APPENDIX O

Agricultural Impact Assessment

global environmental solutions

Agricultural Impact Statement

Tahmoor Mine

Tahmoor South Project

Report Number 630.12180

February 2020

Tahmoor Coal Pty Limited

Version: Final

Agricultural Impact Statement

Tahmoor Mine

Tahmoor South Project

Final

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.com www.slrconsulting.com

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633.10068	Draft 1	November 2013	Murray Fraser	Adele Calandra	
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630.12180	Final	February 2020	Murray Fraser	Rod Masters	Rod Masters

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1 INTRODUCTION

SLR has been commissioned by Tahmoor Coal Pty Limited (Tahmoor Coal) to complete an Agricultural Impact Statement (AIS) for the Tahmoor South Project (the Project). The purpose of this AIS is to form part of the Environmental Impact Statement (EIS) for the Project in support of a development application, to be submitted under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Background

In accordance with the requirements of the EP&A Act, an EIS was prepared to assess the potential environmental, economic and social impacts of the Project. The EIS for the Project was placed on public exhibition by the Department of Planning, Industry and Environment (DPIE) (formerly the Department of Planning and Environment (DPE)) from 23 January 2019 to 5 March 2019.

Key issues raised in submissions received as a result of the public exhibition of the EIS included concerns relating to the proposed extent of longwall mining, the magnitude of subsidence impacts and the extent of vegetation clearing required for the expansion of the reject emplacement area (REA). In response to these and other issues raised in Government agency, local Council, stakeholder and community submissions, and as a result of ongoing mine planning, several amendments have been made to the proposed development, so as to also further reduce the predicted environmental impacts of the Tahmoor South Project.

The key amendments to the Project since public exhibition of the EIS are:

- A revised mine plan, including:
    - an amended longwall panel layout and the removal of LW109;
    - a reduction in the height of extraction within the longwall panels from up to 2.85 metres (m) to up to 2.6 m; and
    - a reduction in the proposed longwall width, from up to 305 m to approximately 285 m.
- A reduction in the total amount of Run-of-Mine (ROM) coal to be extracted over the Project life, from approximately 48 million tonnes to approximately 43 million tonnes of ROM coal, comprising;
    - 30 million tonnes of coking coal product (reduced from 35 million tonnes);
    - 2 million tonnes of thermal coal product (reduced from 3.5 million tonnes)
- A revised extended REA; including:
    - a reduction in the additional capacity required to accommodate the Project;
    - a reduction in the REA extension footprint, from 43 hectares to 11 hectares;
    - an increase in the final height of the REA (from RL 305 metres to RL 310 metres).
- Confirmation of the location and footprint of ancillary infrastructure associated with the ventilation shaft sites (e.g. the power connection easement for ventilation shaft site TSC1); and

- A continuation of the use of the existing upcast shaft (T2); although, operation will reduce from two fans during Tahmoor North operations to one fan once the new ventilation shafts and fans (TSC1 and TSC2) are in operation in Tahmoor South.

No amendments have been made to other key aspects of the Project as presented in the EIS such as the proposed annual coal extraction rate, mining method, traffic movements and employee numbers. A detailed description of the amended development is provided in the Amended Project Report (AECOM 2020).

No issues were raised in submissions on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project Area.

1.2 Overview

Tahmoor Coal owns and operates the Tahmoor Mine, an underground coal mine between the townships of Tahmoor and Bargo, approximately 80 kilometres south-west of Sydney in the Southern Coalfields of NSW (**Figure 1**). The Tahmoor Mine produces up to 3 million tonnes per annum of run-of-mine (ROM) coal.

Tahmoor Coal Pty Ltd (Tahmoor Coal) is a wholly owned subsidiary of SIMEC (Australia) Mining Pty Ltd, which is part of the GFG Alliance.

Tahmoor Coal is seeking approval for the Tahmoor South Project (the Project), being the extension of underground coal mining at Tahmoor Mine to the south of the existing Tahmoor Mine surface facilities area. The proposed development seeks to extend the life of underground mining at Tahmoor Mine until approximately 2035. The proposal will enable mining to be undertaken within the southern portion of Tahmoor Coal's existing lease areas and for operations and employment of the current workforce to continue for approximately a further 13 years.

The Project Area is shown on **Figure 1** and comprises an area adjacent to, and to the south of, the Existing Tahmoor Approved Mining Area. It also overlaps a small area of the Existing Tahmoor Approved Mining Area comprising the surface facilities area, historical workings and other existing mine infrastructure. The Tahmoor South Project Area covers approximately 6,498 hectares, with a subsidence study area (incorporating the proposed longwall footprint) of 2,624 hectares. A total of 17 hectares of surface disturbance will be required for the REA expansion, additional ventilation shafts and associated infrastructure, all of which comprise areas of native vegetation within the subsidence study area.

The proposed development will be accessed via the existing surface facilities at Tahmoor Mine and will extend mining within the Project Area, using longwall methods, with the continued use of ancillary infrastructure at the existing Tahmoor Mine surface facilities area.

1.2.1 Proposed Development

The proposed development will use longwall mining to extract coal from the Bulli seam within the bounds of CCL 716 and CCL 747. Coal extraction of up to 4 million tonnes of ROM coal per annum is proposed as part of the development, with extraction of up to 43 million tonnes of ROM coal over the life of the project. Once the coal has been extracted and brought to the surface, it will be processed at Tahmoor Mine's existing Coal Handling Preparation Plant (CHPP) and coal clearance facilities, and then transported via the existing rail loop, the Main Southern Railway and the Moss Vale to Unanderra Railway to Port Kembla and Newcastle (from time to time) for Australian and international markets.

The proposed development will utilise existing surface infrastructure at the Tahmoor Mine surface facilities area. Some upgrades are proposed to facilitate the extension. The proposed development also incorporates the planning for rehabilitation and mine closure once mining ceases.

1.3 Study Requirements

The EIS for the Project has been prepared in accordance with Division 4.1, Part 4 of the EP&A Act which ensures that the potential environmental effects of a proposal are properly assessed and considered in the decision-making process.

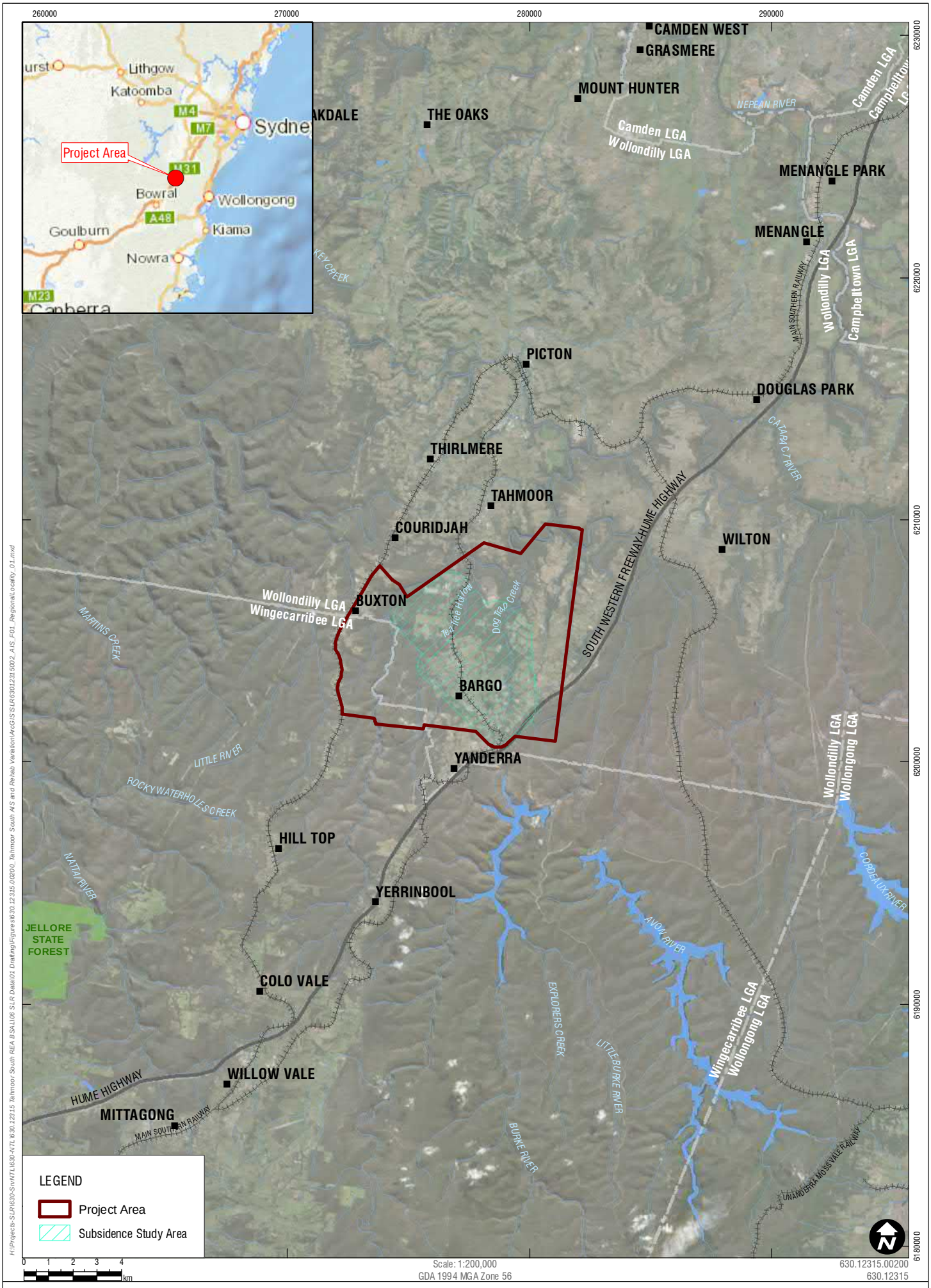
This report has been prepared to address the *Strategic Regional Land Use Policy* (the Policy) (NSW Department of Planning & Infrastructure (DP&I), 2012a). The Policy aims to assist the development of a long-term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing agricultural industries. The Policy applies to areas within NSW where there is high value agricultural land and increasing activity in the coal and coal seam gas industries.

Part of this policy requires all state-significant mining development proposals, whether or not they are located on land mapped as Strategic Agricultural Land (SAL), to prepare an Agricultural Impact Statement (AIS) for consideration at the development application stage. The purpose of an AIS is to assess and report on the potential impacts of the Project on agricultural resources and/or industries within and surrounding the Project 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. SLR has prepared this AIS to address the requirements of the Policy in accordance with the *Guideline for Agricultural Impact Statements* (DP&I, 2012b).

A Biophysical Strategic Agricultural Land (BSAL) Assessment (SLR, 2018) for the Project was completed over areas which required new mining leases, including portions of the proposed expanded reject emplacement area and proposed ventilation shaft sites. A Site Verification Certificate (SVC) was issued on the 5th February 2018 by the NSW Department of Planning and Environment, confirming there is no BSAL in those areas. Following the issue of this SVC, the proposed location of the new ventilation shaft sites required for the project was changed. A subsequent SVC was issued on the 23rd October 2018 to cover the new proposed ventilation shaft location, which again confirmed there is no BSAL in these areas.

1.3.1 Purpose of Report

This AIS has been prepared to assess the impacts of the amended project on agricultural resources and/or industries within and surrounding the Project Area and serves as an update to the Tahmoor South Agricultural Impact Statement (SLR, 2018) (Appendix T of the Tahmoor South EIS).



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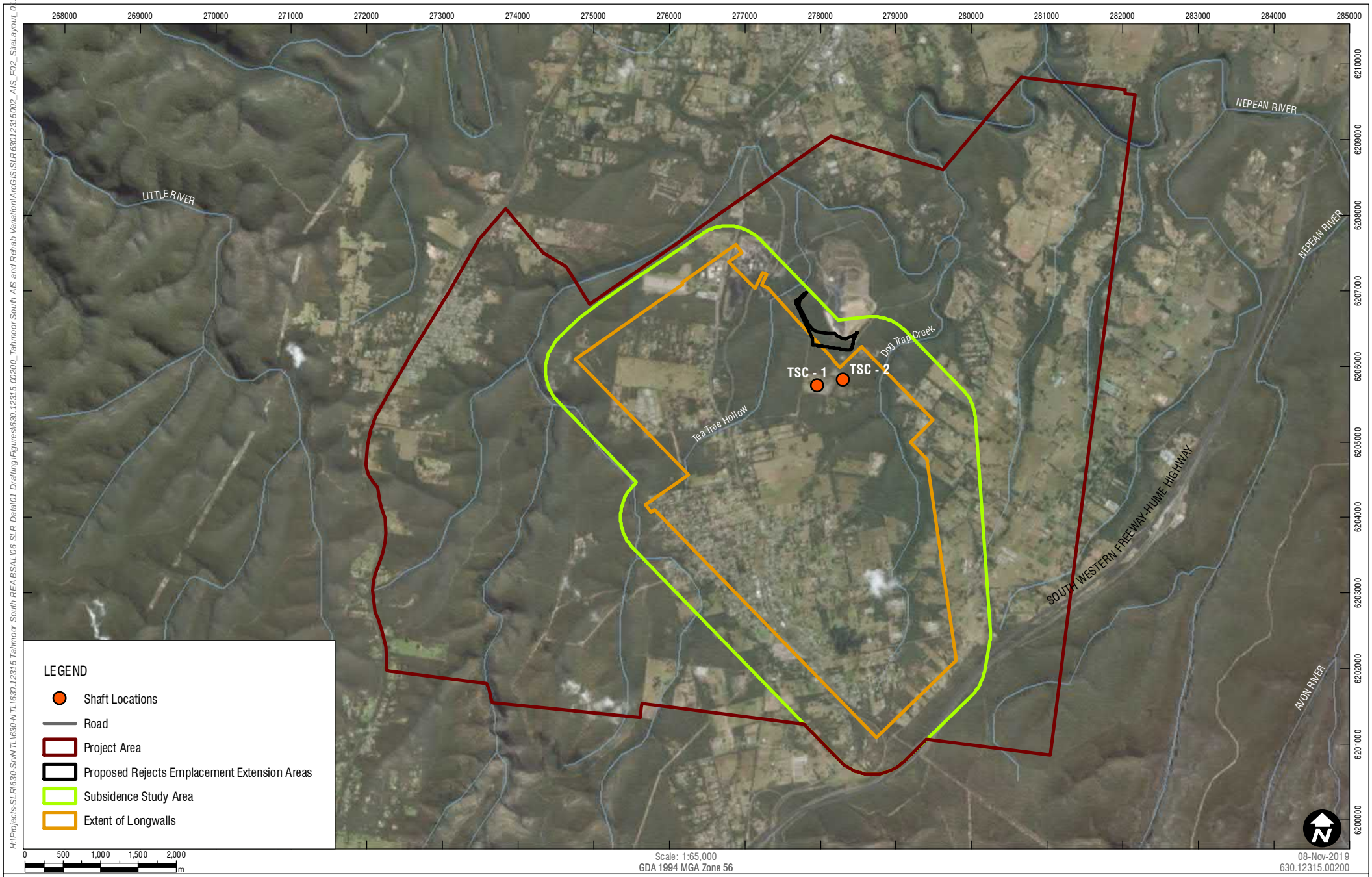
Regional Locality

FIGURE 1



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Site Layout

FIGURE 2

1.4 Project Area and Disturbance Assessment Area

The Study Area subject to this AIS is the entire Project Area of 6,498 hectares. Land to be disturbed by the proposed Project is limited to areas of known and potential disturbance and is termed the Disturbance Assessment Area (DAA) (**Figure 3**) and includes three areas:

- The Subsidence Study Area (SSA): potential surface subsidence associated with the underground mining, including 35° subsidence angle of draw, covering an area of 2,624 hectares.

- The Ventilation Shaft Areas: the proposed new surface infrastructure comprising two ventilation shafts covering a maximum total area of approximately 6 hectares. The entire proposed surface disturbance associated with the ventilation shaft sites is contained within the Subsidence Study Area.

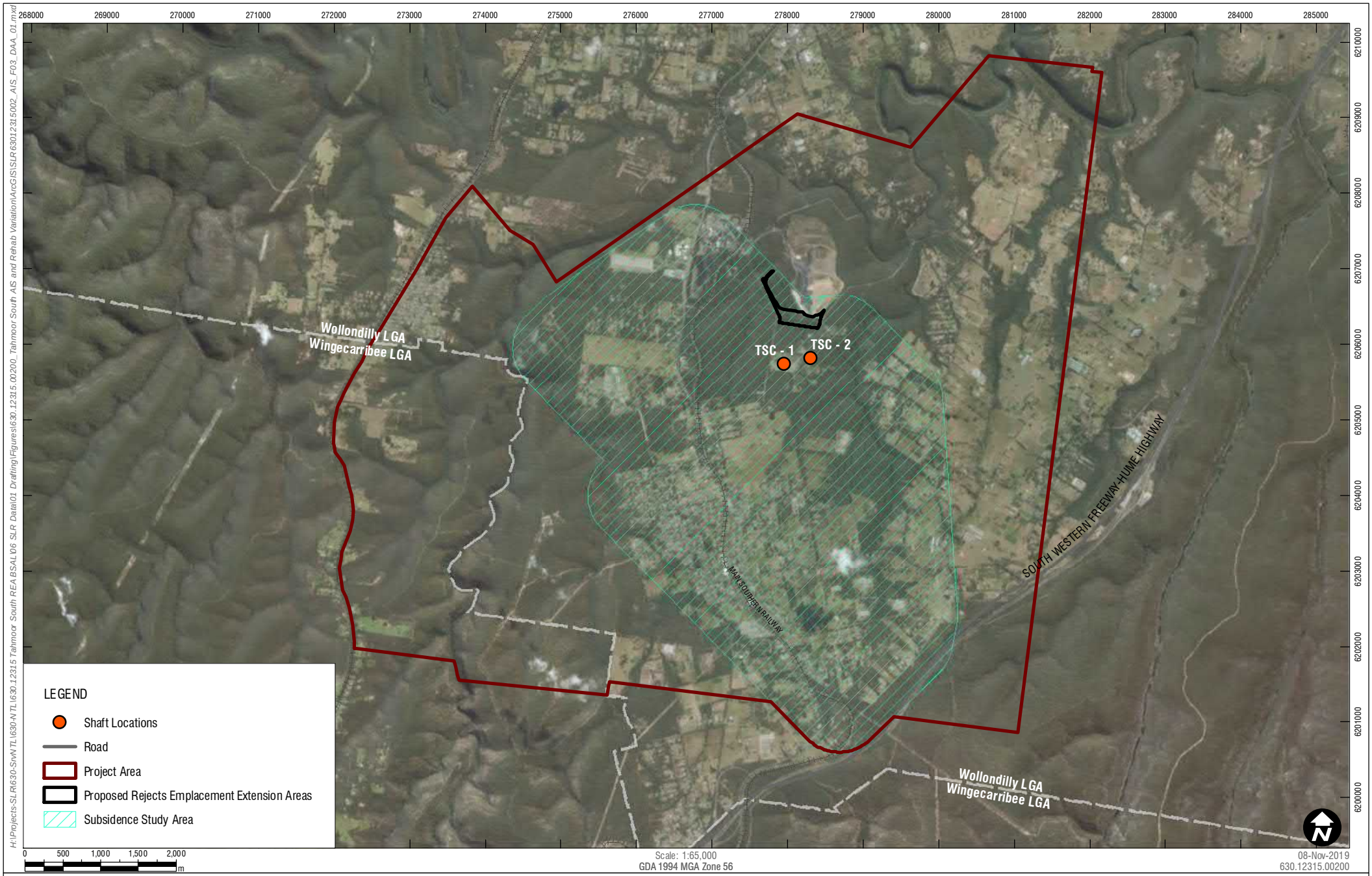
- Extension of the Reject Emplacement Area (REA), footprint of 11 hectares. This includes land that will be permanently removed from potential agricultural production upon completion of the final landform. The REA is wholly contained within the SSA.

