

Centennial Coal

Agricultural Impact Statement

Angus Place Mine

Angus Place Mine Extension Project

Centennial Angus Place Pty Limited

FINAL

January 2014

CCC07-012



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Angus Place Mine Extension Project Agricultural Impact Statement

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TABLE OF CONTENTS

1	Introduction	1
1.1	Project Overview	1
1.2	Project Application Area	2
1.3	Purpose Of This Report.....	2
1.4	Structure Of This Report.....	3
1.5	Methodology	5
2	Agricultural And Water Resources	8
2.1	Climate.....	8
2.2	Topography	8
2.3	Hydrology	8
2.3.1	Surface Water	8
2.3.2	Ground Water.....	12
2.3.3	User Extraction Points.....	12
2.4	Geology	14
2.5	Soil Landscape Units.....	14
2.6	Dominant Soil Types And Inherent Fertility	16
2.7	Acid Sulfate Soils.....	18
2.8	Vegetation And Land Use	18
2.9	Land And Soil Classification.....	20
2.10	Biophysical Strategic Agricultural Land Assessment.....	23
2.10.1	BSAL Assessment – Upper Hunter Strategic Regional Land Use Plan	23
2.10.2	BSAL Assessment – Interim Protocol For Site Verification	24
2.10.3	Biophysical Strategic Agricultural Land Summary	26
3	Local And Regional Agricultural Enterprises	27
3.1	Agricultural History	27
3.2	Agricultural Enterprises And Associated Industries	27
3.2.1	Regional Land Use.....	27
3.2.2	Regional Employment	29
3.3	Regional Agricultural Production Value.....	31
3.4	Potential Agricultural Production Value Of The Project Application Area	31
3.5	Agricultural Support Infrastructure.....	33
4	Assessment Of Potential Impacts	34
4.1	Land Resources	34
4.1.1	Land Temporarily Removed From Agriculture	34
4.1.2	Land Permanently Removed From Agriculture	35
4.2	Water Resources.....	35
4.2.1	Surface Water	35

4.2.2	Groundwater.....	36
4.2.3	Groundwater Reallocation.....	37
4.3	Impact On Biophysical Strategic Agricultural Land	38
4.4	Impact On Agricultural Resources From Biodiversity Offsets	38
4.5	Other Impacts	38
4.5.1	Visual Amenity And Landscape Values	38
4.5.2	Tourism	38
4.5.3	Weed Management And Biosecurity	39
4.5.4	Dust	39
4.5.5	Noise	39
4.5.6	Traffic	39
4.6	Other Agricultural Regional Community Impacts	40
5	Mitigation Measures	41
5.1	Review Of Project Design.....	41
5.2	Proposed Mitigation Measures And Management Strategies	41
5.2.1	Land Resources	41
5.2.2	Water Resources.....	42
5.3	Rehabilitation Of Disturbed Lands: Demonstrated Capacity.....	43
5.4	Demonstrated Planning For Progressive Rehabilitation	43
6	Stakeholder Consultation	45
7	Key Findings	47
8	References	48

TABLES

Table 1.1	AIS Requirements.....	3
Table 2.1	Catchments within the Project Application Area.....	11
Table 2.2	Registered Groundwater Bores & Wells.....	12
Table 2.3	Soil Landscape Units	16
Table 2.4	Dominant Soil Types and Inherent Fertility.....	18
Table 2.5	Land and Soil Classification.....	21
Table 2.6	Applied Biophysical Strategic Agricultural Land Criteria.....	23
Table 2.7	Twelve Step Site Verification Criteria According to Interim Protocol.....	25
Table 2.8	Applied BSAL Criteria: Interim Protocol for Site Verification	26
Table 3.1	Lithgow LGA – Agricultural Land Use.....	28

Table 3.2 Lithgow Regional Agricultural Employment	29
Table 3.3 Lithgow Regional Agricultural Related Employment by Sector	30
Table 3.4 Regional Agricultural Production	31
Table 3.5 Beef Cattle Gross Margin per LSC Class	32
Table 3.6 Merino Meat Lamb Gross Margin per LSC Class	32
Table 3.7 Potential Annual Gross Margins	32
Table 4.1 Temporary Surface Disturbance	34
Table 4.2 Groundwater Extraction Licences	37
Table 4.3 Groundwater Use Gross Margins	37
Table 5.1 Angus Place Rehabilitation Summary	43

FIGURES

Figure 1.1 Regional Locality	6
Figure 1.2 Site Layout	7
Figure 2.1 Slope Analysis	9
Figure 2.2 Topography & Hydrology	10
Figure 2.3 Registered Bores & Wells	13
Figure 2.4 Soil Landscape Units	15
Figure 2.5 Soil Types	17
Figure 2.6 Land & Soil Capability	22

PLATES

Plate 2.1 Typical State Forest landscape on Newnes Plateau	19
Plate 2.2 Typical agricultural landscape on western edge of the Project Application Area	20

APPENDICES

Appendix 1	Agricultural Gross Margin Sensitivity Analysis
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LIST OF ABBREVIATIONS

ABS	Australian Bureau of Statistics
AIS	Agricultural Impact Statement
ASL	above sea level
BOM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
DGRs	Director General's Requirements
DP&I	NSW Department of Planning and Infrastructure
DPI	NSW Department of Primary Industries
EIS	Environmental Impact Statement
I&I	NSW Industry and Investment
ha	hectare
km	kilometre
LCC	Lithgow City Council
LDP	Licensed Discharge Point
LGA	Local Government Area
LSC	Land and Soil Classification
m	metre
M	million
ML	mega litre
mm	millimetre
mg/kg	milligram per kilogram
mg/L	milligram per litre
Mtpa	million tonne per annum
N/A	not applicable
NOW	NSW Office of Water
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PM _{2.5}	particular matter with an equivalent aerodynamic diameter of 2.5 microns or less
PM ₁₀	particular matter with an equivalent aerodynamic diameter of 10 microns or less
Policy, the	<i>Strategic Regional Land use Policy</i>
Project, the	Angus Place Mine Extension Project
RFS	Rural Fire Service
SAL	Strategic Agricultural Land

SDWTS	Springvale Delta Water Transfer Scheme
SRLUP	Strategic Regional Land Use Plan
t	tonne
TSP	total suspended particulate matter
µS/cm	micro Siemens per centimetre
°C	degrees Celsius

1 INTRODUCTION

SLR (formerly GSS Environmental) has been engaged by Centennial Angus Place Pty Limited (Angus Place) to prepare an Agricultural Impact Statement (AIS) for the Angus Place Mine Extension Project (the Project). This AIS is intended to form part of the Environmental Impact Statement (EIS) to be submitted to the New South Wales Department of Planning and Infrastructure (DP&I) as part of the application for development consent the Project under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act, 1979 (EP&A Act).

1.1 Project Overview

Angus Place is managed by Centennial Angus Place under a joint venture arrangement between Centennial Springvale Pty Ltd and Springvale SK Kores Pty Ltd. Centennial Angus Place is 100% owned by Centennial Coal Company Ltd. Centennial Coal Company Ltd is a wholly owned subsidiary of Banpu Public Company Ltd.

Angus Place is an underground coal mine producing thermal coal which is supplied to Wallerawang and Mount Piper power stations for domestic power generation. The Angus Place pit top is located approximately five kilometres (km) north of the village of Lidsdale, eight km northeast of the township of Wallerawang and 15 km northwest of the city of Lithgow (**Figure 1.1**). Angus Place is located within the Lithgow Local Government Area (LGA).

The Project is seeking approval for the continuation of mining at Angus Place beyond March 2016, when the current operation is planned to cease. Longwall mining is proposed to extend towards the east of the existing workings.

Specific objectives of the Project are as follows:

- Continue to extract up to 4 million tonnes per annum of run of mine coal from the Lithgow Seam underlying the Project Application Area.
- Develop underground access headings and roadways from the current mining area to the east to allow access to the proposed mining area.
- Undertake secondary extraction by retreat longwall mining for the proposed longwall panels LW1001 to LW1019.
- Continue to use the existing ancillary surface facilities at the Angus Place pit top.
- Continue to manage the handling of run of mine coal through a crusher and screening plant at the Angus Place pit top, and the subsequent loading of the coal onto the existing road haulage trucks for despatch to offsite locations.
- Continue to operate and maintain the existing ancillary surface infrastructure for ventilation, electricity, water, materials supply, and communications at Angus Place pit top and Newnes Plateau.
- Install and operate seven additional dewatering borehole facilities on Newnes Plateau and the associated power and pipeline infrastructure.
- Upgrade and extend the existing access tracks from Sunnyside Ridge Road to the dewatering borehole facilities.

- Install and operate water transfer boreholes and pipeline infrastructure at the existing Ventilation Facility site (APC-VS2).
- Construct and operate a downcast ventilation shaft (APC-VS3) and upgrade the existing access track to the proposed facility from Sunnyside Ridge Road.
- Manage mine inflows using a combination of direct water transfer to the Wallerawang Power Station, via the SDWTS, and discharge through Angus Place Colliery's licensed discharge point LDP001 and Springvale Colliery's LDP009.
- Continue to undertake existing and initiate new environmental monitoring programs.
- Continue to operate 24 hours per day seven days per week.
- Continue to provide employment to a full time workforce of up to 225 persons and 75 contractors.
- Progressively rehabilitate disturbed areas at infrastructure sites no longer required for mining operations.
- Undertake life-of-mine rehabilitation at the Angus Place pit top and the Newnes Plateau infrastructure disturbance areas to create final landforms commensurate with the surrounding areas and the relevant zonings of the respective areas.
- Transfer the operational management of coal processing and distribution infrastructure to the proposed Centennial Western Coal Services Project.

1.2 Project Application Area

The area subject to this AIS is the entire Project Application Area totaling an area of approximately 10,468 hectares (ha) (**Figure 1.2**). Of relevance to this assessment are the following major proposed project components:

- Proposed Workings: includes land proposed to be subject to underground mining activities covering an area of 2,275 ha.
- Proposed Surface Infrastructure: includes multiple infrastructure components including the proposed ventilation site (AP-VS3), dewatering facility sites and the proposed infrastructure corridor to link the multiple infrastructure components. The actual proposed surface infrastructure area is 23.25 ha (Golder, 2013a). However, the assessment area covers a larger area of 114 ha to incorporate a number of potential alignment options. This is a conservative approach to ensure due diligence following any required mine plan changes during the EIS process.

1.3 Purpose of this Report

This report has been prepared to address the *Strategic Regional Land Use Policy* (the Policy) (DP&I, 2012a). The Policy 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. The Policy applies to areas within NSW where there is high value agricultural land and increasing activity in the coal and coal seam gas 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. The SRLUP and/or Regional Growth Plan covering the Project Application Area has not been released at the time of this assessment.

Part of this policy requires all state-significant mining development proposals, whether or not they are located on land mapped as strategic agricultural land (SAL), to prepare an Agricultural Impact Statement (AIS) for consideration at the development application stage. The purpose of an AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Application Area. The term 'agricultural resource' is used to describe the land on which agriculture is dependent and the associated water resources (quality and quantity) that are linked to that land.

DP&I have issued an exemption, supplementary to the Project's Director General's Requirements (DGRs), whereby an AIS is not required to be prepared as the Project Application Area is not situated on high value agricultural land. However, the proponent, Angus Place, have elected to undertake an AIS for due diligence. SLR has prepared this AIS to address the requirements of the Policy in accordance with the *Guideline for Agricultural Impact Statements* (DP&I, 2012b).

1.4 Structure of this Report

This AIS, in accordance with the *Strategic Agricultural Land Use Policy: Guideline for Agricultural Impact Statements* (DP&I, 2012b), addresses the information listed in **Table 1.1**.

Table 1.1 AIS Requirements

This AIS must include the following information	Addressed in this document in:
Information Relating to the Project application Area and Region	
<i>Detailed assessment of the agricultural resources and agricultural production of the project area</i>	
This section should include detailed information (including maps) on:	
<ul style="list-style-type: none"> the soils, slope, land characteristics, water characteristics (availability, quality); 	Section 2
<ul style="list-style-type: none"> relevant history of the agricultural enterprises from within the project area and also surrounding land acquired as part of the development's buffer and/or offset zone. 	Section 3
For the project area this should include a description of:	
<ul style="list-style-type: none"> any land identified as SAL in a Strategic Regional Land Use Plan on or within two km of the project site (SAL will be further identified in an amendment to the Mining SEPP); 	Section 2
<ul style="list-style-type: none"> the location and area of land to be temporarily removed from agriculture during operation of the project, and the period of time 	Section 2
<ul style="list-style-type: none"> the location and area of land to be returned to agricultural use post-project, and its productive potential relative to pre-project; 	Section 2
<ul style="list-style-type: none"> the location and area of land that will not be returned to agriculture, including areas to be used for environmental plantings or biodiversity offsets; 	Section 2
<ul style="list-style-type: none"> the agricultural enterprises to be undertaken on any buffer and/or offset zone lands for the life of the project, and comparison with enterprises undertaken on the land prior to the project. 	Section 2
<i>Identification of the agricultural resources and current agricultural enterprises within the surrounding locality of the project area</i>	
The AIS must contain maps/information for areas within the locality surrounding the project describing existing agricultural resources. This should include:	
<ul style="list-style-type: none"> soil characteristics, including soil types and depth; 	Section 2
<ul style="list-style-type: none"> topography/slope; 	Section 2
<ul style="list-style-type: none"> key agricultural support infrastructure (e.g. roads, railways, processing facilities); 	Section 3

This AIS must include the following information	Addressed in this document in:
<ul style="list-style-type: none">water resources and other water users' extraction locations;	Section 2
<ul style="list-style-type: none">location and type of agricultural industries;	Section 3
<ul style="list-style-type: none">climate conditions.	Section 2
Describe the location and production levels of each commodity produced by all agricultural enterprises within the locality surrounding the project area.	Section 3
Assessment of Impacts	
<i>Identification and assessment of the impacts of the project on agricultural resources or industries</i>	
The AIS should identify any adverse impacts on agricultural resources and production on the site and in the local area during the operation and post-operation phases of the project. The AIS should include a risk-based assessment (guided by the DGRs) of:	
<ul style="list-style-type: none">the effects of the project on agricultural resources;	Section 4
<ul style="list-style-type: none">consequential productivity effects of this on agricultural enterprises, including productivity impacts of any water moved away from agriculture and any water quality issues as they affect agriculture (this should extend to farm productivity, land values and flow on impacts to regional communities and environment);	
<ul style="list-style-type: none">uncertainty associated with the predicted impacts and mitigation measures and the consequences of and likelihood that these uncertainties will be realised;	
<ul style="list-style-type: none">further risks such as weed management, biosecurity, subsidence, dust, noise, vibration and traffic conditions. The AIS should also consider other aspects, e.g. proposed biodiversity offsets that may result in the loss or dislocation of agricultural resources/industries)	
If the project site is located on or within two km of any land identified as SAL in a Strategic Regional Land Use Plan, the AIS must specifically address the potential impacts of the project on the relevant SAL. This should include a consideration of the relevant Gateway criteria which include matters such as:	
<ul style="list-style-type: none">surface area disturbance, subsidence and soils;	N/A >2km from mapped BSAL
<ul style="list-style-type: none">salinity, soil pH and groundwater;	
<ul style="list-style-type: none">access to agricultural resources and infrastructure; and	
<ul style="list-style-type: none">agricultural scenic and landscape values.	
<i>Account for any physical movement of water away from agriculture</i>	
Any water that is transferred or will no longer be available for agricultural use as a result of the proposal should be identified and fully accounted for.	Section 4
The potential impacts of the development on water resources should be assessed against the minimal impact considerations, consistent with the requirements of the Aquifer Interference Policy (NOW, 2012).	
All predicted impacts should be based on robust modelling.	
<i>Assessment of socio-economic impacts</i>	
The AIS should include an assessment of the impacts on agricultural support services, processing and value adding industries and regional employment.	Section 4
The socio-economic impact assessment must detail agricultural support services and value adding industries relevant to affected agricultural enterprises including potential impacts on local and regional employment.	
The socio-economic impact assessment must also address any potential impact on visual amenity, landscape values and tourism infrastructure relied upon by local and regional agricultural enterprises.	
Mitigation Measures	
<i>Identification of options for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level</i>	
The AIS should document feasible options to avoid, minimise or mitigate potential impacts on agricultural resources including:	
<ul style="list-style-type: none">project design review/alternatives;	Section 5
<ul style="list-style-type: none">proposed monitoring programs to assess predicted versus actual impacts as the project progresses;	

