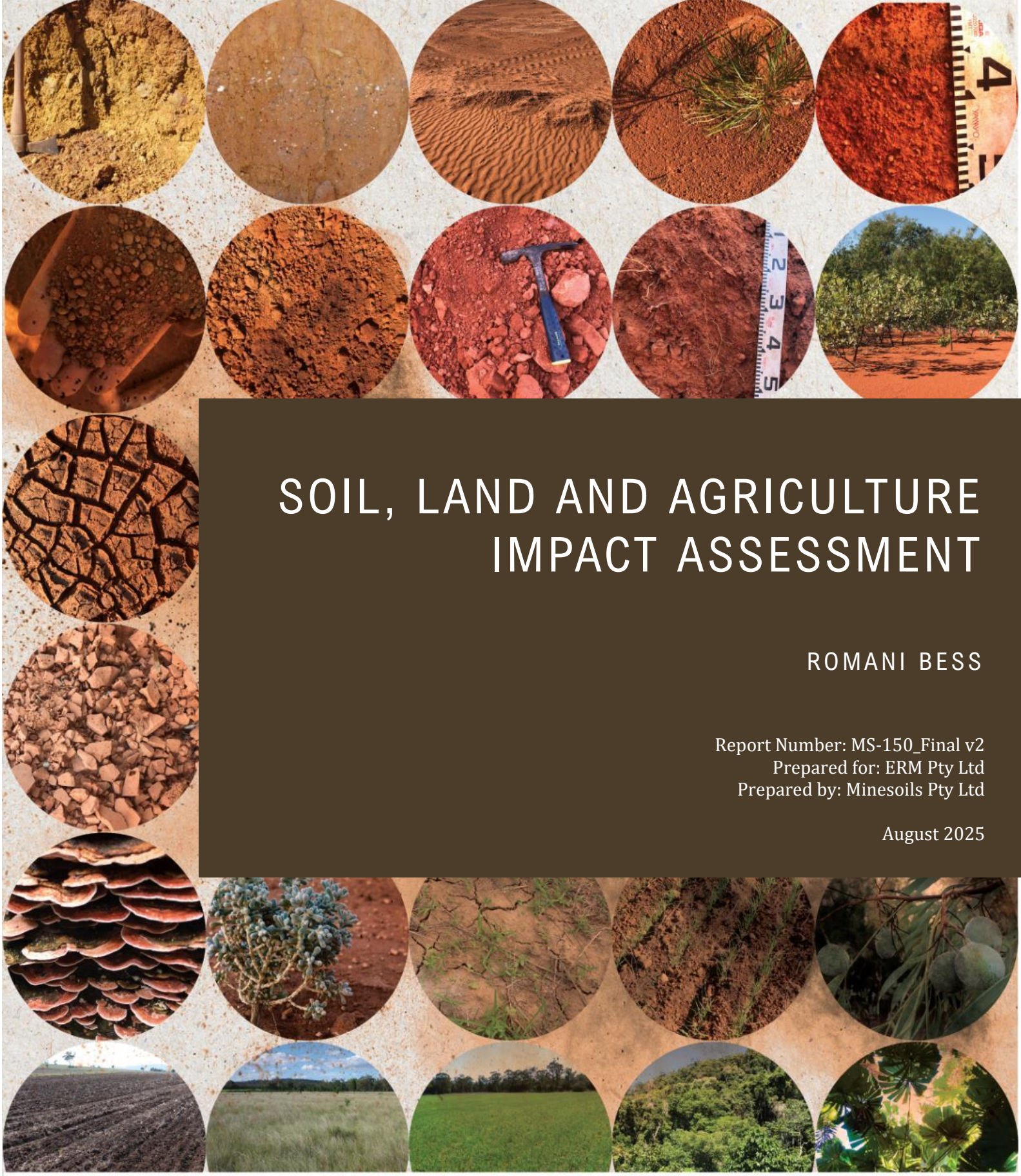

SOIL, LAND AND AGRICULTURE IMPACT ASSESSMENT

ROMANI BESS

Report Number: MS-150_Final v2
Prepared for: ERM Pty Ltd
Prepared by: Minesoils Pty Ltd

August 2025

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DOCUMENT CONTROL

Reference	Date	Prepared by	Approved
MS-150_ Draft 1	22 April 2025	Jake Iskenderian	Matt Hemingway
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1 INTRODUCTION

1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by ERM Pty Ltd (ERM) to conduct a Soil, Land and Agricultural Impact Assessment of the Romani BESS (the Project), located in the Riverina region of New South Wales. The baseline soil, land and agriculture resources are detailed within this report. The impacts on these resources from the proposed construction, operation and decommissioning phases of the Project are addressed in this report in accordance with relevant regulatory requirements and guidelines.

This report supports a State Significant Development (SSD application under Part 4, Division 4.7 of the Environmental Planning and Assessment Act 1979, and forms part of an Environmental Impact Statement (EIS) for the Project.

Soil and agriculture related Secretary's Environmental Assessment Requirements (SEAR's) items that are included for the Project consist of the following:

- *A soil survey to determine the soil characteristics and consider the potential for salinity, acid sulfate soils and erosion to occur;*
- *Completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industries Land Use Conflict Risk Assessment Guide (if required); and*
- *An assessment of impact on agricultural resources and agricultural production on the site and region.*

The objective of this report is to address the above SEARs items.

1.2 THE PROJECT

The Project would involve the construction, operation, and decommissioning of a Battery Energy Storage System (BESS) and associated infrastructure. The Project would comprise of the following:

- Lithium-ion BESS with a storage capacity of 200MW/800MWh.
- Electrical reticulation network that is comprised of a 220 kV substation and grid connection to the existing X5 transmission line, traversing the south of the Project area.
- 220kV power transformer with a height of approximately 6m.
- Permanent O&M compound, control building/control room, switch room with a height of approximately 5m.
- Landscaping works, asset protection zones, access tracks, drainage.
- Vehicle access to/from Booroorban-Tchelery Road.

The construction phase is expected to take approximately 18 months, with construction proposed to commence in 2026. The construction workforce would average 30-50 FTE and peak at 80-100 FTE, while the operational workforce would be 3-5 FTE. It is anticipated that the Project would be operational from 2027 and has an operational lifespan of 30 years. At the end of the proposed operational life, the BESS would be maintained, replaced, or decommissioned. The decommissioning phase would involve removal of all above ground infrastructure, and below ground infrastructure where practicable and in accordance with conditions of consent, and return of the site to its existing land capability.

1.3 THE PROJECT AREA AND DEVELOPMENT AREA

The Project is located on Booroorban-Tchelery Road, Booroorban NSW. The Project is wholly located within the Edward River Council Local Government Area (LGA) (refer **Figure 1**). The Project Area is approximately 21 ha and is comprised land used for agricultural activities such as livestock grazing (and previously irrigated cropping).

Within the Project Area, the Development Area, covering approximately 18 ha, represents the maximum extent of ground disturbing work associated with construction and operation of the Project (refer **Figure 2**). The Development Area is where impacts on soils, land and agriculture would be experienced.

The Development Area and locality have historically been utilised for agricultural practices primarily consisting of irrigated cropping and livestock grazing, with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use. Current land use comprises livestock grazing.

The Project also includes road upgrades at the site entrance and at the intersection of Booroorban-Tchelery Road and Cobb Highway. The area of the road upgrades is approximately 1 ha. The Road Upgrades Area is outside the scope of the Soil, Land and Agricultural Impact Assessment.

1.4 ASSESSMENT APPROACH

The assessment has been undertaken in accordance with the *Large-Scale Solar Energy Guidelines* (LSSE Guidelines) (NSW DPIE, 2022) which outline soil, land and agriculture requirements to be completed for all large-scale solar energy projects or associated infrastructure, such as battery energy storage systems, and is considered suitable for this assessment. This includes requirements to undertake a soil survey and verify land and soil capability (LSC) in accordance with *Land and Soil Capability Assessment Scheme* (LSC Scheme) (EOH 2012). The results of the site verification, as presented in Section 3.2, determined the level of agriculture impact assessment as *Level 1 – Basic*, as per the LSSE Guidelines. However, this assessment has been undertaken in accordance with the content and form of a *Level 2 – Reduced* assessment, which exceeds the detail required by a *Level 1 – Basic* assessment. The assessment requirement pathway for this assessment from the LSSE Guidelines is presented in **Figure 3**. The requirements for the *Level 2 – Reduced* assessment, and where these items are addressed in this report, are presented in **Table 1**.

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GDA2020 MGA Zone 55

0 2000 4000 6000 8000 Meters

Scale 1:200,000 at A4

Project Locality

FIGURE 1

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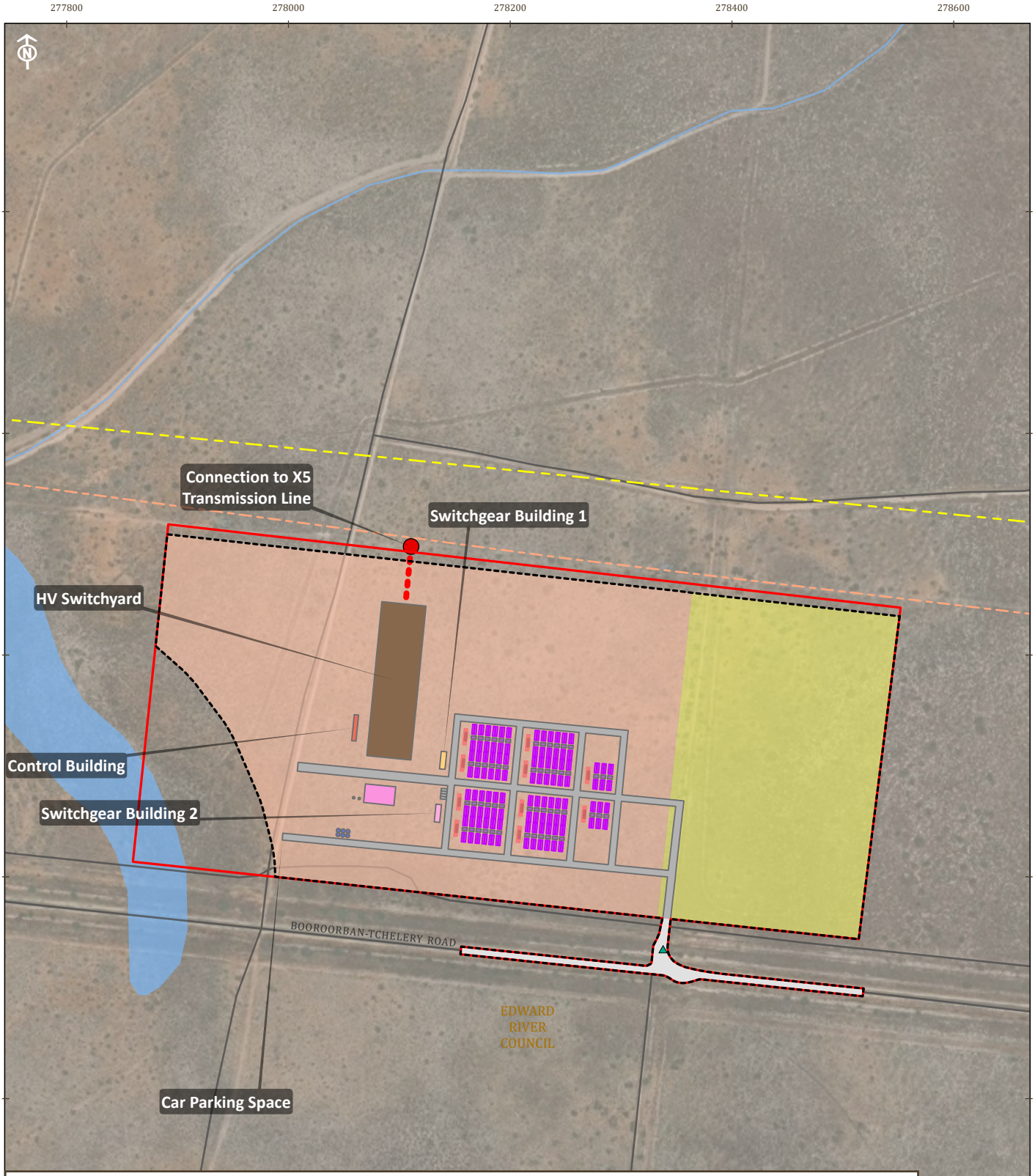

Legend

- Project Site Boundary
- Development Footprint
- Road Upgrade #2
- Proposed Vehicle Access
- Construction Compound
- 200 MW BESS
- Connection to X5 Transmission Line
- Connection to X5 Transmission Line
- Line X5 (220kV, Darlington Point to Balranald)
- PEC (330kV)
- Battery Units
- Car Parking Space
- Control Building
- Earthing Transformer
- Elevated Platform
- Fire Water Tank Pumps & Booster
- HV Switchyard
- Main Transformer
- Step-Up Transformer
- Switchgear Building 1
- Switchgear Building 2
- Underground 33kV Cabling
- Water Features

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GDA2020 MGA Zone 55

0 50 100 150 200 Meters

Scale 1:5,000 at A4

Project Area and Development Area

FIGURE 2

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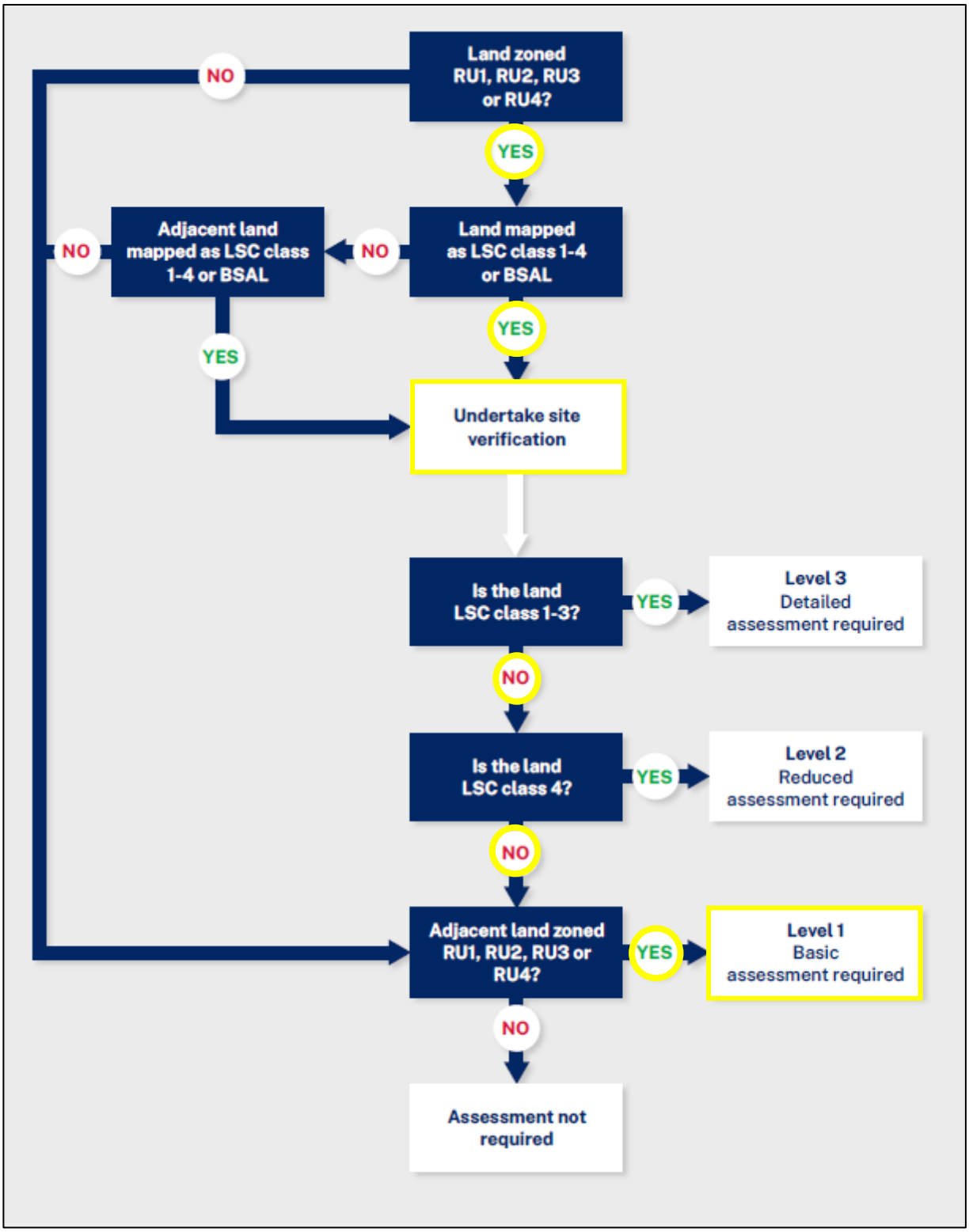
Figure 3. Agricultural Assessment Pathway



(NSW DPIE, 2022)

Table 1: Requirements of 'Level 2 - Reduced' Assessment and Section Addressed

Assessment	Content and form	Section Addressed
Project description Describe the nature, location, intensity and duration of the project and include a map of the project site.	• project description • location • duration • areas of the site that would be disturbed or temporarily removed from agricultural use	**1**
Regional context Describe the regional context.	• zoning of the project site • climate and rainfall • regional landform • regional land use including any significant agricultural industries and/or infrastructure	**2**
Site characteristics and land use description Describe the nature and location of agricultural land with the potential to be impacted by the development. Describe the current agricultural status and productivity of the proposed development area and surrounding locality including the LSC scheme.	• describe the land subject to the project • describe existing agricultural land uses • describe the history of agricultural practices on the project site • identify soil type, fertility, land and soil capability • provide a map showing the verified LSC class of the project site • provide a map showing topography of the site • describe the agricultural productivity of the site	**3**
LUCRA assessment Conduct an assessment of potential land use conflicts, including completion of an assessment in accordance with the Department of Industries' Land Use Conflict Risk Assessment Guide	• land use compatibility and conflicts • discuss compatibility of the development with the existing land uses on the site and adjacent land (e.g. aerial spraying, dust generation and biosecurity risk) during operation and after decommissioning, with reference to the zoning provisions applying to the land	**4** **(Appendix 1)**
Impacts on agricultural land Identify and describe the nature, duration and consequence of any potential impacts on agricultural land subject to the project site and in the wider region	• describe project impacts identified agricultural lands including, but not limited to, potential weeds, pests, dust, bushfire, livestock, crop production • consider impacts to the agricultural productivity of the site • project potential to permanently remove agricultural land and/or fragment or displace existing agricultural industries • consider cumulative impacts of multiple solar projects on agriculture in the region	**5**
Mitigation strategies Outline strategies that may be adopted to mitigate potential impacts on agricultural land and minimise land use conflict.	• strategies to minimise project impacts on agricultural land	**6**

2 REGIONAL CONTEXT

2.1 ZONING

The Project Area is zoned RU1 Primary Production under the *Edward River Local Environmental Plan* (**Figure 4**). Electricity generation is permitted with consent within this land use zone. Further, clause 2.36(1)(b) of the State Environmental Planning Policy (Transport and Infrastructure) 2021 (TISEPP) states development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed non-residential zone. Therefore, the Project is permissible with development consent.

