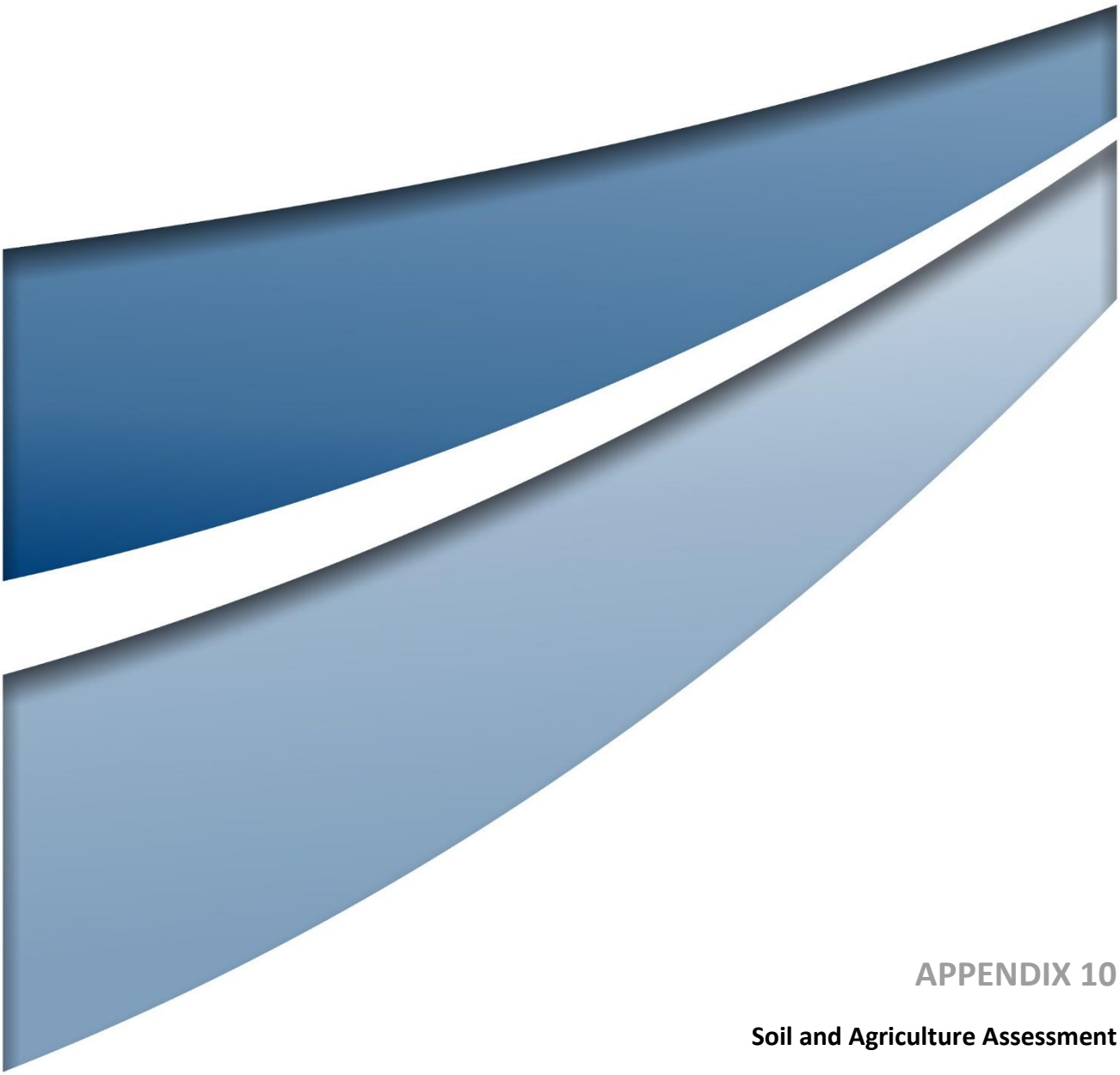
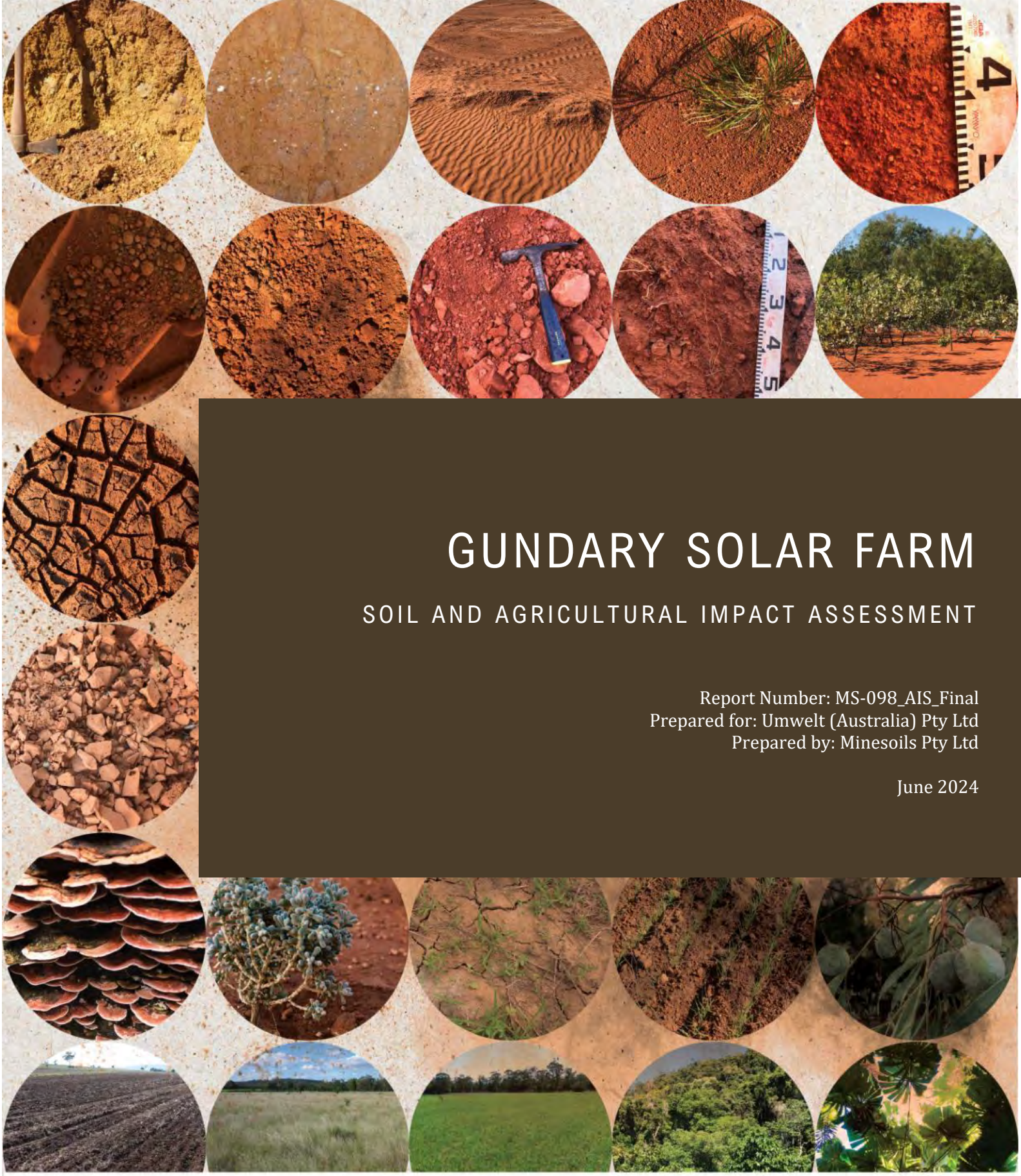


APPENDIX 10

Soil and Agriculture Assessment



GUNDARY SOLAR FARM

SOIL AND AGRICULTURAL IMPACT ASSESSMENT

Report Number: MS-098_AIS_Final
Prepared for: Umwelt (Australia) Pty Ltd
Prepared by: Minesoils Pty Ltd

June 2024

MINESOILS
LAND & REHABILITATION SPECIALISTS

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DISCLAIMER

DOCUMENT CONTROL

Reference	Date	Prepared by	Approved
MS-098_ Draft 1	3 July 2023	Matt Hemingway	Clayton Richards
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MS-098_ Final	24 June 2024	Matt Hemingway	Clayton Richards

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EXECUTIVE SUMMARY

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Limited (Umwelt) to conduct a Soil and Agricultural Impact Assessment of the Gundary Solar Farm (the Project) located in the Southern Tablelands region of New South Wales. The Project will involve the construction, operation, maintenance and decommissioning of a 400 Megawatt peak (MWp) solar farm with a Battery Energy Storage System (BESS) of up to 555 MWp and 1,570 Megawatt hour (MWh) capacity and associated infrastructure to connect the Project to the national electricity grid. The Project is anticipated to have an operational life of 40 years or more.

The Project Area is located in Gundary NSW, approximately 10 kilometres south-east of Goulburn, in the Goulburn Mulwaree Local Government Area (LGA) and covers an area of approximately 702 ha (refer **Figure 2**). The Project infrastructure will cover approximately 512 ha (the development footprint). The Project Area has historically been utilised for agricultural practices with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use. Current land use comprises grazing land with occasional cultivation, and is consistent with the surrounding locality which is predominately utilised for grazing activities.

A soil survey undertaken by Minesoils found the Project Area to contain three dominant soil mapping units:

- Soil Unit 1: Sodosols – covering 570 ha.
- Soil Unit 2: Chromosols – covering 87 ha.
- Soil Unit 3: Dermosols – covering 45 ha.

Site observation and laboratory testing results indicate there is moderate to very high potential risk for dispersion of the subsoils of Soil Unit 1, and moderate to high potential risk for dispersion of the subsoils of Soil Unit 3. Soil Unit 2 presents a negligible to moderate potential dispersion risk and is generally non-sodic, however, caution must be taken over the entire Project Area including Soil Unit 2 despite the range in chemical and physical properties or landscape location of specific soil test sites, as this unit also displays sodicity and moderate dispersion risk in the lower profile at one test site. Direct disturbance activities such as where earthworks are necessary for construction of hard stands or site facilities are therefore very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised. Notwithstanding, there is a high level of confidence regarding the Project activities, surface disturbance requirements and erosion and sediment control management options available to mitigate this risk.

The Project Area was also subject to a site verification assessment of land and soil capability (LSC), in accordance with the LSC Guideline, and was found to contain four LSC classes:

- LSC class 3: high capability land – covering 63 ha, with 21 ha subject to direct disturbance.
- LSC class 4: moderate capability land – covering 114 ha, with 86 ha subject to direct disturbance.
- LSC class 5: moderately-low capability land – covering 277 ha, with 227 ha subject to direct disturbance.
- LSC class 6: low capability land – covering 248 ha, with 178 ha subject to direct disturbance.

There is a high level of certainty about the status of agricultural resources and enterprises in the Project Area, locality and broader region, based on the site verification assessment undertaken, consultation and desktop studies carried out. Further, there is a high level of confidence regarding the Project activities and 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 minimal, temporary, and limited to the Project Area. These impacts can be summarised as the following:

- Temporary removal of 702 ha from agricultural land use within the Project Area for the duration of the Project.

- Temporary removal of potential agricultural primary productivity to the estimated value of up to $280,624 per year for the duration of the Project.
- Temporary impacts on soil resources within the Project Area where surface disturbance occurs.
- Temporary impacts on 21 ha of LSC class 3 land.

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 Goulburn Mulwaree LGA. There will be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure. Further, at the scale of the enterprises operating within the Project Area, impacts are considered offset as the involved landowners would be financially compensated.

Following construction period of approximately one year, subject to the approval of Project stakeholders, the Proponent anticipates the implementation of agrisolar, the integration of solar panels and livestock grazing. This offers the potential to enable the continuation of agricultural land use within the Project Area and mitigate the above listed temporary impacts of the Project.

It is anticipated that by adopting the principles of impact minimisation 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 will have no permanent negative impacts on agricultural resources or enterprises.

1. INTRODUCTION

1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by Umwelt (Australia) Pty Limited (Umwelt) to conduct a Soil and Agricultural Impact Assessment of the Gundary Solar Farm (the Project) located in the Southern Tablelands region of New South Wales. The baseline soil 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 (SDD) Development Consent approval under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (SSD-36651552), as part of the Environmental Impact Statement (EIS) for the Project.

Secretary's Environmental Assessment Requirements (SEAR's) have been issued for the Proponent to address. The objective of this report is address the following items included in the SEAR's for the Project:

- *a soil survey to determine the soil characteristics and consider the potential for erosion to occur; and*
- *an assessment of the agricultural impacts in accordance with the Solar Guidelines.*

In addition, agency advice into the SEARs were received from DPI Agriculture, which has been considered in this report, as detailed in **Table 1**.

1.2 PROJECT DESCRIPTION

The Project will involve the construction, operation, maintenance and decommissioning of a 400 Megawatt peak (MWp) solar farm with a Battery Energy Storage System (BESS) of up to 555 MWp capacity and associated infrastructure to connect the Project to the national electricity grid.

The Project will supply electricity to the National Electricity Market (NEM), via a new onsite connection to the existing 330kV overhead transmission line traversing through the north-west corner of the Project Area. The Project will generate enough clean energy for about 133,000 homes and reduce carbon emissions by 670,000 tonnes. The BESS will have capacity to store up to 1,570 MWh of on-demand energy for supply to the grid.

The Project is anticipated to have an operational life of 40 years or more. Following construction period of approximately one year, the Proponent anticipates that sheep may be introduced to graze within the Project boundary. This combined land use offers the potential to enable the continuation of agricultural usage.

1.3 PROJECT AREA

The Project Area is located in Gundary NSW, approximately 10 kilometres south-east of Goulburn, in the Goulburn Mulwaree Local Government Area (LGA) (refer **Figure 1**). The Project Area is bounded by Windellama Road on the west for approximately 500 m with Kooringaroo Road bordering the northeast corner of the Project Area, and covers an area of approximately 702 ha (refer **Figure 2**). The Project infrastructure will cover approximately 512 ha (the development footprint).

The Project Area has historically been utilised for agricultural practices with evidence of broad native vegetation modification resulting from extensive clearing and agricultural land use. Current land use comprises grazing land with occasional cultivation, and is consistent with the surrounding locality which is predominately utilised for grazing activities.

1.4 SUMMARY OF SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs, including Agency Advice, identify matters that must be addressed in the EIS. **Table 1** references the relevant requirements for agriculture and where these have been addressed in this report.

Table 1: Requirements of SEARs, including Agency Advice, and Section Addressed in this report

Assessment **Requirements**	**Section Addressed**
SEARs (10 November 2022)	
A soil survey to determine the soil characteristics and consider the potential for salinity, acid sulfate soils and erosion to occur	**3**
An assessment of the agricultural impacts in accordance with the Solar Guidelines	**5**
DPI Agriculture Advice (26 September 2022)	
Outline any impacts to water use for agriculture and measures to mitigate against these impacts	**5.3.3**
Undertake a biosecurity risk management plan that will include details to monitor, prevent, eliminate or minimise the introduction, presence, spread or increase of weeds.	**5.4.2**
The depth of cables/ pipes is to be stated. Note that a depth >500mm will allow greater opportunity for agricultural activities, particularly cropping, following decommissioning.	**6.1**
Consider how to integrate the operation of a livestock grazing enterprise with the solar farm operations. If livestock grazing is proposed as part of the enterprise, then the proposed management of livestock and any considerations given to the height and spacing of the panels to enable livestock grazing will need to be addressed in the EIS.	**6.1**
Goulburn Mulwaree Council (29 September 2022)	
The project site could be considered of prime crop and pasture potential therefore an agricultural land impact assessment is required. Should the project proceed, it will lock up a large holding of viable agricultural land from all agricultural uses except limited grazing. Council agrees with the requirement in the scoping report (Section 6.2.5) to undertake soil testing and consideration of agricultural viability in the context of land with access to water supply etc.	**3, 4**

1.5 ASSESSMENT APPROACH

The assessment has been undertaken in accordance with the *Large-Scale Solar Energy Guidelines* (LSSE Guidelines) (NSW DPIE, 2022) which 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 3 – Detailed, as per the LSSE Guidelines. This is due to the verification of LSC Class 3 being location on approximately 64 ha of the Project Area. The assessment requirement pathway is presented in **Figure 3**. The requirements for this level of assessment, and where these items are addressed in this report, are presented in **Table 2**.

1.6 CONSULTATION

Extensive consultation was carried with a range of stakeholder groups and individual stakeholders during the scoping and EIS phases of the Project, as detailed in the main body of the EIS. These include regulators who have a decision-making role in project approvals, and groups or individuals who may be directly or indirectly affected by the Project.

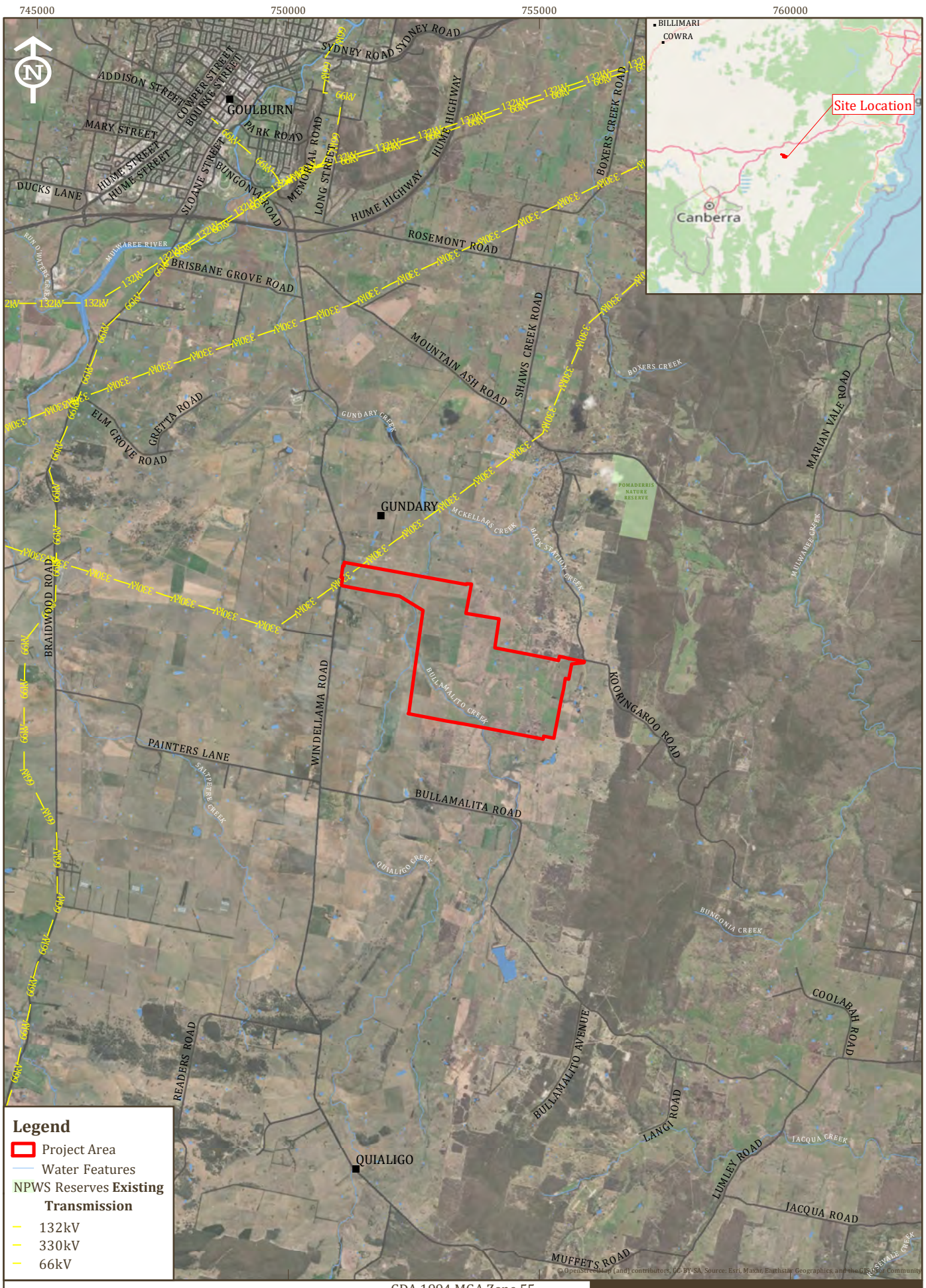
Consultation has included formal and informal engagement with the following as indicated in the main EIS volume:

- NSW Department of Primary Industries;
- NSW Department of Planning, Housing and Infrastructure(DPHI);

- NSW Division of Biodiversity, Conservation and Science;
- Goulburn Mulwaree Council;
- Fire and Rescue NSW (FR NSW), Goulburn;
- NSW Rural Fire Service;
- Transport for NSW
- TransGrid;
- Heritage NSW;
- DPHI Water / Water NSW;
- Local aboriginal groups;
- Neighbouring landowners; and
- The local community.

Direct consultation to inform this assessment was undertaken with land managers regarding current and historical management of land and agricultural practices in the Project Area and its surrounds, and the potential effects on local industries, support services and agribusinesses as a result to changes to agricultural enterprises in the Project Area.

In addition, a meeting was held with the Department of Primary Industry (DPI) – Agriculture on 1 August 2023 to introduce the Project and present the draft outcomes of this assessment. DPI expressed initial satisfaction at the approach to the soil survey and agricultural impact assessment, but emphasised the importance of presenting the cumulative impacts of the Project and other similar Projects on agriculture, specifically land being removed from agriculture and the associated lost agricultural productivity in the Goulburn Mulwaree LGA.



GDA 1994 MGA Zone 55

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Scale 1:100000 at A4

Regional Context

FIGURE 1

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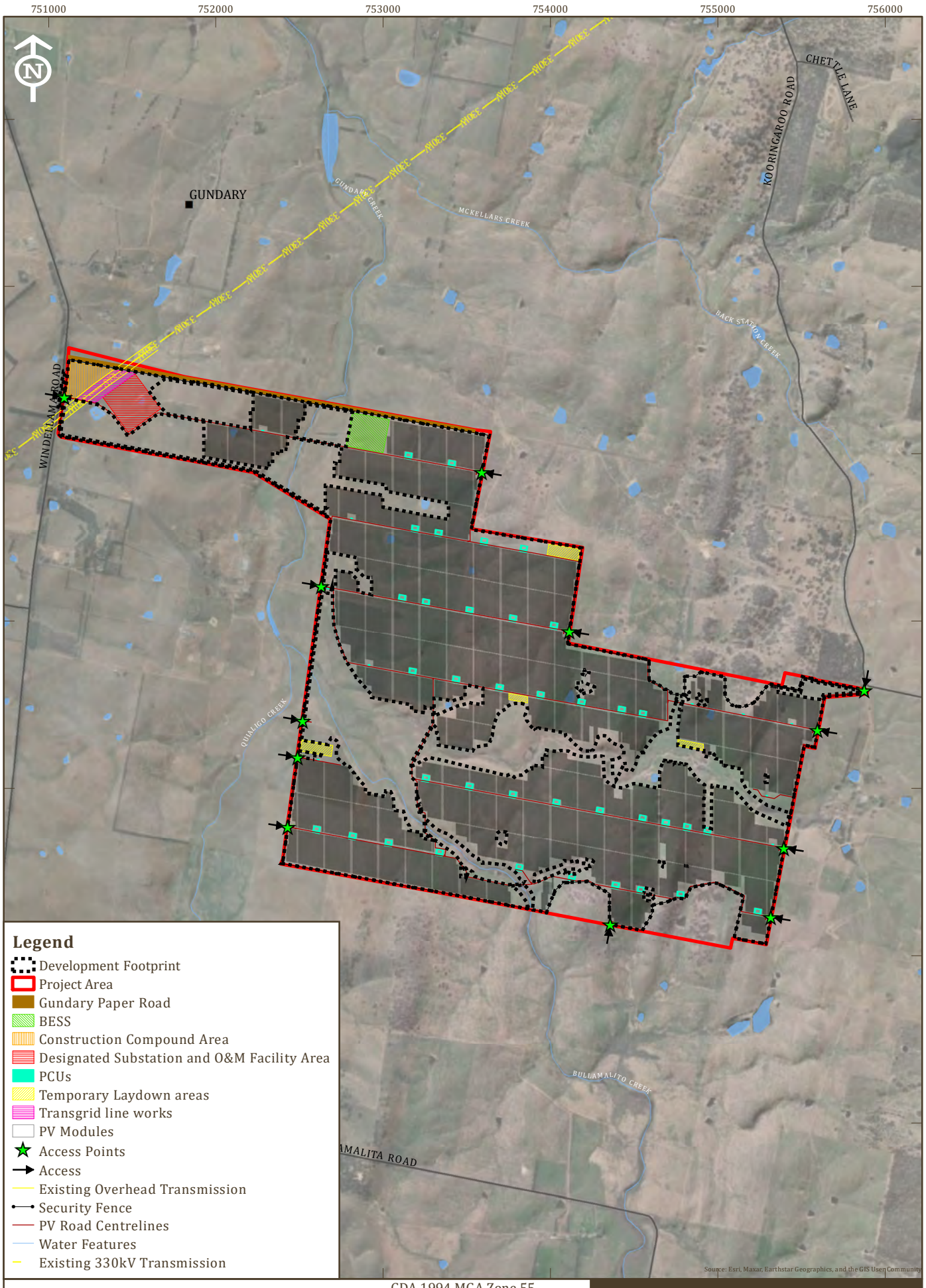

