ADVERTISED
PLAN

AGRICULTURAL ASSESSMENT

CONSTRUCTION AND OPERATION

of the proposed

ELAINE SOLAR FARM

Prepared by

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for

Urbis

Ag-CHALLENGE CONSULTING pty. ltd.

September 2023

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1. Introduction

1.1 Project Brief

ELGIN Energy proposes to develop a solar farm spanning over multiple titles (Table 1) along Woolshed and Midland Highway, Elaine 3334. The proposed solar array area encompasses approximately 184 hectares of farming land approximately 20 kilometres southeast of Ballarat, in the Moorabool Shire. Ag-Challenge Consulting has been engaged to investigate the agricultural impacts of the proposed development.

The Point of Connection is located a short distance to the Elaine Substation and so the site is well placed in relation to this. Site investigations are ongoing and detailed plans are being developed with respect to all physical and cultural considerations and following engagement with communities and authorities.

This investigation describes the existing agricultural use in both a local and regional context. The investigation is to consider the impact of the solar development on the existing uses of the land, identify any potential impacts on adjacent properties and determine whether the proposal is likely to have any adverse impacts on surrounding land uses and the regional agricultural economy.

The proposed solar array development area (Table 1) is hereinafter referred to as the Project Site, and the Project Site consists of 5 parcels of land described in Table 1. An aerial photomap of the Project Site is shown in Figure 1 and the Project Site layout is shown in Figure 2.

Table 1. Titles relating to the Project Site.

Property Address (Elaine)	Standard Parcel Identifier (SPI)	Project Site Boundary Area (ha)	Total Approx. Proposed Solar Array Area (ha)
Woolshed Road	21E\PP3271	96.3	43.9
	21F\PP3271		
	21G\PP3271		
	50\PP3271		
Midland Highway	17\PP3271	170.9	140.5
		267.2 total	184.4 total

1.2 Experience and Capability of Ag-Challenge Consulting

Ag-Challenge Consulting is an agricultural consultancy company servicing the high rainfall and irrigated agriculture industries of Victoria. Based in Warragul, the principals of the company have been providing independent farm consultancy advice since 1988. There are four active consultants within the company that service approximately 200 individual farmer clients with consultancy services and facilitation of discussion groups. The recycled water industry is a significant user of Ag-Challenge Consulting for land capability assessments along with functional irrigation system design and monitoring of recycled water projects. The renewable energy industry been a significant client, using the company services for site selection and design, liaison with adjacent farm businesses and assistance in satisfying the provisions of planning schemes.

Figure 1. The Project Sites (267 ha)

