.gov.au/publications/information-guidelines- independent-experts-scientific-committee-advice-coal-seam-gas) and provide the information outlined in these guidelines including:	A detailed assessment of the impacts of the action on water has been completed. Refer to: • Groundwater – **Section 6.8** and **Appendix 12** • Surface Water – **Section 6.7** and **Appendix 11**. Both of these assessments were undertaken following the IESC information guidelines.
a) Hydrogeological assessment: i. Provision of hydrogeological conceptualisations. ii. Descriptions of geology and hydrogeology. iii. Predictions of groundwater changes over the life of the proposed project (e.g. using numerical groundwater models). iv. Predictions of groundwater recovery beyond the life of the proposed project (e.g. using numerical groundwater models). v. Reference all of the above to analysis on groundwater quality and quantity data gathered from the existing project.	A detailed hydrogeological assessment has been completed for the action. A summary of key findings specific to these questions is provided in **Section 7.3.1**. Further assessment information is provided in **Section 6.8** and the full hydrogeological assessment is provided in **Appendix 12**.

Requirement	Response and Section Where Addressed
b) Surface water assessment: i. An assessment of predicted changes to surface water flows and flood extents (e.g. using numerical model). ii. Provision of mine water balances detailing on-site storages and discharge to surface water requirements. iii. Reference all of the above to analysis on surface water quality and quantity data gathered from the existing project.	A detailed surface water assessment has been completed for the action. A summary of key findings specific to these questions is provided in **Section 7.3.2**. Further assessment information is provided in **Section 6.7** and the full hydrogeological assessment is provided in **Appendix 11**.
c) Ecological and ecohydrological assessment: i. Conceptualisation of the impacts of water resource regimes and changes on biodiversity. ii. Potential impacts from temporal and spatial changes in terrestrial surface water flows and quality in relation to fine-scale topographic features (e.g. soaks, drainage systems, depressions, soil saturation) for known habitat within the two sub-catchments that currently, or may potentially (future colonization), support *Prasophyllum* sp. Wybong. iii. Potential impacts from temporal and spatial changes and quality of water resources (terrestrial surface and groundwater) in relation to fine-scale topographic features (riparian and flood zones) within the two sub-catchments that support White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. iv. In addition to ephemeral creeks, consider potential impacts from temporal and spatial changes and quality of water resources (surface and groundwater) on associated riparian vegetation and aquatic ecosystems (including stream and creek aquatic biota) of the Wybong, Sandy and Anvil Creeks.	An ecological and ecohydrological assessment on MNES is provided in **Appendix 24**. A summary of key findings specific to these questions is provided in **Section 7.3.3**. A detailed assessment of impact on GDEs is provided in **Section 6.10**. A detailed aquatic ecology assessment is provided in the BAR (**Appendix 13**).

Requirement	Response and Section Where Addressed
d) Cumulative impact assessment: i. Identify all surrounding existing and known future operations that could contribute cumulatively to surface water and groundwater impacts. ii. The proposed project area is within the Hunter Subregion of the Northern Sydney Basin Bioregional Assessment (BA) area. While the proposed extension is not within the BA 'additional coal resource developments' pathway, the proponent should consider cumulative impacts with reference to the BA assessment.	Detailed cumulative impact assessments are provided in the Surface Water and Groundwater assessments. A summary of the key findings is included in **Section 7.3.4**.
e) Final landform and rehabilitation assessment: i. Provision of a rehabilitation strategy. ii. Predictions of final void water quality and quantity. iii. Discussion on re-equilibration of groundwater and eventual discharges to the environment. iv. Comprehensive risk assessment.	A detailed final landform and rehabilitation assessment has been provided for the action, including: • A rehabilitation strategy – **Section 6.17** • Final void water quality and quantity – **Section 6.7.3.2** • Re-equilibration of groundwater – **Section 6.8** (specifically **Section 6.8.3.4** which discusses post mining groundwater recovery) and **Appendix 12** • Risk assessment for the MCCO Project – **Appendix 6**.
Other Approvals and Conditions	
Information in relation to any other approvals or conditions required must include the information prescribed in Schedule 4 Clause 5 (a) (b) (c) and (d) of the EPBC Regulations 2000.	Refer to **Section 4.0** which specifies the relevant legislation and policy which applies to the action. A summary description of the proposed monitoring and management measures proposed for the action is provided in **Section 8.0**. Further details on the proposed monitoring measures are provided throughout **Section 6.0**. With regard to monitoring, enforcement and review, under NSW legislation the action will be regulated under a number of acts with two of the primary acts being the EP&A Act and the POEO Act. Conditions of operation will be imposed under both of these acts (development consent conditions and EPL conditions) which will require certain monitoring and mitigation measures to be implemented and set limits for the action to comply with. These requirements will be subject to regular independent audits (reported publicly) and to periodic compliance assessments by NSW Government compliance officers.

Requirement	Response and Section Where Addressed
Environmental Record of Person Proposing to Take The Action	
Information in relation to the environmental record of a person proposing to take the action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.	Refer to **Section 7.4**.
Information Sources	
For information given in an EIS, the EIS must state the source of the information, how recent the information is, how the reliability of the information was tested; and what uncertainties (if any) are in the information.	Refer to **Section 10** for a list of references. These references have been annotated within the EIS as appropriate. The technical studies included as appendices also contain reference lists Where data has been used in this EIS and associated technical studies, the source of the data is stated along with the dates and, where relevant, how the reliability of the data was tested. For the water studies, models were calibrated and sensitivity analysis was undertaken as appropriate to test the reliability of the models. The outcomes of the sensitivity analysis are described in the technical reports.
Anticipated Engagement	
A draft EIS should be provided to DoEE prior to finalisation to ensure the above assessment requirements have been met.	Noted.

7.1.1 Avoidance and Mitigation Responses

Avoidance Measures

Mangoola undertook a detailed constraints study as part of the MCCO Project's pre-feasibility assessment to guide the design of the Project. Through this process, alternative mining options were considered and Mangoola sought to minimise the environmental and community impacts associated with the Project whilst maximising the economic resource recovery. Key elements of the MCCO Project design have been designed to ameliorate the impacts on significant biodiversity features, such as threatened species, endangered populations, TECs and their habitats and to minimise impacts on water. Preliminary biodiversity and water studies were undertaken to inform the pre-feasibility assessment and to assist Mangoola to refine the design of the project.

It is noted that avoidance can be challenging for resource projects as by necessity the resource extraction occurs where the resource is and this limits the ability to 'move' an impact, whereas there is more ability to relocate infrastructure or other project components. Mangoola did, however, make some major design changes to the MCCO project resulting in reductions to the overall disturbance footprint and avoidance of biodiversity and water impacts. These impact reductions are discussed in further detail in **Section 1.4** and in summary have resulted in the following:

- a reduction in disturbance of approximately 400 ha
- avoidance of over 4000 threatened orchids including both *Diuris tricolor* and *Prasophyllum* sp. Wybong
- avoidance of a major realignment of the 500kV Transmission Line, realignment of Ridgelands Road and a second crossing of Big Flat Creek
- avoidance of impacts on three stands of Weeping Myall (*Acacia pendula*) Woodland.

With regard to groundwater impacts, a further key avoidance measure is the standoff distance to the Wybong Creek alluvium which is a key alluvial aquifer in the vicinity of the MCCO Project. The standoff distance (220 m) avoids direct impact on the alluvium and minimises the indirect impacts.

Mitigation Measures

A discussion of mitigation measures, their effectiveness and statutory basis related to biodiversity is provided in **Appendix 24**.

With regard to water, the mitigation measures proposed are outlined in **Section 6.7.5** (surface water) and **Section 6.8.4** (groundwater). Many of the measures proposed for the MCCO Project are in place for the existing mining operations and have therefore been approved for implementation by NSW Government agencies and have been subject to ongoing monitoring and audits and shown to be effective. There is a statutory and policy basis for a number of these controls including:

- water take is in accordance with the provisions of the NSW *Water Management Act 2000* and Mangoola hold all applicable licenses. These licenses have sufficient allocations to provide for all take associated with the MCCO Project. The licensing scheme in NSW includes provision for environmental flows with all licensed water take designed to be sustainable as determined by NSW Government water allocations

- water discharges are managed in accordance with Mangoola's EPL and with the HRSTS. No changes are proposed to Mangoola's already approved water discharge arrangement. The HRSTS has been designed by the NSW Government to manage salt levels in the Hunter River to sustainable levels. Participants in the scheme hold salt credits and when discharge opportunities arise (as notified by the NSW Government), participants must only discharge the salt loads permitted by the credits they hold

- erosion and sediment controls are designed and operated in accordance with the 'Blue Book' (Landcom, 2004 and DECCW, 2008) which is the relevant guideline for the design of such controls in NSW

- groundwater bores in NSW are required to be licensed

- all controls committed to in this EIS by Mangoola will be required to be implemented by development consent conditions. These conditions will be enforceable and will be subject to periodic independent audit to ensure they are implemented and will also be subject to periodic compliance assessments by NSW Government compliance officers

- Mangoola has also committed to, and will be required by a condition of consent to prepare a Water Management Plan for the MCCO Project. This plan will build on the existing Water Management Plan in place for the current Mangoola Coal Mine. The Plan will need to be prepared in consultation with relevant NSW Government agencies and approved for implementation by DPE. Compliance with the plan will be assessed by regular independent audits and through periodic compliance assessments by NSW Government compliance officers.

Cost of Mitigation Measures

In regard to the cost of the mitigation measures, these costs have been included within the operating costs of the MCCO Project. This includes the costs of all proposed water management structures, mitigation measures, monitoring and rehabilitation costs.

Outline of Environmental Management Plan for the MCCO Project

As discussed in **Section 2.10** and **Section 2.11**, Mangoola has an existing EMS and a series of government approved environmental management plans that have been prepared to guide the environmental management of the existing mining operations. These plans are available on the Mangoola website and with relevance to MNES include:

- Site Water Management Plan, including an Erosion and Sediment Control Plan, Surface Water Monitoring Plan, Groundwater Monitoring Program and Surface and Groundwater Response Plan

- Biodiversity and Offset Management Plan and Strategy

- Rehabilitation Management Plan.

As part of implementing the MCCO Project, Mangoola has committed to update each of these management plans and implement them. The plans will outline the management, mitigation and monitoring measures to be implemented as part of the MCCO Project.

These plans will also be required by development consent conditions to be prepared in consultation with relevant government agencies and to be approved by DPE prior to implementation. Compliance with the plans will be assessed by regular independent audits and through periodic compliance assessments by NSW Government compliance officers.

7.2 Key Issues – Biodiversity

The impacts of the action on biodiversity MNES are assessed in detail in **Appendix 24**. The biodiversity MNES assessment specifically addresses the questions posed by DoEE in **Table 7.1** above. A detailed biodiversity assessment following NSW Policy (the FBA) is provided in **Appendix 13** with a summary of the key findings provided in **Section 6.9**.

With regard to Mangoola's approach to the design and planning of the MCCO Project potential biodiversity impacts have been recognised and thoroughly considered throughout the project planning process and as described further in this section through the principles of avoid, mitigate and offset have been considered and addressed.

As demonstrated in **Section 6.9**, the biodiversity offset requirement for the MCCO Project is completely satisfied by the proposed offset strategy. A core component of the proposed biodiversity offset strategy is strategically located local offsets that will offset the biodiversity values impacted by the MCCO Project in perpetuity.

The land-based biodiversity offsets will be secured under Stewardship Agreements, in consultation with the BCT.

7.3 Key Issues – Water Resources

The summary information below should be read in conjunction with **Section 6.7** and **6.8** and **Appendix 11** and **Appendix 12** of this EIS (that is, the Surface Water Assessment and the Groundwater Impact Assessment).

The MCCO Project exists within a well-regulated water resource management system that has been designed by the NSW Government to provide for the sustainable management of the State's water resources. This includes licensing of allowable water take from both surface water and groundwater with consideration of the environmental flow requirements of watercourses and the needs of other water users; control of water pollution, including management of sustainable salt loads associated with all water sources, including mine water discharges; and guidelines that govern the appropriate design of water management systems for mines to provide for appropriate water quality in accordance with pollution control requirements.

The MCCO Additional Project Area lies almost entirely within the catchment of Big Flat Creek which flows to Wybong Creek located approximately 1.5 km to the west of the MCCO Additional Mining Area. Wybong Creek flows to the Goulburn River which is part of the catchment of the Hunter River. The Hunter River is a regulated river with releases from Glenbawn Dam and Glennies Creek Dam managed by WaterNSW under a Water Sharing Plan. Glenbawn Dam is located in the upper reaches of the Hunter River upstream of the MCCO Project Area. Glennies Creek Dam is located on Glennies Creek which joins the Hunter River downstream of the MCCO Project and upstream of Singleton.

The existing Mangoola Coal Mine water management system also forms part of the catchment within the MCCO Project Area.

There are three 'hydrostratigraphic units' in the vicinity of the MCCO Project Area, which are grouped based on their ability to transmit groundwater. These include the following:

- Quaternary colluvium – occurring as a relatively thin and often unsaturated capping forming a non-homogenous ephemeral aquifer aligned along Big Flat Creek and other tributary drainages

- Quaternary alluvium – forming a relatively extensive alluvial aquifer system within the floodplains of Wybong Creek and Sandy Creek
- Permian and Triassic bedrock sediments.

The following sections provide a summary of the key findings related to the assessment requirements from DoEE as they relate to water. These sections are supported by the more detailed assessments elsewhere in this EIS and the technical appendices.

7.3.1 Groundwater

As discussed above, a detailed groundwater (hydrogeological) assessment has been undertaken for the MCCO Project and this assessment has undergone peer review. A summary of the key findings is provided in **Section 6.8** and the detailed technical report is provided in **Appendix 12**. Summary responses drawing on the information in **Appendix 12** are provided in the following sections.

7.3.1.1 Provision of hydrogeological conceptualisations

The following summary of the hydrogeological conceptualisation is taken from the Groundwater Assessment (AGE, 2019) which is included in **Appendix 12**.

Conceptual models are abstractions or simplifications of reality and are typically done at the commencement of hydrogeological assessments to assist in scoping the assessment process. During development of conceptual models, the essence of how the key system components operate and interact is distilled. This section describes the processes that control and influence the storage and movement of groundwater in the hydrogeological systems occurring in vicinity to the MCCO Project and the broader Mangoola region.

Groundwater recharge to the Permian strata occurs via rainfall to the ground surface infiltrating into the formations through the soil cover and weathered profile. The coal seams also occur as subcrops in localised zones across the Mangoola Coal mining footprint. The alluvial and colluvial sediments are also expected to be recharged by seepage through the creek beds when these are flowing. Groundwater-surface water interactions are expected to be more significant within the Wybong Creek and Sandy Creek alluvium than along the smaller Big Flat Creek where there is no significant alluvial sediment present. The Big Flat Creek colluvium is largely unsaturated as it occurs as a surficial capping of limited thickness, and more recently is also subject to drainage due to the approved operations at the adjacent Mangoola Coal Mine.

