TAHMOOR EXTRACTION PLAN LW S1A-S6A

Land and Agricultural Resource Assessment

Prepared for:

Tahmoor Coal
2975 Remembrance Drive
Bargo NSW 2573 Australia

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tahmoor Coal (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.12732.002	April 2022	Murray Fraser	Rod Masters	Rod Masters

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1 Introduction

Tahmoor Coal Pty Ltd, (Tahmoor Coal), owns and operates Tahmoor Mine, an existing underground coal mine that is located approximately 80 km south-west of Sydney in the Southern Coalfield of New South Wales (NSW). Tahmoor Mine surface facilities are situated between the towns of Tahmoor and Bargo within the Wollondilly Local Government Area (LGA). The mine has previously extracted longwalls to the north and west of the surface facilities and has been operating continuously since 1979 when coal was first mined using bord and pillar mining methods, followed by longwall mining methods since 1987.

Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Extracted coal is processed on site at the coal handling and preparation plant (CHPP) and coal clearance facilities prior to transportation via rail to Port Kembla and Newcastle for Australian domestic and export customers.

An Environmental Impact Statement (EIS) was exhibited in early 2019 to gain approval for the Tahmoor South Coal Project, which involves use of the existing surface infrastructure and the expansion of underground longwall mining to the south of the existing workings (referred to as the Tahmoor South Domain). Tahmoor Coal subsequently revised the proposed mine design and submitted amended development applications on two occasions (in February and August 2020). In April 2021, Tahmoor Coal received Development Application Approval (SSD 8445) for the extraction of up to 4 Mtpa of ROM coal, with a total of up to around 33 Mt of ROM coal proposed to be extracted over a 10-year period.

The Tahmoor South Domain is located south of the Bargo River and east of Remembrance Driveway and the township of Bargo. Longwall mining would be used to extract coal from the Bulli coal seam within the bounds of Consolidated Coal Lease (CCL) 716 and CCL 747. Twelve longwalls are proposed in this domain which are divided into a series of six northern (A series) and six southern (B series) longwalls. The A series, Longwalls South 1A to South 6A (LW S1A-S6A), are the focus of the current Extraction Plan application.

The locations of LW S1A-S6A, along with the Study Area and regional locality, are shown in **Figure 1**. The Study Area for this assessment comprises the total combined area of the predicted limit of vertical subsidence, taken as the 20 millimetre subsidence contour (resulting from the extraction of LW S1A-S6A), and the 35 degree angle of draw.

The proposed mine layout for LW S1A-S6A lies within the approved Extent of Longwalls. Minor changes have been made to the mine layout since development consent was received (EIS Layout), as foreshadowed by Tahmoor Coal when it applied for development consent. These changes are all within the predicted extent of the longwall boundaries and are detailed in the Extraction Plan Main Document and the Land Management Plan.

1.1 Assessment Objective

The objective of this Land and Agricultural Resource Assessment is to outline the monitoring and management measures to be implemented to manage these potential subsidence related impacts on agricultural resources, specifically from the extraction of LW S1A-S6A.

This assessment will form part of an Extraction Plan being prepared by Tahmoor Coal for LW S1A-S6A for submission to the NSW Department of Planning and Environment (DPE), formerly the Department of Planning, Industry and Environment (DPIE).

1.1.1 Consultation with Department of Primary Industries

Tahmoor Coal received correspondence from DPI on the 3rd February 2022 which noted:

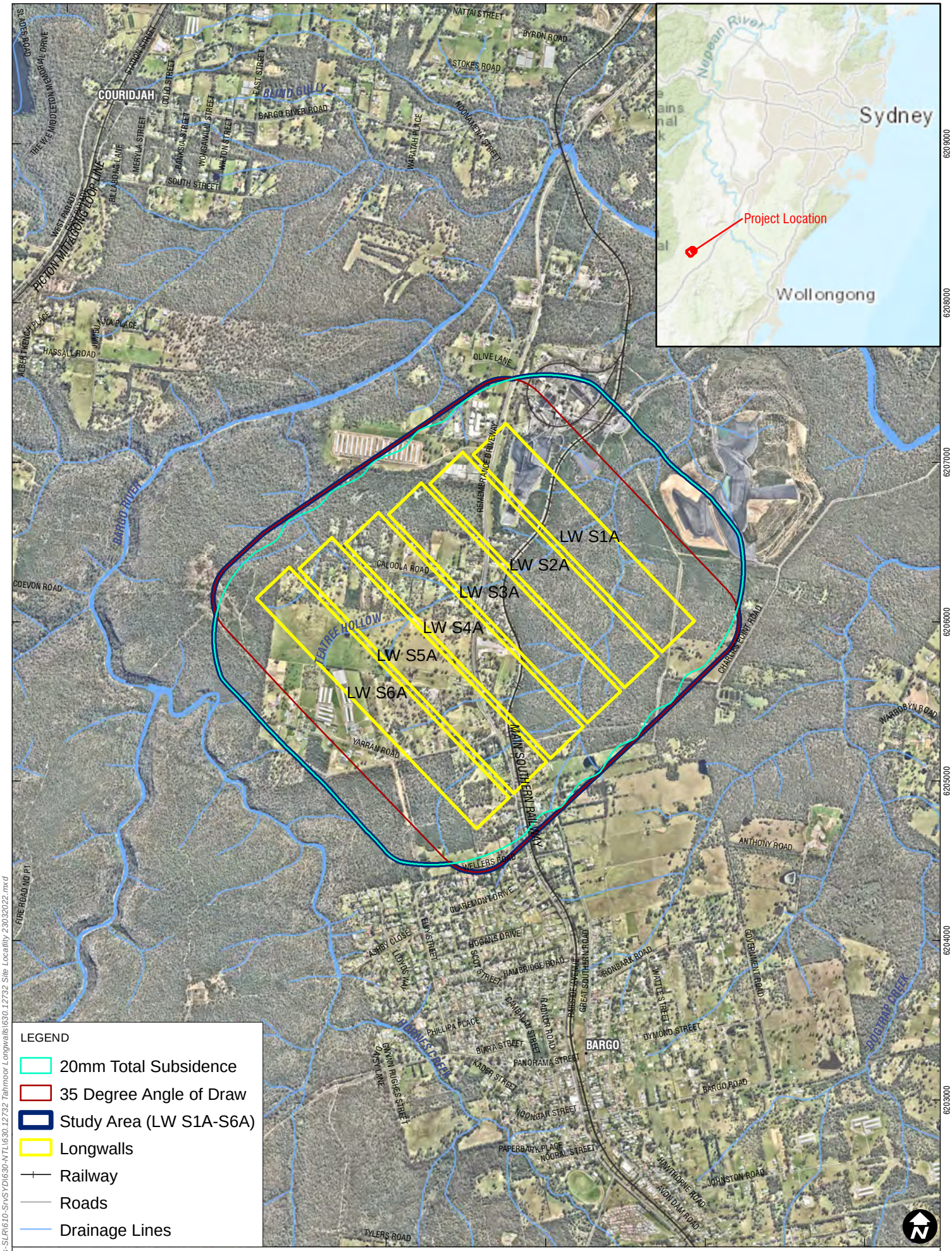
"DPI understands that the company is seeking advice with respect to matters it should consider in the development of the extraction plan. While the DPI does not have any regulatory involvement in this project, we have undertaken a brief review of the agricultural industries in the area and recommend that the company consider the following comments related to agricultural landuses when developing the plan", shown below in **Table 1**:

Table 1 DPI General Comment Register

DPI General Comments	Tahmoor Coal Response	Specific Section Where Addressed
A full assessment of the agricultural landuses in the area that may be potentially impacted so any agricultural developments and associated enterprises in the area are considered in terms of identified risks and economic disruption particularly with subsidence.	An Agricultural Impact Statement was prepared for the first Amendment Report for SSD 8445 approval. For this Extraction Plan, this document has been prepared to complement the information from the Agricultural Impact Statement, and provide any updates on agricultural impacts from the proposed longwalls.	2.8 & 4
Consult with the owners/ managers of affected and adjoining neighbours and agricultural operations in a timely and appropriate manner about; the proposal, the likely impacts and suitable mitigation measures or compensation	Consultation with owners of agricultural businesses in the Study Area has commenced. Tahmoor Coal will continue to consult with the owners during the preparation of the management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans. Further information on management plans to be prepared for infrastructure and structures is provided in the Extraction Plan Main Document. In addition, all landowners in the Study Area have been informed by an information packaged delivered by mail of the proposed development and the subsidence impact claims process in the event that their property is damaged by mining.	6
Consider possible cumulative effects to agricultural enterprises and landholders from subsidence/ other impacting events.	Given the described impacts are of a minor nature and readily managed through application of appropriate mitigation measures and management strategies, any resulting cumulative impacts on agricultural resources and enterprises are also expected to be minor and readily mitigated.	4.4.18