Key:
Project Sites

Transmission Line

Figure 2. Contours and watercourses of Project Sites

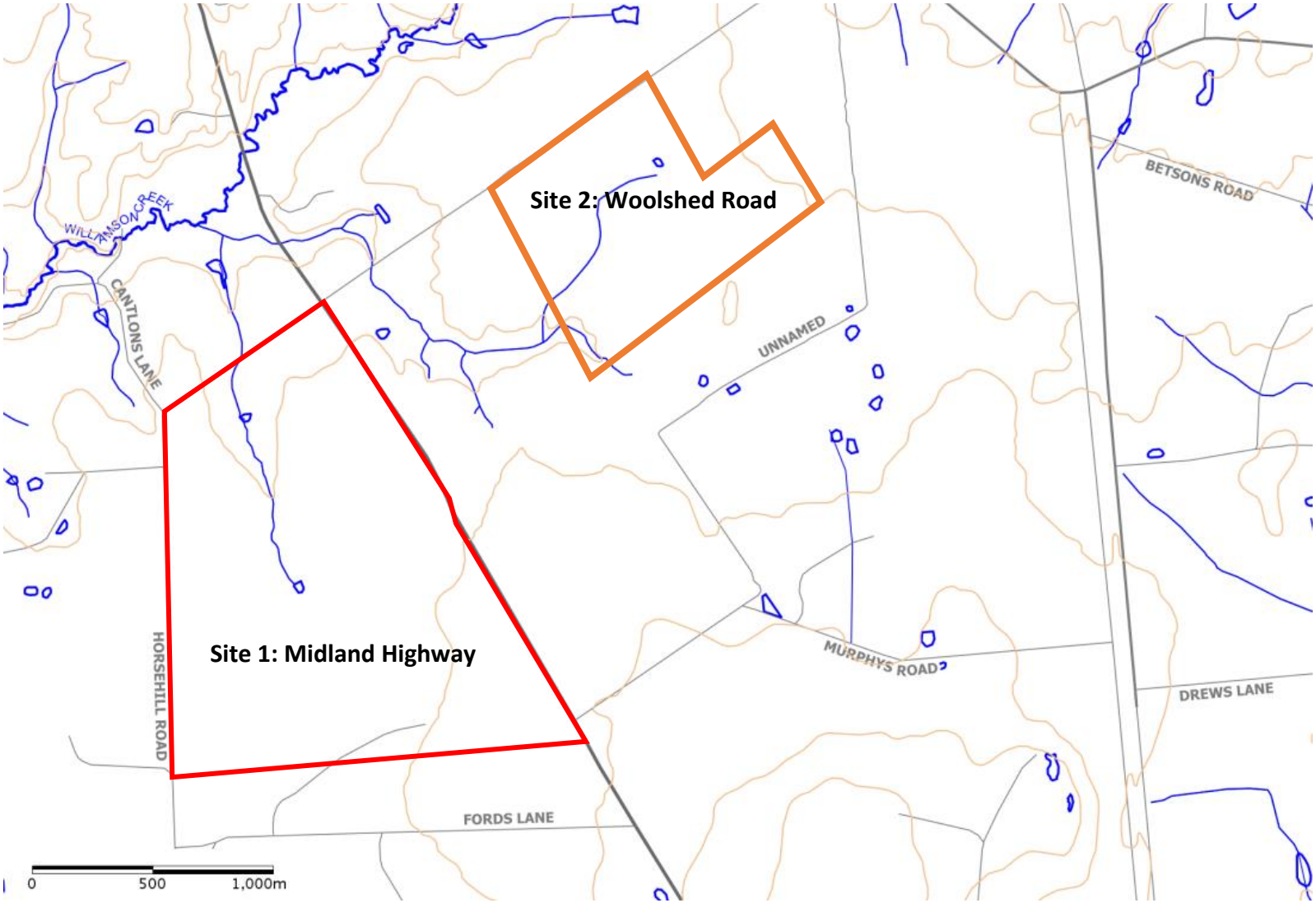
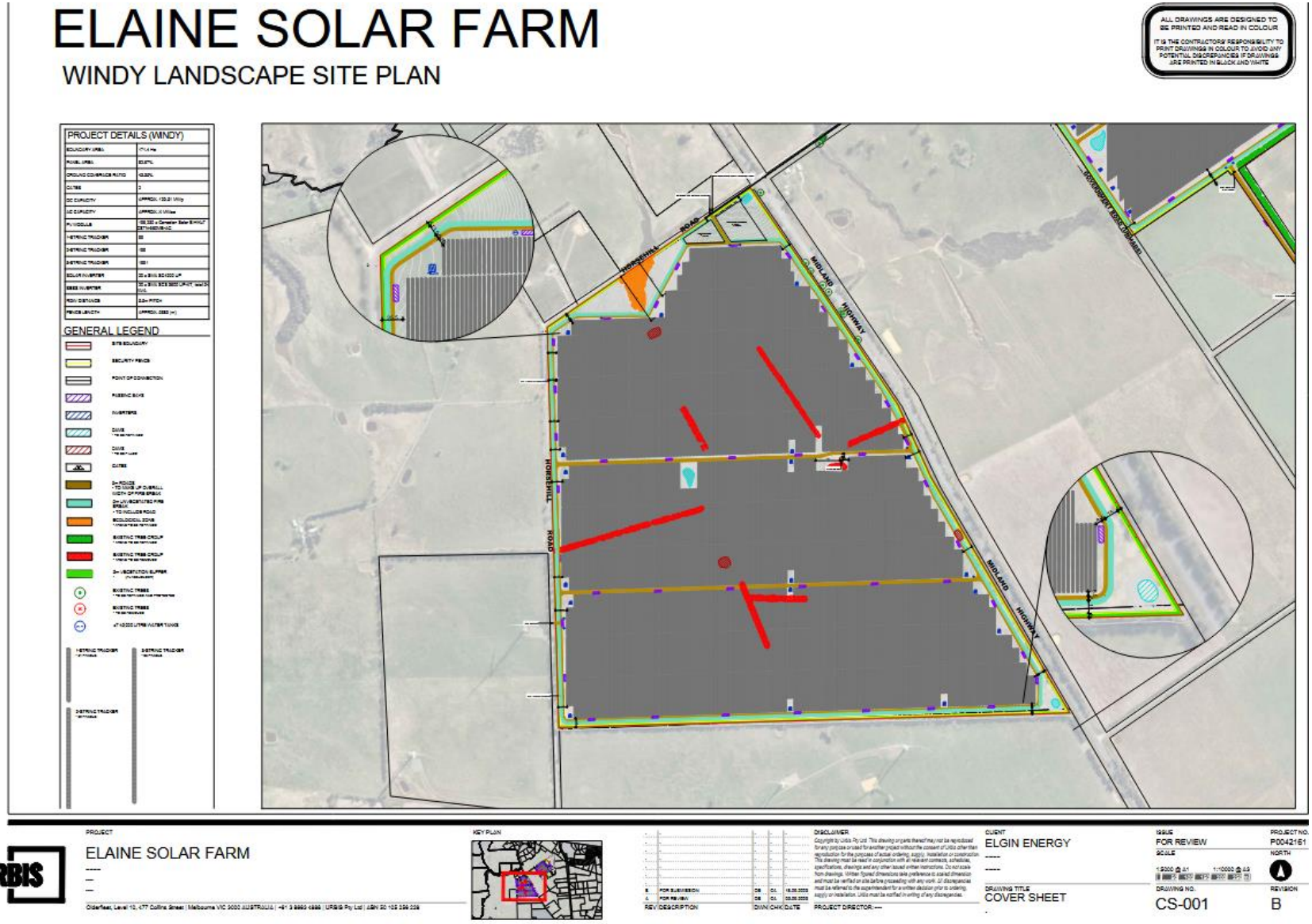


Figure 3. Project Site Layout.



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PLAN

ELAINE SOLAR FARM

PETERS LANDSCAPE SITE PLAN

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IT IS THE CONTRACTORS' RESPONSIBILITY TO PRINT DRAWINGS IN COLOUR TO AVOID ANY POTENTIAL DISCREPANCIES IF DRAWINGS ARE PRINTED IN BLACK AND WHITE

PROJECT DETAILS (PETERS)	
BOUNDARY AREA	74.82 Ha
FENCE AREA	60.60 %
CHOSEN COVERAGE RATIO	43.32%
DATES	-
DC CAPACITY	APPROX. 43.33 MWp
AC CAPACITY	APPROX. 31 MWac
PV MODULE	82,320 x Canadian Solar 540W/LP CS7N-540TB-HC
1-STRING TRACKER	180
2-STRING TRACKER	210
3-STRING TRACKER	442
SOLAR INVERTER	12 x SMA SC4000 UP
BESS INVERTER	12 x SMA SCS 2000 UP-ET, total 24 MVA
ROW DISTANCE	3.0m PITCH
FENCE LENGTH	APPROX. 4300 (m)