2.2 CLIMATE AND RAINFALL

The Bureau of Meteorology (BOM) (BOM, 2024) classify the Riverina in the Hot Dry Zone (with cooler winters) climatic zone. This zone can be very hot in the summer months while in the winter, nights can be considerably cold with cool to mild days.

Annual rainfall in the Riverina has remained relatively stable over the past 30 years, decreasing by around 20 mm (4%) from about 520 mm to about 500 mm when compared to the previous 30 years (BOM and the CSIRO, 2019). Rainfall reliability maps for Riverina over the past 30 years show winter rainfall has been moderately reliable across the region, usually changing by about 50 mm from year to year. This is in contrast to spring and summer rainfall, which have been less reliable. Autumn rainfall has been unreliable across the entire region.

The Riverina region experiences frost risks to agriculture, which tend to occur through dry winter and spring periods, when soil moisture is low, and cloud cover infrequent.

The closest BOM weather station to the Project Area at Hay Airport (Site No. 075019), approximately 63 km northeast (BOM, 2024). The annual average rainfall is 360.6mm, falling throughout the year over approximately 46 rain days, with the average highest rainfall in the month of November and the lowest in the month of July.

The annual average maximum temperature recorded at the site is 25.1°C and the annual average minimum temperature is 10.2°C. The highest average maximum temperature of 34.8°C is recorded in January, while the lowest average maximum temperature of 15.9°C is recorded in June and July.

2.3 REGIONAL LANDFORM

The Project Area is located on the Riverine Plain, the eastern geomorphic subdivision of the Murray Basin that encompasses an area of 77,000 square kilometres (the 'Riverina Murray' region, or the 'Riverina'). The Riverine Plain is characterised by almost flat topography with extremely low gradients dominated by the open plains of native grasslands and semi-arid shrublands, which is traversed by several major rivers and their tributaries that flow from the east and south. The Murray Basin is a large low lying intracratonic basin containing Cainozoic unconsolidated sediments and sedimentary rocks.

The three (3) main rivers of the Riverina Murray region are the Murray, Murrumbidgee and Lachlan Rivers, all fed by numerous creeks and tributaries. These 3 river systems are part of the greater Murray-Darling Basin. In the Project locality, Forest Creek is located approximately 1km south of the Project, the catchment of which extends across the southwest corner of the Project Area. There is also an ephemeral creekline which extends from the west into the north or the Project Area.

The underlying geology of the Project Area consists of Shepparton Formation which formed in a fluvio-lacustrine environment between the Pleistocene and Holocene with the dominant lithology consisting of alluvial floodplain deposits. The Shepparton Formation consists of unconsolidated to poorly consolidated variegated and mottled clay, silt, silty clay, with intercalated lenses of fine to coarse sand and gravel. The formation has been partially modified by pedogenesis and groundwater table fluctuation.

Soil features are of riverine and aeolian origin – that is, deposited by water and wind geomorphological processes. Riverine features of the plains are, especially in the great alluvial fans and fluvial complexes, but minutiae in a broad natural system of river courses changing with time and are associated with complex deposits which vary rapidly both laterally and in depth. The most common aeolian landforms are those which involve accumulation, especially of sandy material, occurring as dunes, lunettes or sand-ridges. In addition, deflationary landforms are present, represented by the occurrences of sheet erosion known as scalds, and the occurrence of dry lake basins (Butler, et al 1973).

2.4 REGIONAL LAND USE

2.4.1 AGRICULTURAL LAND USE

The Riverina Murray region covers approximately 115,000 square kilometres, or 14% of NSW (DPI 2018), including twenty local government areas. The variety of landscapes in the wider Riverina Murray region supports a diverse range of agricultural industries that all place a high value on the region's reliable water supplies.

The region has a long and favourable pastoral history despite of its low stocking rate and its susceptibility to drought and scald (Butler, et al, 1973).

Europeans arrived in the region as early as 1830, with Moulamein (approximately 55 km southwest of the Project Area) being the oldest town in the Riverina (Sydney Morning Herald, 2008). Moulamein's early importance was as a crossroad where wool from western NSW was brought to the local port where the paddle-steamers plying the Edward River could take the cargo downstream.

Following settlement, wool growing quickly became the major local industry. Dominated for over 100 years by squatters and their flocks on immense holdings of land, the introduction of irrigation and the creation of soldier settlement blocks in the 1940s broadened the agricultural industry, increasing the population.

Today, agriculture in the region includes beef grazing and temperate fruit (apples, pears, grapes and cherries) production in the east, through broad-acre cropping (cereal, oilseed and pulses), beef and sheep grazing, intensive poultry and pigs production for products and slaughter, irrigation cropping (cotton, rice and maize), to rangeland grazing in the west. In the Project locality rice is of particular importance, with the largest rice mill in the southern hemisphere located within Deniliquin, approximately 80km south of the Project Area.

The size of farms varies greatly across the region depending on location, landscape and production system. The properties in the south-west of the Riverina region (Murray River LGA, Edward River LGA) are partially influenced by irrigation, but generally contain rangeland. Here, farm sizes are in the 3,000 ha to 4,000 ha range. In the far north-west of the region, (Hay LGA) properties are largest for the Riverina region and typically greater than 7,000ha, reflecting use for large scale grazing enterprises. Moving west into the influence of the irrigation areas and the location of the Project Area, property size decreases (Carrathool, Griffith, Murrumbidgee, Berrigan LGA's) into the 2,000 ha to 3,000 ha range (DPI, 2018).

At the scale of the Edward River LGA within which the Project lies, as of the last agricultural census of 2020 - 2021 (ABS, 2022a), 826,618 ha of land is subject to agricultural activity. The area of land used by agricultural type is presented in **Table 2**, which shows grazing of livestock is the dominant land use for the LGA, accounting for 74% of total area subject to agricultural land use.

Table 2: Edward River LGA Agricultural Land Use 2020 – 2021

Agricultural Land Use	Area	
	ha	%
Livestock Grazing	614,305	74
Cropping	207,145	25
Forestry	4,908	1
Other	261	<1
Total	**826,618**	**100**

2.4.2 AGRICULTURAL ENTERPRISES

At a scale of the locality, agricultural enterprises and land use surrounding the Project Area largely consist of irrigated cropping and livestock grazing on native pastures (refer **Figure 5**). Wheat, rice, barley, cotton and canola broadacre cropping enterprises, as well as vegetable and citrus and stone fruit occur over large areas subject to cropping (including irrigated cropping) throughout the wider Edward River LGA.

The gross value of agricultural enterprises within the Edward River LGA for 2020-2021 is $326 million, as shown in **Table 3** (ABS, 2022b). Cropping activities make up 64% of the agricultural commodity value of the LGA, while Livestock for slaughter make up 23%.

Within the category of livestock slaughtered, sheep and lambs dominate in the LGA followed by cattle and calves, as shown in **Table 4** (ABS, 2022b). Livestock grazing enterprises are represented by the following estimates from the latest agricultural census (2020 – 2021) (ABS, 2022a): 567,453 sheep and lambs and 43,843 head of cattle over 294 livestock grazing business enterprises within the LGA.

For crops, broadacre crops consisting largely of wheat, barley and rice for grain, with broadacre cropping dominating the gross value for agriculture, as shown in **Table 5.** (ABS, 2022b).

Table 3: Edward River LGA Agricultural Gross Value 2021 – 2022 by Enterprise (2022b)

Agricultural Enterprise	Gross Value	
	$	%
Cropping	208,862,940	64
Livestock Slaughtered	73,501,523	23
Livestock Products	43,930,968	13
Total	**326,295,431**	**100**

Table 4: Edward River LGA Agricultural Gross Value 2021 – 2022 by Livestock Slaughter (ABS, 2022b)

Agricultural Enterprise	Gross Value	
	$	%
Sheep and lambs	29,330,830	40
Cattle and calves	27,152,271	37
Pigs	16,959,387	23
Poultry	34,690	<1
Other	24,346	<1
Total	**73,501,523**	**100**

Table 5: Edward River LGA Crop Gross Value by Type 2020 – 2021 (2022b)

Crop	Value	
	$	%
Broadacre crops	132,763,664	64
Vegetables	35,965,216	17
Hay	17,900,691	9
Fruit and nuts	13,980,690	7
Grapes	7,878,667	4
Total	**208,862,940**	**100**

Table 6: Edward River LGA Livestock Products Gross Value by Type 2020 – 2021 (2022b)

Livestock	Value	
	$	%
Milk	24,494,827	56
Wool	19,329,906	44
Eggs	106,235	<1
Total	**43,173,162**	**100**

2.4.3 REGIONAL AGRICULTURAL INFRASTRUCTURE

The key infrastructure item assisting agricultural market access and cost of production is the transport network servicing the Riverina region. Underlining the importance of this issue, total freight costs from farm to port can be as much as 30% of the value of the crop being marketed depending on Australian and world commodity prices in a given season (AgriFutures Australia, 2019). The Riverina Murray is a key transport hub for the distribution of goods across southeastern Australia with rail freight, roads and airport links within reach of major markets. Situated to the southwest of the ACT and bordering Victoria, the region has extensive commercial links to the ACT and Victoria, as well as Sydney and Adelaide.

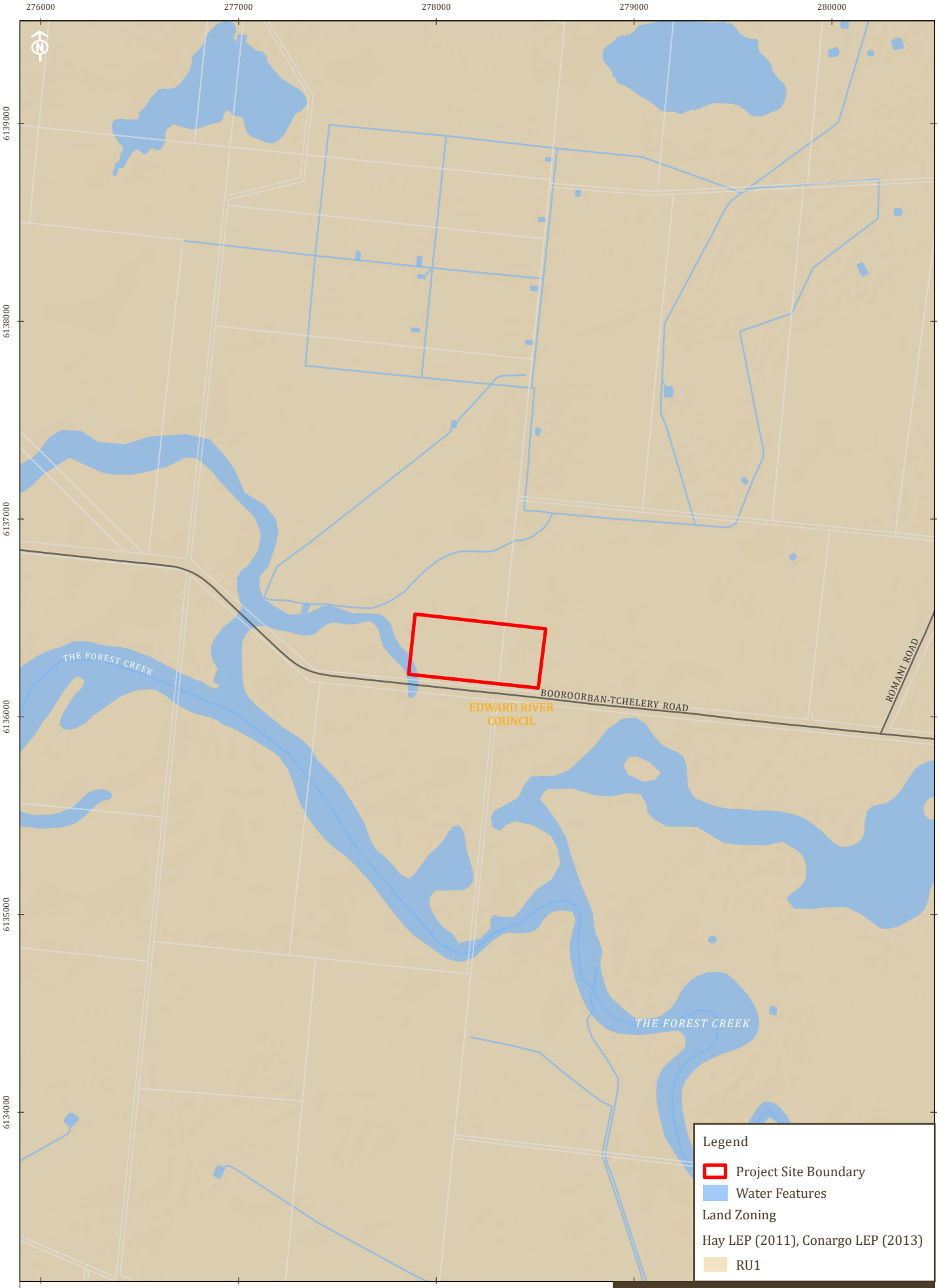
The main transport route for the Project locality is the Cobb Highway which connects to the Sturt Highway and Riverina Highway, with several minor roads surrounding the locality (e.g. Boorooban-Tchelery Road, Romani Road, and Glenhope Road). The Sturt Highway is used for intra-regional transportation consisting of agricultural trucks, freight trucks and local farming traffic as well as low levels of tourist traffic, between the towns of Hay and Balranald. The highway links Adelaide with the Hume Highway 20 km past Wagga Wagga.

In proximity to the Project Area, the agricultural service centres of Hay (approximately 44 km northeast), Griffith (approximately 144 km northeast) and Deniliquin (approximately 83 km southeast) allow access to businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection.

There are rice mills in Leeton, Deniliquin and Coleambally operated by SunRice, which is one of the largest rice food companies in the world. The Deniliquin mill is the largest rice mill in the southern hemisphere.

Wagga Wagga is the focal centre of the Riverina regions beef and sheep industry and is the location of the Wagga Wagga Livestock Marketing Centre (LMC), one of the key livestock exchange facilities in NSW with a reputation as the largest selling centre for sheep in Australia. In the year of 2021/2022, the LMC sold 2,005,091 sheep, representing 30% of the sheep sold in NSW, and 107,274 head of cattle, representing 11% of the cattle sold in NSW (MLA, 2022).

Other infrastructure critical to agricultural production includes energy needs (gas and electricity), telecommunications services, irrigation water infrastructure and urban water and wastewater services. General agricultural improvements such as stock fences, stock yards, shedding, dams and access tracks are widespread throughout the Project locality which reflects the historical and current development of the local lands for livestock grazing.



MINESOILS
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GDA2020 MGA Zone 55

0 250 500 750 Meters

Scale 1:25,000 at A4

Land Zoning

FIGURE 4

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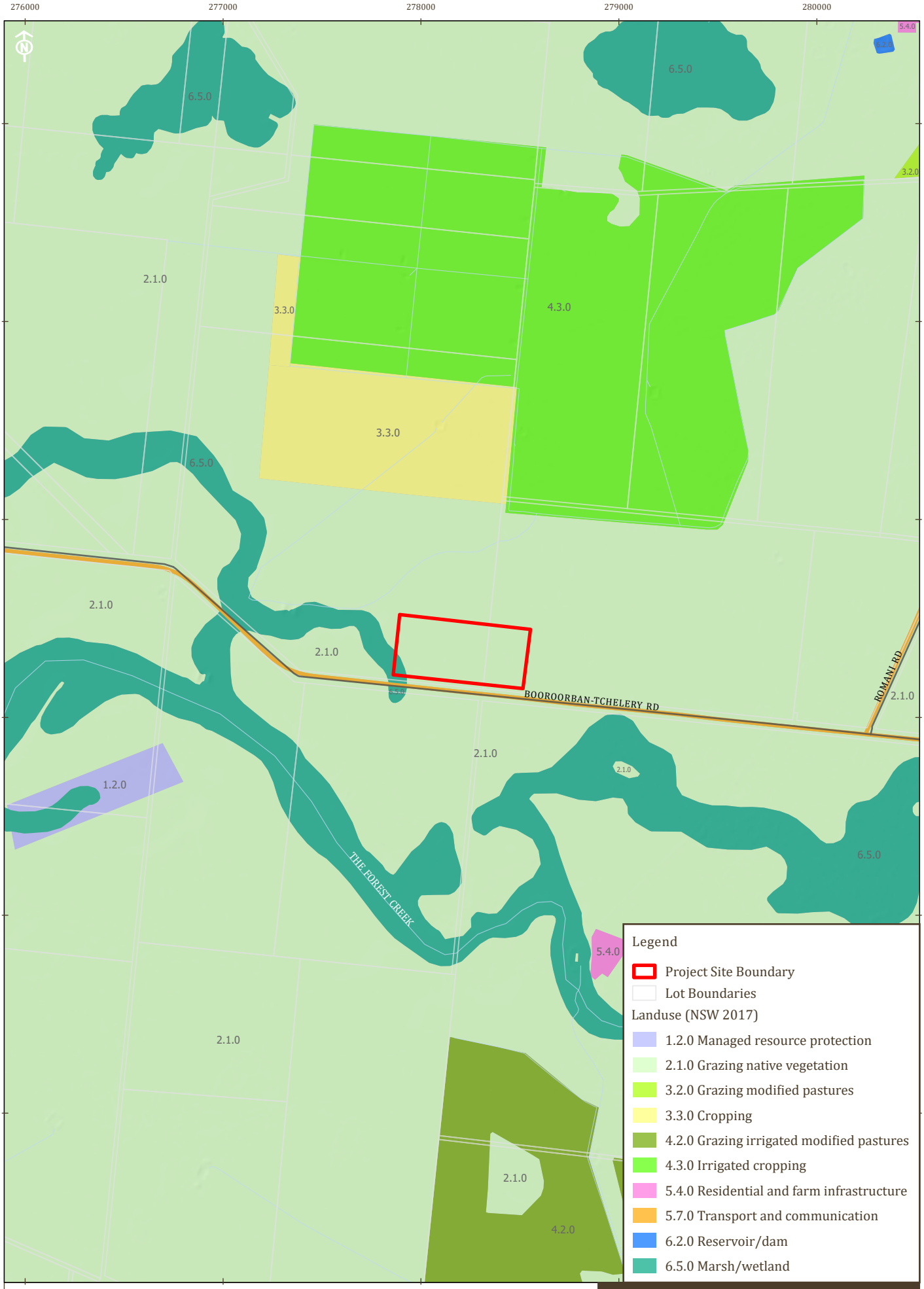

MINESOILS
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GDA2020 MGA Zone 55

0 250 500 750 Meters

Scale 1:25,000 at A4

Land Use

FIGURE 5

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3 SITE CHARACTERISTICS AND LAND USE

3.1 SITE CHARACTERISTICS

3.1.1 LANDSCAPE

A site inspection was undertaken by Minesoils in November 2024. The Project Area was determined to be a generally stable, largely treeless, open plain landform with a range between 80 - 100% surface cover predominantly in the form of low shrubs and pasture for grazing (**Plate 1**).