DPI General Comments	Tahmoor Coal Response	Specific Section Where Addressed
An assessment of the monitoring regime that will identify any changes as a result of the effects of the long wall mining, especially subsidence, this may include impacts of farm infrastructure i.e. buildings, fences, slope changes, water supply infrastructure. (This may overlap with the other documents noted in your letter).	Tahmoor Coal will consult with the agricultural business owners during the preparation of management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans.	6
DPI Poultry Comment		
In relation to the poultry enterprises that exist in the area, that these owner/ managers as well as the processors/owners of the birds be consulted to ensure that production plans can be adjusted if required. This should have at least for 12 month periods of mining activity.	Tahmoor Coal will consult with the agricultural business owners during the preparation of management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties in accordance with these management plans.	6
DPI Horticulture Comments		
For protected cropping enterprises (glasshouses) located in the impacted area, the slope of the glasshouses is critical for efficient irrigation so subsidence may be a potential issue. This may also be an issue for other open horticultural enterprises e.g. olives if they are irrigated with a dripper system.	Tahmoor Coal will consult with the agricultural business owners during the preparation of management plans for each individual agricultural business, and will monitor and manage potential impacts to the properties (including hothouses and greenhouses) in accordance with these management plans.	4.4.16
Dust can also be an issue for greenhouse/glasshouse light transmission so this needs to be addressed if dust levels are an issue above ground.	The extraction of LW S1A-S6A involves the extraction of six underground longwall panels and as such there will be no impact to air quality resulting from this extraction activity. All other activities associated with the Tahmoor South Project that have the potential to create dust will be undertaken in accordance with the approved Air and Greenhouse Gas Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.	4.4.4
With water quality any increase in the total dissolved salts (TDS) or an increase in sodium level will be a limitation to any horticultural system relying on hydroponics or fertigation.	There is no predicted increase in total dissolved salts or sodium in groundwater bores associated with LW S1A-S6A.	4.2.4

Addressing these comments from DPI on consultation, potential impacts and mitigation measures also forms part of this Land and Agricultural Resource Assessment.



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Site Locality

FIGURE 1

2 Agricultural and Water Resources

2.1 Climate

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

Picton BOM Station has recorded an average annual rainfall of 801 millimetres, of which approximately 475 millimetres (60%) falls between November and April, with an average of 70.8 rain days in any given year (**Table 2**). 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 2 Picton Climate Data

Temperature	Average (Mean)	Annual Range
Minimum temperature	8.8°C	1.7°C – 15.4°C
Maximum temperature	23.5°C	16.8°C – 29.3°C
Rainfall	**Average (Mean)**	**Average Rain Days**
Annual Rainfall	800.9 mm	70.8
Wettest month	February 91.0 mm	6.8
Driest month	September 43.5 mm	5.1

Source: *Bureau of Meteorology (2020)*

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 Subsidence Study is generally undulating with a fall from the south-west to the north-east (**Figure 2**). The major topographical feature within the Study Area is Teatree Hollow. The major topographical feature nearby the Study Area is the Bargo River valley, which is located to the north.

Elevation near the Study Area varies from a low point of approximately 265 metres AHD, in the base of Teatree Hollow, downstream from of the proposed LW S1A, to a high point of approximately 345 metres AHD, at the south-western end of the Study Area to the south-west of the proposed LW S6A.


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TENTREE HOLLOW
HORNET CREEK
BARGO
DOGTRAP CREEK
LEGEND
Study Area(LW S1A-S6A)
10m Contour
Drainage Lines
Farm Dam
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Topography and Hydrology
FIGURE 2

2.3 Hydrology

2.3.1 Surface Water

The Study Area is located in the catchment of the Hawkesbury-Nepean River, within the sub-catchment of the Nepean River (**Table 2**). The Nepean River rises in the Great Dividing Range to the west of the Study Area. Flows in the upper reaches of the Nepean River are highly regulated by the Upper Nepean Water Supply Scheme, operated by the Water NSW, incorporating four major water supply dams on the Cataract, Cordeaux, Avon and Nepean Rivers. There are no catchment areas or declared special areas within the Study Area. The nearest catchment area is the Metropolitan Special Area, which is located approximately 4.5 kilometres southeast of the proposed longwalls.

There are two dominant drainage channels associated with the Study Area, Teatree Hollow and Wirrimbirra Creek, which is a tributary to Teatree Hollow (**Table 3**). The streams have flow controlling features along their alignments that include rockbars, riffles, knick points and debris accumulations (MSEC, 2022).

In addition to these drainage channels there are a number of intermitted watercourses and numerous small farm dams. All drainage channels within the Study Area are considered low flow or intermittent channels suggesting that the number of users dependent on flows from these watercourses is limited.

Table 3 Streams within the Study Area

Location	Stream Order	Description
Teatree Hollow	3rd Order	Located directly above the proposed LW S1A-S6A, with a total length of 2.1 kilometres directly mined beneath.
Wirrimbirra Creek	3rd Order	Located directly above the proposed LW S1A-S4A, with a total length of 1.3 kilometres directly mined beneath

2.3.2 Licenced Surface Water Users

The Study Area is located within the Maldon Weir Management Zone of the Upper Nepean and Upstream Warragamba Water Source which is regulated in accordance with the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011. The NSW Water Register indicates there is one WAL is associated with a property located within the Study Area and one WAL is associated with a property located adjacent to the Bargo River downstream of the Study Area (Tahmoor Coal, 2022).

2.3.3 Groundwater

The Study 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 Study 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 Study 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 (Geoterra, 2013).

Illawarra Coal Measures

The Illawarra Coal Measures exhibit low permeability 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).

2.3.4 Licenced Groundwater Users

The Study Area is covered by the Greater Metropolitan Groundwater Sources Water Sharing Plan. Five Department of Industry (Water) registered bores are located within the Study Area, with a further three bores located within the vicinity of the Study Area (**Table 4**). The majority of bores are registered for stock and/or domestic use. Groundwater for these bores is sourced from the Hawkesbury Sandstone Aquifer (SLR, 2022).

Table 4 Registered Groundwater Users

Identifier	Depth (m)	Purpose	Current Use	In Study Area
GW105883	Unknown	Domestic	Water feature & garden irrigation	Outside
GW104323	109	Stock & Domestic	On timer for crop irrigation	Yes
GW032443	130.1	Irrigation	Not currently used	Yes
GW109257	120	Stock & Domestic	Not used, previously used to fill dam	Yes
GW014262	48.8	Stock	Unknown	Yes
GW104659	132	Irrigation	Replenish adjacent dam by timer	Yes
GW111810	142	Stock & Domestic	Used for irrigation via holding tanks	Outside
GW105847	Unknown	Stock & Domestic	Unknown	Outside

2.4 Geology

The Study Area is located within the southern area of the Permo-Triassic Sydney Basin. The main coal bearing sequence is the Illawarra Coal Measures, which contains four workable seams. The upper most seam, located in the north-western part of the Illawarra Coalfield, is the Bulli Seam. 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 Illawarra Coal Measures and is comprised of interbedded sandstones and claystone units up to 310 metres thick. Overlying the Narrabeen Group is the Hawkesbury Sandstone 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, which tends to act as an aquitard.

