MALABAR COAL

MAXWELL PROJECT

Agricultural Impact Assessment

In Support of an Application for a Gateway Certificate

August 2018

Maxwell Project

Agricultural Impact Assessment in Support of an Application for a Gateway Certificate

19/08/2018

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ABBREVIATIONS

Abbreviation	Description
AIP	Aquifer Interference Policy
Application Area	Gateway Certificate Application Area
ASC	Australian Soil Classification
BSAL	Biophysical Strategic Agricultural Land
CHPP	Coal handling and preparation plant
CL	Coal Lease
CIC	Critical Industry Cluster
DPI	NSW Department of Primary Industries
DP&E	NSW Department of Planning and Environment
DP&I	NSW Department of Planning and Infrastructure (now DP&E)
EIS	Environmental Impact Statement
EL	Exploration Licence
ha	Hectare
km	Kilometre
LGA	Local Government Area
LSC	Land and Soil Capability
Malabar	Malabar Coal Limited
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
ML	Mining Lease
Mt	Million tonnes
Mtpa	Million tonnes per annum
NSW	New South Wales
PAC	Planning Assessment Commission (now the Independent Planning Commission)
ROM	Run-of-mine
SEARs	Secretary's Environmental Assessment Requirements
The Project	Maxwell Project

EXECUTIVE SUMMARY

Report Purpose

The New South Wales (NSW) Government has implemented a 'Gateway Process' to assess coal seam gas and coal mine developments that might impact on Strategic Agricultural Land. Maxwell Ventures (Management) Pty Ltd, a wholly owned subsidiary of Malabar Coal Limited (Malabar) is seeking to develop an underground coal mine, known as the Maxwell Project (the Project), in the Upper Hunter Valley. The Project Gateway Certificate Application Area (Application Area) contains land that has been mapped as biophysical strategic agricultural land (BSAL), and hence the Gateway Process has been triggered and a Gateway Certificate is required.

This report represents the Agricultural Impact Assessment required to support the Application for a Gateway Certificate. The Gateway Certificate Application is also supported by other studies including: a subsidence assessment; a BSAL verification assessment; and a preliminary groundwater assessment. These reports also provided core input to support the decision making and impact assessment outlined in this report.

Maxwell Project

The Project would involve extraction of coal from four seams within the Wittingham Coal Measures using bord and pillar with pillar extraction in the Whynot Seam and longwall extraction in the Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam. The Project underground mining area is located entirely within Exploration Licence (EL) 5460. Malabar owns and manages the existing infrastructure within Coal Lease (CL) 229, Mining Lease (ML) 1531 and CL 395 (known as the Maxwell Infrastructure). The Maxwell Infrastructure includes an existing coal handling and preparation plant (CHPP), rail facilities and other infrastructure and services (including water management infrastructure, administration buildings, workshops and services). The Project would include the use of the existing Maxwell Infrastructure and the development of new infrastructure.

The Project would recover approximately 150 Mt of run-of-mine (ROM) coal over a 26 year period of coal extraction.

Gateway Certificate Application Area

Land use and land production capability was assessed through: interviews with property managers within the Application Area; review and analysis of soil mapping data; and assessment of local and regional agricultural data and summaries.

Land use within the Application Area consists primarily of cattle grazing with small areas of opportunistic fodder cropping (under favourable conditions). Surface water is the main water source for stock and domestic use.

The land surface is moderately to steeply sloping with slopes generally between 10 and 30 degrees in the south-east section of the Application Area and generally less than 10 degrees in the north-west section of the Application Area. Land and soil capability (LSC) is generally low to very low (LSC classes 6 and 7) with small areas of moderate to low-moderate capability in the north-west (LSC classes 4 and 5). Soil fertility ranges from moderately low to high within the surveyed area. Detailed soil investigations, including extensive field sampling, conducted by SLR (2015) and SLR (2018) mapped 72 hectares of a soil landscape unit that meets the criteria of BSAL within the Application Area.

Areas of Equine Critical Industry Cluster (CIC) and Viticulture CIC are located to the south of the Application Area.

Potential Impacts

Expected subsidence from underground activities across the underground mining area would vary from; nil in certain areas, to a maximum of 5.8 metres in areas where the underground mining in all four seams occur (Mine Subsidence Engineering Consultants 2018). Small areas of ponding along existing drainage lines and some surface cracking are expected to be the main impacts to the surface from the Project. Based on experience drawn from the existing underground mines in the Hunter Valley and elsewhere, there is expected to be minimal to no impact on agricultural resources if routine maintenance is undertaken.

The Preliminary Groundwater Assessment by HydroSimulations (2018) found no significant impacts on groundwater resources. Potential impacts on highly productive Hunter River alluvium would be within the 'Level 1' minimal impact thresholds as defined by the Aquifer Interference Policy (Department of Primary Industries 2012).

Impacts to BSAL and Agricultural Production

With appropriate management and rehabilitation, no significant impacts on BSAL or local or regional agricultural production are likely as a result of the Project.

01 INTRODUCTION

Maxwell Ventures (Management) Pty Ltd, a wholly owned subsidiary of Malabar Coal Limited (Malabar), is seeking consent to develop an underground coal mining operation, referred to as the Maxwell Project (the Project).

The Project is located in the Upper Hunter Valley of New South Wales (NSW), east-southeast of Denman and south-southwest of Muswellbrook (Figure 01-1). The Project underground mining area is located entirely within Exploration Licence (EL) 5460.

Malabar owns and manages the existing infrastructure within Coal Lease (CL) 229, Mining Lease (ML) 1531 and CL 395 (collectively known as the Maxwell Infrastructure). The Maxwell Infrastructure includes an existing coal handling and preparation plant (CHPP), rail facilities and other infrastructure and services (including water management infrastructure, administration buildings, workshops and services). The Project would include the use of the substantial, existing Maxwell Infrastructure, along with the development of some new infrastructure.

Requirement for a Gateway Certificate

As part of the *Strategic Regional Land Use Policy*, the NSW Government introduced a 'Gateway Process' for upfront assessment of the impacts of State Significant mining and coal seam gas proposals on Strategic Agricultural Land (Department of Planning and Infrastructure [DP&I] 2012a). This process is formalised through clause 50A of the NSW *Environmental Planning and Assessment Regulation 2000* and Part 4AA the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (the Mining SEPP).

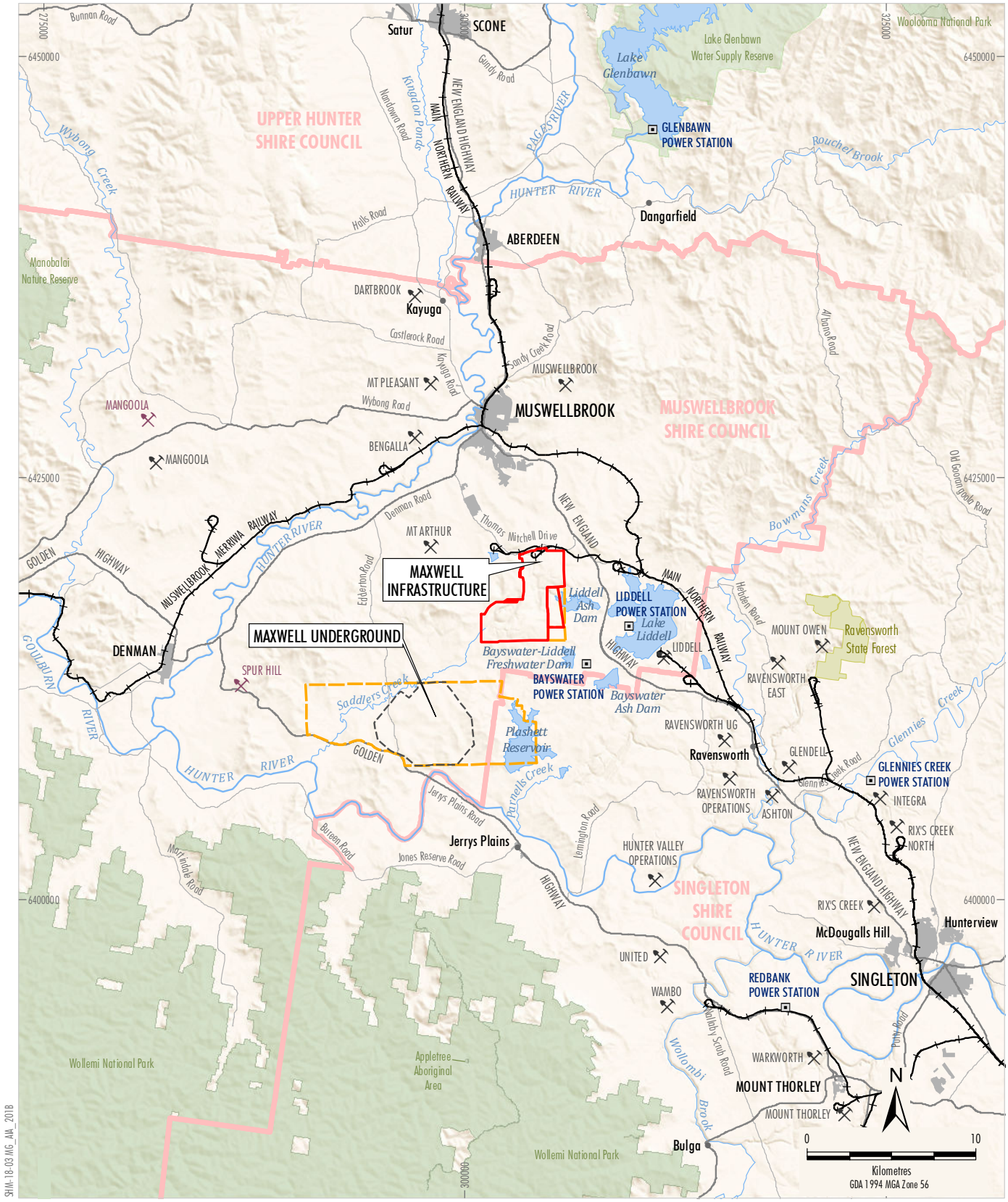
Under the NSW legislation, development in the Upper Hunter Valley that requires a mining lease to be issued to enable the development to be carried out requires:

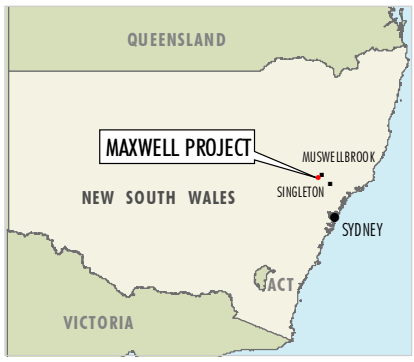
- in relation to proposed development on land mapped as critical industry cluster land in the Mining SEPP – a Gateway Certificate; or
- in relation to proposed development on any other land:
    - a Gateway Certificate; or
    - a Site Verification Certificate that certifies that the land on which the proposed development is to be carried out is not Biophysical Strategic Agricultural Land (BSAL).

The Project would not occur on land mapped as Equine Critical Industry Cluster (CIC) or Viticulture CIC in the Mining SEPP.

Soil test work has identified a soil landscape unit in the proposed mining lease application area that meets the criteria of BSAL. Therefore, a Gateway Certificate is required to accompany the Development Application for the Project.

Accordingly, Malabar is lodging an Application for a Gateway Certificate with the Mining and Petroleum Gateway Panel for those portions of the Project that would require a mining lease (Figure 01-2) in accordance with Part 4AA of the Mining SEPP. This report forms the Agriculture Impact Assessment in support of the Application for a Gateway Certificate. The land that will be the subject of the Application for a Gateway Certificate will herein be referred to as the "Application Area".





LEGEND

- Mining Operation
- Proposed Mining Operations (Application Lodged)
- Railway
- Local Government Boundary
- State Forest
- National Parks and Wildlife Service Estate
- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Indicative Underground Mining Area

Source: © NSW Department of Finance, Services and Innovation (2018); Office of Environment and Heritage NSW (2018)

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Regional Location

Figure 01-1

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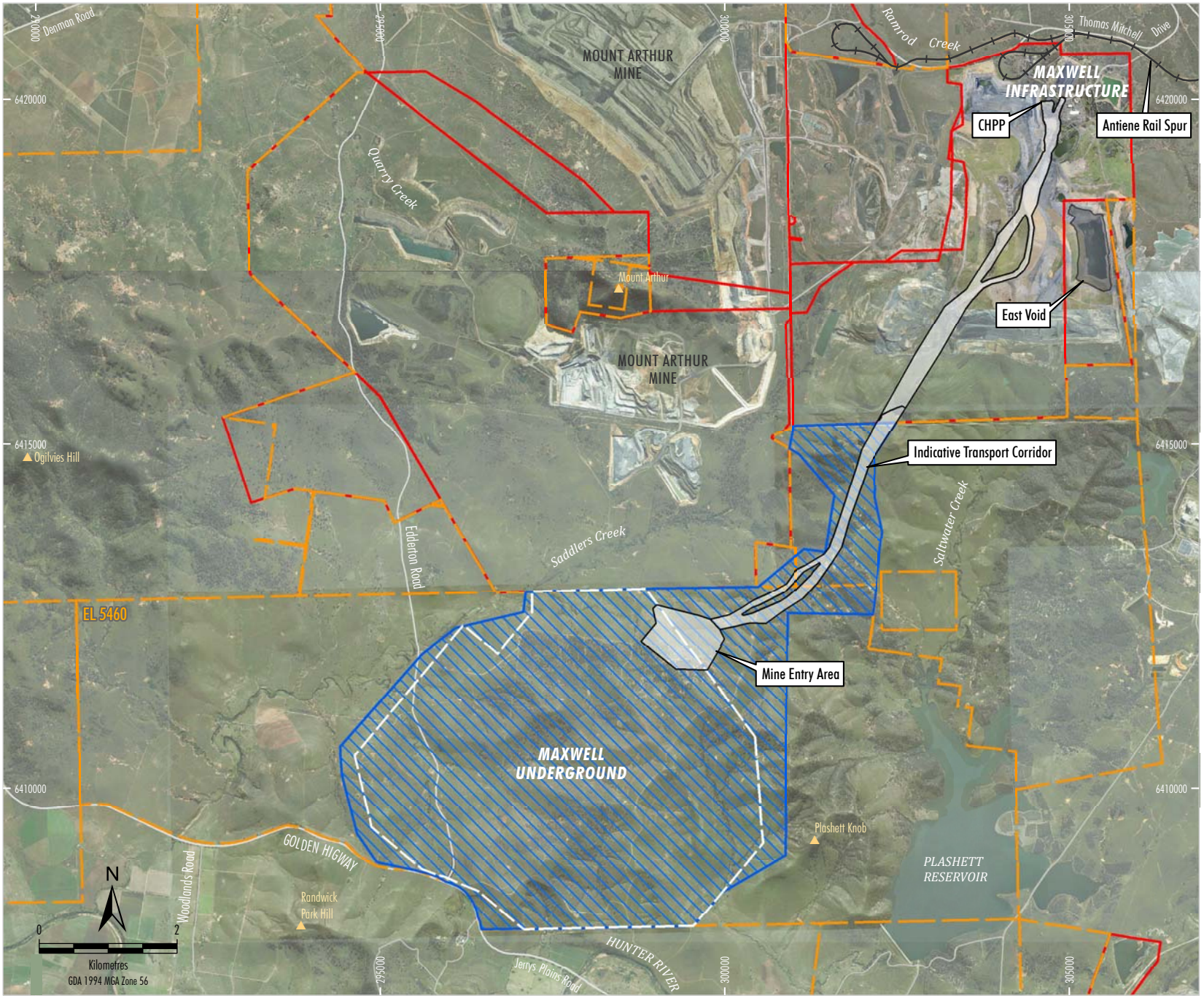

LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Railway
- Gateway Certificate Application Area
- Indicative Underground Mining Area
- Proposed Surface Development Area
- CHPP Reject Emplacement Area

Source: © NSW Department of Finance, Services & Innovation (2018)
Orthophoto: Oct 2016, 2011

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Project General Arrangement and Gateway Certificate Application Area

Figure 01-2

SHM-18-03 MG_AIA_203B

01.1 **Purpose of Assessment**

The purpose of this Agricultural Impact Assessment is to support an Application for a Gateway Certificate for the Project.

This report has been prepared with reference to:

- The Mining SEPP.
- *Upper Hunter Strategic Regional Land Use Plan*, September 2012 by DP&I (DP&I 2012b).
- *Strategic Regional Land Use Policy Guideline for Gateway Applicants*, Fact Sheet, September 2013 (the Guideline) (DP&I 2013).
- *Strategic Regional Land Use Policy Guideline for Agricultural Impact Statements*, October 2012 (DP&I 2012a).
- *Agricultural Impact Statement technical notes: A companion to the Agricultural Impact Statement guideline*, April 2013 by Department of Primary Industries (DPI) (DPI 2013a).
- *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (the Interim Protocol), by the Office of Environment & Heritage (OEH) and the Office of Agricultural Sustainability & Food Security (OAS&FS) (OEH and OAS&FS 2013).
- *NSW Aquifer Interference Policy*: *NSW Government policy for the licensing and assessment of aquifer interference activities* (the AIP) (DPI 2012).

01.2 **Addressing the Relevant Criteria**

This report addresses relevant Gateway assessment criteria in relation to BSAL contained in clause 17H(4)(a) of the Mining SEPP (Table 01-1). In addition, Table 01-2 describes how and where this report addresses the Guideline.

While the Application Area does not overlap with the mapped Equine or Viticulture CICs, the criteria have been considered in this report as there are known equine and viticulture enterprises and mapped CIC land immediately to the south of the Application Area.

Table 01-1 Assessment criteria contained in clause 17H(4) of the Mining SEPP and where they are addressed in this report

Relevant Criteria	Section of this Report
Biophysical Strategic Agricultural Land [Clause 17H(4)(a)]	
Any impacts on the land through surface area disturbance and subsidence	Section 06.2 and Section 06.3 and Subsidence Assessment
Any impacts on soil fertility, effective rooting depth or soil drainage	Section 06.2 and Section 06.3
Increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH	Section 06.2 and Section 06.3, Subsidence Assessment
Any impacts on highly productive groundwater (within the meaning of AIP)	Section 06.2.4 and Preliminary Groundwater Assessment
Any fragmentation of agricultural land uses	Section 06.3
Any reduction in the area of BSAL	Section 06.3
Critical Industry Clusters [Clause 17H(4)(b)]	
Any impacts on the land through surface area disturbance and subsidence	Section 06.4
Reduced access to, or impacts on, water resources and agricultural resources	Section 06.4
Reduced access to support services and infrastructure	Section 06.4
Reduced access to transport routes	Section 06.4
Loss of scenic and landscape values	Section 06.4

Table 01-2 Guideline requirements and where they are met in this report

Guideline requirements for supporting documents	Section of this Report
Describes the proposal's impact in terms of relevant Gateway criteria and mitigation measures to address these impacts	Section 06
Provide high quality photographs, maps or figures that depict local and regional context	Throughout this report
Explain why the site was chosen and discuss any alternatives considered	Section 02
Present relevant technical investigations	Subsidence Assessment, BSAL Verification Assessment and Preliminary Groundwater Assessment
Supply maps and text to describe the areal extent of surface impacts	Throughout this report
Describe land and soil capability (LSC) classes that will be affected	Section 04.3.1 and BSAL Verification Assessment
Estimate likelihood of full rehabilitation and how this might be achieved	Section 06.2
Refer to the Interim Protocol	This report
Refer to the Agricultural Impact Statement	This report
Provide information in a tabular form that demonstrates the pre-development and post development LSC and soil fertility classes	Table 4.2 Section 04.3.3, Section 06.2.6 and BSAL Verification Assessment

Guideline requirements for supporting documents	Section of this Report
Estimate quantities of water likely to be taken from any water source on an annual basis	Preliminary Groundwater Assessment
A strategy for obtaining appropriate water licence/s for the maximum predicted annual take	Preliminary Groundwater Assessment
Establishment of baseline groundwater conditions	Preliminary Groundwater Assessment
A strategy for complying with any water access rules	Preliminary Groundwater Assessment
Estimates of potential water associated impacts on nearby water users	Preliminary Groundwater Assessment
Estimates of potential water impacts on groundwater dependent ecosystems	Preliminary Groundwater Assessment
Estimates of potential saline and contaminated water flow to aquifers and rivers systems	Preliminary Groundwater Assessment
Estimates of the potential to cause or enhance hydraulic connectivity between aquifers	Preliminary Groundwater Assessment
Estimates of the potential for river bank instability, or high wall instability or failure	Subsidence Assessment and Preliminary Groundwater Assessment
Outline method for disposing of water inflows	Section 02.7
A strategy for moving to groundwater modelling using more site-specific data should the proposal progress	Preliminary Groundwater Assessment
Assess groundwater impacts against the AIP	Preliminary Groundwater Assessment
Indicate whether the proposal will result in significant fragmentation of agricultural land use in terms of: area; critical farm and regional infrastructure; change in land use (agricultural intensity or to another land use); use of mine buffer land.	Section 06.3
Quantify any potential reductions in the area of BSAL	Section 06.3

01.3 **Supporting Studies**

Three supporting studies were undertaken for the Project to support the Gateway Certificate Application:

- **BSAL Verification Assessment**:
    - SLR (2015) Biophysical Strategic Land Assessment Drayton South Coal Project (report number 630.11145). Revision 2. (Included in Appendix F of the Drayton South Coal Project Response to Submissions, July 2015.)
    - SLR (2018) Biophysical Strategic Land Assessment Maxwell Project (report number 630.12463).
- **Subsidence Assessment –** MSEC (2018) Maxwell Project: Gateway Application – Subsidence Assessment: Subsidence Predictions and Impact Assessment (report number MSEC995).
- **Preliminary Groundwater Assessment** – HydroSimulations (2018) Maxwell Project: Gateway Application – Preliminary Groundwater Assessment.