The alluvial sediments occurring in the flood plain along Wybong Creek and Sandy Creek can be up to approximately 20 m in thickness. Yields in areas of the alluvium are over 25 L/s, which suggest a high permeability and transmissivity in these areas. This is not consistent across the alluvial units, with some sites having yields of less than 0.5 L/s. There are also areas of brackish to moderate salinity observed within several of the alluvial bores. The salt concentration is due to either upward flow of Permian groundwater through the Triassic strata and into the Quaternary alluvium, and/or evaporative concentration of rainfall recharge. The available data indicates these systems would likely meet NSW Government criteria to be classified as a 'highly productive' groundwater source, which requires TDS concentrations less than 1500 mg/L and water supply works that can yield water at a rate greater than 5 L/s.

The Bioregional Assessment for the Hunter Valley subregion identifies two landscape classes that could potentially support groundwater dependent ecosystems in the vicinity of the MCCO Project; forested wetlands along the Wybong Creek, and rainforest (note as this is outside the potential impact area of the MCCO Project the occurrence of this area of rainforest was not verified) within the higher ground to the west of Wybong Creek. The depth to groundwater within the Wybong Creek alluvium suggests that the forested wetland communities would only occur within the gullies associated with the currently active

incised Wybong Creek channel. A more localised assessment of potential GDEs in the vicinity of the MCCO Project identified small areas along Big Flat Creek with a moderate potential to support GDEs. No areas with a moderate or high potential to support GDEs were identified along Sandy Creek.

The Permian coal measures and Triassic sandstones and conglomerates form less productive groundwater systems, when compared to the shallow alluvial systems, with the coal seams and shallow weathered conglomerates being the most permeable lithology within the bedrock sequences. The unfractured conglomerates, and tuffs within the coal measures retard groundwater flow in a vertical direction. The coal seams occur in a basin structure and any associated groundwater becomes confined by the lower permeability interburden as the seams dip towards the north-west and deepen. There is minimal recorded abstraction of groundwater from the bedrock strata for stock, domestic and other agricultural uses, primarily due to low yields and the high salinity limiting beneficial uses.

Groundwater flows from areas of high head (pressure plus elevation) to low head via the most permeable and transmissive pathways. Although there are few data points within the alluvial systems the flow direction will be a reflection of the topography, with alluvial groundwater flowing 'downstream' towards the Hunter River. The groundwater levels within the Permian are influenced by topography and more recently the progression of mining activities at Mangoola Coal Mine. The lower salinity recorded for the Wybong Creek alluvium suggests that the contribution of Permian groundwater to the Quaternary alluvium is limited. Therefore the high baseflow component of flow in Wybong Creek likely represents the release of groundwater stored within the alluvium in the upgradient catchment.

Depressurisation of the Permian strata below the Big Flat Creek colluvium adjacent to the Mangoola Coal Mine is evident in the hydrographs from the Mangoola Coal Mine monitoring bore network.
The hydrographs indicate a significant reduction in pressure head in the deeper confined units, and a smaller reduction in the shallow sites. This has led to a long term disconnection of Big Flat Creek from the underlying groundwater system. However, prior to mining commencing groundwater levels would only have reached the level of the creek bed in wet years. The drawdown responses observed in the monitoring bores are generally similar to those predicted in the approved Mangoola Coal Mine EIS groundwater assessment (MER, 2006), although the observed responses show some localised variability that cannot be represented by numerical modelling that assumes more uniform hydraulic properties.

The Mt Ogilvie fault is located to the east of the MCCO Project, and offsets the Permian strata by approximately 125 m. On a local scale it is conceptualised as forming a barrier to flow by truncating any permeable units. However, at a formation scale the units on each side of the fault are both Permian Coal Measures and will be hydrogeologically similar. The target coal measures for the MCCO Project are not present at the fault and there are likely to be no significant influences to predicted Project impacts as a result of the fault being present. Minor faulting also occurs throughout the MCCO Proposed Additional Mining Area. Whilst there is the potential for faults to transmit groundwater this has not been established and is expected to be relatively limited, given the limited cross sectional areas of the fault zones and the potential for the fault gouge sediment to retard groundwater flow.

On a local scale, moderately saline groundwater has historically flowed towards Big Flat Creek within the weathered conglomerate, and a deeper (highly saline) confined groundwater flow system associated with the coal seams has flowed towards the north-west. This is shown conceptually in **Figure 7.1** and **Figure 7.2**. **Figure 7.1** shows moderately saline groundwater flow pre-mining within the weathered conglomerate, and a deeper (highly saline) confined groundwater flow system associated with the coal seams. During this time groundwater flow is down topographic gradient, with flow lines converging under Big Flat Creek (**Figure 7.2**).

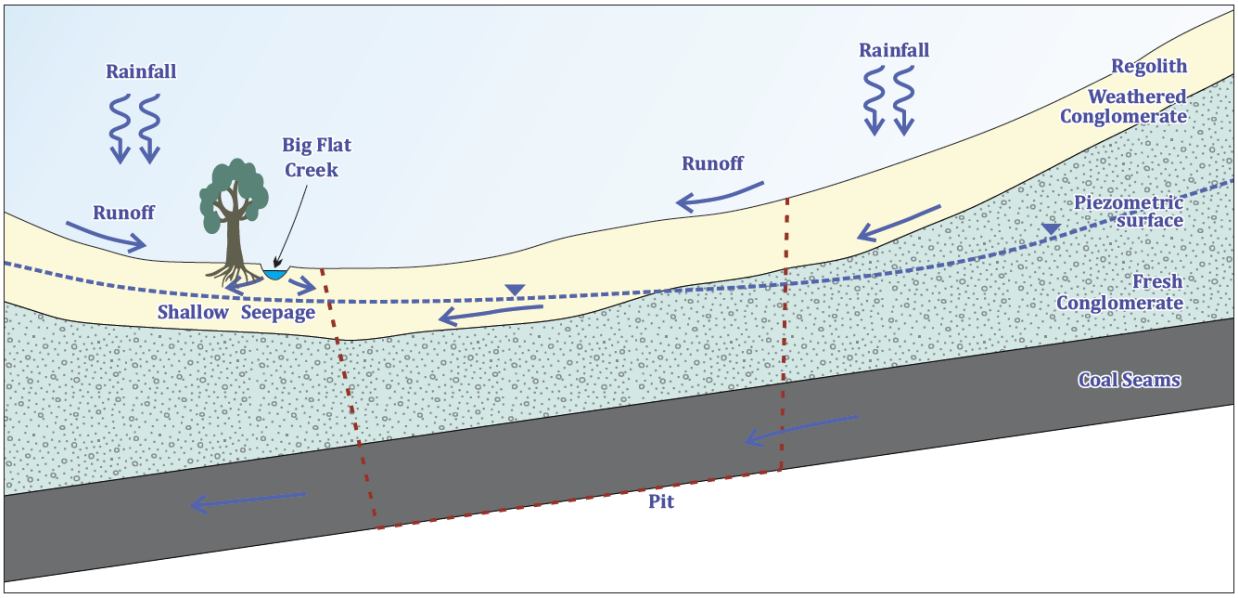


Figure 7.1 Conceptual Hydrogeological Model – Pre Mining of the Current Operations

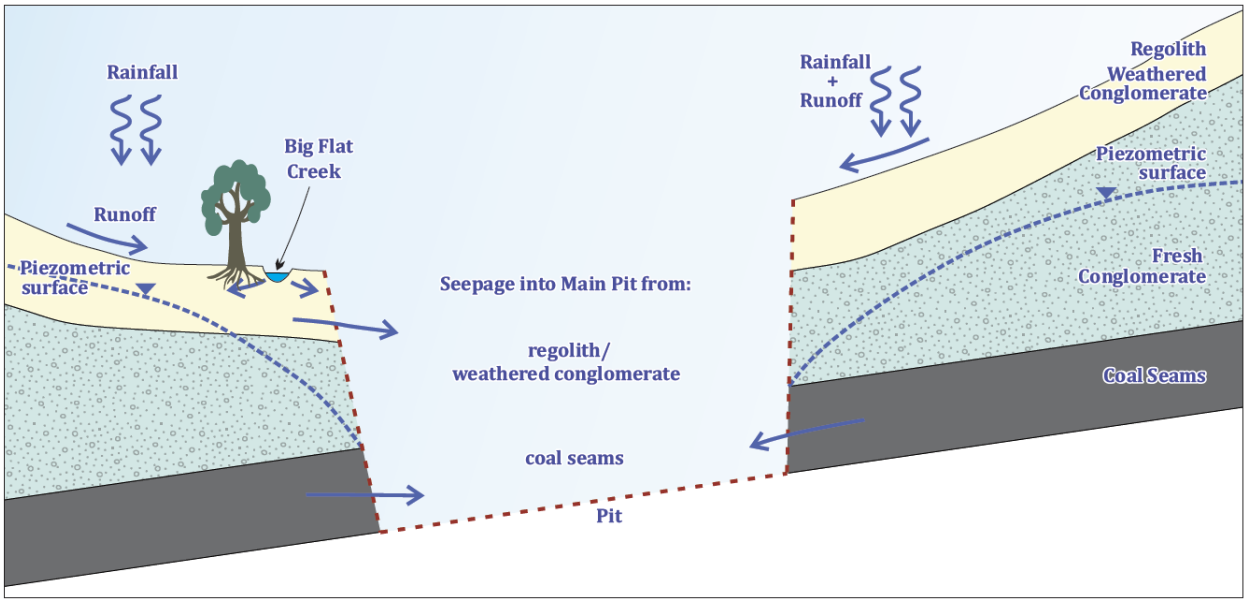


Figure 7.2 Conceptual Hydrogeological Model – During Mining of the Current Operations

During mining at the Mangoola Coal Mine, the groundwater flows for each groundwater system have been intersected and interrupted, as mining has removed the weathered to fresh conglomerate, interburden, and target coal seams. This results in localised groundwater flow towards and into the Mangoola Coal Mine, and localised drawdown of groundwater levels around the perimeter of the Mangoola Coal Mine. Localised drawdown of groundwater levels occurs proximal to the perimeter of the Mangoola Coal Mine. These altered conditions are shown conceptually in **Figure 7.2**.

During the pre-mining and mining phases, there will be periods of surface water flow within the Big Flat Creek flow channel from rainfall events. The high salinity of the underlying groundwater suggests the seepage rates are low.

If the MCCO Proposed Additional Mining Area were to be extracted then this would affect the groundwater system in a similar way to the existing mining operations. The exception being that the groundwater regime underlying Big Flat Creek between the two mining areas will already be affected by mining at Mangoola Coal Mine.

The groundwater assessment built on the above conceptualisation through the development of a detailed groundwater model and completion of a detailed assessment of the predicted effects of the MCCO Project. The approach to modelling and the assessment findings are detailed in **Section 6.8** and **Appendix 12**.

7.3.1.2 Description of geology and hydrogeology

A detailed description of the geology and hydrogeology is provided in the groundwater assessment which is included as **Appendix 12**. A summary is provided below.

Geology

The MCCO Additional Project Area is located in the north-western coal-producing region of the Hunter Coalfield. The coal seams within the MCCO Additional Project Area form part of the Late Permian Newcastle Coal Measures of the Singleton Super Group. They gently dip to the west at about 2 degrees below horizontal and reach a depth to the floor of the lowest seam of approximately 125 m at the lowest point relative to the highest topographical location within the MCCO Additional Mining Area.

In order of increasing depth, the key target seams for mining within the Proposed Additional Mining Area include the:

- Wallarah seam
- Great Northern seam
- Fassifern seam
- Upper Pilot seam.

The existing Mangoola Coal Mine operates within the same coal seams and detailed exploration programs have been undertaken in the local area for both Mangoola Coal Mine and the MCCO Additional Mining Area, providing a good understanding of the local geology.

Hydrogeology

The geological units described previously can be grouped into the following 'hydrostratigraphic units' based on their ability to transmit groundwater:

- Quaternary colluvium – occurring as a relatively thin and often unsaturated capping forming a patchy ephemeral aquifer aligned along Big Flat Creek and other tributary drainages
- Quaternary alluvium – forms a relatively extensive alluvial aquifer system within the floodplains of Wybong Creek and Sandy Creek
- Permian and Triassic bedrock sediments that can be divided into:
    - thin, generally dry and variably permeable weathered rock (regolith)
    - highly weathered water bearing rock along Big Flat Creek
    - non coal interburden such as conglomerates and sandstones that forms aquitards

- low to moderately permeable coal seams that act as the most transmissive strata within the coal measures sequence.

The hydrogeological properties of each of these hydrostratigraphic units are described in **Appendix 12**.

7.3.1.3 Predictions of groundwater changes over the life of the proposed project

Section 6.8.3 describes the predicted changes to groundwater over the life of the MCCO Project that were determined using a numerical groundwater model. Consistent with the conceptualisation the model predicts that the mining voids will act as groundwater sinks with water in the surrounding water bearing strata moving into the voids. The model indicates that much of the groundwater inflow to the void in the MCCO Additional Mining Area (i.e. the new void resulting from the MCCO Project) will be from the Permian and Triassic bedrock sediments with no direct take predicted from alluvial zones due to the MCCO Project. Mangoola has sufficient water licences allocations to readily cater for all groundwater take predicted.

7.3.1.4 Predictions of groundwater recovery beyond the life of the proposed project

Section 6.8.3.4 describes the predicted post mining groundwater recovery. Further detail is provided in **Appendix 12**. At the end of mining the majority of the two mining areas will have been backfilled with spoil and recontoured to simulate a more natural landform. A final void will remain in each area at the locations shown on **Figure 3.7**. The deepest areas of the voids will be similar to the maximum depths mined being approximately 125 m. Post mining conditions were also simulated using the numerical groundwater model using a transient model run over a period of 500 years.

The model results indicate that groundwater levels will gradually recover over time until an equilibrium state is reached. In both mining areas the long term groundwater levels are predicted to equilibrate at a lower level than under pre-mining conditions, with the final voids (non-backfilled mining areas) acting as long-term groundwater sinks. However, within the existing approved mining area at Mangoola Coal Mine the groundwater contours suggest that there is potential for water in backfilled areas away from the final void to migrate into the surrounding bedrock. This is predicted to be a slow process due to the low permeability of the bedrock strata. Modelling has indicated that any outwards migration will likely occur in the deeper strata as many areas of the near surface layers remain unsaturated, and that the majority of the water exiting the existing approved mining area at Mangoola Coal Mine will either be drawn back towards the Mangoola Coal Mine final void or be captured by the MCCO Proposed Additional Mining Area final void. Although some groundwater from Mangoola Coal Mine is not captured it remains in the deeper layers and does not migrate towards the surface.

Water take from the groundwater systems will continue post mining due to the residual drawdown created by flow of groundwater to the final voids. Mangoola has sufficient water licences allocations to readily cater for all groundwater take predicted and would retire groundwater licences to cater for this take in the long term.

7.3.1.5 Use of groundwater quality and quantity data in analysis

Detailed groundwater quality and quantity data was gathered for use in the assessment and modelling process. The data used is described in **Appendix 12** and includes monitoring data from the existing mining operations and surrounds. The data was used to assist in calibrating the numerical groundwater model and in the detailed assessment process.

7.3.2 Surface Water

A detailed surface water assessment has been undertaken for the MCCO Project. A summary of the key findings is provided in **Section 6.7** and the detailed technical report is provided in **Appendix 11**. A summary response to the key points raised in the DoEE assessment requirements is provided in **Table 7.2**.

