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Agricultural and Land Use Impact Assessment

Airly Mine Extension Project

Report Number 633.10214

28 July 2014

Centennial Airly Pty Limited
Glen Davis Rd
Capertree NSW 2846

Version: Revision 1

Agricultural and Land Use Impact Assessment

Airly Mine Extension Project

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Centennial Airly Pty Limited (Centennial Airly) to prepare an Agricultural and Land Use Impact Assessment for the proposed Airly Mine Extension Project (the Project).

This Agricultural and Land Use Impact Assessment has been prepared to support an Environmental Impact Statement (EIS) for the Project. The EIS has been prepared to support the submission of a development application by Centennial Airly to the Department of Planning and Infrastructure (DP&I) to continue mining beyond the current development consent (DA162/91) due to expire on 12 October 2014. The development application also seeks development consent to extend mining into the eastern section of the existing Mining Lease (ML) 1331 and within Authorisation 232 (A232) (**Figure 1.1**).

1.1 Background

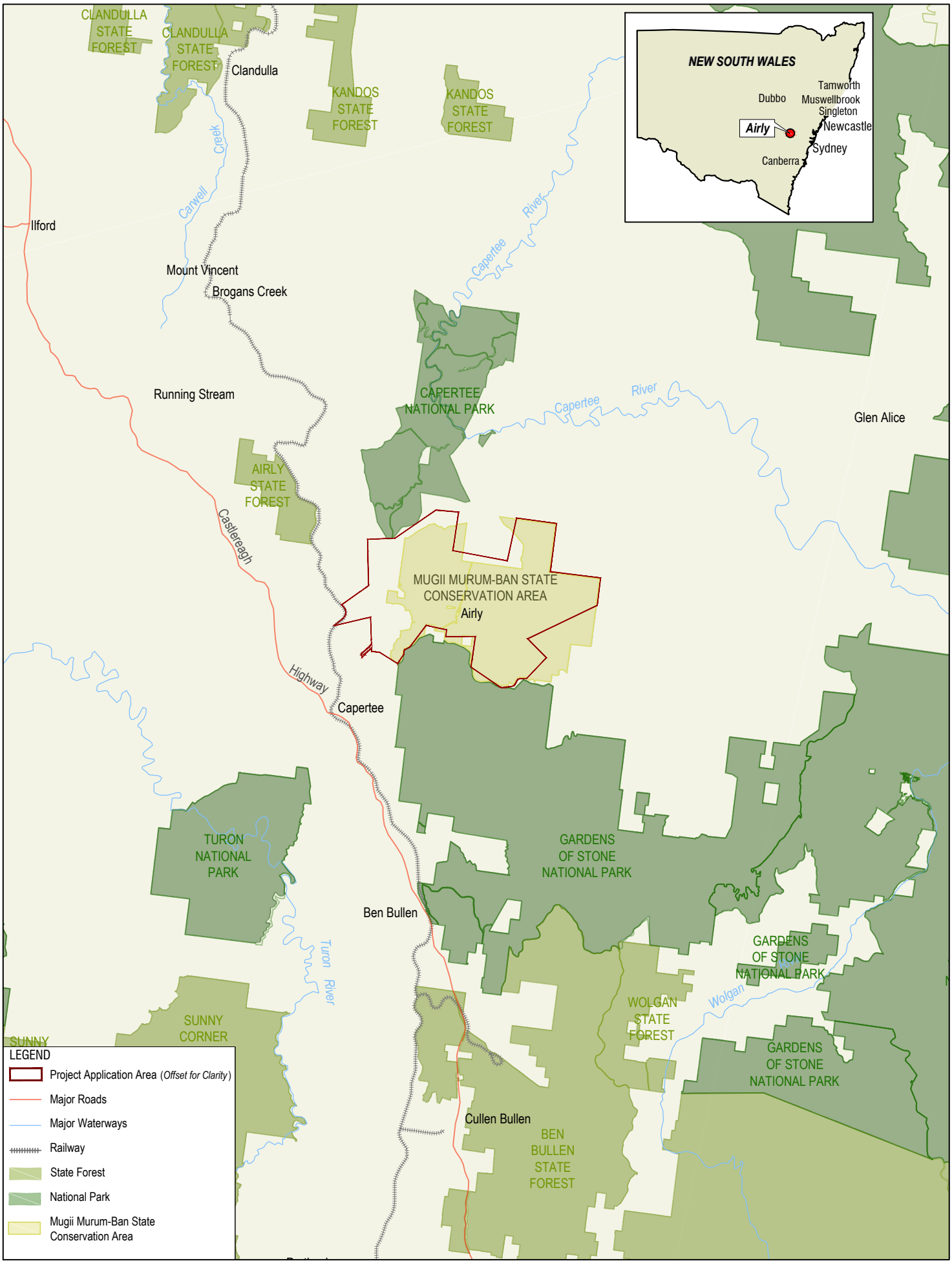
The existing Airly Mine is an underground coal mine located approximately 40 kilometres (km) north north-west of Lithgow. Airly Mine is accessed via the Castlereagh Highway and the Glen Davis Road and is located approximately 4 km north-east from the town of Capertee. The Wallerawang to Gwabegar railway line is located 3 km to the west of the mine (**Figure 1.1**).

Airly Mine is currently approved to extract up to 1.8 million tonnes per annum (Mtpa) of run of mine (ROM) coal from within ML 1331 to be transported by rail under DA162/91 granted on 14 April 1993 following a Commission of Inquiry.

The existing surface infrastructure includes workforce and materials access, water management structures, coal conveyer system, crushing plant, coal stockpile area, coal reclaim facilities, the rail siding, rail load-out facility and mine access (**Figure 1.2**).

Full scale coal mining was started in December 2009 for supply of ROM coal to domestic and international markets. Production at Airly Mine ceased in January 2013 and the mine entered care and maintenance arrangements.

Centennial Airly is seeking development consent for the continuation of mining beyond the expiry of DA162/91, due to expire on 12 October 2014. Centennial Airly is seeking State Significant Development (SSD) consent for the Project under Part 4 Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project is a SSD in accordance with Clause 8 and Schedule 1 (item 5) of the *State Environmental Planning Policy (State and Regional Development) 2011*.



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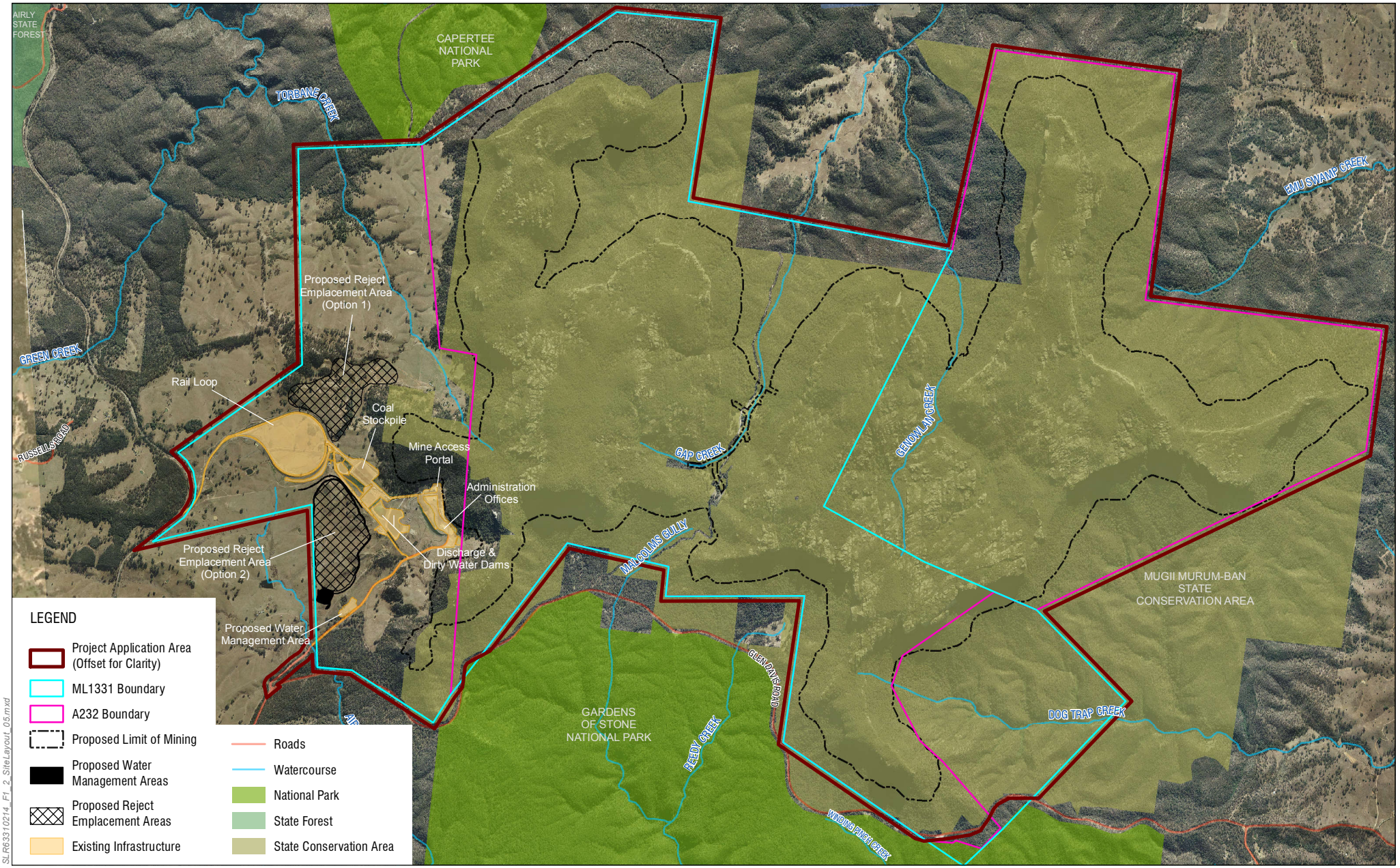
AIRLY AGRICULTURAL AND LAND USE IMPACT ASSESSMENT

Regional Location

FIGURE 1.1



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Airly Agricultural and Land Use Impact Assessment

Site Layout

FIGURE 1.2

1.2 Project Description

1.2.1 Project Description

The Project will:

- In general, include all currently approved operations, facilities and infrastructure of Airly Mine
- Continue to extract up to 1.8 million tonnes per annum (Mtpa) of run of mine (ROM) coal from the Lithgow seam underlying the Project Application Area.
- Extend life of mine by 25 years from the date of consent with rehabilitation to be undertaken within this period on cessation of mining.
- Extract coal using partial extraction methods within ML1331 and extend the mining area to the east of the existing workings into A232 area.
- Ddevelop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining areas.
- Use various partial extraction mining methods, that will manage subsidence to 100 mm but not exceeding a maximum of 125 mm in previously unmined areas and minimise further potential subsidence impacts in areas where the historical New Hartley Shale Mine has already impacted the environment.
- Continue to operate and maintain the existing ancillary surface infrastructure for mine access, underground ventilation, electricity, water, materials supply, and communications at the pit top, and upgrade the infrastructure as required for mining operations.
- Continue to manage the handling of run-of-mine (ROM) coal through a crusher and screening plant at the pit top for transfer to the existing and proposed stockpile areas as required to meet market demands.
- Construct a coal preparation plant (CPP) to beneficiate (wash) ROM coal.
- Transfer beneficiated coal from the CPP, using the existing and new overland conveyor systems being part of the coal handling and preparation plant (CHPP), to the product stockpile area for temporary storage prior to despatch to offsite locations.
- Construct a life of mine reject emplacement area (REA) for the emplacement of reject materials from the CPP and the underground mine.
- Continue to use the existing water storage dams at the pit top for the separation of clean and dirty water.
- Construct appropriately sized new management storage dams for the proposed life of mine REA.
- Continue to manage non-production waste in accordance with the site's Mining Operations Plan;
- Despatch ROM and product coal off site using the existing rail load out facilities for the export and domestic markets.
- Continue exploration activities, predominantly borehole drilling, to further refine the existing geological model.
- Continue to undertake existing and initiate new environmental monitoring and geological exploration programs as appropriate.
- Review and update existing environmental management plans as required.
- Operate 24 hours per day and seven days per week for 52 weeks per year.
- Provide employment to a full time workforce of up to 135 persons and 20 contractors.

- Progressively rehabilitate disturbed areas at the pit top no longer required for mining operations and exploration boreholes.
- Undertake life-of-mine rehabilitation at the pit top infrastructure disturbance areas to create final landforms commensurate with the surrounding areas.

1.2.2 Project Application Area

The Project Application Area is 3,983 ha (hectares) and covered by ML1331 and A232, (**Figure 1.2**). The Project Application Area is located within the Lithgow Local Government Area (LGA).

The following proposed Project components relevant to this assessment:

- Proposed Reject Emplacement Area (REA). Currently two Project alternatives options have been assessed for the location of the proposed REA. Option 1 covers an area of 31 ha and Option 2 covers 34 ha. The preferred alternative is Option 2 based on a number of considerations; please refer to the main report for the assessed risk of each area. The existing environment for both options will be assessed whereas the impact assessment focuses on Option 2 only.
- Proposed Water Management Structures: includes settlement dam, toe drain, pump station and water return pipe, covering an area of 3 ha.
- Proposed 'Limit of Mining': includes land proposed to be subject to underground mining activities.

1.3 Purpose of this Report

This Agricultural and Land Use Impact Assessment has been prepared in accordance with the Director General Requirements (DGRs) issued for the Project. **Table 1.1** provides the relevant DGR's and indicates where specific issues have been addressed in this document.

Table 1.1 – Director-General's Requirements

Director-General Requirements addressed in this report	Where addressed in this report
Land Resources – including a detailed assessment of impacts to:	
• soils and land capability (including erosion and land contamination)	Section 2.12, 4.1
• landforms and topography, including 'the Grotto', cliffs, rock formations, steep slopes, etc; and	Section 4.2
• land use, including agricultural, forestry, conservation and recreational use.	Sections 4.3, 4.4 & 4.5

The Project will constitute SSD pursuant to *State Environmental Planning Policy (State and Regional Development) 2011* and therefore as a SSD, an Agriculture Impact Statement (AIS) is usually required under the revised Strategic Regional Land Use Policy, released September, 2012. An AIS assesses the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Application Area. In accordance with the DGRs, an AIS is not required for the Project; however, the proponent, has elected to undertake meet the AIS Guidelines (*Guideline for Agricultural Impact Statements* (DP&I, 2012)) in this Agricultural and Land Use Impact Assessment for due diligence. **Table 1.2** provides the AIS Guideline requirements and indicates where specific issues have been addressed in this document.

Table 1.2 – Agricultural Impact Statement Guidelines

This AIS guidelines addressed in this report	Where addressed in this report
Information Relating to the Project Application Area and Region	
Detailed assessment of the agricultural resources and agricultural production of the project area	Section 2 & 3
Identification of the agricultural resources and current agricultural enterprises within the surrounding locality of the project area	Section 2 & 3
Assessment of Impacts	
Identification and assessment of the impacts of the project on agricultural resources or industries	Section 4
Account for any physical movement of water away from agriculture	
Assessment of socio-economic impacts	
Mitigation Measures	
Identification of options for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level	Section 5
Consultation	
Document consultation with adjoining land users and Government Departments	Section 6

1.4 Policies and Standards

The relevant NSW Government policies and other standards used in this Agricultural and Land Use Impact Assessment are listed below:

- Agricultural Impact Assessment Guidelines 2012 (DP&I)
- Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC & NHMRC, 1992).
- Department of Land and Water Conservation (1986) Rural Land Capability Mapping, Soil Conservation Service of NSW, Sydney, NSW
- Managing Urban Stormwater Volume 1: Soils and Construction (Landcom, 2004)
- Managing Urban Stormwater Volume 2E: Mines and Quarries (DECC, 2008).
- NSW Department of Planning and Infrastructure (2012) Strategic Regional Land Use Policy
- NSW Department of Planning and Infrastructure (2013) State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007, Strategic Agricultural Land Map – Sheet STA_032
- NSW Office of Water (2012) Aquifer Interference Policy

2 BIOPHYSICAL AND AGRICULTURAL ENVIRONMENT

2.1 Climate

Representative rainfall data for the area has been obtained from the Bureau of Meteorology (BOM) weather station located at Ilford (Waragunyah) (Station 062031; BOM, 2013), which is located approximately 29 km north-west of Airly Mine. Data shows that the Project Application Area experiences a uniform rainfall pattern with an average rainfall of 672 millimetres (mm) per year and an average low of 45 mm in May and an average high of 67 mm in January.

Representative temperature data for the area has been obtained from the Bureau of Meteorology (BOM) weather station located at Lithgow Newnes Forest Centre (Station 0630621; BOM, 2013). Data shows that the Project Application Area experiences a warm summer/cold winter temperature pattern with an average rainfall of an average maximum temperatures range of 9.4 degrees Celsius in July to 23.5 degrees Celsius in February.