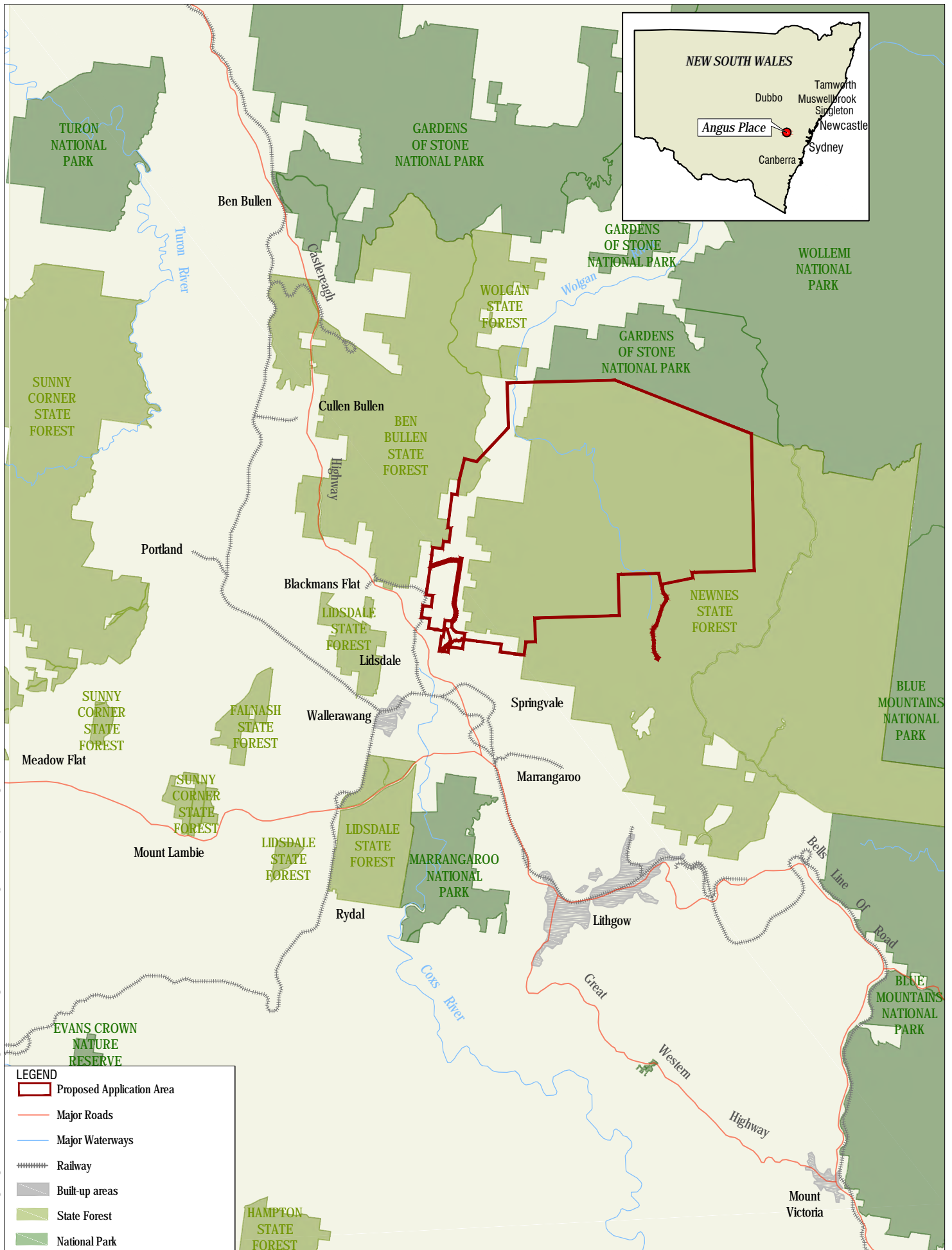
This AIS must include the following information	Addressed in this document in:
<ul style="list-style-type: none">trigger response plans and trigger points at which operations will cease or be modified or remedial actions will occur to address impacts including a process to respond to unforeseen impacts;	
<ul style="list-style-type: none">the proposed remedial action to be taken in response to a trigger event;	
<ul style="list-style-type: none">the basis for assumptions made about the extent to which remedial actions will address and respond to impacts;	
<ul style="list-style-type: none">demonstrated capacity for the rehabilitation of disturbed lands to achieve the final land use and restore natural resources;	
<ul style="list-style-type: none">Demonstrated planning for progressive rehabilitation that minimises the extent of disturbances.	
Consultation	
Document consultation with adjoining landusers and Government Departments	
An AIS should include details of an engagement strategy including:	
<ul style="list-style-type: none">consultation undertaken to date, including consultation undertaken at the Exploration Licence stage;	Section 6
<ul style="list-style-type: none">consultation with relevant government agencies;	
<ul style="list-style-type: none">consultation with impacted landholders and community groups;	
<ul style="list-style-type: none">the issues identified and measures to address these issues;	
<ul style="list-style-type: none">the outcomes of the consultation;	
<ul style="list-style-type: none">any commitments for further consultation.	

1.5 Methodology

The AIS was assessed using the methodology set out below:

- A desktop review of all publicly available information relating to the Project.
- Field visit and site inspection in June, 2013 by GSSE's Senior Agronomist, Murray Fraser.
- Description of the biophysical environment for the Project Application Area and surrounding locality.
- A review of specialist impact assessments which make up part of the EIS for the Project.
- Assessment of potential impacts on agricultural resources and industry, including mitigation measures for any identified impacts.
- Provision of Angus Place's demonstrated capacity for rehabilitation.

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2 AGRICULTURAL AND WATER RESOURCES

2.1 Climate

Representative climate data for the area has been obtained from the nearest Bureau of Meteorology (BOM) weather station located at the Lithgow Newnes Forest Centre, (Station 063062; BOM 2012). The Newnes Forest Centre ceased operation in 1999; however, it is considered to be a reliable and representative dataset for the Project Application Area.

Data from the Newnes Forest Centre shows that the Project Application Area experiences a summer dominant rainfall and temperature pattern with an average rainfall of 1,073 millimetres (mm) per year and an average maximum temperatures range of 9.4 degrees Celsius (°C) in July to 23.5°C in February. The BOM classifies the Lithgow area as having an oceanic climate with warm summers, cool to cold winters and generally steady precipitation year-round.

2.2 Topography

The topography of the region consists of rugged mountain ranges and plateaus characterised by sheer and benched cliffs and steep sided gorges (**Figure 2.1**). The rugged topography is dissected by numerous streams and gullies often bordered by discontinuous belts of flat undulating land.

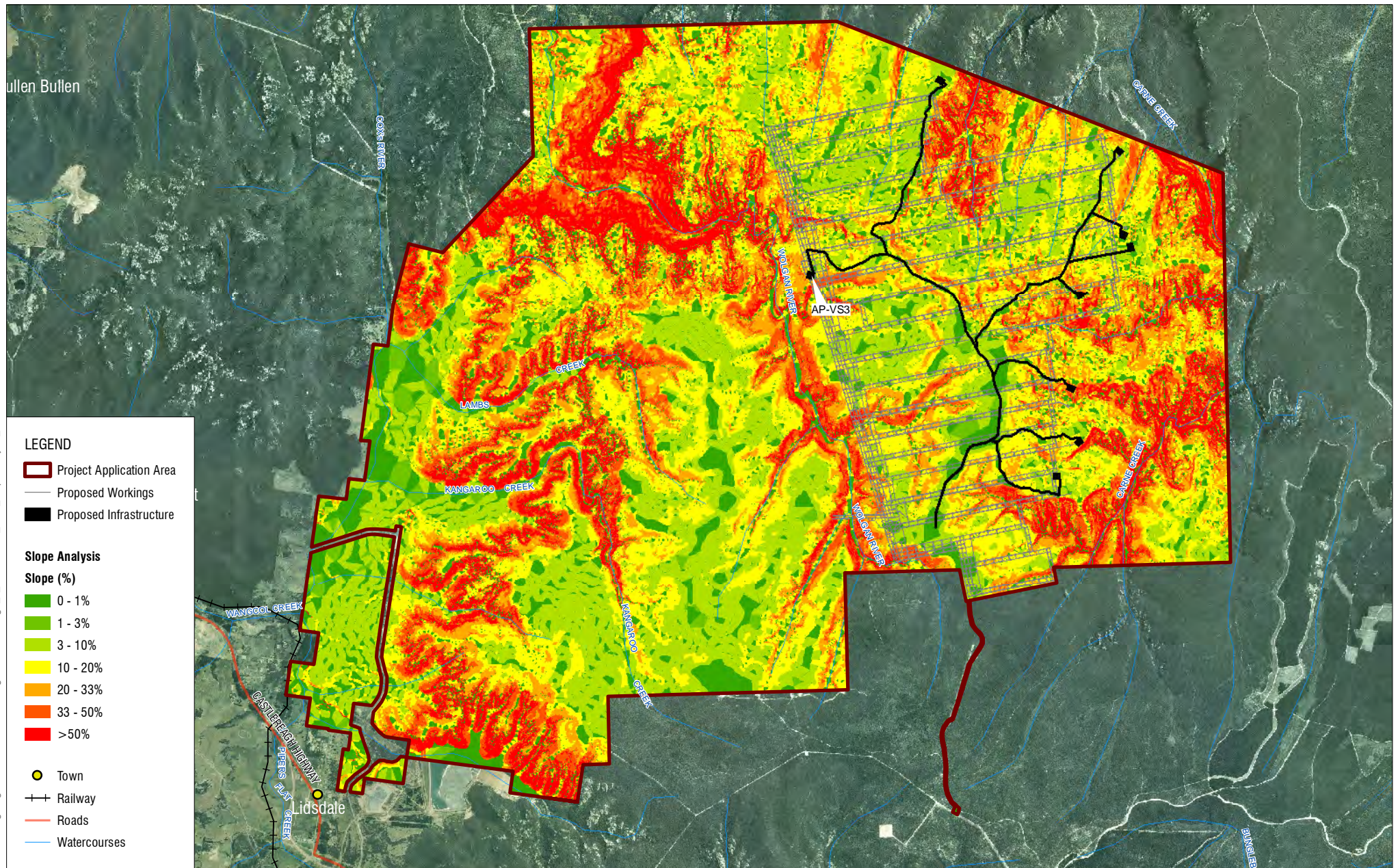
The majority of the Angus Place Mine Extension lies within the Newnes Plateau, which is a relatively undulating plateau occurring between 1,000 metres (m) and 1,180 m above sea level (ASL). The plateau forms part of the divide between the Wolgan and Coxs River valleys. It consists of a number of connecting, wide, gently undulating ridges, dissected by relatively steep-sided valleys with the floors of the creeks and gullies occurring between 960 m and 980 m above sea level (ASL). Sandstone cliffs 40 m in height can be found in the south western and north eastern corners, and along the southern boundary of the lease area. In general, however, the sandstone cliffs range between 10 m and 40 m in height throughout the area. Swamps occur within the headwater valleys along the tributaries of Carne Creek and Marrangaroo Creek and are controlled by the flat topography and impervious shale layers.

2.2.1 Hydrology

2.2.2 Surface Water

The Project Application Area lies wholly within the western boundary of the Hawkesbury-Nepean catchment and covers two adjacent sub-catchments, the Upper Coxs River and the Wolgan River sub-catchments. All catchments are under the jurisdiction of Hawkesbury-Nepean Catchment Management Authority and the Upper Coxs River sub-catchment is also listed within the boundary of Sydney Drinking Water Catchment.

Catchments and associated watercourses for the Project Application Area are shown in **Figure 2.2** and described in **Table 2.1**.



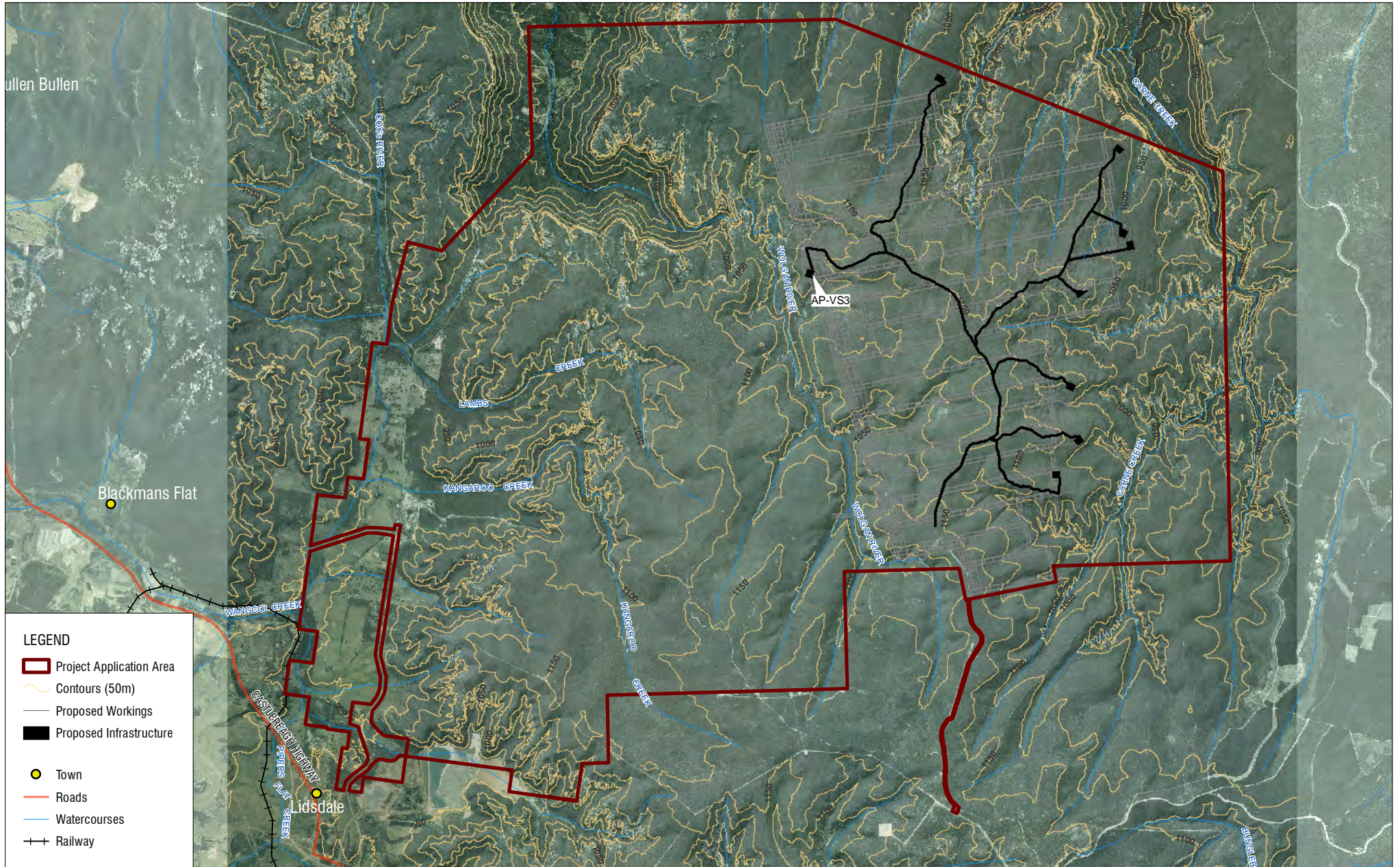


Table 2.1 Catchments within the Project Application Area

Sub-catchments	Minor Catchment	Associated Watercourses	Minor Catchment Area (ha)	% of Project Application Area
Upper Coxs River	Coxs River	Wangool Creek, Springvale Creek, Kangaroo Creek, Lambs Creek, Sawyers Swamp Creek	13,026	30
	Marrangaroo Creek	Unnamed watercourses south of Project Application Area	5,495	30
Wolgan River	Wolgan River Western Branch	Wolgan River	8,526	35
	Wolgan River Eastern Branch	Carne Creek	8,597	35

Source: *Surface Water Impact Assessment* (RPS, 2013a)

2.2.2.1 Upper Coxs River Sub-catchment

The Project Application Area is situated to the east of the Coxs River, which is a major tributary and headwater that flows into Lake Burragorang. The Coxs River minor catchment contains an impoundment, the Lake Wallace reservoir, approximately 5 km south of the Wangool Creek confluence. Lake Wallace provides Energy Australia's Wallerawang Power Station's water requirements and also the town of Wallerawang with drinking water (RPS, 2013a).

Marrangaroo Creek is a minor catchment of the Upper Coxs River sub-catchment. Marrangaroo Creek flows south westerly to converge with the Coxs River downstream of Lake Wallace Reservoir.

Kangaroo Creek flows in a westerly direction past the Angus Place Pit Top eventually joining the Coxs River which then drains into Lake Wallace. Kangaroo Creek is of relevance to the Project as Angus Place's Licensed Discharge Point (LDP) 001 discharges into this creek. Kangaroo Creek does not have regular surface flow upstream of LDP001. Excess mine groundwater is also discharged via Springvale's LDP009 into the Coxs River further downstream of Angus Place's LDP001 (RPS, 2013a).

