Appendix C

Agricultural Impact Statement

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Agricultural Impact Statement

Balranald Mineral Sands Project

Report Number 630.10873

May 2015

Prepared on behalf of EMGA Mitchell McLennan Pty Limited for Iluka Resources Ltd

Version: Final

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Agricultural Impact Statement:

Balranald Mineral Sands Project

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road New Lambton NSW 2305 Australia

(PO Box 447 New Lambton NSW 2305 Australia)
T: 61 2 4037 3200 F: 61 2 4037 3201
E: newcastleau@slrconsulting.comwww.slrconsulting.com

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Executive Summary

SLR Consulting Pty Ltd (SLR) was commissioned by EMGA Mitchell McLennan Pty Ltd (EMM) on behalf of the proponent, Iluka Resources Ltd (Iluka) to prepare an Agricultural Impact Statement (AIS) for the Balranald Mineral Sands Project (Balranald Project). The AIS will accompany an Environmental Impact Statement (EIS) as part of the application for development consent under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Balranald Project is located in south-western NSW. Under the NSW Strategic Regional Land Use Policy, an AIS is required to accompany all new state significant mining and petroleum project applications. It forms part of the EIS, with its purpose being to ensure that a focused assessment of the potential impacts on agricultural resources or industries.

This AIS provides for the Balranald Project which is located within the Murray Basin in south-western NSW, near the town of Balranald, within the Balranald Local Government Area (LGA). The project area is within Iluka's Exploration Licence (EL) 7450. Land uses in the immediate vicinity of the project area are primarily agricultural, and include grazing and broadacre grain crops. Agricultural land is interspersed with areas of native vegetation, primarily Mallee scrub.

Direct impacts to agriculture resources and related industry as a result of the project are limited. The post-mining potential gross margin for the soil assessment area is expected to decrease by $22,775 annually, however there will be a net increase of 1,015 ha land available for livestock production, primarily as increased grazing areas.

Impacts to licensed surface water users are minimal, with only 450 ML required per annum from the *Murrumbidgee Regulated River WSP* which otherwise would be available for irrigated agriculture. Impacts to groundwater users reliant on stock water within the vicinity of the project area will experience minimal drawdowns, whilst there are no anticipated impacts due to groundwater injection.

Rehabilitation of disturbed areas will be progressive throughout the life of the project, with Iluka having previously demonstrated successful progressive rehabilitation at sites including Echo, Kulwin and Jacinth Ambrosia.

The main impact resulting from the Balranald Project will be the proposed biodiversity offset package which will require approximately 22,000 hectares of land as determined using the BioBanking credit calculator.

Comprehensive stakeholder consultation has been undertaken by Iluka since late 2010, and will continue during the life of the Balranald Project. There is general support amongst the local population for the Balranald Project due to the perceived economic and social benefits that may flow through to the Balranald community.

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APPENDIX

Appendix A Agricultural Productivity Gross Margin Sensitivity Analysis

1 INTRODUCTION

1.1 Project Overview

SLR Consulting Pty Ltd (SLR) was engaged by EMGA Mitchell McLennan Pty Ltd (EMM), on behalf of Iluka Resources Ltd (Iluka), to prepare an Agricultural Impact Statement (AIS) for the proposed Balranald Mineral Sands Project (Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

Iluka is seeking development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Balranald Project, broadly comprising:

- open cut mining of the West Balranald and Nepean deposits, referred to as the West Balranald and Nepean mines, including progressive rehabilitation;
- processing of extracted ore to produce heavy mineral concentrate (HMC) and ilmenite;
- road transport of HMC and ilmenite to Victoria;
- backfilling of the mine voids with overburden and tailings, including transport of by-products from the processing of HMC in Victoria for backfilling in the mine voids;
- return of hypersaline groundwater extracted prior to mining to its original aquifer by a network of injection borefields;
- an accommodation facility for the construction and operational workforce;
- gravel extraction from local sources for construction requirements; and
- a water supply pipeline from the Murrumbidgee River to provide fresh water during construction and operation.

Separate approvals, are being sought for:

- the construction of a transmission line to supply power to the Balranald Project; and
- project components located within Victoria.

The Balranald Project is located within the Murray Basin in south-western NSW, near the town of Balranald, within the Balranald Local Government Area (LGA). The Murray Basin forms part of the larger Murray-Darling Basin in Victoria and NSW. The project area is within Iluka's Exploration Licence (EL) 7450. The regional location of the Balranald Project is presented in **Figure 1**.

Land uses in the immediate area of the project area are primarily agricultural, and include grazing and broadacre grain crops. Agricultural land is interspersed with areas of native vegetation, primarily Mallee scrub.

1.2 Approval Process

In NSW, the Balranald Project requires development consent under Part 4, Division 4.1 of the EP&A Act. Part 4 of the EP&A Act relates to development assessment. Division 4.1 specifically relates to the assessment of development deemed to be State significant development (SSD). The Balranald Project is a mineral sands mining development which meets the requirements for SSD.

An application for SSD must be accompanied by an environmental impact statement (EIS), prepared in accordance with the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

An approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for the Balranald Project (with the exception of the transmission line which will be subject to a separate EPBC Act referral process). A separate EIS will be prepared to support an application in accordance with the requirements of Part 8 of the EPBC Act.

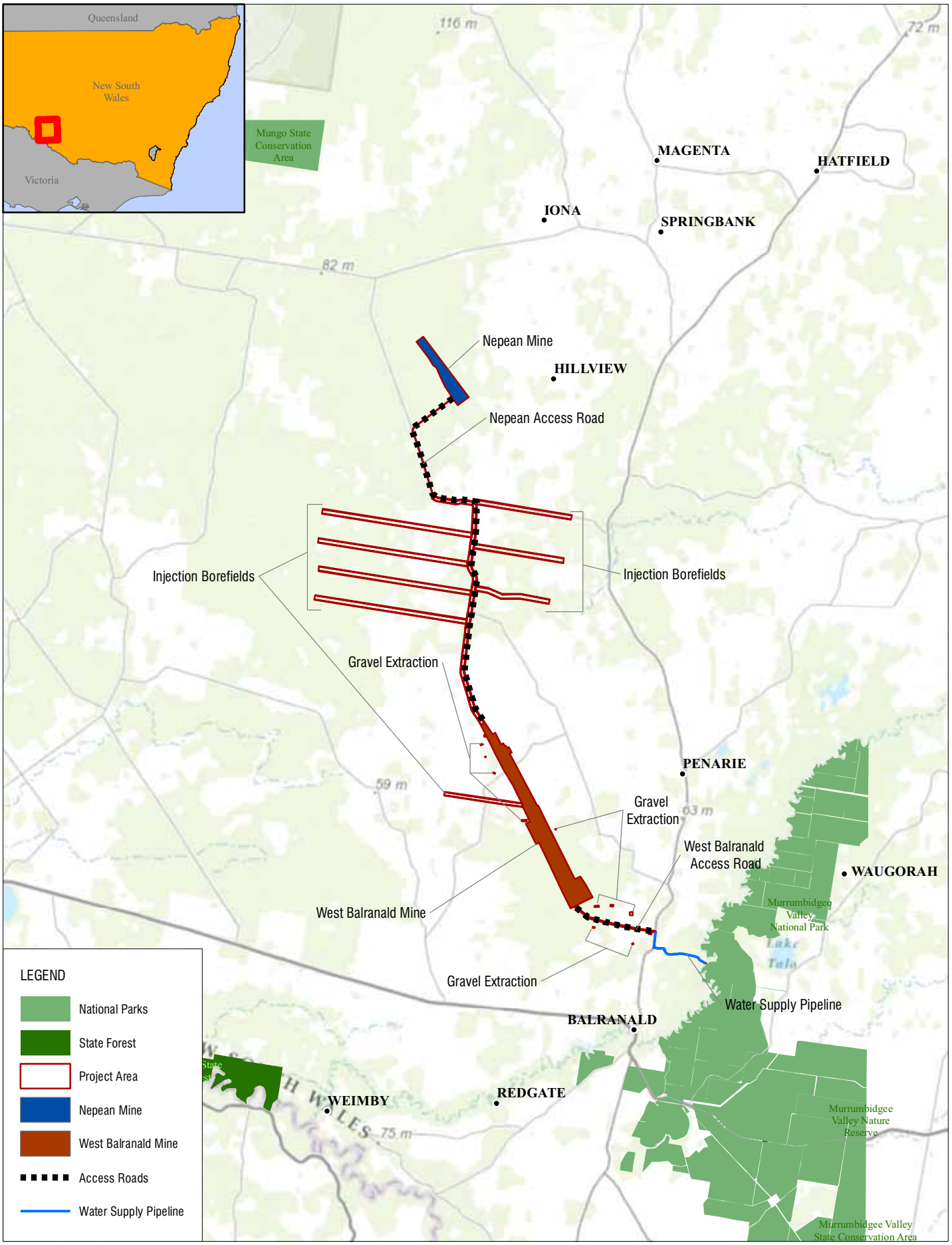
1.3 Secretary's Environmental Assessment Requirements

There are no specific agricultural issues raised in the Secretary's Environmental Assessment Requirements (SEARs) for the Balranald Project.

1.4 Purpose of this Report

The purpose of this AIS is to assess and report on the potential impacts of the Balranald Project on agricultural resources and/or industries within and surrounding the project 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.

The State government's Strategic Regional Land Use Policy (SRLUP) (DP&I, 2012d) requires all state-significant mining development proposals, whether or not they are located on land mapped as Strategic Agricultural Land (SAL), to prepare an AIS for consideration at the development application stage. SLR has prepared this AIS to address the requirements of the *Strategic Agricultural Land Use Policy: Guideline for Agricultural Impact Statements* (DP&I, 2012a) (referred to herein as the AIS Guideline), which was released in conjunction with the NSW Strategic Regional Land Use Plans for the Upper Hunter (DP&I 2012b) and the New England North West (DP&I 2012c).



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SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

Project No.:	630.10873
Date:	16/03/2015
Drawn by:	KC
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Balranald AIS

Regional Locality

FIGURE 1

2 PROJECT DESCRIPTION

2.1 Project Schedule

The Balranald Project will have a life of approximately 15 years, including construction, mining, backfilling of all overburden material, rehabilitation and decommissioning.

Construction of the Balranald Project will commence at the West Balranald mine, and is expected to take about 2.5 years. Operations will commence at the West Balranald mine in Year 1 of the operational phase, which will overlap with approximately the last six months of the construction. The operational phase would include mining and associated ore extraction, processing and transport activities, and would be approximately nine years in duration. This would include completion of backfilling overburden into the pits at both the West Balranald and Nepean mines. Construction of infrastructure at the Nepean mine will commence in approximately Year 5 of the operational phase, with mining of ore starting in Year 6, and being complete by approximately Year 8. Rehabilitation and decommissioning is expected to take a further two to five years following Year 9 of the operational phase.

2.2 Project Area

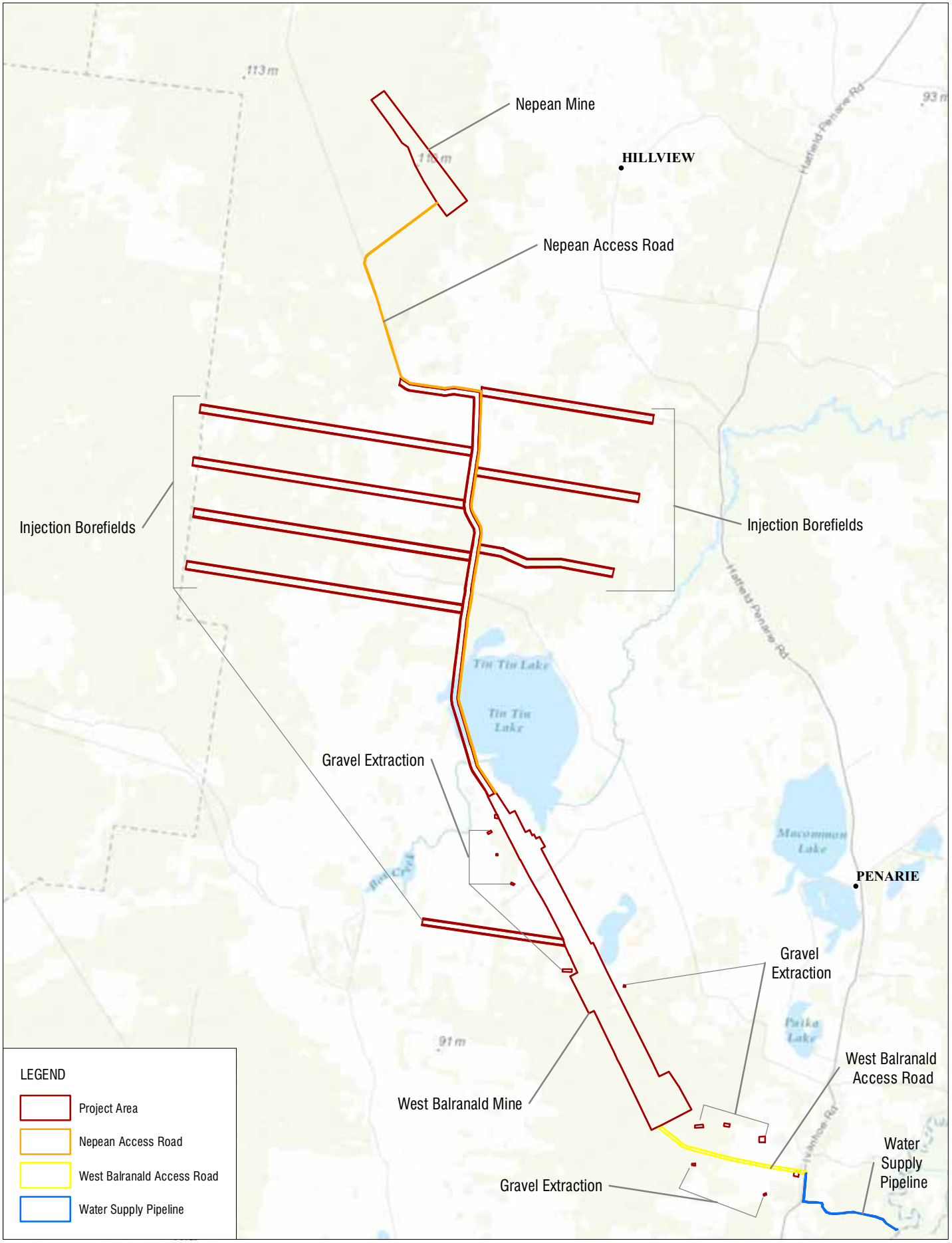
All development for the Balranald Project that is the subject of the SSD application is within the project area, shown in **Figure 2**. The project area is approximately 9,964 hectares (ha), and includes the following key project elements, described in subsequent sections:

- West Balranald and Nepean mines;
- West Balranald access road;
- Nepean access road;
- injection borefields;
- gravel extraction;
- water supply pipeline (from the Murrumbidgee River); and
- accommodation facility.

Within the project area, the land directly disturbed for the Balranald Project is referred to as the disturbance area. The project area and disturbance area for each project element are in **Table 1**.

Table 1 Project Area and Disturbance Area

Project Element	Project Area (ha)	Disturbance Area (ha)
West Balranald mine	3,059	3,059
Nepean mine	805	805
West Balranald access road	128	52
Nepean access road	173	156
Injection borefields	5,721	1,214
Gravel extraction	42	42
Water supply pipeline	29	11
Accommodation facility	7	7
Total	**9,964**	**5,346**



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SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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EMGA Mitchell McLennan

Balranald AIS

Project Area

FIGURE 2

2.2.1 West Balranald and Nepean Mines

The West Balranald and Nepean mines include:

- open cut mining areas (i.e. pit/mine void) that would be developed using conventional dry mining methods to extract the ore;
- soil and overburden stockpiles;
- ore stockpiles and mining unit plant (MUP) locations;
- a processing area (at the West Balranald mine), including a mineral processing plant, tailings storage facility (TSF), maintenance areas and workshops, product stockpiles, truck load-out area, administration offices and amenities;
- groundwater management infrastructure, including dewatering, injection and monitoring bores and associated pumps and pipelines;
- surface water management infrastructure;
- services and utilities infrastructure (e.g. electricity infrastructure);
- haul roads for heavy machinery and service roads for light vehicles; and
- other ancillary equipment and infrastructure.

The location of infrastructure at the West Balranald and Nepean mines would vary over the life of the Balranald Project according to the stage of mining.

2.2.2 Injection Borefields

The Balranald Project requires a network of injection borefields in the project area for the return of hypersaline groundwater to the Loxton Parilla Sands aquifer. Within each borefield, infrastructure is generally located in two 50 m wide corridors (approximately 350 m apart) and typically comprises:

- a network of pipelines with a graded windrow on either side;
- access roads for vehicle access during construction and operation;
- rows of injection wells, with wells spaced at approximately 100 m intervals; and
- a series of water storage dams to store water during well development.

2.2.3 Access Roads

There are two primary access roads within the project area to provide access to the Balranald Project:

- West Balranald access road – a private access road to be constructed from the Balranald Ivanhoe Road to the West Balranald mine.
- Nepean access road – a route comprising private access roads and existing public roads. A private access road would be constructed from the southern end of the West Balranald mine to the Burke and Wills Road. The middle section of the route would be two public roads, Burke and Wills Road and Arumpo Road. A private access road would be constructed from Arumpo Road to the Nepean mine.

The West Balranald access road would be the primary access point to the project area, and would be used by heavy vehicles transporting HMC and ilmenite. The Nepean access road would primarily be used by heavy vehicles transporting ore mined at the Nepean mine to the processing area at the West Balranald mine.

2.2.4 Accommodation Facility

An accommodation facility would be constructed for the Balranald Project workforce. It would operate throughout the construction and operation phases of the project. It would be located adjacent to the West Balranald mine near the intersection of the West Balranald access road with the Balranald Ivanhoe Road.

2.2.5 Water Supply Pipeline

A water supply pipeline would be constructed to supply water from the Murrumbidgee River for operation of the Balranald Project.

2.2.6 Gravel Extraction

Gravel would be required during the construction and operational phases of the Balranald Project. Local sources of gravel (borrow pits) have been included in the project area to provide gravel during the construction phase. During the construction phase, gravel would be required for the construction of the West Balranald access road, internal haul roads and service roads, and hardstand areas for infrastructure. Processing operations, such as crushing and screening activities (if required) would also be undertaken at the borrow pits. Gravel for the operational phase would be obtained from external sources.

2.2.7 Post-Mining Land Use

The post-mining land use will be a mixture of agricultural/pastoral activities and native vegetation. An increase in the area available for agricultural production is a potential benefit for the local community by increasing the area of land capable of sustaining food and fibre production.

In this regard, the *Rehabilitation and Closure Strategy* (EMGA Mitchell McLennan, 2015a) for the project area will include the re-establishment of native chenopod shrubland for grazing by livestock. The final land use proposed is consistent with the pre-mining land use strategies and the relevant planning instruments discussed in the *Rehabilitation and Closure Strategy*.

Rehabilitation objectives have been developed to reflect rehabilitation industry best practices applicable to the elected final land uses.

Rehabilitation of the final landform will be undertaken on a domain basis, which represent land management units or discrete rehabilitation areas/post-mine landforms and will be rehabilitated using varying techniques suited to the type of disturbance and the proposed post-mine land use.

Post-mining agricultural land use has been determined according to the enterprise type best suited to that soil type and landform.

2.3 The Proponent

Iluka is an Australian-listed ASX 100 company and a major participant in the global mineral sands industry. It is involved in the exploration, project development, operation (mining and processing) and marketing of mineral sands products. Iluka's mining and processing operations in Australia produce zircon for ceramics and refractories, and titanium minerals for paint pigments and other protective coatings.

Over recent years, the company has transformed its asset base from its historical reliance on its Western Australian mining operations to new, high quality, longer life operations in the Murray Basin (Victoria and NSW) and Eucla Basin (South Australia). Iluka's existing operations in the Murray Basin include the Douglas and Kulwin mines which have ceased production, and the Woornack, Rownack and Pirro (WRP) mine which commenced production in early 2012.

2.4 Need for the Balranald Project

The majority of HMC produced at Iluka's Murray Basin operations is processed at an existing mineral separation plant (MSP) at Hamilton in Victoria, also operated by Iluka. The Hamilton MSP has a capacity of approximately 0.6 million tonnes per annum (Mtpa). The Hamilton MSP currently relies largely on feed from the WRP mine. Unless a new source of feed (HMC) for the Hamilton MSP is provided by mid-2015 to early 2016, the MSP will either be closed or placed into care and maintenance.

The Balranald Project has been identified as the main source of HMC for the Hamilton MSP once operations at WRP mine are complete.

