BESS ARCTIC PTY LTD C/- GRANSOLAR DEVELOPMENT AUSTRALIA

Deniliquin East Battery Energy Storage System

AGRICULTURAL IMPACT ASSESSMENT

Report No: P00824_AIA
Rev: 001C
16 May 2025

Premise

DOCUMENT AUTHORISATION						
Revision	**Revision Date**	**Proposal Details**				
Draft A	19/06/24	Draft for client review				
Final B	06/03/25	Final report				
Final C	16/05/25	Final report with updated project layout				
Prepared By		**Reviewed By**		**Authorised By**		
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1. INTRODUCTION

1.1 Overview

1.1.1 PROJECT DESCRIPTION

BESS Arctic Pty Ltd C/- Gransolar Development Australia (Gransolar) propose to develop a 100-Megawatt Battery Energy Storage System (BESS) on land adjacent to the Deniliquin substation. The site of the development is located at 21356 Riverina Highway Deniliquin, 2710 (Lot 11 on DP 856212) and is within the Edward River Council Local Government Area (LGA). The proposed development is known as the Deniliquin East BESS and is a State Significant Development (SSD 61612229).

1.1.2 PLANNING PATHWAY

The proposed development is State Significant Development (SSD) under the *State Environmental Planning Policy (Planning Systems) 2021* and the applicable consent authority for the proposal is the NSW Minister for Planning or the Minister's delegate. This Agricultural Impact Assessment (AIA) has been developed to address the agricultural land and soils requirements of the Secretary's Environmental Assessment Requirements (SEARs) dated 28th September 2023. Although there are currently no guidelines relating specifically to soil survey for the development of Battery Energy Storage Systems (BESS), this Agricultural Impact Assessment (AIA) has been prepared generally in accordance with the *Large-Scale Solar Energy Guideline* (NSW Department of Planning and Environment, August 2022)

The Secretary's Environmental Assessment Requirements (SEARs) and attached SEARS advice, issued 28th September 2023, identify the following requirements for the Environmental Impact Statement (EIS) in relation to agricultural land and soil:

Table 1 – SEARS requirements

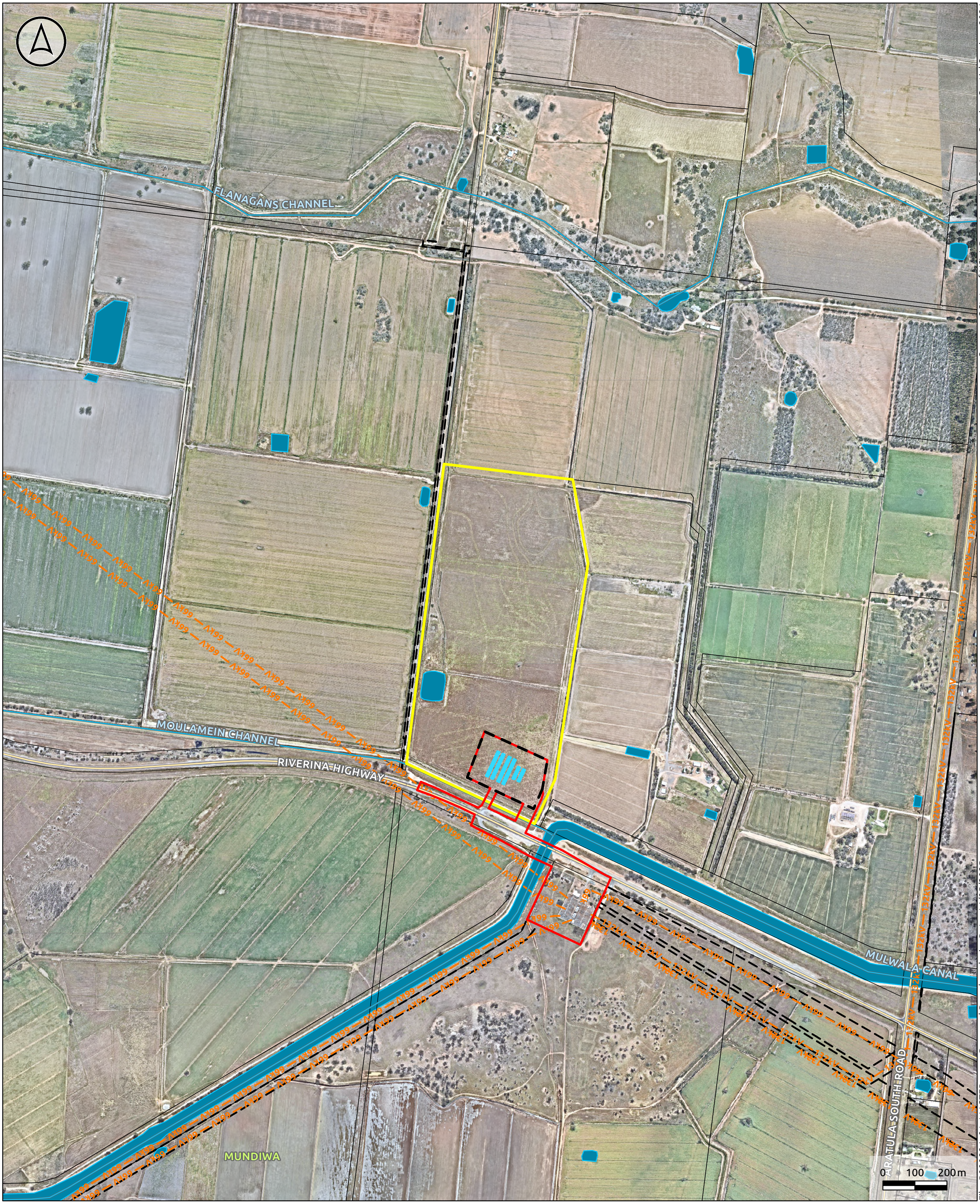
SEARS requirement	Section addressed
Detailed justification of the suitability of the site and that the site can accommodate the proposed development having regard to its potential environmental impacts, land contamination, permissibility, strategic context and existing site constraints.	A LUCRA has been completed as part of the EIS which addresses these issues.
An assessment of the potential impacts of the development on existing land uses on the site and adjacent land, including:	-
> agricultural land, flood prone land, Crown lands, mining, quarries, mineral or petroleum rights; and	> Agricultural impact is assessed in **Section 5.1** > A LUCRA has been completed as part of the EIS which addresses the remaining issues.

SEARS requirement	Section addressed
> a soil survey to determine the soil characteristics and consider the potential for salinity, acid sulfate soils and erosion to occur;	> A Site verification: soil survey is included in **Section 3** > Acid sulfate soils are considered in **Section 1.3.5** > An Erosion assessment is included **Section 4**
> a cumulative impact assessment of nearby developments,	A LUCRA has been completed as part of the EIS which partially addresses these issues. A cumulative impact assessment is provided in the body of the EIS.
An assessment of the compatibility of the development with existing land uses, during construction, operation and after decommissioning, including:	-
> consideration of the zoning provisions applying to the land, including subdivision (if required);	> Land zoning is discussed in **Section 1.3.10**. > Further consideration of land zoning provisions is given in the LUCRA as part of the EIS and Section 4 of the EIS.
> completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide;	A LUCRA has been completed as part of the EIS which addresses these issues.
> assessment of impact on agriculture resources and agricultural production on the site and region."	Agricultural impact is discussed in **Section 5.1**

1.2 Scope

This AIA supports the EIS for the Deniliquin BESS to identify, assess and mitigate any potential impacts to agriculture and soils that may occur during the development. The key objectives of this report are to:

- Identify the soil and land characteristics of the site using a combination of desktop research and site inspection;
- Assess potential impacts of the development related to soil, erosion, and agricultural production;
- Address the SEARs in relation to agricultural land and soil; and
- Highlight or recommend strategies to help mitigate potential for impacts to land and soil occurring during the construction, operation and decommissioning of the project.



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Legend

- Site
- Lease Area Boundary
- Landholding
- Lot
- Road
- Watercourse
- Water Body

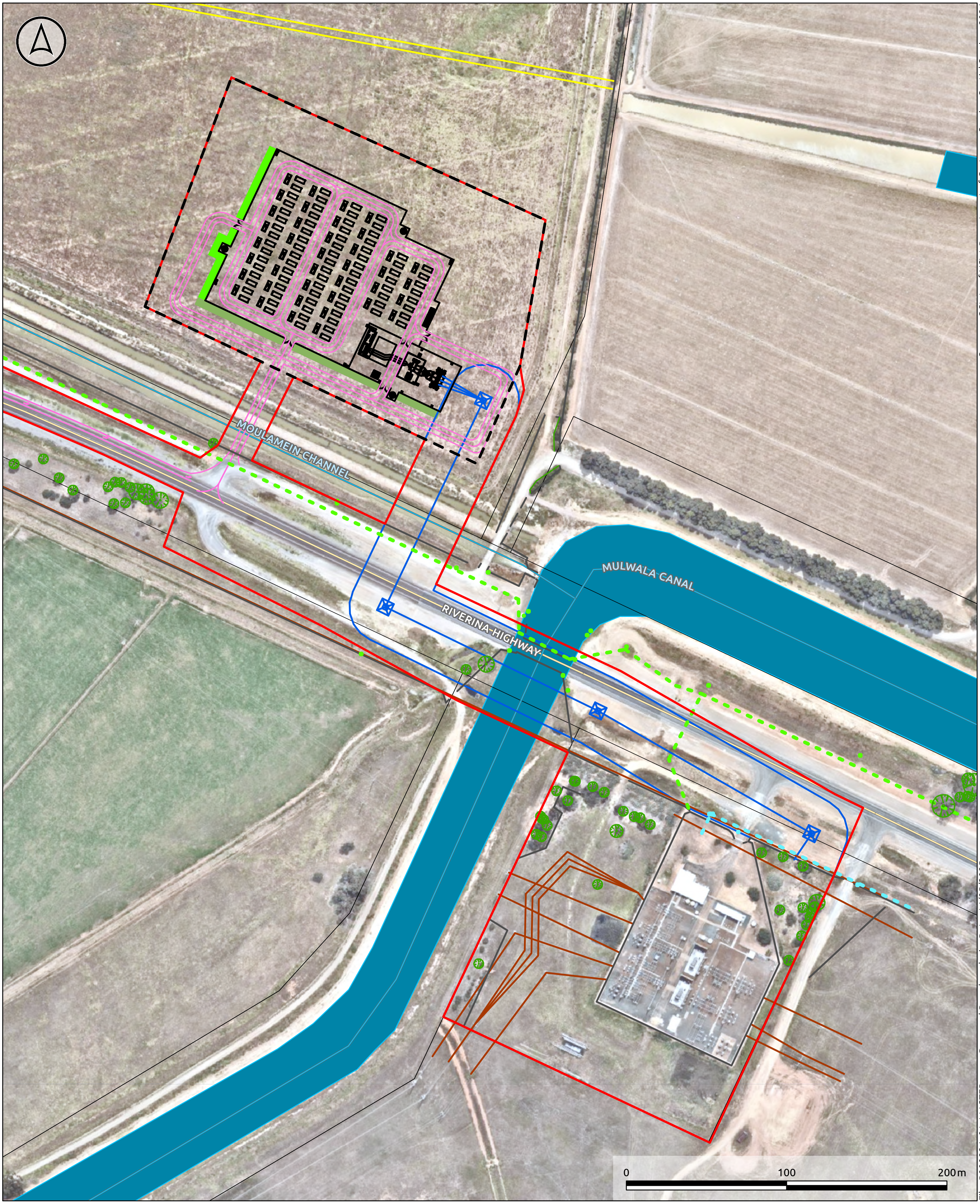
Electricity Transmission Line

- 66kV
- 132kV
- Easement
- Battery

Premise

DENILIQUIN EAST BESS

Figure 1
Local Context



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Legend

- Site
- Lease Area Boundary
- Lot
- Road
- Watercourse
- Major Water Body
- BESS Design
- BESS Roads
- Overhead Transmission Line with 45m Buffer
- Existing OH Electrical Lines
- Existing Easement
- Existing Telstra UG Comms
- Existing Transgrid UG Comms
- Landscape 4m
- Landscape 7m

Premise

DENILIQUIN EAST BESS

Figure 2
Subject Site and Development

1.3 Existing environment

1.3.1 LOCATION

The proposed BESS will be located on land at 21356 Riverina Highway Deniliquin, 2710 (**Figure 2**). It will be situated within a lease area of approximately 3.5 ha located in the southeastern extent of Lot 11 DP856212. The site of the BESS is within the Edward River Council Local Government Area (LGA) within the Riverina region of NSW, approximately 7 km south-east of Deniliquin (**Figure 1**).

1.3.2 LANDFORM

The development site is flat with a high point of approximately 93.5 m Average Height Datum (AHD) to the southwest and a low point of 93.2 m AHD at the northwestern extent of the site. The paddock is speculated to have been used for growing rice and has been graded flat in the past.

1.3.3 HYDROLOGY

The southern boundary of the site is adjoined by Moulamein Channel which transects land to the north of the Riverina Highway from the west near Deniliquin to Mulwala Canal approximately 50 m east of the BESS. Remaining watercourses in the locality are limited to irrigation infrastructure and dams associated with existing agricultural land uses.

1.3.4 GEOLOGY

Underlying geology influences agricultural productivity as parent rock contributes to soil fertility, minerology, and hydrogeological activity. The entirety of the site is within the Shepparton Formation (**Figure 3**) which are described by eSpade mapping as:

"*Unconsolidated to poorly consolidated mottled variegated clay, silty clay with lenses of polymictic, coarse to fine sand and gravel; partly modified by pedogenesis, includes intercalated red-brown paleosols."*

1.3.5 ACID SULFATE SOILS

Acid sulfate soils are soils which are natural high in iron sulphides and are at risk of producing sulfuric acid (H_2SO_4) if disturbed by drainage, excavation or construction. Acid sulfate soils commonly occur in coastal areas under waterlogged conditions. Exposure of these soils to oxygen through digging or draining can cause acidification and have adverse environmental impacts.

Acid sulfate soils are not mapped within the development site or locality (SEED portal, 2020). The likelihood of acid sulfate soils occurring within the study area is considered very low due to its position away from the coast.

Legend

- Site
- Lease Area Boundary
- Landholding
- Lot
- Road
- Watercourse
- Major Water Body

Deniliquin Geological Map 1:250,000

- Coonambidgal Formation.
- Shepparton Formation.

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DENILIQUIN EAST BESS

Figure 3
Geology

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1.3.6 SOILS

Soil information was assessed with a combination of desktop research and a site inspection. Information was assessed online from:

- Australian Soil Classification system soil type mapping of NSW (DPE, 2024)
- Land and Soil Capability Assessment Scheme (OEH 2012)
- Estimated Inherent Soil Fertility of NSW mapping (DPIE, 2021)
- The Central Resource for Sharing and Enabling Environmental Data in NSW (SEED Mapping, 2020)
- NSW Soil and Land Information (eSpade Mapping, 2020)
- NSW Planning Portal Spatial Viewer (NSW ePlanning Spatial Viewer, 2024)
- The Soil Landscapes of Central and Eastern NSW mapping (DPIE 2020) did not contain information on the study area and was excluded from the desktop assessment.

A site inspection was conducted on 23rd April 2024, including visual survey of the full extent of the 3.5-hectare area of the proposed activity and analysis of four soil profile cores located to best represent all soil types present within the survey area. Sample locations were determined using soil and geology mapping, landform features, vegetation changes and other biophysical markers in the landscape.

1.3.6.1 Australian Soil Classification

Australian Soil Classification system soil type mapping of NSW (DPIE 2021) maps the soils across the site as Chromosols. The site inspection identified Red Chromosols and Brown Vertosols, as described in **Table 2.** Mapping of the soil types is included in **Figure 4.**

Table 2 – Soil Units Within Study Area

ASC Soil Type	ASC Description	Detailed Sites	Constraints	Total Area Mapped Within Project Area
Red Chromosol	Soils with a strong texture contrast between the A and B horizons, where the B horizon is not strongly acidic or sodic.	S1, S2, and S3	> Moderate to strongly alkaline subsoils > Lack of water availability due to low rainfall and cost of irrigation. >	2.23 ha
Brown Vertosol	Clay soils with shrink-swell properties that exhibit strong cracking when dry.	S4	> Heavy clay-prone to waterlogging	1.27 ha

ASC Soil Type	ASC Description	Detailed Sites	Constraints	Total Area Mapped Within Project Area
			and gilgai formation. > Cracking clays are unsuitable for some tree types due to root disturbance. > Moderate to strongly alkaline subsoils > Lack of water availability due to low rainfall and cost of irrigation.	