Table 7.2 DoEE Surface Water Assessment Requirements

DoEE Assessment Requirement	Response
An assessment of predicted changes to surface water flows and flood extents (e.g. using numerical model)	Numerical modelling completed. Refer to **Section 6.7** for a summary of the results and Section 3.2.3 of **Appendix 11** for further detail.
Provision of mine water balances detailing on-site storages and discharge to surface water requirements	A detailed mine water balance was completed. All water take including importing water to the site will be licensed under NSW water licensing legislation. Mangoola holds sufficient licences to cater for the predicted water take for the MCCO Project. Discharge of water (if required) from the MCCO Project will be undertaken using Mangoola's approved discharge facility in accordance with the provisions of the EPL and HRSTS. A summary of the findings of the water balance assessment is provided in **Section 6.7.3.1** with further details provided in Section 3.3 of **Appendix 11**.
Reference all of the above to analysis (sic) on surface water quality and quantity data gathered from the existing project	Detailed surface water quality and quantity data was gathered for use in the assessment and modelling process. The data used is described in **Appendix 11** (see in particular Section 2.6) and includes monitoring data from the existing mining operations and surrounds, including government run monitoring stations (e.g. flow gauging data for Wybong Creek.)

7.3.3 Ecohydrological

An assessment of potential ecohydrological impacts as they relate to MNES is provided in **Appendix 24**. This assessment focusses on the potential indirect effects of changes in water flows (surface and groundwater) in relation to MNES. This is separate to the assessment of direct impact which is associated with the areas proposed to be cleared as part of the MCCO Project. In summary, the assessment process found:

- no groundwater impacts are predicted that are likely to impact on *Prasophyllum sp. Wybong* or *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* (Box Gum Woodland CEEC). This finding is due largely to the absence of shallow groundwater impacts predicted in the areas in which these MNES occur
- no surface water impacts are predicted that are likely to impact on Box Gum Woodland CEEC. This finding is due to the areas of this community that are near to but outside of the direct impact area for the MCCO Project being upslope of the MCCO Project. That is, no water will drain from the MCCO Project into an area occupied by the community, or otherwise affect the drainage of this community outside the direct impact area, and therefore no impacts are predicted

- changes in flooding along Big Flat Creek are predicted to be relatively minor and do not interact with any areas of Box Gum Woodland and no known records of *Prasophyllum sp. Wybong* outside the direct impact area

- there is one area where a clean water diversion drain will direct clean water into a catchment area to the west of the direct impact area and release it into an existing dam. When sufficient runoff occurs, the dam will overflow and as per the existing situation, water will travel via overland flow across a largely cleared paddock and eventually enter into Big Flat Creek. There are no records of *Prasophyllum sp.* Wybong in the overland flow path but there is one record in the vicinity and potential habitat is present. A specific hydrological assessment was undertaken to assess the potential changes in flow in the area and used fine scale topographic information to assist with the analysis. The assessment found that while there will be some increased moisture in the area downslope of the dam, it is unlikely that this will adversely impact on *Prasophyllum sp.* Wybong

- the MCCO Project is not predicted to result in any impacts on Sandy Creek or its associated riparian vegetation as it is located to the southeast of and well outside of the impact area of the MCCO Project

- the MCCO Project is not predicted to result in any additional impact on Anvil Creek or its associated riparian vegetation. It is noted that Anvil Creek is located within the impact area of the approved Mangoola Coal Mine which was previously referred and found to not constitute a controlled action

- the MCCO Project is not predicted to result in any significant impacts on Wybong Creek. The predicted changes in flow associated with the MCCO Project were found by the Surface Water Assessment to represents a small and likely indiscernible impact to flow in Wybong Creek. No flooding or water quality impacts were predicted in the Surface Water Assessment. Therefore, no adverse impacts on the riparian vegetation or aquatic ecosystems of Wybong Creek are predicted.

7.3.4 Summary of Cumulative Assessment Outcomes

Groundwater

Apart from the approved mining at Mangoola Coal Mine, there are currently no other active mines within 10 km of the MCCO Proposed Additional Mining Area. The nearest active mines are Bengalla, Mount Pleasant, and Mt Arthur Coal, which are approximately located to the east. Each of these mines extract from the Wittingham Coal Measures, which underlie the Newcastle Coal Measures being targeted within the MCCO Project Area. The groundwater assessment found that given the distance to other mines and the fact that the surrounding mines are not extracting from the same geological sequence means cumulative impacts are not considered likely.

With regard to the cumulative impacts of the MCCO Project and the existing approved mining operations at Mangoola Coal Mine, this has been considered in detail with the existing and approved mining operations included in the numerical groundwater model. The assessment findings outlined in **Section 6.8** and **Appendix 12** provide the outcomes of this cumulative assessment.

Surface Water

In the context of surface water resources potentially impacted by the MCCO Project, there has been significant past development in the upstream, immediate and downstream catchment areas, including widespread agricultural development. There has also been significant development of the surface water resources themselves, including regulation of the water resources, and local and regional water extraction.

Within the Goulburn River catchment there are several coal mines and projects, which comprise approximately 103.5 km^2 of the catchment at their maximum extent of disturbance. This, combined with the maximum reduction of Wybong Creek catchment area as a result of the MCCO Additional Project Area (8.0 km^2), would see a cumulative maximum reduction in the catchment area of the Goulburn River of 1.6 per cent just downstream of the confluence with Wybong Creek. It should be noted that the MCCO Additional Project Area represents only 0.12 per cent of the total reduction in the Goulburn River catchment and that this assessment is very conservative because it is highly unlikely that all five projects would reach their maximum extents at the same time. The reduction in Goulburn River catchment area would decrease with time as progressive rehabilitation results in reductions to impacted catchment areas for each of these projects. The reduction in catchment area as a result of the MCCO Project would halve in the long term. As discussed above, Mangoola has sufficient WALs to cater for all water take associated with the MCCO Project.

Flooding impacts due to the MCCO Project are localised to Big Flat Creek. This creek does not contain any other mines or projects, and therefore there would be no cumulative flooding impacts associated with the MCCO Project.

The MCCO Project is not anticipated to impact downstream water quality in Big Flat Creek and Wybong Creek, and therefore it is unlikely that the MCCO Project will contribute to any cumulative impacts on downstream water quality. All discharges to the Hunter River via the licensed discharge point will be managed in accordance with the EPL and HRSTS which has been designed to manage the salt load of the Hunter River to within sustainable levels.

With regard to water take, as noted above Mangoola holds sufficient water licences for all water take associated with the MCCO Project. The water take licensing system in NSW has been designed to provide for sustainable environmental flows and thereby minimises the cumulative impacts of water take by all water users.

7.4 Environmental Record of Person Proposing to take the Action

The following statement of environmental record has been provided by Mangoola.

The proponent for the MCCO Project is Mangoola Coal Operations Pty Limited which is owned by Glencore Coal Pty Ltd and is part of the wider Glencore group of companies.

Mangoola is committed to maintaining responsible environmental management practices that meet or exceed industry best practice. Environmental management is an integral part of every stage of the mining process to ensure that environmental impacts are minimised.

Mangoola has an EMS in place for its existing mining operation. The EMS provides a risk based platform on which relevant environment and community controls, procedures and management plans have been established and are regularly reviewed. The EMS covers the design, development, production, maintenance and rehabilitation of the operation and its infrastructure. The EMS is structured to ensure that the company adopts a continuous improvement approach to environmental management issues at the site and implement best practice environmental management. The EMS also ensures that all activities at the operation are controlled, such that the company either prevents or minimises any environmental impacts associated with the operation.

Under its EMS, Mangoola has developed a number of environmental management and monitoring plans which provide guidance for minimising the impacts of its operations. Where relevant, these existing plans will be updated and applied to the new activities that form the Proposed Action. The existing plans can be found at: http://www.mangoolamine.com.au/en/Pages/home.aspx

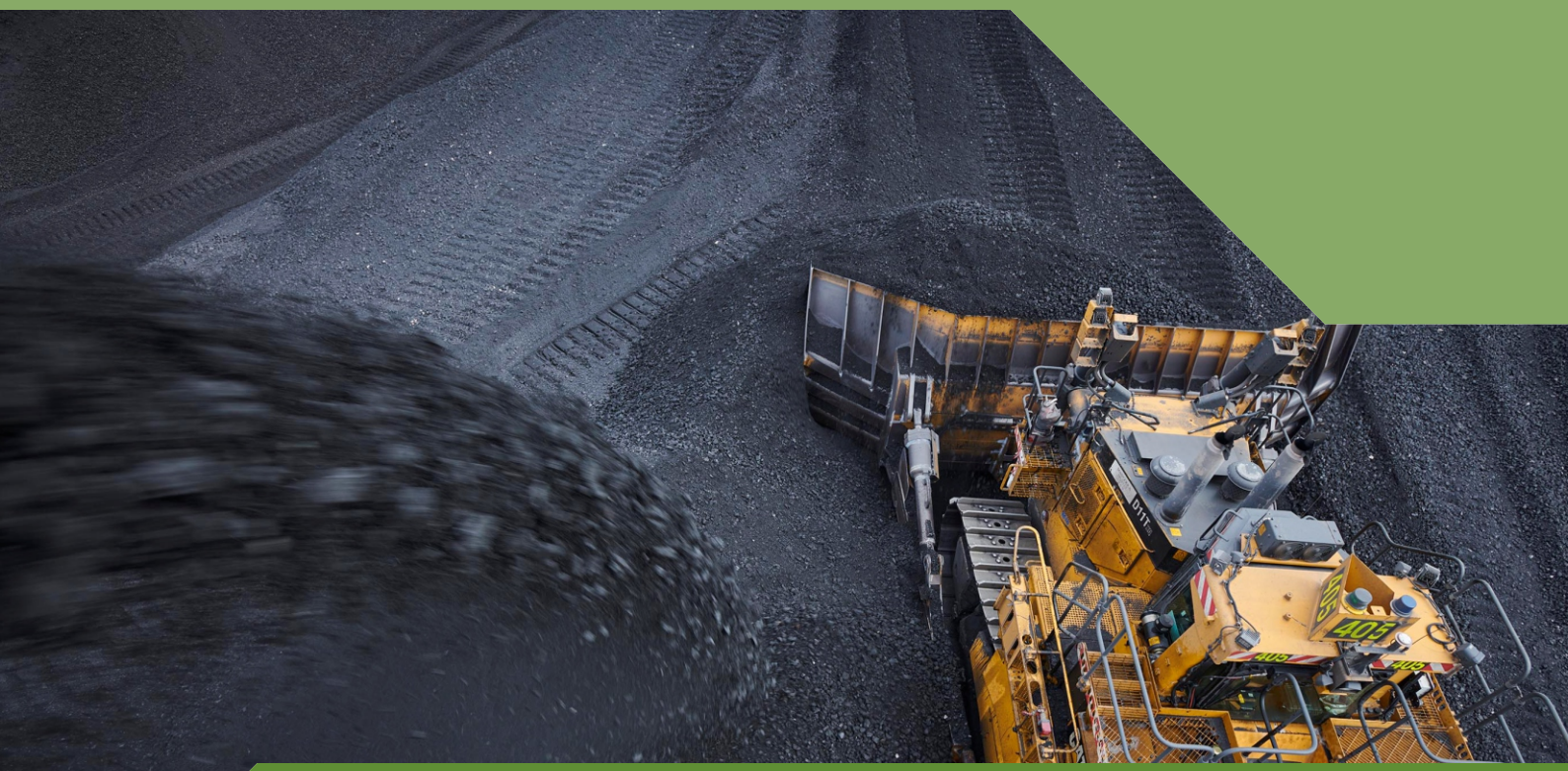
As part of its EMS, Mangoola conducts regular environmental monitoring and auditing to gauge performance, compliance with regulatory requirements, and to minimise impacts on the surrounding community and the environment. In addition an Independent Environmental Audit as required by PA 06_0014 was last completed in December 2016 with another one due in 2019. A copy of the 2016 audit report is available on the Mangoola website (http://www.mangoolamine.com.au/en/publications/Pages/independent-environmental-audits.aspx)

This audit found that Mangoola was being operated with a high level of compliance against its existing approval conditions and management plan requirements.

Mangoola Coal Operations Pty Limited has not been convicted of any offence under any environmental legislation, or had any approvals under environmental protection legislation or other relevant legislation revoked or suspended in the five years immediately prior to this application being lodged.

SECTION 8.0

Summary of Environmental Management and Monitoring Measures



8.0 Summary of Environmental Management and Monitoring Measures

The SEARs for the MCCO Project require that the EIS include a consolidated summary of all the proposed environmental management and monitoring measures, highlighting all of the commitments included in the EIS.

If development consent for the MCCO Project is granted under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act, Mangoola will commit to the environmental management and monitoring measures outlined below.

Surrender of Project Approval

- the existing Project Approval will be surrendered prior to the commencement of mining within the MCCO Additional Project Area, or as otherwise agreed with the Secretary of DPE.

Hours of Operation

- as per the existing operation, mining and associated activities for the MCCO Project will be undertaken 24 hours per day, 7 days per week
- as per the existing operation, blasting will be undertaken 9.00 am to 5.00 pm on Monday to Saturday, with no blasting to be undertaken on Sundays or public holidays without written approval of the EPA
- construction activities within the MCCO Additional Project Area will be conducted up to 24 hours per day, seven days a week, with the exception of the establishment of the proposed Wybong Road and Big Flat Creek overpass and the Wybong Post Office Road realignment
- construction of the proposed Wybong Road and Big Flat Creek overpass and Wybong Post Office Road realignment will generally occur during standard construction hours of 7.00 am to 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturday. Construction activities that are completed within standard construction hours will be managed in accordance with the relevant construction noise criteria. For construction activities proposed to be undertaken outside of standard construction hours Mangoola is committed to managing noise such that the cumulative impact from the existing approved Mangoola Coal Mine operations and construction activities do not exceed the operational noise limits prescribed in PA 06_0014.

Environmental Management Plans

- Mangoola will prepare a Construction Environmental Management Plan (CEMP) prior to the commencement of construction that identifies the environmental and social management controls to be implemented during the construction phase. Mangoola will implement the CEMP
- prior to the commencement of mining in the MCCO Additional Project Area, Mangoola will update the existing environmental management plans for Mangoola Coal Mine. The management plans will address the environmental and social management of the entire Mangoola mining operations including the Approved Project Area and the MCCO Additional Project Area. Further commitments relating to the management plans are included in the issue specific commitments below. Mangoola will implement the updated management plans

- prior to the commencement of mining in the MCCO Additional Project Area, Mangoola will review and update, as required, the existing environmental monitoring programs for Mangoola Coal Mine. This will include relocation or installation of new monitoring locations as required to incorporate the MCCO Project. Mangoola will monitor and continually review the performance of the mining operations.

Social and Economic

A number of mitigation and enhancement strategies are proposed, including:

- the development of a Community Enhancement Program that focuses on facilitating enhancement initiatives for proximal landholders located within the defined management zones for the MCCO Project
- implementation of a range of existing and new mitigation measures that were developed considering community feedback on measures that would address the identified impacts
- a series of property specific measures
- continued implementation of a VPA with MSC
- the development and implementation of a SIMP for the ongoing monitoring and management of social impacts.