02 PROJECT DESCRIPTION

02.1 **Overview of the Maxwell Project**

This section provides an overview of the Project, highlighting details relevant to possible agricultural impacts. Further information on the Project can be found in Malabar's Scoping Report submitted in support of a request for Secretary's Environmental Assessment Requirements (SEARs):

http://www.majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=9526

The Project would involve an underground mining operation that would produce high quality coals over a period of approximately 26 years. At least 75 per cent (%) of coal produced would be capable of being used in the making of steel (coking coals). The Project underground mining area would be located entirely within EL 5460.

The Project would include the following activities:

- Underground bord and pillar mining with pillar extraction in the Whynot Seam.
- Underground longwall extraction in the Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam.
- Development and use of mine access drifts and underground roadways and shafts to access and service the underground mining areas.
- Development and use of a mine entry and associated infrastructure, services and facilities that support underground mining and coal handling activities and provide for personnel and materials access to the underground mine.
- Establishment of an internal access road from Thomas Mitchell Drive to the underground mine entry.
- Establishment of power transmission infrastructure including power lines and substations.
- Establishment of infrastructure associated with mine ventilation and gas management.
- Use of the existing water management systems.
- Progressive development of dams, sumps, pumps, pipelines, water storages, water treatment and other water management infrastructure.
- Production of up to 8 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal.
- Construction and use of a conveyor system to transport coal from the mine entry area to the existing CHPP at the Maxwell Infrastructure for processing.
- Transportation of early ROM coal via internal roads from the mine entry area to the existing CHPP.
- Handling and processing of coal and loading of coal onto trains at the existing Maxwell Infrastructure.
- Transport of product coal via the Antiene Rail Spur and Main Northern Railway to market or to the Port of Newcastle for export, or via conveyor to the Bayswater and/or Liddell Power Stations.
- Emplacement of coarse rejects and tailings and brine within existing voids in CL 229 and ML 1531.
- Continued use of existing facilities and services at the Maxwell Infrastructure, with minor upgrades.
- Monitoring, rehabilitation and remediation of subsidence and other mining effects.
- Management of subsidence impacts on Edderton Road.
- Rehabilitation activities within CL 229, ML 1531 and CL 395, including the rehabilitation of reject and tailings emplacement areas.

- Exploration activities within EL 5460 and Authorisation (AUTH) 173.
- Other associated minor infrastructure, plant, equipment and activities.

An indicative footprint of the Project general arrangement showing the underground mining area and key infrastructure is provided in Figure 01-2 and a summary of project components is provided in Table 02-1.

Table 02-1 Summary of the Project components

Component	Description
Mining Method	Underground extraction using “bord and pillar” and “longwall” mining methods.
Resource	Coal seams in the Wittingham Coal Measures within EL 5460 (Whynot Seam, Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam).
Annual Production	Up to 8 million tonnes of ROM coal per annum.
Mine Life	26 years of coal extraction.
Total Resource Recovered	Approximately 150 million tonnes of ROM coal.
Coal Handling and Preparation	Transport of coal from underground faces to the mine entry via an underground conveyor network. A coal surge stockpile at the underground mine entry would be used prior to transporting ROM coal to the Maxwell Infrastructure CHPP. Transportation of initial ROM coal via internal roads, while an overland conveyor is constructed and commissioned. Subsequently, ROM coal would be transported via the overland conveyor system. Handling and processing of up to 8 million tonnes of ROM coal per annum.
Management of Reject Material (i.e. Stone-derived Material)	Emplacement of coarse rejects and tailings primarily within the existing “East Void” in ML 1531 at the Maxwell Infrastructure precinct.
General Infrastructure	Use of existing Maxwell Infrastructure with minor upgrades. Development of underground mine entries and associated facilities that support the underground mining activities, provides for personnel and materials access to the underground mine and includes coal handling and sizing facilities. Development of infrastructure for power, ventilation and gas management for the underground mine.
Product Transport	Transport of product coal to market or to the Port of Newcastle for export via the Antiene Rail Spur and Main Northern Railway or via conveyor to the Bayswater and/or Liddell Power Stations.[1] Transport of up to 7 million tonnes of product coal per annum along the rail loop (up to 12 train movements per day).
Water Management	Development of a water management strategy based on a detailed site water balance. Water management may include recycling of water on-site, storage of water on-site (including in voids), licensed water extraction and/or consideration of treatment and beneficial use. Augmentations and extensions to existing water management infrastructure and development of new water management storages, sumps, pumps, pipelines, sediment control, mine dewatering, water treatment and wastewater treatment infrastructure.
Workforce	During operation, the Project would directly employ approximately 350 personnel. Additional employment would be generated by Project construction activities and during operations (e.g. cleaners, security personnel, etc.). This additional employment would be quantified and assessed in the EIS.
Hours of Operation	Operated on a continuous basis, 24 hours per day, seven days per week.
Key Environmental Mitigation Measures	To be determined through the environmental assessment and stakeholder consultation process.
Capital Investment Value	To be determined through the detailed mine planning process and provided with the Development Application.

02.2 **Project Construction Activities**

Construction activities would generally be undertaken 24 hours per day, 7 days per week, including surface construction activities.

The initial construction and development phase of the Project would be approximately 12 months and would include the activities outlined in Table 02-2.

Table 02-2 Overview of initial construction and development phase

Component	Description of Activities
Site Access and Site Services to the Maxwell Underground Mine Entry	Installation of temporary erosion and sediment controls. Establishment of temporary vehicle accesses. Establishment of administration and other infrastructure to support construction activities. Construction of water management infrastructure, including sumps, pumps, pipelines and water storages. Construction of a permanent site access from Thomas Mitchell Drive to the Maxwell underground mine entry location. Construction and installation of ancillary infrastructure and services for the Maxwell underground mine entry (e.g. electrical infrastructure, site security).
Maxwell Underground Mine Access and Underground Development	Excavation of an entry area (access floor and wall above the portal), portals and mine access drifts. Use of excavated waste rock from the entry area and access drifts as construction fill (e.g. for hardstand areas, dam embankments and road construction). Installation of the underground mine's ventilation infrastructure. Delivery, assembly and installation of mining equipment, including continuous miners. Development of underground main roadways and gate roads for longwall panels. Installation of underground conveying and coal sizing systems.
Infrastructure at the Maxwell Underground Mine Entry	Construction and development of surface conveyors, ROM coal stockpiles and coal sizing facility. Construction of administration, meeting rooms, bathhouse, workshop, fuel storage, laydown and parking facilities and other ancillary infrastructure.
Coal Handling Infrastructure	Transport of ROM coal via internal road during the development stage of the Project, (reduced tonnages), while the overland conveyor is constructed and commissioned.

Other development activities that would occur over the life of the Project would include:

- Construction of an overland conveyor and ancillary infrastructure to transport ROM coal from the underground mine entry to the existing CHPP.
- Construction of power transmission infrastructure including power lines and substations.
- Delivery, assembly and installation of mining equipment, including a longwall machine.
- Construction of ventilation infrastructure and gas management systems.
- Progressive development and augmentation of sumps, pumps, pipelines, water storages, water treatment and other water management equipment and structures.
- Progressive development of the underground conveyor systems and services.

- Off-site maintenance, replacements and upgrades to roadway development machines and longwall mining machinery.
- Upgrades of existing Maxwell Infrastructure.

02.3 **Underground Mining Operations**

The Project would involve extraction of coal from four seams within the Wittingham Coal Measures using the following underground mining methods:

- bord and pillar with partial pillar extraction in the Whynot Seam; and
- longwall extraction in the Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam.

The Project would produce up to 8 Mtpa of ROM coal. Underground mining activities would be undertaken 24 hours per day, seven days per week

The conceptual layout for each seam is provided on Figure 02-1.

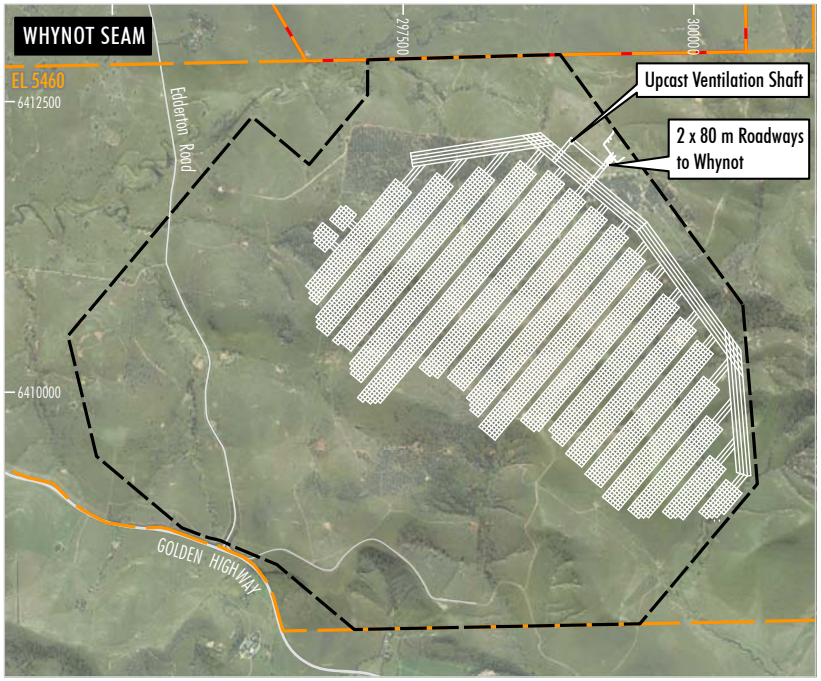
During the development of the EIS and over the life of the Project, the mining layout may vary to account for factors that include: localised geological features; mine economics; coal market demand; detailed mine design considerations; and adaptive management.

The mining layout would be modified within the Project boundaries where required and would be documented in the relevant Mining Operations Plan and Extraction Plans.

02.3.1 Associated Infrastructure and Activities

Other associated infrastructure and activities would include:

- personnel and materials access via drifts from the underground mine entry area;
- materials handling and transport systems to convey coal from the longwall and development faces to the surface;
- underground equipment (e.g. shearers, continuous miners, conveyors, bins) and mobile fleet (e.g. load haul dump vehicles, drill rigs, shuttle cars, personnel carriers);
- ventilation systems for intake and exhaust air from the underground mining areas;
- gas monitoring systems, and gas management and abatement activities;
- water supply for equipment cooling and dust suppression;
- water management systems to transfer groundwater and process water that accumulates in the underground workings to the surface;
- storage and handling of materials used by underground mining equipment (e.g. hydraulic fluids); and
- monitoring, rehabilitation and remediation of subsidence and other mining effects.



LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Indicative Underground Mining Area
- Indicative Underground Mining Layout

Source: © NSW Department of Planning and Environment (2017); Department of Finance, Services & Innovation (2017)
Orthophoto: June 2011

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Kilometres
GDA 1994 MGA Zone 56

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Indicative Underground Mining Layout

Figure 02-1

SHM-18-03 MG_AIA_204A

The final location of surface infrastructure would be determined through detailed mine planning, environmental assessment outcomes and consideration of alternatives, and would be documented in the EIS.

02.4 **Infrastructure and Services**

The Project would include the use of the existing Maxwell Infrastructure and the development of new infrastructure.

Key existing infrastructure at the Maxwell Infrastructure location (Figure 02-2) includes:

- site access road from Thomas Mitchell Drive;
- CHPP, which includes:
  - ROM coal stockpile and ROM hopper;
  - Coal Preparation Plant (CPP); and
  - product coal stockpiles with mechanical stacking and reclaim;
- train load-out facility and rail loop (connecting to the Antiene Rail Spur);
- administration, employee amenities, training centre, emergency services, workshops, store and carpark facilities;
- electrical distribution infrastructure; and
- site water management infrastructure (including water storages, pumps and pipelines and a wastewater treatment facility).

The Project would incorporate minor upgrades and additions to existing infrastructure, which would be documented in the EIS.

02.5 **Coal Processing, Handling and Transport**

The Project would include the use of the substantial existing Maxwell Infrastructure for handling, processing and transportation of coal for the life of the Project.

An overland coal conveyor would be constructed and operated to transport sized ROM coal from the mine entry to the existing CHPP at the Maxwell Infrastructure (Figure 01-2). Some modification to the ROM stockpiling and handling equipment would be required to cater for delivery of coal via conveyor.

ROM coal during the development stage of the Project would be transported via internal roads along a similar route as the proposed overland conveyor. This would cease when the overland conveyor is constructed and commissioned.

ROM coal would be handled at the existing CHPP, and beneficiated through the CPP or bypassed directly to the product coal stockpile.

From the product coal stockpile, product coal would be conveyed to the existing train load-out facility, located over the rail loop, for loading onto trains.

Product coal would be transported via the existing Antiene Rail Spur and Main Northern Railway to domestic market or to the Port of Newcastle for export or via conveyor to the Bayswater and/or Liddell Power Stations.

Consistent with the current approval for the Antiene Rail Spur (DA 106-04-00), coal may be hauled on public roads under emergency or special situations with the prior written permission of the Secretary of the Department of Planning and Environment (DP&E), Roads and Maritime Services and Muswellbrook Shire Council.

SHM-18-03 MG_AIA_205A

LEGEND
Mining Lease Boundary
Railway

Source: © NSW Department of Finance, Services & Innovation (2018)
Orthophoto: Oct 2016

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Existing Maxwell Infrastructure

Figure 02-2

02.6 **Management of CHPP Reject Material**

Approximately 18 million bank cubic metres of CHPP reject material would be produced over the life of the Project, including coarse rejects and tailings.

This CHPP reject material would primarily be emplaced within the existing East Void in ML 1531 at the Maxwell Infrastructure.

Malabar is currently investigating the most efficient process to transport and emplace reject material. While the preference is for a 'co-disposal' process where all material is pumped to the disposal area, some coarse rejects may be trucked via the existing coarse reject system and placed within one of the open cut voids.

At the conclusion of the Project, emplacement areas would be capped and rehabilitation completed, unless consent for continued emplacement is granted.

Malabar will continue to investigate beneficial uses for the voids in CL 229 and ML 1531. This will include CHPP reject material from possible future underground mining activities undertaken by Malabar within EL 5460 and EL 7429 (Spur Hill) and engagement with other mining and industrial facilities in the region (subject to separate assessments and approvals).

02.7 **Water Management**

The Maxwell Infrastructure incorporates water management infrastructure to separate: clean water; oily water; and mine-affected water.

The Project would involve the use of the existing infrastructure with minor augmentations and extensions. New water management infrastructure would also be developed at the underground mine entry and for other Project activities.

The Project would involve the use of a combination of mine water, recycled treated mine water and potable water in underground and surface operations.

Water and brine from water treatment activities would be stored within existing voids in CL 229 and ML 1531.

Final water supply requirements for the Project would be subject to the outcomes of a detailed water balance that would be presented in the EIS.

02.8 **Other Activities**

Potential subsidence impacts on Edderton Road would be managed through either road maintenance or realignment of the road around the underground mining area. These options would be evaluated further, and the preferred option would be presented in the EIS.

Other activities that would be conducted as a component of the Project include monitoring, remediation of subsidence impacts, rehabilitation of surface disturbance, and minor associated infrastructure and activities.

The Project would also include the continued rehabilitation of existing mining disturbance areas within CL 229, ML 1531 and CL 395, including overburden emplacement areas, and eventual relinquishment of areas not required to support the Project. A detailed rehabilitation strategy for these areas will be presented in the EIS.

02.9 **Employment**

During operation, the Project would directly employ approximately 350 personnel.

Additional employment would be generated by Project construction activities.

02.10 Project Rationale and Alternatives

The Project would facilitate the underground mining, processing and sale of coal within EL 5460.

Malabar has elected to proceed with the Project as proposed due to:

- Substantial capital savings associated with the use of the existing Maxwell Infrastructure.
- The proximity of the Project underground mining area to the existing Maxwell Infrastructure.
- The extensive geological and geotechnical data available within the target area in EL 5460 (Section 3.1).
- The short development time to first underground coal and full employment.
- Extraction of a significant coal resource that provides an attractive return on investment.

The Project would produce the following benefits for the local area, for NSW more broadly and for the national economy:

- generation of approximately 350 new direct, long-term jobs for the region, along with many more indirect jobs;
- annual export sales in the vicinity of $700 million annually;
- support for local businesses from the initial capital expenditure and the substantial ongoing operating inputs;
- substantial corporate tax contributions;
- payment of approximately $1.3 billion in royalties to the NSW Government over the initial 26 years of mining;
- certainty around future development within EL 5460;
- support for continued rehabilitation activities within CL 229, ML 1531 and CL 395, including reduction in the volume of final voids through emplacement of reject material generated by coal processing activities; and
- ongoing financial support for community groups as demonstrated by Malabar for more than five years.

As part of its acquisition of EL 5460, Malabar committed to develop the Project solely as an underground mining operation.

Open cut mining is prohibited within EL 5460 under the Mining SEPP and the conditions of EL 5460.

The Project would minimise impacts to amenity, air quality, biodiversity, land, heritage and the road and rail network through the use of the existing Maxwell Infrastructure (including the site access road, CHPP and Antiene Rail Spur). This would avoid the development of additional infrastructure.

The location of the mine entry for the Project has been selected in consideration of:

- locating the mine entry away from sensitive receptors, in a natural valley that mitigates and minimises alteration of the visual landscape (particularly from sensitive viewsheds); and
- minimising the length of underground roadways required to access the coal seams.

The proposed scale of the Project, if approved, would provide sufficient investment certainty for Malabar. The significant resource definition and exploration drilling conducted in EL 5460 to date indicates that the target coal seams are the optimal seams for an underground mining operation.

03 REGIONAL OVERVIEW

The Application Area is located in the Muswellbrook Local Government Area (LGA) which is part of the Hunter Region. The purpose of this section is to provide:

- Contextual information about the broader Hunter region and the Muswellbrook LGA.
- More detailed information about the local biophysical setting of the Application Area.