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Legend

- Site
- Lease Area Boundary
- Landholding
- Lot
- Road
- Watercourse
- Major Water Body

ASC Soil Type (verified on site)

- Chromosols
- Vertosols
- Samples

Premise

DENILIQUIN EAST BESS

Figure 4
Australian Soil Classification

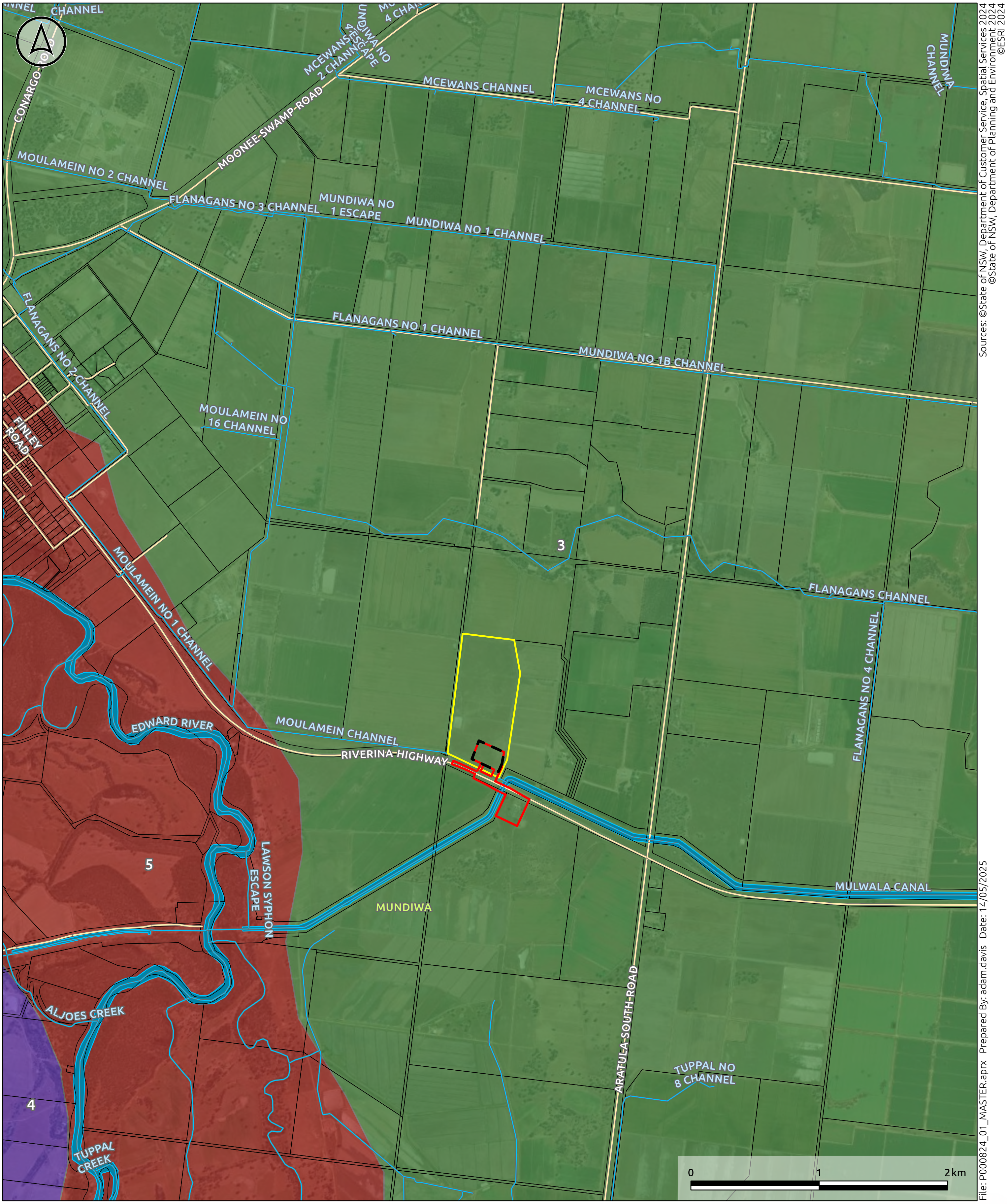
1.3.6.2 Land and Soil Capability

The *Land and Soil Capability Assessment Scheme* (OEH, 2012) ranks the capacity of land to sustain a range of land uses without causing degradation of the land and soil at the site and off-site environment. The LSC Scheme considers the biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics. The final LSC class of the land is based on the most limiting factor.

The *Land and Soil Capability Assessment Scheme* (OEH, 2012) maps the soil of the site as Class 3- High capability land, as described in **Table 3** and mapped in **Figure 5**. The site visit confirmed that the soil is considered Class 3- High capability, but the site is mainly limited in agricultural use by climate, rainfall and lack of irrigation.

Table 3 – LSC Definitions (OEH, 2012)

Class	General definition
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, conservation)	
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.



Legend

- Site
- Lease Area Boundary
- Landholding
- Lot
- Road
- Watercourse
- Major Water Body

Land and Soil Capability

- 3 High capability land
- 4 Moderate capability land
- 5 Moderate–low capability land

Premise

DENILIQUIN EAST BESS

Figure 5
Land and Soil Capability

1.3.6.3 Inherent Soil Fertility

The Estimated Inherent Soil Fertility of NSW mapping (eSpade portal, 2020) provides an approximation of the inherent soil fertility of soils in NSW. The soils of the study area are mapped with an inherent soil fertility of 'Moderate (3)'.

1.3.7 HAZARDS

A review of the NSW ePlanning Spatial Viewer (2024) and the SEED portal (2020) mapping did not identify any known geological hazards within the development site or locality, including:

- Acid sulfate soils are not mapped within the development site or locality (SEED portal, 2020).
- No mine subsidence districts, or underground coal mining is mapped at or within 1 km of the development site (NSW ePlanning Spatial Viewer, 2024).
- No landslide risk land is mapped within the development site or locality (NSW ePlanning Spatial Viewer, 2024).
- No Naturally Occurring Asbestos (NOA) at or within one (1) kilometre of the development site (SEED Portal, 2020).

1.3.8 BIOPHYSICAL STRATEGIC AGRICULTURAL LAND (BSAL)

Biophysical Strategic Agricultural Land (BSAL) is land with high quality soil and water resources capable of sustaining high levels of productivity.

A review of relevant mapping indicates that no BSAL is located within the development site.

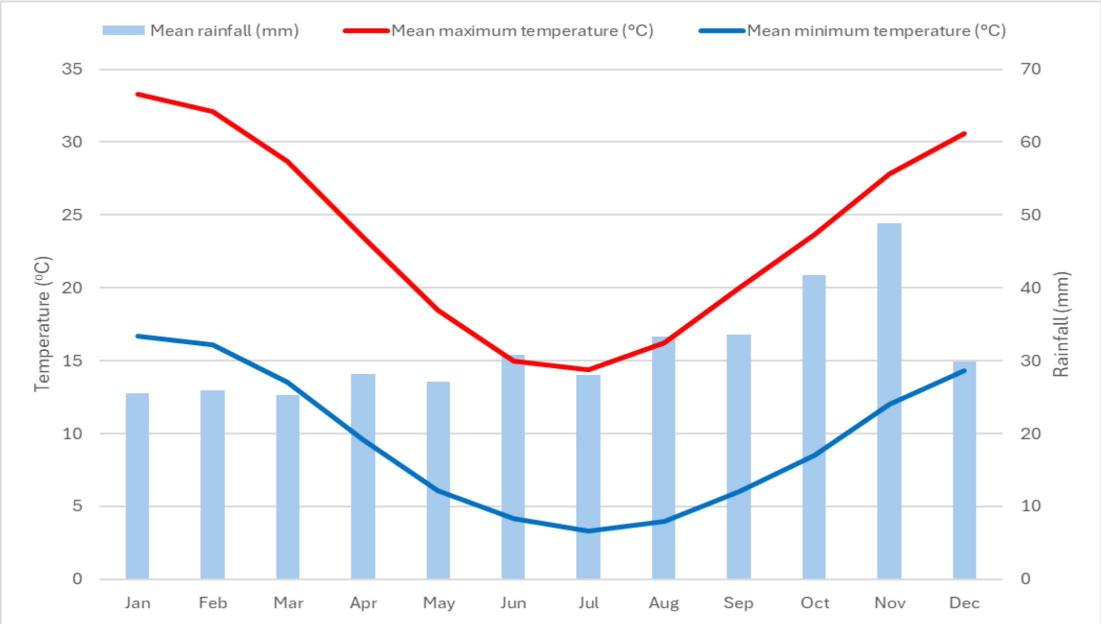
1.3.9 CLIMATE

The closest Australian Bureau of Meteorology (BoM) weather station with daily weather observations is Deniliquin Airport AWS (Station 074258), located approximately 7.2 km west of the site, south of the centre of Deniliquin. Other BoM weather stations are closer to the site but only provide daily rainfall and solar exposure statistics.

Summary climate statistics are provided below and depicted in **Figure 6**:

- The mean annual maximum temperature is 23.7°C and the mean annual minimum temperature is 9.5°C. Records indicate that January is the warmest month and July is the coldest (BoM, 2024).
- Mean annual rainfall is 378.6 mm and records indicate monthly mean rainfall received at the site is highest in the months of August through to November (BoM, 2024).

Figure 6 – Climate Statistics for the Locality



1.3.10 LAND ZONING

The site is zoned RU1 – Primary Production via the *Deniliquin Local Environmental Plan 2013* (LEP) (**Figure 7**). The permissibility of the development is addressed within the EIS.

The following is noted with respect to land use zoning in the locality:

> Land zoned SP2 – Classified Road adjoins the southern boundary of the site and is located along the Riverina Highway.
> The remainder of the locality is zoned RU1 – Primary Production.

Table 4 –Land use zones and objectives

Zone	Objectives
RU1	> 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 land uses within adjoining zones. > To allow the development of non-agricultural land uses that are compatible with the character of the zone.
SP2	> To provide for infrastructure and related uses. > To prevent development that is not compatible with or that may detract from the provision of infrastructure.

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Legend

- Site
- Lease Area Boundary
- Locality
- Landholding
- Battery
- Lot
- Road
- Watercourse
- Water Body

Land Zoning

- RU1 - Primary Production
- SP2 - Infrastructure

Premise

DENILIQUIN EAST BESS

Figure 7
Land Zoning

2. LAND USE AND AGRICULTURAL HISTORY

2.1 Land use

The NSW Landuse 2017 mapping (DPIE, 2020) maps the site use as irrigated cropping (**Figure 8**). However, consultation with the current landowner on 16 April 2024 confirmed that the land has intermittently been used for dryland grazing during favourable weather conditions for approximately 30 years.

The surrounding area primarily consists of land used for irrigated cropping and grazing, and the substation on the adjacent land. Land uses within the site and locality (1 km radius of the site) are outlined in **Table 5** and **Figure 6**.

Other notable land uses throughout the locality include transport and communication along the Riverina Highway, channel/aqueduct along Mulwala Canal, utilities near Deniliquin Substation and Residential and farm infrastructure to the east.

Review of land uses within the locality indicate that land use is predominately used for the purposes of irrigated cropping, with grazing modified pastures the next largest land use.

Table 5 – Land uses within the locality

Land use	Area (ha)	%
1.2.0 Managed resource protection	4.09	1.04
2.1.0 Grazing native vegetation	34.64	8.81
3.2.0 Grazing modified pastures	32.29	8.21
4.3.0 Irrigated Cropping	287.01	73.02
5.4.0 Residential and farm infrastructure	4.90	1.25
5.6.0 Utilities	3.47	0.88
5.7.0 Transport and communication	19.22	4.89
6.4.0 Channel/aqueduct	7.45	1.89
TOTAL	**393.07**	**100%**

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Legend

- Site
- Lease Area Boundary
- Landholding
- Locality
- Lot
- Road
- Watercourse
- Water Body
- Receptors outside 1km Buffer
- Receptors within 1km Buffer

NSWLanduse2017 v1

- 1.2.0 Managed resource protection
- 2.1.0 Grazing native vegetation
- 3.2.0 Grazing modified pastures
- 4.3.0 Irrigated cropping
- 5.4.0 Residential and farm infrastructure
- 5.6.0 Utilities
- 5.7.0 Transport and communication
- 6.2.0 Reservoir/dam
- 6.4.0 Channel/aqueduct

Premise

DENILIQUIN EAST BESS

Figure 8
Land Use and Receptors

2.2 Regional agricultural production

Based on the 2020-21 Australian Agricultural Census (ABARES, 2021), the most important agricultural commodities with the highest gross value for the Edward River LGA were wheat ($51 million), sheep and lambs ($49 million), meat cattle, and barley ($27 million each). These four commodities represent about half of the total agricultural revenue of the Edward River LGA ($308 million).

The primary income generation on the study area is sheep grazing. The indicative value of the four main commodities for the Edward River LGA is calculated in **Table 6**.

Table 6 – 2020-21 Commodity Production Value for the Edward River LGA (ABARES, 2021)

Commodity	Production Value ($m)	Units produced	Average value per unit
Wheat	$51 million	172,880 tonnes	$295.00
Sheep and lambs	$49 million	567,453 animals	$86.35
Meat cattle	$27 million	33,838 animals	$797.92
Barley	$27 million	123,079 tonnes	$219.37

2.3 Agricultural history

The following sections provide an overview of the agricultural history of the study area. This information was obtained via discussions with the property manager as part of this assessment.

2.3.1 PROPERTY HISTORY

The paddock on which the study area is located was purchased by the property manager approximately 5 years ago. It has been used primarily for dryland sheep grazing for the past 30 years. Deniliquin experienced a boom in the rice industry in the 1970's and it is speculated that the paddock was used for irrigated rice cropping during this time. The paddock has been levelled flat in the past and contains evidence of previous irrigation including channels on each boundary.

2.3.2 CURRENT LAND MANAGEMENT PRACTICES

Current land management practices are primarily for occasional time-controlled rotational grazing of sheep. The paddock only has feed suitable for grazing for a short period in winter during the wetter months. Sheep are rotated onto the paddock at approximately 5 dry sheep equivalent per hectare (DSE/ha) for a few weeks in winter when conditions are favourable.

2.3.3 PASTURE AND SOIL AMENDMENTS

Most of the current pastures on the site are annual ryegrass and perennial weeds including Bathurst burr. There is no other evidence of previous pasture improvement. The current property manager has not applied any soil amendments and it is speculated that soil amendments including fertiliser, lime or gypsum have not been applied to the paddock since it was potentially used for irrigated rice cropping in the 1970's.

2.3.4 IRRIGATION AND WATER RIGHTS

The property manager indicated that property on which the study area is located has a 113ML Water Access Licence (WAL). This water allocation is currently being transferred to other parts of the property when available. There was intent to convert parts of the property to irrigated farming, however the paddock that the study area lies within was not considered for irrigation. Although the soil in this paddock is considered moderately capable, water access limits the agricultural capacity of the study area.

2.3.5 PRODUCTIVITY

2.3.5.1 Livestock

Consideration of income generated from the study area has considered an area of 3.5 ha, inclusive of the entire area of the proposed BESS development. The property manager intends to continue using the remainder of the paddock outside of the fenced development for sheep grazing.

The entirety of the income generated by the study area is from dryland sheep grazing. The following information was determined in consultation with the property manager and landowner:

- The carrying capacity of sheep within the study area is estimated to be 1.5 Dry Sheep Equivalent (DSE) per hectare. The study area covers 3.5 hectares and would therefore represent 5.25 Dry Sheep Equivalent (DSE).
- It can be extrapolated from the 2020-21 Australian Agricultural Census (ABARES, 2021) that the average value of sheep and lambs in the Edward River LGA is $86.35 per head (**Table 6**).
- Assuming that there are 5.25 Dry Sheep Equivalent (DSE) produced annual from the study area, the estimated annual agricultural production of the study area is **$453.33.**

3. SITE VERIFICATION: SOIL SURVEY

3.1 Methodology

Although there are currently no guidelines relating specifically to soil survey for the development of BESS, this AIA has been prepared generally following guidelines contained in:

> *Large-Scale Solar Energy Guideline* (NSW Department of Planning and Environment, August 2022)
> *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009)
> *Guidelines for Surveying Soil and Land Resources* (McKenzie et al, 2008)

3.1.1 FIELDWORK

The soil survey was conducted on 23 April 2024 by John Lawrie (Soil Scientist) and Grace Scott (Environmental Scientist). Conditions were dry and sunny.

The soil survey entailed the full extent of the proposed 3.5-hectare BESS disturbance area and used a free-survey technique with soil profile and observation sites located to best represent all soil types present within the survey area.

Samples were collected with a trailer-mounted hydraulic soil corer to a maximum depth of one (1) metre. The location of all observation and sample sites were recorded via GPS. Photographs were taken at all sample sites and for all soil cores.

A total of four (4) cores were analysed for physical properties on site, and one (1) representative core which best reflected the conditions across the site was selected and sent for laboratory analysis.

An overview of the soil survey details is provided in **Table 7**. The location of all soil sample sites is provided in **Figure 9**. The sample sent for laboratory analysis was Sample 3.

Table 7 – Soil Survey Details

Parameter	Soil Survey Details
Total Study Area	3.5 hectares
Number of soil cores observed	4
Laboratory analysed sites	1
Detailed soil profile analysed	S3

3.1.2 LABORATORY ANALYSIS

Selected samples were analysed to provide sufficient information to classify soils in accordance with the Australian Soil Classification (ASC) (Isbell, 2002) and soil taxonomic class. Samples were analysed by a National Association of Testing Authorities Australia (NATA) accredited laboratory (SGS). Samples selected for analysis are identified in the following section.

3.2 Soil survey results

3.2.1 FIELD CHARACTERISTICS

Sites 1, 2 and 3 had similar field characteristics across the flat paddock. Topsoil pH (tested in field with a Manutec soil pH test kit) was pH 6 (moderately acid) across all sites, with alkalinity increasing through the subsoil down to pH 9 (strongly alkaline). Gypsum crystals were visible in the subsoil, likely contributing to the increasing alkalinity at depth. Soil texture across these sites was dominated by fine sandy loam topsoil, gradually changing to medium to heavy clay subsoils. Soil colour was dark reddish grey (7.5 R 4/3) (Munsell Soil Colour Book, 2012). These soils are classified under the Australian Soil Classification (Isbell, 2002) as Red Chromosols. These soils were considered to be the dominant soil type throughout the site and Sample 3 was selected as a representative sample sent for laboratory analysis.