The Project Area contains small areas of subtle sand rises/deposits, as well as soil surface scald, both a result of aeolian geomorphological processes, which have been noted in literature (Butler et al 1973), to be exacerbated in times of drought and continued grazing. This has likely been exacerbated by agriculture land use and saline soil conditions.

The flat nature of the plains which the Project Area lies is highlighted in **Figure 6**, which shows minimal elevation change (approximately 80 m Australian height Datum (AHD) across the area. The wider locality is generally flat although experiences a subtle decrease in elevation from west to east.

An unnamed tributary crosses the southwestern corner of the Project Area, which is part of The Forest Creek catchment. Forest Creek lies approximately 1 km to the south and is part of the Murrumbidgee catchment.

3.1.2 AGRICULTURAL LAND USE

The agricultural land within the Project Area is subject to livestock grazing as the primary land-use, supporting sheep and cattle, which are grazed at a low stocking rate on native and improved pastures for breeding and fattening. Grazing of Merino sheep is the current and historically dominant livestock enterprise on the Project Area and broader locality.

The host property which contains the Project Area is not subject to fertiliser application, and there is minimal ongoing use of herbicides. Livestock are watered through a series of surface dams and troughs, which are filled with pumped water. Windmills, concrete and plastic tanks, troughs and trough pipes are present throughout the wider host property. General agricultural improvements are present, including stock shedding, fences and gates, stock yards, cattle grids and unsealed access tracks.

At the time of inspection, neighbouring properties in the immediate vicinity outside the Project Area were observed to be used for sheep and cattle grazing. Agricultural improvements (e.g. irrigation channels, cattle grids, stock yards, stock fences, dams and existing access tracks) are widespread throughout the locality which reflects the historical and current development of the local lands for grazing and cultivation. No sensitive agricultural activities such as intensive plant or livestock agriculture were observed within the Project Area or its immediate surrounds.

Plate 1: The Development Area is characterised by open plains dominated by low shrubs and pasture for grazing.

3.1.3 AGRICULTURAL PRODUCTIVITY

Agricultural productivity is subject to long term climate and rainfall variables, as well as changes in economic, social and policy frameworks, often at a scale well beyond the Project Area. There is no set agricultural productivity value for land under agricultural use.

The NSW DPI (2023) *Gross Margin Budgets for Livestock* can be used to provide a broad estimation of the productivity of the land for grazing within the Disturbance Footprint. Based on modelling conservative enterprises of Merino ewes (20 micron) – Merino rams as a stocking rate of 1.5 DSE (Dry Sheet Equivalent)/ha, the estimated productivity of the Development Area is $30,296 per annum as summarised in **Table 7**.

An alternative way to estimate the productivity of the Disturbance Footprint is by analysing the information presented from the last agricultural census of 2021-2022 in Section 2.3 (ABS 2022a and 2022b). This information shows that within the Edward River LGA, 614,305 ha of land was used for grazing, of which the gross commodity value of 99% of livestock products and 77% of livestock for slaughter (totalling $99,769,335) can be attributed to that area, resulting in a $/ha ratio of $162/ha. It also shows that within the Edward River LGA, 207,145 ha of land was used for cropping, of which the gross commodity value of cropping (totalling $208,862,940) can be attributed to that area, resulting in a $/ha ratio of $1,008/ha.

By applying these rates to the Disturbance Footprint, the productivity is estimated to be between $2,916 and $18,144 per year, as shown in **Table 8**.

Table 7: Estimated Potential Productivity based on DPI Gross Margin Data

Enterprise	Estimated Gross Margin ($/DSE/year)*	Stocking Rate (DSE)	Development Area (ha)	Gross Margin ($/year)
Merino ewes (20 micron) – Merino rams	46.97	1.5	18	1,268

*Source: DPI, 2023

Table 8: Estimated Potential Productivity based on LGA Data

Enterprise	Estimated Gross Value in LGA ($/ha/year)	Development Area (ha)	Estimated Productivity ($/year)
Livestock Grazing	162	18	2,916
Cropping	1,008	18	18,144

3.2 SOIL SURVEY AND SITE VERIFICATION

3.2.1 EXISTING SOILS INFORMATION

The following section presents the NSW state government regional mapping data for soil types, inherent soil fertility and LSC as applied to the Project Area (NSW and Department of Planning, Industry and Environment, 2024).

Soil Types

The NSW regional soil mapping indicates the dominant soil types within the Development Area are Vertosols, as per Australian Soil Classification (ASC) (Isbell, R. F.,2021) (refer **Figure 7**).

Vertosols are soils with the following:

1. A clay field texture or 35% or more clay throughout the solum except for thin, surface crusty horizons 30 mm or less thick and
2. When dry, open cracks occur at some time in most years. These are at least 5 mm wide and extend upward to the surface or to the base of any plough layer, peaty horizon, self-mulching horizon, or thin, surface crusty horizon; and
3. Slickensides and/or lenticular peds occur at some depth in the solum.

Inherent Soil Fertility

NSW regional mapping provides an estimation of the inherent fertility of soils in NSW. It uses the best available soils and natural resource mapping developed for LSC dataset. The mapping describes soil fertility in NSW according to a five-class system: Low (1), Moderately Low (2), Moderate (3), Moderately High (4), High (5).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy *et al*., 2007).

The Development Area is entirely dominated by soils with Moderate (3) fertility (refer **Figure 8**).

Land and Soil Capability

Land capability, as detailed in LSC Scheme, is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources. Failure to manage land in accordance with its capability risks degradation of resources both on- and off-site, leading to a decline in natural ecosystem values, agricultural productivity, and infrastructure functionality.

The 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 9** 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.

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform, specifically noted as slope, landform position, acidity, salinity, drainage, rockiness; and climate. The eight hazards associated with these biophysical features that are assessed by the LSC scheme are:

1. Water erosion
2. Wind erosion
3. Soil structure decline
4. Soil acidification
5. Salinity
6. Water logging
7. Shallow soils and rockiness
8. Mass movement

Each hazard is assessed against set criteria tables, as described in the LSC Guideline, with each hazard ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

Table 9: Land and Soil Capability Classification

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature 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)	

Class	Land and Soil Capability
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.

The NSW regional based maps of LSC indicate the Development Area and wider Project area consists of LSC class 5: moderate low capability land (refer **Figure 9**).

Strategic Regional Land Use Policy Mapping

The 'NSW Government's Strategic Regional Land Use Policy' (the Policy) defines and identifies strategic agricultural land across NSW. Strategic agricultural land includes land with unique natural resource characteristics, known as biophysical strategic agricultural land (BSAL), and clusters of significant agricultural industries known as critical industry clusters (CICs). The Policy has been developed to achieve balanced land use outcomes, specifically between mining, coal seam gas and agriculture.

There is no BSAL or CICs mapped within the Project Area or the Project locality. The nearest BSAL is located approximately 200 km east of the site.

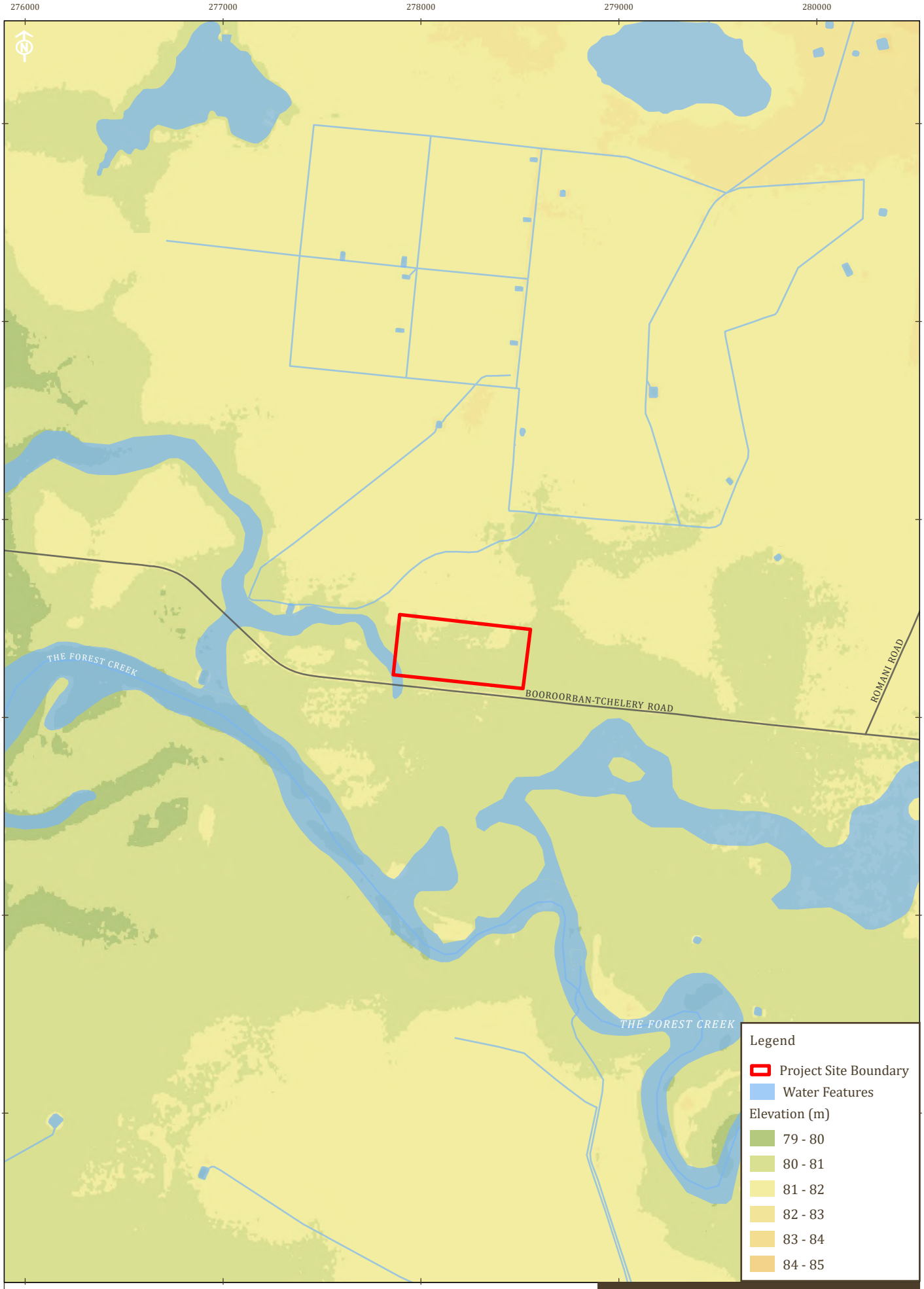
State Significant Agricultural Land

The NSW Department of Primary Industries is undertaking a mapping program to identify State Significant Agricultural Land (SSAL). A map of SSAL is an essential component of agricultural land use planning, enabling clearer local planning with informed prioritisation of future land uses.

There is no SSAL mapped within the Project Area. The nearest SSAL is located approximately 600 m to the north of the site (refer **Figure 10**).

This mapping is noted to be in an early draft stage and is derived from existing statewide information where the most relevant characteristics related to the best agricultural lands are used. The layers used to build this map are the best available in NSW, however these input layers are of variable quality. There will also be real and perceived anomalies because of the factors used (such as slope, salinity, etc.), some of which may not be evident in land values or other readily observable characteristics.

There is presently no method to verify SSAL, nor is there a contextual framework for how it SSAL should be considered and assessed (as there is for LSC and BSAL).



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0 250 500 750 Meters

Scale 1:25,000 at A4

Topography

FIGURE 6

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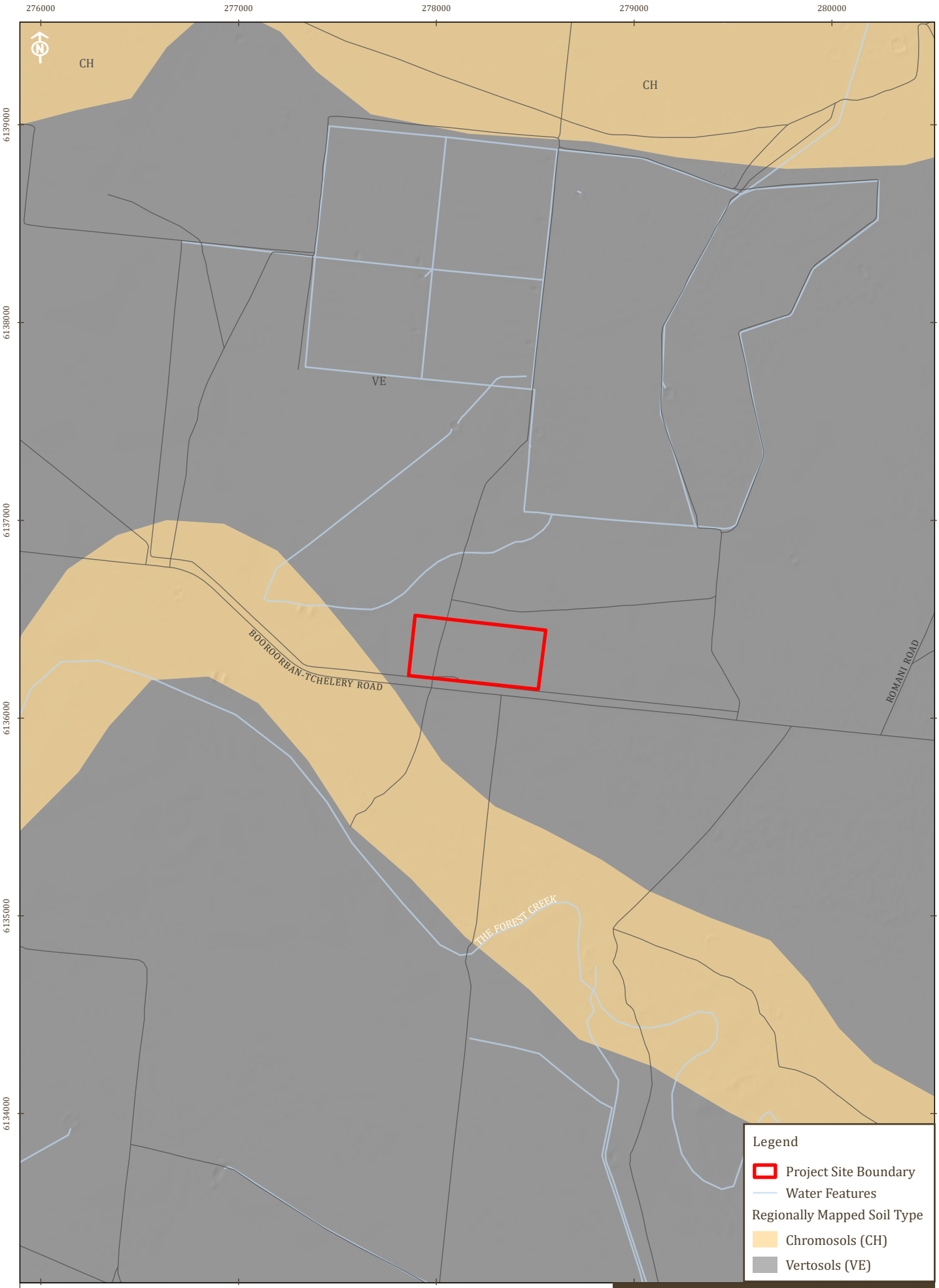

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Regionally Mapped Soil Types