2.2 Topography

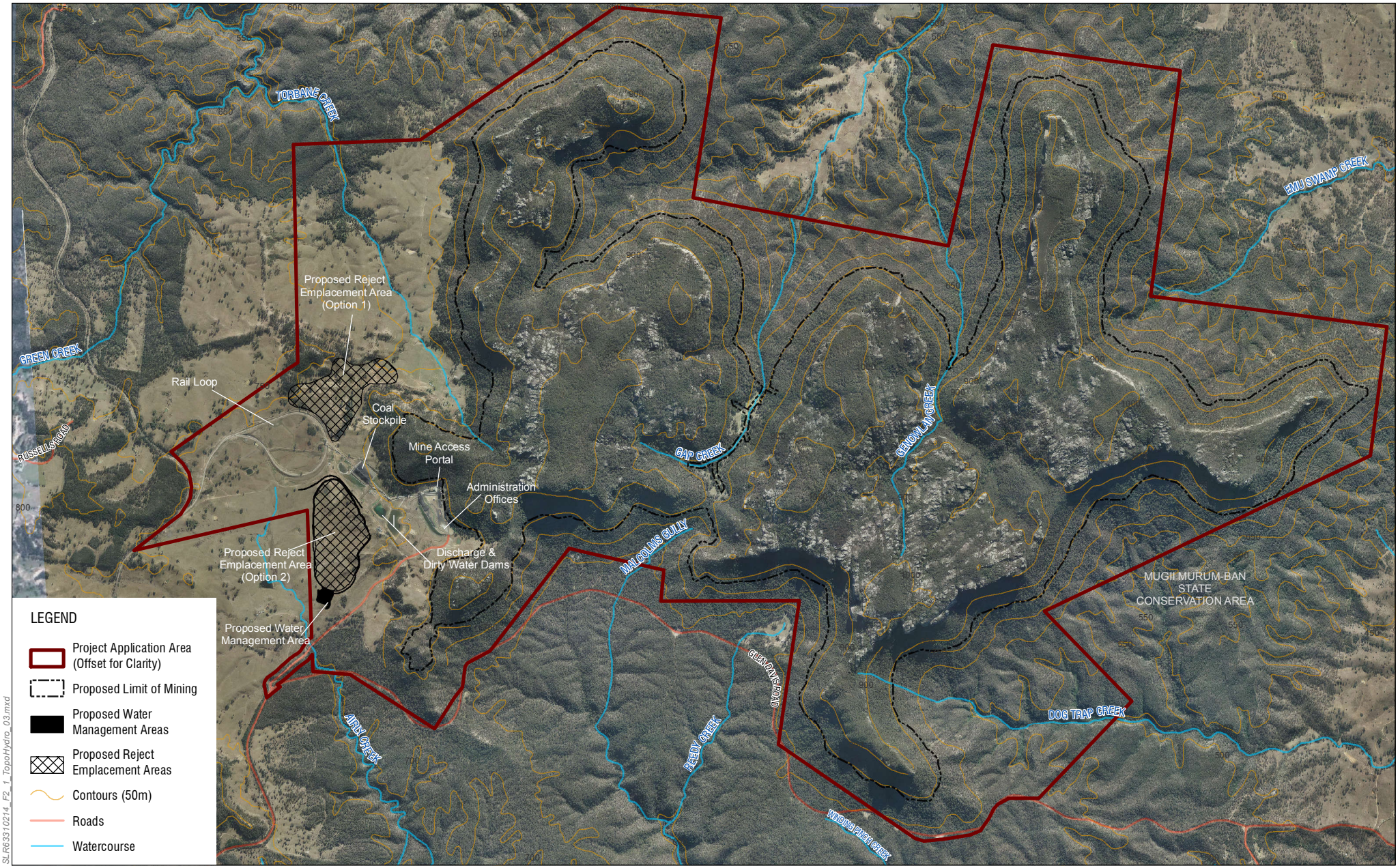
The Project Application Area is located towards the northern boundary of the Western Coalfields, within the Sydney Basin. The topography is dominated by Mount Airly to the west and Genowlan Mountain to the east, which together form a large, elevated plateau within the Project Application Area. Site elevation varies from 1000 metres (m) in the vicinity of Mount Airly, to less than 600 m in the south-eastern section of the Project Application Area (**Figure 2.1**).

Mount Airly and Glenowlan Mountain are surrounded by steep and rugged topography with large areas characterised with cliffs and significant rock outcrop, including 'the Grotto'. Slope gradient surrounding Mount Airly and Glenowlan Mountain exceed 50 per cent (**Figure 2.2**). There are small areas of flat land on plateaus. To the west of Mount Airly there are undulating areas within the Project Application Area with slopes typically between 3-20 %.

2.3 Geology

The Triassic Narrabeen Group covers most of the upper half of the Mount Airly and Genowlan Mountain plateaus. The surface is primarily sandstone underlain by interbedded siltstones, sandstones and shales.
Underlying the Narrabeen Group is the Permian Illawarra Coal Measures which contain a number of coal seams including the Irondale, Lidsdale and Lithgow (**Table 2.1**). Lithology consists of a mixture of sandstone, claystone, mudstone and conglomerate. Regionally the coal measures dip 0.5 degree to 1 degree to the east and the north-east.

The Illawarra Coal Measures are underlain by the Shoalhaven Group which consists of siltstone and lithic sandstone conglomerate, which overlays the Devonian metamorphic strata containing shale, sandstone and limestone.



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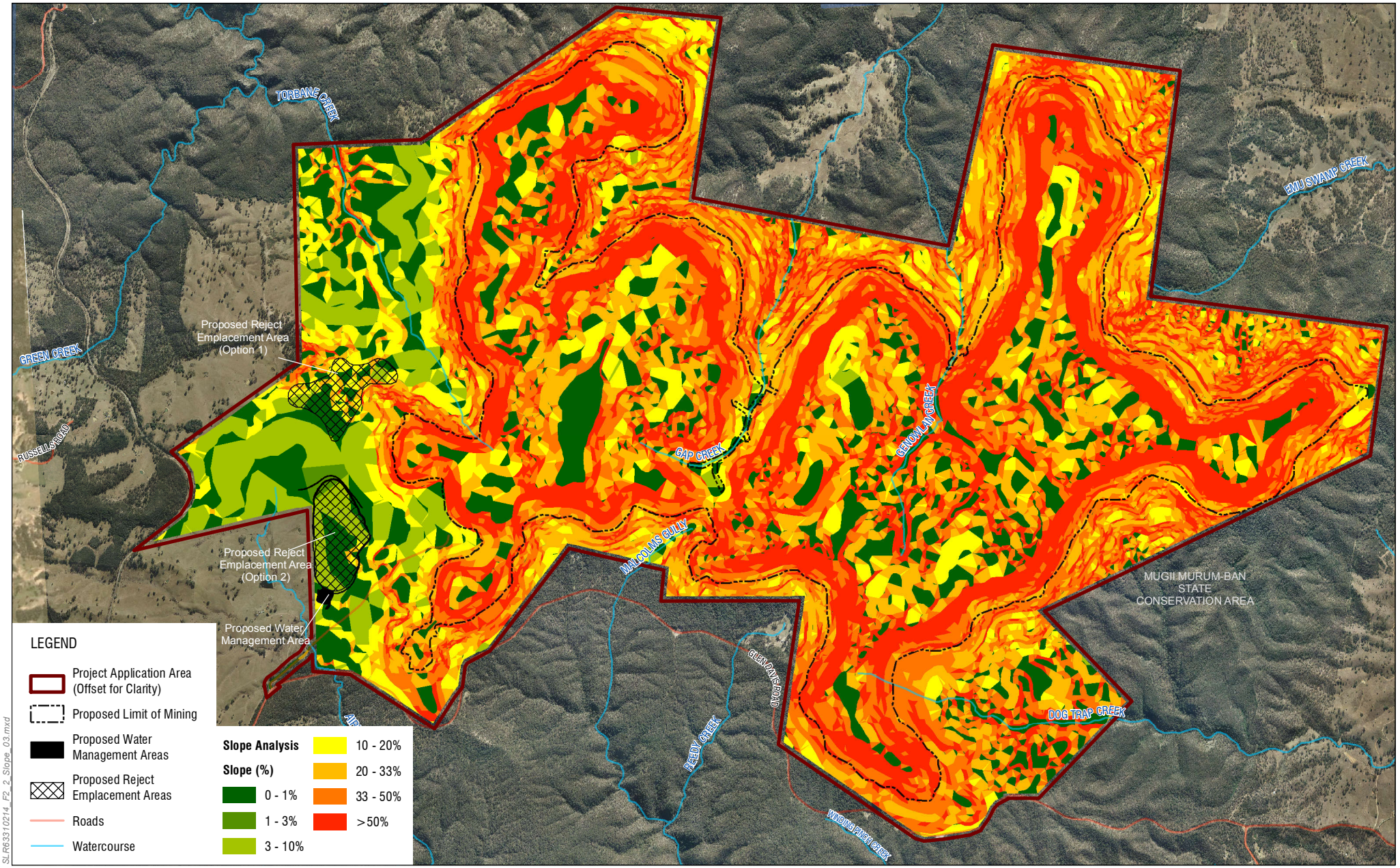
Topography & Hydrology

FIGURE 2.1



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Airly Agricultural and Land Use Impact Assessment

Slope Analysis

FIGURE 2.2

Table 2.1 – Stratigraphy of the Illawarra Coal Measures

Period	Group	Subgroup	Formation
Quaternary	Alluvium		
Triassic	**Narrabeen Group**	Grose	Burralow Formation Banks Wall Sandstone Mount York Claystone Burra-Moko Head Sandstone Caley Formation
Permian	**Illawarra Coal Measures**	Wallerawang Subgroup	Katoomba / Middle River Coal Member Gap Sandstone
		Charbon Subgroup	State Mine Creek Formation Moolarben Coal Member Angus Place Sandstone Baal Bone Formation Glen Davis Formation (Upper Irondale Seam) The Newnes Formation (Middle Irondale Seam) Irondale Seam
		Cullen Bullen Subgroup	Lidsdale Seam Lithgow Seam Marangaroo Conglomerate
	Shoalhaven Group	N/A	Berry Siltstone Snapper Point Formation Shales, tuffs and limestones
Devonian	**Metamorphic Rock**	N/A	Shale, sandstone and limestone

2.4 Hydrology

2.4.1 Surface Water

The Project Application Area lies wholly within the Hawkesbury-Nepean catchment and the Capertee River sub-catchment. A total of four minor catchments comprise the Project Application Area (**Figure 2.1**) and are as follows:

- Torbane-Oaky Creek catchment;
- Airly-Coco Creek catchment;
- Gap-Genowlan Creek catchment; and
- Emu Swamp Creek catchment

The north-west section of the Project Application Area is drained by the Torbane Creek which joins Oaky Creek approximately 3 km downstream of “Carinya” homestead.

The southern section of the Project Application Area is drained by the Airly-Coco Creek catchment which, and within the Project Application Area includes Airly Creek, Malcolms Gully and Dog Trap Creek. The current Water Management System at Airly Mine drains into Airly Creek. This system enters the Capertee River approximately 12 km upstream of the township of Glen Davis.

The northern and central areas of the Project Application Area are drained by Gap and Genowlan Creek system. This system drains in a northerly direction before forming a confluence with the Capertee River north of the Project Application Area. A small section within the eastern boundary of the Project Application Area is drained by the Emu Swamp Creek.

The majority of surface water creeks in the Project Application Area are ephemeral and therefore are characterised by zero flow for some or most of the year except during periods of high rainfall. The majority of creeks within the Project Application Area are first and second order streams except the downstream reaches of Gap, Genowlan and Dog Trap Creeks which are 3rd Order and Torbane Creek, which is predominantly 3rd Order prior to attaining 4th Order for the downstream within the Project Application Area.

All minor catchments drain into the Capertee River, a tributary of the Colo River, which flows in a south-easterly direction into the Hawkesbury River and Broken Bay (GHD, 2013a).

2.4.2 Groundwater

Within the Project Application Area the main sources of groundwater are associated with alluvium, porous and fractured Triassic sandstone above the Illawarra Coal Measures, and the Shoalhaven group.

Alluvium within the Project Application Area is associated with the Gap Creek and Genowlan Creek, and recharged primarily through rainfall events. It is a shallow unconfined aquifer ranging from 1 m to greater than 5 m below ground level (GHD, 2013b). GHD (2013b) has classified the alluvium as 'less productive' according to the NSW Aquifer Interference Policy (NSW Office of Water, 2012) since the yields are typically less than 5 litres/second and/or the groundwater salinity exceeds 1,500 milligrams/litre.

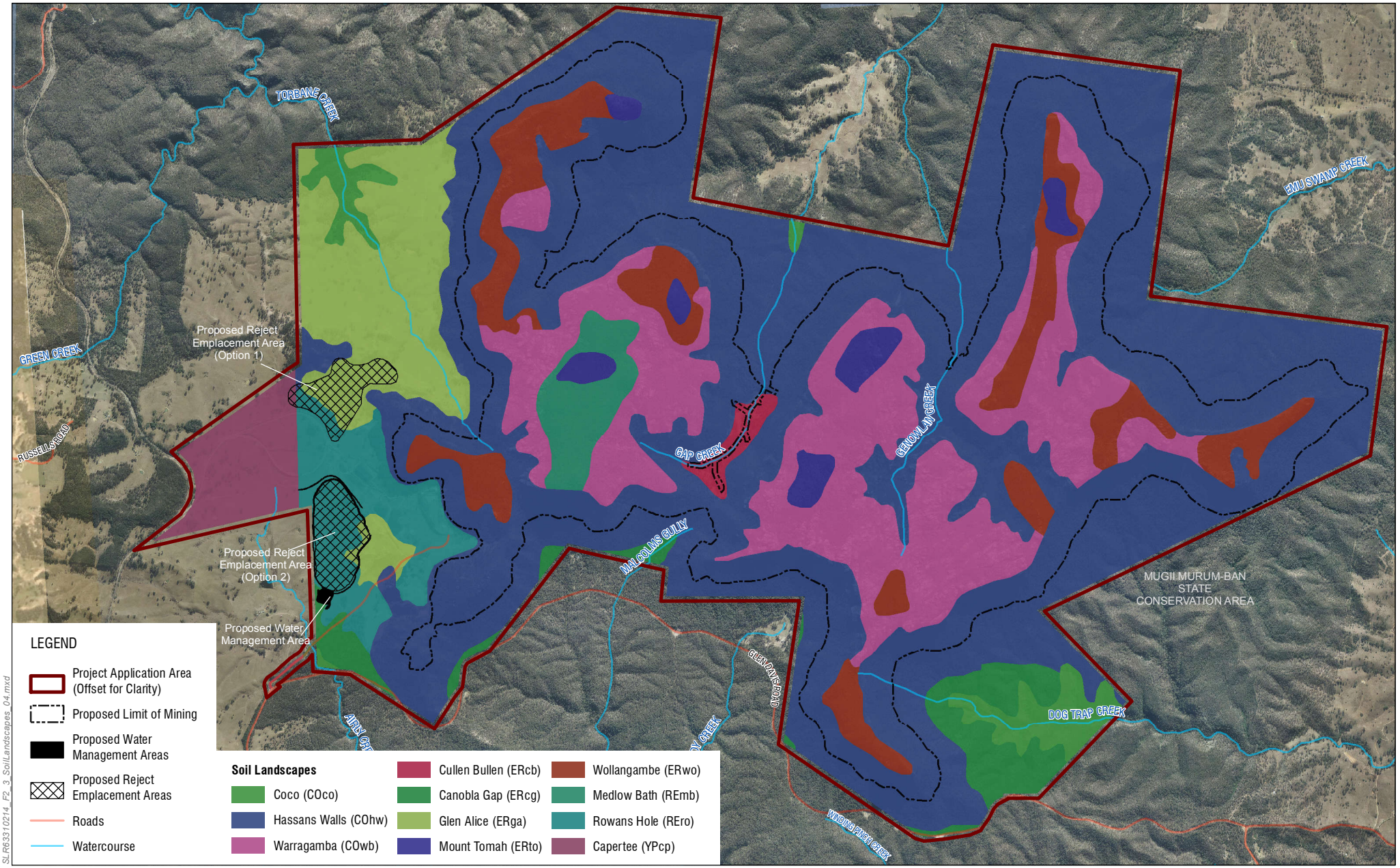
The regional groundwater source is associated with the siltstone and sandstone of the Shoalhaven Group below the Airly Mine target coal seams. The Shoalhaven groundwater has also been classified as 'less productive' due to its brackish to saline nature (GHD, 2013b). Airly Mine has an existing production bore within this groundwater source.

A 'highly productive' groundwater source is present below the Shoalhaven group within Devonian metamorphic strata containing shale, sandstone and limestone. Recharge areas occur to the north, south and east of the Project Application Area and groundwater flow is generally to the east (GHD, 2013b).

2.5 Soil Landscapes

Soil Landscapes are areas of land that have recognisable and specific topographies and soils that can be presented on maps and described by concise statements. The Soil Landscapes within the Project Application Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of the DPI), at the scale of 1:100,000 (Soil Landscape of the Wallerawang; King, 1993) and 1:250,000 (Soil Landscapes of the Bathurst; Kovac et al, 1989).

The majority of the Project Application Area is comprised of the Hassans Walls Soil Landscape. The REA Option 1 is predominately mapped as Glen Alice Soil Landscape, whilst REA Option 2 and the Water Management Structures are almost completely mapped as Rowans Hole Soil Landscape. Descriptions of all 11 Soil Landscapes (**Table 2.2; Figure 2.3**) within the Project Application Area are given below.



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Soil Landscapes

FIGURE 2.3

Table 2.2 – Soil Landscapes

Soil Landscape	Project Application Area		REA Option 1		REA Option 2 & Water Management Structures	
	ha	%	ha	%	ha	%
Canobla Gap	118	2.9	-	-	1	2.7
Capertee	97	2.4	1	3.2	-	-
Coco	86	2.2	-	-	-	-
Cullen Bullen	23	0.6	-	-	-	-
Glen Alice	279	7.0	24	77.4	3	8.1
Hassans Walls	2,176	54.7	<0.5	0.1	-	-
Medlow Bath	72	1.8	-	-	-	-
Mount Tomah	64	1.6	-	-	-	-
Rowans Hole	158	4.0	6	19.3	33	89.2
Warragamba	625	15.7	-	-	-	-
Wollangambe	285	7.1	-	-	-	-
Total	**3,983**	**100.0**	**31**	**100.0**	**37**	**100.0**

2.5.1 Canobla Gap Soil Landscape

The Canobla Gap Soil Landscape consists of undulating to rolling crests and rolling to steep sideslopes. Local relief is less than 100 metres with slopes 20 – 50 %. It is uncleared to partially cleared open-woodland.