2.5 Soil Landscape Units

Soil Landscapes Units (SLU) within the Study 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 3**. four soil landscapes occur in the Study Area and are summarised in **Table 5.**

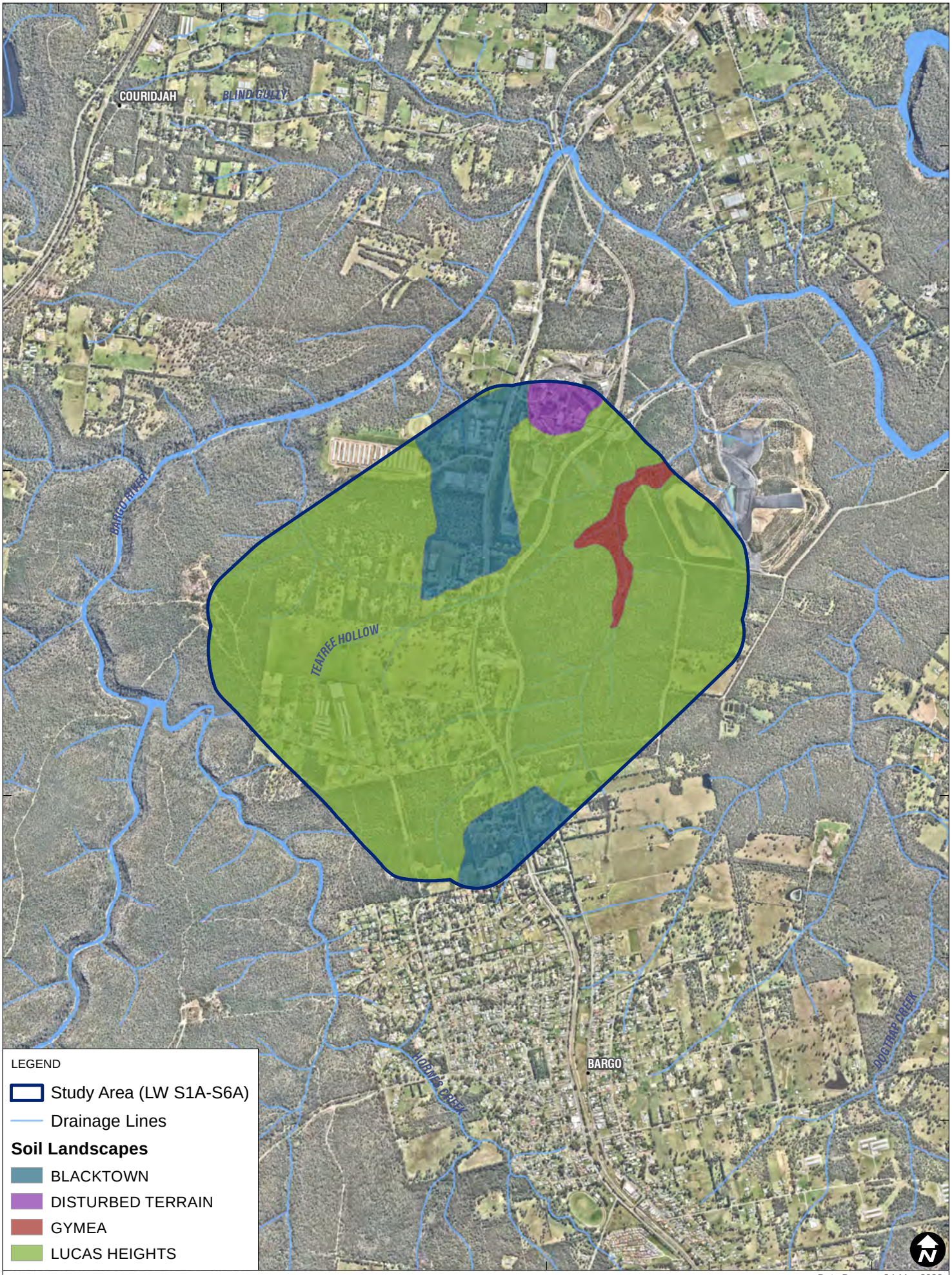
Below is a summary of the key agricultural features of each SLU:

- The majority of the Study Area (88%) is highly constrained for cultivation.
- The Gymea and Disturbed Terrain SLU are highly to severely constrained for any agricultural enterprises, which covers 4% of the Study Area.
- Agricultural land best suited to grazing enterprises is the Blacktown, SLU which covers 12% of the Study Area.
- Lucas Heights SLU has moderate limitations for grazing and high limitations for cultivation and covers the majority (84%) of the Study Area.

Table 5 Soil Landscape Units

Soil Landscape	Study Area		Agricultural Limitation Rating	
Unit	Hectares	%	Grazing	Cultivation
Gymea	14	2	High – Severe	High – Severe
Disturbed Terrain	12	2		
Sub Total	**26**	**4**		
Lucas Heights	572	84	Moderate	High
Blacktown	85	12	Low	Moderate
Total	**682**	**100**		

Source: *Soil Landscapes of the Wollongong – Port Hacking 1:100,000 Sheet* (Hazelton & Tille, 1990)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TEATREE HOLLOW
BARGO
HORNERS CREEK
DOGTRAP CREEK
LEGEND
Study Area (LW S1A-S6A)
Drainage Lines
Soil Landscapes
BLACKTOWN
DISTURBED TERRAIN
GYMEA
LUCAS HEIGHTS
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Soil Landscape Units
FIGURE 3

2.6 Dominant Soil Types and Inherent Fertility

The two dominant Australia Soil Classification (ASC) soil types were digitally mapped by the Office of Environment & Heritage (now NSW Heritage) and are shown on **Figure 4**. Three soil types are present in the Study Area, dominated by Kurosols with some smaller areas of Dermosols and Rudosols & Tenosols (**Table 6**). These soil types are summarised in the major points listed below:

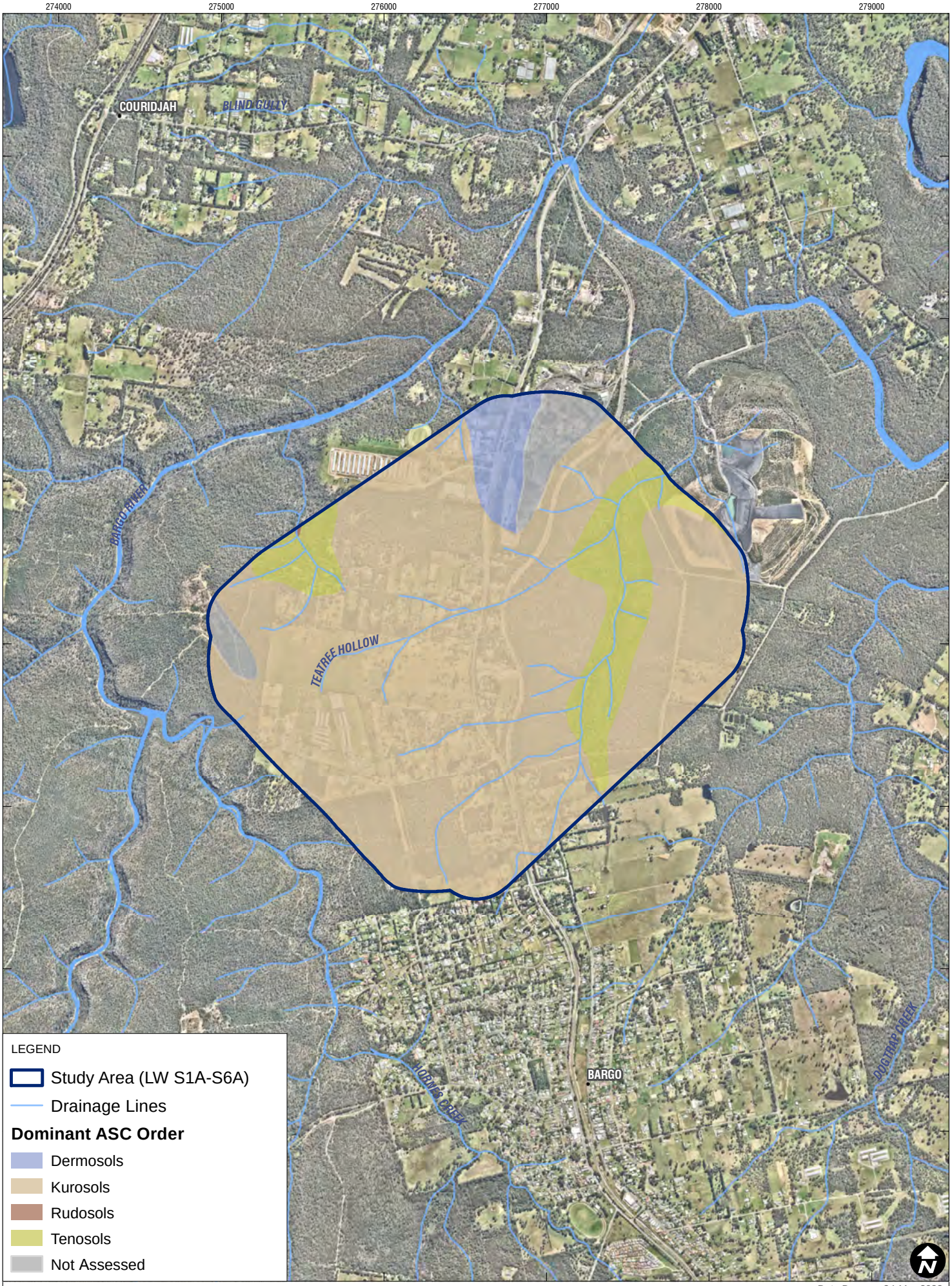
- Kurosols are the main soil type within the Study Area. Kurosols are soils with a strong texture contrast between the A horizons and strongly acidic B horizons and often have unusual subsoil chemical attributes such as high magnesium, sodium and aluminium. Kurosols generally have moderately low inherent fertility and comprise 80% of the Study Area.
- Tenosols are a minor soil type within the Study Area comprising 12% of the total area. 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, generally with moderately low inherent fertility.
- Rudosols comprise <1% of the Study Area and are soils with negligible pedologic organisation, often characterised by a very sandy texture. They are generally young soils which have not had time form structurally with low inherent fertility.
- Dermosols are the remaining soil type within the Study Area comprising 4% of the total area. 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 and high agricultural potential with good structure and water-holding capacity.
- Areas of mine disturbance are not allocated an ASC soil type and comprise 4% of the Study Area.