FIGURE 7

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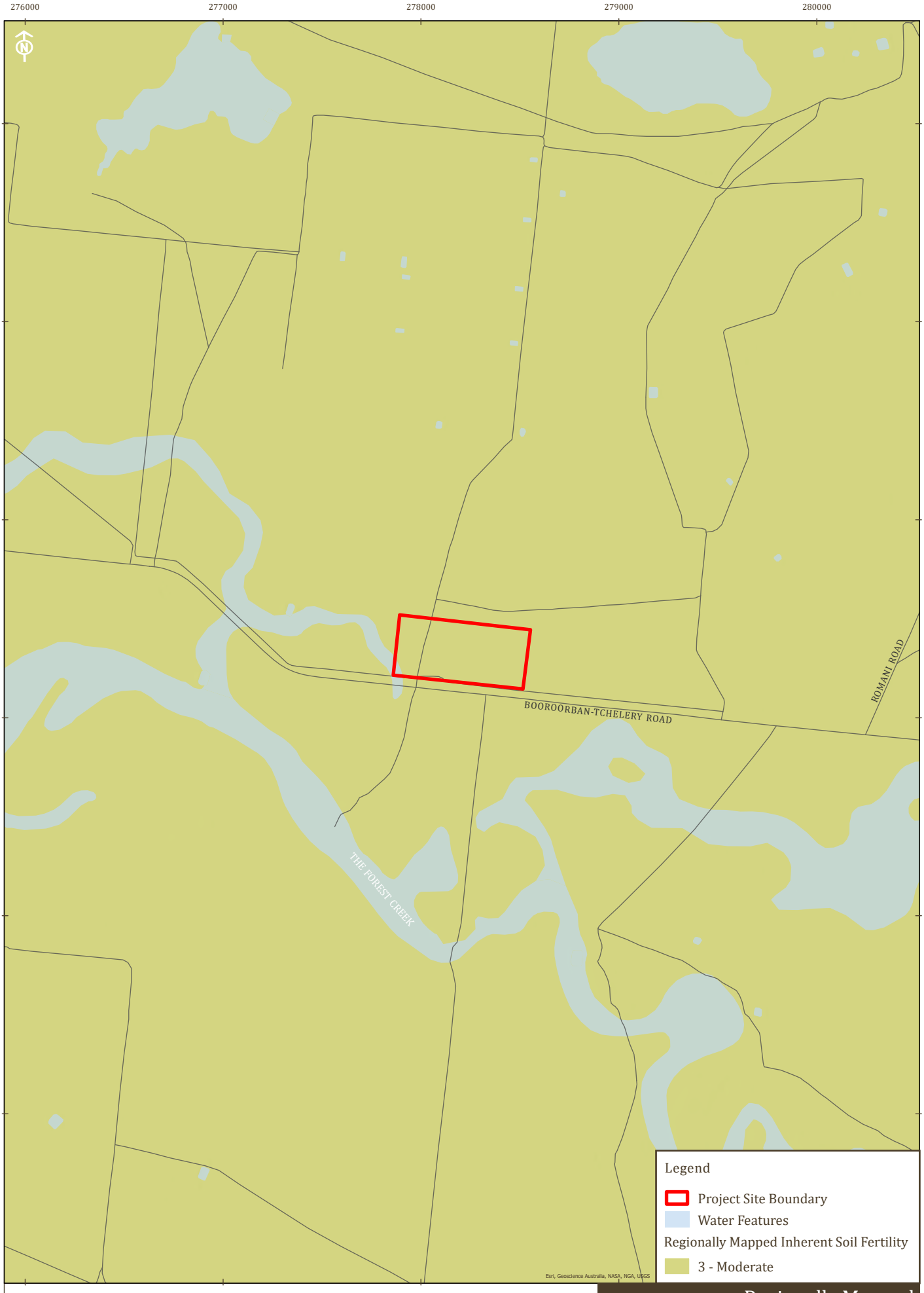

Legend

- Project Site Boundary
- Water Features

Regionally Mapped Inherent Soil Fertility

- 3 - Moderate

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Scale 1:25,000 at A4

Regionally Mapped Inherent Soil Fertility

FIGURE 8

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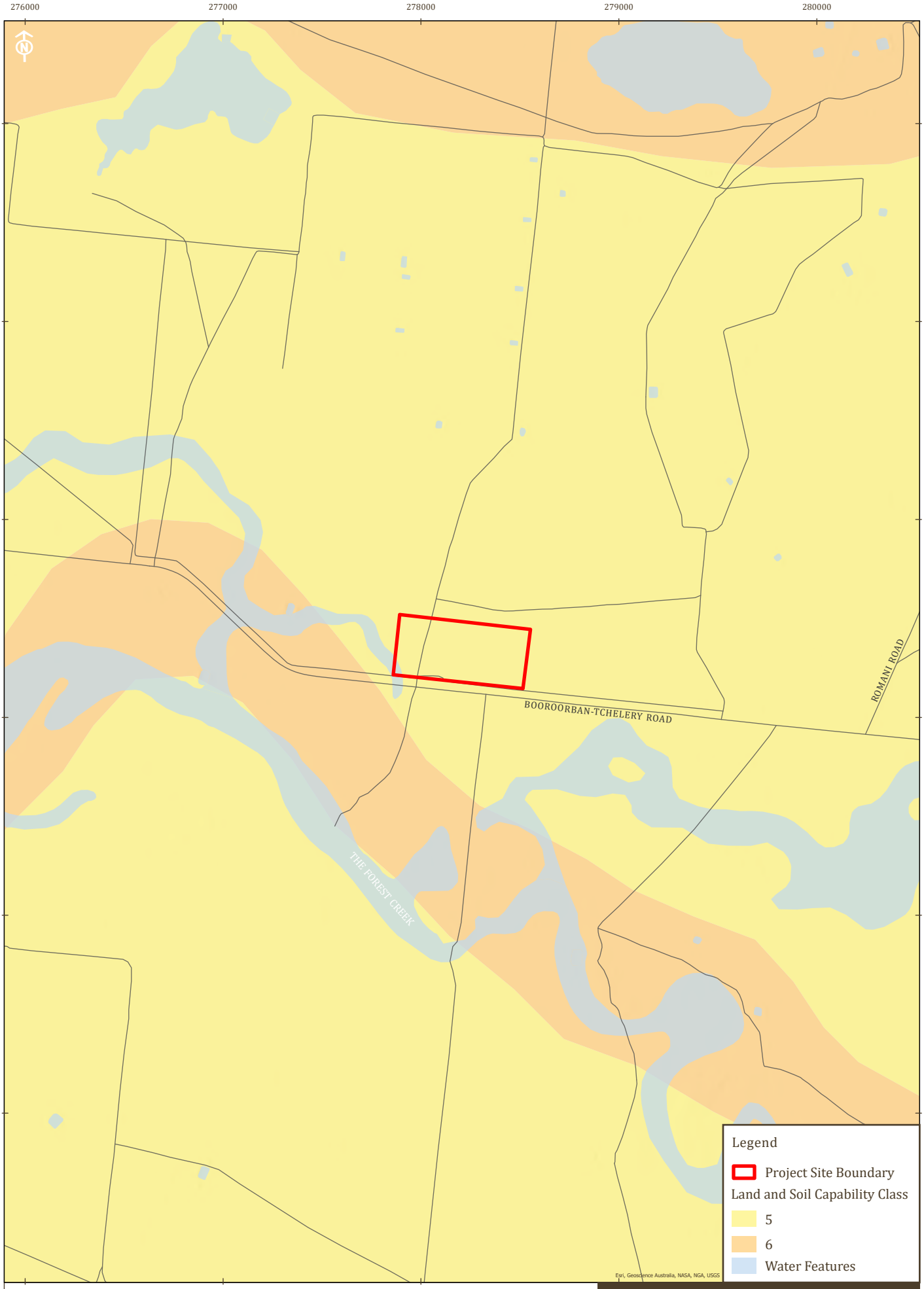

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Scale 1:25,000 at A4

Regionally Mapped Land and Soil Capability

FIGURE 9

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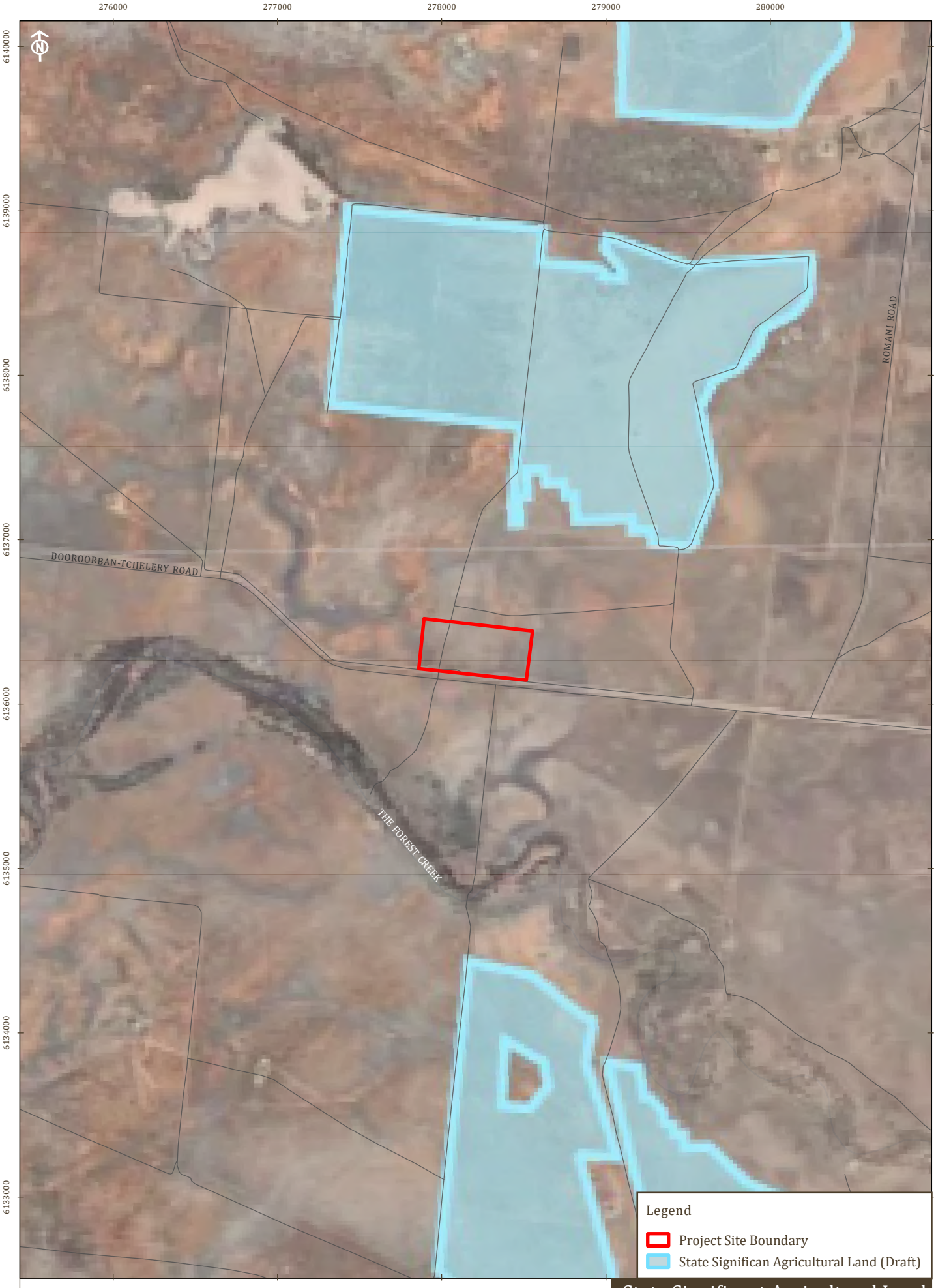

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Scale 1:30,000 at A4

State Significant Agricultural Land

FIGURE 10

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3.2.2 SOIL SURVEY METHODOLOGY

Minesoils undertook a soil and land resource survey to inform the following tasks to be undertaken throughout the EIS process:

- Soil assessment, identifying soil units, soil qualities and risks including erosion, acid sulfate soils (ASS) risk and salinity.
- Land and soil capability (LSC) verification.
- Management and mitigation measures for mitigating soil erosion during construction, operations and decommissioning.

The objective of the Minesoils fieldwork program was to satisfy the field assessment, sampling and testing requirements related to soil and land resources of the LSSE Guideline. The fieldwork plan outlined below was designed to satisfy the following requirements:

- Soil survey and mapping: This was undertaken at a 1:10,000 survey intensity (1 site every 10 ha), and requires collection of landform pattern and element information, soil profile data, and taxonomic parameters to distinguish soil units according to the Australian Soil Classification criteria, within the Project Area.
- LSC verification: The information required for the LSC assessment was collected during both the desktop assessment and verified on the ground during the field program. The LSC system requires data on biophysical features from in situ measurements and regional mapping.
- Soil qualities and risks: Additional information was recorded in the field on erosion and evidence of potentially erosive soils including tunnelling, rill, gully and sheet erosion, which may require specific handling and management techniques during construction or operational activities, and the consequences of this on stripping and rehabilitation. Observations were made on risks of ASS and salinity.

The field program was designed as an integrated free survey. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets (NSCT, 2008). Survey points are irregularly located according to the survey teams' judgement to enable the delineation of soil boundaries. Soil boundaries can be abrupt or gradual, and catena and toposequences are used to aid the description of gradual variation. Soil cores were excavated by a soil corer to a depth of approximately 0.8 – 1.0m or to a point of refusal. Site clearances and dial before you dig (DBYD) plans were undertaken as part of the safety planning requirements and found underground service running through the centre of the Project Area which were avoided during excavation activities.

The survey was over the 18 ha of the Development Area. A total of 2 sites were assessed, resulting in a survey intensity of 1 site per 10 ha. One additional site outside of the Project Area was used for this assessment also. Soil profiles within the Development Area (refer to **Figure 11**) were assessed in accordance with the 'Australian Soil and Land Survey Field Handbook soil classification procedures' (NCST, 2009). Detailed soil profile descriptions were recorded covering the major parameters specified in **Table 10**. Soil profile logging was undertaken in the field using Minesoils' soil data sheets, including GPS recordings and photographs of the landforms and soil profiles. Soils were keyed out in accordance with the Australian Soil Classification (ASC) Third Edition (2008) (Isbell, R. F.,2021).

Soil samples were collected at each of the assessment site's soil horizons to a depth of 1 m, with a total of 6 samples collected. Minesoils chose 3 of these samples that were considered representative to be subject to laboratory testing. The laboratory testing suite for these sites is detailed in the **Table 11**.

Table 10: Detailed soil profile description parameters

Detailed Field Assessment Parameters	
Horizon depth including distinctiveness and shape	Pan presence and form
Field texture grade	Permeability and drainage
Field colour (Munsell colour chart)	Field pH
Pedality structure, grade and consistence	Field moisture
Soil fabric and stickiness	Surface condition
Stones (abundance and size)	Landform pattern / element
Mottles (amount, size and distinctiveness)	Current land use and previous disturbance
Segregations (abundance, nature, form and size)	Vegetation

Table 11: Soil Sample Laboratory Analysis

Lab Analysis	
Analyte	**Methodology**
pH (1:5 water & CaCl)	Rayment & Lyons 2011-4A1
Electrical Conductivity (EC) and Chloride	Rayment & Lyons 2011-3A1
Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio	Rayment & Lyons 2011-15J1
Particle Size Analysis (PSA) (Select samples)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')
Emerson Aggregate Test (EAT) (Select samples)	AS1289.3.8.1-2017

3.2.3 SOIL SURVEY FINDINGS

Soil Mapping Units

The soil survey undertaken by Minesoils found the Project Area to contain one soil mapping unit characterised by Vertosols, as shown on **Figure 11**, and presented in **Table 12**. This is consistent with regional mapping of soil types (refer **Figure 7**).

Table 12: Soil Profile Assessment and Classification

Site #	Assessment Level	Soil Profile - Australian Soil Classification
5	Detailed Field Assessment	Epipedal Black Vertosol
6	Laboratory Analysed	Salic Epipedal Grey Vertosol
7	Detailed Field Assessment	Episodic Epipedal Grey Vertosol

The soils within the Development Area are dominated by Vertosols, which as described in Section 3.2.1, are soils with the following:

1. A clay field texture or 35% or more clay throughout the solum except for thin, surface crusty horizons 30 mm or less thick and
2. When dry, open cracks occur at some time in most years. These are at least 5 mm wide and extend upward to the surface or to the base of any plough layer, peaty horizon, self-mulching horizon, or thin, surface crusty horizon; and
3. Slickensides and/or lenticular peds occur at some depth in the solum.

This unit is characterised by heavy clay soils which are sodic and range from non-saline in the upper horizon to highly and extremely saline at depth. pH ranges from neutral to moderately alkaline. Soil profiles are deep and moderately well drained. There is a sporadic presence of calcareous nodules at depth.

Full soil profile descriptions are included as **Appendix 2**. Laboratory certificates of analysis are included as **Appendix 3**.

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0 50 100 150 Meters

Scale 1:5,000 at A4

Soil Mapping Units

FIGURE 11

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Soil Erodibility

Soil aggregate stability refers to the stability of soil structural units (aggregates) when immersed in water. Instability may be indicated by slaking or clay dispersion. A soil with low aggregate stability is likely to be less resilient to mechanical impacts, more likely to be compacted and poorly structured, or be susceptible to tunnelling if used for earthworks. The Emerson Aggregate Test (EAT) classifies the behaviour of soil aggregates, when immersed, on their coherence in water. **Table 13** shows the EAT class and the dispersion degree during testing and resulting risk of dispersion for that soil.

Table 13: Dispersion Degree and Risk Correlation to EAT Class

EAT Class	Dispersion	
	Degree	Risk
1	Complete dispersion	Very High
2	Partial dispersion	High
3	Complete or partial dispersion after remoulding	Moderate
4 - 8	Well aggregated with no dispersion after remoulding	Negligible

Source: Adapted from Hazelton and Murphy (2011)

Emerson Class Numbers of 1 and 2 indicates a high to very high potential for the soil to disperse when inundated with water. These classes represent the greatest erosion and sediment control hazard to surface disturbance works.