GENERAL LEGEND

- SITE BOUNDARY
- SECURITY FENCE
- POINT OF CONNECTION
- PASSIVE BAYS
- INVERTERS
- GATE
- GATE
- GATES
- 2m ROADS + TO 10m(S) UP OVERALL WIDTH OF FIRE BREAK
- 2m LAY/SCRUTINY FIRE BREAK + TO INCLUDE ROAD
- ECOLOGICAL ZONE
- EXISTING TREE CROP
- EXISTING TREE CROP
- 2m VEGETATION BUFFER
- EXISTING TREES
- EXISTING TREES
- 1-STRING TRACKER
- 2-STRING TRACKER
- 3-STRING TRACKER

PROJECT
ELAINE SOLAR FARM

Oldertleet, Level 12, 477 Collins Street | Melbourne VIC 3000 AUSTRALIA | +61 3 9663 4888 | URBIS Pty Ltd | ABN 50 105 256 228

KEY PLAN

REV	DESCRIPTION	DWN	CHK	DATE
B	FOR SUBMISSION	DB	CL	18.08.2023
A	FOR REVIEW	DB	CL	08.08.2023

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PROJECT DIRECTOR:—

CLIENT
ELGIN ENERGY

DRAWING TITLE
COVER SHEET 02

ISSUE
FOR REVIEW

SCALE
1:5000 @ A1 1:10000 @ A3

PROJECT NO
P0042161

NORTH

DRAWING NO.
CS-002

REVISION
B

2. Regional Context

2.1 Planning Provisions

The Project Site is located within the Farming Zone and Schedule 1 thereof of the Moorabool Planning Scheme. The objectives of the Farming Zone are:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To provide for the use of land for agriculture.*
- *To encourage the retention of productive agricultural land.*
- *To ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture.*
- *To encourage the retention of employment and population to support rural communities.*
- *To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.*
- *To provide for the use and development of land for the specific purposes identified in a schedule to this zone.*

A planning permit is required for the development and use of a Renewable Energy Facility within the Farming Zone, and the Planning Scheme states that a condition of approval is that the facility must meet the provisions of Clause 53.13 of the Planning Scheme. Among other provisions, Clause 53.13 states that the applicant must undertake a site and context analysis including a description of the site and surrounding area and examine the impact of the proposal on strategically important agricultural land, particularly within declared irrigation districts. This agricultural assessment forms part of the response to the provisions of Clause 53.13.

The Project Site is subject to several planning overlays. The whole Project Site resides in a Design and Development Overlay (DDO) and is subject to schedule 2 (DDO2) of the guidelines, which has been created to enhance visual amenity and building design in the shire. Additionally a Bushfire Prone Area (BPA) applies to the entirety of the Project Site and has been created to prioritise the protection of human life and to strengthen community resilience in relation to bushfires.

Additionally, the Solar Energy Facilities Design and Development Guideline (October 2022) specifies a number of factors that also need to be considered during the site selection and decision-making process in order that agricultural production is not unduly detrimentally affected. These factors include:

- *Protecting strategically important agricultural and primary production land from incompatible land use.*
- *Protecting productive agricultural land that is of strategic significance to a local area or in a regional context.*
- *Avoiding the loss of productive agricultural land without considering the impact of the loss on the agricultural sector and its consequential effect on other sectors.*

The agricultural values of the land will be assessed in accordance with these guidelines, including an assessment of the agricultural significance of the land and the location of agriculturally significant land within the shire and the region.

2.2 Climate

The average long-term monthly rainfall data from SILO Long Paddock at Elaine have been recorded in Table 1, and climatic data are found in Appendix III. SILO uses interpolated data from the Bureau of Meteorology (BoM) and other suppliers to construct a spatial grid, to infill values for missing data. The data point which was used at a latitude of -37.75 and longitude of 144.00 and is considered indicative of this site[1]. The Project Site has a temperate climate with cool winters, mild summers, and a moderate average annual rainfall of 667 mm. Rainfall is distributed relatively evenly throughout the year with slightly greater amounts of rainfall throughout winter and spring.

Table 2. Monthly average rainfall (mm) for Elaine (SILO Data Lat: 37.75 Long: 144.00).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Elaine	45	43	35	50	55	59	58	67	67	71	68	51	667

The rainfall data for Elaine (SILO Data) has been entered into a water budget spreadsheet that can be used to predict seasonal surpluses and deficits (Appendix II). Allowing for a 100 mm carry forward of soil moisture from the slightly wetter months into the drier period of the year, and a pasture crop factor ranging from 0.6 in mid-winter through to 1.0 in summer, the growing season for pasture is predicted to be for about 5 months each year, with soil moisture being a significant restriction to growth from October through to May.

The BOM meteorology station at Durdidwarrah (Station No. 87021) records daily maximum and minimum temperatures as well as humidity and wind speed. A summary of the temperature data are provided in Appendix III. Frost is likely to have occurred if the screen temperature at the meteorology station falls to 2°C or less and a severe frost is likely to have occurred if screen temperature drops to 0°C or less. Frost will restrict the growth of pasture and crops, increase risk of livestock mortality (especially in young or susceptible stock), and out of season frosts have the potential to damage pastures and crops at sensitive growth stages. The data in Appendix III identifies frosts commonly occur throughout winter and September with 4-8 frosts expected per month. Importantly severe frosts do occur throughout winter with up to three severe frosts expected per month, and out of season frosts occasionally occur during May and September.

2.3 Regional Land Form

The Project Site is located within the Western Uplands which is a broad flat to gently undulating plain with mildly dissected terraces and slopes very gently towards the northeast.