Table 6 Dominant Soil Types and Inherent Fertility

Australian Soil Classification	Inherent Fertility	Hectares	%
Kurosol	Moderately Low	547	80
Tenosol	Moderately Low	82	12
Dermosol	Moderately High	25	4
Rudosol	Low	<1	<1
Not Assessed (Mine Disturbance)	N/A	28	4
	Total	**682**	**100**

2.7 Acid Sulfate Soils

The likelihood of acid sulfate soils occurring within the Study Area is very low due to its position away from the coast and potential acid sulfate landform type. Furthermore, none of the Soil Landscape Units mapped within the Study Area have acid sulfate soil potential.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ASC Soil Type
FIGURE 4

2.8 Vegetation and Land Use

Review of recent aerial images shows only a minor portion of the Study Area comprises of cleared pastoral land (approximately 27%) that may be suitable for agricultural enterprises, as shown in **Figure 5**. The remainder comprises thick native vegetation along riparian zones and steep slopes, along with mine disturbance areas and small holdings used as rural residential land.

Site inspections in June 2013 and December 2017 by SLR's Principal Agronomist showed several differing agricultural land uses within and adjacent to the Study Area, with poultry production being the main agricultural enterprise. The various land uses at each site were recorded and are shown on **Figure 5** and described in **Table 7**. Plates for each inspection site are shown in **Appendix A**.

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 agriculture and an increase toward rural residential areas. No intensive cropping activities were observed at the time of the inspection and assessment.

Table 7 Observed Land Uses

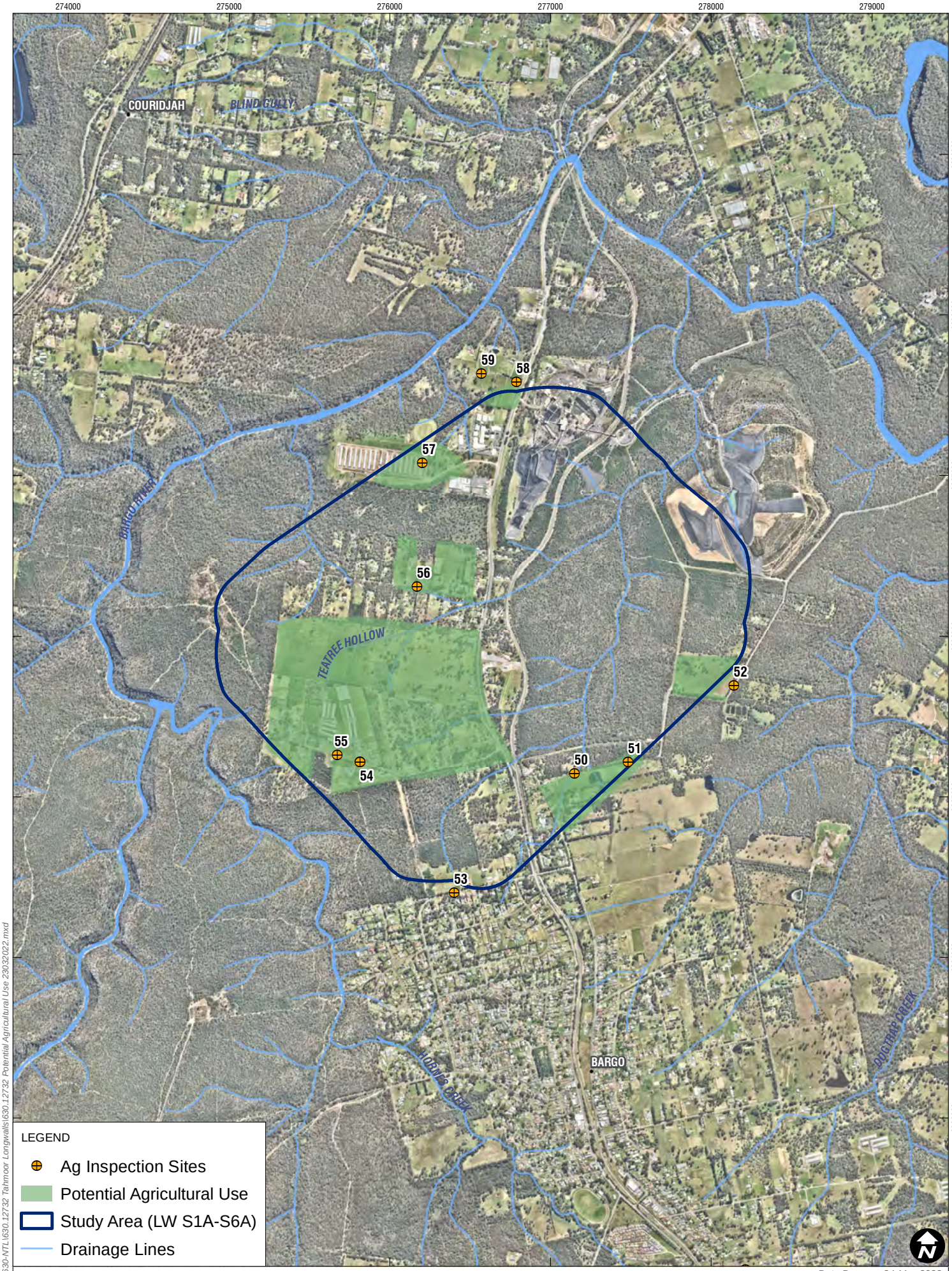
Inspection Site	Land Use
49	Pleasure horses
50	Cattle grazing
51	Cattle feedlot 2013, disused cattle feedlot 2017
52	Pleasure horses
53	Rural residential
54	Hydroponic lettuce and poultry sheds
55	Poultry sheds
56	Cut flower greenhouse 2013, disused cut flower greenhouses 2017
57	Poultry sheds
58	Olives & sheep grazing
59	Irrigated olives & alpaca stud

Grazing is the major agricultural land use within the Study Area (by area) appears to be commonly used as a grass and vegetation management tool rather than an income generating agricultural enterprise. Overall farm size is considered small and many would be classified as hobby farms with a very low potential to produce significant agricultural income. Approximately 182 hectares of potential grazing land is currently available for agricultural use. As previously described in correspondence received from DPI, poultry farms are a significant industry in the area, with three located within and adjacent to the Study Area (**Figure 5**). **Plate 1** and **Plate 2** show two of the intensive agricultural land uses within the area.

Native vegetation, present predominantly in riparian zones within the Study Area, was mapped during the Native Vegetation of Southeast NSW mapping project (Tozer et al., 2006). It includes 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), and a small area of Cumberland River Flat Forest which is listed as an EEC on the BC Act.

Plate 1 Poultry sheds at Site 55

Plate 2 Hydroponic Lettuce at Site 54



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Potential Agricultural Use

FIGURE 5

2.9 Land and Soil Capability Classification

2.9.1 Land and Soil Capability Methodology

The Land and Soil Capability (LSC) classification applied to the Study Area was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second Approximation* (OEH, 2013). 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, which classify the land based on the severity of long-term limitations. The LSC classes are described in **Table 8** and their definition has been based on two considerations:

- 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 land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to 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.

2.9.2 Determining LSC Classes

The LSC for the Study Area has been digitally mapped by the OEH and is summarised in **Table 9** and shown in **Figure 6**. The limitations associated with each LSC Class are discussed below.