Emerson Class Numbers of 3 indicate that while the soil is only slightly dispersive, the remoulding and breaking down of soil bonds can result in increased dispersive behaviour. Remoulding of the soil at a moisture content near the optimum for compaction (simulating the use of these soils in a filling and compaction operation) does not increase the potential for dispersive behaviour, however further breakdown of the soil may occur, by water turbulence or concentrated rapid water flow. Under these circumstances this class of soil may disperse.

Emerson Class Numbers greater than 4 have a low potential for dispersive behaviour. Some swelling or slaking may occur but generally such soils are not readily dispersive.

Table 14 highlights the lowest Emerson Class Number recorded for select laboratory data representative sites of the Project Area, as an indicator of highest potential risk during disturbance activities.

Table 14: Potential Dispersion Risk

Site No.	Soil Depth (m)	EAT	Potential Risk
6	0.20 – 0.30	3	Moderate
6	0.50 – 0.60	3	Moderate

Based on site observation, which included assessment for indicators of erodibility, such as sheet or gully erosion, it can be concluded that there is a minor wind erosion risk due to the nature of the landscape and exposure characteristics. In addition, the dispersion risk status of representative tested soils indicate there is moderate risk (as per **Table 13** EAT risk class) for dispersion of the soils within the Development Area.

The representative laboratory tested soils indicate high levels of sodicity across the Project Area. While sodic soils are generally dispersive, it is important to acknowledge that not all sodic soils disperse, and that not all dispersive soils are sodic. However, given the ranges in salinity of the topsoils tested within the Project Area, all sodic soils should be considered dispersive.

Based on these results, there is a moderate potential risk for dispersion where soils are disturbed by Project construction works and activities within the Development Area. Higher impact activities such as where earthworks are necessary for construction of sub-station pads or site facilities are very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised.

While the generally flat nature of the landscape mitigates the risk of erosion impacts due to soil dispersion, the aeolian processes observed to be operational within the region, along with the chemical instability of the laboratory tested soils, indicate an erosion risk remains present and must be considered and appropriately controlled.

Despite the potential for erosion risk, the overall risk of erosion and sedimentation impacts on agriculture as a result of the Project should be considered low due to the nature of the landform (i.e., flat plain) and the available mitigation measures, which are further described in Section 6.2.1.

Acid Sulphate Soils

Acid sulfate soils (ASS) have been classified into 5 different classes based on the likelihood of the ASS being present in particular areas and at certain depths (NSW Department of Planning and Environment, 2018):

- Class 1: ASS in a class 1 area are likely to be found on and below the natural ground surface.
- Class 2: ASS in a class 2 area are likely to be found below the natural ground surface.
- Class 3: ASS in a class 3 area are likely to be found beyond 1 metre below the natural ground surface.
- Class 4: ASS in a class 4 area are likely to be found beyond 2 metres below the natural ground surface.
- Class 5: ASS are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 metres on adjacent class 1,2,3 or 4 land.

The Project Area does not contain any of the above classes on the NSW Acid Sulfate Soil Planning Map.

Assessing land elevation and distance from the coast, in conjunction with existing ASS mapping for NSW, the potential for ASS is considered a very low risk.

Further, there was no evidence of ASS indicators such as soil gleying, odour, marine sediments and organic materials recorded as part of the soils survey.

3.2.4 SITE VERIFICATION OF LSC

The soil test sites within the Project Area have been assessed and classified ranging from LSC class 6 to class 7, as presented in **Table 15**. The verified LSC classes present within the Project Area are as follows:

- LSC class 6: low capability land – covering 14 ha.
- LSC class 7: very low capability land – covering 6 ha.

The spatial extent of each verified LSC class is shown in **Figure 12**.

Class 6 Land

This classification indicates the land has very high limitations for high-impact land uses. Land use is restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. The defining constraints to this land class within the Development Area is soil structure decline and soil salinity.

Class 7 Land

This classification indicates the 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. The defining constraints to this land class within the Development Area is soil structure decline (based on strongly sodic clay topsoils).

Table 15: LSC Parameters and Overall Class

		Hazard Criteria								
		1	2	3	4	5	6	7	8	Overall
		Water erosion	Wind erosion	Structure	Acidity	Salinity	Water-logging	Soil depth	Movement	Class
5	Epipedal Black Vertosol	1	3	6	2	6	2	1	1	**6**
6	Salic Epipedal Grey Vertosol	1	3	7	2	6	2	1	1	**7**
7	Episodic Epipedal Grey Vertosol	1	3	6	2	6	2	1	1	**6**

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0 50 100 150 Meters

Scale 1:5,000 at A4

Verified Land and Soil Capability

FIGURE 12

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4 LAND USE CONFLICT RISK ASSESSMENT

4.1 OVERVIEW

The Land Use Conflict Risk Assessment (LUCRA) (NSW Department of Primary Industries, 2011) is required as part of an Agricultural Impact Assessment as per the LSSE Guideline. The LUCRA is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict. LUCRA aims to:

- Accurately identify and address potential land use conflict issues and risk of occurrence before a new land use proceeds or a dispute arises.
- Objectively assess the effect of a proposed land use on neighbouring land uses.
- Increase the understanding of potential land use conflict to inform and complement development control and buffer requirements.
- Highlight or recommend strategies to help minimise the potential for land use conflicts to occur and contribute to the negotiation, proposal, implementation and evaluation of separation strategies.

Land use conflicts occur when one land user is perceived to infringe upon the rights or impact the values or amenity of another. In rural areas land use conflicts commonly occur between agricultural and residential uses. However, land use conflicts can also occur between different agricultural enterprises and other primary industries.

Rural amenity issues are the most common land use conflict issues, followed by environmental protection issues. Rural amenity issues include impacts to air quality due to agricultural and rural industry (odour, pesticides, dust, smoke and particulates); use and enjoyment of neighbouring land e.g., noise from machinery; and visual amenity associated with rural industry e.g., the use of netting, planting of monocultures and impacts on views.

Environmental protection issues include soil erosion leading to land and water pollution, clearing of native vegetation, and stock access to waterways.

Direct impacts from neighbouring land uses on farming operations can also cause conflict, such as: harassment of livestock from straying domestic animals; trespass; changes to storm water flows or water availability; and poor management of pest animals and weeds.

4.2 APPROACH

The LUCRA as presented in **Appendix 1** compares and contrasts the Project against adjoining/surrounding land uses and activities for incompatibility and conflict issues based on the risks and impacts identified in **Section 5**, and the mitigation measures and controls presented in **Section 6**. Each potential conflict between the operation of the BESS and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in **Appendix 1**. Performance targets would be determined via management plans specified by the EIS (and specialist impact assessments) and development consent conditions (if approved). Monitoring would be undertaken in accordance with those management plans. Indicative performance targets are presents in **Appendix 1**.

Given the significant overlap between the agricultural impact assessment and land use conflict considerations, many agriculture-related risk items listed in the LUCRA are further detailed in Section 5.

4.3 CONSULTATION

Neighbouring landholders were contacted by Minesoils in December 2024 via phone, who were provided the opportunity to express any concerns relating to land use conflict relating to the project and their agricultural operations. A total of four (4) neighbouring landholders were consulted.

4.4 FINDINGS

The following land use conflict risk items were identified for the Project:

- Construction ground disturbance;
- Construction noise;
- Construction dust;
- Construction traffic;
- Construction workforce;
- Construction work;
- Biosecurity;
- Visual amenity;
- Fire spread;
- Agriculture cessation;
- Operational traffic;
- Operational noise;
- Property devaluation;
- Erosion and sedimentation;
- Livestock interaction;
- Decommissioning and rehabilitation.

Within these risk item categories, 25 potential conflicts were considered as part of the LUCRA. The mitigation measures and controls outlined in this assessment and the wider EIS reduce the level of risk for the majority of considered potential risks with complaints or conflict being managed within normal operations. However, a number of items of potential conflict remain a moderate risk for land use conflict. These are summarised in **Table 16**. The LUCRA methodology including risk ranking matrix and full LUCRA assessment are included as **Appendix 1**.

Table 16: LUCRA High and Moderate Risk Items

Potential Conflict	Conflict Risk
Land users in the locality may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the Project.	**Moderate**
Land users in the locality may be concerned about the risk of fires occurring at the site and their potential to spread to surrounding land, infrastructure or livestock	**Moderate**
Stakeholders may be concerned about the potential for poor rehabilitation outcomes and the resulting long term environmental and agricultural consequence.	**Moderate**

5 IMPACTS ON AGRICULTURAL LAND

The impacts that BESS infrastructure can have on land resources and agricultural productivity range from short term temporary impacts to long term and permanent impacts. Temporary impacts can include the removal of agriculture from Development Areas over the life of the Project, including during the construction, operation and decommissioning phases. Permanent impacts may include changes to land and soil capability and agricultural resources of the Project Area. Permanent impacts are irreversible and can be mitigated by the reinstatement of agricultural lands and land productivity to a pre-disturbance condition and productivity.

This section identifies and describes the nature, duration and consequence of the potential impacts on agricultural land as a result of the Project, for the Project Area and in the wider region, across five risk areas:

- Changes in the amount of land used for agriculture.
- Changes to agricultural productivity and agricultural enterprises.
- Changes to agricultural resources.
- Other potential impacts to agriculture considered for the Project.
- Cumulative impacts of the potential for multiple large scale renewable projects within the region.

5.1 LAND USED FOR AGRICULTURE

The Project would disturb an area of approximately 18 ha of land that is currently subject to agriculture land use. While a portion of this area may be subject to disturbance during the construction phase only (~6 ha), for the purpose of this assessment and to apply a conservative approach, it is assumed that the agriculture would cease within this area for the duration of the Project.

At the end of the life of the project a decision would be made to maintain the BESS, or decommission and remove. If the latter, all infrastructure would be removed and the project area returned to a similar state to what it was prior to the project and in accordance with consent conditions.

For the purpose of this assessment it is anticipated that agricultural land use would be re-established over 18 ha of disturbed agricultural land at the time of decommissioning, unless otherwise agreed with the landowner and/or regulatory authorities (such as if farmers request access track to be retained, etc). Therefore, there would be a temporary decrease of approximately 18 ha of land used for agriculture for the duration of the Project.

Current agricultural land use immediate to the Development Area, and in the broader Project locality would not change as a result of the Project, and there would be no fragmentation or displacement of existing agricultural industries.

The temporary reduction of 18 ha is considered a negligible impact in the context of the land area subject to agriculture use in the Edward River LGA as outlined in Section 2.4.1 (representing 0.002%).

5.2 PRODUCTIVITY AND ENTERPRISES

5.2.1 PRIMARY PRODUCTIVITY

The productivity of the Project Area is described in Section 3.1.3. For the purpose of this assessment, the temporary impact of the Project on productivity of agricultural land based on the change in land use for the duration of the Project is up to approximately $18,144 per year. Due to the minimal disturbance to the landform, following the life of the Project, 18 ha of land removed from agriculture would be returned to agricultural use, with no reductions in land and soil capability. Agricultural enterprises can then re-commence at an equivalent agricultural productivity.

The temporary reduction of agricultural productivity per year is considered a negligible impact in the context of the agricultural industry gross value of the Edward River LGA as outlined in Section 2.4.2 (representing 0.006%).

5.2.2 PRODUCTIVITY OF LAND WITHIN LOCALITY

Agricultural productivity of land outside of the Development Area would not be affected by the Project as the associated agricultural resources would not be affected. Therefore, the Project would not negatively impact any existing agricultural enterprise outside of the Development Area.

5.2.3 AGRICULTURE SUPPORT SERVICES

The Project would have a negligible impact on the viability of local and regional agricultural services and employment. There would be no impacts experienced by employees or contracting services currently engaged (i.e., stock mustering services). Changes to the supply and viability of agricultural support services in the main service centres of Hay, Deniliquin and Griffith are driven by social and market trends far exceeding the scale of the negligible reduction in agricultural land use and productivity as a result of the Project.

5.2.4 CRITICAL MASS THRESHOLDS

Due to the limited reduction in agricultural activity as a result of the Project, and given the nature and scale of the established livestock grazing agricultural industries within the region and wider state, there would be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure.

5.3 AGRICULTURAL RESOURCES

5.3.1 SOILS

Soils within the Development Area would be subject to impacts as part of the construction or maintenance of the BESS and associated infrastructure. In areas where earthworks and excavations are necessary for construction, soils would be subject to higher impact disturbance.

All soil that is proposed to be disturbed during the Project would be stripped and re-used during construction and/or rehabilitation in order to mitigate long term effects on soil resources during operation. All soil stripping and re-use would be localised; that is, soil would be stripped and stored adjacent to disturbance and respread from where it was stripped. This localised approach would promote the reinstatement of the soil profile to its original condition.

Overall, the impacts to the soils of the Project Area are expected to be minimal and temporary. There would be no direct or indirect impacts to the soil resources of the Project locality outside the Project Area.

Soil impact mitigation measures are outlined in Section 6.2.

5.3.2 LAND AND SOIL CAPABILITY

Due to the nature of the Project which would require only localised and sporadic landform modification including minor soil stripping (for excavation works and leveling), impacts on LSC are expected to be minor.

Following the end of life for the Project, areas subject to rehabilitation would be re-graded (where required) and stockpiled topsoil and subsoil would be respread over disturbed areas and revegetated with either native vegetation, improved pastures or a crop species depending on the intended final land use. This strategy, along with good soil management practices as outlined in Section 6.2 would facilitate the rehabilitation in returning the land to an equivalent LSC class.

Therefore, it is anticipated there would be no permanent impacts on LSC classes as a result of the Project over the 18 ha being returned to agriculture.

5.3.3 WATER

A Water Resources Impact Assessment (Appendix O in the EIS) was undertaken for the Project, which found the following:

- Through best practices and proposed measures, the overall impact on water quality is considered negligible, given the limited connectivity to adjacent watercourses; and
- Cumulative impacts on surface water are expected to be negligible.

5.3.4 EROSION AND SEDIMENTATION

There is a moderate potential risk for dispersion where soils are disturbed by Project construction efforts within the Development Area. Higher impact activities such as where earthworks are necessary for construction of sub-station pads or site facilities are very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised. Wind erosion must also be considered and soils exposed as a result of construction should be sown with grass and pasture species with starter fertiliser to provide stabilising ground cover.

However, due to the flat nature of the landform, the risk of erosion and sedimentation impacts on agriculture as a result of the Project is low.

With the implementation of mitigation measures detailed in Section 6.2, it is expected that direct and indirect erosion and sedimentation risks would be limited and manageable.

5.3.5 AGRICULTURAL INFRASTRUCTURE

The Project would have a negligible impact on local and regional agricultural infrastructure. There would be negligible impacts on the road and rail network that connects the agricultural industry to markets, services and suppliers (refer Section 5.4.4).

Adequate paddock fencing would be reinstated to suit post-Project land use. Upgrades to access tracks throughout the Project would benefit post-Project agricultural land uses and is considered a positive impact.

5.4 OTHER POTENTIAL IMPACTS ON AGRICULTURE

5.4.1 WEEDS AND PEST SPECIES

Weeds and pest species (including evidence of rabbits) were observed to be present within the Project Area during Minesoils site inspection. Additional weeds and pest species could be inadvertently brought into the Project Area with imported materials, machinery, or allowed to invade naturally through removal or damage of current vegetation. The presence of weed species has the potential to be a major long term hindrance to agricultural endeavours within the locality and region, as well as rehabilitation efforts within the Project Area.

The impacts of weeds and pest species on agriculture as a result of the Project are anticipated to be minor due to mitigation measures available, which are described in Section 6.3.

5.4.2 BIOSECURITY

Biosecurity is defined in the NSW Biosecurity and Food Safety Strategy 2022 - 2030 (DPI, 2022) as ‘the protection of the economy, environment and community from pests, diseases and weeds.’ It includes measures to prevent new pests, diseases and weeds from entering our country and becoming established.

Given the available mitigation measures as described in Section 6.4, it is considered that biosecurity risks as a result the Project are low and impacts to agricultural resources and enterprises within the region are unlikely to be experienced

5.4.3 AIR QUALITY AND DUST

Construction and decommissioning activities have the potential to increase dust through movement of traffic on unsealed roads on dry days, vegetation removal, and localised dust emissions generated by land disturbance (such as excavation activities required for infrastructure). Dust control measures would be detailed in a Construction

environmental management plan (CEMP). With the implementation of the CEMP, it is expected that the construction and decommissioning activities would have a negligible impact on local air quality.

During operations, ongoing maintenance of infrastructure and land would result in very minor, localised vehicle emissions and generation of dust from vehicles travelling along unsealed internal access tracks. These impacts are unlikely to affect agriculture and standard dust suppression measures would be outlined in an Operational Environmental Management Plan (OEMP) to manage and control dust where required.

5.4.4 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 project operations, leaving fewer transport options for agricultural enterprises.

The roads in proximity to the Development Area are anticipated to experience an increase in traffic volumes during the peak construction period. However, the Traffic Impact Assessment undertaken for the Project determined that the road network is able to accommodate the traffic generated by the development during the construction, operation and decommissioning stages.

Further, no increases in levels of noise and dust that would impact agriculture are anticipated to result from increased traffic.

Therefore, the traffic impacts of the Project are not likely to have consequences on agricultural enterprises within the Project locality.

5.4.5 NOISE AND VIBRATION

Background noise levels are expected to reflect the site's location in a rural setting away from population centres. Background noise sources would include traffic, farm equipment, wind through trees, birds and insects.

Noise levels during construction and operation are predicted to comply with noise criteria. It is expected that noise would be effectively managed and minimised through the adoption of standard management practices. The proponent would implement practicable measures to reduce noise impacts including for example, the careful location of noise generating components within the site to increase the distance to sensitive receivers. Supportive evidence is provided through a Noise Impact Assessment in the EIS.

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. Cattle may tolerate moderate levels of noise and may easily adapt to an intensity level of 60-90 dB. Continuous exposure to noise above 90dB has been known to severely affect animals (Dairy Global, 2017).

The assessment of potential noise impacts has been undertaken via a Noise and Vibration Impact Assessment (NVIA). Appropriate mitigation measures are specified within the NVIA to minimise noise impacts. As a result, the NVIA does not predict greater than 90dBA as a result from the Project where livestock would be located on a non-associated property adjacent to the Project Area. As such, livestock and other agricultural resources are unlikely to be impacted by traffic noise due to the Project.