2.2.2.2 Wolgan River Catchment

The eastern section of the Project Application Area is situated in the Wolgan River sub-catchment. The Wolgan River sub-catchment has two branches, the Western Branch and the Eastern Branch.

The Wolgan River is the main watercourse in the Western Branch which flows northerly off the Newnes Plateau into the Wolgan Valley to join the Capertee and Wollemi Rivers in the Wollemi National Park when it becomes the Colo River. The Wolgan River runs through the centre of the Project Application Area.

Carne Creek is the main tributary to the Eastern Branch and consists of several tributaries that flow east-northerly to join the main course of the river. Carne Creek is situated in the north eastern portion of the Project Application Area.

2.2.3 Ground Water

The regional hydrogeology is considered complex due to the non-uniform sequence of interbedded rocks consisting of heterogeneous lithic properties and therefore varying hydro-permeability. The variability creates rock horizons capable of promoting or inhibiting the flow of groundwater in the region, however, the strata is considered to have low permeability and the flow of groundwater is primarily due to the fractures within the strata.

The regional hydrogeology is also multifaceted by the presence of mine voids from previous and current mining operations, which can act as preferred flow paths for groundwater.

Six aquifers or relatively permeable water-bearing strata have been identified within the Project Application Area above the Lithgow Seam. These six aquifers are categorised into three basic groundwater systems. A brief summary of each groundwater system follows.

- **Perched groundwater system** – a discontinuous, near-surface systems which are independent of the underlying regional groundwater systems, and located within 15 m of the ground surface. The perched groundwater system is derived from excess rainfall which is largely prevented from infiltrating into the deeper systems by less permeable beds.
- **Shallow groundwater system** – this system is a regional groundwater system located in the Narrabeen Group, largely in the Banks Wall Sandstone. This system generally extends to a depth of up to 100 m. The shallow groundwater system is underlain by the Mount York Claystone which forms acts as an aquitard, restricting infiltration to the deep groundwater system.
- **Deep groundwater system** – a less important, deeper groundwater system exists in the strata below the Mount York Claystone, and includes the Illawarra Coal Measures, which generally lie at a depth of more than 200 m. The few water bearing zones that occur in this system are typically fractured rock aquifers.

2.2.4 User Extraction Points

A search of the NOW registered bores database identified 46 registered bores within 10 km of the centre-point of the Project Application Area. Four of these bores are within five km of the centre-point radius (**Figure 2.3**). The registered bores extract from the shallow and the deep groundwater systems with no bores extracting from the perched groundwater system.

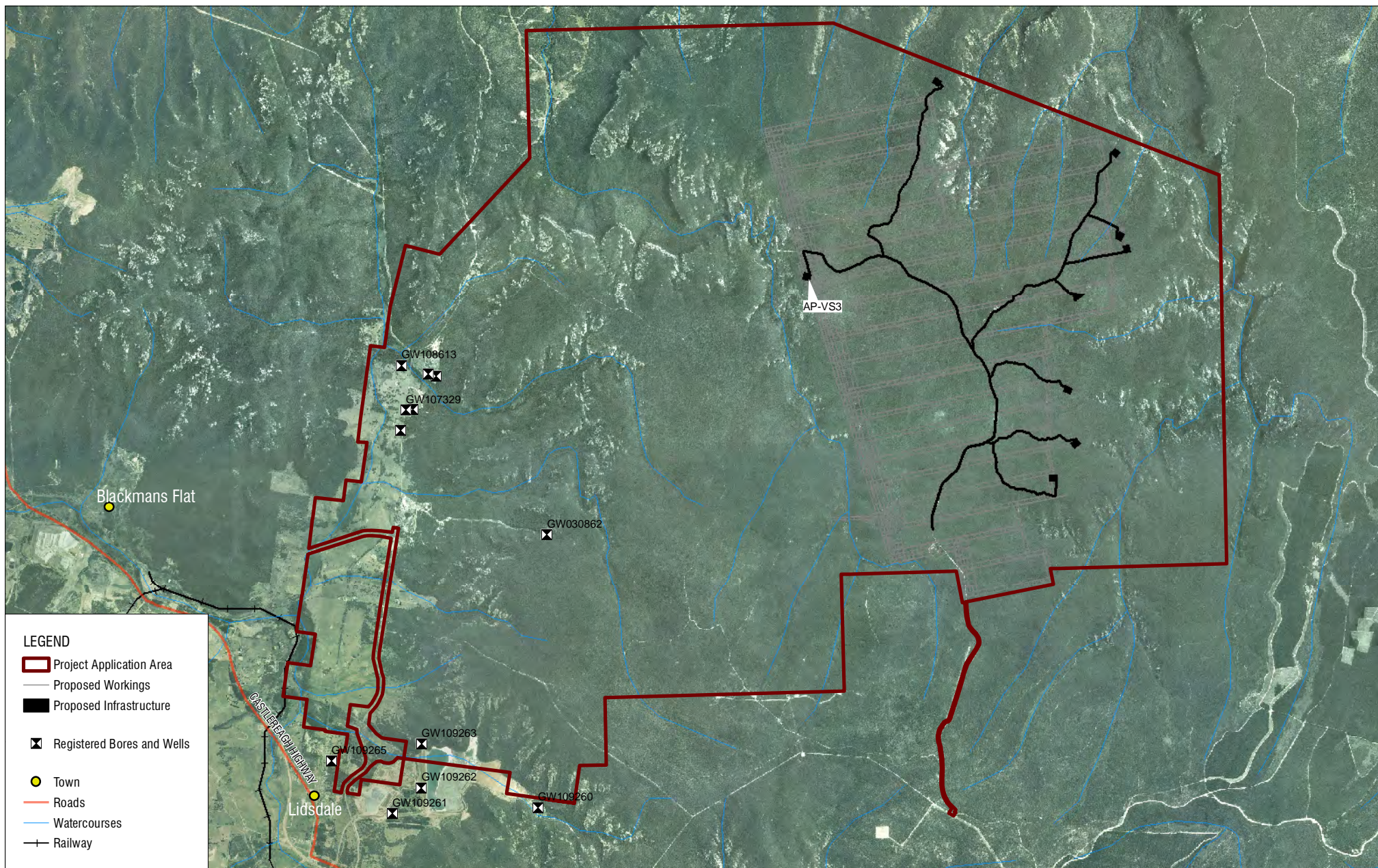
The groundwater bores are operated for a range of uses (**Table 2.2**), including 13 stock and domestic bores within the 10 km centre-point, all of which extract from the deep groundwater system. Within the 5 km centre-point radius there are two stock and domestic bores extracting from the deep groundwater system.

Table 2.2 Registered Groundwater Bores & Wells

Groundwater System	Stock & Domestic	Monitoring	Other Use	Total Bores
Shallow	0	0	3	3
Deep	13	18	12	43
Total	13	18	15	46

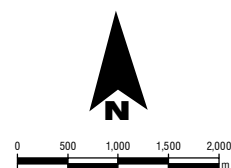
Source: *Groundwater Impact Assessment* (RPS, 2013b)

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ANGUS PLACE AIS

REGISTERED BORES AND WELLS

FIGURE 2.3

2.3 Geology

The Project Application Area is located in the southern portion of the Western Coalfields. The underlying strata comprise mostly sandstones of the Triassic Narrabeen Group, which are inter-bedded with shale and siltstone bands. The Narrabeen Group rocks are underlain by the Illawarra Coal Measures, which comprise inter-bedded sandstone, siltstone, shale and coal. The general dip of the bedding is to the northeast at about two degrees. The plateau area is cut by several deeply incised creek valleys, which drain to the north and west of the Project Application Area.

The Narrabeen Group rocks near the surface belong to the Grose Sub-group and include the Banks Wall Sandstone, the uppermost part of which is deeply weathered and generally very friable. The sandstone, which is up to 200 m thick in this region, is underlain by the Mt York Claystone, a fine grained stratum, with a thickness in this area ranging from four to 11 m, that limits vertical infiltration of groundwater from the overlying strata. The Illawarra Coal measures have a total thickness of about 120 m. The Lithgow Seam is the lowermost seam in the coal measures and is located about 25 m above the base of the coal measures (Aurecon, 2010).

2.4 Soil Landscape Units

The soil landscapes units 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 NSW Department of Primary Industries (DPI)), on the *Wallerawang 1:100,000 Sheet* (King, 1993) as shown in **Figure 2.4**.

As listed in **Table 2.3**, thirteen soil landscapes occur within the Project Application Area. Major points regarding the dominant soil landscape units are provided below.

- Land that is highly to severely constrained for any agricultural activity includes the Mount Sinai, Deanes Creek, Warragamba, Hassan Walls and Coco soil landscape units, which together cover 3,570 ha (34%) of the Project Application Area and 3 ha (2%) of the Proposed Surface Infrastructure assessment area.
- Land that is highly to severely constrained for cultivation (cropping) enterprises covers 6,478 ha of the Project Application Area (62%) and 30 ha (21%) of the Proposed Surface Infrastructure assessment area is
- Agricultural land best suited to grazing enterprises includes the Newnes Plateau, Medlow Bath, Cullen Bullen, Glen Alice and Lithgow soil landscape units, which together cover 3,895 ha of the Project Application Area (37%) and 111 ha (79%) of the Proposed Surface Infrastructure assessment area. These soil landscape units have moderate limitations for cultivation enterprises.
- Long Swamp and Wollangambe soil landscape units, which cover 2,908 ha (28%) of the Project Application Area and 27 ha (19%) of the Proposed Surface Infrastructure assessment area, have moderate to high limitations for grazing enterprises and high to severe limitations for cultivation.

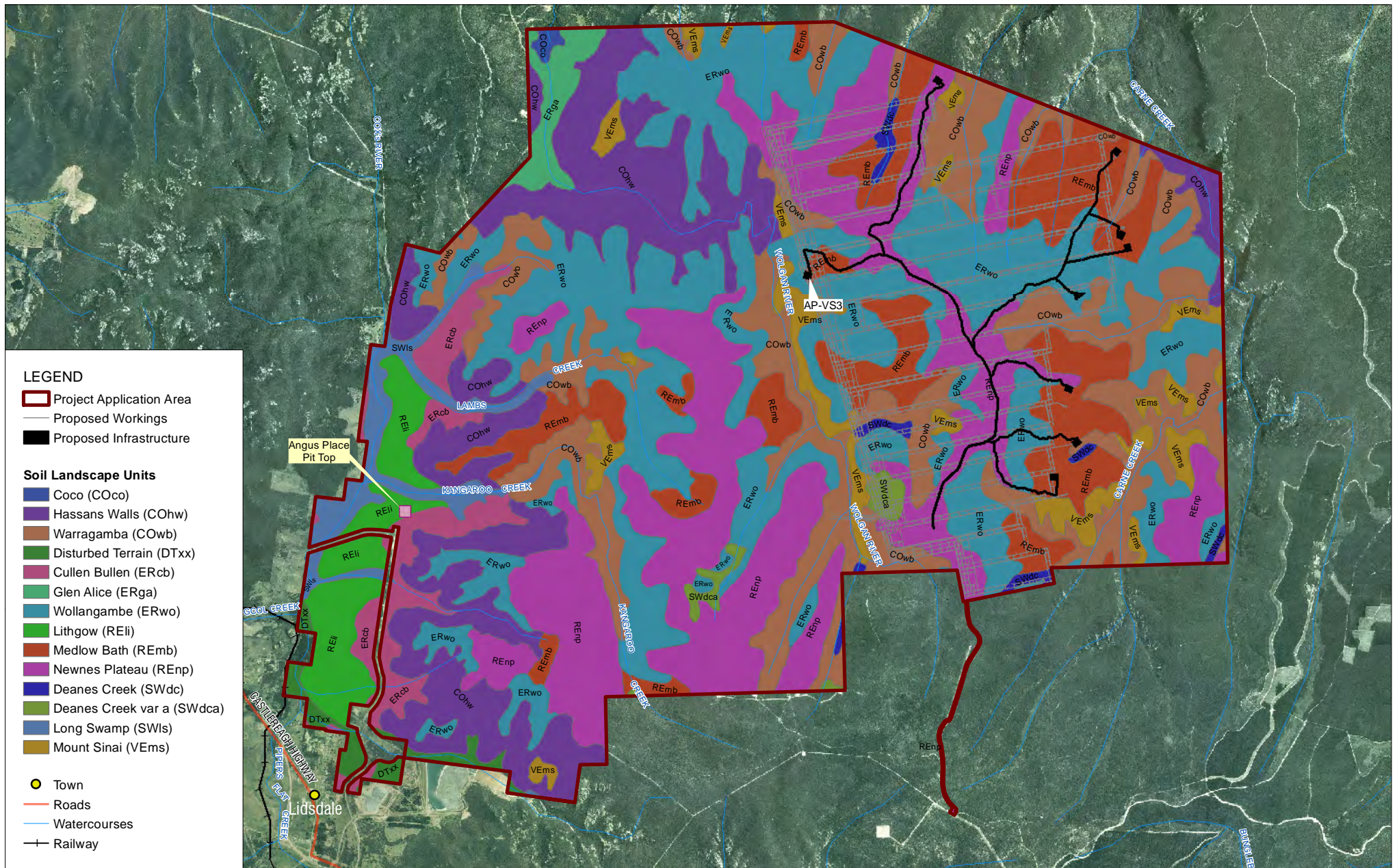


Table 2.3 Soil Landscape Units

Soil Landscape	Project Application Area		Proposed Surface Infrastructure Assessment Area		Agricultural Limitation Rating	
Unit	ha	%	ha	%	Grazing	Cultivation
Mount Sinai	397	4	1	<1	Severe	Severe
Deanes Creek	131	1	1	<1	Severe	Severe
Warragamba	1,609	15	1	<1	Severe	Severe
Hassan Walls	1,418	14	Nil	Nil	High – Severe	Severe
Coco	15	<1	Nil	Nil	High – Severe	Severe
Subtotal	3,570	34	3	2		
Long Swamp	236	2	Nil	Nil	Moderate	Severe
Wollangambe	2,672	26	27	19	Moderate – High	High
Subtotal	2,908	28	27	19		
Newnes Plateau	2,036	19	52	37	Low	Moderate
Medlow Bath	1,097	11	59	52	Low	Moderate
Cullen Bullen	305	3	Nil	Nil	Low	Moderate
Glen Alice	122	1	Nil	Nil	Low	Moderate
Lithgow	335	3	Nil	Nil	Low	Moderate
Subtotal	3,895	37	111	79		
Disturbed Terrain	95	1	Nil	Nil	n/a	
Total	10,468	100	141	100		

Source: *Soil and Land Capability Assessment* (SLR, 2013a)

These soil landscape units are further detailed in the *Soil and Land Capability Assessment* (SLR, 2013a) prepared for the Project

2.5 Dominant Soil Types and Inherent Fertility

The dominant soil types within the Project Application Area were ground-truthed at the scale of 1:100,000 by GSSE as part of the *Soil and Land Capability Assessment* (SLR, 2013a) and are shown in **Figure 2.5**. These soil types are summarised in **Table 2.4** and the major points listed below.