The Western Uplands are a basaltic plain, formed during the Miocene to Holocene period, with deposits of basalt, marine sandstone and shale, which have been weathered over the years by fluvial processes of sheet and valleys incorporating gravel, sand and clay into the area. The soils tend to be acidic, low to very low permeability and with sodic subsoils. Historically they have supported agricultural systems of beef cattle or sheep grazing, cereal cropping, horticulture, or as uncleared nature conservation areas. [2]

[1] https://www.longpaddock.qld.gov.au/silo/point-data/
[2] https://vro.agriculture.vic.gov.au/dpi/vro/coranregn.nsf/pages/soil_landform_units50

2.4 Regional Land Use

Land use within the Western Uplands is a mix of agriculture, forestry, industrial and urban. Agriculture is the dominant land use by area, but plantation forestry is common further south in the catchment. Within the agricultural sector, grazing of sheep is the dominant farm enterprise. Additionally grazing beef farms, cereal and fodder cropping occur across the Western Uplands. Intensive horticulture predominantly through potato cropping occurs further north on the outskirts of Ballarat, on the volcanic soils. Development for intensive horticultural use on the project site is strongly market dependant, but also limited by the availability of commercial water licenses and poor soil structure which is not favourable for intensive cropping and cultivation. There is a diversity of other minor land uses.

There has been some pressure from peri-urban growth onto rural land for rural lifestyle blocks and small lot subdivision in the Moorabool Shire. The major urban centres of Ballarat, Baccus Marsh, and Meredith are all surrounded by peri-urban areas with properties ranging from a few hectares through to 10 or 20 hectares. Agricultural productivity in the peri-urban areas is often quite low, although this is not always the case and some of the small agricultural properties are highly productive. The pressure for these closer development rural holdings is likely to continue.

3 Site Characteristics

3.1 Description of the Land

The Project Site resides within the dissected western uplands and are comprised of a undulating rises and small convex slopes of 1% towards the north east and north west. An ephemeral tributary of Williamson Creek flows through both properties, running north-south on the Midland Highway property and east-west on the Woolshed Road property towards farms dams.

3.2 Soils

The dominant soils of the Corangamite soil-landforms were described by Robinson *et al* (2003) as mottled brown, grey or yellow texture contrast soils (55% of the landscape) with the subdominant soils being grey cracking clay soils. Robinson *et al* describes these soils as typically sandy loam surface soil overlying a sporadically bleached subsurface horizon with some stone.[3]

In descriptive terms, these classifications mean that the dominant soils have contrasting texture between the surface soil and subsoil. Soils inspected at multiple locations within the Project Site consisted of brown loamy sand to silty loam at the surface with a bleached layer below. The surface soils are mostly shallow, poorly structured leading to a buckshot layer at around 50 cm which overlies a medium clay. The depth to the B horizon can vary significantly throughout small localities. The bleached A2 horizon and buckshot is indicative of restricted drainage and of low organic matter and soil fertility.

3.3 Vegetation

Ground cover at the Project site is mostly improved pasture species, in addition to a paddock cropped to oats. The species recorded as present include Perennial Ryegrass, Yorkshire Fog

[3] https://vro.agriculture.vic.gov.au/dpi/vro/coranregn.nsf/pages/soil_landform_units50

grass, Clover, Poa species, Bent grass, Couch Grass, Thistle and Flatweeds. In drainage lines bordering the dams resides capeweed with its presence not noted throughout the paddocks.

Midland Highway Parcel:

There are several stands of re-vegetated and remanent various acacia and eucalyptus tree species along the eastern and southern property boundaries and between the three most northern paddocks. Between the three most southern paddocks on the Midland Highway are mature cypress tree (*Cupressus*) windbreaks. The drainage depression central to the northern border is dominated by Rush (*Juncus*) which is indicative of wet 'swamp-like 'conditions.

Woolshed Road Parcel:

A relatively young stand of revegetated acacia and eucalyptus plantings border the northern side of the most eastern paddock, and a fenced off rectangular planting of Cyprus trees is located in the southern portion of the property. Additionally, remnant scattering of eucalyptus trees are present across the property parcel.

3.4 Water Supply

Stock water for the grazing operations at the project site are supplied through reticulated water supply from a bore and 2 inch mainline to stock troughs in each paddock. The bore is located outside of the project site at 5930 Midland Highway. In addition to the stock troughs each paddock has small rainfed dams which are not reliable as the sole source for stock water supply.

There is a groundwater resource in this area. There is potential for developing this resource for agricultural use and this is investigated in Section 4.2 and in more detail in Appendix IV.

3.5 Farm Infrastructure

The two boundary areas encompassed by the Project Site have historically been farmed as a singular enterprise and are farmed in conjunction with multiple land parcels adjacent to the project site. Most of the farm infrastructure that is available to service the Project Site therefore exists on adjacent land, including shedding, yards, bore, farm laneways and additional stock handling facilities. Within the Project site of the Midland Highway Parcel are central stock handling facilities, loading race and dilapidated shedding. The stock yards and loading race can be retained and moved.

Both properties have boundary fences and internal fences generally in good condition with barbed wires and a top electric wire.

3.6 Current Land Use

The current land use is grazing with predominantly sheep and some beef cattle. At the time of field inspection, the whole property was being grazed by multiple herds of different aged sheep and one herd of angus beef cattle. Pastures were mostly improved. The Project Site is currently being grazed at a stocking capacity of 7-9 DSE/ha, which is considered indicative of the area, given the improved pastures, moderate annual rainfall, and poorly drained soils.[4] During field inspection an oat crop was being grazed in addition to pastures of a ryegrass clover mix. The current landowner operates a number of other properties and periodically uses the subject property for sheep and intermittent cattle grazing.

[4] DSE or dry sheep equivalent is a measure of carrying capacity and is defined as the amount of fodder required to maintain the liveweight of a 45 kg wether.

4 Land Capability and Agricultural Production Potential Assessment

4.1 Agricultural Land Capability Classification

Land Capability Rating systems for a series of land uses, including agricultural land uses were developed by Rowe, Howe and Alley.[5] This Land Capability Rating system adopts the highest assessed value across a range of relevant risk factors to determine the overall land capability rating for a particular site and land use. The Project Site consists of a single land type with little variability in soils throughout the property. For the purpose of the land capability assessment the land can be considered to be of the one type. Land capability assessment is instructive in identifying whether there are severe constraints and serious risk factors impacting on a particular land use.