5.5 CUMULATIVE IMPACTS

The Project has the potential to generate cumulative impacts with numerous other existing, approved or proposed developments in the region, which are numerous and detailed in the EIS for the Project. These generally consist of solar farm and a wind farm projects, with few mining and infrastructure projects.

In the context of agriculture, increased cumulative impacts including changes to land used for agriculture, localised productivity, secondary productivity and some agricultural support services are likely to be experienced. This

would be a result of agriculture land use being inhibited by landform modification and infrastructure, such as the development footprints for wind and solar farms. However, given the nature and scale of the established agricultural industries within the region that interfaces with renewable energy projects (that is, predominantly livestock grazing, with some broadacre cropping), as well as the generally low quality agricultural resources and low stocking rates for the broader region, significant impacts to regional agricultural businesses, industry critical mass thresholds and regional agricultural infrastructure are unlikely to occur in the foreseeable future.

In addition, the applicability of dual land use opportunities for solar and wind farm projects is especially relevant to the nearby South West Renewable Energy Zone given the suitable conditions for sheep grazing and the established sheep and lambing industries and infrastructure (as outlined in Section 2.4.3).

Therefore, given the majority of proposed development in the local and regional context of the Project are renewables developments, the cumulative impact on agriculture for the region is considered to be low given changes to agricultural land use and agricultural productivity are anticipated to be minor for each respective wind and solar Project.

At the scale of NSW, the cumulative risk to agricultural land and productivity because of large-scale solar development is estimated to be very low (DPE 2022). The Australian Energy Market Operator estimates that NSW will need approximately 20,000 MW of large-scale solar generation by 2050. This would require approximately 40,000 ha of land or only 0.06% of rural land in NSW. Even in the highly unlikely scenario that all of NSW's solar generation were located on important agricultural land (this land covers around 13.8% of the state and is 6 to 7 times more agriculturally productive than the remaining 86.2% of the state) only 0.4% of this land would be required (DPE 2022).

6 MITIGATION MEASURES

The Project would include a number of measures to prevent, minimise and manage adverse impacts on agricultural resources. This incorporates procedural mitigation measures along with a land management process that ensures the Project has negligible impact on agricultural resources and enterprises.

In addition to the specific measures described in this assessment, all activities associated with the Project would be conducted in consideration of approval obligations and environmental management measures in development consent stipulated environmental management plans.

6.1 PROJECT DESIGN

The design of the Project is the result of an iterative process and has been adapted progressively as information regarding site constraints, and the potential impacts and risks associated with the development of the Project have become available. Constraints related to cultural heritage, electricity network easements, visual impact, heritage sensitivities and biodiversity values in particular have been considered in developing the proposed layout.

Given the negligible effect the Project would have on agricultural resources and enterprises, (as outlined in Section 5), no further design amendments are recommended to address agricultural impacts.

Further Project design considerations, as well as an analysis of Project alternatives, are presented in the EIS.

6.2 LAND AND SOIL DISTURBANCE MITIGATION

6.2.1 SOIL EROSION MANAGEMENT

Based on site observations and an analysis of laboratory data, higher impact activities such as where earthworks are necessary for construction of sub-station pads or site facilities are very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised. However, due to the nature of the landform, the risk of erosion and sedimentation impacts as a result of the Project remains a low.

Nonetheless, erosion and sedimentation risks present could result in long term, irreversible agricultural impacts if suitable controls are not implemented. As part of the Construction Environmental Management Plan (CEMP) and the Operational Environmental Management Plan (OEMP), the Project would prepare an erosion and sediment control plan (ESCP) that addressed specific soil dispersion risks based on disturbance activity and phase of the Project. The ESCP should include the following:

Construction Phase

- The Project should utilise the existing landform and not endeavour to undertake broad-scale re-contouring of the existing ground levels without referring to this soil and land resource assessments and implementing erosion and sediment control accordingly. As a result, the existing vegetative cover and soil structure would be maintained intact across much of the Project Area.
- Construction areas should be progressively revegetated with grass and pasture species as installation of infrastructure proceeds across the site, if practical.
- At locations where earthworks are necessary, such as for cable trenching, localised erosion and sediment controls would be placed in accordance with the Landcom (2004) guidelines.
- Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance would be prioritised during construction.
- Due to the consistency sodic nature of the soils within the Disturbance Footprint, where soils are subject to high impact disturbance activity such as extensive excavation and surface modification, it is recommended to apply gypsum as an ameliorant to displace the sodium and provide the soil with a stronger aggregate and hold structure when wet. This is especially relevant to stockpiled sodic soils.

- All areas disturbed during construction that are complete and have no further use during construction should be sown with grass to provide long term protection against erosion.

Operation Phase

- Soil disturbance during operation of the Project should be minimal and limited to maintenance activities, involving very small, localised Development Areas on an infrequent basis.
- Standard erosion and sediment control measures should be implemented to minimise the potential for sediment export within areas to be disturbed during operations. These measures would be developed on a case-by-case basis referring to this soil assessment and are likely to include measures such as sediment fencing, localised sediment traps, and progressive stabilisation with vegetation.
- Groundcover should be maintained at a minimum of 70% where practical (subject to long terms seasonal variations, such as drought).

Decommissioning and Rehabilitation Phase

- A detailed Decommissioning and Rehabilitation Plan should be prepared within 18 months of the planned closure of the Project. This plan would detail all aspects of decommissioning and removal of all infrastructure unwanted for post Project land use (some infrastructure may remain for post Project land use purposes i.e., constructed internal roads may be kept as part of the agricultural infrastructure), which may require temporary erosion and sediment control measures.
- During decommissioning, where potential erosive impacts have been identified due to the disturbance of sodic soils in locations of significant disturbance, soil amelioration should be undertaken as part of remediation earthworks. Standard temporary erosion and sediment control measures are to be put in place for high disturbance areas.

6.2.2 SOIL STRIPPING FOR REHABILITATION

Minesoils recommends all Project infrastructure should be removed. This includes below ground cabling in coarser textured soils that may be exposed over time by the aeolian processes observed to be active within the Project Area.

Soil that is proposed to be disturbed during the Project would be stripped and re-used in construction and/or rehabilitation efforts in order to mitigate long term effects on the land and soil capability of the Disturbance Footprint (with the exception of disturbance associated with piling, which would have a negligible impact to the soil profile and not warrant soil stripping and re-use methods). All soil stripping and re-use would be localised; that is, soil would be respread from where it is stripped during construction, reinstating the soil profile to its original condition. Additionally, soils would be stripped only in areas where soil disturbance occurs. This localised, fluid approach is an integral process for successful rehabilitation of the Project.

A site soil management plan that includes soil management measures relating to stripping, management of sodic and dispersive soils, stockpiling, respread/reuse, and land rehabilitation should be prepared for the Project to inform the CEMP, OEMP and a Decommissioning and Rehabilitation Plan.

This section provides information on the following key areas related to the management of the topsoil resources for the area within the Disturbance Footprint that should form the basis of the soil management plan.

Higher Impact Areas

It is recommended that proposed long term small scale stockpiles in areas associated with the higher impact activities where larger amounts of soil would be displaced should be stripped of topsoil. Then the excavated subsoil (only if requiring disturbance) should be placed on the exposed subsoil of the stockpile area to create a low-profile landform of subsoil. A thin layer of topsoil material from the stripped areas should be placed as a ‘cap’ over the subsoil stockpiles to promote vegetation growth. Topsoil materials should otherwise be stockpiled separately to subsoils. Subsoils should be treated gypsum prior to stockpiling.

Topsoil and subsoil depths for these areas should be recorded in GIS and rehabilitated with target species to build up the seedbank over the years of stockpiling.

Stripped Soil Management

The following soil handling techniques are recommended to prevent excessive soil deterioration and dispersion. It is not anticipated the Project would involve major amounts of soil excavation requiring long-term stockpile solutions, however small scale potential soil stockpiling from trenched areas and hardstand locations should abide by the following measures where practicable:

- Strip soil material to maximum excavation depths only.
- Soil should ideally be stripped in a slightly moist condition, where practicable. Material should not be stripped in either an excessively dry or wet condition.
- Push soil into windrows or small stockpiles with graders. This technique is an example of preferential less aggressive soil handling. This minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material.
- The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where necessary, a flow diversion bank or catch drain should be placed up-slope of a stockpile to direct surface water flows away. All stockpiles shall remain in a free-draining location to avoid long term soil saturation.
- Where necessary, silt fences or cleared vegetation should be installed around topsoil stockpiles or stripped areas as a form of erosion and sediment control. Mulch or wood chip from cleared vegetation can also be applied as a veneer over topsoil stockpiles to slow erosion, weed establishment and to maintain moisture content.
- As a general rule, maintain a maximum stockpile height of 3 m. Clayey soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils.
- Seed and fertilise stockpiles as soon as possible. An annual cover crop species that produce sterile florets or seeds may be sown. A rapid growing and healthy annual pasture sward would provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species would not persist in the rehabilitation areas but would provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil. Final rehabilitation target species should be established on stockpiles to build up a desirable species seed bank in the topsoil.
- An inventory of available soil should be maintained to ensure adequate materials are available for planned rehabilitation activities when the time comes.
- Prior to re-spreading stockpiled topsoil onto the Development Area, an assessment of weed infestation on stockpiles should be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading.

Soil Re-spreading and Seedbed Preparation

Stockpile and respreading management measures would not require large volumes of topsoil, however the following re-spreading and seedbank preparation techniques are recommended to prevent excessive soil deterioration and dispersion for any minor areas of topsoil removal.

- Topsoil should be spread to a depth that best reflects pre-disturbance soil horizons.
- Topsoil should be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion. Thorough seedbed preparation should be undertaken to ensure optimum establishment and growth of vegetation.

- All topsoiled areas should be lightly contour ripped (after topsoil spreading or following removal of hardstand from topsoil areas) to create a "key" between the soil and material below. Ripping should be undertaken on the contour. Best results would be obtained by ripping when soil is moist and when undertaken immediately prior to sowing.
- The respread soil surface should be scarified prior to, or during seeding, to reduce run-off and increase infiltration. This can be undertaken by contour tilling with a fine-tyned plough or disc harrow.

6.3 PEST SPECIES

Weeds in general would be managed across the site through a Pest and Weed Management Plan. This would include an ongoing effort to identify and eliminate existing weed populations on-site over the life of the Project. The spread of declared noxious weeds would be prevented by using site specific measures such as direct spraying.

Weed control, if required, would be undertaken in a manner that would minimise soil disturbance. Any use of herbicides would be carried out in accordance with the regulatory requirements. Records would be maintained of weed infestations and control programs would be implemented according to best management practice for the weed species concerned.

Feral animals would be controlled in accordance with Livestock Health and Pest Authority procedures. Feral animal control may be undertaken in consultation with host and neighbouring landholders, as required. Programs to control feral animals would include the determination of appropriate control practices, consultation with appropriate authorities, obtaining appropriate approvals, implementing control practices, and undertaking follow-up monitoring and control as required.

If a substantial increase in the numbers of any known feral fauna species, or the occurrence of a previously unrecorded feral fauna species, is discovered, advice would be sought from a suitably qualified and experienced person on the management and control options for that species and appropriate measures for mitigating any impacts caused by its management on native species.

6.4 BIOSECURITY

At the local level, the mitigation measures outlined for pest species would reduce biosecurity risks. On a regional level, any import of equipment or machinery from overseas would follow the standard procurement safeguards and quarantine procedures as per Australian requirements.

Further, an agricultural Biosecurity Management Plan detailing construction and operational risks and controls in relation to pests, weeds, and diseases would be prepared for the Project.

As NSW DPI Agriculture has noted for other similar renewable energy projects, the agricultural Biosecurity Management Plan should include controls to address the current elevated threat of foot-and-mouth disease (FMD), a serious and highly contagious animal disease that affects all cloven-hoofed animals including cattle and sheep. An incursion of the virus would have severe consequences for Australia's animal health and trade. Key controls should include adherence to government FMD awareness, prevention and preparedness programs and guidance.

6.5 MONITORING PROGRAMS

Monitoring programs are instituted to assess predicted versus actual impacts as the Project progresses in order to implement controls where required. All operations associated with the Project undertaken in accordance with approved environmental management plans and strategies. The management plans would include environmental monitoring programs, where required. Key management plans, or chapters housed within a larger CEMP, that would assist in managing impacts on agricultural land would be stipulated in conditions of development consent.

These management plans, which would include mitigation measures to control impacts to soils and agriculture, would be reviewed and revised where necessary to incorporate the requirements associated with the Project prior to commencement.

6.6 MITIGATION SUMMARY

The mitigation measures pertaining to soils and agriculture that have been referenced in this assessment would form part of the Project approval commitments. A summary of these is presented in **Table 16**.

Table 16: Summary of Mitigation Measures

Risk Category	Mitigation Measure
Agricultural Land Use	The temporary laydown area of approximately 6 ha of agriculture land removed from agriculture use would be re-established following completion of construction works, while the remaining footprint of approximately 12 ha of agriculture land removed from agriculture use would be re-established following decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities).
Agricultural Productivity	The Development Area would be returned to an agricultural productivity following the Project that is an approximate equivalent of pre-Project status.
Soil	All soil that is proposed to be disturbed during the Project would be handled in accordance with the strategy outlines in Section 6.2.1 and a site soil management plan prepared for the Project that includes soil management measures relating to soil stripping, stockpiling, respread/reuse, and land rehabilitation. This would inform the CEMP, OEMP and a Decommissioning and Rehabilitation Plan.
LSC	Through site rehabilitation and good soil management practices as outlined in Section 6.2, the temporarily disturbed laydown area of approximately 6 ha would be returned to an equivalent LSC class following the completion of construction works, while the remaining footprint of approximately 12 ha of disturbed land would be returned to an equivalent LSC class following the end of life for the Project.
Erosion and Sedimentation	Channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures. All soil resources are to be managed throughout construction, operation and decommissioning phases of the Project in accordance with an ESCP which should include recommendations outlined in Section 6.2.1.
Agricultural Infrastructure	Agricultural improvements including irrigation channels, farms dams and stock fences, to be reinstated during decommissioning to suit post-Project land use.
Pest Species	Pest species would be managed in accordance with measures outlined in Section 5.4.1, and a Weed Management Plan prepared for the Project.
Biosecurity	Biosecurity would be managed in accordance with measures outlined in Section 5.4.2 and an Agricultural Biosecurity Management Plan prepared for the Project.

7 SUMMARY

There is a high level of certainty about the status of agricultural resources and enterprises in the Development Area, locality and broader region, based on the soil survey and site verification assessment undertaken, consultation and desktop studies carried out. Further, there is a high level of confidence regarding the Project activities, surface disturbance requirements and commitments to returning land to pre-disturbance agricultural status following the life of the Project.

Based on these factors, the impacts on agriculture as a result of the Project are determined to be generally minor, temporary, and limited to the Development Area. These impacts can be summarised as the following:

- Temporary removal of up to 18 ha of land from agricultural land use during the construction phase of the Project which would be reduced to approximately 12 ha during the operational phase of the Project.
- Temporary removal of potential agricultural primary productivity to the estimated value of up to $18,144 per year for the duration of the Project.
- Temporary impacts on soil resources and LSC within the Development Area where surface disturbance occurs.

The temporary impacts on agriculture listed above are considered a negligible impact in the context of the gross commodity values and land use coverage of the agricultural industries operating within the Edward River LGA. Given the nature and scale of the established agricultural industries within the region and wider state, there would be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure.

At the scale of the enterprises operating within the Development Area, the anticipated impacts are considered offset as the involved landowner would be financially compensated.

A summary of mitigation measures and management recommendations have been provided at Section 6.6 as key controls the temporary risks of the Project on land and soil resources. The reinstatement of a physically and chemically stable soil growth medium over disturbed areas is critical to ensure rehabilitation commitments are able to be met and the 18 ha of agricultural land being disturbed is able to be returned to a pre-disturbance agricultural status.

It is anticipated that by adopting a soil management strategy and targeted soil and erosion management during Project construction and operation, and implementing effective decommissioning and rehabilitation at the end of Project life, the Project would have minor impact on the soils and agricultural productivity of the Project Area, and negligible impact on agriculture industries operation within the region.

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Appendix 1

Land Use Conflict Risk Assessment

Overview

LUCRA is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict.

The LUCRA compares and contrasts the Project against adjoining/surrounding land uses and activities for incompatibility and conflict issues based on the risks and impacts identified in Section 5, and the mitigation measures and controls presented in Section 6. Each potential conflict between the operation of the BESS and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in the following section.

Assumption

The current status of rural land use in the area is not considered likely to change significantly during the life of the Project. For example, due to the location of the Project Area relative to major regional towns, it is considered unlikely that surrounding properties would undergo subdivision to accommodate residential or small-block rural developments. Accordingly, it is not expected that future changes to land use would occur that would generate new land use conflicts in addition to those identified.

Methodology

A risk ranking matrix (**Table A1**) provided by the DPI (2011) is used to rank the identified potential land use conflicts. The risk ranking matrix assesses the economic, social and environmental impacts according to the probability of occurrence and consequence of the impact.

Table A1: Risk Ranking Matrix

	Probability				
Consequence	**A**	**B**	**C**	**D**	**E**
Level 1	25	24	22	19	15
Level 2	23	21	18	14	10
Level 3	20	17	13	9	6
Level 4	16	12	8	5	3
Level 5	11	7	4	2	1

(Source: DPI, 2011)

The risk ranking matrix yields a risk ranking from 25 to 1. It covers each combination of five levels of 'probability' (a letter A to E as defined in **Table A2**) and 5 levels of 'consequence', (a number 1 to 5 as defined in **Table A3**) to identify the risk ranking of each impact. For example, an activity with a 'probability 'of D and a 'consequence' of 3 yields a risk rank of 9. A rank of 25 is the highest magnitude of risk; a highly likely, very serious event. A rank of 1 represents the lowest magnitude of risk; an almost impossible, very low consequence event. Low risk is a ranking score of 10 or below.