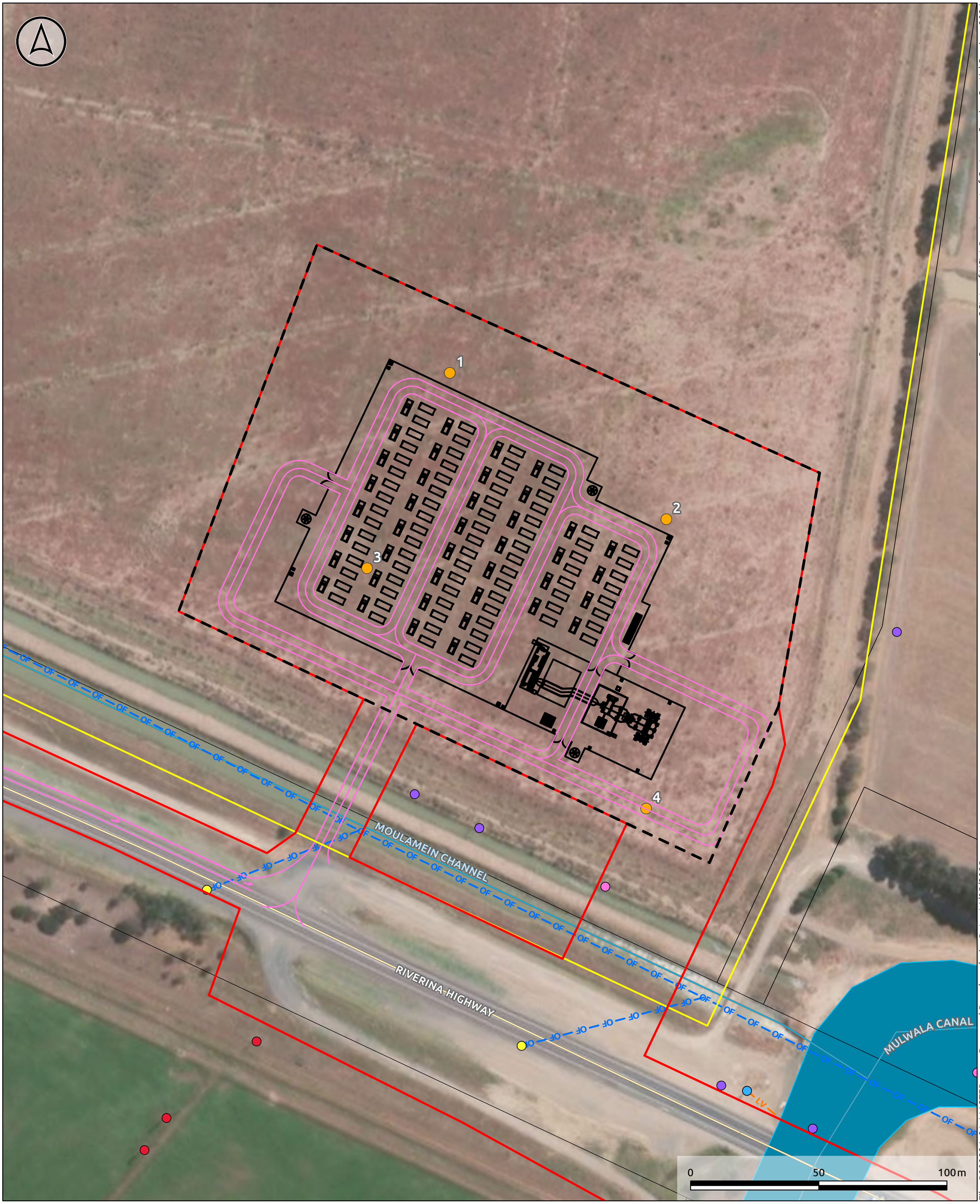
Site 4 was located in a slight depression and had unique field characteristics that were not considered to represent the dominant soil type of the site. Topsoil pH (tested in field with a Manutec soil pH test kit) was pH 6.5 (slightly acid), with alkalinity increasing through the subsoil down to pH 9 (strongly alkaline). Gypsum crystals were visible in the subsoil, likely contributing to the increasing alkalinity at depth. Soil texture at this site was dominated by cracking clays, including a loamy clay topsoil, to medium to heavy clay subsoils. Soil colour was lighter, indicating waterlogging. These soils are classified under the Australian Soil Classification (Isbell, 2002) as Brown Vertosols, due to their high clay content.

3.2.2 SOIL CHEMISTRY RESULTS

The sample sent for laboratory analysis was Sample 3 as it was considered to best represent the dominant soil type across the site. Two National Association of Testing Authorities (NATA) accredited laboratories, SGS Australia and Nutrient Advantage, were used to analyse this sample.

The sample was split into and four (4) standard depths of 0-15, 15-30, 30-60, and 60-90cm. Each layer was sent for basic analysis and the topsoil (0-15cm) was sent for additional laboratory analysis.

Table 8 and **Table 9** contain the analysis parameters and **Table 10** and **Table 11** contain the results.



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Legend

- Site
- Lease Area Boundary
- Landholding
- Lot
- Road
- Watercourse
- Major Water Body
- Samples
- BESS Design
- BESS Roads
- Existing OH Electrical Lines
- Existing Easement
- Existing Telstra UG Comms
- Vegetation

BYDA Lines

- LV — L Essential Energy LV Underground Cable
- OF — O Telstra Optic Fibre

BYDA Points

- Essential Energy Pole
- Essential Energy Underground Earth or Wires
- Telstra Cable Jointing Pit
- Telstra Elevated Junction
- Telstra Marker Post

Premise

DENILIQUIN EAST BESS

Figure 9
Sample Map

Table 8 – Analyses at ALL depths

Tests	Units
pH (CaCl2)	pH Units
EC	dS/m
Moisture	%
ECEC/CEC	Cmol(+)/kg
Calcium	Cmol(+)/kg
Magnesium	Cmol(+)/kg
Potassium	Cmol(+)/kg
Sodium	Cmol(+)/kg
Aluminium (if pH <6.0)	Cmol(+)/kg

Table 9 – Analyses for TOPSOIL only

Tests	Units
PSA	Percentage of gravel, sand, silt, and clay
Emerson Test	Category
Nitrate	mg/kg
Phosphorus	mg/kg
Organic Carbon	%
Sulphate	mg/kg
Boron	mg/kg
Iron	mg/kg
Manganese	mg/kg
Copper	mg/kg
Zinc	mg/kg

Table 10 –ALL Depths Soil Chemistry Data

Soil Layer		0-15cm		15-45cm		45-80cm		80-100cm	
Parameter	**Unit**	**Result**	**Rating[1]**	**Result**	**Rating**	**Result**	**Rating**	**Result**	**Rating**
pH	**1:5 H_2O**	5.6	Moderately acid	7.8	Moderately alkaline	8.8	Strongly alkaline	9.0	Very strongly alkaline
Electrical Conductivity	**dS/m**	0.14	Non-saline	0.13	Non-saline	0.34	Non-saline	3.38	Slightly saline
Cation Exchange Capacity	**cmol(+) /kg**	11.9	Low	22.5	High	28.3	High	70.3	Very high
Nitrate Nitrogen	**mg/kg**	21	Moderate	2.8	Low	1.3	Low	<0.50	Low
Ammonium Nitrogen	**mg/kg**	3.9	Moderate	2.3	Low	1.8	Low	1.2	Low
Available Potassium	**mg/kg**	190	Low	220	Moderate	240	Moderate	240	Moderate
Cations cmol(+)/kg	**Ca^{2+}**	5.3	Moderate	8.1	Moderate	9.3	Moderate	52	Very High
	K^{+}	0.48	Moderate	0.57	Moderate	0.61	Moderate	0.61	Moderate
	Mg^{2+}	4.6	High	11	Very High	14	Very High	12	Very High
	Na^{+}	1.0	High	2.8	High	4.5	High	5.9	High
	Al^{3+}	<0.10	Non-toxic	<0.10	Non-toxic	<0.10	Non-toxic	<0.10	Non-toxic

[1] Ratings based on Hazelton, P. and Murphy, B. (2016)

Soil Layer		0-15cm		15-45cm		45-80cm		80-100cm	
Parameter	Unit	Result	Rating[1]	Result	Rating	Result	Rating	Result	Rating
Calcium/Magnesium Ratio	-	1.2	Ca (low)	0.74	Ca deficient	0.66	Ca deficient	4.3	Balanced
Moisture Content	%	6.4	Very Dry	12	Dry	16	Dry	16	Dry

Table 11 – Topsoil Chemistry Data

Soil Layer				0-15cm		
Parameter	Unit	Size	Type	Result	Rating[2]	MASCC Rating[3]
Particle Size (%)	**%w/w**	**<0.002mm**	**Clay**	36	Clay loam	-
	%w/w	**0.002-0.06mm**	**Silt**	27		-
	%w/w	**0.02–0.2 mm**	**Fine Sand**	9.5		-
	%w/w	**0.2–2 mm**	**Coarse Sand**	27.5		-
	%w/w	**>2 mm**	**Gravel**	0		-
Emerson Class	-	-	-	2	Some dispersion	-
Phosphorous (Colwell)	**mg/kg**	-	-	30	Moderate	-
Total Organic Carbon	**%w/w**	-	-	1.6	Moderate	-

[2] Ratings based on Hazelton, P. and Murphy, B. (2016)
[3] Ratings based on Maximum Allowable Soil Contamination Concentrations for Agricultural Land (MASCC Limits)

Soil Layer				0-15cm		
Parameter	**Unit**	**Size**	**Type**	**Result**	**Rating[2]**	**MASCC Rating[3]**
Organic Matter	**%w/w**	**-**	**-**	2.7	Moderate	-
Sulphur (KCl-40 extractable)	**mg/kg**	**-**	**-**	10	-	-
Boron (CaCl extractable)	**mg/kg**	**-**	**-**	1.4	-	-
Copper	**mg/kg**	**-**	**-**	2.7	-	Not exceeded
Zinc	**mg/kg**	**-**	**-**	0.52	-	Not exceeded
Manganese	**mg/kg**	**-**	**-**	38	-	Not exceeded
Iron	**mg/kg**			140	-	Not exceeded

4. EROSION ASSESSMENT

4.1 The Revised Universal Soil Loss Equation (RUSLE)

RUSLE is specified in the IECA '*Best Practice Erosion and Sediment Control Guidelines*' (2008) ('IECA Manual') to predict the long-term, average, annual soil loss from rill and sheet erosion. The RUSLE equation provides an estimate of the annual soil loss and does not consider individual storm events. The annual soil loss due to erosion (A) is used to determine the erosion risk rating, stabilisation requirements and the level of sediment control required for the site.

In order to calculate the soil erosion hazard and the soil erosion risk, the Revised Universal Soil Loss Equation (RUSLE) from the IECA Manual was used using the following formula:

$$A = K \times R \times LS \times P \times C \qquad \text{(IECA, 2008)}$$

Where:

A: is the predicted soil loss per hectare per year

K: is the soil erodibility factor

R: is the rainfall erosivity factor

LS: is the slope length/gradient factor (varies for each catchment)

P: is the erosion control practice factor (1.3)

C: is the ground cover and management factor (default value of 1 adopted)

4.1.1 SOIL ERODIBILITY FACTOR (K FACTOR)

The K-Factor is a measure of the resistivity to erode of soil to the energy of rain. It is a parameter that effects the total soil loss as it increases. Generally, the particle distribution is the main factor in the measurement.

Soil testing was undertaken as part of the soil assessment for this project but it did not specifically include testing for a K-factor value. As some Emerson testing was carried out to adjust for dispersive soils, K-factors should be increased by 20% for all Emersion Aggregate Class 1 and 2 soils (*Managing Urban Stormwater: Soils and construction - Volume 1*, Landcom, 2004). The adoption of a conservative K factor of 0.03 +20% to 0.036 was estimated by using the default value in the IECA Manual.

It is noted that the values adopted for this assessment have been used for planning purposes only. The Construction Contractor shall undertake assessment of the soil types and extents when considering the proposed works methodology and construction staging.

4.1.2 RAINFALL EROSIVITY FACTOR

R-factor is a measurement of the energy associated with rainfall events, i.e. the erosive energy of the median rainfall for the area. The R-factor can be found in the IECA Manual or calculated using the methodology for estimating R factors from rainfall intensity.

The relevant formula is:

$$R = 164.74(1.1177)^{S}\ S \times 0.6444$$

Where:

R = Rainfall erosivity (MJ.mm/ha.t.yr)

S = 2-year ARI (equivalent to the 0.5EY) 6-hour rainfall event (5.42mm/hr for the site) sourced from BOM IFD for Lat 35.5532, Long 145.0289.

Based on this data, rainfall erosivity (R factor) of 1,392 (MJ.mm/ha.t.yr) was calculated for the project area.

4.1.3 SLOPE LENGTH AND SLOPE GRADIENT (LS FACTOR)

This factor is a combination of the length (L) and steepness (S) of a slope. The way the formula uses this number is to assume that the whole catchment has this ratio. For safety generally the highest LS factor for the catchment is used. This gives the worst possible case of soil loss.

Within the project this will be calculated be 0.24 for the study area.

4.1.4 EROSION PRACTICE AND COVER (P AND C FACTORS)

The P-factor refers to Erosion Control Practice. This allows the user of the formula to adjust the total soil loss as a factor based on practices the erosion control with regards to the compactness of the ground. The industry standard for construction is default at 1.3, defined as '*Compacted and smooth*'.

The C-Factor is a function of cover over the soil. It represents methods for controlling erosion other than altering the soil. As standard practice there is no cover while areas are under construction.

4.1.5 CALCULATED SOIL LOSS

Calculated soil loss (RUSLE) was used to determine the erosion risk rating for implementation during the construction phase of the project and are presented in **Table 12.**

It should be noted that the soil loss estimate is not considered representative of actual annual soil loss for the project area and should be used rather as indicator of potential erosion risk and a link between risk and controls. If at any time circumstances affecting the above factors should change, a reassessment should be conducted immediately.

Table 12 – Calculated Soil Loss

Factor	Units	Study Area Value
Catchment size	Hectares	3.5
Soil erodibility (K Factor)	t ha h $ha^{-1}MJ^{-1}mm$	0.036
Rainfall erosivity (R Factor)	MJ.mm/ha.t.yr	1,392
Cover (C Factor)	Factor (Landcom 2004)	1.0
Conservation practice (P Factor)	Factor (Landcom 2004)	1.3
Length/slope (LS Factor)	Factor (Landcom 2004)	0.24
Average soil loss	t/ha/yr	15.6
Average soil loss for area	t/yr	**54.7**
Erosion Risk Rating	Rating (Landcom 2004)	**Very Low**

4.1.6 DISCUSSION

Based on the above analyses the site has been assessed as a very low erosion risk site by the RUSLE guideline from the *Managing Urban Stormwater: Soils and construction – Volume 1* (Landcom, 2004). General erosion control measures are suggested in the mitigation measures in **Section 6**.

5. POTENTIAL IMPACTS

5.1 Agricultural impact

The proposed BESS would occupy 3.5 hectares of land currently used for sheep grazing. The estimated annual production value of this land is currently **$453.33**, as calculated in **Section 2.3.5**. Land on the study area will be fenced off and will not be used for agricultural purposes once the project commences. The remainder of the paddock outside of the fenced development would continue to be used for grazing.

Given the relatively small area and low annual production value of the site, this change of land use is not considered likely to have a significant impact on the agricultural production of the region or adjacent agricultural land. Once the project is decommissioned, land on the study area will be rehabilitated and returned to its pre-existing land use or another land use as agreed between the landholder and the project owner.

5.2 Soil impacts

5.2.1 CONSTRUCTION

Potential impacts to soil associated with the construction of the development are detailed in **Table 13** below. Impacts were determined by identifying unmitigated risks associated with construction activities and potential impacts to the receiving land.

Table 13 – Potential construction impacts

Activity	Impact	Likelihood	Significance of impact
Vegetation clearing	Vegetation removal has the potential to increase the risk of erosion and sedimentation by exposing soils to weathering processes and reducing soil stability.	Moderate	Moderate
Earthworks and excavation (including trenching)	Increased the risk of erosion through soil disturbance if unmitigated.	Moderate	Moderate
	Exposing subsoils which may be saline or sodic and dispersive may increase the risk of erosion and reduce overall soil fertility.	Moderate	Moderate
	Excavation of buried soil contaminants (heavy metals, pesticides, hydrocarbons) may occur. If unmitigated this may cause impacts to human health and environmental safety.	Low	High
Stockpiling and removal	Mixing of soil horizons may occur if soil is incorrectly removed or stockpiled during construction. Mixing topsoil and subsoil may	Moderate	Moderate

Activity	Impact	Likelihood	Significance of impact
of excavated material	impact long term soil quality and erosion hazard.		
Operating heavy machinery	Soil compaction may occur during the operation of heavy machinery on site if unmitigated. Soil compaction has impacts to erosion risk and long-term impacts to land and soil capability.	Moderate	Moderate
Earthworks, vehicle and pedestrian movements	Earthworks and movements of machinery, vehicles and pedestrians on site may introduce new pests, weeds and disease species to the area or spread species which are present at the site. This includes Bathurst Burr which is present on site and is a major weed of agricultural land in NSW. Sources of biosecurity risks may include caked on organic material or mud in equipment, vehicles, heavy machinery and boots. Biosecurity risks may cause a long term impact to the site and surrounding agricultural community if unmitigated.	Moderate	High
Waste and spills	Waste accumulated during construction activities, including litter and putrescible waste, has the potential to pollute soil and groundwater resources if appropriate measures are not implemented.	Low	Moderate
	The release of potentially harmful chemicals, substances or contaminated stormwater may occur accidentally during construction and has the potential to contaminate soil (i.e., leakage or spill of petroleum, oils or other toxicants from construction machinery and plant equipment resulting from inappropriate storage of contaminated materials, refuelling and/or maintenance activities, leakage from sewer infrastructure).	Low	High

5.2.2 OPERATION

Potential impacts to soil associated with the operation of the development are detailed in **Table 14** below. Impacts were determined by identifying unmitigated risks associated with construction activities and potential impacts to the receiving land.