The Land Capability Rating for grazing use in moderate rainfall areas is provided in Table 3 below. The average annual rainfall of the Project Site is moderate, and the Land Capability Rating for grazing provided below is considered indicative of the agricultural use. For each land feature to be assessed, the appropriate attribute is highlighted in the table. The overall land capability is determined by the highest assessed numerical value, which gives an overall rating of 3. A rating of 3 means that the land is suitable for this use, and there are some risk factors, in relation to the soils on the property which can mostly be managed through a moderate stocking rate.

Table 3. Land Capability for Grazing in moderate rainfall areas.[6]

	Land Capability Class[6]				
Land Feature	**1**	**2**	**3**	**4**	**5**
Slope	Less than 10%	10% to 19%	20% to 34%	35% to 50%	More than 50%
Aspect	E. SE	S, SW, NE	N, NW, W		
Soil Group (Northcote)	Gradational soils, Um soils	Duplex soils with A horizon of 15 to 60 cm thickness	Other duplex soils; Ur & Ug soils, Uc soils with impeding layer within 100 cm	Uc soils with no impeding layer within 100 cm	
Average soil depth	More than 1.0 m	0.6 m to 1.0 m	0.3 m to 0.59 m	0.1m to 0.29 m	Less than 0.1 m
Surface rock	Less than 2%	2% to 14%	15% to 24%	25% to 40%	More than 40%
Site drainage	Well drained	Moderately or excessively well drained	Imperfectly or poorly drained	Very poorly drained	
Nominal DSE/ha rating	More than 15	5 to 15	2 to 5	Less than 2	

A Land Capability Rating of 1 or 2 means that the land is suitable for these uses and the hazards associated with such use are low to very low. It means that this is a sustainable form of land for grazing from an environmental risk perspective. A Land Capability Rating of 3 indicates that there is a minor hazard and risk of land degradation hazard associated with this use, which can usually be corrected with appropriate prudent management. A Land Capability Rating of 4 indicates that significant land degradation risks are associated with the particular land use, while a rating of 5 indicates that risks are severe and that the land may not be suitable for such use without very significant and potentially expensive intervention.

[5] Rowe, Howe & Alley. (1981). *Guidelines for Land Capability Assessment in Victoria*, Soil Conservation Authority.
[6] Rowe, Howe & Alley. (1981). *Guidelines for Land Capability Assessment in Victoria*, Soil Conservation Authority.

The Land Capability Rating for cropping is presented in Table 4, with the highlighted boxes being the assessed rating for the Project Site for each parameter. The rating criteria for cropping use was based on the production of annual horticultural crops such as potatoes and is considered relevant as crops could potentially be grown on this land type with access to commercial irrigation. The combined land parcel is determined to have a Land Capability rating of 4 and is not considered suitable for horticultural cropping. The poor structured and poorly drained soils would likely only continue to worsen with intensive cultivation and tillage practices as a result of cropping. This is difficult to manage appropriately without leaving the land as permanent pasture. While the availability of groundwater for irrigation of horticultural crops is considered a valuable source, the lack of water for crops is not considered the limiting factor. Overall, intensively cropping the land is not considered sustainable without significant modifying practices, ie. No tillage, stubble retention, long period of permanent pasture in rotation.

Table 4. Land Capability Rating for Intensive Cropping.[7]

LAND FEATURES AFFECTING USE	CAPABIITY CLASS[6]				
	1	**2**	**3**	**4**	**5**
SOIL STRUCTURE Gradient: Apedal – weak	0 - 4%	4% to 8%	8% to 15%	15% to 20%	More than 20%
Moderate, S.G.	0 - 8%	8% to 15%	15% to 20%	20% to 35%	More than 25%
Strong	0-15%	15% to 20%	20% to 35%	35% to 50%	More than 50%
FLOODING RETURN PERIOD	More than 20 years	20 years to 10 years	10 years to 5 years	5 years to 1 year	Several times per year
SOIL DRAINAGE CLASS	Well drained, Moderately well drained	Excessively well drained	Imperfectly drained	Poorly drained	Very poorly drained
ROOTING DEPTH	More than 50 cm	50 cm to 30 cm	30 cm to 20 cm	20 cm to 15 cm	Less than 15 cm
TEXTURE OF A HORIZON	L, SL, CL	SCL, LS, S	C	-	-
AGGREGATE STABILITY OF A HORIZON	1 (stable)	2	3	4.5 (dispersing)	
GRAVELS & STONES	Less than 4%	4% to 10%	10% to 20%	20% to 30%	More than 30%
BOULDERS AND ROCK OUTCROP	Less than 0.01%	0.01% to 0.05%	0.05% to 1%	1% to 10%	More than 10%

4.2 Land Quality & Strategically Important Agricultural Land

Agricultural land may be considered to be high value and strategically important due to a combination of features such as high quality or niche soils, good rainfall, access to irrigation, resilience to climate change, existing infrastructure investment and/or its special role within a specific industry.

The soils that are present on both properties are not highly regarded by the broadacre cropping industries due to the poor structure, buckshot layer and poor drainage.

There is the potential for use of bore water for irrigation, with the acquisition of an irrigation licence for SRW. However, it appears likely that groundwater quality is very poor with highly saline groundwater and high concentrations of chloride present in neighbouring monitored bores. This is not considered suitable for irrigation for pastures or horticultural crops (See Appendix IV).

The soils are not considered niche and are considered most suited to permanent perennial pastures and the groundwater resource is likely to only be suitable for stock water use. This

[7] Rowe, Howe & Alley. (1981). *Guidelines for Land Capability Assessment in Victoria*, Soil Conservation Authority.

makes the land that comprises the Project Site not versatile from an agricultural perspective, but still considered as valuable land for a grazing enterprise.