Table A2: Probability Definitions

Level	Descriptor	Description
A	Almost Certain	Common or repeating occurrence.
B	Likely	Known to occur or it has happened.
C	Possible	Could occur or 'I've heard of it happening.'
D	Unlikely	Could occur in some circumstances but not likely to occur.
E	Rare	Practically impossible or 'I've never heard of it happening.'

(Source: DPI, 2011)

Table A3: Consequence Definitions

	Description	Example of Implications
Level 1		
Severe	• Severe and/or permanent damage to the environment • Irreversible • Severe impact on the community • Neighbours are in prolonged dispute and legal action involved	• Harm or death to animals, fish, birds or plants • Long term damage to soil or water • Odours so offensive some people are evacuated or leave voluntarily • Many public complaints and serious damage to Council's reputation • Contravenes Protection of the Environment & Operations Act and the conditions of Council's licences and permits. Almost certain prosecution under the POEO Act
Level 2		
Major	• Serious and/or long-term impact to the environment • Long-term management implications • Serious impact on the community • Neighbours are in serious dispute	• Water, soil or air impacted, possibly in the long term • Harm to animals, fish or birds or plants • Public complaints. Neighbour disputes occur. Impacts pass quickly • Contravenes the conditions of Council's licences, permits and the POEO Act • Likely prosecution
Level 3		
Moderate	• Moderate and/or medium-term impact to the environment and community • Some ongoing management implications • Neighbour disputes occur	• Water or soil known to be affected, probably in the short to medium-term (e.g. 1-5 years) • Management could include significant change of management needed for agricultural enterprises to continue
Level 4		
Minor	• Minor and/or short-term impact to the environment and community • Can be effectively managed as part of normal operations • Infrequent disputes between neighbours	• Theoretically could affect the environment or people but no impacts noticed • No complaints to Council • Does not affect the legal compliance status of Council
Level 5		
Negligible	• Very minor impact to the environment and community • Can be effectively managed as part of normal operations • Neighbour disputes unlikely	• No measurable or identifiable impact on the environment • No measurable impact on the community or impact is generally acceptable

(Source: DPI, 2011)

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Land users in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect nearby creeks and irrigation channels, from surface disturbances during construction activities	C	3	13	Consideration of impacts to surrounding water courses and water quality has been undertaken within the water impact assessment for the EIS. The flat nature of the landform indicates a low water erosion and sedimentation risk. Appropriate mitigation measures are specified within the EIS, including soil erosion and sedimentation controls within this report, to minimise impacts to watercourse health and quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to watercourse health and quality. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved), such as a soil management plan and an erosion and sediment control plan.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Erosion and Sediment Control Plan (ESCP).
Construction Ground Disturbance	Stakeholders may have concerns that the construction and operation of the Project may alter and disturb existing soil properties, undermining the suitability of the land for future agricultural production.	C	2	18	The assessment of soil characteristics, erodibility and land and soil capability has been undertaken within this agricultural assessment. Anticipated impacts and appropriate mitigation measures are provided within this report. Compliance with mitigation measures is anticipated to reduce the risk of potential conflicts related to future land capability for agriculture. Implement all measures specified in this report and associated management plans identified in the EIS and/or consent conditions (if approved).	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Soil and Water Management Plan (SWMP).

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Stakeholders may be concerned about impacts to heritage items or values at the site and locality.	B	4	12	An assessment of impacts to heritage has been undertaken with the preparation of an Aboriginal Cultural Heritage Assessment Report (ACHAR) and a historic heritage assessment. Appropriate mitigation measures are specified within the ACHAR and the historic heritage assessment to minimise impacts to heritage. Compliance with mitigation measures specified within the ACHAR and the historic heritage assessment is anticipated to reduce the risk of conflict related to environmental features, culturally sensitive land and heritage. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, specifically through an Aboriginal Cultural Heritage Management Plan (ACHMP).
Construction Ground Disturbance	Stakeholders may be concerned about potential impacts to biodiversity within the site and locality.	B	3	17	The assessment of impacts to biodiversity has been undertaken via a BDAR. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for impacts on biodiversity within the site and locality. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved). Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.
Construction Noise	Land users in the locality may be concerned construction activity disturbances may affect livestock behaviour and/or breeding.	D	3	9	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Low stocking rates and distance between neighbouring farms in the locality suggest a low risk. Appropriate mitigation measures are specified within the NIA to minimise noise impacts. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Any complaints from neighbours regarding effects to livestock can be managed within normal operations.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Noise	Increased noise generated by construction activities and heavy vehicle movements may be perceived as nuisance to nearby residential properties.	C	4	8	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). The distance between the Project Area and neighbouring residences suggests a low risk. Appropriate mitigation measures are specified within the NIA to minimise noise impacts. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on agricultural land users. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, which will include reference to relevant noise criteria.
Construction Dust	Land users in the locality may be concerned that dust generated by construction activities may have adverse health implications for residential land users within the locality.	D	3	9	The assessment of potential dust impacts has been undertaken as part of the EIS. The distance between the Project Area and neighbouring residences suggests a low risk. With the implementation of mitigation measures, the Project can be constructed without any significant impact to local and regional air quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to air quality impacts. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	4	3	Effectiveness of mitigation measures will be measured as part of the Environmental Management System (EMS), which will include a Construction Environmental Management Plan (CEMP) that outlines dust suppression strategies.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Biosecurity	Land users in the locality may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the Project.	B	2	21	The assessment of impacts to biodiversity has been undertaken via a BDAR. Consideration of the potential for pest species to impact agriculture has been included in this assessment. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for weeds and pests to spread throughout the site and onto neighbouring land. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, specifically Biodiversity Management Plan.
Construction Traffic	Use of local roads during construction of the Project may cause conflict by interacting with agricultural and/or local transport activities, and/or resulting in additional travel time for road users.	C	4	8	The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA), which found the road network can accommodate the traffic generated by the Project during the construction, operation and decommissioning stages. Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved)	D	4	5	The EMS, specifically the Traffic Management Plan (TMP), will include a complaint resolution as a mechanism to address any issues identified by neighbouring land users.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Traffic	Land users in the locality may be concerned about the possibility of increased vehicles during construction or operation may result in an accident with livestock, farm machinery or wildlife on roads.	D	1	19	The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA). The low volume of traffic on local roads suggest a low risk. Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	6	6	The EMS, specifically TMP, will include a complaint resolution as a mechanism to address any issues identified by neighbouring land users
Construction Works	Stakeholders may have concerns that construction activities associated with the Project may damage existing infrastructure including transmission lines and public infrastructure.	C	4	8	Consideration of potential impacts to surrounding service provider infrastructure has been undertaken as part of the EIS. Appropriate mitigation measures are specified within the EIS and will be detailed in a Construction Environmental Management Plan (CEMP) to minimise the risk of construction activities damaging existing infrastructure. Compliance with construction management measures anticipated to reduce the risk of conflict related to damaging existing infrastructure. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	No damage to existing infrastructure including transmission lines during the construction phase due to project activities. Any impacts to public infrastructure will be remedied.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Workforce	Public authorities may be concern about the increased demand for services and infrastructure that may result from the development, especially during the construction stage, including increased accommodation for workers, availability of medical facilities and capacity of surrounding waste facilities	C	5	4	The assessment of impacts related to the increased demand for surrounding services and infrastructure has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Levels of anticipated increased demand and appropriate mitigation measures are specified within the SIA to minimise the risk for logistical issues associated with the increased demand for existing infrastructure and services. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	5	2	Effectiveness of mitigation measures will be measured as part of the EMS.
Construction Workforce	Neighbouring landholders may be concerned about the presence of an accommodation camp within the Project Area (if to be constructed and utilised for the Project). This may be perceived to adversely affect neighbouring agricultural operations or local residents' security.	C	4	8	The assessment of impacts related to the presence of an accommodation camp has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Grazing at low stocking rates and the distance between the Project Area and the nearest sensitive agricultural operation, as well as the distance to the nearest residences, suggest a low risk. All site personnel will be required to follow struct site policies while lodging at accommodation camp. Impacts to agricultural enterprises on neighbouring properties are unlikely to be experienced. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	5	2	Effectiveness of mitigation measures will be measured as part of the EMS.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Agriculture Cessation	Stakeholders in the locality may be concerned about the reduction of land used for agricultural purposes or the reduction of productivity of the land.	A	4	16	The assessment of the reduction of land used for agriculture and the productivity of land has been undertaken within this agricultural assessment. The negligible anticipated impacts and appropriate mitigation measures are provided within the agricultural impact assessment report for stakeholder consideration. A Decommissioning and Rehabilitation Management Plan will ensure the land can be successfully returned to agricultural production following decommissioning.	D	4	5	Rehabilitation objectives and strategies (including performance measures) will be established in the Decommissioning and Rehabilitation Management Plan.
Agriculture Cessation	Land users in the locality may be concerned about impacts to agricultural support infrastructure in the Project locality and wider region.	D	4	5	The assessment of the impacts to agricultural support infrastructure in the Project locality and wider region has been undertaken within this agricultural assessment. Anticipated impacts are determined to be negligible and presented in this report for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	5	2	No complaints from agriculture enterprises regarding impact to agricultural support infrastructure due to project activities.
Fire	Land users in the locality may be concerned about the risk of fires occurring at the site and their potential to spread to surrounding land, infrastructure or livestock.	C	2	18	Consideration of potential bushfire impacts has been undertaken as part of a Preliminary Hazard Analysis (PHA) informing the EIS. Further, a Bushfire Assessment Report (BFAR) was prepared to identify and evaluate the potential hazards and risks associated with bushfires to and from the Project and the use of bushfire prone land. Appropriate mitigation measures are specified within the PHA and BFAR within the EIS to minimise the risk of fire to and from the Project incidents including their risk to people and potential to damage surrounding land. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	2	10	Effectiveness of mitigation measures will be measured as part of the EMS.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Traffic	Land users in the locality may be concerned about an increase in traffic volume on local roads throughout the operational phase of the Project, which may cause conflict by interacting with agriculture transport activities or increasing travel times over the life of the Project.	D	4	5	The assessment of potential traffic impacts during the operational phase of the Project has been undertaken via a Traffic Impact Assessment (TIA). Anticipated impacts are determined to be negligible and presented in the EIS for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.
Operation Traffic	Land users in the locality may be concerned that dust generated by increased vehicle movements along access roads during the operational phase of the Project has the potential to impact air quality and may have adverse health implications for residential land users within the locality.	D	3	9	The assessment of potential dust impacts during the operational phase of the Project has been undertaken as part of the EIS. Anticipated impacts are determined to be negligible and presented in the EIS for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.
Operation Pest Control	Land users in the locality may be concerned that waste generated by the development may increase the presence of pest animals and/or vermin which could impact agricultural productivity.	D	4	5	Consideration of waste related impacts has been undertaken as part of the EIS. Appropriate mitigation measures are specified in the Waste Management Plan (WMP) to minimise the risk of attracting pest animals and/or vermin. Compliance with mitigation measures specified in the EIS is anticipated to reduce the risk of conflict related to pest animals and/or vermin. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	4	3	Effectiveness of mitigation measures will be measured as part of the EMS, specifically WMP.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Workforce	Stakeholders in the locality may be concerned about the effects on local and regional employment.	C	1	4	Consideration of employment impacts has been undertaken as part of the SIA and Economic Assessment. Anticipated impacts are determined to be negligible and outweighed by the employment opportunities of the Project. This finding is presented in the SIA and Economic Assessment. for stakeholder consideration.	E	5	1	Nil
Livestock Interaction	Neighbouring landowners may be concerned about their livestock entering the Development Area and becoming injured or causing damage.	D	4	5	Operational management plans will include a provision to ensure boundary fence is maintained to a suitable standard. Regular inspection of fences should be conducted to assess the condition of the fence, and any issues rectified as soon as practical. If livestock enter the site, the surrounding landowners should be contacted. Efforts will be made to ensure the animal is not distressed and kept away from public roads. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	4	3	Effectiveness of mitigation measures will be measured as part of the EMS.
Insurance Premiums	The placement of the Project in proximity to agricultural business operators may affect insurance premiums for surrounding private property owners.	C	3	13	The Project will implement measures such as Asset Protection Zone (APZ) which ensures that fire cannot spread either from Project's infrastructures to surrounding properties or from adjoining properties. Therefore, avoiding the implications of costs and loss and difficulty in obtaining appropriate insurance for a reasonable premium. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.

Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Property Devaluation	Landowners in the locality may be concerned about potential devaluation of properties due to proximity to BESS.	D	3	9	As outlined in the EIS, there are many factors that may influence land value, being amenities impact of the Project to the locality the key factor to devaluation. The distance between the Project Area and neighbouring residences suggests a low risk. The Project has been refined and where impacts could not be avoided, management and mitigation measures will be adopted to further reduce potential impacts that may cause devaluation of properties as per EIS. Therefore, the residual impacts of the Project during operational phase, after implementation of management and mitigation measures are predicted to be minimal. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Effectiveness of engagement will be measured as part of the EMS.
Electro-magnetic Fields	Land users in the locality and personnel on host lands may be concerned about electro-magnetic fields (EMF) resulting from electrical infrastructure associated with the Project.	D	2	14	Consideration of EMF impacts resulting from the development has been undertaken as part of the EIS. The EIS finds that the potential for the EMF to exceed the accepted levels is considered negligible. This finding is presented in the EIS for stakeholder consideration.	E	5	1	Nil.
Decommissioning	Stakeholders may be concerned about the potential for poor rehabilitation outcomes and the resulting long term environmental and agricultural consequence.	C	1	22	A Decommissioning and Rehabilitation Plan will ensure the land can be successfully returned to pre-disturbance land and soil capability and final land use commitments following decommissioning.	E	2	10	Rehabilitation objectives and strategies (including performance measures) will be established in the Decommissioning and Rehabilitation Management Plan.

Appendix 2

Soil Profile Descriptions

Site Description – Site 5				
Site Reference	5	**ASC Name**	Epipedal Black Vertosol	
Average Slope	0%	**Land Use**	Livestock Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Flat	**Drainage**	Moderate	X: 278150
Surface Condition	Cracked	**Permeability**	Moderate	Y: 6136318

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Dark brown (Munsell 7.5YR 3/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. No coarse fragments. Many roots and moderately well drained. Gradual boundary.
B21	**0.10 – 0.70**	Very dark brown (Munsell 7.5YR 2.5/3) Heavy Clay with strong pedality, rough fabric and moderate consistence. No coarse fragments. Few roots and moderately well drained. Gradual boundary.
B22	**0.70 +**	Very dark brown (Munsell 7.5YR 2.5/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. No coarse fragments. No roots and moderately well drained. Gradual boundary.

Site Description – Site 6				
Site Reference	6	**ASC Name**	Salic Epipedal Grey Vertosol	
Average Slope	0%	**Land Use**	Livestock Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Flat	**Drainage**	Moderate	X: 278471
Surface Condition	Cracked	**Permeability**	Moderate	Y: 6136271

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Dark greyish brown (Munsell 2.5Y 4/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Mildly alkaline pH, non-saline and sodic. No coarse fragments. Many roots and moderately well drained. Gradual boundary.
B21	**0.10 – 0.40**	Dark greyish brown (Munsell 2.5Y 4/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Mildly alkaline pH, highly saline and sodic. No coarse fragments. Few roots and moderately well drained. Gradual boundary.
B22	**0.40 +**	Greyish brown (Munsell 2.5Y 5/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Neutral pH, extremely saline and sodic. No coarse fragments. No roots and moderately well drained.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.8	Non-saline	7.5	Mildly Alkaline	16	Strongly Sodic
0.20 – 0.30	12.4	Highly saline	7.4	Mildly Alkaline	40	Strongly Sodic
0.50 – 0.60	24.1	Extremely saline	7.0	Neutral	28	Strongly Sodic

Site Description – Site 7				
Site Reference	7	**ASC Name**	Episodic Epipedal Grey Vertosol	
Average Slope	0%	**Land Use**	Livestock Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Flat	**Drainage**	Moderate	X: 277969
Surface Condition	Cracked	**Permeability**	Moderate	Y: 6136816

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Greyish brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Moderately alkaline pH, non-saline and sodic. No coarse fragments. Many roots and moderately well drained. Gradual boundary.
B21	**0.15 – 0.50**	Dark greyish brown (Munsell 2.5Y 4/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Strongly alkaline pH, non-saline and sodic. No coarse fragments. Few roots and moderately well drained. Gradual boundary.
B22	**0.50 +**	Greyish brown (Munsell 10YR 5/2) Heavy Clay with strong pedality, rough fabric and moderate consistence. Strongly alkaline pH, highly saline and sodic. No coarse fragments. No roots and moderately well drained.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.7	Non-saline	8.0	Moderately Alkaline	14	Sodic
0.20 – 0.30	1.6	Non-saline	8.5	Strongly Alkaline	20	Strongly Sodic
0.50 – 0.60	12.7	Highly saline	8.8	Strongly Alkaline	38	Strongly Sodic

Appendix 3

Laboratory Certificates of Analysis

Certificate of Analysis E24-00-0900

Client:	Minesoils Pty. Ltd.	Laboratory:	Environmental Analysis Laboratory
Contact:	Clayton Richards	Contact:	EAL Customer Service Team
Address:	PO Box 11034, TAMWORTH, NSW 2340, Australia	Address:	PO Box 157, East Lismore NSW 2480 Australia
Telephone:	0408 474 248	Telephone:	(02) 6620 3678
Email:	clayton@minesoils.com.au	Email:	eal@scu.edu.au

Customer reference:	MS169 Romani	Request ID:	EAL /E24-00-0900
Number of samples:	24	Report ID:	E24-00-0900_EALP1_1
Date samples received:	13 November 2024	Issue date:	12 December 2024

Authorised by:	Kris Saville
Position:	Technical Team Leader

Accreditation No. 14960

Comments: EAL is a NATA accredited laboratory (14960), accredited for compliance with ISO/IEC 17025 - Testing.