2.5 Scope of this Report

This AIS, prepared in accordance with the AIS Guideline*,* provides the following information:

Section 3: Agricultural Resources

- Detailed information on the agricultural land and water resources in the project area, including climate, soils, topography/slopes, land, and water characteristics.

Section 4: Local and Regional Agricultural Enterprises

- History of agricultural enterprises, location, production levels and relevant details of agricultural businesses within the surrounding locality of the project area.

Section 5: Assessment of Potential Impacts

- Temporary foregone agricultural production and employment from altered use of land and water resources.
- Permanent foregone agricultural production and employment from altered use of land and water resources.
- Predicted impact of reallocation of water resources.

- Potential agricultural impact of the biodiversity offset strategy.
- Further potential impacts on agricultural land and water resources including weed management, biosecurity, dust, noise and traffic.

Section 6: Mitigation Measures

- Measures to minimise any negative impacts on agricultural land and water, agricultural businesses and infrastructure at the local and regional level.

Section 7: Stakeholder Consultation

- Evidence of consultation with landholders, community groups and Government agencies.

Specifically, information requirements as set out in the AIS Guideline have been addressed and are cross-referenced in **Table 2**.

Table 2 AIS Requirement (AIS Guideline)

An AIS must include the following information	**Addressed in this AIS:**
Information Relating to the Site and Region	
Detailed assessment of the agricultural resources and agricultural production of the project area	
This section should include detailed information (including maps) on:	
• the soils, slope, land characteristics, water characteristics (availability, quality);	Section 3
• 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 4
For the project area this should include a description of:	
• any land identified as SAL in a Strategic Regional Land Use Plan on or within two kilometres of the project area (SAL will be further identified in an amendment to the Mining SEPP);	Section 3
• the location and area of land to be temporarily removed from agriculture during operation of the Project, and the period of time;	
• the location and area of land to be returned to agricultural use post-Project, and its productive potential relative to pre-Project;	
• the location and area of land that will not be returned to agriculture, including areas to be used for environmental plantings or biodiversity offsets;	
• 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.	
Identification of the agricultural resources and current agricultural enterprises within the surrounding locality of the project area	
The AIS must contain maps/information for areas within the locality surrounding the Project describing existing agricultural resources. This should include:	
• soil characteristics, including soil types and depth;	Section 3
• topography/slope;	
• key agricultural support infrastructure (e.g. roads, railways, processing facilities);	Section 4
• water resources and other water users' extraction locations;	Section 3
• location and type of agricultural industries;	Section 4
• climate conditions.	Section 3
Describe the location and production levels of each commodity produced by all agricultural enterprises within the locality surrounding the project area.	Section 4
Assessment of Impacts	

An AIS must include the following information	Addressed in this AIS:
Identification and assessment of the impacts of the Project on agricultural resources or industries	
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:	
• the effects of the Project on agricultural resources;	Section 5
• 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);	
• uncertainty associated with the predicted impacts and mitigation measures and the consequences of and likelihood that these uncertainties will be realised;	
• 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 area is located on or within 2 kilometres 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:	
• surface area disturbance, subsidence and soils;	N/A SAL not yet mapped
• salinity, soil pH and groundwater;	
• access to agricultural resources and infrastructure; and	
• agricultural scenic and landscape values.	
Account for any physical movement of water away from agriculture	
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.	
All predicted impacts should be based on robust modelling.	
Assessment of socio-economic impacts	
The AIS should include an assessment of the impacts on agricultural support services, processing and value adding industries and regional employment.	Section 5
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	
Identification of options for minimising adverse impacts on agricultural resources, including agricultural lands, enterprises and infrastructure at the local and regional level	
The AIS should document feasible options to avoid, minimise or mitigate potential impacts on agricultural resources including:	
• Project design review/alternatives;	Section 6
• proposed monitoring programs to assess predicted versus actual impacts as the Project progresses;	
• 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;	
• the proposed remedial action to be taken in response to a trigger event;	
• the basis for assumptions made about the extent to which remedial actions will address and respond to impacts;	

An AIS must include the following information	Addressed in this AIS:
• demonstrated capacity for the rehabilitation of disturbed lands to achieve the final land use and restore natural resources;	
• 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:	
• consultation undertaken to date, including consultation undertaken at the Exploration Licence stage;	Section 7
• consultation with relevant government agencies;	
• consultation with impacted landholders and community groups;	
• the issues identified and measures to address these issues;	
• the outcomes of the consultation;	
• any commitments for further consultation.	

3 AGRICULTURAL AND WATER RESOURCES

3.1 Climate

The closest Bureau of Meteorology (BOM) weather station to the project area is situated in the town of Balranald, approximately 12 km to the south (BOM Station 049002, 2015). The Balranald Project is situated in a semi-arid climatic zone, experiencing hot dry summers and cold winters with details in **Table 3**. Mean maximum temperatures at Balranald range from 15.7 °C in July to 33.0 °C in January and mean minimum temperatures range from 3.5 °C in July to 16.4 °C in January.

Mean annual rainfall is 324.3 mm with the highest monthly rainfalls occurring between May and October. The highest annual rainfall at this station (692.3 mm) was recorded in 1973 (WRM, 2014). Relative humidity in the area is higher during the winter months when temperatures are lower. Average 9am readings range from 54% humidity in December to 87% humidity in June while 3 pm readings range from 30% humidity in January to 59% humidity in June (BOM, 2015).

Table 3 Balranald Climate Data

Temperature	Average (Mean)	Annual Range
Minimum temperature	10.0°C	3.5°C – 16.4°C
Maximum temperature	24.3°C	15.7°C – 33.0°C
Rainfall	**Average (Mean)**	**Number of Rain Days**
Annual rainfall	324.3 mm	46.4
Wettest month	May 31.3 mm	4.4
Driest month	January 22.3 mm	2.2

3.2 Topography

The West Balranald mine is generally flat ranging from 62 m to 72 m Australian Height Datum (AHD). Key natural features include Mallee dunes in the south and relatively flat areas comprising dry relic lake beds to the north. Saline ground waters have formed salt basins in many places where the sand plain or dune topography intersects the water table.

The Nepean mine forms part of a large area of linear dune Mallee located on a ridge of higher ground; the terrain is undulating with elevations ranging from 85 m to 100 m AHD.

3.3 Vegetation

The native vegetation in the Balranald region has previously been described by the former NSW Department of Environment and Climate Change (DECC) as Semi-Arid Woodlands and Arid Shrub Lands. The project area predominantly consists of various species of Mallee communities with patches of Belah-Rosewood woodlands and Chenopod-dominated understoreys in the swales and areas with more structured soils. The saltbush and bluebush shrubland and grassland are a valuable grazing resource, providing green fodder for livestock during times of drought. **Plate 1** through to **Plate 10** show the dominant vegetation communities and agricultural land uses within the project area.

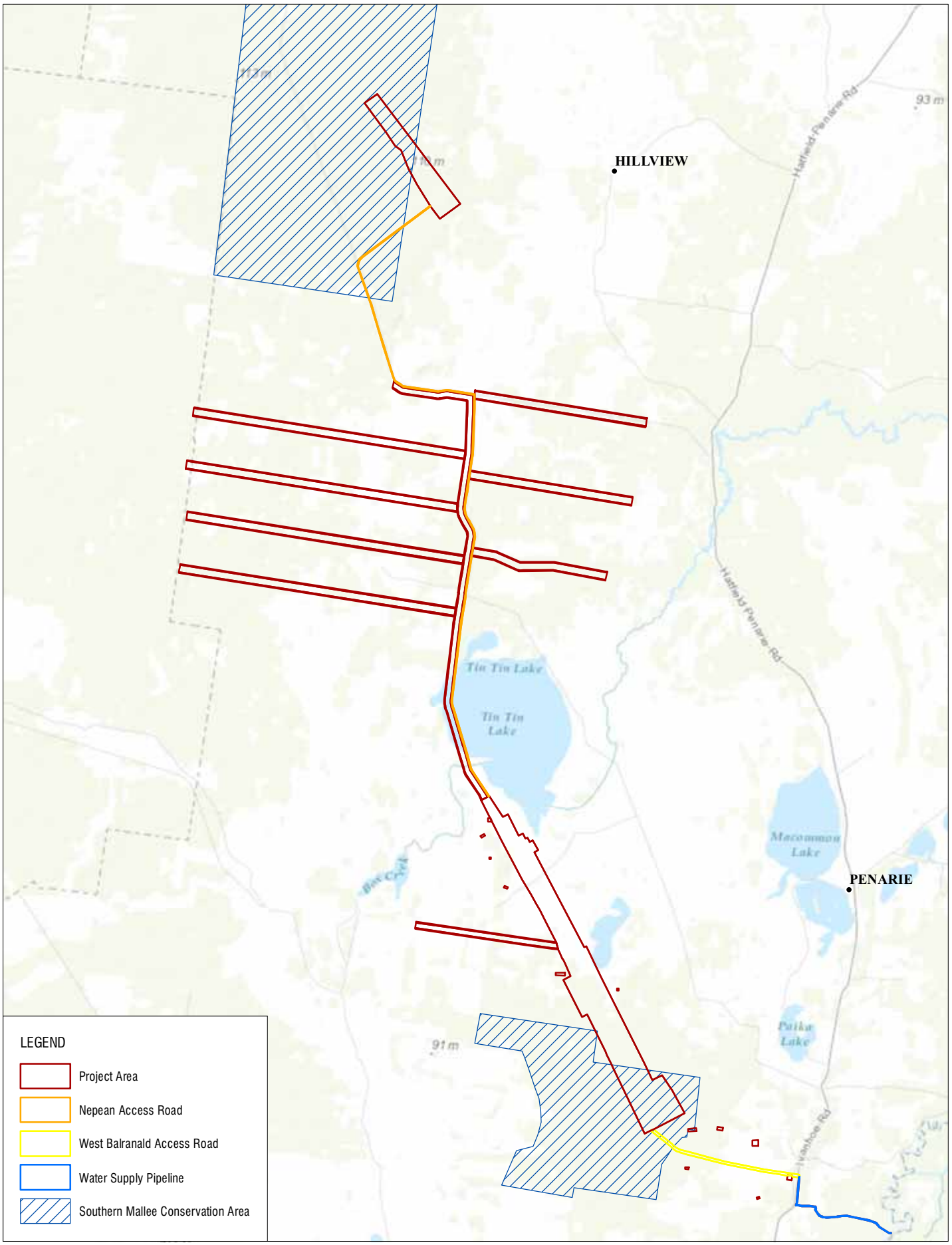
Several natural vegetation communities occur across the project area, these vegetation communities are fully described in the *Balranald Mineral Sands Project Biodiversity Assessment* (Niche Environment and Heritage, 2015). These comprise the following.

- Mallee with spinifex groundcover.
- Mallee with chenopod groundcover.
- Belah with chenopod/saltbush groundcover.
- Belah woodland.
- Black bluebush/grassy low open shrubland.
- Saltbush plains.
- Black box open woodland.
- Derived native grassland/shrubland.
- Modified or cleared/degraded communities including claypans with sparse ground cover and cleared cropland or weedy fallow.

3.3.1 Southern Mallee Conservation Areas

There are several areas of mallee vegetation in the project area which are managed in accordance with Western Lands Lease (WLL) conditions, and conditions in the NSW *Western Lands Act 1901*. These conditions relate to management of certain mallee vegetation, known as 'southern mallee', referred to herein as southern mallee conservation areas (SMCAs), and require land to be managed by lease holders in such a way that conserves vegetation in defined areas of the lease holding. The SMCAs encompassing the project area are shown in **Figure 3**. The SMCAs are subject to specific conditions originally established to protect habitat loss associated with agricultural land uses including clearing and grazing.

Inspection by SLR's Senior Agronomist during September 2012, observed a number of sites within the SMCAs were a virtual monoculture of Mallee scrub, possibly due to many years of overgrazing of palatable understorey species by feral goats and rabbits, which has resulted in degradation of the shrub and ground vegetation layers



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Private Conservation Covenants

FIGURE 3

Plate 1: Mallee woodland at Nepean mine site

Plate 2: Speargrass grazing area at Nepean mine site

Plate 3: Black bluebush grazing area at Nepean mine site

Plate 4: Cleared mallee woodland with onion grass on grazing area at Nepean mine site

Plate 5: Pearl bluebush grazing area at Nepean mine site

Plate 6: Cultivation area on relic lakebed at Nepean mine site

Plate 7: Relic lakebed with rolly poly and onion grass grazing area along Nepean access road

Plate 8: Old-man saltbush grazing area at West Balranald mine site

Plate 9: Bladder saltbush and black bluebush grazing area at West Balranald mine site

Plate 10: Belah woodland with copperburr and nardoo on grazing area at West Balranald mine site

3.4 Hydrology

The project area lies roughly within the geographic centre of the Murray Basin, a low lying, saucer shaped basin of generally internal surface and groundwater drainage that underlies an area of approximately 300,000 km² in southern Australia (Evans & Kellett, 1989).

Surface and groundwater management within the project area is governed by the NSW *Water Act 1912* and NSW *Water Management Act 2000*. Under the *Water Management Act 2000,* there are a number of Water Sharing Plans (WSPs) encompassing and surrounding the project area, including:

Surface water

- Murrumbidgee Regulated River WSP.
- Lachlan Regulated River (WSP).
- NSW Murray and Lower Darling Regulated Rivers (WSP).
- Lachlan Unregulated and Alluvial (WSP).
- Murrumbidgee Unregulated & Alluvium WSP.

Combined

- Lower Murray-Darling Unregulated and Alluvial WSP.

Groundwater

- Lower Murrumbidgee Groundwater Sources WSP.
- Lower Lachlan Groundwater Sources WSP.
- NSW Murray Darling Basin Porous Rock Groundwater WSP (Lower Murray Darling Water Management Area).

Iluka will be required to purchase water allocations from two of these WSPs; the *Murrumbidgee Regulated River WSP* for extraction of river water for fresh water supply and the *NSW Murray Darling Basin Porous Rock Groundwater WSP (Lower Murray Darling Water Management Area)* for the extraction of groundwater.

3.4.1 Surface Water

The project area is located across two surface water catchments, with the West Balranald mine located in the Lower Murrumbidgee River catchment and the Nepean mine in the Lower Murray-Darling catchment.

The Lachlan, Murrumbidgee and Murray rivers are the major permanent surface water features in the vicinity of the project area, shown in **Figure 4.** The Lachlan River flows south-west terminating at Great Cumbung Swamp, a 16,000 ha swamp dependent on flows from the Lachlan River, approximately 80 km to the east of the project area. The Great Cumbung Swamp joins the Murrumbidgee River to the south and becomes part of the Lowbidgee Floodplain (CSIRO, 2008).

Flows within these rivers are regulated by major dams in their headwaters, and by local regulating structures such as Balranald Weirs and the Paika levee, which divert water for irrigation purposes. A number of ancient lakes that would be otherwise dry (e.g. Waldaira, Yanga and Paika Lakes) are artificially filled for irrigation water storage (WRM, 2015).

Permanent surface water flows are confined to the major rivers and their associated backwaters and billabongs which are outside of the project area. The catchments within the project area do not contribute to flows of the major permanent surface water features in the vicinity of the project area, except under extreme flood conditions (WRM, 2015).

Dry relic lake beds occur to the west (Pitarpunga Lake and Muckee Lake) and north (Tin Tin Lake) of the West Balranald mine and are subject to agricultural activities including cropping and grazing.

Local drainage is poorly defined with the exception of Muckee, Pitarpunga and Tin Tin lakes, and Box Creek downstream of the confluence with Arumpo Creek. Identifying local drainage catchments and flowpaths is complicated due to the dunal landforms, which result in numerous small depression storages and small dry lakes. Under existing conditions it is likely that any runoff from the project area would drain via shallow overland sheet flow, before being captured by the dry lakes or depressions evident in the topography (WRM, 2015).

3.4.2 Existing Surface Water Users

There are no known landholders with surface water licences in the project area, as surface water is available only very infrequently. No infrastructure exists for diversion or storage of surface water flows.

3.4.3 Groundwater

The principle hydrogeological units present under the project area are described in the *Balranald Project DFS1 Groundwater Modelling Impact Assessment Modelling* (Jacobs Group, 2015) and are shown in **Table 4**, in order from shallowest to deepest. Generally, depth to groundwater in the vicinity of the project area is approximately 20 m, with salinity decreasing with depth. The Lower Renmark formation is the only aquifer with widespread agricultural use due to its water quality being acceptable to livestock.

Measuring Water Salinity (I&I, 2009) gives a maximum salinity level of 6,400 mg/L for safe long term watering of sheep, up to 8,320 mg/L is given as the maximum that may be safe for limited periods.

Table 4 Major Hydrogeological Units

Name	Aquifer Type	Thickness (m)	Salinity (mg/L)	Comment
Coonambidgal Formation	Unconfined	10	< 3,000	Salinity increases away from river channel alluvium
Shepparton Formation	Unconfined	25 – 50	> 14,000	Very high salinity, low yield
Loxton-Parilla Sands	Nepean – Unconfined West Balranald – Confined	30 – 50	> 35,000	Extreme salinity
Upper Renmark	Confined	40 – 60	7,000 – 35,000	High salinity, low yield
Middle Renmark	Confined	50 – 100	3,000 – 14,000	Minor producer of stock quality water
Geera Clay	Aquitard	50 – 100	>35,000	Interfingers Middle and Lower Renmark Group
Lower Renmark	Confined	60 – 130	1,500 – 14,000	Main producer of stock quality water

Coonambidgal Formation

The Coonambidgal Formation, forms a local scale shallow aquifer in the vicinity of the major river channels, and is associated with the alluvium of the channels and floodplains of the Murrumbidgee, Lachlan and Murray Rivers. Water tables are shallow (< 10 m) and salinities fresh in the vicinities of rivers. The Coonambidgal Formation has steep salinity gradients at the edge of floodplains where groundwater salinity ranges from < 1, 000 mg/L to > 35,000mg/L.

Shepparton Formation Aquifer

The Shepparton Formation is the upper most aquifer within the project area, with a thickness of ranging between 25 m and 50 m and a hydraulic conductivity ranging between 1 m and 2 m/day. Low yielding with salinity levels recorded at > 14,000 mg/L.

Loxton-Parilla Sands Aquifer

The Loxton-Parilla Sands lie over the Renmark Group and range between 30 m and 50 m thick through the project area. Hydraulic conductivity has been recorded at 4 m/day with salinity > 35,000 mg/L.

Renmark Group Aquifers

The Renmark Group consists of the Lower, Middle and Upper Renmark Aquifers. The basal unit is the Lower Renmark Group Aquifer and is believed to be 60 m – 130 m thick with a hydraulic conductivity of between 1 and 4 m/day. The Lower Renmark Group is the main aquifer utilised for stock watering, with salinity being recorded between 1,500 – 14,000 mg/L.

The Middle Renmark Aquifer varies from 50 m thick on the ridges of the Balranald trough to 100 m thick within the Balranald trough, with a hydraulic conductivity of 0.5 to 1 m/day and salinity of between 3,000 – 14,000 mg/L.

The Upper Renmark Aquifer is approximately 60 m thick in the troughs to 40 m on the basement ridges. Hydraulic conductivity varies from 2 m/day through the trough to 1 m/day on the ridges and salinity levels of 7,000 – 35,000 mg/L

Geera Clay

The Geera Clay is a massive silt and clay layer with an average thickness of approximately 100 m, interfingering the Middle Renmark Aquifer. The Geera Clay is thought to act as an aquitard, limiting hydraulic connection between where it interfingers the Middle/Lower Renmark aquifer and the more saline Upper Remark, Loxton-Parilla Sands and the Shepparton Formation (URS, 2012).

All drilling conducted by Iluka across the project area to date has found the Geera Clay in every bore which has been drilled through the base of the Loxton-Parilla Sands (Jacobs Group, 2015).

3.4.4 Existing Groundwater Users

A census of available existing groundwater users within the project area was undertaken by Land and Water Consulting (2014). All bores utilised by the interviews landholders were for stock water use, with one of these bores used for stock and domestic purposes.

Ten of the identified bores were screened in the lower Onley formation (which consists of the Upper, Middle and Lower Renmark Aquifers); five were screened in the Shepparton formation, with one bore having an unknown screen depth. Salinity in these bores varied between 350 mg/L total dissolved solids (TDS) and 5,300 mg/L TDS. The majority of these bores were low yielding, with yields of around 0.4 L/s being typical.