Table 5. Assessment of the agricultural values of the Project Site.

Attribute groups adapted from Solar Energy Facilities – Design and Development Guideline (2022).

Attribute Group	Assessment Criteria	Assessment	Comments
Soils and Landscape	Inherent Soil Quality Niche Soil Inherent Soil Versatility	Poor quality soils No Low versatility	These soils have low permeability, acidic surface soils and moderate water and nutrient holding capacity. The presence of the shallow buckshot layer presents a restriction to cropping due to damaging tillage and cultivation implements. Poor surface soil structure is not suitable for continual cropping, and is most suited to permanent perennial pastures.
Water and Climate	Access to modern irrigation infrastructure	Potential commercial access	Project Site pastures are currently entirely dependent on natural rainfall. Annual rainfall of the area is 667 mm which is moderate and would support a growing season of 5 months. Groundwater is used for stock water, potential for expansion into irrigation with application for an irrigation licence. The property is not within or in close proximity to a declared irrigation district.
Impact of fragmentation	Impact on local and regional productivity	Low	There is negligible impact on local and regional productivity. With the land between the panels to continue to be used for sheep grazing.
Impact of change of land use	Recent reform to update and modernize production or create industry clusters	No	No recent changes to these properties or within the general area.
Specific planning protection for agricultural values	Land set aside or defined for agricultural use and development in a planning scheme or other strategic document	No	The land has no special protection for agricultural values outside the Farming Zone (FZ) and Schedule 1 thereof.
Government Investment	Government investment to support productivity from the site or the area	No	There is no specific government investment relevant to the agricultural use of this property or this area.
Co-location of solar energy facility with agriculture	Opportunity to co-locate the solar energy facility with agricultural production to diversify farm income without reducing productivity	Yes	It is proposed that the solar farm design will enable the grazing of sheep under the panels, thus mitigating some of the potential loss of agricultural production.

Table 5 above has been prepared from the criteria outlined in the Design and Development Guidelines for Solar Energy Facilities (2022) for identifying high value and/or strategically important agricultural land. The Project Site cannot be considered to be versatile agricultural land, but is valuable form a grazing enterprise perspective.

5. Environmental Risks

5.1 Fuel Load and Fire Risk

Fire risk management will be the subject of a separate investigation. However, management of the fuel load from pasture growth beneath the panels requires some mention within an agricultural context. Much of the incident rainfall at the Project Site will be directed by the panels to the soil surface directly below the panel rim. The soil surface beneath the panels will need to be protected from this concentrated rainfall impact, and the growth of the protective ground cover will need to be controlled with planned management. If unplanned, the growth could become a fire hazard.

It is proposed that the growth will be controlled by grazing sheep under the panels. The grazing will have the primary purpose of managing fuel load to a defined maximum for the duration of the fire risk period, while at the same time also maintaining a soil cover in excess of 70% to protect the soil surface from rainfall impact during storm events. These objectives will take precedent over any secondary objectives to optimise liveweight gain in ewes and lambs. The farming objectives can be quite different from the decisions for fire risk mitigation. The solar arrays will be arranged into fenced paddocks that will enable controlled grazing to manage the fire risk, and the paddock shapes and alignments will be arranged so that under panel mustering can be achieved efficiently. Some slashing of pastures will still be required.

5.2 Weeds

No regionally controlled or restricted weed species were recorded during the property inspection. However, this does not mean that the property is free of weeds that will need to be managed. During development of the proposed works, contractors may introduce weed species on vehicles and equipment. A weed management plan will be prepared as part of the Project design. The weed management plan will aim to suppress the growth of weeds and ensure that any regionally controlled weeds of concern are suppressed as far as practical.

5.3 Soil Erosion

The design and management of surface runoff for the Project Site requires special consideration. There is minor evidence of degradation across the Project Site in the form of water erosion near the dams and minor scalding of the soil surface. These weakly structured sandy loam soils are particularly susceptible to erosion if they are overgrazed or otherwise disturbed. Any changes to the site hydrology due to the solar panels and subsequent impact on soil erosion is outside the scope of this report.[8]

Figure 4. Sites of soil erosion on the Midland Highway Property

[8] See Report: Elaine Solar Farm Flooding Impact Assessment, Ecological Australia, 14/09/23

6. Agricultural Impacts of the Proposal

6.1 Impact of Solar Farm on Neighbouring Farms.

All properties north, east, south and west adjoining the Project Site support low intensity livestock grazing. These adjoining properties operate with mostly sheep and some beef cattle. A small parcel of the land to the south of the Woolshed Road property is used as a wind farm for the production of energy. There is no perceived detrimental impact on the continued agricultural use of these properties for grazing operations as a consequence of the development of the Project Site for a solar energy facility.

6.2 The Agricultural Amenity of the Region.

The Australian Bureau of Statistics (ABS) collects and publishes data for agriculture and agricultural production at Statistical Area Level 4 (SA4). SA4 are geographical areas with defined boundaries and broadly similar production systems. The SA4 regions are the largest sub-State regions in the Main Structure of the Australian Statistical Geography Standard and have been designed for the output of a variety of regional data. They are generally representative of regional labour markets, but also tend to represent agricultural groupings as well. Elaine sits within the SA4 Ballarat region which includes the shires of Hepburn, Central Goldfields and the City of Ballarat and forms a geographical bundle of land in the north western part of Victoria.

The 2021 ABS data for the Ballarat region[9] lists the following:

Number of beef cattle	72,568
Number of sheep	1,660,590

Carrying capacity of the Project Site has been estimated at 7-9 DSE/ha. Using the higher figure, the 267 hectares would thus carry around 1,000 ewes (2.2 DSE per ewe) which is around 0.06% of the sheep numbers reported for the Ballarat region. Thus, the potential grazing from the Project Site is not a significant contributor to the agricultural production of the region.