Noise

- Mangoola will review and update the existing Noise Management Plan and then implement the updated plan for the MCCO Project. The Noise Management Plan will detail the monitoring and management controls to be implemented to manage noise impacts associated with the MCCO Project including ongoing implementation of the proactive and reactive management protocols in response to noise trigger levels defined in the plan
- Mangoola commits to the implementation of the following project design and operational controls to assist in managing noise emissions from the site:
    - haul route alignments within the mining area will maximise the available topographical shielding provided by the mine design, where practicable
    - an 8 m high noise bund will be constructed where required on the haul road located on the southern side of Wybong Road connecting the proposed Wybong Road and Big Flat Creek overpass to the Approved Project Area to reduce noise emission primarily to the north and west
    - mobile equipment will be attenuated to sound power levels consistent with the existing fleet
    - mobile crushing plant and scrapers will only operate during the day period
    - mobile crushing plant will be located in shielded locations of the mining areas that provide a good level of shielding in the direction of the nearest receptors
    - significant noise generating fixed infrastructure in the CHPP will remain acoustically treated (clad) at current coverage levels
    - the existing 3.5 m high barrier wall installed to sections of the rail spur will be retained.

- Mangoola will implement both proactive and reactive noise control strategies informed by real-time noise and meteorological monitoring systems. Proactive noise management will involve the discussion and planning of activities in advance of potentially adverse conditions. Specifically, the proactive noise management approach will include:
    - implementation of a system to provide environmental personnel with a daily forecast of expected conditions in the vicinity of the operation, particularly with regard to the potential for noise enhancing meteorological conditions
    - discussion of the noise forecast at daily operational meetings
    - modifying the planned mining activities, as appropriate, to minimise or avoid the potential noise impacts including but not limited to:
        - various levels will be provided for overburden emplacement to allow shielded emplacement during noise enhancing meteorological conditions
        - dozers will be restricted to 1st gear operation if required during periods of noise enhancing meteorological conditions
        - drill pad preparation dozers will be shut down if required during periods of noise enhancing meteorological conditions.
- Mangoola will implement reasonable and feasible receiver based noise mitigation measures which may include measures such as double glazing, insulation or air conditioning to residences located within the active noise management zone (refer to **Section 6.4.3**) upon written request
- Mangoola will maintain the existing noise voluntary acquisition and active management rights for affected private land within the existing Mangoola Project Approval regardless of whether or not these rights are required by the current VLAMP due to the impacts of the MCCO Project
- the real-time and attended noise compliance monitoring locations will be reviewed and revised as necessary prior to the commencement of the MCCO Project to provide adequate coverage of the MCCO Project Area in order to validate EIS predictions and monitor compliance with relevant criteria. The revised noise monitoring program will be included in the updated Noise Management Plan.

Air Quality

- Mangoola will review and update the existing Air Quality Management Plan and then implement the updated plan for the MCCO Project. The Air Quality Management Plan will detail the monitoring and management controls to be implemented to manage air quality impacts associated with the MCCO Project including ongoing implementation of the proactive and reactive management protocols in response to air quality trigger levels defined in the plan
- Mangoola will implement a range of dust management measures for the key dust generating activities as described in **Section 6.5.3** and in **Appendix 9**, with the key proposed controls including the following:
    - minimising the area of disturbed land at any one time, in line with the approved MOP
    - development of a mine plan that provides for timely progressive rehabilitation
    - adopting controls for haul road dust emissions
    - review of meteorological conditions prior to blasting
    - consideration of meteorological conditions in planning the loading and unloading of overburden

- applying water and using dust curtains when drilling overburden
- minimising fall distance during loading and unloading of overburden
- utilising water sprays on ROM coal stockpile areas
- maintaining the existing covered conveyors and belt cleaning
- maintaining and servicing machinery, exhaust systems and plant equipment in accordance with contemporary maintenance practices
- using dust cameras to monitor dust
- enact the TARP process and to investigate dust levels when the TARP process is enacted to identify likely sources of dust from any complaints or potential compliance issues
- using temporary rehabilitation and stabilisation measures on disturbed land.

- Mangoola will implement both proactive and reactive dust control strategies informed by real-time dust and meteorological monitoring systems. Reactive air quality management will assess the need to modify the activities in response to the following triggers:
  - visual conditions, such as excessive visible dust
  - meteorological conditions, such as dry, strong wind conditions
  - ambient air quality conditions (that is, elevated short-term PM_{10} concentrations)
- proactive air quality management will involve the discussion and planning of activities in advance of potentially adverse conditions. Specifically, the proactive air quality management approach will include:
  - implementation of a system to provide environmental personnel with a daily forecast of expected dust conditions in the vicinity of the operation
  - discussion of the dust forecast at daily operational meetings
  - modifying the planned mining activities, as appropriate, to minimise or avoid the potential dust impacts
- specific air quality TARPs will be defined in the Air Quality Management Plan. These triggers will describe the specific actions for managing dust at both private and mine owned residences
- a review of both real-time and attended compliance monitoring locations will be undertaken prior to the commencement of the MCCO Project and the monitoring network revised to provide adequate coverage of the MCCO Project Area in order to validate EIS predictions and monitor compliance with relevant criteria. The revised air quality monitoring program will be included in the updated Air Quality Management Plan
- the proposed dust management measures for the MCCO Project will be prepared in consideration of the NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining (Katestone 2011)
- Mangoola will implement blasting procedures relating to fume management, including a pre-blast review of weather conditions so as to avoid blasting in adverse conditions. The existing Blasting Management Plan will be updated to apply to the MCCO Project and implemented during operations, including key fume management actions, including defining the potential risk zone based upon weather patterns prior to blasting based on an assessment of real-time weather conditions

- private landholders living within a 4 km radius of the active mining area will be offered an inspection and if deemed required cleaning of residential rainwater tanks once per year. Private landholders living within a 4 – 6 km radius of active mining operations will be offered an inspection and if deemed required cleaning of residential rainwater tanks every two years, upon written request.

Blasting

- Mangoola will manage blasting for the MCCO Project to maintain the existing blasting frequency and timing limits. That is, no more than six blast events per week or two blast events per day between the hours of 9.00 am and 5.00 pm Monday to Saturday, with an allowance for additional blasts where there are low vibration blasts, misfires or where blasts are required to ensure the safety of the mine or its workers

- Mangoola will implement the appropriate blast design controls necessary to meet the relevant criteria for private residential receivers, heritage items, rock formations and infrastructure

- Mangoola will design its blasting practices in a manner that will, as far as reasonably practicable:

    - protect the health and safety of people
    - protect property, public infrastructure and livestock
    - minimise dust and fume emissions
    - minimise the frequency and duration of any road closures for blasting, and use all reasonable efforts to avoid road closures during peak traffic periods
    - carry out blast monitoring to confirm the Project is complying with the relevant conditions of the development consent

- Mangoola will review and update the existing Blast Management Plan and then implement the updated plan for the MCCO Project. The Blast Management Plan will include an updated pre-blast assessment protocol that outlines the process for designing blasts to meet the relevant criteria

- the existing multi-station blast monitoring system for Mangoola Coal Mine will continue to be used. This will also be reviewed and revised as required to cover the sensitive receivers located in the vicinity of the MCCO Additional Project Area. In this regard the following locations for monitoring will be considered, subject to access arrangements:

    - north direction – residential receiver 66 or the closest to it
    - east direction – residential receiver 154, or the closest to it
    - south direction – residential receiver 83 or the closest to it
    - north-west direction – residential receiver 139 or 157 or closest to them

- Mangoola will review and update the existing Road Closure Protocol to include potential interactions with Wybong Road, Wybong Post Office Road and Ridgelands Road due to mining in the MCCO Additional Project Area in consultation with MSC. The updated Road Closure Protocol will be implemented

- blasting related closures of public roads associated with the MCCO Project will be limited to a maximum of one closure event per day (noting that more than one road may need to be closed during a closure event)

- Mangoola will offer all private landholders located within 2 km of the MCCO Proposed Additional Mining Area a property inspection prior to the commencement of blasting in the MCCO Additional Project Area to establish the baseline condition of private structures.

Water Resources

- a Construction Erosion and Sediment Control Plan will be prepared to guide the implementation of appropriate erosion and sediment controls as part of the construction phase of the MCCO Project
- Mangoola will review and update the existing WMP for the MCCO Project in consultation with DPI Water and DPE and then implement this plan. Subject to the requirements of the conditions of consent, the WMP will include:
    - a water balance including details of water supply, use, management and transfers
    - an Erosion and Sediment Control Plan that is consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries, or its latest version
    - a Surface Water Management Plan, including
        - relevant baseline data on channel stability and water quality
        - a description of the water management system on site including design objectives and performance criteria
        - trigger levels for investigating any potentially adverse impacts
        - a surface water monitoring program
    - a Groundwater Management Plan, including
        - relevant baseline data on groundwater levels, yield and quality
        - groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts
        - a groundwater monitoring program
- Mangoola will review and update the existing surface water monitoring program for the MCCO Project with the monitoring program to be refined over the life of the mining operation as appropriate. For the initial phases of mining in the MCCO Additional Project Area, Mangoola will undertake the following additional surface water related monitoring in addition to the existing monitoring program:
    - Monthly water quality monitoring in the MCCO Additional Project Area
    - Monitoring of water transferred from the MCCO Additional Project Area to the existing operations
    - Monitoring of areas of erosion risk, including the proposed upslope diversions and downstream of the proposed Wybong Road and Big Flat Creek overpass
- Mangoola will continue monitoring of streamflow, potential erosion and water quality for two years following cessation of operations. Monitoring data will be reviewed at annual intervals over this period. Reviews will involve assessment against long term performance objectives which will be based on the pre-mine baseline conditions or an approved departure from these. If objectives are not met in the two-year period, the monitoring period will be extended

- Mangoola will construct a flood levee to protect the Proposed Additional Mining Area in the MCCO Additional Project Area from potential flood inundation from Big Flat Creek
- the WMP prepared for the MCCO Project will include TARPs for both surface water and groundwater. The TARPs will identify when additional management measures monitoring or rehabilitation measures may be required
- Mangoola will undertake groundwater monitoring in accordance with a groundwater monitoring program. The program will be reviewed annually and revised as necessary. Upon implementation as part of the MCCO Project the following groundwater monitoring will be undertaken:
    - bi-monthly water levels
    - bi-monthly field water quality
    - annual comprehensive water quality analysis at selected bores including pH, electrical conductivity, total dissolved solids, major ions, alkalinity, and dissolved and total metals
- the results of the groundwater monitoring will be reviewed annually to determine if any additional monitoring sites are required, or if optimisation of the existing monitoring sites, frequency of sampling and analytical suite should be undertaken
- the existing groundwater monitoring network detailed in the existing Groundwater Management Plan will be updated with the additional sites installed since the Groundwater Management Plan was developed. Mangoola will also install new monitoring bores to confirm the VWP pressure changes, and also to monitor water levels in the Wybong Creek alluvium and GDEs prior to the commencement of mining in the MCCO Additional Project Area
- Mangoola will monitor any private bores where impacts are predicted to identify if any impacts occur from the MCCO Project. Should these bores be affected by the MCCO Project, Mangoola will repair the bore, provide an alternative water supply or implement other measures agreed with the landowner
- Mangoola will assess the validity of groundwater model predictions by comparing the extraction volumes and groundwater level data against model predictions every three years. If the data indicates significant divergence from the model predictions, an updated groundwater model will be constructed for the simulation of mining.

Biodiversity

- Mangoola will review and update the existing Biodiversity Offset Management Plan and Strategy and then implement the updated plan for the MCCO Project
- Mangoola will retire biodiversity credits for the MCCO Project in accordance with the FBA
- the proposed land-based offsets will be managed as conservation areas from MCCO Project commencement and Stewardship Agreements will be put in place for these offsets within 12 months of development consent being granted, or as otherwise agreed with the Secretary. Stewardship Agreements will provide for the management and in-perpetuity conservation of the proposed offset sites. The proposed offset sites will be established and until such time as the Stewardship Agreements are in place, Mangoola will manage the offsets as conservation areas
- the preliminary completion criteria for the proposed ecological rehabilitation as outlined in the BAR will be updated in consultation with OEH and DRG as part of the revision of the Rehabilitation Management Plan and MOP. As part of updating and finalising the criteria, Mangoola will consider the contemporary best practice guidance on ecological mine rehabilitation available at that point of time.

Historic Heritage

- Mangoola will update and implement the existing Conservation Management Strategy as part of the implementation of the MCCO Project. It is noted that no additional historic heritage management measures are required for new sites identified as part of the MCCO Project, however, ongoing management of the previously recorded sites is required

- in the unlikely event that unexpected historic (non-Aboriginal) archaeological remains are discovered during works associated with the MCCO Project they will be managed in accordance with the existing process for management of unknown heritage sites/items as detailed within the existing Conservation Management Strategy.

Aboriginal Cultural Heritage

- Mangoola will update the existing Mangoola Coal Mine ACHMP for the MCCO Project and implement the updated plan. The updated plan will be prepared in consultation with the RAPs and will include the Aboriginal cultural heritage management measures to be implemented as part of the MCCO Project which are described in **Appendix 16** with a summary reproduced in **Table 8.1**

- the support for the off-site cultural heritage management measures outlined in **Table 8.1** would be available for applications from the local Aboriginal community for a period of three years from the commencement of the MCCO Project. A process and criteria for the application for this support would be developed following approval of the MCCO Project. A budget of $150,000 will be allocated to the off-site cultural heritage management measures as part of the implementation of the MCCO Project.

Table 8.1 Proposed Management and Mitigation Measures

Action	Proposed Management Measure
Onsite Cultural Heritage Management Measures	
Aboriginal Cultural Heritage Management Plan (ACHMP)	
Update ACHMP	The existing ACHMP will be reviewed for the MCCO Project following the granting of Development Consent to outline all Aboriginal heritage management measures for the MCCO Project, responsibilities of all parties and the timeframe for required heritage works. The ACHMP will include a staged approach to the required research and salvage works to ensure that areas required for earliest disturbance are completed as a priority.
ACHMP Dispute Resolution process	The revised ACHMP will include specific provisions regarding ongoing engagement with the RAPs and would include mechanisms for dispute resolution and communications protocols.
Survey, Collection and Analysis	
Survey, collection and analysis	Salvage (excavation, analysis and collection) as per the recommendations of the OzArk AAIA for the salvage of the 26 sites to be harmed within the MCCO Additional Disturbance footprint and planned investigations within the identified rock shelters to determine the veracity of the PAD assessment.