Table 14 – Potential operation impacts

Activity	Impact	Likelihood	Significance of impact
Operating heavy machinery	Soil compaction may occur during the operation of heavy machinery on site if risks are unmitigated. Soil compaction has impacts to erosion risk and long-term impacts to land and soil capability.	Moderate	Moderate
Vehicle and pedestrian movements	Movements of machinery, vehicles and pedestrians on site during operation may introduce new pests, weeds and disease species to the area or spread species which are present at the site. This includes Bathurst Burr which is present on site and is a major weed of agricultural land in NSW. Sources of biosecurity risks may include caked on organic material or mud in equipment, vehicles, heavy machinery and boots. Biosecurity risks may cause a long term impact to the site and surrounding agricultural community if unmitigated.	Moderate	High
Solar panel operation	Reduced soil permeability and localised erosion may occur under the solar panels from water run-off during rainfall or cleaning. This is likely if groundcover is not promptly established under the solar panels.	Moderate	Low
	Erosion, soil loss and sedimentation may continue to occur during operation if risks are unmitigated during construction.	Low	Moderate
	Downstream salinity impacts may occur if water infiltration to saline subsoils increases when pasture is not utilised (i.e. by grazing or slashing).	Low	Moderate
	Impacts to metal or concrete structures may occur if they come into contact with acidic or sodic soils.	Moderate	Low
Grazing	Nutrification or acidification of surface soils may occur if grazing is not appropriately rotated and managed.	Low	Moderate
	Excessive removal of pasture and vegetation may result in soil exposure and erosion if	Low	Moderate

Activity	Impact	Likelihood	Significance of impact
	grazing is not appropriately rotated and managed.		
	Surface soil compaction from foot traffic of sheep may occur if sheep are not appropriately rotated and managed.	Low	Moderate
BESS operation	Erosion, soil loss and sedimentation may continue to occur during operation if risks are unmitigated during construction.	Low	Moderate
	Soil compaction may occur if traffic around the BESS is not appropriately managed and controlled.	Low	Moderate
Waste and spill	The release of potentially harmful chemicals, substances or contaminated stormwater may occur accidentally during operation and has the potential to contaminate soil (i.e., leakage or spill of petroleum, oils or other toxicants from construction machinery and plant equipment resulting from inappropriate storage of contaminated materials, refuelling and/or maintenance activities, leakage from sewer infrastructure, or heavy metal or microplastic contaminants from structures).	Low	High

5.2.3 DECOMMISSIONING

Potential impacts to soil during decommissioning are anticipated to be similar to construction impacts. Long term impacts of decommissioning may include:

- Failure to return the site to the existing or improved land and soil capability;
- Failure to return the site to a safe, stable and non-polluting landform.

6. MITIGATION MEASURES

The following mitigation measures are recommended to minimise impacts to land, soil and agriculture throughout the duration of the project.

The mitigation measures have been formatted as a table and each mitigation measure is assigned a reference number, description of timing and responsibility.

Table 15 – Soil - Mitigation commitments

Ref No.	Potential impact	Commitment	Timing	Responsibility
S1	Erosion and Sedimentation	A Soil and Water Management Plan (SWMP) is to be prepared in accordance with *Managing Urban Stormwater – Soils and Construction Volume 1 (Landcom, 2004).* The SWMP will be prepared as part of a Construction Environmental Management Plan (CEMP) to manage potential risks to soils, surface and ground water. The construction SWMP is to be prepared with reference to relevant development controls within the Deniliquin DCP. Recommended measures for the construction SWMP include but are not limited to: > Measures to minimise and manage the potential for erosion and sediment transport within and from the Project area. > Measures to manage accidental spills and waste storage. > Measures to manage stormwater and the potential for contaminated runoff from the Development site. > Measures to ensure that excavation activities and any stockpiling are managed to	Prior to Construction During Construction	Contractor

Ref No.	Potential impact	Commitment	Timing	Responsibility
		minimise the potential for downstream contamination. > Measures to ensure that areas of exposed soil and the time in which they are exposed are minimised as far as practical.		
S2	Soil disturbance and sedimentation associated with vegetation clearing, excavation, stockpiling activities	The construction of the development shall be managed in compliance with measures specified within the construction SWMP to ensure impacts to water quality are appropriately managed. Measures shall be implemented to ensure that areas of exposed soil and the time in which they are exposed, are minimised as far as practical during construction.	Prior to Construction During Construction	Contractor
S3	Wastes, Spill and Emergency Management	**Construction** The construction SWMP shall include procedures to reduce and manage the risk of emergency events and the potential for wastes and spills to contaminate soils. Recommended measures to manage the potential for contaminated discharge include: > The storage of all fuel chemicals and liquids in sealed bunded areas on level ground away from stormwater drainage lines and waterways > Ensuring refuelling and maintenance activities are restricted to designated areas with appropriate bunding and spill capture controls	During Construction	Contractor

Ref No.	Potential impact	Commitment	Timing	Responsibility
		> Implementing controls as part of the construction SWMP that provide procedures to respond to emergencies and spills. > Ensuring visual inspections of drainage lines and disturbed areas are undertaken during construction to assess any potential soil or surface water issues. > The installation and maintenance of stormwater control measures including drainage networks that segregate stormwater runoff according to its contamination.		
		Operation During operation procedures shall be developed to reduce the potential contamination of soils, surface and ground water, resulting from wastes, spills and/or emergency incidents. Suggested measures to control the potential for contamination during operation include: > The appropriate storage of equipment and hazardous substances during operation. > Ensuring that plant and stormwater control measures are maintained to prevent contamination of soil. > Preparation of appropriate procedures to response to emergency incidents, spills and leaks from the Development site, including operational equipment and maintenance activities.	Operation	Proponent

Ref No.	Potential impact	Commitment	Timing	Responsibility
		Decommissioning A decommissioning plan shall be developed which minimises the contamination of soils, surface and ground water, resulting from wastes, spills and/or emergency incidents. Suggested measures to control the potential for contamination during decommissioning including: > A soil sampling plan to be undertaken prior to decommissioning to assess any risk of contamination. Preparation of procedures to minimise risk of contamination	Decommissioning	Proponent
S4	Soil mixing / topsoil loss	As part of the CEMP for the Project, soil management measures should include: > Assessment of topsoil depth prior to stripping to minimise mixing of topsoil and subsoil > Topsoil and subsoil should be stripped and stockpiled separately for rehabilitation works following excavation > Avoid stripping and stockpiling soil following heavy rain periods > Avoid compaction of topsoil during stripping and stockpiling operations > If required, amelioration of topsoil and/or subsoil during stripping in accordance with a soil scientist's recommendations. > Prevent erosion of stockpiles using soil stabilising biopolymers, cover crops or other forms of stabilisation	Prior to Construction During Construction During Decommissioning	Contractor

Ref No.	Potential impact	Commitment	Timing	Responsibility
		> Test stockpiled soils to determine amelioration requirements prior to reinstatement.		
S5	Soil compaction	As part of the CEMP for the Project, soil compaction management measures should include: > Development of controlled traffic practices for plant machinery movements > Avoid excavation and plant machinery movements on wet soils following heavy rain periods > Prevent long term storage of plant machinery on clay or wet soils > Avoid long term exposure of subsoils which are more susceptible to compaction > Progressively stabilise and rehabilitate soil as soon as practically possible after excavation > Ensure soil is replaced in correct subsoil/topsoil orders > Ensure vegetative cover is re-established after soil rehabilitation	Prior to Construction During Construction During Decommissioning	Contractor
S1	Biosecurity risk	As part of the CEMP and operation plan for the project, biosecurity measures should include: > Implement a "Come Clean, Go Clean" policy (DPI NSW, 2024) for vehicles and machinery entering the site. Mud and plant material must be removed from vehicles and machinery prior to entering and leaving the site.	Prior to Construction During Construction During Operation During Decommissioning	Site Manager

Ref No.	Potential impact	Commitment	Timing	Responsibility
		> Prevent the spread of plant and soil material on to and off site by checking clothes and boots prior to entering and leaving the site. > Implement a weed management plan which involves regular monitoring, spraying and removal of weeds.		

7. CONCLUSION

7.1 Site suitability

The Land and Soil Capability Assessment Scheme (OEH, 2012) maps the soil of the site as Class 3- High capability land. The soil survey identified the soil types across the site as Chromosols and Vertosols under the Australian Soil Classification System (Isbell, 2002). Whilst the soils of the site were considered highly capable, the lack of rainfall and irrigation has limited the site to occasional time-controlled rotational grazing of sheep.

Soil chemical analysis indicated that the soils are moderately fertile throughout the profile. The subsoils are moderately alkaline and sodic at depth. Mitigation measures should be implemented during the construction period which prevent soil horizons being exposed or mixed during excavation or stripping.

The risk of erosion has been assessed as a very low erosion risk site by the RUSLE guideline from the *Managing Urban Stormwater: Soils and construction – Volume 1* (Landcom, 2004). Mitigation measures should be implemented during the construction and decommissioning phases which will minimise erosion risk during works.

The site is considered suitable for the development in respect to zoning, current land use and proximity to the existing substation. Impacts to adjacent agricultural land, soil, and agricultural production of the region are considered to be minimal due to the relatively small size and low production value of the study area.

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Appendix A

Soil analytical results

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Grace Scott	Manager	Jon Dicker
Client	PREMISE	Laboratory	SGS Cairns Environmental
Address	154 PEISLEY STREET ORANGE NSW 2800	Address	Unit 2, 58 Comport St Portsmith QLD 4870
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Facsimile	(Not specified)	Facsimile	+61 07 4035 5122
Email	Grace.scott@premise.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**Mayfair D2 sample**	SGS Reference	**CE175202 R1**
Order Number	**P000350**	Date Received	21 May 2024
Samples	25	Date Reported	19 Aug 2024

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146)

At the clients request, report CE175202 R0 dated 07/06/2024 has been split to only include the D2 sample.

SIGNATORIES

Alyson BERGAMO
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Anthony NILSSON
Operations Manager

Jon Dicker
Manager Northern QLD

Maristela GANZAN
Quality Manager

Mitsuko BALDWIN
Metals Team Leader

Parameter	Units	LOR	Sample Number: CE175202.001 Sample Matrix: Soil Sample Name: D2 0-15

Moisture Content Method: AN002 Tested: 6/6/2024

% Moisture	%w/w	1	-

pH in soil (1:5) Method: AN101 Tested: 30/5/2024

pH	pH Units	0.1	-

Conductivity and TDS by Calculation - Soil Method: AN106 Tested: 30/5/2024

Conductivity of Extract (1:5 as received)	µS/cm	2	-

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: 31/5/2024

Exchangeable Sodium, Na	mg/kg	2	-
Exchangeable Sodium, Na	meq/100g	0.01	-
Exchangeable Sodium Percentage*	%	0.1	-
Exchangeable Potassium, K	mg/kg	2	-
Exchangeable Potassium, K	meq/100g	0.01	-
Exchangeable Potassium Percentage*	%	0.1	-
Exchangeable Calcium, Ca	mg/kg	2	-
Exchangeable Calcium, Ca	meq/100g	0.01	-
Exchangeable Calcium Percentage*	%	0.1	-
Exchangeable Magnesium, Mg	mg/kg	2	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-
Exchangeable Magnesium Percentage*	%	0.1	-
Cation Exchange Capacity	meq/100g	0.02	-
Sodium Adsorption Ratio*	No unit	0.1	-

Soil - Aluminium (KCL Extraction) Method: AN046 Tested: 3/6/2024

Exchangeable Aluminium	mg/kg	1	-

Parameter	Units	LOR	Sample Number: CE175202.001 Sample Matrix: Soil Sample Name: D2 0-15

Particle sizing of soils by sieving Method: AN005 Tested: 6/6/2024

Passing 2.00mm	%w/w	1	100
Retained 2.00mm	%w/w	1	<1
Passing 600µm	%w/w	1	98
Retained 600µm	%w/w	1	2
Passing 300µm	%w/w	1	94
Retained 300µm	%w/w	1	4
Passing 212µm	%w/w	1	92
Retained 212µm	%w/w	1	3
Passing 75µm	%w/w	1	83
Retained 75µm	%w/w	1	9

Particle sizing of soils <75µm by hydrometer Method: AN005 Tested: 6/6/2024

Sedimentation Diameter 1	mm	0.0001	0.0530
Passing Sedimentation Diameter 1	%w/w	1	63
Retained Sedimentation Diameter 1	%w/w	1	<1
Sedimentation Diameter 2	mm	0.0001	0.0377
Passing Sedimentation Diameter 2	%w/w	1	61
Retained Sedimentation Diameter 2	%w/w	1	2
Sedimentation Diameter 3	mm	0.0001	0.0270
Passing Sedimentation Diameter 3	%w/w	1	56
Retained Sedimentation Diameter 3	%w/w	1	4
Sedimentation Diameter 4	mm	0.0001	0.0195
Passing Sedimentation Diameter 4	%w/w	1	48
Retained Sedimentation Diameter 4	%w/w	1	8
Sedimentation Diameter 5	mm	0.0001	0.0143
Passing Sedimentation Diameter 5	%w/w	1	46
Retained Sedimentation Diameter 5	%w/w	1	2
Sedimentation Diameter 6	mm	0.0001	0.0101
Passing Sedimentation Diameter 6	%w/w	1	46
Retained Sedimentation Diameter 6	%w/w	1	<1
Sedimentation Diameter 7	mm	0.0001	0.0072
Passing Sedimentation Diameter 7	%w/w	1	44
Retained Sedimentation Diameter 7	%w/w	1	2
Sedimentation Diameter 8	mm	0.0001	0.0051
Passing Sedimentation Diameter 8	%w/w	1	42
Retained Sedimentation Diameter 8	%w/w	1	2
Sedimentation Diameter 9	mm	0.0001	0.0036
Passing Sedimentation Diameter 9	%w/w	1	40
Retained Sedimentation Diameter 9	%w/w	1	2
Sedimentation Diameter 10	mm	0.0001	0.0015
Passing Sedimentation Diameter 10	%w/w	1	36
Retained Sedimentation Diameter 10	%w/w	1	4
Sedimentation Diameter 11	mm	0.0001	0.0011
Passing Sedimentation Diameter 11	%w/w	1	33
Retained Sedimentation Diameter 11	%w/w	1	2
Clay (<0.002mm)	%w/w	0.1	36
Silt and Clay (<0.005mm)	%w/w	0.1	42
Silt (0.002mm to 0.06mm)	%w/w	0.1	27
Fine Sand (0.06mm to 0.20mm)	%w/w	0.1	9.5

Parameter	Units	LOR	Sample Number: CE175202.001 Sample Matrix: Soil Sample Name: D2 0-15

Emerson Class Number   Method: AN009   Tested: 24/5/2024

Emerson Class Number	No unit	1	2

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser in Soil   Method: AN248   Tested: 3/6/2024

Nitrate/Nitrite Nitrogen, NOx as N	mg/kg	0.05	29

Colwell Phosphorus   Method: AN015   Tested: 31/5/2024

Colwell Phosphorus	mg/kg	1	30

Total Organic Carbon by Heanes Oxidation   Method: AN273   Tested: 3/6/2024

Total Organic Carbon	%w/w	0.05	1.6
Organic Matter	%w/w	0.1	2.7

Potassium Chloride Extractable Sulphur   Method: RL 10D1/AN320   Tested: 31/5/2024

KCl-40-extractable Sulphur, S	mg/kg	1	10

Calcium Chloride Extractable Boron   Method: RL 12C2/AN320   Tested: 31/5/2024

CaCl2-extractable Boron, B	mg/kg	0.05	1.4

Parameter	Units	LOR	Sample Number: CE175202.001 Sample Matrix: Soil Sample Name: D2 0-15
DTPA Extractable Metals in Soil — Method: AN025/AN320 — Tested: 31/5/2024			
Copper, Cu	mg/kg	0.05	2.7
Zinc, Zn	mg/kg	0.05	0.52
Manganese, Mn	mg/kg	0.5	38
Iron, Fe	mg/kg	0.5	140

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Calcium Chloride Extractable Boron   Method: RL 12C2/AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
CaCl2-extractable Boron, B	LB129364	mg/kg	0.05	<0.05	8%

Colwell Phosphorus   Method: ME-(AU)-[ENV]AN015

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Colwell Phosphorus	LB129359	mg/kg	1	<1	0 - 1%	105%

DTPA Extractable Metals in Soil   Method: ME-(AU)-[ENV]AN025/AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD
Copper, Cu	LB129372	mg/kg	0.05	<0.05	0 - 2%
Zinc, Zn	LB129372	mg/kg	0.05	<0.05	4%
Manganese, Mn	LB129372	mg/kg	0.5	<0.5	2 - 4%
Iron, Fe	LB129372	mg/kg	0.5	<0.5	0 - 1%

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)   Method: ME-(AU)-[ENV]AN122

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Exchangeable Sodium, Na	LB129360	mg/kg	2		2 - 10%	100 - 101%
Exchangeable Sodium, Na	LB129360	meq/100g	0.01	<0.01	2 - 10%	NA
Exchangeable Sodium Percentage*	LB129360	%	0.1		6 - 11%	NA
Exchangeable Potassium, K	LB129360	mg/kg	2		1 - 2%	103 - 104%
Exchangeable Potassium, K	LB129360	meq/100g	0.01	<0.01	1 - 2%	NA
Exchangeable Potassium Percentage*	LB129360	%	0.1		0 - 2%	NA
Exchangeable Calcium, Ca	LB129360	mg/kg	2		1 - 4%	104 - 105%
Exchangeable Calcium, Ca	LB129360	meq/100g	0.01	<0.01	1 - 4%	NA
Exchangeable Calcium Percentage*	LB129360	%	0.1		0%	NA
Exchangeable Magnesium, Mg	LB129360	mg/kg	2		0 - 5%	99 - 100%
Exchangeable Magnesium, Mg	LB129360	meq/100g	0.02	<0.02	0 - 5%	NA
Exchangeable Magnesium Percentage*	LB129360	%	0.1		0 - 2%	NA
Cation Exchange Capacity	LB129360	meq/100g	0.02	<0.02	1 - 4%	NA
Sodium Adsorption Ratio*	LB129360	No unit	0.1		0 - 8%	NA

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser in Soil   Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB129430	mg/kg	0.05	<0.05	1%	107%

Potassium Chloride Extractable Sulphur   Method: RL 10D1/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD
KCl-40-extractable Sulphur, S	LB129363	mg/kg	1	1 - 7%

Soil - Aluminium (KCL Extraction)   Method: AN046

Parameter	QC Reference	Units	LOR	MB
Exchangeable Aluminium	LB129463	mg/kg	1	<1.0

Total Organic Carbon by Heanes Oxidation   Method: ME-(AU)-[ENV]AN273

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon	LB129411	%w/w	0.05	<0.05	2%	98%	97%
Organic Matter	LB129411	%w/w	0.1		2%		

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN005	The particle size distribution of a soil is determined by wet sieving, using a maximum of 900 mL of deionised water to sieve all fractions down to 75 µm. Referenced to AS1289.3.6.1 and AS1141.11.
AN005	Following wet sieving of the sample,(particles smaller than 75 µm) a dispersing solution is added and a hydrometer is used to measure sedimentation. Soil density is determined and the percentage of each size fraction calculated. Referenced to AS1289.3.6.3.
AN009	The method follows AS1289 3.8.1 - 2006. Soils are divided into seven classes on the basis of their coherence in water, with one further class being distinguished by the presence of calcium-rich minerals. Class 1: Air-dried crumbs of soil show a strong dispersion reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10min. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
AN009	Class 2: Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognisable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs. Class 3: The soil remoulded at the plastic limit disperses in water. Class 4: The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present. Class 5: The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 5 min.
AN009	Class 6: The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 5 min. Class 7: The air-dried crumbs of soil remain coherent in water and swells. Class 8: The air-dried crumbs of soil remain coherent in water and do not swell.
AN015	Soil sample is extracted in an end over end roller in 0.5 N sodium bicarbonate at pH 8.5 with the supernatant liquor analysed for Phosphorous. Orthophosphate anion (PO_4^{3-}) is reacted with ammonium molybdate and potassium antimony tartrate in sulfuric acid solution. The resulting phospho-molybdate complex is reduced, using ascorbic acid, to an intense blue coloured complex Molybdenum Blue. The absorbance of this complex is measured at 880 nm by Discrete Analyser, and compared with calibration standards to obtain the concentration of orthophosphate in the sample. Based on Rayment & Higginson 9B1.
AN025/AN320	A chelating agent is used to complex metal ions in solution. The extracted elements are determined byICP OES.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M $CaCl_2$) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.