The total DAA assessed is approximately 2,624 hectares, as shown on **Figure 2**. **Table 1** details the disturbance components. The DAA is located entirely within the Wollondilly Local Government Area (LGA).

Table 1 Disturbance Assessment Area

Disturbance Type	Description	DAA (hectares)
Subsidence Study Area (SSA)	Underground mining area (includes the 35° degree subsidence angle of draw)	2,624
Ventilation Shaft Areas	Ventilation shafts TSC1 and TSC2 and infrastructure comprise a maximum of 10 hectares within SSA	0*
Reject Emplacement Area (REA)	REA maximum extension footprint of 11 hectares within the SSA	0*
	Total DAA	**2,624**

*Surface disturbance included in SSA



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Disturbance Assessment Area

FIGURE 3

1.5 Structure of this Report

This AIS, in accordance with the *Strategic Agricultural Land Use Policy: Guideline for Agricultural Impact Statements* (DP&I, 2012b), addresses the information listed in **Table 2**.

Table 2 AIS Requirements

This AIS must include the following information	Section addressed:
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 2
• relevant history of the agricultural enterprises from within the project area and also surrounding land acquired as part of the development's buffer and/or offset zone.	Section 3
For the project area this should include a description of:	
• any land identified as SAL in a Strategic Regional Land Use Plan on or within two kilometres of the project site;	Section 2
• the location and area of land to be temporarily removed from agriculture during operation of the project, and the period of time;	Section 4
• the location and area of land to be returned to agricultural use post-project, and its productive potential relative to pre-project;	Section 4
• the location and area of land that will not be returned to agriculture, including areas to be used for environmental plantings or biodiversity offsets;	Section 4
• the agricultural enterprises to be undertaken on any buffer and/or offset zone lands for the life of the project, comparison with enterprises undertaken prior to the project.	Section 4
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 2
• topography/slope;	
• key agricultural support infrastructure (e.g. roads, railways, processing facilities);	Section 3
• water resources and other water users' extraction locations;	Section 2
• location and type of agricultural industries;	Section 3
• climate conditions.	Section 2
Describe the location and production levels of each commodity produced by all agricultural enterprises within the locality surrounding the project area.	Section 3
Assessment of Impacts	
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 4
• 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).	

This AIS must include the following information	Section addressed:
If the project site is located on or within two 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;	Section 2
• 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 4
The socio-economic impact assessment must detail agricultural support services and value adding industries relevant to affected agricultural enterprises including potential impacts on local and regional employment.	
The socio-economic impact assessment must also address any potential impact on visual amenity, landscape values and tourism infrastructure relied upon by 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 5
• proposed monitoring programs to assess predicted versus actual impacts;	
• trigger response plans and trigger points at which operations will cease or be modified or remedial actions will occur to address impacts including 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;	
• demonstrated capacity for the rehabilitation of disturbed lands to achieve the final land use and restore natural resources;	
• demonstrated planning for progressive rehabilitation minimising extent of disturbances.	
Consultation	
Document consultation with adjoining land users and Government Departments	
An AIS should include details of an engagement strategy including:	
• consultation undertaken to date, including consultation undertaken at the EL stage;	Section 6
• 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.	

1.6 Methodology

The AIS was assessed using the methodology set out below:

- A desktop review of all publicly available information relating to the Project.
- Field visits and site inspections in June 2013, December 2017 and October 2018 by SLR's Associate Agronomist, Murray Fraser.
- Description of the biophysical environment for the Project Area and surrounding locality.
- A review of other specialist impact assessments which also form part of the EIS for the Project.
- Assessment of potential impacts on agricultural resources and industry, including mitigation measures for any identified impacts.
- Provision of Tahmoor Mine's demonstrated capacity for rehabilitation.

2 AGRICULTURAL AND WATER RESOURCES

2.1 Climate

Representative climate data for the Project Area has been obtained from the nearest Bureau of Meteorology (BOM) weather station located at Picton, approximately 10 km to the north of the Project Area (Picton Council Depot, BOM Station 068052, Monthly Climate Statistics).

Picton BOM Station has recorded an average annual rainfall of 803 millimetres (mm), of which approximately 477 mm (60%) falls between November and April, with an average of 71.4 rain days in any given year (**Table 3**). Mean monthly maximum temperatures range between 29.3°C and 16.8 C, with January being the warmest month. Mean monthly minimum temperatures range between 15.4 C and 1.7°C, with July being the coldest month.

Table 3 Picton Climate Data

Temperature	Average (Mean)	Annual Range
Minimum temperature	23.4°C	1.7°C – 15.4°C
Maximum temperature	8.8°C	16.8°C – 29.3°C
Rainfall	**Average (Mean)**	**Number of Rain Days**
Annual rainfall	803.1 millimetres	71.4
Wettest month	February 90.4 millimetres	6.9
Driest month	August 44.1 millimetres	4.8

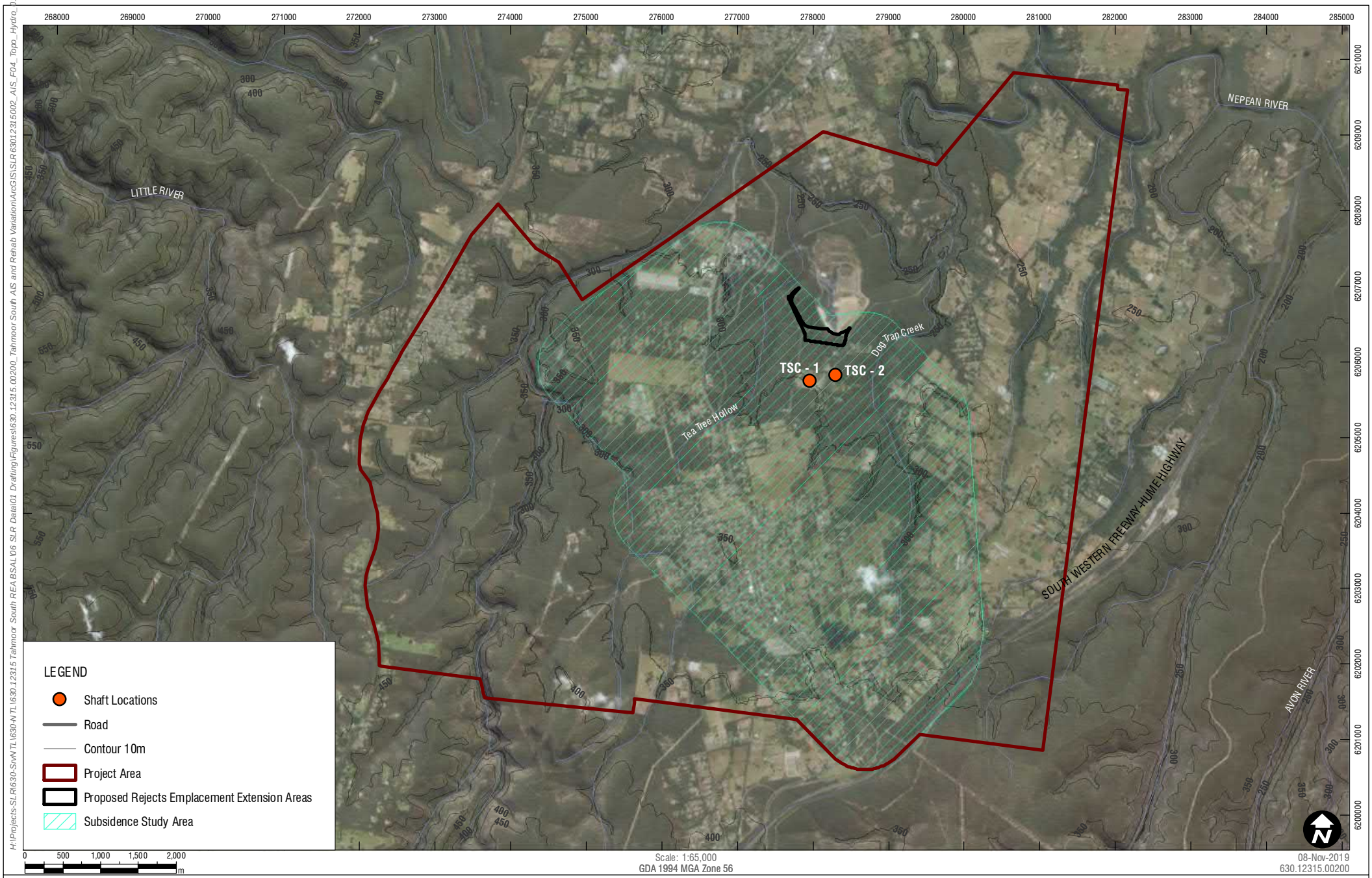
Source: *Bureau of Meteorology* (2018)

The BOM classifies this as a temperate climate zone. The area can be susceptible to occasional heavy showers and thunderstorms due to easterly troughs during warmer months. Summer winds are generally from the south or south-east, with a tendency for afternoon north-easterly winds. During winter, winds are predominantly from the south or south-west.

2.2 Topography

Topography in the region (Wollondilly LGA) is varied, ranging from gently undulating plateaus, ridges and low hills in the upland areas, to a rugged landscape of deeply dissected valleys and gorges within the Hawkesbury Sandstone.

Topography within the Project Area is generally undulating (**Figure 4**) with a fall from the south-west to the north-east. The major topographical features are the Bargo and Nepean River valleys. Surface levels within the Project Area vary from a low point of approximately 105 metres Australian Height Datum (AHD), in the base of the Nepean River valley, to a high point of approximately 375 metres AHD, at the southern end of the Project Area.



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Topography and Hydrology

FIGURE 4

2.3 Hydrology

2.3.1 Surface Water

The Project Area is located in the catchment of the Hawkesbury-Nepean River, within the sub-catchments of the Bargo and Nepean Rivers (**Table 4**). From its headwaters near the townships of Hill Top and Yerrinbool, the Bargo River flows in a generally north-easterly direction to its confluence with the Nepean River, near the Pheasants Nest Weir. The Bargo River consists of a sequence of pools, glides and rock bars across sandstone bedrock, with occasional boulder fields and cobblestone riffles. The Bargo River drains a total catchment of approximately 13,000 hectares at its confluence with the Nepean River.

The Bargo River has ephemeral flow in its upper reaches, which are (to some degree) regulated by the Picton Weir, which is approximately 14 kilometres upstream of the Nepean River confluence. Downstream of the Tea Tree Hollow confluence flow of the Bargo River is perennial due to persistent licensed discharges from the Tahmoor Mine pit top. The Bargo River flows into the Nepean River downstream of the Tea Tree Creek confluence.

The Nepean River rises in the Great Dividing Range to the west of the Project Area. Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, operated by the Sydney Catchment Authority, incorporating four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers. The Nepean Dam is situated approximately 18 kilometres upstream of the Bargo River confluence.

The Nepean River has been extensively modified by the construction of a series of in-stream weirs which have created a series of pondages, with the nearest to the Project Area being the Malden Weir.

The central part of the Project Area is predominantly drained by Tea Tree Hollow and Dog Trap Creek, which generally flow north and eastward toward the Bargo River (**Figure 4**). A small area on the south-west of the central part is drained by headwater tributaries of Hornes Creek which flows into the Bargo River at Picton Weir. Licensed discharges from the Tahmoor Mine pit top enter Tea Tree Hollow at LDP 1.

The eastern part of the Project Area is predominantly drained by Eliza Creek, which flows northward to the Nepean River. A small part of the eastern area is also drained by Cow Creek and Carters Creek which flows north-east to the Nepean River.

Table 4 Project Area Catchments

Catchment	Sub Catchment	Associated Watercourses	Total Catchment Area (Hectares)
Hawkesbury-Nepean River	Bargo River	Tea Tree Hollow	680
		Dog Trap Creek	1,360
		Hornes Creek	1,950
	Nepean River	Eliza Creek	490
		Cow Creek	1,010
		Carters Creek	640

Source: *Surface Water Baseline Study* (Hydro Engineering & Consulting Pty Ltd, 2020)

2.3.2 Groundwater

The Project Area is located within the Sydney Basin porous rock groundwater system (Nepean Groundwater Source, Management Zone 2) which is classed as highly productive. The recognised aquifers/water bearing zones within the area are the:

- Alluvium/sediment aquifers;
- Hawkesbury Sandstone aquifers;
- Narrabeen Group sandstone aquifers; and
- Illawarra Coal Measures water bearing seams.

Alluvium/Sediment Aquifers

Alluvial sediments within the plateau gullies and river bed are too shallow to be used as aquifers for groundwater supply (Geoterra, 2013)

Hawkesbury Sandstone

The Hawkesbury Sandstone aquifers are the principal groundwater source used within the region due to their significantly higher yields and quality in comparison to other water bearing strata. Due to the lack of fracturing and fault lines within the Hawkesbury Sandstone, the associated aquifers are generally primary permeability aquifers. As a result, yields and quality are highest in recharge areas south of the Nepean River. Groundwater monitored in the Hawkesbury Sandstone piezometers within the Project Area is considered low to brackish salinity (less than 6,895 µS/cm) with acid to circum-neutral pH (3.52 to 7.72). Recorded bore yields in the Hawkesbury Sandstone in the Project Area ranged from 0.22 litres per second to 4.5 litres per second (Geoterra, 2013).

Narrabeen Group and Associated Aquitards

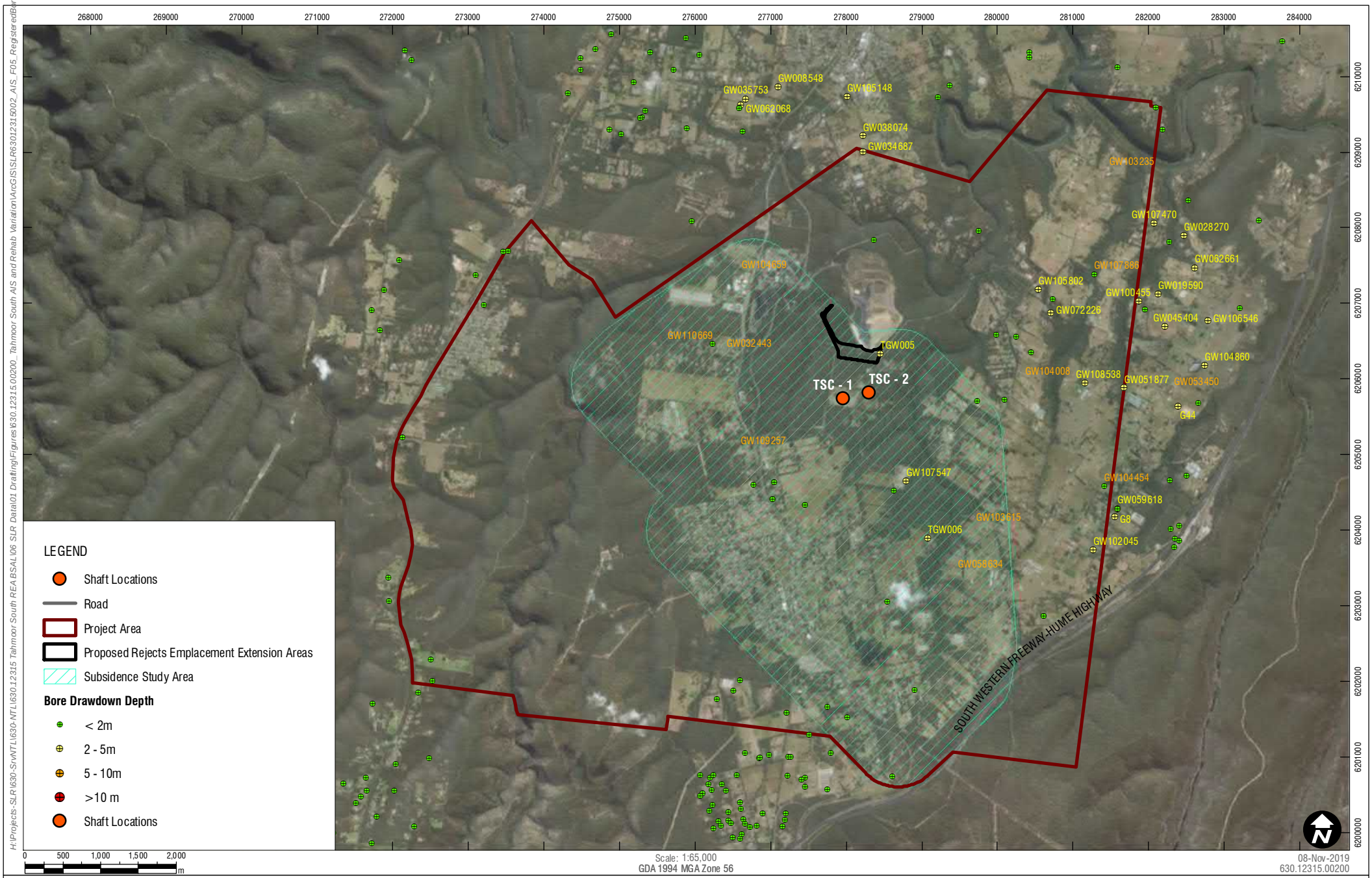
The Narrabeen Group is the other major aquifer within the region, however, the quality and yield is significantly lower than the Hawkesbury Sandstone. The major aquifers are separated by aquitards associated with the Bald Hill Claystone, Stanwell Park Claystone and the Wombarra Claystone. These aquitards are exhibit low permeability and limit vertical groundwater flow between the aquifers

Illawarra Coal Measures

Coal seams within the Illawarra Coal Measures exhibit low permeability than the overlying Hawkesbury Sandstone aquifers due to their depth and fine grained associated rock. Water quality within the water bearing coal seams is considered brackish to moderately saline (Geoterra, 2013).