Table 9 Land and Soil Capability Areas

LSC Class	Agricultural Capability Rating	Hectares	%
4	Moderate	572	84
6	Low	82	12
7	Very Low	<1	<1
Mine Disturbed	Nil	28	4
	Total	**682**	**100**

LSC Class 4 Land

Class 4 land is associated with Dermosols and Kurosols. This classification indicates a moderate land capability, with moderate to serve limitations for some land uses that need to be consciously managed to prevent soil and land degradation. This land is capable of pasture improvement and can be tilled for an occasional crop. LSC Class 4 land comprises the majority (84%) of the Study Area.

LSC Class 6 Land

Class 6 land is associated with Kurosols. The classification indicates low land capability, with very high limitations for high impact land management uses such as cropping. The land is generally more suitable to low impact land uses such as grazing with limitations. LSC Class 6 land comprises 12% of the Study Area.

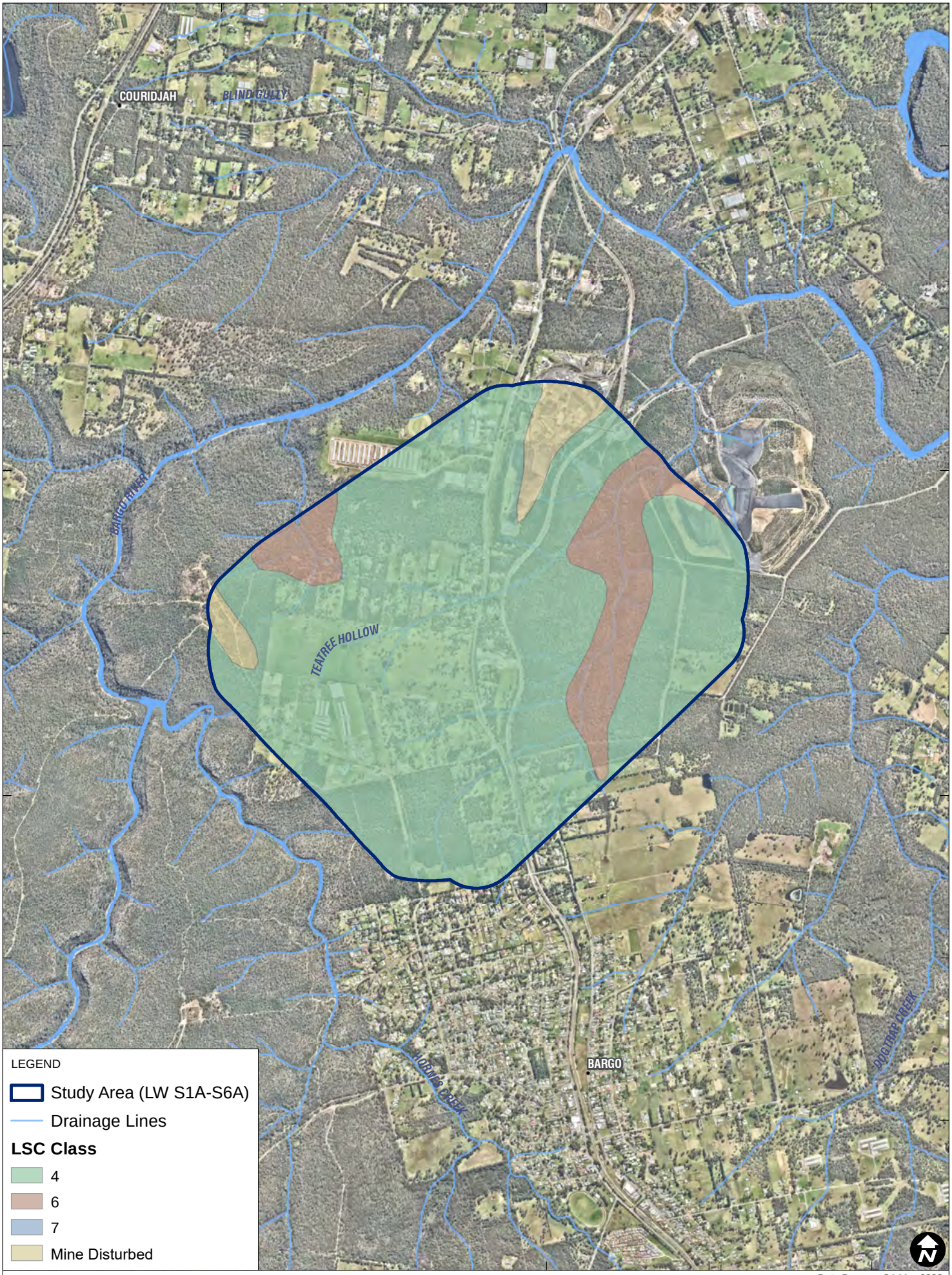
LSC Class 7 Land

Class 7 land indicates very low capability land, with severe limitations for most land uses. It is generally unsuitable for any type of cropping or grazing due to its limitations. It covers a minor portion of the Study Area (<1%).

Within the Study Area, 16% of the land area is considered to have low to very low agricultural capability according to definitions given in *The Land and Soil Capability Assessment Scheme: Second Approximation* (OEH, 2013), whilst the remainder has moderate to moderately low agricultural capability.

2.10 Biophysical Strategic Agricultural Land

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* (DPI, 2013) is between Douglas Park and Camden, approximately 20 kilometres to the north-east of the Study Area.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HORNETS CREEK
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DOGTRAP CREEK
LEGEND
Study Area (LW S1A-S6A)
Drainage Lines
LSC Class
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6
7
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km
Scale: 1:30,000 at A4
Coordinate System: GDA 1994 MGA Zone 56
Date Drawn: 24-Mar-2022
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SLR
Land and Soil Capability
FIGURE 6

3 Local and Regional Agricultural Enterprises

3.1 Regional 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, Picton, in 1841.

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, 2020).

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, 2020).

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, 2020).

3.2 Agricultural Enterprises and Associated Industries

3.2.1 Regional 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 [2011 is the latest regional agricultural data available from ABS]). The agricultural land use is outlined 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 were 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 regional agricultural data available from ABS

3.2.2 Regional 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.** 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 Study Area; however the main agricultural activities generating income within and adjacent to the Study Area observed during the site inspection were small scale horse and cattle grazing along with a number of poultry farms and orchards.

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) - 2011 is the latest regional agricultural data available from ABS

Table 12 Wollondilly LGA Agricultural Related Employment by Sector

Agricultural Production	Number of People	%
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 and 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, Liquor and Tobacco Product Retailing and Wholesaling	113	5
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) - 2011 is the latest regional agricultural data available from ABS

3.3 Regional Agricultural Production Value

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 [2011 is the latest regional agricultural data available from ABS]).

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) - 2011 is the latest regional agricultural data available from ABS

3.4 Potential Agricultural Production Value of the Study Area

Potential agricultural productivity was determined using NSW DPI agricultural gross margin productivity data for agricultural enterprises suitable for each of the LSC classes (see **Section 2.9**) that are present within the Study Area. This analysis has been undertaken on the potential capability of the land rather than current land use. If potential agricultural production values were to be pursued, significant investment in land management and agricultural infrastructure would be required. However, this information can be used to approximate potential farm incomes.

The *Beef Cattle Gross Margin Budget Inland Store Weaners* (DPI, 2019) has been applied to this assessment to determine potential agricultural income for the Study Area. The *NSW Department of Primary Industries Beef Stocking Rates & Farm Size* (DPI, 2006) was used to determine stocking rates in Dry Sheep Equivalents (DSE) for the three LSC's mapped within the Study Area. Full agricultural gross margin information is contained in **Appendix B**.

Table 14 summarises the potential gross margins for each applicable agricultural enterprise per LSC Class. The major points are listed below:

- Class 4 land has the potential to generate approximately $227 per hectare from beef cattle grazing enterprises (yearling beef production).
- Class 6 land has the potential to generate approximately $116 per hectare from beef cattle grazing.
- Class 7 land has the potential to generate approximately $58 per hectare from beef cattle grazing.
- Mine Disturbed land has no agricultural rating and no potential to generate income in its current guise.

Table 14 Gross Margin per LSC Class

LSC	Stocking Rate	Cow & Calf Equivalent	Revenue	Variable Costs	Gross Margin
Class	DSE	Per Hectare	Per Hectare	Per Hectare	Per Hectare
4	8	0.47	$282	$55	$227
6	4	0.24	$144	$28	$116
7	2	0.12	$72	$14	$58

Based on the nominated gross margins, and assuming the required agricultural capital costs and fixed costs are outlaid (not included in the calculations in **Table 14**), the Study Area has the capacity to generate an estimated gross margin of $139,412 per annum (**Table 15**). It is important to note that these figures are derived from the optimum potential uses and are likely to be higher than the actual incomes being achieved from the area under actual production.