METHOD	METHODOLOGY SUMMARY
AN122	Exchangeable Cations, CEC and ESP: Soil sample is extracted in 1 M Ammonium Acetate at pH=7 (or 1M Ammonium Chloride at pH=7) with cations (Na, K, Ca & Mg) then determined by ICP OES/ICP MS and reported as Exchangeable Cations. For saline soils, these results can be corrected for water soluble cations and reported as Exchangeable cations in meq/100g or soil can be pre-treated (aqueous ethanol/aqueous glycerol) prior to extraction. Cation Exchange Capacity (CEC) is the sum of the exchangeable cations in meq/100g.
AN122	The Exchangeable Sodium Percentage (ESP) is calculated as the exchangeable sodium divided by the CEC (all in meq/100g) times 100. ESP can be used to categorise the sodicity of the soil as below: ESP < 6% non-sodic ESP 6-15% sodic ESP >15% strongly sodic Method is referenced to Rayment and Lyons, 2011, sections 15D3 and 15N1.-
AN248	Nitrate / Nitrite in extract by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
AN273	The sample is digested in Dichromate / Sulfuric Acid to oxidise the organic carbon. The determination is completed colourimetrically by Discrete Analyser at 600 nm. Based on Rayment & Higginson 6B1.
RL 10D1/AN320	Air dried <2mm soil is extractedin 0.25M KCl at 40 deg C followed by analysis of filtrate for S by ICP OES. Referenced to Rayment and Lyons method 10D1.
RL 12C2/AN320	Air dried <2mm soil is extracted in 0.01M CaCl2 by refluxing gently for 30 minutes. Extract is then filtered and analysed by ICP OES. Referenced method Rayment and Lyon, 12C2.
SOL061	Soil sample is extrcated 1:10 in 1MKCl with aluminium determined by ICP OES.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
***	Indicates that both * and ** apply.	NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

Appendix B

Site inspection photos

Project: Deniliquin East BESS Site
Inspection **Report date:** 09 Jul 2024
10:37:00 am **Generated by:** Grace Scott
Email: grace.scott@premise.com.au

SiteCam

Deniliquin East BESS Site Inspection 23-24 April 2024

REPORT DETAILS
Capture dates: 23 Apr 2024 to 24 Apr 2024
Captured by: Grace Scott

CONTENTS
Report items: 25
Photos: 56

View online

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Folder: Deniliquin East BESS Site Inspection Record type: General 24 Apr 2024

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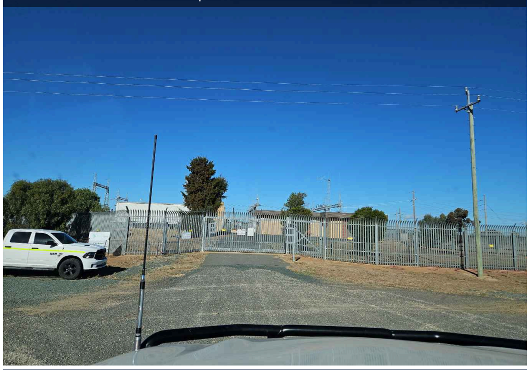

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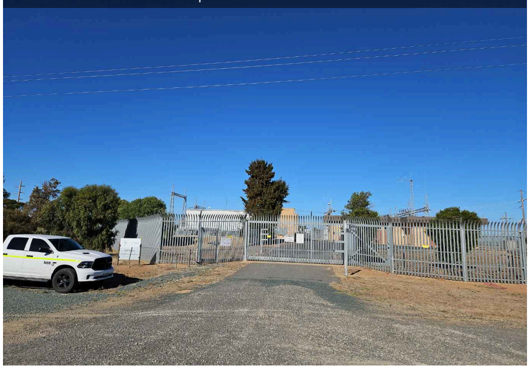

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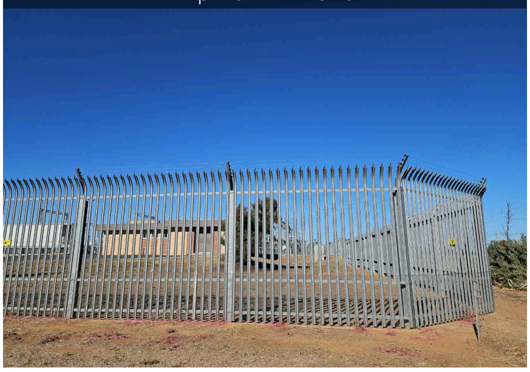

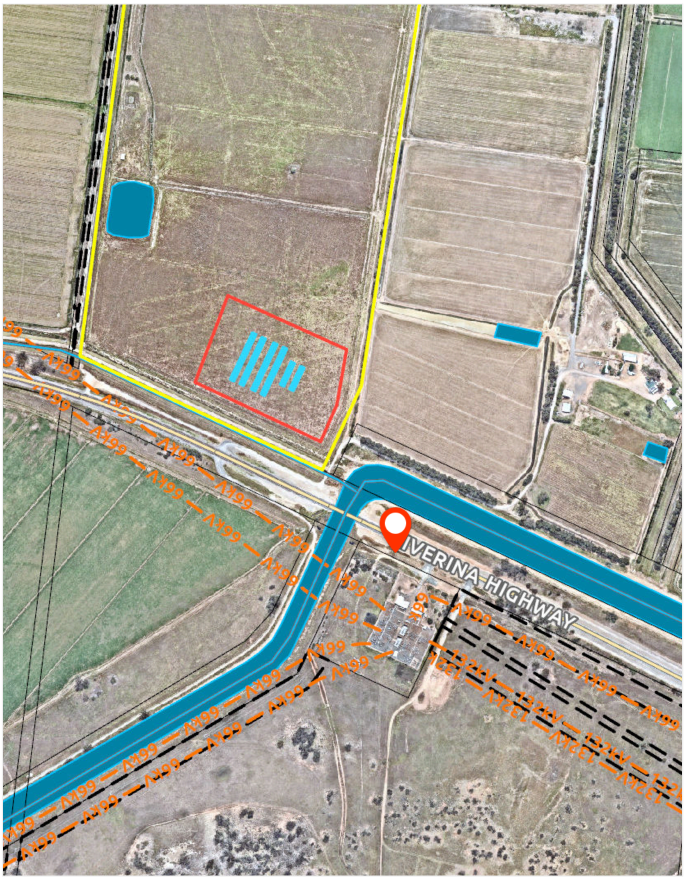

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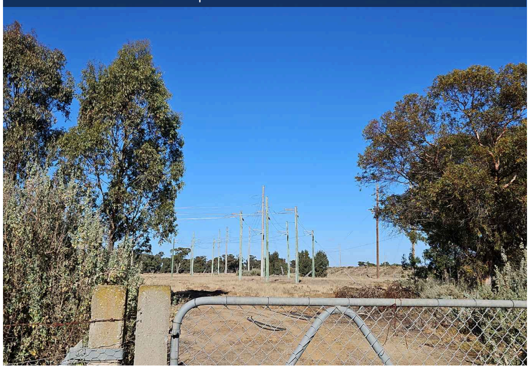

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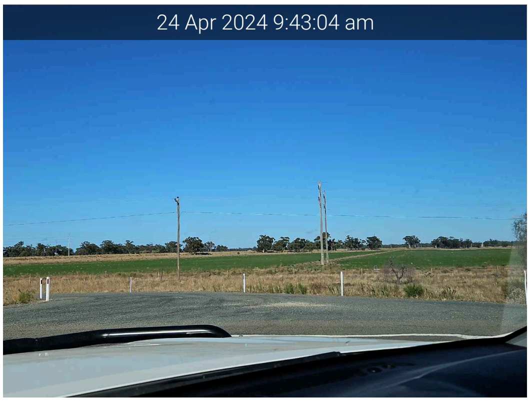

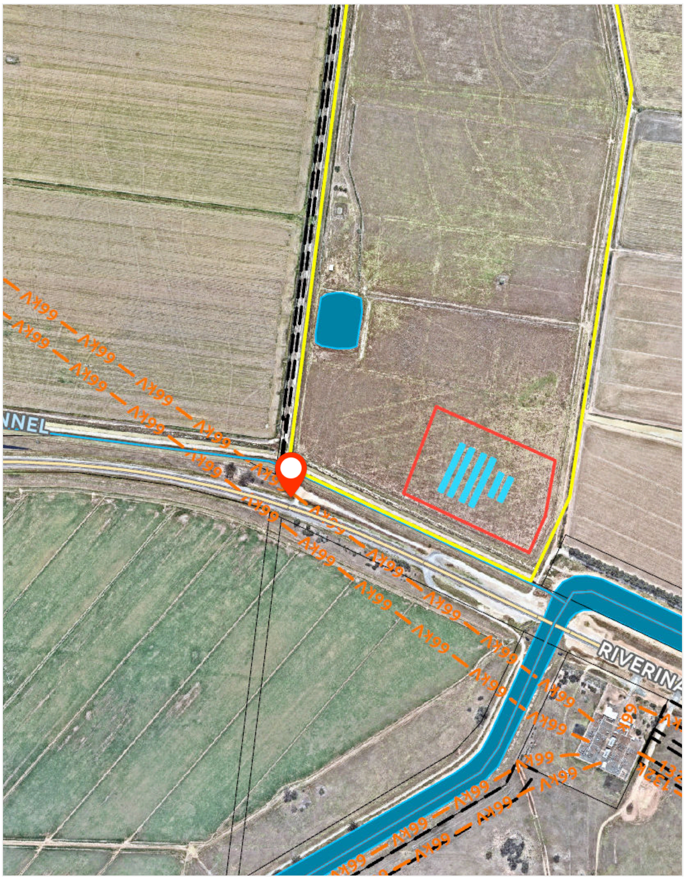

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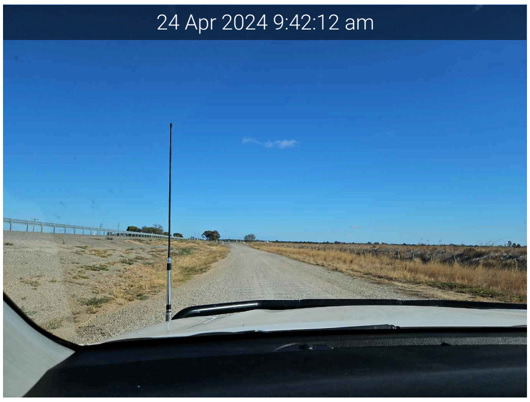

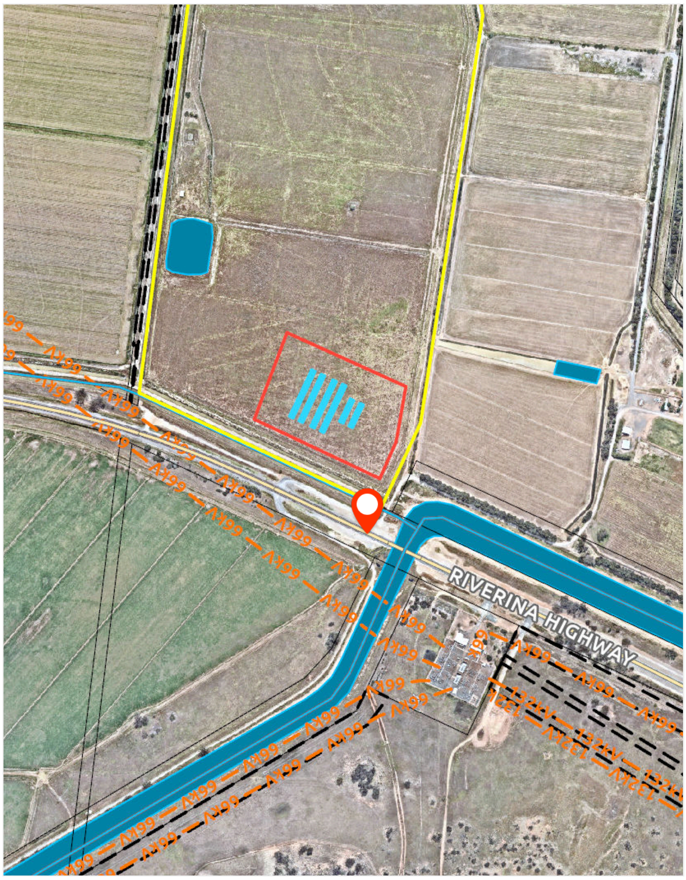

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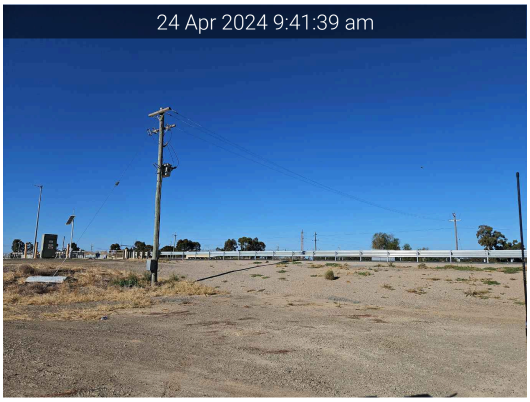

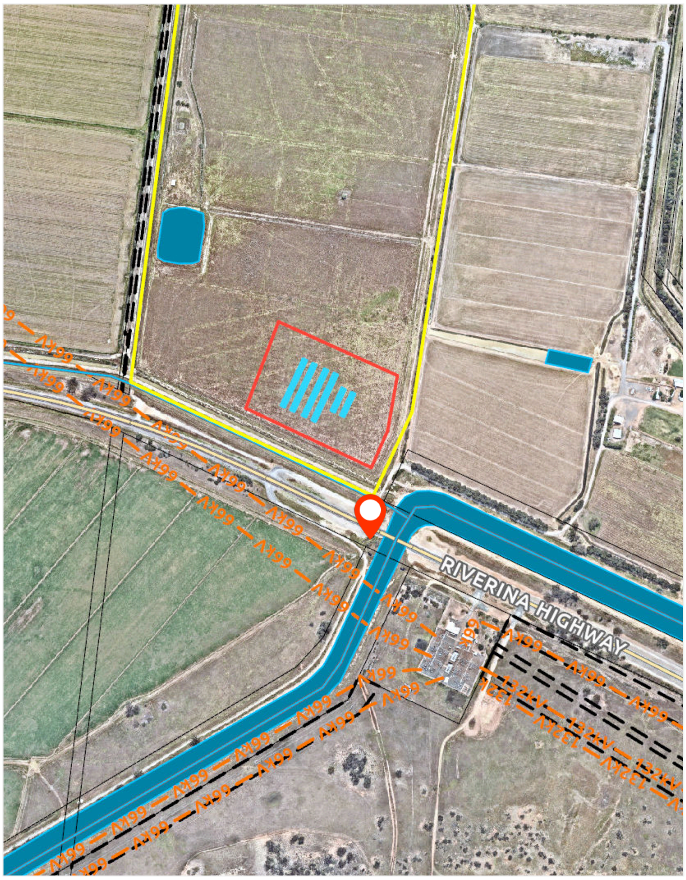

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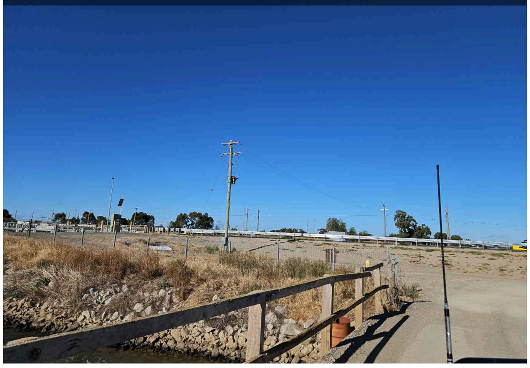