03.1 **Hunter Region**

The Hunter region is the leading regional economy in NSW. The Hunter region population is approaching 1 million people and it supports major sectors that include agriculture, coal mining, tourism, defence, energy and transport. It contains 10 LGAs and covers a total area of 32,870 square kilometres (km^2). The Hunter River Valley (21,400 km^2) occupies over half of this area and most economic activity in the region is stimulated by assets located within the river valley (DP&E 2016).

The coastal city of Newcastle is the capital of the Hunter region. Newcastle's port is a vital hub for export of coal and local rural produce to various markets across the Asia-Pacific. In 2014-15 a total of $15.8 billion of exports was shipped from the Port of Newcastle, 90% of which was coal (DP&E 2016).

Within the Hunter region, the Upper Hunter is recognised as a major supplier of coal, energy, wine and thoroughbred horses, to national and international markets. These industries have driven investment in transport and energy infrastructure and will continue to underpin the growth and diversification of the Hunter's economy and employment base (DP&E 2016).

Data from the Australian Bureau of Statistics (ABS 2008) identifies beef cattle and grape production as the most significant agricultural businesses in the Hunter region. Beef cattle in the Hunter make up approximately 9% of beef cattle producing businesses in NSW and cover 6-8% of the land area occupied by beef cattle production enterprises (Table 03-1). The Hunter region has 16% of the grape growing businesses with grape bearing vines in NSW covering an area that is 7-14% of total vineyards (Table 03-1).

Recent data from the Australian Bureau of Statistics for 2016-17 (Table 03-2) show a general decrease in agricultural output in the Hunter region between 2008 and 2017. The grape growing industry experienced the most significant change, decreasing by approximately 86% in area used to grow grapes for wine production.

Table 03-1 Agricultural production statistics, Hunter Valley and NSW (ABS (2008))

	NSW		Hunter			
Livestock - cattle	No. of agricultural businesses	Estimate of stock numbers or area sown	Number of agricultural businesses	Estimate of stock numbers or area sown	% businesses	% no./ area
Beef cattle						
Livestock - cattle for all purposes - total number (n)	29,997	5,934,675	2,788	447,632	9%	8%
Livestock - cattle - meat cattle						
Livestock - cattle - meat cattle - **total number** (n)	29,301	5,609,002	2,704	407,583	9%	7%
Livestock - cattle - meat cattle - beef breed bulls and bull calves intended for breeding - number (n)	21,684	186,112	1,959	14,092	9%	8%
Livestock - cattle - meat cattle - cows and heifers - 1 year and over - number (n)	25,635	2,882,899	2,290	224,192	9%	8%
Livestock - cattle - meat cattle - calves, excluding bull calves intended for breeding - number (n)	20,818	1,290,432	1,957	96,723	9%	7%
Livestock - cattle - meat cattle n.e.c. (steers bullocks etc.) – 1 year and over - number (n)	15,317	1,249,559	1,237	72,576	8%	6%
Grapes						
Fruit and nuts - grapes - **total area of vines** (ha)	1,581	43,728	250	4,416	16%	10%
Fruit and nuts - grapes **- total area not yet bearing** (ha)	320	3,056	31	112	10%	4%
Grapes - red						
Fruit and nuts - grapes - red - total area of vines (ha)	1,388	21,405	214	1,600	15%	7%
Fruit and nuts - grapes - red - area not yet bearing (ha)	159	1,143	14	52	9%	5%
Fruit and nuts - grapes - red - area bearing (ha)	1,365	20,262	211	1,548	15%	8%
Grapes - white						
Fruit and nuts - grapes - white - total area of vines (ha)	1,389	22,323	224	2,816	16%	13%
Fruit and nuts - grapes - white - area not yet bearing (ha)	227	1,913	21	60	9%	3%
Fruit and nuts - grapes - white - area bearing (ha)	1,359	20,409	217	2,756	16%	14%

Table 03-2 Comparison of agricultural production statistics between 2008 and 2017, Hunter Valley (ABS 2017)

Business	Hunter					
	2008 Estimate of stock numbers or area sown	2008 No. of agricultural businesses	2017 Estimate of stock numbers or area sown	2017 No. of agricultural businesses	% change in estimate of stock numbers or area sown	% change in no. of agricultural businesses
Beef cattle						
Livestock - cattle - total cattle (no.)	447,632	2,788	*504,701*	*1,425*	**+13%**	**-49%**
Livestock - meat cattle - total (no.)	407,583	2,704	*457,077*	*1,286*	**+12%**	**-52%**
Livestock - meat cattle - cows and heifers 1 year and over (no.)	224,192	2,290	*223,517*	*1,140*	**-0.3%**	**-50%**
Livestock - meat cattle - calves less than 1 year (no.)	n/a	n/a	*112,328*	*1,078*	**n/a**	**n/a**
Grapes						
Fruit and nuts - grapes - total - total area (ha)	4,416 ha	250	*2,618 ha*	*69*	**-41%**	**-72%**
Fruit and nuts - grapes - total - area not yet of bearing age (ha)	112 ha	31	*90 ha*	*16*	**-20%**	**-48%**
Fruit and nuts - grapes for wine production - total area (ha)	4,416 ha[1]	n/a	*2,610 ha*	*n/a*	**-41%**	**n/a**

[1] Calculated using the total for both red and white grapes in the ABS 2008 data.

03.2 **Muswellbrook Local Government Area**

Muswellbrook LGA covers an area of 3,405 km^2 and supports a population of about 16,000 (Muswellbrook Shire Council 2015). Muswellbrook is the largest town in the LGA and is the administrative centre. Other towns and villages include Bengalla, Bureen, Denman, Manobolai, Sandy Hollow and Wybong (Muswellbrook Shire Council 2018).

Muswellbrook LGA contains large areas of productive farmland that support a diverse range of agricultural enterprises, including beef, dairy, horse breeding, viticulture, and other horticulture and cropping. Muswellbrook LGA is home to the largest critical mass of thoroughbred horse rearing properties in Australia (over 20 individual stud farms) and is recognised nationally and internationally as a 'Centre for Thoroughbred Breeding Excellence' (Muswellbrook Shire Council 2018). The region's viticultural industry is also renowned for its wine production and processing, with famous brands such as Penfolds, Richmond Grove and Rosemount originating from the region.

Based on ANZSIC class type categories and statistics from the Australian Bureau of Statistics (ABS 2010) beef cattle farming (ANZSIC 0142) is the dominant agricultural land use within the LGA with approximately 35,750 head (Table 3). Dairy cattle farming is also significant with approximately 10,420 head.

Table 03-3 ANZSIC classes, Muswellbrook LGA (ABS 2010).

ANZSIC Class	Statistic
0131 Grape growing	n/a (4,416 ha in Hunter Valley)
0142 Beef cattle farming	35,745 head
0145 Grain-beef cattle farming	n/a
0149 Other grain growing	345.7 ha (cereals for grain)
0159 Other Crop Growing n.e.c.	31.9 ha (Non-cereal broadacre crops)
0160 Dairy cattle farming	10,421 head
0191 Horse farming	n/a

Muswellbrook LGA is also home to a buoyant resource and minerals sector, principally including coal extraction and baseload power generation. The LGA represents one of two of the major centres for coal production in the Hunter Valley (Productivity Commission 2018). A portion of locally-extracted thermal coal feeds into the Liddell and Bayswater power stations, which currently provide approximately 40% of NSW's base load energy requirements (Muswellbrook Shire Council 2018).

From the combined data sources analysed by REMPLAN (2018), mining provides over 68% of the LGA's income (approximately $2.6 billion), and agriculture, forestry and fishing provide 3.6% (approximately $140 million). REMPLAN collates data from ABS (2016), Gross State Product, June 2017, National Input Output Tables and 2014 / 2015 Census Place of Work Employment Data to estimate the regional exports.

Table 03-4 Muswellbrook LGA regional exports by industry

Industry	Muswellbrook	
	$M	%
Mining	$2,634.926 M	68.26%
Electricity, Gas, Water & Waste Services	$780.626 M	20.22%
Agriculture, Forestry & Fishing	$139.093 M	3.60%
Manufacturing	$106.471 M	2.76%
Construction	$42.991 M	1.11%
Rental, Hiring & Real Estate Services	$30.031 M	0.78%
Administrative & Support Services	$24.179 M	0.63%
Transport, Postal & Warehousing	$23.251 M	0.60%
Wholesale Trade	$21.442 M	0.56%
Financial & Insurance Services	$14.833 M	0.38%
Accommodation & Food Services	$10.070 M	0.26%
Public Administration & Safety	$7.588 M	0.20%
Education & Training	$7.314 M	0.19%
Other Services	$4.595 M	0.12%
Information Media & Telecommunications	$4.431 M	0.11%
Professional, Scientific & Technical Services	$4.187 M	0.11%
Retail Trade	$2.932 M	0.08%
Health Care & Social Assistance	$0.954 M	0.02%
Arts & Recreation Services	$0.375 M	0.01%
Total	**$3,860.289 M**	**100.00%**

Source https://www.economyprofile.com.au/muswellbrook/industries/regional-exports

03.3 **Application Area**

03.3.1 Location

The Application Area is located about 15 kilometres (km) south-southwest of Muswellbrook and 20 km north-west of Singleton in the Hunter region of New South Wales (Figure 01-1). It occurs wholly within the Muswellbrook LGA, and is situated immediately north of the Hunter River.

03.3.2 Climate

The Upper Hunter Valley is located in the Australian temperate zone, characterised by hot summers and mild dry winters. Heatwaves can occur between October and March, while night-time frost can occur between May and August (AGE 2012). Historical climatic data from 1884 to 2014 is available from Jerrys Plains Post Office, which was the closest weather station to the Application Area. These data have been compiled by the Bureau of Meteorology (BOM) to produce the following statistics (BOM 2018):

Mean maximum temperature of hottest month (January)	31.8°C
Mean minimum temperature of hottest month (January)	17.2°C
Highest recorded temperature (December 1957)	45.6°C
Mean maximum temperature of coolest month (July)	17.4°C
Mean minimum temperature of coolest month (July)	3.8°C
Lowest recorded temperature (August 1998)	-4.5°C
Mean annual rainfall (summer-dominant)	645 mm
Mean number of rain days (> 1mm)	68
Mean daily evaporation	4.5 mm

Daily evaporation data from Jerrys Plains station can be combined to calculate an average annual evaporation of 1,640 millimetres (mm). This is more than twice the mean annual rainfall, with the highest moisture deficit occurring in summer.

The monthly distribution of temperature and rainfall recorded at Jerrys Plains is shown in Figure 03-1 and Figure 03-2 respectively.

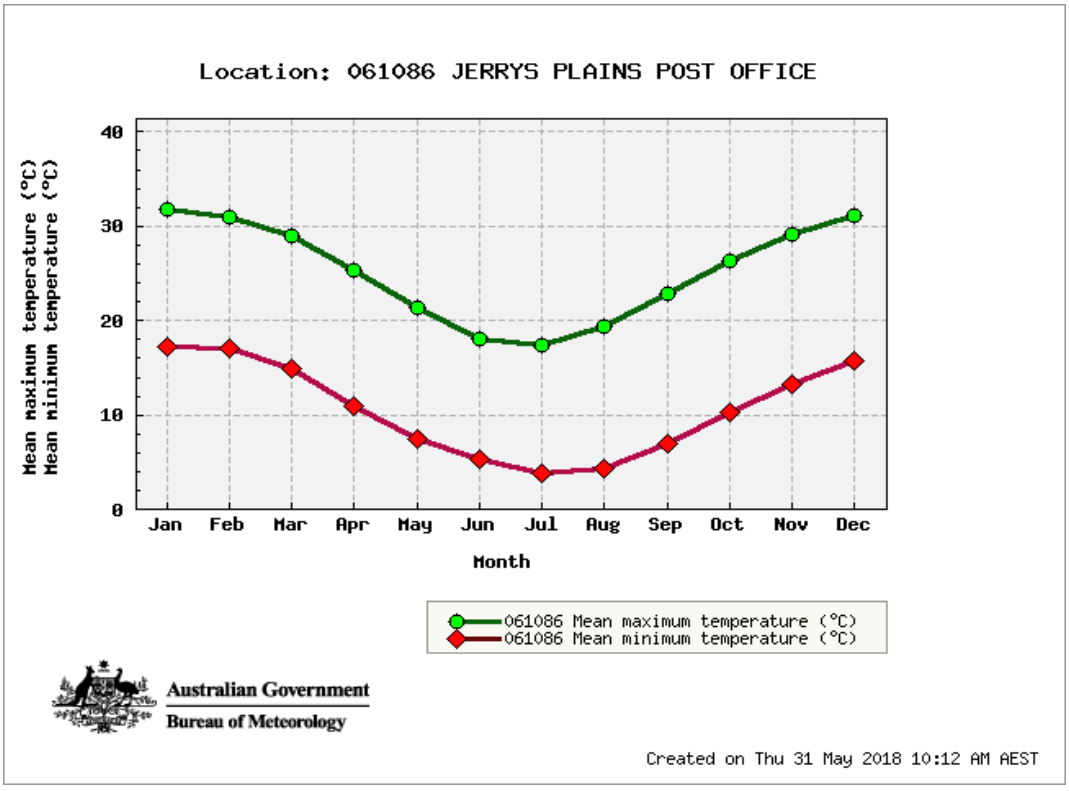


Figure 03-1 Mean monthly temperatures (maximum and minimum) recorded at Jerrys Plains

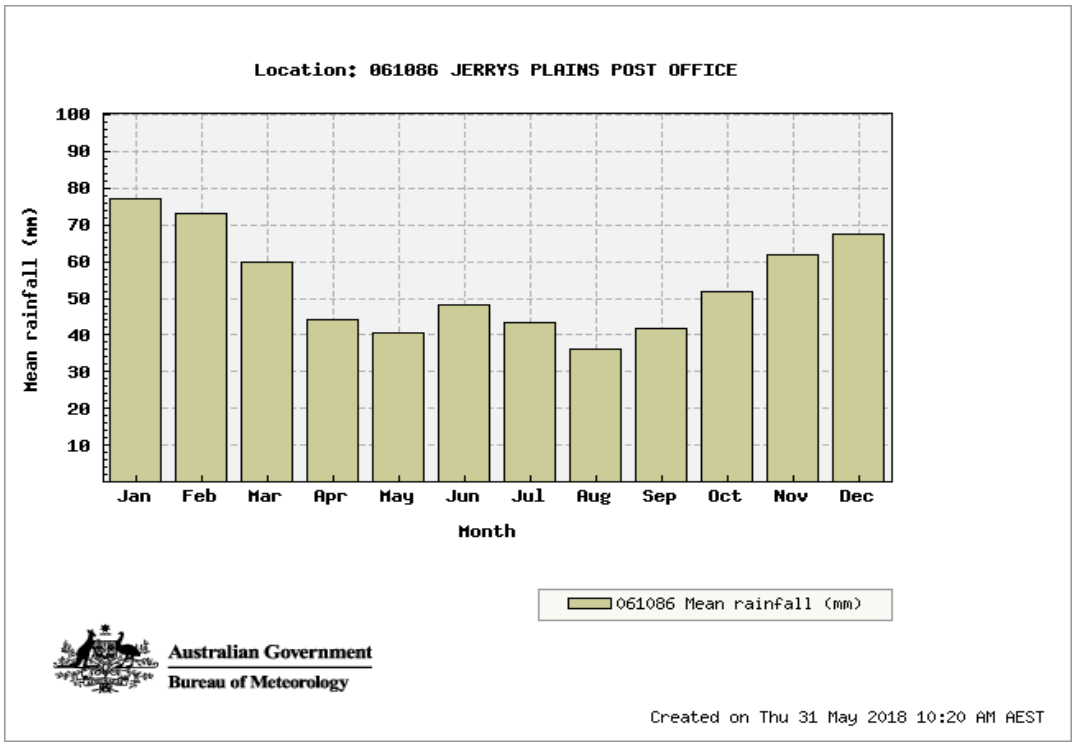


Figure 03-2 Mean monthly rainfall recorded at Jerrys Plains

03.3.3 Geology and Landform

The Project is located in the Hunter Coalfield in the northern part of the Permo-Triassic Sydney Basin. The Wittingham Coal Measures occur widely within the Hunter Coalfield and contain many recoverable seams. The Project targets mining of the Whynot, Woodlands Hill, Arrowfield and Bowfield Seams. The target seams for the Project are within the Jerrys Plains Subgroup, forming part of the upper and middle units of the Wittingham Coal Measures (Whynot Seam, Woodlands Hill Seam, Arrowfield Seam and Bowfield Seam). Above the target seams, the stratigraphy of the area consists of a sequence of sandstone, siltstone and laminate units within the Wittingham Coal Measures.

Unconsolidated Quaternary deposits comprising silts, sands and fine gravels represent the other major geological unit in the Application Area. This unit is associated with colluvial-alluvial activity around the Hunter River and Saddlers Creek, and is relatively thin, averaging less than 10 m thickness (AGE 2012).

The hydrogeological profile of the Application Area and surrounds incorporates:

- A Quaternary alluvial aquifer associated with the Hunter River and tributary creeks, and a smaller alluvial system associated with Saddlers Creek and minor tributaries.
- A thin veneer of weathered bedrock (regolith).
- Coal seams of the Wittingham Coal Measures (AGE 2012).

The alluvial deposits of the Hunter River located to the immediate south of the Application Area are a significant storage for groundwater, particularly within the basal gravel sequence and overlying sands. The alluvial aquifer has a maximum thickness of approximately 18 metres (m) and yields of up to 21 litres per second. In contrast, the Saddlers Creek alluvium has a limited capacity to store and transmit water, exhibits low yields, and does not form a single, well-connected aquifer (AGE 2015).

Topography of the Application Area comprises moderately to steeply undulating low hills controlled by underlying sedimentary coal measures, overlain by alluvial sediments in areas immediately adjacent to drainage features such as Saddlers Creek and the Hunter River. The undulating topography ranges from 110 to 240 metres Australian Height Datum (m AHD) on-site (MSEC 2018) and has created a network of small, ephemeral creeks that drain the Application Area into the Hunter River via two tributaries – Saddlers Creek and Saltwater Creek.

03.3.4 Surrounding Land Use

Cattle grazing, thoroughbred horse breeding and viticulture are the main agricultural activities that occur within 2 km of the Application Area boundary, and a large proportion of these enterprises are situated on the Hunter River floodplain. The major equine enterprises of Coolmore Stud and Godolphin Woodlands Stud are each located to the south of the Application Area on and adjacent to the floodplain, which provides prime agricultural land while the river delivers an ongoing source of water for pasture and crop irrigation. Hollydene Estate, which comprises a vineyard, winery, restaurant and cellar door, is also located to the south of the Application Area. Several other agricultural enterprises operate in the locality, including some dairy farms, an olive grove and olive processing plant (Barnett 2015).

Land to the north of the Application Area is associated with coal mining, including the Mount Arthur Mine and the Maxwell Infrastructure (which was the site of former open cut mining activities) and power generation. Plashett Reservoir occurs to the east of the Application Area (Figure 01-2). This is an off-river storage that provides water for operation of Bayswater Power Station.

04 AGRICULTURAL RESOURCE ANALYSIS OF APPLICATION AREA

Agricultural resource analysis of the Application Area comprised: review of key literature; site inspection and interviews; and review of expert studies in soil resources (SLR 2015, SLR 2018) and groundwater resources (HydroSimulations 2018).

04.1 Review of Key Literature

04.1.1 Upper Hunter Strategic Regional Land Use Plan

The *Upper Hunter Strategic Regional Land Use Plan* (DP&I 2012b) was developed specifically to describe and help protect Strategic Agricultural Land in the Upper Hunter region of NSW (comprising BSAL and CIC land). The *Upper Hunter Strategic Regional Land Use Plan* estimated the population of the region to be approximately 67,500 with the largest towns (Singleton and Muswellbrook) supporting approximately one third (23,900 people). The region's economy is underpinned by:

- Coal mining.
- Agriculture (particularly dairy and beef cattle and pasture production).
- Agriculture associated services.
- Horse breeding.
- Electricity production.
- Tourism.
- Viticulture and wine making.