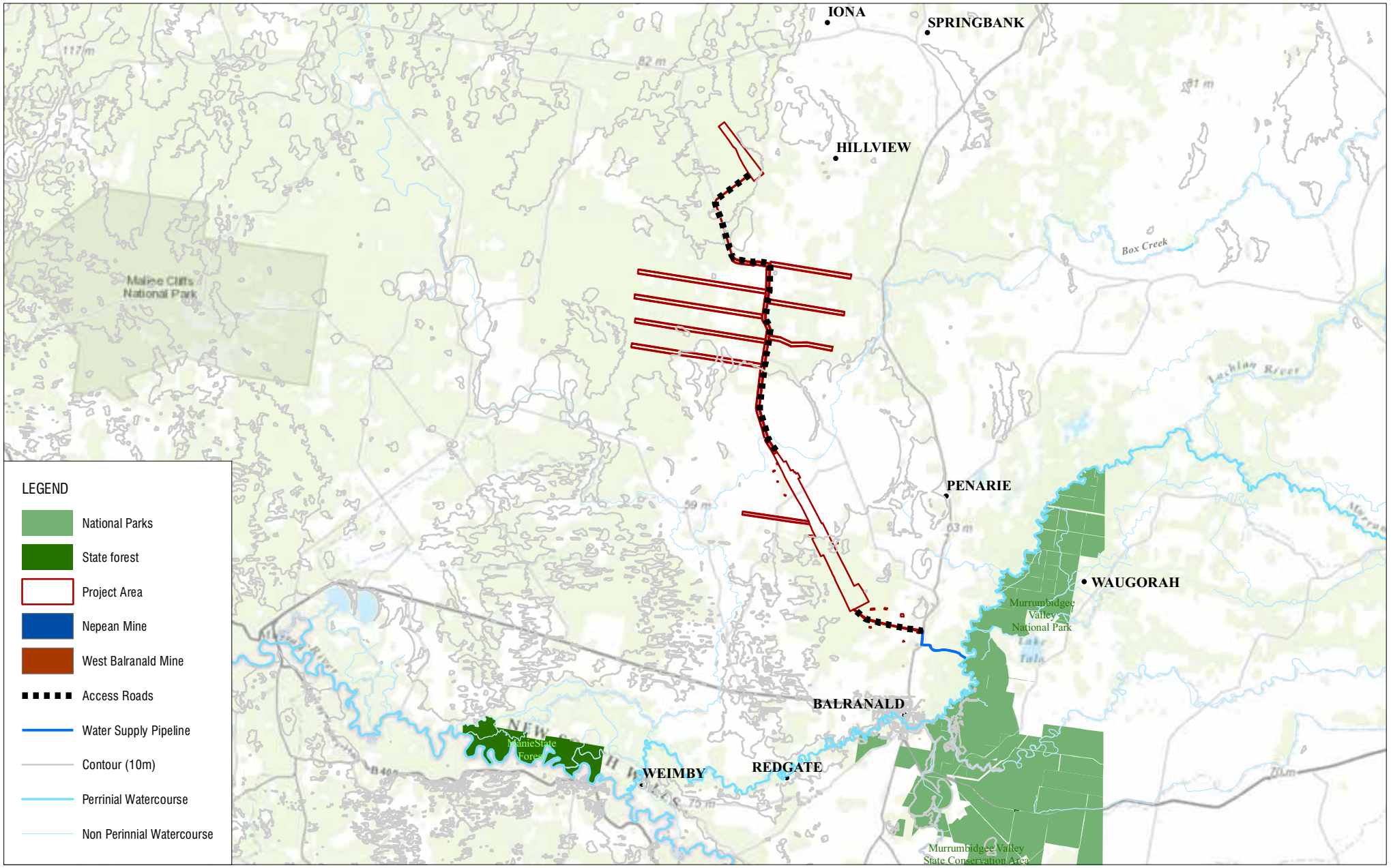
No bores within the project area were screened in the Loxton-Parilla Sands Aquifer.

The *Water Assessment* prepared by EMGA Mitchell McLennan (2015a) identified 113 private landholder bores, shown in **Figure 5**, within the model boundary, an area of approximately 8,000 square kilometres. The majority of these bores are screened in the Onley and Shepparton Formations. Full details of these bores can be found in the Water Assessment.

3.5 Geology and Geomorphology

Geological maps show the surficial geology of the project area to be comprised of Quaternary aged sediments. The sandy surface sediments have been extensively reworked into dunes and sand plains. The surrounding rivers and streams on the Riverina floodplain have cut through the sands and constructed numerous overflow lakes and abandoned Pleistocene channels and basins.

The project area is located close to the centre of the Murray Basin, which is a large structurally controlled depression filled with Tertiary marine and non-marine sediments. This sequence has subsequently been overlain by Quaternary aged aeolian, fluvial and lacustrine sediments and contains two stratigraphical units, the Loxton Parilla Sands and the Shepparton Formation.



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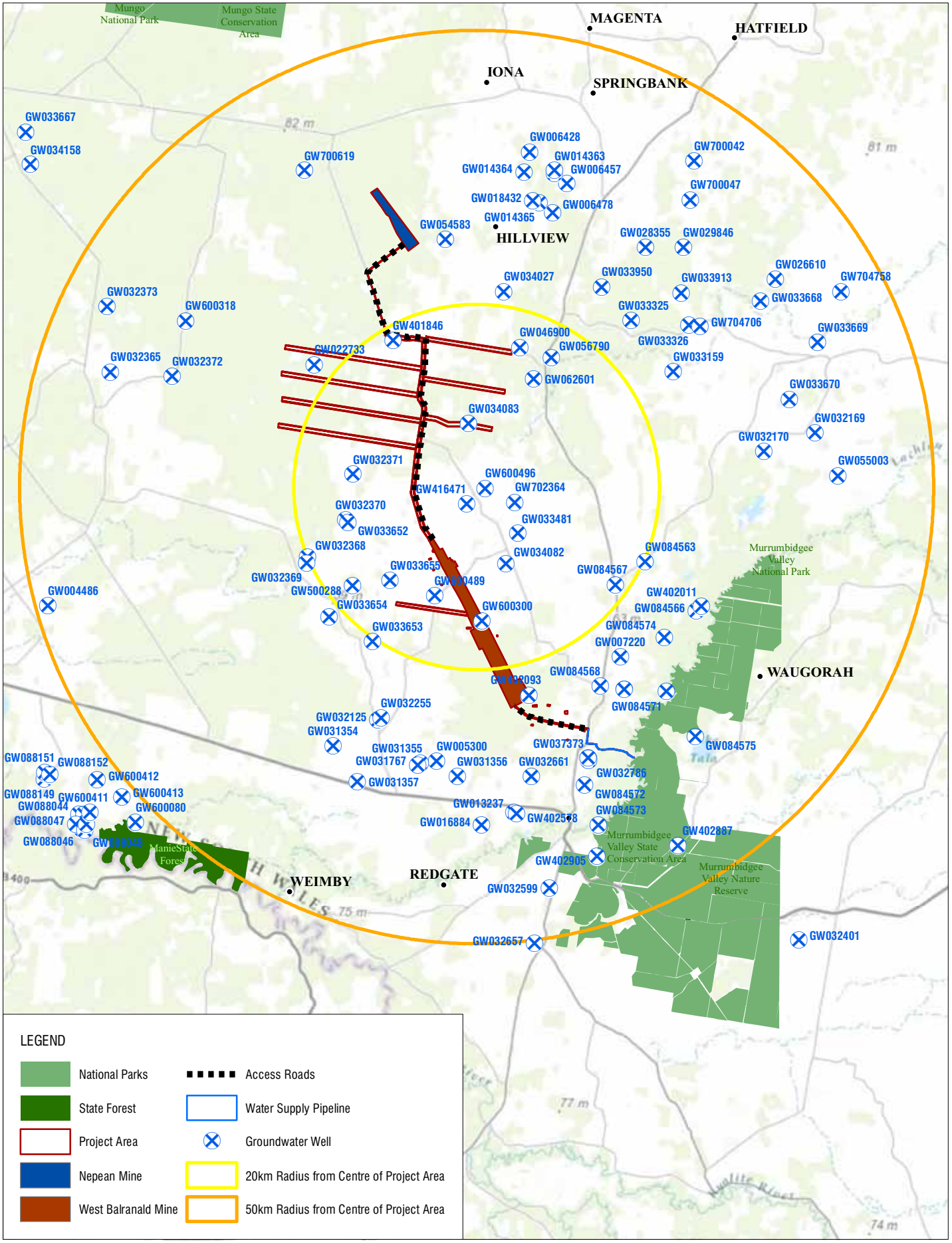
Topology and Hydrology

FIGURE 4



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Balranald AIS

Landholder Groundwater Bores

FIGURE 5

3.6 Land and Soil Capability Assessment

In NSW, the Rural Land Capability System developed by the former NSW Soil Conservation Services, has been widely used to evaluate agricultural potential of land (Emery, 1986). This system has now been replaced by the Land and Soil Classification (LSC) assessment scheme developed for NSW: *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2013a) (here-in referred to as the LSC Guideline). The LSC Guideline builds on the Rural Land Capability system and retains the eight class system, placing additional emphasis on soil limitations and management.

The LSC Class definition has been based on the following two considerations.

- The biophysical features of the land to derive the LSC Classes associated with various hazards.
- The management of these hazards including the level of inputs, expertise and investment required to manage the land sustainably.

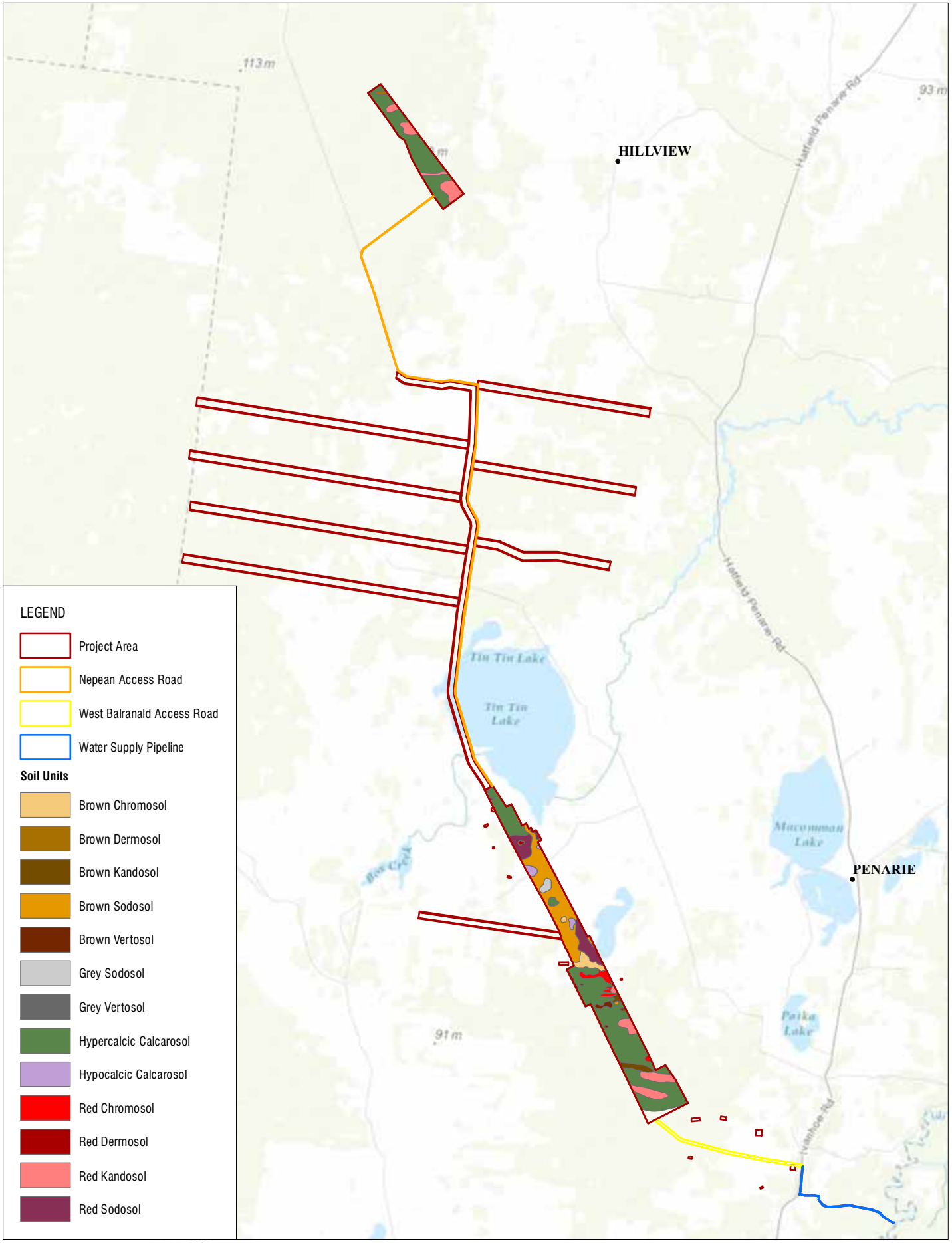
The process and methodology for the Land and Soil Capability Classification are outlined in Section 3.2.2 of the *Soil Resource Assessment* (EMGA Mitchell McLennan, 2015b):

A field survey of approximately 4,000 ha of the project area for the Soil Resource Assessment, predominantly at the West Balranald and Nepean mines was undertaken by Sunraysia Environmental on behalf of EMM between 24 June and 30 July 2014. The area covered in the Soil Resource Assessment is here-in referred to as the soil assessment area.

Thirteen soil types were identified within the soil assessment area, with Hypercalcic Calcarosols (2,072 ha), Brown Sodosols (641 ha) and Red Kandosols (421 ha) the dominant soil types, as shown in **Table 5** and **Figure 6**.

Table 5 Land and Soil Capability Classification

LSC Classification	Soil Unit	Soil Assessment Area (ha)	Area %
4	Red Chromosol	87	2
	Brown Chromosol	86	2
	Subtotal	**173**	**4**
5/6	Red Kandosol	421	11
	Brown Kandosol	76	2
	Subtotal	**497**	**13**
6	Hypercalcic Calcarosol	2,072	55
	Hypocalcic Calcarosol	51	1
	Red Dermosol	6	<1
	Brown Dermosol	13	<1
	Red Sodosol	273	7
	Brown Sodosol	641	17
	Grey Sodosol	34	1
	Brown Vertosol	33	1
	Grey Vertosol	1	<1
	Subtotal	**3,124**	**83**
	Total	**3,794**	**100**



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Soil Types

FIGURE 6

The three LSC Classes found in the soil assessment area are shown in **Table 5** and **Figure 7**. **Figure 8** shows the LSC Classes at West Balranald Mine and **Figure 9** shows LSC for the Nepean mine.

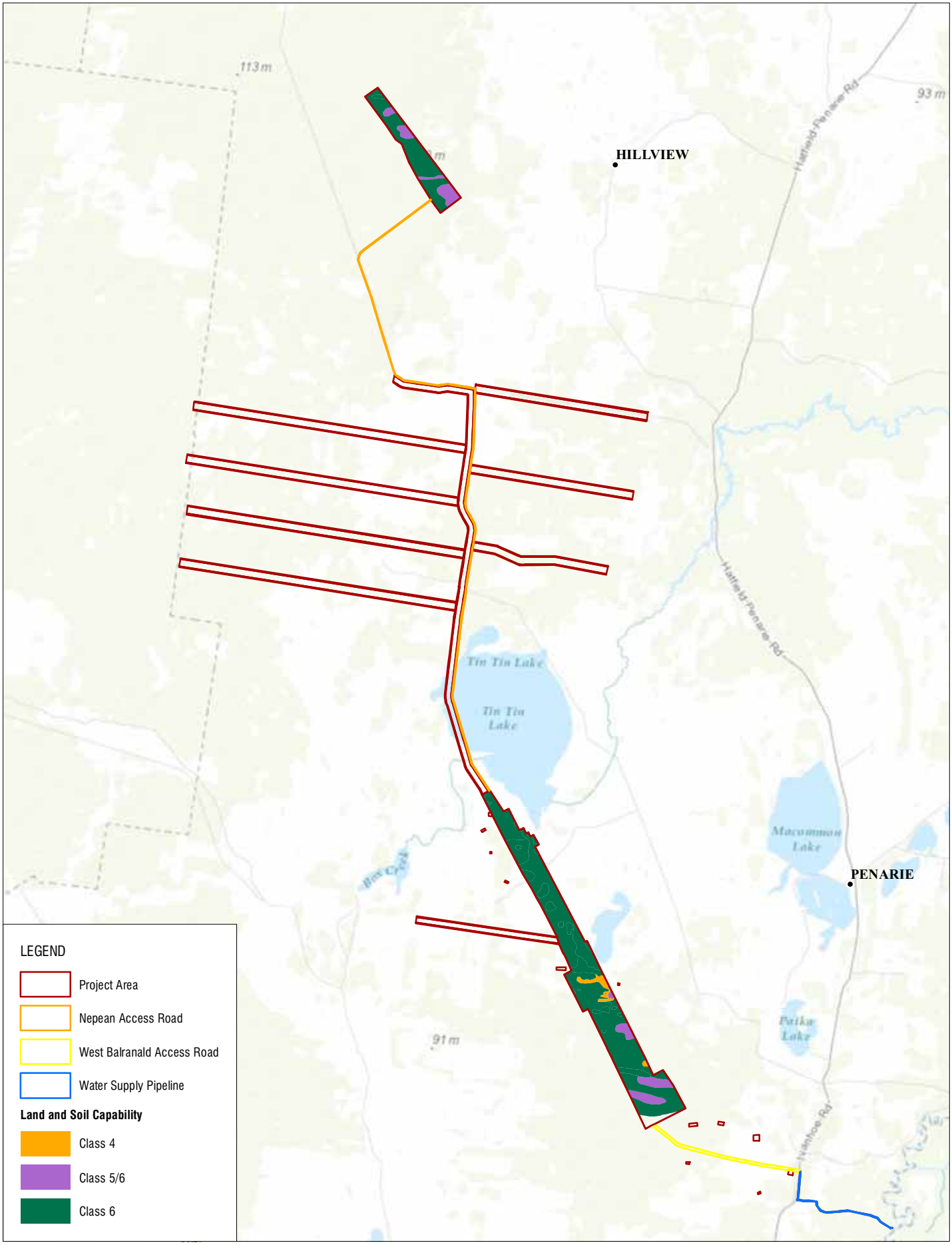
Within the soil assessment area there is 173 ha of LSC Class 4 land, defined by the LSC Guideline as moderate capability land with moderate to high limitations for high impact land uses. Limitations will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology. Cropping enterprises are possible but only with restricted cultivation in rotation with a pasture phase.

There is 497 ha of LSC Class 5/6 land within the soil assessment area, defined by the LSC Guideline as moderate-low capability land with high limitations for high impact land uses. Limitations will restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.

Within the soil assessment area there is 3,124 ha of LSC Class 6 land, defined by the LSC Guideline as low capability land with very high limitations for high impact uses. Land use is restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.

In addition to the Land and Soil Capability assessment the Soil Resource Assessment also carried out a Biophysical Strategic Agricultural Land (BSAL) assessment according to the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013b), which was carried out as a precautionary assessment as the project area did not meet the criteria for reliable water supply. None of the soil types within the soil assessment area satisfied the criteria in the *Interim Protocol* to be classified as BSAL.

In summary, according to the LSC Guideline, the Soil Resource Assessment determined there is 173 ha of Class 4 land suited to cropping and grazing enterprises and 3,621 ha of Class 5/6 and Class 6 land suited to grazing only enterprises within the soil assessment area. None of the area contains BSAL.