Action	Proposed Management Measure
Discovery of previously unknown cultural heritage items	The existing ACHMP includes culturally appropriate management measures for the management of human remains, should this occur. The MCCO Project agrees to follow all relevant NSW Government guidelines regarding the location of human skeletal remains. The existing ACHMP will be updated to include the future disturbance area associated with the MCCO Project and be prepared in consultation with RAPs.
Recording of archaeological sites	The ACHMP will be revised to include the new sites identified in the Aboriginal Archaeology Impact Assessment completed for the MCCO Project.
Care and Control	
Care and control measures regarding Aboriginal objects	Care and control management measures will be developed and included in the ACHMP for Aboriginal objects recovered through the Archaeological research and salvage program implemented for the MCCO Project and for long term storage of artefacts recovered from previous research and salvage programs. The care and control management measures will have regard to cultural considerations. Mangoola acknowledge the desire for a regional Wonnarua Keeping Place. Mangoola also acknowledged the MCCO Project lies on the overlapping boundary to the Gomeroi Native Title Claim. However, this facility does not currently exist. Stone artefacts retrieved due to the MCCO Project salvage program will be kept on-site in an appropriate facility currently being developed as part of the existing Project Approval. Should a regional Keeping Place be developed, subject to community support, Mangoola would consider supporting the relocation of cultural heritage material to that place. Further, Mangoola will consider the repatriation of artefacts across rehabilitation areas as part of a closure planning process at the cessation of mining.
Repatriation of artefacts from MCCO Project Area	Mangoola acknowledge the desire for a regional Wonnarua Keeping Place however, this facility does not currently exist. Mangoola also acknowledged the MCCO Project lies on the overlapping boundary to the Gomeroi Native Title Claim. Stone artefacts retrieved due to the MCCO Project salvage program will be kept on-site in an appropriate facility currently being developed as part of the existing Project Approval. Should a regional Keeping Place be developed, subject to community support, MCCO would consider supporting the relocation of artefacts. MCCO will consider the repatriation of artefacts across rehabilitation areas as part of a closure planning process at the cessation of mining.
Sites not to be impacted	The MCCO Project will implement the Aboriginal archaeological management measures program for sites in the MCCO Additional Project Area that will not be impacted by the MCCO Project as recommended in the AAIA (see Appendix 11.6 of **Appendix 16**) for the MCCO Project. These measures will be further outlined in the updated ACHMP. As noted in the AAIA 45 sites in the MCCO Additional Project Area will be avoided as they are located outside of the Proposed Disturbance Footprint. Further Mangoola will provide for the maintenance of the landscape in a 23.5 ha area termed here the 'MCCO Cultural Heritage Management Area' that encompasses landforms adjacent to the tributary to Big Flat Creek in the south-east of the MCCO Additional Project Area.

Offsite Cultural Heritage Management Measures	
Intergenerational Equity	
Education & Learning	Currently GCAA through its voluntary Community Investment Program is committed to: • The Galuwa Aboriginal School scholarship program which currently supports 30 scholarships for Aboriginal students from the Upper Hunter in years 6, 7 and 8 to support their academic progress, cultural identity and career aspirations • Singleton Clontarf Academy supporting 80 Aboriginal boys and 4 staff at Singleton High School to support the personal development and education of these boys. GCAA's approach to supporting Aboriginal education is to work closely with NSW Department of Education to provide meaningful and needed Aboriginal education support that compliments and does not duplicate existing initiatives within NSW Education and other providers who support Aboriginal Education. Further support of Aboriginal education following approval of the MCCO Project would be considered, to align to this approach to support similar Aboriginal education initiatives where there is a substantiated gap in support or service provision.
Sense of Community and Cultural Identity	Knowledge holders and RAPs raised a range of issues and potential mitigation strategies with regards to cultural loss, these included: • A desire for community (or groups) to come together outside of development application/disturbance processes • A desire for a range of cultural experiences (such as cultural camps, Elders Camps, teaching to younger generations). Mangoola would consider supporting a program or activities to assist in promoting cultural awareness and education for young people.
Employment Leadership, Empowerment and Influence Land Management	Employment opportunities for Aboriginal stakeholders were raised as an item that would benefit the wider community. Mangoola, in consultation or conjunction with GCAA, would consider supporting a traineeship or work experience program through a third party provider in the area of cultural heritage management, biodiversity or land management, ecology, rehabilitation or other appropriately related field. A process and criteria for the application of this support would be developed following approval of the MCCO Project.

Traffic and Transport

- Mangoola will construct the proposed Wybong Post Office Road realignment prior to tying it in with the existing road network (i.e. Wybong Road and section of the existing road not being realigned) to minimise disruption to traffic during the construction phase
- to guide traffic management during the construction phase a Construction Traffic Management Plan (CTMP) will be prepared in consultation with MSC prior to construction commencing. The CTMP will include appropriate Traffic Control Plans and include detail with respect to:
    - traffic control measures in works areas
    - restrictions on the delivery of heavy plant and materials to site
    - identify the appropriate entry/exit points for the proposed construction compound area(s) i.e. Wybong Road and Wybong Post Office Road and Ridgelands Road
    - advising motorists of the change in traffic conditions associated with the work
- Mangoola will maintain the current traffic restrictions which include no Mangoola related traffic using Reedy Creek Road, Mangoola Road, Roxburgh Road or Castlerock Road to get to or from the site, except in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

Visual

- to assist in minimising the visual impacts of the MCCO Project, Mangoola will implement the following controls:
    - planting/seeding of tree screens along sections of Wybong Road, the realigned portion of Wybong Post Office Road and Ridgelands Road to reduce the availability of direct views of mining operations by road users
    - progressive rehabilitation will be undertaken to reduce the duration of visible soil exposure, including the use of temporary rehabilitation as appropriate
    - ongoing management of mobile lighting to reduce the impacts of lighting at night, positioning lights so they are not pointing off site, or are shielded by walls, overburden emplacement areas and/or vegetation, where practicable. Procedures will be implemented regarding the appropriate placement of mobile lighting plant to reduce the potential for lighting impacts on local residents and public roads and to reduce diffuse lighting impacts
    - all new fixed lighting associated with the MCCO Project will be installed and maintained in accordance with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting.

Agriculture

- land management for the MCCO Project will include ongoing sustainable land management measures including control of noxious weeds and feral animals and bushfire management. Mangoola will develop land management strategies for the land managed by Mangoola
- where appropriate and sustainable, Mangoola will continue to productively use the agricultural land not required for mining.

Rehabilitation and Closure

Rehabilitation

- Mangoola will implement a natural landform approach to the design and development of the final landform, outside of the final void areas. The final landform will be designed to:
    - be safe, stable and non-polluting
    - incorporate natural landform design features (i.e. micro relief)
    - incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible
    - sustain the intended land use for the post-mining domains
    - minimise the visual impacts of the development
    - be in keeping with the natural terrain features of the area
- Mangoola will progressively rehabilitate disturbed areas over the life of the MCCO Project
- Mangoola will use temporary revegetation (predominantly fast growing grass species) on unshaped overburden areas and other disturbed areas that are planned to be inactive for prolonged periods
- Mangoola will undertake topsoil handling in accordance with the topsoil stockpile handling strategy detailed in the existing MOP
- Mangoola will develop and implement a management approach to address any areas of potential acid forming materials that may be identified as part of the MCCO Project
- the revegetation strategy for the MCCO Additional Project Area will include:
    - ecological rehabilitation consisting of native vegetation communities (as required to meet the needs of the biodiversity offset strategy)
    - open woodland vegetation and native grassland that contain flora species assemblages characteristic of the dominant vegetation communities impacted by the MCCO Project or known as remnant community type prior to clearance for agriculture
- Mangoola will undertake a rehabilitation monitoring program and use the findings to seek to continually improve rehabilitation outcomes
- the closure and rehabilitation completion criteria outlined in the existing MOP will be reviewed and updated to incorporate the MCCO Additional Project Area.

Mine Closure

- a Conceptual Closure Plan will be developed as part of the implementation of the MCCO Project and will be incorporated into the MOP/Rehabilitation Management Plan and will be developed in consideration of the approach outlined in this EIS, subject to requirements of the Project approval conditions

- Mangoola commits to continue to investigate potentially feasible final void options during the life of the Project as part of preparing a detailed final landform and final void strategy for the Project. This strategy would be prepared as part of the initial MOP for the MCCO Project and then updated over the life of the MCCO Project so that it is responsive to any changes in the mining operation
- a detailed mine closure plan will commence at least five years prior to the anticipated mine closure date (e.g. cessation of mining) with the closure plan being finalised at least two years prior to this date
- a Final Void Management Plan will be developed and included in the Final Closure Plan.

Final Land Use

- Mangoola commits to further investigating supplementary post mining land uses, including potential uses for the final voids, as part of developing the detailed closure plan for the mine
- Mangoola will prepare a Final Land Use Strategy for the Mangoola Coal Mine as part of the mine closure plan.

Greenhouse Gas and Energy

- Mangoola will implement reasonable and feasible energy management controls as part of the Project including the management controls identified in **Section 6.7.3** and **Appendix 22**
- at an operational level, Mangoola will aim to improve energy efficiency and reduce greenhouse emissions from the MCCO Project via:
    - limiting the length of haulage routes (where feasible) and associated fuel consumption
    - scheduling activities so that equipment and vehicle operation and maintenance is optimised
    - selecting new equipment and vehicles that have high energy efficiency
- Mangoola will report on its implementation of reasonable and feasible GHG and energy efficient measures in the Annual Review.

Hazard

- if relocated, the Class 1.1 explosives and AN/ANE storages will be located in accordance with the buffer distances specified in **Table 6.32**
- if relocated, the separation distance between Magazine and the AN/ANE store will be maintained in accordance with the AEISG code for storage of UN3375 (ANE) (January 2015) and other relevant standards and codes
- diesel tanks and refuelling systems will be designed and maintained in accordance with relevant Australian Standards and codes
- surface drainage systems will be designed and maintained to prevent spills or runoff from hazardous materials storage areas entering surrounding land/waterways
- dangerous goods will be stored in dangerous goods compliant stores (in accordance with relevant Australian Standards) with appropriate segregation of incompatible dangerous goods
- Mangoola will implement the safeguards and procedures outlined in **Section 6.19.3**.

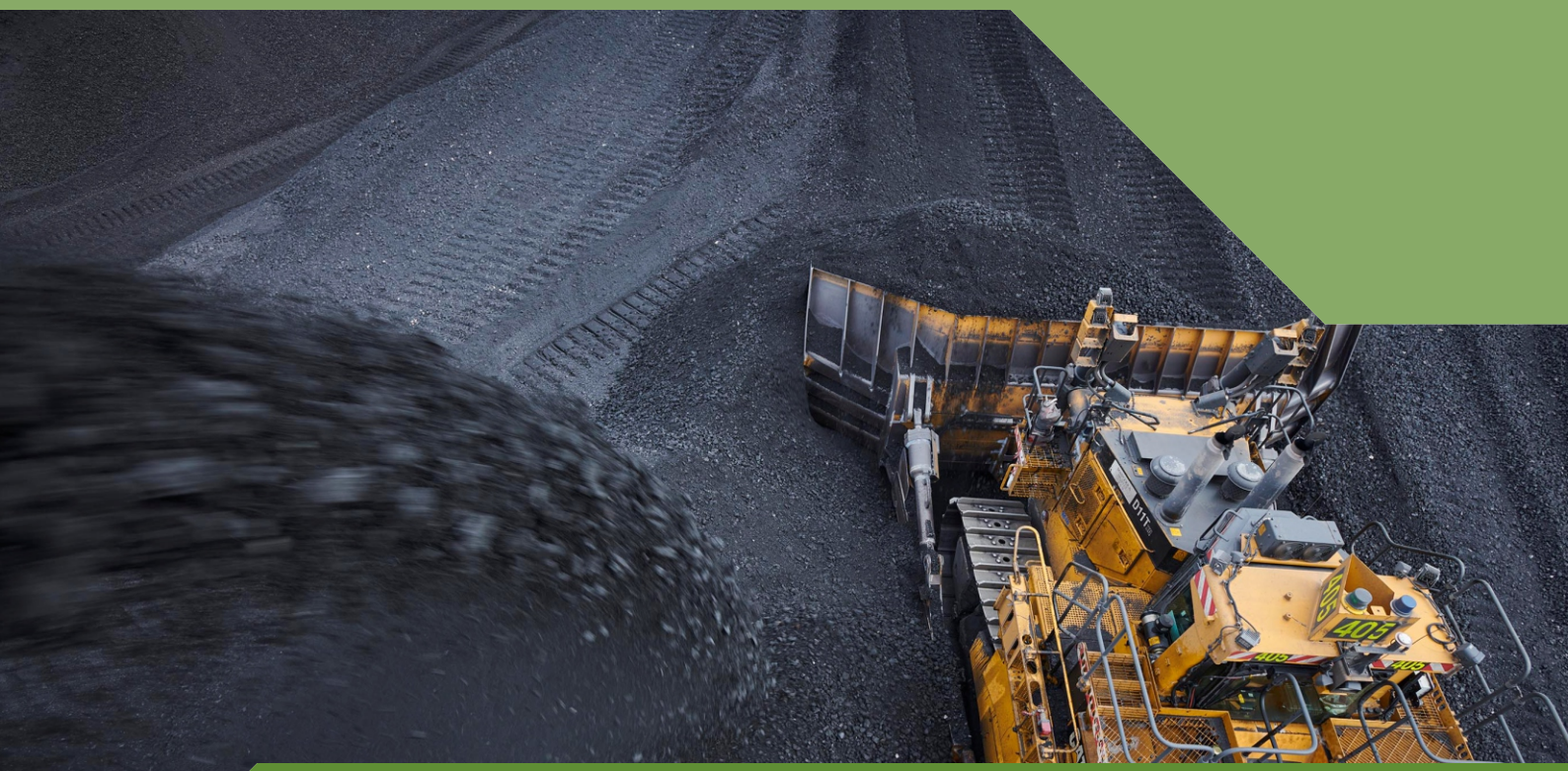
Bushfire

- Mangoola will update the existing Bushfire Management Plan to include land management practices to be applied within the MCCO Additional Project Area, in consultation with the RFS. Mangoola will implement the updated Bushfire Management Plan.

Waste

- no waste will be disposed of on site except for inert wastes and waste tyres buried in the open cut mining areas. Where appropriate, Mangoola will continue to dispose of inert waste within existing open cut voids during the construction, operational and mine closure phases of the MCCO Project
- Mangoola will update the existing Waste Management System and implement it for the MCCO Project. Wastes will continue to be separated on site to allow different waste streams to be appropriately managed. Wastes that cannot be reused or recycled will be transported off site by licensed waste management contractors (except for some inert wastes and waste tyres which may be disposed of on-site).

SECTION 9.0
Conclusion and Justification



9.0 Conclusion and Justification

The SEARs require the EIS to provide both a '*strategic justification for the development focussing on site selection and the suitability of the proposed site'* and to identify '*the reasons why the development should be approved*'. This section addresses these requirements and provides a conclusion discussing the justification for the MCCO Project, taking into consideration the strategic need for the MCCO Project, the environmental, social and economic impacts of the MCCO Project, the principles of Ecologically Sustainable Development (ESD) and the suitability of the site, to assist the consent authority to determine whether or not the MCCO Project is in the public interest.