2.3.3 User Extraction Points

The Project Area is covered by the Greater Metropolitan Groundwater Sources Water Sharing Plan. There were 791 privately-owned groundwater extraction bores identified within, and surrounding the Project Area, with locations of those bores in close proximity to the Project Area (including all bores with predicted impacts) shown in **Figure 5**. Most of the groundwater usage in the area is from the Hawkesbury Sandstone or from surficial alluvium and basalt aquifers (about 89% of the total), with about 10% from the Bulgo Sandstone (Hydro-Simulations,2020).



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Registered Bores (Private)

FIGURE 5

2.4 Geology

The Project is located within the southern area of the Permo-Triassic Sydney Basin. The main coal bearing sequence is the Illawarra Coal Measure, which contains four workable seams. The Project will target the upper most seam, known as the Bulli Seam, and is located in the north-western part of the Illawarra Coalfield.

Overlying the Bulli Seam is the Hawkesbury Tectonic Stage which is comprised of three stratigraphic units, namely the Narrabeen Group, Hawkesbury Sandstone Group and the Wianamatta Group. The Narrabeen Group overlies the Bulli Seam and is comprised of interbedded sandstones and claystone units up to 310 metres thick. Overlying the Narrabeen Group is the Hawkesbury Sandstone Group which is comprised of a series of bedded sandstones up to 185 metres thick. The Wianamatta Group overlies the Hawkesbury Sandstone, and is comprised of shales and siltstones and is relatively thin in comparison.

Another major geological feature is the Bald Hill Claystone which lies at the base of the Hawkesbury Sandstone. The Bald Hill Claystone varies in width to over 25 metres and as it swells when wetted, tends to act as an aquitard.

The Nepean Fault is located within the Project Area, and the proposed mine plan has been developed with consideration of the fault location. The Nepean Fault is east of the Tahmoor North operations and runs in an approximate north-south direction.

2.5 Soil Landscape Units

The soil landscapes units within the Project Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of NSW Department of Primary Industries (DPI)), on the *Wollongong – Port Hacking 1:100,000 Sheet* (Hazelton & Tille, 1990) as shown in **Figure 6**. Descriptions of the seven soil landscape units are given below.

2.5.1 Blacktown

The Blacktown soil landscape unit covers gently undulating rises, broad rounded crests and ridges, with slopes less than 5%, but occasionally up to 10% and local relief is up to 30 metres. It occurs on the Wianamatta Group geological unit, which is predominately comprised of shale. The dominant soils are shallow to moderately deep Chromosols on crest, upper slopes and well drained areas; and deep Dermosols on lower slopes and in drainage depressions. Limitations to the soil landscape unit are moderately reactive soil, low soil fertility and seasonal waterlogging.

This soil landscape unit is suitable for cropping (requiring intensive management practices) and grazing. Much of the Blacktown soil landscape unit has been urbanised or under rural residential development.

2.5.2 Gymea

The Gymea soil landscape unit covers undulating to rolling rises and low hills, with slopes between 10-25% and local relief in 10-80 metres. It occurs on the Hawkesbury Sandstone geological unit consisting of sandstone and some shale and laminite. The dominant soils are shallow to moderately deep Kandosols on crests and inside benches; Kurosols on shale lenses; and shallow to moderately deep Tenosols along drainage lines. Limitations to the soil landscape unit are localised steep slopes, high soil erosion hazard, rock outcrop and very low soil fertility.

The soil landscape unit is not suitable for any agricultural enterprises. Some of this land is within the Metropolitan Special Area (MSA) as part of Sydney's drinking water catchment.

2.5.3 Hawkesbury

The Hawkesbury soil landscape unit covers rugged, rolling to very steep hills, with slopes greater than 25% and local relief 100-200 metres. It occurs on the Hawkesbury Sandstone geological unit consisting of sandstone and some shale and laminite. The dominant soils are shallow Lithosols and Siliceous Sands associated with rock outcrops; Tenosols and Kandosols along joints and fractures; Kurosols on shale lenses; and Tenosols on valley flats. Limitations of the soil landscape unit are extreme erosion hazard, mass movement, steep slopes, rock outcrop and low soil fertility. This soil landscape unit is not suitable for any agricultural enterprises.

2.5.4 Lucas Heights

The Lucas Heights soil landscape unit covers gently undulating crests, ridges and plateau surfaces, with slopes less than 10% and local relief is 10-50 metres. It occurs on the Mittagong Formation geological unit consisting of shale, laminite and quartz sandstone. The dominant soils are moderately deep Kurosols on ridges and plateaus. Chromosols are also present on crests, Kandosols on shoulders of plateaus and ridges. Tenosols occur in valley flats. Limitations to this soil landscape unit are stoniness, low soil fertility and localised surface movement potential.

This soil landscape unit is predominately suited to grazing enterprises.

2.5.5 Luddenham

The Luddenham soil landscape unit covers undulating to rolling low hills, with slopes 5-20% and local relief is 50-80 metres. The dominant soils are shallow Kurosols and massive Dermosols on crests; moderately deep Kurosols on upper slopes; and moderately deep Chromosols and Dermosols on lower slopes. Limitations to this soil landscape unit are erosion hazard, mass movement and moderate surface swelling potential. This soil landscape unit is suited to grazing enterprises.

2.5.6 Volcanic

The Volcanic soil landscape unit covers gently inclined valley floors surrounded by steep sideslopes, with slopes ranging from 5-60% and local relief up to 80 metres. It occurs on Jurassic volcanic breccia. The dominant soils are deep Ferrosols. Limitations to this soil landscape unit are localised erosion hazard, including mass movement on steep slopes. This soil landscape unit is predominately suited to grazing enterprises on localised areas on valley floors.

2.5.7 Disturbed Terrain

Disturbed terrain has been highly modified by human activity to a depth of at least 100 centimetres. The original soil has often been removed, greatly disturbed or buried. This soil landscape unit is not suitable for agricultural production in its current guise.

2.5.8 Soil Landscape Agricultural Limitations

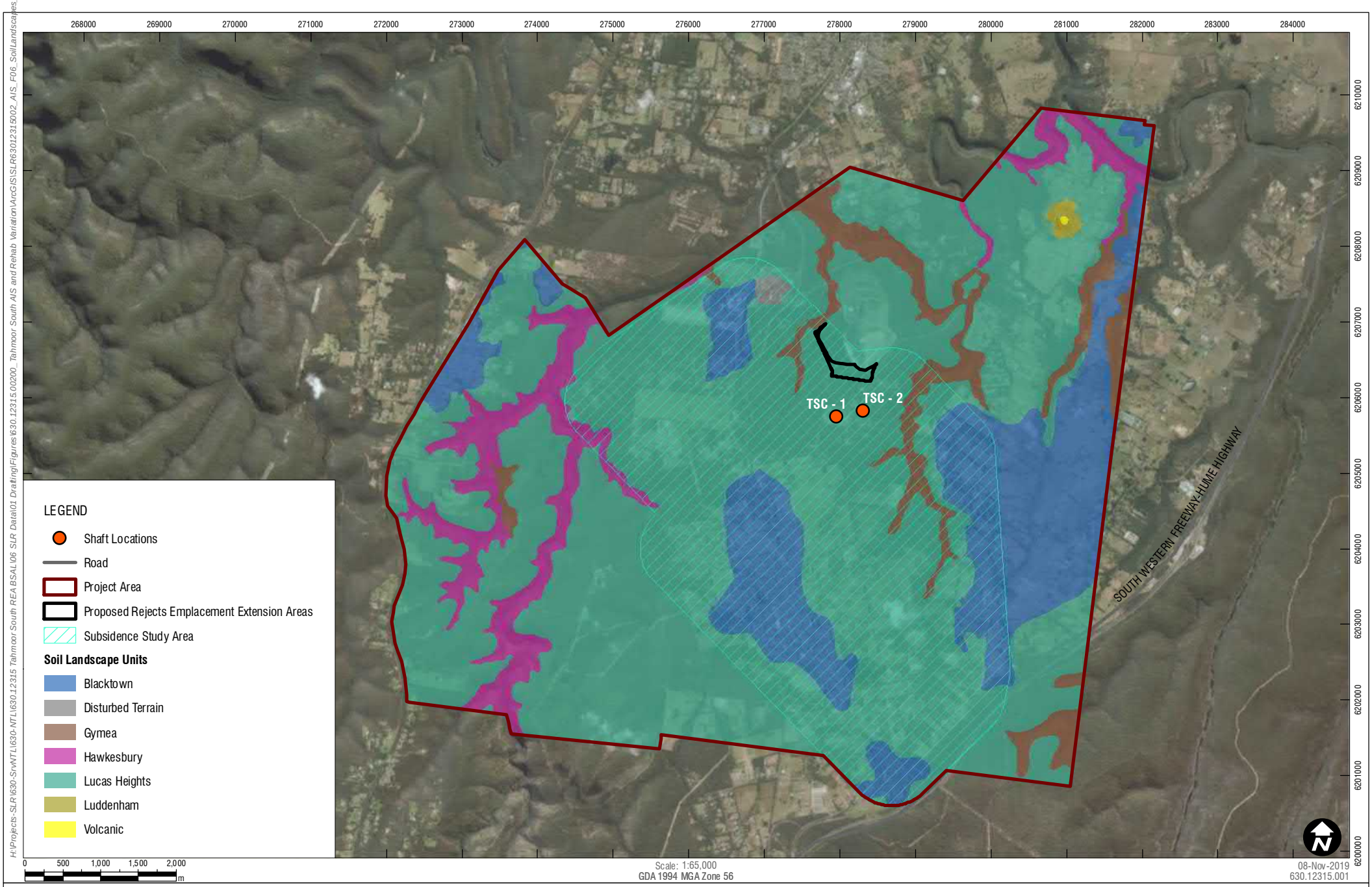
As listed in **Table 5** seven soil landscapes occur in the Project Area. Major points regarding the dominant soil landscape units are shown below:

- The majority of the Project Area (82%) and DAA (77%) is highly to severely constrained for cultivation (cropping) enterprises.
- Land that is highly to severely constrained for any agricultural enterprises includes the Gymea and Hawkesbury soil landscape units, which cover 13% and 4% of the Project Area and DAA respectively.
- Agricultural land best suited to grazing enterprises includes the Blacktown, Luddenham and Volcanic soil landscape units, which cover 18% and 23% of the Project Area and DAA respectively.
- Lucas Heights soil landscape unit has moderate limitations for grazing and high limitations for cultivation and covers 69% and 73% of the Project Area and DAA respectively.

Table 5 Soil Landscape Units

Soil Landscape	Project Area		DAA		Agricultural Limitation Rating	
Unit	**Hectare**	**%**	**Hectares**	**%**	**Grazing**	**Cultivation**
Disturbed Terrain	14	<1	14	<1	Severe	Severe
Gymea	359	6	81	3	High – Severe	High – Severe
Hawkesbury	447	7	19	1	High – Severe	High – Severe
Subtotal	**820**	**13**	**114**	**4**		
Lucas Heights	4,510	69	1,908	73	Moderate	High
Subtotal	**4,510**	**69**	**1,908**	**73**		
Blacktown	1,151	18	602	23	Low	Moderate
Luddenham	16	<1	Nil	0	Low	Moderate
Volcanic	1	<1	Nil	0	Low	Moderate
Subtotal	**1,168**	**18**	**602**	**23**		
Total	**6,498**	**100**	**2,624**	**100**		

Source: *Soil Landscapes of the Wollongong – Port Hacking 1:100,000 Sheet* (Hazelton & Tille, 1990)



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Soil Landscape Units

FIGURE 6

2.6 Dominant Soil Types and Inherent Fertility

The five dominant Australia Soil Classification (ASC) soil types were digitally mapped by the Office of Environment & Heritage and are shown on **Figure 7**. Five soil types are present in the Project Area: Dermosols, Ferrosols, Kurosols, Rudosols and Tenosols. These are summarised in **Table 6** and the major points listed below.

- Kurosols are the major soil type within the Project Area and the DAA. Kurosols are soils with a strong texture contrast between the A horizons and a strongly acidic B horizon. Kurosols generally have moderately low inherent fertility.

- Tenosols are soils with weak pedologic organisation apart from the A horizons. Tenosols comprise three major soil horizons and the profile is characterised by a sandy to sandy loam texture throughout. Tenosols generally have moderately low inherent fertility.

- Rudosols are soils with negligible pedologic organisation. They are generally young soils which have not had time form structurally. Rudosols generally have moderately low inherent fertility.

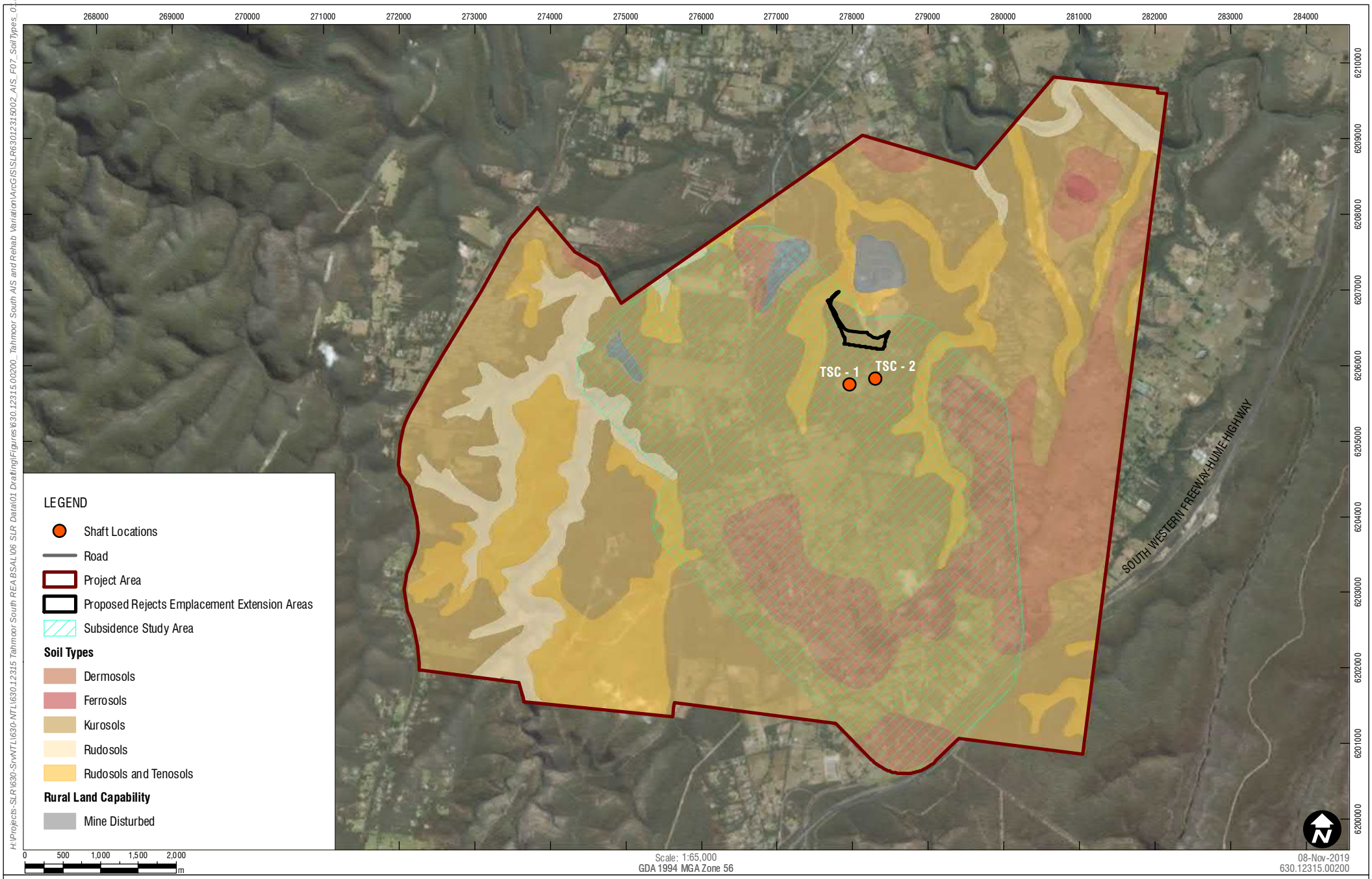
- Ferrosols are soils which are derived from volcanics, are high in free iron oxide and which lack strong texture contrast between the A and B horizons. Ferrosols have moderately high inherent fertility.

- Dermosols are soils with structured B horizons which lack strong texture contrast between the A and B horizons. Dermosols generally have moderately high inherent fertility.

Table 6 Dominant Soil Types and Inherent Fertility

ASC	Project Area		DAA		Inherent Fertility
Soil Type	**Hectares**	**%**	**Hectares**	**%**	**Rating**
Kurosol	3,629	56	1,688	64	Moderately Low
Tenosol & Rudosol	1,031	16	200	8	
Rudosol	509	8	37	1	
Subtotal	**5,169**	**80**	**1,914**	**73**	
Ferrosol	11	<1	Nil	Nil	Moderately High
Dermosol	1,233	19	680	26	
Subtotal	**1,244**	**19**	**680**	**26**	
Disturbed Terrain	85	1	39	1	Nil
Total	**6,498**	**100**	**2,624**	**100**	

In summary, the majority of the Project Area and DAA (80% and 73% respectively) are comprised of soils with moderately low Inherent Fertility. The remainder of the Project Area and DAA comprise soils of moderately high Inherent Fertility, including a small area of volcanic derived Ferrosols which comprise less than 1% of the Project Area and the DAA.