The soils are typically dominated by shallow stony Red Earths (Kandosols), Red and Yellow Podzolics (Kurosols, Chromosols), Structured Yellow Earths (Kandosols) and Structured Yellow Loams (Kandosols) on crests and upper slopes; moderately deep Soloths (Sodosols) and shallow Earthy Sands (Tenosols/Rudosols) on lower slopes in areas of poor drainage.

Limitations to this Soil Landscape include extreme water erosion hazard, rock fall hazard, localised saline and sodic soils, steep slopes and high foundation hazard. This Soil Landscape is generally unsuitable for cultivation or grazing due to severe limitations.

2.5.2 Capertee Soil Landscape

The Capertee Soil Landscape consists of undulating low hills. Local relief is from 60 – 80 metres, with slopes from 3 – 8 %. The soils are dominated by Yellow Podzolic Soils (Kurosols, Chromosols) on midslopes with Red and Brown Podzolics (Kurosols, Chromosols) on upper slopes; with Red Earths (Kandosols) and Yellow Solodic Soils (Sodososls) on lower slopes.

The limitations to this Soil Landscape include moderate water erosion hazard and high structural degradation hazard. This Soil Landscape is generally suitable for grazing and occasional fodder crops.

2.5.3 Coco Soil Landscape

The Coco Soil Landscape consists of narrow crests and ridges and steep sideslopes. Local relief is to 80 – 180 metres, with slopes mostly >25 %. Rock outcrop and surface boulders, cobbles and gravels are common especially on quartzite and porphyry parent materials.

The soils are highly variable; however, are mostly shallow to moderately deep stony Lithosols (Rudosols, Tenosols), Earthy Sands (Tenosols) and Yellow Podzolic Soils (Chromosols, Kurosols) on

porphyries and some quartzite; shallow to moderately deep Yellow and Red Podzolic Soils (Chromosols, Kurosols) and Red Earths (Kandosols) on shales, some limestones and sandstones; shallow Terra Rossa/Red Podzolic Soil intergrades (Dermosols, Chromosols, Kandosols/ Chromosols, Kurosols) on some limestones; and shallow Yellow Podzolic Soils (Chromosols, Kurosols) and Lithosols Rudosols) on schist and some quartzites.

Limitations to this Soil Landscape include shallow stony soils, localised rock outcrop, steep slopes, mass movement hazard, and high foundation hazard. This Soil Landscape is generally unsuitable for cultivation or grazing due to severe limitations.

2.5.4 Cullen Bullen Soil Landscape

The Cullen Bullen Soil Landscape consists of rolling low hills. Slopes are typically 10 – 25 % and local relief is <50 metres. In the Project Application Area slopes were assessed as being generally <10 %. Localised rock outcropping occurs as small isolated low scarps (<5 metres). Extensively cleared open woodland and open forest is associated with this landscape.

The soils are typically dominated by shallow to moderately deep Yellow Podzolic Soils (Kurosols, Chromosols) and Yellow Leached Earths on crests; moderately deep Yellow Podzolic Soils (Kurosols, Chromosols), Yellow Leached Earths (Kandosols) and Soloths (Sodosols) on upper and midslopes; and Yellow Podzolic Soils (Kurosols, Chromosols) on lower slopes.

Limitations to this Soil Landscape include hardsetting topsoils, high water erosion hazard, high run-on, rock outcrop, localised rock fall hazard and localised high foundation hazard. This Soil Landscape is generally suited to grazing and has moderate limitations for cultivation.

2.5.5 Glen Alice Soil Landscape

The Glen Alice Soil Landscape consists of rolling rises and low hills on Shoalhaven Group sediments. Local relief is 10 – 30 metres, with slopes of 5 - 20 %. Extensively cleared open woodland is associated with this landscape. Soils are typically dominated by shallow to moderately deep Red and Yellow Podzolic Soils (Chromosols, Kurosols) on upper and midslopes; moderately deep Red and Yellow Podzolic Soils (Chromosols, Kurosols, Kandosols) and Yellow Solodic Soils (Sodosols) on lower slopes and in poorly drained positions.

Limitations to this Soil Landscape include hardsetting topsoils, localised salinity, localised alkalinity, high water erosion hazard, localised steep slopes and occasional localised flooding. This Soil Landscape is generally suited to grazing and has moderate limitations for cultivation.

2.5.6 Hassans Walls Soil Landscape

The Hassans Walls Soil Landscape consists of cliffs derived from Narrabeen Group sandstones and steep colluvial talus sideslopes developed over the Illawarra Coal Measures and the Shoalhaven Group. Local relief is to >100 metres, with slopes mostly >40 %. Open forest and open woodland is associated with this landscape. Soils are typically dominated by shallow, discontinuous Lithosols (Rudosols) on rocky ledges and cliffs, moderately deep stony Lithosols and Siliceous Sands (Rudosols, Tenosols) on upper slopes; and moderately deep Yellow and Brown Podzolic Soils (Chromosols, Kurosols) on lower slopes.

Limitations to this Soil Landscape include severe rock-fall hazard, steep slopes, extreme water erosion hazard, mass movement hazard, severe foundation hazard, rock outcrop and localised shallow soils, high run-on, and localised non-cohesive soils. This Soil Landscape is generally unsuitable for cultivation or grazing due to severe limitations; however some gentler slopes and narrow drainage flats are capable of light grazing.

2.5.7 Medlow Bath Soil Landscape

The Medlow Bath Soil Landscape consists of narrow crests and moderately inclined sideslopes. Local relief is to 20 – 50 metres, with a slope of 10 – 20 %, and localised rock outcrop. Partially cleared open forest and open woodland characterises this landscape. Soils are typically dominated by moderately deep Earthy Sands (Tenosols) and Yellow Earths (Kandosols) on crests and sideslopes; and shallow Lithosols/Siliceous Sands (Rudosols/Tenosols) associated with rock outcrop.

Limitations to this Soil Landscape include shallow, stony, acid soils of low fertility, high potential aluminium toxicity, moderate erodibility and localised rock outcrop. This Soil Landscape is generally suited to grazing and has moderate to high limitations for cultivation.

2.5.8 Mount Tomah Soil Landscape

The Mount Tomah Soil Landscape consists of rounded crest and rolling hills. Local relief is 40 – 100 metres, and slopes 10 – 30 %. Extensively cleared tall open-forest, closed-forest and woodland is associated with this landscape. The soils are dominated by shallow stony Red Krasnozems (Ferrosols), Structured Loams (Kandosols) and Lithosols (Rudosols/Tenosols) on crests and localised steep slopes; moderately deep to deep Red Krasnozems (Ferrosols) on upper and midslopes; Chocolate Soils (Dermosols) and Structured Loams (Kandosols) on lower slopes.

Limitations to this Soil Landscape include localised steep slopes, mass movement hazard, shallow soils and rock outcrop. This Soil Landscape is generally suitable for cultivation or grazing except on steep slopes.

2.5.9 Rowans Hole Soil Landscape

The Rowans Hole Soil Landscape consists of broad, level to gently inclined rises and valley flats in the Capertee Valley on Shoalhaven Group sediments. Local relief is to 30 metres, with slopes of 5 %. Extensively cleared open-woodland is associated with this landscape. The soils are typically dominated shallow to moderately deep Yellow Podzolic Soils (Kurosols, Chromosols) and Structured Loams on crests and gently inclined sideslopes; shallow to moderatetly deep Red Podzolic Soils in areas of rapid drainage on upper slopes; and moderately deep Yellow Solodic Soils (Sodosols) in areas of slow drainage.

Limitations to this Soil Landscape include high water erosion hazard and localised flood hazard. The Soil Landscape has moderate limitations to grazing and cultivation.

2.5.10 Warragamba Soil Landscape

The Warragamba Soil Landscape consists of narrow convex crests and ridges and steep colluvial sideslopes on Narrabeen Group with minor cliffs and scarps on steeper slopes. Local relief is 80 – 1,230 metres with slopes typically >35 %. Uncleared open woodland is associated with this landscape. The soils are typically dominated by shallow to deep Lithosols (Rudosols, Tenosols) on crests and ridges, Brown Earths (Kandosols) and Red Podzolic Soils (Kurosols, Chromosols) on upper slopes and Yellow Podzolic Soils (Kurosols, Chromosols) on lower slopes.

Limitations to this Soil Landscape include mass movement hazard, steep slopes, severe water erosion hazard, rock fall hazard, acidic, stony soils of low fertility and rock outcrop. This Soil Landscape is generally unsuitable for cultivation or grazing due to severe limitations.

2.5.11 Wollangambe Soil Landscape

The Wollangambe Soil Landscape consists of rounded convex crests and moderately to steeply inclined sideslopes on Narrabeen Group. Local relief is to 100 metres, with slopes usually <35 %. Localised rock outcrop is common including broken scarps and small rock ledges and cliffs. Largely uncleared, open woodland and open forest is associated with this landscape. Soils are typically dominated by Siliceous Sands (Tenosols), Lithosols (Rudosols) and Yellow and Red Earths (Kandosols) on crests; moderately deep Earthy Sands (Tenosols), Yellow Earths (Kandosols) on sideslopes; moderately deep Yellow Podzolic Soils (Chromosols, Kurosols) and Gleyed Podzolic Soils (Hydrosols) developed over shale lenses, with shallow Siliceous Sands (Tenosols) and Lithosols (Rudosols/Tenosols) on small rock ledges and broken scarps.

Limitations to this Soil Landscape include high to severe water erosion, steep slopes, shallow soils, localised rock fall hazard, localised rock outcrop and low soil fertility. This Soil Landscape is generally suited to light grazing and has high limitations for cultivation.

2.6 Dominant Soil Types and Inherent Fertility

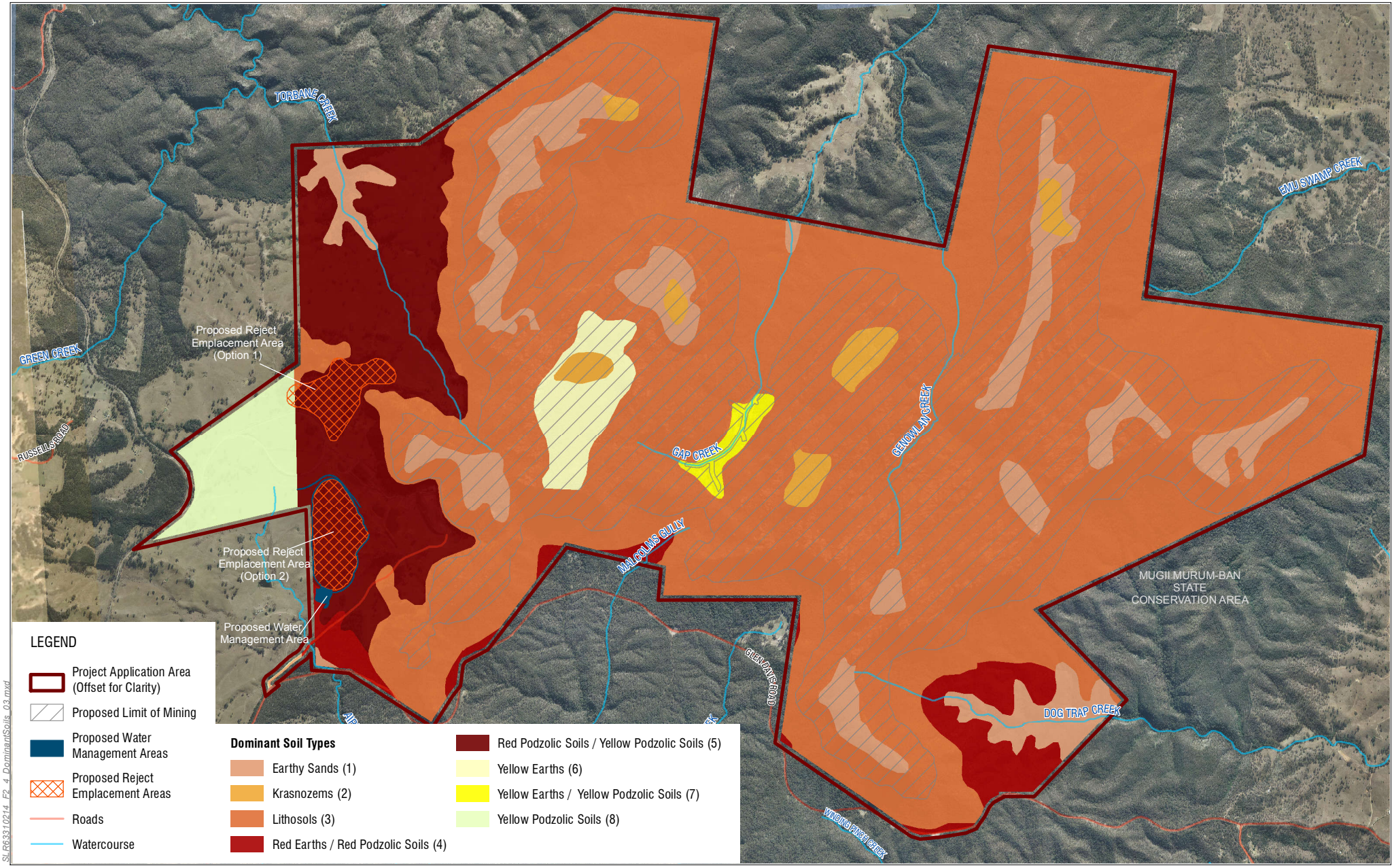
The dominant soil types from the Soil Landscapes described in **Section 2.5** are correlated with inherent fertility from the Great Soils Groups (Charman, 1978) and are listed below (**Table 2.3**).

Table 2.3 – Dominant Soil Types and Inherent Fertility

Inherent Fertility	Soil Landscape	Dominant Soil Type (Great Soil Group)
		Order
Low	Coco	Earthy Sands
	Hassans Walls	Lithosols
	Warragamba	Lithosols
	Wollangambe	Earthy Sands
Moderately Low	Canobla Gap	Red Earths / Red Podzolic Soils
	Capertee	Yellow Podzolic Soils
	Cullen Bullen	Yellow Earths / Yellow Podzolic Soils
	Glen Alice	Red Podzolic Soils / Yellow Podzolic Soils
	Medlow Bath	Yellow Earths
	Rowans Hole	Red Podzolic Soils / Yellow Podzolic Soils
Moderately High	Mount Tomah	Krasnozems

In summary, the majority of the Project Application Area is comprised of soils with low to moderately low inherent fertility as the majority of Soil Landscapes are dominated by a combination of Lithosols and Earthy Sands or Red and Yellow Earths and Podzolic Soils. The one exception is the Mount Tomah Soil Landscape with moderately high inherent fertility; however, this Soil Landscape has limitations associated with steep slopes and mass movement.

The Project Application Area is dominated by Earthy Sands / Lithosols as shown in **Table 2.4** and **Figure 2.4**, covering a total 3,172 ha (79.7 %), with the remainder mostly represented by a combination of Yellow/Red Earths and Podzolic Soils. The proposed REA Options 1 and 2 are located primarily on Red / Yellow Podzolic Soils, totalling 96.7 % and 97.3 % respectively.



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Dominant Soil Types

FIGURE 2.4

Table 2.4 – Dominant Soil Types

Dominant Soil Type	Project Application Area		REA Option 1		REA Option 2 & Water Management Structures	
	ha	%	ha	%	ha	%
Earthy Sands / Lithosols	3,172	79.7	<0.5	0.1	0	0
Red Podzolic Soils / Yellow Podzolic Soils	437	11	30	96.7	36	97.3
Red Earths / Red Podzolic Soils	118	2.9	0	0	1	2.7
Yellow Podzolic Soils	97	2.4	1	3.2	0	0
Yellow Earths	72	1.8	0	0	0	0
Krasnozems	64	1.6	0	0	0	0
Yellow Earths / Yellow Podzolic Soils	23	0.6	0	0	0	0
Total	**3,983**	**100.0**	**31**	**100.0**	**37**	**100.0**

2.7 Rural Land Capability

The land capability system applied to the Project is the Rural Land Capability mapping by the Department of Land and Water Conservation (DLWC, 1998).

This system has classified the land on its potential for sustainable agricultural use if developed, rather than its current land use, and includes three types of land uses:

- land suitable for cultivation;
- land suitable for grazing; and
- land not suitable for rural production.

The system consists of eight classes, which classify the land based on the severity of long-term limitations. Limitations are the result of the interaction between physical resources and a specific land use. A range of factors are used to assess this interaction. These factors include climate, soils, geology, geomorphology, soil erosion, topography and the effects of past land uses. A description of the eight land capability classes is provided in **Table 2.5**.

Table 2.5 – Rural Land Capability Classes

Class	Land Use	Management Options
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)		
I	Regular Cultivation	No erosion control requirements
II	Regular Cultivation	Simple requirements such as crop rotation and minor strategic works
III	Regular Cultivation	Intensive soil conservation measures required such contour banks and waterways
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)		
IV	Grazing, occasional cultivation	Simple practices such as stock control and fertiliser application

Class	Land Use	Management Options
V	Grazing, occasional cultivation	Intensive soil conservation measures required such as contour ripping and banks
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)		
VI	Grazing only	Managed to ensure ground cover is maintained
Land generally incapable of agricultural land use (selective forestry and nature conservation)		
VII	Unsuitable for rural production	Green timber maintained to control erosion
VIII	Unsuitable for rural production	Should not be cleared, logged or grazed

Source: Cunningham *et al*., 1988

The Project Application Area has Rural Land Capability classifications as shown in **Table 2.6** and **Figure 2.5**. The vast majority of the Project Application Area is Class VIII, covering a total 2,805 ha (70.5 %). This land is unsuitable for rural agricultural production. There are some areas of land suitable for grazing enterprises (Class IV and V) covering 534 ha (13.3 %).