Agricultural industries are supported by rich soils, temperate climate and proximity and access to Sydney markets. The Upper Hunter region contributes approximately 2% of the grazing and cropping area of NSW but provides a higher contribution of dairy and beef cattle. It is estimated to produce 15% of the nation's milk and 6% of the nation's cattle for slaughter. The most productive cropping lands are found on the alluvial floodplains along the major rivers and on the volcanic soil plains. On the lower slopes, where there is reliable access to water, lands are more suited to grazing, orchard or viticultural development.

State wide mapping of Strategic Agricultural Land shows significant areas in the Upper Hunter, including BSAL, Equine CIC and Viticulture CIC in the vicinity of the Application Area.

04.1.2 Drayton South Coal Project: Agricultural Impact Statement

The findings of the Agricultural Impact Statements for the Drayton South Coal Project applications (Barnett 2012, 2015) are particularly relevant for this study as they assess the agricultural resources directly within EL 5460. While the Barnett (2012, 2015) assessments were undertaken to assess the impacts of an open cut coal mine with a different footprint to the Project, the assessments provide a detailed agricultural profile of the Application Area.

Barnett (2015) undertook literature review of regional, local and site-specific (within EL 5460) reports and data to assess the agricultural resources of the Application Area. The review included detailed assessment of data associated with soil and land capability (Environmental Earth Sciences 2012), surface water resources (WRM 2012) and groundwater (AGE 2012, 2015) undertaken for the *Drayton South Coal Project Environmental Impact Statement* (the Drayton South EIS) (Hansen Bailey 2015). Barnett (2015) also undertook site inspection over the two properties contained within EL 5460 (Plashett and Bowfield), interviewed land managers, and modelled potential agricultural production assuming best practice property and livestock management.

The Project-owned land over EL 5460 was leased to two land managers, primarily for beef cattle production with some land sown to winter fodder crop. One of the land managers also operated opportunistic horse agistment of dry mares. Barnett (2012) estimated the total land area in EL 5460, subject to farming, was turning over 1,140 head of cattle per year with an estimated gross value of approximately $700,000 per annum. Further analysis, considering improved land and livestock management, led to an estimate that 1,998 cattle could be turned over each year with an estimated gross value of approximately $1.23 million per annum.

The cattle production enterprises are supported by sale yards at Scone and Singleton and to a lesser extent Denman. A number of nearby agricultural producers supply hay, silage and green crop for cattle feed as required by the on-site land managers. Other agricultural support industries include veterinary practices, input suppliers (fertiliser, seed, chemicals and agricultural hardware), irrigation suppliers and engineering services. The Golden Highway, New England Highway and Edderton Road are the key transport routes used by the agricultural enterprises.

The enterprises generally rely on surface-fed water infrastructure with some pumping from the Hunter River.

Within the previously proposed mining footprints, Barnett (2012, 2015) found that the area was dominated by soil and landscapes suitable for grazing with only small areas suitable for occasional cropping.

04.2 Site Inspection and Interviews

Three properties cover the application area, Plashett, Bowfield and Llanillo. A site inspection of the properties was undertaken on 8 June 2018 (Figure 04-1). The three properties are owned by Malabar. Initial interviews were held with Malabar personnel: Richard Webb (Property Manager at Malabar); and Donna McLaughlin (Manager Environment and Community at Malabar). An interview was also held with the current property managers of Bowfield and Llanillo properties. The husband and wife managers have been managing livestock on Bowfield and Llanillo for over 15 years. They assumed the role of lead property managers in early 2018, the lease being previously being held by a relative. The lessee for the Plashett property was unavailable for interview.

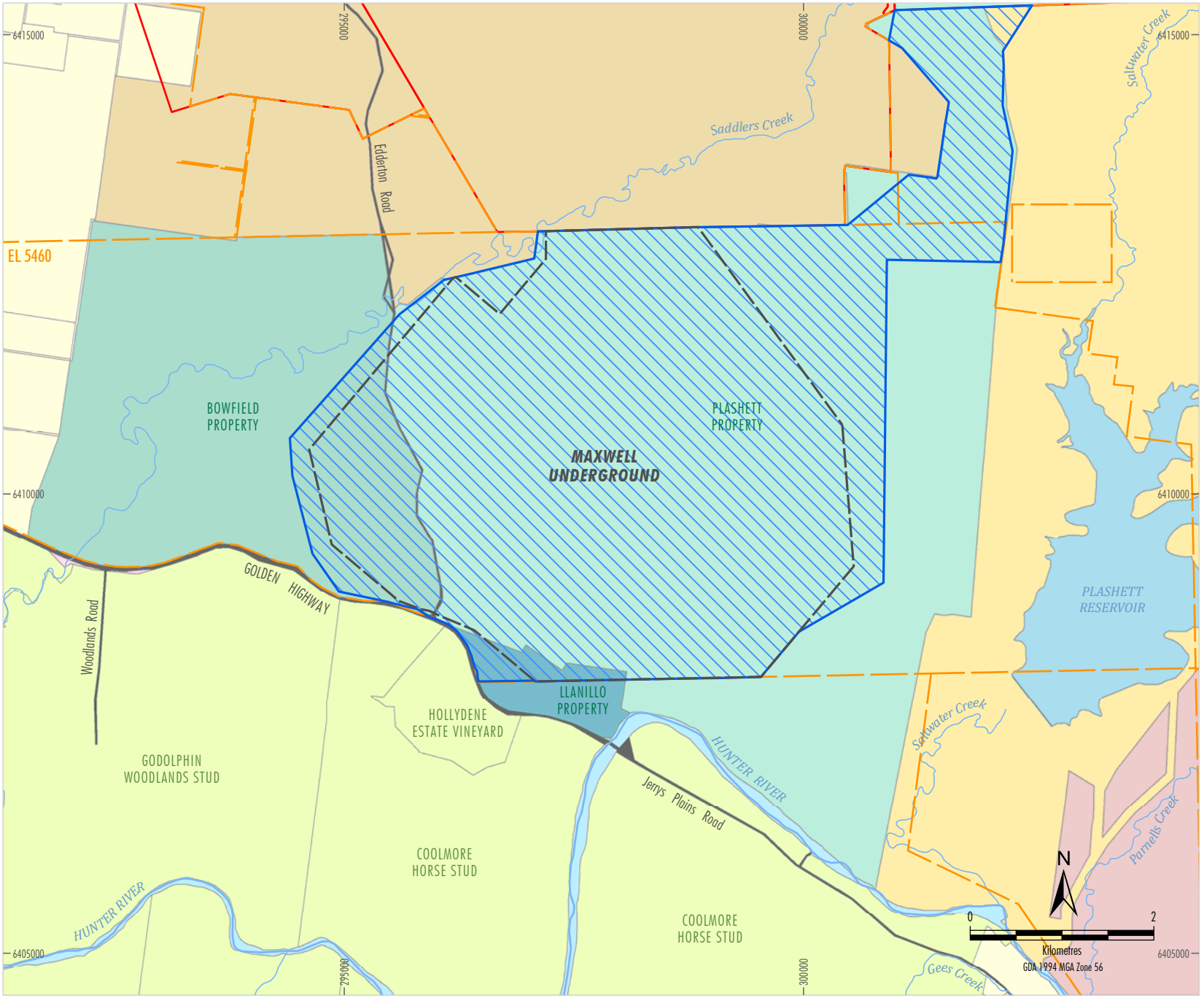
04.2.1 Inspection and interview findings

The properties within the Application Area have been owned by resource companies, formerly AngloAmerican and now Malabar, for over 15 years. During that time, Plashett has been leased to one lessee, while the Bowfield and Llanillo properties have been leased to the one family. Lease conditions state that land management shall be for grazing use (primarily beef cattle) with stocking limits set at: 990 adult cattle plus agreed ewes and horses on Plashett; 340 adult cattle plus horses on Bowfield; and 40 adult cattle and 20 ewes on Llanillo.

Bowfield and Llanillo Properties

The current practice at Bowfield and Llanillo is to produce beef cattle. The lessees currently run Brangus and Angus cattle producing approximately 100 Brangus calves and 100 Angus calves per annum. They also run a small herd of sheep (approximately 15 ewes), as well as horses for recreational use, along with some horse breaking-in and training. Fodder cropping is undertaken opportunistically with approximately 80 ha sown to either oats or lucerne. Fodder crops are mostly grazed along with some hay production.

The properties are managed by a family (2 adults, 2 sons). Cattle are generally sold via Elders at the Singleton or Scone saleyards. Farm infrastructure and input requirements are generally purchased at Pursehouse Rural in Muswellbrook and occasionally at Dapkos in Denman. On the Bowfield property, stock water is sourced directly from dams that capture surface runoff, Saddlers Creek and 2 bores. The bore on the southern side of the creek provides relatively poor quality water for livestock, while the bore on the northern side, serviced by a windmill, provides relatively higher quality stock water.



LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Indicative Underground Mining Area
- Gateway Certificate Application Area

Land Use

- Malabar-owned Land
- Mt Arthur Coal Mine
- Hunter Valley Operations
- AGL-owned Land
- Equine and Viticulture Enterprises
- Other Privately-owned Land
- Crown Land
- Road
- Waterbody

Source: © NSW Department of Finance, Services & Innovation (2018); Chelace (2018)

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Properties within the Application Area

Figure 04-1

SHM-18-03 MG_AIA_206B

The Llanillo property is used for grazing and fodder crop production in conjunction with Bowfield. The Llanillo property holds a licence to pump 90 megalitres (ML) from the Hunter River for irrigation or stock use.

Both the Bowfield and Llanillo properties have infrastructure common to beef grazing properties with fences, sheds, small cattle yards, residences and roads (Figure 04-2, Figure 04-3, Figure 04-4).

Figure 04-2 Bowfield from the main entrance road near the primary residence, view south-easterly over paddocks and yards

Figure 04-3 Bowfield from the main entrance road near the primary residence, view north-westerly towards Saddlers Creek

Figure 04-4 Llanillo view across river flats paddock from Golden Highway towards residence

Plashett Property

The property has infrastructure common to beef grazing properties with fences, sheds, small cattle yards, residences and roads.

Evidence from the site inspection showed that the property is being used primarily for beef cattle grazing. Internal fencing was poorly maintained, cattle were free to move around the property at will, making it difficult to estimate current production on the property.

Water for stock is sourced from surface-fed dams, Saddlers Creek and a series of troughs that are fed from tanks that access water from the Hunter River. The property has a licence to draw 90 ML per annum from the Hunter River.

Richard Webb understands that stock from the property is sold, via an agent, directly to abattoirs in Singleton or Scone.

Figure 04-5 Plashett from a high point at the southern side of the property overlooking part of the Llanillo property and other river flats to the south along the Hunter River

Figure 04-6 Plashett from a high point at the southern side of the property. The view is to the west toward the property's primary residences

Figure 04-7 Plashett from a high vantage point looking north-west towards the proposed site of the underground mine entrance

04.3 Soil and Land Capability

04.3.1 Land and Soil Capability

The Land and Soil Capability (LSC) Assessment Scheme uses the biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil hazards (OEH 2012). The LSC class gives an indication of the land management practices that can be applied to a parcel of land. The LSC classes are outlined in Table 04-1.

LSC class has been mapped across the majority of the Application Area by Environmental Earth Sciences (2012). Within the Application Area, LSC classes 6 and 7 are dominant (Figure 04-8). These LSC classes are considered to be low to very low capability with land use restricted to limited grazing or forestry and nature conservation land uses (Table 04-1). Smaller areas of LSC classes 4 and 5 are found along Saddlers Creek in the north-western section of the Application Area. These LSC classes are considered to be land of moderate capability supporting grazing or cropping with limited cultivation (Table 04-1).

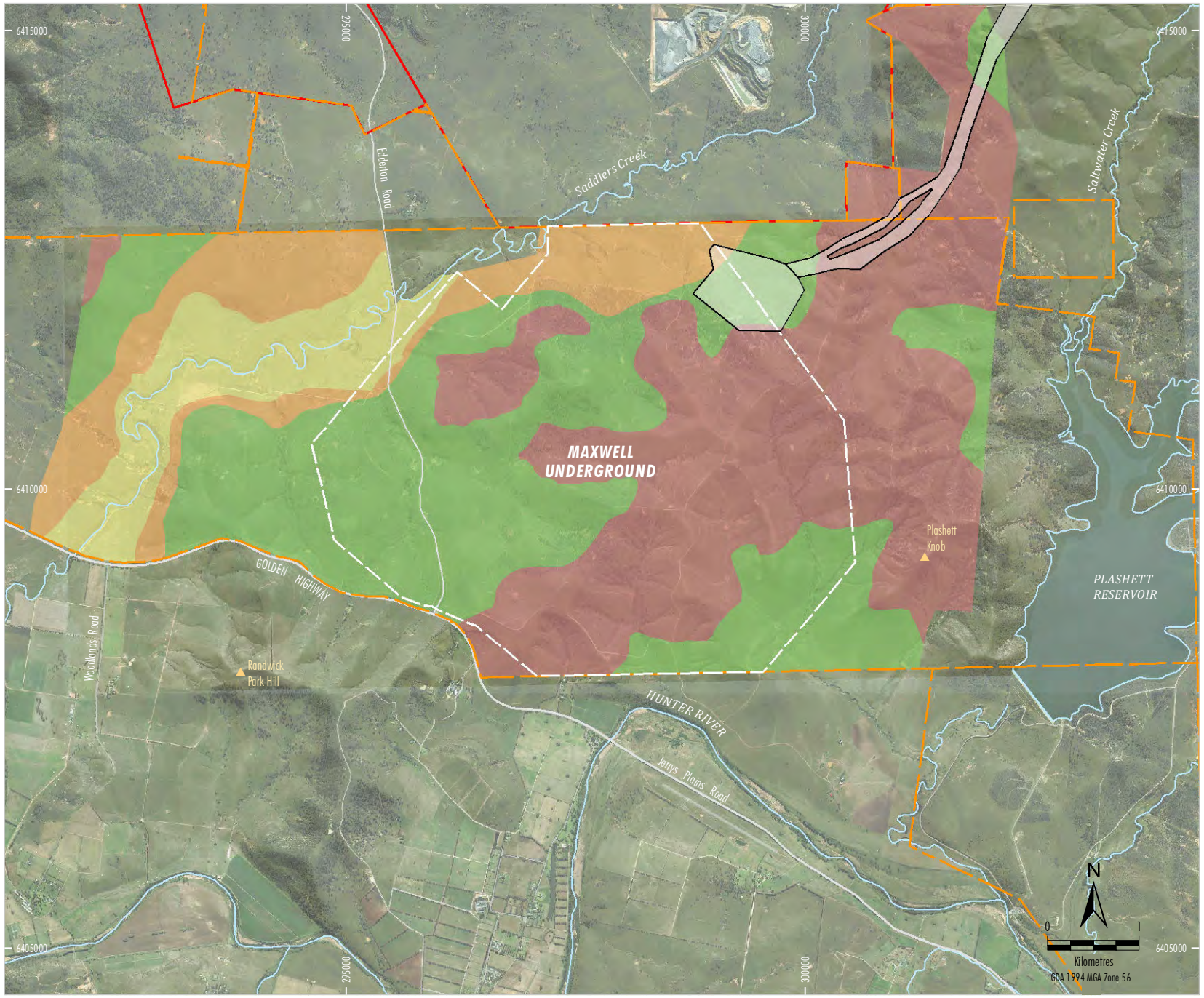
The Project would result in subsidence affecting 15 ha of LSC class 4 land (Table 04-2, Figure 04-8).

Table 04-1 Land capability classes (OEH 2012)

LSC Class	Definition
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	Extremely high capability land: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	Very high capability land: 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.
3	High capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	Moderate capability land: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	Moderate–low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	Low capability land: Land has very high limitations for high-impact land uses. Land use restricted to 6 low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	Very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	Extremely low capability land: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

Table 04-2 LSC classes within the proposed mine development area

LSC Class	Underground development (ha)	Surface infrastructure development (ha)
4	15	0
5	178	4
6	1182	83
7	963	60
Outside study area mapped by Environmental Earth Sciences (2012)	0	16



LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Railway
- Indicative Underground Mining Area
- Proposed Surface Development Area

Land Capability Classes

- Class IV
- Class V
- Class VI
- Class VII

Source: Environmental Earth Sciences (2012); © NSW Department of Finance, Services & Innovation (2018) Orthophoto: Oct 2016, 2011

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Land and Soil Capability

Figure 04-8

SHM-18-03 MG_AIA_208A

04.3.2 Application Area Land Slope

The topography within the Application Area can be largely described as moderate to steeply inclined (McDonald et al 1990). Within the proposed underground mining area slope is steepest in the south-eastern area, generally ranging from 5 to 30 degrees. In the north-eastern area slopes are moderate, generally ranging from 0 to 10 degrees, with localised areas of steeper slopes mostly associated with drainage lines (Figure 04-9).

04.3.3 Survey and BSAL Assessment

Detailed soil mapping and assessment was undertaken by SLR (2015) and SLR (2018) to provide site verification of BSAL across the entire Application Area (Figure 04-10). Soil survey was conducted in two stages, a 1,458 ha area was surveyed and assessed in 2015 (SLR 2015) and this survey was augmented by an additional survey of 1,757 ha in 2018 (SLR 2018) to cover the entire Application Area including a 100 m buffer. For this assessment the combined spatial dataset of soil mapping was used.

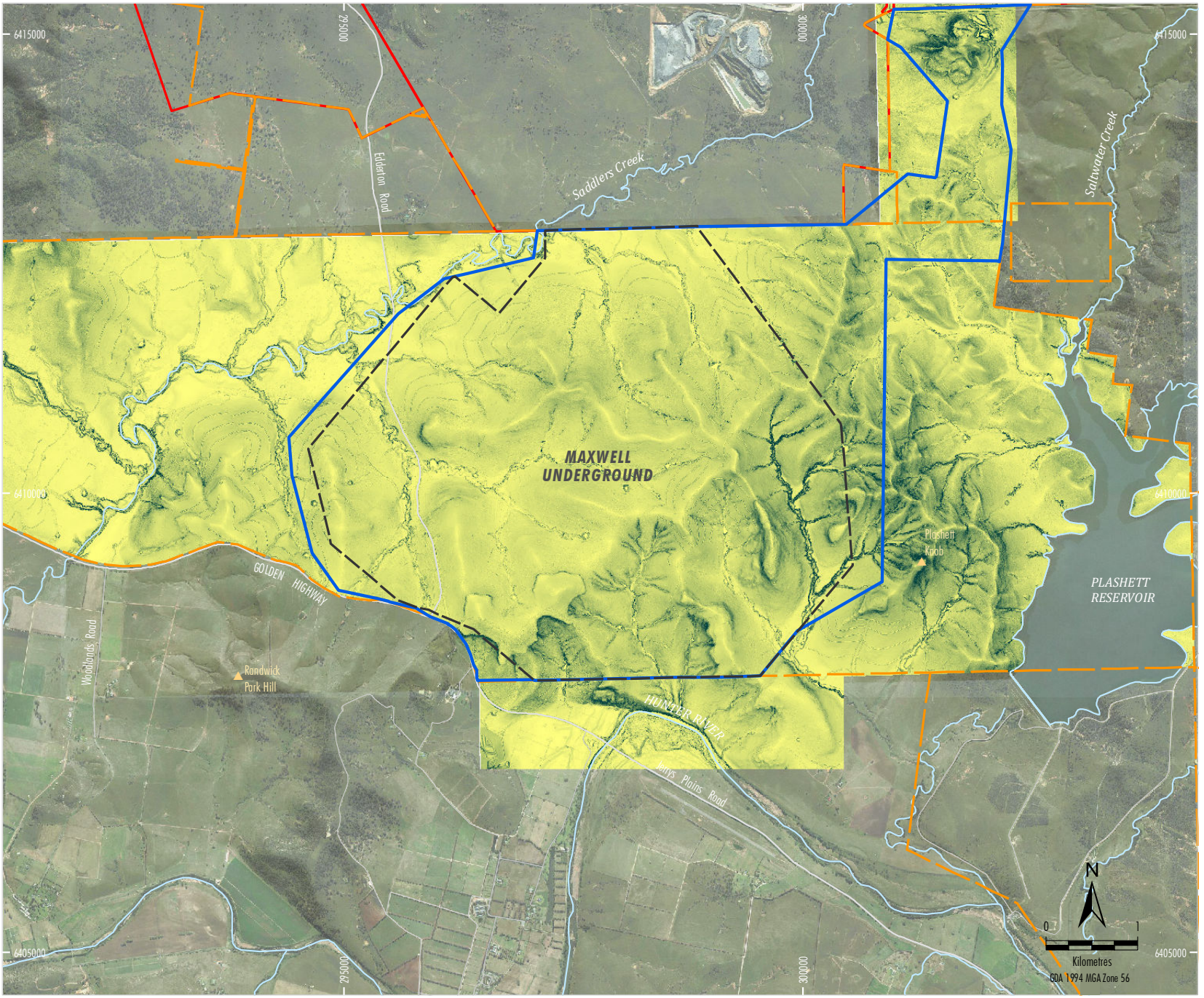
The soil survey and assessment were undertaken in accordance with standards and guidelines for BSAL mapping identified in the Interim Protocol (SLR 2015, SLR 2018, DPI 2013a). The following procedures were used to map soils and identify BSAL within the Application Area:

- Identify the Application Area, including a 100 m buffer.
- Confirm access to reliable water supply.
- Choose appropriate approach to map soils.
- Undertake risk assessment.
- Conduct field survey and BSAL assessment (SLR 2018).