Table 15 Annual Gross Margins per LSC Class

LSC	Gross Margin	Study Area	
Class	Per Hectare	Hectares	Gross Margin
4	$227	572	$129,939
6	$116	28	$9,473
7	$58	<1	Nil
	Total	**682**	**$139,412**

It is expected that income generated from agricultural enterprises within the Study Area would be less than that presented in **Table 13**, due to the small area (182 hectares) available for actual agricultural production (**Figure 5**). The majority of this cleared area is LSC Class 4 and using the gross margin information presented in **Table 14**, beef cattle grazing 182 hectares of LSC Class 4 land has a potential gross margin of $41,347 per annum.

3.5 Regional 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 Study Area is a number of large farm dams which are used for cattle and horse grazing areas.

There are two abattoirs located nearby 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 50 kilometres south-west of the Study 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 and growing sheds, farm dams and groundwater extraction bores.

4 Assessment of Potential Impacts

The primary potential impact to agricultural resources is from subsidence. MSEC (2022) predicts maximum vertical subsidence to be 1,350 millimetres over LW S5A-6SA. Maximum predicted tilt is 9.5 millimetres per metres over LW S6A which is very small when compared to the natural surface grade of slopes within the Study Area.

4.1 Land Resources

4.1.1 Land Temporarily Removed from Agriculture

Based on the natural landscape contours and the predicted subsidence contours, there is unlikely to be any remnant ponding in the agricultural landscape (Tahmoor Coal, 2022). Therefore, there is no land which will be temporarily removed from agriculture as a result of LW S1A-S6A.

4.1.2 Land Permanently Removed From Agriculture

There is no land which will be permanently removed from agriculture as a result of LW S1A-S6A.

4.1.3 Acid Sulfate Soils

As outlined in **Section 2.7** there are no Soil Landscape Units associated with the Study Area with acid sulfate potential. LW S1A-S6A will not impact upon acid sulfate soils.

4.1.4 Impact on Biophysical Strategic Agricultural Land

There is no Biophysical Strategic Agricultural Land within or adjacent to the Study Area. LW S1A-S6A will not impact any Biophysical Strategic Agricultural Land.

4.2 Water Resources

4.2.1 Surface Water

Based on the previous experience of mining beneath streams at Tahmoor Mine, it is likely that fracturing and surface flow diversions will occur in the sandstone bedrock along the streams over LW S1A-S6A, particularly for streams that are located directly above the proposed longwalls. In some of these locations, the fracturing could impact the holding capacity of the standing pools, particularly those located directly above the proposed longwalls. It is unlikely, however, that there would be any net loss of water from the catchment (MSEC, 2022).

Given that drainage channels within the Study Area are considered low flow or intermittent channels, the impact on agricultural users dependent on flows from these watercourses is negligible.

4.2.2 Groundwater

The NSW Aquifer Interference (AI) Policy 2012 established a 2 metre threshold as the maximum allowable drawdown for ‘water supply works’ in order to satisfy the considerations for ‘minimal harm’.

As shown in **Table 16,** all assessed bores will have a predicted drawdown of greater than 2 metres, however all have a greater available drawdown than the predicted drawdown, allowing continued access to groundwater for irrigation and stock & domestic purposes (SLR, 2022).

Table 16 Predicted Impacts to Private Bores

Identifier	Purpose	Condition	Potential Drawdown (m)	Available Drawdown (m)
GW105883	Domestic	Operational	N/A	N/A
GW104323	Stock & Domestic	Operational	14.8	40.4
GW032443	Irrigation	Not currently used	80.1	129.4
GW109257	Stock & Domestic	Not currently used	75.1	82.9
GW014262	Stock	Unknown	5.9	N/A
GW104659	Irrigation	Operational	10.2	88.2
GW111810	Stock & Domestic	Operational	14.8	82.0
GW105847	Stock & Domestic	Unknown	N/A	N/A

N/A = not available

4.2.3 Water Reallocation

Tahmoor Mine currently holds three groundwater extraction licences for a total of 1,642 megalitres, utilised for mine dewatering. However, this water would not be considered as being taken from potential agricultural use as 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, this water would not be considered as being taken from potential agricultural production as the licences are restricted to mine de-watering only. There will be no impact on agricultural users through water reallocation.

4.2.4 Water Resource Impacts on Agricultural Productivity

Given the impacts described previously, longwall subsidence will result in limited impacts on water resources relied upon by agricultural enterprises and should not result in impacts on agricultural productivity. There is no predicted increase in total dissolved salts or sodium in groundwater bores associated with LW S1A-S6A (SLR, 2022).

4.3 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 Tahmoor South 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.

The extraction of LW S1A-S6A is not expected to result in the establishment of any further biodiversity offsets; therefore there will be no impact to agricultural resources resulting from biodiversity offsets.

4.4 Other Impacts

4.4.1 Visual Amenity and Landscape Values

Site inspection during 2013 and 2017 by SLR's Principal 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 extraction of LW S1A-S6A is considered to have negligible impact on visual amenity and landscape value relied upon by local and regional agricultural enterprises.

4.4.2 Tourism

The assessment has not identified any tourism infrastructure within the local area upon which agricultural enterprises are reliant. Therefore, LW S1A-S6A is not anticipated to impact on agriculture-related tourism.

4.4.3 Weed Management and Biosecurity

There is no risk from weed infestation during the extraction of LW S1A-S6A through vehicle movements on and off site. Weeds are currently managed within the frameworks of the Tahmoor Coal Environmental Management System.

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 extraction of LW S1A-S6A has negligible risk to the biosecurity of agricultural resources and enterprises within the region.

4.4.4 Air Quality

The extraction of LW S1A-S6A involves the extraction of six underground longwall panels and as such there will be no impact to air quality resulting from LW S1A-S6A.

All other activities associated with the Tahmoor South Project that have the potential to create dust will be undertaken in accordance with the approved Air and Greenhouse Gas Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.

4.4.5 Noise

The extraction of LW S1A-S6A involves the extraction of six underground longwall panels and as such there will be no impacts to agricultural production from noise generated during the extraction of LW S1A-S6A.

All other activities associated with the Tahmoor South Project that have the potential to generate noise will be undertaken in accordance with the approved Noise Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.

4.4.6 Blasting

The extraction of LW S1A-S6A does not involve any blasting on the surface and as such there will be no impact to agricultural resources from blasting.

All other activities associated with the Tahmoor South Project that have the potential to generate noise will be undertaken in accordance with the approved Noise Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.

4.4.7 Traffic

The extraction of LW S1A-S6A involves the extraction of six underground longwall panels with no increased surface traffic movements, and as such the impact to agricultural resources as a result of increased traffic movements is considered negligible.

All other activities associated with the Tahmoor South Project that have the potential to increase surface traffic movements will be undertaken in accordance with the approved Traffic Management Plan for any onsite construction as well as the ongoing operation of Tahmoor Mine.

4.4.8 Rural Structures

The majority of rural structures within the Study Area are of lightweight construction and are expected to tolerate mining induced tilt. It has been found from past longwall mining experience that tilts of the magnitudes predicted for LW S1A-S6A generally have limited adverse impacts on rural structures. Some minor serviceability impacts could occur at the higher levels of tilt, including door swing and issues with roof and pavement drainage. These serviceability impacts can generally be remediated using normal building maintenance techniques (MSEC, 2022).

Impacts on the rural structures that occur as the result of the extraction of the proposed longwalls are expected to be remediated using well established building techniques and it is unlikely that there would be long term impacts on rural structures resulting from the extraction LW S1A-S6A. It is considered that rural structures can be maintained at all times during the extraction of the proposed longwalls, even if actual subsidence movements were greater than the predictions or substantial non-conventional movements occurred (MSEC, 2022).

4.4.9 Tanks

There are water, gas and fuel storage tanks on some of the properties within the Study Area. There are 74 tanks which have been identified within MSEC's Subsidence Study Area, just less than half of which are not directly above LW S1A-S6A (MSEC, 2022).

Storage tanks are typically constructed above ground level, and therefore are unlikely to experience the full ground movements resulting from the proposed mining. It is possible, that any buried water pipelines associated with the tanks within the Study Area could be impacted by the ground strains, if they are anchored by the tanks, or by other structures in the ground. Any impacts are expected to be of minor nature and easily repaired (MSEC, 2022).