Both of the potential REAs are located on Class V land, which is land suitable for grazing with only occasional cultivation.

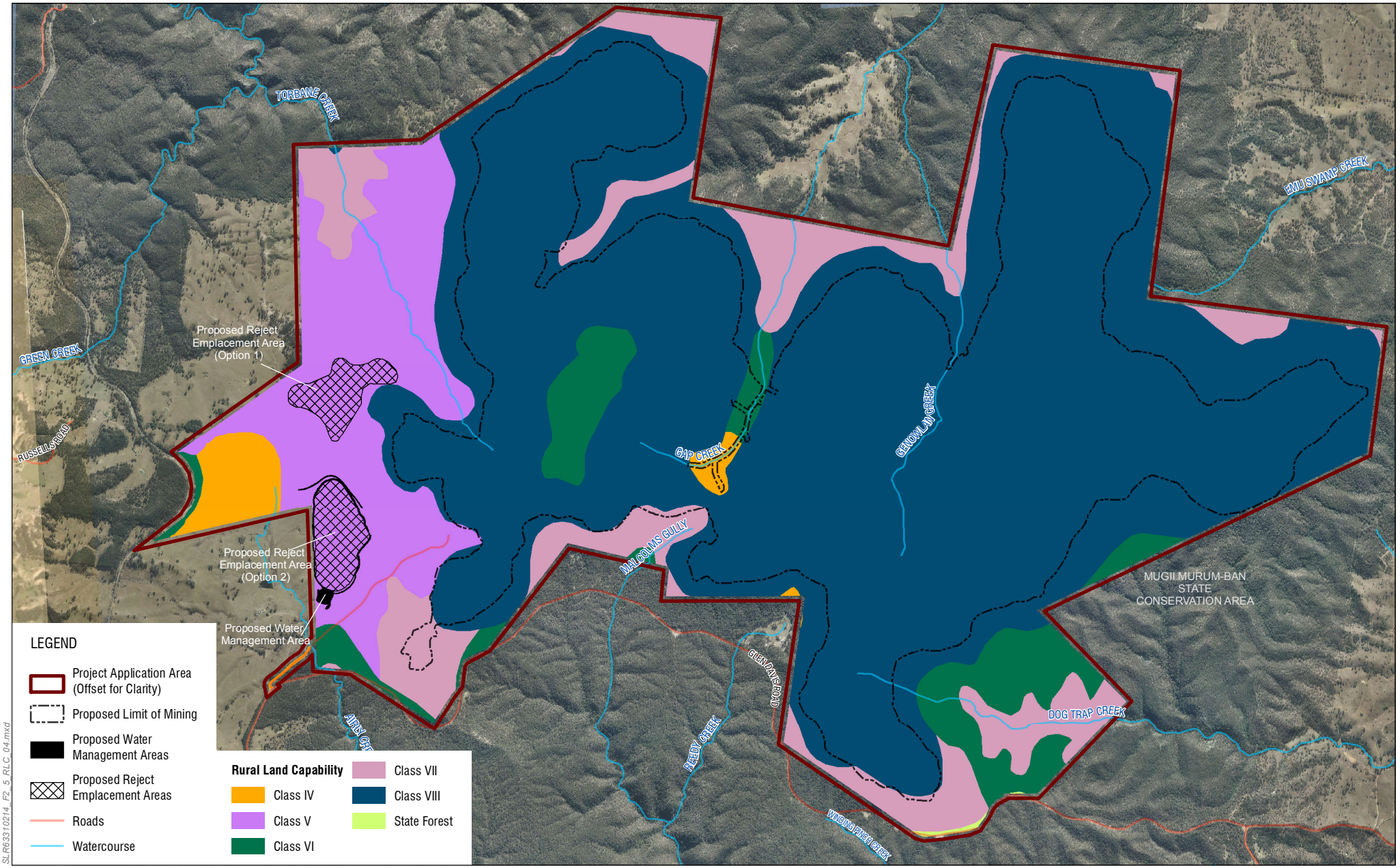
Table 2.6 – Project Application Area and Proposed REAs Rural Land Capability

Rural Land Capability Class	Project Application Area		Proposed REA 1		Proposed REA 2 & Water Management Structures	
	ha	%	ha	%	ha	%
IV	70	1.7	-	-	-	-
V	464	11.6	31	100.0	37	100.0
VI	239	6.0	-	-	-	-
VII	405	10.2	-	-	-	-
VIII	2,805	70.5	-	-	-	-
Total	**3,983**	**100.0**	**31**	**100.0**	**37**	**100.0**

2.8 Biophysical Strategic Agricultural Land

The NSW Strategic Regional Land Use Policy (the Policy) (DP&I, 2012) aims to assist the development of a long-term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing agricultural industries. Seven regions within NSW have been identified as applying under this Policy and each of these regions will progressively have a Strategic Regional Land Use Plan (SRLUP) developed or alternatively a similar plan incorporated into the relevant proposed Regional Growth Plans. Part of this policy addresses the determination of Biophysical Strategic Agricultural Land (BSAL), which is defined by the Policy as "areas with unique natural resource characteristics highly suited for agriculture".

The SRLUP and/or Regional Growth Plan covering the Project Application Area has not been released at the time of this assessment, however, draft BSAL mapping has been released that covers the Project Application Area (Strategic Agricultural Land Map – Sheet STA_032 (DP&I, 2013)). These maps indicate that the Project Application Area does not contain BSAL.



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Rural Land Capability

FIGURE 2.5

2.9 Acid Sulphate Soils

Acid sulfate soils are naturally occurring soils, sediments or organic substrates (e.g. peat) formed under waterlogged conditions that contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. When exposed to the air following the lowering of the water table (through, for example. dewatering, groundwater abstraction, drainage or excavation) the sulfides in these soils readily oxidise, releasing sulfuric acid and iron into the soil and groundwater. This acid can, in turn, release aluminium, nutrients and heavy metals (particularly arsenic) held within the soil matrix (Ahern et al., 2004).

Acid sulfate soils, which are the main cause of acid generation within the soil mantle, are commonly found less than 5 metres above sea level, particularly in low-lying coastal areas. The Project Application Area is located approximately 150 kilometres from the coast and has an elevation range of greater than 450 metres above sea level. It is therefore unlikely that acid sulphate soils (to a depth of 1.5 metres) are present in the Project Application Area.

2.10 Vegetation

A *Flora and Fauna Assessment* of the Project has been completed by RPS (2013). A number of vegetation communities were recorded within the Project Application Area, which are listed below:

- Mountain Gully Grey Myrtle Dry Rainforest.
- Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum – Broad-leaved Hickory Moist Forest.
- Capertee Residual Basalt Brittle Gum - Stringybark Layered Open Forest.
- Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest.
- Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands.
- Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest.
- Mount Airly Sydney Peppermint - Narrow-leaved Stringy - Grey Gum Shrubby Open Forest.
- Sandstone Slopes Sydney Peppermint Shrubby Forest.
- Tableland Scribbly Gum -Narrow-leaved Stringybark –Shrubby Open Forest.
- Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest.
- Capertee Slopes Red Ironbark - Red Stringybark - Narrow-leaved Stringybark Shrubby Woodland.
- Capertee Hills White Box - Tumbledown Redgum - Ironbark - Callitris Shrubby Woodland.
- Pagoda Rock Sparse Shrubland.
- Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath.
- Genowlan Point Dwarf Sheoak Heathland.
- Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest.
- Acacia Thickets.

A total of two EECs were also recorded within the Project Application Area, as listed below:

- Genowlan Point *Allocasuarina nana* Heathland (TSC Act).

- White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act), and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).

2.11 Current Land Use

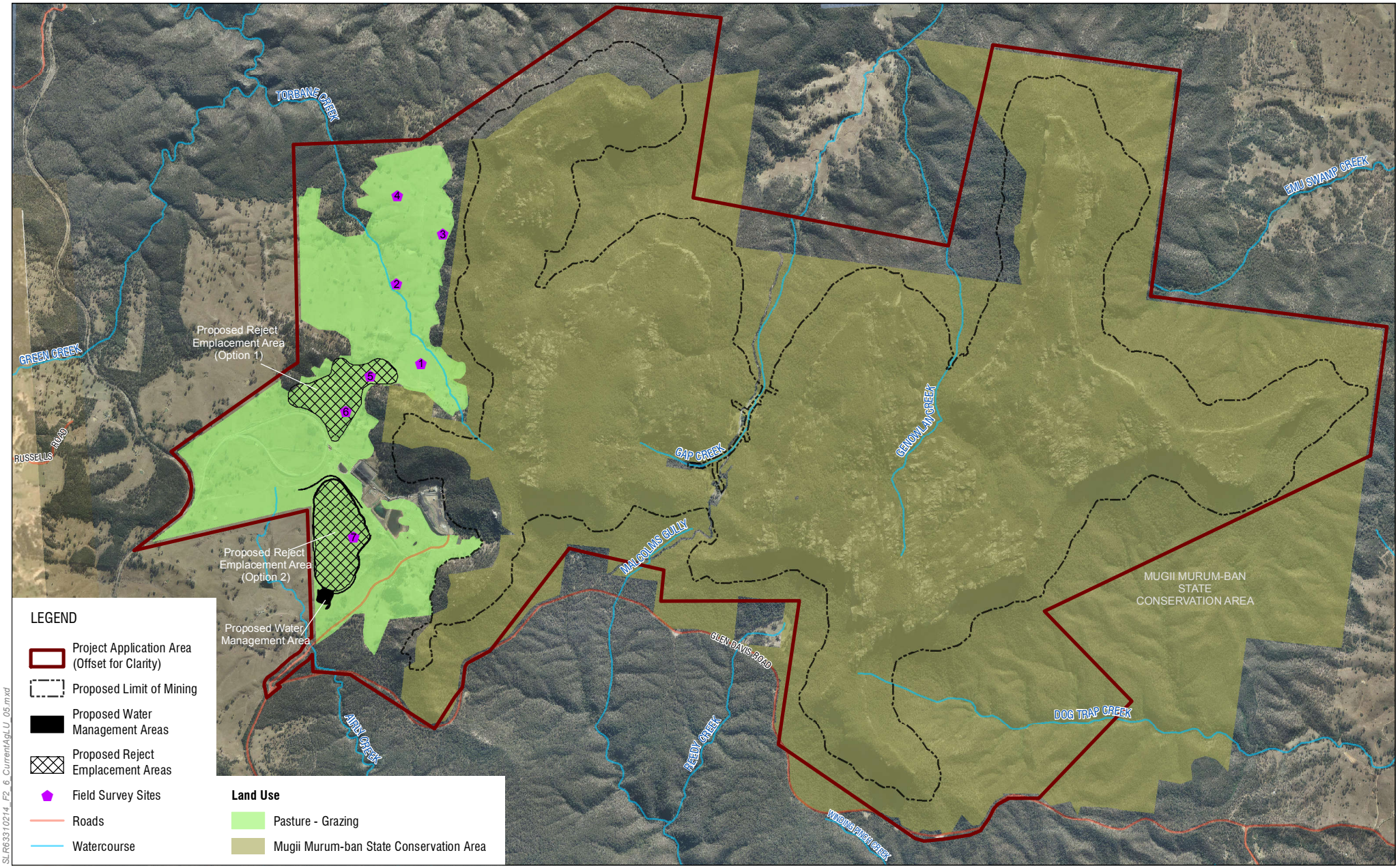
The land use within the Project Application Area is dominated by the Mugii Murum-ban State Conservation Area (3,062 ha) with a portion of the Project Application Area (480 ha) cleared of native vegetation (**Figure 2.6**).

The Mugii Murum-ban State Conservation Area is exclusively used for woodland conservation. The cleared land forms sections of two grazing properties "Airly Station" in the south-west of the Project Application Area and "Carinya" in the north-west of the Project Application Area. Due to slope and soil type constraints, the areas cleared of vegetation within the Project Application Area are not suited to cultivation or cropping enterprises; the current use of cattle grazing is the most suitable. A site survey in October 2013 by SLR's Senior Agronomist found these two properties are used for cattle grazing (**Plate 2.1**). Internal fencing and gates are in poor condition, and there is also no apparent grazing strategy in place as stock have access to most paddocks at any one time. As a result the land is on the verge of being overgrazed. Pastures contain few legumes, indicating that the topsoil is likely to be deficient in phosphorus, sulfur and subsequently nitrogen.

There is some evidence of previous pasture improvement along the valley floor (**Plate 2.2**) with remnant pasture species present including paspalum, phalaris, annual ryegrass, cocksfoot and sub clover. Grazing areas on the slopes (**Plate 2.3**) are dominated by native grass species including red grass, snow grass, Poa tussock and wiregrass.

Significant parts of the land under grazing have considerable populations of broadleaf weed species including black thistle, pin rushes, blackberry, sweet briar, lambs tongue, saffron thistle and catsear. There are also significant areas of gully, sheet and tunnel erosion alongside the access track between "Airly Station" and "Carinya" (**Plate 2.4**), most likely a result of clearing and overgrazing of dispersive soils.

In summary, although the current use of cattle grazing is the most suitable for the cleared land, production could be increased through pasture improvement, increased soil fertility, implementation of time controlled grazing and broadleaf weed control.



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Airly Agricultural and Land Use Impact Assessment

Current Agricultural Land Use

FIGURE 2.6

Plate 2.1 - Angus cattle grazing within Airly Project Application Area (Field Survey Site No. 4)

Plate 2.2 - Grazing area with remnant improved pasture within Airly Project Application Area (Field Survey Site No. 2)

Plate 2.3 - Grazing area with native grass pasture and blackberry within Airly Project Application Area (Field Survey Site No. 3)

Plate 2.4 - Gully, tunnel and sheet erosion at within Airly Project Application Area (Field Survey Site No. 6)

2.12 Existing Land Contamination

A contaminated site is broadly defined as a site at which hazardous substances occur at concentrations above background levels and where the assessment indicates that it poses, or is likely to pose, an immediate or long-term hazard to human health or the environment. Background levels refer to ambient levels of a contaminant in the local area for the site under consideration.

Contamination can occur as a result of past or current industrial, agricultural and commercial activities. These include on site activities such as disposal of wastes, accidental spillage of chemicals, leaching of contaminants from inappropriate landfills, leakage from drums, tanks, pipeworks and drains as well as from the use of agricultural chemicals.

A background review of available information was conducted to determine the site's history and to determine likely areas of environmental concern. This was supported by a site walkover in 2013 (refer **Section 2.11**). The findings of the investigation were that the majority of the land associated within the Project Application Area has not been directly impacted upon with the dominant land use being the Mugii Murum-ban State Conservation Area. A portion of the Project Application Area has been cleared of native vegetation (**Figure 2.6**) and used for agricultural grazing practices (refer **Section 2.11**). Potential sources of contamination from grazing activities are disused sheep/cattle dips and fuel storage areas. During the walkover no evidence of disused dips and disused fuel storage areas were identified. Communications with the client confirmed that these contamination sources are not present in the Project Application Area where disturbance is proposed. The use of old water tanks to reduce gully erosion was observed, however, the water tanks are not considered to be a potential contamination source.

The Project Application Area contains a previous oil shale mine that is within the proposed limit of mining and is considered to be an area of environmental concern due to unknown potential for contamination within the mine working. This area was not accessed as part of the site walkover and further investigations are recommended if direct and indirect impacts are predicted (refer **Section 4.2**).

3 LOCAL AND REGIONAL AGRICULTURAL ENTERPRISES

The assessment of local and regional agricultural enterprises has been undertaken using a combination of employment statistics provided by the Australian Bureau of Statistics (ABS) for the Lithgow region. Potential agricultural production values for the Project Application Area and the proposed REA Options have been calculated using Department of Primary Industries publications, as described below.

3.1 Agricultural History

Whilst the historical and modern use of Lithgow area is based on coal mining, copper smelting, steel manufacturing and other industrial enterprises, the grazing of cattle and sheep, along with some cropping for grain production, have been carried out in the region since the 1830s. Grazing and some cropping activities still occur within the Lithgow Region, although it is not the dominant source of employment or earnings when compared to surrounding districts (Lithgow Tourism, 2012).

3.2 Agricultural Enterprises and Associated Industries

3.2.1 Regional Land Use

Of the land suited to agriculture within the Lithgow LGA only 1.4 % (2,945 ha) is capable of sustaining regular cultivation. Only 64 % (134,563 ha), of the land zoned Rural General 1(a) (210,357 ha) in accordance with the Lithgow Local Environment Plan 1994, which is largely fragmented, is capable of sustaining regular agricultural production such as sheep or beef cattle grazing. There is a bias towards beef cattle and to a lesser extent sheep grazing for agricultural enterprises in the Lithgow LGA (LCC, 2007).

The agriculture land uses for the Lithgow Region (Statistical Area Level 2 (SA2), ABS, 2011) are shown in **Table 3.1**. The major points are summarised below:

- Agriculture accounts for 31 % of land use of the total area within the Lithgow Region.
- Agricultural land is almost exclusively used for grazing of sheep and meat cattle, covering greater than 99 % of all agricultural land. Of these two main grazing enterprises sheep numbers make up 54 % of the grazing animal population.
- Cropping enterprises comprise a minor portion of agricultural activities, utilising <1 % of the agricultural land area.
- Cereal cropping for grain occurs over only 23 ha in the Lithgow Region, which represents <0.1 % of the total LGA land area.
- Minimal irrigation cropping is carried out, comprising <1 % of the agricultural land in the region. Agriculture is a minor water user in the Lithgow Region, with 136 megalitres (ML) used to irrigate approximately 91 ha of agricultural land and an additional 674 ML utilised for other agricultural uses, such as vegetable and fruit growing.