The design of the Solar Farm however includes sheep as part of the management to graze under the panels and assist in managing the fuel loads. It is likely that the overall pasture productivity will be somewhat unaffected by the installation of the solar panels, as rainfall rather than incident light is the main limitation to growth in this locality, and the proposed use of the land with strip fencing to facilitate best practice grazing management will likely lead to an improved level of grazing productivity. Thus, while the grazing from the site is a contributor to regional productivity, it is not a significant contributor to the agricultural production of the region. Agricultural productivity at the Project Site is unlikely to significantly decrease as a consequence of the Solar Farm development.

[9] https://dbr.abs.gov.au/region.html?lyr=sa4&rgn=201

7. Conclusions and Summary

- The Project Site comprises approximately 184 hectares of agricultural land in the Moorabool Shire. The land is currently utilised for sheep and minor cattle grazing.
- The climate of the area has a moderate annual average rainfall of 667 mm, cool to cold winters with a significant frost incidence from June to September, and a growing season of about 5 months.
- The landform is a very gently undulating, basaltic plain system within the Western Uplands.
- The soils are mottled brown texture contrast soils, with sandy to silt loam surfaces, a bleached A2 horizon and buckshot, and are renowned for their low permeability, low acidity and sodic subsoils.
- The main economic driver within the Ballarat region has been grazing, plantation forestry, and intensive horticulture, on the Ferrosol soils where irrigation is available on the outskirts of Ballarat.
- The land proposed for Solar Farm development at the Project Site is of moderate productivity for grazing. The land at both properties consists of improved pasture species, with a carrying capacity of 7-9 DSE/ha.
- The property utilises groundwater from a bore, which may have the potential to be used as irrigation. However, the water salinity data from the neighbouring bores indicates the bore water is not suitable for irrigation, particularly for high value horticultural crops.
- The development of a solar energy facility on the combined property will alter the agricultural use of this land. Cropping of oats will no longer be practical. With appropriate design of the panels and use of strip grazing fences, sheep will be able to graze the land. The carrying capacity will be likely slightly reduced.
- Heightened wildfire risk will occur if attention is not given to how fuel loads are managed. Flexible fuel load management needs to be considered as part of the project design. Under panel grazing with sheep will be part of that management.
- There are no perceived detrimental impacts of the development of the solar energy facility to the surrounding farm businesses. The impacts to the agricultural amenity of the Region are not significant.

Appendix I – Soil Profile Descriptions

Site 1: Midland Hwy Parcel. 200m from northern boundary fence, in open pasture.

Depth (cm)	Horizon	Description
0 – 15	A1	Brown 2.5 YR 5/2 **Sandy Loam** Moderate to Poor Structure *Diffuse transition to:*
15 – 40	A2	Light Brown 7.5 YR 6/3 Bleached Layer **Sandy Loam** Poor structure *Abrupt transition to:*
40 – 55		**Buckshot** Weakly cemented *Abrupt transition to:*
55 – 100	B1	Light Yellowish Brown 10 YR 6/4, with strong reddish yellow and reddish-brown mottles **Medium Clay** Moderate Structure *No auger refusal. Hole termination at 100 cm.*

Gentle 1% convex slope, northwest facing, predominantly ryegrass and clover, with some Yorkshire Fog and bent grass.

Site 2: Midland Hwy Parcel. ~250 m Southwest of stockyards near natural drainage line.

Depth (cm)	Horizon	Description
0 – 10	A1	Brown 2.5 YR 5/2 **Sandy Loam** Moderate to Poor Structure *Diffuse transition to:*
10 – 20	A2	Pale Brown 10 YR 6/3 **Sandy Loam** Poor structure *Abrupt transition to:*
20 – 35		**Buckshot** Weakly cemented *Abrupt transition to:*
35 – 70	B1	Light Yellowish Brown 10 YR 6/4, with strong reddish yellow and reddish-brown mottles **Medium Clay** Moderate Structure *No auger refusal. Hole termination at 70 cm.*

Gentle 1-2% slope towards the east northwest. Pasture consisting of perennial ryegrass, Yorkshire Fog grass, some couch and bent grass.

Site 3: Woolshed Road – South by ~75m of Williamson Creek Tributary

Depth (cm)	Horizon	Description
0 – 10	A1	Brown 2.5 YR 5/2 **Silty Loam** Poor Structure *Diffuse transition to:*
10 – 30	A2	Light Grey 10YR 7/1 **Silty Loam** Poor structure *Abrupt transition to:*
30 – 40		**Buckshot** Weakly cemented *Abrupt transition to:*
40 – 80	B1	Light Yellowish Brown 10 YR 6/4, with strong reddish yellow and reddish-brown mottles **Medium Clay** Moderate Structure *No auger refusal. Hole termination at 80 cm.*

Lower slope, very gentle 0-1% slope towards the northeast. Pasture consisting of Yorkshire fog, perennial ryegrass, clover, minor capeweed.

Site 4: Similar Soils to Site 3: Woolshed ~100m north of neighbouring Wind Farm slight convex slope of 1% towards northwest.

Appendix II – Water Balance

Table 6 Water balance for the Project Site based on records from SILO Long Paddock – Latitude 37.75, Longitude 144.00

Mean Rainfall													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
SILO DATA	45	43	35	50	55	59	58	67	67	71	68	51	667

Evaporation data	January	February	March	April	May	June	July	August	September	October	November	December	
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	
Mean Evaporation	185.1	148.9	122.9	74.7	45.7	31.0	35.9	52.0	74.7	107.9	131.7	168.8	**1185**

Water Balance for Pasture	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Ave Rainfall	45	43	35	50	55	59	58	67	67	71	68	51	667
Evaporation	185	149	123	75	46	31	36	52	75	108	132	169	1185
Crop factor	1.0	1.0	1.0	0.8	0.7	0.6	0.6	0.6	0.7	0.8	1.0	1.0	
Evapotransporation	185	149	123	60	32	19	22	31	52	86	132	169	
Water deficit/excess	-140	-106	-88	-10	23	40	36	36	14	-15	-64	-118	
Growing season with 20 mm soil water	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	