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Project Area

FIGURE 2

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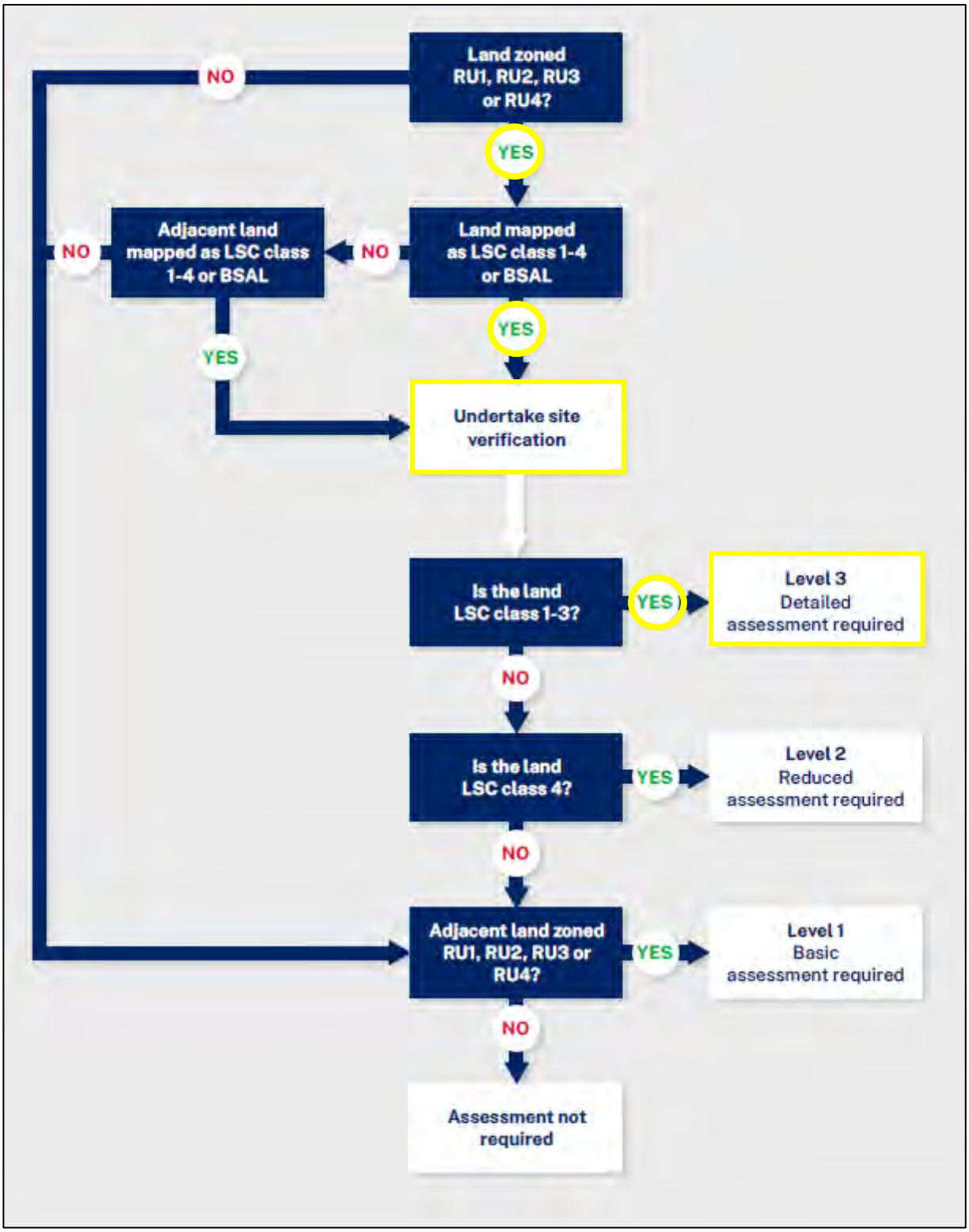
Figure 3. Agricultural Assessment Requirement Pathway



(NSW DPIE, 2022)

Table 2: Requirements of 'Level 3 - Detailed' 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 area.	• Project description • areas of the site that would be disturbed or temporarily removed from agricultural use • location • duration	**1**
Regional context Describe the regional context.	• property zoning • 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 Area • describe existing agricultural land uses • describe the history of agricultural practices on the Project Area • identify soil type, fertility, land and soil capability • provide a map showing the verified LSC class of the Project Area • 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 Area and in the wider region	• describe Project impacts on identified agricultural productivity and enterprises including but not limited to livestock, cropping activities, orchard production., etc • consider impacts to the agricultural land of the site • consider Project potential to temporarily and/or permanently remove agricultural land and/or fragment or displace existing agricultural industries • consider cumulative impacts of multiple solar projects • a detailed assessment of whether the Project would significantly impact the local or regional agricultural industry, including production and supply chains	**5**
Mitigation strategies Outline strategies which may be adopted to mitigate potential impacts on agricultural land and minimise land use conflict.	• outline and consider strategies to mitigate Project impacts on agricultural land • consider co-location with existing agricultural practices and investigate feasibility of agrisolar where it would result in a meaningful benefit • justification for the Project considering other alternatives which would have lesser impacts on agricultural land. Proponents must demonstrate that other project sites and siting options have been considered and state the reasons why the site and layout was chosen over alternative options • an analysis of whether site design could be amended to reduce impacts	**6**

2 REGIONAL CONTEXT

2.1 ZONING

The Project Area is contained within five cadastral lots and is zoned as RU1 (Primary Production) under the *Goulburn Mulwaree Local Environmental Plan 2009* (LEP) (refer **Figure 4**). The objectives of this zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and with adjoining zones.
- To promote the use of agricultural land for efficient and effective agricultural production.
- To avoid or minimise impacts on the natural environment and protect environmentally sensitive land.
- To allow the development of non-agricultural land uses which are compatible with the character of the zone.
- To allow the development of processing, service and value-adding industries related to agriculture and primary industry production.
- To protect and enhance the water quality of receiving watercourses and groundwater systems to reduce land degradation.
- To minimise the visual impact of development on the rural landscape.

Under the LEP, 'electricity generating works' are not listed as prohibited within the RU1 zoning and therefore, under the provisions of the LEP, the Project is permissible with consent. Further, clause 2.36(1) of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* provides that development for the purposes of 'electricity generating works' (which includes battery storage) may be carried out by any person with development consent on a prescribed rural zone, which includes land zoned RU1 under a LEP. The Project, being located on land zoned as RU1 Primary Production, is therefore permissible with consent.

2.2 CLIMATE AND RAINFALL

The Project Area is located in the NSW Southern Tablelands region which, owing to its elevation, has an oceanic climate with warm summers and cool winters and a high diurnal range. Its climate is variable much of the year.

The closest Bureau of Meteorology (BOM) weather station to the Project Area is Goulburn Airport AWS (070330). This station is located approximately 3 km north west of the site and is considered representative of the Project Area. It has a data range from 1991 to present (BOM, 2023). The average maximum temperature ranges from 28.1°C in January, down to 11.8°C in July, while average minimum temperatures range from 12.9°C in January, down to 0.3°C in July.

The annual average rainfall is 575.2 mm, with the highest average monthly rainfall of 61.3 mm falling in November, and the lowest average monthly rainfall of 26.8 mm falling in April. Rain generally falls over approximately 69 days.

2.3 REGIONAL LANDFORM

The Southern Tablelands is a geographic area of NSW, located south-west of Sydney and west of the Great Dividing Range consisting of the three LGAs of Goulburn-Mulwaree, Upper Lachlan Shire and Yass Valley. The area is characterised by high, flat country which has generally been extensively cleared and used for grazing purposes (Goulburn Mulwaree Council et al, 2016). The region also contains a range of natural resources and features, including a number of national parks and State forests, Wombeyan Caves and over 5,000km of waterways.

The Southern Tablelands region falls within the Hawkesbury-Nepean catchment which is within the Sydney drinking water catchment. The confluence of the Wollondilly and Mulwaree Rivers occur within the city of Goulburn north west of the Project Area.

Geomorphically, the region has a general north-west trend which reflects the strike of the underlying geology. Streams tend to either follow the general north-west trend or cut sharply across it. The region is characterised by a series of mountain and valley systems which follow the general trend, with altitudes ranging from between 560 and 1200 metres.

Geologically, the Southern Tablelands lie within the southern portion of the Lachlan Fold Belt. Ordovician rocks are the oldest and most extensive. They are usually sharply dipping and tightly folded metasediments. Silurian volcanics comprising a range of tuffaceous and rhyolitic materials and granitic intrusions are also common. Fluvial sands and gravels of the ancient Shoalhaven River system occur extensively in the Braidwood Area. Common lithologies include siltstones, quartzites, rhyolites, tuffs and alluvium.

Surficial geology mapping (Geoscience Australia, 2016) shows that the geology of the Project Area and surrounding region consists of the following elements (refer **Figure 5**):

- Early Devonian Bindook Group – rhyolitic to dacitic welded ignimbrite and lava, turbiditic quartzose and volcanic sandstone and siltstone; minor conglomerate, limestone blocks, felsic volcanic breccia and intrusives.
- Quaternary Alluvium – channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted
- Wenlock to Lochkovian Mount Fairy Group - rhyolite to dacite flows and intrusives, dacitic tuff and breccia, rhyodacitic ignimbrite, pyroxene andesite, basalt, mafic volcanic breccia, felsic and mafic volcaniclastic conglomerate and sandstone, quartzose sandstone, siltstone and shale, limestone.

2.4 REGIONAL LAND USE

2.4.1 AGRICULTURAL LAND USE

Since the non-Indigenous settlement of the Southern Tablelands of New South Wales from the early 1800s, the predominant agriculture land uses have focused on livestock (in particular sheep and beef) and mixed farming production. Specific areas have developed alternative land uses to grazing, such as Crookwell, which is renowned as a potato growing area. In addition, viticulture for cool climate wine is developing in the region (Goulburn Mulwaree Council et al, 2016).

At the scale of the Goulburn Mulwaree LGA, which covers an area of 323,180 ha, 116,771 ha of land is subject to agricultural activity (ABS, 2022a). The area of land use for of the agricultural types for the Goulburn Mulwaree LGA is presented in **Table 2**, which shows grazing as the dominant land use, accounting for approximately 96% of this area (ABS, 2022a).

Table 2: Goulburn Mulwaree LGA Agricultural Land Use by Type 2021 – 2022 (ABS, 2022a)

Agricultural Land Use	Area	
	ha	%
Grazing	111,800	96
Cropping	4,200	4
Forestry	721	1
Other	50	<1
Total	116,771	100

2.4.2 AGRICULTURAL ENTERPRISES

Agricultural enterprises within the Goulburn Mulwaree LGA are characterised by sheep and cattle grazing, with a strong wool production presence with some cultivation for hay and broadacre crops including canola and wheat for grain (ABS, 2022b).

Beef production is undertaken on a large scale in the region, with some production on smaller properties, usually in peri-urban areas. In recent times, beef prices have increased along with global demand for protein. Beef farming often occurs in mixed farming systems with cropping or wool, enabling economies of scale through grazing rotation, feed production and storage (DPI, 2020).

As with beef, sheep grazing for meat and wool is usually a large-scale enterprise although some smaller properties can also contribute to regional production.

Wool production is the most prominent industry in terms of number of enterprises. The southern tablelands region is known for 'superfine', 'ultrafine' and fine-medium wool production from merino sheep. Wool from the region is sought after as an exclusive fibre globally. Wool growing is a specialised industry with a specific set of biophysical (land and climate) and on-farm management requirements (animal husbandry, wool production and value adding). Sheep are particularly vulnerable to attacks from animals such as dogs and foxes, and producers have added costs (eg fencing, eradication) in managing these pests. Typically, wool growing involves producing lambs for meat as part of the enterprise, however moving wool to lamb enterprises is a longer term trend as wool prices continue to fluctuate (DPI, 2020).

For the last agricultural census year of 2021 – 2022, there were 185 livestock grazing businesses in the LGA (ABS 2022a). The gross value of agricultural enterprises within the Goulburn Mulwaree LGA for 2021-2022 was $51 million (ABS 2022b). As shown in **Table 3**, livestock for slaughter accounts for 67% of the total gross value of agriculture for the LGA. Other key enterprises are livestock products (23%) and cropping (10%).

For livestock slaughtered, cattle and calves make up 47% of the gross value with sheep and lambs making up 45% (refer **Table 4**). Pigs, poultry and other livestock slaughter enterprises contribute <10% combined (ABS, 2022b).

Wool dominates livestock products, with 87% of the gross margin (refer **Table 5**) and hay and broadacre crops comprising 80% of the cropping gross value (**Table 6**).

Table 3: Goulburn Mulwaree LGA Agricultural Commodity Gross Value by Type 2021 – 2022 (ABS, 2022b)

Agricultural Commodity	Gross Value	
	$	%
Livestock for slaughter	34,041,810	67
Livestock products	11,517,098	23
Crops	5,538,638	10
Total	51,097,547	100

Table 4: Goulburn Mulwaree LGA Livestock Gross Value by Type 2021 – 2022 (ABS, 2022b)

Livestock	Value	
	$	%
Cattle and calves	15,969,393	47
Sheep and lambs	15,171,832	45
Poultry	2,830,274	8
Pigs	61,116	<1
Other	9,195	<1
Total	34,041,810	100

Table 5: Goulburn Mulwaree LGA Livestock Products Gross Value by Type 2021 – 2022 (ABS, 2022b)

Livestock	Value	
	$	%
Wool	9,971,083	87
Milk	1,190,088	10
Eggs	355,927	3
Total	11,517,098	100

Table 6: Goulburn Mulwaree LGA Crop Gross Value by Type 2021 – 2022 (ABS, 2022b)

Crop	Value	
	$	%
Hay	2,727,660	49
Broadacre crops	1,725,940	31
Vegetables	521,821	9
Nurseries, cut flowers or cultivated turf	508,342	9
Fruit and nuts	54,875	1
Total	5,538,638	100

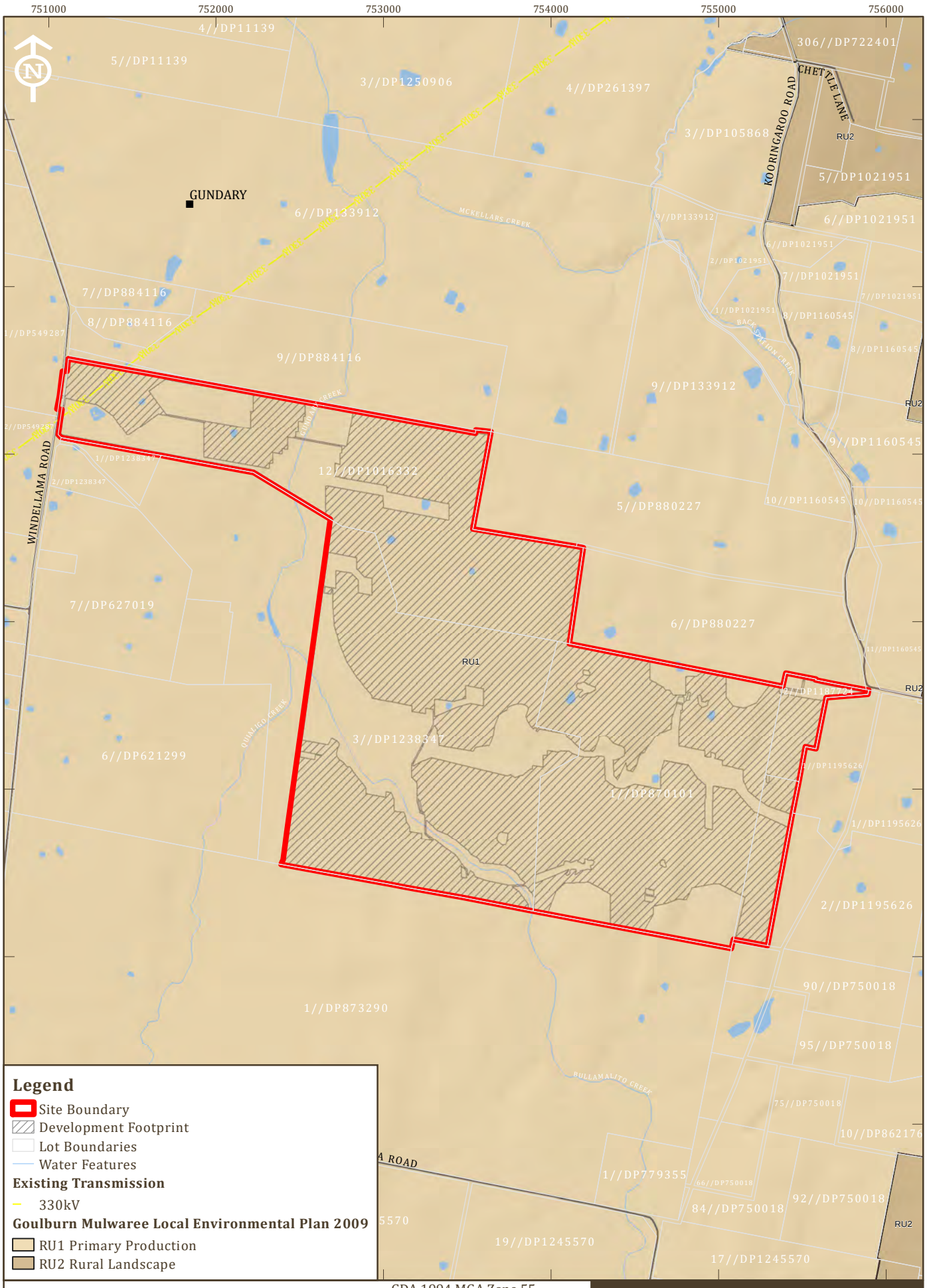
2.4.3 REGIONAL AGRICULTURAL INFRASTRUCTURE

The key infrastructure item assisting agricultural market access and cost of production is the transport network servicing the Southern Tablelands 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 Hume Highway forms the main road transport route connecting Goulburn and Sydney with the main road transport route to Canberra provided via the Hume Highway followed by the Federal Highway. Goulburn Railway Station is connected to the Main Southern Railway Line and services the Southern Regional and Southern Highlands Lines. Connections to Port Kembla, Port Botany, the Port of Melbourne and Western Sydney Airport Badgerys Creek give the region a competitive advantage for general agricultural exports. Further, Sydney and Canberra airports have freight capability. The demand from middle-class global markets, combined with the ability to transport produce from Canberra Airport to Singapore and beyond to Chinese cities, present opportunities for more niche agricultural exports.

In proximity to the Project Area, the large agricultural service centre of Goulburn (10km north west), allows access to businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection.

The region is serviced by sale yards at Yass (South Eastern Livestock Exchange) which, for the last survey period of 2021 – 2022, transacted 574,096 sheep and 45,029 cattle (MLA, 2022). Smaller saleyards are located at Bega, Boorowa, Moss Vale and Young. There are also a number of abattoirs throughout the region located at Goulburn, Harden, Young, Polo Flat in Cooma, Moss Vale and Moruya in the Illawarra Shoalhaven Region. Wool is sold off farm through brokerages, with the Goulburn based Australian Wool Network (AWH) offering wool rehandling and sales. AWH owns NSWs largest wool storage facility located in Goulburn. Wool enterprises are reliant on shearing and other sheep-specific support services.

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



Legend

- Site Boundary
- Development Footprint
- Lot Boundaries
- Water Features

Existing Transmission

- 330kV

Goulburn Mulwaree Local Environmental Plan 2009

- RU1 Primary Production
- RU2 Rural Landscape

GDA 1994 MGA Zone 55

MINESOILS
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0 125 250 500 Meters

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Land Zoning

FIGURE 4

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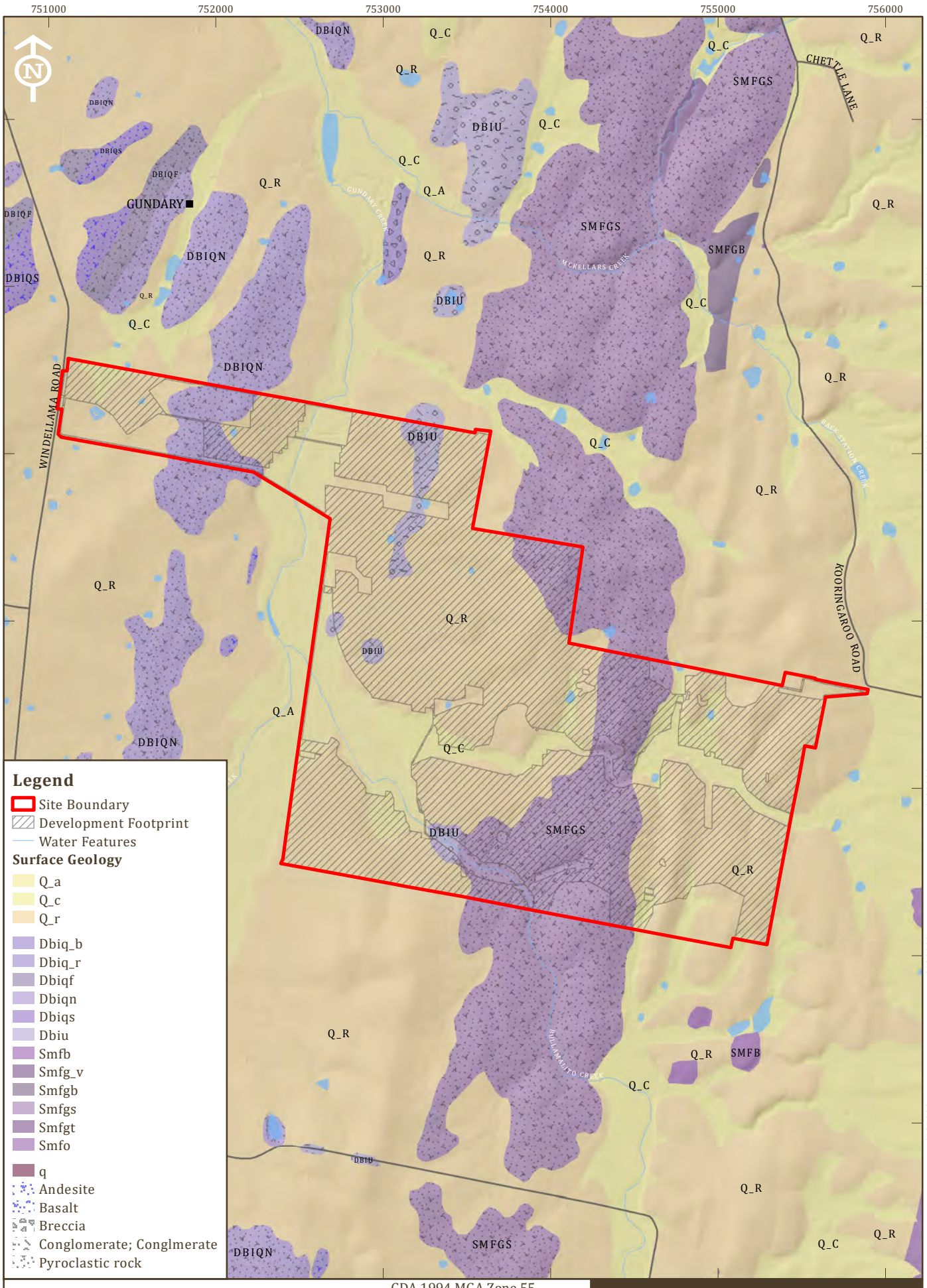
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GUNDARY CREEK
MCKELLARS CREEK
BACK STATION CREEK
MILLAMOLTO CREEK
DBIQN
DBIQS
DBIQF
DBIU
SMFGS
SMFGB
SMFB
Q_C
Q_R
Q_A
Legend
Site Boundary
Development Footprint
Water Features
Surface Geology
Q_a
Q_c
Q_r
Dbiq_b
Dbiq_r
Dbiqf
Dbiqn
Dbiqs
Dbiu
Smfb
Smfg_v
Smfgb
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Smfo
q
Andesite
Basalt
Breccia
Conglomerate; Conglmerate
Pyroclastic rock
GDA 1994 MGA Zone 55
MINESOILS
LAND & REHABILITATION SPECIALISTS
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Scale 1:30000 at A4
Surface Geology
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 May 2023. The Project Area was determined to be a generally stable, free draining landform with 90 - 100% surface cover of pasture. The Project Area would have historically consisted of a combination of open plains and more densely vegetated areas, which has since been highly disturbed in the past by land clearing for agriculture and pasture development, with isolated areas of remnant native trees on some hill crests and hillslopes (**Plate 1**).

The Project Area landscape is characterised by undulating and rolling hills and crests, and broad drainage plains. Rock outcrop and surface rock fragments were observed to be present on upper slopes and crested areas (**Plate 2**). The lowest elevation is approximately 640m on drainage plains associated with Gundary Creek and rises to 710m on crested areas (refer **Figure 6**). Minor sheet erosion and gully erosion associated with surface disturbance was observed (**Plate 3**).

The Project Area is located within the Gundary Creek catchment. Gundary Creek is a tributary of the Mulwaree River and traverses through the western part of the Project Area, flowing in a northerly direction towards Goulburn. Quialigo Creek convergence is located just outside the Project Area (to the west), becoming Gundary Creek from this confluence. Bullamalito Creek traverses through the southwestern part of the Project Area.

3.1.2 AGRICULTURAL LAND USE

The Project Area is subject to livestock grazing as the primary land-use, supporting sheep, cattle and calves, which are grazed on rotation for breeding and fattening, and are watered through a series of surface dams (**Plate 4**) and pumped in water. Historically, the Project Area has been consistently used for grazing of livestock, with very occasional cultivation and/or pasture improvement to select paddocks.