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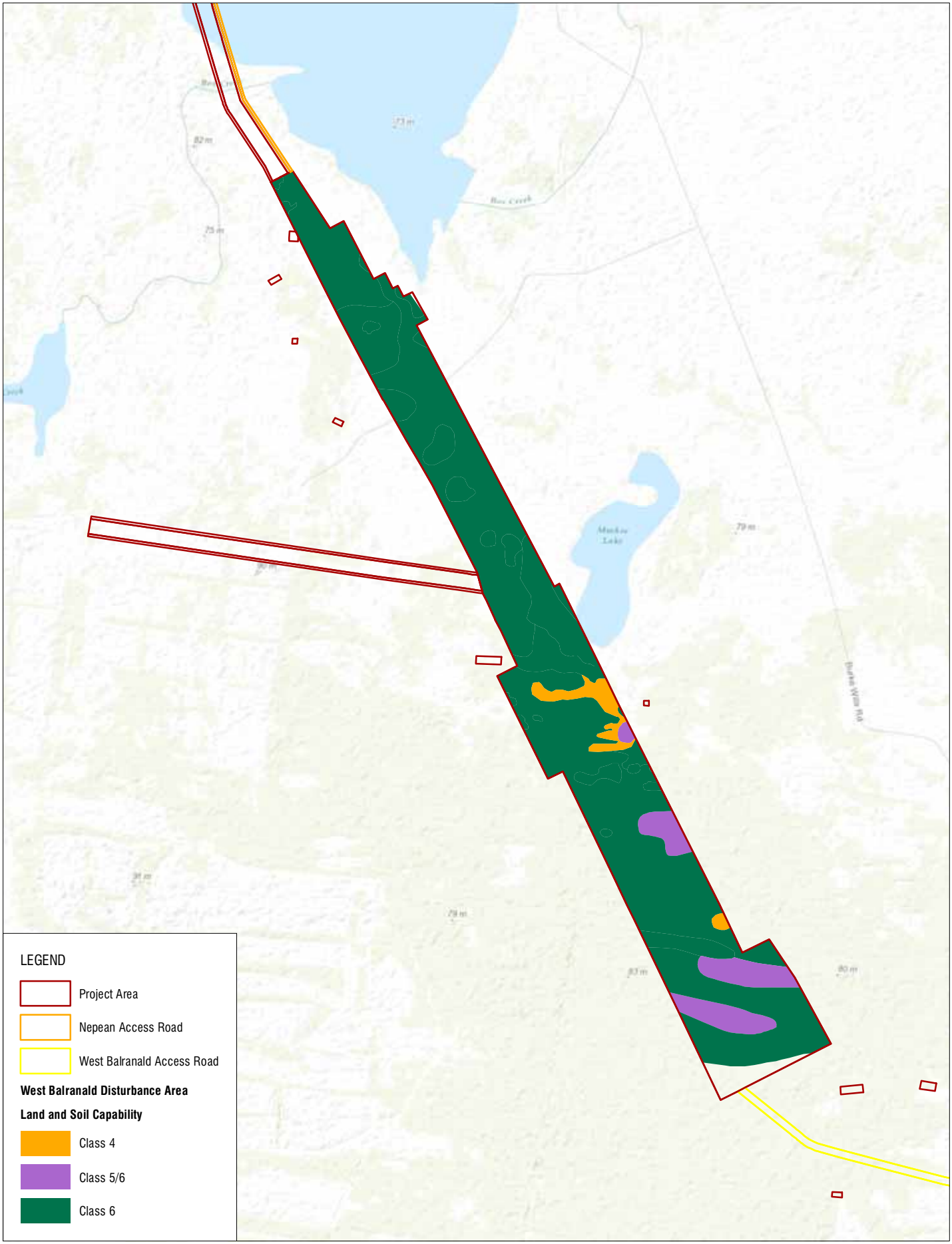
Land and Soil Capability

FIGURE 7



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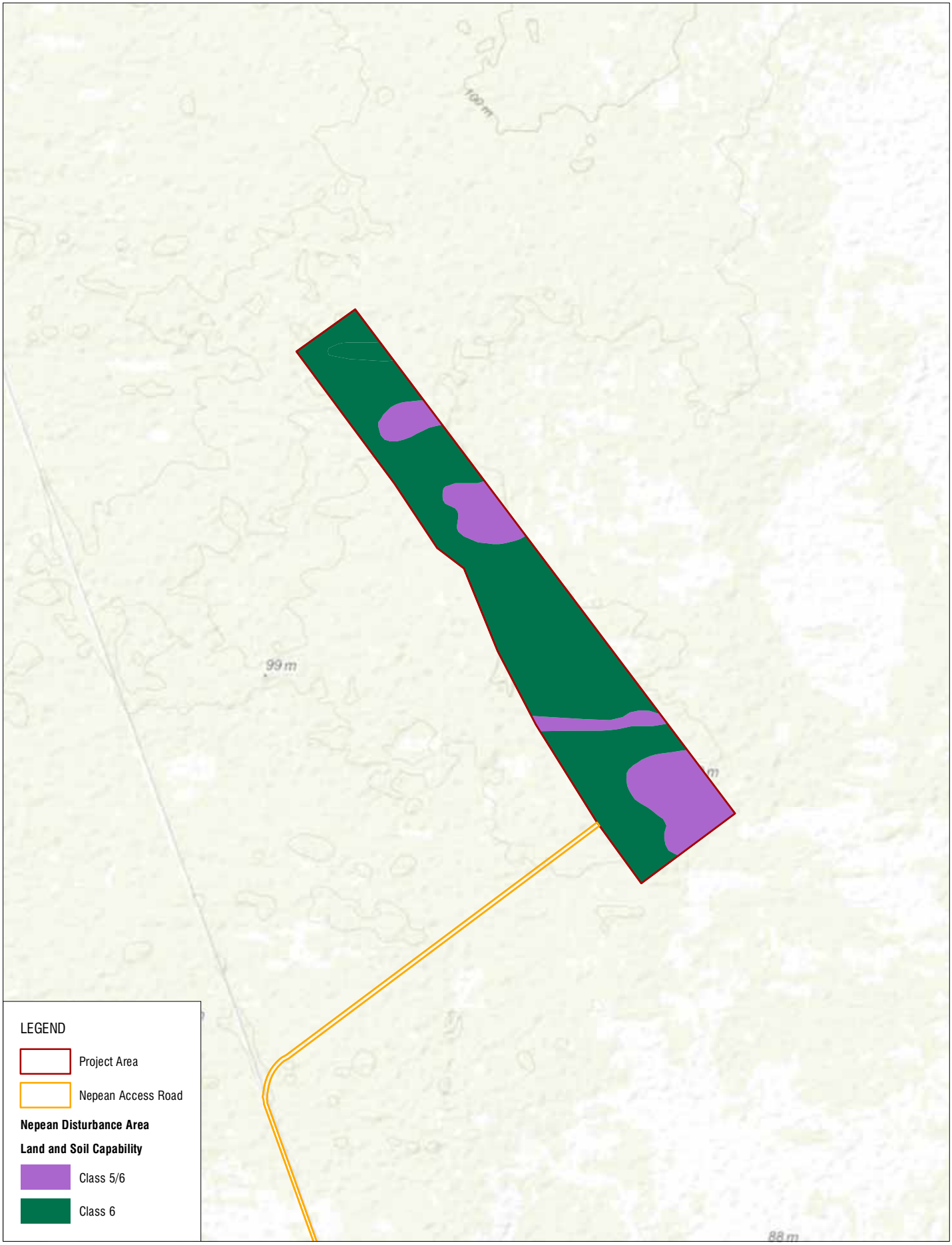
West Balranald Land and Soil Capability

FIGURE 8



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Nepean Land and Soil Capability

FIGURE 9

4 LOCAL AND REGIONAL ARGICULTURAL ENTERPRISES

4.1 Overview

The Balranald Project is located in south-western NSW within the Balranald LGA, which covers 2,169,130 ha and has a population of approximately 2,283 (Australian Bureau of Statistics (ABS), 2011). The Balranald LGA is the area referenced when identifying 'regional' agricultural resources and impacts.

The Balranald LGA borders the Shires of Hay, Wentworth, Central Darling, Carrathool, and Wakool and the Victorian City Councils of Mildura and Swan Hill. Agriculture is the major industry in the Balranald LGA. Land uses within the Balranald LGA compromise mostly of agricultural pastoral activities (grazing livestock with some winter cereal cropping) with some fruit growing and quarrying of gypsum and other minerals.

The project area is approximately 9,964 ha, representing approximately 0.46% of the Balranald LGA, whilst the soil assessment area is approximately 3,794 ha (0.17%).

4.2 Agricultural History

Balranald town is considered the oldest settlement on the lower part of the Murrumbidgee River, situated on a flat saltbush and Mallee plain. After exploration by Thomas Mitchell, the land was opened up to squatters, with the first sheep runs taken up along the Murrumbidgee in the early 1840s. These sheep runs were huge areas with "Canally Station" covering 343,000 acres (138,807 ha) (Landskape, 2012).

In the late 1800's policy of closer settlement was pursued and resulted in the passing of the 1861 and 1884 *Crown Lands Acts*, which resumed these large pastoral holdings, subdivided and subsequently re-allocated the smaller lots as perpetual WLL title, which have subsequently been aggregated once again by larger WLL holders (Landskape, 2012).

Sheep grazing on chenopod shrubs and native grasses has been the main agricultural enterprise since settlement. In more recent years, broadacre cereal cropping has increased in area, whilst viticulture and horticulture industries utilising irrigation have been developed closer to Balranald town where soil type and water quality is better suited to these intensive industries.

4.3 Agricultural Enterprises and Associated Industries

4.3.1 Land Use

The Balranald LGA predominantly supports grazing of sheep with limited cattle grazing to the east, with grazing operations supplemented by cropping activities. Dryland cropping consists of wheat, barley and other cereal crops, while irrigation is predominantly used for grape and citrus production (Scott, 1992). The primary land use types on and surrounding the project area are agriculture, pastoral activities and some quarrying of gypsum and other minerals.

The agriculture land use compiled by the ABS (2011) for the Balranald LGA is shown in **Table 6**. It details the area of land used for agriculture in the region and the specific uses of the land. Following are the major points are summarised.

- Agriculture is the major land use for the region, accounting for 96% of land use.

- Agricultural land is almost exclusively used for grazing, utilising 95% of all agricultural land. The primary enterprise is sheep grazing, which accounts for 95% of livestock numbers, with beef cattle grazing making up the remaining 5%.
- Dryland cropping enterprises comprise a minor portion of agricultural activities at 1%. The primary crops grown are cereals for grain, mainly wheat and barley.
- Irrigation occurs over only 0.4% (approximately 8,000 ha) of the total agricultural area, though irrigated agriculture is a major water user with 42,863 ML/annum applied to this area (5.36 ML/ha/annum) (ABS, 2006). Note these figures are from the 2006 census as 2011 are not yet available.

Table 6 Balranald LGA Agricultural Land Use (2011)

	Units	Balranald LGA
Agricultural Land Area		
Total land area	ha	2,169,130
Area of agricultural land	ha	2,075,748
Proportion of agricultural land	%	96
Agricultural Enterprise		
Land under cropping activities	ha	97,602
Land under grazing activities	ha	1,978,146
Proportion of agricultural land used for grazing	%	95

4.3.2 Employment

A summary of the total regional employment and the proportion of agriculture related employment are shown in **Table 7**. Agriculture (and related industries) is a major employer within the Balranald LGA; with the total of persons employed in the agricultural sector representing 31% of the total employed population.

Table 7 Balranald LGA Employment (2011)

Population Category	Number of Persons
Total Persons	2,283
Total Labour Force	1,076
Total Employed	1,030
Total Unemployed	46
Total Employed in Agriculture	318
Proportion of Employment Related to Agriculture (%)	**31**

The following employment breakdowns were obtained from the 2011 ABS statistics:

- Agricultural production is responsible for 31% of employment.
- Sheep, beef cattle and grain farming are the main employer in the Balranald LGA, accounting for employment of 170 persons.
- Fruit and tree nut growing is the second largest agricultural employer with 86 persons.
- The main agriculture-related processing and manufacturing is forestry-related sawmilling, shearing and, wine and other alcoholic beverage manufacturing.

Detailed agricultural employment figures are not available for the project area; however based on the existing agricultural land uses within the project area, it is expected that income from agricultural enterprises within the project area is generated from sheep meat, wool and winter cereal cropping enterprises.

4.4 Agricultural Production Value – Regional

The latest figures for the value of agricultural production in the Balranald LGA are from the 2006 census which states that agricultural production value total $83 million (ABS, 2006), as detailed in **Table 8**.The main agricultural production by value is dryland winter crop production, and irrigated table and wine grape growing. Income from livestock is mainly derived from the sheep industry, with lamb (livestock slaughterings) and wool (livestock products) sales providing the bulk of income.

Table 8 Balranald LGA Agricultural Production (2006)

Agricultural Production Gross Value	Balranald LGA ($ M)
Crops	57.2
Livestock slaughtering	17.4
Livestock products	8.4
Total gross agricultural production	**83.0**

4.5 Potential Agricultural Production Value of the Project Area

Potential agricultural productivity was determined using NSW Department Primary Industry (DPI) Gross Margin Budgets and agricultural productivity data for agricultural enterprises suitable for each of the Land and Soil Capability Class that will be impacted. This analysis has been undertaken on the potential capability of the land rather than current land use. This information can be used to generate potential farm incomes using gross margin budgets.

Iluka is currently assessing the potential for negotiation with landholders for continued use of agricultural land within the project area which will not be disturbed by mining and related activities. Continued use of land for agricultural activities will also aid in preventing the build-up of fuel loads and subsequent bushfire risk.

As the *Rehabilitation and Closure Strategy (EMGA Mitchell McLennan, 2015a)* proposes progressive rehabilitation of disturbed areas, at any one time the total disturbance area of 5,346 ha will only include a portion of actual mining disturbance. Therefore the entire disturbance area will not be completely removed from potential agricultural production at once, but rather it will comprise four different areas, each dependant on the stage of the project:

- Undisturbed (pre-mining).

- Pre-mining preparation, including clearing of vegetation and topsoil stripping.
- Mining.
- Rehabilitation.

Whilst the project area is 9,964 ha, the purpose of an AIS is to assess the agricultural impact of a project on agricultural resources, for this reason the assessment firstly focuses on the project's soil assessment area (3,794 ha) and the potential agricultural production within this area using a conservative assessment (i.e. total removal of these areas from agricultural production for the life of the project).

Secondly the assessment quantifies potential agricultural production of the soil assessment area excluding the area covered by SMCAs (which cover a total of 1,067 ha within the soil assessment area); this area is referred to herein as the area of actual agricultural disturbance covering 2,727 ha. The location of the SMCAs in relation to the entire disturbance area is shown in **Figure 10**.

The impact assessment for the area of actual agricultural disturbance has been undertaken due to the SMCAs not being available at present for agricultural production.

Actual farm enterprises being conducted within the vicinity of the project area are dependent on numerous factors, including soil and vegetation type, water quality and availability, property history and landholder preference. The following five farm enterprises have been identified as operating within or alongside the project area:

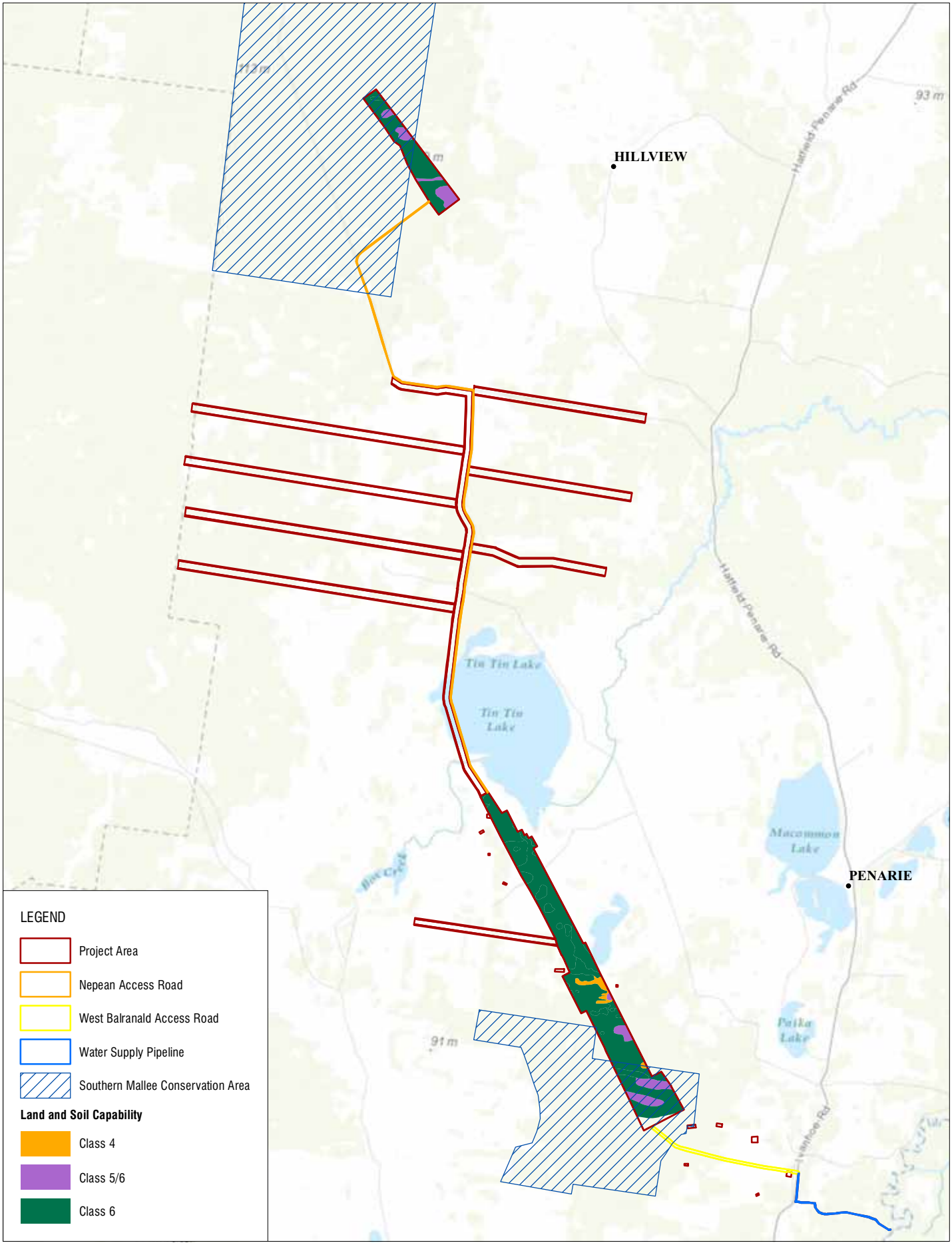
- 20 micron Merino ewes for wool and meat production (DPI, 2014a).
- Feral goats for meat production (Western CMA, 2011).
- Dorper ewes for meat production (DPI, 2014b).
- Weaner cattle for beef production (I&I, 2012).
- Short fallow dryland cropping for wheat production (DPI, 2012a).

The 'average' safe carrying capacity determined for the Balranald LGA is one dry sheep equivalent (DSE) per 4 ha (equivalent to 0.25 DSE/ha), according to the *Balranald Common Plan of Management* (Balranald Shire Council, 2010). This 0.25 DSE/ha carrying capacity has been assumed as the 'average' for LSC Class 6 land, as LSC Class 6 comprises the majority of the soil assessment area and the area of actual agricultural disturbance. The better rated land (lower LSC number) gives a higher DSE carrying capacity whilst the inferior LSC rated land gives a lower DSE carrying capacity.

These assumed ratings are based on the fact that the 'better' rated LSC land will have a higher inherent fertility and soil moisture holding capacity, as described in the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013b).

Table 9 to **Table 13** show the potential gross margin for each of the five agricultural enterprises identified, calculated for both the soil assessment area (3,794 ha), and the area of actual agricultural disturbance (2,727 ha). SMCAs have not been included in the potential agricultural production of the area of actual agricultural disturbance as by definition they are not currently being used for agricultural production.

Gross margins for grape or other irrigated fruit production have not been calculated as both soil type (sodicity and salinity) and water quality (salinity) are unsuitable for the growing of vines and fruit trees within the project area.



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NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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Projection:	GDA 1994 MGA Zone 54

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Balranald AIS

LSC and Covenant

FIGURE 10

Full agricultural gross margin and productivity information is contained in **Appendix A**.

Merino Ewes and Merino Rams

Assumptions used to calculate gross margins in **Table 9** were that a Merino ewe was capable of generating a gross margin of $66 per annum with a DSE rating of 2.5, taken from *Farm Enterprise Budget Series – Oct 2014 – Merino Ewes 20 Micron* (DPI, 2014a).

Table 9 Merino Ewe and Merino Ram Enterprise

LSC	Livestock-Carrying Capacity	Merino Ewe	Gross Margin	Soil Assessment Area	Agricultural Disturbance Area
Class	**Dry sheep equivalent**	**Per ha**	**Per ha**	**Per annum**	**Per annum**
4	0.40	0.16	$10.56	$1,827	$1,758
5/6	0.30	0.12	$7.92	$3,936	$2,028
6	0.25	0.10	$6.60	$20,618	$15,193
Total potential income				**$26,382**	**$18,979**

Potential income for a Merino sheep enterprise over the soil assessment area is $26,382 per annum and the area of actual agricultural disturbance is $18,979 per annum.

Feral Goats

Assumptions used to calculate gross margins in **Table 10** were a feral goat population of 1,920 per 24,000 ha with 50% of the population harvested per annum, with a gross margin of $30 per head. No gross margin was available from the Balranald district (325 mm annual rainfall) so Bourke (350 mm) figures were used from the *Economic Analysis of Feral Goat Control within the Western NSW Rangelands* (Western CMA, 2011). There is no variance in livestock carrying capacity between different LSC for feral goats as their main fodder source is native shrubs and woody weeds and has little correlation with LSC Class.