Table 3.1 – Lithgow LGA: Agricultural Land Use

Agricultural Land Area	**Units**	**Total**
Total land area within LGA	ha	251,372
Area of agricultural land	ha	77,604
Proportion of agricultural land	**%**	**31**
Agricultural Enterprise		
Land under cropping activities	ha	85
Land under grazing activities	ha	77,519
Proportion of agricultural land used for grazing	**%**	**>99%**
Grazing Enterprises		
Sheep and lambs	no.	36,381
Beef cattle	no.	30,420
Dairy cattle	no.	8
Pigs	no.	78
Total	**no.**	**66,887**
Proportion of sheep as total stock	**%**	**54**
Proportion of beef cattle as total stock	**%**	**46**
Proportion of pigs and milk cattle as total stock	**%**	**<1%**
Cropping Enterprises		
Cereals for grain	ha	23
Vegetables for human consumption	ha	3
Orchard trees (including nuts)	ha	35
Non-cereal broad acre crops	ha	24
Total land cropped	**ha**	**85**
Proportion of cropping land used for cereals	**%**	**27**
Irrigation		
Area irrigated	ha	91
Irrigation volume applied	ML	136
Other agricultural uses	ML	674
Total water use	ML	810
Proportion of agricultural land irrigated	**%**	**<1%**

Source: *Australian Bureau of Statistics (ABS), 2011*

3.2.2 Regional Employment

A summary of the total employment within the Lithgow Region and the proportion of agriculture related employment is shown in **Table 3.2**. Employment in the agriculture related sectors is broken down in **Table 3.3**. Agriculture is not a major employer within the region, accounting for only 10 % of the total employed population. The following points are made in relation to this 10 %:

- Agriculture-related wholesaling, retailing manufacturing and processing is responsible for the majority (68 %) of total agricultural-related employment, compared to employment associated with direct agricultural production (32 %).
- The major agricultural production employers are beef cattle comprising 76 % of direct agricultural production. All other sectors are minor employers in the region.
- The main indirect agricultural related employment for the processing and manufacturing sector is road freight transport at 60 %.
- Supermarkets and grocery stores account for the vast majority (75 %) of indirect agricultural related employment in wholesaling and retailing.

Detailed agricultural employment figures are not available for the Project Application Area. However, income generated from agricultural enterprises within the Project Application Area would be minimal due to the small area available for actual agricultural production and most landholders would be reliant on off-farm income. It is therefore concluded that there are minimal individuals directly employed within agriculture in the Project Application Area.

For detailed a detailed economic analysis of the Project refer to the *Economic Impact Assessment* (AIGIS Group, 2014) for the costs and benefits of the Project as a whole.

Table 3.2 – Lithgow Regional Agricultural Employment

Employment Sector	No. of persons	%
Total Regional Employment	7,717	100
Direct Regional Agricultural Employment	247	3
Indirect Regional Agricultural Employment	530	7
Total Regional Employment Related to Agriculture	**777**	**10**

Source: *ABS, 2011*

Table 3.3 – Lithgow Regional Agricultural Related Employment by Sector

Agricultural Related Sector	No. Persons	%
Agricultural Production (Direct)		
Agriculture General	18	2
Beef Cattle Farming (Specialised)	120	15
Nursery Production (Outdoors)	6	1
Onshore Aquaculture	3	<1
Other Livestock Farming	7	1
Logging	5	1

Forestry	6	1
Grain-Sheep or Grain-Beef Cattle Farming	7	1
Horse Farming	5	1
Sheep Farming (Specialised)	25	3
Sheep-Beef Cattle Farming	42	5
Vegetable Growing (Outdoors)	3	<1
Subtotal	**247**	**32**
Agriculture Related Processing and Manufacturing (Indirect)	**No. Persons**	**%**
Bakery Product Manufacturing (Non-factory based)	11	1
Bread Manufacturing (Factory based)	5	1
Cake and Pastry Manufacturing (Factory based)	4	1
Fertiliser Manufacturing	3	<1
Log Sawmilling, Timber Re-sawing and Dressing	32	4
Meat Processing	4	1
Poultry Processing	3	<1
Fruit and Vegetable Processing	19	2
Food Product Manufacturing	6	1
Other Agriculture and Fishing Support Services	8	1
Reconstituted Wood Product Manufacturing	9	1
Road Freight Transport	154	20
Subtotal	**258**	**33**
Agricultural Related Wholesaling and Retailing (Indirect)	**No. Persons**	**%**
Agricultural and Construction Machinery Wholesaling	3	<1
Dairy Produce Wholesaling	3	<1
Other Agricultural Product Wholesaling	9	1
Flower Retailing	7	1
Fresh Meat, Fish and Poultry Retailing	18	2
Fruit and Vegetable Retailing	6	1
Other Grocery Wholesaling	22	3
Supermarket and Grocery Stores	204	26
Subtotal	**272**	**35**
Total Agricultural Related Employment	**777**	**100**

Source: *ABS, 2011*

3.3 Regional Agricultural Production Value

Agricultural production values for the Lithgow Region (SA2) (ABS, 2011) totals $18 million per annum, as presented in **Table 3.4**. The main agricultural production by value is from livestock products and slaughtering, accounting for $17 million (95 %). Cropping enterprises comprise only $1 million of regional agricultural production (5 %).

Table 3.4 – Regional Agricultural Employment

Agricultural Production Gross Value	Total ($)
Crops	1,000,000
Livestock slaughtering	11,000,000
Livestock products	8,000,000
Total gross agricultural production	**18,000,000**

Source: *ABS, 2011*

3.4 Potential Agricultural Production Value of the Project Application Area

Potential agricultural productivity was determined using DP&I agricultural productivity data for agricultural enterprises suitable for each of the Rural Land Capability classes that could potentially be impacted by the Project. This analysis has been undertaken on the potential capability of the land rather than current land use. At present the majority of the Project Application Area is forested and a State Conservation Area. If the below agricultural production values were to be realised, significant investment in land management, agricultural infrastructure and changes to the State Conservation Zoning would be required in order to yield the identified agricultural production values . However this information can be used to approximate potential farm incomes.

The *Beef Cattle Gross Margin Budget Yearling Southern/Central NSW* (DPI, 2012a), the *NSW Department of Primary Industries Beef Stocking Rates & Farm Size* (DPI, 2006) and the *Merino Ewes (20 micron) – Maternal Meat Rams Farm Enterprise Budget Series – December 2011* (DPI, 2011) have been applied to this assessment. Full agricultural productivity information is contained in **Appendix A**.

Table 3.5 and **Table 3.6** summarise the gross margins for each applicable agricultural enterprise per Rural Land Capability Class. The major points are listed below.

- Class IV land has the potential to generate approximately $167/ha from a beef cattle grazing enterprise or $307/ ha from a Merino meat lamb enterprise.
- Class V land has the potential to generate approximately $125/ha from beef cattle grazing enterprise or $230/ha from a Merino meat lamb enterprise.
- Class VI land has the potential to generate approximately $107/ha from beef cattle grazing enterprise or $171/ha from a Merino meat lamb enterprise.
- Class VII land has the potential to generate approximately $54/ha from beef cattle grazing enterprise or $86/ha from a Merino meat lamb enterprise.

Class VIII land is not suited to any agricultural enterprise and as such does not have a gross margin value.

Table 3.5 – Beef Cattle Gross Margin per Rural Land Capability Class

Rural Land Capability	Livestock-carrying Capacity	Cow and Calf	Revenue	Variable Costs	Gross Margin
Class	**Dry sheep equivalent**	**Per ha**	**$ Per ha**	**$ Per ha**	**$ Per ha**
IV	8	0.48	276	109	167
V	6	0.36	207	82	125
VI	4	0.24	138	31	107
VII	2	0.12	69	15	54
VIII	0	N/A	N/A	N/A	0

Table 3.6 – Merino Meat Lamb Margin per Rural Land Capability Class

Rural Land Capability	Livestock-carrying Capacity	Ewe & Lamb	Revenue	Variable Costs	Gross Margin
Class	**Dry sheep equivalent**	**Per ha**	**$ Per ha**	**$ Per ha**	**$ Per ha**
IV	8	3.2	592	285	307
V	6	2.4	444	214	230
VI	4	1.6	296	125	171
VII	2	0.8	148	62	86
VIII	0	n/a	n/a	n/a	0

Both beef cattle and sheep comprise the majority of agricultural revenue in the Lithgow Region, as such an 'average' gross margin per ha was determined by combining these grazing enterprises, shown in **Table 3.7**.

Based on the nominated average gross margins, and assuming the required agricultural capital costs and fixed costs are outlaid (not included in the calculations above) the Project Application Area has the potential to generate an estimated gross margin of $160,753 per annum, whilst the proposed REA Option 2 will have a maximum estimated gross margin of $6,586 compared to $5,518 for REA Option 1 (**Table 3.7**). It is important to note that these figures are derived from the optimum potential agricultural uses and are likely to be much higher than actual agricultural enterprise income being achieved at the time of publication.

Table 3.7 – Potential Annual Gross Margins (Pre-mining)

Rural Land Capability	Average Gross Margin (GM)	Project Application Area		Proposed REA 1		Proposed REA 2 & Water Management Structures	
Class	**$ Per ha**	**ha**	**Gross Margin ($)**	**ha**	**Gross Margin ($)**	**ha**	**Gross Margin ($)**
IV	237	70	16,590	-	-	-	-
V	178	464	82,592	31	5,518	37	6,586
VI	139	239	3,3221	-	-	-	-
VII	70	405	28,350	-	-	-	-
VIII	0	2,805	0	-	-	-	-
Total	**-**	**3,983**	**160,753**	**31**	**5,518**	**37**	**6,586**

3.5 Agricultural Support Infrastructure

There is limited agricultural support infrastructure in the Lithgow LGA. The main arterial road is the Castlereagh Highway whilst the main rail line is the Wallerawang-Gwabegar Railway.

There are a small number of rural merchandise and agricultural businesses which cater to the various 'lifestyle' and 'hobby farms'. The nearest livestock selling centre is the Central Tablelands Livestock Exchange, located at Carcoar, and the Mudgee Regional Saleyards. Both of which are located outside of the Lithgow LGA. Grain production is a minor activity in the area and there are no grain delivery sites in the Lithgow LGA.

4 ASSESSMENT OF POTENTIAL IMPACTS

As discussed in **Section 1.2.3** there two REA options are proposed for the Airly Mine Extension Projects and baseline biophysical and agricultural environment for both REA options has have been described in **Sections 2 & 3**. In terms of soil and land characteristics there is no significant difference between REA Option 1 and 2, as both proposed options are located on soils dominated Red Podzolic Soils / Yellow Podzolic Soils, and on Rural Land Capability Class V.

As discussed previously the preferred option at the time of this Agricultural and Land Use Impact Assessment is REA Option 2, therefore only it has been further assessed.

4.1 Soil and Land Capability

4.1.1 Rural Land Capability

Land associated with the proposed REA will be subjected to surface disturbance. The pre-disturbance lands for REA Option 2 is mapped as Rural Land Capability Class V (refer **Section 2.7**). The rehabilitation objectives of the proposed REAs according to the *Airly Mine Extension Project - Decommissioning and Rehabilitation Strategy* (SLR, 2013a) are as follows:

- The final landform will be safe, stable, non-polluting and free draining.
- All coarse and fine rejects will be encapsulated under non-saline and low–sodicity inert material in accordance with a capping design specification.
- Currently only final landform design has been completed for REA Option 2. With regards to Option 2, the REA will be constructed to a maximum height of 765 metres Australian Height Datum to be compatible with nearby adjacent topography (forested crests to the west of the REA have local high points up to 790 metres Australian Height Datum).
- Batter slopes will be no more than 14 degrees (24.4 %) unless otherwise approved. Outer batters of the REA will be progressively shaped and revegetated through the life of mine.

If the objectives listed above are achieved, than this land should be returned to a Rural Land Capability Class VI. This change in Rural Land Capability is due to the increased slope gradients (up to 24.4 %) in the final landform. Evidence of Centennial Coal's demonstrated capacity for land rehabilitation is provided in **Section 5**.

No changes to Rural Land Capability are predicted within the proposed Limit of Mining. As discussed below in **Section 4.3.1** only the area designated the 'New Hartley Shale Mine Potential Interaction Zone' has the potential for potential subsidence impacts. However this zone is within Rural Land Capability Class 8, the lowest possible class. Thus no impact on Rural Land Capability is predicted due to underground mining activities associated with the Project.

4.1.2 Biophysical Strategic Agricultural Land

According to the current BSAL maps released by the DP&I (2013) there is no BSAL within the Project Application Area. Therefore no BSAL will be impacted (see also **Section 2.8**).

4.1.3 Soil Erosion

Soil erosion can be a significant hazard on and downstream of the Project Application Area when vegetative cover is disturbed and the soil is subjected to the erosive agents of water and wind. The risk of soil erosion is affected by a range of site-specific factors, including soil erodibility, steepness of terrain, slope length and regional weather including rainfall intensity. The highest point risk of soil erosion will be during the construction phase of the Project, specifically construction of the REA.

The soil erodibility (K factor) has been correlated from the Soil Landscapes for the dominant soils associated with the proposed REA option 2 (**Table 4.1**).

Table 4.1 – Soil Erodibility of Proposed REA Option 2 & Water Management Structures

Soil Landscape	K factor		Proposed REA 2 & Water Management Structures	
	Value	Rating	ha	%
Canobla Gap	0.025	Moderate	1	2.7
Glen Alice	0.057	High	3	8.1
Rowans Hole	0.053	High	33	89.2
		Total	**37**	**100.0**

The soils associated with the REA have moderate to high soil erodibility class and therefore high soil erosion hazard. Due to the small size of the disturbance, if erosion and sediment controls outlined in **Section 5** are utilised there is only a minor potential impact.

4.1.4 Contamination

There is an inherent risk associated with the use of petrol, diesel and other mine contaminants, as fuel and oil spills can occur from mining vehicles or other equipment. Considering that the following management procedures outlined in **Section 5** will be implemented by Centennial Airly (*Airly Mine Annual Environmental Management Report*, 2012) there is minimal risk of contamination in accordance with the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC & NHMRC, 1992).

4.2 Landforms and Topography

A detailed assessment *Subsidence Predictions and Impact Assessment* for the Airly Mine Extension Project has been completed by Golder Associates (2013). A summary of the potential impacts on landforms and topography within each 'mining zone' and subsequent impacts on land resources is summarised in **Table 4.2**.

Due to unknown effects of the previous oil shale mining area Golder Associates have noted the uncertainty in predicted subsidence levels within the 'New Hartley Shale Mine Interaction Zone, and indicate that additional surface cracking is possible if sub-critical voids exist in previous oil shale workings.

Table 4.2 – Summary of Subsidence Impacts on Landforms and Topography

Mining Zone	Landform Features within Mining Zone	Management Methodology	Predicted Subsidence	Predicted Impact	Current Land Use	Impact on Land Use
Cliff Line Zone and Zone of First Workings	Deeply Incised Gorges (the Grotto & the Oasis Cliffs Rock Formations (including Pagodas) Steep Slopes	Cliff Line Zone will extend 30 m beyond crest and toe of any cliff. No secondary extraction.	Fracture zone height < 10m. Minimal predicted subsidence (10 to 65 mm).	No fracturing of surface rock structure. No collapse of features including deeply incised gorges, cliffs, rock formations or steep slopes.	Conservation and recreation	None
Panel and Pillar Zone	Cliffs Rock Formations (including Pagodas)	Maximum void width of 61 m. Stable long-term pillars post mining (FOS >1.6)	Limitation of fracture zone height 60-70 m. Subsidence typically < 100 mm, although ranging from 40-60 mm.	No fracturing of surface rock structure. No collapse of features including, cliffs or rock formations.	Conservation and recreation	None
Partial Pillar Extraction Zone	Steep Slopes	Stable long-term pillars post mining (FOS >1.6)	Limitation of fracture zone height 20-35 m. Minimal predicted subsidence (25 to 65 mm). Tilt: 0.5-2.6 mm/m Tensile strain: 0.2-1.1 mm/m Compressive strain: 0.2-1.9 mm/m.	No fracturing of surface rock structure. The predicted tilt and strain indicates there is negligible risk of generating landslides on the steep slopes.	Conservation and recreation	None

Mining Zone	Landform Features within Mining Zone	Management Methodology	Predicted Subsidence	Predicted Impact	Current Land Use	Impact on Land Use
Shallow Zone	Steep Slopes	Stable long-term pillars post mining (FOS >1.6) No secondary extraction.	Limitation of fracture zone height < 10 m. Minimal predicted subsidence (3.5-25.5 mm). Tilt: 0.6-1.1 mm/m Tensile strain: 0.1-0.4 mm/m Compressive strain: 0.2-0.6 mm/m.	No fracturing of surface rock structure. The predicted tilt and strain indicates there is no risk of generating landslides on the steep slopes.	Conservation and recreation	None
New Hartley Shale Mine Interaction Zone	Cliffs Rock Formations (including Pagodas)	Maximum void width restricted to 61 m. Increased set back from the cliffs to half the mining depth.	New subsidence impacts have been predicted based on the presence of sub-critical and super-critical voids in previous workings. *New subsidence predictions* Sub-critical Voids: 500 mm Super-critical Voids: 200 mm	No predicted impact in areas not previously mined. Reactivation of existing fractures and additional fracturing may occur in area associated with previous shale mine workings.	Conservation and recreation	Minimal additional impact to cliffs and rock formations sue to presence or pre-existing damage. Not predicted to further impact current land use.