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Soil Types

FIGURE 7

2.7 Vegetation

Vegetation within the Project Area was mapped during the Native Vegetation of Southeast NSW mapping project (Tozer et al., 2006) and included the Cumberland Shale Sandstone Transition Forest which is listed as an Endangered Ecological Community (EEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act). This study also identified the Southern Highlands Shale Woodland which is listed as an EEC in the BC Act. Other vegetation communities mapped within the Project Area include:

- Coastal Sandstone Ridgetop Woodland
- Hinterland Sandstone Gully Forest
- Lower Blue Mountains Wet Forest
- Sandstone Riparian Scrub
- Sydney Hinterland Transition Woodland
- Wingecarribee-Burragorang Sandstone Forest

Within the DAA vegetation communities were mapped by Niche (2020) as part of the *Biodiversity Assessment Report* prepared for the Project, with the following communities identified:

- Shale Sandstone Transition Forest (derived grasslands, shrubland, regenerating)
- Upper Georges Sandstone Woodland (woodland and shrubland)
- Western Sandstone Gully Forest
- Exotic pasture

Within these vegetation communities five threatened flora species were recorded: *Epacris purpurascens var. purpurascens, Grevillea parviflora subsp. parviflora, Persoonia glaucescens* and *Pomaderris brunnea*. In addition, habitat for *Acacia bynoeana* and *Persoonia hirsuta* was also identified.

The following communities were identified by Niche (2020) within the surface infrastructure area to be cleared:

- Cumberland Shale Sandstone Transition Forest (HN556 Narrow-leaved Ironbark - Broad-leaved Ironbark Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin).
- Upper Georges River Sandstone Woodland (HN564 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin).

Cumberland Shale Sandstone Transition Forest corresponds to Shale Sandstone Transition Forest, which is listed as a Threatened Ecological Community (TEC) under both the BC Act and EPBC Act.

The south-eastern portion of the Project Area encompasses part of the MSA (**Figure 10**), which is an area designated by the Sydney Catchment Authority to protect Sydney's water supply. Activities within and entry to the MSA are severely restricted.

2.8 Agricultural Land Use

Based on the findings of site inspections by SLR's Associate Agronomist, within the DAA there is approximately 677 hectares (26%) available for potential agricultural production in its current state, as shown in **Figure 8**. Site inspections in June 2013 and December 2017 by SLR showed several differing agricultural land uses within the DAA. The various land uses at each site were recorded and are shown on **Figure 9** and described in **Table 7.**

Changes in observed land use between the 2013 and 2017 site inspections are highlighted in red. The changes in land use over the four years indicate a shift away from agricultural land uses and an increase in rural residential areas.

Table 7 Observed Land Uses

Site	Land Use	Site	Land Use
1	Cattle grazing	35	Pleasure horses
2	Irrigated olives	36	Hydroponic lettuce
3	Alpacas 2013, rural residential 2017	37	Standard bred (pacing) horses
4	Cattle and horse grazing	38	Pleasure horses
5	Market garden	39	Pleasure horses
6	Boarding kennels	40	Tomato greenhouses & irrigated vegetables
7	Inghams poultry sheds & cattle grazing	41	Horse pre-training complex
8	Pleasure horses	42	Pleasure horses
9	Sheep grazing	43	Pleasure horses
10	Rural residential	44	Bargo waste facility
11	Standard bred (pacing) horses	45	Cattle grazing 2013, rural residential 2017
12	Cattle grazing	46	Pleasure horses
13	Markey garden	47	Pleasure horses
14	Market garden & Fresian horse stud	48	Cattle grazing 2013, rural residential 2017
15	Oat crop	49	Pleasure horses
16	Hard rock quarry	50	Cattle grazing
17	Cattle grazing	51	Disused cattle feedlot
18	Cordina poultry sheds	52	Pleasure horses
19	Draught horses	53	Rural residential
20	Cattle grazing	54	Hydroponic lettuce
21	Disused poultry sheds	55	Poultry sheds
22	Pleasure horses	56	Disused cut flower greenhouses
23	Sheep grazing	57	Inghams poultry sheds
24	Sheep grazing	58	Olives & sheep grazing
25	Pleasure horses	59	Irrigated olives & alpaca stud
26	Pleasure horses	60	Rural residential
27	Pleasure horses	61	Pleasure horses
28	Pleasure horses	62	Inghams poultry sheds
29	Standard bred (pacing) horses	63	Disused cut flower greenhouses

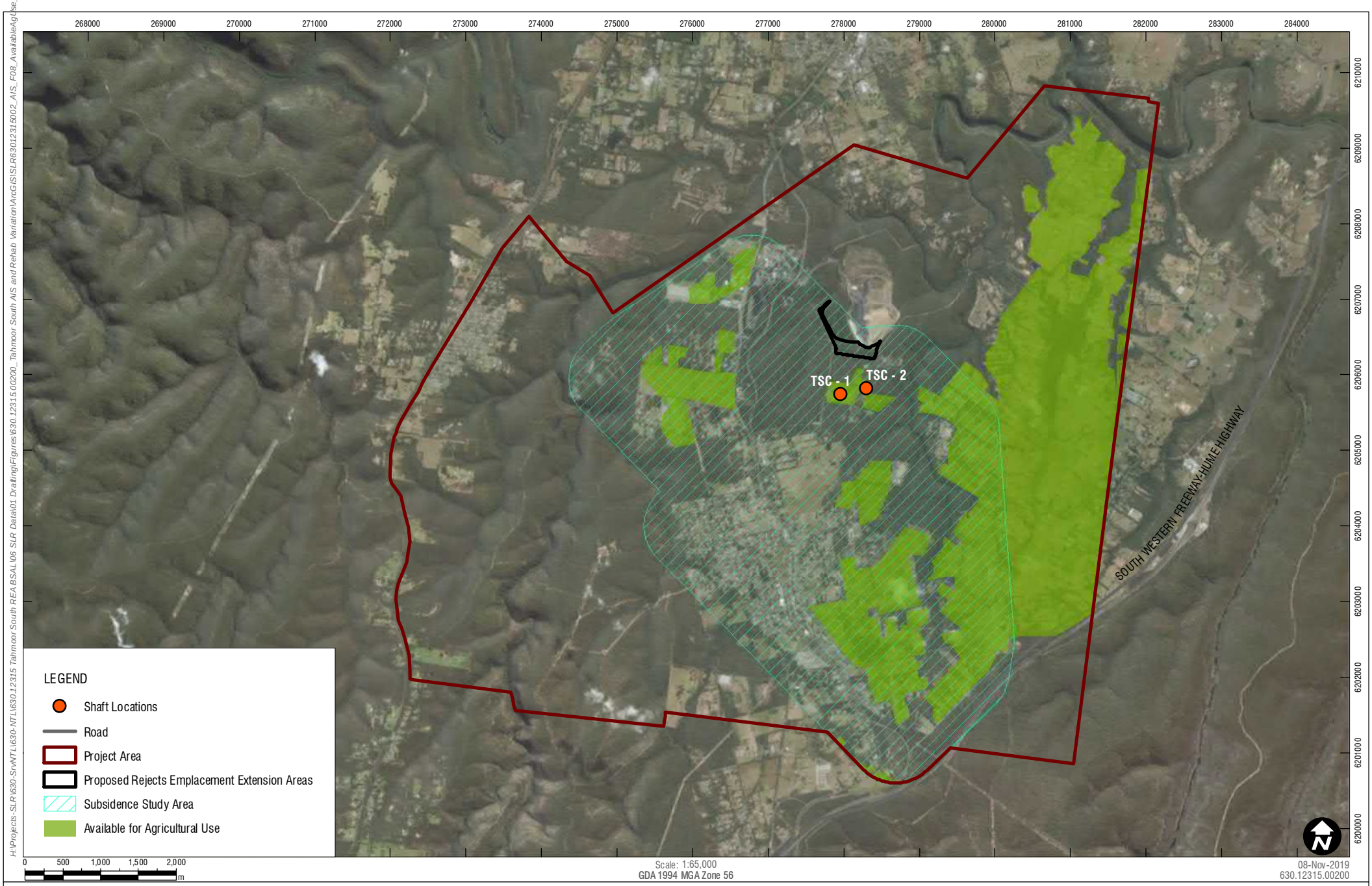
Site	Land Use	Site	Land Use
30	Pleasure horses	64	Boarding kennels
31	Rural residential	65	Critter Bits rural produce store
32	Rural residential	66	Greenhouses & market garden
33	Cattle grazing 2013, rural residential 2017	67	Poultry sheds
34	Horse pre-training complex		

Discussion with the owner of “Critter Bits” rural produce store revealed the majority of the holdings in the area are less than 16 hectares, many with absentee “weekend” owners, grazing is mostly used as a land management tool on these blocks rather than as a generator of agricultural income, as the majority are not large enough to support a grazing enterprise.

The main income generating enterprises related to agriculture in the local area were poultry hatching and growing-out operations (Inghams and Cordina), vegetables grown in market gardens and greenhouses, pacing horse (standard bred trotters) and greyhound breeding and training facilities.

None of the proposed surface disturbance for the REA is located on land being used for agricultural production.

Plate 1 to **Plate 4** shows some of the typical agricultural production within the DAA. Plates for each inspection site are shown in **Appendix A**.



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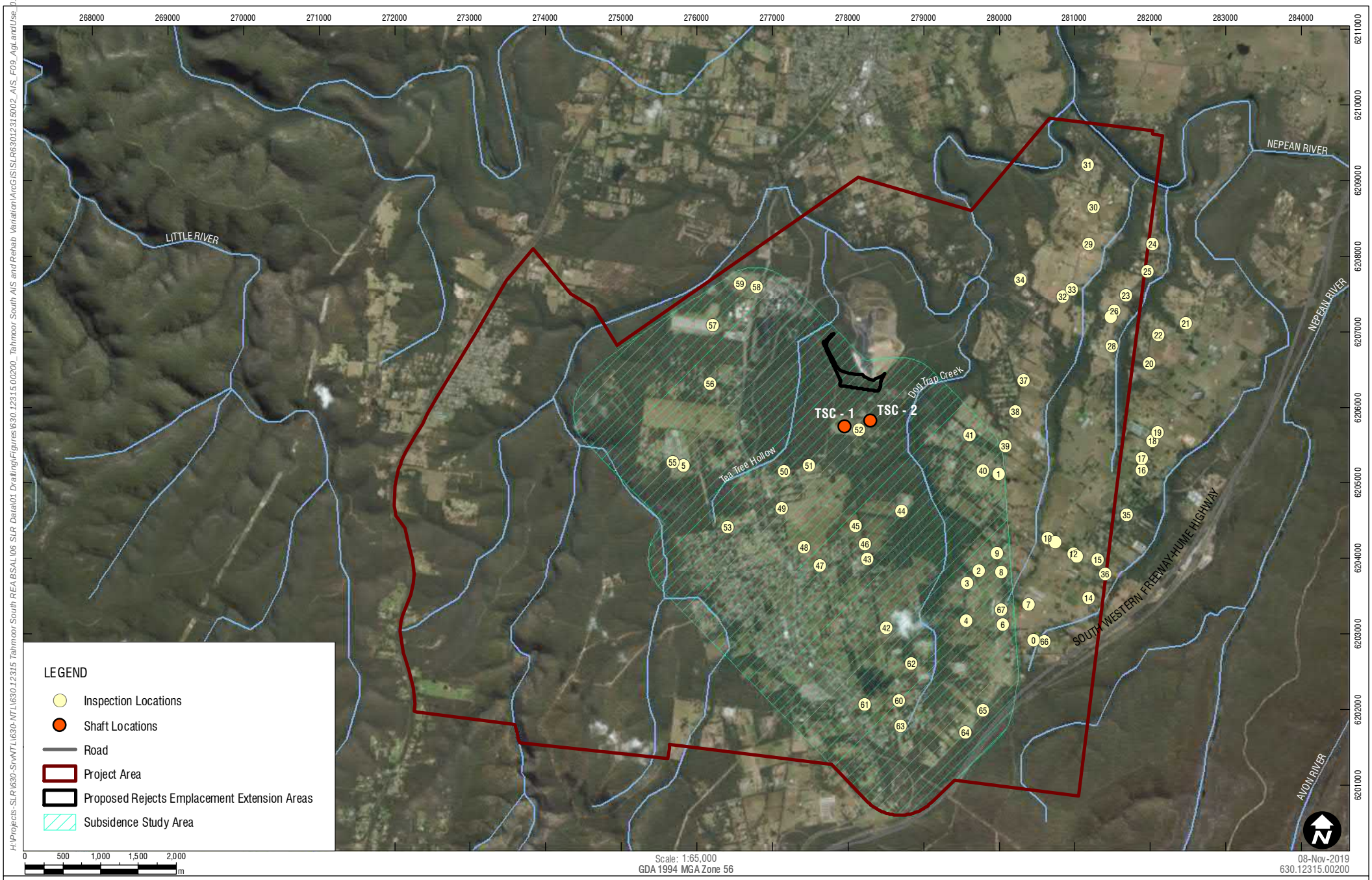
Available for Agricultural Use

FIGURE 8



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Agricultural Landuse Inspection Locations

FIGURE 9

Plate 1 – Spray irrigated olives (Site 2)

Plate 2 – Poultry production and cattle grazing (Site 7)

Plate 3 – Market garden growing irrigated pumpkins and melons (Site 13)

Plate 4 – Hydroponic farm growing lettuce (Site 54)

3 LAND AND SOIL CAPABILITY

3.1 Land and Soil Capability

The Land and Soil Capability (LSC) classification applied to the Project Area was according to the Office of Environment & Heritage (OEH) guideline *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2013a). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes (**Table 8**) which classify the land based on the severity of long-term limitations according to:

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

Table 8 Land and Soil Capability Classification

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

3.1.1 Determining LSC Classes

The LSC for the Project Area and DAA was digitally mapped by the Office of Environment & Heritage and is summarised in **Table 9** and shown in **Figure 10**. Three dominant LSC classes are present within the Project Area, Classes 4, 6 and 7, whilst there is 347 hectares of land which is not classed under the LSC system. The major assessment points are listed below.

- LSC Class 4 land covers 4,615 hectares within the Project Area and 2,254 hectares within the DAA. LSC Class 4 is rated as having moderate agricultural capability and has moderate to high limitations for high-impact land uses. It has restricted 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. This land is capable of pasture improvement and can be tilled for an occasional crop.

- LSC Class 6 land covers 1,000 hectares within the Project Area and 200 hectares within the DAA. LSC Class 6 is rated as having low agricultural capability and has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. This land should not be cultivated for cropping or for establishing pasture grasses, however the land can be used for grazing if careful management and stocking practices are implemented.

- LSC Class 7 land covers 509 hectares within the Project Area and 37 hectares within the DAA. LSC Class 7 is rated as having very low agricultural capability and has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation and is not suitable for cropping and is best left protected by green timber

Within the Project Area there are 374 hectares of land which are not classed for agricultural use. This comprises 271 hectares of MSA restricted land, which is part of the catchment for Nepean and Avon Dams, which are in turn part of the Sydney Water Supply, and 103 hectares of mine disturbed terrain. This non-agricultural classed area comprises 133 hectares (5%) of the DAA.

Table 9 Land & Soil Capability Classes

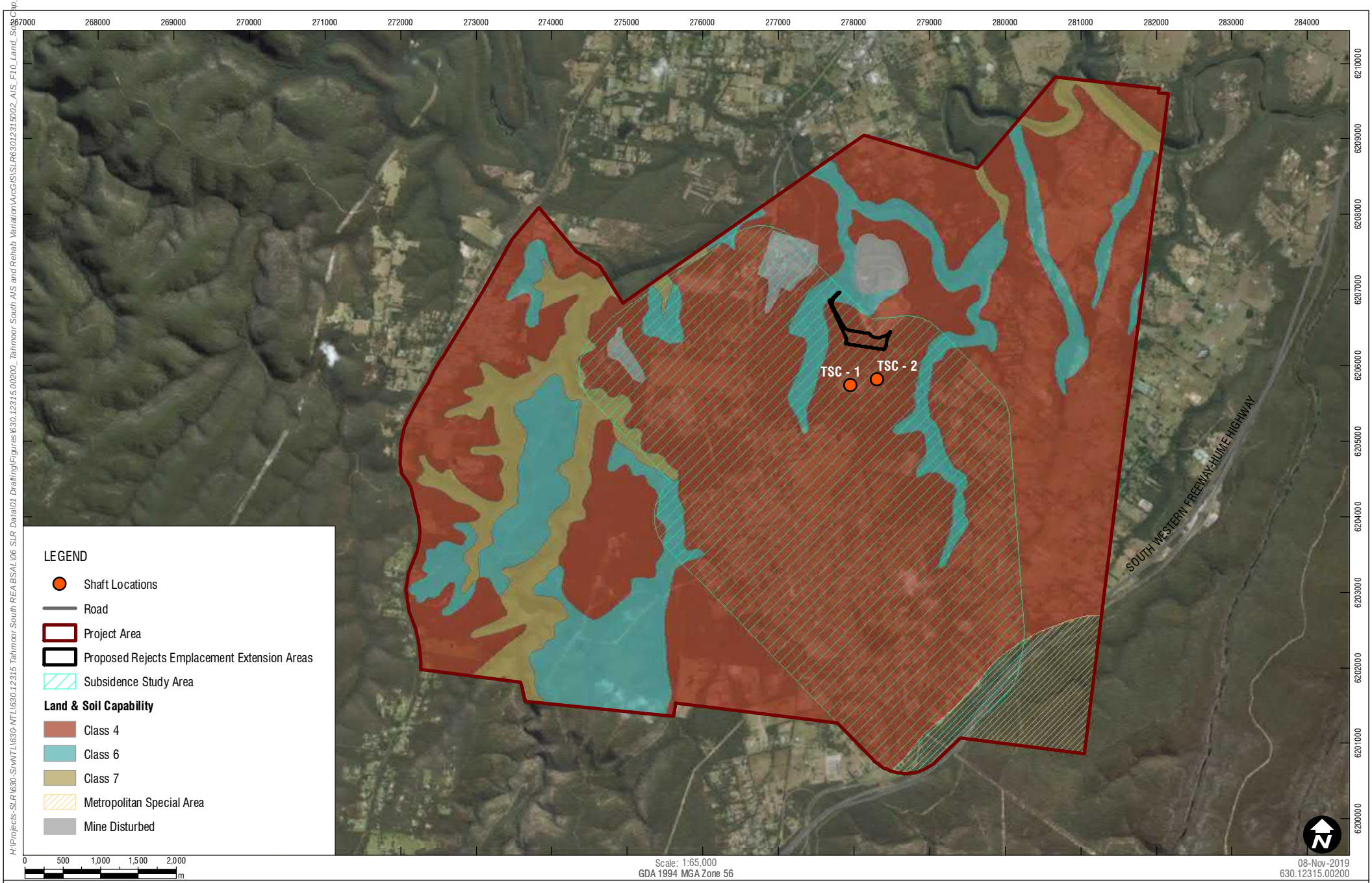
Land & Soil Capability	Project Area		DAA		Agricultural Capability
Class	**Hectares**	**%**	**Hectares**	**%**	
4	4,615	71	2,254	86	Moderate capability land
6	1,000	15	200	8	Low capability land
7	509	8	37	1	Very low capability land
Metropolitan Special Area	271	4	78	3	No classification for agricultural use
Mine Disturbed	103	2	55	2	
Total	**6,498**	**100**	**2,624**	**100**	

The proposed REA extension is located on approximately 11 hectares of LSC Class 4 land. This land is currently native bushland and not used for agricultural production.