The Project Area is not fertilised, and there is minimal ongoing use of herbicides. General agricultural improvements are present, including cattle yards (**Plate 5**), stock fences and gates (**Plate 6**), water pumps and tank, sheds and unsealed access tracks.

Grazing cattle and sheep were observed to be present within the Project Area at the time of the site investigation (**Plates 6** and **7**).

At the time of inspection, neighbouring properties in the immediate vicinity were observed to be used primarily for livestock grazing, with some isolated cultivation also being undertaken within the broader locality. Similar agricultural improvements (e.g. cattle 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 these land uses.

No sensitive agricultural activities such as intensive plant or livestock agriculture were observed to be being undertaken within the Project Area or its immediate surrounds.

Plate 1: The Project Area showing rolling hills with 100% surface cover and isolated areas of native trees.

Plate 2: Surface rock presence on upper slopes and crests

Plate 3: Evidence of gully erosion present

Plate 4: Agricultural infrastructure includes fencing and gates.

Plate 5: Agricultural infrastructure includes cattle yards.

Plate 6: Agricultural infrastructure within the Project Area includes fencing and gates.

Plate 7: Grazing cattle observed during site investigation.

Plate 8: Grazing sheep observed during site investigation.

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 Department of Primary Industries (2023, 2022) Gross Margin Budgets for Livestock can be used to provide a broad estimation of the productivity of the land for grazing within the Project Area. Based on the DPI cattle and sheep enterprise options of 'Growing-out Steers (240 – 460 kgs)' and 'Merino Ewes (20 micron) – Merino Rams,' the estimated productivity of the Project Area ranges from $271,534 to $280,624 per annum as summarised in **Table 7**.

Table 7: Estimated Productivity of Grazing Land within the Project Area

Enterprise	Estimated Gross Margin ($/ha/year)	Grazing Land (ha)	Project Area Gross Margin ($/year)
Growing-out Steers 240 – 460kg	386.80	702	271,534
Merino Ewes (20 micron) – Merino Rams	399.75	702	280,624

An alternative method by which to estimate the potential productivity of the Project Area 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 Goulburn Mulwaree LGA 111,800 ha of land was used for grazing activities, of which the gross commodity value of cattle and calves, and sheep and lambs, from livestock slaughtered and wool and milk from livestock products can be attributed (totalling $42,302,396 combined). This results in an annual $/ha ratio of $378/ ha, and amounts to an agricultural productivity of $265,356 per year for the Project Area.

For the purpose of this assessment, the most conservative agricultural productivity value of $280,624 per year, based on Merino Ewes (20 micron) – Merino Rams gross margins, is adopted.

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 landscapes, soil types, inherent soil fertility and LSC as applied to the Project Area (NSW and Department of Planning, Industry and Environment, 2022).

Soil Landscapes

The Project Area lies within the *Soil and Land Resources of Central and Eastern NSW* (Office of Environment and Heritage, 2018). Soil landscapes are an inventory of soil and landscape information with relatively uniform land management requirements, allowing major soil and landscape qualities and constraints to be identified.

The soil landscapes within the Project Area are shown on **Figure 7** and described below**.**

Bullamalito

Landscapes consist of rises and low hills on Towrang Beds (metamorphic) in the Bullamalito Hills, Baw Baw Hills, Gundary Plains and Turallo Ranges. Local relief 10-60 m; altitude 615-798 m; slopes 3-10%; rock outcrop <2%. Extensively cleared woodland. Soils are characterised by Paralithic Bleached Leptic Tenosols, Red Kurosols, Brown/Yellow Kurosols and Brown Sodosols.

Gundary Creek

Landscapes consist of alluvial plains on Quaternary Alluvium (alluvium) in the Mulwaree Plains, Baw Baw Hills and Bullamalito Hills. Local relief 0-10 m; altitude 628-725 m; slopes 1-2%; rock outcrop nil. Extensively cleared grassland (tussock). Soils are characterised by Yellow Sodosols, Yellow Kurosols and Pedaric Brown Chromosols.

Eastfield's Creek

Landscapes consist of drainage depressions within alluvial plains on Quaternary Alluvium (alluvium) in the Bullamalito Hills, Baw Baw Hills, Braidwood Rises, Bungonia Hills, Butmaroo Hills, Mulwaree Plains, Turallo Ranges and Wollondilly Gorge. Local relief 0-10 m; altitude 623-890 m; slopes 0-3%; rock outcrop nil. Extensively cleared grassland (tussock). Soils are characterised by Stratic Rudosols, Brown Kurosols and Brown Sodosols.

Soil Types

The NSW regional soil mapping indicates the dominant soil types within the Project Area are Sodosols, Kurosols and Natric Kurosols, as per Australian Soil Classification (ASC) (Isbell, R. F.,2021) (refer **Figure 8**).

Sodosols are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid.

Kurosols are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid.

Natric Kurosols are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid and sodic.

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 Project Area is dominated by soils with Moderately Low (2) fertility (refer **Figure 9**).

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 8** and their definition has been based on two considerations:

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

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 8: Land and Soil Capability Classification

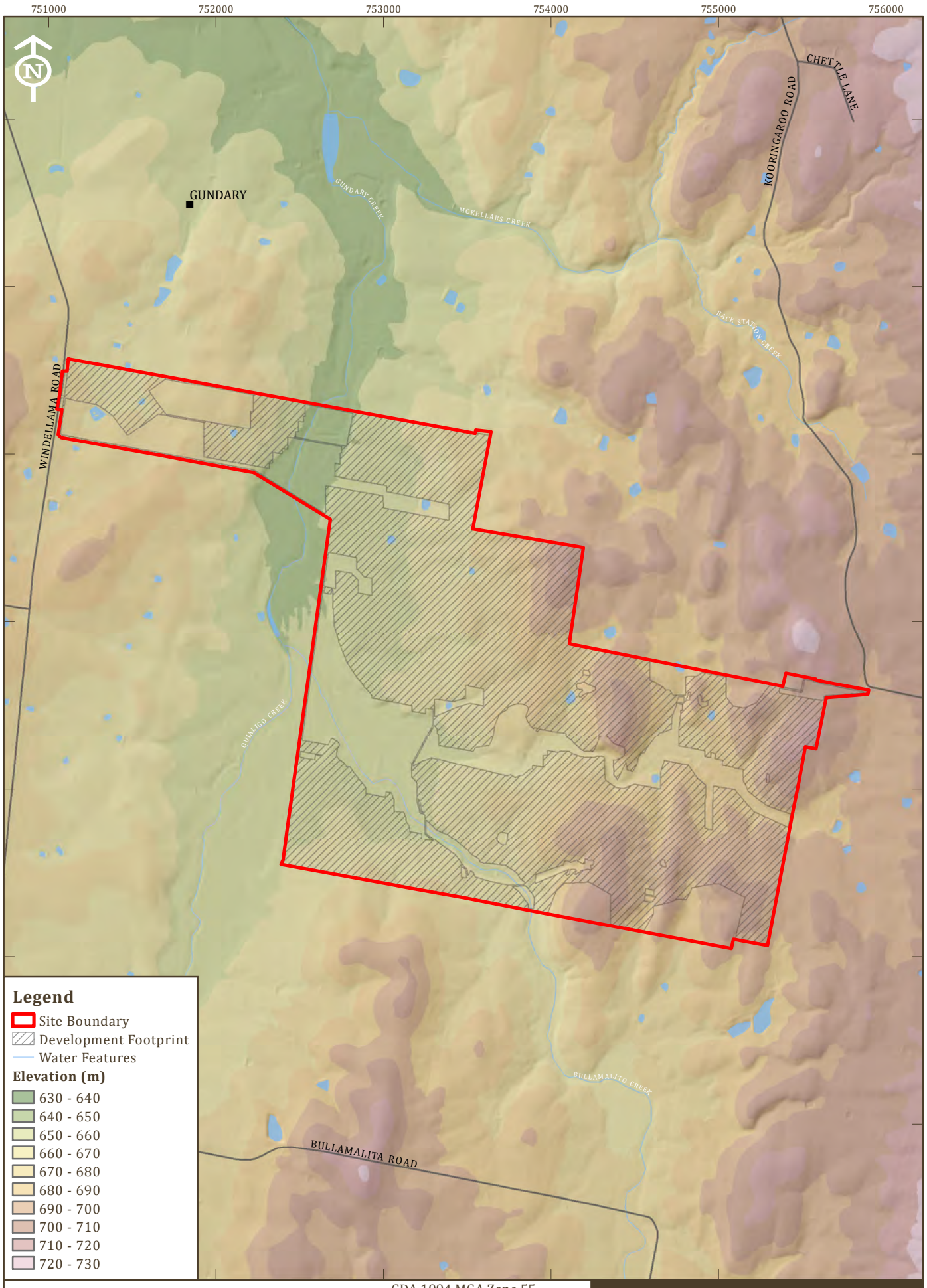
Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management 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)	
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 Project Area consists of LSC class 4: Moderate capability land and LSC class 5: Moderately Low capability land (refer **Figure 10**)

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, particularly 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 13 km northwest of the Project Area.



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Topography

FIGURE 6

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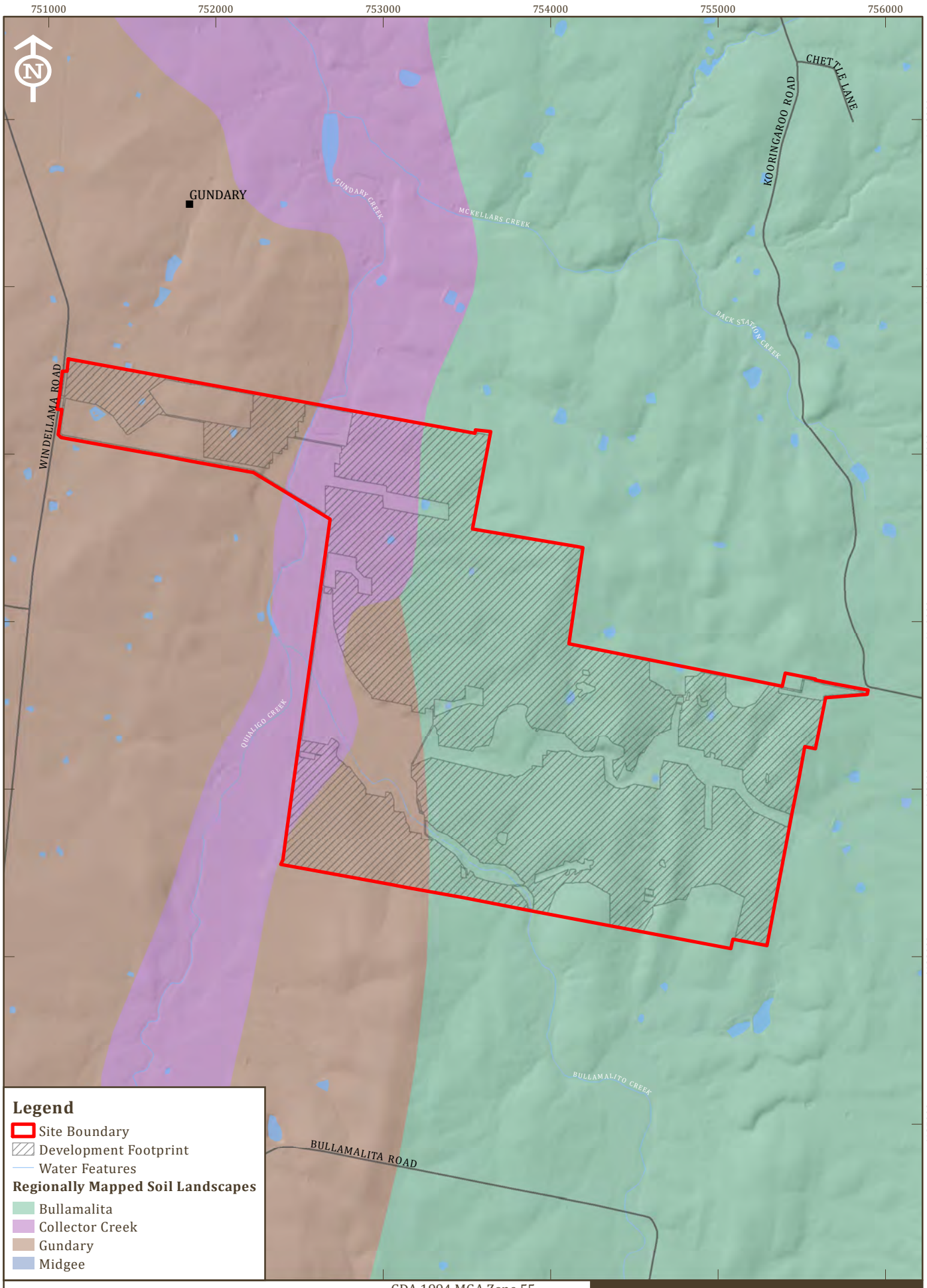

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Regionally Mapped Soil Landscapes

FIGURE 7

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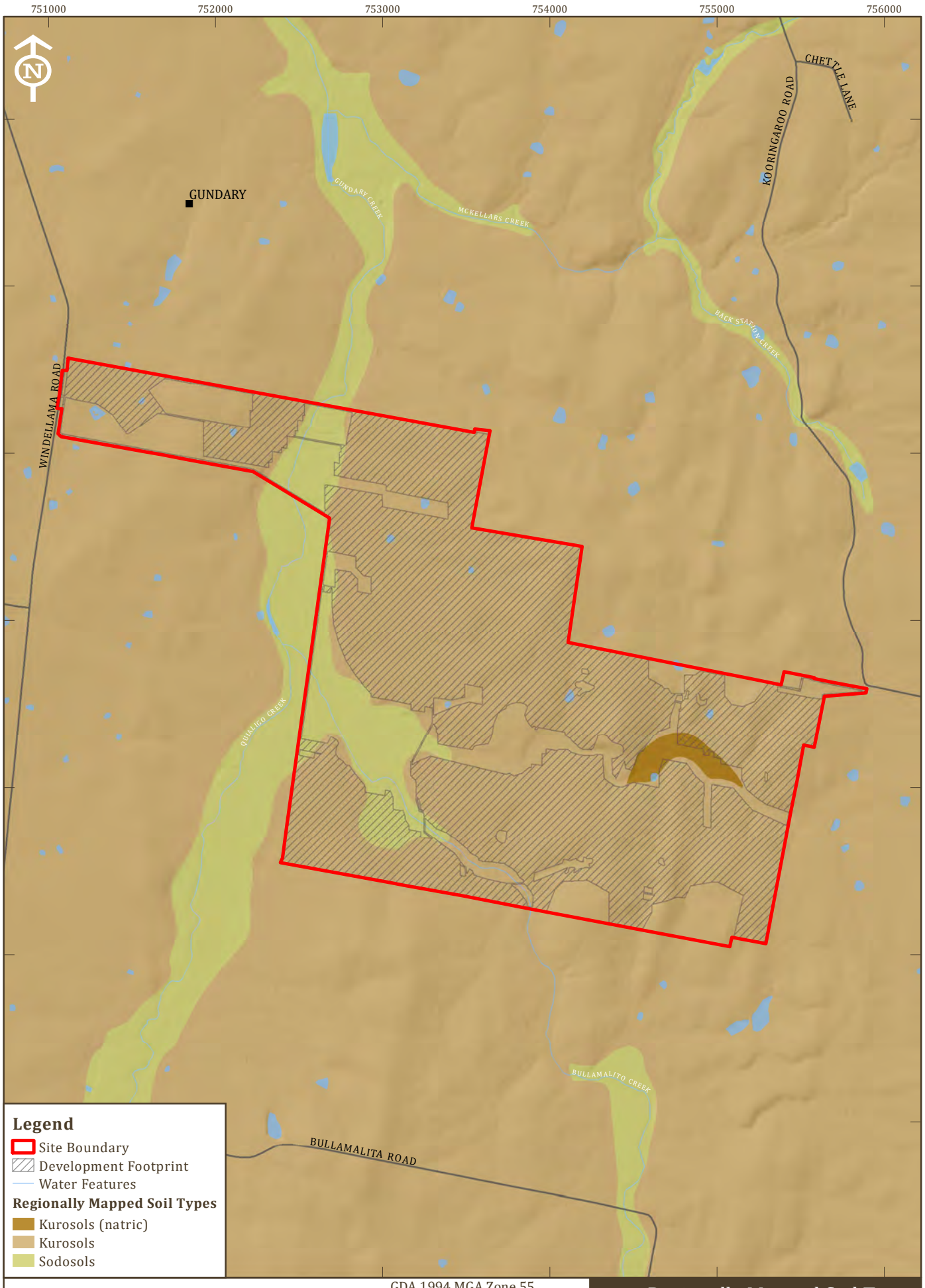

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LAND & REHABILITATION SPECIALISTS

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Regionally Mapped Soil Types

FIGURE 8

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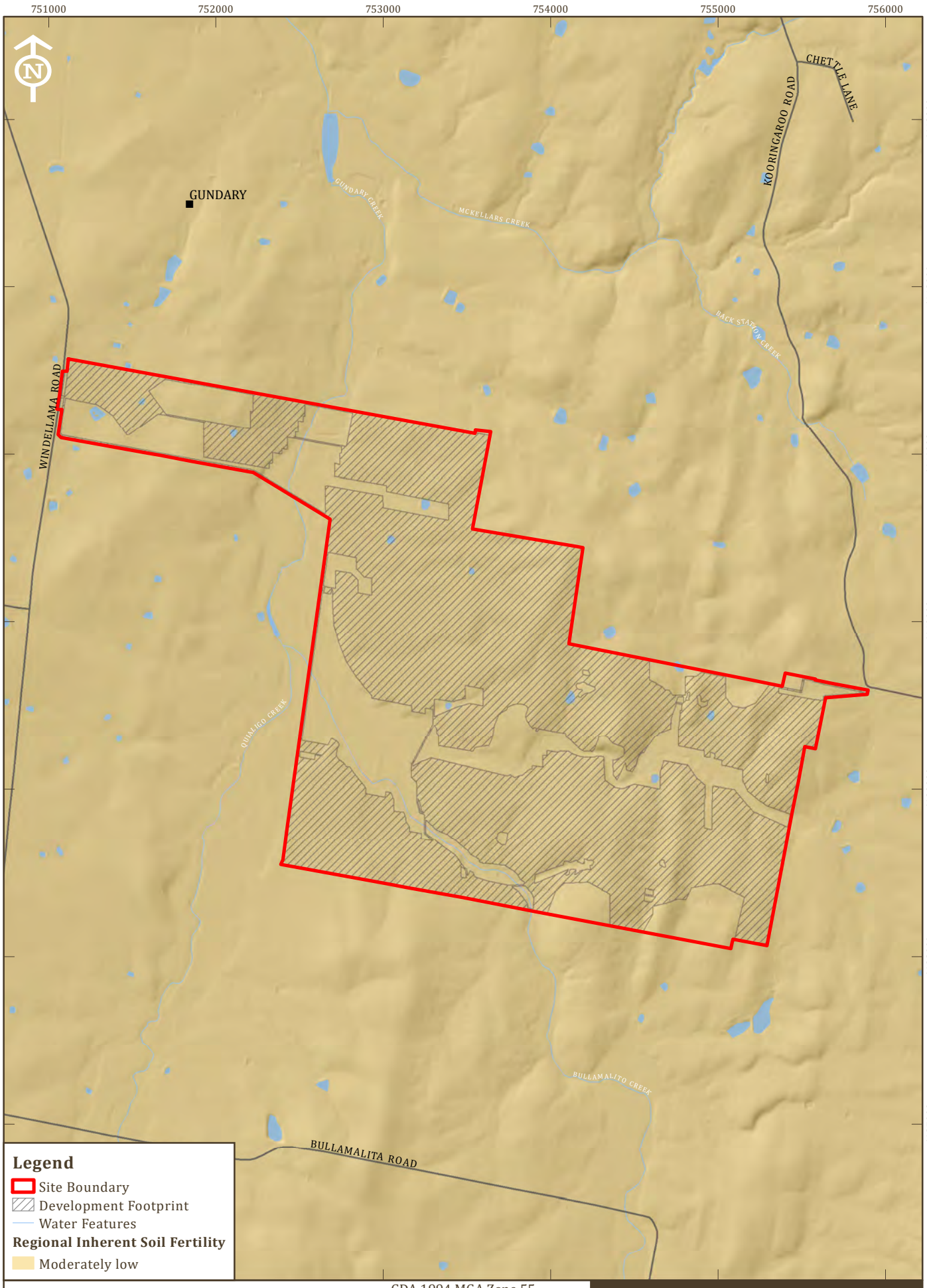

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LAND & REHABILITATION SPECIALISTS

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Regionally Mapped Inherent Fertility

FIGURE 9

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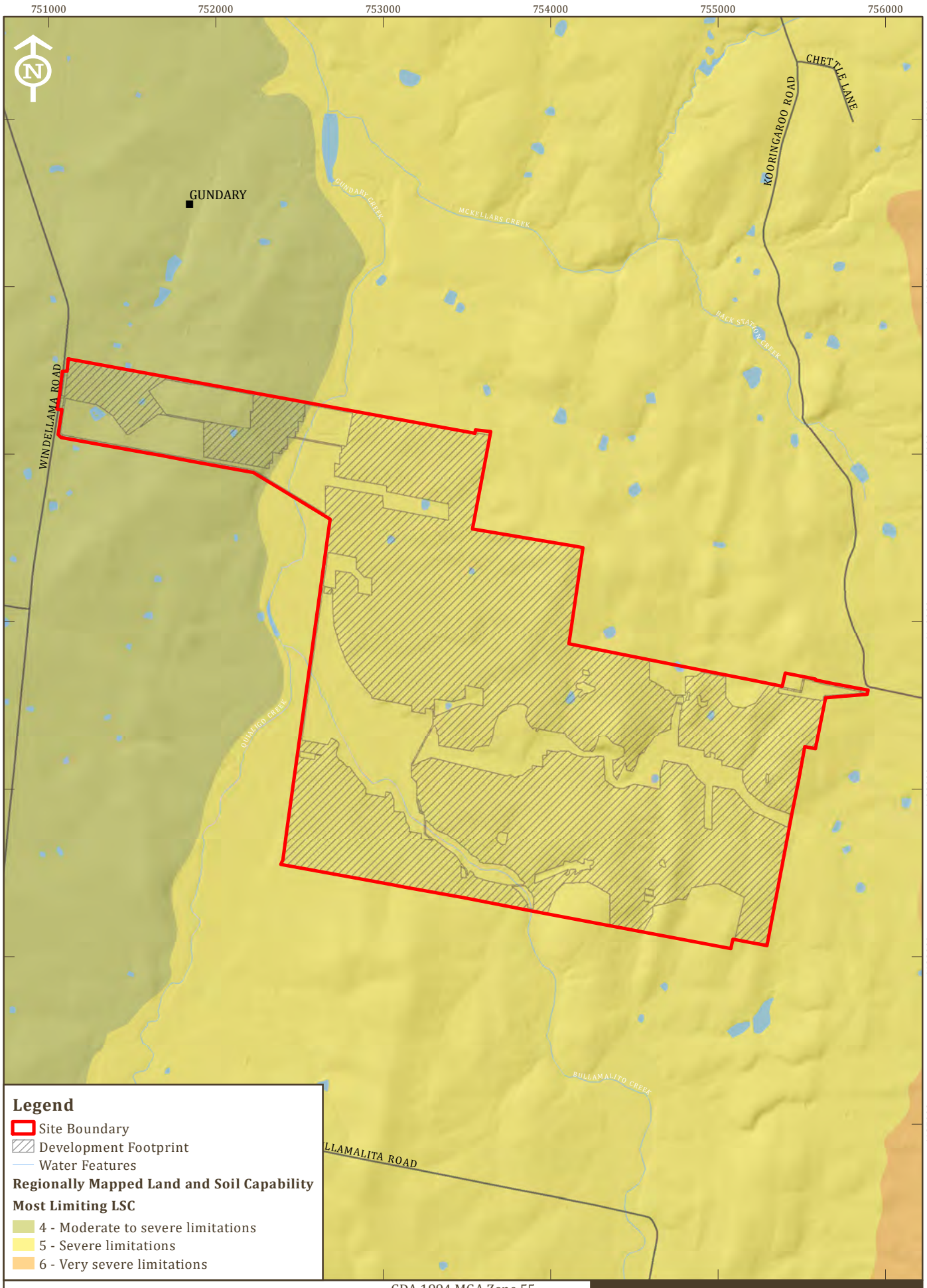

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Regionally Mapped Land and Soil Capability

FIGURE 10

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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. It is intended that the draft SSAL map will provide information to planning authorities, land holders and development proponents about the location of the best agricultural land in the state.

The is no mapped SSAL within the Project Area or its immediate surrounds.

There is presently no method to verify SSAL, nor is there a contextual framework for how SSAL should be considered and assessed (as there is for LSC and BSAL). The assessment of SSAL is not a requirement of the LSSE Guidelines. Based on these factors, and because SSAL is avoided by the Project, further consideration of SSAL is not required in this assessment.

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 1:25,000 survey intensity (1 site every 25 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 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 0.7 – 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 area was the full 702 ha of the Project Area. A total of 30 sites were assessed, resulting in a survey intensity of 1 site per <25 ha. Soil profiles within the Project 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 9**. 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 0.8m, with a total of 102 samples collected. Minesoils chose 45 of these samples that were considered representative and subject to laboratory testing. The laboratory testing suite for these sites is detailed in the **Table 10**.

Duplicate samples at every site were collected during the fieldwork and stored until the EIS is finalised.