Table 10 Feral Goat Enterprise

LSC	Livestock-Carrying Capacity	Feral Goat	Gross Margin	Soil Assessment Area	Agricultural Disturbance Area
Class	**Dry sheep equivalent**	**Per ha**	**Per ha**	**Per annum**	**Per annum**
N/A	0.25	0.04	$1.20	$4,553	$3,272
Total potential income				**$4,553**	**$3,272**

Potential income for a feral goat enterprise over the soil assessment area is $4,553 per annum and the area of actual agricultural disturbance is $3,272 per annum

Dorper Ewes and Dorper Rams

Assumptions used to calculate gross margins in **Table 11** were a Dorper ewe was capable of generating a gross margin of $62 per annum with a DSE rating of 2.7, taken from *Farm Enterprise Budget Series – December 2011 – Dorper Ewes* (DPI, 2014b)

Table 11 Dorper Ewe and Dorper Ram Enterprise

LSC	Livestock-Carrying Capacity	Dorper Ewe	Gross Margin	Soil Assessment Area	Agricultural Disturbance Area
Class	**Dry sheep equivalent**	**Per ha**	**Per ha**	**Per annum**	**Per annum**
4	0.40	0.15	$9.19	$1,589	$1,552
5/6	0.30	0.11	$6.89	$3,424	$1,764
6	0.25	0.09	$5.74	$17,934	$13,215
Total potential income				**$22,947**	**$16,531**

Potential income for a Dorper sheep enterprise over the soil assessment area is $22,947 per annum and the area of actual agricultural disturbance is $16,531 per annum.

Weaner Cattle

Assumptions used to calculate gross margins in **Table 12** were a breeding cow was capable of generating a gross margin of $281 per annum at a DSE rating of 15.25, and progeny were sold as weaners at 260 kg, taken from *Farm Enterprise Budget Series – December 2012 – Inland Weaners* (I&I, 2012).

Table 12 Beef Cattle Inland Weaner Enterprise

LSC	Livestock-Carrying Capacity	Cow and Calf	Gross Margin	Soil Assessment Area	Agricultural Disturbance Area
Class	**Dry sheep equivalent**	**Per ha**	**Per ha**	**Per annum**	**Per annum**
4	0.40	0.026	$7.37	$1,275	$1,246
5/6	0.30	0.020	$5.53	$2,747	$1,415
6	0.25	0.016	$4.61	$14,391	$10,604
Total potential income				**$18,413**	**$13,265**

Potential income for a beef cattle enterprise over the soil assessment area is $18,413 per annum and the area of actual agricultural disturbance is $13,265 per annum.

Short Fallow Wheat

Assumptions used to calculate gross margins in **Table 13** were a wheat price of $275 per tonne, taken from *Farm Enterprise Budget Series– Wheat Short Fallow (No-Till) Central Zone West Winter 2012* (DPI, 2012a). Rainfall use efficiency for a wheat crop is 15.6 kg/ha/mm, with Balranald receiving an average of 160 mm in-crop rainfall per annum, from *Rainfall, Yield And Gross Margin Probabilities For Non-Cereal Crops In Low Rainfall Southern Australia* (Farmtalk, 2006), which equates to 2.5 tonnes/ha on LSC Class 2 land, correlating to 1.5 tonnes/ha on LSC Class 4. LSC Class 2 and 3 have been included in **Table 13** to provide comparative yield and gross margin data between the different LSC classes.

LSC Class 5/6 and LSC Class 6 land is not capable of supporting a wheat cropping enterprise.

Table 13 Wheat Cropping Short Fallow Enterprise

LSC	Wheat	Gross Margin	Gross Margin Soil Assessment Area	Gross Margin Agricultural Disturbance Area
Class	**Tonnes per ha**	**Per ha**	**Per annum**	**Per annum**
2	2.5	$298	N/A	N/A
3	2.0	$238	N/A	N/A
4	1.5	$179	$30,967	$30,251
Total potential income			**$30,967**	**$30,251**

Potential gross income for a short fallow wheat cropping enterprise over the soil assessment area is $30,967 per annum and the area of actual agricultural disturbance is $30,251 per annum.

Agricultural Enterprise Summary

Table 14 summarises the previously calculated agricultural enterprises gross margins.

Table 14 Potential Gross Margin per Enterprise (Pre-Mining)

Enterprise	Average Gross Margin	Soil Assessment Area Enterprise Gross Margin	Agricultural Disturbance Area Enterprise Gross Margin
	Per ha	**Per annum**	**Per annum**
Merino Ewe	$6.95	$26,382	$18,979
Feral Goat	$1.20	$4,553	$3,272
Dorper Ewe	$6.05	$22,947	$16,531
Weaner Beef Cattle	$4.85	$18,413	$13,265
Wheat	$179	$30,967	$30,251

Based on the nominated gross margins, the most profitable enterprise mix would be wheat production on the 173 ha of LSC Class 4 land combined with a Merino ewe enterprise on the remaining 3,621 hectares of LSC Class 5/6 and LSC Class 6 land.

Given the calculated gross margins the soil assessment area has the potential to generate an estimated gross margin of $55,521 per annum from a Merino ewe enterprise (on LSC 5/6 and LSC 6 land) combined with a wheat cropping enterprise (LSC 4), whilst the area of actual agricultural disturbance has the potential to generate a potential gross margin of $47,472 per annum from the same Merino ewe enterprise combined with a wheat cropping enterprise. In addition there is the "opportunity" enterprise of mustering feral goats for sale with an annual gross margin of $4,553 for the soil assessment area and $3,727 across the area of actual agricultural disturbance.

It is important to note that these figures are derived from the optimum potential uses and production outcomes and are likely to be much higher than the actual incomes being achieved at the time of publication. Whilst wheat cropping is the most productive enterprise by gross margin analysis this is assuming 160 mm of in-crop rainfall each cropping season. On a year to year basis the Merino ewe enterprise would be expected to be the most profitable.

4.6 Agricultural Support Infrastructure

There is various purpose-built agricultural support infrastructure in the Balranald LGA, and surrounding LGA's, including:

- Livestock saleyards;
- Rail infrastructure for movement of grain and other produce;
- Fruit packing and grading sheds;
- Wine processing facilities;
- Rural merchandise and machinery businesses;
- Grain receival points (silos); and
- Wool storage facilities.

The main arterial roads which support local and regional transport for the above infrastructure are the Mallee Highway, Balranald Ivanhoe Road, and the Sturt Highway, which all intersect the Balranald township.

5 ASSESSMENT OF POTENTIAL IMPACTS

The project area is approximately 9,964 ha, whilst the area proposed to be disturbed by the Balranald Project (the disturbance area) totals approximately 5,346 ha and includes:

- West Balranald and Nepean mines;
- West Balranald access road;
- Nepean access road;
- injection borefields;
- gravel extraction;
- water supply pipeline (from the Murrumbidgee River); and
- accommodation facility.

The land in the disturbance area will be temporarily removed from agriculture. In addition, there will also be somewhere in the order of 28,000 ha of land permanently removed from potential agricultural production as a result of the provision of biodiversity offsets.

5.1 Land Resources

5.1.1 Land Temporarily Removed from Agriculture

Surface Disturbance Agricultural Economic Impact

As determined in the Soil Resource Assessment the Balranald Project will temporarily remove 3,794 ha of Land and Soil Capability Classes 4, 5/6 and 6 from potential agricultural production during the life of the project (approximately 10 years). These areas will be progressively rehabilitated to a land use and vegetation type in accordance with the Rehabilitation and Closure Strategy prepared for the Balranald Project.

Two separate analyses have been carried out as shown in **Table 15**; the first shows potential income lost as a result the entire soil assessment area being temporarily removed from agriculture, the second calculates potential income lost as a result of the area of actual agricultural disturbance being temporarily removed from agriculture.

Potential gross margin determination for both the soil assessment area and the area of actual agricultural disturbance was calculated using the most productive agricultural enterprises for each LSC Class (calculated in **Section 4.5**), with LSC Class 4 land being utilised for wheat cropping, whilst LSC Classes 5/6 and 6 were running a Merino ewe enterprise using the gross margins presented in **Table 14**.

Table 15 Temporary Disturbance

LSC	Soil Assessment Area			Agricultural Disturbance Area		
Class	Ha	%	Gross Margin	Ha	%	Gross Margin
4	173	4	$30,967	169	6	$30,251
5/6	497	13	$3,936	256	9	$2,028
6	3,124	83	$20,618	2,302	85	$15,193
Total	**3,794**	**100**	**$55,521**	**2,727**	**100**	**$47,472**

Using potential agricultural productivity information described in **Section 4.5**, the estimated net annual economic impact on potential lost agricultural productivity as a result of the temporary removal of land is $55,521 per annum across the soil assessment area and $47,472 per annum over the area of actual agricultural disturbance.

This loss of potential agricultural productivity has been determined over the whole of the soil assessment area and area of agricultural disturbance for the life of the Balranald Project. This is considered a conservative assessment, as it has assumed the most productive enterprises are operating. It is also reasonable to assume that neither the entire soil assessment area, nor the entire area of agricultural disturbance will be removed from agricultural production at the one time. Throughout the life of the Balranald Project there will be differing areas of rehabilitation, mining disturbance and non-disturbed agricultural land. Further detail of the proposed progressive rehabilitation can be found in the Rehabilitation and Closure Strategy.

Variable costs were determined for both the wheat cropping and Merino ewe enterprises. Variable costs are costs which are specific to the operation of that enterprise, such as fertiliser application and crop planting for wheat and shearing, vaccination and feeding for Merino ewes. Variable costs do not include fixed costs which are those associate with the whole farm enterprise such as electricity, rates and fencing. Full variable costs for each enterprise can be found in **Appendix A.**

Variable costs for the wheat cropping enterprise on LSC Class 4 are calculated at $294 per ha, whilst the variable costs for a Merino ewe enterprise differ with livestock carrying capacity and are shown in **Table 16**.

Table 16 Merino Ewe Enterprise Variable Cost

LSC	Livestock-Carrying Capacity	Merino Ewe	Variable Costs	Variable Costs Soil Assessment Area	Variable Costs Agricultural Disturbance
Class	**Dry sheep equivalent**	**Per ha**	**Per ha**	**Per annum**	**Per annum**
5/6	0.30	0.12	$8.77	$4,354	$2,245
6	0.25	0.10	$7.31	$22,805	$16,828
Total variable costs					**$19,073**

Variable costs associated with a wheat cropping enterprise in the soil assessment area are $50,862 and the Merino ewe enterprise $27,159 giving a total of $78,021 per annum. Whilst variable costs associated with wheat cropping and the Merino ewe enterprise in the area of actual agricultural disturbance are $49,686 and $19,073 respectively, giving a total of $68,759 which could have otherwise been spent with local agricultural suppliers, contactors, stock and station agents and other associated agricultural industry within the region.

Post-Mining Land Use

Using potential agricultural productivity information described in **Section 4.5** the estimated net annual economic impact on potential agricultural productivity after final landform and rehabilitation reaches completion, is a net loss of $22,775 per annum.

This is as a result of final landform being nominated as LSC Class 6 across the soil assessment area, aside from 52 ha nominated as final void which has no potential agricultural use. This will result in a net decrease of LSC Class 4 (173 ha) and LSC Class 5/6 (497 ha), and an increase of LSC Class 6 land, increasing the potential grazing area and subsequently reducing the potential cropping area (**Table 16**).

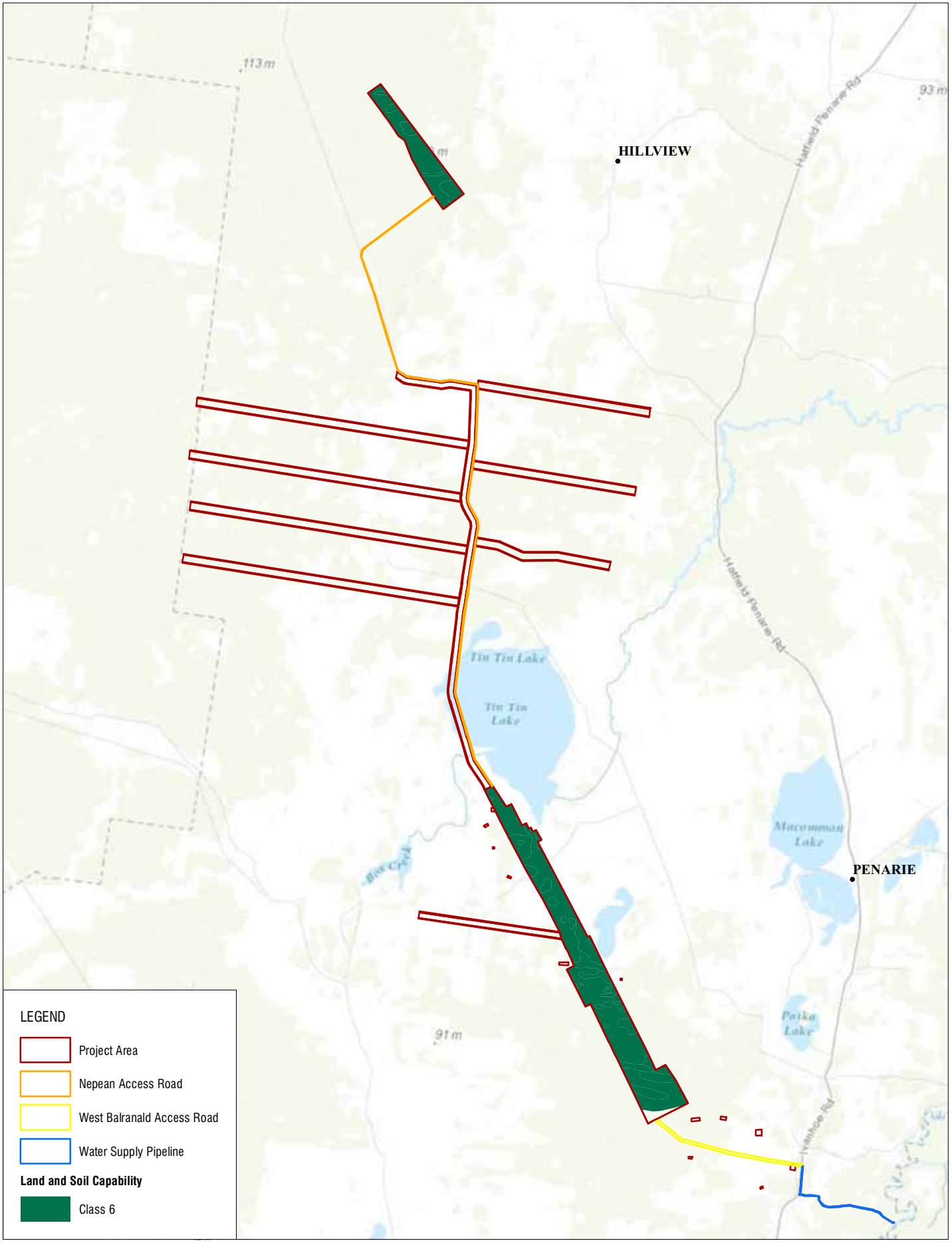
However, there will also be a net increase in the amount of land available for agricultural activity as a result of the Balranald Project, due to the conversion of SMCAs within the soil assessment area from non-agricultural use to potential Merino sheep grazing as outlined in the Rehabilitation and Closure Strategy and shown in **Figure 11**.

Gross margin information was determined using a conservative assessment and assumed the more productive agricultural use of grazing land LSC Class 6 (Merino ewes) upon final rehabilitation (**Table 17**).

Table 17 Post-Mining Land Use Gross Margin

Post Mining Land Use	Post-Mining Land Use Area		Gross Margin	
Enterprise Type	**ha**	**%**	**Per ha**	**Total**
Merino Ewe LSC Class 6	3,742	99	$6.60	$24,697
Final Void	52	1	Nil	Nil

Therefore, once rehabilitation is carried out there could actually be a net gain in agricultural land within the project area of 1,067 ha which equates to an increase in agricultural land within the soil assessment area of 39% due to the inclusion of SMCAs which were not previously available to be utilised by agricultural enterprises.



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SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
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Kilometers

EMGA Mitchell McLennan

Balranald AIS

Post-mining Land and Soil Capability

FIGURE 11

5.1.2 Land Permanently Removed from Agriculture

Potential permanent impacts of the Balranald Project on agricultural land are from the proposed biodiversity offset sites and the final void, which will result approximately 28,052 ha of agricultural land being permanently removed from potential agricultural production.

Biodiversity Offsets

Biodiversity offsets will be required for the Balranald Project. At this stage of the project, actual biodiversity offset sites have not been determined. Niche Environment and Heritage (2015) has undertaken a preliminary calculation of the nature and extent of offsets likely to be required due to the biodiversity impacts associated with the Balranald Project using the BioBanking credit calculator. Based on the results, the preliminary assessment has estimated that about 28,000 ha of offset lands are required. The actual size of the offsets will be determined at a later stage of the project but are expected to be in the order of the preliminary calculation.

Using gross margin data calculated in **Section 4.5** and assuming none of the biodiversity offset sites are currently used for cropping enterprises i.e. they have no or only limited clearing of native vegetation, SLR has assumed a 'worst' case' scenario that 28,000 hectares of LSC Class 5/6 grazing land would be permanently removed from agricultural production. With a Merino ewe enterprise having a gross margin or $7.92 per ha for LSC Class 5/6 land, the resulting biodiversity offsets would reduce potential income from agricultural enterprises by $221,760 per annum. In addition potential variable costs associated with this enterprise would be reduced by $245,560 per annum

Injection Mounding

Iluka have stated there is the possibility of 'mounding' at injection bore sites. The water being injected is classed as hyper-saline and as such there is the potential for agricultural land to be permanently removed from production through increased soil salinity. The bore re-injection field covers an area of 5,721 ha with an actual disturbance area of 1,214 ha. Jacobs Group (2015) state that due to the size of the injection borefield, mounding of the watertable as a result of injection into the Loxton-Parilla Sands is expected to remain a minimum of 3 m below ground surface, avoiding surface mounding and/or waterlogging, and as such will have minimal impact on current LSC.

Final Void

At cessation of the Balranald Project the final void at the West Balranald mine will permanently remove approximately 52 ha from potential agricultural production. Again using the gross margin calculations from **Section 4.5**, this will result in a loss of potential agricultural income of $412 per annum and a loss of potential variable costs of $456.

There will be no final void at the Nepean mine.

5.2 Impact of Biophysical Strategic Agricultural Land

The Soil Resource Assessment found there was no potential BSAL within the Balranald Project area, therefore the project will have no impact on BSAL.

5.3 Impact on Southern Mallee Conservation Areas

Within the soil assessment area there is 1,067 ha of SMCA; shown in **Figure 10**. The majority of the SMCA within the soil assessment area is Mallee scrub with extremely limited agricultural value.

Upon the cessation and rehabilitation of the soil assessment area, the area of land available for productive agricultural use will potentially increase by approximately 1,067 ha of potential grazing land (LSC Class 6). This resumption of SMCAs would have a positive impact on the total area available for agricultural production. It is noted that the final use of the project area would subject to any future changes to the WLL conditions for the impacted land parcels.

5.4 Water Resources

5.4.1 Surface Water and Ephemeral Creeks

The Balranald Mineral Sands Project Surface Water Management Report (WRM, 2015) concludes that there are no local users of surface water that would be impacted by the Balranald Project.

The West Balranald and Nepean mine infrastructure is located outside of the predicted Box Creek and Tin Tin Lake flood extent from an event that exceeds the 1 in 100 AEP and will have no impact on flooding.

Parts of the Nepean access road and injection borefields are located within the flood extent of Box Creek and Tin Tin Lake. The Nepean access road will be constructed at existing ground levels, and will therefore not have any impact on predicted flood levels, velocities or flow distributions. It is possible that should a major flood event occur, the Nepean access road may be inundated and non-trafficable for an extended period of time.

The injection borefields will not impact on flood levels, velocities or flow distributions, as the injection well heads are small and will present little obstruction to flow. The windrows alongside the pipelines are unlikely to impact on peak flood levels, and predicted flood flow velocities are very low within the injection borefield areas, limiting the possibility of infrastructure causing erosion damage.

The Balranald Project is not expected to result in any significant impact to surface water resources (WRM, 2015).

5.4.2 Groundwater

A key component of the Balranald Project is de-watering of the Loxton-Parilla Sands and injection of this hyper-saline water into the Loxton-Parilla Sands. At the West Balranald mine this process involves de-watering and subsequent injection of up to 1,300 L/s, whilst at Nepean mine this volume is significantly less at up to 190 L/s. The dewatering rates will vary during the mine life according to the advance rate of the pit, and the depth of the ore relative to the water table. The ore body is much shallower at Nepean resulting in a lower rate of de-watering (Jacobs Group, 2015)).