3.2 Biophysical Strategic Agricultural Land Assessment

The nearest mapped Biophysical Strategic Agricultural Land (BSAL) according to the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 – Strategic Agricultural Land Map – Sheet STA_41* (DP&I, 2013) is between Douglas Park and Camden, approximately 20 kilometres to the north-east of the Project Area.

In addition to this mapping, the *Tahmoor South Biophysical Strategic Agricultural Land Assessment* (SLR, 2018) found there is no BSAL within the Project Area according to the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2013b). DPE issued a Site Verification Certificate (SVC) for the Project on 5th February 2018, and a subsequent SVC for the revised proposed ventilation shaft sites on 23rd October 2018.



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Land & Soil Capability

FIGURE 10

4 LOCAL AND REGIONAL AGRICULTURAL ENTERPRISES

The Project Area is located within the Wollondilly and Wingecarribee LGAs, shown in **Figure 3**. However, none of the DAA is located within the Wingecarribee LGA, and therefore the 'local' and 'regional' areas will consider the Wollondilly LGA only when determining any potential impacts.

4.1 Agricultural History

Agriculture within the Wollondilly LGA is based on a foundation of market gardens, orchards, dairy and poultry. Early European settlement saw the establishment of small villages including Picton, Menangle, Thirlmere, Tahmoor, Bargo, and Appin.

Picton is one of the earliest European settlements in the area. Agriculture dates back to when a number of cattle went missing in the early days of the colony and were later found in 1795 by a convict near the Nepean River. This area became known as Cowpastures and then Stonequarry until gaining its current name in 1841. The name Picton is believed to have been chosen to honour Sir Thomas Picton, an old soldier friend of Governor Brisbane.

In the 1860's the railway system came to Picton and created a building explosion. The area was proclaimed a municipality in 1895, and in 1939 Wollondilly Shire Council and Picton Municipality amalgamated to create today's LGA (Wollondilly Shire Council, 2017).

Poultry farming was established in in the Wollondilly region during the 1930's. Many Estonian families fled political upheaval in their homeland between 1924 and 1939. Australia offered cheap land and a new life, with many of these people settling at Thirlmere and established poultry farms.

In the late 1940's many Estonians who were caught in European Displaced Persons camps after World War II also chose to come to Australia, and were sponsored and supported by the Thirlmere community. They built on their national connections and helped each other to start poultry farming. By the 1960's there were over 60 families from Estonia involved in poultry farming in Thirlmere. Most farms comprised of 2,000 to 4,000 hens.

Estonians pioneered the Cooperative movement in 1912. The Thirlmere Estonians started "KUNGLA", the Thirlmere farmers' Cooperative in 1939 and was continued by the new settlers after the war. This considerably increased the viability and efficiency of the poultry industry until Thirlmere became the largest producer of eggs in Australia by the 1960's (Migration Heritage Centre, 2017).

Today, Wollondilly LGA is predominantly rural area with several national parks, whilst there are urban areas in 15 towns and villages. Two-thirds of the population live in the urban centres, and one-third in the rural areas. There are five large towns, the largest of which is Tahmoor, whilst Picton is the administrative centre. The LGA encompasses a land area of nearly 260,000 hectares, of which approximately 90% is national park, bushland, water catchment or rural land, including gorges, ranges and plains. Most of the rural land is used for agricultural purposes, including market gardens, orchards, dairy farms, poultry farms and grazing (profile.id, 2017).

4.2 Agricultural Enterprises and Associated Industries

4.2.1 Land Use

Agriculture is a minor land use for the regional area (Wollondilly LGA), accounting for 11% of land use. (Australian Bureau of Statistics (ABS), 2011*). The agricultural land use is displayed in **Table 10**. It details the area of land used for agriculture in the region and the specific uses of the land. The major points are summarised below.

- Agricultural land is almost exclusively used for grazing, utilising 98% of all agricultural land. The primary enterprise is meat cattle farming, which accounts for 60% of livestock numbers, followed by milk cattle (25%) and sheep farming (15%).

- Cropping enterprises comprise a minor portion of agricultural activities. The primary crops grown are vegetables for human consumption along with fruit and nuts. No cereals for grain are grown in the region.

- Minor irrigation cropping is carried out, comprising only 7% of the agricultural land in the region. Agriculture accounts for 5,513 megalitres of volume to irrigate approximately 2,000 ha of agricultural area, while 981 megalitres is utilised for other agricultural uses, such as poultry production and hydroponic vegetables.

- Poultry comprise a large portion of livestock numbers within the Wollondilly LGA, with 2.3 million birds recorded at the last census of these 2.1 million were being raised for poultry meat production. The region also produced 2.4 million dozen eggs.

Table 10 Wollondilly LGA Agricultural Land Use

Agricultural Land Area	**Units**	**Total**
Total land area within LGA	Hectare	255,593
Area of National Parks, nature reserves & other protected lands	Hectare	160,555
Area of agricultural land	Hectare	28,058
Proportion of agricultural land	**%**	**11**
Agricultural Enterprise		
Land under cropping activities	Hectare	598
Land under grazing activities	Hectare	27,460
Proportion of agricultural land used for grazing	**%**	**98**
Grazing Enterprises	**Total**	**%**
Sheep and lambs	2,315	15
Meat cattle	9,553	60
Dairy cattle (excluding house cows)	3,943	25
Pigs	55	<1
Total	**15,866**	**100**
Cropping Enterprises		
Cereals for grain	Hectare	Nil
Vegetables for human consumption	Hectare	461

Agricultural Land Area	Units	Total
All fruit and nuts	Hectare	142
Total land cropped	Hectare	**603**
Irrigation		
Area irrigated	Hectare	2,000
Irrigation volume applied	Megalitre	5,513
Other agricultural uses	Megalitre	981
Total water use	Megalitre	6,494
Proportion of agricultural land irrigated	**%**	**7**

Source: *ABS* (2011*) 2011* is the latest agricultural data available from ABS

4.2.2 Employment

A summary of the total regional employment and the proportion of agriculture related employment is shown in **Table 11.** The regional employment in the agriculture related sectors is shown in **Table 12** (ABS, 2011). The major points are summarised below.

- Agriculture is not a major employer within the region; the total of 1,911 persons employed in the direct and indirect agricultural sectors is only 10% of the total employed population.
- Agriculture-related wholesaling and retailing is responsible for 48% of agricultural employment, followed by processing and manufacturing (26%), and agricultural production (26%).
- The major agricultural production employers are beef cattle farming, poultry farming and vegetable growing, which account for 13% employment in agriculture. Horse farming, dairying and floriculture and nursery production comprise another 6% of employment in agriculture. All other sectors are minor agricultural employers in the region.
- The main agriculture-related processing and manufacturing is poultry processing, comprising 12% of agricultural related employment.
- Supermarkets and grocery stores account for the vast majority of agricultural related wholesaling and retailing employment, comprising 27% of the agricultural related employment.

Detailed agricultural employment figures are not available for the Project Area; however the main agricultural activities generating income within the Project Area observed during the site inspection were poultry and vegetable production, along with greyhound and horse (standard bred) breeding and training.

Table 11 Wollondilly LGA Employment Related to Agriculture

Employment Sector	No. of persons	%
Total Regional Employment	**19,417**	**100**
Direct Regional Agricultural Employment	497	3
Indirect Regional Agricultural Employment	1,414	7
Total Regional Employment Related to Agriculture	**1,911**	**10**

Source: *ABS* (2011*)

Table 12 Wollondilly LGA Agricultural Related Employment by Sector

Agriculture Related Sectors	Number of People	%
Agricultural Production		
Beef Cattle Farming (Specialised)	103	5
Poultry Farming	84	4
Horse Farming	41	2
Dairy Cattle Farming	47	2
Other Livestock Farming and Beekeeping	24	1
Vegetable Growing (Outdoors)	80	4
Floriculture and Nursery Production	44	2
Turf Growing	12	1
Other Crop Growing (Grains, fruit and tree nuts, mushrooms etc.)	33	2
Agriculture (Not further defined)	29	2
Subtotal	**497**	**26**
Agriculture Related Processing and Manufacturing	**Number of People**	**%**
Poultry Processing	229	12
Cereal, Pasta and Baking Mix Manufacturing	56	3
Factory Based Manufacturing Bread, Biscuit, Cake, Pastry	50	3
Meat Processing and Manufacturing (Inc. Cured Meat & Smallgoods)	26	1
Log Sawmilling, Timber Re-sawing and Dressing	25	1
Cheese, Ice-cream, Milk and Other Dairy Product Manufacturing	25	1
Fruit and Vegetable Processing	20	1
Bakery Product Manufacturing (Non-factory based)	17	1
Potato, Corn and Other Crisp Manufacturing	11	1
Food Product Manufacturing (Not further defined)	46	2
Subtotal	**505**	**26**
Agricultural Related Wholesaling and Retailing	**Number of People**	**%**
Supermarket and Grocery Stores	509	27
Fresh Meat, Fish, Poultry, Smallgoods Retailing and Wholesaling	76	4
Fruit and Vegetable Retailing and Wholesaling	63	3
Grocery Wholesaling	66	3
Liquor and Tobacco Product Retailing and Wholesaling	47	2
Food Retailing (Not further defined)	25	1
Timber Wholesaling	20	1
Flower Retailing	14	1
Other Agricultural Product Wholesaling	89	4
Sub total	**909**	**48**
Total Agricultural Related Employment	**1,911**	**100**

Source: *ABS* (2011*)

4.3 Agricultural Production Value – Regional

Agricultural production values for the Wollondilly LGA totals $61.3 M, detailed in **Table 13** The main agricultural production by value is from poultry production, both for meat and eggs (livestock slaughtering and livestock products), and vegetables for human consumption (crops) accounting for almost 90% of the value of agricultural commodities produced (ABS, 2011*).

Table 13 Regional Agricultural Production

Agricultural Production Gross Value	Value (M)	%
Crops	$21.7	35
Livestock slaughtering	$33.0	54
Livestock products	$6.6	11
Total gross agricultural production	**$61.3**	**100**

Source: *ABS* (2011*)

4.4 Potential Agricultural Production Value of the Project Area

Potential agricultural productivity was determined using the NSW Department of Primary Industry agricultural productivity data for agricultural enterprises suitable for each of the Land and Soil Capability classes that will be impacted. This analysis has been undertaken on the total potential capability of the land rather than current land use, as much of the area assessed it not suitable for agriculture in its current form due to native vegetation and other factors. This information can be used to generate potential farm incomes. The *Beef Cattle Gross Margin Budget Inland Store Weaners* (DPI, 2017) has been applied to this assessment. Agricultural Productivity Gross Margin Sensitivity Analysis information is contained in **Appendix B**.

Table 14 summarises the potential gross margin for each Land and Soil Capability Class. Carrying capacity was determined using the NSW DPI *Beef Stocking Rates & Farm Size* (DPI, 2006) which gives potential stocking rates using Dry Sheep Equivalents (DSE). The Wollondilly LGA is in the 800 millimetre per annum rainfall zone and DSE for each LSC Class were calculated accordingly. The major points are listed below.

- LSC Class 4 land has the potential to generate $296 per hectare from beef cattle grazing.
- LSC Class 6 land has the potential to generate $148 per hectare from beef cattle grazing.
- LSC Class 7 land has the potential to generate $74 per hectare from beef cattle grazing.

Table 14 Gross Margin per LSC Class

LSC	Stocking Rate	Cow Calf Unit	Revenue	Variable Costs	Gross Margin
Class	**DSE**	**Per Hectare**	**Per Hectare**	**Per Hectare**	**Per Hectare**
4	8	0.47	$376	$80	$296
6	4	0.24	$188	$40	$148
7	2	0.12	$94	$20	$74
Non-Agricultural	Nil	Nil	Nil	Nil	Nil

Based on the nominated gross margins, the Project Area has the capacity to generate an estimated gross margin of $1,551,706 per annum and the DAA $699,522 (**Table 15**). It is important to note that these figures are derived from the optimum potential uses and are likely to be much higher than the actual incomes being achieved at the time of publication, and to achieve these outcomes would require significant investment in livestock, pasture, fertiliser and agricultural infrastructure.

As discussed in **Section 2.8**, there is 677 hectares of land available for agricultural production within the DAA in its current guise. Using a conservative assessment and assuming this total area is LSC Class 4 land this area has the potential to generate a gross margin of $200,392 per annum from beef cattle production.

Table 15 Potential Annual Gross Margins (Pre-Mining)

LSC	Gross Margin	Project Area		DAA	
Class	**Per Hectare**	**Hectares**	**Gross Margin**	**Hectares**	**Gross Margin**
4	$296	4,615	$1,366,040	2,254	$667,184
6	$148	1,000	$148,000	200	$29,600
7	$74	509	$37,666	37	$2,738
Non-Agricultural	Nil	374	Nil	133	Nil
	Total	**6,498**	**$1,551,706**	**2,624**	**$699,522**

4.5 Agricultural Support Infrastructure

Agricultural support infrastructure within the Wollondilly LGA includes the Hume Highway as the major arterial road, and rail infrastructure providing transport from agricultural areas in the west, south and north of the state.

The main purpose-built agricultural support infrastructure within the Project Area is a number of large poultry sheds which are used for breeding and raising meat chickens.

There are two abattoirs located in Tahmoor. Poultry processing is carried out at the Inghams processing facility whilst the Wollondilly Co-op abattoir processes pigs. The closest livestock selling centre is located at Moss Vale, approximately 45 kilometres south-west of the Project Area.

There are a number of small retail agricultural suppliers that service the numerous small hobby farms in the region. Other purpose built agricultural infrastructure is generally for intensive agricultural enterprises and includes greenhouses and hothouses for cut flower and vegetable production, poultry laying sheds, farm dams and groundwater extraction bores.

5 ASSESSMENT OF POTENTIAL IMPACTS

As outlined in **Section 1.3**, land to be disturbed by the proposed Project is termed the DAA and includes three areas:

- The SSA: potential surface subsidence, covering an area of 2,624 hectares. Disturbance across the entire SAA will not occur as a result of the Project.
- The Ventilation Shaft Area: the proposed new surface infrastructure covering a maximum total area of approximately 6 hectares which is entirely contained within the SSA.
- Expansion of the REA, which will involve disturbance of approximately 11 hectares. The REA expansion is wholly contained within the SSA.

The total DAA assessed is approximately 2,624 hectares, which includes approximately 17 hectares of surface disturbance located entirely within the SSA.

5.1 Land Temporarily Removed from Agriculture

5.1.1 Surface Disturbance: Social and Economic Impact

The proposed Tahmoor South surface infrastructure will temporarily remove 6 hectares of LSC Class 4 land from potential agricultural production during the life of the Project (**Table 16**). The area where TSC1 is located is currently used to graze pleasure horses, while TSC2 is located in Crown Reserve which comprises native bushland.

These areas associated with the surface facilities will be rehabilitated to conditions that are generally consistent with pre-mining conditions in accordance with the *Conceptual Mine Closure Plan* (SLR, 2020).

Table 16 Temporary Surface Disturbance

LSC	Surface Disturbance		Gross Margin	
Class	Hectares	% of DAA	Per Hectare	Total
4	6	<1	$296	$1,776

Using potential agricultural productivity information described in **Section 4.4**, the estimated net annual economic impact on potential agricultural productivity as a result of the temporary loss of land is $1,776 per annum. The flow-on effects to agricultural employment and local business are considered to be negligible as the area of land to be disturbed and associated potential agricultural productivity are very low.

It should be noted that none of the land to be temporarily disturbed by the proposed surface infrastructure has been utilised for agricultural production, either at present or in the past. This land is classed as mine disturbed or comprises shallow soils with low inherent fertility.

There is no change in LSC predicted as a result of subsidence resulting from the Project (MSEC, 2020).

5.1.2 Underground Disturbance: Social and Economic Impact

The *Subsidence Predictions and Impact Assessment* (MSEC, 2020) and site inspections by SLR's Associate Agronomist during 2013, 2017 and 2018 identified a number of potential impacts upon agricultural resources and infrastructure as a result of subsidence:

Rural Structures
Rural structures in existing sound condition within the DAA are expected to remain safe and serviceable during the longwall extraction. The risk of impact is greater for rural structures in existing poor condition, although the risk to public safety remains low, as observed with similar rural structures in poor condition which have not experienced impacts during previous underground mining. Any impacts are expected to be readily remediated.

Only minor impacts to rural structures are expected which can be easily repaired using well established remedial techniques.

Water Tanks
The majority of water tanks are constructed above ground level and are unlikely to experience the curvatures and ground strains resulting from the extraction of the proposed longwalls. However, any buried water pipelines associated with water tanks within the Project Area could be impacted by the ground strains, by the water tanks, or by other structures in the ground.

Only minor impacts to water tanks are expected such as leaking pipe joints, which can be easily repaired using well established remedial techniques. It would be unlikely there will be any adverse impacts on pipelines associated with water tanks with these remedial measures in place.

Gas and Fuel Storages
As gas and fuel storages are generally elevated above ground level they are unlikely to experience the curvatures and ground strains resulting from the extraction of the proposed longwalls. However, any buried gas pipelines associated with the gas and fuel storages within the DAA could be impacted by the curvatures and ground strains, if they are anchored by the attached storage tanks, or by other structures in the ground.

Any impacts to gas and fuel storages are expected to be of a minor nature, including minor gas leaks. It is unlikely that there would be further adverse impacts on pipelines associated with gas and fuel storage tanks, even if the actual subsidence movements exceeded predictions by a factor of two times.

Poultry Sheds
Poultry sheds identified within the DAA are lightweight structures and relatively large with lengths in the order of 80 – 110 metres. Large poultry sheds have previously been mined beneath in the Southern Coalfield. The West Cliff Project mined directly beneath 40 poultry sheds and in all cases the structures remained in safe and serviceable condition. This included four sheds which experienced large non-systematic ground movements which resulted in impacts to the walls and roofs of the sheds, but did not result in the structures becoming unsafe (MSEC, 2020).

It is expected that subsidence movement resulting from longwall extraction on poultry sheds and ancillary building structures will be of a minor nature and readily remediated if required.

Greenhouses and Hothouses

A number of greenhouses and hothouses were identified within the DAA. These structures are relatively lightweight in construction and are normally able to tolerate differential subsidence movements.

Any impacts on hydroponic systems within these greenhouses and nurseries are also expected to be minor, such as leaking pipe joint and readily remediated.