Consistent with the Interim Protocol, land greater than 10% slope was excluded from the soil survey program, along with areas with a slope less than or equal to 10% and less than 20 hectares of contiguous area (SLR 2018). Analysis of LiDAR data captured in June 2018 resulted in the exclusion of a total 1,708 ha from survey. For the remaining 1,507 ha, a rigorous soil survey program was conducted using the approach set out by the Interim Protocol. A total of 96 soil pits dug by backhoe and 8 soil cores (104 samples in total) were sampled from the two surveys (Figure 04-10).

SLR (2015, 2018) mapped 8 different Australian Soil Classification (ASC) soil types classified into 14 soil landscape units across the Application Area (Figure 04-11, Table 04-3). Each soil unit was assessed using the physical and chemical criteria set out in the Interim Protocol to determine BSAL status. Following this assessment only Eutrophic Brown Chromosols (Deep) were found to satisfy the BSAL criteria (SLR 2018). This unit covered 72 ha in the western portion of the Application Area and is bisected by Edderton Road (Figure 04-12).

The Sodosol soil units (654 ha) were considered to have moderately low inherent soil fertility (SLR 2015, SLR 2018,Table 04-3). All other soil units were considered to have moderately high or high inherent soil fertility. Observations from SLR (2015) and SLR (2018) confirm that grazing/cattle grazing is the dominant agricultural land use across the Application Area.



LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Railway
- Gateway Certificate Application Area
- Indicative Underground Mining Area

Slope (degrees)

> 30
25
20
15
10
5
0

Source: © NSW Department of Finance, Services & Innovation (2018); Atlass (2018)
Orthophoto: Oct 2016, 2011

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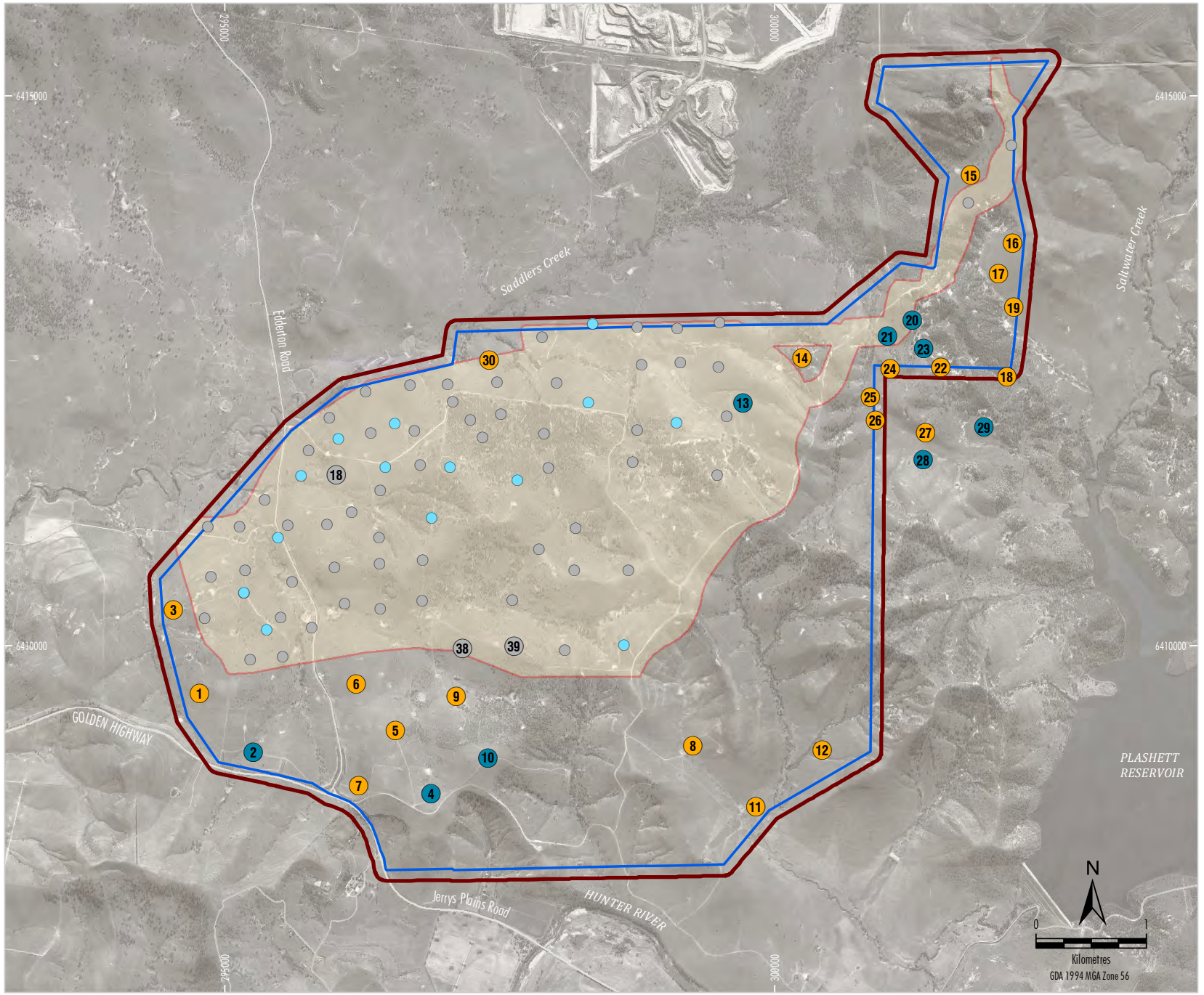
Land Surface Slope within the Application Area

Figure 04-9

SHM-18-03 MG_AIA_209A



LEGEND

- SLR Check Location (14-17 May, 2018)
- SLR Detail Location (14-17 May, 2018)

SLR 2015 Sampled Locations

- Check Site
- Detailed Site (Laboratory Analysed)
- Area Previously Assessed for BSAL (SLR 2015)
- Gateway Certificate Application Area
- BSAL Assessment Area

Source: SLR (2018); © NSW Department of Finance, Services & Innovation (2018)
Orthophoto: Oct 2016, 2011

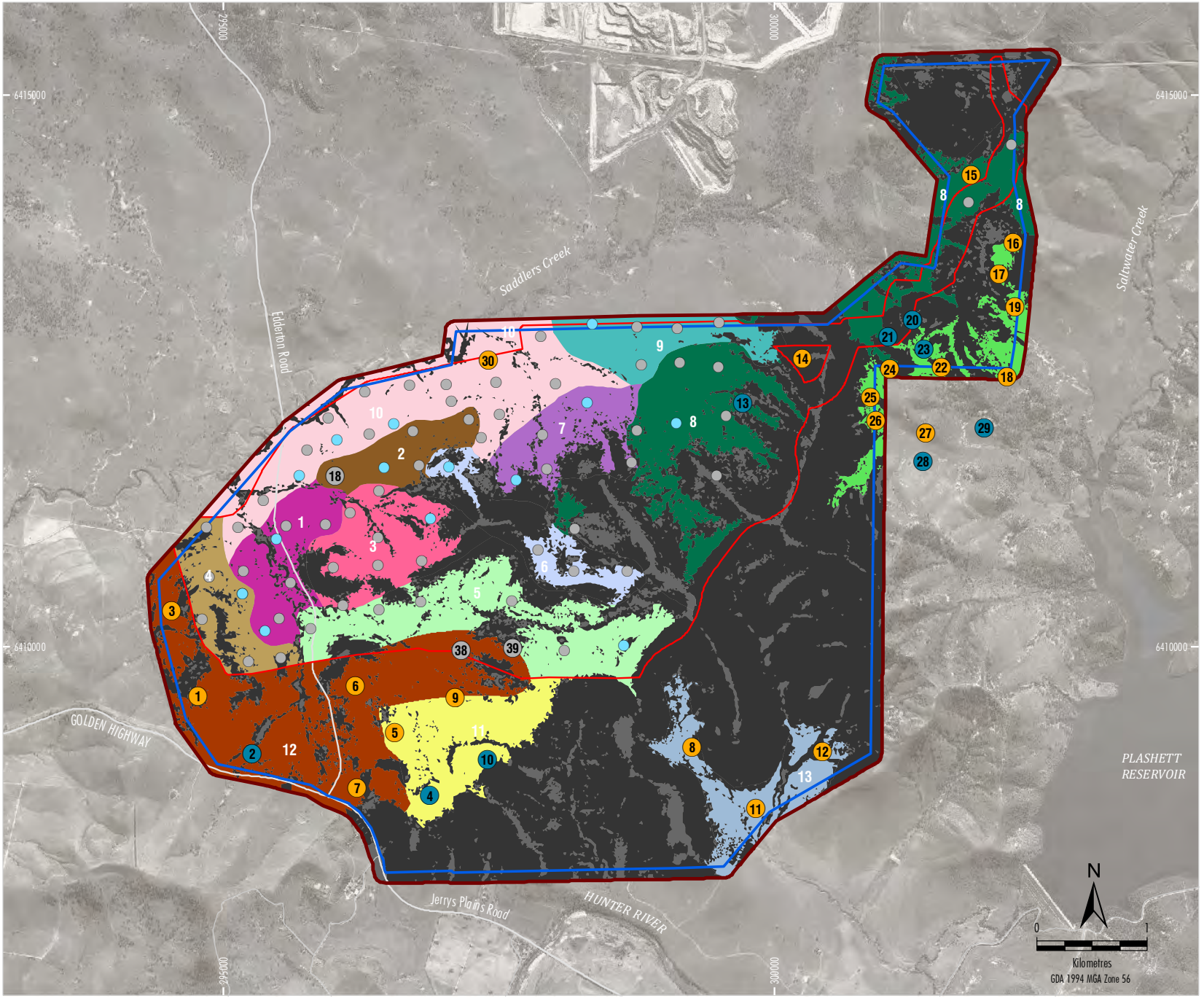
MALABAR COAL

MAXWELL PROJECT

BSAL Assessment Area from SLR (2015) and SLR (2018) Including Soil Sampling Locations

Figure 04-10

SHM-18-03 MG_AIA_210A



Source: SLR (2018); © NSW Department of Finance, Services & Innovation (2018)
Orthophoto: Oct 2016, 2011

MALABAR COAL

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Australian Soil Classification Soil Types (SLR 2018)

Figure 04-11

SHM-18-03 MG_AIA_211A

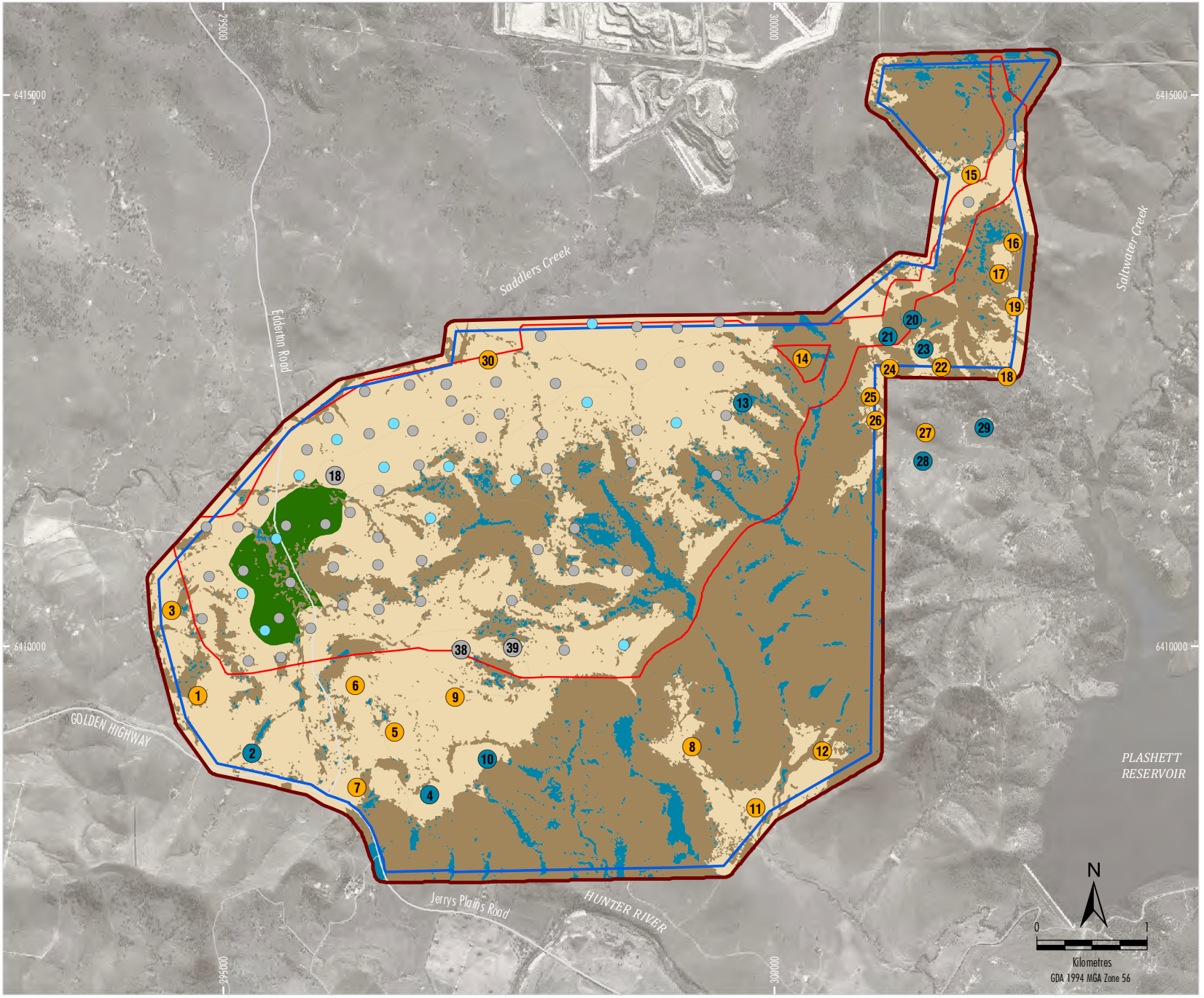

LEGEND
SLR Check Location (14-17 May, 2018)
SLR Detail Location (14-17 May, 2018)
SLR 2015 Sampled Locations
Check Site
Detailed Site (Laboratory Analysed)
Area Previously Assessed for BSAL (SLR 2015)
Gateway Certificate Application Area
BSAL Assessment Area
BSAL Verification
Verified BSAL
Verified Non-BSAL
BSAL Exclusion Zone - Slope > 10%
BSAL Exclusion Zone - < 20 ha Contiguous
Source: SLR (2018); © NSW Department of Finance, Services & Innovation (2018)
Orthophoto: Oct 2016, 2011
MALABAR COAL
MAXWELL PROJECT
Verified BSAL within the Application Area
Figure 04-12
Saddlers Creek
Saltwater Creek
Edderton Road
GOLDEN HIGHWAY
Jerrys Plains Road
HUNTER RIVER
PLASHETT RESERVOIR
6415000
6410000
295000
300000
N
0
1
Kilometres
GDA 1994 MGA Zone 56
SHM-18-03 MG_AIA_212A

Table 04-3 ASC soil types and areas within the Application Area and a 100 m buffer (SLR 2018)

Soil Landscape Unit	BSAL status	Inherent Soil Fertility	Area (ha)
Eutrophic Brown Chromosol (Deep)	Verified BSAL	Moderately high	72
Eutrophic Brown Chromosol (Moderate – Unit A)	Verified Non-BSAL	Moderately high	76
Eutrophic Brown Chromosol (Moderate – Unit B)	Verified Non-BSAL	Moderately high	71
Eutrophic Brown Chromosol (Shallow)	Verified Non-BSAL	Moderately high	57
Epipedal Black Vertosol	Verified Non-BSAL	High	71
Epipedal Brown Vertosol	Verified Non-BSAL	Moderately high	103
Eutrophic Grey/Brown Chromosol	Verified Non-BSAL	Moderately high	63
Eutrophic Red Chromosol	Verified Non-BSAL	Moderately high	254
Mesonatric Brown Sodosol	Verified Non-BSAL	Moderately low	228
Self-mulching Brown Vertosol (Deep)	Verified Non-BSAL	High	53
Self-mulching Brown Vertosol (Moderate)	Verified Non-BSAL	High	33
Subnatric Brown Sodosol (Unit A)	Verified Non-BSAL	Moderately low	144
Subnatric Brown Sodosol (Unit B)	Verified Non-BSAL	Moderately low	226
Subnatric Brown Sodosol (Unit C)	Verified Non-BSAL	Moderately low	56
		Total mapped soil area	**1507**
Slope excluded 2018	Verified Non-BSAL	NA	1068
Contiguous excluded 2018	Verified Non-BSAL	NA	110
Slope excluded 2015	Verified Non-BSAL	NA	456
Contiguous excluded 2015	Verified Non-BSAL	NA	74
		Total excluded area	**1708**
		Total assessed area	**3215**

04.4 **Groundwater Resources and Use**

The Project is located in the Hunter Coalfield in the northern part of the Permo-Triassic Sydney Basin, which forms the southern portion of the Sydney-Gunnedah-Bowen Basin (Department of Mineral Resources 1988).

The geology of the Application Area and surrounds has been described by AGE (2012, 2015) and HydroSimulations (2018).

In summary, the groundwater system in the vicinity of the Application Area comprises:

- Groundwater within Quaternary alluvial deposits.
- Groundwater within porous and/or fractured consolidated sedimentary rock of the Permian coal measures.

The Hunter River alluvium is a “highly productive” groundwater resource. The Saddlers Creek alluvium and the Permian coal measures are “less productive” groundwater resources (HydroSimulations 2018).

The Project would target coal seams within the Wittingham Coal Measures, which form a geological subgroup of the Permian Coal Measures. The coal seams generally dip gently to the south-west and are separated by interburden comprising siltstone, sandstone, claystone and tuff.

The Permian coal measures within the study area are overlain by thin unconsolidated Quaternary age deposits along the alignments of Saddlers Creek and the Hunter River. The Quaternary deposits consist of silts, sand and minor fine gravels of mixed colluvial-alluvial origin.

Most of the groundwater usage in the area is from the Hunter River alluvium. Comparatively few registered bores exist in the Permian porous rock aquifer, likely due to its lower yield and poorer water quality.