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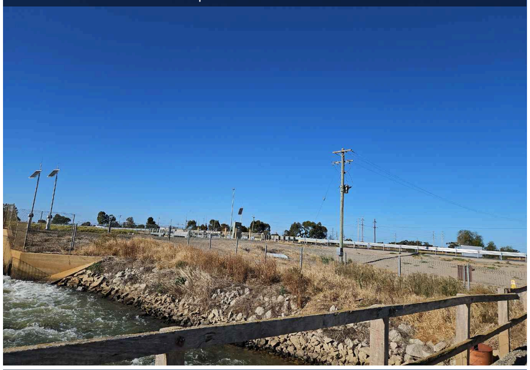

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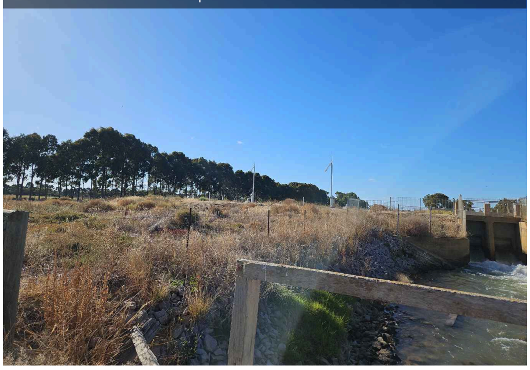

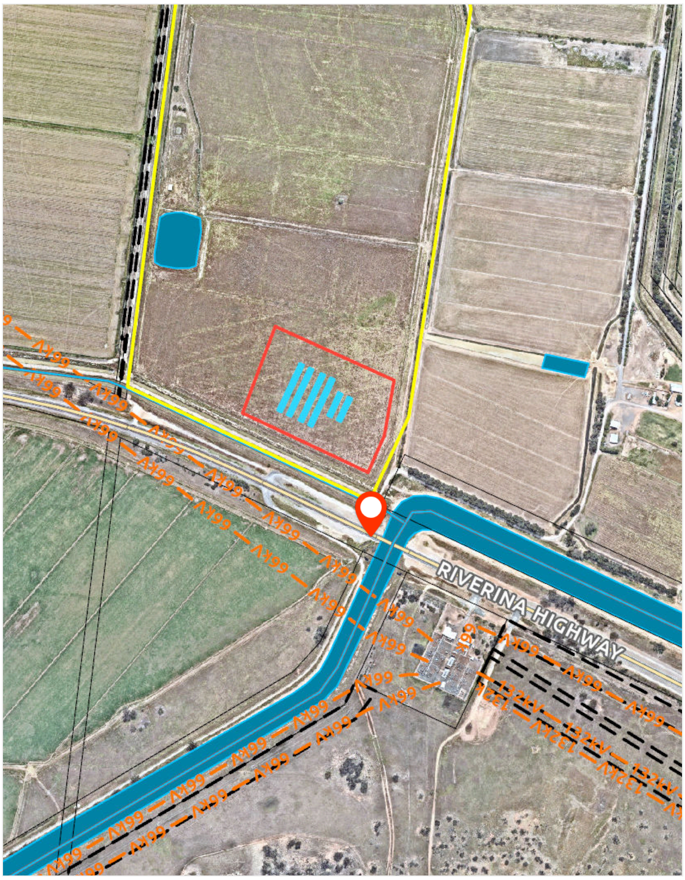

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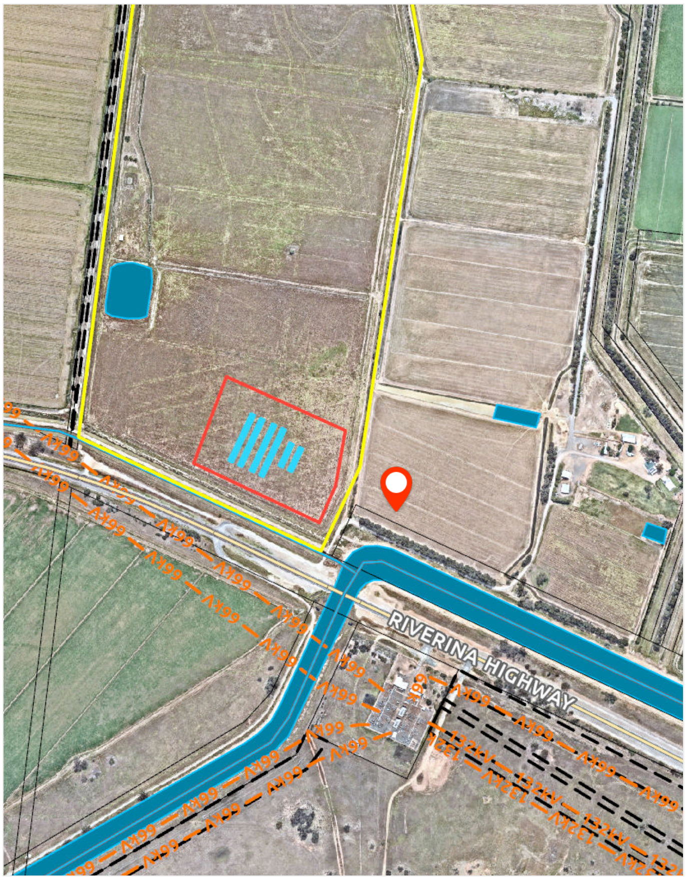

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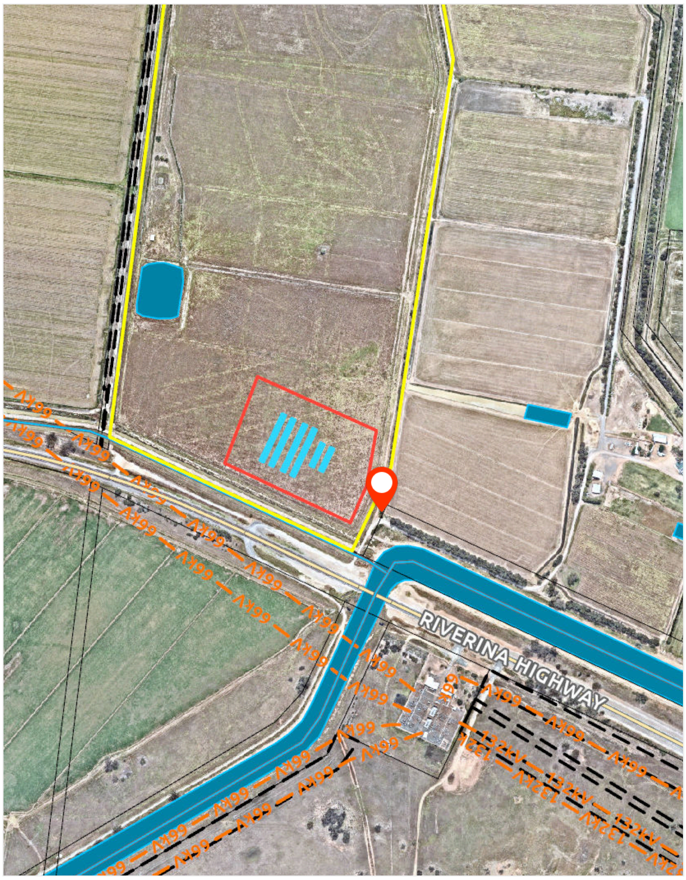

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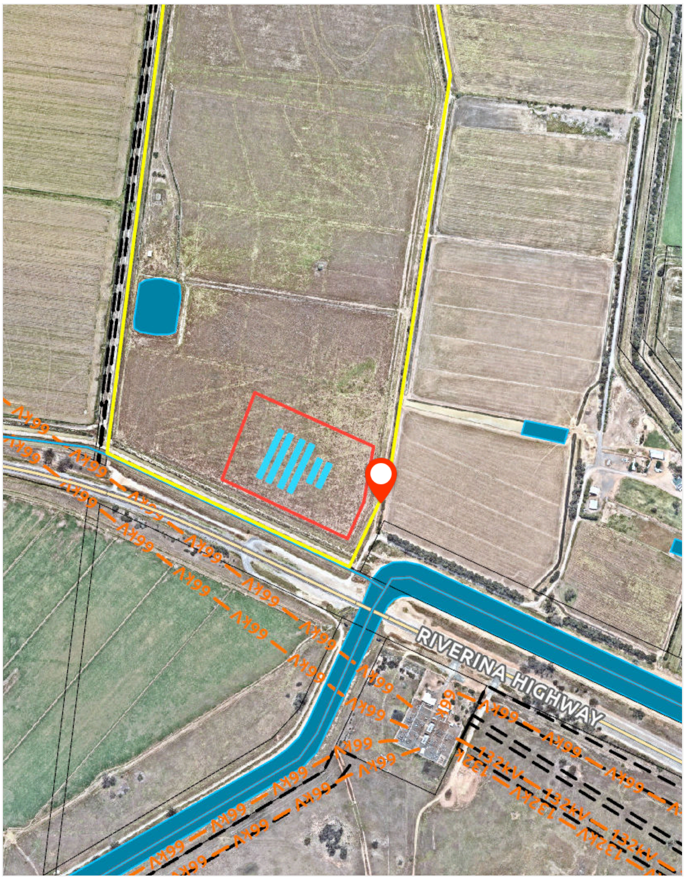

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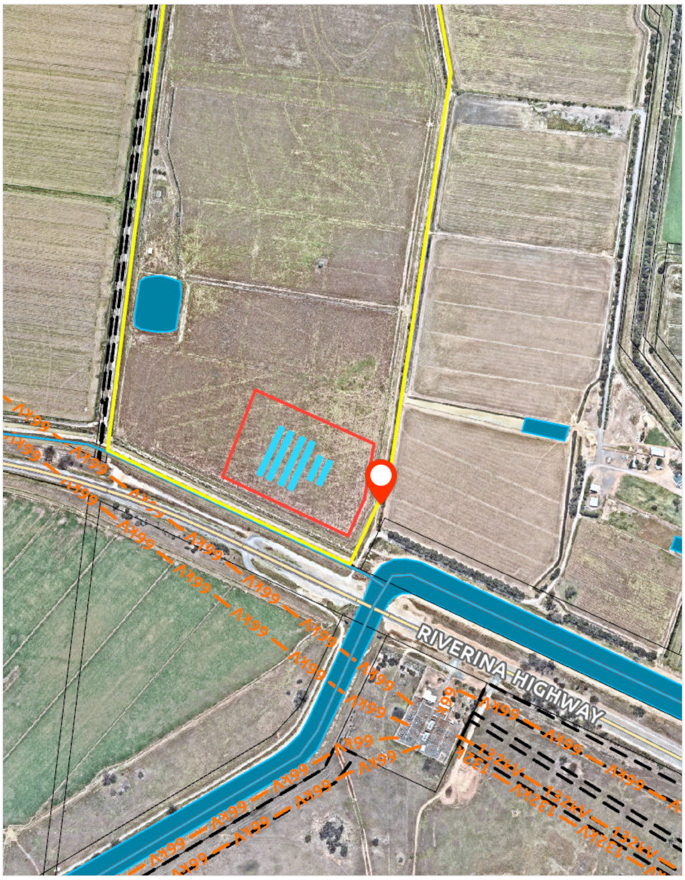

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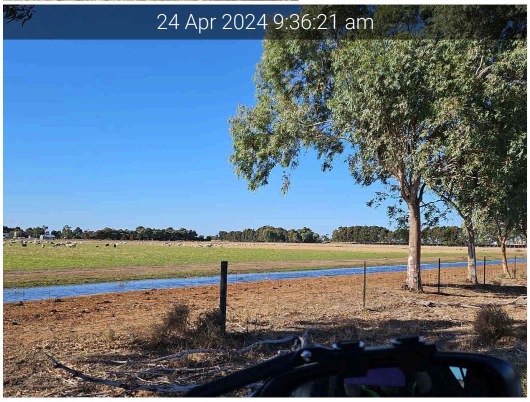

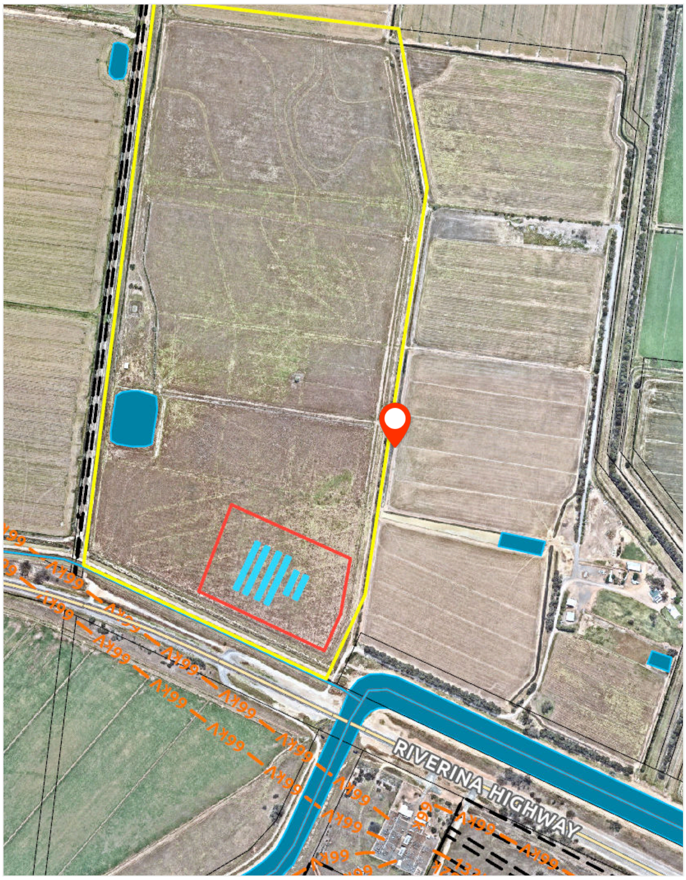

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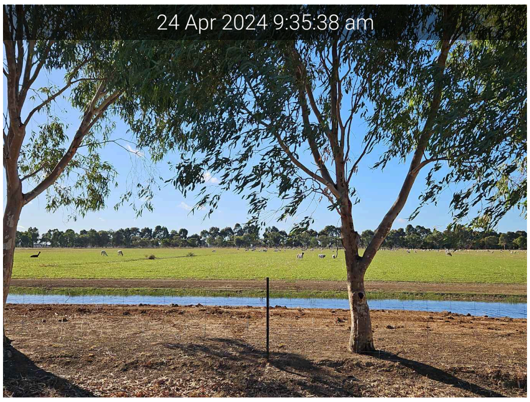

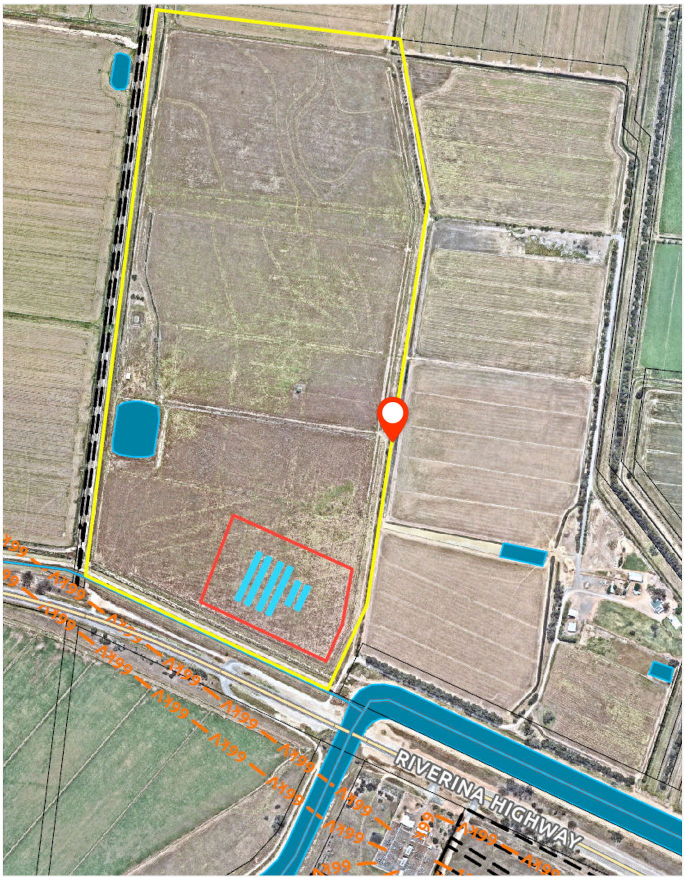

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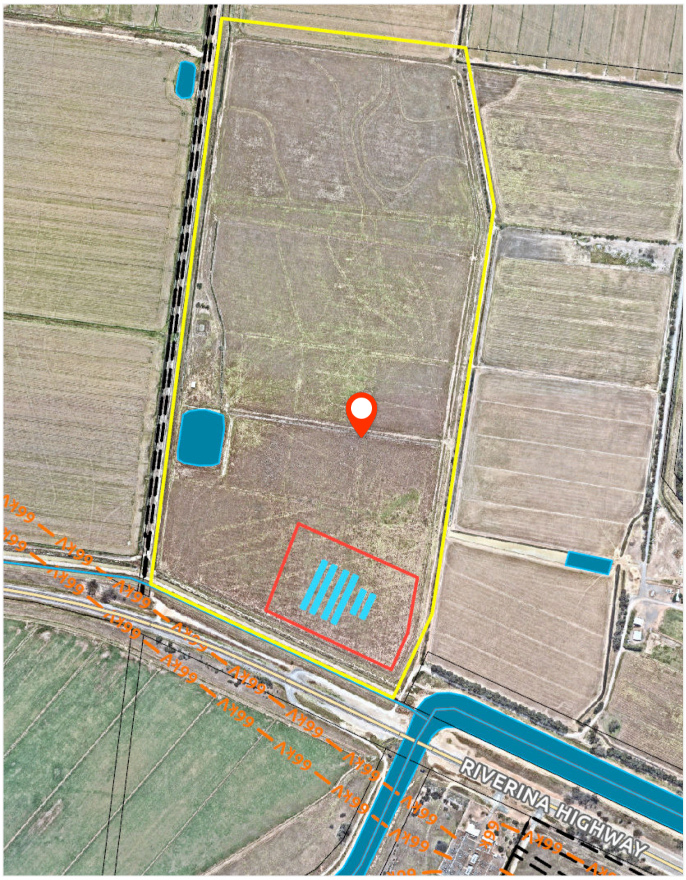