Irrigation Systems

There are a number of agricultural irrigation systems within the DAA, including irrigated olives, vegetable and hydroponic grown lettuce. These systems are generally constructed from polyethylene pipe which can tolerate ground movements much larger than the predicted mine subsidence movements.

Any impacts are only expected to be of a minor nature, such as leaking pipe joints, which can be easily repaired.

Farm Fences

Farm wire fencing can be affected by tilting of the fence posts and by changes of tension in the fence wires due to strain as mining occurs. These types of fences are generally flexible in construction and can usually tolerate tilts of up to 10 millimetres per metre and strains of up to 5 millimetres per metre without significant impacts. It is possible, that some of the wire fences within the DAA could be impacted as the result of the extraction of the proposed longwalls.

Any impacts farm fences are likely to be of a minor nature and relatively easy to remediate.

Farm Dams

Subsidence induced tilts can affect the water levels around the perimeters of farm dams, increasing freeboard on one side, and decreasing on the other. Tilt can potentially reduce the storage capacity of farm dams, by causing them to overflow or impacting the stability of dam walls.

It is unlikely that the majority (96%) of farm dams within the DAA would experience adverse impacts on the storage capacity due to small changes in freeboard of less than 500 millimetres.

Changes in freeboard of greater than 500 millimetres are predicted to occur at 12 dams within the DAA with a maximum predicted freeboard change of 630 millimetres. Some of these dams may experience reduced storage levels; however, these could be remediated by increasing the heights of the impacted dam walls.

The predicted curvatures and strains resulting from longwall extraction could be sufficient to cause cracking in the bases and walls of some farm dams within the DAA.

There is extensive experience of mining directly beneath farm dams in the Southern Coalfield, which indicates that the incidence of impacts on dams is very low. Farm dams are generally constructed with cohesive materials (clay) which can absorb conventional subsidence movements without the development of significant cracking. Non-conventional movements can result in localised cracking and deformations at the surface which could result in adverse impacts to some farm dams.

During the previous extraction of Longwalls 22 – 31; 103 farm dams experienced subsidence movements. While a small number of landowners have advised of impacts, there has been only one claim to the Subsidence Advisory NSW (formerly the Mine Subsidence Board) for impacts on farm dams at the time of this report.

It expected that the rates of impact on the farm dams will be very low and could be managed with the implementation of suitable management strategies.

Groundwater Wells and Bores

There are 791 registered privately-owned groundwater bores identified within, and surrounding the DAA, the majority of which access the Hawkesbury Sandstone (shallow) aquifers, which are predicted to undergo some changes in standing water levels and volumes as a result of the Project (see **Section 5.2.2**). All bores predicted to undergo change are shown on **Figure 5**.

Such impacts will be managed through mitigation measures, as summarised in **Section 6**. There are no agricultural enterprises identified within the DAA which will be impacted by subsidence associated with the Project which cannot be mitigated.

5.1.3 Land Permanently Removed from Agriculture

There is no land within the DAA currently used for agricultural enterprises which will permanently be removed from production. However, there is approximately 11 hectares within the DAA, comprising the final rehabilitated REA footprint, which will be permanently removed from potential agricultural production at completion of the Project. This area is mapped by OEH as LSC Class 4 land (**Table 17**).

Table 17 Land Permanently Removed from Potential Agricultural Production

Land & Soil Capability	Area Permanently Impacted		Potential Gross Margin	
Pre-REA	**Hectares**	**% of DAA**	**Per Hectare**	**Total**
4	11	<1	$296	**$3,256**
6	<1	<1	$0	**$0**
Rehabilitated REA	**Hectares**	**% of DAA**	**Per Hectare**	**Total**
7	11	<1	$74	**$814**

This REA footprint is proposed to be rehabilitated to LSC Class 7. Using the gross margin data from **Table 15** this rehabilitated area would have a potential gross margin of $814 per annum.

As advised previously, the surface infrastructure areas will be decommissioned following the cessation of mining and with a preliminary final land use of returning the land to native bushland (SLR, 2020).

Total calculated loss as a result of land permanently removed from potential agricultural production, changing from Pre-REA Class 6, to rehabilitated REA Class 7 (**Table 17**) is $2,442 per annum calculated over 11 hectares. When compared to the gross annual value of agricultural production for the Wollondilly LGA ($61.3 million) this amount would be considered a negligible impact on agricultural enterprises, agricultural employment and related industries. It should be noted this was undertaken as a precautionary assessment as none of 11 hectares has been used for agricultural production currently or in the past.

There is no land predicted to be permanently removed from agricultural production as a result of subsidence (MSEC, 2020).

5.2 Water Resources

5.2.1 Surface Water

The *Surface Water Impact Assessment* (2020) for the Tahmoor South Project has been prepared by Hydro Engineering & Consulting Pty Ltd. The potential impact of the Project on surface water, and subsequently agriculture, is summarised below. The Project has the potential to impact surface water features, described in **Section 3.3.1**, in three aspects:

- flow rate and/or quantity of water flow;
- physical stability of the watercourses; and
- water quality.

Water Flow

The proposed expansion of the REA will remove approximately 69 hectares of water catchment area, which represents approximately 0.5% of the catchment area of the Bargo River at its confluence with the Nepean River. Drainage from the REA is collected in a series of perimeter drains and sediment dams. Water in these areas is diverted to the pit top area for reuse in the pit top recycled water supply. Recycled water is also sourced from runoff from the pit top catchments (including the REA) and water recovered from the underground mining operations.

Recycled water is returned for reuse underground. Water recovered from mining operations in excess of the recycling plant capacity is diverted for treatment in a waste water treatment plant before being discharged to Tea Tree Hollow via Licensed Discharge Point 1 (LDP1).

The net reduction in dry weather flow in Tea Tree Hollow is equal to the decrease in mine water make. The minimum groundwater recovery rate (during the Project) is about 3.3 megalitres per day however this is predicted to occur for the first half of 2024 only. The average predicted groundwater recovery rate for the Project period is about 4.9 megalitres per day (Hydro-Simulations, 2020). Allowing for an ongoing 1 megalitre per day treatment and recycling that would imply a transient reduction in flows in Tea Tree Hollow below LDP1 averaging 0.1 megalitres per day and up to 1.7 megalitres per day. This would be offset by recent revisions to the REA water management system which sees additional pumping capacity to transfer water from the REA sediment dams for treatment in the waste water treatment plant and release via LDP1 (Hydro Engineering & Consulting Pty Ltd, 2020).

There is no predicted significant surface ponding and therefore no capture of run-off due to subsidence in the Project Area. Post-subsidence topography indicates that there are no subsidence induced depressions evident within watercourses. There is no predicted impact on flows into or within local watercourses (Hydro Engineering & Consulting Pty Ltd, 2020).

Results of water balance simulation modelling (Hydro Engineering & Consulting Pty Ltd, 2020) indicate that total discharges and spill from the combined existing Tahmoor North and the Project is unlikely to increase significantly from current levels.

Combined, these predicted impacts are expected to have a negligible impact on agricultural enterprises within the Project Area and region.

Physical Stability of Watercourses

Predicted changes in water flow velocity, shape and profile of the surface water features in the Project Area are not considered likely to impact agricultural resources or enterprises. Reduced stability of the bed or banks of watercourses in the Project Area is also considered unlikely (Hydro Engineering & Consulting Pty Ltd, 2020).

Water Quality

Contamination of surface waters by gas drainage has not previously been reported as an issue at Tahmoor, most likely due to the relative absence of perennial water bodies. It is considered likely there would be enhanced strata gas emissions generated as a result of the Project and that some of these may be visible as bubbling in more persistent pools in overlying watercourses (Hydro Engineering & Consulting Pty Ltd, 2020).

Fracturing of bed rock in sections of Tea Tree Hollow and Dog Trap Creek is predicted to occur and upsidence related buckling of stream beds is predicted along some sections of these creeks. Based on past experience in the Southern Coalfields, including experience at the existing Tahmoor operation, it is expected that upsidence induced fracturing may lead to releases of aluminium, iron, manganese and zinc. It is likely these will be seen as transient spikes in the concentration of these and possibly other metals which would be relatively localised. The extent of these impacts is expected to be similar to impacts observed in similar streams in the Southern Coalfield (Hydro Engineering & Consulting Pty Ltd, 2020).

One of the effects of longwall subsidence on watercourses commonly reported is the emergence of what are referred to as ferruginous springs. These are concentrated (point) inflows which have a distinctive orange to red/brown colouration caused by enhanced groundwater inflows and oxidation of iron commonly present in shallow groundwater in the area. This is often accompanied by iron flocs, staining of the bed, increased turbidity and the build-up of iron rich slimes. Changes can also occur to the chemical composition of surface flows due to either increased or decreased groundwater fed baseflow contribution to watercourses.

Such impacts have the potential to impact Tea Tree Hollow, Dog Trap Creek and downstream watercourses. Notwithstanding, it is not anticipated that localised and transient increases in metal concentrations will affect agriculture within or downstream of the Project Area.

5.2.2 Groundwater

According to the *Tahmoor Colliery Annual Groundwater Report 2011-2012* (Geoterra, 2012), no adverse changes to groundwater quality have been observed or reported within the Project Area. This includes no distinctive changes in salinity, pH or water quality with regards to dissolved metals or nutrients.

The *Tahmoor South Project EIS Groundwater Assessment* (Hydro-Simulations, 2020) predicts drawdown of greater than two metres at groundwater bores shown in **Table 18**. During the bore census Hydro-Simulations (2020) identified 791 registered groundwater bores.

Hydro-Simulations (2020) calibrated 'base case' model simulates a total of 46 registered bores as potentially impacted by the Tahmoor South mine in excess of the 2 metre drawdown criteria of the Aquifer Interference Policy. The number of bores impacted beyond 2 metres rises to a possible 58 registered bores when modelled around predictive sensitivity. When taking into account cumulative impacts of mining at Tahmoor and the other mines within the groundwater model area, the number of impacted bores increases to 94 registered bores.

The noted drawdown impacts on the Permian fractured rock aquifer mean that the Project is classified within Level 2 of the Aquifer Interference Policy's minimal impact considerations. Tahmoor Coal have committed to "make good" provisions for any groundwater users shown to be adversely affected by mine operations and associated impacts.

Table 18 Groundwater Impact Predictions

Predicted Drawdown	Bores Numbers Exceeding Threshold		
	Calibrated 'Base Case' Model		Predictive Sensitivity Model
Metres	Tahmoor South	Cumulative Mining	Additional Bores Impacted
Greater than 2	46	228	+21
Total bores in groundwater model area 791			

The predicted total annual take of groundwater from the Permo-Triassic rock aquifer as mine inflows to the Project is 5 megalitres per day on average, peaking at an annualised rate of 7.5 – 8.0 megalitres per day, which equates to approximately 1,900 megalitres to 2,900 megalitres per annum towards to end of the Projects operational life. The groundwater entitlement volume currently held by Tahmoor Coal is 1,642 megalitres per annum, and therefore an additional 1,058 – 1,258 megalitres of licensed groundwater will be required to licence the peak predicted take of 2,700 – 2,900 megalitres per annum.

The Project will result in changes to the hydraulic properties and depressurisation of the Permian and Triassic porous and fractured rock strata will result in mixing of potentially chemically different groundwater between overlying and underlying units. However, it is considered unlikely that this will result in changes to the beneficial uses of hydrogeological units utilised for water supply Hydro-Simulations, 2020).

5.2.3 Water Reallocation

Underground water management will be undertaken as part of the Project and will consist of water transfers within the underground workings to the surface through the Tahmoor Mine bore network. Tahmoor has three groundwater licences with a total volume of 1,642 megalitres per annum, detail of which are shown in **Table 19**. Groundwater is discharged into Tea Tree Hollow via LDP 1.

Table 19 Groundwater Extraction Licences

Licence Number	Bore Name	Extraction Volume (megalitres)
10BL602333	Line 1	1,642 per annum
10BL602337	Line 2	
10BL602336	No.3 Shaft	

In addition to the groundwater extraction licences Tahmoor Coal has a 5 megalitres per annum surface water extraction licence (10AL103025) for the Maldon Weir Water Management Zone.

Agricultural Productivity Impact

Applying a conservative assessment and assuming that all of the 2,700 megalitres could have been be used for irrigated cropping, the GM for the production of surface irrigated lucerne has been calculated. Surface irrigated lucerne uses on average 8 megalitres per hectare per annum; therefore, a maximum of 338 hectares could be irrigated using the 2,700 megalitres of proposed licensed groundwater extraction. Assuming five cuts of lucerne per season, at 2.5 tonnes per cut is achievable, the total annual revenue and for this enterprise is $2,613 per hectare with a gross margin of $1,405 per hectare. Gross margins were determined using *Dryland Lucerne Hay Gross Margin Budget Northern Zone Summer 2010-11* (DPI, 2010) and *Surface Irrigated Lucerne – Established Stand Summer 2011-2012* (DPI, 2011) (**Appendix B**).

There is no land mapped by OEH as suitable for irrigation within the Project Area (LSC Class 3), However, during the 2013 and 2017 site inspections small areas of irrigated agriculture were observed. Given lucerne hay can be grown as a dryland or irrigated crop this was chosen as the comparison enterprise. With a potential 2,700 megalitres not being available for agriculture it is assumed that the land would otherwise be used for dryland lucerne production with productivity levels represented by LSC Class 3 (**Table 20**) The estimated net annual economic impact on potential agricultural productivity as a result of using this land for dryland lucerne production rather than irrigated lucerne production is a difference in estimated potential gross income of $301,496 per annum. Using the same assessment principles as for groundwater, the 5 megalitres of licensed surface water could potentially generate $880 per annum if used for irrigated lucerne production.

Table 20 Groundwater Use Gross Margin

LSC	Cropping Type	Lucerne Tonnes	Revenue	Variable Cost	Gross Margin	Total
Class	**Lucerne**	**Per Hectare**	**Per Hectare**	**Per Hectare**	**Per Hectare**	**Per Annum**
3	Dryland	5	$1,440	$927	$513	$173,394
3	Irrigation	12.5	$2,613	$1,208	$1,405	$474,809

These assumptions consider groundwater removed by Tahmoor Coal through de-watering would otherwise be available for agricultural use. However, Licence Condition 16 of all three groundwater extraction licences states '*this is a special purpose (mine de-watering) licence'; as such, the licence is including the volumetric groundwater allocation not transferrable, and the licence will be lapsed at the conclusion of mining operations'*. Therefore, whilst Tahmoor Coal currently holds groundwater extraction licences for 1,642 megalitres (with potential increase to 2,700 megalitres), this water would not be

considered as being taken from potential agricultural production as the licences are restricted to mine de-watering only.

Long-Term Use of Reallocated Water

Whilst Licence Condition 16 of all three groundwater extraction licences states '*this is a special purpose (mine de-watering) licence*', which is not transferable, the groundwater allocation associated with these three licences may then be reallocated to agricultural production at the conclusion of mining operations.

At the completion of mining operations and following rehabilitation, the surface water licence held by Tahmoor, should it become surplus to requirements, may be sold on the water transfer market, and as such water may become available for agriculture or some other beneficial use.

5.3 Impact of Biophysical Strategic Agricultural Land

The nearest mapped BSAL is approximately 20 kilometres north-east of the Project Area (DP&I, 2013) between Douglas Park and Camden, furthermore no potential BSAL was identified within the Project Area during the BSAL assessment in **Section 3.2**. Therefore, the Project is highly unlikely to impact any BSAL.

5.4 Impact on Agricultural Resources from Biodiversity Offsets

A regional Biodiversity Offset Strategy (BOS) has been proposed by Tahmoor Coal to offset the loss of vegetation from clearing associated with the construction of the new surface facilities required to support the Project. The *Biodiversity Assessment Report* (Niche, 2020) identifies five proposed biodiversity offset sites comprising 381 hectares, for the BOS:

- Rockford Road
- Pit Top
- 185 Charlies Point Road
- Bargo Colliery Land
- 220 Charlies Point Road

None of the identified sites are on potentially agriculturally productive land, and all are heavily timbered with native bushland. Therefore, the BOS will have negligible impact on agricultural resources, enterprises or BSAL.

5.5 Impact on State Forests and Conservation Areas

The DAA encompasses a small part of the MSA as shown on **Figure 10**, which comprises a portion of the Upper Nepean State Conservation Area. Importantly, the proposed extent of longwalls does not extend into the MSA, nor does the limit of subsidence. The impact of underground mining and subsidence in this area has therefore been assessed as being negligible.

5.6 Other Impacts

5.6.1 Visual Amenity and Landscape Values

The Project aims to maximise the use of existing surface infrastructure, and there is no new surface infrastructure proposed to be installed on currently utilised agricultural land (**Figure 7**). The *Visual Impact Assessment* (Green Bean Design, 2020) undertaken for the Project found the Project has a negligible to low visual impact. Among other reasons, this can be attributed to the REA and SIA being located within a landscape context of sloping and ridgeline formations with moderate to dense tree cover and a high visual absorption capacity.

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

5.6.2 Tourism

The agricultural audit conducted by SLR did not identify any tourism infrastructure in the local area upon which agricultural enterprises are reliant. The Project will have no anticipated impact on local agriculture-related tourism (e.g. wineries).

5.6.3 Weed Management and Biosecurity

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

Biosecurity is defined in the *NSW Biosecurity Strategy 2013 – 2021* (NSW 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.

The vast majority of equipment used at Tahmoor Mine is site-dedicated and poses no biosecurity risk. Any import of equipment or machinery from interstate or overseas will follow the standard procurement safeguards and quarantine procedures as per NSW and Australian requirements.

Given the processes above, it is considered the Project is highly unlikely to represent an increased risk to the biosecurity of agricultural resources and enterprises within the region.

5.6.4 Air Quality

There is potential for the Project to generate dust primarily as a result of construction activities, mine operations (including crushing and transfer of coal), mine ventilation and site rehabilitation. Minor disturbance of groundcover during the construction phase of the SIA and site commissioning, along with mobilisation of equipment to and between sites, has the potential to generate dust, with impacts dependent on road and weather conditions.

Predictions were made for residences in proximity of the Project in the *Air Quality Impact Assessment* (ERM, 2020). As the REA progresses south, there is potential for exceedances of the EPA's dust criteria at the residences located in the vicinity of the proposed expanded REA in the later mining years.

Dispersion modelling results predict that one mine owned receptor will experience maximum 24-hour average PM_{10} concentrations above 50 µg/m³, due to the Project's operations alone. Notably this exceedance is predicted to occur on only one day per year. Further, with the incorporation of the TARP and other dust management practices, this exceedance is unlikely to occur in practice. This receptor is not related to agricultural resources or enterprises.