The Saddlers Creek alluvium is not commonly targeted for water supply. Two bores used for stock and domestic purposes are located within the alluvium (Bowfield House Well and Bowfield Well). These bores are on land owned by Malabar (the Bowfield property).

Excluding bores on land owned by Malabar, there are 147 registered bores within 10 km of the Application Area. The listed purpose of these bores is distributed as follows:

- Domestic/stock – 44 bores;
- Irrigation – 25 bores;
- Bores used for municipal water supply – 1 bore;
- Industrial or dewatering bores (including mining purposes) – 4 bores;
- Monitoring or test bores – 54 bores; and
- Bores with no listed purpose – 19 bores.

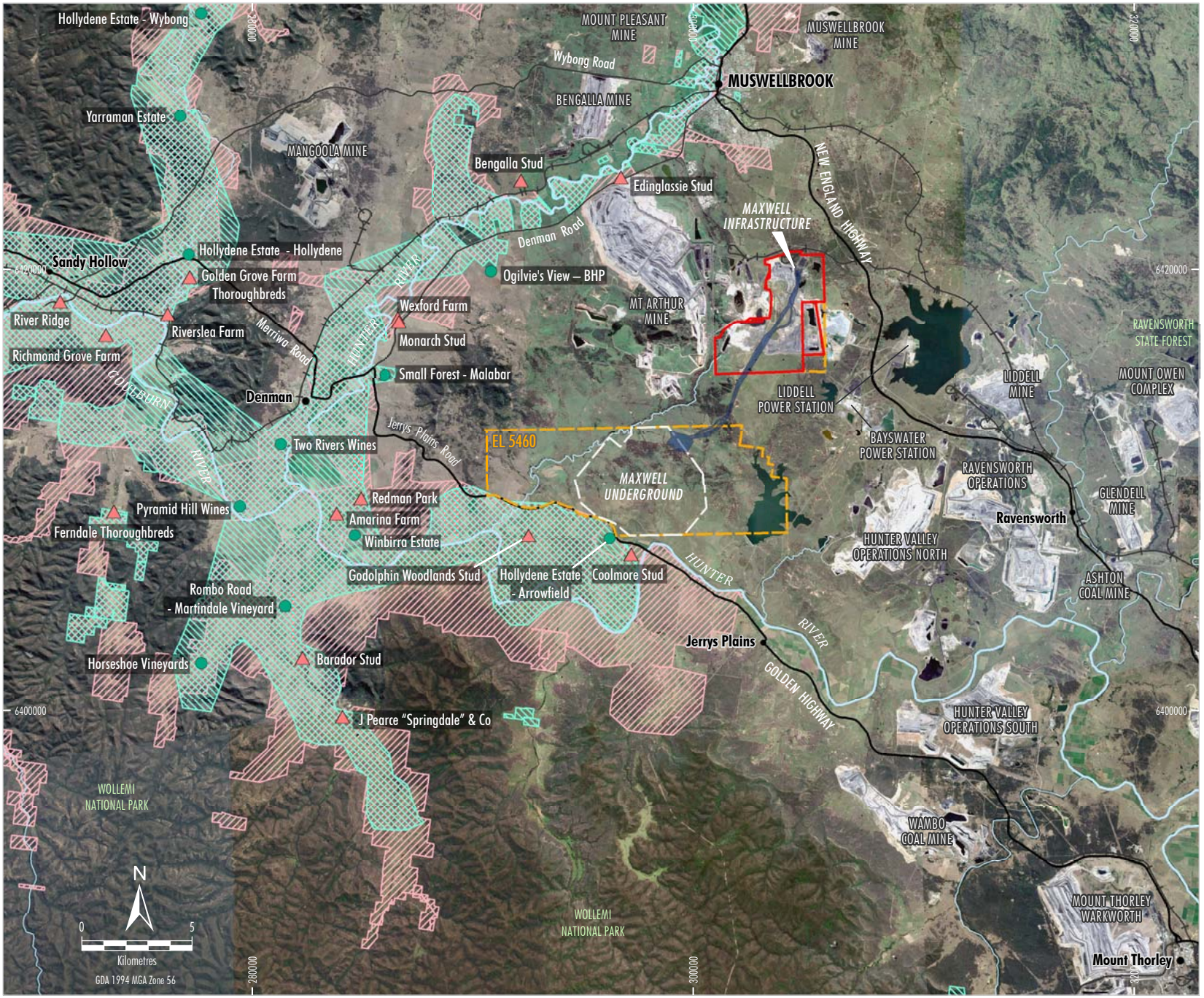
The bores used for irrigation typically have completed depths ranging from approximately 7 to 20 m.

05 ADJACENT EQUINE AND VITICULTURE INDUSTRY RESOURCE ANALYSIS

DP&I (2012b) defines a critical industry cluster (CIC) as a cluster that meets the following criteria:

- There is a concentration of enterprises that provides clear development and marketing advantages and is based on an agricultural product.
- The productive industries are interrelated.
- It consists of a unique combination of factors such as location, infrastructure, heritage and natural resources.
- It is of national and/or international importance.
- It is an iconic industry that contributes to the region's identity.
- It is potentially substantially impacted by coal seam gas or mining proposals.

There is no Equine CIC or Viticulture CIC land mapped within the Application Area in the Mining SEPP. However, there are confirmed areas of both Equine and Viticulture CICs found adjacent to the Application Area (Figure 05-1) and consideration of these CICs has been undertaken via review of literature and other publicly available data.



LEGEND

- Exploration Licence Boundary
- Mining and Coal Lease Boundary
- Railway
- Indicative Underground Mining Area
- Proposed Surface Development Area
- Equine Enterprise
- Viticulture Enterprise
- Equine Critical Industry Cluster
- Viticulture Critical Industry Cluster

Source: Short and Thompson (2013); © NSW Department of Finance, Services & Innovation (2018); Office of Environment and Heritage NSW (2018)
Orthophoto: Google Digital Globe (2017)

MALABAR COAL

MAXWELL PROJECT

Equine and Viticulture Enterprises in the Vicinity of the Project

Figure 05-1

SHM-18-03 MG_AIA_207E

05.1 Adjacent Equine Industry Analysis

05.1.1 Overview of the equine industry in the Hunter Valley

The Equine CIC has been mapped as covering 254,900 ha of land within the Upper Hunter (DPI 2014). It is comprised of a number of stud and broodmare farms supported by specialised veterinary services, stock agents and farriers located in two broad corridors stretching from Jerrys Plains in the south to the area surrounding Scone in the north and the Bylong Valley in the west (DP&E 2015). Primarily, the focus of the industry is on thoroughbred horses for the racing industry, although the industry includes horse agistment and horses bred for other purposes. The industry is considered an important component of the cultural identity of the region, particularly in the Upper Hunter (DP&E 2015).

DP&I (2012b) lists the following features of the Upper Hunter region that make it suitable to support a world class equine industry:

- Temperate climate with low risk of pests and disease.
- Clean air and attractive surrounding landscapes that appeal to clients and investors.
- Ready access to quality lucerne hay and grain supplies.
- Ready access to beef cattle enterprises and facilities to support pasture management.
- Ready access to international airports, racing and training facilities and support services.
- Well drained alluvial soils and highly productive pastures for lactating mares and their foals.
- Adjoining slopes for developing strong boned yearlings and for running dry mares.
- Reliable water sources for equine needs and irrigation (>900 mm rainfall or within 2 km of the regulated river systems and closely associated with alluvial groundwater).

The equine industry in the Hunter Valley produces around half of all thoroughbred horses in Australia, and around 70% of Australia's thoroughbred horse exports. The industry is estimated to generate around $300 million in income to the region each year, including horse exports estimated at over $100 million. The industry is also a significant local employer, directly providing jobs for around 1,100 people, and is a significant contributor to the regional economy with over 85% of all operating costs being spent in the region (DP&E 2016).

Thoroughbred Breeders Australia and Racing Australia maintain detailed breeding statistics and provide qualitative estimates of the value of the thoroughbred breeding industry. The Racing Season 2015/2016 Fact Book (Racing Australia 2016) lists total Australian Sales in 2015/16 at $530 million and places Australia as the second thoroughbred producer globally, behind the USA, accounting for 14% of the global breeding mares. Racing Australia reported on sales results for thoroughbreds in Australia for the 2016/17 financial year, totalling $587 million (Racing Australia 2017).

The Australian Stockhorse Association is based in Scone and also contributes to the equine industry in the Upper Hunter; DPI (2013b) estimates that 97% of Australian stockhorses are either based in the Hunter or have Hunter bloodlines. The region also supports polo clubs, major horse events and a range of supporting services and infrastructure, including (DPI 2013b):

- A specialist equine hospital at Scone (largest in the southern hemisphere).
- The world class Hunter Valley Equine Research Centre at Scone.
- Experienced veterinarians, farriers, equine dentists, breeders, managers and support staff.
- Equine education and training facilities at Scone TAFE and Tocal Agricultural College.
- A complex network of specialist horse transport and feed companies, specialist breeding, rearing, training, spelling and competition facilities and events.
- Access to cost effective feed, including hay and grains from the local growers.
- Transport network for ready access to regional grain and hay supplies, specialist transport services and ready access to domestic and international airports to transport investors, shuttle stallions and export yearling horses.

- A reliable high-volume source of high quality water to irrigate pastures, provide for livestock needs, clean facilities and maintain attractive surroundings.

In addition to infrastructure and support services, the physical landscape is considered important to the thoroughbred horse breeding industry in the Upper Hunter region. The combination of "uncleared, naturally vegetated and complexly eroded steep hills as a backdrop, cleared steep to undulating grassy side slopes, and the manicured patchwork of intensively used lower slopes and river flats, with their grid-work of post and rail fenced paddocks, natural riparian landscapes of the Hunter River course, cultural vegetation, houses and other buildings, creates a landscape for the studs that is both distinctive and of substantial intrinsic scenic quality" (Lamb, 2013).

Lamb (2013) concluded that "Landscape values are engineered at considerable expense by individual studs, designed to demonstrate high standards of thoroughbred racehorse production and management in a manicured and cultured landscape. Extensive consideration is given to the size and character of paddocks and fencing, grouping of farm infrastructure and buildings, interconnection of fenced spaces, impressions given by entranceways and landscaped areas, and to maintaining open views in all directions".

05.1.2 Equine Enterprises nearby the Application Area

Two premier thoroughbred studs in Australia, Coolmore and Godolphin Woodlands studs, are within close proximity of the Application Area. These enterprises have been identified and mapped as part of the Equine CIC (DP&I 2012b). Coolmore and Godolphin Woodlands horse studs are located adjacent to the Application Area on the southern side of the Golden Highway (Figure 05-1). Both studs are considered to play an important role in the Hunter thoroughbred industry (DP&E 2015).

The Godolphin Woodlands Stud is primarily a broodmare operation with facilities for foals and yearlings. It has a heritage listed historic homestead and accommodation for staff (DP&E 2015). Godolphin is owned by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the United Arab Emirates and Ruler of Dubai (Godolphin 2018).

Coolmore Australia, a Swiss registered company, purchased the Coolmore Stud in 1991. The property had been operating as farming, grazing and thoroughbred breeding operation since 1912. The Coolmore Stud is a fully integrated thoroughbred breeding operation; stallions service mares from other farms within the Hunter thoroughbred industry and are also shuttled to service mares overseas. The Coolmore Stud includes its own veterinary hospital and laboratory and has facilities for mares, foals and yearlings. It also has a small airstrip, a number of historic homesteads and accommodation for employees. During the breeding season, the Coolmore Stud employs up to 150 people, with up to 90 people residing on the property (DP&E 2015).

Marsden Jacob Associates (2016), commissioned by the horse studs, valued Coolmore Australia and Godolphin Woodlands (formerly Darley Australia) studs as Australia's largest thoroughbred breeding studs, with the combined stallion fee earning comprising 50% of the service fees in the Hunter Valley. Short and Thompson (2013a) described Coolmore and Godolphin Woodlands studs as central to the functioning of the Equine CIC due to physical scale and market share and believe that any impacts on their business operations will impact all other related and support services in the CIC. This view was supported by the DP&E (2015) who describe the Coolmore and Godolphin Woodlands studs as essential to the equine industry in the Upper Hunter.

Water for both Coolmore and Godolphin Woodlands studs is drawn primarily from the Hunter Regulated River Water Source. Godolphin Woodlands has access to 3764.28 ML per annum from the Hunter River (Water Access Licences [WAL] 1034, 1033, 1321, 789, 1271, 1020, 1215) and Coolmore has access to 5290 ML per annum from the Hunter River (WALs 11175, 13797, 616, 1311). Water access is predominantly via general security, with smaller volumes available via supplementary and domestic and stock categories (WaterNSW 2018). Ross Watson (2015), an agronomist commissioned by Coolmore Australia, states that the Coolmore Stud is the largest area of irrigated pasture on a single property in the Hunter Region, and the largest area of pasture serviced by travelling irrigation systems in the southern hemisphere.

05.1.3 Issues Raised in Relation to Previous Open Cut Mining Applications

The Drayton South Coal Project was a proposed open cut coal mine situated within EL 5460. Concerns relating to impacts on the Equine CIC, and the Coolmore and Godolphin Woodlands studs in particular, were critical in the refusal of the Drayton South Coal Project proposal by the Planning Assessment Commission (PAC). The PAC Determination Report (PAC 2017) concluded that key potential impacts on the operation of Coolmore and Godolphin Woodlands Stud that would have arisen from an open cut mine in such close proximity as the proposed Drayton South Coal Project would have included:

- Impacts on air quality associated with dust from open cut operations.
- Blast noise and vibration.
- Reputational risk.

05.2 Adjacent Viticulture Industry Analysis

05.2.1 Overview of the viticulture industry in the Hunter Valley

The wine industry (viticulture and wine making) was recognised by DP&I (2012) as a significant enterprise in the Upper Hunter and has a base in the Singleton and Muswellbrook LGAs. The area mapped as Viticulture CIC covers approximately 59,842 ha of the region (DPI 2014). It is noted that recent data (Table 03-2) indicates that the area under vine for grape production reduced by over 40% between 2008 and 2017.

Muswellbrook Shire Council (2015, 2018) describes the Upper Hunter viticulture industry as one of Australia's most well-known wine regions that is renowned internationally. Major viticulture establishments in the Muswellbrook LGA include Hollydene Estate, James Estate Wines, Small Forest and Two Rivers (Muswellbrook Shire Council 2018). The Small Forest viticulture enterprise occupies land owned by Malabar (outside of the Application Area). Muswellbrook Shire Council (2015) estimated the capital value of investment associated with Hunter Valley wine and grape production at $450 million in 2010 (although the estimation method is not known), with the Upper Hunter producing approximately half of the region's wine grapes.

The value of the Hunter Valley viticulture industry also extends to tourism, contributing to tourism revenue in 2010 in the Hunter Valley of $256 million (Muswellbrook Shire Council 2015). Hunter Valley viticulture and tourism industries combined contribute $1.8 billion per annum into the NSW economy. The industry in the Hunter Valley also employs over 7,000 people with an additional 10,000 indirectly employed (Muswellbrook Shire Council 2015).

05.2.2 Viticulture CIC Adjacent to Application Area boundary

Hollydene Estate is located to the south of the Application Area boundary (Figure 05-1) and was purchased by Coolmore Australia in 2013. The Hollydene Estate houses a winery, cellar door and restaurant. Most of the vineyards at the estate have been removed to facilitate development of the Coolmore Stud. Hollydene Estate has development approval for the construction of tourist cabins and function centres in addition to refurbishment of the cellar door and restaurant (DP&E 2015).

Hollydene Estate is approximately 80 ha and produces approximately 2,000 cases of a wide range of red and white wines annually (Short and Thompson 2013b).

Water for Hollydene Estate is drawn largely from the Hunter Regulated River Water Source with 95 ML per annum available as general security entitlement (WAL 12987) and 1 ML per annum available as domestic and stock entitlement (WAL 31159).

06 IMPACT ASSESSMENT

06.1 Review of Impacts of Mine Subsidence on Agricultural Landscapes

A literature review was undertaken to describe the documented impacts of planned mine subsidence on agricultural production. Particular attention was given to papers that presented measured impacts in agricultural regions with landscapes (topography and soils) and climatic regimes similar to those in the Application Area.

06.1.1 Physical effects of planned mine subsidence

This section describes the key features of mine subsidence with a particular focus on impacts that may affect agricultural activities and production.

The primary and secondary impacts of mine subsidence are well studied and described by multiple authors (e.g. Bell & Genske 2001; Bell *et al*. 2000; Palamara *et al.* 2006). Following extraction of the selected coal seam, subsidence can form a shallow depression (i.e. trough), generally within days of mining, settling over weeks to months (Bell *et al*. 2000).

With alteration to surface topography it follows that surface runoff patterns and soil moisture patterns may also be altered. Areas of increased surface slope can increase erosion risk, especially along areas of concentrated water flow, including pre-existing drainage lines. Likewise, areas of decreased slope may retain water and form temporary ponds following rainfall. In areas with shallow water tables, ponding from groundwater can also occur.

Depending on the nature of the underground mine, surface cracking can result from planned subsidence. Surface cracks generally appear in tensile zones parallel to longwall edges or the longwall end. Bedrock with fractures and joints can also influence the pattern of cracking. As the extraction face progresses, transient cracks can develop, opening and closing as the area moves from tensile to compressive phases. Larger cracks that may require remediation are usually located around the perimeters of the longwall. Large, isolated cracks can also develop along steep slopes.

Cracking at the surface or subsurface can alter or create new flow paths altering surface and groundwater flow. Cracking can also provide erosion initiation points. The amount of change in surface and subsurface water flows will be dependent on the overlying strata and nature of the subsidence (Booth 2006; Sidle *et al*. 2000). In a landscape which is undulating and of high relief, subsidence impacts may be harder to recognise, whereas in flatter landscapes of low relief and higher water tables, the impacts of subsidence can be more obvious (Asadi *et al*. 2004).

06.1.2 Impacts on agricultural landscapes and production

Worldwide there have been a few studies that have sought to quantify the impacts of mine subsidence on agricultural landscapes and production. There has been an ongoing program of research undertaken by the Illinois Mine Subsidence Research Program (including Darmody *et al*. 1989; Darmody 1995; Darmody *et al*. 1998), and these studies conclude that soil erosion and surface ponding are key factors that may impact productivity. The Illinois Mine Subsidence Research Program studies landscapes which are very flat with rich agricultural soil. Soil erosion has been found to be negligible with surface ponding considered the most important potential impact to productivity. However, land forming mitigation through ditch creation (drainage) or fill have been shown to successfully ameliorate any negative impacts.

In Australia, Beltana No. 1 Underground Mine in the lower Hunter Valley and Kestrel Mine in central Queensland have been subject to several studies that sought to quantify the impact of longwall mine subsidence on agricultural crop and pasture production and soil parameters (Trotter and Frazier 2009; Thompson *et al.* 2010; Frazier *et al*. 2010; Frazier 2015). Erosion control structures such as contour banks have been used as part of historical agricultural management and soils range from sandy alluvial soils to black cracking clays (vertosols).

06.1.3 Beltana No. 1 Underground Mine

Beltana No. 1 Underground Mine has been the subject of several key studies to examine the impacts of subsidence on agricultural/viticultural production (Trotter and Frazier 2009; Thompson *et al*. 2010).

Beltana No. 1 Underground Mine is located approximately 16 km south-west of Singleton in the Hunter Valley, NSW (approximately 35 km to the south-east of the Project). Agricultural land use consists of cattle grazing (native and improved pasture), lucerne cropping, viticulture and olive farming (Frazier *et al*. 2010). The landform is gentle to undulating, with vineyards and other cropping located mainly on alluvium and toe-slopes. Soils include alluvial soils, yellow podzols and chocolate soils with the alluvial soils occupying lower parts of the landscape (Kovac and Lawrie 1991). The climate is warm-temperate with hot wet summers and cool mild winters. For Singleton, the mean maximum temperature is 30°C in December to January and 18°C in June to July. The mean annual rainfall is 722 mm. Following extraction of the coal seam, subsidence of up to 2 m was measured (Thompson *et al*. 2010) with associated changes in surface slope and cracking recorded.