Table 9: 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 10: 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)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')
Emerson Aggregate Test (EAT)	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 three dominant soil mapping units, as shown on **Figure 11**, and presented in **Table 11**:

- Soil Unit 1: Sodosols – covering 570 ha.
- Soil Unit 2: Chromosols – covering 87 ha.
- Soil Unit 3: Dermosols – covering 45 ha.

Soil Unit 1 is characterised by Sodosols, which, as outlined in Section 3.2.1, are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is sodic and not strongly acid. Soils with strongly subplastic upper B2 horizons are excluded.

This unit is characterised by loam, loamy sand and sandy loam topsoils with weak to moderate structure overlying sodic clay subsoils with moderate to strong structure. pH ranges from moderately acidic in the topsoil to moderately alkaline, usually trending with depth. These soils are largely non saline with some exceptions of slightly to moderately saline topsoils and subsoils respectively. Soil profile drainage ranges from poor to moderate and depth ranges from shallow on crests and upper slopes to deep on mid and lower slopes. The sodic nature of this unit presents an increased management risk.

This soil mapping unit is the most dominant within the project area and covers the lower, mid and upper slopes and crests that characterise the Project Area. Representative sites for this unit, which include detailed laboratory data, consist of sites 2, 13, 14, 17, 22, 23, 26, 28 and 30.

Soil Unit 2 is characterised by Chromosols, which are defined as soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is not sodic and not strongly acid. Soils with strongly subplastic upper B2 horizons are also included even if they are sodic.

This unit is similar to Soil Unit 1 albeit without the sodic upper B horizons. It is characterised by loam, loamy sand and sandy loam topsoils with weak to moderate structure overlying silty clay, medium clay and heavy clay subsoils with moderate to strong structure. pH ranges from moderately acidic in the topsoil to neutral of moderately acidic at depth. These soils are consistently non-saline and generally non-sodic. Soil profile drainage ranges from poor to moderate and depth is deep.

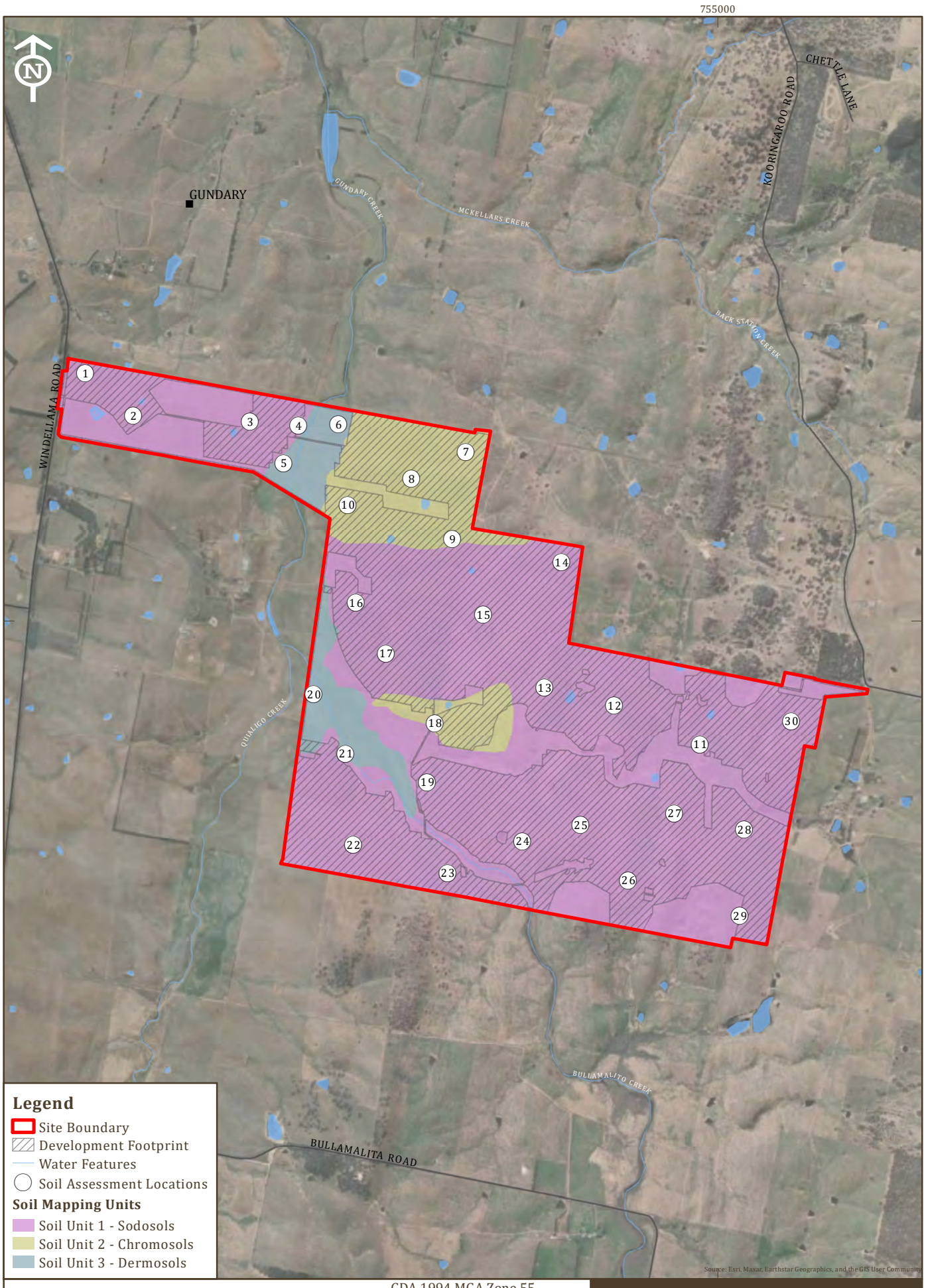
This soil mapping unit occurs in close association with Soil Unit 1; Sodosols, occupying mid and upper sloped areas. Representative sites for this unit, which include detailed laboratory data, consist of sites 7 and 8.

Soil Unit 3 is characterised by Dermosols, which are defined as soils which:

1. Have B2 horizons that have grade of pedality greater than weak throughout the major part of the horizon, and
2. Do not have clear or abrupt textural B horizon.

This unit is characterised by silty loam and loam topsoils with moderate structure overlying silty clay loam, loam and sandy loam subsoils with moderate to weak structure. pH ranges from moderately acidic in the topsoil to strongly alkaline at depth. These soils are consistently saline at depth and sodic. Soil profiles are poor to well drained, and depth is anticipated to be very deep.

This soil mapping unit occurs on drainage flats. Representative sites for this unit, which include detailed laboratory data, consist of sites 5 and 6.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Site Boundary
Development Footprint
Water Features
Soil Assessment Locations
Soil Mapping Units
Soil Unit 1 - Sodosols
Soil Unit 2 - Chromosols
Soil Unit 3 - Dermosols
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
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Soil Mapping Units
FIGURE 11
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Full soil profile descriptions are included as **Appendix 2**. Laboratory certificates of analysis are included as **Appendix 3**.

Table 11: Soil Mapping Units and Soil Units Summary

Site #	Soil Mapping Units		Soil Profile - Australian Soil Classification	ASC Family Criteria
	#	Name		
1	1	Sodosols	Red Sodosol	-
2	1	Sodosols	Eutrophic Hypernatric Red Sodosol	BEKOVNR
3	1	Sodosols	Brown Sodosol	-
4	1	Sodosols	Brown Sodosol	-
5	3	Dermosols	Mottled-Sodic Eutrophic Grey Dermosol	BELMW
6	3	Dermosols	Sodic Eutrophic Black Dermosol	BELLW
7	2	Chromosols	Bleached-Mottled Eutrophic Red Chromosol	BFKOWNR
8	2	Chromosols	Sodic Eutrophic Red Chromosol	BELOWNR
9	2	Chromosols	Yellow Chromosol	-
10	2	Chromosols	Yellow Chromosol	-
11	1	Sodosols	Brown Sodosol	-
12	1	Sodosols	Yellow Sodosol	-
13	1	Sodosols	Eutrophic Mottled-Mesonatric Brown Sodosol	BEKOWNR
14	1	Sodosols	Eutrophic Mesonatric Brown Sodosol	BEKOVNR
15	1	Sodosols	Yellow Sodosol	-
16	1	Sodosols	Yellow Sodosol	-
17	1	Sodosols	Eutrophic Mottled-Subnatric Brown Sodosol	BEKOWNR
18	2	Chromosol	Yellow Chromosol	-
19	1	Sodosols	Yellow Sodosol	-
20	3	Dermosols	Black Dermosol	-
21	1	Sodosols	Yellow Sodosol	-
22	1	Sodosols	Eutrophic Mottled-Subnatric Red Sodosol	BFLMVNR

Site #	Soil Mapping Units		Soil Profile - Australian Soil Classification	ASC Family Criteria
	#	Name		
23	1	Sodosols	Eutrophic Mottled-Subnatric Brown Sodosol	BEKOWNR
24	1	Sodosols	Yellow Sodosol	-
25	1	Sodosols	Brown Sodosol	-
26	1	Sodosols	Eutrophic Subnatric Brown Sodosol	BEKOVNR
27	1	Sodosols	Yellow Sodosol	-
28	1	Sodosols	Eutrophic Mottled-Subnatric Yellow Sodosol	BGKOVNR
29	1	Sodosols	Red Sodosol	-
30	1	Sodosols	Eutrophic Mottled-Subnatric Red Sodosol	BGLOVNR

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 12** shows the EAT class and the dispersion degree during testing and resulting risk of dispersion for that soil.

Table 12: 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 13 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 13: Potential Dispersion Risk

Site No.	ASC	Soil Depth (m)	EAT	Potential Risk
2	Eutrophic Hypernatric Red Sodosol	20-30	1	Very High
		40-50	2	High
5	Mottled-Sodic Eutrophic Grey Dermosol	70-80	2	High
6	Sodic Eutrophic Black Dermosol	20-30	3	Moderate
		50-60	3	Moderate
7	Bleached-Mottled Eutrophic Red Chromosol	30-40	3	Moderate
		60-70	4	Negligible
8	Sodic Eutrophic Red Chromosol	30-40	4	Negligible
		60-70	4	Negligible
13	Eutrophic Mottled-Mesonatric Brown Sodosol	20-30	2	High
		50-60	4	Negligible
14	Eutrophic Mottled-Mesonatric Brown Sodosol	20-30	2	High
17	Eutrophic Mottled-Subnatric Brown Sodosol	20-30	4	Negligible
		50-60	4	Negligible
22	Eutrophic Mottled-Subnatric Red Sodosol	25-35	3	Moderate
		50-60	2	High
23	Eutrophic Mottled-Subnatric Red Sodosol	20-30	3	Moderate
		50-60	3	Moderate
26	Eutrophic Subnatric Brown Sodosol	20-30	3	Moderate
		50-60	2	High
28	Eutrophic Mottled-Subnatric Yellow Sodosol	20-30	3	Moderate
		40-50	2	High
30	Eutrophic Mottled-Subnatric Red Sodosol	15-25	3	Moderate
		40-50	2	High

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 minimal erosion and sedimentation risk associated with the topsoils currently present in the Project Area with evidence of minor sheet erosion and minor gully erosion associated with surface disturbance (**Plate 2**). However, the dispersion risk status of the tested soils indicate there is moderate to very high potential risk for dispersion of the subsoils of Soil Unit 1, and moderate to high potential risk for dispersion of the subsoils of Soil Unit 3. The representative laboratory tested soils also indicate high levels of sodicity primarily in the clay subsoils associated with Soil Units 1 and 3. Based on these results, there is a high potential risk for dispersion Soil Unit 1 and 3 are disturbed within the Project 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 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 soils tested within the Project Area, all sodic soils should be considered dispersive.

Soil Unit 2 presents a negligible to moderate potential dispersion risk and is generally non-sodic, however, caution must be taken over the entire Project Area including Soil Unit 2 despite the range in chemical and physical properties or landscape location of specific soil test sites. This unit also displays sodicity and moderate dispersion risk in the lower profile at one test site. The likely sodic inconsistency within this soil mapping unit, and given this units close association with Soil Unit 1, means controls should be consistent and applied across the entire Project Area where any disturbance occurs (including changes to vegetation cover). Recommended control measures are presented 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 30 soil test sites within the Project Area have been subject to the site verification assessment of LSC, in accordance with the LSC Guideline and outlined in Section 3.2.1.

Based on the results of the LSC verification assessment, it is concluded that the Project Area contains three LSC classes:

- LSC class 3: high capability land – covering 63 ha.
- LSC class 4: moderate capability land – covering 114 ha.
- LSC class 5: moderately-low capability land – covering 277 ha.

- LSC class 6: low capability land – covering 248 ha.

The spatial extent of each LSC class is shown in **Figure 12**. The LSC verification assessment outcomes for the eight hazards group for the soil profiles assessed is presented in **Table 14**.

Class 3 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. The key limitations of this class within the Project Area include water erosion, wind erosion, soil structure decline, soil acidity and soil salinity. Class 3 land exists along open drainage flats in the west of the Project Area and in two limited hillcrest areas in the east of the Project area. Of the 64 ha LSC class 3 land mapped, 21 ha will be subject to land surface impacts, as shown on **Figure 12**.

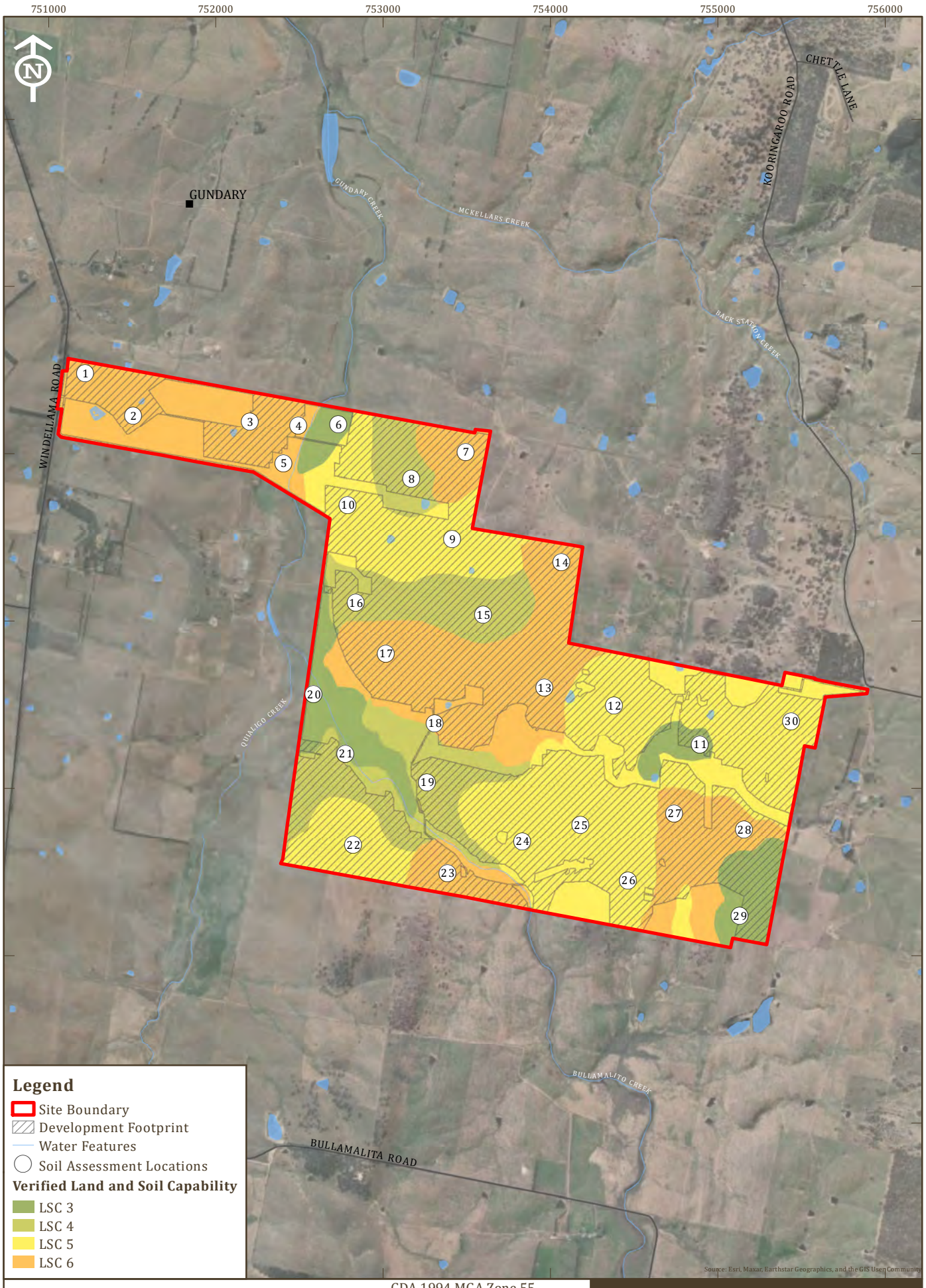
Class 4 land has moderate to high limitations for high-impact land uses that will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology. The key limitation of this class within the Project Area is wind erosion. Of the 115 ha LSC class 4 land mapped, 86 ha will be subject to land surface impacts.

Class 5 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. The key limitations of this class within the Project Area are water erosion, wind erosion and acidity. Of the 277 ha LSC class 5 land mapped, 227 ha will be subject to land surface impacts.

Class 6 land is associated with Soil Unit 1 and has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. The key limitations of this class within the Project Area include soil depth, water-logging and wind erosion. Of the 252 ha LSC class 6 land mapped, 178 ha will be subject to land surface impacts.

Table 14: 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
1	Red Sodosol	3	6	1	5	1	3	1	1	6
2	Eutrophic Hypernatric Red Sodosol	3	6	1	3	4	2	4	1	6
3	Brown Sodosol	3	5	3	4	1	1	6	1	6
4	Brown Sodosol	5	5	3	4	1	6	1	1	6
5	Mottled-Sodic Eutrophic Grey Dermosol	2	5	4	4	4	6	1	1	6
6	Sodic Eutrophic Black Dermosol	1	3	3	3	3	1	1	1	3
7	Bleached-Mottled Eutrophic Red Chromosol	3	6	1	5	3	6	1	1	6
8	Sodic Eutrophic Red Chromosol	3	4	3	3	2	2	1	1	4
9	Yellow Chromosol	3	5	3	4	1	3	1	1	5
10	Yellow Chromosol	5	4	3	4	1	2	1	1	5
11	Brown Sodosol	2	3	3	3	1	3	1	1	3
12	Yellow Sodosol	3	5	3	3	1	2	4	1	5
13	Eutrophic Mottled-Mesonatric Brown Sodosol	3	6	1	5	1	3	1	1	6
14	Eutrophic Mesonatric Brown Sodosol	3	7	1	5	1	1	6	1	6
15	Yellow Sodosol	3	4	3	3	1	2	4	1	4
16	Yellow Sodosol	3	4	3	3	1	2	1	1	4
17	Eutrophic Mottled-Subnatric Brown Sodosol	3	6	1	5	1	2	1	1	6
18	Yellow Chromosol	3	6	1	4	1	2	1	1	6
19	Yellow Sodosol	3	4	3	4	1	2	1	1	4
20	Black Dermosol	1	3	3	3	1	2	1	1	3
21	Yellow Sodosol	3	4	3	3	1	2	1	1	4
22	Eutrophic Mottled-Subnatric Red Sodosol	5	4	3	4	1	2	3	1	5
23	Eutrophic Mottled-Subnatric Brown Sodosol	3	4	4	3	1	6	1	1	6
24	Yellow Sodosol	5	4	3	4	1	2	1	1	5
25	Brown Sodosol	3	5	1	3	1	2	4	1	5
26	Eutrophic Subnatric Brown Sodosol	5	5	1	5	1	2	3	1	5
27	Yellow Sodosol	5	6	1	3	1	2	3	1	6
28	Eutrophic Mottled-Subnatric Yellow Sodosol	5	6	1	5	1	2	4	1	6
29	Red Sodosol	3	3	3	3	1	2	1	1	3
30	Eutrophic Mottled-Subnatric Red Sodosol	5	3	3	3	1	2	3	1	5



GDA 1994 MGA Zone 55

MINESOILS
LAND & REHABILITATION SPECIALISTS

0 125 250 500 Meters

Scale 1:30000 at A4

Verified Land and Soil Capability

FIGURE 12

D:\RST002_MineSoils\MS098_Gundary\MS098_012_VerifiedLSC.mxd 6/06/2024 1:04:26 AM

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 solar farm and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in **Appendix 1**. Performance targets will be determined via management plans specified by the EIS (and specialist impact assessments) and development consent conditions (if approved). Monitoring will be undertaken in accordance with those management plans. Indicative performance targets are presents in **Appendix 1**.

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

For the majority of items that are not soils and agriculture related, (such as visual amenity, biodiversity impacts, property values, etc), detailed assessments are referenced in the EIS, which include details of the impacts avoidance, minimisation and/or mitigation strategies recommended, well beyond the scope and scale required of a LUCRA.

4.3 FINDINGS

There are 41 risk items that 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. There are no high risk potential conflicts, however a number of items of potential conflict remain a moderate risk and may require further consultation and management in addition to standard operations. These are summarised in **Table 15**. The LUCRA methodology including risk ranking matrix and full LUCRA assessment are included as **Appendix 1**.

Table 15: LUCRA Moderate Risk Items and Risk Controls Summary

Risk Item	Risk Reduction Controls
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.	The assessment of potential traffic impacts has been undertaken via a Traffic Impact Assessment (TIA). 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).
Stakeholders in the locality who wish to maintain views of the existing agricultural landscape may be concerned about the change in visual amenity resulting from the solar farm	The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA). Appropriate mitigation measures are specified within the LVIA to minimise the risk of altered amenity for surrounding residents and public within the locality. Compliance with mitigation measures specified within the LVIA is anticipated to further limit visual impact from the Project. 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).
Land users in the locality may be concerned about weed, plant pest, plant disease or pest animal introduction and/or spread	The assessment of impacts to biodiversity has been undertaken via a Biodiversity Development Assessment Report (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 and relevant agencies (i.e. Biodiversity and Conservation Division) 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).
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	Consideration of potential hazards and risks have 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 risks associated with bushfires to and from the Project and the management of bushfire prone land. Appropriate mitigation measures are specified within the PHA and BFAR within the EIS to minimise the risk of fire and other hazardous events to and from the Project including their risk to people and potential to damage surrounding land. Ongoing consultation with stakeholders and relevant agencies (DPHI Hazard, RFS and FRNSW) 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).

Risk Item	Risk Reduction Controls
Landowners in the locality may be concerned about potential devaluation of properties due to proximity to solar farm infrastructure.	There are many factors that may influence land value, being amenities impact (noise, visual, air quality) of the Project to the locality the key factor to devaluation. Given construction impacts will be temporary, it is unlikely to have a permanent impact on the amenity of the locality. 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. However, it is more than just the physical visual, noise or amenity impacts that impact buyer and seller behaviour. It is also the perception or anticipation of these impacts and the associated fear or anxiety that can impact property prices. The high-profile nature of the Project including its presence in media articles and in signage on Windellama Road and throughout Goulburn may contribute to increased impact of the Project on property prices. Ongoing consultation with stakeholders will identify and address concerns if they arise. This issue is further addressed in the EIS
Public Authorities may have concerns regarding the potential for cumulative impacts arising from the proximity of state significant developments.	A detailed assessment of potential cumulative impacts has been undertaken as part of the EIS. Appropriate mitigation measures (where required) are specified in the EIS to minimise the potential for cumulative impacts to occur at or near the Project Area. Anticipated impacts are determined to be minor and presented in the EIS for Public Authority consideration.
Stakeholders may be concerned about the potential for poor rehabilitation outcomes and the resulting long term environmental and agricultural consequence.	Potential impacts associated with the decommissioning of the Project have been considered in the EIS. Furthermore, a Decommissioning and Rehabilitation Plan will be developed should the Project be approved, will ensure the land can be successfully returned to pre-disturbance land and soil capability and final land use commitments following decommissioning.

4.4 SUMMARY

In summary the LUCRA identifies seven potential conflicts being assessed with residual moderate risk, and 36 potential conflicts with residual low risk. No high risk items were identified.

The majority of risks identified pertain to the wider locality and community, as opposed to the agricultural operations of immediate neighbours. The residual land use conflict risk is considered acceptable in the context of the Project scale and can be maintained by the Project with respect to the wider locality and community. Residential land use conflict risk can be avoided or managed accordingly with immediate neighbours.

Ongoing consultation with stakeholders is expected to continue throughout all stages of the Project to identify and address concerns if they arise.

5 IMPACTS ON AGRICULTURAL LAND

The impacts solar farming activities 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 the Project Area over full the life of the Project, including the construction, operation and decommissioning phases. Permanent impacts may include changes to land and soil capability and agricultural resources of the Project Area. Impacts 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 solar farms within the region.

5.1 LAND USED FOR AGRICULTURE

The Project will be undertaken on an area of approximately 702 ha of land that is currently subject to agriculture land use. The Proponent intends to use as much of the Project Area as possible for agricultural purposes during the operational phase of the Project. Land being used simultaneously for agriculture and the solar farm is known as agrisolar and is further described in Section 6.4. However, for the purpose of this assessment and to apply a conservative approach, it is assumed that the agriculture will cease within the Project Area for the duration of the Project.

Therefore, there will be a temporary decrease of approximately 702 ha of land used for agriculture for the duration of the Project. This is considered a minor impact in the context of the scale of land area subject to agriculture use in the Goulburn Mulwaree LGA as outlined in Section 2.4.1 (0.6%).

It is anticipated that agricultural land use will be re-established over the entire 702 ha Project Area at the time of decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities). There will be no permanent decrease in land available for agriculture use.