There are no private agricultural receptors that are predicted to experience annual average $PM_{2.5}$, PM_{10}, TSP concentration or dust deposition levels above the EPA assessment criteria as a result of the Project.

Potential impacts from nitrogen dioxide, sulfur dioxide and hydrocarbon resulting from gas flaring were found to be well below their respective Environment Protection Authority (EPA) criteria. Modelling of odorous emissions from the ventilation vents indicate that the 99th percentile odour concentration limit of 7 ou will not be exceeded at the nearby residences. However, there may be peak periods where odour may be detected at the closest receptors.

On this basis, it is concluded the Project will have negligible impact on air quality for agricultural resources and enterprises.

5.6.5 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. Noise levels are predicted to generally reduce as a result of the project compared to existing levels (EMM, 2020). The predicted noise reductions are due to a number of proposed mitigation measures regarding pit top operations and the REA.

A maximum of six privately owned properties are predicted to be impacted by mine noise emissions more than 5dB above the relevant project noise trigger levels (PNTL), however none of these properties are engaged in agricultural production.

Traffic noise generated during construction and operation of the Project is predicted to be within the NSW Road Noise Policy criteria at all receiver locations.

Predicted noise levels for the Project will have negligible impact on agricultural production within the area.

5.6.6 Traffic

Agricultural enterprises can be impacted by increased traffic movements through an increase in noise and dust, and also through the cumulative impact of road transport being utilised by mining operations, leaving fewer transport options for agricultural enterprises.

Noise and dust emissions generated by the Project, including those associated with traffic movements, are anticipated to have a negligible impact on agricultural resources and enterprises within the area (EMM, 2020 and ERM, 2020).

There will be some increase in road traffic as a result of the Project, peaking in 2020; however, the *Traffic Impact Assessment* (Transport and Urban Planning, 2020) found that the Tahmoor Mine access intersection will have satisfactory to good operation in terms of vehicle delay and level of service. The

transportation of coal extracted from the Project Area will be via the rail network and will therefore not result in increased road traffic.

The *Traffic Impact Assessment* (Transport and Urban Planning, 2020) found that the Project will not adversely impact on the local road network. On this basis the impact to agricultural resources and enterprises as a result of increased traffic movements associated with the Project is considered negligible.

5.7 Other Impacts to Regional Community and the Environment

No other impacts are anticipated that will affect the regional community or the environment.

6 MITIGATION MEASURES

6.1 Review of Project Design

The proposed longwall mine plan has been reviewed and revised by Tahmoor Coal in order to mitigate potential subsidence impacts and avoid the MSA. The final mine plan has been developed to minimise impacts from underground workings on land and surface infrastructure within the Project Area.

The nature of underground longwall mining avoids significant disturbance to productive agricultural land, especially when compared to open cut mining methods.

6.2 Proposed Management Measures

This section describes the proposed management measures and monitoring plans to be implemented for the 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 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 the Tahmoor Coal Environmental Management System (EMS) (including issue-specific environmental management plans and monitoring programs) to be developed for the Project. A summary of key measures is provided in this section.

6.2.1 Land Resources

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

- No proposed disturbance to productive agricultural land from the construction of surface infrastructure.
- Negligible disturbance to productive agricultural land from the impact of subsidence.
- Management of soil resources within the Project Area so that they can be used in the rehabilitation program.
- The final land use option stated in the Project's *Conceptual Mine Closure Plan* (SLR, 2020) is reinstatement of disturbed land within the REA to native bushland.

Minimisation of Disturbance to Agricultural Lands

All areas subject to mine-induced subsidence will be inspected as part of the Subsidence Monitoring Program. Where there is any evidence of cracking, or other surface expressions related to subsidence, all remedial works will be undertaken in accordance with the requirements of the approved Extraction Plan.

There are no areas currently utilised for agricultural enterprises which will be disturbed by construction of the proposed surface facilities or extension of the REA.

Land Resources: Continued Use of Existing Agricultural Areas

All agriculturally productive land within the Project Area will continue to be utilised under the chosen management strategies and enterprises of the current landholders.

There is no land owned by Tahmoor Coal which is considered agriculturally productive.

Soils Resources

The Project's *Conceptual Mine Closure Plan* (SLR, 2020) provides general soil management practices to minimise the impact of the Project on soil resources. These practices include the:

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

Re-Establishment of Agricultural Lands

The Project's *Conceptual Mine Closure Plan* (SLR, 2020) has been designed to minimise the impact of the Project the surrounding area. This includes:

- A rehabilitation strategy for the areas that are expected to be affected by surface disturbance;
- Rehabilitation objectives;
- 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 re-vegetation program based on current industry good practice and progressive learning as the site program is implemented;
- Objectives and preliminary success criteria for mine closure; and
- A monitoring program to progressively assess performance of the rehabilitated areas.

There is no proposed surface disturbance of agriculturally productive land by the Project.

6.2.2 Water Resources

The Project is anticipated to impact groundwater resources associated with agricultural and associated enterprises (Hydro-Simulations, 2020). The drawdown impacts from the Project on the Permian fractured rock are classified within Level 2 of the Aquifer Interference Policy's minimal impact considerations.

Tahmoor Coal have committed to the implementation of 'make good' provisions for affected groundwater users. These measures may include deepening and/or replacing impacted bores and wells, and/or providing an alternative water source to affected users.

A Groundwater Management Plan will require development and approval. This will need to define groundwater level triggers, and a Trigger, Action, Response Plan (TARP).

The Project is anticipated to have negligible impact on surface water resources (Hydro Engineering & Consulting Pty Ltd, 2020).

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

The Water Management System will also describe the water management protocols and response procedures for the Project Area's water resources.

6.2.3 Agricultural Enterprise Assets

It is anticipated the Project will have some minor impacts on agricultural enterprise assets such as rural structures, tanks, sheds, fencing and farm dams (MSEC, 2020). Tahmoor Coal will develop an Extraction Plan which will include monitoring and management strategies for any predicted subsidence impacts. Extraction Plans are based on a risk matrix with mitigation measures and have been developed and successfully implemented for the extraction of previous longwalls. Following are the mitigation measures for predicted subsidence impacts to specific agricultural assets.

Rural Structures

Tahmoor Coal has a long history of managing the impacts to rural structures as a result of subsidence through the development and effective implementation of an Extraction Plan. This management plan provides for the identification of rural structures in poor pre-mining condition which are, or may become, hazardous due to longwall extraction. Should any impacts occur to rural structures, they will be repaired in accordance with the requirements of Subsidence Advisory NSW and in accordance with the Extraction Plan.

Water Tanks

Only minor impacts to water tanks are expected such as leaking pipe joints, which can be easily repaired using well established remedial techniques.

Gas and Fuel Storages

Any impacts are to gas and fuel storages are expected to be of a minor nature, including minor gas leaks, which can be easily repaired using well established remedial techniques.

Poultry Sheds

It is expected that subsidence movement resulting from longwall extraction on poultry sheds and ancillary building structures can be managed by the implementation of the management measures committed to in the Extraction Plan, which may include visual monitoring during active subsidence. The level of monitoring and management may vary depending on the type and age of poultry in the sheds and the level quarantine necessary.

Greenhouses and Nurseries

It is expected that subsidence movements on greenhouses and hothouses within the Project Area can be managed by the implementation of the Extraction Plan, which may include visual monitoring during active subsidence. Any impacts on hydroponic systems within these greenhouses and nurseries are also expected to be readily managed in accordance with the Extraction Plan.

Irrigation Systems

Elevated strains can occur in irrigation pipelines where they are anchored to the ground, or where non-systematic ground movements occur, however these impacts are only expected to be of a minor nature, such as leaking pipe joints, which can be easily repaired.

Farm Fences

Any impacts farm fences are likely to be of a minor nature and relatively easy to remediate by re-tensioning fencing wire, straightening fence posts, and if necessary, replacing some sections of fencing.

Farm Dams

Tahmoor Coal has a long history of managing the impacts to farm dams as a result of subsidence through the development and effective implementation of an Extraction Plan This has included the assessment of potential environmental or safety consequences as a result of farm dam breach. The Extraction Plan provides for visual monitoring of farm dams immediately prior to and following active subsidence at each dam.

Mitigation measures for impacts to farm dams include increasing the height of the dam wall to offset loss in freeboard due to subsidence induced tilts, and repair of dam bases and walls with cohesive material where cracks have developed due to curvature and strain. If impacts occur to farm dams, Tahmoor Coal will supply water to the landowner on a temporary basis until the dam is repaired.

Groundwater Bores

Tahmoor Coal has previously developed Extraction Plans for the management of potential impacts to groundwater bores during the extraction of Longwalls 22 to 30. Where drawdowns exceed the Aquifer Interference Level 1 Minimum Impact policy criterion of a two metre maximum cumulative drawdown, Tahmoor Coal have committed to “make good” provisions for any groundwater users adversely affected by mine operations and associated impacts, that being provision of alternative water supply or remedial works (deepening and/or widening) of existing wells or bores.

Tahmoor Coal will continue to develop Extraction Plans to monitor and manage potential impacts to agricultural enterprise assets during the extraction of longwalls for the life of the Project.

6.2.4 Noise

The Project proposes a number of mitigation measures to reduce operations noise, including:

- Cladding of the CHPP to lower noise source and low frequency noise.
- Construction of an acoustic wall to reduce noise from the train loader, ROM stockpile dozer and overall site noise.
- Modifications to the noise bund to reduce ROM stockpile dozer and overall site noise.

6.3 Rehabilitation of Disturbed Lands: Demonstrated Capacity

A summary of the area of rehabilitation carried out over the past five years and area to be rehabilitated upon final closure by Tahmoor is shown in **Table 21**.

Table 21 Tahmoor Rehabilitation Summary

Mine Lease Area		Area Impacted/Rehabilitated (hectares)				
		2014	2015	2016	2017	2018*
Tahmoor Mine	Total active disturbance	65.5	59	62	62	62
	Total area rehabilitated	0	6.5	0	0	8
	Total area maintenance & weed control	0	6.5	0	4	0
*predicted 2018						

Source: *Tahmoor Coal (2015a & 2016)*

Tahmoor Coal, on average, rehabilitates approximately 1 to 2 hectares per year; however 3 to 4 years of rehabilitation works can be concentrated into 1 year, due to the nature of the REA operation. Progressive rehabilitation by Tahmoor Coal will continue as sites become available.

Tahmoor Coal has previously demonstrated successful rehabilitation of disturbed lands at the Tahmoor site to achieve nominated final land use and restoration of natural resources.

Rehabilitation of seven hectares was undertaken in 2012 for surface disturbance associated with eleven exploration boreholes as part of the Tahmoor South Exploration Program. Rehabilitation activities included levelling and re-contouring of the land, scarification and application of fertiliser and seed to the specification of the land owner. These drill sites were signed off for successful rehabilitation by the landowner and the Division of Resources & Energy (DRE) (Tahmoor Coal, 2012).

Rehabilitated areas of the Tahmoor Mine REA surface area are well established and have provided vegetation cover to effectively minimise the potential for erosion. **Plate 5** to **Plate 9** show various stages of rehabilitation at Tahmoor Coal's current REA. Tahmoor has shown an ongoing commitment to the rehabilitation of mine disturbance areas.

Plate 5 – Deep ripping prior to seeding and spreading previously cleared timber

Plate 6 – Temporary REA batter stabilisation through planting with millet

Plate 7 – Rehabilitated REA showing timber spread for native animal habitat

Plate 8 - Rehabilitated REA showing native shrubs

Plate 9 – Progressive rehabilitation on REA

6.4 Demonstrated Planning for Progressive Rehabilitation

During 2015 Tahmoor Coal prepared and submitted an amended Mining Operations Plan (MOP) in accordance the *Interim Mining Operations Plan Guideline* (DRE, 2012). Tahmoor Coal's MOP now contains significant detail on mine closure domains, with rehabilitation indicators and assessable completion criteria specified for each domain (from Tahmoor's development consent and mining lease approval conditions) through to 2019. Rehabilitation activities conducted during the annual review reporting period were accordance with those proposed in the MOP (Tahmoor Coal, 2015b).

Planning for progressive rehabilitation is detailed in the Project's *Rehabilitation and Conceptual Mine Closure Plan* (SLR, 2020). Principal rehabilitation objectives for the Project include:

- achieving an acceptable post-disturbance land use;
- creating a stable post-disturbance landform; and
- preserving downstream water quality;

In addition to the above key rehabilitation objectives the Tahmoor also takes into account mine closure issues, with specific reference to:

- making appropriate decisions which comply with or exceed approvals, licences and agreements;
- working constructively with local authorities, stakeholders and communities;

- contributing to the conservation of biodiversity;
- planning, designing and closing operations in a manner that enhances sustainable development; and
- engaging and communicating openly with communities, with due regard and respect for local interests, cultures and customs.

6.5 Other General Mitigation Measures

On-going consultation with relevant government agencies, stakeholder and the community will be undertaken throughout the life of the Project, as detailed in **Section 7**.

7 STAKEHOLDER CONSULATION

The Tahmoor Mine currently undertakes extensive community consultation in accordance with the *Tahmoor Mine Social Involvement Plan* (SIP). The SIP includes a Stakeholder Consultation Program, and a list of stakeholders.

Tahmoor Coal has undertaken consultation with government agencies, local Aboriginal groups, the Tahmoor Coal Community Consultative Committee (TCCCC), surrounding residents and the wider community and service providers during pre-feasibility, feasibility and planning stages of the Project. Tahmoor Coal has a strong commitment to stakeholder engagement and consults with the community through forums such as:

- quarterly meetings with the TCCCC;
- meetings with individual landowners and stakeholders;
- community newsletters;
- publications in local newspapers, the *Macarthur Chronicle* and the *Wollondilly Advertiser*
- community information sheets relating to specific development issues, including the *End of Panel Report*, which is distributed to the TCCCC;
- a 24 hour dedicated complaints line;
- community open days and mine visits; and
- community events.

Tahmoor Coal has previously established a good working relationship with its local community and seeks to continue this during the life of the Project. In particular, the site focuses on providing timely and accurate information regarding its sustainable development performance to its varied stakeholders, with the following goals:

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

A summary of consultation with various stakeholders undertaken by Tahmoor Coal regarding the Project is shown in **Table 22**, including the date of consultation, with whom and the type of consultation engaged.

Table 22 Tahmoor Coal Consultation Summary

Reason for Consultation	Date	Details
NSW Department of Planning and Environment (DPE)		
Presentation of proposed development	05/07/12	Overview of proposed development provided to DPE.
Submission of PEA	12/09/12	Overview of proposed development and preliminary identification of potential impacts provided to DPE.
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
Consolidation of Consents	22/02/13	Overview of existing development consents at Tahmoor Mine and discussion of proposed consent strategy for the proposed development.
Noise Assessment	05/09/13	Discussion regarding noise monitoring and modelling, application of the *Industrial Noise Policy* (INP) and setting of noise goals. This meeting was also attended by EPA.
Noise Assessment	13/11/17	Overview of the updated project and clarification on the assessment methodology. The DPE confirmed the noise assessment was to be conducted in accordance with the NSW *Industrial Noise Policy.*
Government Agency Briefing	18/12/17	Meeting to provide DPE and relevant agencies a briefing of the proposed development, including history of the Tahmoor South Project EIS process to date, and to understand key agency issues for consideration in the EIS.
Pre-lodgement meeting	16/03/18	Meeting to provide an update on the progress of the EIS and the planned lodgement date.
Briefing on approval pathway	02/05/18	Overview of approval pathway
Social impact assessment discussion	13/07/18	Overview of updated guideline and assessment
Update on project	13/11/19	Overview of Amended Project
Federal Government Department of Environment & Energy (DoEE)		
EBPC referral briefing	22/09/17	Discussion regarding the EPBC referral for the proposed development.
Australian Rail Track Corporation (ARTC)		
Presentation of proposed development and subsidence impacts	29/01/14	Overview of proposed development and identification of potential impacts on ARTC infrastructure.
DI Water (formerly NSW Office of Water (NOW) under DPI) and Water NSW (formerly Sydney Catchment Authority (SCA))		
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
Presentation of the proposed approach to undertaking the	31/10/12	Presentation of the baseline monitoring program and proposed model for the Groundwater Assessment.

Reason for Consultation	Date	Details
Groundwater Assessment.		
Presentation of preliminary model results from the Groundwater Assessment.	27/11/13	The preliminary results from the groundwater model were presented to NOW.
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
Presentation of proposed development and discussion of approach to environmental assessments. This meeting was also attended by NPWS.	20/11/12	A field inspection of Cow Creek was undertaken in addition to a meeting on the potential impacts of the proposed development on SCA lands.
Presentation of proposed development and discussion of preliminary results from the environmental impact assessments. This meeting was also attended by EPA and OEH.	12/12/13	Concerns were raised by SCA regarding the potential impacts of the proposed development on SCA lands.
Wingecarribee Shire Council		
PFM	05/10/12	Overview of proposed development and preliminary identification of potential impacts.
Presentation to General Manager and senior Council staff	12/11/12	Tahmoor Coal provided an overview of proposed development and preliminary identification of potential impacts. Council raised concerns regarding the impacts of coal mining on lands within the Wingecarribee LGA.
Presentation to Wingecarribee Coal Consultation Committee	29/11/13	Tahmoor Coal provided an overview of proposed development and preliminary identification of potential impacts. Committee raised concerns regarding the impacts of coal mining on lands within the Wingecarribee LGA and noted its objection to longwall mining.
Project Briefing	11/10/17	Tahmoor Coal advised that SEARs have been re-issued for the proposed development and work was being undertaken to finalise the EIS. Advised that whilst the Project Area extends into the Wingecarribee LGA, no activities associated with the proposed development would take place in the LGA.
Wollondilly Shire Council		
General discussion regarding proposed development.	17/09/12	Tahmoor Coal provided an overview of proposed development and preliminary identification of potential impacts.
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.