- Tenosols are the main soil order present in the Project Application Area. Tenosols are skeletal soils with minimal pedological development beyond the topsoil horizon with minimal profile development. Tenosols in the Project Application Area are generally strongly acidic, have low inherent fertility and comprise 87% (9,060 ha) of the Project Application Area and 99% (139 ha) of the Proposed Surface Infrastructure assessment area.
- Kandosols are the other soil order of note in the Project Application Area. Kandosols are uniformly textured soils which are poorly structured in the subsoil. Kandosols in the Project Application Area are generally strongly acidic, have moderately low to moderate inherent fertility and comprise 5% (566 ha) of the Project Application Area and 1% (1 ha) of the Proposed Surface Infrastructure assessment area.
- Rudosols and, Kurosols and comprise the remaining 7% (747 ha) of the Project Application Area, and only 1% (1 ha) of the Proposed Surface Infrastructure assessment area

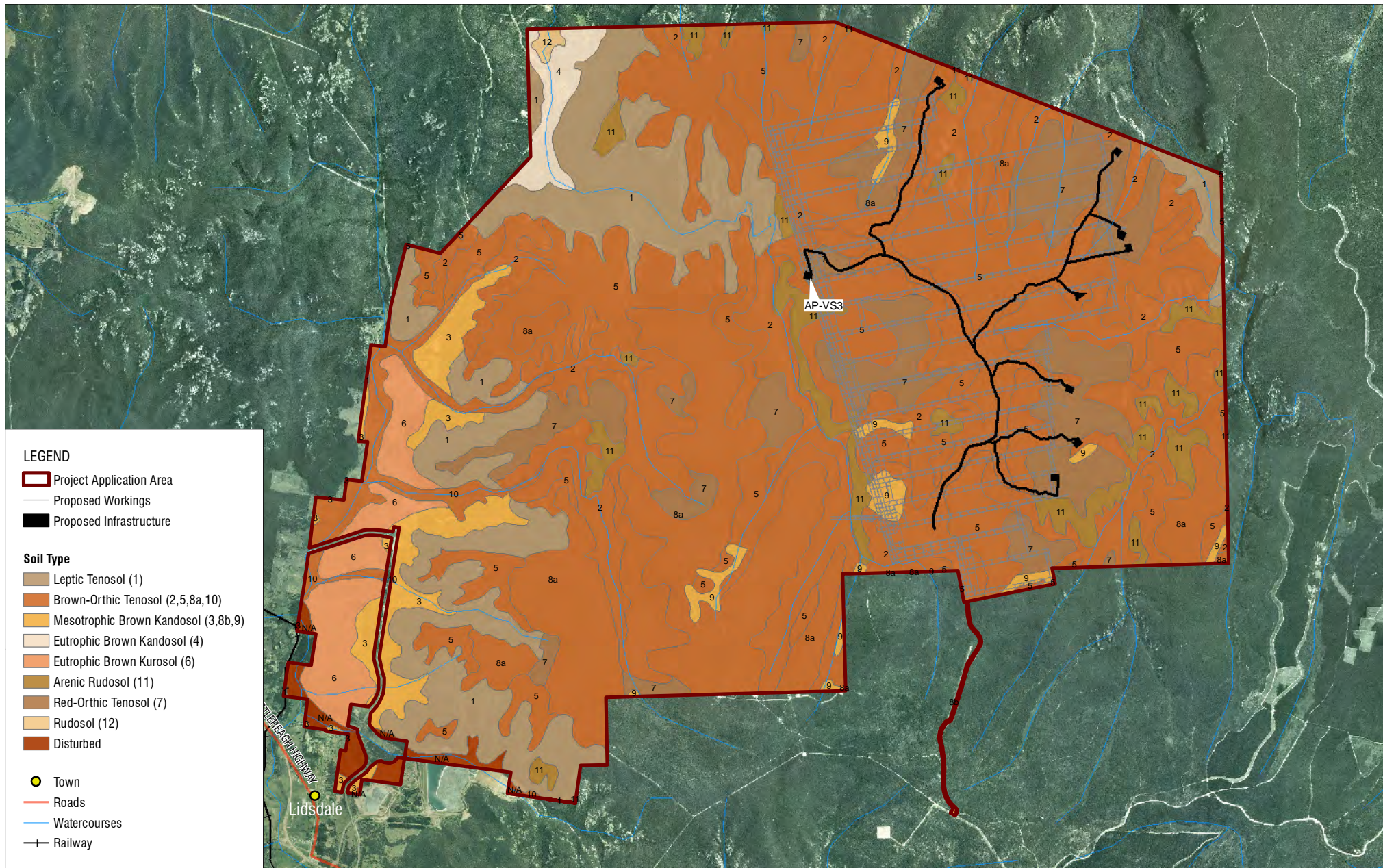


Table 2.4 Dominant Soil Types and Inherent Fertility

Australian Soil Classification Soil Type	Associated Soil Landscape	Project Application Area		Proposed Surface Infrastructure Assessment Area		Inherent Fertility
Name	Name	ha	%	ha	%	
Leptic Tenosol	Hassan Walls	1,418	14	Nil	Nil	Low
Brown-Orthic Tenosol	Warragamba	1,609	15	1	1	
Brown-Orthic Tenosol	Wollangambe	2,672	26	27	19	
Red-Orthic Tenosol	Medlow Bath	1,097	11	59	42	
Brown-Orthic Tenosol	Newnes Plateau (a)	2,028	19	52	37	
Brown-Orthic Tenosol	Long Swamp	236	2	Nil	Nil	
Arenic Rudosol	Mount Sinai	397	4	1	1	
Rudosol	Coco	15	<1	Nil	Nil	
Subtotal		9,472	91	140	99	
Mesotrophic Brown Kandosol	Cullen Bullen	305	3	Nil	Nil	Moderate
Eutrophic Brown Kandosol	Glen Alice	122	1	Nil	Nil	
Eutrophic Brown Kurosol	Lithgow	335	3	Nil	Nil	
Mesotrophic Brown Kandosol	Deanes Creek	131	1	1	1	
Mesotrophic Brown Kandosol	Newnes Plateau (b)	8	<1	Nil	Nil	
Subtotal		901	8	1	1	
Disturbed Terrain		95	1	Nil	Nil	n/a
Total		10,468	100	141	100	

Source: *Soil and Land Capability Assessment* (SLR, 2013a)

2.6 Acid Sulfate 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 sulphate soils, which are the main cause of acid generation within the soil mantle, are commonly found less than 5 m above sea level, particularly in low-lying coastal areas. The Project Application Area is located approximately 150 km from the coast and has an elevation range of 960 – 1,080 m ASL. It is therefore unlikely that acid sulphate soils (to a depth of 1.5 m) are present.

2.7 Vegetation and Land Use

The Newnes State Forest is located on the Newnes Plateau and contains both native forest and pine plantations. The Newnes Plateau is adjacent to the Wollemi National Park, part of the World Heritage listed Greater Blue Mountains area, whilst a portion of the Ben Bullen State Forest covers the western side of the Project Application Area (**Figure 1.2**)

The vegetation associated with the Project Application Area is dominated by native woodland (**Plate 2.1**). The *Flora and Fauna Assessment* (RPS, 2013c) undertaken for the Project identified 30 native vegetation communities. Of these, five were listed as endangered ecology communities, with two occurring within the Proposed Workings area and Proposed Surface Infrastructure assessment area, namely Newnes Plateau Shrub Swamp and Temperate Highland Peat Swamp on Sandstone.

A total of 13 threatened flora species were noted to have potential to occur within Project Application Area, and of these, two were recorded during the RPS survey, being *Persoonia hindii* and *Veronica blakelyi*.

The majority of the Project Application Area is not used for agriculture. Of the total 10,468 ha within the Project Application Area, there is 615 ha (6%) along the western boundary which has been cleared and is currently utilised for agricultural activities (**Figure 2.2**). A site inspection in June 2013 by SLR's Senior Agronomist, in conjunction with a desktop assessment, found that the dominant agricultural activities being carried out on the cleared area are small scale grazing with beef cattle, sheep, horses and goats. These grazing areas consisted of semi-improved cocksfoot, tall fescue, native grass and clover pastures on the flatter areas and valley floor, with native grasses and some clover on the hillslopes (**Plate 2.2**). One cultivated paddock, of approximately 20 ha, planted to a grazing crop of oats, was observed at the time of assessment.

It was also observed that the described grazing areas are being encroached upon by rural residential development, with lot sizes becoming too small for reliance on income generated by agricultural enterprises.



Plate 2.1 Typical State Forest landscape on Newnes Plateau



Plate 2.2 Typical agricultural landscape on western edge of the Project Application Area

2.8 Land and Soil Classification

In NSW the Rural Land Capability System developed by the former NSW Soil Conservation Service, which has been widely used to evaluate agricultural potential of land (Emery, 1986), has now been largely replaced by the new Land and Soil Classification (LSC) assessment scheme developed for NSW: *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2012). The LSC scheme builds on the Rural Land Capability system and retains the eight class system, however places additional emphasis on specific soil limitations and management.

The LSC classes are based on the biophysical features of the land associated with various hazards and the management of these hazards including the level of inputs, expertise and investment required to manage the land sustainably. Full details regarding the LSC assessment are provided in the *Soil and Land Capability Assessment* (SLR, 2013a).

The LSC Assessment for the Project Application Area and the relevant agricultural capability rating is summarised in **Table 2.5** The distribution of the LSC classes throughout the Project Application Area is shown in **Figure 2.6**. In summary, the major assessment points are:

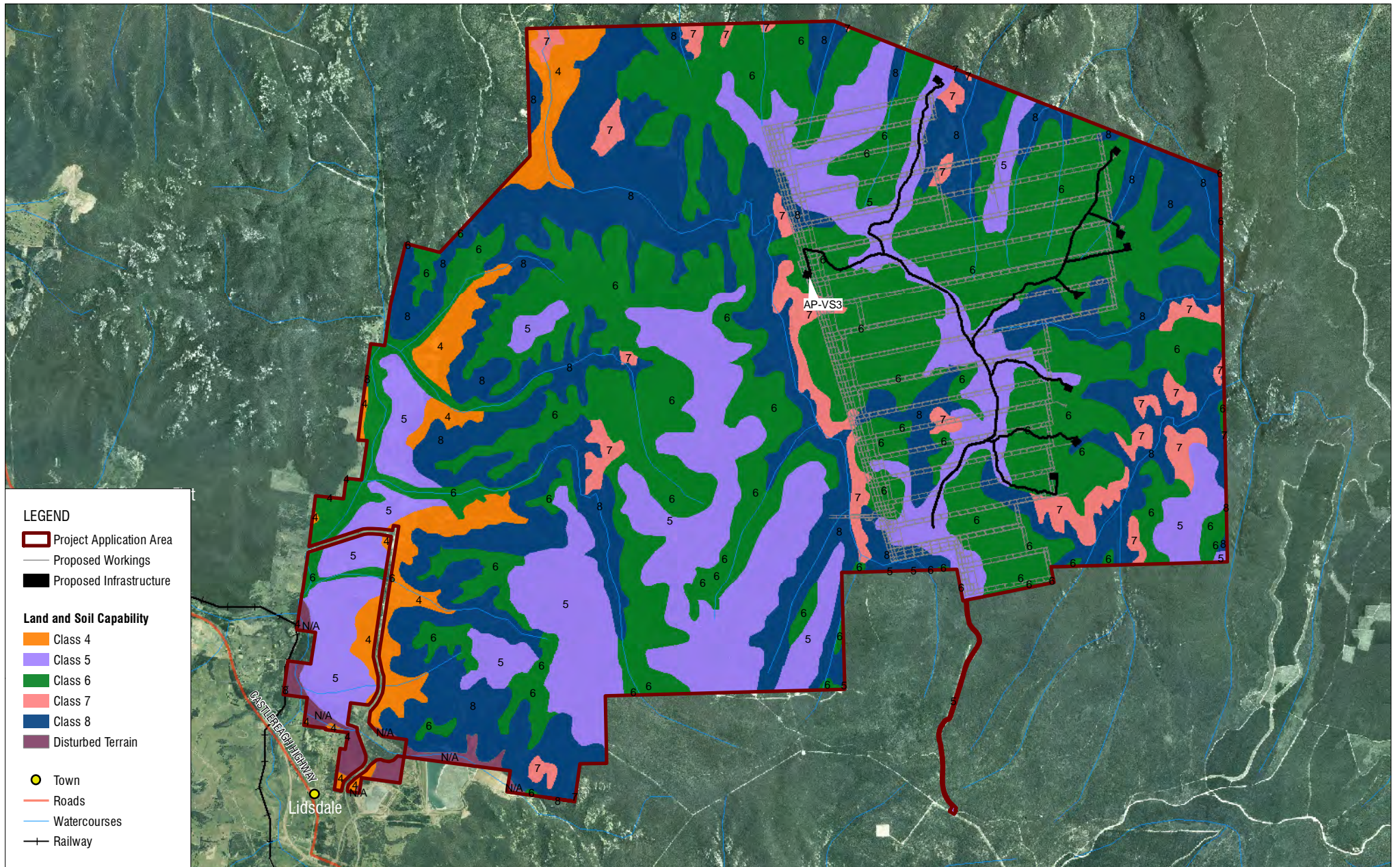
- The three dominant LSC Classes present in the Project Application Area are Class 5 (2,607 ha), Class 6 (3,900 ha) and Class 8 (3,027 ha).
- Class 4 land is the best class of land found in the Project Application Area and is associated with the Glen Alice and Cullen Bullen soil landscape units. Class 4 land is considered to be moderately capable land primarily suited to pasture cropping and grazing enterprises. The land has moderate to high limitations for high-impact activities (e.g. regular cultivation). Class 4 land covers 4% of the Project Application Area and is not found in the Proposed Surface Infrastructure assessment area.

- Class 5 land is associated with the Lithgow, Newnes Plateau (a), Newnes Plateau (b) and Long Swamp soil landscape units and is considered moderately-low capability land that is primarily suited to grazing enterprises. Class 5 land covers 25% of the Project Application Area and 37% (52 ha) of the Proposed Surface Infrastructure assessment area.
- Class 6 land is associated with the Wollangambe, Medlow Bath and Deanes Creek soil landscape units and is considered to have a low capability for agricultural enterprises and is suited to grazing enterprises only. Class 6 land covers 37% of the Project Application Area and 62% (87 ha) of the Proposed Surface Infrastructure assessment area.
- Class 7 land is associated with the Mount Sinai and Coco soil landscape units and is considered to have a very low capability for agricultural enterprises and is suitable for green timber coverage with native vegetation. This class covers a minor part of the Project Application Area (4%) and Proposed Surface Infrastructure assessment area (<1%).
- Class 8 land is associated with the Hassan Walls and Warragamba soil landscape units and is considered to have extremely low capability for agriculture. Class 8 land covers 29% of the Project Application Area and <1% of the Proposed Surface Infrastructure assessment area.

Within the Project Application Area, 96% of the land area is considered to have moderately low to extremely low agricultural capability according to definitions given in the *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2012). Using these definitions the entire Proposed Surface Infrastructure assessment area has moderately low to extremely low agricultural capability.

Table 2.5 Land and Soil Classification

LSC	Associated Soil Landscape	Project Application Area		Proposed Surface Infrastructure Assessment Area		Agricultural Capability Rating
Class	Name	ha	%	ha	%	
4	Glen Alice	122	1	Nil	Nil	Moderate
	Cullen Bullen	305	3	Nil	Nil	
Subtotal		427	4	Nil	Nil	
5	Lithgow	335	3	Nil	Nil	Moderately low
	Newnes Plateau (a)	2,028	20	52	37	
	Newnes Plateau (b)	8	<1	Nil	Nil	
	Long Swamp	236	2	Nil	Nil	
Subtotal		2,607	25	52	37	
6	Wollangambe	2,672	26	27	19	Low
	Medlow Bath	1,097	10	59	42	
	Deanes Creek	131	1	1	<1	
Subtotal		3,900	37	87	62	
7	Mount Sinai	397	4	1	<1	Very low
	Coco	15	<1	Nil	Nil	
Subtotal		412	4	1	<1	
8	Hassans Walls	1,418	14	Nil	Nil	Extremely low
	Warragamba	1,609	15	1	<1	
Subtotal		3,027	29	1	<1	
Disturbed Terrain		95	1	Nil	Nil	N/A
Total		10,468	100	141	100	



2.9 Biophysical Strategic Agricultural Land Assessment

The NSW Government recently released the Policy 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 industries. Part of this policy is the development of SRLUPs and/or Regional Growth Plans, which includes the determination of biophysical strategic agricultural land (BSAL). BSAL is defined as areas with unique natural resource characteristics highly suited for agriculture.

The SRLUP/Regional Growth Plan for land within the Project Application Area has not been released at this point in time. Notwithstanding, and adopting a precautionary approach, SLR (2013a) assessed the Project Application Area against the BSAL criteria contained in the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c) and the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* ((OEH & DPI - Office of Agricultural Sustainability and Food Security (DPI-OASFS) 2013).

2.9.1 BSAL Assessment – Upper Hunter Strategic Regional Land Use Plan

The first BSAL assessment was undertaken using the criteria from the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c).

The minimum requirement for rainfall reliability for the region was met for the Project Application Area (mean rainfall 1,073 mm, refer **Section 2.1**); therefore, only the LSC and fertility class were further assessed by SLR (2013a). To do this, this assessment compares the LSC Classes against each soil types inherent fertility attributes to determine if the BSAL criteria, as specified in are met in the Project Application Area. The soil fertility and the outcomes of the BSAL assessment are shown in **Table 2.6**.