Current agricultural land use adjacent to the Project Area and in the broader Project locality will not change as a result of the Project, and there will be no fragmentation or displacement of existing agricultural industries. Further, no biodiversity offsets which would remove land from agricultural use will be required for the Project.

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 impact of the Project on productivity of agricultural land based on the change in land use within the Project Area is up to $280,624 per year.

This is considered a minor impact in the context of the agricultural industry gross value of the Goulburn Mulwaree LGA as outlined in Section 2.4.2 (0.6%).

Due to the minimal disturbance to the landform, following the life of the Project, all land removed from agriculture will be returned to agricultural use, with no reductions in land and soil capability. Agricultural enterprises can then re-commence at an equivalent agricultural productivity.

5.2.2 PRODUCTIVITY OF LAND WITHIN LOCALITY

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

5.2.3 AGRICULTURE SUPPORT SERVICES

The Project will have a negligible impact on local and regional agricultural services. Changes to the supply and viability of agricultural support services in Goulburn are driven by social and market trends far exceeding the scale of the minor reduction in agricultural land use and productivity as a result of the Project.

The reduction in livestock being sold will be a negligible impact on the South Eastern Livestock Exchange, as this reduction is estimated to represent <1% of all livestock transacted.

5.2.4 CRITICAL MASS THRESHOLDS

Due to the minimal reduction in agricultural activity as a result of the Project and given the nature and scale of the established agricultural industries within the region and wider state, there will 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

Over the majority of the Project Area, soils will be subject to minor disturbance as part of the construction or maintenance of solar arrays and electrical cabling trenches. In areas where earthworks are necessary for construction of the BESS, substation and switching station, site facilities or access tracks, soils will be subject to higher impact disturbance.

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

Additionally, soils may be stripped only in areas where soil disturbance occurs. The depth of soil salvaged will be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered.

Impacts on soil biological balance and nutrient availability are linked to the status of vegetation beneath the panels. If grass cover is maintained across the site both between and under the panel rows to provide groundcover, there will be negligible soil composition and productivity impacts as a result of the panels.

However, if vegetation beneath the panels is significantly reduced or eliminated over long periods during operations, the soil may be temporarily sterilised and will require additional efforts and costs at the time of site decommissioning to restore the soil to a level of productivity equivalent to pre-disturbance conditions.

Land clearing activities associated with the construction phase will be controlled and managed through the effective implementation of a Construction Environmental Management Plan (CEMP) and a Biodiversity Management Plan (BMP). Furthermore, a Sheep Grazing Vegetation Management Plan will be developed for the operational phase of the Project to maintain groundcover.

Detailed soil impact mitigation measures are outlined in Section 6.2.

Overall, with the implementation of the proposed mitigation measures, the impacts to the soils of the Project Area are expected to be minimal and temporary. With the mitigation measures, there will be no direct or indirect impacts to the soil resources of the Project locality outside the Project Area.

5.3.2 LAND AND SOIL CAPABILITY

Due to the nature of the Project which will require only localised and sporadic landform modification including minor soil stripping (for excavation works and leveling), impacts on LSC are expected to be minor. The surface disturbance footprint for large site infrastructure is shown on **Figure 12**.

Approximately 21 ha of LSC class 3 land will be subject to disturbance as part of the Project. LSC class 3 is considered important agricultural land as per the *LSSE Guidelines*.

Due to the nature of the Project which will 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, disturbance footprints will be re-graded (where required) and any minor stockpiles of topsoil and subsoil be respread over disturbed areas and rehabilitated with either native vegetation or improved pastures depending on the intended final land use. This strategy, along with good soil management practices as outlined in Section 6.2 will facilitate the rehabilitation in returning the land to an equivalent LSC class.

Therefore, it is anticipated there will be no permanent impacts on LSC classes within the Project Area as a result of the Project.

5.3.3 WATER

A Water Resources Impact Assessment for the Project (Umwelt, 2024a) considered the potential impacts and appropriate measures to mitigate any potential impacts on water resources associated with the Project. The following conclusions relevant to soils and agriculture are made with respect to the potential Project impacts on water resources:

Impacts to surface water resources during the construction and decommissioning phases of the Project can be adequately managed.

Potentially adverse impacts on soil and surface water resources during the operational phase are not expected provided:

- appropriate stormwater treatment measures are implemented; and
- rehabilitation following ground disturbance in the construction phase is undertaken to minimise the risk of ongoing erosion and appropriate groundcover is maintained throughout the operational phase of the Project.

No interaction with the groundwater table is anticipated throughout all phases of the Project and therefore, no impacts to groundwater resources expected.

The potential for adverse impacts on the receiving surface water quality can be adequately managed by implementation of appropriate hazardous materials storage and handling measures (that will be documented in an OEMP) and appropriate design and siting of the on-site wastewater management system.

No impacts to the availability of supply to downstream and nearby water users (groundwater and surface water) as all water sourced for the Project will be undertaken in accordance with the WM Act 2000 and relevant water sharing plans.

Therefore, there is anticipated to be no impact on agricultural water resources within the Project Area or the broader locality.

5.3.4 EROSION AND SEDIMENTATION

Erosion risks are associated with the widespread presence of sodic and dispersive soils with a moderate to very high potential dispersion risk and are anticipated where higher impact surface disturbance is undertaken (such as earthworks for infrastructure). Suitable erosion and sedimentation controls, as outlined in Section 6.2, will be implemented that target these specific erosion hazards to reduce impacts to surface soils and waterways.

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

5.3.5 AGRICULTURAL INFRASTRUCTURE

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

Stock fences, dams and access tracks will be retained to accommodate potential agrisolar. Upgrades to access tracks throughout the Project will benefit post-Project agricultural land uses and is considered a positive impact. Dams within the Project Area that will be disturbed by the Project will be re-instated during decommissioning.

5.4 OTHER POTENTIAL IMPACTS ON AGRICULTURE

5.4.1 WEEDS AND PEST SPECIES

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 hindrance to rehabilitation, regeneration activities, and agricultural endeavours.

Weeds in general will be managed across the site through a series of control measures as detailed in the Vegetation Management Plan and a Biosecurity Risk Management Plan, including:

- Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.
- Rehabilitation monitoring programs and routine inspections will be undertaken to identify potential weed infestations; and
- There will be an ongoing effort to identify and eliminate (spray) existing weed populations on-site over the life of the Project.

The spread of declared noxious weeds will be prevented by using the measures above. The monitoring and control of weed populations using herbicides within the site will significantly reduce weed infestations. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with the regulatory requirements. Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned.

Feral animal control may potentially be undertaken in consultation with neighbouring landholders, as required. Programs to control feral animals will 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 will 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.

Feral animals may include goats, foxes, cats, rabbits, pigs, and dogs and will be controlled in accordance with Livestock Health and Pest Authority procedures.

With the effective implementation of measures to manage and control the spread of weeds and pest species within and around the Project Area, it is unlikely that weeds and pests will have an impact on agriculture within the Project locality.

5.4.2 BIOSECURITY

Biosecurity is defined in the 'Draft NSW Biosecurity Strategy' (DPI, 2021) 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. At the local level, as per Section 5.4.1 above, appropriate weed management will reduce biosecurity risks. On a regional level, any import of equipment or machinery from overseas will follow the standard procurement safeguards and quarantine procedures as per Australian requirements. Given the processes above, it is considered that the Project will not have any potential impact on the biosecurity of agricultural resources and enterprises within the region.

A Biosecurity Risk Management Plan will be prepared as part of the CEMP and Operation Environmental Management Plan (OEMP), and will inform the Sheep Grazing Vegetation Management Plan for the Project.

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 will be detailed in a 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 will 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 will be outlined in an 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 solar farm operations, leaving fewer transport options for agricultural enterprises.

The construction period is expected to generate the largest increase in traffic access to the Project Area, with management strategies to mitigate potential conflicts with surrounding landholders outlined in the and a subsequent Traffic Management Plan (TMP).

Traffic access to the Project Area during operation of the Project is expected to cause negligible conflicts with surrounding landholders, as the operation is only expected to employ up to four full time employees, it is expected that traffic impacts of the Project are not likely to have material consequences on agricultural enterprises within the Project locality.

A Traffic Impact Assessment (TTPP, 2024) demonstrated that the road network on the proposed transport routes used by the Project has sufficient capacity to accommodate the peak construction traffic generation of the Project.

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

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 (e.g., harvesters, boom sprayers and tractors), wind through trees, birds and insects.

Noise levels during construction, operation and decommissioning are predicted to comply with noise criteria. It is expected that noise will be effectively managed and minimised through the adoption of reasonable and feasible management practices. No surrounding receivers are expected to be exposed to noise levels greater than 75 dB. Supportive evidence is provided in a noise and vibration impact assessment completed for the Project (Umwelt, 2024b).

Vibration issues are not expected to be significant during either construction, operation or decommissioning due to the distance between the site and the nearest sensitive receivers.

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 90 dB has been known to severely affect animals (Dairy Global, 2017).

Appropriate mitigation measures are specified within the noise and vibration impact assessment to minimise noise impacts. As a result, predicted noise levels are well below 90 dBA as a result of the Project where livestock will 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 construction, operational and decommissioning noise due to the Project.

5.5 CUMULATIVE IMPACTS

The Project has the potential to generate cumulative impacts with other existing, approved or proposed developments in the region. At the time of finalising this report there are 25 developed, approved or proposed SSDs listed on the Major Projects website in the Goulburn Mulwaree LGA and neighbouring LGAs, in addition to the Project as detailed further in the EIS for the Project. Of these, there are eight developed, approved or proposed solar farm SSDs in the Goulburn Mulwaree LGA or surrounding LGA's as set out in **Table 16** that have been assessed for potential cumulative agricultural impacts.

For the purpose of this cumulative impacts review, wind farms and transmission line projects in the region are assumed to be able to facilitate agriculture land use and enterprises as part of ongoing operations. Proposed projects with small scale disturbance footprint (such as Goulburn Base Hospital Redevelopment) have also been excluded from consideration as they do not pose a significant risk to agriculture cumulatively.

Increased cumulative impacts including changes to land used for agricultural, localised productivity, secondary productivity and some agricultural support services are likely to be experienced where solar farm Projects in the region do not implement agrisolar, as outlined in **Table 16**, which shows a total of approximately 6,065 ha within the region subject to potential removal from agricultural land use, with an associated estimated potential productivity loss per year of $2,424,484.

For the proposed solar farm projects within the Goulburn Mulwaree LGA, there is approximately 1,266 ha of land subject to potential cessation of agricultural land use, in addition to that of the Project (702 ha), totalling 1,968 ha, measured against a total agricultural land use of 116,771 ha (refer Section 2.4.1). This represents 1.7% of land used for agriculture within the LGA.

The cumulative lost primary productivity per year is estimated to be $506,084 for the proposed solar farm projects, including the Project, within the Goulburn Mulwaree LGA, in addition to the lost primary productivity of the Project of up to $280,624, totalling an estimated $786,708. Measured against a total agricultural commodities gross value

for the LGA of $51,097,547 (refer Section 2.4.2). This represents an estimated 1.5% of agriculture productivity value within the LGA.

However, the applicability of agrisolar to solar farm projects is especially relevant to the Goulburn Mulwaree LGA and wider region given the suitable conditions for sheep grazing and the established sheep and lambing industries and infrastructure (as outlined in Section 2.4.3).

Therefore, where agrisolar is implemented, 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 Project.

On a broader scale, the cumulative risk to agricultural land and productivity across NSW 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).

Overall, with or without the implementation of agrisolar at the above listed solar farm projects, given the nature and scale of the established agricultural industries within the region and wider state, significant impacts to critical mass thresholds and regional and state agricultural infrastructure are unlikely to occur.

Table 16: Developed, Approved or Proposed Solar Farm Projects with Area and Estimated Lost Agricultural Productivity

Project	LGA	Area (ha)	Estimated Lost Primary Productivity Per Year*
Gundary Solar Farm (the Project)	Goulburn Mulwaree LGA	702	$280,624
Capital Solar Farm	Goulburn Mulwaree LGA	100	$39,975
Marulan Solar Farm	Goulburn Mulwaree LGA	406	$162,299
Merino Solar Farm	Goulburn Mulwaree LGA	760	$303,810
Goulburn Mulwaree LGA Sub Total		**1,968**	**$786,708**
Springdale Solar Farm	Sutton, Yass Valley LGA	370	$147,908
Western Range Solar Farm	Upper Lachlan Shire LGA	420	$167,895
Gunning Solar Farm	Upper Lachlan Shire LGA	676	$270,231
Wattle Creek	Upper Lachlan Shire LGA	614	$245,446
Blind Creek Solar Farm	Palerang LGA	1,026	$410,144
Wallaroo Solar Farm	Yass Valley LGA	391	$156,302
Yass Solar Farm	Yass Valley LGA	600	$239,850
Total		**6,065**	**$2,424,484**

* Conservatively assumes no agrisolar implemented. Primary productivity is based on assumption of cattle grazing as existing land use, using Merino Ewes (20 micron) – Merino Rams (399.75 $/ha/year) DPI Gross Margin Budgets for Livestock as per Section 3.1.1.

6 MITIGATION MEASURES

The Project will 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 enterprise.

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

6.1 SITE SELECTION AND DESIGN

The Project Area was shown to be suitable as it provides the optimal combination of:

- A strong electricity network with multiple high voltage (HV) transmission lines passing through the area, providing good system strength. A strong point of connection to the existing transmission network is available, making it an ideal site for increasing generation capacity on NEM with minimal requirements for additional transmission infrastructure. Moreover, the proximity of load centres means that less energy is lost in the transportation of the generated energy so more can be used rather than wasted.
- The availability of renewable resources, including solar and wind.
- Proximity to high population and electrical load (demand) centres of Canberra, Sydney, Goulburn and other towns in the region.
- Existing agricultural land use within and surrounding the Project Area, which is compatible with large scale solar energy generation, and potential to implement agrivoltaics.
- The Project Area has been cultivated for agricultural production and is relatively flat minimising land clearing and earthworks through construction.
- Preliminary environmental assessment indicates much of the area has been intensively cultivated for agricultural purposes, any remaining areas of significance can be avoided or mitigated.

The Proponent has made key decisions regarding the Project in response to agricultural and land use considerations. The Project Area was also considered suitable as it is not mapped as either Biophysical Strategic BSAL or LSC class 1 or 2.

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

The Project will consist of a number of solar array areas or blocks comprised of PV modules arranged in a series of long rows. The modules are mounted on frames which are fixed to piles driven into the soil. This method of installation includes an ability to track the sun's path throughout the day, in order to maximise the electricity yield that is generated.

This installation was chosen for its simplicity, maturity and cost-effectiveness, and because it allows retention of existing grassland vegetation in situ with minimal ground disturbance in order to facilitate agrisolar and minimise soil impacts. This design approach is a critical mitigation measure employed to potentially reduce the impacts to agriculture as a result of the Project (if agrisolar is implemented).

Further, underground cabling would be installed with the relevant *Australian Standards: AS/NZS 3000:2018: Electrical installations* and would be at a depth of at least 600 millimetres below ground. As noted by the DPI in the SEAR's for the Project (refer Section 1.4), in the event that decommissioning fails to remove all buried cabling, cables at depths >500mm will allow greater opportunity for agricultural activities, particularly cropping.

No further design amendments are recommended.

A full description of 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, there are no significant erosion and sedimentation issues present within the Project Area. However, as the dispersion risk status of the tested soils indicate, there is a potential risk for dispersion of soils within the Project Area which would result in long term agricultural impacts.

Generally, channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures.

The Project will 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 will be maintained intact across much of the Project Area.
- Solar arrays are typically pole mounted, with the poles being supported on a driven or screw pile, so that there is no excavation required other than for electrical cabling.
- Construction areas should be progressively revegetated with grass and pasture species as installation of solar panels proceeds across the site.
- At locations where earthworks and excavation are necessary, such as for cable trenching, localised erosion and sediment controls will be placed in accordance with the Landcom (2004) guidelines (The "Blue Book").
- Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance will be prioritised during construction.
- If sodic subsoils of Soil Unit 1 and 3 are inadvertently exposed, 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.
- All areas disturbed during construction that are not in active use for over 3 months, should be sown with grass and pasture species with starter fertiliser to provide stabilising ground cover and a healthy topsoil 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 disturbance 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.
- During operation, mounted solar panels will change orientation during the day, with any rainfall runoff being distributed in the area around each panel, and not drained permanently to a single point on the ground.
- Measures to manage any bare areas and erosion that develop beneath the solar arrays over time should be included in a land or groundcover management plan for implementation during ongoing operation of the proposal.

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 will 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 subsoils 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

The very minor amount of soil that is proposed to be disturbed during the Project will 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 Project Area.

The entirety of the Project Area has been assessed to determine suitability for stripping and re-use. This will allow site managers to make decisions on soil stripping for re-use when the locations of soil disturbance for surface infrastructure have been finalised. This localised, fluid approach is an integral process for successful rehabilitation of the Project. This section provides information on the following key areas related to the management of the topsoil resources for the area within the Project Area.

Soil Stripping Strategy

Laboratory soil analytical results (refer **Appendix 2**) were used in conjunction with the field assessment to determine the potential risk associated with soil material recovery and re-use. Structural and textural properties of soils, along with stones, dispersion potential, sodicity and high acidity are the most common and significant limiting factors in determining depth of soil suitability for re-use, however, given the limited surface disturbance and lack of a soil bank for the site, it is anticipated that all soil stripping and re-use will be localised; that is, soil will be respread from where it is stripped during construction, reinstating the soil profile to its original condition.

Additionally, soils will be stripped only in areas where soil disturbance occurs. The depth of soil salvaged should be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered.

Due to the sodic nature and dispersion risk of the soils in parts of the Project Area, controls must be implemented to manage the risk of surface water erosion with potential to occur once excavated. Upon respreading, clay subsoils that have been excavated for trenching will be used exclusively as a subsoil, and encapsulated by the loamy topsoils with which they are currently capped.

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 will 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.

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 will 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. 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 will provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will 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 disturbance 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

The Project does not anticipate large volumes of topsoil to require significant stockpile and respreading management measures, 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 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 will 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.

6.2.3 SOIL BIOLOGY MANAGEMENT

During the approximately 40 year life of the Project soil hydrological and ecological processes may be impacted. In addition to reducing the landscape's ability to support ecosystem services during the solar facility's lifespan, these changes may leave legacy effects that persist long after the installation is removed, if effective rehabilitation is not undertaken post decommissioning.

Based on the intensity of the panel array layout and potential for stock to graze under the panels, the soil will be able to retain and store nutrients. Upon decommissioning the areas under the panels may be seen to have a short term decrease in productivity compared to adjacent areas, however commitments to achieve a groundcover level during the post operative period will be sufficient to increase soil productivity to match adjacent analogue areas.

Several mitigation measures are available for the operational phase to mitigate the long term impacts of the Project on soil biological balance and nutrient availability. These include:

- Routine vegetation monitoring and maintenance.
- Erosion and sediment controls to preserve topsoil material.
- Routine monitoring and management of visible surface erosion, such as rilling caused by concentrated flows from infrastructure.
- Promotion of grass cover in spacing between each of the solar panel array rows.
- Weed management strategies to promote continued presence of pasture species and seedbank within topsoil.

These should be incorporated into the Biodiversity Risk Management Plan, which will guide operational environmental management following the final design of the Project and would be approved by the relevant statutory authority.

A small soil sampling program is a means to demonstrate the ongoing protection of soil health during operation of the Projects. This may be required where existing grass cover is considered marginal.

Soil sterilisation, localised or widespread, remains a minor risk throughout the Project. However, soil rehabilitation measures at the decommissioning stage can be employed to restore soil biological balance and nutrient availability. Measures include the application of mulch and organic materials, fertilisers, soil ameliorants and regenerative farming practices. Further, the spacing between each of the solar panel rows are anticipated to remain biologically active and act as an established source of bioactivity for spreading into potentially sterilised islands following the removal of panels.

6.3 MONITORING PROGRAMS AND MANAGEMENT PLANS

Monitoring programs are instituted to assess predicted verses 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 will include environmental monitoring programs, where required. Key management plans, or chapters housed within a larger Environmental Management Strategy, that will assist in managing impacts on agricultural land will be stipulated in conditions of development consent.

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

- Sheep Grazing Vegetation Management Plan
- Noise and Vibration Management Plan
- Soil and Water Management Plan
- Traffic Management Plan
- Waste Management Plan
- Emergency Management Plan, including Bushfire and Hazards
- Biosecurity Risk Management Plan
- Rehabilitation Management Plan

6.4 AGRISOLAR

Agrisolar refers to co-developing the same area of land for both use as a solar farm as well as for agriculture activities (Clean Energy Council, 2021). By implementing complementary solar energy and agricultural production, impacts to existing agricultural land use and enterprises, including primary and secondary productivity, can be reduced.

Solar farms typically require access to relatively flat or gently sloping land in sunny areas within proximity to electricity transmission networks, where biodiversity impacts can be avoided or minimised. This often means that land which has been previously cleared or zoned for agricultural use is well-situated to host solar farm developments.

Where solar farms are proposed and developed, there is increasing interest in exploring the opportunities for complementary agricultural activities which can benefit from a number of the valuable characteristics of solar arrays, including:

- the provision of partial shading and weather protection (including sun, rain, hail and wind).
- improved soil moisture retention, which can lead to improved vegetation growth beneath the panels.
- protection from predators for sheep.

Sheep grazing delivers benefits for the operation of solar farms, as the vegetation is maintained in a cost-effective and safe manner by reducing the need for mowing or spraying. This maintenance reduces the risk of fire hazard, protecting the solar assets and neighbouring properties.

The implementation of agrisolar as part of the Project is especially applicable given the suitable conditions for sheep grazing and the established sheep and lambing industries and infrastructure with the Goulburn Mulwaree LGA.

During the detailed design phase prior to construction commencing, the Project will consider design measures to enable the efficient movement of sheep between sections of the solar farm to facilitate rotational grazing. With the development of solar farms commencing in Australia from around 2015 onwards, the local experience of agrisolar practices is still developing and currently dominated by the practice of sheep grazing on solar farms (Clean Energy Council, 2021).

The Proponent is committed to exploring the integration of solar panel installation with the existing agricultural use at the Project Area as a means of mitigating the impacts to agriculture and anticipates that sheep can be introduced to graze within the Project Area during the operation phase of the Project, subject to necessary approvals and climate conditions permitting.

Grazing would commence following construction and after a resting period of approximately 1 year, subject to availability of stock feed and site conditions, and would occur generally consistent with the *Australian Guide to Agrisolar for Large-Scale Solar* (the Guideline).

A short trial would be conducted initially in a small, controlled area within the site to assess any potential issues associated with co-use. The trial would determine potential success of site wide adoption of agrisolar and demonstrate the sheep aren't going to damage equipment.

Based on Merino sheep success in agrisolar operations in other NSW solar farms, and established presence as an key agricultural enterprise within the LGA and wider region, Merino sheep are intended to be used.

Existing agricultural improvements, including stock fences and watering infrastructure (e.g. farm dam) and would be retained to accommodate trails. The broader Project boundary would be fully fenced.

Stocking rates would be trailed and amended over time however would commence with 10 sheep per hectare in accordance with the Guideline, subject to site conditions (e.g. drought).

A sheep grazing vegetation will be prepared following the approval of the Project, in consultation with DPI Agriculture, to further develop a strategy for the agrisolar trials. This would involve specific measures relating to the following:

- Agrisolar infrastructure - the proposed sheep handling infrastructure such as fencing, yards and laneways under the solar array, watering/fodder, drainage and dust suppression arrangements, shelters, connectivity to other paddocks, camps and infrastructure such as woolshed, dip, chemical store, fodder store and yards etc.
- Sheep husbandry – explanation of the breed(s) (meat/wool) and breeding plan, sex and ages of sheep to be utilised (wethers/ewes/lambs etc), stocking rates, proposed welfare and animal health requirements such as integrated pest management.
- Pasture management – given that the property has been used for both grazing and cropping and the likelihood of weed invasion with introduction of pasture; details on the systems and stocking rates approach used to establish, manage and maintain pasture growth and weed management.
- Waste Management - plans for the disposal of used water, spent fodder, dead animals/animal products, chemicals and contaminated matter, etc.

6.5 DECOMISSIONING AND REHABILITATION

Decommissioning of the Project will occur at the end of its operational life. A decommissioning plan for the Project and associated infrastructure will be prepared in advance of decommissioning in consultation with the relevant regulatory authorities and landholders. The basis of the plan will be that the Project and associated infrastructure are to be decommissioned in line with the applicable legislative requirements and best practice guidelines existing at that time. Should the Project be approved, the development consent for the Project will include standard conditions regarding the cessation of operations, decommissioning and rehabilitation of the Project Area.

6.6 MITIGATION SUMMARY

The mitigation measures pertaining to soils and agriculture that have been referenced in this assessment will form part of the Project approval commitments. A summary of these is presented in **Table 17**.