Reason for Consultation	Date	Details
General discussion regarding proposed development and status of the EIS	29/07/13	Tahmoor Coal provided an overview of proposed development and potential impacts to Councillors and Council Executive Management of Council. Council raised specific concerns regarding subsidence and some concerns about more general environmental impacts associated with the proposed development. Council representatives also expressed an interest in the potential economic benefits of the proposed development.
Meeting with Wollondilly Shire Council Strategic Planners regarding urban growth	03/12/13	Tahmoor Coal and Council discussed the urban growth plans for the township of Bargo and the potential impacts of mine subsidence on urban growth areas. The Subsidence Impact Assessment was updated to include an assessment of conventional subsidence parameters for the 2,000 additional houses identified in the *Wollondilly Growth Management Strategy* (2011).
General discussion on the implications that the proposed development may pose for Council's future considerations of development applications within the proposed development Area.	23/01/14	Tahmoor Coal and Council had a further discussion regarding the urban growth plans for the township of Bargo and the potential impacts of mine subsidence on urban growth areas. The meeting was held with Wollondilly Shire Council's Strategic Planners, Illawarra Coal and the Mine Subsidence Board (now SA NSW).
Meeting with General Manager and strategic planning staff to discuss development contributions	14/03/14	Development contributions mechanisms discussed.
Meeting to discuss Planning Agreement	02/05/14	Planning agreement mechanism discussed.
Meeting to discuss Planning Agreement	12/06/14	Planning agreement mechanism discussed.
Project Briefing	07/09/17	Tahmoor Coal advised that SEARs have been re-issued for the proposed development and work was being undertaken to finalise the EIS.
Meeting with Wollondilly Shire Council senior managers	31/05/18	Project overview and impact assessment
Meeting with Wollondilly Shire Council Environment team	31/07/18	Project overview and impact assessment
Meeting with Wollondilly Shire Council Councillors	26/11/18	Project overview and impact assessment
Presentation to Wollondilly Shire Council Councillors	4/11/19	Project overview and impact assessment
Transport for NSW		
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
Office of Environment and Heritage		

Reason for Consultation	Date	Details
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
General discussion regarding proposed development. This meeting was also attended by EPA and SCA.	12/12/13	Overview of proposed development and preliminary identification of potential impacts. The preliminary outcomes of technical specialist investigations and modelling were also presented.
Biodiversity offsets required to mitigate the biodiversity impacts of the proposed development.	9/7/14	The Biodiversity Offset Strategy for the proposed development was presented and discussed with OEH.
Project briefing	18/12/17	Overview of project, impact assessment overview and plan to submit development application and EIS in Q1 2018.
Overview of subsidence impacts on streams	20/06/18	Overview of project, impact assessment overview
Biodiversity offsets required to mitigate the biodiversity impacts of the proposed development.	11/09/18	The Biodiversity Offset Strategy for the proposed development was presented and discussed with OEH.
Update on Amended Project	November 2019	Biodiversity offset credits
NSW Environment Protection Authority		
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts. Refer to **Section 9.2.1**.
Noise Assessment for the proposed development. This meeting was also attended by DPE.	05/09/13	Discussion of noise monitoring and modelling, application of INP and setting of noise goals. INP and noise goals were considered as part of the Noise Impact Assessment (refer **Section 11.9**).
Potential air quality impacts of the proposed development.	09/13	Correspondence regarding the air quality impact assessment (AQIA) undertaken via email in lieu of a face to face meeting.
General discussion regarding proposed development. This meeting was also attended by OEH and SCA.	12/12/13	Tahmoor Coal provided an overview of proposed development and preliminary identification of potential impacts. The preliminary outcomes of technical specialist investigations and modelling were also presented.
Noise Assessment	13/11/17	Overview of the updated project was provided, and clarification sought on the assessment methodology. The DPE confirmed the noise assessment was to be conducted in accordance with the NSW *Industrial Noise Policy*.
Project briefing	18/12/17	Overview of project, impact assessment overview and plan to submit development application and EIS in 2018.
Noise assessment	16/03/18	Overview of the results of the noise assessment.
Project overview	October 2018	Overview of project and impact assessment overview
Update on Project	November 2019	Overview of Amended Project and Noise Impact Assessment
NSW DRG (Formerly NSW Trade & Investment – Division of Resources and Energy)		

Reason for Consultation	Date	Details
Presentation of the concept plan for the proposed development.	29/06/12	Overview of proposed development and preliminary identification of potential impacts. The DRG provided in principle support for a mine plan capable of maximising the available resource. The importance of managing potential subsidence impacts and other environmental issues was discussed.
PFM	18/10/12	Overview of proposed development and preliminary identification of potential impacts.
Meeting to discuss subsidence assessment and impacts	27/11/13	Impacts have been assessed as part of the Subsidence Impact Assessment (MSEC, 2020), the Groundwater Assessment (HydroSimulations, 2020), the Surface Water Assessment (HEC, 2020 and the Terrestrial Ecology Assessment (Niche Environment and Heritage, 2020).
Subsidence infrastructure inspection of the APA – Sydney – Moomba gas pipeline; and the Gorodok – Ethane pipeline.	28/07/14	Gas pipeline inspection, in particular: crossing of the pipeline with the Main Southern Railway line; location of pipeline in relation to resident's homes; and road crossings of pipeline at Avon Dam Road and Remembrance Driveway.
Government Agency Briefing	18/12/17	Meeting to provide DPE and relevant agencies a briefing of the proposed development, including history of the Tahmoor South Project EIS process to date, and to understand key agency issues for consideration in the EIS.
Concept Project Development Plan	16/01/18	Overview of project, impact assessment overview and plan to submit development application and EIS in 2018. An overview of the mine plan constraints and geological background was also provided.
Project briefing	28/06/18	Overview of project
Project overview	October 2018	Overview of project and impact assessment overview
National Parks and Wildlife Service (NPWS)		
General discussion regarding proposed development. This meeting was also attended by SCA.	20/11/12	Field inspection of Cow Creek and a meeting on the potential impacts of the proposed development on SCA lands.
NSW Health		
General discussion regarding proposed development	7/3/14	Overview of the proposed development (via email). NSW Health raised concerns regarding human health impact of the proposed development including air quality and noise impacts.
Subsidence Advisory NSW (SA NSW) (formerly Mine Subsidence Board)		
General discussion regarding proposed development	27/11/13	Overview of proposed development and preliminary identification of potential impacts.
General discussion on the implications that the proposed development may pose for Council's future considerations of development applications within the Project Area.	23/01/14	Further discussion regarding the urban growth plans for the township of Bargo and the potential impacts of mine subsidence on urban growth areas. The meeting was held with Wollondilly Shire Council's Strategic Planners, Illawarra Coal and the Mine Subsidence Board.

Reason for Consultation	Date	Details
Meeting to discuss subsidence assessment and impacts	27/11/13	Impacts have been assessed as part of the Subsidence Impact Assessment (MSEC, 2020), the Groundwater Assessment (HydroSimulations, 2020), the Surface Water Assessment (HEC, 2020) and the Terrestrial Ecology Assessment (Niche Environment and Heritage, 2020).
Project briefing	16/11/2017	Overview of project, impact assessment overview and plan to submit development application and EIS.
Project briefing	17/07/18	Overview of project and impact assessment overview
Roads and Maritime Services (RMS)		
General discussion regarding proposed development	3/12/13	Overview of proposed development and preliminary identification of potential impacts. RMS raised concerns regarding the potential impacts of the proposed development on the M31 Hume Motorway, specifically M31 bridges including spanning the Nepean River.
APA / Gorodok		
General discussion regarding proposed development and subsidence impacts to high pressure gas pipeline	10/12/13	Impacts have been assessed as part of the Subsidence Impact Assessment (MSEC, 2020).
Sydney Water		
General discussion regarding proposed development and subsidence impacts to Sydney Water assets	19/02/14	Impacts have been assessed as part of the Subsidence Impact Assessment (MSEC, 2020).
Federal Member for Hume – Angus Taylor		
General discussion regarding proposed development	13/6/14	General discussion regarding proposed development.
Site inspection of Tahmoor Mine	31/07/14	General discussion and update on the Tahmoor South Project and the Tahmoor Mine. Site surface inspection including the following areas: gas extraction plant; gas flare plant; and third party gas power generation plant; the recycle water treatment plant and the waste water treatment plant; water discharge points; surface buildings; and CHPP.
General discussion regarding proposed development	October 2018	General discussion regarding proposed development.
State Member for Wollondilly – Jai Rowell		
General discussion regarding proposed development	24/9/12 8/4/14 05/02/18	General discussion regarding proposed development.
State Member for Goulburn – Pru Goward		
General discussion regarding proposed development	5/10/12	General discussion regarding proposed development.

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

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

It is anticipated that a further social impact assessment will be undertaken during detailed closure planning. It is anticipated that the social impact study will consider the Tahmoor South Project's expenditure patterns within the local area, community contributions, and location of employees as well as potentially affected local businesses and suppliers. The outcomes of the social impact study will be used to assess feasible options to minimise negative social impacts associated with mine closure.

8 KEY FINDINGS

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

The key findings of the AIS are listed below.

- There will be 11 hectares of LSC Class 4 land permanently removed from potential agricultural production as a result of the Project. This land will be rehabilitated to LSC Class 7. This area is currently native bushland and not used for agricultural production.

- There is no land which has been, or is currently used for agriculture, which will be permanently impacted by surface disturbance associated with the Project.

- The Project Area contains no areas of verified BSAL. In addition, there is no mapped BSAL within two kilometres of the Project Area.

- Post-mining agricultural economic activity in the Project Area is expected to be similar to pre-mining activity as there are only small changes predicted between the pre- and post-mining Land and Soil Capability classifications, specifically the final REA landform.

- Any impacts to agricultural resources or enterprises from mine induced subsidence are expected to be minor and readily mitigated.

- The Project will have a positive impact on surface water resources relied upon by agriculture through discharge of water ‘suitable for agricultural use’ into Tea Tree Hollow via LDP 1.

- The Project will impact groundwater resources relied upon by agriculture; however these are expected to be readily mitigated.

- The *Economic Impact Assessment* of the Project (Ernst & Young, 2020) confirmed that the Project will provide considerable positive economic benefits to the local and broader communities. These benefits are much greater than the potential income lost by existing or potential agricultural enterprises, calculated as a precautionary assessment on impacted agricultural resources.

- Stakeholder and community consultation has not revealed any issues regarding agricultural resources or enterprises and will be ongoing throughout the life of the Project.

In summary, the Project will have negligible impacts on surrounding agricultural resources, enterprises and dependent industries.

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Appendix A

Land Use Inspection Plates

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Site 10

Site 11

Site 12

Site 13

Site 14

Site 15

Site 16

Site 17

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Site 21

Site 22

Site 23

Site 24

Site 25

Site 26

Site 27

Site 28

Site 29

Site 30

Site 31

Site 32

Site 33

Site 34

Site 35

Site 36

Site 37 Trotting Track No Photos

Site 38

Site 39

Site 40

Site 40

Site 41

Site 42

Site 43

Site 44 Bargo Tip No Photos

Site 45

Site 46

Site 47

Site 48

Site 49 Horse Paddock No Photos

Site 50

Site 51

Site 52

Site 53

Site 54

Site 55

Site 56

Site 57

Site 58

Site 59

Site 59

Site 60

Site 61

Site 62

Site 63

Site 64

Site 65

Site 66

Site 67

Appendix B

Agricultural Gross Margin Sensitivity Analysis

BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: February 2017

Enterprise: **Inland store weaners**

Enterprise Unit: **100 cows**

Pasture: **Native pasture**

INCOME:			**Standard Budget**	**Your Budget**
42	steer weaners @	$1,079 /hd	$45,318	
21	heifer weaners @	$828 /hd	$17,388	
1	CFA Bull @	$1,554 /hd	$1,554	
6	CFA cows @	$1,116 /hd	$6,696	
0	Dry cows @	$1,116 /hd	$0	
13	Other culls @	$1,116 /hd	$14,508	
83				
	A. Total Income:		**$85,464**	

VARIABLE COSTS:						
Replacements	1	Bull @	$6,000	/hd	$6,000	
Livestock and vet costs: see section titled beef health costs for details.					$1,061	
Hay & Grain or silage. Low level supplementary feeding for 3 months					$2,250	
Drought feeding costs.					$0	
Pasture maintenence (372 Ha of native pasture)					$0	
Livestock selling cost (see assumptions on next page)					$5,792	
B. Total Variable Costs:					**$15,103**	

GROSS MARGIN (A-B)	**$70,361**
GROSS MARGIN/COW	**$703.61**
GROSS MARGIN/DSE*	**$47.29**
GROSS MARGIN/HA	**$189.14**

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 405c/kg and steer weight to 240 kg, gross margin would fall to $621 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**					GM $ per Cow
		395	**405**	**415**	**425**	**435**	
Steer wt.							
-40 kgs	**220**	542	559	576	593	610	
-20 kgs	**240**	603	621	640	658	677	
0	**260**	664	684	704	724	744	
+20 kgs	**280**	724	746	767	789	810	
+40 kgs	**300**	785	808	831	854	877	

An increase of 5% in weaning percentage increases gross margin per cow by $44.32

Assumptions **Inland store weaners**

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

Sales

Steers sold at 9 months	260 kg	@415c/kg live weight
Heifers sold at 9 months	230 kg	@360c/kg live weight
21 heifers retained for replacement.		
Cull cows cast for age at 10 years	240 kg	@465c/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	@370c/kg dressed weight

Selling costs include: Commission 4%; yard dues $8.00/hd; MLA levy $5/hd; average freight cost to saleyards $12/hd; NLIS tags $3.60

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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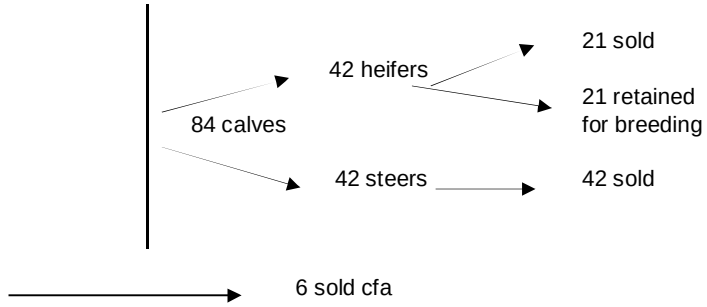
Age structure

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 back-grounders 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.

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.

NSW Department of Primary Industries Farm Enterprise Budget Series

DRYLAND LUCERNE HAY

Northern Zone **Summer 2010-11**

1. GROSS MARGIN BUDGET:

			Sample Budget $/ha	Your Budget $/ha
INCOME: Assumes most bales are prime hay quality.				
2 cuts per season	@ 2.00 t/ha per cut			
Total Yield =	**4.00** tonnes per hectare			
@	40 bales per tonne (25 kg bales)			
60% AFIA Grade A1	96 bales/ha@	$8.50 / bale	$816	
20% AFIA Grade B2	32 bales/ha@	$6.50 / bale	$208	
20% AFIA Grade C3	32 bales/ha@	$4.00 / bale	$128	

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

A. TOTAL INCOME $/ha:	**$1,152**

VARIABLE COSTS:

see following pages(s) for details

Depreciation of establishment cost (over 4 years).....	$52.32
Fertiliser.....	$125.00
Herbicide.....	$17.96
Insecticide.....	$0.00
Mow, rake & bale (contract).....	$524.40
Twine @ $0.113/bale.....	$18.13
Cart and stack 100% of hay ($10.68/t).....	$42.72
B. TOTAL VARIABLE COSTS $/ha:	**$780.52**
C. GROSS MARGIN (A-B) $/ha:	**$371.48**

SENSITIVITY TABLE

EFFECT OF HAY YIELD AND PRICE ON GROSS MARGIN PER HECTARE

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

DRYLAND LUCERNE HAY

Northern Zone **Summer 2010-11**

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

AGRONOMIC NOTES:

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

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

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

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

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

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

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

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

Profitability: Profitability may vary widely depending on dry matter yield and hay prices. Please refer to the sensitivity table and factor in the seasonal and market risks in your planning activities.

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

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

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

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

MACHINERY ASSUMPTIONS:

Tractor: PTO power: 57kW (76 HP)

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

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

SURFACE IRRIGATED LUCERNE - Established stand

Farm Enterprise Budget Series - Northern Zone

Summer 2011-2012

1. GROSS MARGIN BUDGET:

			Sample Budget $/ha	Your Budget $/ha
INCOME:				
7 cuts	per season	@ 1.90 t/ha per cut		
Total Yield =	**13.30** tonnes perhectare			
@	40 bales per tonne (25 kgbales)			
60% AFIA Grade A1	320 bales/ha at	$8.80 / bale	$2,816.00	
20% AFIA Grade B2	106 bales/ha at	$5.00 / bale	$530.00	
20% AFIA Grade C3	106 bales/ha at	$3.00 / bale	$318.00	
See http://www.afia.org.au/quality/national_grades/ for more details on hay grades used.				
A. TOTAL INCOME $/ha:			**$3,664.00**	

VARIABLE COSTS:

see following page(s) for details

Depreciation of establishment cost.....	$101.91	
Fertiliser.....	$241.85	
Herbicide.....	$60.15	
Insecticide.....	$6.33	
Irrigation.....	$443.90	
Mow, rake & bale (contract).....	$1,773.80	
Twine @ $0.113/bale.....	$60.29	
Cart and stack 100% of hay ($10.68/t).....	$142.04	
B. TOTAL VARIABLE COSTS $/ha:	**$2,830.28**	
C. GROSS MARGIN (A-B) $/ha:	**$833.72**	
D. GROSS MARGIN $/ML:	**$83.37**	

SENSITIVITY TABLES

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

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

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

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

SURFACE IRRIGATED LUCERNE - Established stand

Farm Enterprise Budget Series - Northern Zone **(diesel pump from river-regulated)**

Summer 2011-2012

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

AGRONOMIC NOTES:

Herbicides: paraquat + diquat and diuron applied to established stands to clean up weeds.
To reduce the likelihood of herbicide resistance, rotate herbicide groups and weed management techniques.

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

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

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

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

Use of a particular brand name does NOT imply recommendation of that brand by NSW DPI.
Always read chemical labels and follow directions, as it is your legal responsibility to do so.

LABOUR REQUIREMENTS: Labour to apply fertiliser or spray is not costed. If we assume a labour cost of $21/hr the total labour cost would be $29.93/hectare, reducing the gross margin to $804/ha.
This does not include labour required to irrigate since this is more likely to be an overhead cost.

MACHINERY ASSUMPTIONS:

Tractor: pto power: 57 KW (76 HP) FEL = front end loader
Machinery costs refer to variable costs of: fuel, oil, filters, tyres, batteries and repairs.
Mow, Rake, Bale costs: Assumes raking is done twice. Use your own costs if you use your own machinery.

Irrigation Costs: Estimated water usage charge of $31.75 per ML assumed, your charges may be different.
Estimated water pumping cost of $12.64 per ML assumed, your costs may be different.

Water use assumed: 10.0 ML/Ha
Costs calculated using a flood/furrow system with diesel powered pumping from surface supply.

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
5 Foelsche Street
Darwin NT 0800
Australia
T: +61 8 8998 0100
F: +61 2 9427 8200

GOLD COAST
Ground Floor, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628