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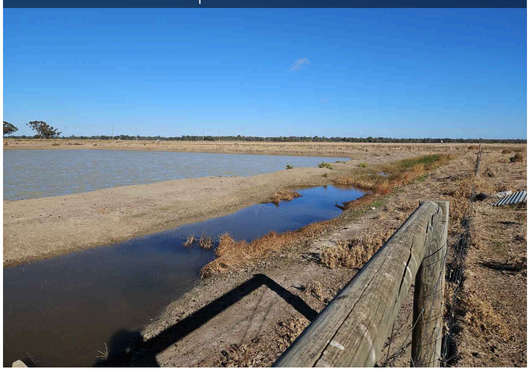

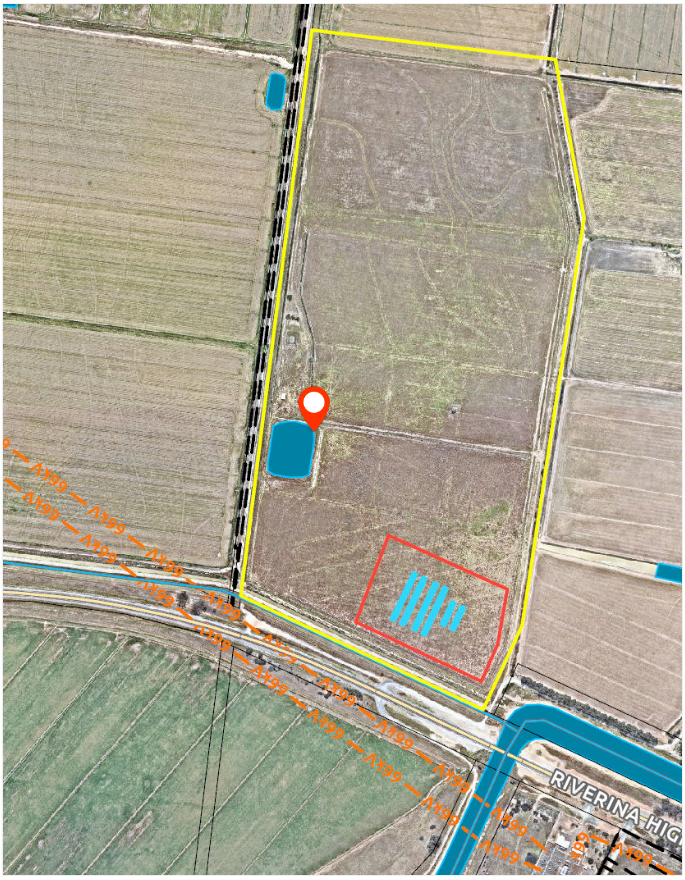

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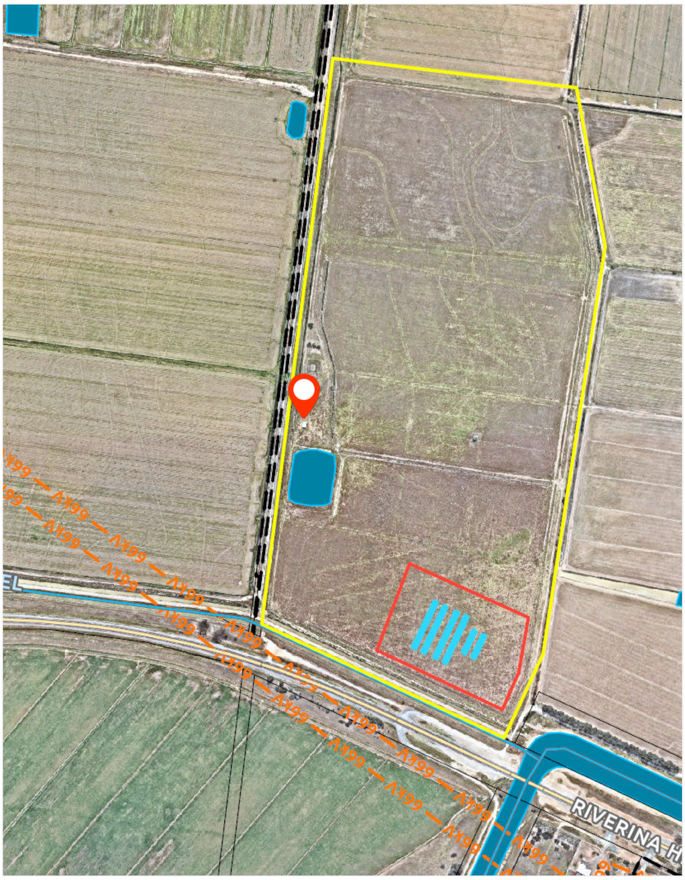

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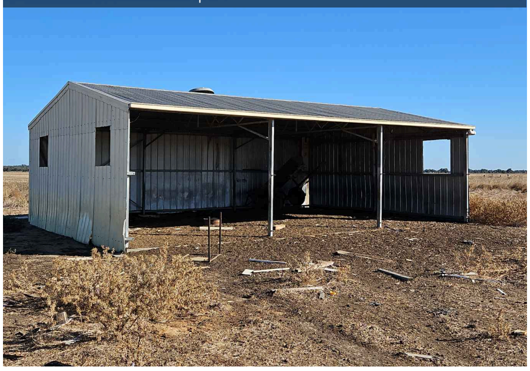

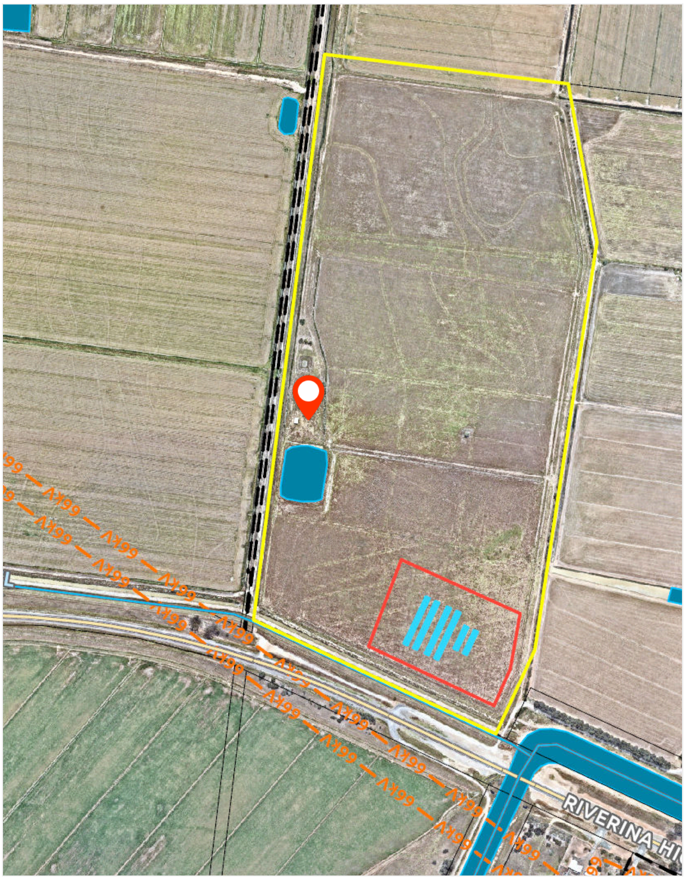

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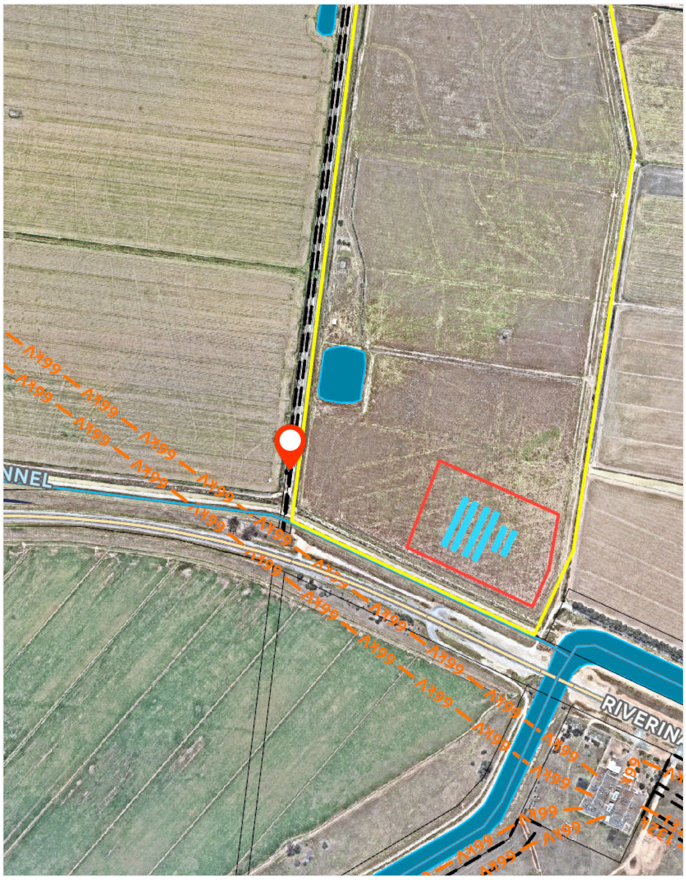

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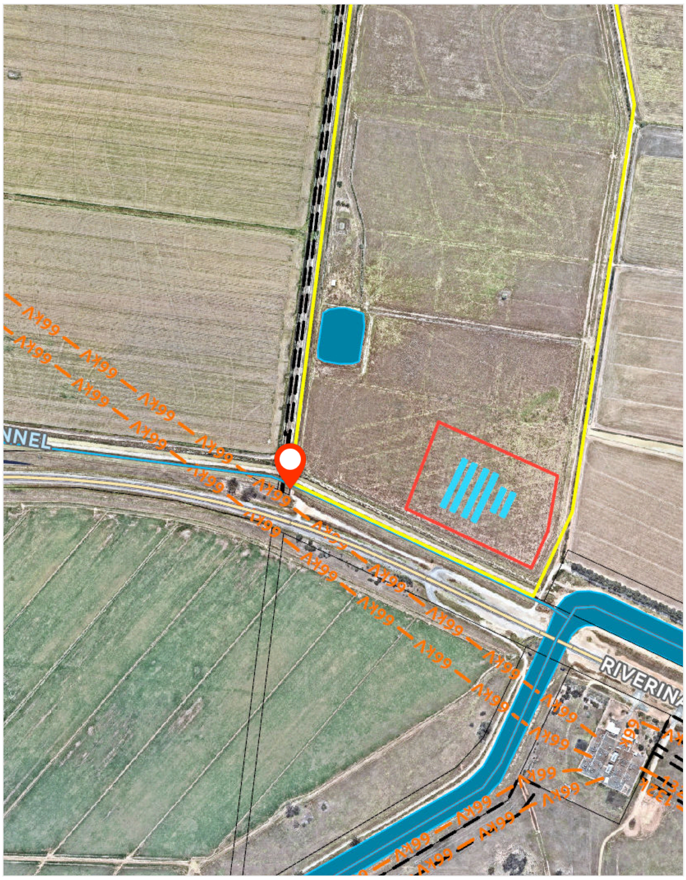

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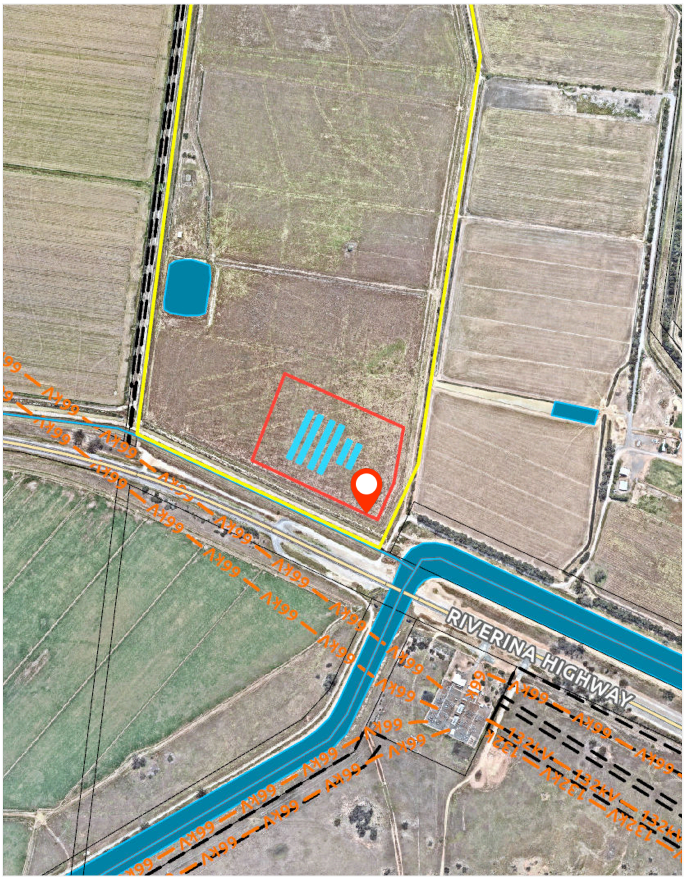

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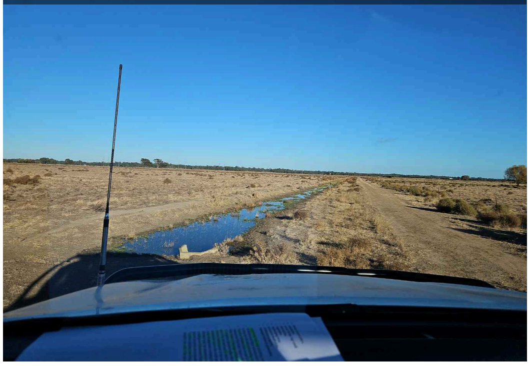

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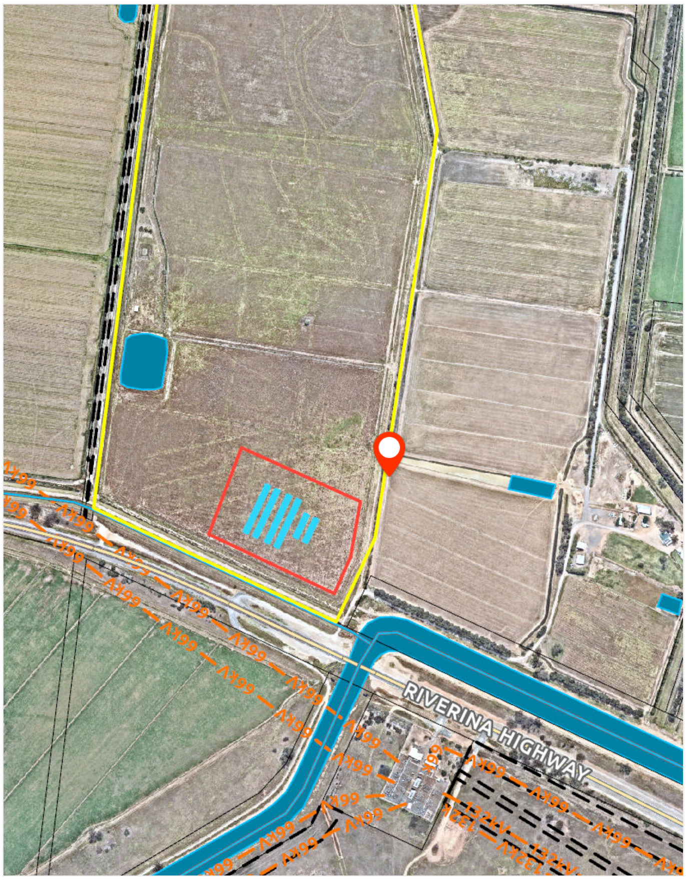