Table 17: Summary of Mitigation Measures

Risk Category	Mitigation Measures		
	Construction	**Operation**	**Decommissioning**
Agricultural Land Use	-	• Consider implementing Agrisolar to reduce area of land removed from agricultural service.	• Agriculture land use to be re-established over the entire Project Area at the time of decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities).
Agricultural Productivity	-	• Consider implementing Agrisolar during operation at a suitable stocking rate.	• Project Area will be returned to an equivalent agricultural productivity following decommissioning (unless otherwise agreed with the landowner and/or regulatory authorities).
Soils	• All soil that is proposed to be disturbed during the Project will be stripped and re-used in construction (ie, for cable trenches) and/or stockpiled for later use in rehabilitation (ie, for infrastructure areas subject to more significant excavation and earthworks). • Soil that will be generally respread from where it is stripped during construction (i.e, trenches), should be reinstated to a soil profile that matches original condition. • Soils will be stripped only in areas where soil disturbance occurs. • The depth of soil salvaged should be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered. • Upon respreading during construction, clay subsoils that have been excavated for trenching will be used exclusively as a subsoil, and encapsulated by the loamy topsoils with which they are currently capped. • Due to the sodic nature and dispersion risk of the soils in parts of the Project Area, controls must be implemented to manage the risk of surface water erosion with potential to occur once excavated. • Soil should ideally be stripped in a slightly moist condition. Material should not be stripped in either an excessively dry or wet condition. • Long term stockpiles in areas associated with the higher impact activities (excavation and earthworks)where larger amounts of soil will 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. Topsoil and subsoil depths for these areas should be recorded in GIS. • 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 will provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.	• Maintain groundcover at a minimum 70% where practical (subject to long terms seasonal variations, such as drought) • Maintain a maximum stockpile heights of 3 m • An inventory of available soil should be maintained to ensure adequate materials are available for planned rehabilitation activities when the time comes. • Routine vegetation monitoring and maintenance. • Implement erosion and sediment controls to preserve topsoil material. • Implement routine monitoring and management of visible surface erosion, such as rilling caused by concentrated flows from infrastructure. • Promotion of grass cover in spacing between each of the solar panel array rows. • Weed management strategies to promote continued presence of pasture species and seedbank within topsoil. • Final rehabilitation target species should be established on stockpiles in the lead up to decommissioning to build up a desirable species seed bank in the topsoil.	• Stockpiled soil must be available for use in rehabilitation. • Soil will be generally respread from where it is stripped during construction, reinstating the soil profile to its original condition. • Prior to re-spreading stockpiled topsoil onto the disturbance 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. • Topsoil should be spread to a depth that 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 will 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. • Restore soil biological balance as required, through the application of mulch and organic materials, fertilisers, soil ameliorants and regenerative farming practices.

Risk Category	Mitigation Measures		
	Construction	**Operation**	**Decommissioning**
Erosion and Sedimentation	• 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 will be maintained intact across much of the Project Area. • Impacts to channelised drainage patterns should be minimised and the Project should limit hard engineering solutions for erosion control and preference soft, vegetated structures. • Solar arrays are typically pole mounted, with the poles being supported on a driven or screw pile, so that there is no excavation required other than for electrical cabling . • Construction areas should be progressively revegetated with grass and pasture species as installation of solar panels proceeds across the site. • At locations where earthworks and excavation are necessary, such as for cable trenching, localised erosion and sediment controls will be placed in accordance with the Landcom (2004) guidelines (The "Blue Book"). • Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance will be prioritised during construction. • If sodic subsoils of Soil Unit 1 and 3 are inadvertently exposed, 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. • All areas disturbed during construction that are not in active use for over 3 months, should be sown with grass and pasture species with starter fertiliser to provide stabilising ground cover and a healthy topsoil to provide long term protection against erosion.	• Soil disturbance during operation of the Project should be minimal and limited to maintenance activities, involving very small, localised disturbance 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. • During operation, mounted solar panels will change orientation during the day, with any rainfall runoff being distributed in the area around each panel, and not drained permanently to a single point on the ground. • Measures to manage any bare areas and erosion that develop beneath the solar arrays over time should be included in a Sheep Grazing Vegetation Management Plan for implementation during ongoing operation of the proposal. • Implement routine vegetation monitoring and maintenance. • Implement routine monitoring and management of visible surface erosion, such as rilling caused by concentrated flows from infrastructure. • Promotion of grass cover in spacing between each of the solar panel array rows.	• A detailed Decommissioning and Rehabilitation Plan should be prepared within 18 months of the planned closure of the Project. This plan will 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 subsoils 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.
Infrastructure	-	• Stock fences, some dams, and access tracks to be retained/ reinstated during operations to accommodate agrisolar.	• Stock fences, dams, and access tracks to be reinstated during decommissioning to accommodate post-Project agriculture land use.
Pest Species	• Regular monitoring to identify and eliminate (spray) existing weed populations on-site throughout construction. • Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with the regulatory requirements. • Implement program to control feral animals	• Regular monitoring to identify and eliminate (spray) existing weed populations on-site throughout operation. • Records will be maintained of weed infestations and control programs will be implemented according to best management practice for the weed species concerned. • Implement program to control feral animals.	• Prior to re-spreading stockpiled topsoil onto the disturbance area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and / or “scalping” of weed species prior to topsoil spreading. • Rehabilitation monitoring programs and routine inspections will be undertaken to identify potential weed infestations.
Biosecurity	Biosecurity risk management measures will be included in a Biosecurity Risk Management Plan, CEMP and OEMP, and will be referenced in a Sheep Grazing Vegetation Management Plan for the Project.		

7 SUMMARY

There is a high level of certainty about the status of agricultural resources and enterprises in the Project Area, locality and broader region, based on the 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, and by taking a conservative assessment approach that does not account for the likely implementation of agrisolar, the impacts on agriculture as a result of the Project are determined to be minimal, temporary, and limited to the Project Area. These impacts can be summarised as the following:

- Temporary removal of 702 ha from agricultural land use within the Project Area for the duration of the Project.
- Temporary removal of potential agricultural primary productivity to the estimated value of up to $280,624 per year for the duration of the Project.
- Temporary impacts on soil resources within the Project Area where surface disturbance occurs.
- Temporary impacts to approximately 21 ha of LSC class 3 land.

The temporary impacts on agriculture listed above are considered minor impact in the context of the gross commodity values and land use coverage of the agricultural industries operating within the Goulburn Mulwaree LGA. There will be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure. Further, at the scale of the enterprises operating within the Project Area, impacts are considered offset as the involved landowners would be financially compensated.

Following construction, the proponent anticipates that sheep can be introduced to graze within the Project boundary. This integrated land use of solar panels and livestock grazing offers the potential to enable the continuation of agricultural land usage and mitigate the above listed temporary impacts of the Project.

Further, it is anticipated that by adopting the principles of the mitigation hierarchy 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 will have no permanent negative impacts on agricultural resources or enterprises.

A summary of mitigation measures and management recommendations have been provided at Section 6 to eliminate the permanent risks and control the temporary risks of the Project on land and soil resources. The salvage of topsoil material for re-use purposes combined with sound erosion and sedimentation management practices during construction, operational and decommissioning phases of the Project, will ensure rehabilitation requirements are met and land is returned to a pre-disturbance agricultural status.

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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 solar farm 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 will undergo subdivision to accommodate residential or small-block rural developments. Accordingly, it is not expected that future changes to land use will occur that will 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)

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	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). 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.
Construction	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. 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.
Construction	Increased noise generated by construction activities and heavy vehicle movements may be perceived as nuisance to surrounding residential properties.	C	4	8	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). 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	Land users in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the site and locality, including local waterways and dams, 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. 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 Soil and Water Management Plan (SWMP). Groundcover is maintained where possible and practical. Identified erosion areas progressively rehabilitated.

Minesoils

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	Use of surrounding roadways during construction of the solar farm may cause conflict by interacting with agricultural and/or local transport activities, and/or resulting in additional travel time for road users or potentially impacting / degrading the physical condition of local roads, particularly Windellama Road.	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. Liaison with relevant road authorities (ie. Council and Transport for NSW) regarding ongoing maintenance of road surface during construction 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 and disciplinary procedure as a mechanism to address any issues identified by neighbouring land users. Damaged or degraded roads to be repaired
Construction	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). Appropriate mitigation measures are specified within the TIA to minimise impacts to the traffic environment, including reduced speed limits and increased number of road warning signs. 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. There will be a 24/7 complaint line available. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	2	10	The EMS, specifically TMP, will include a complaint resolution and disciplinary procedure as a mechanism to address any issues identified by neighbouring land users.
Construction	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	Stakeholders may have concerns that construction activities associated with the solar farm 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.	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.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction	Stakeholders may have concerns that the construction and operation of the solar farm 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).
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. 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.
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	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.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Noise	Land users in the locality may be concerned about an increase in noise levels generated from power inverters, substation, transformer system, tracker motors and maintenance activities throughout the operational phase of the Project.	C	3	13	The assessment of potential noise impacts has been undertaken via a Noise Impact Assessment (NIA). Anticipated impacts are determined presented in the EIS for land user consideration. 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. Noise does not exceed the adopted Noise Policy. Exceedance no greater than 5dBA above background levels.
Operation Visual Amenity	Stakeholders in the locality who wish to maintain views of the existing agricultural landscape may be concerned about the change in visual amenity resulting from the solar farm	B	3	17	The assessment of visual impacts to surrounding amenity has been undertaken via a Landscape and Visual Impact Assessment (LVIA). Appropriate mitigation measures are specified within the LVIA to minimise the risk of altered amenity for surrounding residents and public within the locality. Compliance with mitigation measures specified within the LVIA is anticipated to further limit visual impact from the Project. Ongoing consultation with stakeholders will identify and address concerns if they arise.	C	4	8	Effectiveness of mitigation measures will be measured as part of the EMS which will include reference to measures proposed to minimise visual impacts.
Operation Visual Amenity	The solar farm location and potential for glare and reflectivity has the potential to impact the amenity of surrounding residential properties	C	3	13	The assessment of glare and reflectivity impacts to surrounding residential properties has been undertaken via a LVIA. Appropriate mitigation measures are specified within the LVIA to reduce and mitigate glare impact of the Project. Compliance with mitigation measures specified within the LVIA is anticipated to avoid potential glare impact from the Project. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS which will include reference to measures proposed to minimise glare impact.
Operation Social	Stakeholders in the locality may be concerned about impacts on agriculture-based tourism	C	3	13	Consideration of potential impacts to agriculture-based tourism has been undertaken as part of the EIS. Anticipated impacts are determined to be negligible and presented in the EIS for stakeholder consideration. 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 which will include a complaint handling system.
Operation Pest Control	Land users in the locality may be concerned about weed, plant pest, plant disease or pest animal introduction and/or spread	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 Vegetation Management Plan (VMP).

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operation Pest Control	Neighbouring property owners may be concerned about sprays from weed control adversely affecting adjacent land	D	4	5	Weed mitigation measures will be undertaken as per methodology specified in the Vegetation Management Plan (VMP) identified in the EIS and/or consent conditions (if approved), including spraying in a manner to prevent spray drift. 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 Vegetation Management Plan (VMP).
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.
General Operation	Land users in the locality may be concerned about changes to site run-off water quality during operational phases of the Project	C	3	13	Consideration of impacts to surrounding water courses and water quality has been undertaken within the water impact assessment of the EIS. 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 an erosion and sediment control plan.	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS.
General Operation	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. No fires caused by the construction, operation and decommissioning of the Project Area.
General Operation	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	No unreasonable additional pressure to local employment due to project activities

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	Neighbouring landowners may be concerned about livestock used for vegetation control on Project Area entering adjacent properties	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. 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.
General Operation	Neighbouring landowners may be concerned about their livestock entering the Project 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.
General Operation	Land users in the locality 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.
General Operation	The placement of the solar farm on agriculturally viable land may cause conflict with surrounding agricultural operators interested in expanding their operations onto the Project Area.	C	3	13	Existing consultation and engagement for the Project has not identified any intent for surrounding agricultural industries to expand operations onto the Project Area in the short term. The reversibility of the Project would allow the site to be returned to its existing agricultural land use, therefore minimising potential for long term conflict.	E	3	6	Effectiveness of engagement will be measured as part of the EMS.
General Operation	The placement of the solar farm on land that may be viable for sub-division may cause conflict with surrounding business operators interested in expanding production onto the site.	D	3	9	Existing consultation and engagement for the Project has not identified any intent for nearby enterprises to expand operations onto the Project Area in the short term. The reversibility of the project would allow the site to be returned to its existing land use, therefore minimising potential for long term conflict.	E	3	6	Effectiveness of engagement will be measured as part of the EMS.
General Operation	The placement of the solar farm in proximity to agricultural business operators may affect insurance premiums for surrounding private property owners.	C	3	13	The Project will implement measures to reduce bushfire risk and manage any potential impacts, such as incorporating a Asset Protection Zone (APZ) around the perimeter of the solar farm 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.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	Landowners in the locality may be concerned about potential devaluation of properties due to proximity to solar farm infrastructure.	B	3	17	As outlined in the EIS, there are many factors that may influence land value, being amenities impact (noise, visual, air quality) of the Project to the locality the key factor to devaluation. Given construction impacts will be temporary, it is unlikely to have a permanent impact on the amenity of the locality. 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. However, it is more than just the physical visual, noise or amenity impacts that impact buyer and seller behaviour. It is also the perception or anticipation of these impacts and the associated fear or anxiety that can impact property prices. The high-profile nature of the Project including its presence in media articles and in signage on Windellama Road and throughout Goulburn may contribute to increased impact of the Project on property prices. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	3	9	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Landowners in the locality may be concerned about potential increase in council rates as a result of the change in land use of the Project Area.	C	3	13	Under the *Local Government Act 1993* solar farms or renewable energy developments are not identified as a subcategory and as such they are required to be identified as a business category or agriculture or may be grouped with other locational activity. This could result in some increase in land value and subsequent increases in rates. However, it is not anticipated that this will impact land value or council rates on neighbouring agricultural properties. 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.
General Operation	Land users in the locality may be concerned that waste generated by the development has the potential to enter surrounding residential land.	D	4	5	Consideration of waste related impacts has been undertaken as part of the EIS. Risk will be mitigated by implementing standard operation measures specified in the WMP identified in the EIS and/or consent conditions (if approved). 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, specifically WMP
General Operation	Land users in the locality may be concerned that the change in land use may attract people to the area who may not otherwise visit the area, including workers. This may be perceived to adversely affect a resident's security.	D	3	9	Workforce behaviour will be managed through the implementation of the EMS, which will encourage positive workforce behaviour. 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 engagement will be measured as part of the EMS.
General Operation	Stakeholders may have concerns regarding the ownership of the site i.e., whether it is a foreign-owned company	D	4	5	Engagement for the Project has introduced the Project and the Proponent (Lightsource bp) to surrounding stakeholders. Notification to stakeholders outlined the Proponent's ownership and consultation has provided an opportunity for stakeholders to provide feedback.	E	4	3	Effectiveness of engagement will be measured as part of the EMS.

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
General Operation	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 Historic Heritage Assessment (HHA). Appropriate mitigation measures are specified within the ACHAR and HHA to minimise impacts to heritage. Compliance with mitigation measures specified within the ACHAR and HHA 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) and Unanticipated Finds Protocol (UFP).
General Operation	Stakeholders may be concern 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.	E	3	6	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Public Authorities may have concerns regarding the potential for cumulative impacts arising from the proximity of state significant developments.	B	3	17	An assessment of potential cumulative impacts has been undertaken as part of the EIS. Appropriate mitigation measures (where required) are specified in the EIS to minimise the potential for cumulative impacts to occur at or near the Project Area. Anticipated impacts are determined to be minor and presented in the EIS for Public Authority consideration.	D	3	9	Effectiveness of engagement will be measured as part of the EMS.
General Operation	Dispersion of dust and/or agricultural/ rural products from surrounding land uses may impact the productivity of the solar farm panels, potentially causing conflict between agricultural land users and the solar farmland use.	C	4	8	Compliance with mitigation measures specified within the EIS together within the ongoing maintenance of solar panels and site infrastructure, is anticipated to reduce the risk of conflict related to the functioning of the solar farm panels.	D	5	2	No impact to solar farm operations or infrastructure.
Decommissioning	Amenity impacts (noise and dust) associated with decommissioning of the project infrastructure and rehabilitation of the site	D	3	9	Continued implementation of the EMS Ensure potentially affected sensitive receivers have access to a site contact to report issues and are consulted as to the potential impacts from decommissioning. Reduce speed of vehicles accessing the site.	D	4	5	No exceedances of noise and dust criteria
Decommissioning	Inadequate removal of infrastructure including commercial and industrial wastes.	D	3	9	Removal of infrastructure and remediation of Project Area to an agreed standard is stipulated in land contracts with project landowners. Removal of infrastructure and remediation of Project Area will be a condition of project approval/ consent. The adequacy of removal will be as required through relevant legislation, such as the POEO Act 1997 prior to returning the site back to the landowners.	D	4	5	Complete removal of infrastructure including commercial and industrial wastes as per Project consent conditions

Activity	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
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 1				
Site Reference	1	**ASC Name**	Red Sodosol	
Average Slope	5%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper Slope	**Drainage**	Imperfect	X: 751220
Surface Condition	Soft	**Permeability**	Moderate	Y: 6141482

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Brown (Munsell 10YR 4/3) Loamy Sand with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.25 – 0.40**	Dark greyish brown (Munsell 10YR 4/2) Loam with weak pedality. 50% coarse fragments 10mm. Few roots and moderately drained. Clear boundary.
B21	**0.40 – 0.70**	Yellowish red (Munsell 5Yr 4/6) Silty Clay with moderate pedality. No coarse fragments. Very few fine roots and moderately drained. 10% distinct red mottling. Clear boundary.
B22	**0.70+**	Dark reddish grey (Munsell 5YR 4/2) Silty Clay with moderate pedality. No coarse fragments. No roots and moderately drained. 15% distinct orange mottling.

Site Description – Site 2				
Site Reference	2	**ASC Name**	Eutrophic Hypernatric Red Sodosol (BEKOVNR)	
Average Slope	4%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Moderate	X: 751506
Surface Condition	Soft	**Permeability**	Moderate	Y: 6141228

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark reddish brown (Munsell 5YR 3/2) Loamy Sand with moderate pedality. Slightly acidic pH, slightly-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.20 – 0.35**	Brown (Munsell 10YR 4/3) Loam with weak pedality. Slightly acidic pH, non-saline and sodic. 80% coarse fragments 10 – 50mm. Few roots and moderately drained. Clear boundary.
B2	**0.35 – 0.65**	Yellowish-red (Munsell 5YR 4/6) Silty Clay with strong pedality. Strongly alkaline pH, moderately saline and sodic. No coarse fragments. Few roots and moderately drained.
C	**0.65+**	Parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	2.1	Slightly saline	6.1	Slightly Acidic	3.7	Non sodic
0.20 – 0.30	0.8	Non-saline	6.4	Slightly Acidic	12.7	Sodic
0.40 – 0.50	4.8	Moderately saline	8.5	Strongly Alkaline	29.6	Sodic

Site Description – Site 3				
Site Reference	3	**ASC Name**	Brown Sodosol	
Average Slope	8%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Crest	**Drainage**	Moderately Well	X: 752204
Surface Condition	Soft	**Permeability**	High	Y: 6141191

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) Sandy Loam with moderate pedality. 30% coarse fragments 20 – 100mm. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.30**	Greyish brown (Munsell 10YR 5/2) Loam with weak pedality. 60% coarse fragments 20 – 50mm. Common roots and well drained.
B	**0.30 +**	Light yellowish brown (Munsell 10YR 6/4) Light Medium Clay with moderate pedality. 40% coarse fragments 20 - 100mm. Very few fine roots and moderately well drained. Floating rock refusal to corer.

Site Description – Site 4				
Site Reference	4	**ASC Name**	Brown Sodosol	
Average Slope	15%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Lower Slope	**Drainage**	Poor	X: 752493
Surface Condition	Soft	**Permeability**	Moderate	Y: 6141171

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 10YR 5/3) Sandy Loam with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.20 – 0.35**	Bleached pale brown (Munsell 10YR 6/3) Loam with weak pedality. No coarse fragments. Few roots and imperfectly drained. Clear boundary.
B2	**0.35 +**	Light yellowish brown (Munsell 10YR 6/4) Silty Clay with moderate pedality. 10% coarse fragments 10mm. Very few fine roots and poorly drained. 20% distinct orange mottling.

Site Description – Site 5				
Site Reference	5	**ASC Name**	Mottled-Sodic Eutrophic Grey Dermosol (BELMW)	
Average Slope	1%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Drainage Flat	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Flat	**Drainage**	Poor	X: 752406
Surface Condition	Soft	**Permeability**	High	Y: 6140947

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Dark brown (Munsell 7.5YR 3/2) Silty Loam with moderate pedality. Moderately acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.25 – 0.35**	Grey (Munsell 7.5YR 5/1) Silty Loam with weak pedality. Mildly alkaline pH, non-saline and sodic. No coarse fragments. Few roots and moderately drained. Clear boundary.
B21	**0.35 – 0.65**	Dark greyish brown (Munsell 10YR 4/2) Silty Clay Loam with moderate pedality. Strongly alkaline pH, non-saline and sodic. Very few fine roots and moderately drained. 10% orange mottling. Gradual boundary.
B22	**0.65+**	Greyish brown (Munsell 2.5Y 5/2) Loam with moderate pedality. Strongly alkaline pH, slightly-saline and sodic. No coarse fragments. No roots and poorly drained. 50% orange mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.0	Non-saline	5.6	Moderately Acidic	8.7	Sodic
0.25 – 0.35	0.8	Non-saline	7.8	Mildly Alkaline	23.8	Sodic
0.40 – 0.50	1.7	Non-saline	8.4	Strongly Alkaline	31.4	Sodic
0.70 – 0.80	2.4	Slightly saline	8.5	Strongly Alkaline	40.4	Sodic

Site Description – Site 6				
Site Reference	6	**ASC Name**	Sodic Eutrophic Black Dermosol (BELLW)	
Average Slope	0%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Drainage Flat	**Soil Fertility**	Moderately high	MGA 55
Landform Element	Flat	**Drainage**	Well	X: 752732
Surface Condition	Soft	**Permeability**	High	Y: 6141176

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Very dark grey (Munsell 5YR 3/1) Loam with moderate pedality. Slightly acidic pH, non-saline and sodic. No coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.20 – 0.50**	Very dark grey (Munsell 5YR 3/1) Loam with moderate pedality. Neutral pH, non-saline and sodic. No coarse fragments. Common roots and well drained. Gradual boundary.
B22	**0.50 +**	Yellowish-brown (Munsell 10YR 5/4) Loamy Sand with weak pedality. Strongly alkaline pH, moderately saline and sodic. No coarse fragments. Common fine roots and well drained.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.9	Non-saline	6.2	Slightly Acidic	8.8	Sodic
0.20 – 0.30	0.9	Non-saline	6.8	Neutral	17.6	Sodic
0.50 – 0.60	6.0	Moderately saline	8.7	Strongly Alkaline	31.3	Sodic

Site Description – Site 7				
Site Reference	7	**ASC Name**	Bleached-Mottled Eutrophic Red Chromosol (BFKOWNR)	
Average Slope	7%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Upper slope	**Drainage**	Poor	X: 753493
Surface Condition	Firm	**Permeability**	Low	Y: 6141011

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.30**	Yellowish brown (Munsell 10YR 5/4) Loamy Sand with weak pedality. Moderately acidic pH, non-saline and non-sodic. 20% coarse fragments 10mm. Many roots and well drained. Gradual boundary.
A2	**0.30 – 0.60**	Bleached Light Brown (Munsell 7.5YR 6/4) apedal Clay Loam. Slightly acidic pH, non-saline and non-sodic. 50% coarse fragments 10 – 20mm. Few roots and poorly drained. Abrupt boundary.
B2	**0.60 +**	Red (Munsell 2.5YR 4/6) Heavy Clay with moderate pedality. Neutral pH, non-saline and non-sodic. No coarse fragments. No roots and poorly drained. 30% distinct yellow mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.2	Non-saline	5.8	Moderately Acidic	3.0	Non sodic
0.30 – 0.40	0.4	Non-saline	6.5	Slightly Acidic	3.8	Non sodic
0.60 – 0.70	0.6	Non-saline	6.5	Neutral	3.9	Non sodic

Site Description – Site 8				
Site Reference	8	**ASC Name**	Sodic Eutrophic Red Chromosol (BELOWNR)	
Average Slope	6%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Upper slope	**Drainage**	Moderate	X: 753170
Surface Condition	Firm	**Permeability**	Moderate	Y: 6140851

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.25**	Brown (Munsell 10YR 4/3) Loam with moderate pedality. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.25 – 0.55**	Yellowish-red (Munsell 5YR 4/6) Heavy Clay with moderate pedality. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Few roots and moderately drained. Clear boundary.
B22	**0.55 +**	Yellowish-brown (Munsell 10YR 5/4) Heavy Clay with strong pedality. Moderately acidic pH, non-saline and sodic. No coarse fragments. Very few fine roots and moderately drained.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	5.8	Moderately Acidic	1.9	Non sodic
0.30 – 0.40	0.2	Non-saline	5.6	Moderately Acidic	2.6	Non sodic
0.60 – 0.70	0.3	Non-saline	5.8	Moderately Acidic	6.7	Sodic

Site Description – Site 9				
Site Reference	9	**ASC Name**	Yellow Chromosol	
Average Slope	5%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Midslope	**Drainage**	Imperfect	X: 753414
Surface Condition	Soft	**Permeability**	Moderate	Y: 6140490

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark grey (Munsell 10YR 4/1) Sandy Loam with weak pedality. 10% coarse fragments 10mm. Many roots and well drained. Gradual boundary.
A2	**0.20 – 0.35**	Grey (Munsell 10YR 5/1) Loam with weak pedality. 40% coarse fragments 10mm. Few roots and moderately drained. Clear boundary.
B2	**0.35 +**	Brownish yellow (Munsell 10YR 6/6) Silty Clay with moderate pedality. No coarse fragments. Very few fine roots and imperfectly drained. 30% distinct grey mottling. 20% manganese nodules.