REA Final Landform

The final landform drainage design for the REA Option 2 will be completed following development consent and documented in the Mining Operations Plan. The final REA landform will include shaped areas to achieve a stable, free draining final landform (SLR, 2013a). Therefore the post-mining landform will by moderately different to the current pre-mining landform, however, it will be compatible with nearby adjacent topography. For example forested crests to the west of the REA Option 2 have local high points up to 790 metres AHD, compared to 765 metres AHD for the REA final landform.

4.3 Agricultural Land Resources

4.3.1 Land Temporarily Removed From Agriculture

Surface Disturbance: Social and Economic Impact

As previously outlined the surface disturbance associated with the construction of the REA Option 2 will temporarily remove a maximum of 37 ha of land available for agriculture. Using the potential agricultural productivity information described in **Section 3.4**, the estimated net annual economic impact on potential agricultural productivity as a result of the temporary loss of land is $6,052 per annum. The flow-on effects to agricultural employment and local business are considered to be negligible as the area of land to be disturbed and associated potential agricultural productivity are very low.

Potential Subsidence Impacts: Social and Economic Impact

According to the *Subsidence Predictions and Impact Assessment for Airly Mine* (Golder Associates, 2013) the Project will have negligible surface impact on the land. One exception to this is the area designated the 'New Hartley Shale Mine Potential Interaction Zone'. As previously discussed, due to unknown effects of the previous oil shale mining area Golder Associates have noted the uncertainty in predicted subsidence levels, and indicate that surface cracking is possible if sub-critical voids exist in previous oil shale working. The predicted impacts are minimal above the significant impact already in existence in this area. However, it must be noted that this zone is currently within Rural Land Capability Class 8, which is not suitable for agriculture. Thus no impact on agriculture is predicted due to underground mining activities associated with the Project.

4.3.2 Land Permanently Removed From Agriculture

There is no land within the Project Application Area that will be permanently removed from agriculture, although there will be land that experiences a reduction in Rural Land Capability from Class V to VI on land associated with the REA (see **Section 4.1.1**). The change in post-mining Rural Land Capability will result in a reduced potential income of $1,517 per annum on the 37 ha associated with REA Option 2 and Water Management Structures (**Table 4.3**).

When compared to the gross annual value of agricultural production for the Lithgow Region ($18 M) and the net present value for the Project of $366 million (AIGIS Group, 2014), a post-mining annual loss of $1,517 is considered a negligible impact on agricultural enterprises and related industries.

Table 4.3 – Potential Pre- & Post-Mining Annual Gross Margins for REA Option 2 and Water Management Structures

Rural Land Capability	Average Gross Margin (GM)	Pre-Mining		Post-Mining	
Class	**$ Per ha**	**ha**	**Gross Margin ($)**	**ha**	**Gross Margin ($)**
V	178	37	6,586	-	-
VI	139	-	-	37	5,069
Total	**-**	**37**	**6,586**	**37**	**6,052**

4.4 Agricultural Water Resources

4.4.1 Surface Water

A *Surface Water Impact Assessment* for the Airly Mine Extension Project has been completed by GHD (2013a). A summary of the potential impacts and subsequent impacts to agricultural water resources are summarised below.

Current Surface Water Infrastructure

The water management system associated with the management of clean and dirty water at Airly Mine currently consists of:

- Coarse sediment basins upstream of the 109 ML Dirty Water Dam;
- a 109 ML dirty water dam that over flows into the discharge dam; a 35 ML discharge dam for the storage of clean water for use or discharge via a licensed discharge point (LDP001);
- a 7 ML dam into which overflows from surface drains and the coal stockpile discharge, and where fine sediments settle out and water then discharges out via licensed discharge point LDP002; and
- a 1 ML train loader dam that collects water from the area around the train loading facility, allows sediment to settle and then discharges water via licensed discharge point LDP003 .

Impact on Water Quality

Water discharged from Airly Mine via a licenced discharge point (LDP001) flows into Airly Tributary / Airly Creek. The baseline water quality in Airly Creek is considered brackish, very hard and of calcium/magnesium – sulfate type. The median (50^{th} percentile) chemical parameters of Airly Creek, Airly Tributary and current discharges from LDP001 are shown in **Table 4.4.**

Table 4.4 – Airly Surface Water Monitoring Results

Analyte (Unit)	LDP001	Airly Creek	Airly Tributary
pH (Value)	8.2	7.5	7.4
Electrical Conductivity (μS/cm)	715	2,365	2,735
Total Suspended Solids (mg/L)	5	6	2

The data provided shows that the Electrical Conductivity value and Total Suspended Solid concentration of the surface water discharged from LDP001 are lower than that exhibited at the Airly Creek and Airly Tributary monitoring locations. Also, the Electrical Conductivity of water discharged through LDP001 is expected to decline over the life of the Project as the reliance on groundwater from the production bore decreases and ground water flows into the mine workings increase. Therefore the water quality of any potential discharge from LDP001 is expected to improve compared to the data shown in **Table 4.4**.

Therefore over the life of the Project the water discharged from LDP001 is likely to be higher quality than the current water flow through Airly Creek and Airly Tributary, and therefore no negative impact on surface water quality is predicted.

Catchment Impacts

Surface impacts due to underground mining are predicted to be limited to the New Hartley Shale Mine Potential Interaction Zone. The predicted surface cracking and fractures in this area can potentially lead to a loss of surface water flow to the strata beneath, however the loss of surface water flow from the catchment is expected to be insignificant.

Predicted base flow hydrogeological modelling for the entire Project determined a potential reduced annual flow between Gap Creek and Genowlan Creek of approximately 3.3 %, however this impact will continue to reduce further downstream. Therefore there is no anticipated impacted water flow downstream of the Project Application Area and nearby agricultural resources or enterprises.

Conclusion

It is concluded that the Project will have a negligible impact on surface water quality and flow within the catchment and therefore will not negatively impact water sources required for agriculture.

4.4.2 Groundwater

A *Groundwater Impact Assessment* for the Airly Mine Extension Project has been completed by GHD (2013b). As described in **Section 2.4** the Project Application Area contains a number of groundwater sources. According to GHD (2013b) the predicted impacts for all groundwater sources are less than the Level 1 minimal impact considerations under the Aquifer Interference Policy (NSW Office of Water, 2012). The potential impacts of the Project on each groundwater source is summarised below.

Alluvium

The Gap Creek and Genowlan Creek alluvium is predicted to experience drawdown of up to 3.5 metres and 1.1 metres, respectively along a short length of the catchment associated with the Permian strata. No impact is predicted on the more hydrologically important areas of these creeks associated with the Triassic strata and associated alluvium. This drawdown is not anticipated to affect groundwater quality as similar drawdown conditions were experienced between August 2012 and April 2013 due to drier climate conditions and no differences in groundwater quality were recorded. There are also no groundwater dependent ecosystems (GDEs) or groundwater supply works located within the alluvium.

'Less Productive' Porous and Fractured Rock Groundwater

The proposed Project may result in depressurisation within the fracture zones overlying the Lithgow Seam of up to 7.5 metres and up to 6 metres within the underlying Marrangaroo Formation. There is predicted to be minimal depressurisation (up to 0.1 metres) of the underlying Shoalhaven Group regional groundwater source.

'Highly Productive' Fractured Rock Groundwater

No drawdown or groundwater quality impacts are predicted for the 'Highly Productive' Fractured Rock Groundwater.

Conclusion

The Project is not anticipated to have any short or long term detrimental effects on groundwater which is relied upon by agriculture, as all sources are considered to meet the Level 1 minimal consideration according to the Aquifer Interference Policy.

4.4.3 Water Reallocation

The Water Access Licence for Airly Mine will not need to be increased due to the proposed Project. Groundwater extraction will occur from the Airly Mine workings and also from the Production Bore (supply work licence number 10BL603503), located within the Shoalhaven Group. The Shoalhaven groundwater source is considered unsuitable for agricultural use due to its high Electrical Conductivity (4,626 microsiemens/centimetre) (I&I, 2009). Therefore the Project will not remove any water from potential agricultural use.

Registered Boreholes

There are currently 36 registered bores within a 5 km radius of the Project Application Area. The majority (35) of the registered bores are registered for domestic, irrigation and / or stock use, the other bore registered bore within the Project Application Area (GW068640), is the Airly Mine production bore.

The registered domestic and stock bores primarily extract groundwater from the 'Less Productive' lower regional groundwater source to the east of the Project Application Area. Some registered bores are also located within Genowlan Creek alluvium to the north-east.

4.5 Other Impacts

4.5.1 Impact on Agricultural Resources from Biodiversity Offsets

There has been no EEC or threatened species identified over the proposed footprint for REA Option 2. A Biodiversity Offset Strategy commensurate with the level of Project impact will be developed.

4.5.2 Impact on State Forests, Conservation Areas and World Heritage Areas

The Project Application Area encompasses 3,062 ha of the Mugii Murum-ban State Conservation Area (SCA) (**Figure 1.1**). The Flora and Fauna Assessment (RPS, 2013) has determined that the predicted minor subsidence impacts from the Project (Golder Associates, 2013) is considered unlikely to significantly impact flora and fauna within the Project Application Area, including the Mugii Murum-ban SCA.

The Project does not encompass any State Forests or the nearby Gardens of Stone National Park, which is part of the Greater Blue Mountain World Heritage Area. Therefore the Project is expected to have negligible impact on State Forests, Conservation Areas and World Heritage Areas.

4.5.3 Visual Amenity and Landscape Values

This Project will primarily utilise or add to existing surface infrastructure with the proposed REA options the only new surface infrastructure outside the currently disturbed area (**Figure 1.2**). The *Visual Impact Assessment* (Green Bean Design, 2013) undertaken found the Project to have a negligible to low visual impact on the surrounding area.

Field survey by SLR did not identify any agricultural enterprises which were reliant upon visual amenity or landscape values as a component of their operations. On this basis, the Project is considered to have negligible impact on visual amenity and landscape value relied upon by local and regional agricultural enterprises.

4.5.4 Tourism and Recreational Activity

Field survey by SLR did not identify any agricultural enterprises which were reliant upon tourism. Therefore the Project is not anticipated to have an impact on local agriculture-related tourism.

The only recreational area located within the Project Application Area is the Mugii Murum-ban State Conservation Area which was created in March 2011 and is managed by the National Pparks and Wildlife Service. Recreational bushwalking and camping form the major recreational activity within the Mugii Murum-ban State Conservation Area. As previously discussed in **Section 4.2** the mine plan has been developed to minimise the potential subsidence impacts on natural landforms and topography and therefore negligible impact is predicted recreational activity.

4.5.5 Weed Management and Biosecurity

There is a moderate risk from weed infestation during the construction and operational phases of the Project through vehicle movements on and off site. Weeds will be managed within the framework of the Airly Mine Environmental Management System, including environmental management plans and monitoring programs.

Biosecurity is defined in the *Draft NSW Biosecurity Strategy* (DPI, 2012b) as ‘the protection of the economy, environment and community from pests, diseases and weeds’. It includes measures to prevent new pests, diseases and weeds from entering the country and becoming established. Any equipment or machinery imported from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements.

It is considered that the Project will cause a negligible increased risk to weed management or biosecurity of agricultural resources and enterprises within the region.

4.5.6 Air Quality

The *Air Quality Impact Assessment* (SLR, 2013b) determined that main activities that will affect air quality included:

- Handling, processing and transportation of ROM coal and product coal;
- Handling and transportation of coal rejects;
- Wind erosion from open and exposed areas such as coal stockpiles and rejects emplacement areas; and
- Ventilation fans.

Results of the impact assessment determined that the short and long term concentrations of TSP, PM_{10} and $PM_{2.5}$ would be below the relevant NSW Environment Protection Authority air quality criteria. Therefore air quality is unlikely to impact agricultural production within the Project Application Area or surrounding area.

4.5.7 Noise and Vibration

Generally, agriculture is only impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress. Results of the *Noise and Vibration Impact Assessment* undertaken by SLR (2013c), indicate that the operational, construction and rail noise are all predicted to be significantly below the relevant noise criteria at the nearest receiver locations, and will result in negligible increases in cumulative mining and industrial noise levels. On this basis, noise is unlikely to impact agricultural production within the Project Application Area or surrounding area.

4.5.8 Traffic

Adequate local and regional transport infrastructure is critical for viable agricultural enterprises. The *Traffic and Rail Impact Assessment* (Barnson, 2013) has determined that the current transport infrastructure along the Castlereagh Highway and Glen Davis Road is adequate for thepredicted 12.5 % increase in staff driving to Airly Mine. Additionally there is no predicted increase in rail movements along the Wallerawang-Gwabegar rail line. Therefore no predicted impacts on agriculture are predicted due traffic associated with the Project.

5 MITIGATION MEASURES

5.1 Review of Mining System: Subsidence Impact Management

Initially a number of different mining systems were assessed for suitability during pre-feasibility studies, however it was concluded that the preferred method of mining was not suitable across the entire Project Application Area. This was due to the presence of five different geotechnical mining environments within the proposed underground mining area, therefore specific mining systems were identified for specific parts of the Project Application Area in order to minimise subsidence and therefore eliminate potential surface damage.

As discussed previously one exception to this is the area designated the 'New Hartley Shale Mine Potential Interaction Zone'. Due to unknown effects of previous oil shale mining there is uncertainty in the predicted subsidence level, and significant surface impact is possible if sub-critical voids exist in previous oil shale working. Impacts in this area would be mitigated by the proposed use of an increase in the size of the cliff zone of first workings. This will eliminate any further impact to the already weakened cliff in this zone. A subsidence monitoring and management program will be developed to manage any potential surface impacts.

5.2 Topsoil Stripping & Stockpiling and Erosion & Sediment Control

The *Decommissioning and Rehabilitation Strategy* (SLR, 2013a) provides general soil management practices, including topsoil stripping and erosion and sediment control, to minimise the impact of the Project on soil resources.

Soil sampling will be undertaken at the footprint of the proposed REA prior to disturbance to confirm the depth of soil to be salvaged and characteristics of the soil resource. Soil handling procedures and amelioration requirements will be developed following soil characterisation to preserve the soil structure and enhance physical and chemical properties for re-use on rehabilitated areas.

Soil stripping and handling techniques described below are intended to maximise the soil resource salvaged and minimise deterioration of the soil resource. Soil stripping procedures are:

- Clearly define areas of disturbance requiring soil stripping following vegetation clearing (using survey pegs/posts);
- Undertake soil testing to characterise subsoils and topsoils prior to stripping and determine the type and application rates for any soil ameliorants to be applied during stockpiling.
- Confirm the stripping depth for topsoils and subsoils. Topsoils and subsoils are generally to be stripped and handled separately;
- Mulch all cleared trees on site and mix into topsoils as a soil conditioner; and
- Maintain topsoil in a slightly moist condition during stripping where possible. Material will not be stripped in either excessively dry or excessively wet conditions.

Topsoil handling and stockpiling procedures to minimise erosion and sediment loss are:

- Windrow topsoil stockpiles on relatively flat areas along the contour. Considerations will include ease of access and minimising re-handling (i.e. avoid locations that will be required for future mining operations).

- Construct topsoil and subsoil stockpiles at a maximum height of 3 m, with slopes no greater than 1:3 (vertical to horizontal).

- Stockpiles will trimmed to be free-draining and lightly ripped to produce a friable surface to enhance infiltration and minimise erosion.

- Where long-term stockpiling is planned (i.e. greater than six months), stockpiles will be fertilised and seeded with a seed mix including a fast growing sterile cover crop and perennial pasture species. The cover crop species will not persist in the rehabilitation areas but provide competition for emerging weeds and promote desirable microbial activity in the soil.

- Stockpiles will be demarcated with signage including the stockpile identification. The volume, height, stripping location, soil type and date of stripping will be recorded in a topsoil and subsoil stockpile register.

- Appropriate erosion and sediment controls (e.g. bunds along the upslope perimeter and sediment fences along the toes of the downslope batter) will be installed.

- Regular inspections to assess erosion, vegetation cover and weed presence will be undertaken and maintenance works conducted as required.

- Prior to re-spreading stockpiled topsoil, weed presence will be assessed and, if required, weeds will be treated with herbicide application and/or weeds “scalped” to minimise weed transport to rehabilitation areas.

- Soil characterisation will be undertaken prior to re-emplacement to determine the need for additional amelioration following re-emplacement.

A detailed Erosion and Sediment Control Plan will be developed prior to the commencement of rehabilitation works in accordance with NSW industry guidelines *Managing Urban Stormwater Volume 1: Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater Volume 2E: Mines and Quarries* (DECC, 2008).

5.3 Contamination

The Centennial Airly (*Airly Mine Annual Environmental Management Report*, 2012) outlines appropriate contamination mitigation measures as outlined below:

- Plant and equipment must be inspected prior to commencement on site in accordance with the requirements of the Coal Mines Health and Safety Act.

- Plant and equipment must be inspected in accordance with the Airly Mine Mechancial Engineering Management Plan prepared under the requirements of Coal Mines Health and Safety Act 2002 for fuel, oil or hydraulic fluid leakage, damaged or deteriorated hydraulic lines and other areas of potential failure on a daily basis.

- Any leakages or deteriorated hoses or similar areas of potential failure must be repaired before the plant or equipment is permitted to be used on the site.

- Servicing is undertaken in a designated area onsite.

- All road registered vehicles where possible are fuelled and serviced off site.

- Emergency response spill kits are available at all servicing, hydrocarbon storage and refuelling areas. Absorbent materials are to be available at all times on refuelling vehicles and during any fuelling activity of plant and equipment. Materials are to include, at a minimum absorbent materials, emergency bunding and absorbent pads. Spill kits shall be used to absorb any minor drips or spills that may occur.

- All incidents or uncontrolled spillages are reported immediately to the relevant supervisors and the Airly Mine Environmental Coordinator.

- The operator must be in attendance at all times during the fuelling process. Fuelling activities are never to be left unattended.