De-watering of the Loxton-Parilla Sands and subsequent hydraulic conductivity may result in a temporary draw-down of third party bores within a 15 km radius of the West Balranald mine and within a 2 km radius of the Nepean mine.

Groundwater impacts in the Olney Formation (within the Lower Renmark Aquifer) due to injection into the Loxton-Parilla Sands are unlikely to occur due to the presence of the Geera Clay (Jacobs Group, 2015).

Modelling indicates the Olney Formation can support the proposed extraction of up to 150 ML/annum for use during the three years of mine construction. The drawdown is expected to be localised and not have significant impact on the regional groundwater system or other water users (Jacobs Group, 2015).

Water balance model predictions indicate de-watering and re-injection used in the Balranald Project will not impact the Murrumbidgee or Murray Rivers (Jacobs Group, 2015).

Water Allocations and Licensing

As previously stated, there are a number of WSPs that apply to water sources encompassing and surrounding the Balranald project area. Iluka will be required to purchase water allocations from two of these WSPs, including the *Murrumbidgee Regulated River WSP* for extraction of river water for fresh water supply and the *NSW Murray Darling Basin Porous Rock Groundwater WSP (Lower Murray Darling Water Management Area)* for the extraction of groundwater. Allocations for the extraction of fresh water are likely to be required to be purchased from the private market. Allocations for the extraction of groundwater are likely to be required to be purchased from the NSW government via a controlled allocation order under the *Water Management Act 2000.*

In the order of 600 ML of high or general-security water licences will be required for the project, and of these 150 ML will be sourced from the *NSW Murray Darling Basin Porous Rock Groundwater WSP (Lower Murray Darling Water Management Area)* and 450 ML from the *Murrumbidgee Regulated River WSP*.

Environmental Impact

The WSPs contain environmental rules to protect the water sources and their ecosystems, including allocating a minimum amount of water for environmental flows etc. Any use of water from the regulated water sources by Iluka will be in accordance with the relevant WSP and therefore environmental impacts will be negligible.

Agricultural Productivity Impact

The majority of water that will be extracted from the regulated groundwater sources is hyper-saline water which cannot be used for agricultural production (of which most will be returned to the water source via injection) and will have no impact on agricultural productivity.

There will be two sources of water used for the project. The first will be during the three years of construction where 150 ML per annum will be extracted from the Onley Formation. Due to salinity and low yields this water is not suitable for irrigated cropping, and as such will have minimal impact on agricultural production.

The project will also require a fresh water supply of 450 ML per annum from the Murrumbidgee River which is considered a supply of water that could otherwise have been used for agricultural activities, such as irrigated winter cereal cropping. A conservative assessment of the value of this water was made, assuming that all of this water could have been be used for irrigated wheat cropping. The gross margin for the production of flood irrigated wheat has been calculated, and compared to the alternate use of dryland cropping.

Wheat requires 2.5 ML/ha (DPI, 2012b); therefore, a maximum of 180 ha of irrigated wheat could be farmed annually using the 450 ML of purchased water. The gross margin for this enterprise is $664 per ha and, at a yield of five tonnes per ha, taken from *Farm Enterprise Budget Series – Flood Irrigated Wheat Central Zone Winter 2012*(DPI, 2012b).

With this water temporarily not being available for agriculture it is assumed that the equivalent area of land would otherwise be used for dryland cropping with productivity levels of LSC Class 2 (refer **Table 13**), i.e. land suitable for irrigated cropping.

The estimated net annual economic impact on potential agricultural productivity as a result of using this land for dryland cropping ($298 per ha) rather than irrigated cropping ($664 per ha) is lowering the potential gross annual income by $66,060. When compared to the $83M generated in agricultural production within the Balranald LGA, a loss of $66,060 would be considered a minimal impact.

Long-term Use of Reallocated Water

At the completion of mining operations and following rehabilitation, the water licences may be sold on the open market, allowing this water to again be available for agricultural production or some other beneficial use.

NSW Aquifer Interference Policy

Due to the relatively high salt content and/or very low yields, the groundwater sources within and surrounding the project area, they are classified as 'less productive' according to the *NSW Aquifer Interference Policy* (NOW, 2012).'

Any reductions in alluvial groundwater levels as a result of the Balranald Project are expected to be temporary and localised, and are expected to be less than the Level 1 minimal impact considerations from the *NSW Aquifer Interference Policy* (NOW, 2012), and are therefore considered acceptable.

5.5 Other Impacts

5.5.1 Visual Amenity and Landscape Values

The *Balranald Project Environmental Impact Statement* (EMGA Mitchell McLennan, 2015c) prepared for the Balranald Project included a visual impact assessment which considered representative viewpoints surrounding both the West Balranald and Nepean mines. The assessment also took into account transient receptors along four roads surrounding the Balranald Project.

Generally, visual and lighting impacts were considered low to moderate based the distances between viewpoints and mining operations, and screening provided by existing landform and vegetation. A number of visual and lighting impact management measures can be implemented to mitigate and manage impacts during operation of the Balranald Project.

5.5.2 Tourism

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

5.5.3 Weed Management and Biosecurity

There is moderate risk from weeds during the construction and operational phases of the Balranald Project through continued vehicle movements on and off-site. Iluka proposes to implement an Environmental Management Strategy (EMS) and biodiversity management plan (BMP) as part of the Balranald Project. Weeds would be managed through the implementation of both the EMS and the MBP.. Continued inspection for weed germination will be conducted during the construction and operational phases of the Balranald Project.

Biosecurity is defined in the *NSW Biosecurity Strategy 2013 – 2021* (DPI, 2013) as 'protecting the economy, environment and community from the negative impacts of 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 Balranald Project is unlikely to represent an increased risk to the biosecurity of agricultural resources and enterprises within the region.

5.5.4 Air Quality

There is potential for the Balranald Project to generate dust through mine operation, processing and transportation, impacting on air quality. Disturbance of groundcover during the construction phase and site commissioning, along with mobilisation of equipment to and between sites, also has the potential to generate dust, with impacts highly dependent on road and weather conditions. Agricultural enterprises have the potential to be impacted by dust through increased levels of stress in livestock and deposition on forage and crop plants, reducing production levels.

The *Air Quality and Greenhouse Gas Assessment - Balranald Mineral Sands Project* (Environ, 2015) examined predicted concentrations of airborne particulates, gaseous pollutants, and dust deposition. The emissions were quantified and modelled for Year 1, Year 4 and Year 8 of operation to assess the potential for air quality impacts on the surrounding environment. Ground level concentrations and dust deposition rates associated with all mining years assessed were predicted to be within the relevant impact assessment criteria for all assessment locations for all years.

Trace metal/metalloid, recued sulfur compounds and combustion related gaseous emissions concentrations predicted due to the Balranald Project would be compliant with relevant impact assessment criteria across all years assessed, and therefore are not expected to impact agricultural resources or enterprises.

Therefore, air quality impacts as a result of the Balranald Project are not expected to significantly impact agricultural resources or enterprises.

The mitigation and air quality control measures proposed as part of the Balranald Project have been reviewed against the *NSW Coal Mining Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* and were taken into account in the quantification of project-related emissions.

5.5.5 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.

The *Balranald Mineral Sands Project – Noise Assessment* (EMGA Mitchell McLennan, 2015d) assessment has taken into account the relevant policies and guidelines to satisfy the SEARs. Both unattended long-term and attended short-term noise monitoring were undertaken at sites representative of the most sensitive receptors to characterise the existing noise environment.

Modelling results show that during adverse weather conditions for all assessment periods and all stages of the mine life, two assessment locations identified as dwellings are predicted to experience noise levels above the operational criterion of 35 dB(A); of these, one is predicted to experience noise levels above the affectation criterion of 40 dB(A).

The privately owned land assessment has identified three land parcels in the affectation zone. However, the project area covers the majority of the three land parcels and it is therefore expected most of this land would be subject to acquisition and/or compensation agreements irrespective of the noise impact assessment.

The low frequency assessment identified that criterion will be met at all privately owned receptors.

Potential sleep disturbance impacts from operational maximum noise level events have been assessed and are expected to satisfy the relevant criteria for all assessment locations.

Construction noise limits are predicted to be exceeded at one receptor due to construction of the access road between Nepean and West Balranald mines. The impacts to this sensitive receptor are expected to be short-term and the impacts can be minimised with mitigation measures if required.

In the study *Responses of Farm Animals to Sonic Booms* (Casaday and Lehmann, 1967) animal installations were selected for observations on animal behaviour under sonic boom conditions. The number of animals observed in this study included approximately 10,000 commercial feedlot beef cattle, 100 horses, 150 sheep and 320 lactating dairy cattle. Booms during the test period were scheduled at varying intervals during the morning hours Monday to Friday of each week.

Results of the study showed that the reactions of the sheep and horses to sonic booms were slight. Dairy cattle were little affected by sonic booms (125 dB to 136 dB). Only 19 of 104 booms produced even a mild reaction, as evidenced by a temporary cessation of eating, rising of heads, or slight startle effects in a few of those being milked. Milk production was not affected during the test period, as evidenced by total and individual milk yield. The researchers developed a summary by species and farms indicating that the few abnormal behavioural changes observed were well within the range of activity variation within a group of animals. They defined these changes as horses jumping up and galloping around the paddock, bellowing of dairy cattle, and increased activity by beef cattle (Casaday and Lehmann, 1967). In order to provide for a conservative assessment, the lowest airblast exposure studied (125 dB) was adopted as a criterion for the purposes of assessment of livestock impacts.

Considering these factors, noise generated as a result of the Balranald Project is not expected to impact agricultural resources or enterprises.

5.5.6 Traffic

Agricultural enterprises can be impacted by noise and dust as a result of increased mine traffic movement, and through the cumulative impact of road transport being utilised by mining operations, leaving fewer transport options for agricultural enterprises.

The road traffic noise associated with the Balranald Project's construction and operation is expected to comply with relevant goals for nearest receptors aligning the Balranald Ivanhoe Road, McCabe Street, Sturt Highway and the Balranald Tooleybuc Road, and therefore is unlikely the impact agricultural resources or enterprises.

Transport of HMC and ilmenite will be undertaken using a fleet of suitable trucks that may be owned and operated by Iluka or private operators. Impact upon the availability of transport for the movement of local agricultural produce such as livestock and grain is anticipated to be minimal, and as such the impact on agricultural resources and enterprises as a result of the Balranald Project is also expected to be minimal.

5.5.7 Social

The *Social Assessment* (EMGA Mitchell McLennan, 2015e) concluded the net benefit of the Balranald Project for the Balranald community would be positive. The main implications to the Balranald community as a result of the Balranald Project are summarised below:

- Exploration activities have been conducted by Iluka in the Balranald region since the early 1990's, which has resulted in the gradual introduction to the possibility of mining activities into a long established agricultural area.
- Iluka endeavours to draw the majority of its workforce from the local region, which for the Balranald Project, is defined as the area within a 200 km radius of Balranald town. Based on data from other mineral sands mines in the Murray Basin, it is has been assumed that 80% of the workforce would be drawn from this local region, with 20% coming from outside this region.
- Balranald town is the only urban area in relative proximity to the project area, which would result in a range of related expenditure within the township.
- Most community sectors, such as education, health and emergency services have a degree of spare capacity due to recent and continuing population decline, with the Balranald Project helping to arrest this decline.
- Given the relatively short operational life of approximately 10 years, there is a relatively short period of project-related impacts and injections into the local community, rather than a long term or permanent change to the local economy and community.

There is support for the Balranald Project due to the perceived economic and social benefits that may flow to the Balranald community.

5.5.8 Regional Agricultural Economic Impact

The *Economic Assessment* (Gillespie Economics, 2015) found there would be no significant direct or flow-on economic impacts to the regional agricultural sector as a result of the construction and operational phases of the Balranald Project.

5.6 Other Impacts to Regional Community and the Environment

No other impacts are anticipated from the Balranald Project which will affect the regional community or the environment.

6 MITIGATION MEASURES

6.1 Review of the Project Design

The Balranald Project has been developed throughout Iluka's pre-feasibility study and preparation of the EIS to avoid and minimise land disturbance where possible. Commitments in the Rehabilitation and Closure Strategy for the Balranald Project will increase the overall agricultural capacity of the project area compared to its existing capacity, as rehabilitation of the project area will include the re-establishment of native chenopod shrubland for grazing by livestock. The final land use proposed is consistent with the pre-mining land use strategies and the relevant planning instruments discussed in the Rehabilitation and Closure Strategy.

6.2 Proposed Management Measures

This section describes the proposed management measures and monitoring plans to be implemented for the Balranald Project to minimise potential agricultural impacts. The proposed management and monitoring plans will include trigger points and plans for predicted and unforeseen impacts of the Balranald Project. It will include appropriate operational responses and remedial action, including the basis for each trigger response.

The recommendations and commitments made in the relevant specialist assessments will be adopted and incorporated into any conditions required under an EMS (including issue-specific environmental management plans and monitoring programs) to be developed for the Balranald Project. A summary of key measures is provided in this section.

6.2.1 Land Resources

Agricultural land resource management for the Balranald Project will include the key components listed below.

- Minimise disturbance to agricultural land, where practicable.
- Manage soil resources within the project area so that they can be used in the rehabilitation program.
- Use of appropriate soil ameliorants such as gypsum to improve structure of sodic soils during rehabilitation, and as such improve future agricultural potential.
- Inclusion of agricultural lands in the Balranald Project's Rehabilitation and Closure Strategy.
- Commitment in the Balranald Project's Rehabilitation and Closure Strategy to re-instate the nominated vegetation and land use type at cessation of mining activities.

Minimisation of Disturbance to Agricultural Lands

Iluka will seek to minimise the amount of agricultural land disturbed by the Balranald Project at any one time to ensure that adjacent agricultural uses can continue. As far as practicable, mine planning will minimise land clearance in advance of operations and will include progressive rehabilitation of disturbed areas behind mining operations. This will reduce the duration of temporary impacts on agricultural land.

Land Resources Continued Use of Existing Agricultural Areas

An Agricultural Land Management Plan will be prepared to address the management of Iluka-owned agricultural land within the project area.

The Plan will document the measures that will be taken to allow a series of objectives to be met, including:

- The proactive management of Iluka-owned agricultural land, where possible continuing existing agricultural practices.
- The maintenance or improvement of the value of properties owned by Iluka.
- Ensuring that the Plan complements the operations of the mine.

Soil Resources

The Balranald Project's Rehabilitation and Closure Strategy provides general soil management practices to minimise the impact of the Balranald 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 and provide benefit during final rehabilitation.

Re-Establishment of Agricultural Lands

The Balranald Project's Rehabilitation and Closure Strategy has been designed to minimise the impact of the Balranald Project on agricultural land. This includes:

- A rehabilitation strategy for the areas affected by surface disturbance.
- Rehabilitation objectives of final land use.
- Short- and long-term objectives for the overall rehabilitation of the site, including acceptable post-disturbance land use and stability of the post-disturbance landform.
- A revegetation program based on current industry good practice and progressive learning as the site program is implemented.
- Objectives and preliminary success criteria for mine closure.
- A monitoring program to progressively assess performance of the rehabilitated areas.
- The potential for more land within the project area suitable for intermittent and low intensity grazing uses following final rehabilitation.

Visual Amenity and Landscape Values

The visual impact assessment included in the EIS includes mitigation measures to minimise the impact of the Balranald Project on visual amenity and landscape values relied upon by agriculture, which include:

- Progressive rehabilitation of disturbed areas to minimise the extent of, and views to, the most visually obtrusive elements in the project area.
- Installing directional light fittings in the processing area to minimise light spill.
- Avoiding placement of lighting at the top of overburden stockpiles (at night), where safe and practical, to provide screening and limit light spill on top of overburden stockpiles.

6.2.2 Water Resources

The Balranald Project will have minimal impact on water resources (surface and groundwater) associated with agricultural resources and associated enterprises. A Water Management Plan will be developed and will include monitoring of surface and groundwater.

An Erosion and Sediment Control Plan (ESCP) will also be prepared and will include aspects to control and manage erosion and sedimentation generated on site, minimising water quality impacts.

6.3 Demonstrated Capacity for Rehabilitation of Disturbed Lands

The successful restoration of the project area to target land uses and vegetation communities identified in the Rehabilitation and Closure Strategy is a critical component of the Balranald Project to mitigate long-term impacts on agricultural resources.

Rehabilitation and closure activities are a major focus in Iluka's mine planning and constitute a significant, ongoing activity of the company. In most cases, Iluka is able to rehabilitate mined areas to patterns similar to that existing prior to mining, and has a record of successful rehabilitation activities in Western Australia, as well as early stages of rehabilitation in the Murray Basin, Victoria.

Iluka has previously demonstrated successful rehabilitation of disturbed lands at the Eneabba, Gingin and Waroona mines in the mid-west and south-west of Western Australia. In the Murray Basin, re-establishment of previously mined areas Echo and Kulwin mines to grazing and pastoral has been undertaken.

A closure planning working group was established in the second half of 2009 to design and oversee best practice management for the safe closure and re-establishment of former mining and processing sites across Iluka's Australian operations. Rehabilitation and closure activities are a major focus of Iluka's mining operations.

Iluka's Jacinth-Ambrosia operation in the Eucla Basin in South Australia is the first mining and processing operation to be permitted in a mixed use regional reserve, the Yellabinna Regional Reserve. Mining is allowed under a multiple use framework with high standards applied and enforced in terms of protecting the environment and minimising the impact on the area's unique biodiversity.

Extensive environmental management planning and assessment was required to gain progressive approvals for the Jacinth-Ambrosia Project, from exploration through to construction and, subsequently, the operational phase, which is conducted under a Mining and Rehabilitation Plan. Key environmental issues for the Jacinth-Ambrosia Project include the containment of hyper-saline water used in concentrating activities; management plans for native fauna, as well as a requirement to remove all waste materials from the site.

Iluka has shown an ongoing commitment and a demonstrated capacity to the rehabilitation of mine disturbance areas. **Plate 11** through to **Plate 15** show various stages of progressive rehabilitation at the Echo, Jacinth-Ambrosia and Kulwin mines.

Plate 11: Earthworks at Echo mine showing backfilled area prior to shaping and replacement of subsoil and topsoil

Plate 12: 1 GPS fitted carry-grader and tractor at Jacinth Ambrosia mine

Plate 13: Seeding equipment used for sowing Rye Corn at Echo mine

Plate 14: Soil replacement operation at Echo mine

Plate 15: Crop rehabilitation zone after 2 years at Kulwin mine (October 2012)

6.4 Demonstrated Planning for Progressive Rehabilitation

Planning for progressive rehabilitation is detailed in the Balranald Project's Rehabilitation and Closure Strategy. Principal rehabilitation objectives for the Balranald Project include:

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

In addition to the above key rehabilitation objectives, the Iluka Environment and Community Policy also take 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.

Iluka has committed to a policy of post-mining land use being consistent with the Rehabilitation and Closure Strategy.

7 STAKEHOLDER CONSULTATION

Iluka places a high level of importance on engagement both with the local community and government stakeholders. This is important for the Balranald Project due to it being the first project in NSW for Iluka. Prior to the SEARs being sought, Iluka had undertaken a substantial amount of consultation with government stakeholders since late 2010, as well consultation with local community and Aboriginal stakeholders, organisations and businesses.

The key components of the stakeholder engagement process are initial stakeholder identification, stakeholder assessment and stakeholder engagement. Each of these components is described below. Initial stakeholder engagement commenced in late 2010, well in advance of commencement of the SSD approval process. This included the introduction of the Balranald Project to a number of key government and community stakeholders, and has been ongoing. Detailed communication records were documented as part of the process.

The stakeholder identification process involved compiling a list of all stakeholders likely to be relevant to the Balranald Project taking into account the varied occupations, interests, needs and life styles of people and community infrastructure that could be impacted by the Balranald Project.

The broad stakeholder groups identified included property owners, Balranald Shire Council (BSC), local businesses, schools and training centres, neighbouring local councils, State and Commonwealth government agencies, the local community, special interest groups, Aboriginal groups, employees of Iluka, State and Commonwealth members and ministers and the media.

Following the stakeholder identification process, an assessment of the stakeholders was undertaken to further understand the extent to which the various parties were likely to be impacted by and/or have an interest in the Balranald Project. This informed the development of appropriately tailored stakeholder engagement strategies and schedule.

The SEARs for the Balranald Project, issued on 2 December 2014, identified stakeholders that must be consulted during the preparation of the EIS. These stakeholders had all been identified previously and have been consulted with during the preparation of the EIS.

Government agencies were engaged prior to SEARs being sought to identify key issues for the EIS and to seek guidance on assessment approaches and government policies that apply to the Balranald Project.