Trotter and Frazier (2009) studied the impact of subsidence on irrigated lucerne and native pasture production above the Beltana No. 1 Underground Mine. They sampled total biomass using traditional field sampling methods, proximal crop sensing and remote sensing methods. In addition, soils were sampled via cores and EM38 soil conductivity surveys. Sampling was conducted across longwall panels and in control areas to cover a range of likely impacts. No significant impacts in production or soil characteristics were found that could be associated with longwall mine subsidence.

Thompson *et al*. (2010) conducted a detailed study of the impact of longwall mine subsidence on wine grape production from 2003 to 2008. Sampling included key grape and vine parameters to capture quality and quantity parameters at scales from individual vines to the vineyard block and vineyard region scale. Sampling was undertaken prior to subsidence and following subsidence and across longwall panels to examine changes in potential impacts over time or across the vineyard. Key changes in yield were found to be more associated with changes in seasonal climatic conditions rather than subsidence and they concluded that any impacts were likely to be highly localised rather than affecting productivity more broadly.

MSEC (2018) details the mining conditions at the Beltana No. 1 Underground Mine and suggests that this mine and resulting surface impacts represent a reasonable indication of surface impacts and surface cracking in particular that may occur at the proposed Project. Cracking at Beltana No. 1 Underground Mine was mapped in detail with a total cracking length of 494 m over a total area of 17.7 square metres (m^2) found. Most cracks were less than 25 mm in width (62%), 26% of cracks were between 25-50 mm and 12% of cracks were between 50-100 mm. Out of a total survey area of 112,476 m^2 cracking was found to affect 0.02% of the total area. Pit excavations showed that cracks were shallow and generally less than 0.5 m in depth, with some wider cracks reaching below 1 m in depth.

06.1.4 Kestrel Mine

The Kestrel Mine has also been subject to several studies that aimed to quantify the impact of subsidence on agricultural production.

The Kestrel Mine is located 50 km north-east of Emerald in central Queensland. The site is very gently to gently sloping with maximum gradients of 5%. The vertosol topsoil varies in depth from 0.5 to 2 m and is underlain by a highly dispersible sub-soil which is prone to erosion. Numerous erosion control measures including contour banks and grassed waterways were implemented prior to any mining activity (Trotter and Frazier 2009).

The agricultural land use at the site is primarily pastoral and cropping. Kestrel leases the property ‘Gordon Downs’ to the Northern Australian Pastoral Company as a background grazing property. There are areas of permanent pastures, both improved and unimproved and forage crops which were used for grazing purposes. The area has also been used for cereal crop production.

The climate of the area has characteristics intermediate between those of tropical and temperate climatic types. It is also transitional between humid and semi-arid, and is regarded as sub-humid (Winders, Barlow & Morrison 1985). The mean annual rainfall for the area is 536 mm (data obtained for Emerald, Queensland). The area experiences an average of 60 days of rain per year, with the highest recorded annual rainfall being 883 mm and the lowest recorded annual rainfall being 284 mm. The mean maximum daily temperature for the area is 30°C and the mean minimum daily temperature for the area is 16°C (data obtained for Emerald, Queensland). The area experiences extremes in temperature, with the highest temperature of 47°C and low temperatures of 10°C.

Hinchliffe *et al*. (2003) studied the impact of longwall mine subsidence on wheat and soybean crops at the Kestrel Mine in 2000 and 2001. They compared subsided areas with unsubsided areas using measures of plant germination and yield as well as soil parameters. There was no apparent difference in crop or soil parameters that implied a negative impact from longwall mine subsidence. They concluded that while impacts such as soil cracking and change in slope are apparent, these impacts are highly localised and ameliorated through normal agricultural management practices.

Further study over the site was undertaken across the 2007 and 2008 seasons (Trotter and Frazier 2009). Sampling was undertaken to assess forage sorghum, sown pasture and soil parameters at subsided and unsubsided (control) sites. Field sampling examined plant biomass, species composition, plant height, soil electrical conductivity, soil pH and soil moisture. Techniques commonly used in precision agriculture including EM38 conductivity survey, hand/machine mounted crop sensors and satellite remote sensing were used to provide a broader, landscape view. The study concluded there were no negative impacts on plant or soil parameters that could be attributed to subsidence.

Frazier (2015) further studied an established pasture paddock over the Kestrel Mine. The paddock had been subject to several years of conservation grazing practices that aimed to re-establish Queensland Bluegrass (*Dichanthium sericium*). This study targeted several longwall areas to determine if patterns of impact with time could be found; that is, if there was a recovery following subsidence or any impacts that compound over time. Samples were taken for plant cover and diversity using field samples and satellite imagery. No significant negative impact was found across any of the zones above any of the longwall panels in comparison to a control area. Further it was found that conservative grazing practices had substantially increased the presence of Bluegrass.

06.1.5 Blakefield South Mine

Blakefield South Mine longwalls 1 to 5 were extracted beneath South Bulga longwalls in the Whybrow Seam and hence represents multi-seam conditions similar to the Project (MSEC 2018). Detailed crack mapping found that most cracks (79%) were less than 100 mm with the majority of these cracks being less than 50 mm. The largest crack found was 500 mm. Within the study site of 5.1 km^2 it is estimated that less than 0.09% of the total area was affected by cracking. Compressive heaving and steps were also observed with typical step height of 50 mm. A maximum step of 800 mm was found as a result of localised vertical ground shear.

06.1.6 Narrabri Mine

Longwalls at the existing Narrabri Mine underlie agricultural land comprising grazing, dryland crops, contour banks and ephemeral streams.

Whitehaven Coal has prepared End of Panel Reports for LW101 to LW105 at the existing Narrabri Mine describing subsidence impacts, including surface cracking and monitoring results following the completion of mining each longwall (Whitehaven Coal 2013, 2014, 2015a, 2015b, 2016).

With respect to impacts to agricultural production, the End of Panel Reports describe:

- The only area affected by subsidence, with regards to agricultural suitability, was where water ponded at an ephemeral creek. The ponded water is currently pumped downstream when required. The ephemeral nature of the creek system is such that any ponding that does occur is for relatively short periods only, and on this basis, has negligible effect on agricultural use or agricultural suitability.

- Contour banks, or parts thereof, were undermined during the extraction of LW101 to 105. The subsidence impacts to the contour banks did not affect their structural stability or functionality.
- Ploughing of the land overlying Longwall 103 was undertaken during the extraction of LW103, however, the ploughing was limited due to poor climatic conditions.

Several farm dams have been undermined during extraction of LW101 to LW105. No structural damage to these dams has been noted at any site following subsidence.

06.1.7 Conclusions from literature review

Planned mine subsidence has an impact on the surface landscape with lowering of the surface above the underground mining areas. Secondary impacts, including surface cracking, altered surface flow patterns with potential ponding or increased erosion risk, can be predicted with a high degree of certainty at the paddock scale.

Several studies from within Australia and worldwide have demonstrated that localised impacts occur as a result of underground coal mining, such as those caused by an individual crack. However, none of the studies have shown widespread impacts that have significantly reduced agricultural productivity over the short or long-term during or following mining. Further, common agricultural maintenance practices such as cultivation, ripping or minor land forming (e.g. restoring contour banks or small channel formation) have proven effective in managing short-term impacts.

06.2 Nature of Proposed Mining Activities

The Project proposes to use underground mining methods: bord and pillar mining with pillar extraction in the Whynot Seam; and longwall mining in the Woodlands Hill, Arrowfield and Bowfield Seams (Figure 02-1). Within the Application Area, subsidence is the primary factor that may affect agricultural productivity.

Smaller areas that are not BSAL would also need to be removed from agricultural production for the life of the Project for infrastructure development such as the mine entry area, roads and coal transport conveyor systems.

06.2.1 Predicted surface subsidence

The extent and nature of subsidence is related to: extracted panel thickness; depth of cover; overlying geology and surface topography (MSEC 2018). MSEC (2018) modelled the extent and nature of subsidence associated with the Project and assessed related secondary impacts on other land resources. This section provides a summary of the findings presented in MSEC (2018).

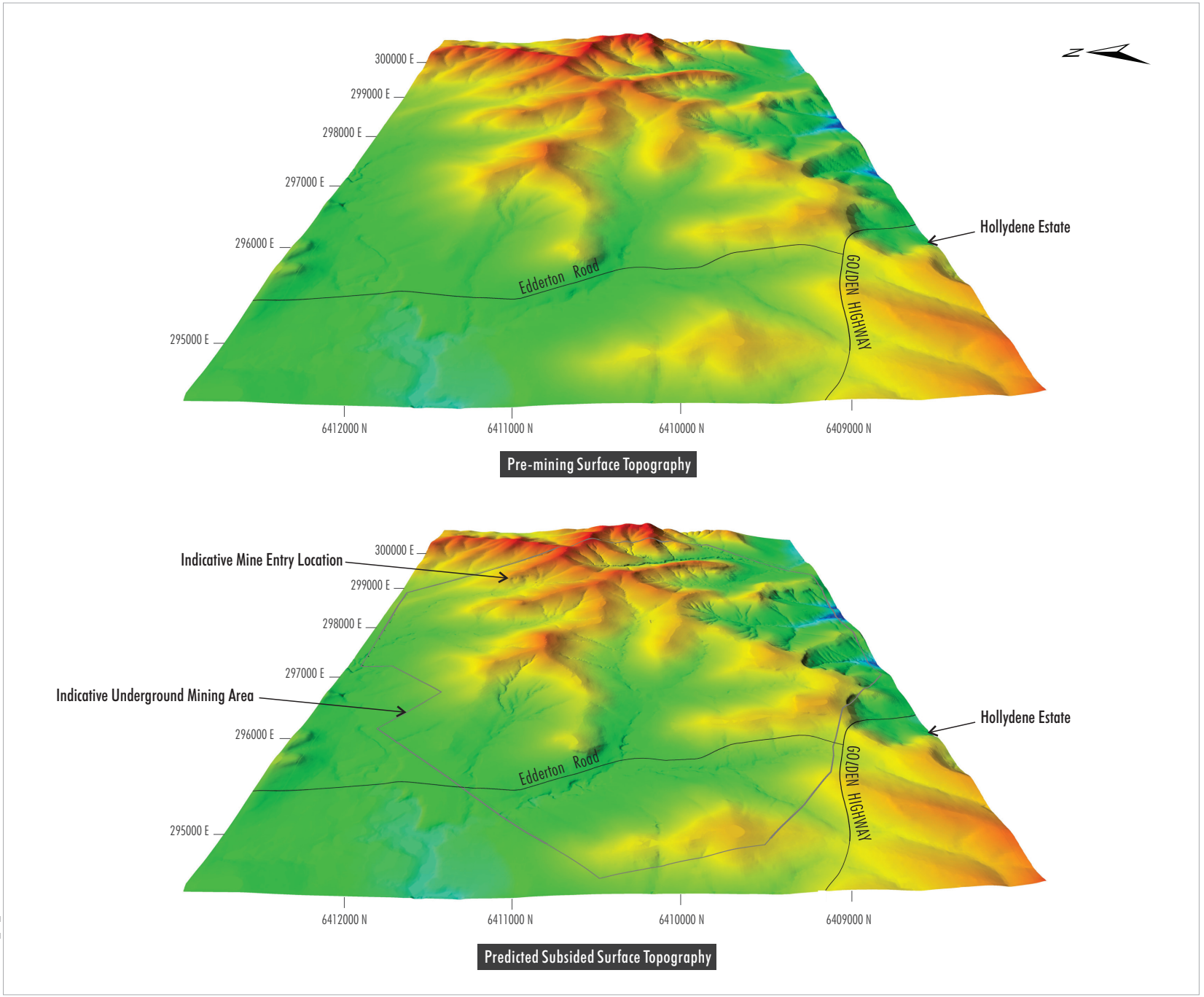
MSEC (2018) modelled the likely surface subsidence (horizontal and vertical movement along with associated stresses and strains) and assessed the likely subsidence related consequences on the landscape and land use. The data modelling outcomes and impact predictions were calibrated via observations from previous mining including the Beltana No. 1 Underground Mine and Blakefield South Mine that were considered to have similar characteristics and potential impacts as those of the Project.

As the Project proposes multi-seam mining, subsidence parameters were consolidated into a summary table that considered the cumulative predictions following the completion of all mining Table 06-1. Figure 06-1 shows a comparison of the pre-mining topographic surface and the final predicted topographic surface once all mining and subsidence has been completed. The Project was predicted to have a maximum vertical subsidence of 5.8 m, with this occurring progressively, over the 26 year period of mining. Extraction of 4 seams occurs in the south-west areas of the Project over an area of approximately 145 ha, or 8% of the total underground mining area.

As a result of subsidence, a range of likely consequences on the land surface and land use have been predicted by MSEC (2018).

Table 06-1 Maximum predicted total conventional subsidence parameters (MSEC 2018, Table 4.2)

Seam	Maximum predicted vertical cumulative subsidence (m)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km^{-1})	Maximum predicted total sagging curvature (km^{-1})
Whynot Seam	0.5	20	0.5	1.0
Woodlands Hill Seam	3.2	45	2.0	1.5
Arrowfield Seam	5.4	50	2.0	2.0
Bowfield Seam	5.8	50	2.0	2.0



LEGEND
Elevation (m AHD)

275
250
225
200
175
150
125
100

Source: MSEC (2018)

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Pre-mining and Post-mining Surface Topography

Figure 06-1

SHM-18-03 MG_AIA_001B

06.2.2 Surface Cracking

Underground mining can result in surface cracking, heaving, buckling, humping and stepping of the land surface (MSEC 2018). The amount of surface impact depends upon a number of factors including: mine geometry; depth of cover; overburden geology; bedrock joints; near surface geological features; soil thickness and condition.

MSEC (2018) predicts that cracking in the flatter areas above the underground mining areas would typically be between 25-50 mm, with some isolated cracking at around 100 mm or greater. Cracking along steeper slopes is expected to be greater, typically in the order of 50-100 mm, with isolated cracks around 200 mm or greater.

The sill in the Whynot Seam is above the south-western ends of the longwall panels in the Woodlands Hill, Arrowfield and Bowfield Seams. It is possible that where this sill spans longwalls that it could result in localised irregular movements. It is expected that any cracking would be less than 50 mm.

The land use above the Application Area is primarily cattle grazing with associated infrastructure. All of this land is owned by Malabar. While active subsidence occurs, there are safety risks to cattle and personnel. Access by cattle, other livestock and unauthorised personnel to areas of active subsidence should be restricted (e.g. via temporary fencing) until the area is inspected and deemed safe.

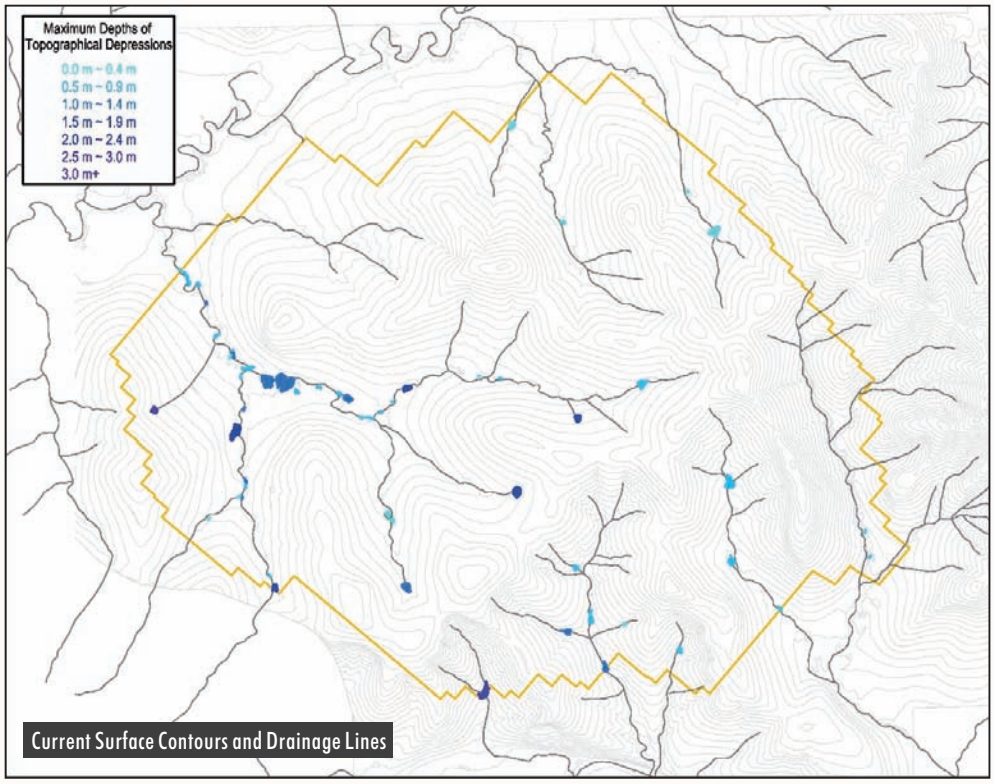
Management and remediation strategies for cracking include:

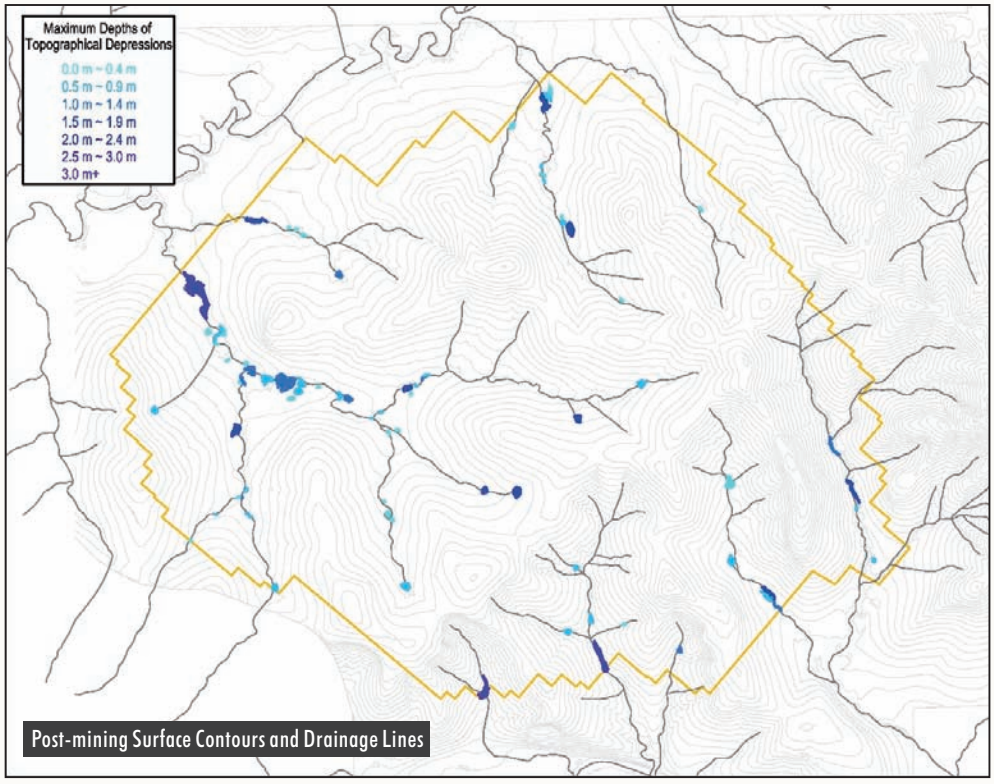
- Visual monitoring of the surface following subsidence to identify larger cracks that could lead to safety, access or erosion issues.
- Where soils and slopes allow; ripping or tyning of larger surface cracks.
- For some larger cracks that don't self-heal, remediation could include infilling with soil or other suitable materials or erosion protection works and revegetation. Figure 5.3 of the Subsidence Assessment (MSEC 2018) shows a possible rehabilitation approach to remediate larger cracks.
- Develop site specific management plans for areas that require broader remediation.
- Restricting access by livestock and unauthorised personnel to areas of active subsidence.