Site Description – Site 10				
Site Reference	10	**ASC Name**	Yellow Chromosol	
Average Slope	4%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately High	MGA 55
Landform Element	Lower slope	**Drainage**	Moderate	X: 752788
Surface Condition	Soft	**Permeability**	Moderate	Y: 6140695

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark brown (Munsell 7.5YR 3/2) Sandy Loam with weak pedality. 10% coarse fragments 10mm. Many roots and well drained. Gradual boundary.
A2	**0.20 – 0.40**	Dark grey (Munsell 10YR 4/1) Loam with weak pedality. 30% coarse fragments 10mm. Few roots and moderately drained. Clear boundary.
B2	**0.40 +**	Brownish yellow (Munsell 10YR 6/8) Medium Clay with moderate pedality with increasing structure at depth. No coarse fragments. Very few fine roots and moderately drained. 40% faint grey mottling.

Site Description – Site 11				
Site Reference	11	**ASC Name**	Brown Sodosol	
Average Slope	1%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Plain	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Flat	**Drainage**	Imperfect	X: 754894
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139264

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Brown (Munsell 10YR 5/3) Sandy Loam with moderate pedality. coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.25**	Bleached light brownish grey (Munsell 10YR 6/2) Loam with weak pedality. No coarse fragments. Few roots and moderately drained. Clear boundary.
B21	**0.25 – 0.40**	Olive Brown (Munsell 2.5Y 4/3) Medium Clay with moderate pedality. No coarse fragments. Few fine roots and imperfectly drained. 10% faint orange mottling. Clear boundary.
B22	**0.40+**	Brownish yellow (Munsell 10YR 6/6) Medium Clay with weak pedality. 20% coarse fragments 10 – 20mm. Very few fine roots and imperfectly drained. 10% distinct orange mottling. 30% soft manganese nodules.

Site Description – Site 12				
Site Reference	12	**ASC Name**	Yellow Sodosol	
Average Slope	5%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper/ Crest	**Drainage**	Moderate	X: 754379
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139496

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) Sandy Loam with weak pedality. 30% coarse fragments 10 – 150mm. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.30**	Bleached light brownish grey (Munsell 10YR 6/2) Silty Loam with weak pedality. 30% coarse fragments 10 – 150mm. Few roots and moderately drained. Abrupt boundary.
B2	**0.30 – 0.60**	Reddish yellow (Munsell 7.5YR 6/8) Heavy Clay with moderate pedality. 30% coarse fragments 10 – 150mm. Very few fine roots and moderately drained. 20% faint grey mottling.
BC	**0.60+**	Transition horizon to parent material

Site Description – Site 13				
Site Reference	13	**ASC Name**	Eutrophic Mottled-Mesonatric Brown Sodosol (BEKOWNR)	
Average Slope	3%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope Crest	**Drainage**	Imperfect	X: 753965
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139604

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Very dark greyish brown (Munsell 10YR 3/2) Loamy Sand with moderate pedality. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
B2	**0.15 +**	Yellowish brown to brown (Munsell 10YR 5/4 to 10YR 4/3) Heavy Clay trending to loam at depth, with strong pedality. Moderately alkaline to moderately acidic pH, non-saline and sodic in upper horizon. No coarse fragments. Very few fine roots and imperfectly drained. 20% distinct red mottling. 20% distinct grey mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	2.4	Slightly saline	6.5	Slightly Acidic	4.4	Non sodic
0.20 – 0.30	1.3	Non-saline	8.3	Moderately Alkaline	23.7	Sodic
0.50 – 0.60	0.8	Non-saline	5.8	Moderately Acidic	3.4	Non sodic

Site Description – Site 14				
Site Reference	14	**ASC Name**	Eutrophic Mesonatric Brown Sodosol (BEKOVNR)	
Average Slope	5%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper/ Crest	**Drainage**	Well	X: 754066
Surface Condition	Soft	**Permeability**	High	Y: 6140352

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Yellowish-brown (Munsell 10YR 5/4) Loamy Sand with moderate pedality. Neutral pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Many roots and well drained. Clear boundary.
B2	**0.15 – 0.40**	Yellowish-brown (Munsell 10YR 5/6) Heavy Clay with weak pedality. Mildly alkaline pH, non-saline and sodic. 30% coarse fragments 10 – 50mm. Common roots and well drained. Clear boundary.
C	**0.40 +**	Parent material

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.8	Non-saline	6.5	Neutral	1.8	Non sodic
0.20 – 0.30	0.8	Non-saline	7.4	Mildly Alkaline	17.5	Sodic

Site Description – Site 15				
Site Reference	15	**ASC Name**	Yellow Sodosol	
Average Slope	8%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Moderate	X: 753597
Surface Condition	Soft	**Permeability**	Moderate	Y: 6140038

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.12	Dark brown (Munsell 7.5YR 3/2) Sandy Loam with weak pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	0.12 – 0.25	Bleached light brownish grey (Munsell 10YR 6/2) Loam with weak pedality. 20% coarse fragments 10mm. Few roots and moderately drained. Clear boundary.
B2	0.25 – 0.60	Olive yellow (Munsell 2.5Y 6/6) Heavy Clay with moderate pedality. No coarse fragments. Few fine roots and moderately drained.
C	0.60	Parent material.

Site Description – Site 16				
Site Reference	16	**ASC Name**	Yellow Sodosol	
Average Slope	3%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Moderately Well	X: 752835
Surface Condition	Soft	**Permeability**	High	Y: 6140111

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark yellowish brown (Munsell 10YR 3/4) Sandy Loam with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.35**	Yellowish brown (Munsell 10YR 5/6) Loam with strong pedality. No coarse fragments. Few roots and moderately well drained. Clear boundary.
B22	**0.35 +**	Olive yellow (Munsell 2.5Y 6/6) Heavy Clay with strong pedality. No coarse fragments. Very few fine roots and moderately well drained.

Site Description – Site 17				
Site Reference	17	**ASC Name**	Eutrophic Mottled-Subnatric Brown Sodosol (BEKOWNR)	
Average Slope	4%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Lower slope	**Drainage**	Moderate	X: 753016
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139807

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Brown (Munsell 10YR 4/3) Loamy Sand with weak pedality. Strongly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.20 – 0.40**	Brown (Munsell 7.5YR 4/2) Loamy Sand with weak pedality. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Few roots and moderately drained. Clear boundary.
B	**0.40 +**	Yellowish-brown (Munsell 10YR 5/4) Heavy Clay with moderate pedality. Neutral pH, non-saline and sodic. No coarse fragments. Very few fine roots and moderately drained. 10% red mottling. 40% grey mottling.

Sample Depth	ECe		pH(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.5	Non-saline	5.4	Strongly Acidic	4.2	Non sodic
0.20 – 0.30	0.7	Non-saline	6.0	Slightly Acidic	3.1	Non sodic
0.50 – 0.60	0.4	Non-saline	7.1	Neutral	9.3	Sodic

Site Description – Site 18				
Site Reference	18	**ASC Name**	Yellow Chromosol	
Average Slope	9%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Lower slope	**Drainage**	Moderate	X: 753309
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139389

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) Loamy Sand with weak pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	0.10 – 0.30	Bleached light grey (Munsell 10YR 7/1) Loamy Sand with weak pedality. No coarse fragments. Few roots and imperfectly drained. Clear boundary.
B2	0.30 +	Brownish yellow (Munsell 10YR 6/8) Heavy Clay with moderate pedality. No coarse fragments. Very few fine roots and poorly drained. 40% distinct grey mottling.

Site Description – Site 19				
Site Reference	19	**ASC Name**	Yellow Sodosol	
Average Slope	4%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Lower slope	**Drainage**	Moderate	X: 753263
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139036

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.10	Brown (Munsell 7.5YR 4/3) Sandy Loam with weak pedality. No coarse fragments. Many roots and well drained. Gradual boundary.
A2	0.10 – 0.30	Light brown (Munsell 7.5YR 6/3) Loamy Sand with weak pedality. No coarse fragments. Common roots and moderately drained. Clear boundary.
B2	0.30 +	Light yellowish brown (Munsell 2.5Y 6/4) Heavy Clay with moderate pedality. No coarse fragments. Few fine roots and moderately drained.

Site Description – Site 20				
Site Reference	20	**ASC Name**	Black Dermosol	
Average Slope	0%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Drainage Flat	**Soil Fertility**	High	MGA 55
Landform Element	Flat	**Drainage**	Moderately Well	X: 752585
Surface Condition	Soft	**Permeability**	High	Y: 6139563

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Very dark grey (Munsell 10YR 3/1) Loam with moderate pedality. coarse fragments. Many roots and well drained. Gradual boundary.
B21	**0.10 – 0.45**	Black (Munsell 10YR 2.5/1) Clay Loam with moderate pedality. No coarse fragments. Common roots and moderately well drained. Clear boundary.
B22	**0.45 +**	Olive Brown (Munsell 2.5Y 4/3) Silty Clay Loam with moderate pedality. No coarse fragments. Very few fine roots and moderately well drained.

Site Description – Site 21				
Site Reference	21	**ASC Name**	Yellow Sodosol	
Average Slope	3%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Lower slope	**Drainage**	Moderate	X: 752776
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139208

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 10YR 5/3) Sandy Loam with weak pedality. No coarse fragments. Many roots and well drained. Gradual boundary.
A2	**0.15 – 0.40**	Light brown (Munsell 7.5YR 6/3) Loamy Sand with weak pedality. 20% coarse fragments 10 – 20mm. Many roots and moderately drained. 10% soft manganese nodules. Clear boundary.
B2	**0.40 +**	Light yellowish brown (Munsell 2.5Y 6/4) Medium Clay with moderate pedality. No coarse fragments. Very few fine roots and moderately drained. 40% distinct grey mottling.

Site Description – Site 22				
Site Reference	22	**ASC Name**	Eutrophic Mottled-Subnatric Red Sodosol (BFLMVNR)	
Average Slope	11%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Moderate	X: 752821
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138664

Plate 1 – Soil Profile

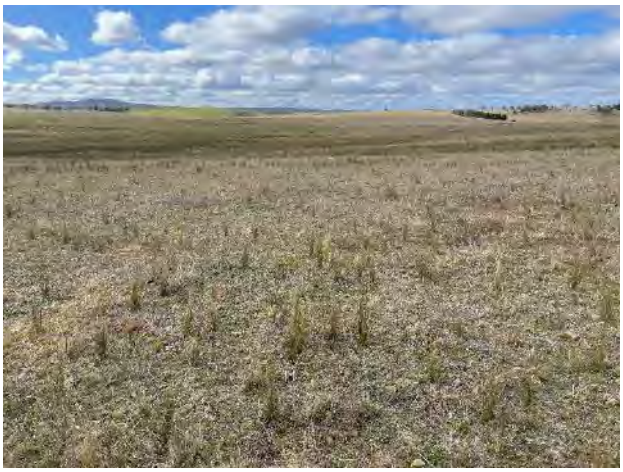

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.20**	Dark brown (Munsell 10YR 3/3) Loam with weak pedality. Strongly acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Many roots and well drained. Clear boundary.
B21	**0.20 – 0.40**	Yellowish-red (Munsell 5YR 4/6) Silty Clay with weak pedality. Moderately acidic pH, non-saline and sodic. 10% coarse fragments 10 – 50mm. Few roots and moderately well drained. Gradual boundary.
B22	**0.40 – 0.90**	Yellowish-brown (Munsell 10YR 5/6) Silty Clay Loam with moderate pedality. Mildly alkaline pH, non- saline and sodic. 10% coarse fragments 10 – 50mm. Very few fine roots and moderately drained. 10% distinct red mottling. 10% distinct grey mottling.
C	**0.90+**	Parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	5.3	Strongly Acidic	5.2	Non sodic
0.25 – 0.35	0.5	Non-saline	5.9	Moderately Acidic	14.7	Sodic
0.50 – 0.60	1.5	Non-saline	7.4	Mildly Alkaline	48.4	Sodic

Site Description – Site 23				
Site Reference	23	**ASC Name**	Eutrophic Mottled-Subnatric Brown Sodosol (BEKOWNR)	
Average Slope	7%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Poor	X: 753386
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138495

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Brown (Munsell 10YR 4/3) Silty Loam with strong pedality. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.35**	Brown (Munsell 10YR 5/3) Loamy Sand with moderate pedality. Slightly acidic pH, non-saline and sodic. No coarse fragments. Few roots and imperfectly drained. Clear boundary.
B2	**0.35 +**	Brown (Munsell 10YR 4/3) Heavy Clay with strong pedality. Neutral pH, non-saline and sodic. No coarse fragments. No roots and poorly drained. 20% distinct red mottling. 30% distinct yellow mottling.

Sample Depth	ECe		$pH_{(1\text{-}5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.0	Non-saline	6.5	Slightly Acidic	4.0	Non sodic
0.20 – 0.30	0.9	Non-saline	6.4	Slightly Acidic	6.7	Sodic
0.50 – 0.60	0.7	Non-saline	6.6	Neutral	12.2	Sodic

Site Description – Site 24				
Site Reference	24	**ASC Name**	Yellow Sodosol	
Average Slope	12%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Midslope	**Drainage**	Moderate	X: 753831
Surface Condition	Firm	**Permeability**	Moderate	Y: 6138683

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) Sandy Loam with moderate pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.25**	Light grey (Munsell 10YR 7/1) Loam with moderate pedality. No coarse fragments. Few roots and moderately drained. Clear boundary.
B2	**0.25 +**	Olive yellow (Munsell 2.5Y 6/6) Heavy Clay with moderate pedality. No coarse fragments. Very few fine roots and moderately drained. 10% faint grey mottling.

Site Description – Site 25				
Site Reference	25	**ASC Name**	Brown Sodosol	
Average Slope	8%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper slope	**Drainage**	Moderate	X: 754180
Surface Condition	Firm	**Permeability**	Moderate	Y: 6138781

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.10	Dark brown (Munsell 10YR 3/3) Loamy Sand with weak pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	0.10 – 0.25	Bleached very pale brown (Munsell 10YR 7/3) Loamy Sand with weak pedality. No coarse fragments. Few roots and moderately drained. Abrupt boundary.
B2	0.25 – 0.60	Yellowish brown (Munsell 10YR 5/8) Medium Clay with moderate pedality. No coarse fragments. Very few fine roots and moderately drained. 10% red mottling.
C	0.60+	Parent material.

Site Description – Site 26				
Site Reference	26	**ASC Name**	Eutrophic Subnatric Brown Sodosol (BEKOVNR)	
Average Slope	19%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper slope	**Drainage**	Moderate	X: 754463
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138450

Plate 1 – Soil Profile

Plate 2 –Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Dark brown (Munsell 10YR 3/3) Loamy Sand with weak pedality. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.15 – 0.30**	Light yellowish brown (Munsell 10YR 6/4) Silty Loam with weak pedality. Neutral pH, non-saline and sodic. No coarse fragments. Very few roots and moderately drained. Clear boundary.
B2	**0.30 – 0.70**	Dark yellowish-brown (Munsell 10YR 4/4) Light Medium Clay with moderate pedality. Mildly alkaline pH, non-saline and sodic. No coarse fragments. No roots and moderately drained. 5% faint grey mottling.
C	**0.70+**	Parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.1	Non-saline	6.3	Slightly Acidic	2.5	Non sodic
0.20 – 0.30	0.2	Non-saline	6.8	Neutral	7.0	Sodic
0.50 – 0.60	1.1	Non-saline	7.6	Mildly Alkaline	12.8	Sodic

Site Description – Site 27				
Site Reference	27	**ASC Name**	Yellow Sodosol	
Average Slope	15%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper slope	**Drainage**	Moderate	X: 754742
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138851

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Very dark brown (Munsell 7.5YR 3/1) Loamy Sand with weak pedality. 20% coarse fragments 10 – 50mm. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.30**	Dark yellowish brown (Munsell 10YR 4/4) Loam with weak pedality. 50% coarse fragments 10 – 50mm. Very few roots and moderately drained. Clear boundary.
B21	**0.30 – 0.70**	Reddish yellow (Munsell 7.5YR 6/8) Light Medium Clay with moderate pedality. 20% coarse fragments 10 – 50mm. No roots and moderately drained. 20% distinct red mottling. 10% faint grey mottling.
BC	**0.70+**	Transition horizon to parent material.

Site Description – Site 28					
Site Reference	28	**ASC Name**	Eutrophic Mottled-Subnatric Yellow Sodosol (BGKOVNR)		
Average Slope	14%	**Land Use**	Grazing	**Coordinates**	
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55	
Landform Element	Midslope	**Drainage**	Moderate	X: 755158	
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138754	

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.15**	Very dark greyish brown (Munsell 10YR 3/2) Loamy Sand with moderate pedality. Slightly acidic pH, non-saline and non-sodic. 20% coarse fragments 10 – 20mm. Many roots and well drained. Gradual boundary.
A2	**0.15 – 0.30**	Brown (Munsell 10YR 5/3) Loamy Sand with weak pedality. Moderately acidic pH, non-saline and non-sodic. 60% coarse fragments 10 – 100mm. Few roots and moderately drained. Clear boundary.
B2	**0.30 – 0.55**	Brownish yellow (Munsell 10YR 6/6) Heavy Clay with moderate pedality. Moderately acidic pH, non-saline and sodic. 10% coarse fragments 10 – 100mm. Very few fine roots and moderately drained. 10% distinct red mottling.
C	**0.55+**	Parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.1	Non-saline	6.3	Slightly Acidic	2.1	Non sodic
0.20 – 0.30	0.6	Non-saline	5.9	Moderately Acidic	2.8	Non sodic
0.40 – 0.50	0.4	Non-saline	5.9	Moderately Acidic	7.2	Sodic

Site Description – Site 29				
Site Reference	29	**ASC Name**	Red Sodosol	
Average Slope	3%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Crest	**Drainage**	Moderate	X: 755132
Surface Condition	Soft	**Permeability**	Moderate	Y: 6138238

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Very dark brown (Munsell 7.5YR 3/1) Loam with weak pedality. No coarse fragments. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.25**	Brown (Munsell 10YR 5/3) Loamy Sand with weak pedality. 20% coarse fragments 10 – 20mm. Few roots and moderately drained. Clear boundary.
B2	**0.25 +**	Reddish yellow (Munsell 5YR 6/8) Medium Clay with weak pedality. No coarse fragments. Few fine roots and moderately drained.

Site Description – Site 30				
Site Reference	30	**ASC Name**	Eutrophic Mottled-Subnatric Red Sodosol (BGLOVNR)	
Average Slope	10%	**Land Use**	Grazing	**Coordinates**
Landform Pattern	Hillslope	**Soil Fertility**	Moderately Low	MGA 55
Landform Element	Upper slope	**Drainage**	Moderate	X: 755439
Surface Condition	Soft	**Permeability**	Moderate	Y: 6139401

Plate 1 – Soil Profile

Plate 2 – Landscape

Plate 3 – Surface

Horizon	Depth (m)	Description
A1	**0.00 – 0.10**	Very dark greyish brown (Munsell 10YR 3/2) Loam with weak pedality. Slightly acidic pH, non-saline and non-sodic. 20% coarse fragments 10mm. Many roots and well drained. Clear boundary.
A2	**0.10 – 0.25**	Brown (Munsell 10YR 5/3) Silty Loam with weak pedality. Slightly acidic pH, non-saline and non-sodic. 80% coarse fragments 10 – 100mm. Common roots and moderately drained. Clear boundary.
B2	**0.25 – 0.80**	Yellowish-red (Munsell 5YR 5/6) Heavy Clay with moderate pedality. Moderately acidic pH, non-saline and sodic. No coarse fragments. Very few fine roots and moderately drained. 30% distinct red mottling.
C	**0.80+**	Parent material.

Sample Depth	ECe		$pH_{(1-5water)}$		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.8	Non-saline	6.5	Slightly Acidic	2.0	Non sodic
0.15 – 0.25	0.4	Non-saline	6.1	Slightly Acidic	4.0	Non sodic
0.40 – 0.50	0.4	Non-saline	5.7	Moderately Acidic	7.8	Sodic

Appendix 3

Laboratory Certificates of Analysis

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

39 soil samples supplied by Minesoils Pty Ltd on 23rd May, 2023 - Lab Job No. P1010
Analysis requested by Matt Hemingway. Job Ref: MS-Gundary
Address Not Given

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in sample)	TOTAL GRAVEL > 2 mm (% of total oven-dry equivalent)	GRAVEL > 4.75 mm (% of total oven-dry equivalent)	GRAVEL 2.00-4.75 mm (% of total oven-dry equivalent)	COARSE SAND 200-2000 µm (0.2-2.0 mm) (% of total oven-dry equivalent)	FINE SAND 20-200 µm (0.02-0.2 mm) (% of total oven-dry equivalent)	SILT 2-20 µm (% of total oven-dry equivalent)	CLAY < 2 µm (% of total oven-dry equivalent)
2 0-10	P1010/1	14.4%	1.9%	0.0%	1.9%	20.8%	50.7%	18.4%	8.3%
2 20-30	P1010/2	13.3%	29.0%	21.4%	7.6%	19.6%	26.6%	14.3%	10.5%
2 40-50	P1010/3	21.9%	0.1%	0.0%	0.1%	2.6%	7.9%	35.8%	53.6%
5 0-10	P1010/4	25.3%	0.3%	0.0%	0.3%	10.3%	30.3%	40.9%	18.1%
5 25-35	P1010/5	17.0%	4.8%	2.3%	2.5%	4.6%	28.1%	49.3%	13.2%
5 40-50	P1010/6	15.9%	12.5%	5.6%	6.9%	7.4%	23.4%	27.7%	29.0%
5 70-80	P1010/7	9.1%	2.3%	1.0%	1.3%	29.5%	33.8%	16.8%	17.6%
6 0-10	P1010/8	17.1%	0.2%	0.0%	0.2%	24.1%	45.6%	16.6%	13.6%
6 20-30	P1010/9	14.1%	0.0%	0.0%	0.0%	19.8%	49.7%	16.1%	14.4%
6 50-60	P1010/10	11.0%	5.6%	2.9%	2.7%	18.7%	55.2%	13.4%	7.1%
7 0-10	P1010/11	11.5%	14.3%	5.4%	8.9%	22.6%	43.9%	14.1%	5.1%
7 30-40	P1010/12	8.4%	17.4%	2.7%	14.7%	20.4%	31.8%	10.6%	19.7%
7 60-70	P1010/13	19.9%	3.5%	1.8%	1.7%	3.7%	12.2%	3.6%	77.0%
8 0-10	P1010/14	16.8%	1.7%	0.0%	1.7%	13.3%	50.0%	22.5%	12.4%
8 30-40	P1010/15	24.9%	0.0%	0.0%	0.0%	1.5%	8.4%	12.5%	77.6%
8 60-70	P1010/16	23.7%	3.5%	2.6%	0.9%	0.6%	7.2%	17.2%	71.6%
13 0-10	P1010/17	14.7%	10.3%	2.5%	7.8%	18.4%	44.5%	17.0%	9.8%
13 20-30	P1010/18	17.0%	4.8%	0.6%	4.3%	9.7%	22.0%	7.5%	56.0%
13 50-60	P1010/19	17.7%	5.2%	0.4%	4.9%	32.3%	36.5%	13.9%	12.0%
14 0-10	P1010/20	11.4%	42.8%	31.7%	11.1%	18.1%	21.8%	11.8%	5.6%
14 20-30	P1010/21	22.7%	0.3%	0.0%	0.3%	8.8%	10.8%	13.6%	66.5%
17 0-10	P1010/22	17.6%	6.3%	1.7%	4.6%	14.3%	56.0%	15.2%	8.2%
17 20-30	P1010/23	11.9%	44.4%	29.0%	15.4%	9.9%	27.9%	12.3%	5.5%
17 50-60	P1010/24	19.6%	9.3%	1.7%	7.7%	8.2%	17.0%	6.5%	59.0%
22 0-10	P1010/25	18.3%	4.7%	1.4%	3.3%	30.9%	39.4%	13.4%	11.6%
22 25-35	P1010/26	22.7%	3.1%	0.0%	3.1%	14.2%	14.2%	27.2%	41.3%
22 50-60	P1010/27	19.8%	3.2%	0.3%	2.9%	19.3%	9.0%	40.6%	28.0%
23 0-10	P1010/28	17.8%	8.1%	4.0%	4.1%	15.4%	46.7%	25.0%	4.7%
23 20-30	P1010/29	13.5%	5.2%	1.4%	3.8%	21.0%	48.1%	19.4%	6.3%
23 50-60	P1010/30	26.9%	0.3%	0.0%	0.3%	4.8%	17.9%	4.7%	72.3%
26 0-10	P1010/31	19.1%	6.4%	0.0%	6.4%	21.4%	43.7%	20.8%	7.7%
26 20-30	P1010/32	12.5%	14.2%	0.0%	14.2%	19.4%	35.6%	24.6%	6.3%
26 50-60	P1010/33	18.8%	1.6%	0.0%	1.6%	14.5%	25.7%	14.9%	43.3%
28 0-10	P1010/34	16.3%	19.6%	13.2%	6.4%	12.3%	56.4%	7.2%	4.5%
28 20-30	P1010/35	13.0%	29.8%	20.0%	9.8%	9.6%	40.3%	16.3%	4.0%
28 40-50	P1010/36	17.6%	0.0%	0.0%	0.0%	0.4%	29.8%	16.1%	53.7%
30 0-10	P1010/37	20.9%	20.6%	12.3%	8.3%	14.6%	36.5%	17.7%	10.6%
30 15-25	P1010/38	12.6%	40.2%	34.5%	5.7%	7.0%	26.1%	17.3%	9.4%
30 40-50	P1010/39	21.4%	2.0%	0.0%	2.0%	2.7%	10.0%	18.9%	66.4%

Note:

1: The Hydrometer Analysis method was used to determine the percentage sand, silt and clay,
modified from SOP meth004 (California Dept of Pesticide Regulation), using method of Gee & Bauder (1986),
in *Methods of Soil Analysis. Part 1* Agron. Monogr. 9 (2nd Ed). Klute, A., American Soc. of Agronomy Inc., Soil Sci. Soc. America Inc., Madison WI: 383-411.
2: Australian Standard 1289.3.8.1-1997 (see attached)
3. Analysis conducted between sample arrival date and reporting date.
4. This report is not to be reproduced except in full. Results only relate to the item tested.
5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
6. This report was issued on 13/06/2023.