4.4.10 Farm Fencing

Farm fences are generally flexible in construction and can usually tolerate mine subsidence movements. Impacts to fences may include tension loss and changes to post alignment. The most vulnerable section of farm fences are gates, particularly long gates, or those with latches as they are less tolerant to differential horizontal movements and tilts between the gate posts and the ground. Any impacts on the wire fences or gates are likely to be of a minor nature and relatively easy to remediate by re-tensioning the fencing wire, straightening the fence posts, and if necessary, replacing some sections of fencing (MSEC, 2022).

4.4.11 Farm Dams

There are 45 farm dams which have been identified within the MSEC Subsidence Study Area. The length of farm dams within the MSEC Subsidence Study Area vary between 8 metres and 99 metres and the plan areas vary between 26 m^2 and 5,047 m^2. The dams are typically of earthen construction and have been established by localised cut and fill operations within the natural watercourses. The farm dams are generally shallow, with the dam wall heights generally being less than 3 metres (MSEC, 2022).

The maximum predicted final tilt for the farm dams is 0.75 %, which represents a change in grade of 1 in 133. Mining induced tilts can affect the water levels around the perimeters of farm dams, with the freeboard increasing on one side, and decreasing on the other. The predicted changes in freeboard at the farm dams within the Study Area is less than 300 millimetres at 41 dams, and it is unlikely that the majority of the farm dams within the would experience adverse impacts on the storage capacities due to these small changes in freeboard (MSEC, 2022).

The predicted changes in freeboard are greater than 500 millimetres at one 1 dam within the Study Area (i.e. < 1 % of the total). It is possible, that this dam could experience a reduced storage level, however, this could be remediated by increasing the height of the affected dam wall.

The maximum predicted conventional curvatures and strains for farm dams could be sufficient to result in cracking in the bases and walls of some farm dams within the Study Area.

4.4.12 Surface Water Extraction

At locations of minimum natural gradient, the predicted subsidence may result in a very slight reduction in surface grade (i.e. less than 1%). This level of change is not expected to result in impacts to overland flow and therefore impacts to registered surface water extraction will be negligible (Tahmoor Coal, 2022).

4.4.13 Groundwater Wells and Bores

Temporary lowering of the regional piezometric surface over the subsidence area due to extraction of LW S1A-S6A may occur, with impacts more notable directly over extracted panels. Groundwater levels may reduce up to 80 metres at GW032443 and GW109257, which are located directly over LW S1A and S4A, however neither of these bores are in use. The remaining four assessed private bores are anticipated have a drawdown of between six and 15 metres, with all bores having an available drawdown greater than the predicted drawdown (**Table 16**), meaning there will still be water available for extraction (SLR, 2022).

It is anticipated that groundwater levels will recover over a few months to two to three years. However, it must be noted the rate of groundwater level recovery is significantly affected by climatic conditions at the time. There is no predicted permanent post mining reduction in the Hawkesbury Sandstone Aquifer groundwater levels (SLR, 2022).

4.4.14 Impact on State Forest

There are no State forests or conservation areas present within the Study Area. The extraction of LW S1A-S6A is not expected to impact the State Forest.

4.4.15 Poultry Sheds

There are 21 poultry sheds within the Study Area. The poultry sheds are lightweight structures up to 113 metres in length. The Inghams Bargo Chicken Breeder Complex Production Complex is located on Remembrance Drive, beyond the finishing ends of LW S2A-S3A. The Inghams Turkey Farm and Bargo Valley Produce poultry sheds are located on Yarran Road, to the west of LW S6A. Part of one shed at Bargo Valley Produce is located directly above LW S6A.

The poultry sheds are predicted to experience relatively mild conventional subsidence, tilt, curvatures and strains. Tilt can potentially affect the serviceability of poultry sheds by altering the watering and drainage systems in the sheds. The predicted changes in grade are small and unlikely, therefore, to result in any adverse impacts on the serviceability of the tanks. Mining-induced curvature and ground strain can result in the opening of gaps or cracks in the wall linings of the poultry sheds. The potential for impacts are, however, considered low as only one shed at Bargo Valley Produce is above the proposed LW S6A.

It is expected that the predicted mine subsidence movements on the poultry sheds and ancillary building structures can be managed by the implementation of suitable management strategies, including visual monitoring during active subsidence (MSEC, 2022).

4.4.16 Horticulture & Permaculture

Irrigation Systems

Irrigation systems are used on commercial and private properties for production of olives, lettuce and other horticultural applications. Elevated troughs are located on Bargo Valley Produce on Yarran Road, to the west of LW S6A. Irrigation systems are usually constructed from polyethylene pipes which can tolerate ground movements much larger than the predicted mine subsidence movements within the Study Area. Elevated strains can occur in the pipelines where they are anchored to the ground, or where they are subjected to non-systematic ground movements. Impacts are expected to be minor, including leaking joints, which could be readily remediated (MSEC, 2022).

Glass Houses

No glass houses have been identified within the Study Area, though there are a number of greenhouses and hothouses. As these structures are relatively lightweight in construction, they are usually able to tolerate differential subsidence movements. Impacts can occur, e.g., if the roof materials are designed to be slid open or closed to ventilate the greenhouse or hothouse, differential horizontal movements can cause the frames to crack and prevent sliding of the materials. It is expected that the predicted mine subsidence movements on the greenhouses and hothouses can be managed by the implementation of suitable management strategies, including visual monitoring during active subsidence (MSEC, 2022).

Hydroponic Systems

There are no known hydroponic systems within the Study Area. However, there are a number of greenhouses and hothouses. These buildings may have hydroponic systems. While the water pipes are usually flexible and able to tolerate differential subsidence movements, the drainage of the systems may require monitoring and adjustment, if necessary. It is expected that the predicted mine subsidence movements on the hydroponic systems can be managed by the implementation of suitable management strategies, including visual monitoring during active subsidence (MSEC, 2022).

4.4.17 Agricultural Regional Community Impacts

No other impacts which may affect the regional agricultural community, resources or enterprises have been identified in this assessment.

4.4.18 Cumulative Impacts

Given the previously described impacts are of a minor nature and readily managed through application of appropriate mitigation measures and management strategies, any cumulative impacts on agricultural resources and enterprises are also expected to be minor and readily mitigated.

5 Mitigation Measures and Management Strategies

This section describes the proposed mitigation measures and management strategies recommended to minimise potential agricultural impacts. Whilst the majority of impacts on agricultural enterprises and resources have been assessed as negligible, as a matter of best practice, Tahmoor Coal has adopted a number of mitigation measures to further minimise these impacts. A summary of key measures specifically in relation to potential agricultural impact is provided below.

5.1 Soil Resources

Whilst there are no earthworks proposed during the extraction of LW S1A-S6A, in the unlikely event they would be required, gypsum will be applied for any remediation earthworks where sodic subsoils (exchangeable sodium is greater than 5%) are exposed. The application of gypsum will minimise the potential for tunnel erosion to occur on disturbed subsoil. The recommended application rates are shown in **Table 17**.

Table 17 Gypsum Application Rates

Exchangeable Sodium (ESP)	Gypsum Rate per Hectare	Gypsum Rate per Square Metre
5 to 10%	2 to 5 tonnes	0.2 to 0.5 kilograms
Greater than 10%	5 tonnes	0.5 kilograms

It is noted that there are no soil stripping or stockpiling activities anticipated within the Study Area associated with the extraction of LW S1A-S6A.

5.2 Surface Water Resources

Where impacted watercourses have sediment accumulations upstream, it is expected that some of the fractures would be naturally filled over time with sediment during subsequent flow events, as has previously been observed. Where little sediment is present, the impacts are likely to remain for longer periods of time and remediation may be required after the completion of mining, which could include sealing these fractures and voids with grout (MSEC, 2022).

Tahmoor Coal has previously developed Water Management Plans to manage the potential impacts on streams during the mining of longwalls. The management plans include ground monitoring, water quality and pool level monitoring and visual inspections. The plans also commit to remediation of aquatic ecosystems if impacts occur. A Water Management Plan has been prepared as part of the Extraction Plan for LW S1A-S6A.

5.3 Groundwater Resources

All currently operating private bores are predicted to be impacted by a maximum incremental drawdown of greater than two metres, however all impacted bores have a greater available drawdown than the predicted drawdown. Tahmoor Coal have committed to “make good” provisions for any groundwater users shown to be adversely affected by mine operations and associated impacts. These commitments are detailed in the Water Management Plan, which has been prepared as part of the Extraction Plan for LW S1A-S6A.