06.2.3 Surface drainage

The topography within the Application Area can be largely described as moderate to steeply sloping, with slopes greater than 10 degrees in the south-east and gentler slopes generally between 5 to 10 degrees in the north-west (Figure 04-9, Figure 06-2). In the south-eastern portion of the Application Area, water sheds generally to the south, flowing directly to the Hunter River or its tributary, Saltwater Creek. In the north-west, water sheds to the north-west into Saddlers Creek. There are some areas with slope less than 5 degrees along some of the drainage lines in the north and north-west of the Application Area.

There are no named drainage lines within the Application Area (MSEC 2018). All drainage lines are ephemeral watercourses that flow only after periods of sustained rainfall. Strahler stream classification identifies these drainage lines as generally first or second order watercourses with small sections of third order watercourses. These ephemeral drainage lines manifest as open depressions across the landscape, generally with a shallow incised channel and occasional small ponds (Figure 06-3). Many farm dams have been constructed along these drainage lines (Figure 06-2).





SHM-18-03 MG_AIA_002A

Source: MSEC (2018), Figure 5.4

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Current and Post-mining
Surface Contours and Drainage Lines

Figure 06-2

SHM-18-03 MG_AIA_003A

Source: MSEC (2018), Figures 5.9 and 5.10

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Drainage Lines and Channel Form within the Application Area

Figure 06-3

Drainage lines exist across the Application Area and would be subject to the full range of predicted subsidence progressively as each seam is mined. Changed surface topography following subsidence would either decrease or increase the local slope in and around drainage lines. Where slope is decreased, generally upstream of chain pillars, stream power would decrease and localised ponding may occur (Figure 06-2). MSEC (2018) has modelled areas of likely maximum subsidence based on changes in current and post-mining surface contours. MSEC (2018) predicts that topographical depressions are likely to be less than 1 ha in the north-western section of the Application Area, with the largest predicted depression being approximately 2 ha and 3.2 m deep. In the steeper south-eastern section of the Application Area, ponding is expected to be shallower with ponded areas generally less than 0.5 ha.

MSEC (2018) notes that within the area defined as BSAL by SLR (2018), topographic depressions with a maximum depth of 3.2 m and total surface area up to 2.5 ha may occur.

The actual extents and depths of ponding are expected to be smaller than the topographical depressions due to factors such as surface water runoff, permeation and evaporation (MSEC 2018).

Where slope is increased, for example downstream of chain pillars, stream power may increase and hence increase risk of erosion.

Cracking across drainage line channel beds is also possible especially where bedrock is at or near the surface (MSEC 2018). MSEC (2018) notes that experience at other mines in the regions shows that although some drainage line channel cracking has been noted at South Bulga Mine and Beltana No. 1 Underground Mine, there were no observable diversions of surface flow into the cracks once remediation had been undertaken.

Management and remediation strategies for cracking include:

- Visual monitoring of drainage lines following subsidence to identify regions of larger topographic change and significant cracking that could lead to ponding, erosion or water capture issues.
    - Develop site specific management plans to either ameliorate the landscape through minor works or enhance the altered landscape to benefit the ongoing agricultural management.
- Where needed, undertake minor works to re-establish drainage lines adversely impacted by ponding. Alternately areas of increased ponding may be developed to provide further water sources within the property, dam banks may be developed to increase pond size.
- Establish site specific methods to stabilise any significant areas of increased erosion.
- Implement crack remediation through infilling with local soil or other suitable material and local regrading of the local slope.

Subsidence management and remediation would occur progressively as areas are mined in each seam.

Both the Hunter River and Saddlers Creek are outside of primary subsidence impacts. MSEC (2018) predicted that any subsidence at either the Hunter River or Saddlers Creek would be less than 5 mm.

The Hunter River is over 500 m away from the underground mining area at the closest point. MSEC (2018) predicts no significant impacts on the main channel (less than 5 mm subsidence) or the floodplain or underlying alluvium (less than 20 mm subsidence). MSEC (2018) predicts no adverse impacts from the Project on the Hunter River and associated floodplain.

Saddlers Creek is approximately 240 m away from the underground mining area at its closest point to the underground mining area. The creek is expected to experience negligible subsidence, less than 5 mm (MSEC 2018).

The extent of subsidence impacts should be monitored during the life of the Project to confirm that subsidence impacts are within predictions.

06.2.4 Groundwater

The relevant criteria in relation to BSAL requires consideration of any impacts on highly productive groundwater, within the meaning of the AIP (DPI 2012). HydroSimulations (2018) have classified the Hunter River alluvial aquifer as a highly productive groundwater source. While the alluvial aquifer associated with Saddlers Creek is classified as a less productive groundwater source. The groundwater within the Saddlers Creek alluvium is naturally saline due to sub-cropping coal seams beneath the alluvium and does not meet the salinity criteria for highly productive groundwater.

The assessment of potential impacts on highly productive groundwater is informed by the Preliminary Groundwater Assessment undertaken by HydroSimulations (2018). As part of the Preliminary Groundwater Assessment (HydroSimulations 2018), a numerical model was developed using available hydrology, hydrogeology and geological structure data. The model was used to simulate the impacts of the Project on the existing groundwater regime over time. HydroSimulations (2018) found that the Project is predicted to meet the 'Level 1' minimal impact thresholds for highly productive groundwater (the Hunter River alluvial aquifer). In particular, HydroSimulations (2018) predict that the Project would result in:

- No known risks to high priority groundwater dependent ecosystems and high priority cultural sites listed in relevant Water Sharing Plans.
- No material impacts to any privately-owned bores (i.e. no drawdown greater than 2 m) in the Hunter River alluvial aquifer.
- No measurable impact on water quality in the Hunter River alluvial aquifer or the Hunter River.

HydroSimulations (2018) predicts that the groundwater impacts of the Project would not directly impact the Equine or Viticulture CICs in the immediate vicinity through reduced access or availability to groundwater resources, because:

- There would be negligible drawdown in the alluvial aquifer associated with the Hunter River and the estimated groundwater take would be licensed in the Hunter Regulated River Alluvial Water Source, with Malabar currently holding licences up to a total 332 units.
- There would be no measurable impact on water quality in the Hunter River alluvial aquifer or the Hunter River.
- The predicted maximum licensable take from the Hunter Regulated River Source is 95 ML per annum and Malabar currently holds licences up to a total 1,423 units.

06.2.5 Surface infrastructure

Key surface infrastructure within the Application Area include:

- 20 farm dams.
- Unsealed tracks.
- Land contouring.
- Cattle yards and fencing.
- Edderton Road.
- Low voltage powerlines.

It could be expected that phases of tensile and compressive strain associated with subsidence may result in damage to dams, tracks, land contouring, yards and fences. However, impacts are expected to beminor and readily ameliorated through a program of pre-subsidence inspection and works if required, followed by post-subsidence assessment and remedial works if required. It is likely that some current infrastructure would be upgraded as part of mine development.

Impacts to Edderton Road and the low voltage powerlines would be managed through a specific Built Feature Management Plan as part of the EIS process. Experience throughout the Hunter Valley indicates that Built Feature Management Plans for infrastructure such as Edderton Road and the low voltage powerlines are readily manageable with only minor, temporary impacts.

The Golden Highway and associated bridge across Hunter River are outside the Application Area and are unlikely to be impacted. However, these significant infrastructure features should be subject to monitoring and, if impacted, managed as part of a Built Feature Management Plan.

06.2.6 Agricultural land use

MSEC (2018) provides a detailed description of the likely subsidence associated with the Project. As underground mining (bord and pillar, and longwall) has little direct surface impact on the landscape, subsidence is considered the most significant impacting factor of the proposed Project. Key impacts from the predicted subsidence include:

- Surface cracking and deformation.
- Changes in surface water drainage.
- Changes in surface water storage.
- Potential enhanced erosion.
- Changes in groundwater resources.
- Impacts to associated surface infrastructure.

In addition, up to approximately 170 ha of land would need to be developed to support surface mine infrastructure within the Application Area. There would be no surface development on areas mapped as BSAL. The Project may involve minimal temporary disturbance (<1 ha) to BSAL associated with monitoring, exploration and remediation activities.

For the period of active mining and remediation it may be necessary to remove areas from agricultural production to ensure the safety of people and livestock. During this time, it is recommended that high levels of ground cover vegetation are maintained and cultivation avoided to improve surface soil stability and minimise erosion risk. Grazing of livestock land can largely continue as usual with temporary removal of livestock from areas undergoing active subsidence until the area is deemed stable to ensure animal safety.

In general, it is expected that impacts to agricultural land use in the Application Area would be short term, with minimal to no impacts to production, including over areas identified as BSAL.

In addition, it is expected that the Project would not result in significant changes to LSC class. It is expected that the surface development area can be rehabilitated back to pre-mining LSC (classes 5, 6 and 7).

06.3 Assessment against Gateway Criteria

Evidence from modelling and assessment undertaken for the Project (MSEC 2018, SLR 2015, SLR 2018, HydroSimulations 2018) and from assessment of similar projects in Australia and worldwide, show that there is likely to be insignificant impacts to agricultural resources and agricultural production as a result of the Project, given appropriate management and rehabilitation (Table 06-2, Table 06-3, Table 06-4).

It is expected that the Project consent conditions would require an Extraction Plan that incorporates a Land Management Plan, Built Features Management Plans and Rehabilitation Management Plan. With appropriate development and implementation of these plans it is expected that there would be no significant impact on the agricultural resources within the Gateway Certificate Application Area.

Given that the total area of BSAL within the Application Area is approximately 72 ha and no surface development would occur on BSAL (other than the existing Edderton Road alignment), it is expected that there would be insignificant impact to the area of BSAL. Surface cracking and drainage line ponding are likely to occur within the mapped BSAL area, however, these impacts are able to be managed and mitigated through appropriate management and rehabilitation.

Table 06-2 Summary of Agricultural Impact Assessment

Agricultural Resource, Practice or Infrastructure	Potential Impact	Management or Mitigation	Consequence to Agricultural Productivity
Resource			
BSAL	Subsidence impacting BSAL through: • ponding; and • erosion or degradation. Temporary loss of access to BSAL during active subsidence.	Approximately 2.5 ha of verified BSAL is likely to be affected by surface ponding following periods of rainfall. This surface ponding can be managed through local reshaping or regrading works to ameliorate any significant ponding. Land management planning and action to minimise erosion through retention of high levels of ground cover, minimising cultivation, repairing residual soil cracks and managing areas of poor drainage. Land management actions to ameliorate erosion/degradation should it occur. Remediation of subsidence impacts.	No significant impact
Soil	Subsidence impacting soil quality through: • ponding; and • erosion. Loss of agricultural soil through infrastructure development. Minimal ponding expected along existing creek lines.	Land management planning and action to minimise erosion through retention of high levels of ground cover, minimising cultivation, repairing residual soil cracks and managing areas or poor drainage. Land management actions to ameliorate erosion should it occur. Rehabilitation upon closure to reinstate previous or other agreed land use.	No significant impact
Surface Water Drainage lines	Altered topography/catchment through subsidence (catchment area will remain almost the same for all watercourses). Ponding along creek lines. Altered dam storage or damage to dam wall or floor. Channel cracking.	Draining or incorporation of ponded areas into land management. Inspect dams before and after subsidence to ensure no damage or change to productivity. Dam repairs or augmentation made as required. Inspect channels before and after subsidence. Channel restoration works made as required. Licensing of surface water take.	No significant impact
Groundwater	Negligible impacts predicted to highly productive groundwater.	Licensing of groundwater take. Groundwater and surface water monitoring with regular review of monitoring results against predictions.	No significant impact

Agricultural Resource, Practice or Infrastructure	Potential Impact	Management or Mitigation	Consequence to Agricultural Productivity
Practice			
Grazing	Small areas unavailable to grazing in active subsidence until made safe for livestock and unauthorised personnel. Temporary loss of pasture areas: • ponding; and • soil degradation.	Temporary restrictions on access for livestock and unauthorised personnel. Land management planning and action to minimise erosion through retention of high levels of ground cover, minimising cultivation, repairing residual soil cracks and managing areas of poor drainage.	No significant impact
Fodder cropping	Fodder cropping areas unavailable in the area of current mining until made safe for vehicles and unauthorised personnel. Temporary loss of cropping area: • ponding; and • soil degradation.	Temporary restrictions on access. Land management planning and action to minimise erosion through retention of high levels of ground cover, minimising cultivation, repairing residual soil cracks and managing areas of poor drainage.	No significant impact
Infrastructure			
Fences and gates	Damage to fences and gates.	Monitor and repair as required.	No significant impact
Dams	Loss of dam storage volume. Damage to dam wall or floor.	Inspect dam prior to undermining. Monitor post subsidence to determine any impacts. Alter dam configuration if required. Repair dam wall or floor if required.	No significant impact
Contour banks and other erosion control works	Damage to banks or alteration to function.	Monitor post subsidence to determine any impacts. Repair banks if required.	No significant impact

Table 06-3 Assessment against BSAL gateway criteria

Criteria in Clause 17H(4)(a) of the Mining SEPP	Impact Assessment
Any impacts on the land through surface area disturbance and subsidence	The Application Area would be subject to mine subsidence and minimal surface disturbance for mining related infrastructure. There would be no surface development for the Project on areas of BSAL. The Project may involve minimal temporary disturbance (<1 ha) to BSAL associated with monitoring, exploration and remediation activities. Vertical subsidence of up to 5.8 m is predicted with minimal impact on the surface agricultural resources (Section 6.2).
Any impacts on soil fertility, effective rooting depth or soil drainage	Minor changes to landscape topography are likely to result in small areas of ponding along existing watercourses and creek lines. These areas could be locally reshaped or regraded to reinstate the previous drainage patterns or incorporated into the landscape as an environmental or agricultural resource. Evidence from the existing mines within Australia indicates that there would be no significant impact to soil fertility or soil rooting depth.
Increases in land surface micro-relief, soil salinity, rock outcrop, slope and surface rockiness or significant changes to soil pH	Minor changes to landscape topography are likely to result in localised increases and decreases in land slope. With appropriate management, including maintaining cover and rehabilitating any cracking that may form, these changes are expected to be insignificant.
Any impacts on highly productive groundwater (within the meaning of the AIP)	Modelling by HydroSimulations (2018) predicts than any impacts to the highly productive Hunter River alluvium would be within the definition of a 'Level 1' minimal impact.
Any fragmentation of agricultural land uses	Throughout the Project life, the majority of the Application Area would be suitable for agricultural production under the current land use intensity. Internal agricultural infrastructure (fences, dams, tracks) would remain functional with appropriate management. Approximately 170 ha of land will be required for mine infrastructure development for the life of the mine. This land would be fully rehabilitated to previous or other agreed land use upon mine closure. No areas of BSAL would be used for mine surface infrastructure development. Therefore, there would be insignificant fragmentation of agricultural land use.
Any reduction in the area of BSAL	The total area of BSAL within the Application Area is approximately 72 ha. Changes in the area and productive capacity of BSAL are expected to be nil or negligible. There would be insignificant impact to the area of BSAL within the Application Area.

06.4 Consideration of Potential Equine CIC and Viticulture CIC Impacts

While the Equine and Viticulture CICs are not located within the Application Area, their location immediately south of the Application Area warrants consideration of potential impacts.

The PAC Determination Report for the Drayton South Coal Project (PAC 2017) considered potential impacts to the Equine CIC, most notably Coolmore and Godolphin Woodlands horse studs, may occur via:

- Impacts on air quality associated with dust from open cut operations.
- Blast noise and vibration.
- Reputational risk.

In contrast to Drayton South Coal Project, the proposed Maxwell Project is an underground mine that would significantly reduce or eliminate any potential impacts on air quality or blast noise. The Project would also be largely unnoticeable from the Coolmore and Godolphin Woodlands studs or vineyard premises, or anywhere along the Golden Highway, as the mine entry location would be situated behind several ridgelines and approximately 5 km away (Figure 01-2, Figure 06-1).

The area subject to potential subsidence to the north of the studs and vineyards is moderately undulating and any subsidence would be hard to recognise visually (Asadi *et al*. 2004). It is predicted that subsidence would not directly affect the Coolmore and Godolphin Woodlands studs or vineyards.

An assessment of impacts against the CIC gateway criteria is presented in Table 06-4.

Table 06-4 Consideration of CIC gateway criteria

Criteria from clause 17H(4)(b) of the Mining SEPP	Impact assessment
Any impacts on the land through surface area disturbance and subsidence	The Project does not coincide with any areas of Equine or Viticulture CIC.
Reduced access to, or impacts on, water resources and agricultural resources	There would no direct or subsidence impacts on agricultural resources used by the Equine or Viticulture CIC. The Project would not have any significant impacts on water resources used by nearby equine and viticulture enterprises (surface water extraction from the regulated Hunter River).
Reduced access to support services and infrastructure	The Project would not have any material impact on support services or infrastructure, as there would be no property acquisitions or other impacts likely to isolate any CIC property from, or lead to the closure of, a CIC support service such as an equine veterinarian or winery.
Reduced access to transport routes	Primary access to the Project would be via Thomas Mitchell Drive, which was used as the access for the former Drayton Mine for several decades. Thomas Mitchell Drive is also used by the Mt Arthur Mine and an industrial estate. Access to the nearby equine and viticulture enterprises is via the Golden Highway. The Coolmore and Godolphin Woodlands studs also use Edderton Road to access Scone. Potential subsidence impacts on Edderton Road would be managed to maintain access, either through road maintenance or realignment of the road around the underground mining area. As there would be limited overlap between Project-related traffic and key transport routes used by equine and viticulture enterprises, there would be no material reduced access to transport routes.
Loss of scenic and landscape values	The Project would not have any material impact on scenic or landscape values in consideration of the scale of the surface development and its location.

07 CONCLUSIONS AND RECOMMENDATIONS

Detailed assessment of potential impacts of the Project has forecast no significant impact on agricultural production and BSAL, nor any impact to the adjacent Equine and Viticulture CICs.

The Application Area is moderately agriculturally productive. Cattle grazing is the dominant land use with some small areas of opportunistic fodder cropping. A small area of BSAL (72 ha) occurs within the western part of the Application Area and is bisected by Edderton Road (SLR 2015, 2018).

MSEC (2018) modelled the potential subsidence based on the underground mining layout and undertook an impact assessment for the potential consequences of subsidence in the area. MSEC (2018) also drew upon experience from measured subsidence and associated impacts from other mines in Australia, especially those from nearby mines.

Modelling predicted a maximum final vertical subsidence of 5.8 m from the 4 combined coal seams in some areas directly above underground mining areas. Subsidence, and remediation of observed impacts, would occur progressively in areas as each seam is mined. Subsidence is likely to result in localised soil cracking, ponding, increased erosion risk, infrastructure disturbance and changes to farm dams. Based on the modelling and experience from nearby mines, there would be little to no risk of detrimental consequences from subsidence to agricultural resources if appropriate land management and rehabilitation is undertaken. Ponding is the most likely possibly detrimental consequence, however, ponds can be drained through channel creation and/or creek channel works, or incorporated into the working agricultural landscape.

Groundwater assessment and modelling by HydroSimulations (2018) found no significant impacts on groundwater resources would result from the Project, notably those associated with the Hunter River. Any potential impacts to highly productive groundwater were found to be within the ‘Level 1’ minimal impact thresholds as defined by the AIP.

Given the nature of the production systems and the nature of the impacts predicted for the Project, it is likely that agricultural production can continue throughout the life of the Project, with access to small areas being restricted temporarily while subsidence and rehabilitation are taking place. Approximately 170 ha of agricultural land (non-BSAL) would also be required for infrastructure development and would be rehabilitated upon mine closure.

This report represents the Agricultural Impact Assessment undertaken to support the Gateway Certificate Application for the Project. As such it has drawn upon regional and local datasets and relied upon modelling and assessment based on a defined Application Area and proposed mine layout.

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