Landowners directly affected by infrastructure associated with the Balranald Project have been engaged on a regular basis regarding Iluka's exploration activities, and the development of the Balranald Project. Landowners who are indirectly affected (such as adjoining landowners and landowners adjacent to haul routes) have also been engaged with through face to face meetings and at community information sessions.

Stakeholder engagement undertaken by Iluka has been substantial. Iluka has considered the matters raised during stakeholder engagement and will continue to work closely with local, state and Commonwealth authorities, service providers, community groups and affected landowners to help inform the Balranald Project's design and management and ensure the Balranald Project meets community expectations.

Iluka will continue its comprehensive stakeholder engagement to ensure community issues and perceived impacts on Iluka activities are understood and to maintain working partnerships with stakeholders to address community needs.

Further detail of stakeholder consultation undertaken by Iluka is contained in **Chapter 7**of the EIS.

8 KEY FINDINGS

This AIS has been prepared in accordance with the SEARs for the Balranald Project and the *Agricultural Impact Statement Guidelines* (DP&I, 2012a) which seeks to balance economic growth in rural NSW with the sustainable management and use of natural resources and agricultural land.

Key findings of the Balranald Project AIS are listed below.

- The project area and soil assessment area contain no areas of potential BSAL, as defined under *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*
- The soil assessment area of 3,794 ha and has a potential annual gross margin of $55,521 per annum. The area currently utilised for agricultural enterprises, assessed as the area of actual agricultural disturbance has a potential annual gross margin of $47,472.
- The post-mining potential gross margin for the soil assessment area is expected to decrease by $22,775 annually, however there will be a net increase of 1,015 ha land available for livestock production, primarily through increase grazing area resulting from the resumption and rehabilitation of the SMCAs.
- Land permanently removed from potential agricultural production comprises approximately 22,000 ha required for biodiversity offsets as determined using the BioBanking credit calculator, and 52 ha associated with the proposed final void at the West Balranald mine.
- Irrigation water temporarily removed from potential agricultural production totals 450 ML per annum from the *Murrumbidgee Regulated River WSP*. No groundwater will be removed from irrigators as a result of the project. The impact to existing groundwater users within the vicinity of the project area is predicted to be minimal
- There are no licenced surface water users within the project area. Impacts to surface water flow as a result of the project are predicted to be minimal.
- Mounding of the watertable as a result of injection into the Loxton-Parilla Sands is expected to remain a minimum of 3 m below ground surface, avoiding surface mounding and/or waterlogging, resulting in minimal impact on current LSC Class.
- Post-mining, water licences will be sold on the open market. This means the water will be available for agricultural or some other beneficial use. There will be some temporary loss of potential agricultural productivity from the Balranald Project's non-agricultural use of purchased water licences during the life of the Balranald Project.
- The implementation of a Land Management Plan on Iluka-owned agricultural land that will not be impacted by surface disturbance will ensure on-going opportunities for agricultural activities and no material impact to neighbouring agricultural activities.
- Rehabilitation of disturbed areas will be progressive throughout the life of the project, as previously demonstrated at mine sites operated by Iluka. The proposed final land use is consistent with pre-mining land use strategies.
- Impacts to agricultural industries and related enterprises relating to visual amenity and landscape values, tourism, weed management and biosecurity, air quality, noise and traffic are predicted to be minimal as a result of the Balranald Project.
- There is general support amongst the local population for the project due to the perceived economic and social benefits that may flow through to the Balranald community

- The Balranald Project will provide considerable economic activity to the regional economy. This activity is much greater than the potential activity generated by the impacted agricultural resources (Gillespie Economics, 2015).
- Comprehensive stakeholder consultation by Iluka has been undertaken and will continue during the life of the Balranald Project.

In summary, the Balranald Project will provide substantial economic benefits to the region and has been designed to minimise impacts on surrounding agricultural resources and dependent industries.

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Appendix A

Agricultural Productivity Gross Margin Sensitivity Analysis

MERINO EWES (20 mic) - Merino Rams, wether lambs finished

Farm Enterprise Budget Series - Oct 2014 (average wool and sheep price 12 Jan to 14 July)

Department of Primary Industries

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

INCOME

						Standard Budget ($)	Your Budget ($)
Wool		**number**	**class**	**kg /hd**	**$/kg**		
Shear		960	ewes	5.64	$6.94	$37,578	
		208	ewe hoggets	5.64	$7.04	$8,259	
		20	rams	8.00	$6.94	$1,110	
		842	lambs 4 months	1.18	$3.11	$3,082	
Crutch		1188	Adults/hoggets	0.40	$4.64	$2,205	
		842	lambs	0.30	$4.64	$1,172	
Sheep Sales		**number**	**class**	**$ /hd**			
		177	CFA ewes	$92.90	(22.6 kg cwt)	$16,443	
		4	CFA rams	$72.48		$290	
	10 months	421	wether lambs	$119.24	(22.0 kg cwt)	$50,200	
		187	ewe hoggets	$100.00	(18 months)	$18,700	
Fodder		**tonnes**	**type**	**value per tonne**			
Graz/fodder crop		0 t	0	$0 /t		$0	
				A. Total Income:		**$139,039**	

VARIABLE COSTS

Replacements		**number**	**class**	**cost ($)**	**reps**		
		4	rams	$1,000.00		$4,000	
Wool Harvesting & Selling Costs							
Shearing		2010	ewe/hogget/lamb	$6.69	1	$13,440	
		20	rams	$9.50	1	$190	
Crutching		2010	ewe/hogget/lamb	$1.21	1	$2,437	
		20	rams	$2.09	1	$42	
Wool tax				2.00%		$1,068	
Commission, warehouse, testing charges				$40.17/ bale		$1,888	
Wool - cartage		47	bales	$5.00		$235	
- packs		47	packs	$11.65		$548	
Sheep Health		**number**	**class**				
Broadspectrum		1188	adults/hoggets	$0.46	2	$1,093	
		860	lambs	$0.23	3	$593	
Narrowspectrum		1188	adults/hoggets	$0.28	1	$333	
		860	lambs	$0.15	1	$129	
Dipping		2030	adults/hoggets	$1.13	1	$2,294	
Fly control (long acting)		1188	adults/hoggets	$1.76	1	$2,091	
		842	weaners	$1.47	1	$1,238	
Vaccination- 6 in 1		1188	adults/hoggets	$0.27	1	$321	
		890	lambs	$0.27	2	$481	
Mark		445	wether lambs	$1.54	1	$685	
Mules + Mark (include OJD)		445	lambs	$4.23	1	$1,881	
Scanning		1000	ewes	$0.88	1	$880	
Livestock Selling Costs							
Livestock cartage		789	sale sheep	$2.10		$1,657	
Commission on sheep sales				5.00%		$4,282	
Levies (Yard dues, MLA Transaction levy and RLPB rates)						$3,776	
Pasture maintenance		254 ha	@	$36 /ha		$9,068	

Fodder

			Supplementary feed @ $230 /t			
Ewes/Hoggets	1188	3.1 kg/hd/week	$0.23 /kg	10 weeks	$8,470	
Ewe lambs	415	2.8 kg/hd/week	$0.23 /kg	12 weeks	$3,207	
Wether lambs	421	5.0 kg/hd/week	$0.23 /kg	14 weeks	$6,778	
	Total feed	80,242 kg	@	$230	**$18,456**	
Graz/fodder crop	0 ha	@	$0 /ha		$0	
			B. Total Variable Costs:		**$73,104**	

	excl. fodder	incl. fodder
GROSS MARGIN (A-B)	**$84,390**	**$65,935**
GROSS MARGIN /EWE	**$84.39**	**$ 65.93**
GROSS MARGIN /DSE	**$33.22**	**$25.96**
GROSS MARGIN /HA	**$332.24**	**$259.59**

ASSUMPTIONS

1. Flock Parameters

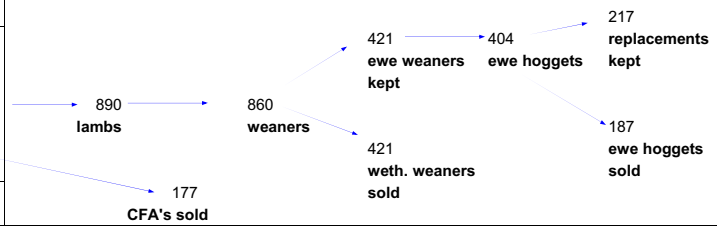
Flock mortality	4%	Ram %	2%
Productive life	5 years	Marking %	89%
Ewe body weight	55 kg	Weaning %	86%
DSE rating /ewe	2.54	Weaning age	3 months
Stocking rate/ha	10 dse's		

Pasture maintenance = 90kg single super @ $330t + $6.00 application

2. Flock Structure

Sheep numbers are modified to reflect mortality throughout the year.

Age	Number of ewes
1.5	217
2.5	208
3.5	200
4.5	192
5.5	184
6.5	0
Total	**1000**



3. Wool Prices

Merino Ewe	Micron	AWEX Type	Clean price	Yield	Greasy price	Specifications (all 35n/ktex)	Proportion of Clip
- Fleece GTM	20	MF5B.	$11.74	65%	$7.65	1%VMB, 90mm	75%
- Skirtings/bellies	19	MP5B.	$9.35	56%	$5.22	4.8%VMB, 80mm	20%
- Cardings	20	MZ2B.	$5.88	52%	$3.05	2.9%VMB.	5%
					$6.94	→	used in budget

4. Sensitivity Tables - Changes in Gross Margin $/DSE (includes fodder)

Wool Cut kg/hd	Adult Greasy Wool Price $/Kg greasy				
$25.96	$5.55	$6.25	$6.94	$7.63	$8.33
4.51 kg	$20.87	$22.03	$23.19	$24.35	$25.51
5.08 kg	$21.97	$23.27	$24.58	$25.88	$27.19
5.64 kg	$23.06	$24.51	**$25.96**	$27.41	$28.86
6.20 kg	$24.15	$25.75	$27.34	$28.94	$30.53
6.77 kg	$25.24	$26.98	$28.72	$30.46	$32.20

Ewe hoggets $/Hd	Value of wether lambs $/Hd				
$25.96	$95.39	$107.32	$119.24	$131.16	$143.09
$80.00	$20.80	$22.68	$24.56	$26.44	$28.31
$90.00	$21.50	$23.38	$25.26	$27.14	$29.01
$100.00	$22.20	$24.08	**$25.96**	$27.84	$29.71
$110.00	$22.90	$24.78	$26.66	$28.54	$30.41
$120.00	$23.60	$25.48	$27.36	$29.23	$31.11

Wether Lmb $/Hd	Weaning %				
$25.96	69%	77%	86%	95%	103%
$95.39	$17.93	$20.08	$22.20	$24.39	$26.57
$107.32	$19.43	$21.77	$24.08	$26.46	$28.83
$119.24	$20.93	$23.46	**$25.96**	$28.53	$31.09
$131.16	$22.44	$25.15	$27.84	$30.59	$33.34
$143.09	$23.94	$26.84	$29.71	$32.66	$35.60

Ewe Hogget $/Hd	Weaning %				
$25.96	69%	77%	86%	95%	103%
$80.00	$20.13	$22.36	$24.56	$26.82	$29.07
$90.00	$20.53	$22.91	$25.26	$27.67	$30.08
$100.00	$20.93	$23.46	**$25.96**	$28.53	$31.09
$110.00	$21.33	$24.01	$26.66	$29.38	$32.09
$120.00	$21.73	$24.56	$27.36	$30.23	$33.10

Note: The above sensitivity tables vary price and quantities by +/- 10% and +/- 20%.

M. Ewe lambs kg/Hd/wk	Feeding ewes/hoggets kg/Hd/week				
$25.96	1.55 kg	2.33 kg	**3.10 kg**	3.88 kg	4.65 kg
1.40 kg	$28.26	$27.42	$26.59	$25.76	$24.92
2.10 kg	$27.94	$27.11	$26.27	$25.44	$24.61
2.80 kg	$27.63	$26.79	**$25.96**	$25.12	$24.29
3.50 kg	$27.31	$26.48	$25.64	$24.81	$23.98
4.20 kg	$26.99	$26.16	$25.33	$24.49	$23.66

M. Weth. Lmb kg/hd/wk	Grain price $/Tonne				
$25.96	$115.00	$172.50	**$230.00**	$287.50	$345.00
2.5 kg	$30.26	$28.78	$27.29	$25.81	$24.33
3.8 kg	$29.93	$28.28	$26.63	$24.98	$23.33
5.0 kg	$29.59	$27.77	**$25.96**	$24.14	$22.33
6.3 kg	$29.26	$27.27	$25.29	$23.31	$21.32
7.5 kg	$28.92	$26.77	$24.62	$22.47	$20.32

Note: The feeding sensitivity tables vary quantities/cost by +/- 25% and +/- 50%.

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.

Results and Discussion

Average benefits and costs

The average benefits and costs (over 20 years) for alternative goat management options are summarised in Tables 5, 6 and 7 for the Bourke, Cobar and Broken Hill districts, respectively. Costs include capital, overhead and variable components, opportunity costs (OC) due to sheep or goat income foregone, and sheep purchases. Benefits are derived from cost savings and sales of feral goats and sheep.

The highest average net benefit, in all districts, is derived from the 'value added with reduced livestock' option because this allows increased turnoff of feral goats (since no livestock are grazed in the goat paddock) and generates additional income in the short term from sale of sheep removed from the goat paddock.

The TGP control scenario 1 – boundary fencing of as much of the property as possible - has the highest capital cost, high goat opportunity cost, and results in negative average net benefit in all districts. However, at Broken Hill the average net benefit is only slightly negative because with only 60% of the property fenced the goat opportunity cost is minimised.

Use of the 'goat paddock' for grazing by livestock results in a small negative average net benefit at Bourke and small positive average net benefits elsewhere. In contrast, fencing of an equal area of good country, capable of achieving a modest increase in carrying capacity beyond the exchange of goats for sheep, provides positive net benefits in all districts due both to increased sheep income and reduced goat opportunity cost compared to use of a 'goat paddock' exclusively for livestock. However, the benefit is still considerably less than the best of the goat management scenarios.

For all districts the do-nothing option has a high goat opportunity cost and average negative net benefit.

Table 5. Average annual benefits and costs of feral goat control options for the Bourke district ($)

Benefits and Costs	Do nothing	Opportunistic harvest		Value added goats		Livestock with TGP control		
		Current	Max. harvest	Constant livestock	Reduced livestock	5% Goat country	5% Good country	100% of property
Benefits								
Cost savings	16,908	100	100	0	0	0	0	0
Goat income	0	42,749	47,853	64,449	64,579	26,020	27,643	20,800
Sheep income	0	0	0	0	10,400	5,960	10,589	31,047
Total benefits	16,908	42,849	47,953	64,449	74,979	31,980	38,769	51,847
Costs								
Capital	0	2,370	2,878	7,956	7,956	7,956	7,956	20,637
Overhead	0	2,900	2,900	3,429	3,429	3,429	3,392	470
Variable	0	11,634	11,634	10,379	10,379	10,379	10,378	3,383
OC (goats)	42,649	0	0	0	0	14,040	1,560	42,680
OC(sheep)	11,384	0	0	0	620	0	0	0
Sheep pur.	0	0	0	0	0	1,465	3,848	4627
Total costs	54,033	16,904	17,412	21,764	22,384	35,804	23,286	71,797
Net benefits	-37,125	25,945	30,541	42,685	52,595	-3,824	14,207	-19,950

DORPER EWES - Dorper Rams

Farm Enterprise Budget Series - Oct 2014 (average wool and sheep price 12 Jan to 14 July)

Department of Primary Industries

Flock size: 1000 ewes
Ewe body weight: 65 kgs
DSE rating: 2.7 dse's / ewe

INCOME

						Standard Budget ($)	Your Budget ($)
Wool		**number**	**class**	**kg /hd**	**$/kg**		
Shear		0	ewes	0.00	$0.00	$0.00	
		0	rams	0.00	$0.00	$0.00	
		0	ewe lambs	0.00	$0.00	$0.00	
Crutch		0	mixed ages	0.00	$0.00	$0.00	
Sheep Sales		**number**	**class**	**$ /hd**			
		177	CFA ewes	$87.09	(28.6 kg cwt)	$15,414	
		4	CFA rams	$72.48		$290	
	7 months	289	weth lambs	$108.52	(21.0 kg cwt)	$31,362	
	9 months	289	weth lambs	$127.24	(24.0 kg cwt)	$36,772	
		349	ewe lambs	$117.00	(11 months)	$40,833	
Fodder		**tonnes**	**type**	**value per tonne**			
Graz/fodder crop		0 t	0	$0.00		$0	
				A. Total Income:		**$124,672**	

VARIABLE COSTS

		number	**class**	**$ /hd**			
		4	rams	$1,000.00		$4,000.00	
Wool Harvesting & Selling Costs							
Shearing		0	ewes/hoggets	$6.69		$0.00	
		0	rams	$9.50		$0.00	
Crutching		0	ewes/hoggets	$1.21		$0.00	
		0	rams	$2.09		$0.00	
Wool tax				2.00%		$0.00	
Commission, warehouse, testing charges				$40.17/ bale		$0.00	
Wool - cartage		0	bales	$5.00		$0.00	
- packs		0	packs	$11.65		$0.00	
Sheep Health		**number**	**class**	**cost ($)**	**reps**		
Broadspectrum		1211	adults/hoggets	$0.46	2	$1,114	
		1210	lambs	$0.23	3	$835	
Narrowspectrum		1211	adults/hoggets	$0.33	1	$400	
		1210	lambs	$0.15	1	$182	
Dipping		1211	adults/hoggets	$1.13	1	$1,369	
Fly control (long acting)		0	adults/hoggets	$1.76	0	$0	
		0	ewe weaners	$1.47	0	$0	
Vaccination- 6 in 1		1211	adults/hoggets	$0.27	1	$327	
		1210	lambs	$0.27	2	$653	
Mark		605	wether lambs	$1.54	1	$932	
Mark plus OJD		605	ewe lambs	$3.93	1	$2,376	
Scanning		1000	ewes	$0.88	1	$880	
Livestock Selling Costs							
Livestock cartage		1,108	sale sheep	$2.10		$2,327	
Commission on sheep sales				5.00%		$6,234	
Levies (Yard dues, MLA Transaction levy and RLPB rates)						$5,055	
Pasture maintenance		272 ha	@	$36 /ha		$9,710	

Fodder

Supplementary feed @ $230 /t

Ewe/hoggets	1168	5.0 kg/hd/week	$0.23 /kg	12 weeks	$16,123	
Ewe lambs	217	2.8 kg/hd/week	$0.23 /kg	12 weeks	$1,677	
Mixed sex lambs	927	5.0 kg/hd/week	$0.23 /kg	8 weeks	$8,528	
	Total feed	114,470 kg	@	$230	**$26,328**	
Graz/fodder crop	0 ha	@	$0 /ha		$0	
			B. Total Variable Costs:		**$62,722**	

	excl. fodder	incl. fodder
GROSS MARGIN (A-B)	**$88,278**	**$61,950**
GROSS MARGIN /EWE	**$88.28**	**$61.95**
GROSS MARGIN /DSE	**$32.46**	**$22.78**
GROSS MARGIN /HA	**$324.55**	**$227.76**

ASSUMPTIONS

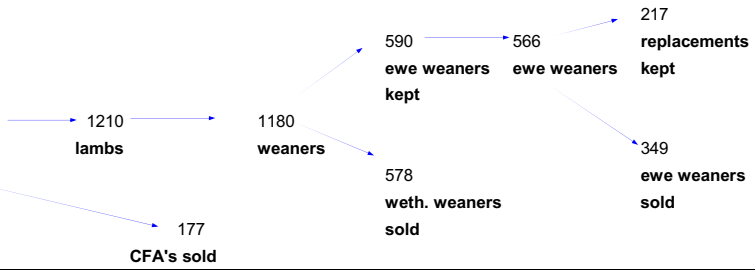
1. Flock Parameters

Flock mortality	4%	Ram %	2%
Productive life	5 years	Marking %	121%
Ewe body weight	65 kg	Weaning %	118%
DSE rating /ewe	2.72	Weaning age	3 months
Stocking rate/ha	10 dse's	Pasture maintenance = 90kg single super @ $330t + $6.00 application	

2. Flock Structure

Sheep numbers are modified to reflect mortality throughout the year.