Table 2.6 Applied Biophysical Strategic Agricultural Land Criteria

Soil Landscape	Soil Name	LSC	Inherent Fertility	BSAL	BSAL Limitation
Unit	ASC	Class	Class	Yes/No	Description
Cullen Bullen	Kandosol	4	Moderate	No	LSC class
Glen Alice	Kandosol	4	Moderate	No	LSC class
Newnes Plateau (b)	Kandosol	5	Moderate	No	LSC Class
Lithgow	Kurosol	5	Moderate	No	LSC class
Newnes Plateau (a)	Tenosol	5	Low	No	LSC class & fertility
Long Swamp	Tenosol	5	Low	No	LSC class & fertility
Wollangambe	Tenosol	6	Low	No	LSC class & fertility
Medlow Bath	Tenosol	6	Low	No	LSC class & fertility
Deanes Creek	Kandosol	6	Moderate	No	LSC class
Mount Sinai	Rudosol	7	Low	No	LSC class & fertility
Coco	Rudosol	7	Low	No	LSC class & fertility
Hassan Walls	Tenosol	8	Low	No	LSC class & fertility
Warragamba	Tenosol	8	Low	No	LSC class & fertility
Disturbed Terrain	Not Assessed	N/A			

Source: *Soil and Land Capability Assessment* (SLR, 2013a)

The inherent fertility class and LSC classifications for the soil types associated with Newnes Plateau (a), Long Swamp, Wollangambe, Medlow Bath, Mount Sinai, Coco, Hassan Walls and Warragamba soil landscape units indicate that the soil resources do not qualify as BSAL under the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c).

The soil types associated with Cullen Bullen, Glen Alice, Lithgow, Newnes Plateau (b) and Deanes Creek soil landscape units do not meet the LSC class criteria and therefore also not qualify as BSAL under the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c).

Whilst the Project Application Area met the minimum rainfall criteria of >350 mm per annum in nine out of ten years, no soil types qualified as BSAL under the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c) criteria.

2.9.2 BSAL Assessment – Interim Protocol for Site Verification

The second BSAL assessment undertaken by SLR (2013a) used the criteria from the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH & DPI-OASFS, 2013). This methodology used a two phase verification assessment:

Phase 1 – Confirm access to reliable water supply.

Phase 2 - 12 step site verification criteria.

Phase 1 Assessment – Access to Reliable Water Supply

For lands to be classified as BSAL they must have access to reliable water supply defined as:

- Greater than 350 mm rainfall per annum (in nine out of ten years); or
- Within 150 m of a regulated river; or
- Within 150 m of a 5th order unregulated river; or
- Within 150 m of an unregulated river that flows 95% of the time; or
- Access to highly productive groundwater (as defined by NSW Office of Water).

Phase 2 Assessment - Verification Criteria

The 12 step site verification criteria are shown in **Table 2.7**. If a criterion fails to meet any of the BSAL conditions (except step 5 or step 6), the site is rejected as BSAL and the remaining conditions are not assessed.

Table 2.7 Twelve Step Site Verification Criteria According to Interim Protocol

Step Number	Criteria	BSAL Definition
1	Slope	Slope of less than or equal to 10%
2	Rock Outcrop	Rock outcrop of less than 30%
3	Surface Rockiness	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter
4	Gilgai	Less than 50% of the area has gilgai depression that are deeper than 500 mm
5	Slope	Slope of less than 5%
6	Rock Outcrop	Nil rock outcrop
7	Soil Fertility	Moderate fertility (if < 5 % slope, nil rock outcrop)
		Moderately high or high fertility (if < 5% slope, 5-30% rock outcrop)
		Moderately high or high fertility (if > 5% slope)
8	Physical Barrier	Effective rooting depth to a physical barrier is greater than or equal to 750 mm
9	Soil Drainage	Soil drainage is better than poor
10	pH	pH within range of 5.0 to 8.9 when measured in water or pH within range of 4.2 to 8.1 when measured in calcium chloride.
11	Soil Salinity	Electrical conductivity in a saturated extract less than or equal to 4 dS/m or if gypsum is present, chlorides less than 800 mg/kg
12	Chemical Barrier	Effective rooting depth to a chemical barrier is greater than or equal to 750 mm

Source: *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH & DPI-OASFS, 2013)

BSAL Assessment Results

The minimum requirement for Phase 1 was met for all soil types with an average annual rainfall of approximately 1,073 mm for the Project Application Area (**Section 2.1**). A summary of the Phase 2 BSAL verification criteria assessment across the Project Application Area is provided in **Table 2.8** and the key findings are:

- Soil types associated with Hassan Walls, Warragamba, Glen Alice, Wollangambe, Medlow Bath, Newnes Plateau (b), Mount Sinai and Coco soil landscape units did not meet the criteria for Step 1 with slopes greater than 10%. All remaining soil types met the criteria for Steps 2 to 4.
- Soil types associated with Cullen Bullen, Lithgow, Newnes Plateau (a) and Deanes Creek soil landscape units are all classified as generally >5% slope for Step 5, and 'Nil rock outcrop' for Step 6. These soil types all have 'Moderate' fertility according to the Interim Protocol and did not meet the minimum criteria for Step 7.
- The soil type associated with Long Swamp soil landscape unit is classified as 'less than 5% slope' for Step 5, and 'Nil rock outcrop' for Step 6. This soil type has 'Low' fertility according to the Interim Protocol and did not meet the minimum criteria for Step 7.

Table 2.8 Applied BSAL Criteria: Interim Protocol for Site Verification

Soil Landscape	Site Verification Step										BSAL
Unit	1	2	3	4	5	6	7	8	9	10	
Hassan Walls	✗	-	-	-	-	-	-	-	-	-	No
Warragamba	✗	-	-	-	-	-	-	-	-	-	No
Cullen Bullen	✓	✓	✓	✓	✗	-	✗	-	-	-	No
Glen Alice	✗	-	-	-	-	-	-	-	-	-	No
Wollangambe	✗	-	-	-	-	-	-	-	-	-	No
Lithgow	✓	✓	✓	✓	✗	-	✗	-	-	-	No
Medlow Bath	✗	-	-	-	-	-	-	-	-	-	No
Newnes Plateau (a)	✓	✓	✓	✓	✗	-	✗	-	-	-	No
Newnes Plateau (b)	✗	-	-	-	-	-	-	-	-	-	No
Deanes Creek	✓	✓	✓	✓	✗	-	✗	-	-	-	No
Long Swamp	✓	✓	✓	✓	✓	✓	✗	-	-	-	No
Mount Sinai	✗	-	-	-	-	-	-	-	-	-	No
Coco	✗	-	-	-	-	-	-	-	-	-	No

Source: *Soil and Land Capability Assessment* (SLR, 2013a)

2.9.3 Biophysical Strategic Agricultural Land Summary

As discussed two BSAL assessments have been completed due to differing BSAL assessment criteria contained firstly in the *Upper Hunter Strategic Regional Land Use Plan* (DP&I, 2012c) and secondly the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEI & DPI-OASFS, 2013). Both assessments determined that no BSAL is present within the Project Application Area.

The nearest mapped BSAL according to the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 - Strategic Agricultural Land Map - Sheet STA_32* (DP&I, 2013) is approximately 14 km to the north-west of the Project Application Area.

3 LOCAL AND REGIONAL AGRICULTURAL ENTERPRISES

3.1 Agricultural History

Whilst the modern Lithgow economy was established based on coal mining, copper smelting, steel manufacturing and other industrial enterprises, the grazing of beef cattle and sheep, along with some cropping for grain production have been carried out in the region since the 1830s. There are records of flour milling from locally grown wheat as far back as 1837, and later in 1857 a wool mill was developed to produce tweed from locally sourced wool. The wool mill operation continued for 115 years, ceasing operation in 1972. 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

The Project Application Area has experienced forestry activities in conjunction with the coal mining industry since early European settlement. However, it is assumed that given the terrain and soils within the area, very little other agricultural activity occurred in the immediate vicinity of the Project Application Area.

The agriculture land uses for the Lithgow LGA (Local Government Area), ((Australian Bureau of Statistics (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 beef cattle, covering greater than 99% of all agricultural land. Of these two main grazing enterprises sheep numbers make up 54% 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 LGA, 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 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.

Forestry has not been assessed as an agricultural enterprise as it is not included as an agricultural enterprise in the *Guideline for Agricultural Impact Statements* (DP&I, 2012b).

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		
	Units	Total
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 of total stock	%	54
Proportion of beef cattle of total stock	%	46
Proportion of pigs and milk cattle of 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: ABS (2011)

3.2.2 Regional Employment

A summary of the total employment within the Lithgow Region (Lithgow LGA) and the proportion of agriculture related employment is shown in **Table 3.2**. Agriculture is not a major employer within the region, accounting for only 9% of the total employed population.

Table 3.2 Lithgow Regional Agricultural Employment

Employment Sector	No. of persons	%
Total Regional Employment	7,717	100
Direct Regional Agricultural Employment	207	3
Indirect Regional Agricultural Employment	492	6
Total Regional Employment Related to Agriculture	699	9

Source: ABS (2011)

Employment in the agriculture related sectors is broken down in **Table 3.3** and the following key points made in relation to this 9% employed in agriculture are:

- Agriculture-related wholesaling, retailing manufacturing and processing is responsible for the majority (70%) of total agricultural-related employment, compared to employment associated with direct agricultural production (30%).
- The major agricultural production employers are beef cattle comprising 68% 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 71%.
- Supermarkets and grocery stores account for the vast majority (70%) of indirect agricultural related employment in wholesaling and retailing.

Detailed agricultural employment figures are not available for the Project Application Area. However, a detailed agricultural enterprise assessment has been carried out in **Section 3.4**.

Table 3.3 Lithgow Regional Agricultural Related Employment by Sector

Agricultural Related Sector	No. Persons	%
Agricultural Production (Direct)		
Agriculture General	18	3
Beef Cattle Farming (Specialised)	91	13
Nursery Production (Outdoors)	6	1
Onshore Aquaculture	3	<1
Other Livestock Farming	7	1
Grain-Sheep or Grain-Beef Cattle Farming	7	1
Horse Farming	5	1
Sheep Farming (Specialised)	25	4
Sheep-Beef Cattle Farming	42	6
Vegetable Growing (Outdoors)	3	<1
Subtotal	207	30
Agriculture Related Processing and Manufacturing (Indirect)	No. Persons	%
Bakery Product Manufacturing (Non-factory based)	11	2
Bread Manufacturing (Factory based)	5	1
Cake and Pastry Manufacturing (Factory based)	4	1
Fertiliser Manufacturing	3	<1
Meat Processing	4	1
Poultry Processing	3	<1
Fruit and Vegetable Processing	19	3
Food Product Manufacturing	6	1
Other Agriculture and Fishing Support Services	8	1
Road Freight Transport	154	22
Subtotal	217	31
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	3
Fruit and Vegetable Retailing	6	1
Other Grocery Wholesaling	22	3
Supermarket and Grocery Stores	204	29
Agricultural and Construction Machinery Wholesaling	3	<1
Subtotal	275	39
Total Agricultural Related Employment	699	100

Source: ABS (2011)

3.3 Regional Agricultural Production Value

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

Table 3.4 Regional Agricultural Production

Agricultural Production Gross Value	Total (M)
Crops	\$1
Livestock slaughtering	\$11
Livestock products	\$6
Total gross agricultural production	\$18

Source: ABS (2011)

3.4 Potential Agricultural Production Value of the Project Application Area

After field inspection by SLR's Senior Agronomist it is expected that income generated from agricultural enterprises within the Project Application Area would be minimal due to the small area available for actual agricultural production, with most landholders reliant on off-farm income. It is therefore concluded that there are minimal individuals directly employed within agriculture in the Project Application Area.

Notwithstanding, potential agricultural productivity was determined using the NSW Department of Trade and Investment agricultural productivity data for agricultural enterprises suitable for each of the LSC classes that are within the Project Application Area and could potentially be impacted upon by the Project (see **Section 2.9**). This analysis has been undertaken on the potential agricultural capability of the land rather than current land use. At present the majority of the Project Application Area is native woodland and not suitable for agricultural production in its current guise. If the below agricultural production values were to be realised, significant investment in land management and agricultural infrastructure would be required in order to yield the identified agricultural production values. However this information can be used to approximate potential agricultural income.

The *Beef Cattle Gross Margin Budget Yearling Southern/Central NSW* ((NSW Industry and Investment (I&I), 2012), 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, 2011a) have been applied to this assessment. Full agricultural productivity information is contained in **Appendix 1**. Gross margins for each applicable agricultural enterprise per LSC Class are shown in **Table 3.5** and **Table 3.6**. The major points are listed below:

- Class 4 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 5 land has the potential to generate approximately \$125/ha from beef cattle grazing enterprise or \$230/ha from a Merino meat lamb enterprise.
- Class 6 land has the potential to generate approximately \$107/ha from beef cattle grazing enterprise or \$171/ha from a Merino meat lamb enterprise
- Class 7 land has the potential to generate approximately \$54/ha from beef cattle grazing enterprise or \$86/ha from a Merino meat lamb enterprise.

- Class 8 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 LSC Class

LSC	Livestock-carrying Capacity	Cow and Calf	Revenue	Variable Costs	Gross Margin
Class	Dry sheep equivalent	Per ha	Per ha	Per ha	Per ha
4	8	0.48	\$276	\$109	\$167
5	6	0.36	\$207	\$82	\$125
6	4	0.24	\$138	\$31	\$107
7	2	0.12	\$69	\$15	\$54
8	Nil	N/A	N/A	N/A	Nil

Table 3.6 Merino Meat Lamb Gross Margin per LSC Class

LSC	Livestock-carrying Capacity	Ewe & Lamb	Revenue	Variable Costs	Gross Margin
Class	Dry sheep equivalent	Per ha	Per ha	Per ha	Per ha
4	8	3.2	\$592	\$285	\$307
5	6	2.4	\$444	\$214	\$230
6	4	1.6	\$296	\$125	\$171
7	2	0.8	\$148	\$62	\$86
8	Nil	N/A	N/A	N/A	Nil

Both beef cattle and sheep comprise the majority of agricultural revenue in the Lithgow LGA, 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 in **Table 3.5** and **Table 3.6**), the Project Application Area has the potential to generate an estimated gross margin of \$1,136,203 per annum whilst the Proposed Surface Infrastructure assessment area has a potential gross margin of \$21,419 (see **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

LSC	Average Gross Margin	Project Application Area		Proposed Surface Infrastructure Assessment Area	
Class	Per ha	ha	Gross Margin	ha	Gross Margin
4	\$237	427	\$101,199	Nil	Nil
5	\$178	2,607	\$464,064	52	\$9,256
6	\$139	3,900	\$542,100	87	\$12,093
7	\$70	412	\$28,840	1	\$70
8	Nil	3,027	Nil	1	Nil
Disturbed Terrain	Nil	95	Nil	Nil	Nil
Total	-	10,468	\$1,136,203	141	\$21,419

3.5 Agricultural Support Infrastructure

There is limited agricultural support infrastructure in the Lithgow LGA. The main arterial road is the Great Western Highway, whilst the main rail line is the Main Western 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 located at Carcoar Central Tablelands Livestock Exchange, approximately 52 km from the Project Application Area and 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.

In the broad regional context, agriculture is a minor contributor to the local economy with total gross agricultural production of \$18 M; this is in comparison the Bathurst LGA at \$47 M (ABS, 2011). Approximately 33% of land within the Lithgow LGA is suitable for agricultural production (Bathurst LGA 63%). The total value of agricultural production to the Lithgow LGA is low.

The average value of agriculture (livestock and cropping activities) for agriculturally suitable land in the Lithgow LGA in 2011 was calculated at \$135/ha from a total agriculture production value of \$18 M (ABS, 2011). This low value per ha and the smaller holding size suggests that many agricultural enterprises are reliant on off-farm income (Lithgow City Council (LCC), 2007 and LCC, 2010).

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).

There small areas of traditional agricultural production, such as beef cattle, sheep, horse and goat grazing, within the Project Application Area, however they are far removed from any areas of potential disturbance.

4 ASSESSMENT OF POTENTIAL IMPACTS

The land within the Project Application Area with the potential to be disturbed by the Proposed Surface Infrastructure will be a maximum of 23.25 ha. The Proposed Surface Infrastructure area includes the proposed disturbance associated with the construction of a ventilation shaft, dewatering and water transfer boreholes, and associated infrastructure and access tracks

Whilst none of this land is currently being used for agricultural activities an agricultural productivity assessment has been applied against its potential agricultural value.

4.1 Land Resources

4.1.1 Land Temporarily Removed From Agriculture

4.1.1.1 Surface Disturbance: Social and Economic Impact

To ensure due diligence and allow for the incorporation of possible alignment changes during the EIS process a Proposed Surface Infrastructure assessment area of 141 ha has been assessed for potential surface disturbance (**Figure 1.2**). The Proposed Surface Infrastructure assessment area includes all Asset Protection Zones as defined by the NSW Rural Fire Service (RFS) in *Standards for Asset Protection Zones* (RFS, 2006).

The Proposed Surface Infrastructure assessment area has been assessed under the scenario that it will temporarily remove 141 ha of land from potential agricultural production during the life of the Project (approximately 25 years), which represents 1.4% of the Project Application Area. The LSC classes within this 141 ha are listed in **Table 4.1**.