- Storage of fuel containers is to be in a designated and bunded fuel storage area.

- Should a major spill occur, it shall be handled in accordance with the Airly Mine Pollution Incident Response Management Plan.

5.4 Demonstrated Rehabilitation Capacity: Charbon Colliery (Centennial Coal)

The Charbon Colliery (Charbon) also owned by Centennial Coal, is an open cut and underground mine located approximately 25 km north of Airly Mine. Centennial Coal has previously demonstrated successful rehabilitation of disturbed lands at Charbon Colliey to achieve the nominated final land use and restoration of natural resources. Rehabilitated areas of surface disturbance have well established vegetative cover, minimising the potential for erosion.

In order to demonstrate Centennial Coal's capacity for rehabilitation, examples of successful rehabilitation are shown below. **Plates 5.1** and **5.2** show an aerial view of previous in-pit emplacement areas and water management structures following rehabilitation. Centennial Airly will utilise successful rehabilitation techniques developed and refined at the Charbon Colliery during the life of the Project at Airly Mine.

Plate 5.1: Shaped in-pit emplacement profiled to be compatible with adjacent undisturbed landform

Plate 5.2: Rehabilitation area following construction of water management structures and stabilisation with cover crops.

6 STAKEHOLDER CONSULTATION

The Project has undertaken consultation via the Airly Special Monitoring Committee (SMC) which has facilitated broader community consultation by the way of technical sessions prior to the completion and lodgement of the EIS.

A total of three technical sessions have been facilitated for the Project allowing the community and stakeholders to ask questions and develop an understanding of the environmental assessment process, key studies undertaken, methodology and findings. The topics covered in these technical sessions included Mine design, Subsidence Impact Assessment, Ground and Surface Water Assessment, Aquatic Ecology, Biodiversity – Flora and Fauna, Cultural Heritage Assessment, Visual Amenity, Air Quality, Noise and Vibration, and Final Landform (rehabilitation)

Newsletters have also been prepared and distributed to land holders, via the web site and via other community organisations (refer http://www.centennialcoal.com.au/Operations/Projects/Airly-Extension.aspx). Additional consultation has also been undertaken outside of the SMC via other established forums such as the Capertee Valley Progress Association and directly with landholders as and when required.

7 KEY FINDINGS

The key findings of this *Agricultural and Land Use Impact Assessment* are as follows:

- The Project Application Area is located primarily within the Mugii Muran-ban State Conservation Area, and as such the majority of the land use is woodland conservation. However, there is approximately 480 ha of land currently available for cattle grazing.

- The major disturbance elements of the Project assessed in this Agricultural and Land Use Impact Assessment is the proposed construction of a new REA and underground mining activities.

- A field survey and desktop study has determined that the two proposed REA options would be located on Rural Land Capability Class V land dominated by Yellow/Red Podzolic Soils that have moderately low fertility. If final rehabilitation objectives are met, the proposed REA Option 2 land will be returned to Class VI resulting in a minor reduction in soil and land capability.

- Due to the different mining techniques proposed to be utilised throughout the Airly Mine Extension Project, no surface impacts are predicted from underground mining with the exception of potential surface impacts within the New Hartley Shale Mine Potential Interaction Zone. There is still no predicted impact on landforms in the Project Application Area including cliffs and pagodas.

- There will be no land permanently removed from agriculture as a result of the Project. The Project will only have a minimal impact due to land that will be temporarily removed from agriculture.

- The Project will have negligible impact on surface and groundwater resources relied upon by agriculture.

In conclusion, the proposed Project is assessed as having negligible to minimal impacts to soil, land and agricultural resources.

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SLR (2013c) Noise and Vibration Impact Assessment – Airly Mine Extension Project

Gross Margins

BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: December 2012

Enterprise: **Yearling (Southern/Central NSW)**

Enterprise Unit: **100 cows**

Pasture: **Improved**

INCOME:				**Standard Budget**	**Your Budget**
42	steers 12-15 months @		$697 /hd	$29,274	
22	heifers 12-15 months @		$611 /hd	$13,431	
1	CFA Bull @		$1,210 /hd	$1,210	
7	CFA cows @		$758 /hd	$5,307	
11	Other culls @		$758 /hd	$8,340	
83					
	A. Total Income:			**$57,561**	

VARIABLE COSTS:					
Replacements	1	Bull @	$6,500 /hd	$6,500	
Livestock and vet costs: see section titled beef health costs for details.				$1,203	
Ear tags @	$2.00			$40	
Fodder crops				$0	
Hay & Grain				$0	
Droughts can increase feed costs. For example costs see main menu.				$0	
Pasture maintenence (211 ha improved pasture per 100 cows)				$10,550	
Livestock selling cost (see assumptions on next page)				$4,534	
	B. Total Variable Costs:			**$22,827**	

	GM including pasture cost	GM excluding pasture cost	
GROSS MARGIN (A-B)	**$34,735**	**$45,285**	
GROSS MARGIN/COW	**$347.35**	**$452.85**	
GROSS MARGIN/DSE*	**$20.57**	**$26.81**	
GROSS MARGIN/HA	**$164.62**	**$214.62**	

Change in gross margin ($/cow) for change in price &/or the weight of sale stock

(Note: Table assumes that the price and weight of other stock changes in the same proportion as steers. As an example if steer sale price falls to 330c/kg and steer weight to 195 kg, gross margin would fall to $278 per cow. This assumes that price and weight of all other sale stock falls by the same percentage.

Dresses wt kgs / **Stock sold**		**Steer sale price cents/kg dw**				
		320	**330**	**340**	**350**	**360**
Steer dw						
-40 kgs	**185**	212	225	238	251	264
-20 kgs	**195**	263	278	293	308	322
0	**205**	315	331	**347**	364	380
+20 kgs	**215**	366	384	402	420	438
+40 kgs	**225**	417	436	456	476	496

GM $ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by $29.84

Assumptions **Yearling (Southern/Central NSW)**

Enterprise unit is 100 cows weighing on average 540 kg
Weaning rate: 86%, conception 92%

Sales

100% steers sold at 12-15 months	205 kg	@340c/kg	dressed weight
100% sale heifers sold at 12-15 months	185 kg	@330c/kg	dressed weight
20 heifers retained for replacement.			
Cull cows cast for age at 10 years	281 kg	@270c/kg	dressed weight
100% of preg tested empty cows culled	"	"	"
4% cows culled for other reasons	"	"	"
Bulls run at 3% & sold after 4 years use	448 kg	@270c/kg	dressed weight

Selling costs include: Commission 5%, MLA levy $5/hd, average freight cost to abattoirs 5.5c/kg dw, NLIS tags @ $2.90 for all sale cattle.

Cows: age at first calf : 24 months

Mortality rate of adult stock: 2%

The average feed requirement of a cow + followers is rated at 2.60 LSU or 17.91 dse's*. This is an average figure and will vary during the year.

Age structure

Age	Number
2	20
3	17
4	15
5	13
6	11
7	9
8	8
9	7
Total Joined	**100**
10	7

Marketing Information:
Suited to the domestic trade and can access MSA grading with careful preparation. Note that for MSA grading producers need to be licensed. Good frame, later maturing steers can also be suited to the Japanese grain fed markets at slightly heavier feeder weights than above. (see Export feeder budget 0-2 th)

Production Information:
A common production system in the south west slopes; and the southern and central tablelands areas.

MERINO EWES (20 micron) - Maternal Meat Rams

Farm Enterprise Budget Series - Dec 2011 (average wool and sheep price 1 June to 1 Dec)

Flock size: 1000 ewes
Ewe body weight: 55 kgs
DSE rating: 2.5 dse's / ewe

INCOME

						Standard Budget ($)	Your Budget ($)
Wool		**number**	**class**	**kg /hd**	**$/kg**		
Shear		960	ewes	5.39	$8.47	$43,836.23	
		20	rams	4.50	$3.94	$354.60	
		441	ewe lambs	2.50	$5.07	$5,589.68	
Crutch		980	adults	0.40	$4.80	$1,882.54	
		873	lambs	0.25	$1.84	$402.26	
Sheep Sales		**number**	**class**	**$ /hd**			
		177	CFA ewes	$88.85	(22.6 kg cwt)	$15,725.92	
		4	CFA rams	$60.48		$241.92	
	8 months	441	weth lambs	$102.48	(21.0 kg cwt)	$45,193.68	
		432	ewe lambs	$165.00	(11 months)	$71,280.00	
Fodder		**tonnes**	**type**	**value per tonne**			
Graz/fodder crop		0 t	0	$0 /t		$0.00	
				A. Total Income:		**$184,506.83**	

VARIABLE COSTS

Replacements	**number**	**class**	**cost ($)**	**reps**		
	4	rams	$900.00		$3,600.00	
	217	ewes (1.5 years)	$135.00		$29,295.00	
Cartage	217	ewes (1.5 years)	$2.00		$434.00	
Wool Harvesting & Selling Costs						
Shearing	960	ewes	$5.89	1	$5,650.53	
	20	rams	$8.50	1	$170.02	
	441	ewe lambs	$5.89	1	$2,595.71	
Crutching	1833	ewe/lambs	$1.13	1	$2,073.92	
	20	rams	$1.95	1	$39.04	
Wool tax			2.00%		$1,041.31	
Commission, warehouse, testing charges			$39.27/ bale		$1,531.57	
Wool - cartage	39	bales	$18.00		$702.00	
- packs	39	packs	$13.81		$538.59	
Sheep Health	**number**	**class**				
Broadspectrum	1412	adults	$0.65	2	$1,835.60	
	882	lambs	$0.33	3	$873.18	
Narrowspectrum	1412	adults/hoggets	$0.38	1	$536.56	
	882	lambs	$0.21	1	$185.22	
Dipping	980	adults	$1.16	1	$1,136.80	
	441	ewe lambs	$1.16	1	$511.56	
Fly control (long acting)	980	adults	$1.85	1	$1,813.00	
	873	weaners	$1.55	1	$1,353.15	
Vaccination- 6 in 1	980	adults	$0.27	1	$264.60	
	930	lambs	$0.27	1	$251.10	
Mark no OJD vaccine	465	wether lambs	$1.55	1	$720.75	
Mark/OJD vaccine	465	ewe lambs	$3.94	1	$1,833.03	
Scanning	1002	ewes	$0.80	1	$801.28	
Livestock Selling Costs						
Livestock cartage	1,054	sale sheep	$2.00		$2,108.00	
Commission on sheep sales			5.00%		$6,622.08	
Levies (Yard dues, MLA Transaction levy and RLPB rates)					$2,611.35	
Pasture maintenance	247 ha	@	$41 /ha		$10,161.58	

Fodder

Supp. feed - ewes 2.1kg - lambs 3.5kg grain/hd/wk @ $150 /t

Ewes	1392	ewes	$0.32 /week	10 weeks	$4,384.80	
Lambs	432	ewe lambs	$0.21 /week	12 weeks	$1,088.64	
	441	wether lambs	$0.53 /week	10 weeks	$2,315.25	
Graz/fodder crop	0 ha	@	$0 /ha		$0.00	
			B. Total Variable Costs:		**$89,079.21**	

	excl. fodder	incl. fodder
GROSS MARGIN (A-B)	**$103,216.31**	**$95,427.62**
GROSS MARGIN /EWE	**$103.22**	**$95.43**
GROSS MARGIN /DSE	**$41.79**	**$38.63**
GROSS MARGIN /HA	**$417.88**	**$386.35**

ASSUMPTIONS

1. Flock Parameters

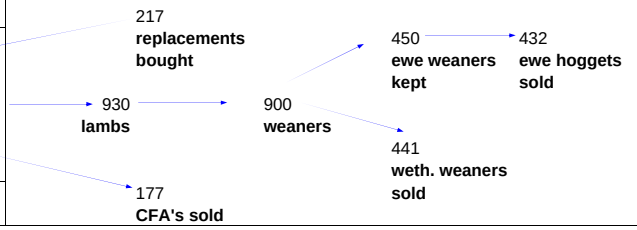
Flock mortality	4%	Ram %	2%
Productive life	5	Marking %	93%
Ewe body weight	55 kg	Weaning %	90%
DSE rating /ewe	2.47	Weaning age	3 months
Stocking rate/ha	10 dse's		

Pasture maintenance = 90kg single super @ $346t + $10.00 application

2. Flock Structure

Sheep numbers are modified to reflect mortality throughout the year.

Age	Number of ewes
1.5	217
2.5	208
3.5	200
4.5	192
5.5	184
6.5	0
Total	**1002**



3. Wool Prices

Merino Ewe	Micron	AWEX Type	Clean price	Yield	Greasy price	Specifications (all 35n/ktex)	Proportion of Clip
- Fleece GTM	20	MF5B.	$14.17	65%	$9.24	1%VMB, 90mm	75%
- Skirtings/bellies	19	MP5B.	$12.17	56%	$6.79	4.8%VMB, 80mr	20%
- Cardings	20	MZ2B.	$7.09	52%	$3.68	2.9%VMB.	5%
					$8.47	→	used in budget

4. Sensitivity Table - Adult wool price and wool cut per head

Effect of wool price and cut on gross margin per DSE (incl. fodder costs)

Wool Cut kg/hd	Adult Greasy Wool Price $/Kg greasy				
$38.63	$6.78	$7.62	$8.47	$9.32	$10.16
4.31 kg	$32.55	$33.94	$35.33	$36.72	$38.11
4.85 kg	$33.85	$35.42	$36.98	$38.55	$40.11
5.39 kg	$35.16	$36.90	**$38.63**	$40.37	$42.11
5.93 kg	$36.46	$38.37	$40.29	$42.20	$44.11
6.47 kg	$37.77	$39.85	$41.94	$44.03	$46.11

5. Sensitivity Table - Value of wether lambs and 1st X ewe lambs

1st X ewe lmb $/Hd	Value of Domestic lamb $/Hd				
$38.63	$81.98	$92.23	$102.48	$112.73	$122.98
$132.00	$29.68	$31.41	$33.15	$34.89	$36.63
$148.50	$32.42	$34.15	$35.89	$37.63	$39.37
$165.00	$35.16	$36.90	**$38.63**	$40.37	$42.11
$181.50	$37.90	$39.64	$41.38	$43.11	$44.85
$198.00	$40.64	$42.38	$44.12	$45.86	$47.59

6. Sensitivity Table - Weaning % and cost of replacement ewes

Replace ewes $/Hd	Weaning %				
$38.63	72%	81%	90%	99%	108%
$108.00	$33.17	$37.09	$41.01	$44.96	$48.87
$121.50	$31.98	$35.90	$39.82	$43.77	$47.69
$135.00	$30.80	$34.72	**$38.63**	$42.58	$46.50
$148.50	$29.61	$33.53	$37.45	$41.40	$45.32
$162.00	$28.42	$32.34	$36.26	$40.21	$44.13

7. Sensitivity Table - Weaning % and value of cast for age ewes

CFA ewes $/Hd	Weaning %				
$38.63	72%	81%	90%	99%	108%
$71.08	$29.59	$33.51	$37.42	$41.37	$45.29
$79.96	$30.19	$34.11	$38.03	$41.98	$45.90
$88.85	$30.80	$34.72	**$38.63**	$42.58	$46.50
$97.73	$31.40	$35.32	$39.24	$43.19	$47.11
$106.62	$32.01	$35.92	$39.84	$43.79	$47.71

Note: In all sensitivity tables, prices and quantities have been varied by +/- 10% and +/- 20%.

Canola: Short Fallow (No-till)

Central Zone - West

Winter 2012

1. GROSS MARGIN BUDGET:

		Standard Budget $/ha	Your Budget $/ha
INCOME:			
1.60 tonnes/ha @	$460.00 /tonne (on farm)	$736.00	
	A. TOTAL INCOME $/ha:	**$736.00**	
VARIABLE COSTS:			
See opposite page for detail			
	Sowing	$55.72	
	Fertiliser	$193.00	
	Herbicide	$28.10	
	Insecticide	$46.09	
	Contract windrowing & harvesting	$125.00	
	Levies	$9.87	
	Crop Insurance	$12.82	
	Cartage, grading & bagging	$0.00	
	B. TOTAL VARIABLE COSTS $/ha:	**$470.61**	
	C. GROSS MARGIN (A-B) $/ha:	**$265.39**	

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$380 /t	$420 /t	**$460 /t**	$500 /t	$540 /t
1.00	- $80	- $41	- $2	$37	$76
1.20	- $6	$40	$87	$134	$180
1.40	$67	$122	$176	$231	$285
1.60	$141	$203	**$265**	$328	$390
1.80	$215	$285	$355	$425	$495
2.20	$362	$447	$533	$618	$704
2.40	$435	$529	$622	$715	$809

Gross Margin ($/ha)

PRODUCT TRADE NAMES

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Canola: Short Fallow (No-till)

Central Zone - West

Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	$19.60/L	**$1.96**	**$1.96**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: 2,4-D amine 300 g/L (Surpass®)	Feb/Mar	with above			1.00 L	$3.80/L	**$3.80**	**$3.80**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Apr	0.03	76.36	**$2.50**	1.00 L	$8.67/L	**$8.67**	**$11.17**
Sowing - treated seed	Apr/May	0.12	104.36	**$12.22**	3.00 kg	$14.50/kg	**$43.50**	**$55.72**
Nitrogen and Sulfur fertiliser (eg: Extra Sul®)	Apr/May	with above			100 kg	$0.90/kg	**$90.00**	**$90.00**
Starter fertiliser eg: MAP	Apr/May	with above			100 kg	$1.03/kg	**$103.00**	**$103.00**
Mite control eg: omethoate 290 g/L (Le-mat®)	May	0.03	76.36	**$2.50**	0.10 L	$30.00/L	**$3.00**	**$5.50**
Grass weed control eg: haloxyfop-R 520 g/L (Verdict®)	Jul	0.03	76.36	**$2.50**	0.075 L	$61.09/L	**$4.58**	**$7.08**
Broadleaf weed control eg: clopyralid (Lontrel®)	Jul	with above			0.30 L	$32.86/L	**$9.86**	**$9.86**
Heliothis control eg: alpha-cypermethrin (Fastac Duo®)	Sept	contract		**$18.15**	0.30 L	$8.07/L	**$2.42**	**$20.57**
Aphid control (1 year in 2) eg: pirimicarb (Pirimor WG®)	Sept	contract		**$18.15**	0.5 kg	$43.80/kg	**$21.90**	**$20.03**
Contract Windrow	Oct	contract		**$75.00**				**$75.00**
Contract-Harvest	Nov			**$50.00**				**$50.00**
Crop Levies					$1.50/tonne + 1.02% of on-farm value			**$9.87**
Crop Insurance					1.74%	of on-farm value		**$12.82**

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.