Age	Number of ewes
1.5	217
2.5	208
3.5	200
4.5	192
5.5	184
6.5	0
Total	**1000**



3. Sensitivity Tables - Changes in Gross Margin $/DSE (includes fodder)

Export Lamb $/Hd	Value of Domestic lamb $/Hd				
$22.78	$86.82	$97.67	**$108.52**	$119.37	$130.22
$101.79	$18.02	$19.11	$20.21	$21.30	$22.40
$114.52	$19.30	$20.40	$21.49	$22.59	$23.68
$127.24	$20.58	$21.68	**$22.78**	$23.87	$24.97
$139.96	$21.87	$22.96	$24.06	$25.16	$26.25
$152.69	$23.15	$24.25	$25.34	$26.44	$27.54

CFA ewes $/Hd	Value of ewe lambs $/Hd				
$22.78	$93.60	$105.30	**$117.00**	$128.70	$140.40
$69.67	$18.85	$20.27	$21.70	$23.13	$24.55
$78.38	$19.39	$20.81	$22.24	$23.66	$25.09
$87.09	$19.92	$21.35	**$22.78**	$24.20	$25.63
$95.79	$20.46	$21.89	$23.31	$24.74	$26.17
$104.50	$21.00	$22.43	$23.85	$25.28	$26.70

Domestic Lmb $/Hd	Weaning %				
$22.78	94%	106%	**118%**	130%	142%
$86.82	$13.19	$16.89	$20.58	$24.32	$28.05
$97.67	$14.06	$17.87	$21.68	$25.52	$29.37
$108.52	$14.94	$18.86	**$22.78**	$26.73	$30.68
$119.37	$15.82	$19.84	$23.87	$27.93	$32.00
$130.22	$16.70	$20.83	$24.97	$29.14	$33.31

Export Lamb $/Hd	Weaning %				
$22.78	94%	106%	**118%**	130%	142%
$101.79	$12.88	$16.55	$20.21	$23.90	$27.60
$114.52	$13.91	$17.70	$21.49	$25.32	$29.14
$127.24	$14.94	$18.86	**$22.78**	$26.73	$30.68
$139.96	$15.97	$20.01	$24.06	$28.14	$32.22
$152.69	$17.00	$21.17	$25.34	$29.56	$33.77

Note: The above sensitivity tables vary price and quantities by +/- 10% and +/- 20%.

Feed m/sex lamb kg/Hd/wk	Feeding ewes kg/Hd/week				
$22.78	2.50 kg	3.75 kg	**5.00 kg**	6.25 kg	7.50 kg
2.50 kg	$27.31	$25.83	$24.34	$22.86	$21.38
3.75 kg	$26.52	$25.04	$23.56	$22.08	$20.60
5.00 kg	$25.74	$24.26	**$22.78**	$21.29	$19.81
6.25 kg	$24.96	$23.47	$21.99	$20.51	$19.03
7.50 kg	$24.17	$22.69	$21.21	$19.73	$18.24

Feed m/sex lamb kg/hd/wk	Grain price $/Tonne				
$22.78	$115.00	$172.50	**$230.00**	$287.50	$345.00
2.5 kg	$28.40	$26.37	$24.34	$22.32	$20.29
3.8 kg	$28.01	$25.78	$23.56	$21.34	$19.11
5.0 kg	$27.62	$25.20	**$22.78**	$20.36	$17.94
6.3 kg	$27.22	$24.61	$21.99	$19.38	$16.76
7.5 kg	$26.83	$24.02	$21.21	$18.40	$15.58

Note: The feeding sensitivity tables vary quantities/costs by +/- 25% and +/- 50%.

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BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: December 2012

Enterprise: **Inland weaners - stores**

Enterprise Unit: **100 cows**

Pasture: **Native pasture**

INCOME:			**Standard Budget**	**Your Budget**
42	steer weaners @	$468 /hd	$19,656	
21	heifer weaners @	$368 /hd	$7,728	
1	CFA Bull @	$1,113 /hd	$1,113	
6	CFA cows @	$624 /hd	$3,744	
0	Dry cows @	$624 /hd	$0	
13	Other culls @	$624 /hd	$8,112	
83				
	A. Total Income:		**$40,353**	

VARIABLE COSTS:					
Replacements	1	Bull @	$6,000	/hd	$6,000
Livestock and vet costs: see section titled beef health costs for details.					$1,036
Ear tags @		$2.00			$42
Hay & Grain or silage. Low level supplementary feeding for 3 months					$2,400
Droughts can increase feed costs. For example costs see main menu.					$0
Pasture maintenence (372 Ha of native pasture)					$0
Livestock selling cost (see assumptions on next page)					$2,774
B. Total Variable Costs:					**$12,252**

GROSS MARGIN (A-B)	**$28,101**
GROSS MARGIN/COW	**$281.01**
GROSS MARGIN/DSE*	**$18.89**
GROSS MARGIN/HA	**$75.54**

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 170c/kg and steer weight to 240 kg, gross margin would fall to $231 per cow. This assumes that price and weight of all other sale stock falls by the same percentage.

Liveweight (kg's) of Stock sold		**Steer sale price cents/kg live**				
		160	**170**	**180**	**190**	**200**
Steer wt.						
-40 kgs	**220**	183	202	221	239	258
-20 kgs	**240**	211	231	251	271	291
0	**260**	238	259	281	303	325
+20 kgs	**280**	265	288	311	334	358
+40 kgs	**300**	292	316	341	366	391

GM $ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by $19.33

Assumptions **Inland weaners - stores**

Enterprise unit is 100 cows weighing on average 480 kg
Weaning rate: 84% - conception rate 90%

Sales

Steers sold at 9 months	260 kg	@180c/kg	live weight
Heifers sold at 9 months	230 kg	@160c/kg	live weight
21 heifers retained for replacement.			
Cull cows cast for age at 10 years	240 kg	@260c/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	420 kg	@265c/kg	dressed weight

Selling costs include: Commission 3.5%, yard dues $3.00/hd, MLA levy $5/hd, average freight cost to saleyards $5.50/hd, NLIS tags @ $2.90 for all sale cattle.

Cows: age at first calf : 24 months

Mortality rate of adult stock: 2%

The average feed requirement of a cow + followers is rated at 2.21 LSU or 15.25 dse's. This is an average figure and will vary during the year.

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Age structure

Age	Number
2	21
3	18
4	15
5	13
6	11
7	9
8	7
9	6
Total Joined	**100**
10	6

Marketing Information:

Mainly sold to grass fatteners for growing out.
Steers likely to end up in feedlots after further weight gain on grass.
Following sale, heifers either grown out to become breeders or fattened for the local trade market or Korean grass fed category. If individual cull cow weights drop below 200kg dressed weight then the per kilogram price will decline.

Production Information:

Mixed sex weaners sold from March to June from lighter country or at heavier stocking rates than for vealers. Common on unimproved areas with some supplementary feed in normal years.
This enterprise is the most drought susceptible.

Wheat: Short Fallow (No-till)

Central Zone - West

Winter 2012

1. GROSS MARGIN BUDGET:			PREVIOUS CROP:	CEREAL Standard Budget	CANOLA Standard Budget	PULSES Standard Budget	Your Budget
After	**INCOME:**			$/ha	$/ha	$/ha	$/ha
Pulses	1.90 tonnes/ha @	$275.00 /tonne (on farm) (PH)				$522.50	
Canola	1.80 tonnes/ha @	$275.00 /tonne (on farm) (PH)			$495.00		
Cereal	1.50 tonnes/ha @	$275.00 /tonne (on farm) (PH)		$412.50			
		A. TOTAL INCOME $/ha:		**$412.50**	**$495.00**	**$522.50**	
	VARIABLE COSTS:						
	See opposite page for detail						
		Cultivation		$0.00	$0.00	$0.00	
		Sowing		$44.35	$44.35	$44.35	
		Fertiliser		$130.02	$130.02	$130.02	
		Herbicide		$54.96	$54.96	$54.96	
		Insecticide		$0.00	$0.00	$0.00	
		Fungicide		$8.15	$8.15	$8.15	
		Contract-harvesting		$48.00	$48.00	$48.00	
		Levies		$4.21	$5.05	$5.33	
		Crop Insurance		$4.23	$5.07	$5.36	
		Cartage, grading & bagging		$0.00	$0.00	$0.00	
		B. TOTAL VARIABLE COSTS $/ha:		**$293.91**	**$295.60**	**$296.16**	
		C. GROSS MARGIN (A-B) $/ha:		**$118.59**	**$199.40**	**$226.34**	

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

After Cereal

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$235.00	$255.00	$275.00	$295.00	$315.00
0.50	-$162	-$152	-$143	-$133	-$123
1.00	-$47	-$28	-$8	$12	$31
1.50	$68	$97	**$119**	$156	$186
2.00	$183	$222	$261	$301	$340
2.50	$298	$347	$396	$445	$494

Gross Margin ($/ha)

After Canola

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$235 /t	$255 /t	**$275 /t**	$295 /t	$315 /t
0.30	-$208	-$202	-$197	-$191	-$185
0.80	-$93	-$77	-$62	-$46	-$30
1.30	$22	$47	$73	$98	$124
1.80	$137	$172	**$199**	$243	$278
2.30	$252	$297	$342	$387	$432
2.80	$364	$418	$473	$528	$583
3.30	$473	$537	$602	$667	$731

Gross Margin ($/ha)

After Pulses

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$235 /t	$255 /t	**$275 /t**	$295 /t	$315 /t
0.40	-$185	-$177	-$170	-$162	-$154
0.90	-$70	-$53	-$35	-$17	$0
1.40	$45	$72	$100	$127	$155
1.90	$160	$197	**$226**	$272	$309
2.40	$275	$322	$369	$416	$463
2.90	$385	$442	$499	$556	$613
3.40	$495	$561	$628	$694	$761

Gross Margin ($/ha)

PRODUCT TRADE NAMES

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

Wheat: Short Fallow (No-till)

Central Zone - West

Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Dec/Jan	0.03	76.36	**$2.50**	1.20 L	$8.67/L	**$10.40**	**$12.90**
Weed control eg: triclopyr 600 g/L (Garlon®)	Dec/Jan	with above			0.10 L	$19.60/L	**$1.96**	**$1.96**
Weed control eg: glyphosate 540 g/L (Roundup PowerMAX®)	Feb/Mar	0.03	76.36	**$2.50**	1.00 L	$8.67/L	**$8.67**	**$11.17**
Weed control eg: 2,4-D amine 300 g/L (Surpass®)	Feb/Mar	with above			1.00 L	$3.80/L	**$3.80**	**$3.80**
Nitrogen Fertiliser- After Canola eg: Urea	May	0.12	104.36	**$12.22**	80 kg	$0.70/kg	**$56.00**	**$68.22**
Nitrogen Fertiliser- After Cereal eg: Urea	May	0.12	104.36	**$12.22**	80 kg	$0.70/kg	**$56.00**	**$68.22**
Nitrogen Fertiliser- After Pulses eg: Urea	May	0.12	104.36	**$12.22**	80 kg	$0.70/kg	**$56.00**	**$68.22**
Sowing	May	0.12	104.36	**$12.22**	35 kg	$0.92/kg	**$32.13**	**$44.35**
Starter fertiliser eg: MAP	May	with above			60 kg	$1.03/kg	**$61.80**	**$61.80**
Grass weed control eg:clodinafop-propargyl (Topik®)	Jun/July	0.03	76.36	2.50	0.09 L	$130.00/L	**$11.44**	**$13.94**
Uptake®	Jun/July	with above			0.25 L	$6.80/L	**$1.70**	**$1.70**
Broadleaf weed control eg: LVE Agritone® 500g/L	July	0.03	76.36	**$2.50**	0.70 L	$10.00/L	**$7.00**	**$9.50**
Foliar Fungicide eg: tebuconazole 430 g/L (Folicur®)	July/Aug	0.03	76.36	2.50	0.145 L	$39.00/L	**$5.66**	**$8.15**
Contract-harvest - After Canola	Nov	contract		**$48.00**				**$48.00**
Contract-harvest - After Cereal	Nov	contract		**$48.00**				**$48.00**
Contract-harvest - After Pulses	Nov	contract		**$48.00**				**$48.00**
Crop Levies - After Canola					1.02%	of on-farm value		**$5.05**
Crop Levies - After Cereal					1.02%	of on-farm value		**$4.21**
Crop Levies - After Pulses					1.02%	of on-farm value		**$5.33**
Crop Insurance - After Canola					1.03%	of on-farm value		**$5.07**
Crop Insurance - After Cereal					1.03%	of on-farm value		**$4.23**
Crop Insurance - After Pulses					1.03%	of on-farm value		**$5.36**

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

NOTES:

Sowing Time:
- Sowing at the optimum time for the selected variety is critical for maximum yield.
- There is a 4 to 7% yield loss for every week delay past the optimum sowing time.
- Seed price used above is for purchased seed; if using retained seed adjust budget accordingly.

Place in rotation:
- Short fallow wheat crops perform differently depending on the previous crop.
- Pulse and canola crops provide an effective disease break and yield benefit for the following wheat crop. Additionally, a pulse crop improves soil nitrogen reducing the amount of fertiliser required to achieve PH quality.
- Short Fallow: Fallow or weed free period of 5-6 months between harvest of one crop and sowing of the next crop. For example, canola harvested in November would be under a 5-6 month fallow until sowing in May of the following year.

Weed control:
- Timing of fallow herbicide applications vary according to rainfall
- Weed control, if required, should be implemented either pre-emergent or within 6 to 8 weeks after sowing time to limit yield loss.
- Uptake oil @ 0.25 L/ha assumes a water rate of 50 L/ha.
- An additional knockdown herbicide application (eg. glyphosate 540 g/L @ 1.0 L/ha) should be considered if weeds are present at the time of sowing. Triasulfuron @ 35 g/ha can also be tankmixed with glyphosate immediately prior to sowing for residual control of some weed species.
- Rotate herbicide groups and use other non-chemical methods to delay herbicide resistance.

Fertiliser:
- Adequate phosphorus is essential before applying extra nitrogen fertiliser.
- To achieve PH quality, wheat must have a protein level of 13% or higher.
- Seasonal conditions will also have a large effect on grain size and protein percentage.
- Nitrogen fertiliser applications may be split i.e. some applied presowing and some applied in the mid to late vegetative stage (2nd node to flag leaf emergence) .
- The later nitrogen fertiliser is applied to a crop, the greater its effect on raising protein percentage, and the less effect it has on increasing yield.

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

Labour:
- The labour required for machinery operations is 0.71 hr/ha
- Using a labour cost of $22/hr, an additional $15.58 can be deducted from the budget

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

Flood Irrigated Wheat

Central Zone — Winter 2012

1. GROSS MARGIN BUDGET:

		Standard Budget $/ha	Your Budget $/ha
INCOME:			
5.00 tonnes/ha @	$265.00 /tonne (on farm) (AH)	$1,325.00	
	A. TOTAL INCOME $/ha:	**$1,325.00**	
VARIABLE COSTS: See opposite page for detail			
	Cultivation	$46.02	
	Sowing	$95.12	
	Fertiliser	$264.67	
	Herbicide	$62.24	
	Insecticide	$0.00	
	Irrigation	$74.64	
	Contract-harvesting	$78.00	
	Levies	$13.52	
	Crop Insurance	$27.16	
	Cartage, grading & bagging	$0.00	
B. TOTAL VARIABLE COSTS $/ha:		**$661.37**	
C. GROSS MARGIN (A-B) $/ha:		**$663.63**	
D. GROSS MARGIN FOR ALTERNATIVE DRYLAND CROP (SF WHEAT)		**$419.12**	
E. EXTRA GROSS MARGIN DUE TO IRRIGATION (C-D)		**$244.51**	
F. GROSS MARGIN/ML (E÷ML WATER APPLIED)*		**$61.13**	

* **See agronomic notes on irrigation**

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

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$225 /t	$245 /t	**$265 /t**	$285 /t	$305 /t
3.50	$161	$228	$296	$364	$432
4.00	$264	$341	$419	$496	$574
4.50	$367	$454	$541	$628	$716
5.00	$470	$567	**$664**	$761	$857
5.50	$573	$679	$786	$893	$999
6.00	$676	$792	$908	$1,025	$1,141
6.50	$779	$905	$1,031	$1,157	$1,283

← Gross Margin ($/ha)

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

YIELD	ON FARM PRICE ($/tonne)				
tonnes/ha	$225 /t	$245 /t	**$265 /t**	$285 /t	$305 /t
3.50	-$65	-$48	-$31	-$14	$3
4.00	-$39	-$19	$0	$19	$39
4.50	-$13	$9	$31	$52	$74
5.00	$13	$37	**$61**	$85	$110
5.50	$38	$65	$92	$118	$145
6.00	$64	$93	$122	$151	$181
6.50	$90	$121	$153	$184	$216

← Gross Margin ($/ML)

PRODUCT TRADE NAMES

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

This budget is ONLY A GUIDE and should be altered for movements in crop and input prices, changes in seasonal conditions and the farm characteristics.

Flood Irrigated Wheat

Central Zone Winter 2012

CALENDAR OF OPERATIONS:

Operation	Month	Machinery hrs /ha	Machinery Cost $/hour	Machinery Total $/ha	Inputs rate/ha	Inputs Cost $	Inputs Total $/ha	Total Cost $/ha
Off-set	Jan	0.35	60.82	**$21.12**				**$21.12**
Chisel Plough	Feb	0.22	54.87	**$12.25**				**$12.25**
Land plane	Mar	0.05	53.40	**$2.88**				**$2.88**
Light Cultivation	Mar	0.17	57.07	**$9.77**				**$9.77**
Pre-irrigation	Mar				1.50 ML	$18.66/ML	**$27.99**	**$27.99**
Pre-sowing weed control eg: glyphosate 540 g/L (Roundup PowerMax®)	Apr	0.05	53.40	**$2.88**	1.50 L	$8.67/L	**$13.01**	**$15.88**
Nitrogen fertiliser eg: Urea	May	0.17	57.07	**$9.77**	217 kg	$0.70/kg	**$151.90**	**$161.67**
Sowing	May	0.17	74.40	**$12.50**	90 kg	$0.92/kg	**$82.62**	**$95.12**
Starter fertiliser eg: MAP	May	with above			100 kg	$1.03/kg	**$103.00**	**$103.00**
Weed control eg: chlorsulfuron 750 g/L (Glean®)	May	0.05	53.40	**$2.88**	20 g	$0.08 /g	**$1.60**	**$4.48**
Grass weed control eg:diclofop-methyl + fenoxaprop (Tristar® Advance)	Jun	0.05	53.40	**$2.88**	1.50 L	$26.00/L	**$39.00**	**$41.88**
Irrigation	Aug/Sept				1.25 ML	$18.66/ML	**$23.33**	**$23.33**
Irrigation	Sept/Oct				1.25 ML	$18.66/ML	**$23.33**	**$23.33**
Contract-harvest	Nov	contract		**$78.00**				**$78.00**
Crop Levies					1.02%	of on-farm value		**$13.52**
Crop Insurance					2.05%	of on-farm value		**$27.16**

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

NOTES:

Sowing time:
- Sowing at the optimum time for the selected variety is critical for maximum yield, regardless of irrigation.
- There is a 4 to 7% yield loss for every weeks delay past the optimum sowing time.
- Seed price used above is for purchased seed; if using retained seed adjust budget accordingly.

Weed control:
- Weed control, if required, should be implemented either pre-emergent or within 6 to 8 weeks after sowing time to avoid yield loss.
- Glyphosate for fallow knockdown weed control.
- A wide range of herbicides can be used, including chlorsulfuron for early weed control and fenoxaprop for in-crop grass control.
- Rotate herbicide groups and use other non-chemical methods to avoid herbicide resistance developing.

Fertiliser:
- Adequate phosphorus is essential before applying extra nitrogen fertiliser. Nitrogen is essential to maintain protein levels and can be applied either at sowing or top-dressed in-crop.

Irrigation:
- Pre-irrigation may be optional, dependent on stored moisture following summer rainfall
- In-crop irrigation: timing and amount dependent on in-crop winter rainfall: generally two irrigations (2.5 ML/ha) in spring is sufficient.
- This budget is applicable for the Central Zone east, a higher water requirement may be required for the central zone west than the figures used in this budget.
- Some of the yield response for irrigated crops is due to stored soil moisture and growing season rainfall which can be sufficient to grow a dryland crop.Thus the Gross Margin per ML is obtained by (GM/Ha of irrigated crop – GM/Ha alternative dryland crop)÷ML of irrigation water applied.
- Cost/ML is calculated based on the management and usage charges for regulated Maquarie river.

Machinery:
- A tractor with 57 kW (77 HP) pto power and 66kW (90 HP) engine power is assumed.
- Machinery costs refer only to variable costs: fuel, oil, filters, tyres, batteries & repairs.
- Contract-harvesting does not include the cost of fuel.

Labour:
- The labour required for machinery operations is 1.95 hr/ha
- Using a labour cost of $22/hr, an additional $42.97 can be deducted from the budget

Important notes:
- These gross margins are only a guide. They do not include overhead costs.
- **Use your own figures and price assumptions to estimate your own gross margin.**
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