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checked: .....
Graham Lancaster (Nata signatory)
Laboratory Manager

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	2 0-10	2 20-30	2 40-50	5 0-10	5 25-35
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/1	P1010/2	P1010/3	P1010/4	P1010/5
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.07	6.35	8.45	5.64	7.76
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.090	0.084	0.562	0.109	0.084
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	4.5	1.8	5.2	3.4	3.0
	Exchangeable Calcium (kg/ha)		2,019	817	2,346	1,548	1,330
	Exchangeable Calcium (mg/kg)		901	365	1,047	691	594
	Exchangeable Magnesium (cmol+/kg)		1.2	1.2	12	1.5	2.0
	Exchangeable Magnesium (kg/ha)		331	323	3,389	396	536
	Exchangeable Magnesium (mg/kg)		148	144	1,513	177	239
	Exchangeable Potassium (cmol+/kg)		0.53	0.30	0.44	0.27	0.14
	Exchangeable Potassium (kg/ha)		460	263	382	232	124
	Exchangeable Potassium (mg/kg)		205	117	171	104	55
	Exchangeable Sodium (cmol+/kg)		0.25	0.50	7.6	0.53	1.6
	Exchangeable Sodium (kg/ha)		128	258	3,932	270	819
	Exchangeable Sodium (mg/kg)		57	115	1,755	121	366
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.06	0.09	0.02	0.18	0.01
	Exchangeable Aluminium (kg/ha)		12	18	3.2	37	2.0
	Exchangeable Aluminium (mg/kg)		5.2	8.0	1.4	16	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.10	0.06	<0.01	0.14	<0.01
	Exchangeable Hydrogen (kg/ha)		2.2	1.4	<1	3.2	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	1.4	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	6.6	4.0	26	6.0	6.7
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	68	46	20	57	44
	Magnesium (%)		18	30	48	24	30
	Potassium (%)		7.9	7.6	1.7	4.4	2.1
	Sodium - ESP (%)		3.7	13	30	8.7	24
	Aluminium (%)		0.87	2.2	0.06	3.0	0.15
	Hydrogen (%)		1.5	1.6	0.00	2.4	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	3.7	1.5	0.42	2.4	1.5
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	1	2	..	..
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	5YR 3/2 Dark Reddish Brown	10YR 4/3 Brown	5YR 4/6 Yellowish Red	7.5YR 3/2 Dark Brown	7.5YR 5/1 Gray
	Mottles Munsell Colour		..	..	..	..	..
			..	..	..	..	..
	Degree of Mottling (%)		..	..	..	..	..

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
	Sample ID:	2 0-10	2 20-30	2 40-50	5 0-10	5 25-35
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/1	P1010/2	P1010/3	P1010/4	P1010/5

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs).
17. This report was issued on 14/06/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Accreditation No. 14960
Accredited for compliance with ISO/IEC 17025 - Testing

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39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Sample ID:	5 40-50	5 70-80	6 0-10	6 20-30	6 50-60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/6	P1010/7	P1010/8	P1010/9	P1010/10
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.41	8.53	6.15	6.77	8.70
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.194	0.249	0.097	0.091	0.260
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	5.0	2.4	3.8	3.2	1.8
	Exchangeable Calcium (kg/ha)		2,247	1,094	1,724	1,458	797
	Exchangeable Calcium (mg/kg)		1,003	489	770	651	356
	Exchangeable Magnesium (cmol+/kg)		4.8	2.5	1.5	1.3	1.1
	Exchangeable Magnesium (kg/ha)		1,294	688	412	343	303
	Exchangeable Magnesium (mg/kg)		578	307	184	153	135
	Exchangeable Potassium (cmol+/kg)		0.24	0.18	0.37	0.14	<0.12
	Exchangeable Potassium (kg/ha)		212	159	327	119	<112
	Exchangeable Potassium (mg/kg)		95	71	146	53	<50
	Exchangeable Sodium (cmol+/kg)		4.6	3.5	0.57	1.00	1.4
	Exchangeable Sodium (kg/ha)		2,361	1,799	294	513	704
	Exchangeable Sodium (mg/kg)		1,054	803	131	229	314
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.01	0.01	0.03	0.01	<0.01
	Exchangeable Aluminium (kg/ha)		2.4	2.3	6.5	2.6	<1
	Exchangeable Aluminium (mg/kg)		1.1	1.0	2.9	1.2	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	0.14	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	3.2	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	1.4	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	15	8.7	6.5	5.7	4.4
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	34	28	59	57	41
	Magnesium (%)		33	29	23	22	25
	Potassium (%)		1.7	2.1	5.8	2.4	2.5
	Sodium - ESP (%)		31	40	8.8	18	31
	Aluminium (%)		0.08	0.13	0.50	0.23	0.10
	Hydrogen (%)		0.00	0.00	2.2	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	1.1	0.96	2.5	2.6	1.6
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	2	..	3	3
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 4/2 Dark Grayish Brown	2.5Y 5/2 Grayish Brown	5YR 3/1 Very Dark Gray	5YR 3/1 Very Dark Gray	10YR 5/4 Yellowish Brown
	Mottles Munsell Colour		..	10YR 3/1, 7.5YR 5/6	..	..	..
	Degree of Mottling (%)		..	Very Dark Gray, Strong Brown 25, 10	..	..	..

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
	Sample ID:	5 40-50	5 70-80	6 0-10	6 20-30	6 50-60
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/6	P1010/7	P1010/8	P1010/9	P1010/10

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
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17. This report was issued on 14/06/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
		Sample ID:	7 0-10	7 30-40	7 60-70	8 0-10	8 30-40
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/11	P1010/12	P1010/13	P1010/14	P1010/15
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.83	6.49	6.53	5.77	5.58
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.051	0.043	0.100	0.049	0.030
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.1	2.4	6.2	4.0	5.8
	Exchangeable Calcium (kg/ha)		957	1,073	2,782	1,809	2,584
	Exchangeable Calcium (mg/kg)		427	479	1,242	808	1,153
	Exchangeable Magnesium (cmol+/kg)		0.82	2.0	9.0	1.2	4.8
	Exchangeable Magnesium (kg/ha)		222	547	2,453	326	1,309
	Exchangeable Magnesium (mg/kg)		99	244	1,095	146	584
	Exchangeable Potassium (cmol+/kg)		0.55	0.36	0.59	0.25	0.25
	Exchangeable Potassium (kg/ha)		482	313	514	217	218
	Exchangeable Potassium (mg/kg)		215	140	230	97	97
	Exchangeable Sodium (cmol+/kg)		0.11	0.19	0.63	0.11	0.32
	Exchangeable Sodium (kg/ha)		59	98	326	56	167
	Exchangeable Sodium (mg/kg)		26	44	146	25	75
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.09	0.02	0.02	0.05	1.2
	Exchangeable Aluminium (kg/ha)		18	3.3	3.2	10	238
	Exchangeable Aluminium (mg/kg)		8.2	1.5	1.4	4.5	106
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.10	0.02	<0.01	0.13	0.16
	Exchangeable Hydrogen (kg/ha)		2.1	<1	<1	2.9	3.6
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	1.3	1.6
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	3.8	5.0	16	5.8	12
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	56	48	38	70	46
	Magnesium (%)		21	40	55	21	39
	Potassium (%)		14	7.2	3.6	4.3	2.0
	Sodium - ESP (%)		3.0	3.8	3.9	1.9	2.6
	Aluminium (%)		2.4	0.33	0.10	0.87	9.5
	Hydrogen (%)		2.5	0.40	0.00	2.2	1.3
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	2.6	1.2	0.69	3.4	1.2
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	3	4	..	4
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 5/4 Dark Yellowish Brown	7.5YR 6/4 Light Brown	2.5YR 4/6 Red	10YR 4/3 Brown	5YR 4/6 Yellowish Red
	Mottles Munsell Colour		..	..	10YR 5/3	..	5YR 4/2
			..	..	Brown	..	Dark Reddish Gray
	Degree of Mottling (%)		..	..	20	..	..

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
	Sample ID:	7 0-10	7 30-40	7 60-70	8 0-10	8 30-40
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/11	P1010/12	P1010/13	P1010/14	P1010/15

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
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17. This report was issued on 14/06/2023.

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
		Sample ID:	8 60-70	13 0-10	13 20-30	13 50-60	14 0-10
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/16	P1010/17	P1010/18	P1010/19	P1010/20
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.83	6.48	8.30	5.83	6.51
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.051	0.105	0.223	0.084	0.033
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	3.2	6.1	3.5	3.9	3.0
	Exchangeable Calcium (kg/ha)		1,417	2,734	1,571	1,745	1,335
	Exchangeable Calcium (mg/kg)		633	1,220	701	779	596
	Exchangeable Magnesium (cmol+/kg)		6.8	1.9	9.4	1.4	2.2
	Exchangeable Magnesium (kg/ha)		1,854	504	2,547	389	587
	Exchangeable Magnesium (mg/kg)		828	225	1,137	174	262
	Exchangeable Potassium (cmol+/kg)		0.20	0.40	0.20	0.79	0.37
	Exchangeable Potassium (kg/ha)		178	347	174	695	320
	Exchangeable Potassium (mg/kg)		79	155	78	310	143
	Exchangeable Sodium (cmol+/kg)		0.87	0.39	4.1	0.22	0.10
	Exchangeable Sodium (kg/ha)		447	201	2,088	114	54
	Exchangeable Sodium (mg/kg)		200	90	932	51	24
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	1.6	0.04	0.02	0.05	0.02
	Exchangeable Aluminium (kg/ha)		319	8.9	3.3	9.1	4.1
	Exchangeable Aluminium (mg/kg)		143	4.0	1.5	4.1	1.8
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.35	0.10	<0.01	0.13	<0.01
	Exchangeable Hydrogen (kg/ha)		7.7	2.2	<1	3.0	<1
	Exchangeable Hydrogen (mg/kg)		3.5	<1	<1	1.3	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	13	8.9	17	6.5	5.6
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	24	69	20	60	53
	Magnesium (%)		53	21	55	22	38
	Potassium (%)		1.6	4.5	1.2	12	6.5
	Sodium - ESP (%)		6.7	4.4	24	3.4	1.8
	Aluminium (%)		12	0.50	0.10	0.69	0.36
	Hydrogen (%)		2.7	1.1	0.00	2.1	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.46	3.3	0.37	2.7	1.4
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	4	..	2	4	..
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 5/4 Yellowish Brown	10YR 3/2 Very Dark Grayish Brown	10YR 5/4 Yellowish Brown	10YR 4/3 Brown	10YR 5/4 Yellowish Brown
	Mottles Munsell Colour		2.5Y 7/2, 2.5YR 3/4 Light Gray, Dark Reddish Brown	.. ..	5YR 4/6, 10YR 3/1 Yellowish Red, Very Dark Gray	.. ..	.. ..
	Degree of Mottling (%)		50, 40	..	50, 7	..	..

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
	Sample ID:	8 60-70	13 0-10	13 20-30	13 50-60	14 0-10
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/16	P1010/17	P1010/18	P1010/19	P1010/20

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 21	Sample 22	Sample 23	Sample 24	Sample 25
		Sample ID:	14 20-30	17 0-10	17 20-30	17 50-60	22 0-10
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/21	P1010/22	P1010/23	P1010/24	P1010/25
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.44	5.43	6.04	7.06	5.30
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.141	0.065	0.031	0.074	0.052
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	4.6	1.8	1.9	5.1	1.8
	Exchangeable Calcium (kg/ha)		2,064	811	855	2,268	815
	Exchangeable Calcium (mg/kg)		921	362	382	1,012	364
	Exchangeable Magnesium (cmol+/kg)		8.7	0.91	1.1	12	0.95
	Exchangeable Magnesium (kg/ha)		2,359	248	294	3,136	258
	Exchangeable Magnesium (mg/kg)		1,053	111	131	1,400	115
	Exchangeable Potassium (cmol+/kg)		0.31	0.39	0.16	0.31	0.23
	Exchangeable Potassium (kg/ha)		274	340	138	269	205
	Exchangeable Potassium (mg/kg)		122	152	62	120	92
	Exchangeable Sodium (cmol+/kg)		2.9	0.16	0.11	1.7	0.21
	Exchangeable Sodium (kg/ha)		1,481	80	54	896	110
	Exchangeable Sodium (mg/kg)		661	36	24	400	49
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.02	0.34	0.06	0.02	0.69
	Exchangeable Aluminium (kg/ha)		3.7	69	12	4.4	139
	Exchangeable Aluminium (mg/kg)		1.7	31	5.2	2.0	62
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.14	0.12	<0.01	0.22
	Exchangeable Hydrogen (kg/ha)		<1	3.1	2.7	<1	4.9
	Exchangeable Hydrogen (mg/kg)		<1	1.4	1.2	<1	2.2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	16	3.7	3.4	19	4.1
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	28	48	56	27	44
	Magnesium (%)		53	24	32	62	23
	Potassium (%)		1.9	10	4.6	1.6	5.7
	Sodium - ESP (%)		17	4.2	3.1	9.3	5.2
	Aluminium (%)		0.11	9.1	1.7	0.12	17
	Hydrogen (%)		0.00	3.7	3.5	0.00	5.3
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.53	2.0	1.8	0.44	1.9
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	2	..	4	4	..
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 5/6 Yellowish Brown	10YR 4/3 Brown	7.5YR 4/2 Brown	10YR 5/4 Yellowish Brown	10YR 3/3 Dark Brown
	Mottles Munsell Colour		2.5YR 4/6 Red	.. ..	.. ..	.. ..	.. ..
	Degree of Mottling (%)		30	..	..	..	..

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 21	Sample 22	Sample 23	Sample 24	Sample 25
	Sample ID:	14 20-30	17 0-10	17 20-30	17 50-60	22 0-10
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/21	P1010/22	P1010/23	P1010/24	P1010/25

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
		Sample ID:	22 25-35	22 50-60	23 0-10	23 20-30	23 50-60
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/26	P1010/27	P1010/28	P1010/29	P1010/30
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.92	7.39	6.46	6.39	6.55
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.057	0.175	0.100	0.039	0.116
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	1.8	1.3	6.1	1.7	4.8
	Exchangeable Calcium (kg/ha)		818	581	2,720	742	2,161
	Exchangeable Calcium (mg/kg)		365	259	1,214	331	965
	Exchangeable Magnesium (cmol+/kg)		1.8	2.4	0.93	0.52	12
	Exchangeable Magnesium (kg/ha)		477	642	254	142	3,140
	Exchangeable Magnesium (mg/kg)		213	287	113	63	1,402
	Exchangeable Potassium (cmol+/kg)		0.14	<0.12	0.25	0.12	0.26
	Exchangeable Potassium (kg/ha)		124	<112	222	<112	224
	Exchangeable Potassium (mg/kg)		55	<50	99	<50	100
	Exchangeable Sodium (cmol+/kg)		1.0	3.5	0.31	0.17	2.3
	Exchangeable Sodium (kg/ha)		527	1,822	159	86	1,190
	Exchangeable Sodium (mg/kg)		235	813	71	38	531
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	1.8	0.04	0.02	0.01	0.06
	Exchangeable Aluminium (kg/ha)		358	9.0	3.8	2.9	12
	Exchangeable Aluminium (mg/kg)		160	4.0	1.7	1.3	5.3
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.47	<0.01	0.14	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		10	<1	3.2	<1	<1
	Exchangeable Hydrogen (mg/kg)		4.7	<1	1.4	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	7.0	7.3	7.7	2.5	19
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	26	18	79	66	25
	Magnesium (%)		25	32	12	21	61
	Potassium (%)		2.0	1.0	3.3	5.0	1.4
	Sodium - ESP (%)		15	48	4.0	6.7	12
	Aluminium (%)		25	0.61	0.25	0.58	0.31
	Hydrogen (%)		6.7	0.00	1.9	0.35	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	1.0	0.55	6.5	3.2	0.42
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	3	2	..	3	3
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	5YR 4/6 Yellowish Red	10YR 5/6 Yellowish Brown	10YR 4/3 Brown	10YR 5/3 Brown	10YR 4/3 Brown
	Mottles Munsell Colour		5YR 4/3 Reddish Brown	.. ..	.. ..	.. ..	2.5YR 3/4 Dark Reddish Brown
	Degree of Mottling (%)		7	..	..	..	10

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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
	Sample ID:	22 25-35	22 50-60	23 0-10	23 20-30	23 50-60
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/26	P1010/27	P1010/28	P1010/29	P1010/30

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
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6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. 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.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 31	Sample 32	Sample 33	Sample 34	Sample 35
		Sample ID:	26 0-10	26 20-30	26 50-60	28 0-10	28 20-30
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/31	P1010/32	P1010/33	P1010/34	P1010/35
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.34	6.75	7.62	6.34	5.92
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.048	0.026	0.124	0.047	0.025
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	4.4	1.4	6.3	5.0	2.3
	Exchangeable Calcium (kg/ha)		1,964	633	2,833	2,238	1,049
	Exchangeable Calcium (mg/kg)		877	283	1,265	999	468
	Exchangeable Magnesium (cmol+/kg)		1.3	0.78	12	1.2	1.0
	Exchangeable Magnesium (kg/ha)		342	211	3,275	326	278
	Exchangeable Magnesium (mg/kg)		152	94	1,462	146	124
	Exchangeable Potassium (cmol+/kg)		0.38	0.12	0.24	0.28	0.12
	Exchangeable Potassium (kg/ha)		331	<112	207	242	<112
	Exchangeable Potassium (mg/kg)		148	<50	93	108	<50
	Exchangeable Sodium (cmol+/kg)		0.15	0.17	2.7	0.14	0.11
	Exchangeable Sodium (kg/ha)		79	90	1,402	72	57
	Exchangeable Sodium (mg/kg)		35	40	626	32	25
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.03	0.01	0.02	0.03	0.27
	Exchangeable Aluminium (kg/ha)		5.8	2.3	4.5	5.8	54
	Exchangeable Aluminium (mg/kg)		2.6	1.0	2.0	2.6	24
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	0.07
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	1.7
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	6.2	2.5	21	6.6	3.9
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	71	57	30	75	59
	Magnesium (%)		20	31	56	18	26
	Potassium (%)		6.1	4.9	1.1	4.2	3.2
	Sodium - ESP (%)		2.5	7.0	13	2.1	2.8
	Aluminium (%)		0.47	0.47	0.11	0.43	6.8
	Hydrogen (%)		0.11	0.00	0.00	0.05	1.9
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	3.5	1.8	0.52	4.2	2.3
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	3	2	..	3
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 3/3 Dark Brown	10YR 6/4 Light Yellowish Brown	10YR 4/4 Dark Yellowish Brown	10YR 3/2 Very Dark Grayish Brown	10YR 5/3 Brown
	Mottles Munsell Colour		..	..	..	..	..
			..	..	..	..	..
	Degree of Mottling (%)		..	..	..	..	..

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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 31	Sample 32	Sample 33	Sample 34	Sample 35
	Sample ID:	26 0-10	26 20-30	26 50-60	28 0-10	28 20-30
	Crop:	N/G	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/31	P1010/32	P1010/33	P1010/34	P1010/35

Notes:

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample 36	Sample 37	Sample 38	Sample 39
		Sample ID:	28 40-50	30 0-10	30 15-25	30 40-50
		Crop:	N/G	N/G	N/G	N/G
		Client:	Minesoils	Minesoils	Minesoils	Minesoils
	Parameter	Method reference	P1010/36	P1010/37	P1010/38	P1010/39
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.86	6.50	6.05	5.72
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.064	0.081	0.044	0.076
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	0.52	9.1	3.1	1.1
	Exchangeable Calcium (kg/ha)		232	4,093	1,372	509
	Exchangeable Calcium (mg/kg)		104	1,827	612	227
	Exchangeable Magnesium (cmol+/kg)		7.6	1.5	0.84	8.0
	Exchangeable Magnesium (kg/ha)		2,082	414	228	2,167
	Exchangeable Magnesium (mg/kg)		929	185	102	968
	Exchangeable Potassium (cmol+/kg)		0.18	0.43	0.24	0.45
	Exchangeable Potassium (kg/ha)		157	379	212	394
	Exchangeable Potassium (mg/kg)		70	169	94	176
	Exchangeable Sodium (cmol+/kg)		1.4	0.24	0.18	0.98
	Exchangeable Sodium (kg/ha)		724	122	93	502
	Exchangeable Sodium (mg/kg)		323	54	42	224
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	7.1	0.24	0.17	1.4
	Exchangeable Aluminium (kg/ha)		1,439	49	34	289
	Exchangeable Aluminium (mg/kg)		642	22	15	129
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	2.5	<0.01	0.07	0.50
	Exchangeable Hydrogen (kg/ha)		57	<1	1.5	11
	Exchangeable Hydrogen (mg/kg)		25	<1	<1	5.0
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	19	12	4.6	12
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	2.7	79	67	9.1
	Magnesium (%)		39	13	18	64
	Potassium (%)		0.92	3.7	5.3	3.6
	Sodium - ESP (%)		7.2	2.0	4.0	7.8
	Aluminium (%)		37	2.1	3.7	12
	Hydrogen (%)		13	0.00	1.5	4.0
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	0.07	6.0	3.6	0.14
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	2	..	3	2
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	10YR 6/6 Brownish Yellow	10YR 3/2 Very Dark Grayish Brown	10YR 5/3 Brown	5YR 5/6 Yellowish Red
	Mottles Munsell Colour		5YR 5/8 Yellowish Red	.. ..	2.5YR 4/8 Red	10YR 6/4 Light Yellowish Brown
	Degree of Mottling (%)		20	..	1	7

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Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

		Sample 36	Sample 37	Sample 38	Sample 39
	Sample ID:	28 40-50	30 0-10	30 15-25	30 40-50
	Crop:	N/G	N/G	N/G	N/G
	Client:	Minesoils	Minesoils	Minesoils	Minesoils
Parameter	Method reference	P1010/36	P1010/37	P1010/38	P1010/39

Notes:

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AGRICULTURAL SOIL ANALYSIS REPORT

39 samples supplied by Minesoils Pty. Ltd. on 23/05/2023. Lab Job No. P1010

Analysis requested by Matt Hemingway. Your Job: MS-Gundary

Not Given

			Sample ID:	***Heavy Soil***	***Medium Soil***	***Light Soil***	***Sandy Soil***
			Crop:				
			Client:	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
	Parameter		**Method reference**	**Indicative guidelines - refer to Notes 6 and 8**			
	pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	*6.5*	*6.5*	*6.3*	*6.3*
	Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	*0.200*	*0.150*	*0.120*	*0.100*
	Exchangeable Calcium	**(cmol,/kg)**	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	*15.6*	*10.8*	*5.0*	*1.9*
		(kg/ha)		*7000*	*4816*	*2240*	*840*
		(mg/kg)		*3125*	*2150*	*1000*	*375*
	Exchangeable Magnesium	**(cmol,/kg)**		*2.4*	*1.7*	*1.2*	*0.60*
		(kg/ha)		*650*	*448*	*325*	*168*
		(mg/kg)		*290*	*200*	*145*	*75*
	Exchangeable Potassium	**(cmol,/kg)**		*0.60*	*0.50*	*0.40*	*0.30*
		(kg/ha)		*526*	*426*	*336*	*224*
		(mg/kg)		*235*	*190*	*150*	*100*
	Exchangeable Sodium	**(cmol,/kg)**		*0.3*	*0.26*	*0.22*	*0.11*
		(kg/ha)		*155*	*134*	*113*	*57*
		(mg/kg)		*69*	*60*	*51*	*25*
	Exchangeable Aluminium	**(cmol,/kg)**	**Inhouse S37 (KCl)	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		*121*	*101*	*73*	*30*
		(mg/kg)		*54*	*45*	*32*	*14*
	Exchangeable Hydrogen	**(cmol,/kg)**	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	*0.6*	*0.5*	*0.4*	*0.2*
		(kg/ha)		*13*	*11*	*8*	*3*
		(mg/kg)		*6*	*5*	*4*	*2*
	Effective Cation Exchange Capacity (ECEC) (cmol,/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol,/kg)	*20.1*	*14.3*	*7.8*	*3.3*
	Calcium (%)		**Base Saturation Calculations - Cation cmol,/kg / ECEC x 100	*77.6*	*75.7*	*65.6*	*57.4*
	Magnesium (%)			*11.9*	*11.9*	*15.7*	*18.1*
	Potassium (%)			*3.0*	*3.5*	*5.2*	*9.1*
	Sodium - ESP (%)			*1.5*	*1.8*	*2.9*	*3.3*
	Aluminium (%)			*6.0*	*7.1*	*10.5*	*12.1*
	Hydrogen (%)						
	Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol,/kg)	*6.5*	*6.4*	*4.2*	*3.2*
	Emerson Aggregate Test (EAT)		**AS1289.3.8.1-2017	*Class 3–8*			
	Moist Munsell Colour		**Inhouse Munsell Soil Colour Classification	..			
				..			
	Mottles Munsell Colour			..			
				..			
	Degree of Mottling (%)			..			

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Not Given

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	Sample ID:				
	Crop:				
	Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8		

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