Appendix III – Climate Data

Table 7 *Mean Temperature data from BOM station at Durdiwarrah.*

Durdidwarrah (87021)													
Statistics	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Maximum temperature													
Mean maximum temperature (°C)	24.1	24	21.4	17.2	13.9	11.1	10.5	11.7	14	16.7	19.4	22.2	17.2
Highest temperature (°C)	42.5	40	37	31.2	24.7	18.8	19.4	23.4	25.8	31.5	37.2	38.2	42.5
Date	31-Jan	16-Feb	12-Mar	13-Apr	5-May	5-Jun	29-Jul	29-Aug	26-Sep	28-Oct	24-Nov	10-Dec	31-Jan
	1968	1983	1998	1985	1978	1998	1975	1982	1975	1977	1982	1980	1968
Lowest maximum temperature (°C)	13.3	11.6	11.9	10.1	5	5.3	4.6	6.1	5.8	7.6	9.5	11.8	4.6
Date	5-Jan	9-Feb	31-Mar	7-Apr	31-May	12-Jun	25-Jul	2-Aug	5-Sep	16-Oct	7-Nov	1-Dec	25-Jul
	1991	1996	1975	1995	1977	1993	1986	1995	1995	1984	1994	1996	1986
Decile 1 maximum temperature (°C)	17.5	17.4	15.9	13	10.8	9	8.4	9	10	11.9	13.4	15.4	
Decile 9 maximum temperature(°C)	33	32.8	29	24	19.2	14.6	13.7	15.9	19	23.6	26.9	30.2	
Mean number of days ≥ 30 °C	5.5	5.9	2.3	0.1	0	0	0	0	0	0.2	1	3.4	18.4
Mean number of days ≥ 35 °C	1.4	1.5	0.3	0	0	0	0	0	0	0	0.1	0.5	3.8
Mean number of days ≥ 40 °C	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum temperature													
Mean minimum temperature (°C)	11.3	11.8	10.5	8.5	6.5	4.6	4	4.4	5.6	7	8.4	10.1	7.7
Lowest temperature (°C)	2.2	3.9	1.7	0.1	-1.2	-3.1	-3.5	-2.9	-1.9	-1.7	-1.3	2.4	-3.5
Date	2-Jan	10-Feb	25-Mar	26-Apr	17-May	17-Jun	21-Jul	6-Aug	26-Sep	5-Oct	6-Nov	2-Dec	21-Jul
	1968	1980	1965	1981	1999	1969	1982	1974	1970	1965	1977	1982	1982
Highest minimum temperature (°C)	27.5	25.6	22.1	19.6	18	12.2	11.2	12.3	18.8	20.4	21.3	25	27.5
Date	21-Jan	9-Feb	12-Mar	5-Apr	2-May	8-Jun	28-Jul	21-Aug	30-Sep	13-Oct	27-Nov	7-Dec	21-Jan
	1997	1970	1985	1992	1997	1995	1975	1982	1980	1977	1984	1994	1997
Decile 1 minimum temperature (°C)	7.5	8	6.7	4.5	2.8	0.6	0.3	1	1.5	2.9	4.4	6.4	
Decile 9 minimum temperature (°C)	15.9	17	15.1	12.5	10.4	8.1	7.2	7.6	9.4	11.5	12.3	14.2	
Mean number of days ≤ 2 °C	0	0	0	0.4	1.5	6.3	7.9	5.4	4.2	1.8	0.4	0	27.9
Mean number of days ≤ 0 °C	0	0	0	0	0.3	2.2	2.7	1.8	0.8	0.2	0.1	0	8.1

Appendix IV – Groundwater

The development for irrigation is regulated by Southern Rural Water (SRW) in this part of Victoria and is currently classified as incorporated within an irrigation district. There is no current cap on the irrigation users, with the potential to apply for an irrigation licence, subject to approval by SRW, using the current bore.[10] Table 3 has been provided below to summarise the water quality in nearby monitored bores in relation to salinity levels, to provide an indication of the water quality in the existing bore, and if irrigation is a viable option for the property.

Table 3. Quality of Water Measured in Bores surrounding the property[11]

Bore Number	Conductivity (mS/cm)	Total Dissolved Solids (TDS) (mg/L)	Chloride (mg/L)
51221	4,800	2,432	1,500
84026	8,650	*5,536*	2,740
84027	5,400	*3,456*	1,830
51218	8,000	4,327	2,600
55318	3,060	*1,958*	600
Median	**5,400**	**3,380**	**1,830**
Salinity Risk Assessment Category[12]	**Extreme**	**Extreme**	**Extreme**

Italicised Values calculated from Conductivity – Approximately 1000 uS/cm = TDS 640 mg/L[13]

The median salinity measures of the bore water in the surrounding areas, classifies the groundwater as saline and at extreme risk to the salinity levels in the soil and at risk to the soil sodicity. As the median chloride concentrations are significantly above the threshold of 400 mg/L where damage to foliage may occur at times of high evaporation, there is the potential for leaf burn and scold if used for irrigation. Ultimately the use of groundwater for irrigation, for horticultural crops or pasture is not considered as a viable option. This could be verified with groundwater quality sampling of the existing bore.

This review of the groundwater potential for the Project Site should not be relied upon as being definitive and a hydrogeologist should be engaged if a further and more definitive investigation is deemed necessary.

[10] Phone Conversation with Southern Rural Water, 13/09/2023 - Claire
[11] Accessed from Visualising Victorias Groundwater - https://www.vvg.org.au/vvg_map.php?agreement=Agree+and+Continue#
[12] EPA Doc 168.3, Figure 6-1 Recycled Water Salinity Risk Assessment, p. 54
[13] EPA Document 168.3, p. 53