Table 4.1 Temporary Surface Disturbance

LSC	Proposed Surface Infrastructure Assessment Area		Gross Margin	
Class	ha	% of Project Application Area	Per ha	Total
4	Nil	Nil	\$237	Nil
5	52	0.5	\$178	\$9,256
6	87	0.8	\$139	\$12,093
7	1	<0.1	\$70	\$70
8	1	<0.1	Nil	Nil
Disturbed Terrain	Nil	Nil	Nil	Nil
Total	141	1.4	-	\$21,419

Using 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 \$21,419 per annum (**Table 4.1**). The flow-on effects to employment and local business are considered negligible as the area of land to be disturbed and associated potential agricultural productivity is very low.

4.1.1.2 Other Impacts: Social and Economic Impact

The *Subsidence Predictions and Impact Assessment* (MSEC, 2013) identified potential impacts on manmade and natural features as a result of subsidence and these are:

- Wire fencing used in agriculture can be affected by tilting of fence posts and by changes of tension in the fence wires due to strain as mining occurs. These types of fences are generally flexible in construction and can usually tolerate tilts of up to 10 mm/m and strains of up to 5 mm/m without significant impacts. It is likely, therefore, that some of the wire fences within the Project Application Area would be impacted as the result of mining.
- Groundwater wells or bores. There were no registered groundwater bores identified above the Proposed Workings. There were, however, registered groundwater bores identified in the vicinity of the Proposed Workings, with the locations shown in **Figure 2.3**. The registered uses of these bores are for groundwater monitoring or mine dewatering. No detrimental impacts are anticipated on any other groundwater users in the area (RPS, 2013b).
- Ponding. The predicted post-disturbance slope gradients are expected to be very similar to the natural grades along drainage lines. Therefore it is not expected that any significant change in ponding or scouring along drainage lines will occur. Where the natural gradients are naturally low upstream of longwall chain pillars, some minor ponding may occur (MSEC, 2013)

Such impacts are readily managed through mitigation measures, as summarised in **Section 5**.

Total potential loss to agricultural enterprises due to the proposed surface infrastructure is \$21,419 per annum. 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 \$27.24 M per annum (Agis Group, 2013), \$21,419 is considered a negligible impact on agricultural enterprises and related industries. The only area of actual agricultural production (615 ha) is well outside the Proposed Surface Infrastructure assessment area and Proposed Workings and will not be impacted by the Project.

4.1.2 Land Permanently Removed From Agriculture

Following cessation of mining the *Decommissioning and Rehabilitation Strategy* (SLR, 2013b) proposes to rehabilitate the disturbed land to create final landforms commensurate with the end land uses in accordance with the proposed land zoning in the draft *Lithgow City Local Environmental Plan* (2013). The final land use for the Proposed Surface Infrastructure area is woodland, which is consistent with the proposed RU3 Forestry for all infrastructure areas on Newnes Plateau.

There is no land within the Project Application Area that will be permanently removed from agriculture as a result of the Project.

4.2 Water Resources

4.2.1 Surface Water

Angus Place is a net water producer with excess water to be managed with a combination of direct transfer to the Wallerawang Power Station via the SDWTS, and discharge through LDP001 and Springvale's LDP009.

The Project will lead to increased groundwater inflows to underground workings with distribution of discharges dependant on the water management strategy chosen. If the SDWTS is not upgraded from its current capacity of 30 ML/day, discharges at LDP001 will increase by 1,821 ML/year (RPS, 2013a). However if the SDWTS is upgraded to 45 ML/day most of the discharge will occur at Springvale's LDP009, further downstream of LDP001 and closer to Lake Wallace.

These discharges are not expected to significantly change the current salt concentration of the Coxs River in the long term. Salt levels in the Coxs River average 600 micro Siemens ($\mu\text{S}/\text{cm}$), ranging between 400 $\mu\text{S}/\text{cm}$ to 1,200 $\mu\text{S}/\text{cm}$. Median salt values at monitoring points downstream of LDP001 are below 1,000 $\mu\text{S}/\text{cm}$ (RPS, 2013a). These daily releases will have a positive impact on water security for downstream agricultural enterprises as water within this salinity range is suitable for all livestock and moderately salt sensitive plants such as lucerne, perennial grasses and cereal crops (I&I, 2009).

RPS (2013a) recommends current water quality requirements of pH 6.5 – 8.0, total suspended solids 30 milligrams per litre (mg/L) and oil and grease of 10 mg/L be maintained, therefore there are no impacts expected on water quality in the Coxs River catchment.

The *Surface Water Assessment* (RPS, 2013a) states that predicted subsidence above the Proposed Workings will increase the overall permeability of catchments within the Newnes Plateau resulting in enhanced groundwater infiltration and shallow aquifer recharge. The increase in overall permeability will potentially reduce immediately available runoff. An overall net decline in baseflow of 0.74 ML/day is predicted within the catchment (RPS, 2013b). As this impact is localised to the area within the vicinity of the Proposed Workings it is unlikely to impact agricultural enterprises which are located well west of the Proposed Workings, and is further offset by increased discharges into the Coxs River from LDP001 or Springvale's LDP009 as a result of the Project.

Flood modelling by RPS (2013a) indicates the impact of flooding on agricultural areas, roads and transport as a result of the Project will be minimal, with limited changes to modelled flood extents and out of bank flood duration.

It can be concluded that the Project is unlikely to cause long term impacts on surface water quality or quantity within the Project Application Area or further downstream, which are relied on by agriculture.

4.2.2 Groundwater

Coal mines surrounding the Project Application Area were included in the groundwater impact model to adequately address Aquifer Interference Policy (NOW, 2012) requirements and the Project's DGRs. The Groundwater Impact Assessment (RPS, 2013b) states that there are no detrimental impacts anticipated on any other groundwater users in the vicinity of the Project Application Area. This is supported by the Groundwater Impact Model for the area (CSIRO, 2013), which predicts only minor impacts to the shallow groundwater system and baseflow. This was modelled on a conservative basis whereby the model was unable to replicate the self-healing nature of creek sand swamps, and as such over-predicts the magnitude of potential impacts.

No deterioration in groundwater quality has been observed during current operations at Angus Place, with current inflow water quality between 700 – 1,000 $\mu\text{S}/\text{cm}$ and no detrimental impacts to groundwater quality are predicted as a result of the Project within the Project Application Area or potential regional influence (RPS, 2013b).

The only known groundwater use in the vicinity of the Project Application Area is for mining supply (RPS, 2013b). As there are no other groundwater users within the vicinity of the Project Application Area, there are no detrimental impacts anticipated upon agricultural enterprises reliant on groundwater resources associated with the Project. Given the similarities of the proposed development with past operations at Angus Place Colliery there are no detrimental impacts anticipated upon agricultural enterprises reliant on groundwater resources associated with the Project.

4.2.3 Groundwater Reallocation

The *Western Coalfields Water Balance* (GHD, 2013) shows groundwater licences held by Angus Place total 5,224 ML (**Table 4.2**). There is the possibility that groundwater extracted via Angus Place's current groundwater extraction licences could be used for agricultural irrigation, given the groundwater electrical conductivities fall in the range 700 – 1,000 $\mu\text{S}/\text{cm}$ (RPS, 2013b), which is defined as good quality groundwater and suitable for all agricultural enterprises (I&I, 2009).

Table 4.2 Groundwater Extraction Licences

Licence Number	Bore Name	Extraction Volume (ML/year)	Groundwater Source
10BL601851	Bore 940	2,523	Sydney Basin Richmond
10BL601838	Collector System	2,701	Sydney Basin Cocks River
Total		5,224	

Source: *Western Coalfields Water Balance* (GHD, 2013)

4.2.3.1 Agricultural Productivity Impact

Groundwater removed by the Angus Place Colliery through de-watering would otherwise be available for agricultural use. Whilst there is not land suitable for irrigation within the Project Application Area (LSC Class 1, 2 or 3), there is land suited to irrigation within the region. Applying a precautionary assessment and assuming that all of this water could have been used for irrigated cropping, the gross margin for the production of spray-irrigated lucerne has been calculated.

Spray-irrigated lucerne uses on average 8 ML/ha/annum; therefore, a maximum of 653 ha could be irrigated using the 5,224 ML of groundwater extraction licences. Assuming five cuts of irrigated lucerne per season, at 2.5 tonnes per/ha/cut, the gross annual revenue for this enterprise is \$3,440/ha with a gross margin of \$780/ha. Gross margins were determined using *Dryland Lucerne Hay Gross Margin Budget Northern Zone Summer 2010-11* (I&I, 2010) and *Surface Irrigated Lucerne – Established Stand Summer 2011-2012* (DPI, 2011b) (**Appendix 1**). Therefore, the water could have been used to generate \$509,340 per annum (**Table 4.3**).

With the water removed from agricultural use, it is assumed that the land would otherwise be used for dryland lucerne production. Productivity levels are summarised in **Table 4.3** and the 5,224 ML has the capacity to generate \$309,643 per annum from for dryland lucerne production (**Table 4.3**).

Table 4.3 Groundwater Use Gross Margins

LSC	Farming Type	Lucerne	Potential Revenue	Variable Costs	Gross Margin	Total
Class		Tonnes per ha	Per ha	Per ha	\$ Per ha	653 ha
3	Irrigation	12.5	\$3,440	\$2,660	\$780	\$509,340
3	Dryland	5	\$1,440	\$975	\$465	\$303,643

In summary, the total potential gross income, which could be generated from a 653 ha irrigated lucerne enterprise utilising 5,224 ML of licenced water extraction, is \$509,340 per annum. By changing the enterprise to dryland lucerne this reduces the total potential gross income by \$205,697 per annum.

4.2.3.2 Long-term Use of Reallocated Water

At the completion of mining operations and following rehabilitation, water licences held by Angus Place Colliery, which are surplus to requirements, may be sold on the water transfer market, and as such water may become available for agriculture or some other beneficial use.

4.3 Impact on Biophysical Strategic Agricultural Land

The *Soil and Land Capability Assessment* (GSSE, 2013a) did not identify any potential BSAL within the Project Application Area; therefore the Project will not have an impact upon BSAL.

Furthermore the nearest mapped BSAL is approximately 15 km to the north-west of the Project Application Area and will not be impacted by the Project.

4.4 Impact on Agricultural Resources from Biodiversity Offsets

A regional biodiversity offset strategy has been proposed by Angus Place to offset the loss of vegetation clearing associated with the construction of the new surface facilities required to support the Project.

The proposed regional offset strategy will take into consideration the impacts and offset requirements for other Centennial projects in the locality including the Springvale Colliery Mine Extension Project, the Neubecks Project and the Airly Mine Extension Project. Until the biodiversity offset strategy is formalised, impacts upon agricultural resources cannot be determined as the area of agricultural land which may be used for biodiversity offsets is not known, however Centennial will aim to minimise any impact of these biodiversity offsets on productive agricultural land.

4.5 Other Impacts

4.5.1 Visual Amenity and Landscape Values

The Project aims to maximise the use of existing surface infrastructure, and there is no new surface infrastructure proposed to be installed on currently utilised agricultural land (**Figure 2.2**). The *Visual Impact Assessment* (Golder, 2013b) undertaken found the Project to have a negligible to low visual impact. Among other reasons, this can be attributed to the proposed Angus Place surface infrastructure to be located within a landscape context of sloping and ridgeline formations with moderate to dense tree cover and a high visual absorption capacity, far removed from any agricultural enterprises. On this basis, the Project will have negligible impact on visual amenity and landscape value relied upon by local and regional agricultural enterprises.

4.5.2 Tourism

The impact assessment has not identified any tourism infrastructure in the local area upon which agricultural enterprises are reliant. Therefore the Project is not anticipated to have an impact on local agriculture-related tourism.

4.5.3 Weed Management and Biosecurity

There is moderate risk from weed infestation during the construction and operational phases of the Project through vehicle movements on and off site. Weeds are currently managed within the frameworks of the Angus Place Mine Environmental Management System, which includes issue-specific environmental management plans and monitoring programs. Continued inspection for weed germination will be conducted during the construction phase of the Project.

Biosecurity is defined in the *Draft NSW Biosecurity Strategy* (DPI, 2012) 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 our country and becoming established. On a regional level, appropriate weed management will reduce biosecurity risks. Any import of equipment or machinery from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements. Given the processes above, it is considered the Project is unlikely to represent an increased risk to the biosecurity of agricultural resources and enterprises within the region.

4.5.4 Dust

There is potential for the Project to generate dust primarily as a result of construction activities, mine operations (including crushing and transfer of coal), mine ventilation and site rehabilitation. The *Air Quality and Greenhouse Gas Assessment* (SLR, 2013c) undertaken for the Project advised the predicted results showed that construction, mine operations and subsequent rehabilitation activities are unlikely to cause any exceedences of the relevant ambient air quality criteria for TSP, PM₁₀ and PM_{2.5} concentrations or dust deposition at any identified surrounding sensitive receptors.

On this basis, it is concluded the Project will have negligible impact on agricultural resources and enterprises. Mitigation measures to minimise dust generation are discussed in **Section 5**.

4.5.5 Noise

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 construction noise modelling assessment undertaken by SLR (2013d), *Noise Impact Assessment*, indicates that the relevant intrusive and amenity noise criteria will 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.

The operational noise criteria for the Newnes State Forest recreational area is predicted to be met at distances of approximately 550 m to 700 m from the Vent Shaft 2 area and less than 100 m from the proposed borehole locations, which is well within the distance to the nearest agricultural enterprise (approximately 6 km). Similarly traffic noise generated during construction and operation of the Project is predicted to be within the NSW Road Noise Policy criteria at all receiver locations.

On this basis, noise is unlikely to impact agricultural production within the area.

4.5.6 Traffic

Noise and dust emissions generated by the Project, including those associated with traffic movements, are anticipated to have a negligible impact on agricultural resources and enterprises within the area (SLR, 2013c; SLR, 2013d). There will be an increase in road traffic as a result of the Project from the construction phase and additional vehicle movements in the operational phase. The transportation of coal extracted from the Project Application Area will be via dedicated haul roads to nearby power stations and will therefore not result in increased road traffic.

The *Traffic Impact Assessment* (ARC Traffic Transport, 2013) found that the Project will not adversely impact on the local road network. On this basis, and considering there are few agricultural enterprises within the Project Application Area, the impact to agricultural resources and enterprises as a result of increased traffic movements associated with the Project is considered negligible.

4.6 Other Agricultural Regional Community Impacts

Other impacts which may affect the regional community include bushfire risk, social impact, greenhouse gas production and economic impact, all of which are addressed fully in the EIS with specialist studies assessing these regional impacts and the recommended mitigation measures and management strategies to ensure impact to the regional community as a result of the Project is minimised. These specialist studies include:

- *Bushfire Hazard Assessment* (Golder, 2013a)
- *Economic Impact Assessment* (Agis Group, 2013)
- *Social Impact Assessment* (Marshall, 2013)
- *Air Quality and Greenhouse Gas Assessment* (SLR, 2013c)

5 MITIGATION MEASURES

5.1 Review of Project Design

As part of the pre-feasibility and feasibility phases undertaken for the Angus Place Mine Extension Project, a detailed mine design exercise was undertaken by Angus Place in parallel with the exploration drilling program, baseline environmental surveys and the development of the subsidence model. Various mine layouts were developed and assessed in response to information being received on geological, geotechnical, environmental, surface infrastructure and mining constraints.

Furthermore, a number of locations within the Project Application Area were considered by Angus Place for the Proposed Surface Infrastructure. The proposed locations were identified and selected as the optimal option in consideration of the existing surface environment, including vegetation communities, soil type and watercourses.

5.2 Proposed Mitigation Measures and Management Strategies

This section describes the proposed mitigation measures and management strategies recommended to be implemented to minimise potential agricultural impacts as a result of the Project. It is proposed that the recommendations made in the specialist assessments (as relevant) undertaken for the Project be adopted and incorporated into Angus Place's Environmental Management System (including issue-specific environmental management plans and monitoring programs).

Whilst the majority of impacts on agricultural enterprises and resources have been assessed as negligible, as a matter of best practice Angus Place has adopted a number of mitigation measures to further minimise these impacts. A summary of key measures specifically in relation to potential agricultural impact is provided below.

5.2.1 Land Resources

5.2.1.1 Minimisation of Disturbance to Agricultural Lands

No land currently used for agricultural production will be impacted by the Project.

5.2.1.2 Soil Resources

The *Decommissioning and Rehabilitation Strategy* (SLR, 2013b) provides general soil management practices to minimise the impact of the Project on soil resources. These practices include the:

- Identification and quantification of potential soil resources for rehabilitation.
- Optimisation and recovery of useable topsoil and subsoil during stripping operations.
- Management of soil reserves in stockpiles so as not to degrade the resource.
- Establishment of effective soil amelioration procedures to maximise the availability of soil reserve for future rehabilitation works.