Although, groundwater quality is not predicted to adversely change, it will continue to be monitored and compared to groundwater quality triggers in the Trigger Action Response Plans which are prescribed to act as early warning measures for any changes in groundwater quality

5.4 Tanks

Only minor impacts to tanks are expected, if impacts occur the structure will be repaired in accordance with the *Coal Mine Subsidence Compensation Act 2017*.

5.5 Farm Fencing

In the unlikely event of damage to fence tensioning or farm gates, Tahmoor Coal will remediate the damage in consultation with relevant stakeholders.

5.6 Farm Dams

It is expected that all farm dams in the Study Area can be maintained during the extraction of the proposed longwalls, even if impacts were greater than the predictions or substantial non-conventional movements occurred. Any substantial cracking in the dam bases or walls within the Study Area could be repaired by reinstating with cohesive materials. If any farm dams were to lose water as a result of mining, Tahmoor Coal would provide an alternative water source until the completion of repairs in accordance with the *Coal Mine Subsidence Compensation Act 2017* (MSEC, 2022).

6 Monitoring & Consultation

Tahmoor Coal notifies all residents and/or businesses within the 20 millimetre subsidence area and 35 degree angle of draw prior to commencement of all first and second workings. Comprehensive monitoring of all potentially impacted properties within these areas is undertaken from the commencement of extraction, and continues regularly until extraction is completed. Further monitoring is completed during the post-extraction phase in accordance with the relevant management plan for the residence / business (refer to the Extraction Plan for further details).

Agricultural reports completed during the extraction of Longwalls West 1, West 2 and West 3 in the Western Domain show that no impacts to agricultural resources or enterprises have been observed during the extraction of these longwalls. These inspections are based on baseline reporting undertaken by SLR prior to the commencement of extraction. An example of this reporting, the *Tahmoor Coal LW W1-W2 Agricultural Inspection Report*, is given in **Appendix C**.

In relation to the poultry enterprises that exist in the area, that the owner/manager as well as the processor/owner of the birds will be consulted during the preparation of the relevant management plan for each agricultural business to ensure that production plans can be adjusted if required. Monitoring will also be detailed in the relevant management plan, as agreed during consultation with the poultry enterprises.

Tahmoor Coal keeps a complaints register for any public matters resulting from aspects of mine operation. The complaints register is tracked using the compliance program Cority, which allows Tahmoor Coal to enter the details of complaints, as well as details of investigation procedures and outcomes as required. Tahmoor Coal also employs a Consultation Manager to track and undertake consultation with landowners.

7 Findings

This Land and Agricultural Resource Assessment has been prepared to be included in Tahmoor Coal's Extraction Plan LW S1A-S6A. The purpose of this Land and Agricultural Resource Assessment is to assess and report on the potential impacts on agricultural resources within and adjacent to the Study Area and recommend mitigation measures to alleviate any identified impacts. The key findings are listed below:

- The majority agricultural land use by area within the Study Area is for small scale cattle and horse grazing areas, which are not major contributors to agricultural income generation. This small scale grazing is mostly carried out as a land and vegetation management tool. Land available for agricultural land use comprises 27% of the Study Area.
- There are three poultry enterprises within the Study Area, and impacts are expected to be minor and readily remediated using well accepted techniques.
- Post-mining agricultural economic potential in the Study Area is expected to be very similar to pre-mining potential.
- The longwall mining will have minor impacts on surface and groundwater resources relied upon by agriculture, comprising two WALs and six private bores. Any surface or groundwater impacts will be "made good" by Tahmoor Coal.
- Any impacts resulting from longwall mining are expected to be minor and temporary, and can be managed through application of appropriate mitigation measures and management strategies.
- As a result of any impacts being minor, any cumulative impacts on agricultural resources and enterprises are also expected to be minor, and can be managed through application of appropriate mitigation measures and management strategies.
- Continuation of longwall mining by Tahmoor Coal will provide considerable positive economic benefits to the local and broader communities. These benefits are far greater than any potential income lost by existing or potential agricultural enterprises.

In summary, the extraction of LW S1A-S6A will provide considerable economic benefits to the region whilst having negligible impact on agricultural resources, enterprises or related industries.

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Appendix A

Site Inspection Plates

Site 50 – Cattle grazing

Site 51 – Cattle feedlot 2013, disused cattle feedlot 2017

Site 52 – Pleasure horses

Site 53 – Rural residential

Site 54 – Hydroponic lettuce and poultry sheds

Site 55 – Poultry sheds

Site 56 – Cut flower greenhouse 2013, disused cut flower greenhouses 2017

Site 57 – Poultry sheds

Site 58 – Olives & sheep grazing

Site 59 – Irrigated olives & alpaca stud

Appendix B

Agricultural Productivity Gross Margin Data

NSW GOVERNMENT | Department of Primary Industries

BEEF CATTLE GROSS MARGIN BUDGET

Farm enterprise Budget Series: April 2019

Enterprise: **Inland store weaners**

Enterprise Unit: **100 cows**

Pasture: **Native pasture**

INCOME:			**Standard Budget**	**Your Budget**
42	steer weaners @	$725 /hd	$30,467	
21	heifer weaners @	$463 /hd	$9,727	
1	CFA Bull @	$1,554 /hd	$1,554	
6	CFA cows @	$963 /hd	$5,779	
0	Dry cows @	$963 /hd	$0	
13	Other culls @	$963 /hd	$12,522	
83				
	A. Total Income:		**$60,049**	

VARIABLE COSTS:						
Replacements	1	Bull @	$3,500	/hd	$3,500	
Livestock and vet costs: see section titled beef health costs for details.					$1,244	
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)					$4,776	
		B. Total Variable Costs:			**$11,770**	

GROSS MARGIN (A-B)	**$48,279**
GROSS MARGIN/COW	**$482.79**
GROSS MARGIN/DSE*	**$32.45**
GROSS MARGIN/HA	**$129.78**

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 269c/kg and steer weight to 240 kg, gross margin would fall to $419 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**				
		259	**269**	**279**	**289**	**299**
Steer wt.						
-40 kgs	**220**	358	375	393	411	429
-20 kgs	**240**	399	419	438	457	477
0	**260**	441	462	483	504	525
+20 kgs	**280**	483	505	528	550	572
+40 kgs	**300**	524	548	572	596	620

GM $ per Cow

An increase of 5% in weaning percentage increases gross margin per cow by $27.08

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	@279c/kg	live weight
Heifers sold at 9 months	230 kg	@201c/kg	live weight
21 heifers retained for replacement.			
Cull cows cast for age at 10 years	240 kg	@401c/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.

Appendix C

Example Tahmoor Coal LW W1-W2 Agricultural Inspection Report

Table 1 Property Owner

Tahmoor Coal LW W1 – W2 Agricultural Inspections			20/07/2020
Mining Sequence	**During Mining Inspection**	**Property & Site**	**XXXXX**
Easting & Northing	XXXXX		
Current Land Use	Sheep grazing grass pasture		
Dominant Landform	Lower slope to creek flat		
Soil Surface Condition	Uneven surface +/- 150 millimetres in places		
Rainfall Since Last Inspection	15.24 mm		
Baseline Property Condition			
Erosion Presence	Nil	Minor	Widespread
Boundary Fence Condition	Good	Stock proof	Not stock proof
Boundary Fence Posts	Straight	Minor lean	Major lean
Boundary Fence Wire	Full Tension	Minor sag	Major sag
Internal Fence Condition	Good	Stock proof	Not stock proof
Internal Fence Posts	Straight	Minor lean	Major lean
Internal Fence Wire	Full Tension	Minor sag	Major sag
Paddock Gate Condition	Good	Stock proof	Not stock proof
Out-Building Condition	Useable	Unusable	N/A
Paddock Dams	Holding Water	No Water	N/A
Surface Slumping	Nil	Yes	*If yes, depth and width*
Surface Cracking	Nil	Yes	*If yes, depth and width*
Vegetation Dieback	Nil	Yes	Eucalypt
Additional Comments	<u>February Comments (02/03/2020):</u> No observed changes since January report Significant rainfall has however resulted in grass and shrub growth <u>March Comments (27/03/2020):</u> No observed changes since February report Increased vegetation growth <u>April Comments (24/04/20):</u> No observed changes since March report <u>May Comments (21/05/20):</u> Increased vegetation growth along riverbank due to recent rain. Dieback of paddock vegetation has begun as the change of season approaches. <u>June Comments (30/06/20):</u> Seasonal changes corresponding with mid-winter timing		


Property Owner east towards sheds (left: June 20; right: current)

Property Owner south towards Stonequarry Creek (left: June 20; right: current)


Property Owner ground surface (left: June 20, right: current)

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