9.1 Justification for the MCCO Project

Mangoola Coal Mine has provided substantial economic benefits at Commonwealth, State, regional and local levels since commencement of operations in 2010. Based on the current progression of mining and future planning the currently approved operation will complete mining in the Approved Project Area by 2025, with production reducing in the later years of mining. With the MCCO Project, the benefits flowing from the mining operations will be secured through until 2030, with an additional eight years of mining in the MCCO Additional Project Area. Should the MCCO Project not be approved, the closure of the Mangoola Coal Mine at the end of its planned life would result in the loss of approximately 400 full-time positions, plus the loss of flow on jobs and economic benefits for the local and regional communities. If approved, the MCCO Project would provide for ongoing employment opportunities for the Mangoola workforce and provide ongoing economic benefits to the local area, the region and the State. Further details of these economic benefits are discussed in **Section 6.2** and **Section 9.5**.

The MCCO Project, as proposed is a logical continuation of Mangoola Coal Mine into a new mining area immediately north of the existing operation. The proposed continuation involves mining the same coal seams as the existing mine, using the same techniques and equipment. The MCCO Project has been designed to maximise resource recovery and operational efficiencies between the MCCO Additional Project Area and existing Mangoola Coal Mine operations whilst aiming to minimise environmental and social impacts.

The MCCO Project provides an opportunity to efficiently integrate the mining of the Proposed Additional Mining Area with the existing Mangoola Coal Mine operations and will utilise the approved mining infrastructure including the approved capacity within the Mangoola CHPP and train loading facilities thus avoiding the need for new infrastructure. The proposed haul road overpass for Big Flat Creek and Wybong Road allows Big Flat Creek to remain and minimises disruption to traffic on Wybong Road.

The integrated operation of the two mining areas together will allow for the distribution of overburden between the mining areas allowing for improved final landform outcomes. As an integrated mining operation, there is adequate capacity within existing emplacement areas for tailings disposal while additional available overburden will provide flexibility in the conceptual final landform design.

The same leading practice environmental management approach and controls used at the existing operation will continue to apply to the MCCO Project. This includes integrated mine design and management to minimise dust and noise, manage water, and implementation of the same industry leading rehabilitation techniques. As part of implementing the MCCO Project, Mangoola will continue to manage and respond to issues or community concerns that arise as it does for the existing operations.

Not proceeding with the MCCO Project would significantly increase the cost of extracting the identified resources at a later date relative to the MCCO Project due to the efficiencies inherent in the continued use of the Mangoola Coal Mine plant and its infrastructure. The extraction of this resource now, while there is existing mining equipment operating at the site and available mining infrastructure, is substantially more efficient than seeking to mine the resource at some future date following closure of the existing operations. Such future operations may not be commercially viable.

Glencore is committed to transitioning to a low-carbon economy and has recently announced publicly that to assist in meeting the growing needs of a lower carbon economy, globally the company aims to prioritise its capital investment to grow production of commodities essential to the energy and mobility transition and to limit its coal production capacity broadly to current levels. The MCCO Project will extend the life of the existing operation providing production for another approximately five years. In this regard the MCCO Project fits within the production cap as per Glencore's commitment as it is focused on sustaining current coal production in order to increase the life of the existing Mangoola Coal Mine and is not proposing an increase in production or output. This additional five years of production meets existing market demand for coal from Glencore.

9.2 Environmental, Social and Economic Impacts

As detailed in **Section 6.0**, the environmental, social and economic impacts of the MCCO Project have been identified and subject to a detailed environmental assessment based on:

- assessment of the site characteristics (existing environment)
- historical/actual knowledge and data from the existing mining operations and surrounds
- focused consultation with relevant government agencies
- engagement with local community and other stakeholders
- environmental and social risk analysis
- application of the principles of ESD, including the precautionary principle, intergenerational equity, conservation of biological diversity and valuation and pricing of resources
- expert technical assessment.

The key issues identified, including those specified in the SEARs, were subject to comprehensive specialist assessment to identify the potential impacts of the MCCO Project on the existing environment. These assessments are detailed in **Section 6.0** and the appendices to this EIS.

Whilst there are many complex aspects which must be read in their entirety to fully understand these assessments, **Table 9.1** provides a very broad overview of the key outcomes of the environmental, social and economic impact assessment.

Table 9.1 Broad Overview of Environmental, Social and Economic Outcomes

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Social and Economic	• Through Mangoola's pre-emptive project and mine design which avoids and minimises impacts, the social impacts of the MCCO Project have been minimised where practicable • A key focus from a social assessment perspective is the impact of the MCCO Project on proximal landholders due to perceptions of impacts on property value and a dwindling sense of community, and amenity impacts associated with being near neighbours to a large development • To address these issues, a number of mitigation and enhancement strategies are proposed, including the continued implementation of a VPA with MSC; the development of a Community Enhancement Program; implementation of a range of existing and new mitigation measures to address the identified impacts; a series of property specific measures; and the implementation of a SIMP for the ongoing monitoring and management of social impacts • These mitigation measures have been specifically targeted to address the issues identified in the SIA and based on stakeholder feedback • The SIA has found that while a number of social and environmental issues have been raised by landholders in proximity to the MCCO Project – the broader community of Muswellbrook is more accepting of the proposal due to the predicted economic benefits at a local and regional level • The MCCO Project is not anticipated to place any additional pressure on population as a result of the operation and/or construction workforces. The MCCO Project will provide ongoing employment opportunities for the existing workforce (approximately 400 employees) for an additional five years of mine life providing significant ongoing benefits for local and wider communities through employment, use of local services, community participation, local and regional expenditure, community investment and payment of royalties and taxes • A cost benefit analysis of the MCCO Project indicates that the overall net benefits of the Project (after full incorporation of costs, including environmental and social costs) would be in the order of $408.6M in NPV terms.
Noise	• As part of the design of the MCCO Project, Mangoola has incorporated a range of noise controls to minimise noise impacts • Seven residences are predicted to experience noise from the MCCO Project at levels where it is expected that voluntary acquisition rights will apply as outlined in the VLAMP • Nineteen residences (located on 14 properties) with predicted exceedances of 3-5 dB above the project noise trigger levels will be offered acoustic treatments to reduce noise inside the residence • There are predicted to be no exceedances of the sleep disturbance criterion • No adverse cumulative noise impacts are anticipated as a result of the MCCO Project • There are no predicted changes to operational road traffic noise • Construction road traffic is not predicted to exceed the relevant criterion • Noise impacts will continue to be managed through the implementation of proactive noise management and monitoring measures which will be used to adaptively manage mining operations as required to minimise noise impacts.
Air Quality	• The MCCO Project will comply with the applicable annual average PM_{10}, incremental 24-hour average PM_{10}, $PM_{2.5}$, TSP and dust deposition criteria, as outlined in the VLAMP, at all privately owned residences

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• The maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations for the MCCO Project when considered alone meet the criteria at all private receivers. When the MCCO Project is considered cumulatively with existing background levels the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations are predicted to meet the criteria at all but one sensitive receiver (property ID 83). Property ID 83 is subject to voluntary acquisition under the existing approved operation and is within the predicted noise voluntary acquisition zone for the MCCO Project. The modelling indicates that the MCCO Project will contribute to, but will not be the primary cause of, exceedances of the criteria • Proactive and reactive dust control measures will continue to be implemented to minimise dust emissions over the life of the MCCO Project, including by adaptively managing the mining operations to minimise impacts in adverse conditions • Comprehensive air quality management controls have been incorporated into the design of the MCCO Project to minimise the contribution of the MCCO Project to impacts on local and regional air quality.
Blasting	• Blasting activities will be managed so that relevant blast criteria are met at private residences and blast sensitive infrastructure • Road closures will be limited to no more than one per day (noting that more than one road may need to be closed during a closure event).
Water Resources	• A comprehensive water management system has been designed for the MCCO Project to manage water in accordance with legislative requirements and relevant guidelines • The water management system for the MCCO Project builds on the existing system at Mangoola Coal Mine and maximises water recycling and reducing external water import • The MCCO Project Additional Mining Area void will intercept groundwater in the bedrock including in the coal seams. There will be no direct take of any alluvial groundwater as a result of the mining within the MCCO Proposed Additional Mining Area • Mining will continue to reduce flux (flows) between the bedrock and the Wybong Creek alluvium with the majority of the total change in flux during active mining (maximum 33 ML/year) attributed to the continued operations within the approved Mangoola Coal Mine (maximum 30 ML/year). The incremental change due to mining within the MCCO Proposed Additional Mining Area is a maximum of 3 ML/year • The key potential impacts of the MCCO Project on surface water relate primarily to the ephemeral Big Flat Creek, with water capture associated with the mine water management system resulting in reduced catchment flowing to Big Flat Creek (and to a smaller degree to Wybong Creek) and resulting reductions in flow • Water quality in downstream watercourses is not predicted to be adversely impacted by the MCCO Project. No adverse impacts related to water quality have been predicted by the surface water assessment • Modelling indicates the potential for groundwater drawdown to impact one private bore due to mining in the MCCO Proposed Additional Mining Area. Another private bore is already predicted to be impacted by mining within the Approved Project Area. Mangoola will offer to monitor any private bores where impacts are predicted and should any bores be affected by the MCCO Project, Mangoola will repair the bore, provide an alternative water supply or implement other measures agreed with the landowner • Flood modelling indicates some small localised changes to flooding in Big Flat Creek, however, there are no adverse impacts on private landholders or on flooding in

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	Wybong Creek • Studies indicate that existing water licences held by Mangoola are sufficient for the water needs of the MCCO Project • No changes to the approved water discharge arrangements are required.
Biodiversity	• Avoidance of impacts to key biodiversity values was a key driver for the MCCO Project and the impacts were reduced through changes to the mine plan and infrastructure design • The biodiversity impacts of the MCCO Project are being assessed, managed and offset under the Framework for Biodiversity Assessment and the NSW Biodiversity Offsets Policy for Major Projects • The MCCO Project will result in the disturbance to approximately 570 ha of native vegetation and fauna habitat, of which 356 ha is woodland or open forest and 214 ha is derived native grassland • Four NSW listed threatened ecological communities occur within the MCCO Additional Project Area, one of which is listed as threatened at the Commonwealth level; White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Ecological Community • Eleven threatened species have been recorded in the MCCO Additional Project Area including five birds, four bats and two orchids • Mangoola has secured a biodiversity offset package for the MCCO Project that fully satisfies the credit requirements of the MCCO Project. This includes the establishment of land-based offsets that significantly contribute to local and regional conservation.
Historic Heritage	• No potential heritage items of local or state significance were identified in the MCCO Additional Project Area • Direct impacts on the identified potential heritage items that are within the MCCO Additional Project Area will not result in an adverse impact to the historical heritage of the wider study area or the local area more broadly • No indirect impacts to any listed or potential historical heritage items were identified.
Cultural Heritage	• A comprehensive Aboriginal Cultural Heritage Assessment process was completed for the MCCO Project in consultation with the RAPs and Knowledge Holders for the MCCO Project • The assessment noted that the surrounding area is held to be of higher significance to many members of the Wonnarua and Gomeroi community, however based on consultation with RAPs, the sites and/or places within the MCCO Additional Project Area were held in no higher significance or value(s) than any other • The assessment process found the MCCO Additional Project Area has a relatively low cultural significance when compared to other places within the wider region • An archaeological survey identified 26 Aboriginal sites that would be impacted by the MCCO Project (11 Isolated Finds and 15 Artefact Scatters). A majority of these (92 per cent) sites were assessed as having low scientific significance and two sites (8 per cent) have either low-moderate or moderate scientific significance • Mangoola has developed management and mitigation measures in consultation with the RAPs involved in the assessment and these will be implemented in consultation and participation of the knowledge holders and community stakeholders.

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
Traffic and Transport	• The MCCO Project will require the realignment of a portion of Wybong Post Office Road • The proposed realignment will have minimal impact on travel distances (approximately 1.6 km longer when travelling towards Muswellbrook) and will provide an improved standard of road over the realigned section. The change in travel time associated with the increased length of Wybong Post Office Road is approximately 55 seconds. Travel time heading west along Wybong Road towards Sandy Hollow is decreased by this time while travel time heading east towards Muswellbrook is increased due to the intersection with Wybong Road being further west than the current intersection point • During construction the MCCO Project is predicted to result in short term traffic increases, including an average of approximately 16 heavy vehicles per day and a peak of approximately 35 heavy vehicles per day. The assessment has confirmed that all intersections which were modelled will continue to operate at acceptable levels of service • During construction of the haul road overpass of Wybong Road a two-lane bypass road is proposed to be in place to enable Wybong Road to remain open • The MCCO Project does not seek any increase to the current approved maximum annual production rate or employment levels and as such, no operational traffic changes are anticipated above those that have been previously assessed and approved.
Visual	• The proposed operations are not expected to be visible from any private residences • The MCCO Project would be visible from small sections of public roads surrounding the site • Visual impacts associated with views from public roads will be reduced over time with progressive rehabilitation • The progressive rehabilitation of emplacement areas and shaping of the final landform through the continued use of natural landscape design principles is expected to reduce the visual impact of emplacement areas.
Land Use and Agriculture	• The primary existing land use of the MCCO Additional Project Area is mining and low intensity grazing • The mine owned grazing land impacted is primarily low productivity land • The MCCO Project is not predicted to result in adverse impacts on surrounding private agricultural land and the mining operations are expected to continue to coexist with the surrounding agricultural land uses • The MCCO Project will have some impacts on some rural residences (for example impacts above relevant noise criteria), however, these will be addressed by impact mitigation and management measures and overall, the proposed mining operations are expected to be able to continue to coexist with the surrounding land uses in the region.
Rehabilitation and Final Landform	• The existing approach to final landform establishment and rehabilitation at Mangoola Coal Mine, which includes the use of natural landform design principles and rehabilitation of native woodland communities are recognised as industry leading practice. These practices will be applied to the MCCO Project • The rehabilitation strategy proposed aims to minimise environmental impacts throughout the life of, as well as upon completion of, the MCCO Project • The MCCO Project will provide for a fully integrated rehabilitation program and final landform

Environmental/ Social Issue	Overview of Key Outcomes (after Proposed Management, Mitigation and Offsets)
	• The existing approved final landform for Mangoola Coal Mine has one final void. The MCCO Project plans to establish this void generally as currently approved however improved due to the application of a revised natural landform design and shallower slopes on the low wall. One additional void is planned for the MCCO Additional Project Area. Both of the voids proposed have been designed to minimise the areas of unusable land • Ecological rehabilitation on the site will contribute to the biodiversity offset strategy for the MCCO Project • The Biodiversity Offset Strategy will improve local and regional biodiversity outcomes through establishment of strategic habitat corridors, while also providing areas for managed agriculture.
Greenhouse Gas	• The predicted greenhouse gas emissions associated with the MCCO Project have been quantified, including the scope 1, 2 and 3 emissions. The implications of the predicted emissions in the context of climate change policy have been assessed • A range of energy and greenhouse gas management initiatives will be implemented as part of the MCCO Project to improve energy efficiency and reduce the greenhouse gas emissions of the on-site mining operations.
Waste	• The existing waste management plan will be updated to incorporate the MCCO Project. The existing plan is based on the principles of avoid, re-use and recycle, with waste disposed of in accordance with legislative requirements where necessary.