5.2.1.3 Wire Fencing

Any subsidence impacts on wire fencing could be remediated by re-tensioning the fence wire, straightening fence posts, and if necessary, replacing some sections of fencing. The development of an Extraction Plan is recommended in the *Subsidence Predictions and Impact Assessment* (MSEC 2013) and will include mitigation measures for possible subsidence damage to wire fencing and gates.

5.2.1.4 Dust

The *Air Quality and Greenhouse Gas Impact Assessment* (SLR, 2013c) recommends procedures to minimise the impact of dust generated in association with construction and during the life of the Project, including unsealed roads to be kept sufficiently watered to minimise windblown and traffic generated dust, and truck movements being controlled on site and restricted to designated roadways. During construction all loaded trucks should be covered to minimise dust.

5.2.2 Water Resources

The Project will have negligible anticipated impact on water resources (surface and groundwater) associated with agricultural resources and associated enterprises (RPS, 2013a; RPS 2013b). A Water Management Plan will be developed and will include monitoring of surface and groundwater.

The Water Management Plan will include aspects that will control run-off generated from the surface development area. This will minimise off-site water quality impacts and the volume of surface water run-off that is contained on-site and therefore unavailable for agricultural uses.

The Project also includes the installation of a number of boreholes for a ventilation shaft, dewatering bore facilities and service boreholes that will be drilled between the underground workings and the ground surface. Previous service boreholes at Angus Place have been installed using blind boring, mud rotary drilling methods to minimise any potential mixing of different quality water between aquifers. On completion of drilling the service bores are cased and grouted over their full length. The grouting of the service bores will prevent the possibility of shallow aquifers draining to deeper aquifer or the underground and will also prevent any cross contamination of aquifers of differing water quality (RPS, 2013b).

The *Surface Water Assessment* (RPS, 2013a) recommends a number of surface water management options which will minimise impact of the Project on water resources which include:

- Expansion the surface water monitoring network within the Newnes Plateau to detect any significant impacts on surface flows as a result of the Project.
- Installation at least one flow station on the Coxs River to monitor real time natural flows for comparison with the increased discharges at LPD001.
- Implementation of a surface water management strategy that aims to minimise discharge to Coxs River.
- Continue to meet current water quality requirements at LDPs, with treatment occurring should water quality fall outside these ranges.

5.2.2.1 Farm Dams

There are no farms dams located within the Proposed Workings area, therefore there are no impacts predicted as a result of subsidence.

5.3 Rehabilitation of Disturbed Lands: Demonstrated Capacity

The successful restoration of agricultural land to target LSC classification is an important component of mining operations to negate any long-term impacts on agricultural resources. Angus Place has previously demonstrated successful rehabilitation of disturbed lands at disturbance sites to achieve nominated final land use and restoration of natural resources. Rehabilitated areas of Angus Place's previous surface disturbance have well established vegetative cover, effectively minimising the potential for erosion.

Examples of successful rehabilitation are taken directly from the *2012 Angus Place Annual Environmental Management Report* (Centennial, 2013) and are briefly described below:

- During 2012, 18 borehole sites on the Newnes Plateau were rehabilitated in accordance with the Angus Place rehabilitation standard which was drafted by Angus Place in consultation with Forests NSW. The standard requires consultation with the Landowner (Forests NSW) to determine an appropriate timeframe for rehabilitation activities to adhere to.
- Boreholes currently being rehabilitated are from the 2011 Stage 1 Exploration Program and the 2010 Exploration Boreholes. Initial rehabilitation activities involved removing all surface infrastructure, fencing, and waste and used materials from the sites upon completion of the works. Established sumps were also refilled with stockpiled soils while topsoil and windrowed vegetation was strategically spread over the disturbed area. The last inspection undertaken in December 2012 indicated minimal disturbance at the borehole locations. Strategically placing windrowed trees in the entry of the sites prevented vehicle access to the area after the exploration program was completed.
- Minor rehabilitation activities were carried out at the Angus Place Colliery pit top during the reporting period. This included the seeding of the area surrounding the new car park and adjacent to the 302 Conveyor.

To date Angus Place has completed five ha of surface disturbance rehabilitation, to a combination of native woodland and grass pasture, with detail given in **Table 5.1**, which also shows the total area of surface disturbance to be rehabilitated in the future (35 ha). Angus Place has shown an ongoing commitment to the rehabilitation of mine disturbance areas.

Table 5.1 Angus Place Rehabilitation Summary

Mine Lease Area		Area Impacted/Rehabilitated (ha)	
		Current to Date	2013 Estimate
Angus Place Colliery	All disturbed areas to be rehabilitated at closure	35	52.3
	Total area rehabilitated to native woodland	5	5.1

Source: *Angus Place Annual Environmental Management Report* (2013)

5.4 Demonstrated Planning for Progressive Rehabilitation

Planning for progressive rehabilitation is detailed in the *Decommissioning and Rehabilitation Strategy* (SLR, 2013b). Principal rehabilitation objectives for the Project include:

- Commencing progressive rehabilitation of disturbed areas as soon as practicable.
- Creating a stable post-mining landform that is consistent with surrounding areas and preserves downstream water quality.

In addition to these key rehabilitation objectives the Angus Place Environment and Community Policy also takes into account mine closure issues, with specific reference to:

- Making appropriate decisions which comply with or exceed approvals, licences and agreements.
- Working constructively with local authorities, stakeholders and communities.
- Contributing to the conservation of biodiversity.
- Planning, designing and closing operations in a manner that enhances sustainable development.
- Engaging and communicating openly with communities, with due regard and respect for local interests, cultures and customs.

Angus Place has committed to a policy of post-mining land use being consistent with the *Decommissioning and Rehabilitation Strategy* (SLR, 2013b).

6 STAKEHOLDER CONSULTATION

Angus Place has undertaken consultation with government agencies, local Aboriginal groups, the Angus Place Community Consultative Committee, surrounding residents and the wider community and service providers during pre-feasibility, feasibility and planning stages of the Project.

At commencement of the Project, the *Angus Place Mine Extension Project Stakeholder Engagement Plan October 2011 – December 2014* (Centennial, 2011) was developed to provide a consistent management framework for the identification and consultation with stakeholders that have an interest in the Project. The objectives of the plan are to:

- Establish a process for engagement with stakeholders, with clear outcomes for Angus Place and the various stakeholders.
- Openly communicate with stakeholders about the Project.
- Provide a means of community access to the Angus Place Project Team via a dedicated information phone line (the Angus Place Community Information Hotline).

A number of different strategies for communicating with the community throughout the Project were identified and undertaken, including:

- the Angus Place Community Consultative Committee which meets every six months;
- meetings with individual landowners and stakeholders;
- community newsletters;
- publications in the local newspaper, the *Lithgow Mercury*;
- the Centennial Coal website;
- community open days and information sessions; and
- community surveys.

Outcomes of Angus Place Stakeholder Engagement Strategies are outlined in the *Angus Place Mine Extension Stakeholder Engagement Plan* (Centennial, 2011), and include the following:

- To maintain and continue to develop trust in Angus Place's operations with neighbouring residents, community, government and other stakeholders through comprehensive and well-timed engagement and communication.
- Contribute to good working relationships with neighbouring residents, community and government by proactively anticipating and addressing concerns regarding the Project.
- Be responsive to community concerns by incorporating community feedback into periodic internal and external reviews of environmental compliance and community engagement.

- Contribute to the development of local social capital and capacity by sponsoring and donating to local community organisations.

Full details of consultation undertaken by Angus Place are contained in the EIS prepared for the Project. No issues regarding impacts to agricultural resources or enterprises were raised by stakeholders during the extensive consultation process.

Angus Place is committed to on-going community consultation and will continue to engage with the community for the purposes of providing information relating to the Project and on-going operations of Angus Place.

7 KEY FINDINGS

This AIS has been prepared for the Angus Place Mine Extension Project in accordance with the *Strategic Regional Land Use Policy* (DP&I, 2012a) and *Guideline for Agricultural Impact Statements* (DP&I, 2012b). The purpose of this AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Application Area.

The key findings of the AIS are listed below.

- There will be no land permanently removed from agriculture as a result of the Project.
- There is no land which has been, or is currently used for agriculture, which will be impacted by the Project. Note forestry was not assessed as an agricultural enterprise as it is not included as an agricultural enterprise in the *Guideline for Agricultural Impact Statements* (DP&I, 2012b).
- Only 6% (615 ha) of the Project Application Area is cleared land which is currently used for agricultural production. The main agricultural land use within the Project Application Area is beef cattle, horse and goat grazing in areas along the western edge.
- There are no agricultural enterprises located within or adjacent to the Proposed Workings or the Proposed Surface Infrastructure assessment area.
- The Project Application Area contains no areas of potential BSAL. In addition there is no mapped BSAL within 2 km of the Project Application Area.
- Post-mining agricultural economic activity in the Project Application Area is expected to be similar to pre-mining activity as there is no change predicted between the pre- and post-mining LSC classifications.
- The Project will have a positive impact on surface water resources relied upon by agriculture through increased discharge of water 'suitable for agriculture' into the Coxs River catchment
- The Project will have negligible impact on groundwater resources relied upon by agriculture.
- The Project will provide considerable positive economic benefits to the local and broader communities with a net present value of \$681 M. These benefits are much greater than the potential income lost by existing or potential agricultural enterprises, calculated as a precautionary assessment on impacted agricultural resources.
- No issues regarding impacts to agricultural resources, enterprises or stakeholders were raised during the consultation process.
- Stakeholder and community consultation will be ongoing throughout the life of the Project.

In summary, the Project will provide economic benefits to the region whilst having negligible impact on agricultural resources, enterprises or related industries.

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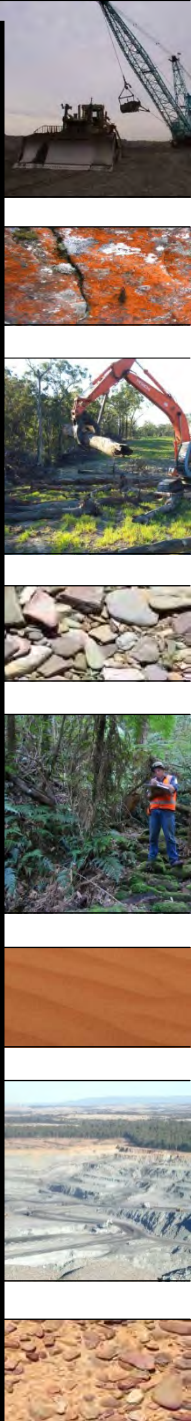
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SLR (2013d) Angus Place Mine Extension Project Noise Impact Assessment

Agricultural Gross Margin Sensitivity Analysis



APPENDIX 1



BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: June 2012

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

Enterprise Unit: **100 cows**

Pasture: **Improved**

			Standard Budget	Your Budget
INCOME:				
42	steers 12-15 months @	\$687 /hd	\$28,844	
22	heifers 12-15 months @	\$611 /hd	\$13,431	
1	CFA Bull @	\$1,253 /hd	\$1,253	
7	CFA cows @	\$701 /hd	\$4,909	
11	Other culls @	\$701 /hd	\$7,714	
83				
A. Total Income:			\$56,150	
VARIABLE COSTS:				
Replacements	1 Bull @	\$5,000 /hd	\$5,000	
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 maintenance (211 ha improved pasture per 100 cows)			\$10,550	
Livestock selling cost (see assumptions on next page)			\$4,437	
B. Total Variable Costs:			\$21,230	
			GM including pasture cost	GM excluding pasture cost
GROSS MARGIN (A-B)			\$34,920	\$45,470
GROSS MARGIN/COW			\$349.20	\$454.70
GROSS MARGIN/DSE*			\$20.67	\$26.92
GROSS MARGIN/HA			\$165.50	\$215.50

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 325c/kg and steer weight to 195 kg, gross margin would fall to \$281 per cow. This assumes that price and weight of all other sale stock falls by the same percentage.

Dresses wt kgs		Steer sale price cents/kg dw				
Stock sold		315	325	335	345	355
Steer dw						
-40 kgs	185	217	230	243	256	269
-20 kgs	195	267	281	296	311	325
0	205	317	333	349	365	382
+20 kgs	215	366	384	402	420	438
+40 kgs	225	416	436	455	475	495

GM \$ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by \$29.59

Assumptions Yearling (Southern/Central NSW)

Enterprise unit is 100 cows weighing on average 500 kg

Weaning rate: 86%, conception 92%

Sales

100% steers sold at 12-15 months	205 kg	@335c/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	255 kg	@275c/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	432 kg	@290c/kg dressed weight

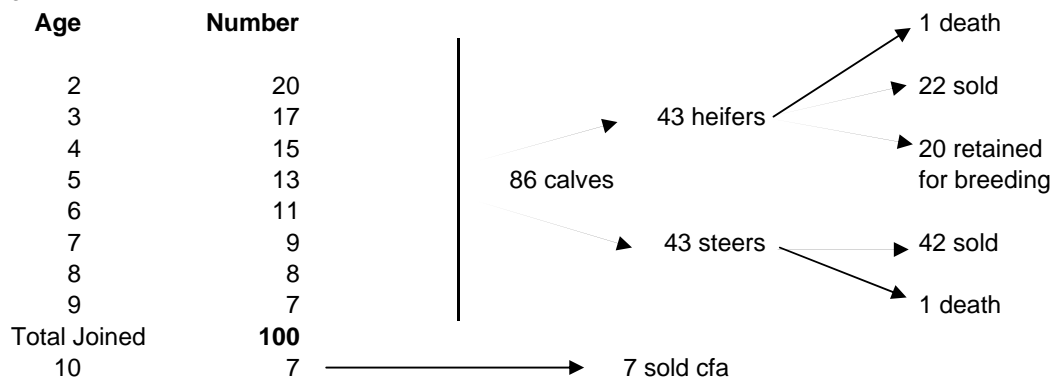
Selling costs include: Commission 5%, MLA levy \$5/hd, average freight cost to abattoirs 5.5c/kg dw, NLIS tags @ \$2.90 for all sale cattle.

Cows: age at first calf : 24 months

Mortality rate of adult stock: 2%

The average feed requirement of a cow + followers is rated at 16.89 dse's*. This is an average figure and will vary during the year.

Age structure



Marketing Information:

Suited to the domestic supermarket trade and could access MSA grading with careful preparation. Note that for MSA grading producers need to be licensed. Good frame, well muscled, later maturing steers can be suited to the Japanese grain fed markets at heavier turn off weights than above. Steer portion may also be suited for live export to the Japanese feeder steer market (Angus and Murray Grey and Shorthorn breeds preferred) as a lighter weight option.

Production Information:

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

MERINO EWES (20 micron) - Terminal Rams

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



Industry & Investment

Flock size: 1000 ewes
Ewe body weight: 55 kgs
DSE rating: 2.4 dse's / ewe

INCOME

	number	class	kg /hd	\$/kg
Wool				
Shear	960	ewes	5.39	\$8.47
	20	rams	3.50	\$3.94
Crutch	1177	mixed ages	0.40	\$4.80
	882	xb lambs	0.25	\$1.84
Sheep Sales				
	number	class	\$ /hd	
	177	CFA ewes	\$88.85	(22.6 kg cwt)
	4	CFA rams	\$60.48	
8 months	441	mixed sex lambs	\$110.46	(21.0 kg cwt)
10 months	441	mixed sex lambs	\$126.24	(24.0 kg cwt)
Fodder	tonnes	type	value per tonne	
Graz/fodder crop	0 t	0	\$0 /t	

A. Total Income:

VARIABLE COSTS

Replacements	number	class	cost (\$)	reps
	4	rams	\$900.00	
	217	ewes	\$135.00	
Cartage	217	ewes	\$2.00	

Wool Harvesting & Selling Costs

Shearing	960	ewes	\$5.89	1
	20	rams	\$8.50	1
Crutching	1177	ewes	\$1.13	1
	20	rams	\$1.95	1
	882	weaners	\$1.13	1
Wool tax			2.00%	
Commission, warehouse, testing charges			\$39.27/ bale	
Wool - cartage	35	bales	\$18.00	
- packs	35	packs	\$13.81	

Sheep Health

Broadspectrum	980	adults	\$0.65	2
	930	lambs	\$0.33	3
Narrowspectrum	980	adults/hoggets	\$0.38	1
	930	lambs	\$0.21	1
Dipping	980	adults	\$1.16	1
	980	adults	\$1.85	1
Fly control (long acting)	882	weaners	\$1.55	1
Vaccination- 6 in 1	980	adults	\$0.27	1
	930	lambs	\$0.27	1
Mark	930	lambs	\$1.55	1
Scanning	1000	ewes	\$0.80	1

Livestock Selling Costs

Livestock cartage	1,063	sale sheep	\$2.00	
Commission on sheep sales			5.00%	
Levies (Yard dues, MLA Transaction levy and RLPB rates)				

Pasture maintenance	247 ha	@	\$41 /ha	
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Fodder

		Supp. feed - ewes 2.1kg - lambs 3.5kg grain/hd/wk @ \$150 /t		
Ewes	960	ewes	\$0.32 /week	10 weeks
Lambs		ewe lambs	\$0.21 /week	12 weeks
	882	finisher lambs	\$0.53 /week	10 weeks
Graz/fodder crop	0 ha	@	\$100 /ha	

B. Total Variable Costs:

	excl. fodder	incl. fodder
GROSS MARGIN (A-B)	\$91,420.60	\$83,766.10
GROSS MARGIN /EWE	\$91.42	\$83.77
GROSS MARGIN /DSE	\$37.93	\$34.76
GROSS MARGIN /HA	\$379.34	\$347.58

This budget should be used as a GUIDE ONLY and should be changed by the grower to take account of movements in commodity and input prices, changes in seasonal conditions and individual farm characteristics. Estimated prices are GST exclusive.