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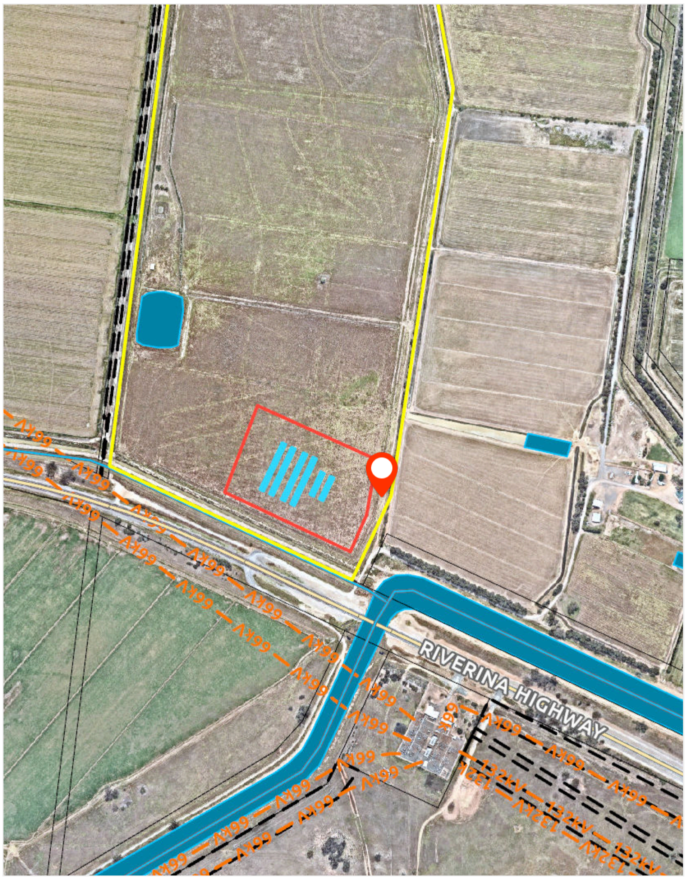
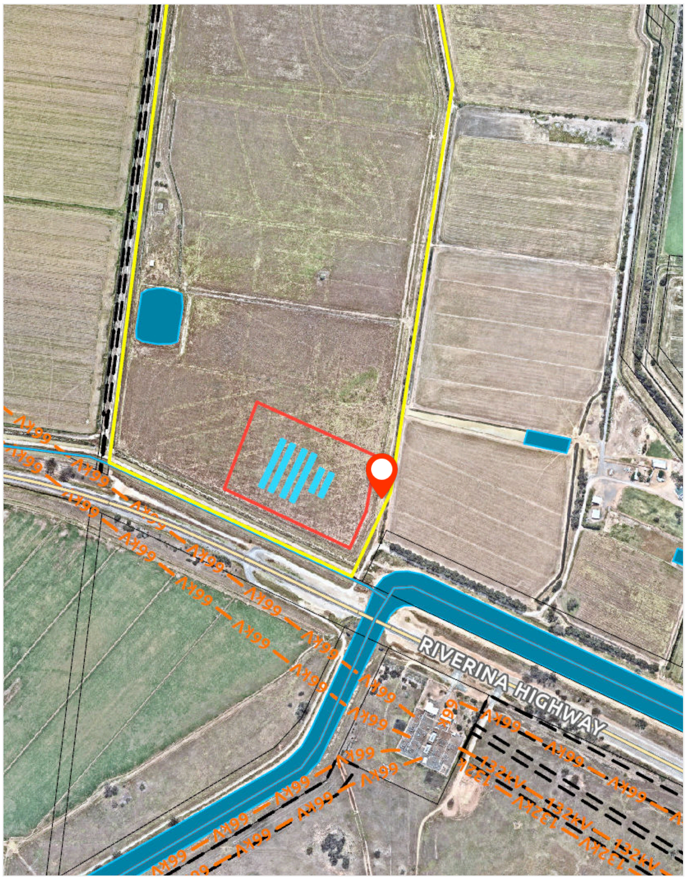
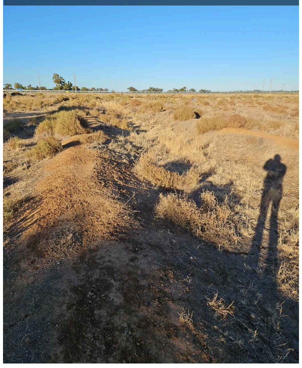


Item 22 **ID:** A008

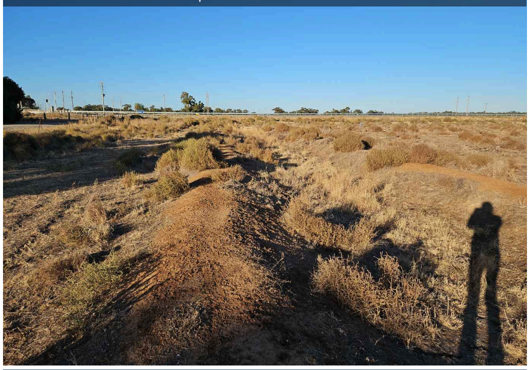


ID: A007

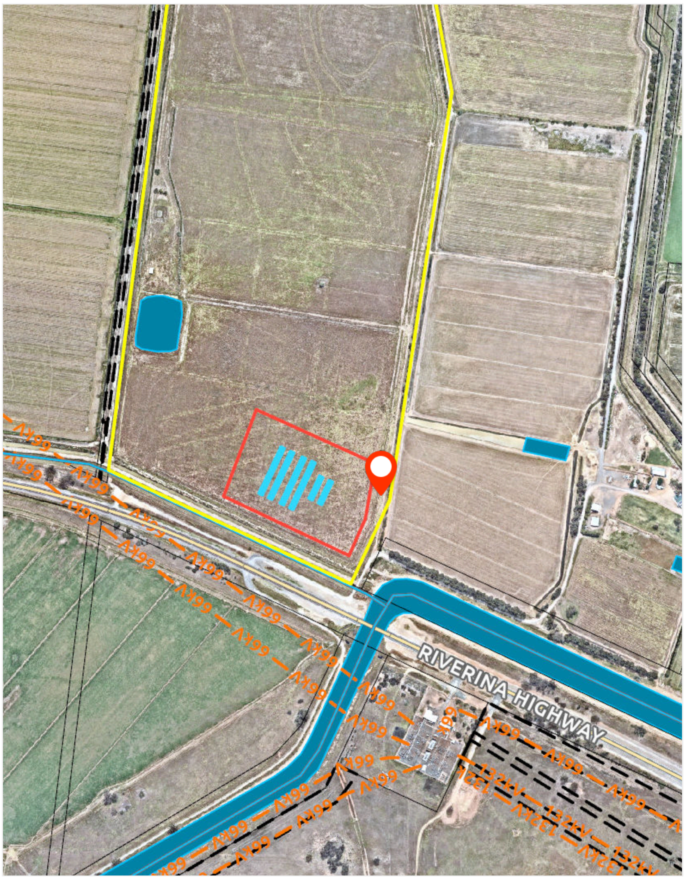
24 Apr 2024 8:01:35 am



24 Apr 2024 8:01:40 am

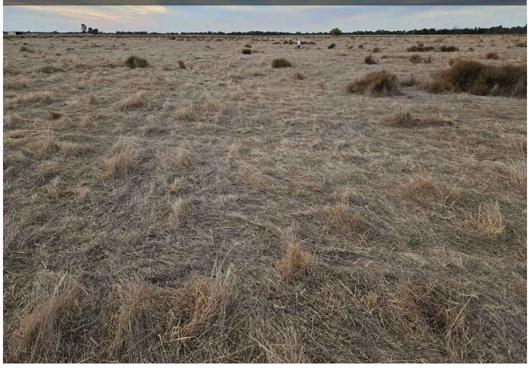


24 Apr 2024 8:01:44 am

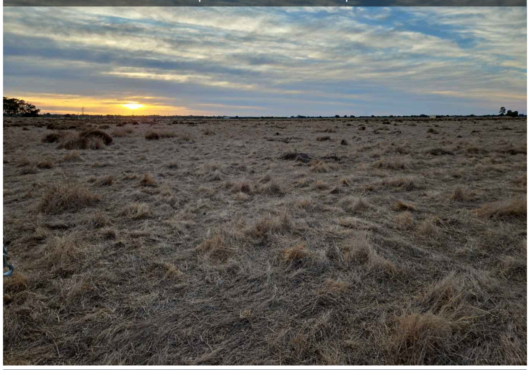


ID: A006

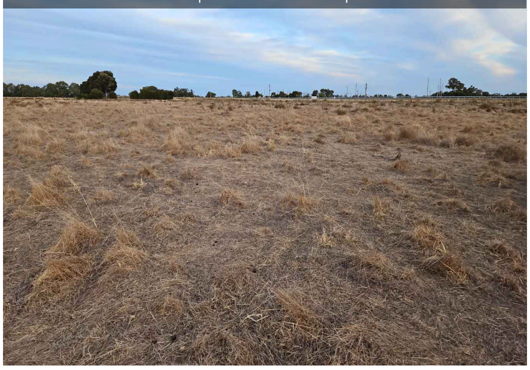
23 Apr 2024 5:30:00 pm



23 Apr 2024 5:30:06 pm



23 Apr 2024 5:30:11 pm



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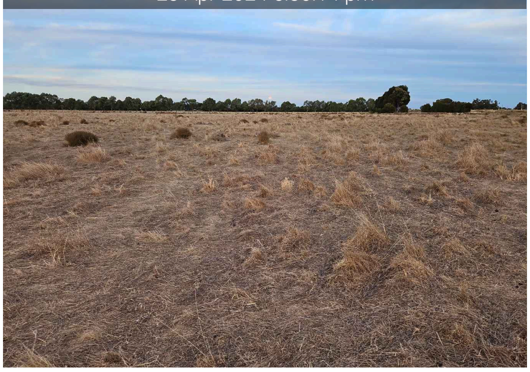
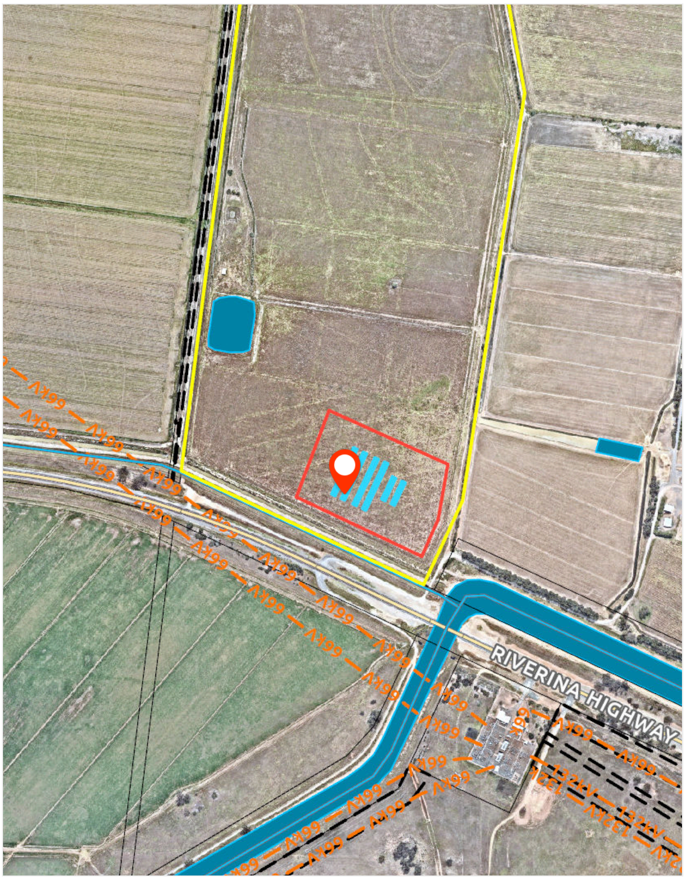


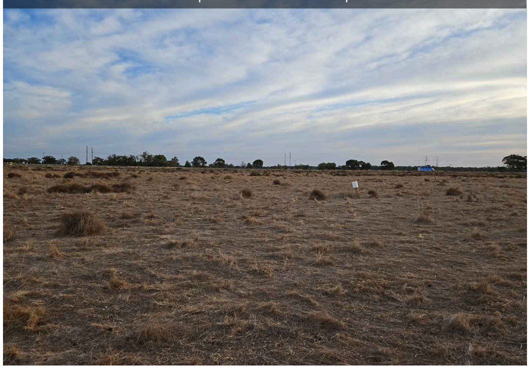


ID: A005

23 Apr 2024 5:05:07 pm

23 Apr 2024 5:05:11 pm

23 Apr 2024 5:05:14 pm



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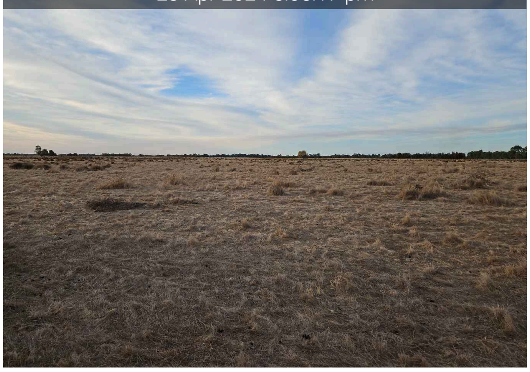

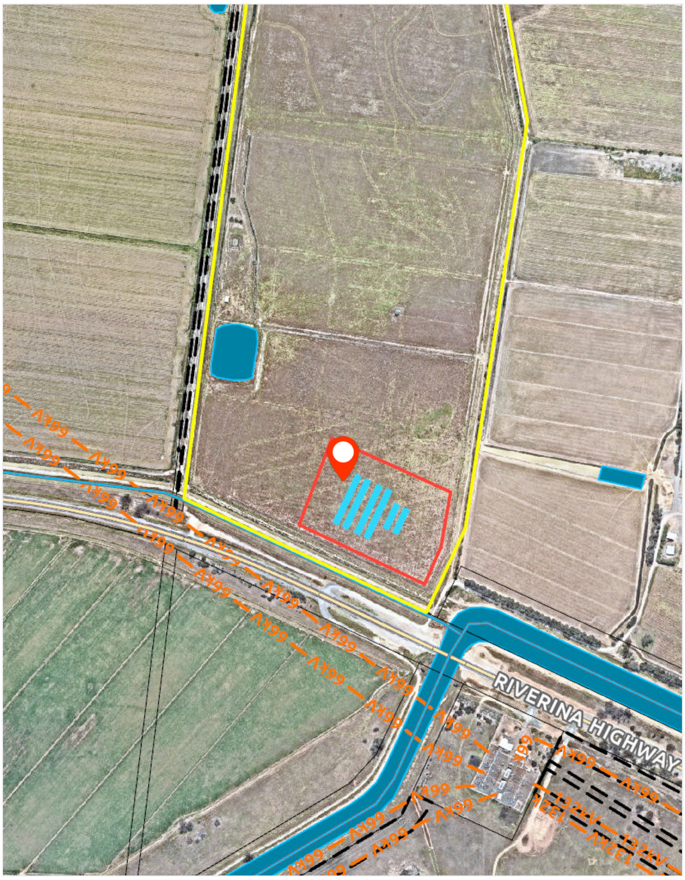

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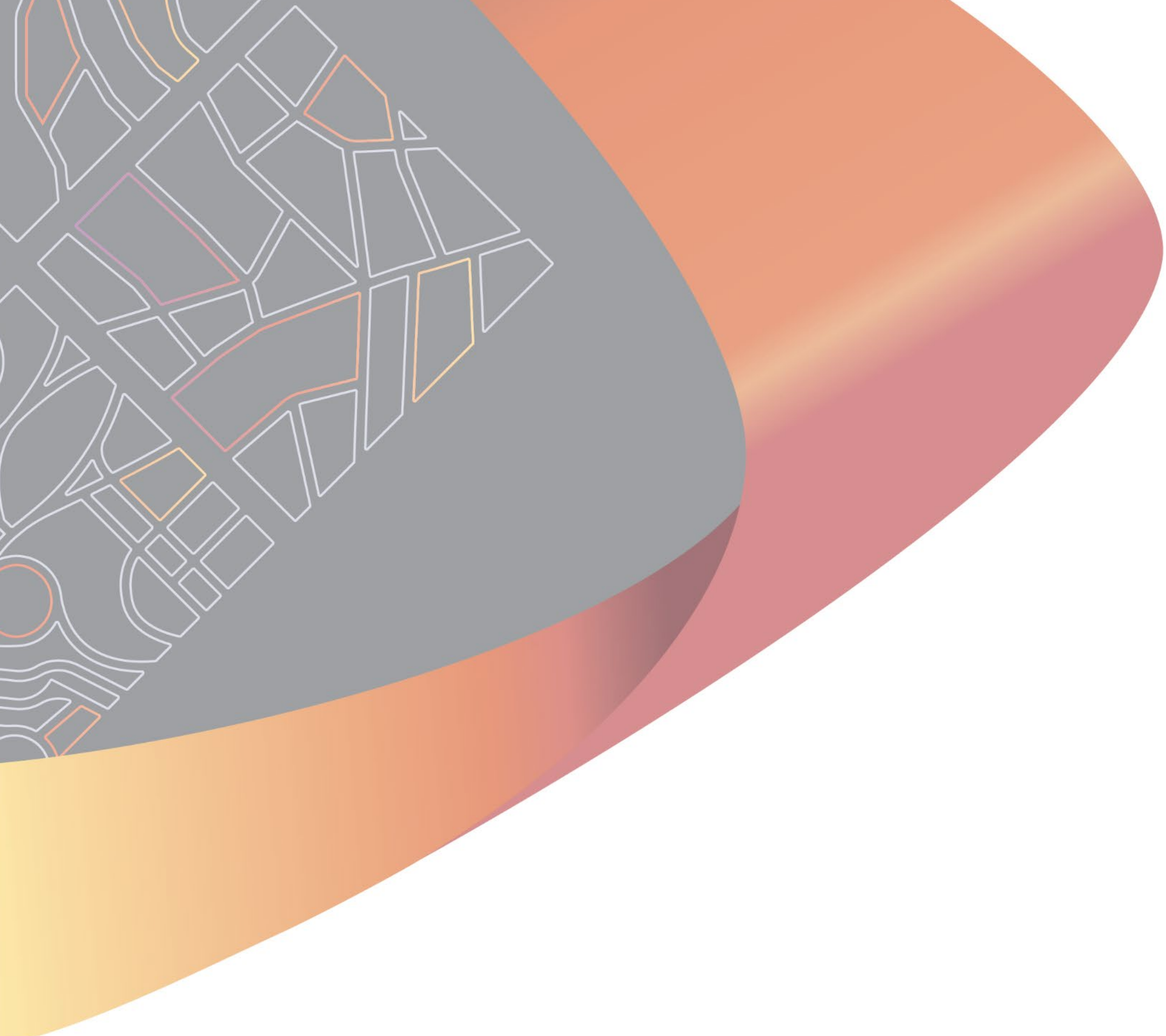

Premise