The impacts of the MCCO Project have been kept to a minimum through:

- obtaining a detailed understanding of the issues and impacts by scientific evaluation and stakeholder engagement
- incorporating the extensive experience and learnings from the existing mining operations and applying these learnings to the proposed operations
- detailed project planning including the completion of iterative environmental and mine planning studies that investigated various project options and resulted in changes to the project that reduced impacts
- active engagement with stakeholders, including proximal landholders, to identify key concerns and issues and to allow these to be considered in the MCCO Project design process
- commitment to proactive and appropriate strategies to avoid, minimise, mitigate, offset or manage a range of potential environmental impacts (refer to **Section 6.0** and **Section 8.0**).

9.3 Suitability of the Site

The development of a coal mine and associated infrastructure is limited, by its nature, to the location of the coal resource. For the MCCO Project, the resource proposed to be extracted is located adjacent to an existing operating coal mine, on land owned by Mangoola and on land currently used for low intensity grazing. The MCCO Additional Project Area generally consists of land with lower land capability and in the absence of mining, low intensity agriculture would be the most likely primary land use. In terms of land use, given the higher value that will be generated by mining the available coal resources when compared to the alternate values to be generated by agricultural land uses that would otherwise occur, it would be reasonable to determine that mining is the preferred land use for the site for the duration of the MCCO

Project. Post mining, the area will be rehabilitated and whilst the predominant post mining land use is proposed as native vegetation, that land (outside the final void) would be capable of being used for low intensity grazing as it is currently.

The site currently has a range of biodiversity values and some of these values will be impacted by the MCCO Project, however, Mangoola has developed an offset strategy that fully offsets these impacts in accordance with government policy and which will contribute to and improve conservation outcomes in the local area and region.

The predominant existing land use for the broader MCCO Project Area is mining, with the proposed project consistent with this existing land use. Mangoola Coal Mine has been operating since 2010 and has demonstrated that it can operate in a manner that coexists with the other surrounding land uses which are primarily agriculture. Some of the key objectives for the MCCO Project are to maximise the use of previously disturbed areas, maximise use of existing mining infrastructure and further development of existing environmental and social mitigation and management strategies to mitigate and manage the predicted impacts associated with the MCCO Project, thereby limiting potential for conflicts with other land uses.

From a mining perspective, the MCCO Project is a logical continuation of the existing mine into adjacent resources and from a land use perspective, as a continuation of an existing land use, it is considered that while some impacts are predicted, with the application of the management and mitigation measures committed to by Mangoola, these impacts can be managed to a level that can coexist with surrounding land uses. Mangoola considers that this outcome has been demonstrated through its existing mining operations.

Mangoola has actively engaged with stakeholders including the local community, to seek to understand the key concerns and issues associated with the MCCO Project and to assist with managing these issues through appropriate project design and application of management, mitigation and offset measures.

Extensive management, mitigation and offset measures have been incorporated into the MCCO Project to minimise impacts, including land use impacts and conflicts. As described in **Section 6.17.5** the approach to post mining land use proposed is consistent with the strategic land use objectives for the area. The final landform for the MCCO Project will include the continued use of natural landform design processes incorporating micro-relief principles, consistent with the existing mining operations.

As discussed above and in **Section 6.15.2**, the land within the MCCO Additional Disturbance Area is predominantly comprised of land classes that provide opportunity for low intensity agricultural uses. It is considered that the use of this land for coal mining purposes provides by far the highest economic returns from the land relative to any other identified permissible uses of the land.

9.4 Ecologically Sustainable Development

An objective of the EP&A Act is to encourage ESD within NSW. As outlined in **Section 4.3**, the MCCO Project requires Development Consent under Divisions 4.1 and 4.7 of Part 4 of the EP&A Act. This section provides an assessment of the MCCO Project in relation to the principles of ESD.

To justify the MCCO Project with regard to the principles of ESD, the benefits of the MCCO Project in an environmental and socio-economic context should outweigh any negative impacts. The principles of ESD encompass the following:

- the precautionary principle

- intergenerational 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.

9.4.1 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 MCCO Project, the EIS includes an extensive evaluation of all the key components of the MCCO Project. Detailed assessment of all key issues and necessary management procedures has been conducted and is comprehensively documented in this EIS.

The assessment process has involved a detailed study of the existing environment (refer to **Section 6.0**), and the use of engineering and scientific modelling to assess and determine potential impacts as a result of the MCCO Project. These models have been calibrated using data gathered from the existing mining operation (e.g. noise, air, water and blast monitoring data) to ensure the models are robust and appropriately characterise the MCCO Project and to allow impacts to be predicted and evaluated. To this end, there has been careful evaluation as part of the project design and assessment process to avoid, where possible, irreversible damage to the environment.

The decision making process for the design, impact assessment and development of management processes has been transparent in the following respects:

1. Government authorities, landholders potentially affected by the MCCO Project, the local community, the Aboriginal community and other stakeholders were consulted during preparation of this EIS (refer to **Section 5.0**). This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures.

2. The community has been engaged throughout the development and assessment of the MCCO Project through a range of mechanisms including one-on-one meetings, community information sessions to inform project design and management of key issues, and community newsletters amongst other mechanisms (refer to **Section 5.0**) which provided landholders and stakeholders with both information and the opportunity to influence MCCO Project outcomes.

3. Mangoola will update and implement the existing comprehensive EMS. Through implementation of the EMS and related environmental management programs, Mangoola will seek to implement best practice management. The MCCO Project will incorporate the practices previously implemented and demonstrated to be effective at the existing approved operations. The EMS will incorporate the additional controls committed to in this EIS (refer to **Section 8.0**).

4. This EIS has been undertaken on the basis of the best available scientific information about the MCCO Project Area and has been informed by site specific survey, monitoring, modelling and environmental and social assessment. 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. As noted above, the models used were calibrated using real data from the existing operations where appropriate, and a validation program has also been proposed to measure predicted against actual impacts of the MCCO Project (refer to **Section 8.0**), so that contingency measures, if required, can be implemented in a timely and proactive manner.

5. An auditing and review process will be an integral component of the EMS, providing for verification of project performance by independent auditors and relevant government agencies. The MCCO Project will implement an auditing and verification process consistent with those currently undertaken at the existing operations.

9.4.2 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 refers to equality between generations. It requires that the needs and requirements of today's generations do not compromise the needs and requirements of future generations in terms of health, biodiversity and productivity.

The objectives of the MCCO Project are outlined in **Section 1.2** and with regard to intergenerational equity they include to:

- conduct mining in an environmentally responsible manner to minimise project specific and cumulative environmental and social impacts
- minimising additional mining disturbance footprint by maximising the use of existing disturbed areas and utilising the capacity of existing infrastructure
- maintaining and extending the employment opportunities for Mangoola employees
- developing comprehensive mitigation and management strategies to mitigate and offset predicted impacts associated with the MCCO Project
- establishing a final landform that is safe, stable and sustainable.

Further to the MCCO Project objectives, a range of environmental management measures discussed in **Section 6.0** and **Section 8.0** have been developed and evaluated to minimise the impact on the environment to the greatest extent reasonably possible.

Mangoola will rehabilitate the land post mining as part of the MCCO Project and has demonstrated through its existing high quality rehabilitation practice that this will be done to a high standard, providing a rehabilitated landscape that is suitable for use by future generations. The proposed biodiversity offsets will also provide long-term conservation outcomes that will provide benefit for future generations.

The design of the MCCO Project and commitment to the management of environmental issues as outlined in this EIS will mitigate and offset the predicted impacts of the MCCO Project and maintain the health, diversity and productivity of the environment for future generations. The MCCO Project will also make a

significant contribution to maintaining services in the community through the direct and flow on effects of employee and operational expenditure and through development contributions in accordance with the EP&A Act.

The EP&A Act requires the consent authority to consider matters of relevance to the public interest. Matters of public interest have been held to include intergenerational equity. Greenhouse gas emissions associated with coal combustion, and the established links to climate change, are likely to generate environmental impacts across generations with the predicted impacts associated with greenhouse gas emissions further discussed in **Section 6.18**.

9.4.3 Conservation of 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 MCCO Project are described in this EIS (refer in particular to **Section 6.9** and **Appendix 13**). Potential impacts are also outlined in this EIS (refer to **Section 6.9**) and measures to ameliorate any negative impact are outlined in **Section 8.0**.

NSW Government policy requires the biodiversity impacts of a project to be quantified and offset using a credit driven mechanism. The impacts of the MCCO Project have been quantified and Mangoola has secured all of the required offsets to fully meet the biodiversity offset credit needs of the Project. The retirement of biodiversity credits not only fully offsets the impacts of the MCCO Project on biodiversity, it provides in-perpetuity conservation of areas of high biodiversity value and provides for ongoing improvement of the values through active management and conservation.

The proposed offset strategy for the MCCO Project will result in significant conservation areas being established in both the local area and region, contributing to long-term conservation and biological diversity outcomes. The proposed local conservation areas will build on the existing conservation areas already established by Mangoola, adding to the existing conservation network.

9.4.4 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 follows:

> 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; and
>
> (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

The polluter pays principle applies to the MCCO Project through the discharge of salt in surface water discharges to the Hunter River catchment through the HRSTS (refer to **Section 6.7**). Pricing of resources is also captured in the regulatory regime applying to surface and groundwater extractions.

Project considerations have included the costs of management measures to minimise potential environmental and social impacts. There will also be additional costs associated with establishing and managing ecological offsets to reduce the magnitude of ecological impacts. In many cases, operational efficiencies are also associated with improved environmental outcomes. For example, efficient haul routes reduce total noise and dust emissions and diesel use (with associated greenhouse gas and particulate emission reductions). The MCCO Project also optimises the valuation and pricing of the coal resources with minimal impact by optimising available use of the existing infrastructure and equipment.

9.5 Conclusion

As outlined in **Section 9.3**, the MCCO Project has been assessed against the principles of ESD as required by the EP&A Act and EP&A Regulation. This assessment has indicated that while the MCCO Project, like any large scale development, will have impacts, these impacts can be effectively managed, mitigated and offset and the development will result in significant economic benefits. The assessment therefore concludes that the MCCO Project is consistent with the principles of ESD.

The Economic Assessment (refer to **Appendix 7**) describes a range of positive benefits from the MCCO Project that will result at a local, regional and State level. These benefits include:

- provide ongoing employment opportunities for the Mangoola workforce of approximately 400 employees, rising to a peak of approximately 480
- creation of up to approximately 145 additional construction jobs (peak) over the construction phase of the MCCO Project
- provide a net benefit in the Upper Hunter region of $92.6M in NPV terms
- provide a net benefit $408.6M to NSW over the life of the MCCO Project in NPV terms
- provide a royalty revenue stream flowing to the NSW Government estimated to be $121M over the life of the MCCO Project.

The revenue, expenditure and employment associated with the construction and operation of the MCCO Project will stimulate economic activity in the regional economy, as well as for the broader NSW economy. Over the life of the MCCO Project, the Hunter Region's Gross Regional Product is projected to increase by $599M in NPV terms. NSW's Gross State Product (including the Hunter) increases by around $686M (NPV terms).

A cost benefit analysis was undertaken for the MCCO Project which assessed the net benefit of the MCCO Project when all external and internal costs were considered, including environmental and social externality costs. The cost benefit analysis determined that the MCCO Project would result in a net benefit of $408.6M in NPV terms over the life of the MCCO Project (refer to **Section 6.2**). The MCCO Project will also provide considerable additional benefits in the form of royalties, taxation and other government revenue which will be recycled through the economy.

With the implementation of the management, mitigation and offset measures proposed by Mangoola, the assessment has concluded that the MCCO Project would result in a net benefit to the NSW community.

SECTION 10.0
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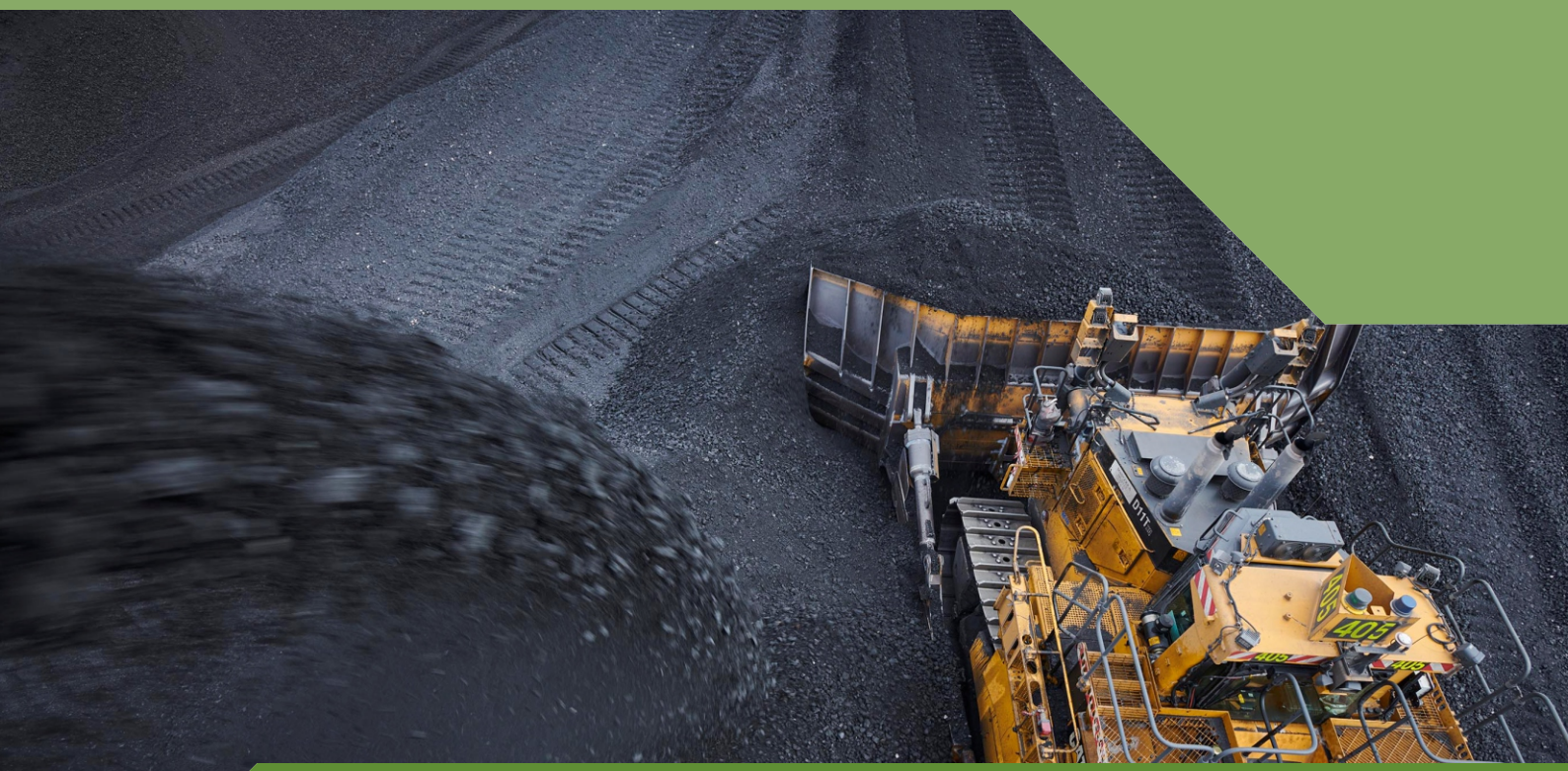