ASSUMPTIONS

1. Flock Parameters

Flock mortality	4%	Ram %	2%
Productive life	5 years	Marking %	93%
Ewe body weight	55 kg	Weaning %	90%
DSE rating /ewe	2.4	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	217 replacements bought	930 lambs	900 weaners
2.5	208			
3.5	200			
4.5	192			
5.5	184			
6.5	0			
Total	1000			882 mixed sex lambs sold
			177 CFA's sold	

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, 80mm	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				
\$34.76	\$6.78	\$7.62	\$8.47	\$9.32	\$10.16
4.31 kg	\$28.49	\$29.91	\$31.34	\$32.77	\$34.19
4.85 kg	\$29.83	\$31.43	\$33.03	\$34.64	\$36.24
5.39 kg	\$31.19	\$32.98	\$34.76	\$36.54	\$38.32
5.93 kg	\$32.53	\$34.49	\$36.45	\$38.41	\$40.37
6.47 kg	\$33.87	\$36.01	\$38.15	\$40.28	\$42.42

5. Sensitivity Table - Value of mixed sex lamb (1st cross terminal)

Export Lmb \$/Hd	Value of Domestic lamb \$/Hd				
\$34.76	\$88.37	\$99.41	\$110.46	\$121.51	\$132.55
\$100.99	\$26.53	\$28.45	\$30.37	\$32.29	\$34.21
\$113.62	\$28.72	\$30.64	\$32.56	\$34.48	\$36.40
\$126.24	\$30.92	\$32.84	\$34.76	\$36.68	\$38.60
\$138.86	\$33.11	\$35.03	\$36.95	\$38.87	\$40.79
\$151.49	\$35.31	\$37.23	\$39.15	\$41.07	\$42.99

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

Replace ewes \$/Hd	Weaning %				
\$34.76	72%	81%	90%	99%	108%
\$108.00	\$30.08	\$33.63	\$37.19	\$40.72	\$44.27
\$121.50	\$28.86	\$32.42	\$35.97	\$39.50	\$43.06
\$135.00	\$27.65	\$31.20	\$34.76	\$38.28	\$41.84
\$148.50	\$26.43	\$29.99	\$33.54	\$37.07	\$40.62
\$162.00	\$25.21	\$28.77	\$32.33	\$35.85	\$39.41

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

CFA ewes \$/Hd	Weaning %				
\$34.76	72%	81%	90%	99%	108%
\$71.08	\$26.41	\$29.96	\$33.52	\$37.04	\$40.60
\$79.96	\$27.03	\$30.58	\$34.14	\$37.66	\$41.22
\$88.85	\$27.65	\$31.20	\$34.76	\$38.28	\$41.84
\$97.73	\$28.27	\$31.82	\$35.38	\$38.90	\$42.46
\$106.62	\$28.89	\$32.44	\$36.00	\$39.52	\$43.08

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

This budget should be used as a GUIDE ONLY and should be changed by the grower to take account of movements in commodity and input prices, changes in seasonal conditions and individual farm characteristics. Estimated prices are GST exclusive.

DRYLAND LUCERNE HAY

Northern Zone

Summer 2010-11

1. GROSS MARGIN BUDGET:

INCOME: Assumes most bales are prime hay quality.

2 cuts per season @ 2.00 t/ha per cut

Total Yield = **4.00** tonnes per hectare

@ 40 bales per tonne (25 kg bales)

Sample Budget	Your Budget
\$/ha	\$/ha

60% AFIA Grade A1	96 bales/ha@	\$8.50 / bale	\$816	
20% AFIA Grade B2	32 bales/ha@	\$6.50 / bale	\$208	
20% AFIA Grade C3	32 bales/ha@	\$4.00 / bale	\$128	

See http://www.afia.org.au/quality/national_grades/ for more details on hay grades used.

A. TOTAL INCOME \$/ha:

\$1,152	
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VARIABLE COSTS:

see following pages(s) for details

Depreciation of establishment cost (over 4 years).....	\$52.32	
Fertiliser.....	\$125.00	
Herbicide.....	\$17.96	
Insecticide.....	\$0.00	
Mow, rake & bale (contract).....	\$524.40	
Twine @ \$0.113/bale.....	\$18.13	
Cart and stack 100% of hay (\$10.68/t).....	\$42.72	

B. TOTAL VARIABLE COSTS \$/ha:

\$780.52	
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C. GROSS MARGIN (A-B) \$/ha:

\$371.48	
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SENSITIVITY TABLE

EFFECT OF HAY YIELD AND PRICE ON GROSS MARGIN PER HECTARE

Yield Cuts	Total tonnes/ha	Grade A1 \$6.50	Grade A1 \$7.50	Grade A1 \$8.50	Grade A1 \$10.50	Grade A1 \$12.50
		Grade B2 \$4.50	Grade B2 \$5.50	Grade B2 \$6.50	Grade B2 \$8.50	Grade B2 \$10.50
		Grade C3 \$2.00	Grade C3 \$3.00	Grade C3 \$4.00	Grade C3 \$5.00	Grade C3 \$6.00
		\$208 /tonne	\$248 /tonne	\$288 /tonne	\$360 /tonne	\$432 /tonne
1 cuts	2.0	-72	8	88	232	376
2 cuts	3.0	-53	67	187	403	619
2 cuts	3.5	-1	139	279	531	783
2 cuts	4.0	51	211	371	659	947
3 cuts	5.0	70	270	470	830	1,190
3 cuts	6.0	175	415	655	1,087	1,519
4 cuts	8.0	298	618	938	1,514	2,090

DRYLAND LUCERNE HAY

Northern Zone

Summer 2010-11

CALENDAR OF OPERATIONS:		Machinery			Inputs			Total Cost \$/ha
Operation	Month	hrs/ha	Cost \$/hour	Total \$/ha	Rate/ha	Cost \$	Total \$/ha	
Spray - 2,4-DB 500g/L	Jul	0.10	17.05	1.71	1.0 L	16.25/L	16.25	17.96
Apply Single Super	Aug	contract		20.00	250kg	0.42/kg	105.00	125.00
Mow, rake 3 times and bale	Oct	contract		262.20				262.20
Cart and stack hay in shed	Oct	\$0.27	per bale @ 80 bales/ha per cut					21.36
Mow, rake 3 times and bale	Jan	contract		262.20				262.20
Cart and stack hay in shed	Jan	\$0.27	per bale @ 80 bales/ha per cut					21.36

AGRONOMIC NOTES:

Herbicides: 2,4-DB applied to established stands to clean up weeds.

To reduce the likelihood of herbicide resistance, rotate herbicide groups and weed management techniques.

For more information, refer to the I&I NSW Management Guide "Weed Control in Pastures and Lucerne 2010"

Establishment: This budget assumes a stand life of four years, so depreciation of establishment cost is the cost of establishment divided by four.

This budget should be looked at in conjunction with the budget for establishment of a dryland lucerne stand.

Fertilisers: Nutrient requirements should be assessed with soil tests, strip trials and paddock history records.

Hay storage: The assumption is made that all of the hay is stored on farm prior to selling.

Hay Grades: The Australian Fodder Industry Association (AFIA) has developed a national grading system for legume and cereal hays. It is based on digestible dry matter, crude protein percentage and metabolisable energy.

Profitability: Profitability may vary widely depending on dry matter yield and hay prices.

Please refer to the sensitivity table and factor in the seasonal and market risks in your planning activities.

AFIA (Incorporated in 1996) is the peak body for the hay and silage industries. Further information and a fodder vendor declaration form is available from AFIA Phone: 03 9890 6855 Website: www.afia.org.au

Use of a particular brand name does NOT imply recommendation of that brand by I&I NSW.

Always read chemical labels and follow directions, as it is your legal responsibility to do so.

LABOUR REQUIREMENT Labour for carting hay from the paddock to the shed is accounted for in this budget at \$1.50 per bale.

MACHINERY ASSUMPTIONS:

Tractor: PTO power: 57kW (76 HP)

Machinery costs refer to variable costs of: fuel, oil, filters, tyres, batteries and repairs.

Mow, Rake, Bale costs: If you use your own machinery for mowing, raking and baling then substitute this cost in your own budget.



SURFACE IRRIGATED LUCERNE - Established stand

Farm Enterprise Budget Series - Northern Zone

Summer 2011-2012

1. GROSS MARGIN BUDGET:

INCOME:

7 cuts per season @ 1.90 t/ha per cut

Total Yield = **13.30** tonnes per hectare

@ 40 bales per tonne (25 kg bales)

60% AFIA Grade A1	320 bales/ha at	\$8.80 / bale
20% AFIA Grade B2	106 bales/ha at	\$5.00 / bale
20% AFIA Grade C3	106 bales/ha at	\$3.00 / bale

See http://www.afia.org.au/quality/national_grades/ for more details on hay grades used.

A. TOTAL INCOME \$/ha:

Sample Budget	Your Budget
\$/ha	\$/ha
\$2,816.00	
\$530.00	
\$318.00	
\$3,664.00	

VARIABLE COSTS:

see following page(s) for details

Depreciation of establishment cost.....
Fertiliser.....
Herbicide.....
Insecticide.....
Irrigation.....
Mow, rake & bale (contract).....
Twine @ \$0.113/bale.....
Cart and stack 100% of hay (\$10.68/t).....

B. TOTAL VARIABLE COSTS \$/ha:

\$101.91	
\$241.85	
\$60.15	
\$6.33	
\$443.90	
\$1,773.80	
\$60.29	
\$142.04	
\$2,830.28	

C. GROSS MARGIN (A-B) \$/ha:

D. GROSS MARGIN \$/ML:

\$833.72	
\$83.37	

SENSITIVITY TABLES

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

Yield Cuts	tonnes/ha	Grade A1 \$6.80	Grade A1 \$7.80	Grade A1 \$8.80	Grade A1 \$10.80	Grade A1 \$12.80
		Grade B2 \$3.00	Grade B2 \$4.00	Grade B2 \$5.00	Grade B2 \$7.00	Grade B2 \$9.00
		Grade C3 \$1.00	Grade C3 \$2.00	Grade C3 \$3.00	Grade C3 \$4.00	Grade C3 \$5.00
		\$195 /tonne	\$235 /tonne	\$275 /tonne	\$347 /tonne	\$419 /tonne
4 cuts	5.8	-\$820	-\$588	-\$356	\$62	\$480
5 cuts	8.3	-\$623	-\$291	\$41	\$639	\$1,237
6 cuts	10.8	-\$427	\$5	\$437	\$1,215	\$1,993
7 cuts	13.3	-\$230	\$302	\$834	\$1,792	\$2,750
8 cuts	15.8	-\$34	\$598	\$1,230	\$2,368	\$3,506
9 cuts	18.3	\$163	\$895	\$1,627	\$2,945	\$4,263
10 cuts	20.8	\$359	\$1,191	\$2,023	\$3,521	\$5,019

3. EFFECT OF YIELD AND PRICE ON GROSS MARGIN PER MEGALITRE:

Yield Cuts	tonnes/ha	Grade A1 \$6.80	Grade A1 \$7.80	Grade A1 \$8.80	Grade A1 \$10.80	Grade A1 \$12.80
		Grade B2 \$3.00	Grade B2 \$4.00	Grade B2 \$5.00	Grade B2 \$7.00	Grade B2 \$9.00
		Grade C3 \$1.00	Grade C3 \$2.00	Grade C3 \$3.00	Grade C3 \$4.00	Grade C3 \$5.00
		\$195 /tonne	\$235 /tonne	\$275 /tonne	\$347 /tonne	\$419 /tonne
4 cuts	5.8	-\$82	-\$59	-\$36	\$6	\$48
5 cuts	8.3	-\$62	-\$29	\$4	\$64	\$124
6 cuts	10.8	-\$43	\$1	\$44	\$122	\$199
7 cuts	13.3	-\$23	\$30	\$83	\$179	\$275
8 cuts	15.8	-\$3	\$60	\$123	\$237	\$351
9 cuts	18.3	\$16	\$89	\$163	\$294	\$426
10 cuts	20.8	\$36	\$119	\$202	\$352	\$502

SURFACE IRRIGATED LUCERNE - Established stand

Farm Enterprise Budget Series - Northern Zone

(diesel pump from river-regulated)

Summer 2011-2012

CALENDAR OF OPERATIONS:		Machinery			Inputs			Total Cost \$/ha
Operation	Month	hrs/ha	Cost \$/hr	Total \$/ha	Rate/ha	Cost \$	Total \$/ha	
Spray - paraquat + diquat	Jul	0.10	24.51	2.45	2.5 L	10.28	25.70	28.15
Spray - diuron	Jul	with above			2.50 L	7.70	19.25	19.25
Apply Single Super	Aug	0.42	21.55	9.05	125kg	0.35	43.75	52.80
Spray aphids -dimethoate	Aug	0.10	24.51	2.45	0.37 L	10.49	3.88	6.33
Fertiliser- #Muriate of Potash	Aug	0.42	21.55	9.05	250kg	0.72	180.00	189.05
Irrigate	Oct				1.25 ML	44.39	55.49	55.49
Irrigate	Nov				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	Nov	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Nov	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Irrigate	Nov				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	Dec	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Dec	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Irrigate	Dec				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	Dec	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Dec	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Herbicide (haloxyfop-R)	Dec	0.10	24.51	2.45	0.1 L	103.00	10.30	12.75
Irrigate	Feb				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	Feb	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Feb	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Irrigate	Mar				1.25 ML	44.39	55.49	55.49
Mow, rake & bale + accumulator	Mar	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Mar	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Irrigate	Apr				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	Apr	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	Apr	contract	0.27	per bale @ 76 bales/ha per cut				20.29
Irrigate	May				1.25 ML	44.39	55.49	55.49
Mow, rake, bale & accumulator	May	contract		253.40				253.40
Cart & stack in shed (tractor + FEL)	May	contract	0.27	per bale @ 76 bales/ha per cut				20.29

AGRONOMIC NOTES:

Herbicides: paraquat + diquat and diuron applied to established stands to clean up weeds.

To reduce the likelihood of herbicide resistance, rotate herbicide groups and weed management techniques.

Fertilisers: # In areas of long term irrigated hay production, there is a possibility that higher rates of potash may be required to correct chronic potassium deficiency.

Hay storage: The assumption is made that all of the hay is stored on farm prior to selling.

Hay Grades: The Australian Fodder Industry Association (AFIA) has developed a national grading system for legume and cereal hays. It is based on digestible dry matter, crude protein content and metabolisable energy.

AFIA (Incorporated in 1996) is the peak body for the hay and silage industries. Further information and a fodder vendor declaration form is available from AFIA. Phone: 03 9890 6855 Website: www.afia.org.au

Use of a particular brand name does NOT imply recommendation of that brand by NSW DPI.

Always read chemical labels and follow directions, as it is your legal responsibility to do so.

LABOUR REQUIREMENTS: Labour to apply fertiliser or spray is not costed. If we assume a labour cost of \$21/hr the total labour cost would be \$29.93/hectare, reducing the gross margin to \$804/ha.

This does not include labour required to irrigate since this is more likely to be an overhead cost.

MACHINERY ASSUMPTIONS:

Tractor: pto power: 57 KW (76 HP) FEL = front end loader

Machinery costs refer to variable costs of: fuel, oil, filters, tyres, batteries and repairs.

Mow, Rake, Bale costs: Assumes raking is done twice. Use your own costs if you use your own machinery.

Irrigation Costs: Estimated water usage charge of \$31.75 per ML assumed, your charges may be different.

Estimated water pumping cost of \$12.64 per ML assumed, your costs may be different.

Water use assumed: 10.0 ML/Ha

Costs calculated using a flood/furrow system with diesel powered pumping from surface supply.

This budget should be used as a GUIDE ONLY and should be changed by the grower to take account of movements in crop and input prices, changes in seasonal conditions and individual farm characteristics. Estimated prices are GST exclusive.