Certificate of Analysis

Request ID: EAL/E24-00-0900 Report ID: E24-00-0900_EALP1_1 Issue date: 12 December 2024

				Client Sample ID:	3 - 0 - 10	3 - 20 - 30	3 - 50 - 60	6 - 0 - 10	6 - 20 - 30
				Sample Date:	5 November 2024	5 November 2024	5 November 2024	5 November 2024	10 November 2024
				Sampled By:	C. Richards	C. Richards	C. Richards	C. Richards	M. Hemingway
				Your Client:	ERM	ERM	ERM	ERM	EMM
				EAL Sample ID:	E24-00-0900-0001	E24-00-0900-0002	E24-00-0900-0003	E24-00-0900-0004	E24-00-0900-0005
Parameter	**Unit**	**Method Reference**	**LOR**		---	---	---	---	---
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---		7.06	7.69	7.29	7.45	7.40
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05		5.77	4.87	5.37	9.00	7.87
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22		2590	2190	2410	4040	3530
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10		1160	976	1080	1800	1580
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01		15.1	17.1	17.0	15.8	15.2
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2		4120	4650	4620	4310	4130
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1		1840	2070	2060	1930	1840
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12		1.47	0.74	0.87	1.18	0.84
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112		1280	644	759	1030	738
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50		574	288	339	461	330
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065		3.47	8.69	13.5	4.92	15.7
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33		1780	4470	6970	2530	8080
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15		797	2000	3110	1130	3610
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01		0.02	0.01	< 0.01	0.02	0.02
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1		4.8	2.3	1.8	3.4	3.0
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1		2.1	1.0	< 1	1.5	1.3
Hydrogen - Exchangeable	cmol+/kg	** Rayment & Lyons 2011 - 15G1	<0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen - Exchangeable	kg/ha	** Rayment & Lyons 2011 - 15G1	<1		< 1	< 1	< 1	< 1	< 1
Hydrogen - Exchangeable	mg/kg	** Rayment & Lyons 2011 - 15G1	<1		< 1	< 1	< 1	< 1	< 1
Calcium - Base Saturation	%	** Calculation	<0.1		22	16	15	29	20
Magnesium - Base Saturation	%	** Calculation	<0.1		59	54	46	51	38
Potassium - Base Saturation	%	** Calculation	<0.1		5.7	2.3	2.4	3.8	2.1
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1		13	28	37	16	40
Aluminium - Base Saturation	%	** Calculation	<0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hydrogen - Base Saturation	%	** Calculation	<0.1		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium/Magnesium Ratio	---	** Calculation	<0.1		0.4	0.3	0.3	0.6	0.5
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---		25.8	31.4	36.7	30.9	39.6
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005		0.174	0.749	1.56	0.314	2.14
Moisture Content	%	Inhouse S2 (105°C)	<0.1		9.6	13.5	17.7	10.8	14.7
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		0.0	0.0	0.1	0.0	0.0
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		0.0	0.0	0.0	0.0	0.0
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		0.0	0.0	0.1	0.0	0.0
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		11.2	6.9	6.0	8.9	8.4
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		30.8	26.5	27.8	22.7	21.5
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		7.6	6.1	8.3	8.0	9.8
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1		50.4	60.6	57.7	60.5	60.4
Colour Code	---	** Inhouse S84	---		10YR 4/3	---	---	2.5Y 4/2	---
Emerson Aggregate Test - Class	---	** Inhouse S28	---		---	2	2	---	3
Colour Description	---	** Inhouse S84	---		Brown	---	---	Dark Grayish Brown	---

Certificate of Analysis

Request ID: EAL/E24-00-0900 Report ID: E24-00-0900_EALP1_1 Issue date: 12 December 2024

			Client Sample ID:	3 - 0 - 10	3 - 20 - 30	3 - 50 - 60	6 - 0 - 10	6 - 20 - 30
			Sample Date:	5 November 2024	5 November 2024	5 November 2024	5 November 2024	10 November 2024
			Sampled By:	C. Richards	C. Richards	C. Richards	C. Richards	M. Hemingway
			Your Client:	ERM	ERM	ERM	ERM	EMM
			EAL Sample ID:	E24-00-0900-0001	E24-00-0900-0002	E24-00-0900-0003	E24-00-0900-0004	E24-00-0900-0005
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
Colour Code	---	** Inhouse S84	---	---	7.5YR 3/4	7.5YR 4/4	---	2.5Y 4/2
Colour Description	---	** Inhouse S84	---	---	Dark Brown	Brown	---	Dark Grayish Brown

			Client Sample ID:	6 - 50 - 60	7 - 0 - 10	7 - 20 - 30	7 - 50 - 60	9 - 0 - 10
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0006	E24-00-0900-0007	E24-00-0900-0008	E24-00-0900-0009	E24-00-0900-0010
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---	7.01	8.02	8.52	8.75	7.99
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05	7.85	10.5	11.7	12.1	7.44
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22	3530	4730	5270	5410	3340
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10	1570	2110	2350	2420	1490
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01	16.6	13.5	14.9	14.9	15.3
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2	4510	3670	4050	4070	4170
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1	2010	1640	1810	1820	1860
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12	0.90	1.64	1.30	1.23	1.40
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112	785	1430	1140	1070	1220
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50	350	641	510	480	546
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065	9.62	4.28	6.87	17.6	3.88
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33	4950	2210	3540	9050	2000
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15	2210	985	1580	4040	893
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01	0.02	0.01	0.02	0.03	0.02
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1	3.4	2.5	3.4	5.4	4.8
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1	1.5	1.1	1.5	2.4	2.2
Hydrogen - Exchangeable	cmol+/kg	** Rayment & Lyons 2011 - 15G1	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen - Exchangeable	kg/ha	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Hydrogen - Exchangeable	mg/kg	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Calcium - Base Saturation	%	** Calculation	<0.1	22	35	34	26	27
Magnesium - Base Saturation	%	** Calculation	<0.1	47	45	43	33	55
Potassium - Base Saturation	%	** Calculation	<0.1	2.6	5.5	3.7	2.7	5.0
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1	28	14	20	38	14
Aluminium - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hydrogen - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium/Magnesium Ratio	---	** Calculation	<0.1	0.5	0.8	0.8	0.8	0.5
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---	34.9	30.0	34.8	45.8	28.0
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005	4.15	0.116	0.273	2.19	0.161
Moisture Content	%	Inhouse S2 (105°C)	<0.1	18.1	9.8	14.8	17.6	11.3
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0	0.0
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0	0.0
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0	0.0
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	5.5	5.9	4.6	3.6	10.2

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			Client Sample ID:	6 - 50 - 60	7 - 0 - 10	7 - 20 - 30	7 - 50 - 60	9 - 0 - 10
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0006	E24-00-0900-0007	E24-00-0900-0008	E24-00-0900-0009	E24-00-0900-0010
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	17.3	19.3	16.4	17.7	28.1
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	10.7	10.5	15.5	22.7	7.7
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	66.5	64.3	63.5	56.0	53.9
Colour Code	---	** Inhouse S84	---	---	10YR 5/2	2.5Y 4/2	10YR 5/2	2.5Y 5/1
Emerson Aggregate Test - Class	---	** Inhouse S28	---	3	---	---	---	---
Colour Description	---	** Inhouse S84	---	---	Grayish Brown	Dark Grayish Brown	Grayish Brown	Gray
Colour Code	---	** Inhouse S84	---	2.5Y 5/2	---	---	---	---
Colour Description	---	** Inhouse S84	---	Grayish Brown	---	---	---	---

			Client Sample ID:	9 - 20 - 30	9 - 50 - 60	12 - 0 - 10	12 - 20 - 30	12 - 50 - 60
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0011	E24-00-0900-0012	E24-00-0900-0013	E24-00-0900-0014	E24-00-0900-0015
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---	8.24	8.10	7.28	8.26	8.60
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05	7.85	6.68	8.69	10.9	7.69
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22	3520	3000	3900	4870	3450
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10	1570	1340	1740	2180	1540
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01	16.8	15.0	11.0	13.5	13.0
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2	4560	4080	2990	3670	3530
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1	2040	1820	1330	1640	1570
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12	1.04	0.95	1.08	0.67	0.75
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112	914	833	945	585	657
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50	408	372	422	261	293
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065	7.68	14.3	3.09	7.18	12.1
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33	3960	7370	1590	3700	6250
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15	1770	3290	711	1650	2790
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01	0.02	0.02	0.02	0.02	0.02
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1	3.6	3.4	3.2	4.8	4.0
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1	1.6	1.5	1.4	2.2	1.8
Hydrogen - Exchangeable	cmol+/kg	** Rayment & Lyons 2011 - 15G1	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen - Exchangeable	kg/ha	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Hydrogen - Exchangeable	mg/kg	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Calcium - Base Saturation	%	** Calculation	<0.1	24	18	36	34	23
Magnesium - Base Saturation	%	** Calculation	<0.1	50	41	46	42	39
Potassium - Base Saturation	%	** Calculation	<0.1	3.1	2.6	4.5	2.1	2.2
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1	23	39	13	22	36
Aluminium - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hydrogen - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium/Magnesium Ratio	---	** Calculation	<0.1	0.5	0.4	0.8	0.8	0.6
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---	33.3	36.9	23.8	32.2	33.5
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005	0.422	1.48	0.236	0.524	1.65

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			Client Sample ID:	9 - 20 - 30	9 - 50 - 60	12 - 0 - 10	12 - 20 - 30	12 - 50 - 60
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0011	E24-00-0900-0012	E24-00-0900-0013	E24-00-0900-0014	E24-00-0900-0015
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
Moisture Content	%	Inhouse S2 (105°C)	<0.1	13.6	14.9	9.1	13.6	15.3
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.2	0.0	0.2	0.0	0.0
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0	0.0
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.2	0.0	0.2	0.0	0.0
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	7.2	4.8	10.8	8.3	9.7
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	20.7	16.8	29.6	20.4	24.4
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	9.7	13.3	7.5	8.3	15.2
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	62.2	65.1	51.9	63.0	50.7
Colour Code	---	** Inhouse S84	---	---	---	10YR 4/4	10YR 4/3	10YR 4/4
Emerson Aggregate Test - Class	---	** Inhouse S28	---	2	2	---	---	---
Colour Description	---	** Inhouse S84	---	---	---	Dark Yellowish Brown	Brown	Dark Yellowish Brown
Colour Code	---	** Inhouse S84	---	2.5Y 4/2	2.5Y 4/1	---	---	---
Colour Description	---	** Inhouse S84	---	Dark Grayish Brown	Dark Gray	---	---	---

			Client Sample ID:	15 - 0 - 10	15 - 20 - 30	15 - 50 - 60	17 - 0 - 10	17 - 20 - 30
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0016	E24-00-0900-0017	E24-00-0900-0018	E24-00-0900-0019	E24-00-0900-0020
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---	7.97	8.14	7.71	7.86	7.31
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05	8.82	6.24	6.69	7.66	5.89
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22	3960	2800	3000	3440	2640
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10	1770	1250	1340	1540	1180
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01	17.2	17.4	18.7	17.0	16.0
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2	4690	4720	5090	4630	4360
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1	2090	2110	2270	2070	1950
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12	1.14	0.78	0.91	0.83	0.71
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112	997	684	796	731	621
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50	445	305	355	326	277
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065	5.13	13.4	12.7	7.46	16.9
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33	2640	6920	6550	3840	8730
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15	1180	3090	2920	1710	3900
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01	0.02	0.02	0.02	0.02	0.02
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1	4.2	3.5	3.9	4.6	3.3
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1	1.9	1.6	1.8	2.1	1.5
Hydrogen - Exchangeable	cmol+/kg	** Rayment & Lyons 2011 - 15G1	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

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			Client Sample ID:	15 - 0 - 10	15 - 20 - 30	15 - 50 - 60	17 - 0 - 10	17 - 20 - 30
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	EMM	EMM	EMM
			EAL Sample ID:	E24-00-0900-0016	E24-00-0900-0017	E24-00-0900-0018	E24-00-0900-0019	E24-00-0900-0020
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---	---
Hydrogen - Exchangeable	kg/ha	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Hydrogen - Exchangeable	mg/kg	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1	< 1
Calcium - Base Saturation	%	** Calculation	<0.1	27	17	17	23	15
Magnesium - Base Saturation	%	** Calculation	<0.1	53	46	48	52	40
Potassium - Base Saturation	%	** Calculation	<0.1	3.5	2.1	2.3	2.5	1.8
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1	16	36	33	23	43
Aluminium - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hydrogen - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium/Magnesium Ratio	---	** Calculation	<0.1	0.5	0.4	0.4	0.5	0.4
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---	32.3	37.8	39.0	33.0	39.6
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005	0.352	1.58	3.72	0.463	2.41
Moisture Content	%	Inhouse S2 (105°C)	<0.1	8.8	14.1	16.6	11.8	16.6
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.1	0.1	0.0	0.0	0.6
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0	0.0
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.1	0.1	0.0	0.0	0.6
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	8.9	6.6	4.0	7.9	7.1
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	20.9	18.3	21.1	23.7	19.8
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	12.6	11.9	9.6	7.9	9.8
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	57.6	63.2	65.3	60.6	62.7
Colour Code	---	** Inhouse S84	---	2.5Y 4/3	10YR 4/4	10YR 4/4	10YR 4/4	---
Emerson Aggregate Test - Class	---	** Inhouse S28	---	---	---	---	---	2
Colour Description	---	** Inhouse S84	---	Olive Brown	Dark Yellowish Brown	Dark Yellowish Brown	Dark Reddish Brown	---
Colour Code	---	** Inhouse S84	---	---	---	---	---	7.5YR 4/4
Colour Description	---	** Inhouse S84	---	---	---	---	---	Brown

			Client Sample ID:	17 - 50 - 60	19 - 0 - 10	19 - 20 - 30	19 - 50 - 60
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	---	---
			EAL Sample ID:	E24-00-0900-0021	E24-00-0900-0022	E24-00-0900-0023	E24-00-0900-0024
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---	7.51	7.30	7.00	6.81
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05	6.80	7.48	5.90	5.39
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22	3050	3360	2650	2420
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10	1360	1500	1180	1080
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01	17.4	16.7	18.0	19.7
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2	4730	4540	4910	5350

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			Client Sample ID:	17 - 50 - 60	19 - 0 - 10	19 - 20 - 30	19 - 50 - 60
			Sample Date:	10 November 2024	10 November 2024	10 November 2024	10 November 2024
			Sampled By:	M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
			Your Client:	EMM	EMM	---	---
			EAL Sample ID:	E24-00-0900-0021	E24-00-0900-0022	E24-00-0900-0023	E24-00-0900-0024
Parameter	**Unit**	**Method Reference**	**LOR**	---	---	---	---
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1	2110	2030	2190	2390
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12	0.81	1.37	0.87	0.87
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112	705	1200	766	762
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50	315	535	342	340
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065	13.2	10.3	11.9	11.1
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33	6790	5330	6150	5700
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15	3030	2380	2740	2540
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01	0.03	0.03	0.03	0.02
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1	5.0	5.4	5.6	3.5
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1	2.2	2.4	2.5	1.6
Hydrogen - Exchangeable	cmol+/kg	** Rayment & Lyons 2011 - 15G1	<0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hydrogen - Exchangeable	kg/ha	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1
Hydrogen - Exchangeable	mg/kg	** Rayment & Lyons 2011 - 15G1	<1	< 1	< 1	< 1	< 1
Calcium - Base Saturation	%	** Calculation	<0.1	18	21	16	15
Magnesium - Base Saturation	%	** Calculation	<0.1	46	46	49	53
Potassium - Base Saturation	%	** Calculation	<0.1	2.1	3.8	2.4	2.4
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1	35	29	32	30
Aluminium - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1
Hydrogen - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium/Magnesium Ratio	---	** Calculation	<0.1	0.4	0.4	0.3	0.3
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---	38.2	35.9	36.7	37.0
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005	3.82	1.42	3.91	5.26
Moisture Content	%	Inhouse S2 (105°C)	<0.1	15.7	12.1	18.3	18.7
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.3	0.3	0.1	0.0
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.0	0.0	0.0	0.0
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	0.3	0.3	0.1	0.0
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	3.7	7.1	6.9	5.2
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	20.1	22.4	18.8	17.9
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	12.9	12.5	10.5	18.5
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	63.0	57.8	63.7	58.5
Colour Code	---	** Inhouse S84	---	---	5YR 4/4	7.5YR 4/4	7.5YR 4/6
Emerson Aggregate Test - Class	---	** Inhouse S28	---	3	---	---	---
Colour Description	---	** Inhouse S84	---	---	Reddish brown	Brown	Strong Brown
Colour Code	---	** Inhouse S84	---	7.5YR 4/4	---	---	---
Colour Description	---	** Inhouse S84	---	Brown	---	---	---

Notes:

Certificate of Analysis

Request ID: EAL/E24-00-0900 Report ID: E24-00-0900_EALP1_1 Issue date: 12 December 2024

- Conversions to kg/ha = mg/kg x 2.24.
- Soluble salts are included in exchangeable cation results. No pre-wash is carried out unless specifically requested.
- The chloride estimate result (Electrical Conductivity x 640) is considered an estimate, and is generally an over-estimate.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- ** denotes NATA accreditation does not cover the performance of this service.
- .. denotes not requested, no data/information or no guidelines available.
- All analysis is on a dry weight basis.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (available on request or at scu.edu.au/eal).
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full.
- Results only relate to the item tested.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Guidelines for phosphorus have been reduced for Australian soils.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Methods from Rayment and Lyons, 2011. Soil Chemical Methods - Australasia. CSIRO Publishing, Collingwood.
- The Morgan 1 Extract is adapted from 'Science in Agriculture', 'Non-Toxic Farming', and 'LaMotte Soil Handbook'.
- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- DOC analysis is carried out on samples as they are supplied, with results corrected to 105°C oven dried basis.
- Conversions for 1 cmol+/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm.
- ppm = mg/kg dried sample