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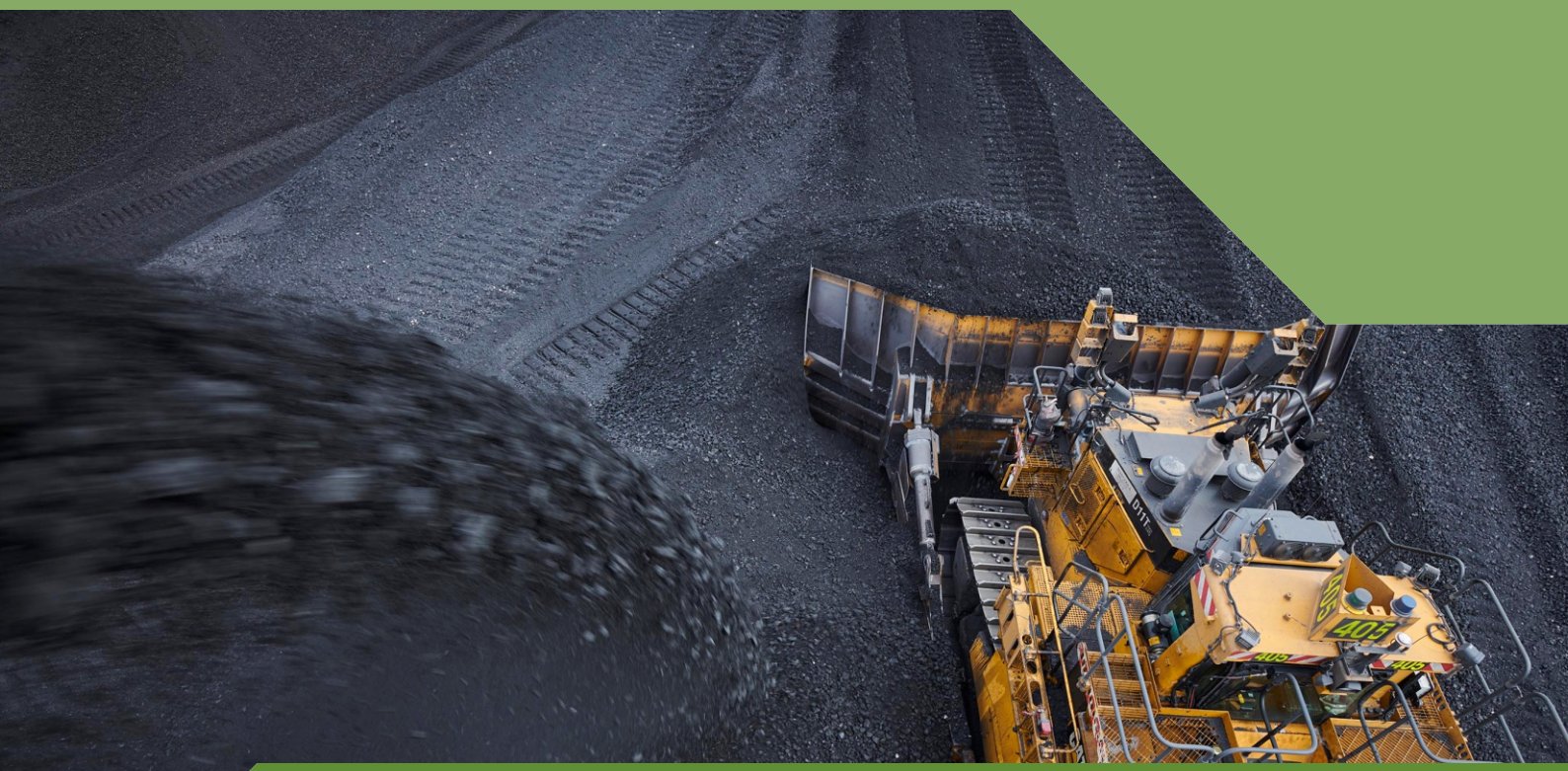
SECTION 11.0
Abbreviations and Glossary



11.0 Abbreviations and Glossary

Table 11.1 Abbreviations

Abbreviation	Definition
AAIA	Aboriginal Archaeological Impact Assessment
ABS	Australian Bureau of Statistics
ACHAR	Aboriginal Cultural Heritage Assessment Report
ACHM	Australian Cultural Heritage Management
ACHMP	Aboriginal Cultural Heritage Management Plan
ACHOA	Aboriginal Cultural Heritage Offset Area
AEP	Annual Exceedance Probability
AGE	Australasian Groundwater and Environmental Consultants
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AIS	Agricultural Impact Statement
AIP	Aquifer Interference Policy
AL	Assessment Lease
ANC	Acid Neutralising Capacity
ANE	Ammonium Nitrate Emulsion
ANZECC	Australian and New Zealand Environment and Conservation Council
APZ	Asset Protection Zone
AQIA	Air Quality Impact Assessment
ARD	Acid Rock Drainage
ARTC	Australian Rail Track Corporation Ltd
BAR	Biodiversity Assessment Report
BCT	Biodiversity Conservation Trust
BIA	Blast Impact Assessment
BOA	Biodiversity Offset Areas
BSAL	Biophysical Strategic Agricultural Land
BVT	Biometric Vegetation Types
CCC	Community Consultative Committee
CEEC	Critically Endangered Ecological Community
CHPP	Coal Handling and Preparation Plant
CIC	Critical Industry Cluster
CO	Carbon Monoxide
CTMP	Construction Traffic Management Plan

Abbreviation	Definition
dB	Decibels
DEC	Former Department of Environment and Conservation (now OEH)
DECCW	Former Department of Climate Change and Water (now OEH)
DoEE	Commonwealth Department of the Environment and Energy
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DPI Water	Department of Primary Industries – Water
DRG	Division of Resources and Geoscience
EC	Electrical Conductivity
EEC	Endangered Ecological Community
EIA	Economic Impact Assessment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority of NSW
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000 (NSW)*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EL	Exploration Lease
EPL	Environment Protection Licence
EMS	Environmental Management System
ENM	Environmental Noise Model
ESD	Ecologically Sustainable Development
ETL	Electricity Transmission Line
FBA	Framework for Biodiversity Assessment
GCAA	Glencore Coal Assets Australia
GDEs	Groundwater Dependent Ecosystems
GHG	Greenhouse gas
GHGEA	Greenhouse Gas and Energy Assessment
GJ	Gigajoules
Glencore	Glencore Coal Pty Limited
GWIA	Groundwater Impact Assessment
ha	Hectare
HHA	Historic Heritage Assessment
HRSTS	Hunter River Salinity Trading Scheme
ICNG	Interim Construction Noise Guideline
IEA	International Energy Agency
IESC	Independent Expert Scientific Committee

Abbreviation	Definition
IPC	Independent Planning Commission
IPCC	Intergovernmental Panel on Climate Change
Infrastructure SEPP	State Environmental Planning Policy (Infrastructure) 2007
km	kilometres
kV	Kilovolt (1000 volts)
LEP	Local Environmental Plan
LGA	Local Government Area
LoS	Level of Service
LSC	Land and Soil Capability
m	metres
M	Million
m/s	metres per second
Mbcm	Million bank cubic metres
MCCO	Mangoola Coal Continued Operations
MIA	Mine Infrastructure Area
MJ	Megajoules
Mining SEPP	State Environmental Planning Policy (Mining, Petroleum and Extractive Industries 2007
ML	Megalitres
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MSC	Muswellbrook Shire Council
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAF	Non-acid Forming
NGA	National Greenhouse Accounts
NHMRC	National Health and Medical Research Council
NIA	Noise Impact Assessment
NEPM	National Environment Protection Measures
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NOW	NSW Office of Water
NPC	Net Present Cost
NPV	Net Present Value
NPfI	Noise Policy for Industry
NPW Act	*National Parks and Wildlife Act 1974*

Abbreviation	Definition
NPW Regulation	*National Parks and Wildlife Regulation 2009*
NSW	New South Wales
OEH	Office of Environment and Heritage
OzArk	OzArk Environmental and Heritage Management
PA	Project Approval
PAD	Potential Archaeological Deposit
PAF	Potential Acid Forming
PBP	Planning for Bushfire Protection
PCT	Plant Community Type
PCWP	Plains Clans of the Wonnarua People
PEA	Preliminary Environmental Assessment
pH	Potential Hydrogen
PHA	Preliminary Hazard Analysis
PM	Particulate matter
PM_{10}	Particulate matter less than 10 micro metres in diameter
$PM_{2.5}$	Particulate matter less than 2.5 micro metres in diameter
PMF	Probable Maximum Flood
PNTL	Project Noise Trigger Levels
POEO Act	*Protection of the Environment Operations Act 1997*
RAPs	Registered Aboriginal Parties
RBL	Rating Background Level
RFS	Rural Fire Service
RMS	Roads and Maritime Services
ROM	Run-of-mine
RWD	Raw Water Dam
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP 33	State Environmental Planning Policy 33 – Hazardous and Offensive Development
SEPP 44	State Environmental Planning Policy 44 – Koala Habitat Protection
SEPP 55	State Environmental Planning Policy 55 – Remediation of Land
SIA	Social Impact Assessment
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SRLUP	Strategic Regional Land Use Plan
SSD	State Significant Development
TARP	Trigger Action Response Plan
tCO_{2-e}	Tonnes of CO_2 equivalent

Abbreviation	Definition
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TSP	Total suspended particulate matter, usually in the size range of zero to 50 micrometres
TSS	Total Suspended Solids
TTIA	Traffic and Transport Impact Assessment
Umwelt	Umwelt (Australia) Pty Ltd
VCA	Voluntary Conservation Agreement
VLAMP	Voluntary Land Acquisition and Mitigation Policy
VPA	Voluntary Planning Agreement
VWPs	Vibrating Wire Piezometers
WALs	Water Access Licences
Water Act	*Water Act 1912*
WLALC	Wanaruah Local Aboriginal Land Council
WMP	Water Management Plan
WNAC	Wonnarua Nation Aboriginal Corporation
WSP	Water Sharing Plan
µg	micrograms
µm	micrometres
per cent	per cent

Table 11.2 Glossary

Glossary	
Acid Rock Drainage	Drainage of acidic water from rock material
Alluvium	Sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.
Amenity	An agreeable feature, facility or service which makes for a comfortable and pleasant life
Aquifer	A water-bearing rock/sediment formation
Archaeological	Pertaining to the study of culture and description of its remains
Attenuation	The reduction in magnitude of some variable in a transmission system, for example, the reduction of noise with distance as it travels through air
Catchment Area	The area from which a river or stream receives its water
Coal Resources	All of the potentially useable coal in a defined area, based on geological data at certain points and extrapolations from these points
Coarse Reject	Lumps of carbonaceous shale up to 200 mm in size separated in the coal preparation process
Conservation	The management of natural resources in a way that will preserve them for the benefit of both present and future generations
Ecology	The science dealing with the relationships between organisms and their environment
Ecosystem	Organisms of a community together with its non-living components through which energy and matter flow
Electrical Conductivity	The measure of electrical conduction through water or a soil-water suspension generally measured in millisiemens per centimetre or microsiemens per centimetre. An approximate measure of soil or water salinity
Environmental Planning and Assessment Act 1979	NSW Government Act to provide for the orderly development of land in NSW
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance
Fault	A fracture or fracture zone along which there has been displacement of the sides relative to one another. Displacement can be vertical and/or horizontal
Fauna	All vertebrate animal life of a given time and place
Floodplain	Large flat area of land adjacent to a stream which has been deposited during previous stream flow events and is inundated during times of high flow
Flora	All vascular plant life of a given time and place
Geology	Science relating to the earth, the rocks of which it is composed and the changes it undergoes
Groundwater	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table
Habitat	The environment in which a plant or animal lives; often described in terms of geography and climate
Indigenous	Native to, or originating in, a particular region or country

Glossary	
In situ	In its original place
kL (Kilo litre)	One thousand litres
kV (Kilo Volt)	One thousand volts
LA1 Noise Level	The noise level exceeded for one per cent of the time. It is used in assessment of sleep disturbance
LA90 Noise Level	The noise level, measured in dB(A), exceeded for 90 per cent of the time, which is approximately the average of the minimum noise levels. The L90 level is often referred to as the 'background' noise level and is commonly used to determine noise criteria for assessment purposes
LAeq Noise Level	The equivalent continuous noise level, measured in dB(A), during a measurement period
LAMax Noise Level	The maximum noise energy, measured in dB(A), during a measurement period
Land Capability	The ability of a parcel of land to be used in a sustainable manner (that is without permanent damage) for a given land use
Landform	Sections of the earth's surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc.)
Mean	The average value of a particular set of numbers
Megalitre (ML)	One million litres
Meteorology	Science dealing with atmospheric phenomena and weather
Mitigate	To lessen in force, intensity or harshness. To moderate in severity
Native	Belonging to the natural flora or fauna in a region
Outcrop	Bedrock exposed at the ground surface
Overburden Emplacement	An area for placing overburden or waste rock, removed from above and between the coal seams
Particulates	Fine solid particles which remain individually dispersed in gases
pH	Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity
Piezometer	A small diameter bore lined with a slotted tube used for determining the standing water level of groundwater
Protection of the Environment Operations Act 1997	NSW legislation administered by the EPA that regulates discharges to land, air and water
Proximal Landholders	Landholders and residents in close proximity to the current mining operations (within 4 km) in the state suburbs of Mangoola, Castle Rock, Wybong and Manobalai
Radial Analysis	Radial analyses are developed using 3D topographic information and electronic data files relating to the proposed Project to identify what can theoretically be seen from particular vantage points. The radial analysis illustrates what is visible from a height of 1.7 m at that location (i.e. from average eye height)

Glossary	
Rehabilitation	The process of restoring to a condition of usefulness. In regard to mining, relates to restoration of land from a degraded or mined condition to a stable and vegetated landform
Revegetation	The process of re-establishing vegetation cover
Run-of-mine (ROM)	Bulk material extracted from a mine, before it is processed in any way
Salinity	A measure of the concentration of dissolved solids in water
Seam	An identifiable discrete coal unit
Sediment Dam	A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge
Site Specific	Relating to conditions existing at a particular location
Socio-economic	Combination of social and economic factors
Sound Power Level	The total sound energy radiated per unit time measured as 10 times a logarithmic scale, the reference power being 12 picowatts
Spontaneous Combustion	Spontaneous ignition of some or all of a combustible material
Stratigraphy	the branch of geology concerned with the order and relative position of strata and their relationship to the geological timescale
Subsidence	The vertical movement of a point on the surface of the ground as it settles above a coal panel extracted by underground mining
Surface Infrastructure	Any manmade object, facility or structure on the surface of the land
Tailings	Fine residual waste material separated in the coal preparation process
Thermal Coal	Includes medium to high ash, low sulphur coals used for domestic power generation and medium to low ash energy coals which are exported
Topography	Description of all the physical features of an area of land and their relative positions, either in words or by way of a map
Total Dissolved Solids (TDS)	A measure of salinity expressed in milligrams per litre (mg/L)
Total Suspended Particulates (TSP)	A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre (µg/m3) for air
Woodland	Land covered by trees that do not form a closed canopy

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