Notes:

Soil type: - Suitable for all high fertility wheat soils. Avoid acid soils containing high aluminium.

Place in rotation - Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop and sowing of the next crop. For example, wheat harvested in November would be under a 5-6 month fallow until sowing in the following May.

Sowing time: - Sow on the first sufficient rains after mid-April (10% yield loss/week after early May).
- Seed price used above is for purchased seed. Do not use retained Canola seed.

Fertiliser: - Canola needs 30% more nitrogen than wheat. The majority of nitrogen should be applied at sowing. Avoid applying high levels of nitrogen in direct contact with the seed.
- A fertiliser with sulfur such as Extra Sul and Starter 15, or gypsum should also be used.

Weed control: - Timing of fallow herbicide applications will vary according to rainfall.
- An additional knockdown herbicide application (eg.glyphosate 540 g/L @1.0 L/ha) should be considered if weeds are present at the time of sowing.
- There are 4 hebicicide tolerant canola groups: conventional, triazine tolerant (TT), imidazolinone tolerant (CLEARFIELD®) and Roundup Ready®. This budget is for conventional canola and should be adjusted for your own herbicide strategy.
- Conventional canola: Clopyralid for capeweed, skeleton weed and saffron thistle control.
- Verdict® for grass weeds unless high levels of wireweed or fumitory are likely; use trifluralin if this is the case.

Insect control: - Earthmite control is essential in most years.
- Aphids need to be monitored from early budding. When colonies begin to spread control may be needed.
- Monitor for heliothis from flowering onwards.

Windrowing: - Windrowing is strongly recommended to reduce shattering losses and allow earlier harvest.

Machinery: - A tractor with 196 kW (263 HP) pto power and 242kW (325 HP) engine power is assumed.
- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.

Labour: - Contract-harvesting does not include the cost of fuel.
- The labour required for machinery operations is 0.23 hr/ha
- Using a labour cost of $22/hr, an additional $5.02 can be deducted from the budget

Important notes: - These gross margins are only a guide. They do not include overhead costs.
- **Use your own figures and price assumptions to estimate your own gross margin.**
- Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI.

Field Peas: Short Fallow (No-till)

Central Zone - West

Winter 2012

1. GROSS MARGIN BUDGET:

		No-Till Standard Budget $/ha	Your Budget $/ha
INCOME:			
1.80 tonnes/ha @	$290.00 /tonne (on farm)	$522.00	
	A. TOTAL INCOME $/ha:	**$522.00**	
VARIABLE COSTS:			
See opposite page for detail			
	Sowing	$136.22	
	Fertiliser	$72.10	
	Herbicide	$0.00	
	Insecticide	$20.57	
	Contract-harvesting	$50.00	
	Levies	$5.30	
	Crop Insurance	$9.10	
	Cartage, grading & bagging	$0.00	
	B. TOTAL VARIABLE COSTS $/ha:	**$293.28**	
	C. GROSS MARGIN (A-B) $/ha:	**$228.72**	

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

YIELD tonnes/ha	ON FARM PRICE ($/tonne) $230 /t	$260 /t	**$290 /t**	$320 /t	$350 /t
0.90	- $78	- $51	- $25	$1	$27
1.20	- $11	$25	$60	$95	$130
1.50	$57	$100	$144	$188	$232
1.80	$124	$176	**$229**	$281	$334
2.10	$191	$252	$313	$375	$436
2.40	$258	$328	$398	$468	$538
2.70	$325	$404	$483	$561	$640

Gross Margin ($/ha)

PRODUCT TRADE NAMES

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Field Peas: Short Fallow (No-till)

Central Zone - West

Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	$19.60/L	**$1.96**	**$1.96**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Broadleaf weed control eg: 2,4-D amine 300g/L (Surpass®)	Feb/Mar	with above			1.00 L	$3.80/L	**$3.80**	**$3.80**
Sowing seed	May	0.12	104.36	**$12.22**	100 kg	$1.24/kg	**$124.00**	**$136.22**
Fertiliser eg: MAP	May	with above			70 kg	$1.03/kg	**$72.10**	**$72.10**
Broadleaf weed control eg: metribuzin 750 g/kg (Sencor 750®)	May	0.03	76.36	**$2.50**	0.30 kg	$36.00/kg	**$10.80**	**$13.30**
Weed control eg: Haloxyfop-R 520 g/L (Verdict®)	July	0.03	76.36	**$2.50**	0.075 L	$61.09/L	**$4.58**	**$7.08**
Heliothis control eg: alpha-cypermethrin (Fastac Duo®)	Sep	contract		**$18.15**	0.30 L	$8.07/L	**$2.42**	**$20.57**
Pre-harvest desiccation eg: glyphosate 540 g/L (Roundup PowerMax®)	Oct	contract		**$18.15**	1.80 L	$8.67/L	**$15.61**	**$33.76**
Contract-harvest	Nov	contract		**$50.00**				**$50.00**
Crop Levies					1.02%	of on-farm value		**$5.30**
Crop Insurance					1.74%	of on-farm value		**$9.10**

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.

NOTES:

Soils:
- Suitable for lighter textured soils through to the heavier clay soils. Paddocks should be free of sticks and stones for harvesting. Best harvested with crop lifters or a pea front.

Place in rotation
- Useful as a break crop in cereal rotations for disease control, weed control and nitrogen benefits at the lower fertility end of the rotation.
- Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop and sowing of the next crop. For example, wheat harvested in November would be under a 5-6 month fallow until sowing in the next May.

Inoculation:
- With Group E inoculant is essential.

Seed source:
- Seed should be obtained from central and northern areas and preferably certified growers, to minimise the risk of introducing pea weevil.
- Seed price used above is for purchased seed; if using retained seed adjust budget accordingly.

Fertiliser:
- Adequate levels of phosphorus and sulfur should be applied.

Sowing time:
- Ideally mid May to mid June.

Weed control:
- Broader spectrum of broadleaf herbicides available than for other pulse crops.
- Timing of fallow herbicide application will vary according to rainfall.
- An additional knockdown herbicide application (eg. glyphosate 540 g/L @ 1.0 L/ha) should be considered if weeds are present at the time of sowing.
- Trifluralin for grass weed control if wireweed is present, if not, there are several post emergent options for grass control.
- Metribuzin is used for broadleaf weed control in this budget
- Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance.

Insect control:
- Crops must be monitored from flowering for pea weevil and heliothis.

Desiccation:
- Desiccation may be required in seasons with wet springs to ensure even ripening. Use Roundup PowerMax® where seed is not being retained for sowing. If retaining seed for sowing consider Reglone®.

Machinery:
- A tractor with 196 kW (263 HP) pto power and 242kW (325 HP) engine power is assumed.
- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.
- Contract-harvesting does not include the cost of fuel.

Labour:
- Using a labour cost of $22/hr, an additional $4.12 can be deducted from the budget

Important notes:
- These gross margins are only a guide. They do not include overhead costs.
- **Use your own figures and price assumptions to estimate your own gross margin.**
- Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI.

Field Peas: Short Fallow (No-till)

Central Zone - West

Winter 2012

1. GROSS MARGIN BUDGET:

		No-Till Standard Budget $/ha	Your Budget $/ha
INCOME:			
1.80 tonnes/ha @	$290.00 /tonne (on farm)	$522.00	
	A. TOTAL INCOME $/ha:	**$522.00**	
VARIABLE COSTS:			
See opposite page for detail			
	Sowing	$136.22	
	Fertiliser	$72.10	
	Herbicide	$0.00	
	Insecticide	$20.57	
	Contract-harvesting	$50.00	
	Levies	$5.30	
	Crop Insurance	$9.10	
	Cartage, grading & bagging	$0.00	
	B. TOTAL VARIABLE COSTS $/ha:	**$293.28**	
	C. GROSS MARGIN (A-B) $/ha:	**$228.72**	

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

YIELD tonnes/ha	ON FARM PRICE ($/tonne) $230 /t	$260 /t	**$290 /t**	$320 /t	$350 /t
0.90	- $78	- $51	- $25	$1	$27
1.20	- $11	$25	$60	$95	$130
1.50	$57	$100	$144	$188	$232
1.80	$124	$176	**$229**	$281	$334
2.10	$191	$252	$313	$375	$436
2.40	$258	$328	$398	$468	$538
2.70	$325	$404	$483	$561	$640

Gross Margin ($/ha)

PRODUCT TRADE NAMES

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Field Peas: Short Fallow (No-till)

Central Zone - West

Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	$19.60/L	**$1.96**	**$1.96**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Broadleaf weed control eg: 2,4-D amine 300g/L (Surpass®)	Feb/Mar	with above			1.00 L	$3.80/L	**$3.80**	**$3.80**
Sowing seed	May	0.12	104.36	**$12.22**	100 kg	$1.24/kg	**$124.00**	**$136.22**
Fertiliser eg: MAP	May	with above			70 kg	$1.03/kg	**$72.10**	**$72.10**
Broadleaf weed control eg: metribuzin 750 g/kg (Sencor 750®)	May	0.03	76.36	**$2.50**	0.30 kg	$36.00/kg	**$10.80**	**$13.30**
Weed control eg: Haloxyfop-R 520 g/L (Verdict®)	July	0.03	76.36	**$2.50**	0.075 L	$61.09/L	**$4.58**	**$7.08**
Heliothis control eg: alpha-cypermethrin (Fastac Duo®)	Sep	contract		**$18.15**	0.30 L	$8.07/L	**$2.42**	**$20.57**
Pre-harvest desiccation eg: glyphosate 540 g/L (Roundup PowerMax®)	Oct	contract		**$18.15**	1.80 L	$8.67/L	**$15.61**	**$33.76**
Contract-harvest	Nov	contract		**$50.00**				**$50.00**
Crop Levies					1.02%	of on-farm value		**$5.30**
Crop Insurance					1.74%	of on-farm value		**$9.10**

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.

NOTES:

Soils:
- Suitable for lighter textured soils through to the heavier clay soils. Paddocks should be free of sticks and stones for harvesting. Best harvested with crop lifters or a pea front.

Place in rotation
- Useful as a break crop in cereal rotations for disease control, weed control and nitrogen benefits at the lower fertility end of the rotation.
- Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop and sowing of the next crop. For example, wheat harvested in November would be under a 5-6 month fallow until sowing in the next May.

Inoculation:
- With Group E inoculant is essential.

Seed source:
- Seed should be obtained from central and northern areas and preferably certified growers, to minimise the risk of introducing pea weevil.
- Seed price used above is for purchased seed; if using retained seed adjust budget accordingly.

Fertiliser:
- Adequate levels of phosphorus and sulfur should be applied.

Sowing time:
- Ideally mid May to mid June.

Weed control:
- Broader spectrum of broadleaf herbicides available than for other pulse crops.
- Timing of fallow herbicide application will vary according to rainfall.
- An additional knockdown herbicide application (eg. glyphosate 540 g/L @ 1.0 L/ha) should be considered if weeds are present at the time of sowing.
- Trifluralin for grass weed control if wireweed is present, if not, there are several post emergent options for grass control.
- Metribuzin is used for broadleaf weed control in this budget
- Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance.

Insect control:
- Crops must be monitored from flowering for pea weevil and heliothis.

Desiccation:
- Desiccation may be required in seasons with wet springs to ensure even ripening. Use Roundup PowerMax® where seed is not being retained for sowing. If retaining seed for sowing consider Reglone®.

Machinery:
- A tractor with 196 kW (263 HP) pto power and 242kW (325 HP) engine power is assumed.
- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.
- Contract-harvesting does not include the cost of fuel.

Labour:
- Using a labour cost of $22/hr, an additional $4.12 can be deducted from the budget

Important notes:
- These gross margins are only a guide. They do not include overhead costs.
- **Use your own figures and price assumptions to estimate your own gross margin.**
- Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI.

NSW GOVERNMENT Primary Industries

Barley: Short Fallow [No-till]

Central Zone - West

Winter 2012

1. GROSS MARGIN BUDGET:

				Malt Standard Budget $/ha	Feed Standard Budget $/ha	Your 2006 Budget $/ha
INCOME:						
Feed Barley	2.20 tonnes/ha @	$140.00	/tonne (on farm) (feed)		$308.00	
Malt Barley	1.90 tonnes/ha @	$180.00	/tonne (on farm) (malt)	$342.00		
		A. TOTAL INCOME $/ha:		**$342.00**	**$308.00**	
VARIABLE COSTS:						
See opposite page for detail						
		Sowing		$49.70	$49.70	
		Fertiliser		$61.80	$61.80	
		Herbicide		$80.05	$80.05	
		Insecticide		$0.00	$0.00	
		Contract-harvesting		$48.00	$48.00	
		Levies		$6.32	$6.43	
		Crop Insurance		$3.51	$3.16	
		Cartage, grading & bagging		$0.00	$0.00	
		B. TOTAL VARIABLE COSTS $/ha:		**$249.39**	**$249.14**	
		C. GROSS MARGIN (A-B) $/ha:		**$92.61**	**$58.86**	

2. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER HECTARE:

Malt Barley

YIELD tonnes/ha	ON FARM PRICE ($/tonne) $140 /t	$160 /t	**$180 /t**	$200 /t	$220 /t
1.40	- $50	- $22	$5	$33	$60
1.60	- $23	$9	$40	$72	$103
1.80	$5	$40	$75	$110	$146
1.90	$18	$55	**$93**	$130	$167 ←
2.20	$59	$102	$145	$188	$231
2.40	$86	$133	$180	$227	$274
2.60	$112	$163	$214	$265	$316

Gross Margin ($/ha)

Feed Barley

YIELD tonnes/ha	ON FARM PRICE ($/tonne) $100 /t	$120 /t	**$140 /t**	$160 /t	$180 /t
1.70	- $76	- $42	- $9	$24	$58
1.90	- $56	- $19	$18	$55	$93
2.10	- $37	$4	$45	$86	$128
2.20	- $27	$16	**$59**	$102	$145 ←
2.50	$2	$51	$100	$149	$198
2.70	$18	$71	$124	$177	$230
2.90	$35	$92	$149	$206	$263

Gross Margin ($/ha)

Barley: Short Fallow [No-till]

Central Zone - West

Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	$19.60/L	**$1.96**	**$1.96**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: 2,4-D amine 300 g/L (Surpass®)	Feb/Mar	with above			1.00 L	$3.80/L	**$3.80**	**$3.80**
Sowing seed	May	0.12	104.36	**$12.22**	35 kg	$1.07/kg	**$37.49**	**$49.70**
Starter fertiliser eg: MAP	May	with above			60 kg	$1.03/kg	**$61.80**	**$61.80**
Grass weed control eg: diclofop+fenoxaprop (Tristar® Advance)	Jul	0.03	76.36	**$2.50**	1.50 L	$26.00/L	**$39.00**	**$41.50**
Broadleaf weed control eg: MCPA LVE 500 g/L (MCPA LVE®)	Jul	with above			0.70 L	$10.00/L	**$7.00**	**$7.00**
Contract-harvest	Nov	contract		**$48.00**				**$48.00**
Crop Levies - 2 row feed						1.02% of on-farm value		**$6.43**
Crop Levies - malt						1.02% of on-farm value		**$6.32**
Crop Insurance - 2 row feed					1.03%	of on-farm value		**$3.16**
Crop Insurance - malt					1.03%	of on-farm value		**$3.51**

*** Input and crop prices are correct at the time of writing (March 2012). Market uncertainty makes estimation of future pricing impractical.

NOTES:

Sowing time:
- Sowing at the optimum time for the selected variety is critical for maximum yield.
- Seed price used above is for purchased seed; if using retained seed adjust budget accordingly.

Place in rotation:
- Barley is a useful crop to follow wheat in the rotation.
- Barley will respond to good soil fertility, however it is better adapted to lower nitrogen fertility situations than wheat.
- Select lower nitrogen paddocks for malting barley.
- Tulla & Yambla are more tolerant to acid soils.
- Barley is a useful break crop where root lesion nematode is a problem, but check the varieties tolerance rating.
- Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop and sowing of the next crop. For example, canola harvested in November would be under a 5-6 month fallow until sowing in the following May.

Variety:
- Feed varieties will usually yield more than a standard malting variety.

Weed control:
- Timing of fallow herbicide applications will vary according to rainfall.
- Barley is generally more competitive than wheat in relation to weeds.
- An additional knockdown herbicide application (i.e. glyphosate 540 g/L @1.0 L/ha) should be considered if weeds are present at the time of sowing.
- Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance.

Machinery:
- A tractor with 196 kW (263 HP) pto power and 242kW (325 HP) engine power is assumed.
- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.
- Contract-harvesting does not include the cost of fuel.

Labour:
- The labour required for machinery operations is 0.23 hr/ha

Important notes:
- These gross margins are only a guide. They do not include overhead costs.
- **Use your own figures and price assumptions to estimate your own gross margin.**
- Use of a particular brand name does NOT imply a recommendation of that brand by NSW DPI.